Sixth National Communication of Luxembourg under the United Nations Framework Convention on Climate Change

including Luxembourg's Biennial Report No 1

28 February 2014

Aménagement du territoire
Environnement
Transports
Travaux publics

Pour un développement durable

LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère du Développement durable
et des Infrastructures

Sixth National Communication of Luxembourg under the United Nations Framework Convention on Climate Change
including Luxembourg's Biennial Report No 1

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This Communication is presenting the situation in Luxembourg on the 1st January 2014.

Names of Ministries recently changed with the appointment of a new Government on the 4th of December 2013. New names are used throughout the report though reference documents could refer to Ministries' names at the time of publication. There is one exception: the former Ministry of the Environment became the Department of the Environment of the Ministry of Sustainable Development and Infrastructure in September 2009. Since this is the main Ministry/Department involved in climate change related activities, the distinction has been kept in the report but both terminologies are interchangeable. Nevertheless, the acronym used through the report is MDDI-DEV for *Ministère du Développement durable et des Infrastructures – Département de l'Environnement*.

This final version now includes the Executive Summary as well as some further information, clarifications and corrections to the text. The latter is highlighted in light grey.

Table of Content – TO BE DONE – Issue with the “styles” in Word

Chapter I

Executive Summary

National communications are designed to provide a consistent, comparable, accurate and complete account of action being taken by Parties to the United Nations Framework Convention on Climate Change (hereafter, UNFCCC) to address climate change. Luxembourg's Sixth National Communication on Climate Change (hereafter, NC6) provides an overview of the situation and actions undertaken for addressing the challenge of climate change and it reflects progress made since the submission of its Fifth National Communication in February 2010. This NC6 also comprises the 1st Biennial Report (hereafter, BR1) developed Parties under the Convention have to provide according to Decision 2/CP.17 and its Annex I.

Key developments since the last National Communication are listed in the box below.

Box ES-1 – Key achievements since Luxembourg's Fifth National Communication on climate change

1. adoption of the second "Action Plan for reducing CO_2 emissions" in May 2013;
2. Climate Agreement ("Pacte Climat") with the municipalities;
3. enhanced reporting for Chapters VI to IX.

The NC6 also addresses most of the recommendations of the 2012 UNFCCC Report of the In-Depth, Review of the Fifth National Communication of Luxembourg through (a) more detailed presentation(s) of research and evaluation activities; and improvements in the quality and transparency of reporting on financial resourcing and technology cooperation actions.

Luxembourg's Sixth National Communication provides:

- a detailed description of Luxembourg's national circumstances as context for Luxembourg's emissions profile and overarching responses to climate change (Chapter 2);
- the most recent inventory of greenhouse gas emissions and the methodologies used to calculate these emissions (Chapter 3);
- a description of Luxembourg's national climate change policies and measures (Chapter 4);
- sectoral projections for Luxembourg's greenhouse gas emissions (Chapter 5);
- evidence of Luxembourg's vulnerability to climate change impacts and adaptation measures to address those impacts (Chapter 6);
- Luxembourg's international efforts to assist developing countries through financial and capacity building support to address their specific climate change challenges and information on international technology cooperation (Chapter 7);
- details of progress by Luxembourg in climate research and systematic observation (Chapter 8);
- an overview of efforts to increase knowledge of climate change issues through public awareness-raising education and training activities within the country but also in the developing countries (Chapter 9).

I.1. CLIMATE CHANGE IN LUXEMBOURG

Annual mean temperatures for Luxembourg-City are now usually above the 30 years averages of the last century. Indeed, the 1951-1980, the 1961-1990 or the 1971-2000 mean yearly temperatures for the capital city – around 9°C – are nowadays regularly exceeded. Yearly averages increase is mainly driven by higher air temperatures during winter seasons. Other meteorological stations disseminated throughout the country show similar results. With regard to other meteorological parameters – rainfalls, sunshine hours, relative humidity – no clear trends can be identified yet, probably because the very small size of the country (2 586 km^2) limits the identification of such changes.

Climate change effects are also witnessed by increasing frost-free periods, earlier blooming seasons and higher flood frequencies over the last 20 years. For the future, higher average yearly temperatures are anticipated with consequences on public health (heat waves), floods (higher frequency and intensity), vegetation cycles (longer periods with frost risks after early blooming) and forests (degradation of its phytosanitary state).

I.2. GREENHOUSE GAS EMISSIONS: STATE, KEY DRIVERS AND PRESSURES

Luxembourg is a Party to the Kyoto Protocol. The related European Union Burden-Sharing Agreement limits Luxembourg's greenhouse gas (GHG) emissions for the Kyoto period 2008-2012 to an average of 28% below their 1990 level.

In 2011,[1] carbon dioxide (CO_2) was the main source of GHG in Luxembourg. This source counted for 92% of the total GHG emissions calculated in CO_2e (excl. LULUCF).[2] The second source of GHG was nitrous oxide (N_2O) with 3.8% of the total emissions. Methane (CH_4) was the third source with 3.6%. Fluorinated gases only accounted for 0.6% of the total emissions.

The very high share of carbon dioxide is the result of a GHG emissions structure that is vastly dominated by energy related releases in the atmosphere: in 2011, 88.4% of the total GHG emissions were generated by energy production, combustion or distribution. Industrial processes related emissions only represented 5.6% of that total and agriculture (rearing, farming, soils) only 5.5%. The other sources of GHG emissions (solvents, waste, waste water) were negligible.

1 The latest official GHG inventory according to Decision 280/2004/EC as well as according to the UNFCCC requirements covers the period 1990-2011. First estimates for the year 2012 have however already been produced and, where relevant, results from this exercise are provided in the text.

2 CO_2e stands for CO_2 equivalents, i.e. other GHG gases are converted into CO_2 according to their 100-year global warming potential (GWP).
LULUCF stands for "Land Use, Land Use Change & Forestry". This covers carbon sinks (or sources) due to land cover and changes induced to it, whether through human activities (deforestation, reforestation, renaturation, conversion to agricultural land or settlements) or due to natural causes (fires, storms). In the rest of the executive summary, unless indicated, GHG total emissions are excluding emissions from LULUCF activities.

One element explaining the predominance of CO_2 and of energy sources in the total GHG emissions is the very high share of road transportation related emissions: in 2011, this source category was responsible of more than 56% of the total emissions originating from Luxembourg. With its location at the heart of the main traffic axes for Western Europe, Luxembourg is a focal point for international road traffic and has, therefore, had traditionally a high volume of road transit traffic for both goods (freight transport) and passengers (tourists on their way to or back from southern Europe). The latter has increased even further by the high number of commuter journeys observed every working day: 156 000 persons, i.e. about 30% of the residential population, that mostly (around 90%) commute by car. In comparison with international traffic, domestic traffic plays only a relatively small role since it is responsible for only one quarter of the total road fuels sold in Luxembourg. Consequently, in 2011, "road fuel sales to non-residents" (transit traffic, commuters and "fuel tourism") represented about 41% of the total GHG emissions.[3]

With 15.6% of the total emissions in 2011, industries (energy combustion and industrial processes) were the second main emitting sources of GHG, whereas energy combustion in buildings (houses, offices and commercial activities) represented 12% of that total. The fourth main source of emissions was public electricity and heat production with some 8% of the total. For this latter source category, the share was not even 2% in 2001. In fact, the development of combined heat-power installations, but mainly the setting up, in 2002, of a gas and steam power station with an electrical output of 350 MWel (now 376 MWel), increased in a few years almost tenfold the weight of that source category in total GHG emitted. This is a perfect example on how, due to the small size of Luxembourg and of its economy, one individual project can have important effects on some key environmental parameters.

I.3. GREENHOUSE GAS EMISSIONS: PAST TRENDS AND PROJECTIONS

Total GHG emissions amounted to 12.098 Mio. tonnes of CO_2-equivalents (t CO_2e) in 2011, i.e. 6.2% below their 1990 level and 8.1% below the Kyoto commitment period base year value of 13.167 Mio. t CO_2e. Several phases can clearly be distinguished over the period 1990 to 2011:

- firstly, from base year up to 1993, Luxembourg's emissions remained rather stable;
- then, between 1994 and 1998, they started to decrease significantly to reach their lowest value in 1998: 8.6 Mio. t CO2e;
- from 1999 up to 2004, emissions increased recurrently;
- from 2004 to 2006, a stabilisation peaking at 13.1 Mio. t CO2e is observed;

3 According to IPCC rules for GHG inventories, "road fuel sales to non-residents" are to be considered in Luxembourg's GHG balance since these rules are based on the "origin" principle.

- a decrease occurred between 2006 and 2007 followed by a period of relative stability of the emissions with the exception of 2009, and to a lesser extent 2011, two years more impacted by the financial and economic crisis.

The evolution during those years can essentially be explained by changes in production techniques, as well as by changes in the final "energy-mix" consumption: less solid fuels, more natural gas and ever increasing liquid fuels in line with increasing transport flows. Of course, increasing or decreasing activities for certain source categories also played a crucial role in Luxembourg's GHG emissions trend. As an example, the move from blast furnaces to electric arc furnaces in the steel industry between 1994 and 1998 explains the significant decrease observed for GHG emissions over that period.

Estimating GHG emissions for the coming year is a difficult exercise for Luxembourg. On the one side, the size of the country implies that emissions would be affected by a single plant which might start new activities, close them down or change its production processes. On the other side, the important weight of "road fuel sales to non-residents" in the total emissions exerts a high uncertainty on the estimates. This weight is depending on many factors such as price differentials, pay tolls for motorways, economic cycles, development of alternatives to road freight, and so on; i.e. a set of parameters on which Luxembourg alone cannot act. Nevertheless, Luxembourg will have to take more actions to comply with the "Climate & Energy package" objective that it has been assigned by the European Commission (EC) at the 2020 horizon, i.e. a 20% reduction in the non EU ETS sectors compared to 2005.

The challenge of bridging the gap

The actual level of GHG emissions, as well as the projected trends, would require important efforts for Luxembourg in order to respect both the Kyoto commitment and the "Climate & Energy package" objectives defined by the EC. But Luxembourg is facing a critical challenge in this respect since, at national level; it has only limited emissions reduction potentials. Indeed, with the move from blast to electric arc furnaces in the steel sector during the 1990s, Luxembourg very soon exhausted its only major technical potential for GHG emissions reduction. Other industrial activities present relatively small mitigation potentials and those installations which are emitting the most are part of the actual EU ETS scheme and will more likely be part of the post-Kyoto EU ETS scheme.

Looking at energy production, the picture is similar with no mitigation potentials, on the contrary. In fact, up to the end of the last century, Luxembourg did not have any significant fossil-fuel plants and most of its electricity needs were satisfied by imports.[4] Consequently, any investments in power plants – whether they are using fossil fuels or renewable energy sources – is not replacing

4 For which, according to IPCC rules, related emissions were counted in GHG balances of exporting countries, not in the one of Luxembourg.

electricity production from inefficient existing fossil-fuel plants. In other terms, investing in its own electricity production capacities does not offer any mitigation potentials for Luxembourg.

Thus, any energy-efficient fossil fuel-based electricity generating plant that Luxembourg might decide to construct will automatically lead to an increase of its national GHG emissions. This is clearly illustrated by growing emissions in the public electricity and heat production these last years after the starting up of highly efficient combined heat-power (CHP) installations and of the ultramodern gas and steam power station mentioned above: they have led to an additional amount of approx. 1.2 Mio. t CO_2e in Luxembourg's GHG balance, i.e. around 9 to 10% of the total emissions. This also implies that the implementation of the EU CHP installation guidelines, which in other countries may lead to CO_2 reductions thanks to increased efficiency, is counterproductive for Luxembourg. For this reason, Luwembourg will now primarily promote production units based on renewable energy sources, with a special focus on biomass, wood and solar energy. This will be achieved by adopting new instruments and reinforcing existing ones, such as special tariffs for electricity produced from renewable sources that are in place since 1994. However, no GHG reductions could be expected from these measures, since encouraging electricity generation from renewable energy sources, which is associated with major investments, will not substitute electricity generation from highly efficient national production plants, which have just been constructed. Such a support will mainly result in replacing imported electricity, which does not appear in Luxembourg's GHG balance according to IPCC rules for GHG inventories.

Consequently, considering the main emissions source categories, room for manoeuvres left for deploying mitigation policies are lying in the fields of road transportation and buildings. These are two sectors identified as those to focus on in the 2013 second national "Action Plan for reducing CO_2 emissions" [Ministry of Sustainable Development and Infrastructure, Department of the Environment (2013b)]. Luxembourg has therefore implemented various policies and measures in these two domains.

I.3.1. Road transportation

- vehicle tax reform: since the 1st January 2007, the annual tax is based on CO_2 emissions;[5]
- promotion of CO_2-efficient vehicles: since the 1st January 2008 and up to end 2014 according to the emissions in g CO_2/km, subsidies for the purchase of low emission vehicles or of vehicles running on natural gas or electricity only, moved by fuel cells or "hybrid". This subsidy has been complemented for a while by a so-called "*prime à la casse*" for new vehicles registered for the first time in 2009 that replace vehicles older than 10 years. All these financial supports have been regularly evaluated to adapt or amend them in due time;

[5] Other emissions are also considered: for instance, diesel vehicles – which emit less CO_2 than gasoline vehicles – must have a particle filter to benefit from a low tax.

- "Kyoto-cent": climate cents are levied on both gasoline and diesel sold since the 1st January 2007 (2 ct€/litre for gasoline, 2.25 ct€/litre for diesel);
- promoting the use of biofuels of the second generation according to EU legal texts;
- promoting public transports: Luxembourg has an ambitious modal-split target at the 2020 horizon: 25% of home-work journeys by public transport against 75% by private vehicles. Instruments for reaching this goal, amongst other objectives in the transport sector, consist of a strategy called "MoDu" (for "*mobilité durable*").

I.3.2. Buildings (residential, commercial, institutional)

Numerous policies, measures and incentives have been promulgated to increase energy-efficiency in buildings as well as for promoting the use of renewable energy sources. These measures concern old buildings (renovation) as well as new constructions that have to comply with more and more stringent energy constraints.

I.4. Bridging the gap – target assessment 2008-2012

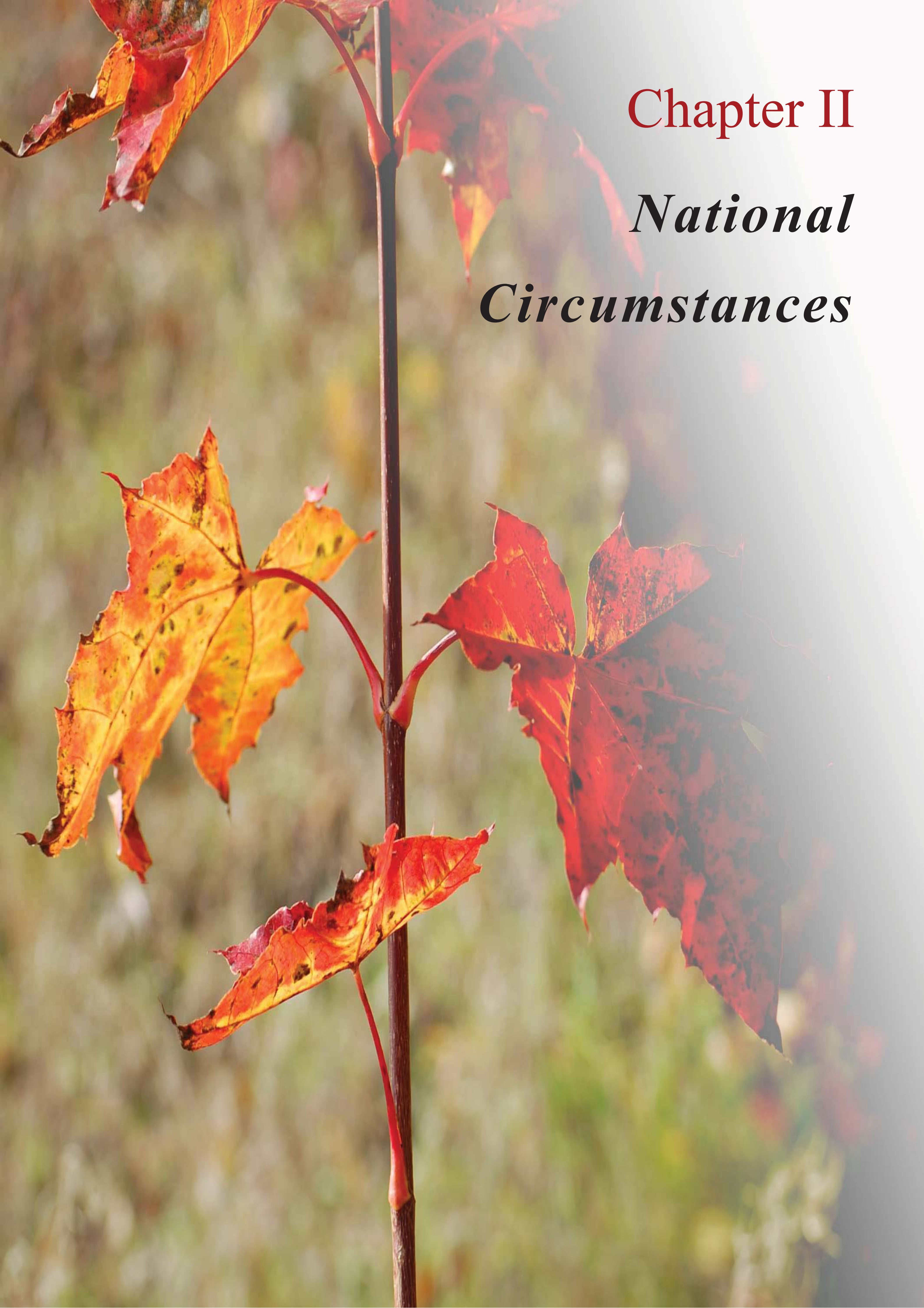
As a conclusion, due to limited mitigation potentials and to considerations linked to the size and the location of the country, as well as to the anticipated economic and demographic growths that might offset part of the energy-efficiency gains, there is a risk that national policies and measures might not be sufficient to bridge the gap between allocated emissions under the Kyoto Protocol and the estimated emissions for the Kyoto period. In fact, recent calculations anticipate that, including the expected effects of implemented and additional policies and measures, GHG emissions should reach an annual average of 12.08 Mio. t CO_2e over the Kyoto commitment period 2008-2012, i.e. some 206 Mio. t CO_2e per year above the annual amount Luxembourg is supposed to emit to respect its -28% Kyoto reduction target. As a consequence, and since no or little reductions from carbon sinks are expected, Luxembourg anticipates a use of project-based mechanisms and international emissions trading of about 15;1 Mio. t CO_2e over the commitment period. The "Clean Development Mechanism" (CDM) is expected to provide about half of the emission reductions, "Joint Implementation" (JI) and "International Emissions Trading" (IET) the remaining half.

I.5. Financing the use of Kyoto flexible mechanisms: the "Kyoto Fund"

In order to finance the purchase of tonnes of CO_2 in the framework of project-based mechanisms and international emissions trading, a fund was created by a Law of 23rd December 2004: the "Kyoto Fund"- later renamed "Climate & Energy Fund". Sources of revenue of this Fund are annual budgetary grants, 40% of the CO_2-based vehicle tax and 100% of the "Kyoto-cent".

Chapter II

National Circumstances



In line with paragraph 8 of the UNFCCC reporting guidelines, Chapter II provides a description of national circumstances and how they affect GHG emissions and removals, as well as how these circumstances and changes therein affected GHG emissions and removals over time.

Socio-economic developments and physical characteristics (geography and climate) are presented in the various sections of this chapter. They are complemented by a discussion of how both the UNFCCC and the Kyoto Protocol are challenging Luxembourg's action with regard to climate change ***[→ Section II.12]***. The chapter concludes with an overview of the main developments of and drivers to GHG emissions in Luxembourg since 1990 ***[→ Section II.13]***.

II.1. THE GRAND-DUCHY OF LUXEMBOURG[6]

The Grand Duchy of Luxembourg has been an independent sovereign state since the Treaty of London was signed on 19 April 1839. The country is a **parliamentary democracy** in the form of a **constitutional monarchy** and is the second smallest Member State of the EU-28, after Malta. For many years, it has been characterized by **high economic and demographic growth rates**. The country is **located in the heart of North-Western Europe** and has direct borders with Belgium, Germany and France ***[→ Figure II.1-1]***. It is therefore a crossroad for international trade and related transport flows, the most dynamic source of its GHG emissions.

The organisation of the Grand Duchy starts from the principle that the responsibilities of the different powers should be given to diverse apparatus of the state. As in every parliamentary democracy, the separation of powers is flexible in Luxembourg: many links exist between the legislative and executive branches, and solely the judicial power remains completely independent.

Legislative power resides in the joint action of the Parliament (*Chambre des Députés*), the Government and the Council of State (*Conseil d'Etat*); each entity serving a wholly separate function.

Parliament is made up of 60 members of Parliament (hereafter, MPs) elected for a five-year term combining a one-person-one-vote suffrage and a system of proportional representation. Its primary function is to vote on bills submitted by the Government and to control the executive branch. The MPs also possess a right of parliamentary initiative which is exercised by bringing in bills (*propositions de Loi*).

The Government has a right of initiative in legislative matters known as governmental initiative, which allows it to bring in bills (*projets de Loi*). After being examined by the Council of State, bills are put to the vote before Parliament, where the government normally holds a majority. After the parliamentary vote, the Grand Duke promulgates the legislative text, i.e. he commands its

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6 Part of this section is based on texts from: the "political portal" (http://www.luxembourg.public.lu/en/luxembourg-glance/politics-institutions/index.html), as well as on the following documents: Press and Information Service of the Luxembourg Government (2006), (2007) and (2012).

publication in the compendium of legislation known as the *Mémorial*, whereupon the text acquires legal status.

The Council of State is composed of 21 councillors. State councillors are formally appointed and dismissed by the Grand Duke on proposal by the Government, Parliament or the Council of State. In Luxembourg's unicameral system, the Council of State exerts the moderating influence of a second legislative assembly. It is required to voice its opinion on all items of legislation; that is to say on all bills brought in before the Parliament prior to voting by the MPs. Its opinion must entail a thorough examination to ensure compliance of the draft texts with the Constitution, international conventions and the rule of law. The role of the Council of State is one of persuasion rather than enforcement and is therefore advisory in nature.

Executive power is the prerogative of the Grand Duke, together with the Government and its members, i.e. the Ministers and, eventually, Secretaries of State. In practice the Grand Duke chooses the Prime Minister on the basis of election results, which takes place every five years jointly with the election of the members of the European Parliament (the "European Elections"). Then, the Prime Minister himself proposes the members of the Government. The Government appointed by the Grand Duke presents its political programme to the Parliament which takes a vote of confidence, thereby giving the newly appointed Government a parliamentary majority on which it can rely. The actual Government, stemming from the general elections of the 20th of October 2013, has been appointed on the 4th of December 2013 and should remain in place up to the next general elections, in 2018. It is made up of the Prime Minister, one Vice Prime Minister and 16 members having the title of Ministers (13) or of Secretary of State (3). It is worth noting that the number of ministerial departments generally exceeds the number of members of the Government called upon to serve in office; thus a single minister normally holds more than one portfolio.[7]

As a conclusion, a parliamentary democracy in the form of a constitutional monarchy suits perfectly well to a country such as Luxembourg where social consensus and dialogue are key words. Consensus and dialogue have been, and will continue to be, of particular relevance for the definition of climate change related policies and action plans, as well as for the designing of related legislative texts. Luxembourg's first Action Plan for mitigating CO_2 emissions [Ministry of the Environment (2006b)] and the process leading to its revision up to May 2013 [Ministry of Sustainable Development and Infrastructure, Department of the Environment (2013b)] *[→ Section IV.1]* are good examples of bringing these two key words into play.

7 For more information on the Government in place in Luxembourg since December 2013, refer to http://www.gouvernement.lu/3311528/20131204-. Its political programme can be downloaded here: http://www.gouvernement.lu/3322796/Programme-gouvernemental.pdf. Climate change related actions are presented on pages 82 to 88.

Box II.1-1 – Legislative procedure in Luxembourg

Two types of legislative initiative are distinguishable:

> *Projet de Loi*: this preliminary draft of a law is drawn up by the relevant Ministry, approved by the Cabinet and then submitted to the Council of State for its opinion. It is then submitted to the Parliament.
>
> *Proposition de Loi*: one or more MPs may bring in a bill, which is submitted to the Conference of Presidents of the Parliament, which decides on its referral to a committee. The text of the proposal is submitted to the Council of State for its opinion and sent to the Government for its position.

Once the Council of State has given its opinion, the bill is sent to the relevant parliamentary committee which examines it and reports to the Parliament.

The debate in plenary session of the Parliament is conducted in two stages: a general discussion and a discussion article by article. Any deputy may propose amendments.

In Luxembourg's unicameral system, once the Parliament has voted on the draft, it must vote a second time on the whole text after a period of at least three months. It can however dispense with this vote if the Council of State accepts the waiver. If the latter does not give its consent, the Parliament must hold a second vote after a minimum period of three months.

The law finally adopted by the Parliament enters into force only after it has been promulgated by the Grand Duke, i.e. published in the *Mémorial* (compendium of legislation).

FIGURE II.1-1 – GEOGRAPHIC LOCATION OF LUXEMBOURG

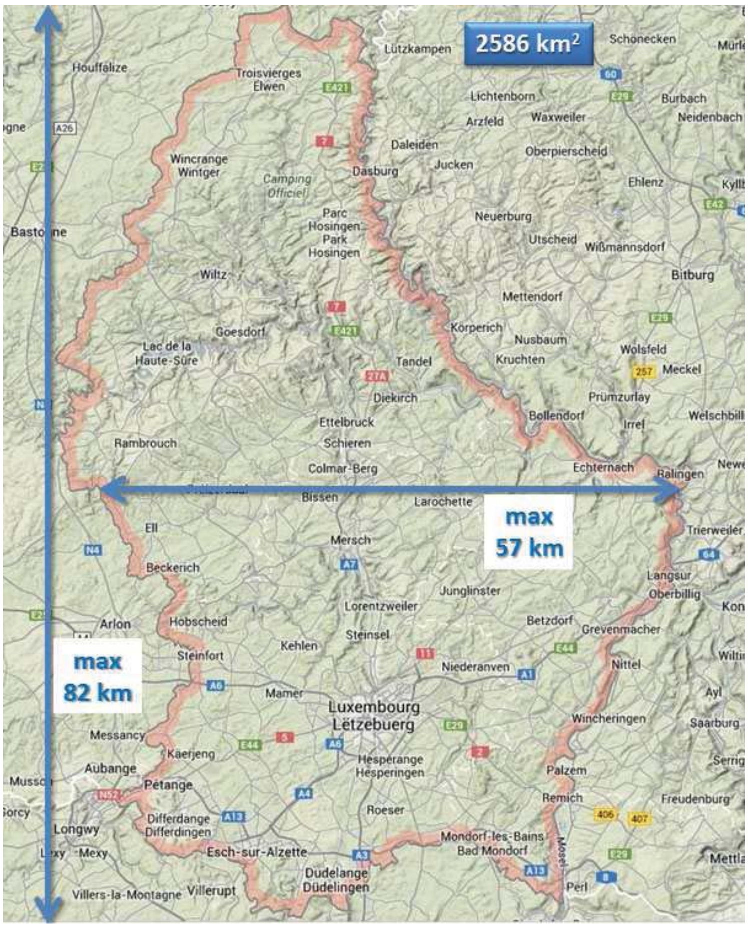
Source: Google Maps.

II.2. GEOGRAPHY

Luxembourg is a territory of 2 586 km². The maximum distance from north to south is some 82 km, from west to east about 57 km *[→ Figure II.2-1]*. Of the total area of Luxembourg, in 2012, 85.5% was agricultural land and land under forest – with around 51% for agriculture and 35% for forests. The built-up areas occupied 9.5% of the total surface and land covered by water and transport infrastructure about 5% *[→Table II.2-1 & Figure II.2-2]*.

The north of Luxembourg is a part of the Ardennes and is called "Ösling". Its altitude is at an average of 400 to 500 meters above sea level. The "Ösling" landscape is affected by hills and deep river valleys, as for instance the Sure River (Sauer). With 560 m, the highest elevation is called the "Kneiff" in Wilwerdange. In the South of Luxembourg lies the rank "Gutland", which belongs to the "Lothringer Stufenland". This area has higher population and industrial densities than "Ösling". The lowest point in the country, called "Spatz" (129 m above sea-level), is located at the confluence of the Moselle and the Sure rivers in Wasserbillig. Most important rivers are the Moselle, the Sure, the Our – all three delimiting the border with Germany – and the Alzette.

FIGURE II.2-1 – LUXEMBOURG SIZE



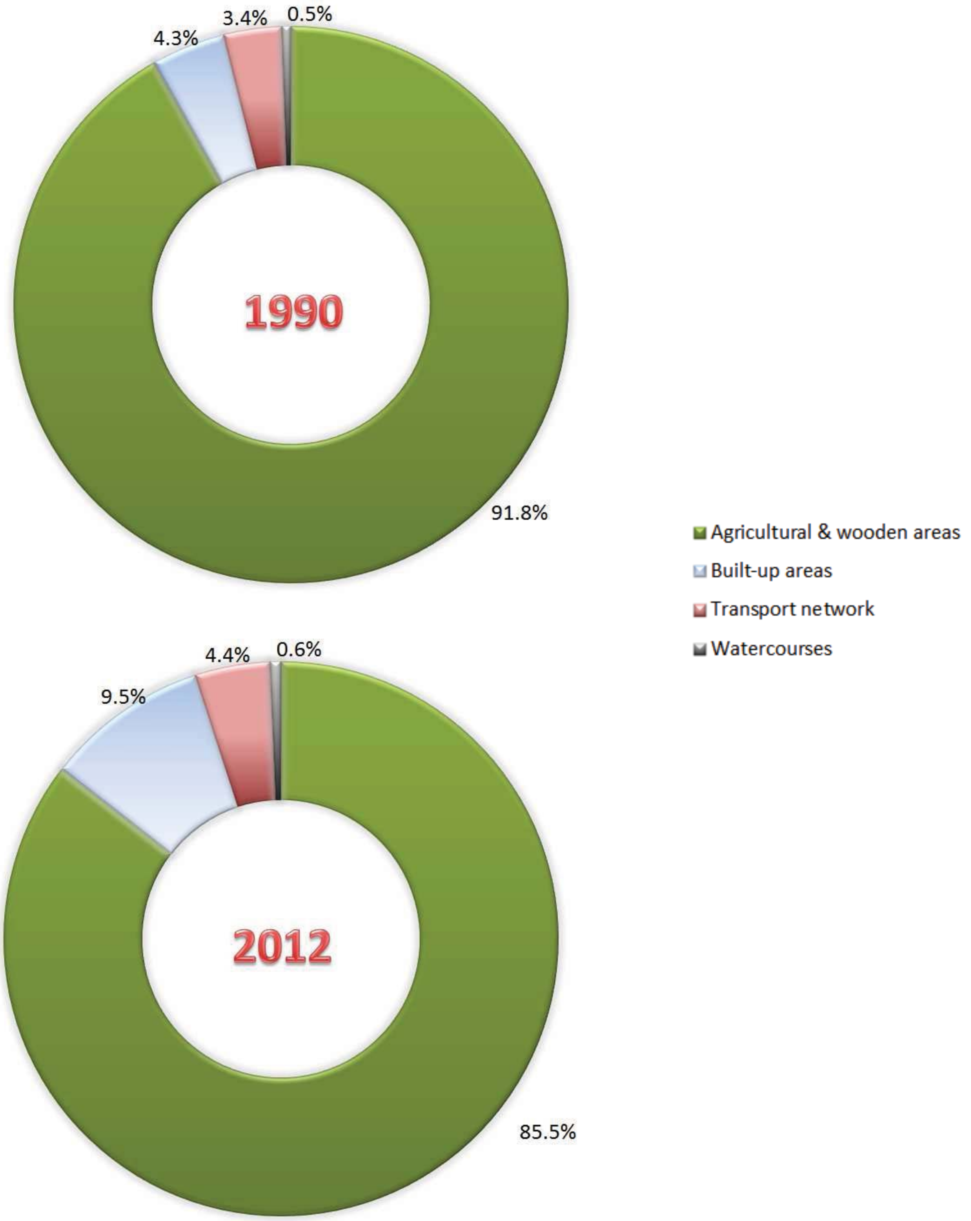
Source: Google Maps.

TABLE II.2-1 – LAND USE IN LUXEMBOURG: 1972-2012

percentages	1972	1990	2000	2010	2012
Total land	100.0	100.0	100.0	100.0	100.0
Agricultural & wooden area	93.2	91.8	87.4	85.7	85.5
Built-up area	3.1	4.3	8.1	9.3	9.5
of which industrial area & other	*na*	*na*	*2.7*	*3.0*	*3.1*
Transport network & sheets of water	3.2	3.4	3.9	4.4	4.4
Watercourses	**0.5**	**0.5**	**0.6**	**0.6**	**0.6**

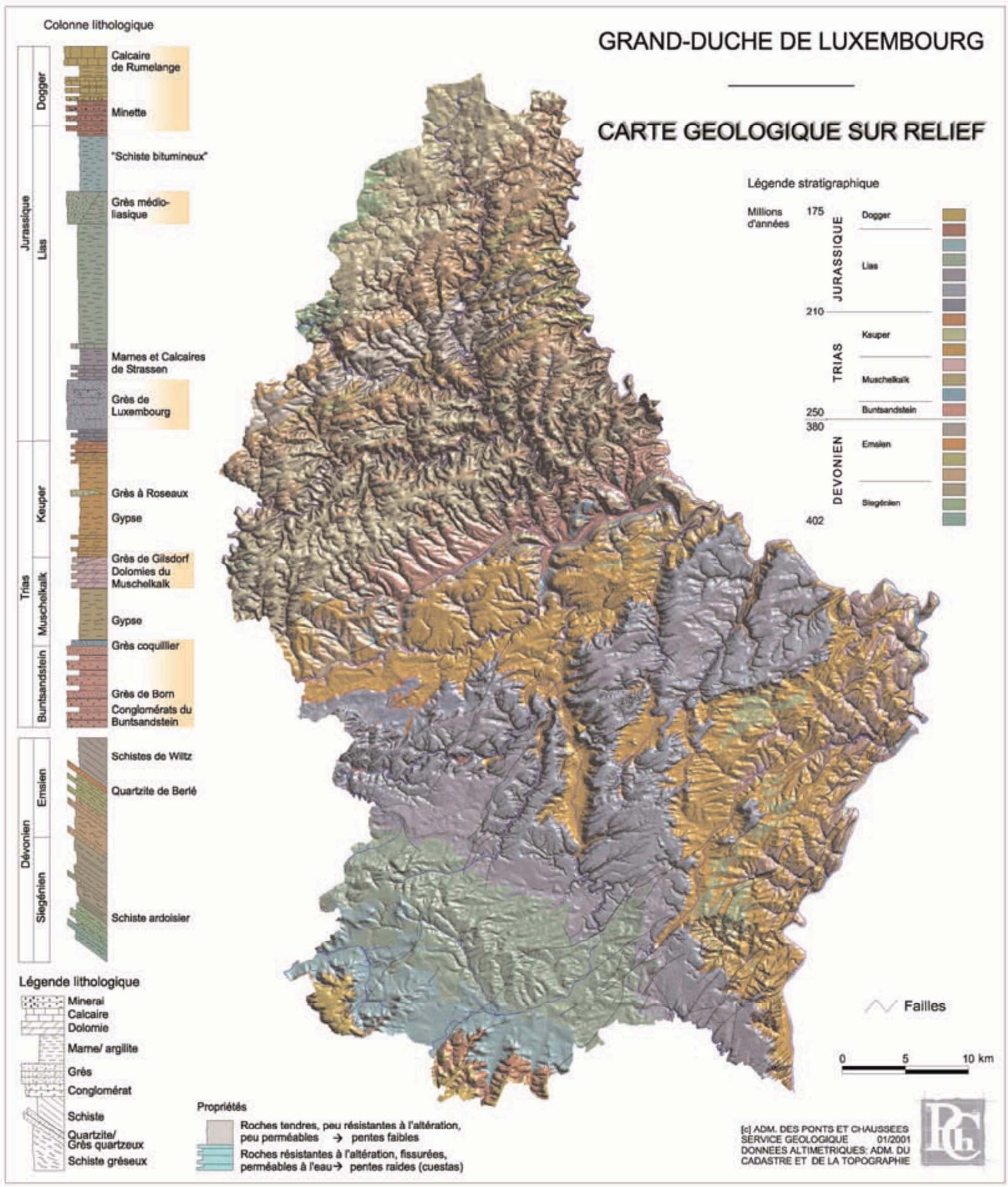
Source: STATEC, *Statistical Yearbook*, Table A.1101 (updated 19.07.2013): http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=137&IF_Language=fra&MainTheme=1&FldrName=1.
Note: na = not available.

FIGURE II.2-2 – LAND USE IN LUXEMBOURG: 1990 & 2012



Source: STATEC, *Statistical Yearbook*, Table A.1101 (updated 19.07.2013): http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=137&IF_Language=fra&MainTheme=1&FldrName=1.

FIGURE II.2-3 – GEOLOGICAL MAP OF LUXEMBOURG'S TERRITORY



Source: STATEC, *Annuaire statistique du Luxembourg 2012*, page 39: http://www.statistiques.public.lu/fr/publications/series/annuaire-stat-lux/index.html.

II.3. CLIMATE[8]

II.3.1. Present climate: an increasing average air temperature during the last decades

The climate in Luxembourg can be characterized as a **moderate oceanic Western European climate** with mild winters and comfortable summers [Georgen et al., 2013].

As shown by the long-term annual means (WMO reference period from 1971 to 2000) measured at the Findel-Airport meteorological station *[→ Table II.3-1]*,[9] temperatures have an unimodal distribution, with the lowest long-term mean values occurring during January (0.6°C – was 0.0°C for the period 1961-1990) and the highest air temperature in July (17.5°C – was 16.9°C for the period 1961-1990). Absolute minimum and maximum air temperatures ever recorded until 31 December 2012 were -20.2°C (2 February 1956) and 37.9°C (8 & 12 August 2003).

TABLE II.3-1 – LONG-TERM MEAN VALUES (1961-1990 & 1971-2000) OF AIR TEMPERATURE AND PRECIPITATION FOR FINDEL-AIRPORT STATION

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average air t° [°C]	0.0	1.1	4.0	7.5	11.8	14.9	16.9	16.4	13.4	9.1	3.8	1.0	8.3
	0.6	1.4	4.7	7.7	12.4	15.1	17.5	17.3	13.5	8.9	4.0	1.8	8.7
Mean min. air t° [°C]	-2.3	-1.8	0.6	3.3	7.1	10.2	12.0	11.8	9.3	5.7	1.2	-1.3	4.7
	-1.8	-1.5	1.2	3.5	7.7	10.5	12.6	12.5	9.5	5.6	1.4	-0.5	5.1
Mean max. air t° [°C]	2.3	4.2	7.9	12.1	16.8	20.0	22.0	21.6	18.2	13.0	6.6	3.3	12.3
	2.9	4.5	8.7	12.3	17.3	20.0	22.6	22.5	18.1	12.6	6.6	4.0	12.7
Mean monthly precipitation sum [mm]	71.1	61.7	70.1	61.0	81.2	81.5	68.4	72.2	69.8	74.7	83.1	79.6	874.4
	72.1	57.2	66.7	56.6	78.1	79.8	71.6	64.3	71.3	82.0	77.9	84.9	862.5

Sources: 1961-1990 – ASTA, *Annuaire météorologique et hydrologique 1990*.
1971-2000 – Aéroport de Luxembourg, Service Météorologique: http://www.meteolux.lu/IMG/pdf/resume_tricennales.pdf.

According to definitions for GHG reporting, **Luxembourg is situated in a cool climate region** since its annual average air temperature is below 15°C: 8.7°C for the reference period 1971 to 2000 *[→ Table II.3-1]* and 9.2°C for the reference period 1981 to 2010.[10]

Climate conditions have significant impacts on energy use for heating or cooling purposes. An increase in average air temperature in the forthcoming years could have a positive impact on energy consumption, especially in the residential, commercial and institutional sectors. However, in case of a substantial increase of air temperatures, an increase in energy consumption related to a more frequent use of air conditioning systems could be expected.

8 The text of this Section has been prepared by Pfister, L., Junk, J., Ferrone, A., Hoffmann, L. of the *Centre de Recherche Public-Gabriel Lippmann*.

9 http://www.ana.public.lu/en/meteo/index.html.

10 See also a graphic representation (http://www.meteolux.lu/IMG/pdf/temperatures_moyennes_par_annee_47-11.pdf).

As shown by measures at the Findel-Airport meteorological station, two conclusions can be drawn: firstly, an increase in average air temperature is observed over the last decades; secondly, annual precipitation does not show such clear trends *[→ Table II.3-2]*. Similar observations have been obtained in scientific studies on the climate in Luxembourg, notably in Christian Ries (éditeur) (2005) and Pfister et al. (2005a). From 1990 onwards, annual mean air temperatures for the Findel-Airport station started to increase rather sharply to systematically exceed the 1961 - 1990 mean value *[→ Figure II.3-1]*. Temperature highs have mostly been observed during the last 15-20 years *[→Figure II.3-2]*.

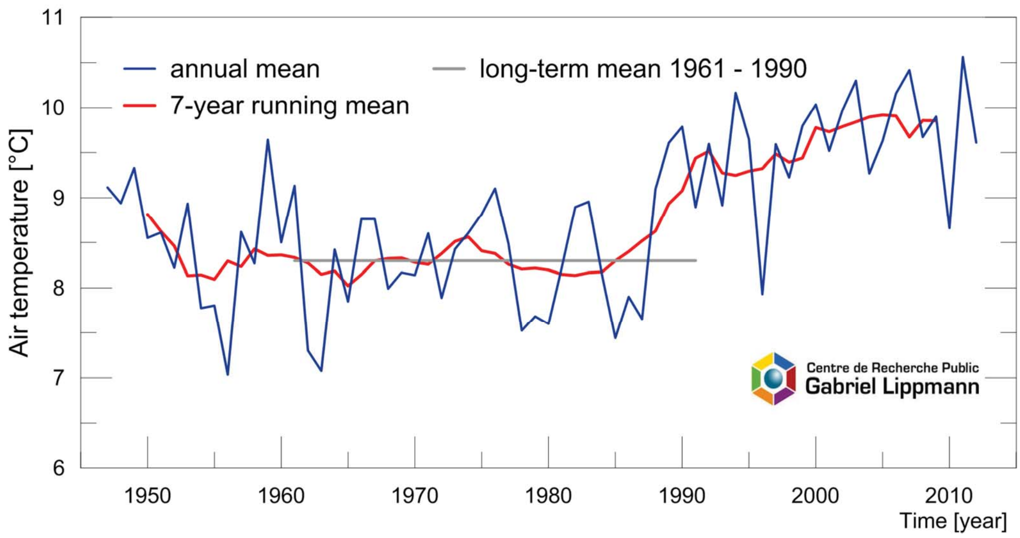
TABLE II.3-2 – MEAN VALUES OF AIR TEMPERATURE (DAILY MEAN, MAXIMUM & MINIMUM) AND PRECIPITATION FOR THE FINDEL-AIRPORT STATION FOR DIFFERENT TIME SPANS AND INDIVIDUAL YEARS

	1951-1980	1961-1990	1971-2000	1981-2010
Average air temperature [°C]	8.3	8.3	8.7	9.2
Mean minimum air temperature [°C]	4.6	4.7	5.1	5.6
Mean maximum air temperature [°C]	12.3	12.3	12.7	13.1
Mean yearly precipitation sum [mm]	819.6	874.5	862.4	869.9

	1990	2000	2005	2010	2011	2012
Average air temperature [°C]	9.8	10.0	9.6	8.7	10.6	9.6
Mean minimum air temperature [°C]	6.0	6.5	na	5.0	6.6	5.9
Mean maximum air temperature [°C]	13.8	13.8	na	12.4	14.8	13.5
Mean yearly precipitation sum [mm]	1020.5	1036.4	718.2	918.5	700.0	951.3

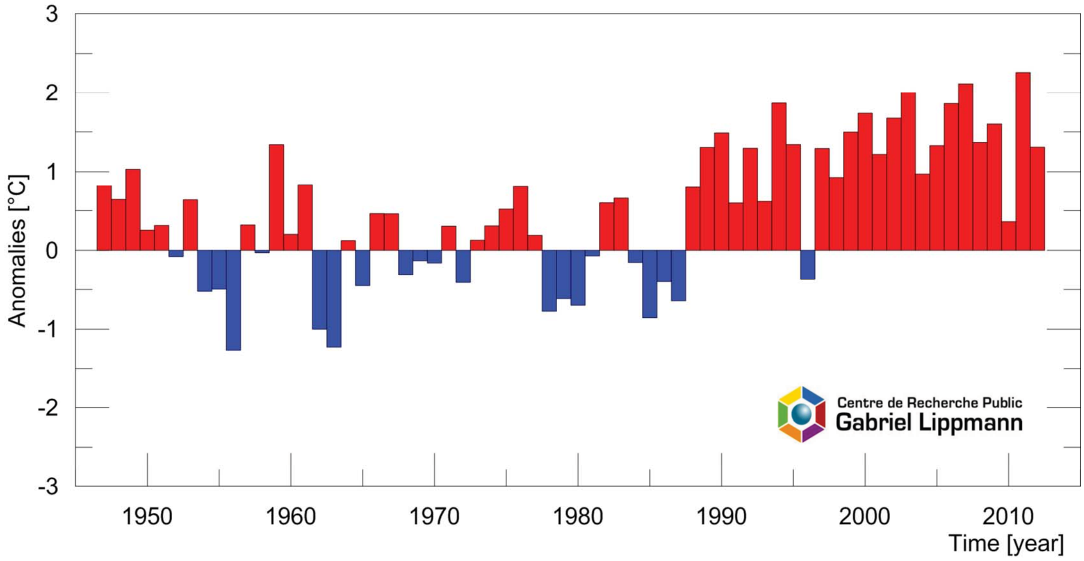
Sources: ASTA, *Atlas hydro-climatologique du Grand-Duché de Luxembourg 2009* and Findel-Airport station (SMA) ; various sources from the Aéroport de Luxembourg, Service Météorologique: http://www.meteolux.lu/publications.
Note: na = not available.

FIGURE II.3-1 – AVERAGE ANNUAL AIR TEMPERATURE, 7-YEAR RUNNING MEAN, AND LONG-TERM ANNUAL MEAN 1961-1990 FOR THE FINDEL-AIRPORT STATION: 1947-2012



Sources: Findel-Airport station (SMA) and *Centre de Recherche Public-Gabriel Lippmann*, unpublished.

FIGURE II.3-2 – ANOMALIES OF ANNUAL AIR TEMPERATURE FROM THE REFERENCE PERIOD 1961-1990 FOR THE FINDEL-AIRPORT STATION: 1947-2012

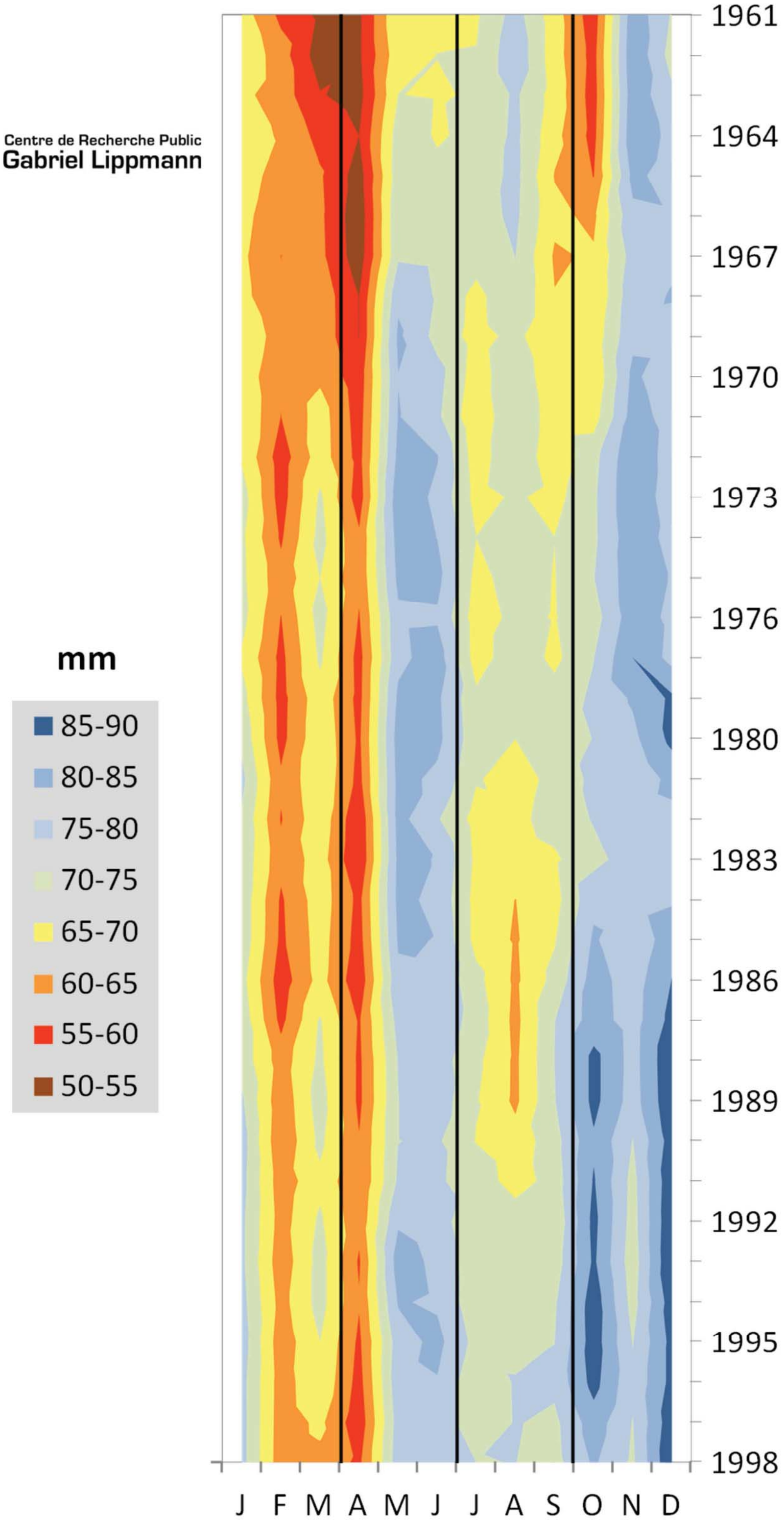


Sources: Findel-Airport station (SMA) and *Centre de Recherche Public-Gabriel Lippmann*, unpublished.
Note: anomalies from the reference period 1961 till 1990: long-term mean: 8.3°C.

Further analysis of the data suggests that the average air temperature in Luxembourg has increased during the winter seasons, coupled with longer frost-free periods.

With regard to annual precipitation, no clear changes can be detected from the direct measurements *[→ Table II.3-2]*. However, the seasonal distribution of precipitation totals has shown substantial variability through the past 65 years *[→Figure II.3-3]*. Most of this variability can be attributed to changes in the large-scale atmospheric circulation patterns. An increase in westerly atmospheric fluxes during winter months has reportedly been responsible over the past 30 years for significant redistributions of winter rainfall totals. In combination with higher air temperatures, this has led to higher flood frequencies in most national river basins [Pfister et al., 2000 and 2004].

FIGURE II.3-3 – PRECIPITATION 30-YEAR MOVING AVERAGE: 1947 – 2012

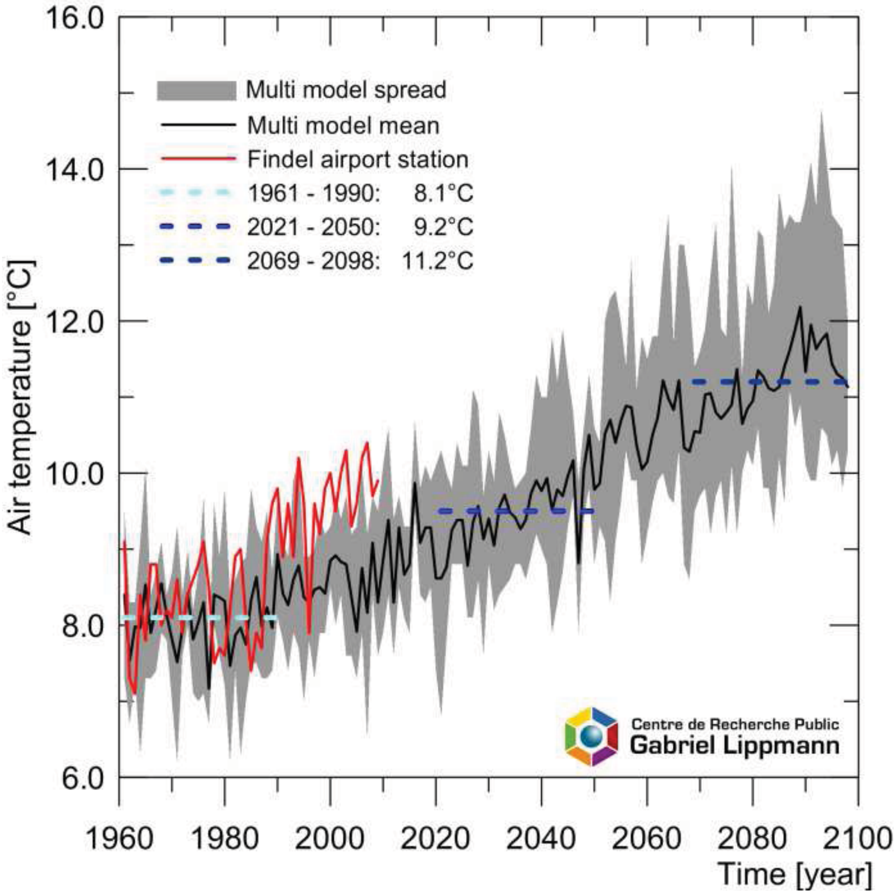


Sources: Findel-Airport station (SMA) and *Centre de Recherche Public-Gabriel Lippmann*, unpublished.
Note: values are given for middle of averaging period

II.3.2. Climate projections: continuing rise in air temperature

Preliminarily results taken from a project from the Department "Environment and Agro-biotechnology" of the *Centre de Recherche Public-Gabriel Lippmann* suggest an increase in mean air temperature for the Grand-Duchy of Luxembourg. Based on selected results of the FP6 ENSEMBLES project climate change projections,[11] mean annual temperatures are expected to reach up to 11.6°C for the period 2071 till 2100. This value refers to the GHG emission scenario A1B *[→Figure II.3-4]*.[12]

FIGURE II.3-4 – PROJECTIONS OF MEAN ANNUAL AIR TEMPERATURE



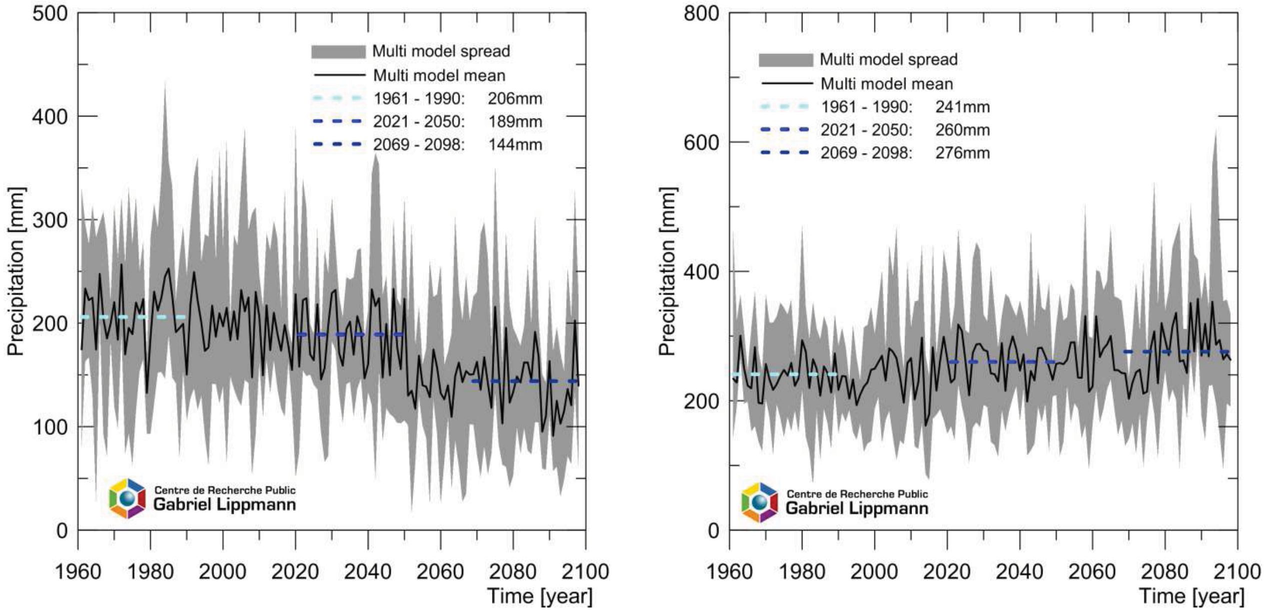
Source: *Centre de Recherche Public-Gabriel Lippmann*.
Notes: (1) based on selected ENSEMBLES data sets, A1B emission scenario.
(2) anomalies from the reference period 1961 till 1990: long-term mean: 8.9°C.

Preliminarily results concerning changes in precipitation suggest a relative stability in annual totals until 2100 *[→Figure II.3-5]*. However, a substantial redistribution of seasonal precipitation totals can be expected in the second half of the 21st century, with a decrease in summer rainfall and an increase in winter precipitation *[→Figure II.3-6]*.

11 http://ensembles-eu.metoffice.com.

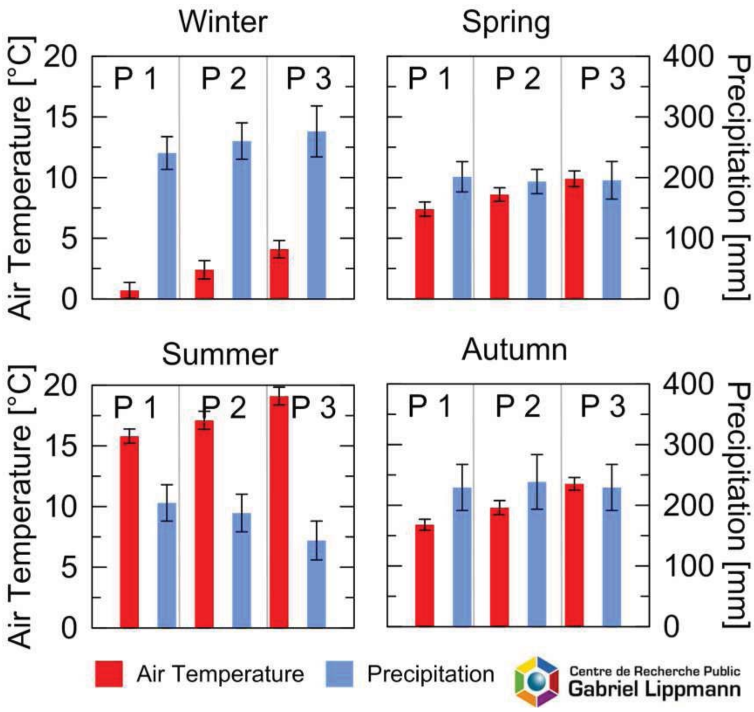
12 First results were published in a serie of peer reviewed papers: Eickermann et al. (2014), Goergen et al. (2013), Junk et al. (2014), Matzarakis et al. (2013), Molitor et al. (2013), Molitor et al. (2014).

FIGURE II.3-5 – PROJECTIONS OF PRECIPITATION SUMS FOR THE METEOROLOGICAL SEASONS



Source: *Centre de Recherche Public-Gabriel Lippmann*.
Notes: (1) based on selected ENSEMBLES data sets, A1B emission scenario.
(2) JJA = meteorological summer season (June – July – August); DJF = meteorological winter season (December – January – February).

FIGURE II.3-6 – PROJECTIONS OF MEAN ANNUAL AIR TEMPERATURE AND PRECIPITATION SUMS FOR THE METEOROLOGICAL SEASONS



Source: *Centre de Recherche Public-Gabriel Lippmann*, Georgen et al. (2013).
Notes: (1) based on selected ENSEMBLES data sets, A1B emission scenario.
(2) periods: P1 = 1961-1990 // P2 = 2021-2050 // P3 = 2069-2098.

II.4. POPULATION AND WORKFORCE

II.4.1. A strong population growth driven by immigration

End 2012, the **population of Luxembourg** amounted to 537 000 inhabitants. Within slightly more than 50 years, the residential population has grown by some 222 000 inhabitants or about 70.5% – 39.7% since 1990 ***[→Table II.4-1]***. The average annual growth rate of the resident population of Luxembourg is high compared to the rates of its neighbouring regions: between 1990 and 2012, the average annual growth rate for Luxembourg (1.5%) was about 4 times higher than its equivalent for the *Grande Région*.[13] It even reached 1.7% p. a. since 2000 ***[→Figure II.4-2]***.

Demographic growth in Luxembourg is actually dominated by **immigration**. Nationals themselves saw their number stagnating, and without immigrants taking the citizenship of Luxembourg they would even have fallen. End 2012, 43.8% of the residential population did not have the citizenship of Luxembourg. This percentage was only around 30% in 1990 ***[→Figure II.4-1]***. The main driver behind these demographic trends is the economic restructuring and development of the country towards the tertiary sector coupled with attractive wages ***[→ Section II.5]***.

TABLE II.4-1 – CALCULATED POPULATION: 1960-2012

calculated on 31st December	1960	1990	1995	2000	2005	2010	2011	2012
Resident population (x 1000)	314.9	384.4	411.6	439.0	469.1	511.8	524.9	537.0

Source: STATEC, *Statistical Yearbook*, Table B.1100 (updated 18.04.2013): http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=383&IF_Language=fra&MainTheme=2&FldrName=1.

Population projections are based on scenarios derived from past statistical data. It therefore comes as no surprise that population forecasts a continuation of the demographic trend in Luxembourg. Projections calculated by STATEC in 2010 forecast, under the "baseline" scenario, that almost 750 000 inhabitants could be living in Luxembourg by 2050 ***[→Figure II.4-2]***.[14] As it is the case for any forecasts, these predictions should be treated with caution because they cannot predict radical changes in the economic structure or demographics of a country, especially a small one whose economy relies heavily on a few economic sectors. However, since population growth is one of the key drivers for domestic energy use, mainly in the housing and transportation sector, these forecasts illustrate the scale of one of the many challenges Luxembourg is facing in the definition of measures aiming at reducing its GHG emissions.

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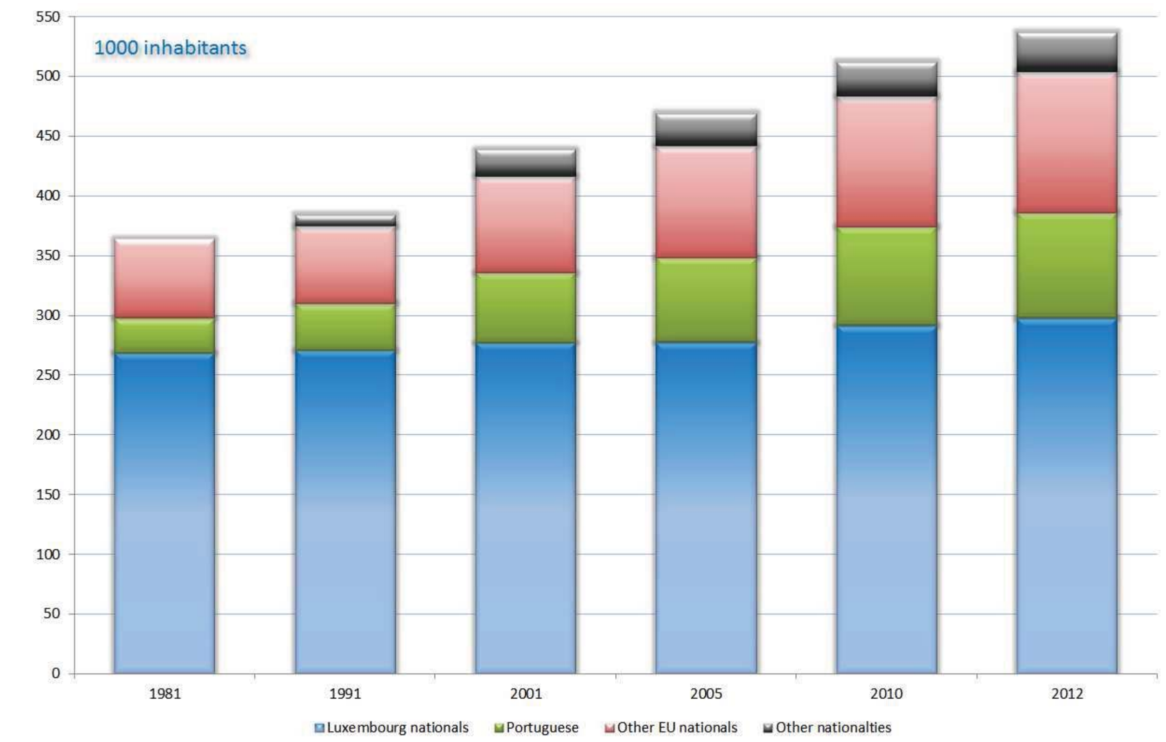
13 Refer to Box II.4-1 for a presentation of the *Grande Région*.

14 For details, see STATEC (2012), *Projections socio-économiques 2010-2060*, Bulletin du STATEC N° 5/2010, Luxembourg, pages 262-272 (http://www.statistiques.public.lu/fr/publications/series/bulletin-statec/2010/05-10-Projpop/index.html). Other projections, which are a bit lower than STATEC's baseline scenario, are also produced in the framework of the European Commission Ageing Working Group: http://europa.eu/epc/working_groups/ageing_en.htm and http://europa.eu/epc/pdf/2012_ageing_report_en.pdf, as well as http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Population_projections.

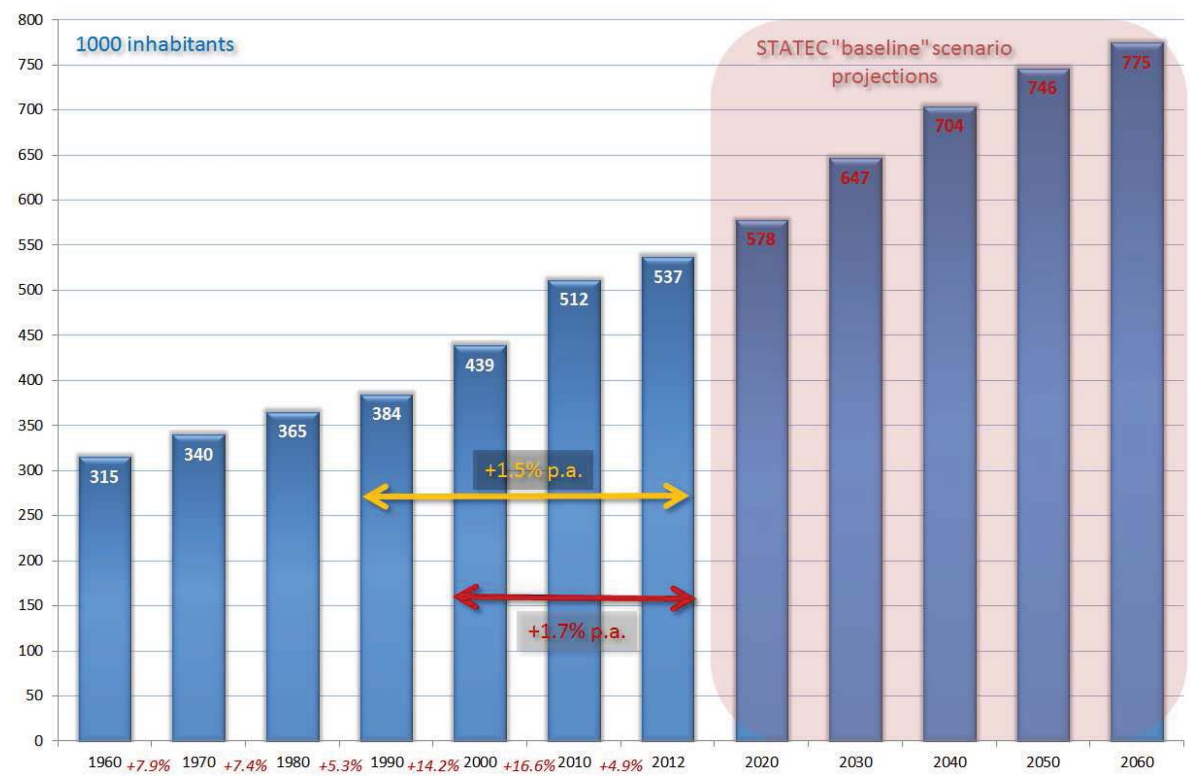
FIGURE II.4-1 – POPULATION STRUCTURE ON 31ST DECEMBER: 1981-2012



Source: STATEC, *Statistical Yearbook*, Table B.1101 (updated 19.07.2013): http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=384&IF_Language=fra&MainTheme=2&FldrName=1.

Note: 1981, 1991 and 2001 data are coming from population censuses held every decade, other years are calculated by STATEC.

FIGURE II.4-2 – POPULATION ON 31ST DECEMBER: 1960-2060



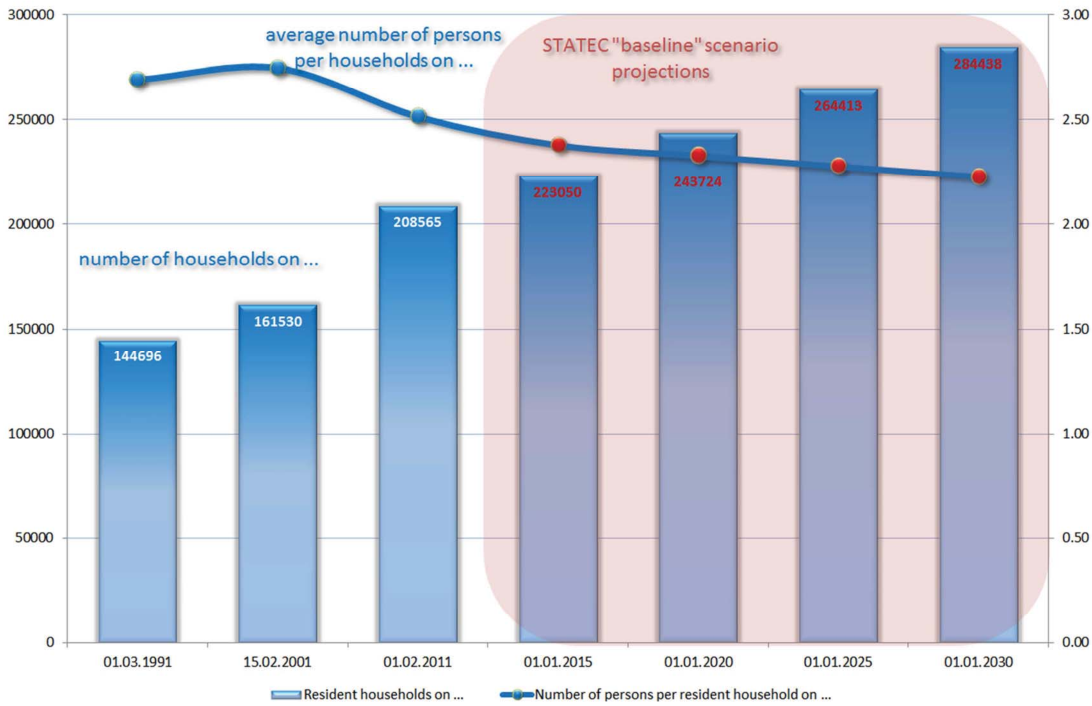
Sources: STATEC, *Statistical Yearbook*, Table B.1100 (updated 18.04.2013): http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=383&IF_Language=fra&MainTheme=2&FldrName=1

STATEC, *Bulletin du STATEC N°5/2010 – Projections socio-économiques 2010-2060* (published 26.10.2010): http://www.statistiques.public.lu/fr/publications/series/bulletin-statec/2010/05-10-Projpop/index.html

It is also worth analysing **households** when discussing population growth. Based on population censuses that are usually taking place every 10 years, the number of households grew by 44.1% between the 1991 and 2011 censuses (from 144 696 households in 1991 to 208 565 in 2011); i.e. slightly more than the population (+34.7% between 1991 and 2011). Consequently, the average number of persons per household fell from 2.69 in 1991 to 2.52 in 2011.

A projection calculated by STATEC in 2011 foresees an increase of households along with the population predicted growth, combined with a continuous decrease of the average number of persons per household (2.33 in 2020, 2.23 in 2030). *[→Figure II.4-3]*.

FIGURE II.4-3 – HOUSEHOLDS AND AVERAGE NUMBER OF PERSONS PER HOUSEHOLDS: 1991-2030



Sources: STATEC, *Statistical Yearbook*, Table B.1400 (updated 14.05.2013):
http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=494&IF_Language=fra&MainTheme=2&FldrName=3&RFPath=92
STATEC, *Economie et Statistiques N° 55 – Projection des ménages privés et des besoins en logements 2010 - 2030* (published 26.10.2010), table 9, p. 26:
http://www.statistiques.public.lu/catalogue-publications/economie-statistiques/2011/55-2011.pdf

II.4.2. Workforce: the importance of cross-border commuters

The economic restructuring and development of Luxembourg led to a doubling of the workforce in the last 20 years. The resident population of Luxembourg nationality was unable to meet this increasing demand for labour. The number of Luxembourg nationals employed increased from some 103 700 units in 1995 to 123 700 in 2012, representing an average annual growth rate of only 1%. How, therefore, could this urgent economic need be satisfied? The initial response was to resort to **immigration**. The number of foreign employees living and working in Luxembourg rose from 54 900 in 1995 to 96 100 in 2012 – an average annual growth rate of 3.3%. But, this was not enough. So the **cross-border commuters** came into play. Between 1995 and 2012, the number of cross-border workers increased from 56 900 to 159 100, at an average annual growth rate of 6.2% *[→Table II.4-2]*.[15]

For 2012, among the persons employed, 49.5% of the commuters came from France, 25.3% from Germany and 25.2% from Belgium. In total, the commuters accounted for 42% of the total workforce in Luxembourg and for 29.6% (i.e. more than a quarter) of the residential population *[→Figure II.4-4]*.[16] The commuting flows amongst the various regions of the *Grande Région* clearly show the economic attraction of Luxembourg *[→Figure II.4-5]*.

A vast majority of workers from abroad commute by car.[17] However, in order to alter the current modal split of home-work journeys, Luxembourg invests predominantly and jointly with the neighbouring regions into the public transport offer *[→ Section IV.1.4]*.

TABLE II.4-2 – PERSONS EMPLOYED: 1995-2012

in thousand persons	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
Resident workers – Lux. nationals *(B.3106 & E.2309)*	103.7	106.3	108.7	109.1	110.0	111.6	116.2	117.6	119.7	123.7
Resident workers – foreigners *(B.3106 & B.3107)*	54.9	67.2	77.9	80.7	83.8	88.7	88.3	89.7	93.5	96.1
Cross-border workers *(B.3107)*	56.9	90.3	121.2	129	139.2	149.4	148.3	151.9	156.6	159.1
Total workers/employment *(E.2309)*	**215.5**	**263.8**	**307.8**	**318.8**	**333.0**	**349.7**	**352.8**	**359.2**	**369.8**	**378.9**

Sources: MDDI-DEV calculations on the basis of STATEC, *Statistical Yearbook*, Tables B.3106 (updated 28.10.2013), B.3107 (updated 28.10.2013) & E.2309 (version 10.2013):
http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=493&IF_Language=fra&MainTheme=2&FldrName=3&RFPath=92
http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=494&IF_Language=fra&MainTheme=2&FldrName=3&RFPath=92
http://www.statistiques.public.lu/stat/TableViewer/document.aspx?ReportId=1497&IF_Language=fra&MainTheme=5&FldrName=2

Notes: (1) due to revisions in the calculation of the various measures of employment, it is not possible to go back further than 1995.
(2) this table presents the total employment, i.e. paid workers and self-employed workers. Figures are annual cumulative averages.

FIGURE II.4-4 – CROSS-BORDER COMMUTERS GROWTH: ANNUAL CUMULATIVE AVERAGES 1980-2012

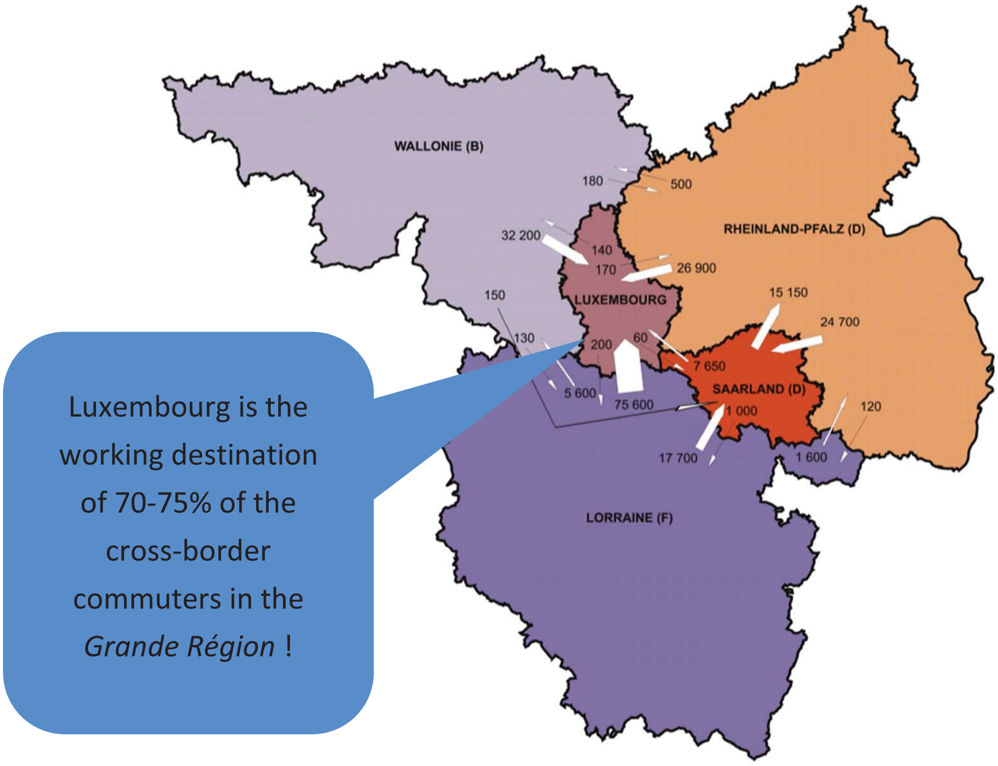
Source: STATEC, *Statistical Yearbook*, Table B.3107 (updated 28.10.2013):
http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=494&IF_Language=fra&MainTheme=2&FldrName=3&RFPath=92.

15 Figures indicated in this paragraph are annual cumulative averages.

16 Calculated from STATEC, *Statistical Yearbook*, Table B.3107:
http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=494&IF_Language=fra&MainTheme=2&FldrName=3&RFPath=92.

17 According to a recent study, for 2010, it was estimated that 86% of the cross-border commuters were only using their car for their home-work journeys. This percentage was 91% in 2007: http://www.ceps.lu/?type=module&id=104&tmp=1900.

FIGURE II.4-5 – COMMUTING FLOWS 2011



Source: INSEE, IGSS, STATEC, IWEPS, Statistisches Amt Saarland, Statistisches Landesamt Rheinland-Pfalz: http://www.statistiques.public.lu/stat/TableViewer/document.aspx?ReportId=498&IF_Language=fra&MainTheme=2&FldrName=3&RFPath=92.

Box II.4-1 – The *Grande Région*

The *Grande Région* is the geographic unit that includes Luxembourg, the Region of Wallonia in Belgium, Lorraine in France and two German *Länder*: Saarland and Rheinland-Pfalz.

Today, this structure is more a cooperative space than an effective integrated region defining and modelling its own policies and development. This is the result of the diversity of the territories constituting the *Grande Région*, of its dimension and of the barriers created by institutional and administrative structures in each country. De facto, being a sovereign state amongst country regions, Luxembourg has a special status in this cooperative space: it is the main driving force behind the *Grande Région*, a position re-enforced by its demographic and economic development as shown by the figures in the table below.

Grande Région entity	population change (1st January)	population annual average growth rate (1st January)	GDP at current price annual average growth rate	total employment in 2012
	% 1990-2012	*% 1990-2012*	*% 1990-2012*	*1990=100*
BE-Wallonia	9.33%	0.41%	3.84%	116
DE-Rheinland-Pfalz	7.79%	0.34%	2.48%	117
DE-Saarland	-6.30%	-0.30%	2.28%	116
FR-Lorraine	2.27%	0.10%	2.52%	102
Luxembourg	**38.37%**	**1.49%**	**7.26%**	**201**

Wallonia –GDP: 2010 compared to 1992 // total employment in 2008.

Lorraine – GDP: 2009 compared to 1990 // total employment in 2010.

More information on the *Grande Région* can be found on line:

http://www.granderegion.net/fr/index.html

http://www.grande-region.lu/eportal/pages/HomeTemplate.aspx

II.4.3. Effects on GHG emissions: rising emissions due to road transport flows

Both demographic and employment strong increases in Luxembourg should have impacts on GHG emissions. The 3 CRF sub-categories that are the most likely influenced by the demographic and workforce developments are the **residential sector** (CRF 1A4b), the **commercial & institutional sector** (CRF 1A4a) and **road transportation** (CRF 1A3b). For the latter, a distinction has been made between emissions due to residents and those generated by non-residents – whether they are in transit or commuting for work or leisure – i.e. "road fuel sales to non-residents" *[→ Figure II.4-5 & Box II.8-1]*.[18]

Emissions from **commercial and institutional sectors** (1A4a) decreased over the period 1990-2012,[19] what seems quite remarkable as economic activity in the tertiary sector have gone up during the whole period, hence offices building constructed surfaces too. Overall emissions in this sector have ranged between a minimum of 0.43 Mio. t CO_2e in 2007, and a maximum of 0.77 Mio. t CO_2e in 1998 *[→ Figure II.4-6]*.

Emissions development for the **residential sector** is, however, less favourable. Indeed, over the period 1990-2012, emissions increased by 45% whereas population augmented by 39.7%. This growth is actually very close to the one accounted for the number of households: +44.1% between 1991 and 2011. At the same time, the average number of persons per household diminishes from 2.69 to 2.52 *[→ Section II.4-1]*. For this sector, overall emissions have ranged between a minimum of 0.67 Mio. t CO_2e in 1990, and a maximum of 1.23 Mio. t CO_2e in 2004 *[→ Figure II.4-6]*.

Nevertheless, there is a break in time series for building related energy statistics between 1999 and 2000 as the figure below clearly demonstrates. It is then more accurate to analyse the developments since 2000. This analysis gives the following results:

- for the commercial and institutional sectors (1A4a), emissions declined by 1.8% between 2000 and 2012 – range [0.43 ; 0.61] Mio. t CO_2e;
- for the residential sector (1A4b), emissions declined by 9.4% between 2000 and 2012 – range [0.92 ; 1.23] Mio. t CO_2e.

Gains in energy efficiency as well as the expansion in the use of natural gas as heating fuel in Luxembourg *[→ Section II.6]* are the main drivers behind this relatively flat evolution.

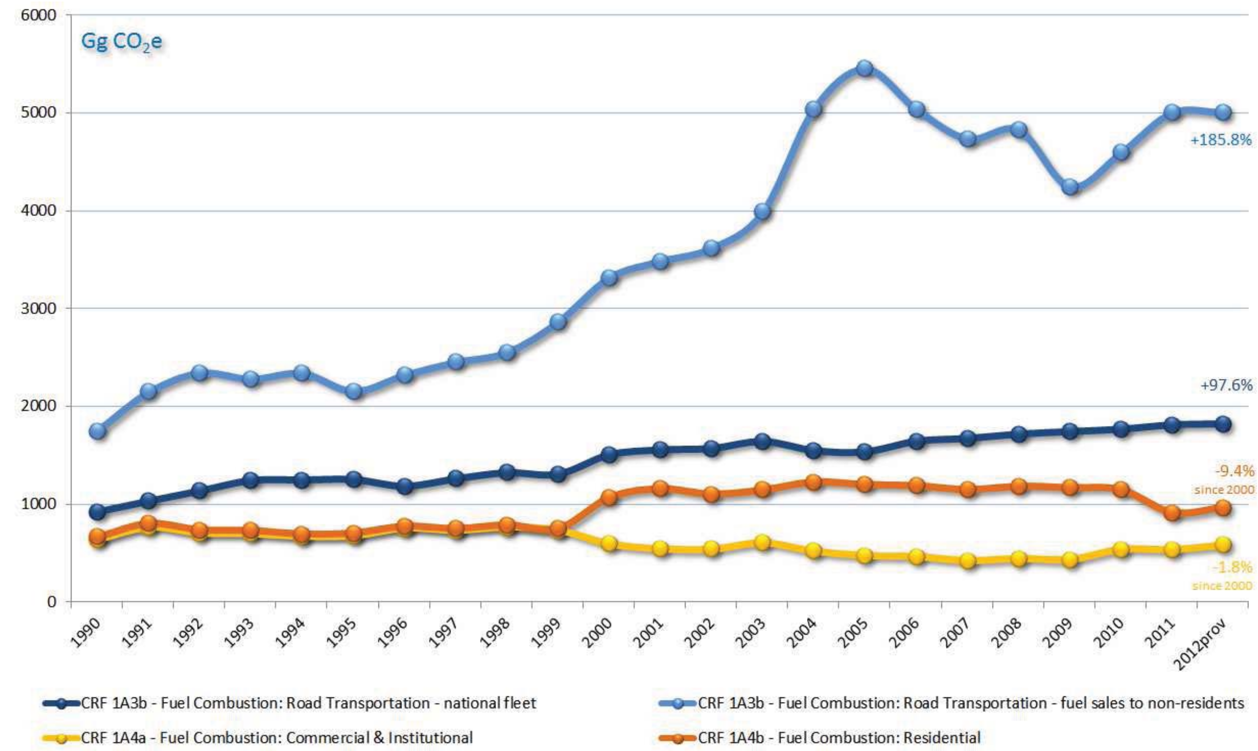
Concerning **road transportation**, both emissions generated by the national vehicles fleet – i.e. by vehicles owned by people living or business settled in Luxembourg – and by the non-residents – "road fuel sales to non-residents" – showed dramatic increases over the period 1990-2012: +97.6% and +185.8% respectively *[→ Figure II.4-6]*. For the national fleet, the evolution is correlated with

18 The notion and the importance of "road fuel sales to non-residents" in GHG emissions are discussed in Section II.8 below.

19 2012 data are provisional data estimated by the Department of the Environment during the summer of 2013 for the EC and the European Environment Agency: more on this in Section III.1 below.

both the population and economic activity growth. It is also explained by an increasing rate for passenger cars per inhabitants (from 477 to 658 passenger cars per 1000 inhabitants between 1990 and 2011, i.e. the highest rate within the EU[20]). Regarding "road fuel sales to non-residents", the rise is undoubtedly linked to the growing number of commuters crossing the borders every working day as well as to the general increase of road freight traffic in Europe – amongst which an important share transit through Luxembourg because of its location and grasps the opportunity to fill up due to lower road fuel prices in Luxembourg compared to its neighbouring countries.[21] Lower road fuel prices in Luxembourg are essentially the result of lower excise rates. These, though inferior than in the neighbouring countries (Belgium, France and Germany), are not the lowest within the EU.[22]

FIGURE II.4-6 – GHG EMISSIONS FOR SELECTED CRF FUEL COMBUSTION ACTIVITIES SUB-CATEGORIES: 1990-2012



Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2.
Notes: (1) 2012 data are provisional data estimated by the Department of the Environment during the summer of 2013 for the EC and the European Environment Agency: more on this in Section III.1 below.
(2) CRF 1A4a&b: there are breaks in time series between 1999 & 2000, hence the growth rates are calculated on the basis of the year 2000.

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20 Data extracted from European Commission (DG MOVE), *EU transport in figures – Statistical pocketbook*, 2013 edition, p.83. http://ec.europa.eu/transport/facts-fundings/statistics/doc/2013/pocketbook2013.pdf.

21 An analysis of road fuel prices based on data compiled by the UK DECC, shows that fuel prices, including taxes and duties, have always been lower in Luxembourg than in its three neighbouring countries (Belgium, France and Germany) – period covered by DECC statistics is January 1999 – November 2013. However, considering the last 10 years, road fuel prices developments were similar between Luxembourg and Belgium, and steadily higher than for the two other countries (i.e. higher indexes with January 2003 = 100). Looking at price differentials between Luxembourg and the three neighbouring countries, it appears that they have reduced over the period 1999-2013, especially with France: **diesel** – Belgium from -13% to -12%; France from -25% to -10%; Germany from -21% to -16% - **unleaded gasoline** - Belgium from -22% to -14%; France from -25% to -9%; Germany from -23% to -14% (analysis file available upon request).
Source data: see https://www.gov.uk/government/statistical-data-sets/comparisons-of-industrial-and-domestic-energy-prices-monthly-figures.

22 See, e.g., http://www.energy.eu/fuelprices/.

II.5. ECONOMIC PROFILE

One of the main characteristics of economic growth in Luxembourg is its volatility. Generally speaking, the economic cycle in Luxembourg follows that of other European countries, but the amplitude of the GDP variations is more pronounced. This is a common feature of small economies, open to the outside world, and therefore more vulnerable to external shocks. It would however appear that over the past fifteen years the amplitude of GDP variations in Luxembourg has diminished, as has the gap in relation to the European cycle [Ministry of the Economy, STATEC, 2012, graphic 3].

II.5.1. A bit of history

The turn of the 20th century up to the First World War was characterized by a sustained growth in the steel industry that attracted new inhabitants, which induced a population concentration in the city of Luxembourg and the canton of Esch-sur-Alzette (mining region) while, up to then, Luxembourg was rather a rural country. Afterwards, up to the 1950s, economic development was mostly flat (annual average GDP growth of 1.6%) due to the crises associated with the two World Wars and the economic recession in the early 1930's.

Following the Second World War, during the "*Trente glorieuses*" (i.e. 1945-1975), GDP growth reached levels of almost 4% a year. The 1975-1985 world economic crisis brought a temporary end to these years of exceptional growth. The average annual GDP growth was "only" 2.3% during this period.

Nevertheless, during the 1960s, Luxembourg's economic growth had been slightly beneath the percentages recorded for the, at that time, European Community Member States.[23] This is one of the reasons that encouraged authorities to diversify the economy, which gradually shift from an industry dominated structure to a services one. This led to an exceptional growth in Luxembourg as from the mid-1980s, largely due to a boom in the financial sector: both the GDP level per inhabitant and the GDP growth then exceeded those of the majority of industrialised countries in Europe at that time.[24]

More precisely, when looking at labour productivity and employment respective contributions to economic growth in Luxembourg, a clear hiatus between the periods 1960-1985 and 1985 and after appears. This reveals a real change of "economic regime" in the country.[25] Up until the mid-1980s, annual GDP variations were largely due to variations in productivity. The period between the end of the Second World War and the 1980's is marked by what could be called an "industrial regime".

23 Annual average GDP growth 1960-1974: Luxembourg: +4.1%, UE-15: +4.6%.

24 Annual average GDP growth 1985-2007: Luxembourg: +5.3%, UE-15: +2.3%.

25 This is clearly illustrated by graphics published in Ministry of the Economy, STATEC (2009), graphics 1.1.15, and Ministry of the Economy, STATEC (2012), graphic 6.

Steelmaking was at the core of the Luxembourg economy at that time and, consequently, the economic somersaults could be attributed to this sector. Then, starting in the mid-1980s, variations in GDP and in labour productivity started to diverge and employment became the main driver of economic growth. Moreover, productivity showed a tendency to subside. That is the period when the economy shifted towards a service economy boosted by the financial sector and that Luxembourg began, from the second half of the 1980's, to substantially outstrip growth in neighbouring countries. This period is also the one characterized by the beginnings of high population and cross-border commuters growths (as depicted in *Section II.4*).

II.5.2. Recent economic development: the industrial decline and the increasing weight of financial & corporate services

The economic restructuring and development of the country towards the tertiary sector described in the previous section led to the following **economic cycles** since 1990:

- up to 1992, the continuation of the exceptional growth initiated around 1985;
- the effects of the economic slowdown in Luxembourg during the period between 1992 and 1996 and the economic downturn in 2001 – as well as the less impressive growth in 2002-2004 – which is mirrored by a stagnation of the GDP level per inhabitant in Luxembourg in comparison with the EU-15;
- the good economic performance of Luxembourg between 2005 and 2008;
- the financial and economic crisis that started end 2008 and that has been particularly pronounced in the first semester of 2009
- from 2010 onwards, a very slow recovery could be observed, though it flattened quickly for the industry and commercial sectors *[→ Section II.5-3]*.[26]

Nowadays, **gross value added** is mainly generated in the financial intermediation (banking and insurances), real estate and services to business sector. The share of total gross value added in this branch has increased from about 38% in 1995 to 45% in 2012.[27] While the commercial sector has maintained a constant share at about 16 to 18%, the share of the industry sector has decreased significantly from 15% in 1995 to less than 7% in 2012. Other service activities ranged between a share of 20 to 24% and construction kept a rather constant share in total gross value added between 6 and 7%. The contribution of the agricultural sector is negligible with less than 1% ***[→ Table II.5-1 & Figure II.5-1]***.

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26 For more details on the economic evolution and structure of Luxembourg, refer to Ministry of the Economy, STATEC (2009), section 1.1.2, and Ministry of the Economy, STATEC (2012).

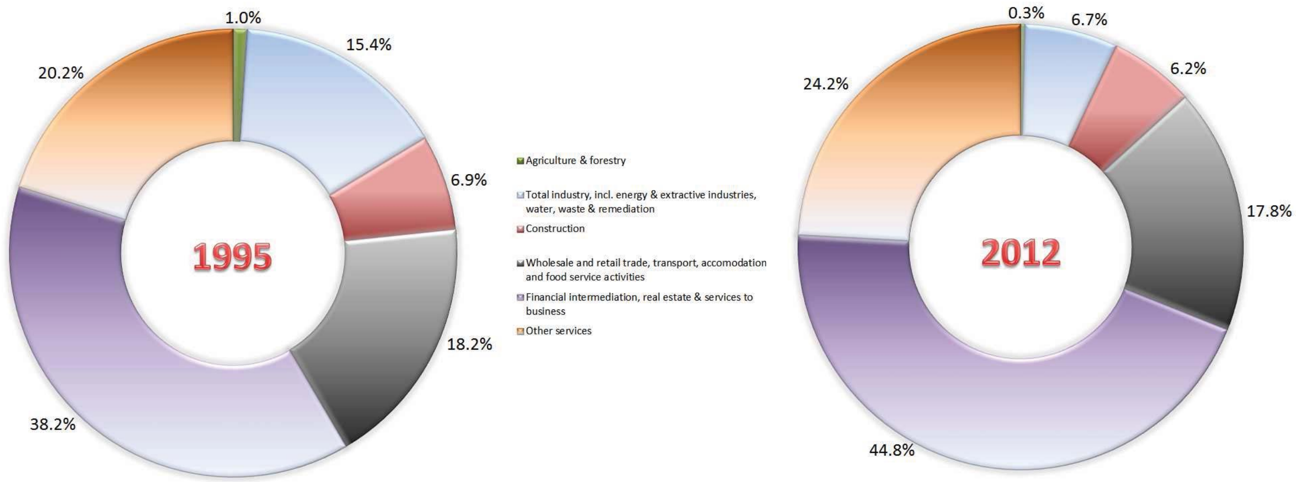
27 Data prior to 1995 are and will not be translated into the new European System of Accounts (ESA).

TABLE II.5-1– SECTORAL GROSS VALUE ADDED AT CURRENT PRICES: 1995-2012

	mio. EUR	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012
Agriculture, forestry & fishing (A)		140.6	134.3	120.7	118.6	135.4	122.5	97.6	103.1	111.0	131.4
	%	*1.0%*	*0.7%*	*0.4%*	*0.4%*	*0.4%*	*0.4%*	*0.3%*	*0.3%*	*0.3%*	*0.3%*
Total industry, including extractive industries, energy production & distribution, water supply, sewerage, waste management and remediation activities (C to E)		2103.5	2504.7	2902.6	3033.3	3629.6	3187.9	2280.2	2585.4	2633.9	2594.0
	%	*15.4%*	*12.8%*	*10.7%*	*9.9%*	*10.7%*	*9.5%*	*7.1%*	*7.3%*	*7.0%*	*6.7%*
Construction (F)		947.0	1266.9	1796.4	1902.4	2175.4	2102.4	2050.2	2087.1	2223.8	2379.7
	%	*6.9%*	*6.5%*	*6.6%*	*6.2%*	*6.4%*	*6.3%*	*6.4%*	*5.9%*	*5.8%*	*6.2%*
Wholesale and retail trade, transport, accomodation and food service activities (G to I)		2492.1	3365.5	4570.7	4830.5	5363.3	5676.5	5146.3	6026.3	6946.7	6844.2
	%	*18.2%*	*17.2%*	*16.9%*	*15.8%*	*15.9%*	*16.9%*	*16.1%*	*17.0%*	*18.5%*	*17.8%*
Financial and insurance activities; real estate activities; professional, scientific and technical activities; administrative and support service activities (K to N)		5225.0	8218.4	11812.4	14419.6	15670.9	15274.8	14713.6	16492.3	16815.2	17224.3
	%	*38.2%*	*41.9%*	*43.7%*	*47.2%*	*46.3%*	*45.4%*	*46.1%*	*46.4%*	*44.8%*	*44.8%*
Other services: information and communication; public administration, defence, education, human health and social work activities; arts, entertainment and recreation; other service activities; activities of household (J & O to U)		2764.9	4131.4	5857.5	6253.7	6839.0	7244.3	7613.3	8217.2	8839.0	9292.1
	%	*20.2%*	*21.1%*	*21.6%*	*20.5%*	*20.2%*	*21.6%*	*23.9%*	*23.1%*	*23.5%*	*24.2%*
Total: all NACE rev2 branches		**13672.9**	**19621.2**	**27060.4**	**30558.0**	**33813.5**	**33608.4**	**31901.0**	**35511.5**	**37569.6**	**38465.5**
Annual growth rate - current prices					**12.9%**	**10.7%**	**-0.6%**	**-5.1%**	**11.3%**	**5.8%**	**2.4%**
Annual growth rate - constant prices/in volume					**5.4%**	**6.8%**	**-1.3%**	**-6.1%**	**3.3%**	**1.4%**	**-0.7%**

Source: STATEC, *Statistical Yearbook*, Tables E.2304 (current prices) & E.2305 (constant prices) (updated 10.2013): http://www.statistiques.public.lu/stat/TableViewer/document.aspx?ReportId=1497&IF_Language=fra&MainTheme=5&FldrName=2

FIGURE II.5-1 – SECTORAL GROSS VALUE ADDED AT CURRENT PRICES: 1995 & 2012



Source: STATEC, *Statistical Yearbook*, Table E.2304 (updated 10.2013): http://www.statistiques.public.lu/stat/TableViewer/document.aspx?ReportId=1497&IF_Language=fra&MainTheme=5&FldrName=2

It is therefore obvious that the financial sector has been the principal engine driving the economy for almost three decades. Luxembourg is a global leader in the investment fund industry as well as the Euro area's private banking centre. When it comes to the amount of assets managed by undertakings for collective investment, Luxembourg ranks as the largest EU fund domicile jurisdiction and the second largest fund domicile jurisdiction globally.[28] However, the radical shift from an industrial economy based on steel to a service economy based on banking and finance initiated in the 1960s has led to an economy which is again dominated by a few activities. It is the case to such a point that there is, at the present, a high correlation between evolutions in banking

28 This concerns UCITS (Undertakings for Collective Investment in Transferable Securities Directives – http://en.wikipedia.org/wiki/Undertakings_for_Collective_Investment_in_Transferable_Securities_Directives). Some statistics available in the Luxembourg Bankers' Association (ABBL) Facts & Figures publication: http://www.abbl.lu/fr/news-publications/abbl-publications/abbl-facts-figures (for instance, page 15 of the December 2013 edition) as well as in the European Fund and Asset Management Association (EFAMA) Asset Management in Europe latest report, Exhibit 20, p. 18 - http://www.efama.org/statistics/SitePages/Asset%20Management%20Report.aspx.

activities and in GDP. In 2002, the Government, therefore, initiated a new process of diversification via the "**Luxembourg Cluster Initiative**" that actively encourages networking between the private and the public sectors in domains Luxembourg might have comparative advantages in. The focus is placed on key technologies that have been identified as being important for the future sustainable development of the Luxembourg economy. The 5+2 "clusters" are (i) eco-innovation technologies, (ii) healthcare and biotechnologies, (iii) information & communication technologies, (iv) materials technologies, and (v) space technologies; (vi) logistics and (vii) maritime activities represent other innovation sectors in which Luxembourg is significantly improving its positioning.[29] Four of these "clusters" have been identified as "priorities" by the Ministry of the Economy: (i) eco-innovation technologies, (ii) healthcare and biotechnologies, (iii) information & communication technologies, and (vi) logistics [Ministry of the Economy, Observatoire de la Compétitivité, 2013, Chapter 5]. The eco-innovation and, to a lesser extent, the materials technologies "clusters" might have implications with regard to measures for reducing GHG emissions in Luxembourg.

II.5.3. The financial and economic crisis of these last years

With an economy heavily depending on the financial sector and related activities, as well as on a few large enterprises, some operating in the fields of steelworks and of the automotive industry (glass, tyres), the financial then economic crisis has had, and still has, important effects.

As OECD pointed it out in its 2010 economic survey, "*Luxembourg has experienced a severe recession as the result of the international financial crisis. Output contracted sharply and unemployment has risen. Luxembourg's economy was heavily exposed to the downturn in world trade and the financial centre has been strongly affected. However, policy support from accommodative euro area monetary policy and a fiscal stimulus package helped stabilise the economy*." [OECD, 2010a].

Looking at the main economic activity indicator, i.e. **GDP in volume**, the economic situation started to deteriorate during the second half of 2008. GDP in volume reached a low the first half of 2009, with a 5.6% decline recorded for the whole year. Consequently, the year 2009 is set to be the worst seen in Luxembourg since the iron and steel crisis in the mid-1970s. Since then, GDP in volume marginally increased but it flattened throughout the year 2012 that has finally seen a slightly negative growth of -0.2% [Ministry of the Economy, STATEC, 2013c, Chapter 2]. Forecasts for the next years are rather pessimistic, compared to the high growth rates Luxembourg experienced in the past ***[→ Section II.5.1]***: 2% growth for 2013 and 2.7% for 2015 [Ministry of the Economy, STATEC, 2013c, Chapter 7].

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29 For more details, see the portal and the website presenting the "innovative clusters": http://www.clusters.lu/ and http://www.innovation.public.lu/en/clusters/index.html.

The short-term growth would, according to STATEC, be mainly driven by the external demand, whereas the national private consumption should go on stagnating. One of the reasons behind this sluggish consumption is **unemployment**. Though the number of cross-border commuters continued to climb these last years *[→ Section II.4.2]*, unemployment dramatically increased. Between mid-2012 and mid-2013, unemployment growth rate – inferred on an annual basis – is set to about 15% – to be compared to an annual growth rate of around 10% during the ten preceding years (but a 35% increase for 2009) [Ministry of the Economy, STATEC, 2013c, Chapter 5]. Against this general trend, Luxembourg manufacturing suffered particularly badly, even though the negative effects on employment were offset by massive recourse to partial unemployment. In the financial and associated sectors, job losses were not so significant [Ministry of the Economy, STATEC, 2013c, Chapter 5, graphics 121 and 122].

In fact, in Luxembourg, the impact of falling activity at the end of 2008 and throughout the year 2009 took a while to affect employment and unemployment figures – refer also to comments in *Section II.4.2*). In terms of employment, temporary workers were some of the first affected. However, this had little impact on the unemployment rate given the high proportion of temporary cross-border workers. The adjustment in the labour factor also often initially led to an exceptionally sharp fall in working hours, delaying job losses. As underlined above, partial unemployment is a case in hand and was used to minimise the damage. With the rapid collapse in output and almost non-existent short-term visibility for many companies at that time, this measure was highly popular. Finally, the number of people in job schemes started to climb again from the 2nd quarter of 2009 on, damping down the rise in unemployment. However, general labour market trends were for ongoing but slowing decline. Indeed, if the unemployment rate[30] was 3.5% in 2000, it reaches now 8.7% and is on a continuing rising trend since 2008.

These developments actually underlines a "**paradox**" of Luxembourg's economic development: unemployment is increasing and at the same time new jobs are created, though at a lower pace than during the prosperous years – i.e. between the mid-nineties and around 2008. This could be explained, notably, by the structural changes that the financial and associated sectors experienced during the years 2000, where better qualified jobs were requested and cannot be satisfied by residents.

Finally, as in many other Western countries, in order to minimize the crisis effects, the Government injected money in the economy by **maintaining public investments**. The Government, that started its work during the summer of 2009, pledged to "greening" its economy by promoting "green growth", ensuring a sustainable development and supporting "green" and renewable energy sources. The new Government, in place since early December 2013 also put forwards "green investments and "green jobs" in its multiannual work programme. It intends to

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30 Unemployment rate in a "broad sense", i.e. registered unemployed persons and persons benefiting from employment measures (training, etc.) – see Ministry of the Economy, STATEC (2013c), table 23, p. 78.

make Luxembourg a pioneer within the *Grande Région* with regard to energy efficiency and renewable energy sources. This should, in turn, lead to the creation of "green jobs" the programme says [Government of the Grand Duchy of Luxembourg (2013), p. 83].

II.5.4. Effects on GHG emissions: it is not so much modifications in the economic structure than particular changes that affect the GHG emissions trend

Since the main structural changes affecting Luxembourg's economic profile took place before 1990 (→ *Section II.5.1*), they do not come out in the GHG emissions trends for some emblematic CRF sub-categories: total GHG excluding LULUCF, public electricity and heat production (CRF 1A1a), manufacturing industries and construction combustion and processes emissions (CRF 1A2+2A+2C1) and "road fuel sales to non-residents" (CRF 1A3b, part) *[→ Figure II.5-2]*.

While the increasing shares in gross value added from less energy and carbon intensive sectors (as financial and services) has a positive effect on the carbon intensity of the Luxembourg economy, the overall GHG emissions trend is mostly determined by the developments of the 3 CRF (sub-) categories displayed in *Figure II.5-2*. The residential, commercial and institutional sectors do not really influence the general trend, as we have seen in *Section II.4.3*.

Regarding electricity and heat production, the jump in 2002 is the result of a new power plant that started its operation that year *[→ Section II.6]*.

Manufacturing industries and construction sharp fall up to 1998 is linked to structural changes in one industrial sector, the steel industry *[→ Section II.7]*.

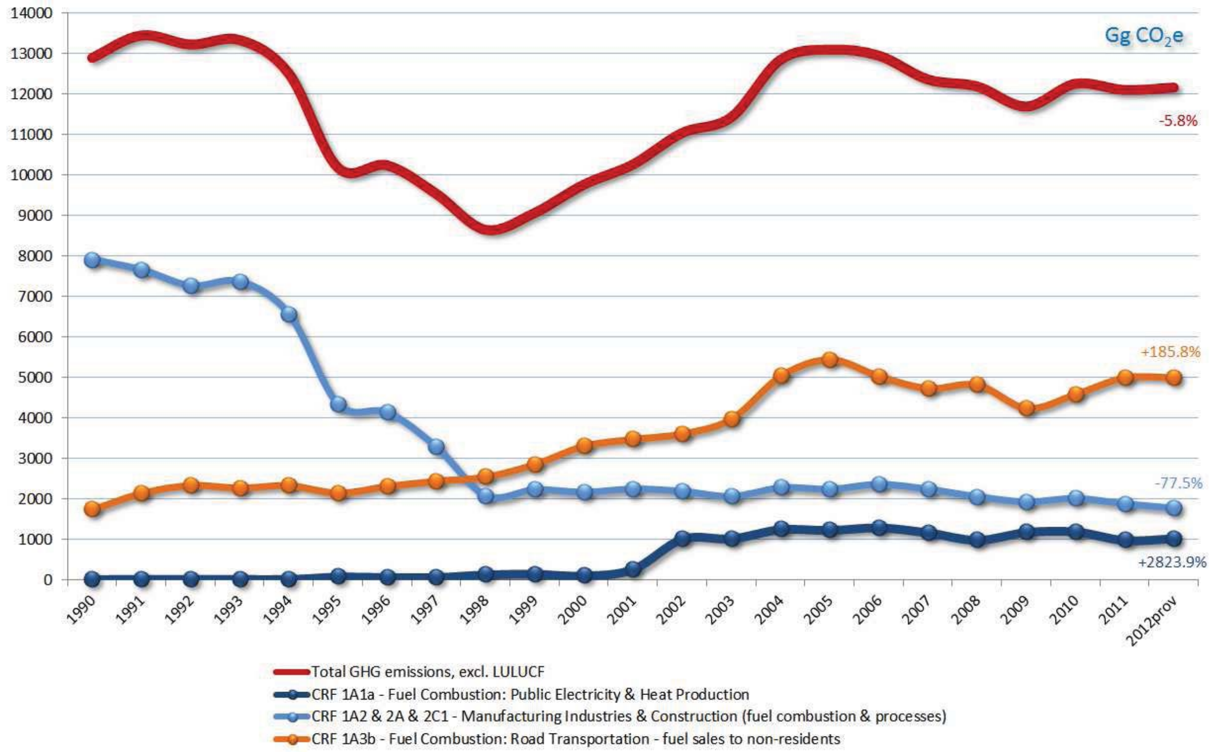
With regard to "road fuel sales to non-residents", the evolution has been briefly described in *Section II.4.3* and will be exposed in detail in *Section II.8* below.

Finally, the impacts of the financial and economic crisis are visible for the year 2009 and are mostly due to a decrease in "road fuel sales to non-residents" and not to lower emissions for manufacturing industries and construction. This reduction was in line with a sharp decline of road freight transport throughout Europe during that year.

To conclude, GHG emissions trends in Luxembourg are not so much influenced by the economic profile of the country, but for the most part by:

- the energy-mix for both production and consumption of fuels (liquid, solid, gaseous, biomass) *[→ Section II.6]*;
- due to its size and the size of its energy and industrial sector, structural changes in these sectors that could be initiated by a single entity *[→ Sections II.6 & II.7]*;
- road transportation related fuel sales *[→ Section II.8]*.

FIGURE II.5-2 – GHG EMISSIONS FOR SELECTED CRF FUEL COMBUSTION ACTIVITIES SUB-CATEGORIES: 1990-2012



Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2.
Note: 2012 data are provisional data estimated by the Department of the Environment during the summer of 2013 for the EC and the European Environment Agency: more on this in Section III.1 below.

II.6. ENERGY

CRF sub-category covered	1A1a		
share in total GHG emissions, excl. LULUCF	***1990***	0.3% =	35.56 Gg CO_2e
	2011	8.22% =	994.69 Gg CO_2e
	2012prov	8.55% =	1039.62 Gg CO_2e

II.6.1. A total change in Luxembourg's energy-mix

Primary and final energy consumption in Luxembourg experienced dramatic changes since 1990. Overall **primary energy consumption** increased by 27.4% between 1990 and 2012. Whereas solid fuels and coal declined by more than 95% over the period, liquid fuels (incl. kerosene) and natural gas consumptions increased by 79% and 145% respectively *[→ Table II.6-1 & Figure II.6-1]*.

Final energy consumption increased by 23.4% between 1990 and 2012. As for primary energy consumption, all the energy sources have seen their consumption increase over the period, except solid fuels and coal *[→ Table II.6-2 & Figure II.6-2]*.[31]

31 The percentages reported in this paragraph and the previous one would have been higher if the cutting date would have been 2011: 30% increase for primary energy consumption and 27% increase for final energy consumption. Indeed, an economic slowdown characterized the year 2012.

However, over the period 1990-2012, the final energy-mix of Luxembourg changed considerably with a dropping share for solid fuels – for which the main part was used in the iron and steel industry – in favour of liquid fuels and natural gas and, to a lesser extent, to new energy sources based on the biomass. Indeed, in 2012, 83% of the **final energy consumption** was covered by fossil fuels – 65.7% by liquid fuels including the important volume of road fuels as well as kerosene,[32] 15.9% by natural gas and 1.3% by coal. The remaining 17% of the consumption were either electricity (12.7%) and heat (1.8%) or renewable energy sources, including organic waste incineration with energy recovery, biogas, and biofuels (2.6%). Going back to 1990, 23.8% of the final energy consumption was stemming from solid fuels and coal, 46% from liquid fuels, 13.5% from natural gas and 10.4% from electricity *[→ Table II.6-2 & Figure II.6-2]*. What did happen?

- regarding **solid fuels and coal**, the important decline (-93.4%) is the result of a change in production processes in the steel industry sector: the production process was moved from blast furnaces to electric arc furnaces between 1994 and 1998 and, therefore, solid fuels (mainly imported coke, but also imported anthracite) were replaced, to a very large extent, by electricity and natural gas;
- **liquid fuels** increase (+76.4%) was driven by road fuel sales and kerosene, but with the former being 4 to 5 times higher in quantity than the latter. This is especially "road fuel sales to non-residents" that explains a great deal of the sharp increase *[→ Section II.8]*;
- the 45.5% increase in **natural gas** final consumption followed the continuous extension of the natural gas network in Luxembourg so that this fuel ranked second after the consumption of liquid fuels in 2012 – and even first if "road fuel sales to non-residents" and kerosene are not considered.

Natural gas has also become the main energy source of Luxembourg's national electricity production capacity. In 1990, more than 90% of Luxembourg's electric energy consumption was imported and one medium size power plant of about 70 MW was run by the iron and steel company Arbed.[33] That power plant was mainly run on blast furnace gas – a side product of the blast furnaces in the steel industry – and was phased out in 1998 after the last blast furnace went out of service. In the early 1990s, small combined heat-power (CHP) installations (or cogeneration) plants appeared. Their setting up was encouraged financially by the Government. Later on, cogeneration facilities managed by business companies came into operation. These installations either partly supply the public network or produce energy for the sole purpose of their own activities. In mid-2002, the ultra-modern, for that time, TWINerg power plant started its commercial operation. Located in Esch-sur-Alzette, TWINerg is a gas and steam turbine power

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32 Diesel being the first liquid fuel in terms of volumes sold. The liquid fuel consumption in Luxembourg is much lower than the level of fuel sales, because large amounts of road fuels are bought by foreign commuters and transit traffic passing through Luxembourg: see section II.8.1 below.

33 Then Arcelor and now, Arcelor-Mittal.

station running on natural gas, with an electrical output of 376 MWel (efficiency 55.7%).[34] There are plans for decoupling heat at a later stage (28 MWth) for remote heating of the new Belval-Ouest district project.[35] If almost all of these cogeneration plants run on natural gas, gas oil remains the emergency fuel in case of a natural gas supply disruption.

The impact of TWINerg in the primary energy consumption mix is clearly visible in ***Table II.6-1*** and its associated ***Figure II.6-1***: electricity imports dropped and natural gas primary consumption increased. To complement this analysis, an energy balance for electric power provided ***[→ Table II.6-3 & Figure II.6-3]***.

II.6.2. Effects on GHG emissions: a sharp increase between 2001 and 2002

GHG emissions of the public electricity and heat production (CRF 1A1a) are somewhat reflecting the changes described above. A sharp increase occurred in 2002 when the TWINerg power plant started to operate at full capacity. The impact of this installation on GHG emissions is around 0.9 to 1 Mio. t CO_2e per year, i.e. about 8% of the total GHG emissions, excluding LULUCF. The rather important decreases observed between 2007 and 2008, and again between 2010 and 2011, are the result of maintenance operations of TWINerg over several months, i.e. months with no substantial production[36] ***[→ Figure II.6-4]***.

Figure II.6-4 does include GHG emissions due to waste incineration since the sole incinerator of the country recovers energy during the process. Therefore, and according to the inventory accounting rules, related emissions for the non-organic part of waste incineration have to be reported under CRF sub-category 1A1a ***[→ Section II.11]***.

The decline observed in the 1990s for the industrial sector related emissions – mostly the result of the move from blast furnaces to electric arc furnaces in the steel industry – does not appear in ***Figure II.6-4***. Indeed, and according to the inventory accounting rules, since those manufacturing industries that produce energy do it for their own needs – i.e. an auto-production that is not primarily intended to supply public networks – related emissions have to be recorded under CRF sub-category 1A2 (manufacturing industries).

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34 http://www.twinerg.lu/en_index.html, "Environment" tab and http://www.ilr.public.lu/gaz/documents/statistiques/rapport2011.pdf, p. 29.

35 http://www.belval.lu/en/.

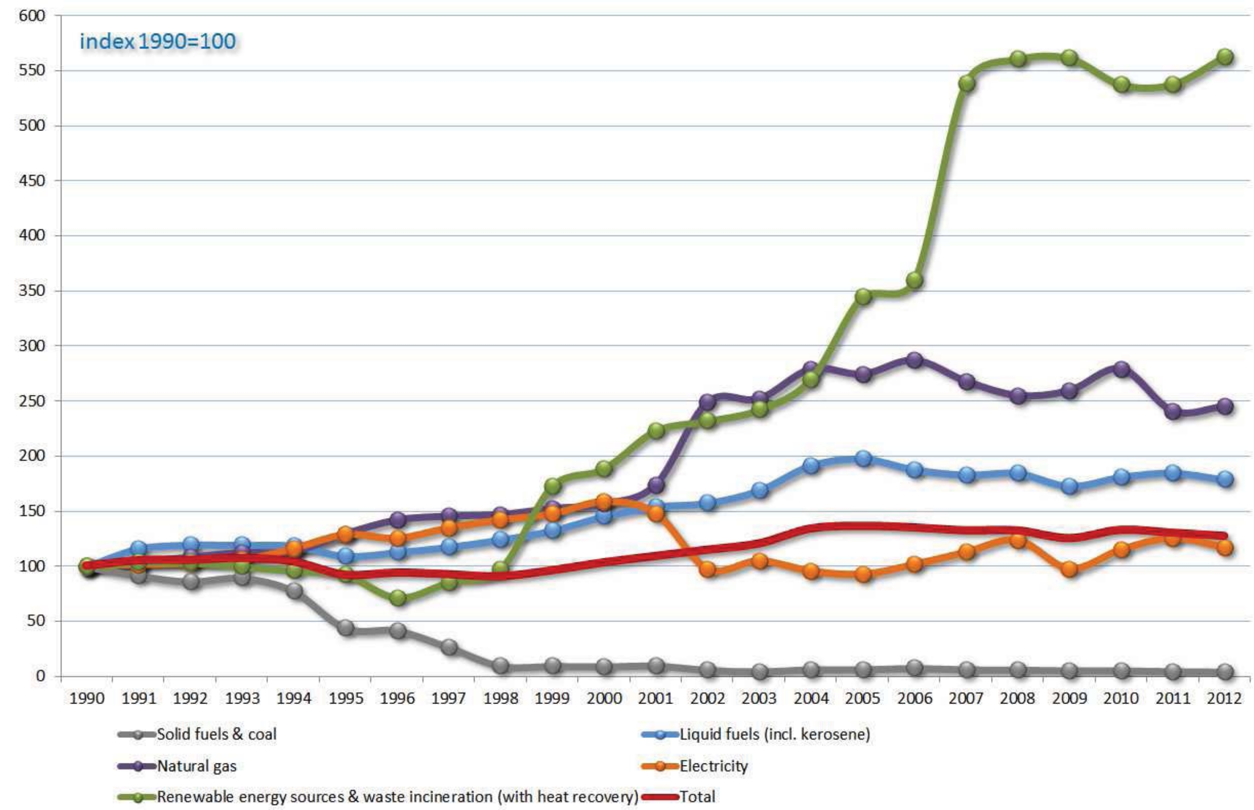
36 The maintenance operations are ckearly visible from monthly statistics published by the ILR (*Institut Luxembourgeois de Régulation*) – see http://www.ilr.public.lu/electricite/statistiques/releve_detaille_ilr/index.html, yearly tables *importation, exportation, production*. In 2008, the plant had an extremely low production between May and July. In 2011, between August and October. The whole second semester of the year 2012, the production was relatively low compared to "usual" monthly levels as Figure II.6-4 clearly shows.

TABLE II.6-1 – PRIMARY ENERGY CONSUMPTION: 1990-2012

TJ	1990 (base year)	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Solid fuels & coal	49939.83	45812.91	43145.01	44770.76	38726.29	22010.21	20893.02	13306.17	4861.42	4814.73	4594.52	4957.84
	33.23%	*28.98%*	*27.20%*	*27.75%*	*24.76%*	*15.90%*	*14.78%*	*9.57%*	*3.57%*	*3.33%*	*2.96%*	*3.02%*
Liquid fuels (incl. kerosene)	66030.62	76910.67	79078.34	78994.97	78578.11	72455.60	74715.90	77882.37	82209.79	87715.26	96236.54	102063.69
	43.94%	*48.66%*	*49.86%*	*48.97%*	*50.24%*	*52.35%*	*52.85%*	*56.00%*	*60.30%*	*60.72%*	*61.99%*	*62.27%*
Natural gas (1)	19925.91	20717.94	21593.35	22427.07	22593.81	25819.65	28324.39	29023.46	29305.68	30397.85	31231.01	34718.00
	13.26%	*13.11%*	*13.61%*	*13.90%*	*14.45%*	*18.65%*	*20.03%*	*20.87%*	*21.50%*	*21.04%*	*20.12%*	*21.18%*
Electricity	13256.15	13464.58	13631.32	14006.50	15423.82	17083.75	16644.80	17889.96	18859.16	19580.75	21059.69	19649.82
	8.82%	*8.52%*	*8.59%*	*8.68%*	*9.86%*	*12.34%*	*11.77%*	*12.86%*	*13.83%*	*13.55%*	*13.57%*	*11.99%*
Heat	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.03	2.02
	NA	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*0.00%*	*0.00%*
Renewable energy sources & waste	1125.52	1167.21	1167.21	1125.52	1083.84	1042.15	808.71	964.61	1100.93	1946.32	2125.98	2514.58
incineration (with heat recovery) (2)	*0.75%*	*0.74%*	*0.74%*	*0.70%*	*0.69%*	*0.75%*	*0.57%*	*0.69%*	*0.81%*	*1.35%*	*1.37%*	*1.53%*
Total	**150278.03**	**158073.31**	**158615.23**	**161324.82**	**156405.87**	**138411.36**	**141386.82**	**139066.58**	**136336.98**	**144454.91**	**155247.76**	**163905.94**

TJ	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Solid fuels & coal	3083.62	2369.15	3328.54	3248.87	3876.79	3280.32	3136.57	2801.27	2806.63	2443.45	2249.59
	1.79%	*1.31%*	*1.65%*	*1.58%*	*1.91%*	*1.65%*	*1.58%*	*1.49%*	*1.41%*	*1.25%*	*1.18%*
Liquid fuels (incl. kerosene)	104261.62	111789.85	126709.57	130884.49	124308.27	121227.03	122120.30	114419.02	119823.60	122367.06	118230.19
	60.43%	*61.74%*	*62.91%*	*63.82%*	*61.24%*	*60.91%*	*61.40%*	*60.75%*	*59.99%*	*62.54%*	*61.78%*
Natural gas (1)	49629.00	50238.00	55632.00	54720.18	57237.24	53426.14	50856.70	51751.75	55665.22	48021.10	48894.89
	28.76%	*27.75%*	*27.62%*	*26.68%*	*28.20%*	*26.85%*	*25.57%*	*27.48%*	*27.87%*	*24.54%*	*25.55%*
Electricity	12952.77	13931.02	12698.58	12323.47	13490.64	14981.85	16412.67	12987.43	15290.40	16677.00	15553.86
	7.51%	*7.69%*	*6.30%*	*6.01%*	*6.65%*	*7.53%*	*8.25%*	*6.90%*	*7.66%*	*8.52%*	*8.13%*
Heat	6.47	9.85	13.60	17.53	21.62	28.95	41.83	63.37	86.23	107.84	120.34
	0.00%	*0.01%*	*0.01%*	*0.01%*	*0.01%*	*0.01%*	*0.02%*	*0.03%*	*0.04%*	*0.06%*	*0.06%*
Renewable energy sources & waste	2613.45	2729.81	3039.80	3884.22	4051.33	6066.24	6312.04	6322.08	6053.39	6057.07	6338.08
incineration (with heat recovery) (2)	*1.51%*	*1.51%*	*1.51%*	*1.89%*	*2.00%*	*3.05%*	*3.17%*	*3.36%*	*3.03%*	*3.10%*	*3.31%*
Total	**172546.92**	**181067.68**	**201422.09**	**205078.77**	**202985.90**	**199010.52**	**198880.12**	**188344.92**	**199725.46**	**195673.51**	**191386.94**

FIGURE II.6-1 – PRIMARY ENERGY CONSUMPTION: 1990-2012



Source: STATEC, *Statistical Yearbook*, Table A.4200 (updated 19.11.2013):
http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=6139&IF_Language=fra&MainTheme=1&FldrName=4&RFPath=54

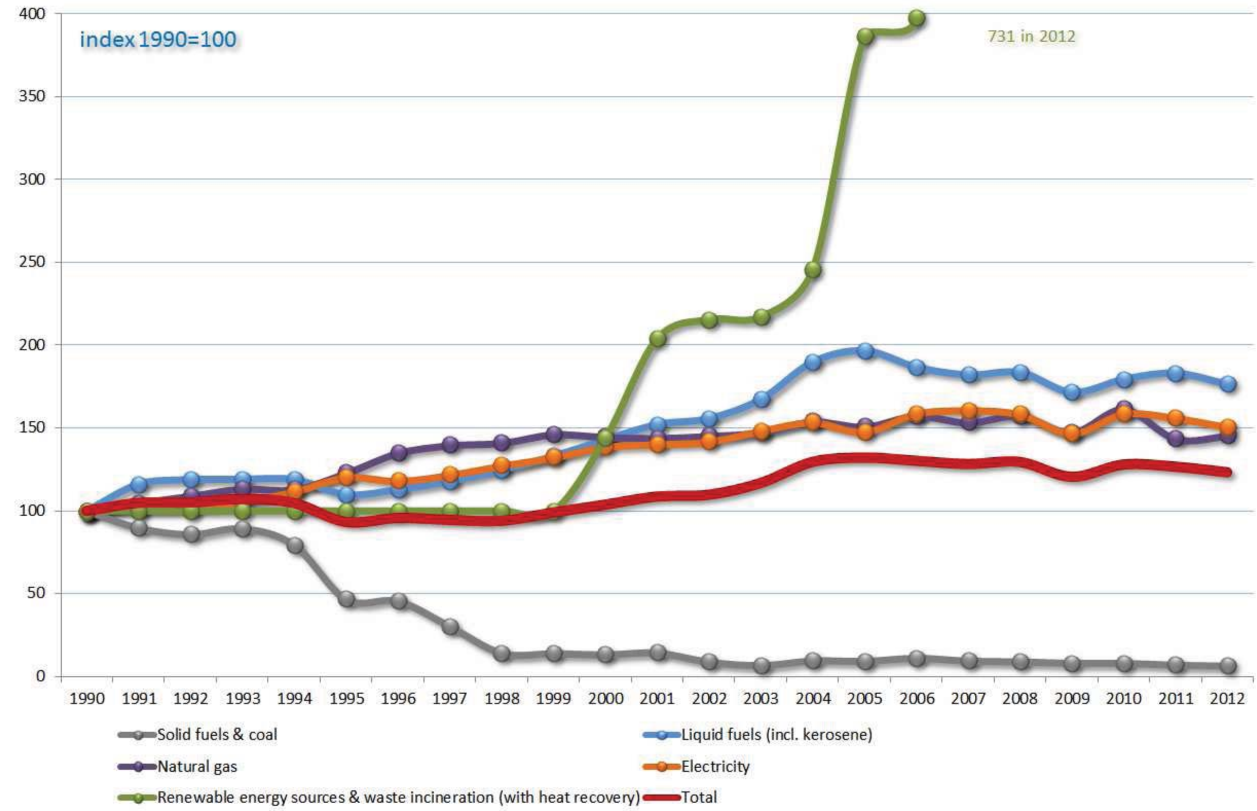
Notes: (1) natural gas is expressed in GCV;
(2) only the organic fraction of waste is counted. The biogas included as renewable energy source is expressed in GCV that also comprises blended biofuels. There is a break in time series between 1999 & 2000 (II).

TABLE II.6-2 – FINAL ENERGY CONSUMPTION: 1990-2012

TJ	1990 (base year)	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Solid fuels & coal	34331.76	30814.85	29475.07	30689.24	27268.21	16035.03	15670.77	10422.20	4882.65	4835.75	4594.52	4957.84
	23.83%	*20.38%*	*19.46%*	*19.85%*	*18.05%*	*11.91%*	*11.35%*	*7.64%*	*3.60%*	*3.39%*	*3.07%*	*3.16%*
Liquid fuels (incl. kerosene)	66193.31	76911.52	78669.97	78837.44	78753.71	72682.85	74734.38	78046.98	82554.07	88082.74	94644.90	100723.34
	45.95%	*50.87%*	*51.93%*	*51.00%*	*52.14%*	*53.99%*	*54.13%*	*57.20%*	*60.90%*	*61.67%*	*63.26%*	*64.28%*
Natural gas (1)	19426.75	20389.72	21227.08	22064.44	21989.91	23906.63	26251.24	27155.58	27436.94	28435.91	28125.74	27997.84
	13.49%	*13.49%*	*14.01%*	*14.27%*	*14.56%*	*17.76%*	*19.01%*	*19.90%*	*20.24%*	*19.91%*	*18.80%*	*17.87%*
Blast furnaces gas	8 457.34	7 234.79	6 196.46	6 514.24	5 503.55	2 731.89	2 511.66	1 347.31	NO	NO	NO	NO
	5.87%	*4.79%*	*4.09%*	*4.21%*	*3.64%*	*2.03%*	*1.82%*	*0.99%*	*NA*	*NA*	*NA*	*NA*
Electricity	14988.74	15198.08	15281.82	15826.10	16747.20	18045.11	17710.16	18254.45	19091.81	19835.80	20790.21	21033.19
	10.41%	*10.05%*	*10.09%*	*10.24%*	*11.09%*	*13.40%*	*12.83%*	*13.38%*	*14.08%*	*13.89%*	*13.90%*	*13.42%*
Heat (2)	NO	NO	NO	NO	125.60	586.15	547.21	563.54	949.98	986.41	537.71	667.87
	NA	*NA*	*NA*	*NA*	*0.08%*	*0.44%*	*0.40%*	*0.41%*	*0.70%*	*0.69%*	*0.36%*	*0.43%*
Renewable energy sources & waste incineration (with heat recovery) (3)	644.77	644.77	644.77	644.77	644.77	644.77	644.77	644.77	644.77	644.77	926.86	1315.21
	0.45%	*0.43%*	*0.43%*	*0.42%*	*0.43%*	*0.48%*	*0.47%*	*0.47%*	*0.48%*	*0.45%*	*0.62%*	*0.84%*
Total	**144042.67**	**151193.72**	**151495.17**	**154576.24**	**151032.95**	**134632.42**	**138070.20**	**136434.83**	**135560.21**	**142821.38**	**149619.94**	**156695.29**

TJ	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Solid fuels & coal	3083.62	2369.15	3328.54	3248.87	3876.79	3280.32	3136.57	2801.27	2806.63	2443.45	2249.59
	1.95%	*1.41%*	*1.78%*	*1.70%*	*2.06%*	*1.77%*	*1.68%*	*1.61%*	*1.52%*	*1.34%*	*1.27%*
Liquid fuels (incl. kerosene)	103120.21	110821.65	125715.23	130171.42	123605.43	120541.81	121487.76	113538.02	118810.49	121233.69	116779.56
	65.16%	*65.80%*	*67.33%*	*68.31%*	*65.81%*	*65.17%*	*65.06%*	*65.31%*	*64.38%*	*66.37%*	*65.69%*
Natural gas (1)	28258.28	28673.98	29942.33	29338.04	30622.60	29822.71	30616.00	28658.82	31411.99	27916.40	28262.17
	17.86%	*17.02%*	*16.04%*	*15.39%*	*16.31%*	*16.12%*	*16.39%*	*16.49%*	*17.02%*	*15.28%*	*15.90%*
Blast furnaces gas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	NA	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
Electricity	21260.54	22252.42	23007.38	22149.42	23806.48	24097.50	23750.44	22004.89	23777.46	23403.84	22578.67
	13.43%	*13.21%*	*12.32%*	*11.62%*	*12.68%*	*13.03%*	*12.72%*	*12.66%*	*12.88%*	*12.81%*	*12.70%*
Heat (2)	1149.89	2906.68	3149.21	3172.87	3332.59	2696.05	3056.68	2623.00	3199.20	3261.54	3199.98
	0.73%	*1.73%*	*1.69%*	*1.66%*	*1.77%*	*1.46%*	*1.64%*	*1.51%*	*1.73%*	*1.79%*	*1.80%*
Renewable energy sources & waste incineration (with heat recovery) (3)	1389.38	1400.35	1585.12	2490.84	2564.57	4521.14	4698.09	4220.66	4539.66	4416.79	4710.26
	0.88%	*0.83%*	*0.85%*	*1.31%*	*1.37%*	*2.44%*	*2.52%*	*2.43%*	*2.46%*	*2.42%*	*2.65%*
Total	**158261.92**	**168424.23**	**186727.81**	**190571.46**	**187808.45**	**184959.53**	**186745.54**	**173846.65**	**184545.43**	**182675.71**	**177780.23**

FIGURE II.6-2 – FINAL ENERGY CONSUMPTION: 1990-2012



Source: STATEC, *Statistical Yearbook*, Table A.4300 (updated 19.11.2013): http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=6149&IF_Language=fra&MainTheme=1&FldrName=4&RFPath=51

Notes: (1) natural gas is expressed in GCV;
(2) from 2000 onwards, heat that is consumed by the cogeneration power plants themselves is no longer included, hence the break in time series (||);
(3) only the organic fraction of waste is counted. The biogas included as renewable energy source is expressed in GCV that also comprises blended biofuels. There is a break in time series between 1999 & 2000 (||).

TABLE II.6-3 – ENERGY BALANCE FOR ELECTRIC POWER: 1990-2012

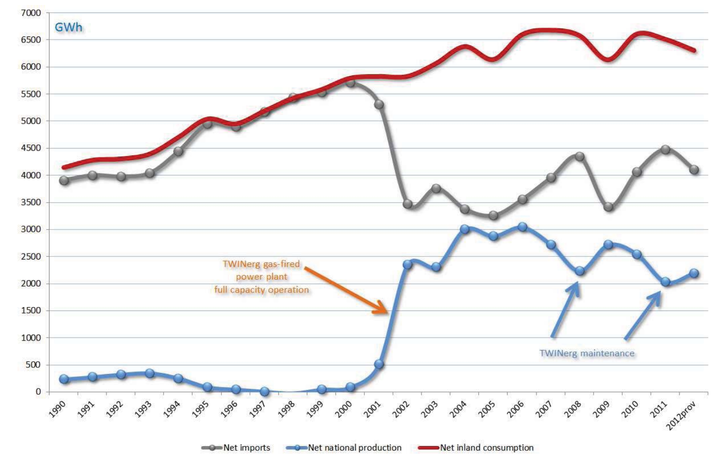
GWh		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Imports		**4665.46**	**4718.45**	**4523.56**	**4440.97**	**5015.24**	**5693.47**	**5712.33**	**6026.52**	**6366.60**	**6193.53**	**6445.38**	**6383.25**
National production		**626.24**	**676.37**	**662.49**	**669.79**	**622.07**	**527.70**	**482.06**	**430.92**	**409.91**	**390.16**	**449.58**	**928.65**
	cogeneration	NO	NO	NO	NO	30.00	99.84	122.35	124.83	198.03	205.15	227.96	321.41
	thermic power stations	558.72	622.11	594.14	607.83	505.96	346.53	306.24	213.96	104.76	51.62	51.50	457.25
	of which, TWINerg **(2)**	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*323.03*
	hydro-electricity	67.52	54.26	68.35	61.96	86.11	81.33	53.46	89.28	101.98	115.23	140.80	118.03
	wind	NO	NO	NO	NO	NO	NO	NO	2.74	4.61	17.14	24.74	23.70
	biomass & biogas	NO	NO	NO	NO	NO	NO	NO	0.12	0.52	1.01	4.54	8.20
	gas from WWTPs	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	gas from landfills sites	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	photovoltaic	NO	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00	0.04	0.05
Total		**5291.70**	**5394.82**	**5186.04**	**5110.76**	**5637.31**	**6221.17**	**6194.39**	**6457.44**	**6776.51**	**6583.68**	**6894.96**	**7311.90**
exports		**754.92**	**715.17**	**542.95**	**394.41**	**565.57**	**744.15**	**808.06**	**846.96**	**924.12**	**654.97**	**736.85**	**1066.79**
conversion uses and losses		**389.32**	**395.43**	**334.28**	**318.06**	**364.83**	**434.15**	**431.95**	**418.98**	**428.05**	**340.97**	**359.49**	**414.82**
net inland consumption		**4147.45**	**4284.22**	**4308.82**	**4398.30**	**4706.91**	**5042.87**	**4954.38**	**5191.50**	**5424.34**	**5587.75**	**5798.62**	**5830.29**
Total		**5291.70**	**5394.82**	**5186.04**	**5110.76**	**5637.31**	**6221.17**	**6194.39**	**6457.44**	**6776.51**	**6583.68**	**6894.96**	**7311.90**

Summary in GWh	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2000
Net imports	**3910.54**	**4003.28**	**3980.61**	**4046.57**	**4449.67**	**4949.32**	**4904.28**	**5179.56**	**5442.48**	**5538.56**	**5708.52**	**5316.46**
Net national production (1)	**236.91**	**280.95**	**328.21**	**351.73**	**257.24**	**93.55**	**50.11**	**11.94**	**-18.14**	**49.19**	**90.09**	**513.83**
Net inland consumption	**4147.45**	**4284.22**	**4308.82**	**4398.30**	**4706.91**	**5042.87**	**4954.38**	**5191.50**	**5424.34**	**5587.75**	**5798.62**	**5830.29**
Net inland consumption in Mio. MJ **(3)**	14929.64	15421.98	15510.50	15832.61	16943.53	18152.88	17834.36	18687.90	19526.07	20114.28	20873.35	20987.38
Net inland consumption in 1000 toe	356.68	368.44	370.56	378.25	404.79	433.68	426.07	446.47	466.49	480.54	498.68	501.40

GWh		2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012prov
Imports		**6413.64**	**6562.18**	**6506.31**	**6391.61**	**6823.54**	**6846.58**	**6829.87**	**6022.47**	**7279.51**	**7096.00**	**6732.00**
National production		**2808.65**	**2784.36**	**3373.52**	**3336.93**	**3518.95**	**3190.23**	**2713.28**	**3142.69**	**3223.53**	**2643.00**	**2798.00**
	cogeneration	341.50	382.28	421.57	417.92	438.09	362.39	378.35	337.12	383.70	393.00	437.00
	thermic power stations	2333.31	2285.48	2787.37	2736.60	2866.49	2598.86	2089.25	2571.43	2607.40	2049.00	2104.00
	of which, TWINerg **(2)**	*2275.65*	*2237.29*	*2731.06*	*2646.00*	*2774.01*	*2511.69*	*2047.16*	*2552.13*	*2586.70*	*2029.77*	*2108.79*
	hydro-electricity	99.73	73.94	95.64	85.03	102.67	107.19	121.23	97.02	100.25	61.00	97.00
	wind	24.73	26.17	39.40	52.45	57.99	64.29	60.59	63.47	55.08	64.00	75.00
	biomass & biogas	9.30	15.13	20.34	27.24	32.60	36.59	38.51	47.22	50.40	49.00	52.00
	gas from WWTPs	NO	NO	NO	NO	NO	NO	5.32	5.85	5.14	6.00	6.00
	gas from landfills sites	NO	NO	NO	NO	NO	NO	NO	0.26	0.41	0.00	1.00
	photovoltaic	0.08	1.36	9.20	17.70	21.11	20.90	20.03	20.32	21.15	21.00	26.00
Total		**9222.29**	**9346.53**	**9879.83**	**9728.54**	**10342.49**	**10036.81**	**9543.15**	**9165.16**	**10503.04**	**9739.00**	**9530.00**
exports		**2939.92**	**2799.41**	**3131.58**	**3131.31**	**3266.55**	**2886.84**	**2483.53**	**2604.45**	**3216.07**	**2614.00**	**2622.00**
conversion uses and losses		**450.53**	**475.68**	**366.33**	**453.13**	**472.35**	**466.47**	**474.25**	**423.09**	**674.15**	**608.00**	**593.24**
net inland consumption		**5831.84**	**6071.44**	**6381.92**	**6144.11**	**6603.59**	**6683.49**	**6585.37**	**6137.62**	**6612.82**	**6517.00**	**6314.76**
Total		**9222.29**	**9346.53**	**9879.83**	**9728.54**	**10342.49**	**10036.81**	**9543.15**	**9165.16**	**10503.04**	**9739.00**	**9530.00**

Summary in GWh	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Net imports	**3473.72**	**3762.77**	**3374.73**	**3260.30**	**3556.99**	**3959.74**	**4346.34**	**3418.02**	**4063.44**	**4482.00**	**4110.00**
Net national production (1)	**2358.12**	**2308.67**	**3007.19**	**2883.81**	**3046.60**	**2723.76**	**2239.03**	**2719.59**	**2549.38**	**2035.00**	**2204.76**
Net inland consumption	**5831.84**	**6071.44**	**6381.92**	**6144.11**	**6603.59**	**6683.49**	**6585.37**	**6137.62**	**6612.82**	**6517.00**	**6314.76**
Net inland consumption in Mio. MJ **(3)**	20992.95	21855.45	22973.07	22117.02	23771.02	24058.65	23705.43	22093.65	23804.25	23459.32	22731.32
Net inland consumption in 1000 toe	501.53	522.14	548.84	528.39	567.90	574.78	566.34	527.83	568.70	560.46	543.07

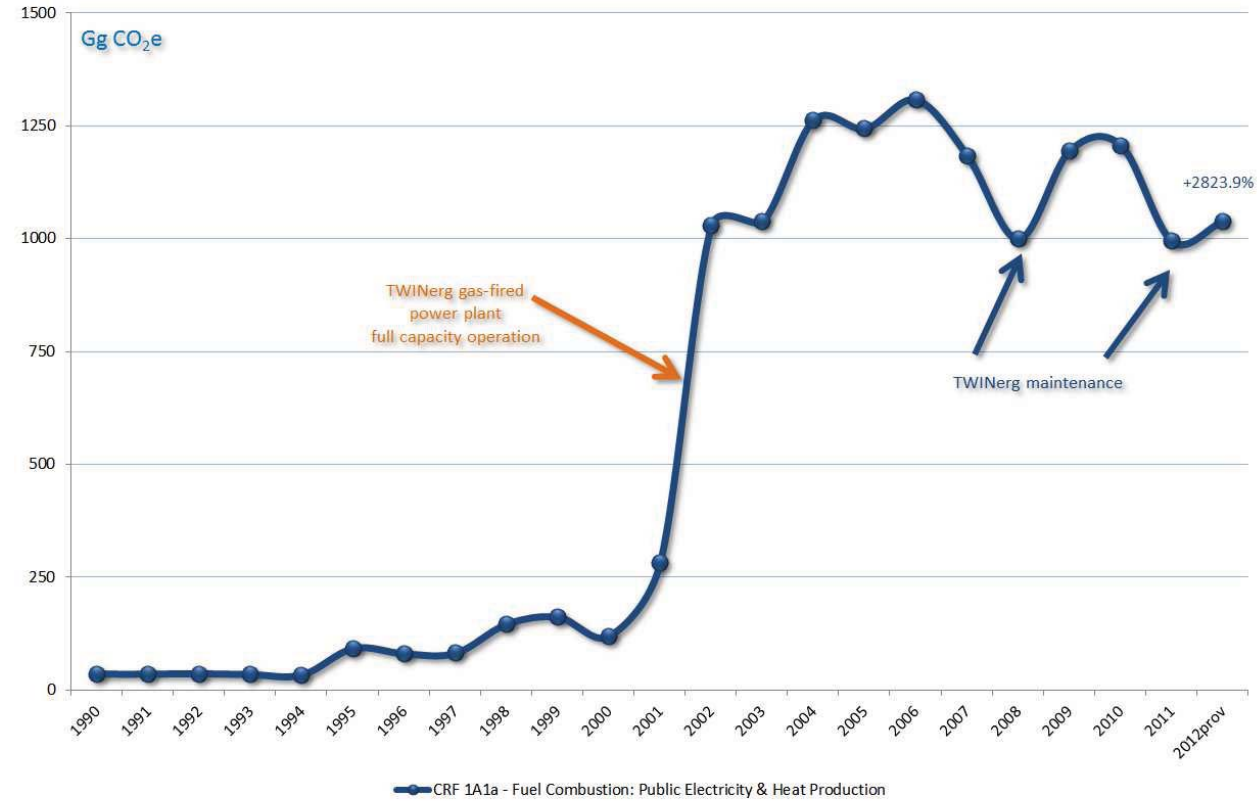
FIGURE II.6-3 – ENERGY BALANCE FOR ELECTRIC POWER: 1990-2012



Sources: compiled by the MDDI-DEV on 28.06.2013 using data published by the Ministry of the Economy – Energy Department, the *Institut Luxembourgeois de Régulation* and STATEC (Table A.4203).

Notes: (1) the net national production is the difference between the national production and the conversion process uses and losses.
(2) as indicated in the main text, the TWINerg power plant started its commercial operation in 2002. The recorded value for 2001 corresponds to a testing phase in production.
(3) net inland consumption expressed in TJ (Mio. MJ) differs slightly from the corresponding figures in Table II.6-2 – less than 2% – because data sources, units and calculations are not exactly the same.
(4) provisional data for 2012 relates to gross national production, cogeneration, conversion process uses and losses, net inland consumption, and net national production.

FIGURE II.6-4 – GHG EMISSIONS FOR PUBLIC ELECTRICITY & HEAT PRODUCTION (CRF SUB-CATEGORY 1A1A): 1990-2012



Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2.
Note: 2012 data are provisional data estimated by the Department of the Environment during the summer of 2013 for the EC and the European Environment Agency: more on this in Section III.1 below.

II.7. INDUSTRY

CRF (sub-)categories covered	1A2 & 2		
share in total GHG emissions, excl. LULUCF	***1990***	61.4% =	7926.20 Gg CO_2e
	2011	16.2% =	1964.65 Gg CO_2e
	2012prov	15.3% =	1859.99 Gg CO_2e
1A2	***1990***	48.9% =	6304.70 Gg CO_2e
	2011	10.7% =	1293.16 Gg CO_2e
	2012prov	10.2% =	1240.34 Gg CO_2e
2	***1990***	12.6% =	1621.50 Gg CO_2e
	2011	5.6% =	671.49 Gg CO_2e
	2012prov	5.1% =	619.65 Gg CO_2e

II.7.1. An activity branch dominated by the metallurgy

Over the period under review, **metallurgy** – steel and aluminium in Luxembourg – usually represented around one third of the manufacturing industry total gross value added. Nevertheless, after reaching a peak in both 2007 and 2008 – with 40% of the manufacturing industry total gross value added – the share of metallurgy dropped to about 20% since 2009 when the financial and economic crisis started to affect Luxembourg's industrial activities, and principally its steel industry. Looking at the metallurgy weight in manufacturing industry production, from 2009 onwards, it dropped from around 40% to 30%.

Consequently, it would be expected that GHG emissions trends in the industrial sector were driven by the activities and changes that occurred in these two branches. But, aluminium production in Luxembourg is a secondary production using aluminium scraps. Since there are no transformation activities from bauxite, this branch only records emissions related to combustion activities, i.e. there are no emissions stemming from industrial processes. Then, as underlined in *Section II.6*, the iron and steel industry has been characterized by a move from blast furnaces to electric arc furnaces between 1994 and 1998. Consequently, industrial emissions are nowadays depending on changes in activities or processes in a various number of manufacturing branches as illustrated below.

Industrial process emissions include emissions from industrial installations pertaining to 3 sectors only: clinker, flat glass, iron and steel. They also cover consumption of halocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) – the fluorinated gases or F-gases.

II.7.2. Effects on GHG emissions: iron & steel used to set the pace

Overall emissions related to fuel combustion and processes in the manufacturing industry and construction sector were dominated by emissions generated by the iron and steel production plants up to 1998: from 1990 to 1998, GHG emissions in Luxembourg were reduced by one third due to the move from blast furnaces to electric arc furnaces. 1998 is also the year with the lowest GHG emissions, excluding LULUCF, ever recorded for Luxembourg since 1990 *[→ Figure II.7-1]*.

When the move from blast furnaces to electric arc furnaces was completed, iron and steel was no longer the main emitter of GHG and the overall emissions trend started to fluctuate according to changes in the various manufacturing and construction sub-categories. Excluding iron and steel from the picture shows that, in some cases, emissions produced by the other manufacturing industries and construction activities did evolve in an erratic way. This is particularly the case for CRF sub-category 1A2f *[→ Figure II.7-2]*. Though such irregular developments are explained by the small size of Luxembourg's industrial activities,[37] for sub-category 1A2f, the reason also lies in the way the emissions have been estimated. CRF sub-category 1A2f is a sector where unallocated activity data for the manufacturing industries and construction are reported. These unallocated activity data stem from discrepancies between the top-down overall statistics and the bottom-up information used to build the inventory.[38]

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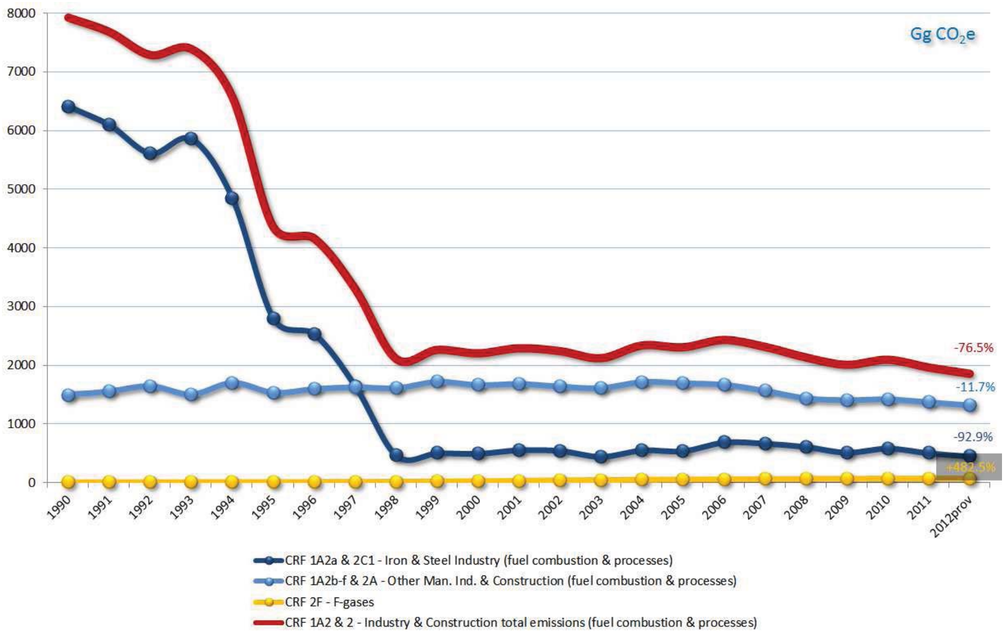
37 A change in one unit might have important impact on an aggregated trend: cf discussion in Section II.12.2 below.

38 Ministry of Sustainable Development and Infrastructure, Environment Agency (2013), p. 190-194.

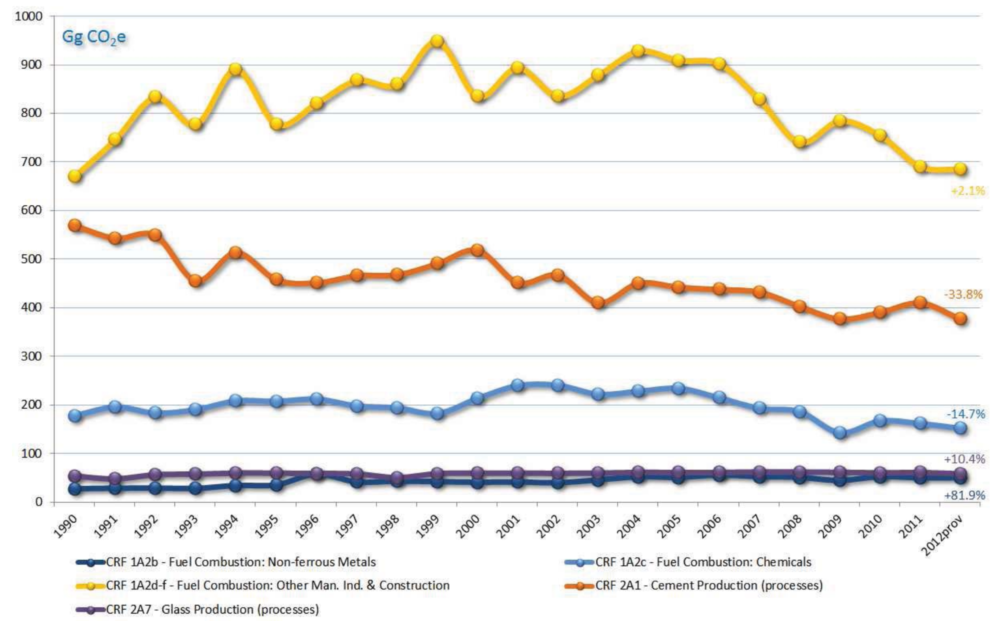
The striking increase of F-gases emissions *[→ Figure II.7-1]* is the consequence of supposedly growing use in the country, notably due to an increasing use of air conditioning, but also of the hypothesis made for their estimation.[39]

FIGURE II.7-1 – GHG EMISSIONS FOR SELECTED CRF INDUSTRIAL SUB-CATEGORIES: 1990-2012



Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2.
Note: 2012 data are provisional data estimated by the Department of the Environment during the summer of 2013 for the EC and the European Environment Agency: more on this in Section III.1 below.

FIGURE II.7-2 – GHG EMISSIONS FOR SELECTED CRF INDUSTRIAL SUB-CATEGORIES EXCL. IRON & STEEL: 1990-2012



Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2.
Note: 2012 data are provisional data estimated by the Department of the Environment during the summer of 2013 for the EC and the European Environment Agency: more on this in Section III.1 below.

39 Ministry of Sustainable Development and Infrastructure, Environment Agency (2013), p. 249-254.

II.8. ROAD TRANSPORTATION

CRF sub-category covered	1A3b		
share in total GHG emissions, excl. LULUCF	***1990***	20.7% =	2676.51 Gg CO_2e
	2011	56.4% =	6821.76 Gg CO_2e
	2012prov	56.2% =	6834.88 Gg CO_2e
national fleet	***1990***	7.2% =	923.93 Gg CO_2e
	2011	15.0% =	1815.27 Gg CO_2e
	2012prov	15.0% =	1825.40 Gg CO_2e
"road fuel sales to	***1990***	13.6% =	1752.58 Gg CO_2e
non-residents"	**2011**	41.4% =	5006.49 Gg CO2e
	2012prov	41.2% =	5009.48 Gg CO_2e

II.8.1. Diverse inland and cross-border road transport flows

Luxembourg's location and its economic development have made it a **focal point for international road traffic**. Luxembourg is located at the heart of the main traffic axes for Western Europe *[→ Figure II.8-1]* and, therefore, has traditionally had a high volume of road transit traffic for both goods (freight transport) and passengers (tourists on their way to or back from southern Europe). The latter has increased even further by the **high number of commuter journeys** observed every working day. In comparison with international traffic, domestic traffic plays only a relatively small role since it responsible for only about one quarter of the total road fuels sold in Luxembourg.

Road traffic is also the largest source of emissions in Luxembourg's GHG balance. Fuel quantities sold at Luxembourg's petrol stations, after having been converted into GHG volumes, are, according to IPCC reporting rules, totally included in the GHG balance, although around 75% of the emissions cannot be assigned to vehicles registered in Luxembourg and are actually emitted mostly abroad. This phenomenon is referred to as "**road fuel sales to non-residents**" whether they are in transit or commuting for work or leisure. Indeed, due to lower taxed fuel (gasoline and diesel),[40] Luxembourg is an attractive "fuelling station" for daily commuters from neighbouring countries and cross-border shoppers, but, in first instance, for international road transit traffic crossing its territory (mainly freight transport). "Road fuel sales to non-residents" is briefly defined in Box II.8-1.

With numerous trucks transiting through Luxembourg, as well as a passenger cars market dominated by diesel vehicles in at least two of its neighbouring countries – namely Belgium and France – it is not surprising that diesel oil is the first liquid fuel in terms of volumes sold *[→ Figure II.8-2]*.

40 Relatively low excises rates – but not the lowest within the EU – and low VAT rate: see last paragraph of Section II.4.3 above as well as footnote 16.

The allocation of fuel sales between residents ("domestic") and non-residents ("exports") is not made on the basis of statistics or counting, but well using the COPERT model. Box II.8-2 describes the methodology that has been applied for the GHG inventory.

Box II.8-1 – "Road fuel sales to non-residents"

It covers fuel sales to non-residents, i.e.:

1. road vehicles in transit: freight trucks, buses & coaches, passenger cars, whose an important share fills up in Luxembourg because of lower fuel prices;

2. cross-border commuters who are also benefiting of the cheaper fuel prices;

3. "fuel tourism", known as "*Tanktourismus*" in Luxembourg: people driving especially to Luxembourg for benefiting of lower fuel prices, as well as lower prices on other commodities such as non-alcoholic & alcoholic beverages, tobacco, etc. (Luxembourg usually applies the lower taxation rates adopted at EU levels, e.g. VAT is set at 15%).

Box II.8-2 – The COPERT model

For estimating GHG emissions of the road transport sector, Luxembourg uses, such as many EU countries, the COPERT model, version IV, developed by the National Technical University of Athens [Kouridis et al (2000) for COPERT III and updated versions available on the European Environment Agency website (http://www.eea.europa.eu/publications/copert-4-2014-estimating-emissions/at_download/file) and Emisia website (http://www.emisia.com/copert/Download.html)].

Input data are based on car fleet statistics of registered vehicles in Luxembourg as well as on various parameters, such as annual average distance covered by each vehicle category. Emission factors are defaults from COPERT IV. With this information it is thus possible to estimate annual fuel consumptions for the domestic or national vehicle fleet, i.e. vehicles owned by people living or business settled in Luxembourg. However, this fuel consumption estimate is much lower than the total road fuel sales in Luxembourg, the difference being "road fuel sales to non-residents". Lacking data on the vehicles commuting or transiting to or through Luxembourg, it is quite difficult to use the COPERT model to estimate their respective emissions on the basis of fuel sold.

Therefore, Luxembourg uses a five steps calculation procedure to calculate road transportation GHG emissions, assuming that the domestic fleet resembles the vehicle fleet of commuters, cross-border shoppers and transit vehicles:

1. fuel consumption and GHG emissions of the domestic vehicle fleet are estimated for each fossil fuel type using COPERT IV, version 8.0;

2. implied emission factors are calculated from the above mentioned data, by dividing the emissions relative to each gas and fuel type by the corresponding calculated fuel consumption;

3. biofuel quantities were subtracted from the quantities of fuel sold, to differentiate between fossil and biogenic emissions;

4. national emissions per fuel type were calculated by multiplying the implied emissions factors with the corresponding quantities of fuel calculated in step 3.

5. national emissions per GHG are obtained by adding the corresponding national emissions per fuel type.

For more details, see Ministry of Sustainable Development and Infrastructure, Environment Agency (2013b), p. 202-205.

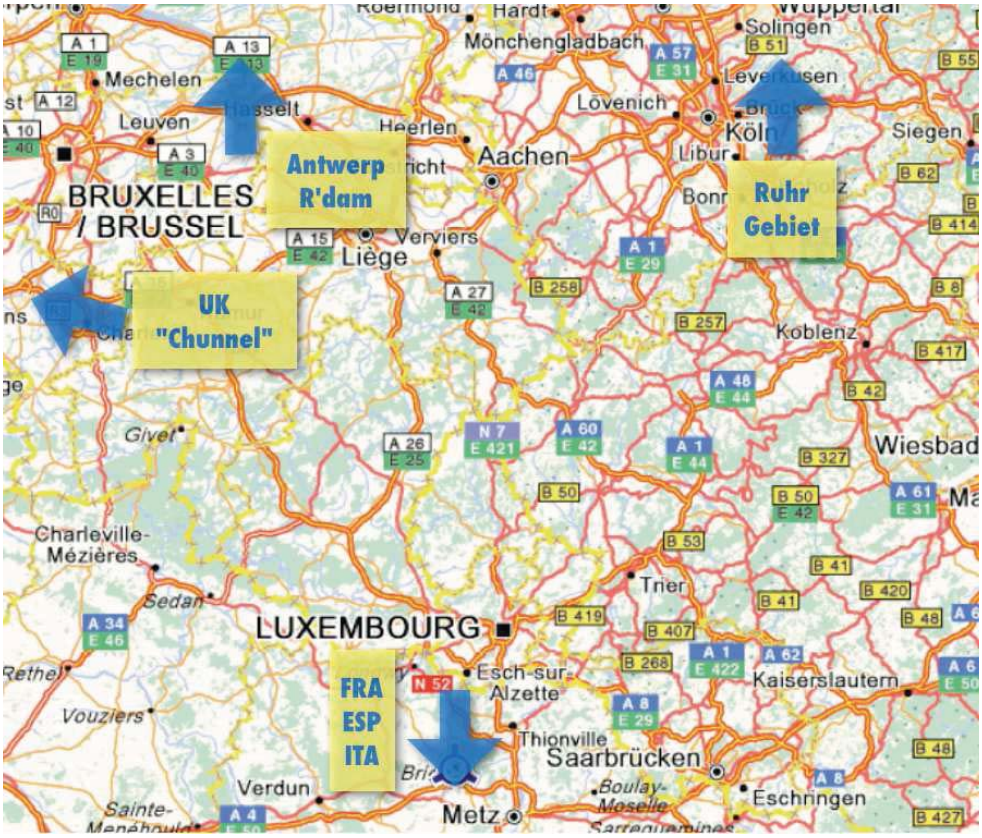
II.8.2. Effects on GHG emissions: an untypical situation

Combining the size of the country and of its economy, on the one side, and lower road fuel prices that implies a disproportionate volume of road fuel sales compared to its resident population, on the other side, Luxembourg presents a completely untypical and unique structural feature in its

GHG emissions balance. In 2011, some 6.82 Mio. t CO_2e were produced by the road transportation sector and out of these, 5 Mio. t CO_2e, or 73.5%, was the result of road fuels bought by non-residents and were, consequently, merely emitted abroad. That last amount represented around 41.5% of the total 2011 GHG emissions for Luxembourg (excluding LULUCF) – this share is 56.4% for the whole CRF sub-category 1A3b *[→ Figure II.8-3]*.[41]

Both emissions generated by the national vehicles fleet and by the non-residents – "road fuel sales to non-residents" – showed dramatic increases over the period 1990-2011: +98% and +185% respectively.[42] For the national fleet, the evolution is correlated with both the population and economic activity growth. It is also explained by an increasing rate for passenger cars per inhabitants (from 477 to 658 passenger cars per 1000 inhabitants between 1990 and 2011, i.e. the highest rate within the EU[43]). Regarding "road fuel sales to non-residents", the rise is undoubtedly linked to the growing number of commuters crossing the borders every working day as well as to the general increase of road freight traffic in Europe.

FIGURE II.8-1 – MAIN ROAD FREIGHT AXES CROSSING LUXEMBOURG



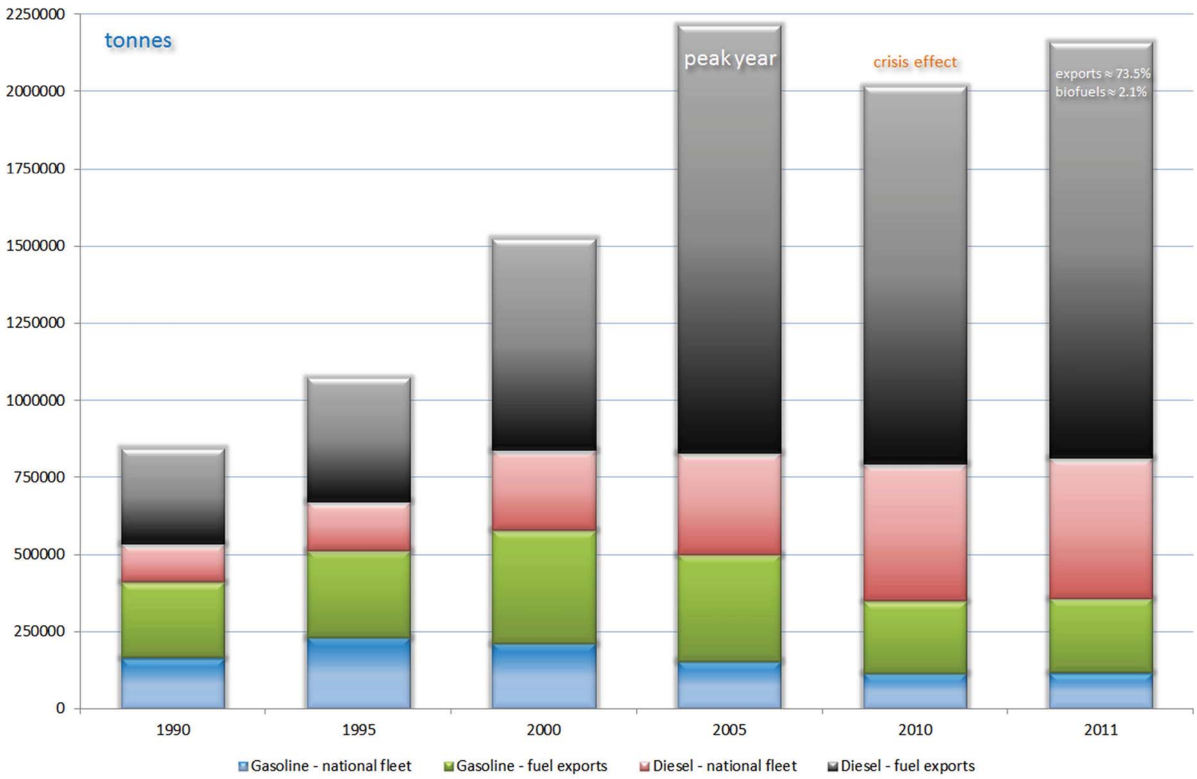
Source: ViaMichelin.

[41] For 2012, provisional data gives the following values and percentages: 6.83 Mio. t CO2e were produced by the road transportation sector and out of these, 5 Mio. t CO2e, or 73.3%, was the result of road fuels bought by non-residents, i.e. around 41.2% of the total 2012 GHG emissions for Luxembourg (excluding LULUCF) – this share is 56.2% for the whole CRF sub-category 1A3b.

[42] Corresponding percentages were +67% and +211% in 2005, the peak year with regard to road transportation related emissions and +98% and +186% in 2012.

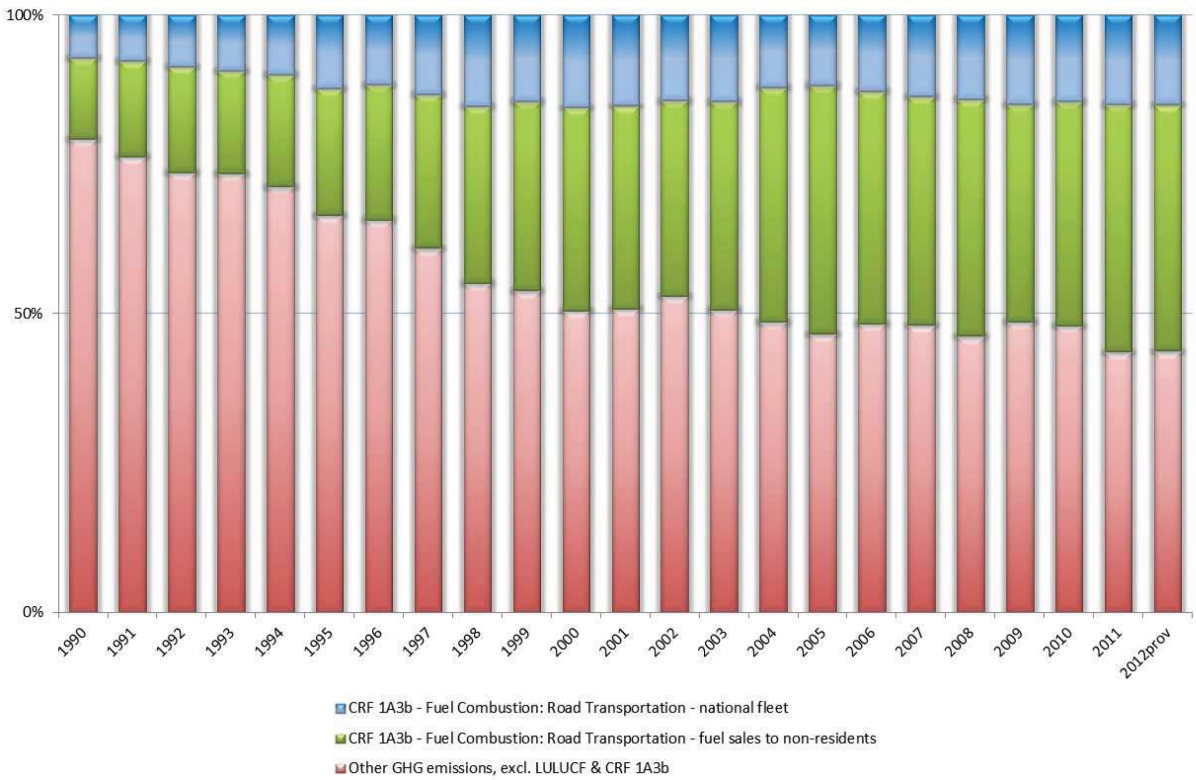
[43] Data extracted from European Commission (DG MOVE), *EU transport in figures – Statistical pocketbook*, 2013 edition, p.83. http://ec.europa.eu/transport/facts-fundings/statistics/doc/2013/pocketbook2013.pdf.

Figure II.8-2 – Road fuel sales: 1990-2011 in tonnes



Source: Ministry of Sustainable Development and Infrastructure, Environment Agency (2013b), Table 3-50, p. 201.

Figure II.8-3 – GHG emissions for road transportation (CRF sub-category 1A3b): 1990-2012



Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2.
Note: (1) excluding CO_2 emissions from biofuels, which are reported as "memo item".
(2) 2012 data are provisional data estimated by the Department of the Environment during the summer of 2013 for the EC and the European Environment Agency: more on this in Section III.1 below.

II.9. AGRICULTURE

CRF (sub-)categories covered		1A4c & 4		
share in total GHG emissions, excl. LULUCF		***1990***	5.9% =	759.95 Gg CO_2e
		2011	6.0% =	721.08 Gg CO_2e
		2012prov	6.0% =	727.04 Gg CO_2e
	1A4c	***1990***	0.1% =	16.75 Gg CO_2e
		2011	0.5% =	57.42 Gg CO_2e
		2012prov	0.5% =	57.31 Gg CO_2e
	4	***1990***	5.8% =	743.2 Gg CO_2e
		2011	5.5% =	663.7 Gg CO_2e
		2012prov	5.5% =	669.7 Gg CO_2e

II.9.1. A sector that concentrates in fewer units but shows stability in land consumption

In 2012,[44] 2 137 farms were counted. They were managing a **utilized agricultural area** (UAA) of 131 492 ha, i.e. a bit more than 50% of the territory of Luxembourg. The UUA was divided almost equally between arable land (62 563 ha) and permanent pasture and meadows (67 292 ha). With 1 565 ha, permanent crops represented only 1.2% of the total UUA. The remaining surfaces were dedicated to horticulture and family gardens.

About a half of the arable land was covered by cereals in 2012 (mostly wheat and barley and, to a lesser extent, triticale). Permanent pasture and meadows were mainly grazing land (58 136 ha) and permanent crops related to vineyards for their most part ***[→ Table II.9-1]***.

Since 1990, the UAA did not change a lot: a 4,1% increase. However, arable land surfaces climbed by 12.5%, whereas permanent pastures & meadows stepped back by about 2.2%. Permanent crops increased by 8.7%.

Since the 1950s, agriculture has undergone profound structural changes, with the **number of farms** falling by 92.4% between 1950 and 2012 (i.e., a 4% decline annually on average). Since 1990, 1 666 farms closed down, which corresponds to more than 75 farms on average per year. In percentage, the reduction reached -44% (i.e., a 2.6% decline annually on average). This reduction in the number of units touches all the size classes. Only those farms with more than 50 ha stabilized between 1990 and 2012: -4.6%. These bigger farms are the only one seeing their numbers increased since 1950.[45]

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44 Agriculture yearly censuses are reflecting the situation on the 15th of May. The latest census is available here: http://www.statistiques.public.lu/stat/ReportFolders/ReportFolder.aspx?IF_Language=fra&MainTheme=4&FldrName=2&RFPath=7274.

45 Data mentioned in this paragraph are extracted from STATEC, *Statistical Yearbook*, Table D.2101: http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=696&IF_Language=fra&MainTheme=4&FldrName=2&RFPath=7274.

In 2012, 4 131 ha were classified under **organic farming** – i.e. 3.1% of the total UAA – and 82 farms were active in this field – i.e. 3.8% of all the farms.[46] In 2000 (first data collected on organic farming), the corresponding percentages were 0.8% of the UUA and 1.1% of all the farms. The surfaces dedicated to organic farming are peaking since 2006 (2006: 3 516 ha & 2007: 3 733 ha). It has to be stressed that incentives are given for organic farming. Further on, the preservation and the development of natural zones in the rural landscapes is supported via the agri-environment support scheme.[47] The most important **agri-environmental measure** is the "premium for the upkeep of the landscape and the countryside", designed to maintain agricultural activity on lands suitable for farming, vineyards and horticulture, using forms of exploitation that are adapted to the natural setting and landscape and respectful of the environment. This premium was introduced in 1997 in the context of Regulation (EC) 2078/1992.

Livestock population in Luxembourg has also undergone some changes since 1990. With regard to cattle, its total population size declined throughout the period 1990-2012. However, a shift did occur within the cattle population with a reduction for dairy cattle (-32%) and an increase for female mature non-dairy cattle (+73.7%) *[→ Table II.9-2]*. In fact, cattle population and its evolution are strongly influenced by changes in the agricultural policy and, more precisely, in the Common Agricultural Policy of the EU (CAP). This is the case for dairy cows, whose declining population results from the combination of increasing milk yields and the introduction of a milk production cap (administrative quota system for milk production). Furthermore, several reductions in the milk quota were decided in the framework of the CAP. Another factor influencing cattle population is, of course, prices (which, themselves are affected by agricultural policy changes and targets). As an example, the peak in the non-dairy cattle population observed in 1991 can be explained by a sharp price fall of the bovine meat price that year. This price fall led farmers to postpone slaughtering until early 1992.

Table II.9-2 presents the population for a selection of livestock categories, those which are the main sources of methane and nitrous oxide emissions. Actually, in 2011, cattle accounted for 97.2% of methane emissions due to enteric fermentation and for 61.6% of the emissions of the same gas stemming from manures. Cattle were also responsible of 88.4% of the nitrous oxide emissions due to manure management schemes.[48]

More detailed data on agricultural activities are compiled in a booklet - *the agriculture of Luxembourg in figures* published by the *Service d'Economie Rurale* (SER)[49] – and are also available on the SER website[50] and in STATEC's *Statistical Yearbook*.[51]

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46 Farms that are converted or in course of being converted and recognized by the authorities in the scope of Council Regulation (EC) 834/2007 of 28 June 2007 on organic production and labelling of organic products and repealing Regulation (EEC) 2092/91.

47 Rural Development Plan 2007-2013: http://www.ma.public.lu/aides_financieres/aides_communautaires/aides_rural/brochure.pdf, p. 20-21.

48 For 2012, provisional data gives the following percentages: 97.2%, 58.3% and 87.8%.

49 http://www.ser.public.lu/publikationen/Landwirtschaft_in_Luxbg/lux_landw_zahl_en.pdf.

II.9.2. Effects on GHG emissions: slow decrease in emissions

In Luxembourg, emissions are recorded for 4 CRF categories and sub-categories: fuel combustion - agriculture, forestry & fisheries (CRF 1A4c), enteric fermentation (CRF 4A), manure management (CRF 4B) and agricultural soils (CRF 4D).

Total GHG emissions related to agricultural activities slowly decline by about 4.3% between 1990 and 2012,[52] i.e. at an annual average rate of -0.2%. Enteric fermentation saw its emissions falling by 8.4%, whereas agricultural soils, the decrease reaches 14.7%. For manure management, emissions remained quite stable between 1990 and 2012 (+1.5%), though opposite variations are observed for the two GHG emitted by this activity: methane increased by nearly 13.8% and nitrous oxide declined by 21.9%. Fuel combustion related emissions increased by almost 15% since 2000 – there is a break in time series for agriculture related energy statistics between 1999 and 2000 as *Figure II.9-1* below clearly demonstrates.

Agricultural soils emissions present a more erratic evolution than the other (sub-)categories *[→ Figure II.9-1]*. This is explained mainly by important changes in crops, as well as in N-fertilizer use, which showed a slack in 2003 and a peak in 2004. The lower N-fertilizer use in 2003 was the result of the drought that characterized that year's summer. The evolution of that CRF category also shapes the overall agriculture emission pattern since it is the biggest contributor to agriculture related emissions (40-45% over the period 2000-2012). Excluding fuel combustion related emissions characterized by a break in time series, it is also worth noting that the shares in the total agricultural emissions of each category for which emissions have been reported have not changed much over the period.

TABLE II.9-1 – AGRICULTURAL UTILIZED AREA: 1950-2012

	ha	1950	1970	1990	2000	2005	2010	2011	2012
Arable land		79628	64228	55891	60927	60017	61951	62117	62563
	%	55.3%	47.5%	44.3%	47.7%	46.5%	47.3%	47.3%	47.6%
cerals		52699	45341	32980	28639	28497	29713	28786	27837
dried pulses		407	423	537	431	467	336	268	166
tubers & roots		13083	3302	1057	906	659	642	667	698
industrial plants & plants for energy purpose		14	62	1999	3344	4685	4867	5400	5368
forage plants		11070	13528	19024	26079	22869	25536	25998	27451
other crops		146	13	22	2	978	717	835	752
fallow land		2209	1559	272	1527	1861	139	163	291
Permanent pastures & meadows		60893	69094	68827	65277	67245	67593	67638	67292
	%	42.3%	51.1%	54.5%	51.1%	52.1%	51.6%	51.5%	51.2%
pastures (grazing land)		32276	39509	41070	44407	57747	58608	58333	58136
Kitchen gardens		1483	317	121	53	27	10	10	13
	%	1.0%	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
Horticulture		145	63	19	21	34	48	54	59
	%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Permanent crops		1904	1441	1440	1365	1546	1503	1512	1565
	%	1.3%	1.1%	1.1%	1.1%	1.2%	1.1%	1.2%	1.2%
vineyards		1188	1180	1326	1249	1275	1266	1273	1286
Agricultural utilized area (UAA)		**144053**	**135143**	**126298**	**127643**	**129128**	**131106**	**131330**	**131492**

Sources: SER: http://www.ser.public.lu/statistics/agr_structures/statec_15_mai_pluriannuel.pdf
STATEC, *Statistical Yearbook*, Table D.2100 (updated 21.03.2013):
http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=695&IF_Language=fra&MainTheme=4&FldrName=2&RFPath=7274

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50 http://www.ser.public.lu/statistics/index.html.

51 Tables D series: http://www.statistiques.public.lu/stat/ReportFolders/ReportFolder.aspx?IF_Language=fra&MainTheme=4&FldrName=2.

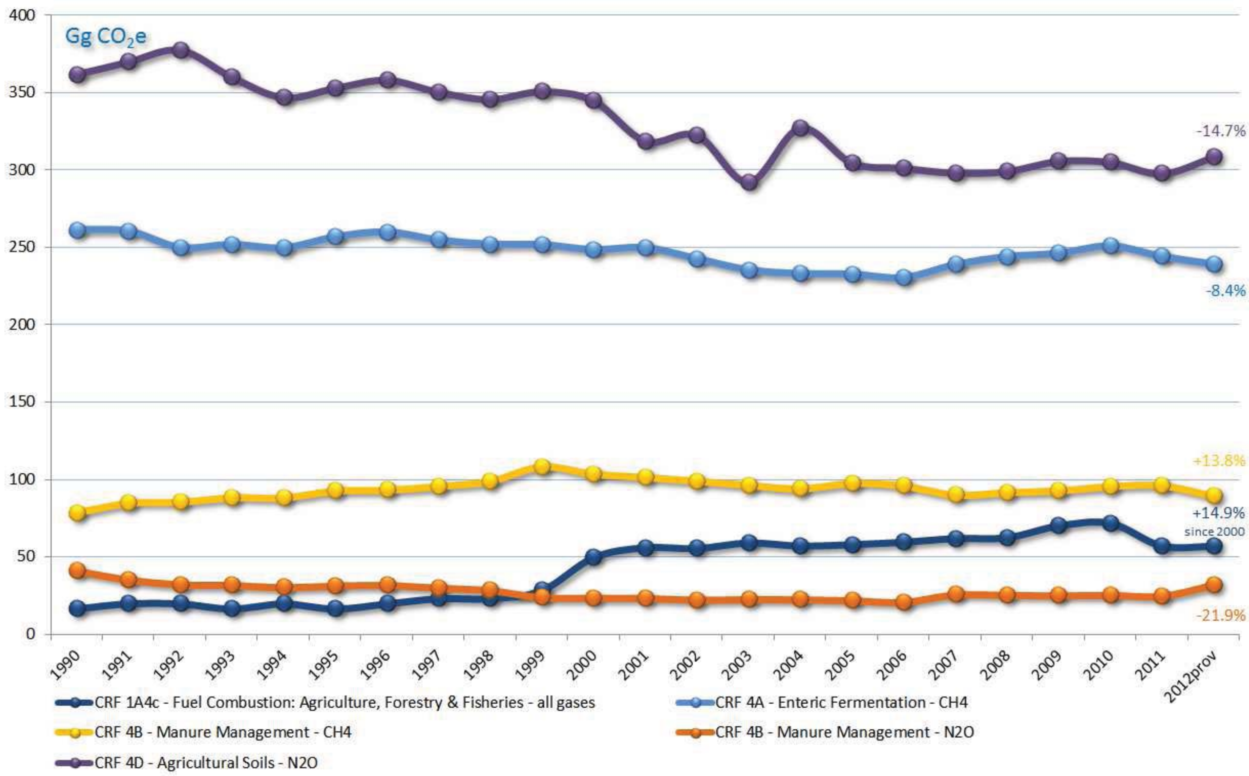
52 2012 data are provisional data estimated by the Department of the Environment during the summer of 2013 for the EC and the European Environment Agency: more on this in Section III.1 below.

TABLE II.9-2 – LIVESTOCK POPULATION FOR SELECTED ANIMALS' CATEGORIES: 1990-2012

heads	1990	2000	2005	2010	2011	2012
Dairy cattle	217451	205072	185235	198892	192535	188473
Non-dairy cattle	58840	43346	39340	41273	40452	39831
suckler cows	*17563*	*27610*	*27615*	*32871*	*31744*	*30501*
other cows	*4485*	*5261*	*4078*	*3735*	*3661*	*3605*
Swine	75463	80141	90147	83774	89158	90023
Sheep	7281	7971	10277	9084	8951	8211
Horses, mules & asses	1722	3154	4193	4601	4594	4887

Sources: SER: http://www.ser.public.lu/statistics/agr_structures/statec_15_mai_pluriannuel.pdf
STATEC, *Statistical Yearbook*, Table D.2107 (updated 23.08.2013):
http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=702&IF_Language=fra&MainTheme=4&FldrName=2&RFPath=7274

FIGURE II.9-1 – GHG EMISSIONS FOR AGRICULTURE (CRF SUB-CATEGORY 1A4C & CRF SECTOR 4): 1990-2012



Sources: MDDI-DEV – Submission 2013v1.2.
Notes: (1) 2012 data are provisional data estimated by the Department of the Environment during the summer of 2013 for the EC and the European Environment Agency: more on this in Section III.1 below.
(2) CRF 1A4c: there is a break in time series between 1999 & 2000, hence the growth rate is calculated on the basis of the year 2000.

II.10. FORESTRY

CRF sub-category covered	5A1		
share in total GHG emissions, incl. LULUCF	***1990***	1.8% =	239.26 Gg CO_2e
	2011	|3.4%| =	-401.87 Gg CO_2e
	2012prov	NA =	NE

II.10.1. Forests in Luxembourg: an old asset under a shared responsibility[53]

With the retreat of farming over the last century, the forest area has increased to reach nowadays some 89 000 ha, covering a bit less than 35% of the national territory as a whole (ranging from 42% in Ösling to 31% in Gutland). The Ardennes region is the most heavily wooded.

Forests are managed by the public authorities – the Nature and Forests Agency (NFA) – and by private forest owners represented by an association – *Lëtzebuerger Privatbësch – Family Forestry Luxembourg*.[54] NFA administers municipal woods (some 35% of the forests of Luxembourg), woods owned by the state (13%) and those belonging to public administration (2%). Public forests are managed according to Resolutions, criteria and indicators of the "Forest Europe Process",[55] as well as national close to nature sylvicultural guidelines. 70% of public forests are certified by either FSC or PEFC certification schemes.

The remaining 50% are private forests, which are extremely fragmented[56] and only partially managed. However, professional foresters have been assigned to *Lëtzebuerger Privatbësch* to promote sustainable forestry in private forests. This is notably done under the "Luxembourg Certification Scheme for Sustainable Forest Management".[57]

The different forests types are:

- broadleaved forests – mostly beech & oak – for 47% of the total (¾ of these trees are located in public forests);
- mixed forests – lobed-leaved trees and conifers such as spruces & pines – for 35% of the total (two thirds being located in private forests);
- coppices and bark hedges for 15% of the total (almost 90% being placed in private forests);
- non forested areas – shrubs, forest roads, quarries, clear cuttings, etc. – for a bit more than 3%.

The Luxembourg forest contains no natural forest and has been strongly stamped by human activity.[58] Old-growth forests (over 100 years) cover 16 800 ha, or 61% of the broadleaved forest. Conifer groves are younger, because their production cycle is shorter. Total reforestation between 1985 and 2005 covered 8 250 ha, versus 12 800 ha during the previous period, despite the massive tree planting campaign after the storms of 1984 and 1989-90. As a whole, the Luxembourg forest is relatively old.

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53 Some texts of this section have been extracted from OECD (2010b).

54 http://www.privatbesch.lu/.

55 www.foresteurope.org.

56 In particular, because of the pattern of transmission through successive generations.

57 http://www.privatbesch.lu/index.php?id=9 and http://www.pefc.lu/. The latter is a joint web portal of and for the public authorities and the private owners.

58 The beech stands of Gutland, for instance, have been overexploited to produce charcoal for the iron industry.

Observations on the phytosanitary state of Luxembourg forest show sharp degradation of the forest, which appears today to have stabilised.[59] The declining health of these forests results from complex factors that include air pollution (causing acidification and eutrophication), climate change, diseases due to insect infestations, impoverishment of forest soils, and deficiencies in magnesium and calcium. The situation has been aggravated by replanting with a poor choice of species and inappropriate forestry activities in private forests.

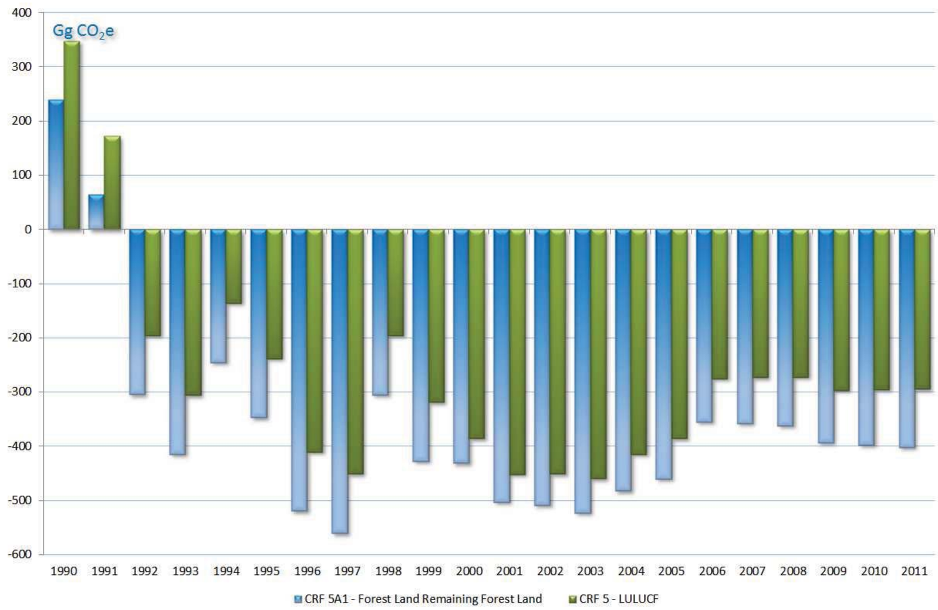
The ageing of the forest also increases the risk of infestation by insects and other parasites. Insect attacks have affected 8 800 m³ of beech stands in Ösling and 3 750 m³ in Gutland, adding to the damage caused by overabundant populations of game, whose browsing has affected 5% of mature trees and 66% of replanting.

II.10.2. GHG emissions: forests act as a sink in Luxembourg

Emissions estimates for CRF sub-category 5A1 shows that "forest land remaining forest land" acts as a sink , except for two years, 1990 and 1991, for which net emissions are reported *[→ Figure II.10-1]*. This is the consequence of the important storms that touched the country in early 1989-90 and severely hit Luxembourg's forests, for which two-thirds consists of single-story stands, which are more unstable than multi-storied forests in the face of storms.

For the LULUCF sector in general, the trend is similar to that for CRF sub-category 5A1, which represents the main part of LULUCF emissions & removals *[→ Figure II.10-1]*.

FIGURE II.10-1 – GHG EMISSIONS & REMOVALS FOR FOREST LAND REMAINING FOREST LAND (CRF SUB-CATEGORY 5A1) AND THE LULUCF SECTOR: 1990-2011



Sources: Nature and Forests Agency and Environment Agency – Submission 2013v1.2.
Note: positive values correspond to net emissions and negative values to net removals.

59 http://www.environnement.public.lu/forets/dossiers/pfn/index.html.

II.11. WASTE

CRF (sub-)categories covered	1A1a part & 6		
share in total GHG emissions, excl. LULUCF	***1990***	0.9% =	116.40 Gg CO_2e
	2011	1.0% =	124.71 Gg CO_2e
	2012prov	1.1% =	132.82 Gg CO_2e
1A1a pt	***1990***	0.3% =	33.92 Gg CO_2e
	2011	0.5% =	66.38 Gg CO_2e
	2012prov	0.6% =	73.72 Gg CO_2e
6	***1990***	0.6% =	82.48 Gg CO_2e
	2011	0.5% =	58.33 Gg CO_2e
	2012prov	0.5% =	59.09 Gg CO_2e

II.11.1. Managed waste streams bearing concrete results[60]

Luxembourg has for many years been pursuing an active policy of **waste management** based on prevention and recovery with a view to minimising environmental impact and supplying high-quality secondary raw materials. It gives priority to recovering materials for reintroduction into the economic circuit.

The legislative and regulatory framework is based on the amended "Waste Prevention and Management Act" (*Plan Général de Gestion des Déchets*, PGGD),[61] which calls for full-cost pricing at every stage of waste management and sets the following goals:

- preventing and reducing waste production and pollution from waste;
- recovery through reuse, recycling or any other environmentally appropriate method;
- disposal of final waste in environmentally and economically appropriate ways.

Other laws and grand-ducal regulations concerning specific waste flows supplement the PGGD Act and transpose European legislation into national law (movements of hazardous waste, packaging waste, waste oils, PCBs, waste incineration, sewage sludge, waste electrical and electronic equipment (WEEE), batteries etc.). European legislation plays an increasing role in determining policies and establishing objectives. Luxembourg must also comply with other international commitments relating to cross-border waste movements and to the ecological management of waste and resource productivity.

II.11.1.1. Municipal waste: high generation but also high recovery rate

Under the impact of **separate collection and recovery measures**, there has been a continuous decoupling between municipal waste, residual waste for disposal and GDP these last 10 to 15

60 Some texts of this section have been extracted from OECD (2010b).
61 http://www.environnement.public.lu/dechets/dossiers/pggd/index.html.

years. The volume of waste that must be dealt with has been growing less quickly than GDP, although at a rate close to growth in private consumption, while both population and cross-border employment have been rising *[→ Section II.2]*. However, **waste generation per capita** (at 673 kg) is among the highest in Western Europe. It is, however, including waste generated by cross-border commuters and by (small) services businesses whose numbers increased considerably since 1990.

But, collection and recovery rates of municipal waste are among the best in Europe. With separate collection, some 50% of total municipal waste can now be recovered – a rate of around 60% for organic waste. Recovery volumes are rising, reflecting the growing network of recycling centres and active public awareness about trash sorting. Separate municipal waste collection amounts to more than 300 kg per capita every year, making Luxembourg's performance among the best in Western Europe. Most of the waste collected is exported for recycling (primarily to Germany, Belgium, France and the Netherlands).

There has been a decrease of **municipal waste being incinerated or stored in landfill** sites since 1990: -20%. More than two-thirds of this waste are incinerated with energy recovery (74%), while the remainder goes to landfills (26%). The objective of reducing landfill-destined biodegradable waste to 35% of the 1995 level by 2016 has already been achieved.

II.11.1.2. Industrial, commercial and service waste: important volumes but declining

Industrial, commercial and service waste was estimated at 1.32 Mio. t in 2010, of which most waste was generally exported to Germany, France, Belgium and the Netherlands for treatment. Indeed, Luxembourg does not have recycling or recovery installations on its small territory. The same holds for municipal waste collected through recycling centres or schemes, which are, therefore, mostly sent abroad for valorisation or other treatments.

Final industrial waste declined during the period under review, reflecting the combined impact of the closure of a mill and of the implementation of "Waste Prevention and Management Plans" (*Plan de Prévention et de Gestion des Déchets*, PPGDs) by businesses, which have diverted many types of waste from disposal to recovery. In fact, companies are to appoint a "waste management officer" and prepare a PPGD that requires firms to evaluate their prevention and recycling potential and to institute ecological management of their waste. More than 3 000 firms have established such a plan since 1995.

II.11.1.3. Other waste streams are also subject to valorisation

There are about 13 000 tonnes of **sewage sludge** generated each year, most of which is used in agriculture (50 to 55%) as fertilizer (sludge spreading) or composted (around 40%). There are also 9.4 Mio. t of **inert waste**, consisting primarily of construction materials (87% excavated earth), demolition waste and road maintenance waste that have to go to dedicated disposal sites where they are recovered, notably via grinding operations. The volume of inert waste generated, which is closely linked to construction activity, has risen in recent years.

II.11.1.4. Waste reduction and materials recovery: the solution for Luxembourg waste management policy

Luxembourg has few levers available for influencing the design or composition of products. It can however act on consumer habits and on household and business participation in selective sorting and in waste prevention and ecological management programmes. Its policy is to introduce separate collection and appropriate management systems, together with information targeted at households and consumers, as well as advisory services, training and assistance to businesses.

For more than 20 years now, separate collection of **municipal waste** has been based on both mobile and fixed collection, a network of 21 recycling centres and a programme of regular public information. Separate collection applies to all recoverable items and "problem waste". The volumes collected by voluntary delivery to recycling centres have more than doubled since 1999.

To prevent the **generation of consumer waste**, the emphasis is on informing the public about the products that generate waste, components that are hazardous to the environment and health, and available substitutes. These efforts rely on joint public- and private-sector initiatives and on economic instruments.

With regard to **industrial, commercial and service waste**, the main instruments for achieving waste prevention targets and reintroducing materials into the economic circuit are the PPGDs and the advice provided to businesses by the *SuperDrecksKëscht® fir Betriber* programme (cf Box II.11-1).

II.11.1.5. Treatment and disposal of final waste

Municipal waste treatment, as well as separate collection and recycling centres, is under the responsibility of three inter-communal syndicates operating, respectively, two controlled landfills and an incineration plant with energy recovery.

Regarding **industrial, commercial and service waste**, thanks to the PPGDs, remaining quantities to be eliminated are such that domestic facilities are less justified than in the past. Non-household waste for disposal is exported to specialised facilities in neighbouring countries, primarily in Germany. Due to the size of the country and of its economy, total quantities exported may vary sharply from one year to the next.

<u>Box II.11-1 – The *SuperDrecksKëscht*® (SDK): a success story in managing hazardous waste</u> (1)

SDK is a programme for managing problem waste sponsored by the Environment Agency in co-operation with the communes – household component – and the *Chambre des Métiers* (Trades Council) – business component. The programme is based on the principles of prevention, reduction and recovery of waste:

i) all recyclable materials are processed to recover a maximum of secondary materials, and all problem substances are treated to minimise their impact on the environment; and

ii) substance flows, from generation to transformation into new raw materials or until their disposal in an environmentally friendly manner, must be clearly presented so that they can be audited at any time.

The SDK programme is ISO 14001 certified and has had a legal basis since 2005.

The household component (*SuperDrecksKëscht® fir Birger*) has been handling household waste since 1985. It includes:

− collection by mobile containers, collection at fixed recycling centres, and home pickup on request;

− actions targeting particular flows of waste, organised in co-operation with private partners (e.g. for batteries, medications and syringes);

− numerous information and awareness campaigns, in the schools and elsewhere.

The business component (*SuperDrecksKëscht® fir Betriber*), in place since 1992, concerns non-household waste generated by businesses and by public and private establishments. Participation is voluntary and is done by contract. It includes:

− assistance and advice for certifying ecological management of waste, with (i) a situation report on waste management in the firm, and help in preparing the waste balance sheets; (ii) assistance in preparing the firm's Waste Prevention and Management Plan (PPGD); (iii) assistance in implementing the PPGD (separate collection, storage, treatment, finding of licensed enterprises, prevention of waste generation through use of durable materials or introduction of environmentally friendly production methods); and (iv) information, training and awareness activities for employees;

− collection of small quantities of waste on request;

− collection of particular flows in co-operation with public and private sector partners.

A quality label is awarded service firms and waste transport companies that manage their waste in an environmentally responsible manner consistent with the SDK concept. Compliance with management criteria is audited once a year. Firms that have had the label for five consecutive years are audited only every two years. The list of certified firms is published on the Internet.

The cost of the household component is fully covered by the government through the Environment Protection Fund. The cost of the business component is shared: assistance, advisory and training services are financed by the government, while waste collection and treatment is covered by the firms.

Since 2007, the SDK concept has been exported in the form of franchise contracts that are available to public authorities and to public and private establishments in other countries seeking to institute a waste management system along the lines of the Luxembourg model **(2)**. Finally, the SDK has been awarded with "Best Practice in Europe" by the European Commission **(3)**.

(1) this box is an extract from OECD (2010b). More information available at http://www.sdk.lu/.
(2) see http://www.superdreckskescht.com/.
(3) see http://ec.europa.eu/environment/waste/prevention/pdf/SDK_Factsheet.pdf.

II.11.2. Effects on GHG emissions: a yearly increase of 0.6% on average since 1990

In Luxembourg's GHG inventory, emissions are recorded for 4 CRF sub-categories: waste incineration (CRF 6C but part of CRF 1A1a since energy is recovered), solid managed waste disposal on land (CRF 6A1), waste water treatment (CRF 6B) and composting (CRF 6D) *[→ Figure II.11-1]*.

Total waste related GHG emissions have increased by 14.1% between 1990 and 2012.[62] Excluding waste incineration, the emissions have decreased by 28.4%. This latter evolution was mainly driven by the fact that for **solid managed waste disposal on land** (CRF 6A1) emissions have been reduced by 55.2% between 1990 and 2012 *[→ Figure II.11-1]*. This development is due to:

- a decrease in the quantity of waste being landfilled, notably through the development of recycling schemes and the expansion of both the numbers of and the various waste categories collected by recycling centres;
- the aerobic pre-treatment before landfilling;
- the recent installation of methane recovery systems at waste dumping sites.

However, **waste incineration** related emissions[63] – that are presented under CRF sub-category 1A1a – public electricity and heat production – in the inventory because energy from waste burning is recovered in the sole incinerator of the country and injected in the electric public network – did increase a lot, setting the upward trend for the overall waste emissions. The big jump in the series between 1997 and 1998 *[→ Figure II.11-1]*, which is responsible of the increasing waste incineration emissions, is due to methodological reasons and to the fact that incinerated waste composition data are only available for some years, requesting interpolations. Therefore, the overall trend presented in this section for waste, including incineration, should be looked at with caution. In the inventory, it is mostly hidden since, for the last years, waste incineration represents between 5% and 7% of the total public electricity and heat production category emissions (CRF 1A1a) and around 0.5% of the total GHG emitted in Luxembourg, excluding LULUCF.

Wastewater handling emissions have decreased by 9.3% between 1990 and 2012. Wastewater treatment plant (WWTP) capacities expressed in population-equivalents have steadily grown since 1990. This justifies, but only partly, the increasing N_2O emissions for this source category. Indeed, WWTP capacities grew by some 80% over the period 1990 to 2012, whereas nitrous oxide emissions increased by 17.4%. Therefore, technical changes, with regard to wastewater treatment, have an unquestionable role too.

Concerning **compost production**, this activity started on an "industrial scale" only in the early 1990s. It experienced a steady growth from 1993 to 2006 and then stabilizes.

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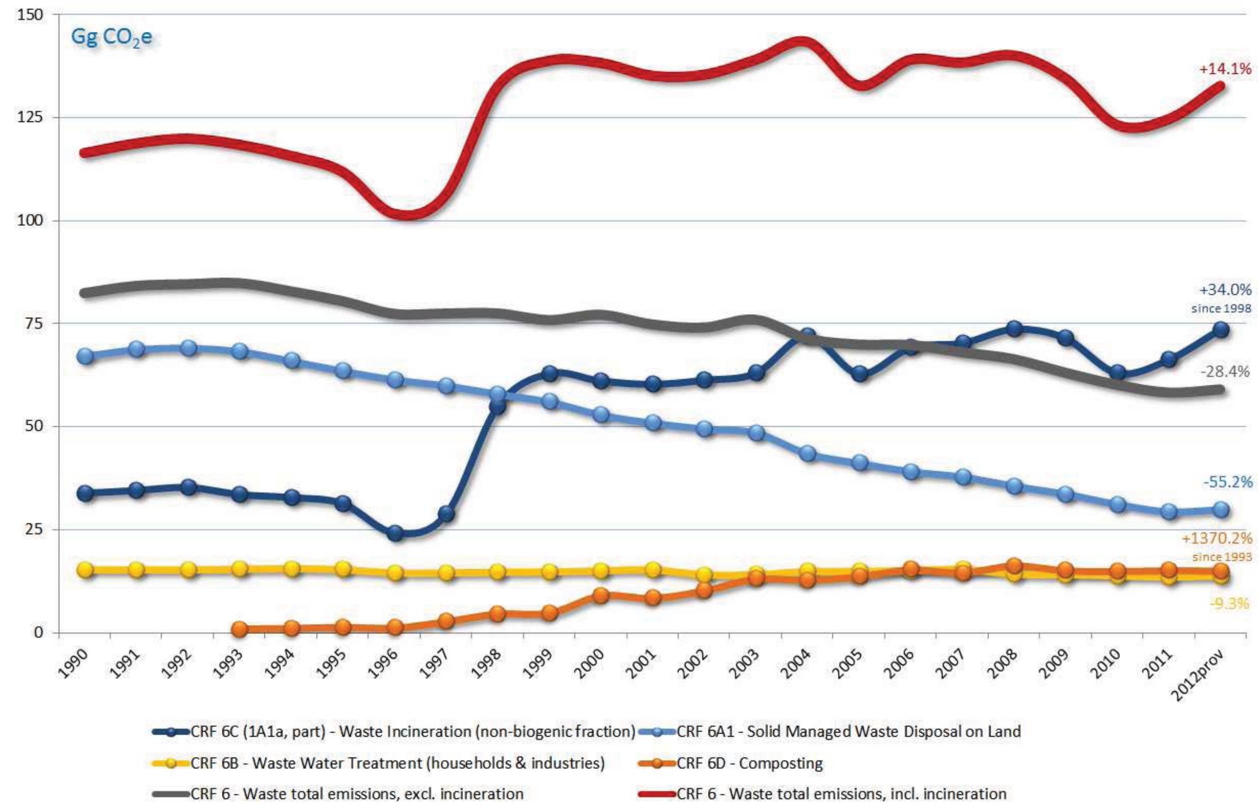
62 2012 data are provisional data estimated by the Department of the Environment during the summer of 2013 for the EC and the European Environment Agency: more on this in Section III.1 below.

63 Emissions commented here cover only the "non biogenic" fraction of waste to be incinerated – the "biogenic" fraction is reported under memo items for CO_2 and under biomass for the other gases.

FIGURE II.11-1 – GHG EMISSIONS FOR WASTE (CRF SUB-CATEGORY 1A1A, PART & CRF SECTOR 6): 1990-2012



Sources: Environment Agency, Water Agency and MDDI-DEV – Submission 2013v1.2.
Notes: (1) 2012 data are provisional data estimated by the Department of the Environment during the summer of 2013 for the EC and the European Environment Agency: more on this in Section III.1 below.
(2) CRF 1A1a, part: there is a break in time series between 1997 & 1998, hence the growth rate is calculated on the basis of the year 1998.

II.12. UNFCCC AND KYOTO PROTOCOL: A DEMANDING CHALLENGE FOR LUXEMBOURG

II.12.1. The road transportation dilemma

Since Luxembourg is a small open economy integrated in the European internal market **where mobility of tax bases are likely to be high**, only marginal variations in the price differentials for petrol and diesel can be initiated by the authorities. Indeed, if Luxembourg's rates of taxation and prices were higher than those in the surrounding countries, it would be rather easy for any citizen of Luxembourg to avoid domestic taxation and to practise arbitrage: no location in Luxembourg is further than a maximum of 25-30 km away from a border with a neighbouring country. Lower taxation rates for certain goods – such as fuels, e.g. – have therefore always been part of Luxembourg fiscal policy and will remain crucial in the future, because of the country's geographical location and its small area. Whereas in larger neighbouring states, increasing certain tax rates would result in a slight shift in demand and in arbitrage deals at the outer fringes of their national territory – with a corresponding relatively slight reduction in tax revenues – this would not be the case for Luxembourg where such a policy may result in big losses in tax incomes.

However, since road transportation, and more precisely "road fuel sales to non-residents", is the main contributor to GHG emissions in Luxembourg, as underlined in the new national "Action Plan for reducing CO_2 emissions" [Ministry of Sustainable Development and Infrastructure, Department of the Environment (2013b)], Luxembourg will use a policy mix of instruments with the aim of progressively reducing road transport related emissions.

With regard to the instrument of excise duties, Luxembourg will gradually increase road fuels excise rates following a cautious approach based on a better knowledge of the factors determining road fuel sales in Luxembourg that also takes into account the impact on the public finances of the country. Furthermore, in its programme, the new Government that took office early December 2013 *[→ Section II.1]* underlines that a **feasibility study on the progressive way out of "fuel tourism"** – and more generally of "road fuel sales to non-residents" – should be realized so to evaluate the economic impacts of such a decision on the medium and long terms [Government of the Grand Duchy of Luxembourg (2013), p. 84]. Definitely, a long term planning of a gradual "decoupling" of road fuel sales revenues from public current expenditure is necessary; all of this taking place in an overall context of future regulatory changes in Europe that will affect other national fiscal incomes.[64] As a first step and provided that the public finance situation allows it, the programme suggests that current expenditures will no longer be financed by additional tax revenues on road fuel sales and that these revenues should progressively be reallocated to measures aiming at an energy transition towards a more sustainable economic and social model – gradual decoupling of road fuel sales revenues from public current expenditure [Government of the Grand Duchy of Luxembourg (2013), p. 84].

With regard to other instruments, the new Luxembourg Government considers the organization of transport and the necessity to overcome existing problems linked to the traffic intensity as primary objectives. In this context, it intends to promote sustainable ways of transport consisting of public and non-motorized modes of transport. The re-organisation is intended to encompass both the national territory and the neighboring regions of Germany, France and Belgium where many commuters come from, leading to a doubling of the workforce in Luxembourg during the day. All this is intended to be done in a conceptual way where new modes of transport such as electro-mobility and car sharing are potentially promoted.

II.12.2. Country and economy sizes

Special attention must also be made for the **small size of the country's economy** in a different context: it is a contributory factor to the fact that, in spite of the healthy economic situation, the courses of the overall development of the country, of the demand for energy and of the emissions

64 For instance, by 2015 two major changes will impact Luxembourg's economic activities: (i) modifications of banking practices and rules; (ii) the payment of the VAT in the consumption country for goods and services bought on the internet and no longer in the country where the merchant is located.

balance are often affected by a single plant which is starting its activities, closing them down or changing its production processes. This became particularly clear when the steel industry switch from blast furnaces to electric arc furnaces was completed during the 1990s: from 1990 to 1998, GHG emissions in Luxembourg were reduced by one third *[→ Section II.7]*.

These last years, the construction of a single power station, the TWINerg gas and steam plant, represents a further illustrative example as depicted in *Section II.6*. When TWINerg started its operation in mid-2002, Luxembourg, which did not have so far any substantial electricity generating capacity, saw, at once, its GHG emissions increasing by 0.9 to 1 Mio. t CO_2e per year. To give another illustration on how this project affected the GHG emissions pattern in Luxembourg, one can underline that it represents 35% of the allocated emissions volume of the whole GHG EU Emissions Trading System sector (EU ETS) for the commitment period under the Kyoto Protocol.

The impact that single industrial projects might have, plays also the other way round when a production unit or a plant is closed down. Also, a sufficiently long breakdown in one of the main industrial unit of the country could have impacts on the total GHG emissions, such as the long maintenance operations of the TWINerg power plant in 2008 and 2011 demonstrates *[→ Section II.6.2]*.

If these issues might not be a major concern for large economies, it is for Luxembourg, as shown by the examples discussed above.

II.12.3. Limited GHG emissions reduction potentials

As of today, Luxembourg **does not have those significant technical potentials** which exist in other countries where residual "old-technology" industrial and power plants still operate. In Luxembourg, there were almost none, and there still is none of those GHG reduction potentials stemming from the modernisation or the replacement of existing national industrial or power plants. In fact, with the move from blast to electric arc furnaces in the steel sector during the 1990s, Luxembourg very soon exhausted its only major technical potential for GHG emissions reduction. With the process change in the steel industry – an activity which accounted for almost 50% of Luxembourg's total GHG emissions in 1990 (excluding LULUCF)[65] – total emissions from industry and electricity generation – i.e. largely the sectors covered by the EU ETS – decreased to just 2.2 Mio. t CO_2e in 1998 – or about 26% of total GHG emissions (excluding LULUCF) – coming from slightly more than 7.9 Mio. t CO_2e in 1990 - or about 62% of total GHG emissions (excluding LULUCF) *[→ Table III.1-3]*.[66]

65 Sum of CRF sub-categories 1A2a and 2C1. The percentages are 4.2% for 2011 and 3.8% for 2012 (provisional data).

66 Sum of CRF sub-categories 1A1a, 1A2 and 2, excluding F-gases. The lowest share (23.8%) was obtained in 2011 –23.2% in 2012 (provisional data) – and the lowest absolute value (2.24 Mio. t CO_2e) in 1998.

Also, any ultramodern fossil fuel-based electricity generating plant that Luxembourg might decide to construct will automatically lead to an increase of its national GHG emissions, since there are no existing power plants which can be stopped in return. Thus, those highly efficient CHP installations and the ultramodern gas and steam power station (TWINerg) that have been promoted and are operating in Luxembourg since 1998, and that use natural gas and, sometimes, gas oil as inputs, have led to an additional amount of approx. 1.2 Mio. t CO_2e in the GHG balance.[67] It is therefore clear that any new fossil-fuel power generating installation that might be constructed will inevitably lead to a deterioration of Luxembourg's GHG balance. This also implies that the implementation of the EU CHP installation guidelines, which in other countries may lead to CO_2 reductions thanks to increased efficiency, is counterproductive for Luxembourg. For this reason, Luxembourg's authorities will only promote heat production from renewable energy sources, focusing mainly on biomass, wood and solar energy.[68] More precisely, CHP installations using renewable energies, biogas addition in distribution networks and the mobilization of wood resources will be favoured.

II.12.4. The "origin" principle of the IPCC reporting Guidelines vs. the "polluter pays" principle

The "origin" or "territorial" principle applied for reporting GHG emissions under the IPCC Guidelines generates a GHG balance for Luxembourg that looks significantly less favourable than would a "consumer" or "polluter pays" approach produce. The "origin" principle is in favour of Luxembourg in that its imports of electricity are excluded from its GHG emission balance: those emissions are attributed to the electricity producing countries. But, as indicated above, "road fuel sales to non-residents" related emissions are reported in Luxembourg's GHG balance.

If the "polluter pays" principle is used as a yardstick, Luxembourg's assessment is that, for 2011, GHG emissions according to the IPCC Guidelines are some 0.83 Mio. t CO_2e "too high" (1.1 Mio. t CO_2e for 2012) *[→ Figure II.12-1]*.[69]

Thus, Luxembourg's efforts to develop efficient, low-carbon electricity production are not rewarded in the actual reporting system for GHG emissions. Luxembourg has, for many years, promoted the construction and the development of highly efficient CHP installations and of a modern gas and steam power plant. Luxembourg has also actively supported power generation and uses based upon renewable energies and, for all these policies, further developments are still in the offing. The impact of these policies has been evaluated using GEMIS 4.2:[70] it has been

67 1 Mio. t CO_2e for the TWINerg and 0.2 Mio. t CO_2e for CHP installations.

68 See the second Action Plan for mitigating CO_2 emissions [Ministry of Sustainable Development and Infrastructure, Department of the Environment (2013b)].

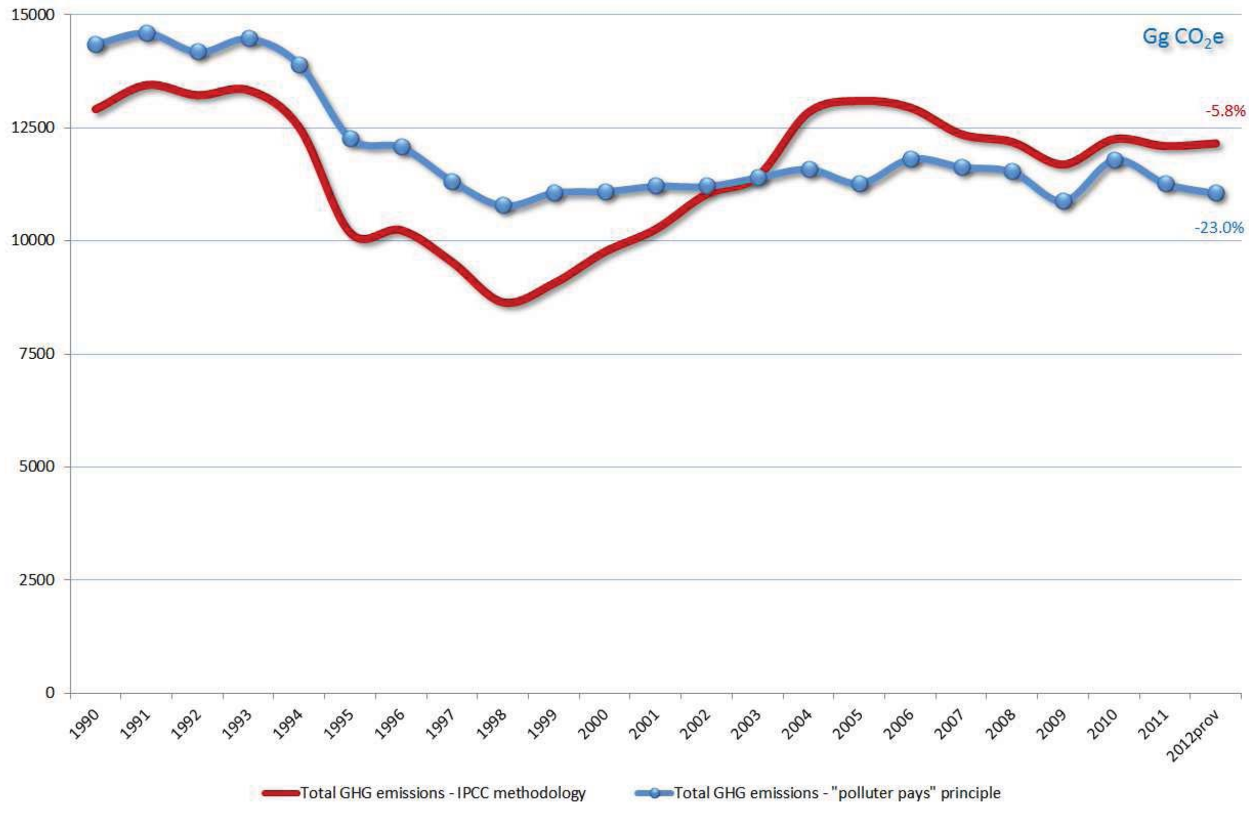
69 After having reached a "surplus" of 1.8 Mio. t CO_2e in 2005.

70 GEMIS stands for "Global Emission Model for Integrated Systems": http://www.iinas.org/gemis-de.html.

estimated that electricity imports – with, nowadays, an average emission factors of around 0.75 (kt CO_2 per GWh) – have fallen by more than 1 200 GWh since 2001 – the last year before the TWINerg power plant operates at full capacity – and have been replaced by national electricity generation with a current average emission factor of 0.41 (kt CO_2 per GWh).

So, in terms of the GHG balance, the promotion of renewable energies in the electricity sector, which is associated with major investments, is of little interest. Moreover, additional capacities based upon renewable energies cannot actually be used to replace any electricity from inefficient existing fossil-fuel plants in Luxembourg. Nor will they substitute the highly efficient national production plants which have just been constructed. In reality, they will replace the imported electricity which does not appear in Luxembourg's GHG balance. In this sense, the existing system provides Luxembourg with the incentive not to earmark the generally scant subsidies for Europe's priority investments in renewable energies but, instead, to invest these in measures which might improve its GHG balance.

FIGURE II.12-1 – TOTAL GHG EMISSIONS, EXCLUDING LULUCF – IPCC AND "POLLUTER PAYS" APPROACHES: 1990-2012



Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2.

Notes: (1) 2012 data are provisional data estimated by the Department of the Environment during the summer of 2013 for the EC and the European Environment Agency: more on this in Section III.1 below.

(2) the "polluter pays" principle figures have been obtained from the total GHG emission according to the IPCC methodology by excluding emissions from "road fuel sales to non-residents" and for electricity generated that is exported, and by adding an estimate for electricity production emissions generated abroad for satisfying Luxembourg consumption (i.e. emissions relating to electricity imports):

emissions "polluter pays" principle = emissions IPCC methodology – emissions "road fuel sales to non-residents" + emissions electricity net imports

II.12.5. The "origin" principle of the IPCC reporting Guidelines vs. the "environmental accounting" principle

It is also possible to compare total GHG emissions (excluding LULUCF) as calculated according to the IPCC Guidelines with those due to the "resident units", i.e. resident population, businesses and services. Such a comparison can be performed using environmental accounting methods, and more precisely the so-called "Air Emissions Accounts " (AEA). Environmental accounts usually combine monetary accounts and "ecosystems" information in physical units – in the case of AEA, augmented by the amounts of pollutants and further gases released in the atmosphere. In other terms, through AEA, it is possible to combine environmental information with economic data from the national accounts (both totals and structural information), to show, in the case of AEA, air emissions resulting from economic and households activities.[71]

The concept is the following: emissions reported under the IPCC Guidelines are allocated either to businesses according to their NACE Rev. 2 activity code[72] or to households, whether they cover heating, transportation or other households related activities. Then, emissions by resident units engendered abroad – the "rest of the world" as it is defined in national accounts – are added up. These emissions basically cover transportation related activities (vessels, vehicles and planes operating under Luxembourg's licences). Finally, emissions generated on the national territory but that can be attributed to non-resident units are subtracted. For Luxembourg, this subtraction is rather big due to the important share of cross-border commuters and of "road fuel sales to non-resident" *[→ Sections II.4-2 & II.8-2]*.

Using equations linked to the environmental accounts terminology, the IPCC and AEA approaches could be synthetized as follows:

IPCC approach ≈	*emissions allocated to businesses in EA* *+ emissions allocated to households in EA* *– emissions generated abroad attributed to residents* *+ emissions generated on the national territory attributed to non-residents*	*AEA approach =*	*emissions allocated to businesses in EA* *+ emissions allocated to households in EA* *+ emissions generated abroad attributed to residents* *– emissions generated on the national territory attributed to non-residents*

where EA = Environmental Accounts.

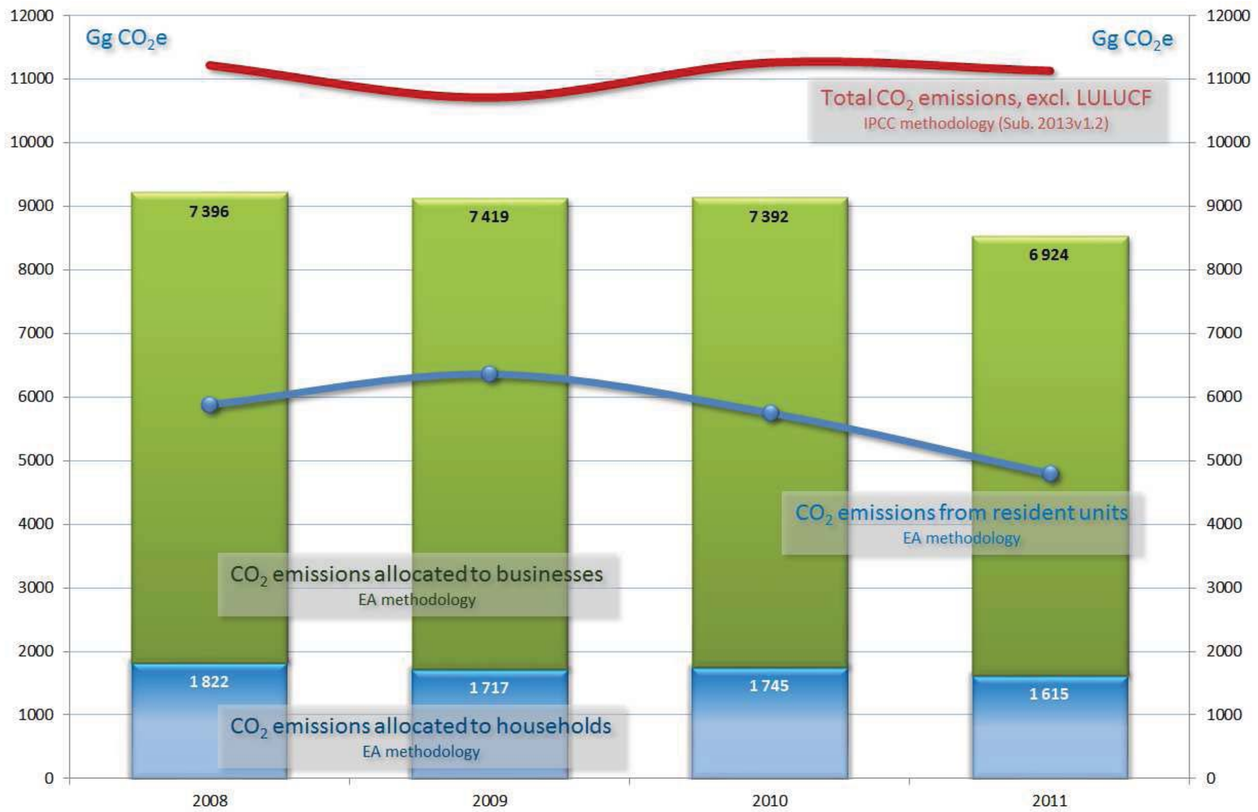
First comparative results are presented in ***Figure II.12-2*** below for CO_2 only, excluding LULUCF. They cover the years 2008 to 2011 since a major change in the NACE classification occurred in 2008 and, therefore, as such the historical series are not totally compatible. Moreover, calculated emissions in accordance with IPCC "rules" using the equation above differ substantially from

71 For more information on this topic, consult the *Manual for Air Emissions Accounts* published by Eurostat (http://epp.eurostat.ec.europa.eu/portal/page/portal/product_details/publication?p_product_code=KS-RA-09-004) as sell as http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Air_emissions_accounts_statistics.

72 The NACE Rev. 2 is a statistical classification of economic activities: see http://epp.eurostat.ec.europa.eu/portal/page/portal/nace_rev2/introduction.

emissions recorded in submission 2013v1.2. The "statistical gap" reported in the AEA tables under the heading "Other adjustments and statistical discrepancy" – which calculates the difference between the "IPCC emissions" reconstructed from the EA and the submitted emissions under the UNFCCC – reaches 10 to 12% for the years covered – with the former superior to the latter. Nevertheless, this "statistical gap" also includes emissions related to international bunkers: if AEA data are "adjusted" for bunkers related emissions, the "statistical gap" drops to 0.2% for the years 2008 and 2010 and to 0.5% for the years 2009 and 2011.

FIGURE II.12-2 – TOTAL CO_2 EMISSIONS, EXCLUDING LULUCF – IPCC AND EA APPROACHES: 2008-2011



Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2.
MDDI-DEV calculations based on Eurostat Tables env_ac_ainah_r1 (updated 15.05.2013) & env_ac_ainah_r2 (updated 12.12.2013).

Notes: (1) CO_2 emissions allocated to households = heating, transportation and other types of emissions that could be attributed to households according to national accounting rules.
(2) CO_2 emissions allocated to businesses = emissions that could be attributed to manufacturing enterprises, retail, service activities, etc. according to national accounting rules.
(3) CO_2 emissions from resident units = the sum of the emissions allocated to households and businesses as well as emissions generated abroad by residents for transportation activities diminished by emissions generated on the national territory that could be attributed to non-residents, i.e. mainly "road fuel sales to non-residents".
(4) total CO_2 emissions, excl. LULUCF as submitted to the UNFCCC according to IPCC Guidelines.

II.13. NATIONAL CIRCUMSTANCES: OVERVIEW

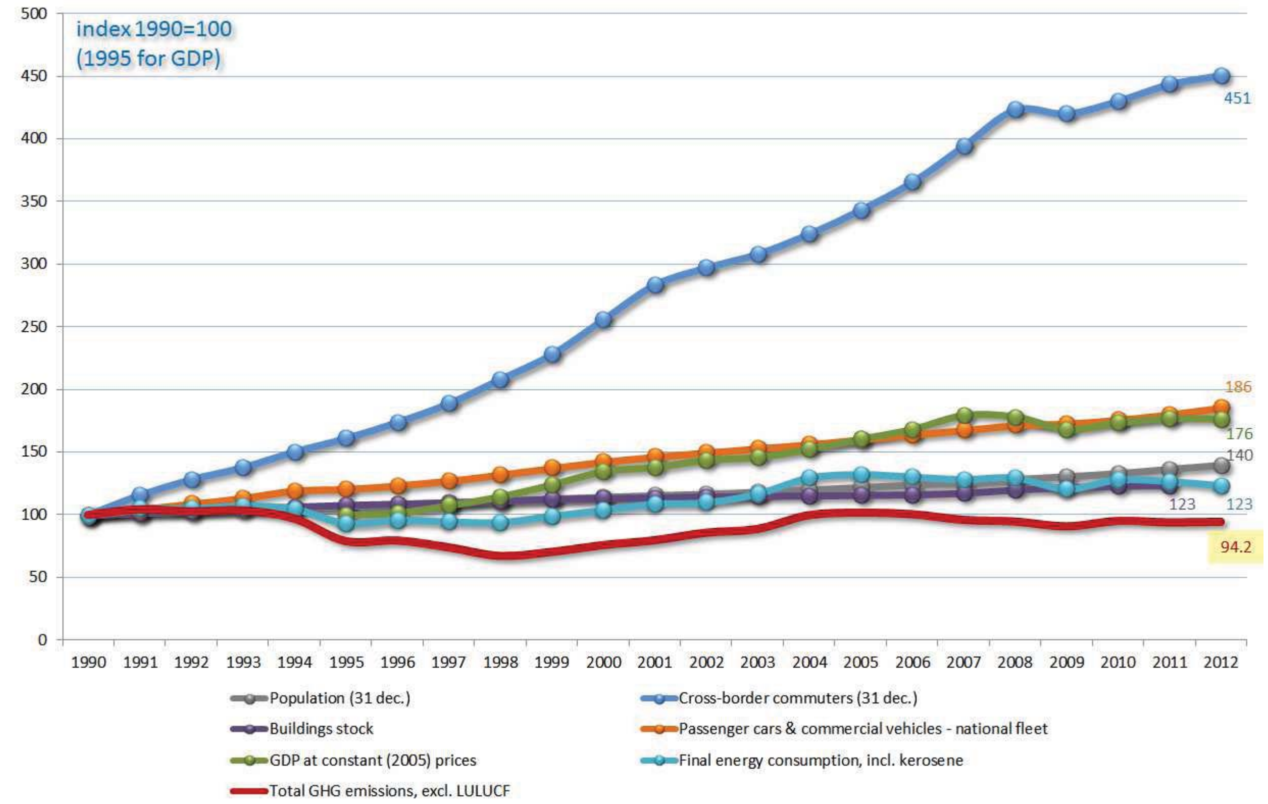
Key points that plays a role on GHG emissions trends in the past and in the future are:

- a country characterized for most of the years covered by this Communication by both **high demographic** and **high economic growth** in a stagnating region, hence an **attractive economic destination**;

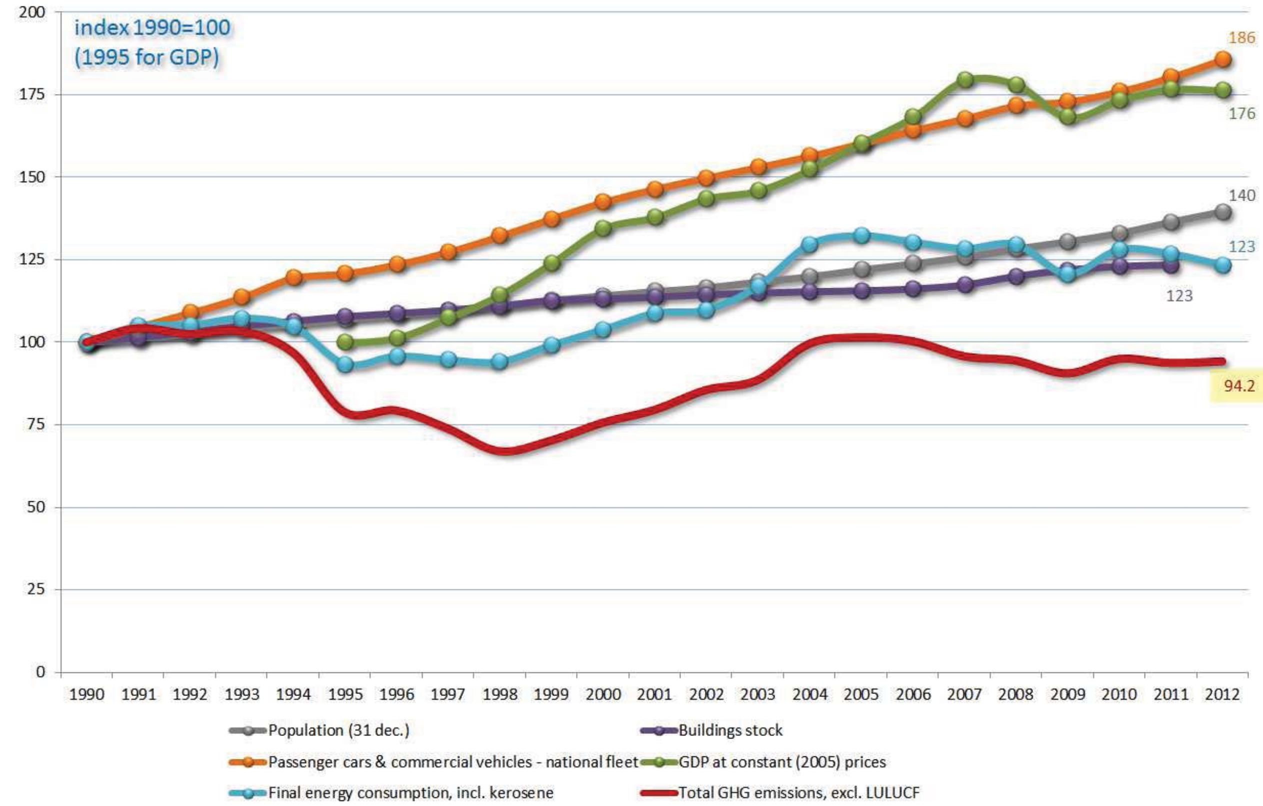
- **strong population growth** due to immigration and that is expected to go on;
- **even stronger cross-border commuters growth** that is expected as well to go on once the financial and economic crisis will be over;
- **increase of built-up areas** (housing, offices, services, infrastructures) as a consequence of the previous statements;
- location at the **heart** of the main Western Europe **transit routes** for both **goods and passengers**;
- **increase of transport flows** as a consequence of the previous statements;
- **small** size and open economy: a new industrial project, a technological change, a closure or a breakdown of a production unit might have significant impacts on the GHG emissions and increase the overall uncertainty of GHG projections;
- **limitations in taxation policies** due to short distances to neighbouring countries;
- a country that **needs to co-operate and to interact with its neighbours** since environmental issues quickly become cross-border issues;
- **limited national** GHG emissions reduction potential.

Figures II.13-1a & b & II.13.2 provide a quick overview of the trends of some key variables since 1990.

FIGURES II.13-1a – KEY VARIABLES TRENDS – 1: 1990-2012



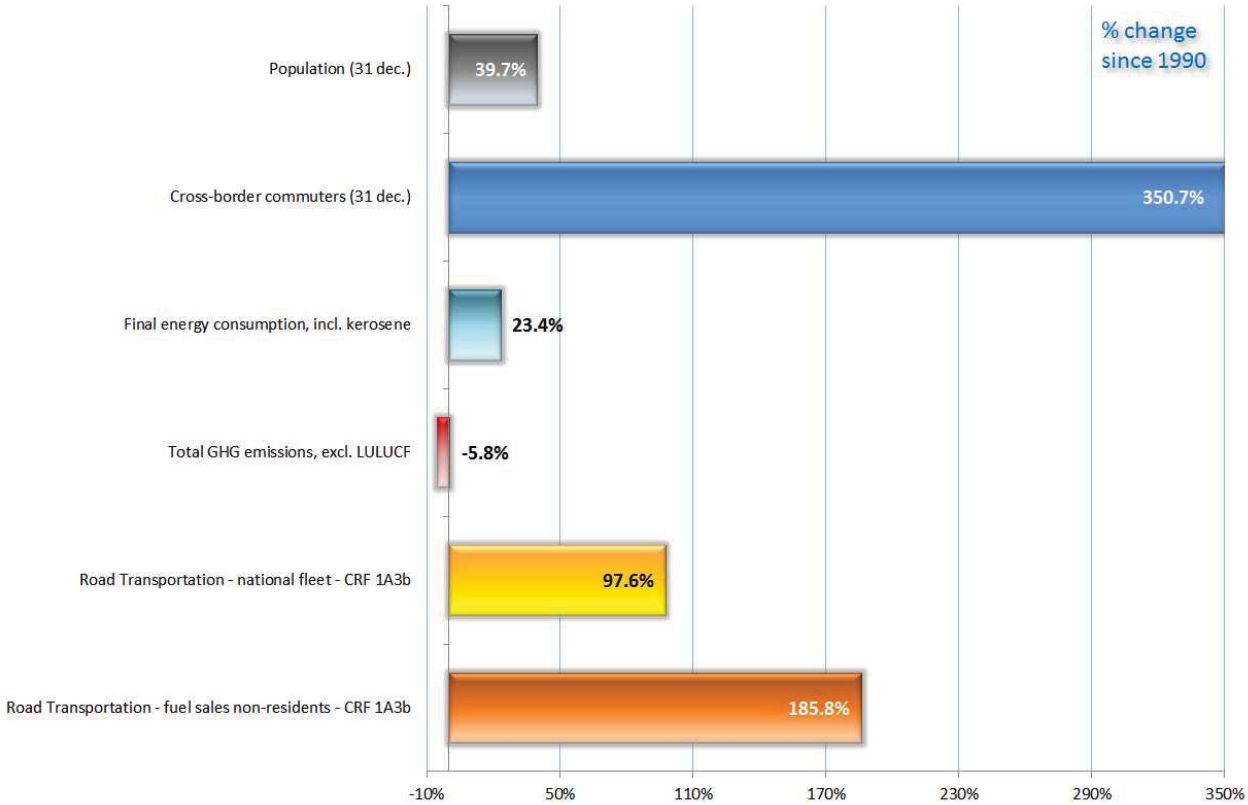
FIGURES II.13-1b – KEY VARIABLES TRENDS – 1: 1990-2012 (EXCL. CROSS-BORDER COMMUTERS)



Sources: population: STATEC, *Statistical Yearbook*, Table B.1100 (updated 18.04.2013).
http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=383&IF_Language=fra&MainTheme=2&FldrName=1
commuters: STATEC, *Statistical Yearbook*, Table B.3107 (updated 28.10.2013).
http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=494&IF_Language=fra&MainTheme=2&FldrName=3&RFPath=92
buildings stock: MDDI-DEV estimates on the basis of STATEC, *Statistical Yearbook*, Table D.4200 & results from the 2011 population census.
http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=1368&IF_Language=fra&MainTheme=4&FldrName=4&RFPath=35
http://www.statistiques.public.lu/stat/tableviewer/document.aspx?ReportId=8624
cars & vehicles: STATEC, *Statistical Yearbook*, Table D.6102 (updated 05.02.2013).
http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=7066&IF_Language=fra&MainTheme=4&FldrName=6&RFPath=7611
GDP: STATEC, *Statistical Yearbook*, Table E.2101 (updated 10.2013).
http://www.statistiques.public.lu/stat/TableViewer/document.aspx?ReportId=1497&IF_Language=fra&MainTheme=5&FldrName=2
energy: STATEC, *Statistical Yearbook*, Table A.4300 (updated 19.11.2013).
http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=6149&IF_Language=fra&MainTheme=1&FldrName=4&RFPath=51
GHG: Environment Agency and MDDI-DEV – Submission 2013v1.2.

Notes: (1) energy: there is a break in time series between 1999 & 2000.
(2) buildings stocks = stock of permanently occupied dwellings.
(3) 2012 GHG data are provisional data estimated by the Department of the Environment during the summer of 2013 for the EC and the European Environment Agency: more on this in Section III.1 below.

FIGURE II.13-2 – KEY VARIABLES TRENDS – 2: 1990 & 2012



Sources: population: STATEC, *Statistical Yearbook*, Table B.1100 (updated 18.04.2013).
http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=383&IF_Language=fra&MainTheme=2&FldrName=1
commuters: STATEC, *Statistical Yearbook*, Table B.3107 (updated 28.10.2013).
http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=494&IF_Language=fra&MainTheme=2&FldrName=3&RFPath=92
energy: STATEC, *Statistical Yearbook*, Table A.4300 (updated 19.11.2013).
http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=6149&IF_Language=fra&MainTheme=1&FldrName=4&RFPath=51
GDP: STATEC, *Statistical Yearbook*, Table E.2101 (updated 10.2013).
http://www.statistiques.public.lu/stat/TableViewer/document.aspx?ReportId=1497&IF_Language=fra&MainTheme=5&FldrName=2
GHG: Environment Agency and MDDI-DEV – Submission 2013v1.2.

Notes: (1) 2012 GHG data are provisional data estimated by the Department of the Environment during the summer of 2013 for the EC and the European Environment Agency: more on this in Section III.1 below.

Chapter III

GHG Inventory Information, including National System and the National Registry

Chapter III comprises three main sections. Firstly, GHG emissions as reported in the latest inventory submission to the UNFCCC Secretariat is analysed in details, as suggested in UNFCCC reporting guidelines, paragraphs 10 to 12. The years covered are 1990 to 2011, complemented by first estimates for the year 2012 *[→ Section III.1]*. Then, in line with paragraphs 30 and 31 of the Kyoto Protocol reporting guidelines, a general description of the National System under Article 5, paragraph 1 of the Protocol is provided *[→ Section III.2]*. This section is complemented by some additional information relating to requests formulated in Article 10, paragraph (f), of the Kyoto Protocol *[→ Section III.2.8]*. Finally, this chapter concludes by a description of the National Registry as demanded by paragraph 32 of the Kyoto Protocol reporting guidelines *[→ Section III.3]*.

III.1. MAIN TRENDS IN GHG EMISSIONS[73]

This section presents Luxembourg's GHG emissions trends between the base year (1990) and the latest year covered by **submission 2013v1.2**, i.e. 2011. Submission 2013v1.2 is the latest submission officially submitted to the UNFCCC Secretariat;[74] the next one (2014v1.x) has to be delivered to the UNFCCC before the 15th of April 2014 and will cover the years 1990 to 2012. However, a first version of this submission had to be delivered by EU Member States to the European Commission (EC) by the 15th of January 2014.

During the 2013 summer, the Department of the Environment undertook the calculation of first estimates for 2012, or "**nowcasts**" – some of these having been already presented and discussed in *Chapter II*. It is the fifth year that Luxembourg produces first estimates and Box III.1-1 describes briefly how they have been calculated. This work was initiated in 2009 – with 2008 "nowcasts" – at the same time as the EC, together with the European Environment Agency (EEA), did a similar exercise that is now repeated every year.[75] Moreover, from this year onwards, the "approximated GHG inventories" will become compulsory as requested by Article 8 of Regulation No 525/2013 on a mechanism for monitoring and reporting GHG emissions.[76] These "nowcasts" are included in the analysis of the main trends since they have proven to be rather good proxies of the final GHG emissions data submitted to both the EC and the UNFCCC (see Box III.1-1). In this section, 2012 data, results and comments are identified by the use of a dark orange colour.

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73 This section of the NC6 covers sections III.A and III.B of the Outline and General Structure of the NC5 according to IPCC reporting guidelines (para. 5), which are still valid for the NC6.

74 http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/zip/lux-2013-crf-15apr.zip.

75 Latest use: http://www.eea.europa.eu/media/newsreleases/climate-and-energy-targets-2013.These EC/EEA "nowcasts", together with national "nowcasts" for those countries which calculated them, such as Luxembourg, have been used for the 2013 EU GHG emissions trends and projections report [European Environment Agency (2013)].

76 Regulation (EU) No525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:165:0013:0040:EN:PDF).

Luxembourg being a small country, its GHG inventory is characterized by a rather high number of CRF (sub-)categories which do not occur or are not applicable. ***Table III.1-1a*** gives an overview of those CRF (sub-)categories for which emissions or removals are recorded and those for which emissions or removals are either not occurring or not applicable or not (yet) estimated. Completeness and transparency indexes are presented in ***Table III.1-1b***: for the inventory year 2011, the transparency index (cells reported as "included elsewhere" – IE – compared to the number of estimates to be reported) was 93% and the completeness index (cells reported as "not estimated" – NE – compared to the number of estimates to be reported) reached 95%. A more complete picture – including activity data and emission factors sources as well as estimations' tier levels – is provided in Annex A.I as an excerpt of summary tables of submission 2013v1.2.

Box III.1-1 – 2012 GHG emissions "nowcasts"

During the 2013 summer, the Department of the Environment calculated, for the fifth time, emissions estimates for the previous year. This was made possible with an anticipated good level of confidence because of the structure of GHG emissions in Luxembourg and of data used to perform the "nowcasts". As an example, for the approximated 2010 inventory, the difference between the final submitted GHG estimates and the estimated emissions was only 0.5%. Of course, the further the detailed CRF sub-categories, the further the differences are significant in general. But "biggest" differences were recorded for the smaller source sub-categories for which sufficiently detailed updated activity data were missing at the time of the "nowcasting" exercise **(1)**.

In Luxembourg, GHG emissions, excluding LULUCF, reported in the inventory are mainly made of CO_2 (92% in 2011). The energy sector (CRF 1) is the main contributor to emissions (88.4% in 2011). Consequently, other gases, which are sometimes less straightforward to estimate than CO_2, as well as the other GHG sources – industrial processes, solvents & other product use, agriculture and waste – represent only a small fraction of the total emissions, excluding LULUCF.

However, EU ETS data of a definite year being available during the first trimester of the following year, they could be used for the estimation of industrial processes related emissions so that this sector could also be "nowcasted" with a good level of confidence: in Luxembourg, only 3 enterprises are included in CRF sector 2 and they are all three taking part to this system. Of course, EU ETS data also helped in the calculations of CRF sub-category 1A2 (manufacturing industries & construction).

For CRF category 1A (fuel combustion), together with EU ETS data, yearly energy statistics could be used to perform the "nowcasts", even if all the breakdowns by sectors were not yet totally on hand in the data sets that are usually available, for most of the fuels, at the end of the first semester of the next year.

Consequently, CRF sectors 1A and 2 (94% of the total emissions, excluding LULUCF, in 2011) could be estimated for 2012 using rather precise data, whereas for the other sectors or (sub-)categories, simple methods have been used, e.g. an average of the 5 last years or a simple reproduction of the 2011 value (i.e. a zero-growth hypothesis). In some case, however, demographic data could be used: that was the case for solid waste disposal on land, waste incineration and domestic waste water treatment, for which ratios based on inhabitants could be applied to 2012 population figures. Due to the fact that yearly agriculture activity data are usually extracted from censuses performed on the 15th of May [Ministry of Sustainable Development and Infrastructure, Environment Agency (2013b), note on p. 291], agriculture related categories – mainly 4A and 4B – could already be "nowcasted" using the probably final data that will be used in the next official submission.

More details can be provided, if requested: the result of this exercise has not been disseminated within the country but used internally and provided to the EC and the EEA. EEA used the results of the latest "nowcasting" exercise in the 2013 EU GHG emissions trends and projections report [European Environment Agency (2013)].

(1) Due to methodological changes for some sub-categories between the inventory used as a basis for the "nowcasts" and the one that is finally submitted, the comparison exercise is often biased; except for the first estimates for the year 2010.

Table III.1-1a – List of GHG sources or sinks with related GHG emissions or removals

GHG source & sink categories *(CRF nomenclature)*	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
1. ENERGY	✓	✓	✓			
A. Fuel Combustion	✓	✓	✓			
1. Energy Industries	✓	✓	✓			
a. Public Electricity and Heat Production	✓	✓	✓			
b. Petroleum Refining	NO	NO	NO			
c. Manufacture of Solid Fuels and Other Energy Industries	NO	NO	NO			
2. Manufacturing Industries and Construction	✓	✓	✓			
a. Iron and Steel	✓	✓	✓			
b. Non-Ferrous Metals	✓	✓	✓			
c. Chemicals	✓	✓	✓			
d. Pulp, Paper and Print	✓	✓	✓			
e. Food Processing, Beverages and Tobacco	✓	✓	✓			
f. Other	✓	✓	✓			
3. Transport	✓	✓	✓			
a. Civil Aviation	✓	✓	✓			
b. Road Transportation	✓	✓	✓			
c. Railways	✓	✓	✓			
d. Navigation	✓	✓	✓			
e. Other Transportation	NA	NA	NA			
4. Other Sectors	✓	✓	✓			
a. Commercial/Institutional	✓	✓	✓			
b. Residential	✓	✓	✓			
c. Agriculture/Forestry/Fisheries	✓	✓	✓			
5. Other	NO	NO	NO			
a. Stationary	NO	NO	NO			
b. Mobile	NO	NO	NO			
B. Fugitive Emissions from Fuels	✓	✓	NO			
1. Solid Fuels	NO	NO	NO			
a. Coal Mining	NO	NO	NO			
b. Solid Fuel Transformation	NO	NO	NO			
c. Other	NO	NO	NO			
2. Oil and Natural Gas	✓	✓	NO			
a. Oil	NA,NO	NA,NO	NO			
b. Natural Gas	✓	✓				
c. Venting and Flaring	NO	NO	NO			
d. Other	NA	NA	NA			
2. INDUSTRIAL PROCESSES	✓	NO	NO			
A. Mineral Products	✓	NO	NO			
1. Cement Production	✓					
2. Lime Production	NO					
3. Limestone and Dolomite Use	IE					
4. Soda Ash Production and Use	IE,NO					
5. Asphalt Roofing	NO					
6. Road Paving with Asphalt	NO					
7. Other: Glass Production	✓	NO	NO			
B. Chemical Industry	NO	NO	NO	NO	NO	NO
1. Ammonia Production	NO	NO	NO	NO	NO	NO
2. Nitric Acid Production			NO	NO	NO	NO
3. Adipic Acid Production	NO		NO	NO	NO	NO
4. Carbide Production	NO	NO		NO	NO	NO
5. Other	NO	NO	NO	NO	NO	NO
C. Metal Production	✓	NO			NO	NO
1. Iron and Steel Production	✓	NO			NO	NO
2. Ferroalloys Production	NO	NO			NO	NO
3. Aluminium Production	NO	NO			NO	
4. SF_6 Used in Aluminium and Magnesium Foundries						NO
5. Other	NA	NA	NA	NA	NA	NA

GHG source & sink categories *(CRF nomenclature)*	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
D. Other Production	NO					
1. Pulp and Paper						
2. Food and Drink	NO					
E. Production of Halocarbons and SF_6				NO	NO	NO
1. By-product Emissions				NA,NO	NA	NA
2. Fugitive Emissions				NO	NO	NO
3. Other				NA	NA	NA
F. Consumption of Halocarbons and SF_6				✓	✓	✓
1. Refrigeration and Air Conditioning Equipment				✓	✓	NO
2. Foam Blowing				✓	NO	NO
3. Fire Extinguishers				NO	NO	NO
4. Aerosols/ Metered Dose Inhalers				✓	NO	NO
5. Solvents				NO	NO	NO
6. Other applications using ODS substitutes				NO	NO	NO
7. Semiconductor Manufacture				NO	NO	NO
8. Electrical Equipment				NO	NO	✓
9. Other: Noise Reduction Windows				NO	NO	✓
G. Other	NA	NA	NA	NA	NA	NA
3. SOLVENT AND OTHER PRODUCT USE	✓		✓			
A. Paint Application	✓					
B. Degreasing and Dry Cleaning	✓		NA			
C. Chemical Products, Manufacture and Processing	✓					
D. Other	✓		✓			
4. AGRICULTURE		✓	✓			
A. Enteric Fermentation		✓				
1. Cattle		✓				
2. Buffalo		NO				
3. Sheep		✓				
4-10. Other: Horses, Goats, Swine, Poultry, Rabbits, Cervidae		✓				
B. Manure Management		✓	✓			
1. Cattle		✓	✓			
2. Buffalo		NO	NO			
3. Sheep		✓	✓			
4-10. Other: Horses, Goats, Poultry, Rabbits, Cervidae		✓	✓			
8. Swine		✓	✓			
11-14. AWMS			✓			
C. Rice Cultivation		NO				
D. Agricultural Soils			✓			
1. Direct Soil Emissions			✓			
2. Pasture, range and paddock manure			✓			
3. Indirect Emissions			✓			
4. Other			NA			
E. Prescribed Burning of Savannas		NA	NA			
F. Field Burning of Agricultural Residues		NO	NO			
G. Other		NA	NA			
5. LULUCF	✓	NE,NO	✓			
A. Forest Land	✓	NO	NO			
1. Forest Land remaining Forest Land	✓	NO	NO			
2. Land converted to Forest Land	✓	NO	NO			
B. Cropland	✓	NO	✓			
1. Cropland remaining Cropland	✓	NO	NO			
2. Land converted to Cropland	✓	NO	✓			
C. Grassland	✓	NO	NO			
1. Grassland remaining Grassland	IE,NO	NO	NO			
2. Land converted to Grassland	✓	NO	NO			
D. Wetlands	✓	NO	NO			
1. Wetlands remaining Wetlands	NE,NO	NO	NO			
2. Land converted to Wetlands	✓	NO	NO			
E. Settlements	✓	NE	NE			
1. Settlements remaining Settlements	NE	NE	NE			
2. Land converted to Settlements	✓	NE	NE			
F. Other Land	✓	NO	NO			
1. Other Land remaining Other Land						
2. Land converted to Other Land	✓	NO	NO			
G. Other (please specify)	NE	NE	NE			
Harvested Wood Products	NE	NE	NE			

GHG source & sink categories *(CRF nomenclature)*	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
6. WASTE	NO	✓	✓			
A. Solid Waste Disposal on Land	NA,NO	✓				
1. Managed Waste Disposal on Land	NO	✓				
2. Unmanaged Waste Disposal Sites	NO	NO				
3. Other	NA	NA				
B. Wastewater Handling		✓	✓			
1. Industrial Wastewater		NO	✓			
2. Domestic and Commercial Wastewater		✓	✓			
3. Other		NA	NA			
C. Waste Incineration	IE	IE	IE			
D. Other	NO	✓	✓			
7. OTHER	NA	NA	NA	NA	NA	NA
MEMO ITEMS	✓	✓	✓			
International Bunkers	✓	✓	✓			
Aviation	✓	✓	✓			
Marine	✓	✓	✓			
Multilateral Operations	NO	NO	NO			
CO_2 Emissions from Biomass	✓					

Sources: Environment Agency and MDDI-DEV - Submission 2013v1.2.
Legend:
✓ - emissions reported at least once over the period 1990-2011
IE - included elsewhere
NA - not applicable
NE - not estimated
NO - not occuring
CRF (sub-)categories & sectors for which emissions existed at least once over the period 1990-2011. Covers ✓ , IE & NE.

TABLE III.1-1b – TRANSPARENCY AND COMPLETENESS IN UNFCCC SUBMISSION 2013V1.2: 2010

	Submission 2013v1.2				
CRF sector	*# estimates*	*IE*	*NE*	*TR*	*CP*
Energy (sectoral approach) – CRF 1	87	0	0	100%	100%
Industrial Processes – CRF 2	104	2	5	98%	95%
Solvent and Other Product Use – CRF 3	10	0	0	100%	100%
Agriculture – CRF 4	55	0	1	100%	98%
LULUCF – CRF 5	36	1	9	99%	75%
Waste – CRF 6	18	3	0	97%	100%
Total	**310**	**6**	**16**	**93%**	**95%**

Sources: Ministry of Sustainable Development and Infrastructure, Environment Agency (2013b), Table 1-12, p. 89.
Notes: The exercise focuses on sectoral report tables only. The level of detail for CRF sources and categories is up to 4 digits for the energy sector (e.g. CRF sub-category 1A1a) and 3 digits for the other sectors (e.g. CRF sub-category 4D3). Finally, only the 6 GHG are covered by this counting exercise.
Transparency (TR) [%] = [1 – (number of IE/number of estimates)]*100
Completeness (CP) [%] = [1 – (number of NE/number of estimates)]*100
CRF sector 1 includes waste incineration that is reported under CRF sub-category 1A1a since the energy produced while burning waste is recovered. Hence, the number of IE for CRF sector 6 includes waste incineration.

III.1.1. GHG trend: the supremacy of CO_2 and of the energy sector

Luxembourg ratified the United Nations Framework Convention on Climate Change in 1994, and the Kyoto Protocol in 2002. Pursuant to that Protocol and the terms of the European agreement distributing the burden among, at that time, the EU-15 Member States, Luxembourg undertook **to reduce its GHG emissions by 28% below their 1990 level over the period 2008-12**. This is the deepest cut of any agreed by the 15 Member States. When the Act approving the Kyoto Protocol was adopted in Luxembourg (2001), its GHG emissions were down by more than 30% between 1990 and 1998 *[→ Tables III.1-2, III.1-3 or III.1-4]*.

In 2011, carbon dioxide was the main source of GHG in Luxembourg. This source counted for 92% of the total GHG emissions calculated in CO_2e – total excluding LULUCF.[77] The second source of GHG was nitrous oxide with 3.8% of the total emissions. Methane was the third source with 3.6%. Fluorinated gases only accounted for 0.6% of the total emissions, with hydrofluorocarbons representing 0.55% of the total and sulphur hexafluoride representing 0.06% of the total. Perfluorocarbons only accounted for 0.001% of the total *[→ Table III.1-2 & Figures III.1-2a to III.1-2c & III.1-4b]*. For 2012, first estimates – "nowcasts" – lead to the following percentages: CO_2 = 91.9%, N_2O = 3.9%, CH_4 = 3.5% and F-gases = 0.6% *[→Table III.1-2 & Figures III.1-2a to III.1-2c]*.

In 2011, total GHG emissions amounted to 12.098 Mio. t CO_2e, 6.2% below their level in 1990 and 8.1% below the level retained for the base year under the Kyoto Protocol.[78] Several phases can clearly be distinguished over the period 1990 to 2011 *[→ Figures III.1-1a & III.1-1b]*:

- firstly, from base year up to 1993, Luxembourg's emissions remained rather stable;
- then, between 1994 and 1998, they started to decrease significantly to reach their lowest value in 1998, when they were down by more than 30%;
- from 1999 up to 2004, emissions augmented recurrently;
- from 2004 to 2006, a stabilisation peaking at 13.1 Mio. t CO_2e is observed;
- a decrease occurred between 2006 and 2007 followed by a period of relative stability of the emissions with the exception of 2009, and to a lesser extent 2011, two years more impacted by the financial and economic crisis.

For 2012, first estimates for total GHG emissions reach the value of 12.157 Mio. t CO_2e, 7.7% below the base year level considered under the Kyoto Protocol.

According to data validated during the peer-review of Luxembourg's initial report facilitating the calculation of the assigned amount pursuant to Article 3, paragraphs 7 and 8, of the Kyoto Protocol, Luxembourg obtained an assigned amount of 47 402 996 t CO_2e for the commitment period 2008-2012 under the Kyoto Protocol.[79] This represents, therefore, **annual maximum emissions of 9 480.60 Gg CO_2e**. In 2011, total GHG emissions were 21.6% above this annual target (+22% in 2012) *[→ Figure III.1-1b]*.

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77 In Section III.1, when it is referred to "total (GHG) emissions" it is meant "total GHG emissions excluding LULUCF". Reference is made to total emissions excluding LULUCF since this is the one that counts for the reduction target under the Kyoto Protocol.

78 The base year for CO_2, CH_4 and N_2O is 1990. For the F-gases, the base year is 1995. When the assigned amount under the Kyoto Protocol was determined, F-gases emissions were equal in 1990 and 1995 due to a lack of background data and methods at that time. Now, as Table III.1-2 shows, F-gases emissions are no longer the same in 1990 and 1995.

79 http://unfccc.int/resource/docs/2007/irr/lux.pdf, p. 4.

As portrayed in *Chapter II* presenting Luxembourg's national circumstances, the evolution during these last 20 years can essentially be explained by **changes in production techniques**, as well as by **changes in the final "energy-mix" consumption**. Of course, **increasing or decreasing activities** for certain source categories also played a crucial role in Luxembourg's GHG emissions trend. During the last years, **the financial and economic crisis and its aftermaths** also played a part.

A good example for a **technological change** in production took place in the iron and steel industry, where the steel production process was moved from blast furnaces to electric arc furnaces between 1994 and 1998 and, therefore, solid fuels (coke) were replaced, to a very large extent, by electricity and natural gas. Due to that technological change, the total energy consumption in steel industry was significantly reduced and the "energy-mix" greatly modified *[→ Section II.6.1]*. This process change was the main driver for the reduction in GHG emissions observed between 1994 and 1998 *[→ Figure III.1-1b]*. Changes also occurred in the industrial and residential/commercial/institutional sectors, where the consumption of liquid fuels (residual oil, gasoil) was reduced in favour of natural gas in conjunction with the extension of the natural gas network in Luxembourg.

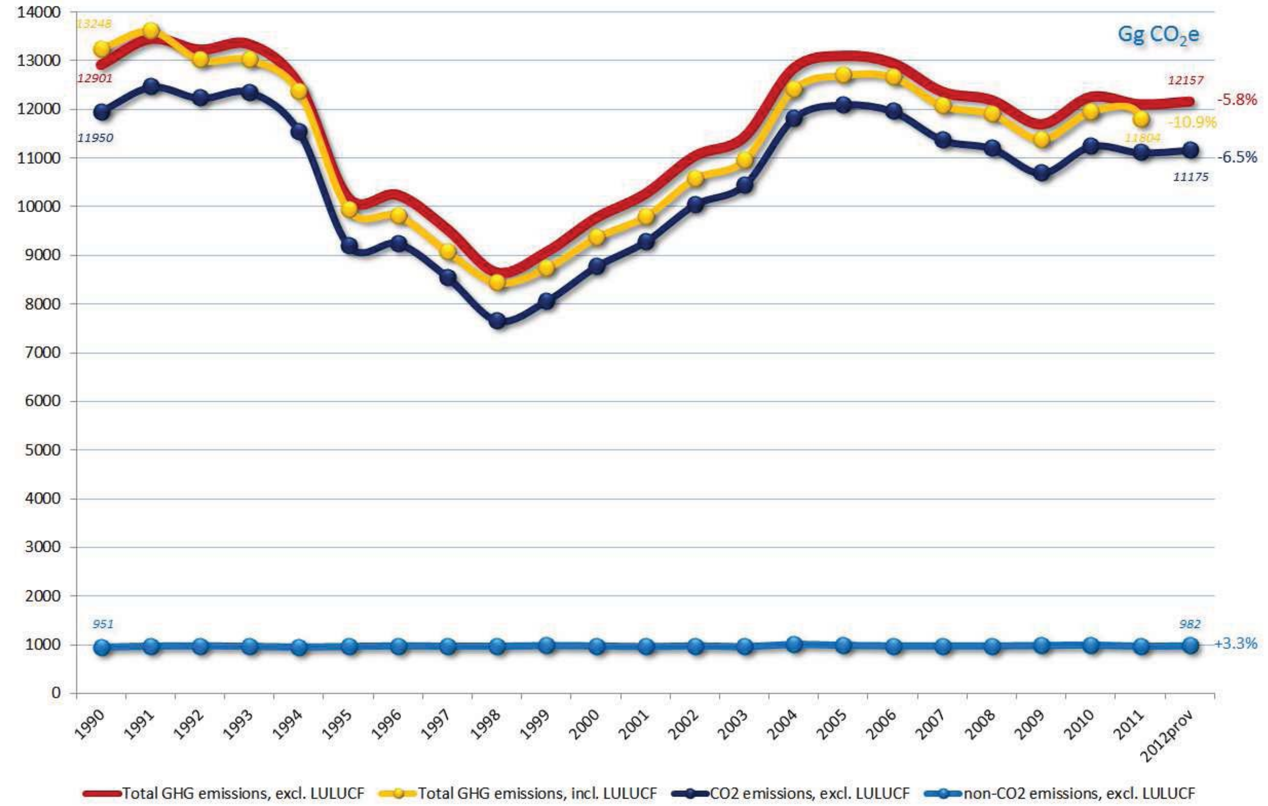
The road transport sector, on the other hand, is a clear example on **how activity levels of a source category can influence the overall GHG emission trend**. Indeed, the upward trend for GHG emissions recorded from 1999 to 2004 was merely justified by increasing energy consumption and fuel sales in the transport sector. The stabilization spotted for the inventory years 2004 to 2006 was largely the result of relatively steady sales of road fuels that peaked in 2005. Finally, the decrease in total emissions from 2006 to 2007 and the period of relative stability that followed was driven by a "road fuel sales to non-residents" related emissions reduction, which reached its lower level in 2009 (financial and economic crisis), combined with a diminution of GHG emissions from the power generation sector, the latter being exceptionally important in both 2008 and 2011 because, as stressed in *Section II.6.2*, these two years the main power plant of the country experienced maintenance activities which resulted in several months without substantial production *[→ Figures II.6-4 & III.1-1b]*.

More detailed explanations are provided in *Sections III.1.3* (dealing with gases) *& III.1.4* (dealing with CRF sectors).

A fundamental point worth mentioning when analysing Luxembourg's GHG emission trends and their composition over time, is **the small size of Luxembourg**, and therefore, the special nature of its economy. Indeed, the structure of the economy, the related energy demand and the energy and emission balances may vary significantly, whether a new economic activity starts its operations or an existing one ceases them. This characteristic explains, for instance, the reduction of emissions pertaining to the industrial sector: with 7.9 Mio. t in 1990, CO_2e emissions from industrial processes and fuel combustion in industry accounted for 61.4% of total GHG emissions. They could eventually be reduced to 2.1 Mio. t in 1998 – i.e. 24.4% of total GHG emissions – mainly after the reorganization of the steel industry took place in the mid-nineties (move from blast furnaces to electric arc furnaces indicated above) *[→ Section II.7]*. At that time, GHG emissions of Luxembourg were almost one third below the base year level. Another illustrative example is the building of the TWINerg power plant *[→ Section II.6]*. This plant started its operation in mid-2002 and, by 2010, was responsible of about 0.95 Mio. t CO_2, i.e. around 8% of the total GHG emissions.[80] However, due to another economic slowdown in 2012, anticipated emissions of the TWINerg felt to 0.77 Mio. t CO_2.

These considerations can easily be identified in ***Tables III.1-3 & III.1-4***, and their associated figures, which assemble CRF source categories in such a way that GHG and individual gas emission sources are distributed between main emitters – such as energy production, industry, road transportation – and other categories.

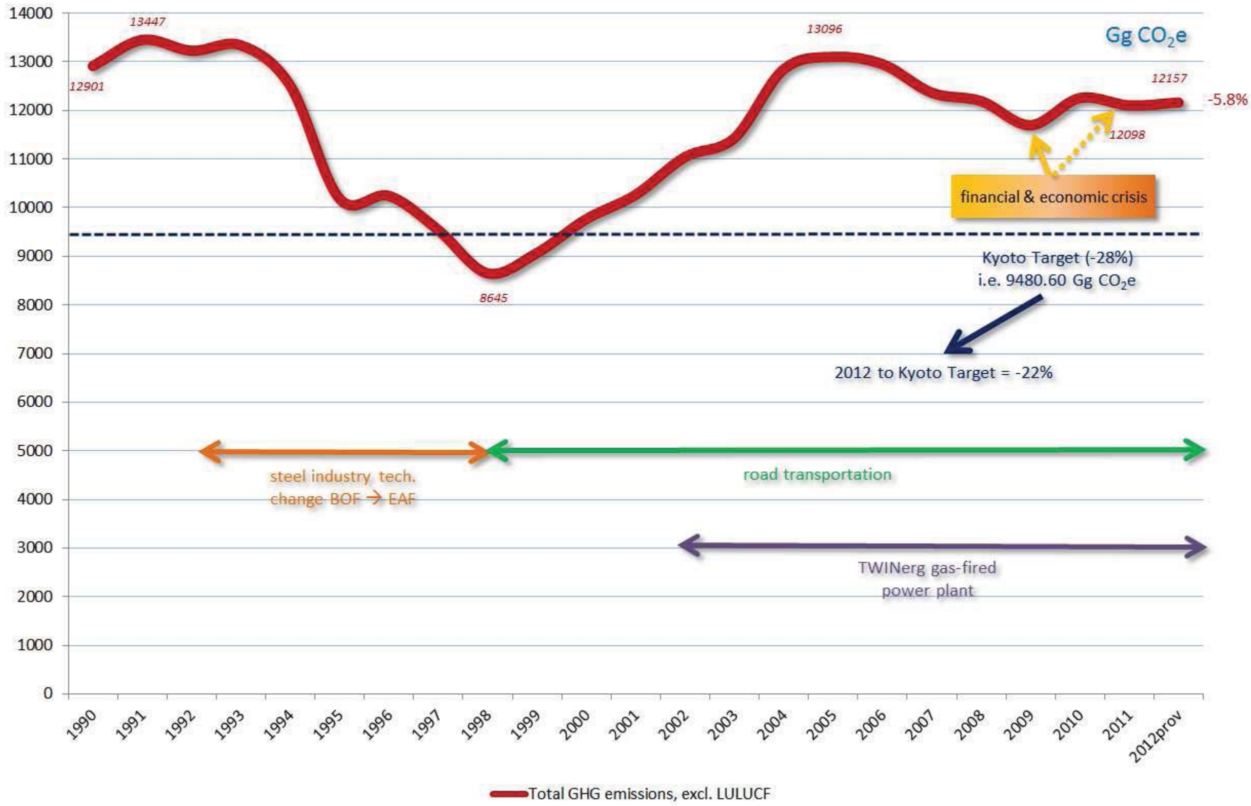
FIGURE III.1-1a – GHG EMISSIONS AND REMOVALS – OVERVIEW CO_2 VS. NON-CO_2: 1990-2012



Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2.
Note: 2012 data are provisional data estimated by the Department of the Environment during the summer of 2013 for the EC and the European Environment Agency.

80 The highest emissions recorded for the TWINerg plant were 1.02 Mio. t CO_2 in 2006, i.e. 7.8% of the total GHG emissions reported for that year. In this analysis, the "outlier" years 2008 and 2011 are "excluded" due to several months without substantial production (maintenance).

FIGURE III.1-1b – GHG EMISSIONS (EXCL. LULUCF): 1990-2012



Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2.

Note: 2012 data are provisional data estimated by the Department of the Environment during the summer of 2013 for the EC and the European Environment Agency.

TABLE III.1-2 – GHG EMISSIONS AND REMOVALS – OVERVIEW BY MAIN GASES AND CRF SECTORS: 1990-2012

Gg (1000 t.) CO_2 equivalent	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012prov
CO_2 emissions, incl. net CO_2	12295.16	12641.51	12043.55	12055.18	11411.36	8969.12	8845.37	8107.21	7474.34	7755.59	8392.51	8842.86	9603.74	9998.92	11417.27	11719.50	11691.00	11106.76	10934.14	10405.63	10957.51	10828.84	NE
from LULUCF (1)	92.80%	92.82%	92.46%	92.53%	92.26%	90.24%	90.00%	89.25%	88.46%	88.70%	89.52%	90.16%	90.72%	91.18%	91.87%	92.20%	92.26%	91.90%	91.77%	91.33%	91.64%	91.74%	NA
CO_2 emissions, excl. net CO_2	11950.26	12471.93	12242.15	12363.86	11550.17	9210.07	9258.86	8561.14	7672.68	8077.25	8780.74	9297.22	10057.77	10461.40	11834.49	12107.85	11969.26	11382.58	11209.10	10704.66	11255.34	11125.58	11175.13
from LULUCF	92.63%	92.75%	92.59%	92.73%	92.36%	90.49%	90.43%	89.79%	88.76%	89.13%	89.97%	90.62%	91.13%	91.56%	92.15%	92.45%	92.44%	92.10%	91.97%	91.57%	91.86%	91.96%	91.92%
CH_4 (2) emissions, incl. net CH_4	461.51	471.95	462.68	466.72	460.99	469.59	473.25	468.33	467.24	475.18	467.14	466.74	467.41	457.89	452.75	451.79	447.46	442.31	444.81	444.89	452.87	437.00	NE
from LULUCF (1)	3.48%	3.47%	3.55%	3.58%	3.73%	4.72%	4.82%	5.16%	5.53%	5.43%	4.98%	4.76%	4.42%	4.18%	3.64%	3.55%	3.53%	3.66%	3.73%	3.90%	3.79%	3.70%	NA
CH_4 (2) emissions, excl. net CH_4	461.51	471.95	462.68	466.72	460.99	469.59	473.25	468.33	467.24	475.18	467.14	466.74	467.41	457.89	452.75	451.79	447.46	442.31	444.81	444.89	452.87	437.00	426.91
from LULUCF	3.58%	3.51%	3.50%	3.50%	3.69%	4.61%	4.62%	4.91%	5.41%	5.24%	4.79%	4.55%	4.23%	4.01%	3.53%	3.45%	3.46%	3.58%	3.65%	3.81%	3.70%	3.61%	3.51%
N_2O (3) emissions, incl. net N_2O	478.96	492.49	506.20	491.81	481.62	483.53	491.72	488.82	485.54	486.95	484.19	461.56	469.54	458.20	504.17	481.21	471.01	469.22	466.03	470.28	472.39	462.95	NE
from LULUCF (1)	3.62%	3.62%	3.89%	3.78%	3.89%	4.86%	5.00%	5.38%	5.75%	5.57%	5.16%	4.71%	4.44%	4.18%	4.06%	3.79%	3.72%	3.88%	3.91%	4.13%	3.95%	3.92%	NA
N_2O (3) emissions, excl. net N_2O	476.11	489.64	503.35	488.96	478.77	480.68	488.88	485.97	482.69	484.10	481.37	458.76	466.76	455.45	501.45	478.52	468.33	466.58	463.41	467.68	469.83	460.41	478.90
from LULUCF	3.69%	3.64%	3.81%	3.67%	3.83%	4.72%	4.77%	5.10%	5.58%	5.34%	4.93%	4.47%	4.23%	3.99%	3.90%	3.65%	3.62%	3.78%	3.80%	4.00%	3.83%	3.81%	3.94%
HFCs (4)	12.01	12.01	12.21	12.93	13.68	15.59	15.91	17.17	19.99	23.96	28.62	34.15	41.86	46.76	49.18	53.01	56.91	61.11	63.46	65.54	66.47	67.00	76.52
	0.09%	0.09%	0.09%	0.10%	0.11%	0.15%	0.16%	0.18%	0.23%	0.26%	0.29%	0.33%	0.38%	0.41%	0.38%	0.40%	0.44%	0.49%	0.52%	0.56%	0.54%	0.55%	0.63%
PFCs (4)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0.01	0.01	0.01	0.02	0.11	0.15	0.17	0.21	0.24	0.22	0.20	0.18	IE
	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	NA
SF_6 (4)	1.13	1.21	1.29	1.37	1.46	1.55	1.71	1.87	1.97	2.05	2.15	2.82	3.37	4.09	4.60	5.04	5.71	6.15	6.57	7.00	7.39	7.75	IE
	0.01%	0.01%	0.01%	0.01%	0.01%	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	0.03%	0.03%	0.04%	0.04%	0.04%	0.04%	0.05%	0.05%	0.06%	0.06%	0.06%	NA
1. Energy	10429.93	11044.32	10895.15	11042.59	10325.04	8340.89	8451.30	7867.11	7140.20	7508.49	8189.11	8769.05	9529.95	10012.38	11356.22	11635.80	11438.98	10852.50	10736.99	10298.52	10839.35	10688.67	10792.63
	80.85%	82.13%	82.40%	82.82%	82.57%	81.95%	82.54%	82.51%	82.60%	82.85%	83.90%	85.47%	86.34%	87.63%	88.43%	88.85%	88.35%	87.81%	88.10%	88.10%	88.47%	88.35%	88.77%
2. Industrial Processes	1621.50	1543.72	1473.95	1452.53	1361.33	1001.64	946.35	839.11	682.94	725.05	756.56	704.85	728.96	674.47	719.70	716.11	773.21	767.21	705.99	641.57	660.24	671.49	619.65
	12.57%	11.48%	11.15%	10.89%	10.89%	9.84%	9.24%	8.80%	7.90%	8.00%	7.75%	6.87%	6.60%	5.90%	5.60%	5.47%	5.97%	6.21%	5.79%	5.49%	5.39%	5.55%	5.10%
3. Solvent and Other Product Use	23.90	22.98	21.88	20.85	19.57	19.74	19.42	19.00	17.88	17.30	15.81	16.54	16.76	15.09	17.39	16.65	16.25	17.48	16.90	16.11	14.34	15.77	16.35
	0.19%	0.17%	0.17%	0.16%	0.16%	0.19%	0.19%	0.20%	0.21%	0.19%	0.16%	0.16%	0.15%	0.13%	0.14%	0.13%	0.13%	0.14%	0.14%	0.14%	0.12%	0.13%	0.13%
4. Agriculture	743.20	751.50	746.10	732.99	716.24	734.71	744.12	731.74	726.01	735.77	721.34	694.40	687.42	647.66	677.83	657.76	649.53	653.65	661.28	670.65	677.94	663.65	669.73
	5.76%	5.59%	5.64%	5.50%	5.73%	7.22%	7.27%	7.67%	8.40%	8.12%	7.39%	6.77%	6.23%	5.67%	5.28%	5.02%	5.02%	5.29%	5.43%	5.74%	5.53%	5.49%	5.51%
5. LULUCF	347.75	172.43	-195.75	-305.83	-135.96	-238.10	-410.64	-451.08	-195.50	-318.81	-385.41	-451.56	-451.26	-459.74	-414.49	-385.65	-275.59	-273.18	-272.34	-296.43	-295.26	-294.20	NE
	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
6. Waste	82.48	84.21	84.61	84.89	82.89	80.52	77.43	77.53	77.54	75.93	77.20	74.85	74.09	76.02	71.42	70.04	69.87	68.09	66.44	63.14	60.21	58.33	59.09
	0.64%	0.63%	0.64%	0.64%	0.66%	0.79%	0.76%	0.81%	0.90%	0.84%	0.79%	0.73%	0.67%	0.67%	0.56%	0.53%	0.54%	0.55%	0.55%	0.54%	0.49%	0.48%	0.49%
7. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total GHG including LULUCF	13248.77	13619.16	13025.94	13028.02	12369.12	9939.39	9827.97	9083.42	8449.06	8743.72	9374.62	9808.13	10585.93	10965.88	12428.07	12710.71	12672.25	12085.76	11915.26	11393.55	11956.83	11803.72	NE
	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	NA
Total GHG excluding LULUCF	12901.02	13446.74	13221.69	13333.84	12505.07	10177.48	10238.60	9534.50	8644.56	9062.53	9760.03	10259.69	11037.18	11425.61	12842.57	13096.36	12947.84	12358.94	12187.60	11689.99	12252.09	12097.92	12157.45
	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2.

Notes: 2012 data are provisional data estimated by the Department of the Environment during the summer of 2013 for the EC and the European Environment Agency.

(1) these percentages are relative to the total GHG emissions, including LULUCF.

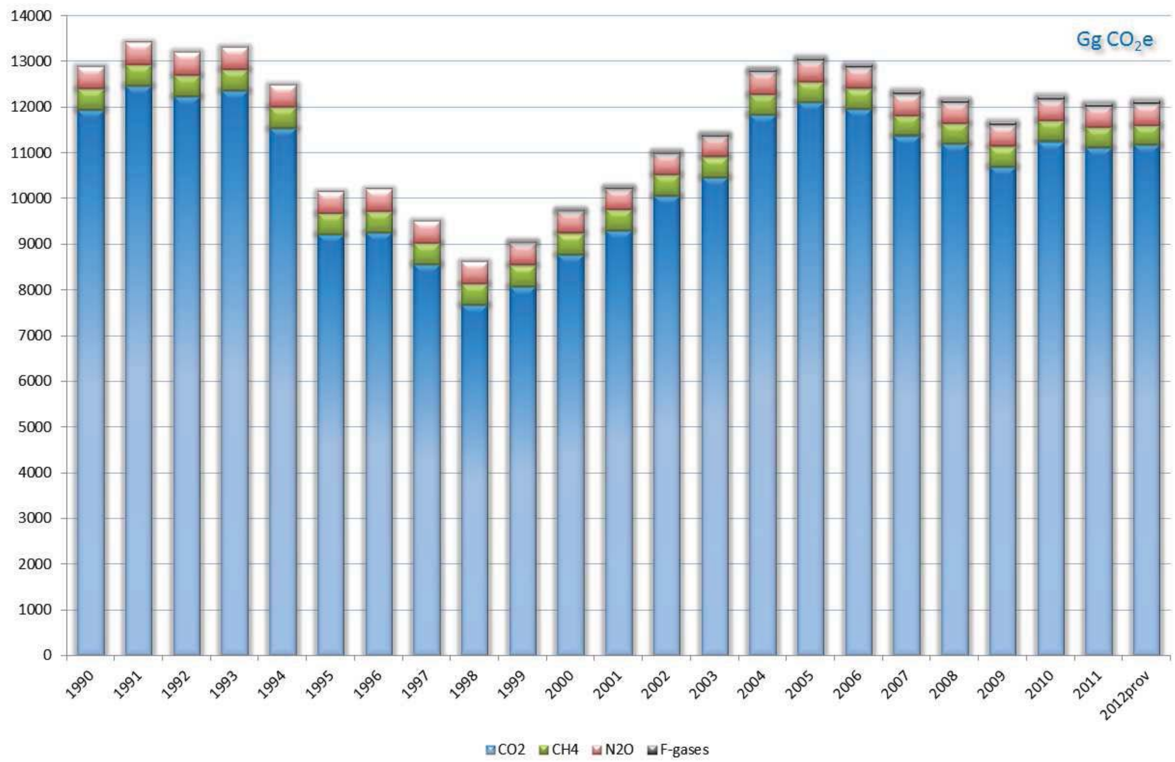
(2) the methane emissions are converted in CO_2 equivalents by multiplying the emissions by 21, i.e. the global warming potential (GWP) value for methane based on the effects of GHG over a 100-year time horizon.

(3) the nitrous oxide emissions are converted in CO_2 equivalents by multiplying the emissions by 310, i.e. the global warming potential (GWP) value for nitrous oxide based on the effects of GHG over a 100-year time horizon.

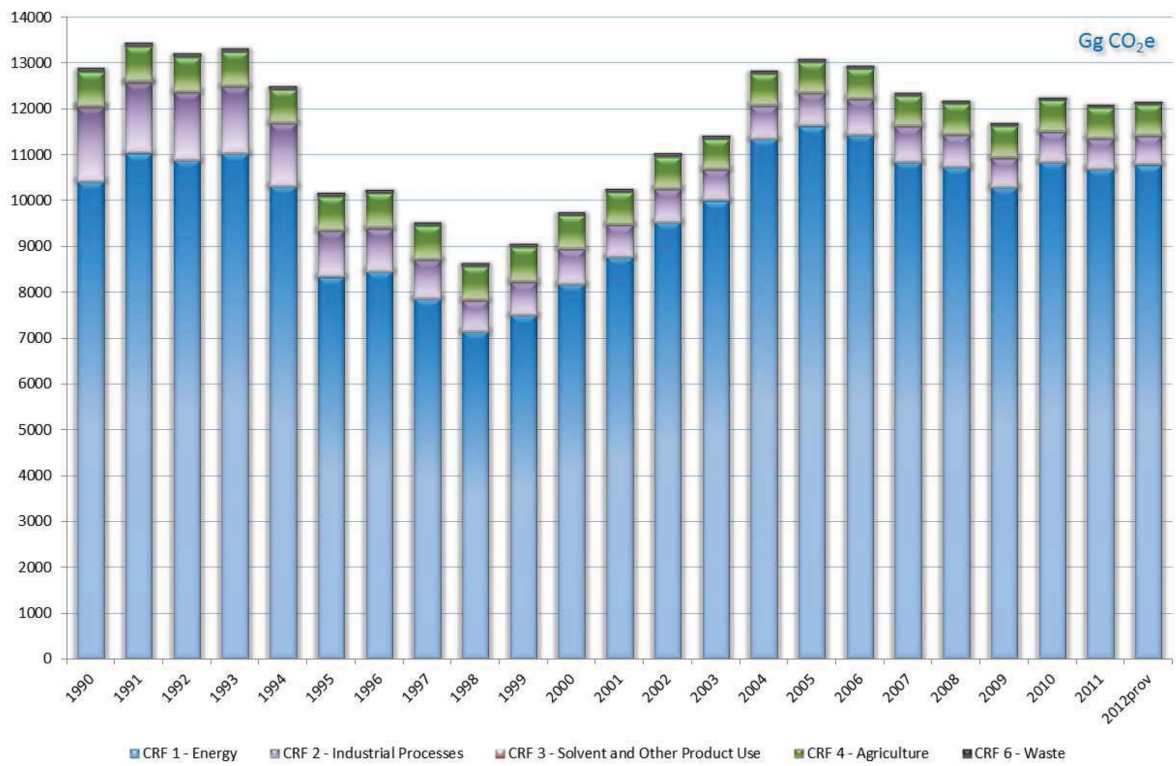
(4) the F-gases are those not covered by the Montreal Protocol, i.e. the HFCs, PFCs and SF_6 expressed in CO_2 equivalents using the global warming potential (GWP) values based on the effects of GHG over a 100-year time horizon.

FIGURES III.1-2a – GHG EMISSIONS (EXCL. LULUCF) – MAIN GASES & SECTORS: ABSOLUTE VALUES 1990-2012

GHG



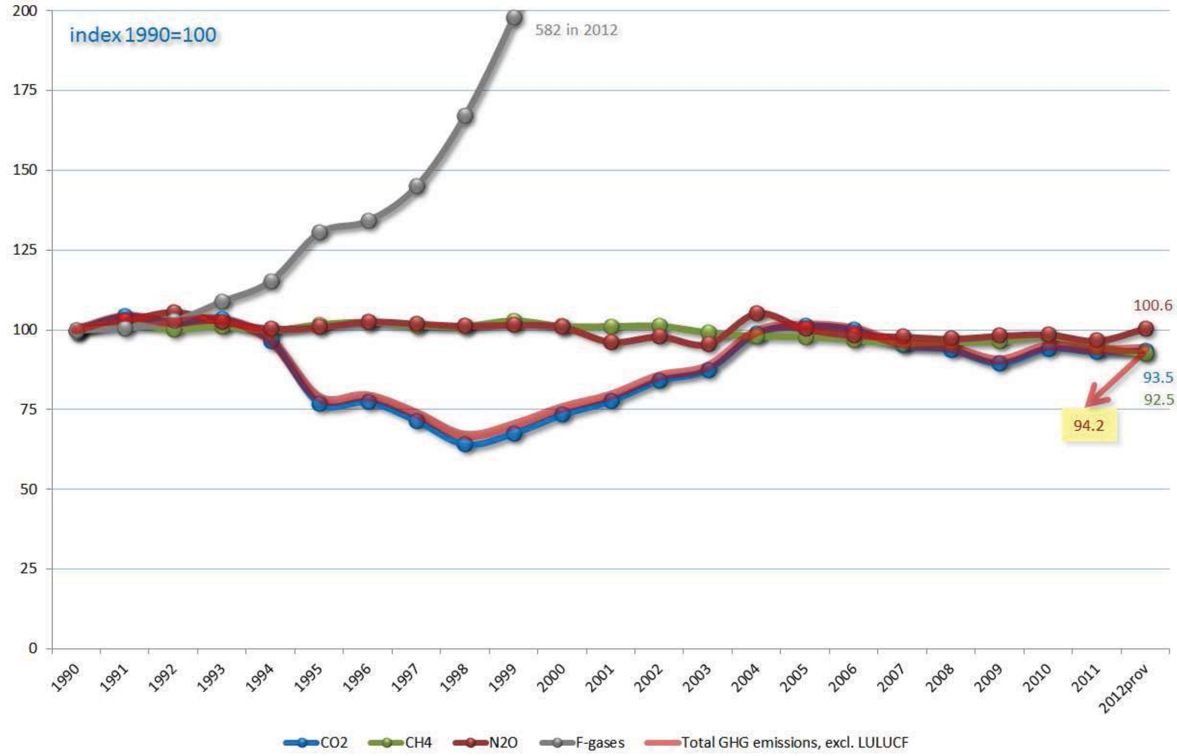
CRF sectors



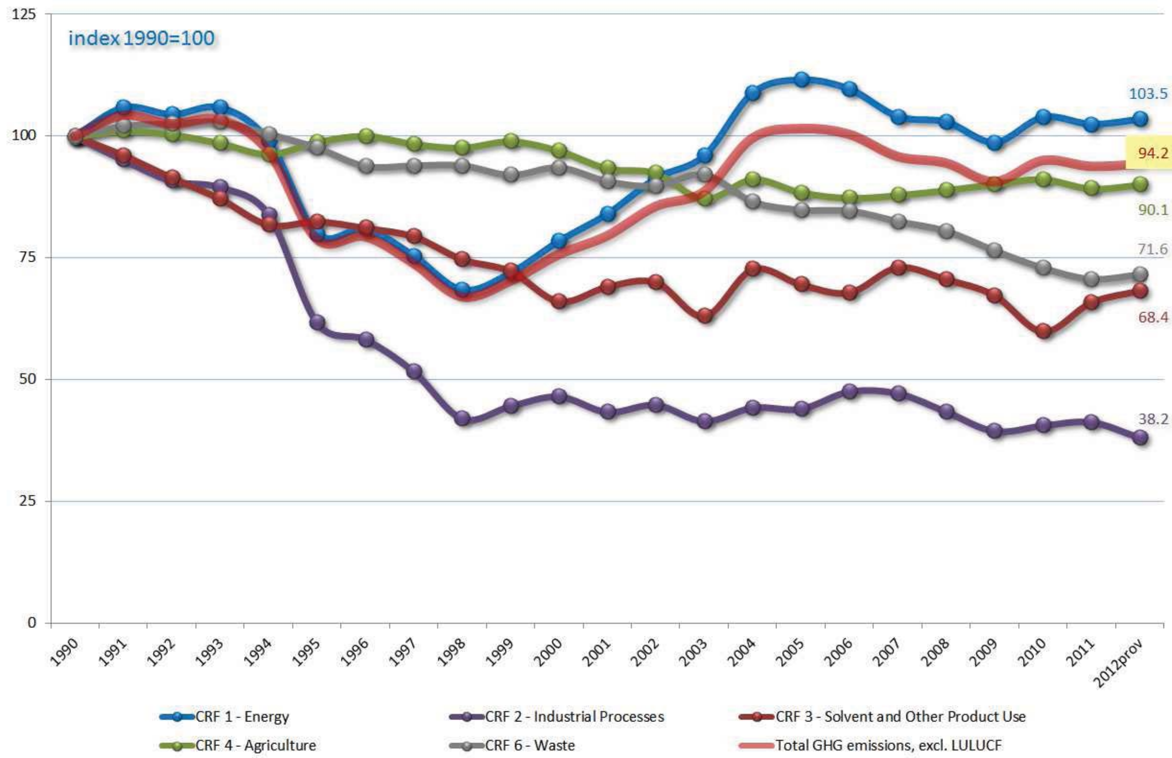
Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2.
Notes: 2012 data are provisional data estimated by the Department of the Environment during the summer of 2013 for the EC and the European Environment Agency.

FIGURES III.1-2b – GHG EMISSIONS (EXCL. LULUCF) – MAIN GASES & SECTORS: INDEXES 1990-2012

GHG



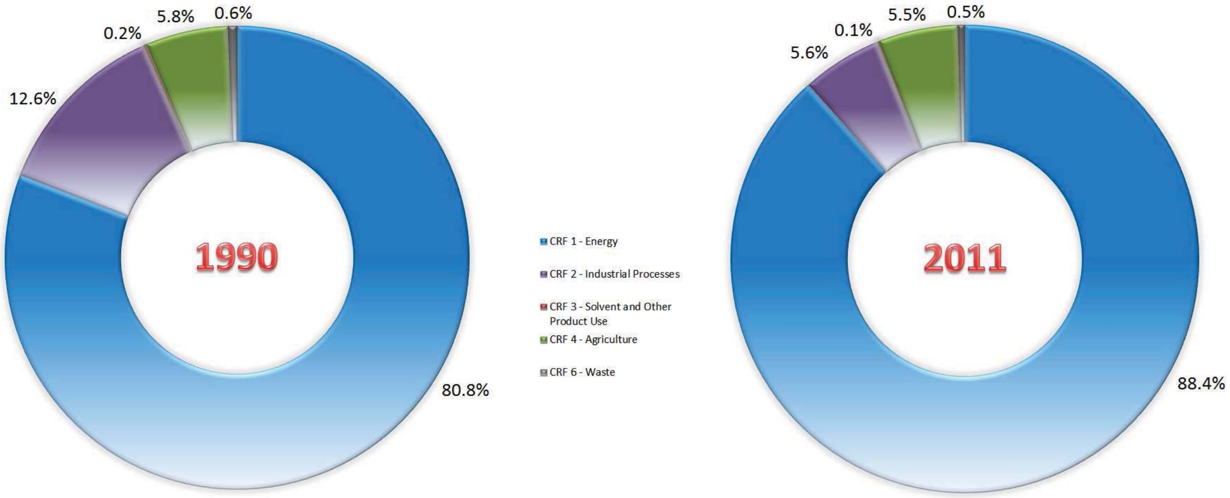
CRF sectors



Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2.

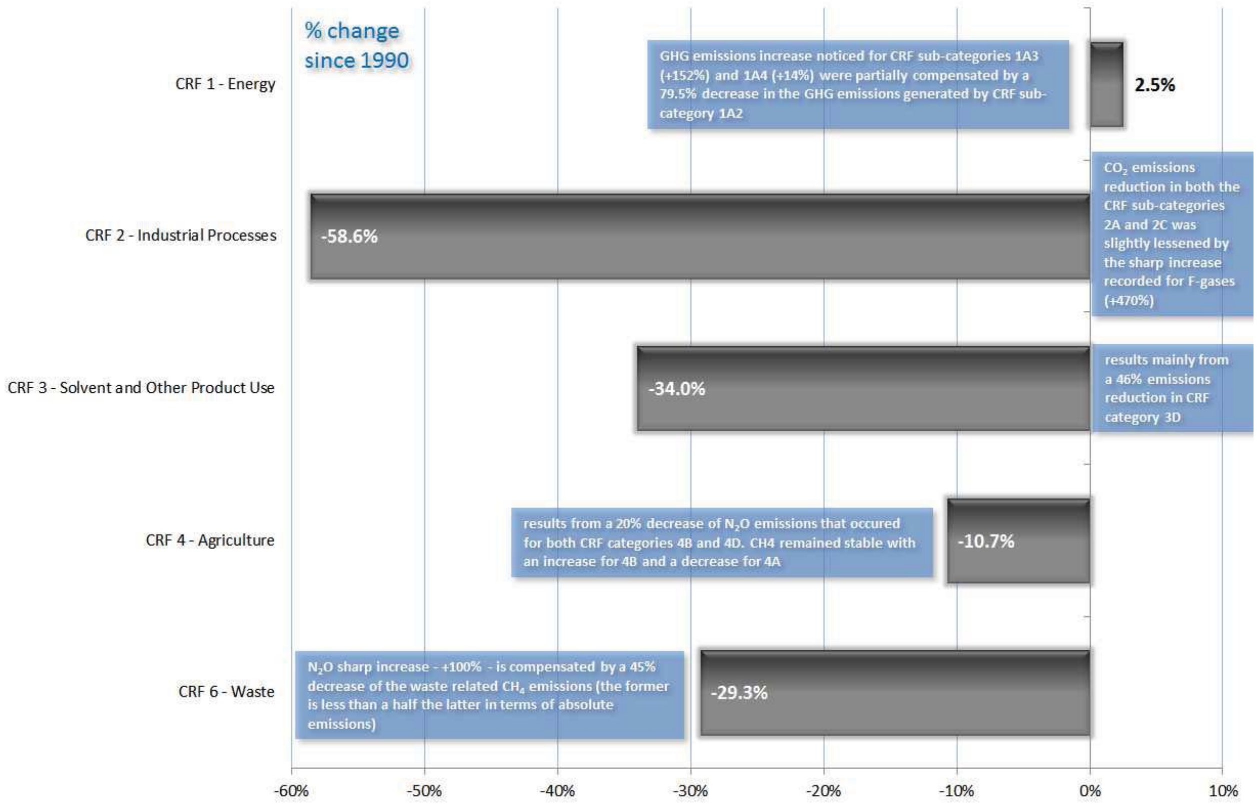
Notes: 2012 data are provisional data estimated by the Department of the Environment during the summer of 2013 for the EC and the European Environment Agency.

FIGURE III.1-2c – GHG EMISSIONS (EXCL. LULUCF) – CONTRIBUTION OF EACH CRF SECTOR TO TOTAL EMISSIONS: 1990 & 2011



Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2.

FIGURE III.1-2d – GHG EMISSIONS (EXCL. LULUCF) – OVERVIEW BY CRF SECTOR: % CHANGE 1990-2011



Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2.

TABLE III.1-3 – GHG EMISSIONS (EXCL. LULUCF) – SECTOR-BASED BREAKDOWN: 1990-2012

Gg (1000 t.) CO_2 equivalent	CRF Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Main Emitting Source Categories												
Public Electricity & Heat Production	1A1a	NO	NO	NO	NO	NO	60.25	55.79	52.22	90.65	97.83	57.40
(excl. waste incineration)		NA	NA	NA	NA	NA	0.59%	0.54%	0.55%	1.05%	1.08%	0.59%
Iron & Steel	1A2a + 2C1	6411.26	6105.20	5621.52	5866.34	4856.27	2803.08	2542.04	1652.27	471.74	512.84	505.30
(fuel combustion & processes)		49.70%	45.40%	42.52%	44.00%	38.83%	27.54%	24.83%	17.33%	5.46%	5.66%	5.18%
Other Manufacturing Industries &	1A2b/c/d/e/f + 2A	1501.81	1565.59	1654.72	1512.98	1710.75	1541.49	1605.02	1635.24	1619.25	1726.66	1670.89
Construction (fuel combustion & processes)		11.64%	11.64%	12.52%	11.35%	13.68%	15.15%	15.68%	17.15%	18.73%	19.05%	17.12%
Road Transportation - national fleet	1A3b	923.93	1035.59	1139.68	1246.64	1251.33	1255.73	1187.80	1263.55	1325.87	1311.89	1509.71
		7.16%	7.70%	8.62%	9.35%	10.01%	12.34%	11.60%	13.25%	15.34%	14.48%	15.47%
Road Transportation - fuel sales to	1A3b	1752.58	2150.85	2345.58	2283.92	2342.38	2158.43	2325.36	2456.06	2556.62	2867.43	3319.81
non-residents		13.58%	16.00%	17.74%	17.13%	18.73%	21.21%	22.71%	25.76%	29.57%	31.64%	34.01%
Residential Fuel Combustion	1A4b	669.65	803.79	738.50	732.32	696.85	706.86	776.59	752.53	789.52	753.00	1070.27
		5.19%	5.98%	5.59%	5.49%	5.57%	6.95%	7.58%	7.89%	9.13%	8.31%	10.97%
Commercial & Institutional Fuel	1A4a	636.78	766.23	707.23	698.89	673.30	678.85	757.82	734.79	768.78	736.16	596.39
Combustion		4.94%	5.70%	5.35%	5.24%	5.38%	6.67%	7.40%	7.71%	8.89%	8.12%	6.11%
Agriculture (fuel combustion,	1A4c+4	759.95	771.58	766.15	749.69	736.27	751.39	764.10	755.11	749.38	764.37	771.23
livestock, crops, soils)		5.89%	5.74%	5.79%	5.62%	5.89%	7.38%	7.46%	7.92%	8.67%	8.43%	7.90%
Other Source Categories												
Municipal Waste Incineration	1A1a (6C)	35.56	36.33	37.10	35.29	34.53	32.97	25.51	30.22	56.28	64.44	62.61
(with energy & heat recovery)		0.28%	0.27%	0.28%	0.26%	0.28%	0.32%	0.25%	0.32%	0.65%	0.71%	0.64%
Other Transport	1A3a/c/d	29.05	29.36	29.39	29.56	28.76	23.56	26.12	25.76	25.64	25.82	25.34
		0.23%	0.22%	0.22%	0.22%	0.23%	0.23%	0.26%	0.27%	0.30%	0.28%	0.26%
Other Energy Sources	1A5 + 1B2b	60.94	61.81	61.83	58.16	57.03	47.47	57.99	61.17	73.45	82.85	47.27
(incl. lubricants reported under 1A3b)		0.47%	0.46%	0.47%	0.44%	0.46%	0.47%	0.57%	0.64%	0.85%	0.91%	0.48%
F-gases	2F	13.14	13.22	13.50	14.30	15.14	17.14	17.62	19.05	21.95	26.01	30.78
		0.10%	0.10%	0.10%	0.11%	0.12%	0.17%	0.17%	0.20%	0.25%	0.29%	0.32%
Solvent & Other Product Use	3	23.90	22.98	21.88	20.85	19.57	19.74	19.42	19.00	17.88	17.30	15.81
		0.19%	0.17%	0.17%	0.16%	0.16%	0.19%	0.19%	0.20%	0.21%	0.19%	0.16%
Municipal Waste Disposal on Land	6A	67.13	68.84	69.22	68.35	66.06	63.60	61.50	60.05	58.03	56.13	52.96
		0.52%	0.51%	0.52%	0.51%	0.53%	0.62%	0.60%	0.63%	0.67%	0.62%	0.54%
Waste Water Handling	6B	15.35	15.37	15.39	15.51	15.64	15.43	14.63	14.63	14.79	14.89	15.14
		0.12%	0.11%	0.12%	0.12%	0.13%	0.15%	0.14%	0.15%	0.17%	0.16%	0.16%
Composting	6D	NO	NO	NO	1.03	1.19	1.49	1.30	2.85	4.72	4.91	9.11
		NA	NA	NA	0.01%	0.01%	0.01%	0.01%	0.03%	0.05%	0.05%	0.09%
Total GHG excluding LULUCF		12901.02	13446.74	13221.69	13333.84	12505.07	10177.48	10238.60	9534.50	8644.56	9062.53	9760.03
		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Memo Items												
International Bunkers - Aviation		397.88	415.87	402.06	397.64	504.47	571.83	621.34	743.35	901.15	1016.72	969.00
		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
International Bunkers - Marine		0.07	0.07	0.07	0.10	0.08	0.08	0.08	0.08	0.08	0.09	0.10
		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CO_2 Emissions from Biomass		159.05	160.93	163.73	159.33	157.46	153.78	135.56	146.84	139.67	148.82	149.63
		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Gg (1000 t.) CO_2 equivalent	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012prov
Main Emitting Source Categories												
Public Electricity & Heat Production	221.45	966.72	972.83	1189.58	1179.27	1236.83	1111.86	923.96	1121.88	1142.37	926.53	964.00
(excl. waste incineration)	2.16%	8.76%	8.51%	9.26%	9.00%	9.55%	9.00%	7.58%	9.60%	9.32%	7.66%	7.93%
Iron & Steel	565.89	553.25	452.56	563.05	549.98	696.73	677.20	621.15	523.93	594.84	512.54	457.63
(fuel combustion & processes)	5.52%	5.01%	3.96%	4.38%	4.20%	5.38%	5.48%	5.10%	4.48%	4.86%	4.24%	3.76%
Other Manufacturing Industries &	1690.48	1646.22	1620.22	1724.01	1701.39	1675.70	1572.71	1446.07	1414.10	1428.75	1377.17	1325.85
Construction (fuel combustion & processes)	16.48%	14.92%	14.18%	13.42%	12.99%	12.94%	12.73%	11.87%	12.10%	11.66%	11.38%	10.91%
Road Transportation - national fleet	1558.88	1574.07	1645.74	1551.96	1539.59	1648.30	1676.73	1720.89	1746.82	1771.65	1815.27	1825.40
	15.19%	14.26%	14.40%	12.08%	11.76%	12.73%	13.57%	14.12%	14.94%	14.46%	15.00%	15.01%
Road Transportation - fuel sales to	3487.66	3620.88	3990.36	5043.71	5455.37	5041.22	4740.15	4829.89	4249.81	4596.61	5006.49	5009.48
non-residents	33.99%	32.81%	34.92%	39.27%	41.66%	38.93%	38.35%	39.63%	36.35%	37.52%	41.38%	41.21%
Residential Fuel Combustion	1159.94	1103.95	1147.69	1227.90	1202.34	1190.19	1151.05	1184.06	1170.24	1149.19	916.54	969.42
	11.31%	10.00%	10.04%	9.56%	9.18%	9.19%	9.31%	9.72%	10.01%	9.38%	7.58%	7.97%
Commercial & Institutional Fuel	546.00	542.12	607.22	520.54	477.56	466.48	425.02	446.52	436.31	540.08	538.61	585.56
Combustion	5.32%	4.91%	5.31%	4.05%	3.65%	3.60%	3.44%	3.66%	3.73%	4.41%	4.45%	4.82%
Agriculture (fuel combustion,	750.72	743.18	707.05	735.27	716.04	709.35	715.93	724.04	741.03	750.07	721.08	727.04
livestock, crops, soils)	7.32%	6.73%	6.19%	5.73%	5.47%	5.48%	5.79%	5.94%	6.34%	6.12%	5.96%	5.98%
Other Source Categories												
Municipal Waste Incineration	61.82	62.83	64.69	73.77	64.52	70.98	72.11	75.57	73.26	64.70	68.16	75.61
(with energy & heat recovery)	0.60%	0.57%	0.57%	0.57%	0.49%	0.55%	0.58%	0.62%	0.63%	0.53%	0.56%	0.62%
Other Transport	27.29	24.39	21.74	17.52	11.92	9.23	12.41	14.06	13.41	14.39	14.34	14.34
	0.27%	0.22%	0.19%	0.14%	0.09%	0.07%	0.10%	0.12%	0.11%	0.12%	0.12%	0.12%
Other Energy Sources	61.20	63.50	53.54	52.57	53.49	53.93	50.72	47.75	47.18	50.83	52.16	51.16
(incl. lubricants reported under 1A3b)	0.60%	0.58%	0.47%	0.41%	0.41%	0.42%	0.41%	0.39%	0.40%	0.41%	0.43%	0.42%
F-gases	36.97	45.24	50.87	53.88	58.20	62.79	67.47	70.27	72.76	74.06	74.93	76.52
	0.36%	0.41%	0.45%	0.42%	0.44%	0.48%	0.55%	0.58%	0.62%	0.60%	0.62%	0.63%
Solvent & Other Product Use	16.54	16.76	15.09	17.39	16.65	16.25	17.48	16.90	16.11	14.34	15.77	16.35
	0.16%	0.15%	0.13%	0.14%	0.13%	0.13%	0.14%	0.14%	0.14%	0.12%	0.13%	0.13%
Municipal Waste Disposal on Land	51.00	49.60	48.62	43.56	41.31	39.23	37.93	35.72	33.77	31.29	29.50	30.06
	0.50%	0.45%	0.43%	0.34%	0.32%	0.30%	0.31%	0.29%	0.29%	0.26%	0.24%	0.25%
Waste Water Handling	15.35	14.17	14.21	14.98	14.98	15.20	15.49	14.35	14.17	13.92	13.61	13.93
	0.15%	0.13%	0.12%	0.12%	0.11%	0.12%	0.13%	0.12%	0.12%	0.11%	0.11%	0.11%
Composting	8.50	10.32	13.19	12.88	13.75	15.44	14.68	16.38	15.20	15.01	15.21	15.11
	0.08%	0.09%	0.12%	0.10%	0.11%	0.12%	0.12%	0.13%	0.13%	0.12%	0.13%	0.12%
Total GHG excluding LULUCF	10259.69	11037.18	11425.61	12842.57	13096.36	12947.84	12358.94	12187.60	11689.99	12252.09	12097.92	12157.45
	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Memo Items												
International Bunkers - Aviation	1048.06	1135.52	1182.93	1287.13	1307.80	1223.89	1315.56	1324.25	1268.69	1297.17	1229.63	NE
	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
International Bunkers - Marine	0.10	0.11	0.11	0.11	0.14	0.15	0.13	0.14	0.11	0.10	0.13	NE
	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CO_2 Emissions from Biomass	163.83	163.75	181.66	201.03	295.32	301.33	446.75	460.47	446.95	467.17	443.39	NE
	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2.

Notes: 2012 data are provisional data estimated by the Department of the Environment during the summer of 2013 for the EC and the European Environment Agency.

(1) the methane emissions are converted in CO2 equivalents by multiplying the emissions by 21, i.e. the global warming potential (GWP) value for methane based on the effects of GHG over a 100-year time horizon.

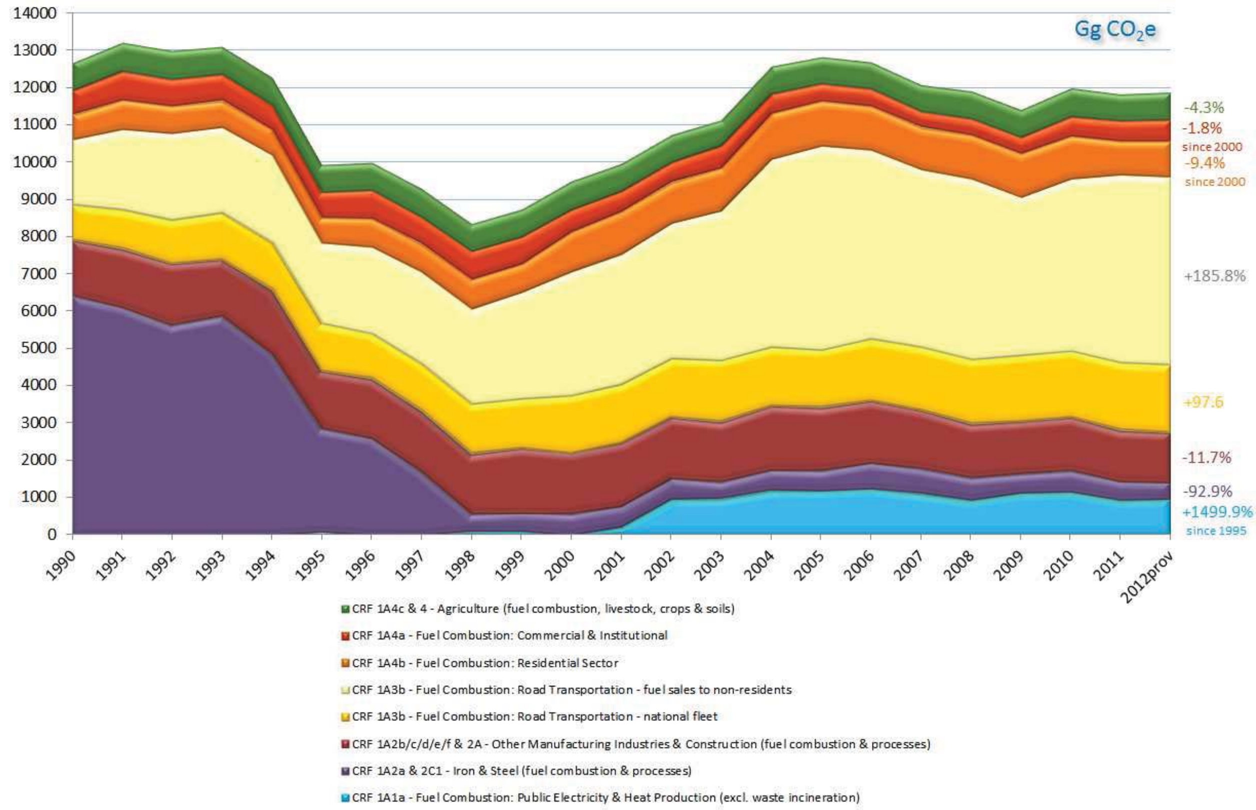
(2) the nitrous oxide emissions are converted in CO2 equivalents by multiplying the emissions by 310, i.e. the global warming potential (GWP) value for nitrous oxide based on the effects of GHG over a 100-year time horizon.

(3) the F-gases are those not covered by the Montreal Protocol, i.e. the HFCs, PFCs and SF6 expressed in CO2 equivalents using the global warming potential (GWP) values based on the effects of GHG over a 100-year time horizon.

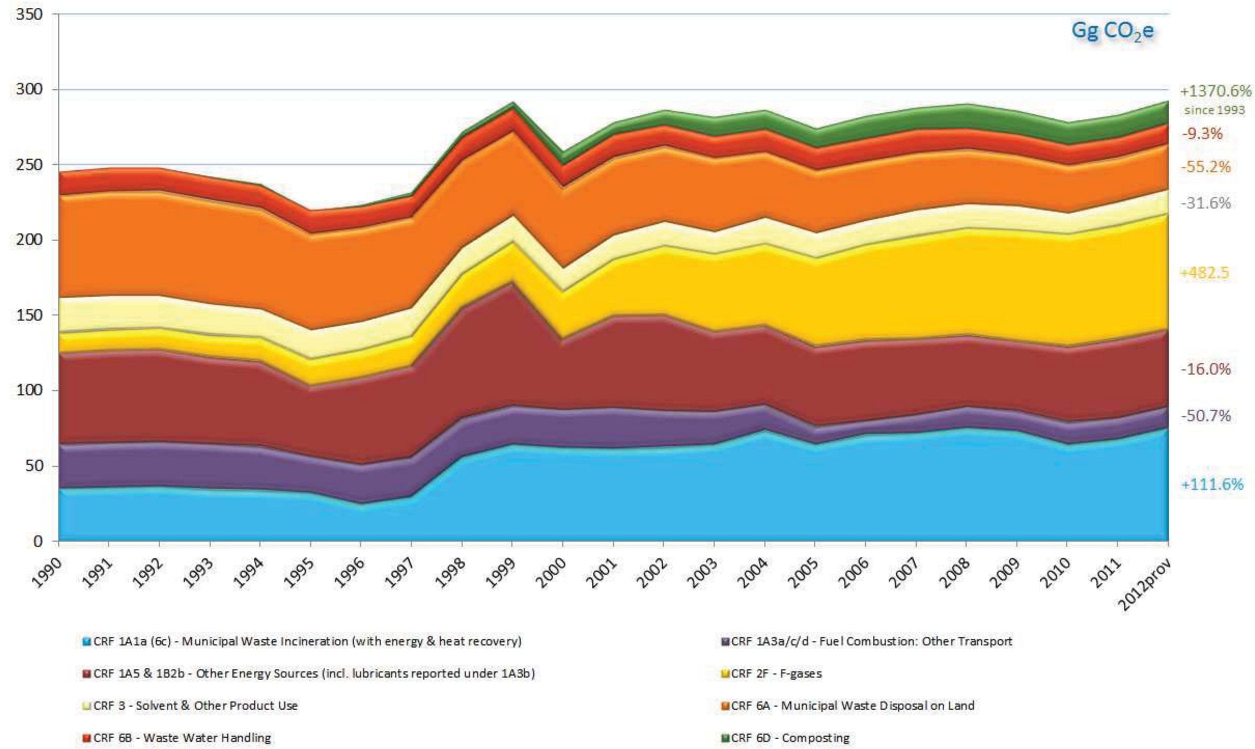
(4) CRF 1A4a&b: there are breaks in time series between 1999 & 2000: the two CRF 1A4 sub-categories had a very similar level because national energy statistics does not allow for distinguishing these two sub-categories before 2000. Hence, a 50-50 distribution was carried out in the inventories.

FIGURES III.1-3a – GHG EMISSIONS (EXCL. LULUCF) – SECTOR-BASED BREAKDOWN: ABSOLUTE VALUES 1990-2012 (2011 for memo items)

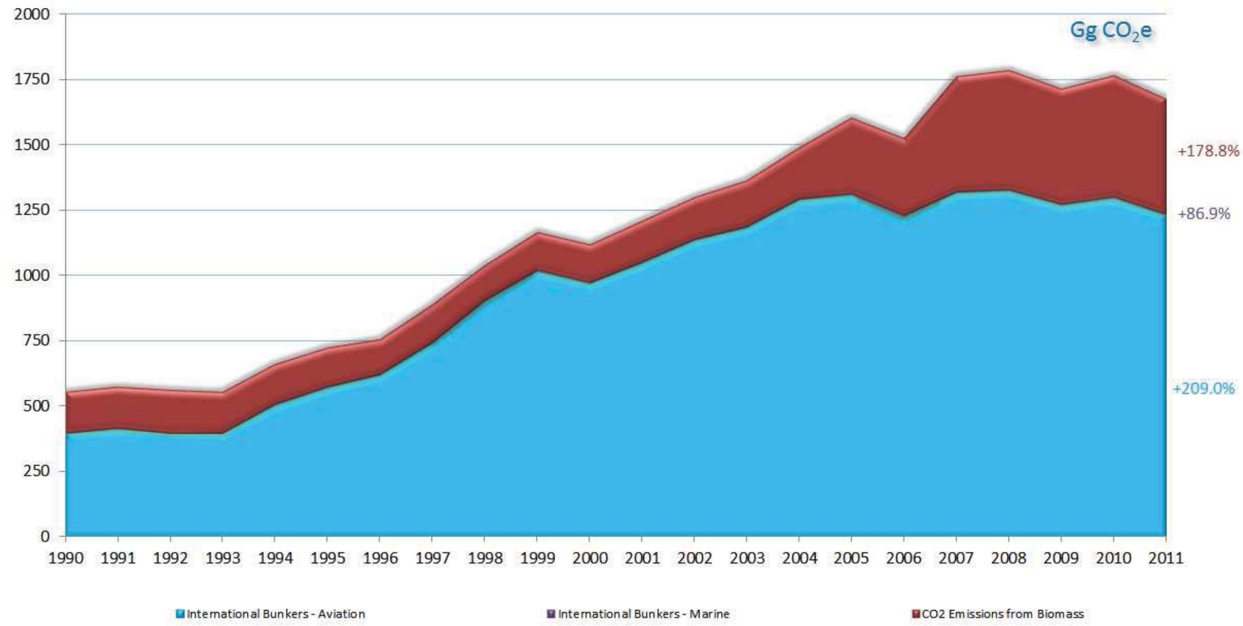
Main emitting source categories



Other source categories

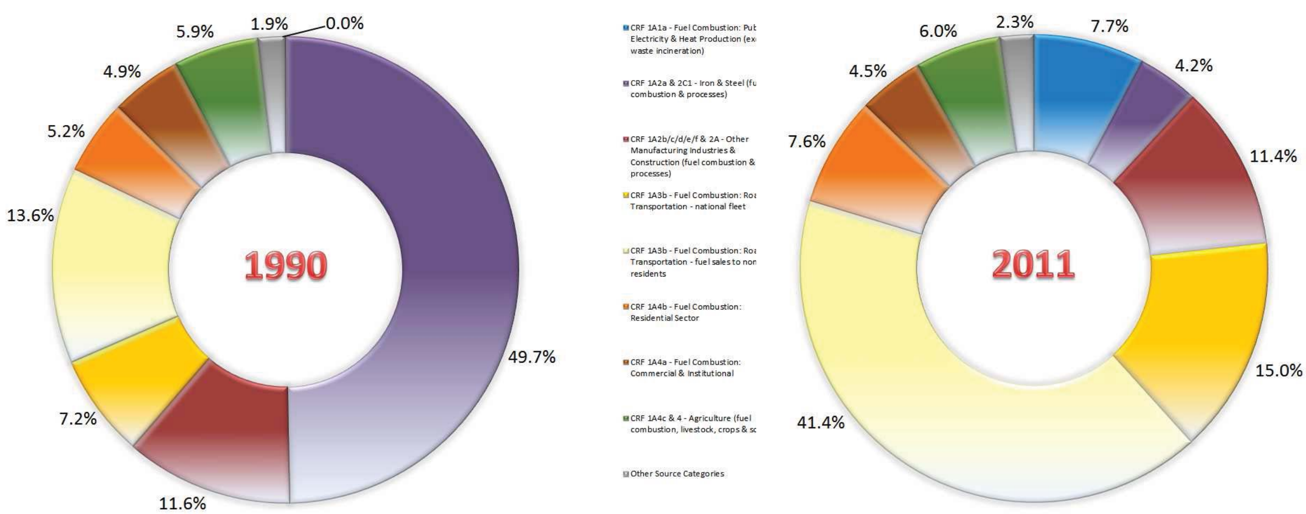


Memo Items



Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2.
Notes: 2012 data are provisional data estimated by the Department of the Environment during the summer of 2013 for the EC and the European Environment Agency (no 2012 "nowcasts" for the memo items).

FIGURES III.1-3b – SECTOR-BASED BREAKDOWN: CONTRIBUTION TO TOTAL EMISSIONS 1990 & 2011



Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2.

TABLE III.1-4 – GHG EMISSIONS AND REMOVALS – DETAILS BY MAIN GASES: 1990-2012

Gg (1000 t.) CO_2 equivalent	1990 (base year)	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
CO_2	**11950.26**	**12471.93**	**12242.15**	**12363.86**	**11550.17**	**9210.07**	**9258.86**	**8561.14**	**7672.68**	**8077.25**	**8780.74**
	92.63%	*92.75%*	*92.59%*	*92.73%*	*92.36%*	*90.49%*	*90.43%*	*89.79%*	*88.76%*	*89.13%*	*89.97%*
of which											
CRF 1 - Energy	10327.26	10927.36	10768.39	10913.01	10192.31	8213.42	8317.96	7728.97	7000.37	7367.10	8044.96
	80.05%	*81.26%*	*81.44%*	*81.84%*	*81.51%*	*80.70%*	*81.24%*	*81.06%*	*80.98%*	*81.29%*	*82.43%*
CRF 1A1 - Fuel Combustion from Energy Industries	33.29	34.01	34.73	33.04	32.32	91.07	79.62	80.46	144.48	159.47	117.30
	0.26%	*0.25%*	*0.26%*	*0.25%*	*0.26%*	*0.89%*	*0.78%*	*0.84%*	*1.67%*	*1.76%*	*1.20%*
CRF 1A2 - Fuel Combustion from Manuf. Industries & Construction	6285.43	6121.42	5795.50	5921.31	5201.13	3343.75	3201.46	2450.11	1412.48	1523.45	1438.07
	48.72%	*45.52%*	*43.83%*	*44.41%*	*41.59%*	*32.85%*	*31.27%*	*25.70%*	*16.34%*	*16.81%*	*14.73%*
CRF 1A3 - Fuel Combustion from Transport	2672.53	3170.77	3460.24	3501.54	3560.39	3379.01	3477.92	3678.89	3842.35	4135.64	4778.73
	20.72%	*23.58%*	*26.17%*	*26.26%*	*28.47%*	*33.20%*	*33.97%*	*38.59%*	*44.45%*	*45.63%*	*48.96%*
of which, "fuel sales to non-residents" (1)	1749.98	2140.27	2328.74	2265.14	2320.66	2136.21	2302.03	2429.17	2530.19	2837.46	3284.90
	13.56%	*15.92%*	*17.61%*	*16.99%*	*18.56%*	*20.99%*	*22.48%*	*25.48%*	*29.27%*	*31.31%*	*33.66%*
CRF 1A4 - Fuel Combustion from Other Sectors	1309.70	1574.84	1451.59	1433.96	1376.88	1389.12	1540.82	1497.06	1567.67	1505.30	1699.22
	10.15%	*11.71%*	*10.98%*	*10.75%*	*11.01%*	*13.65%*	*15.05%*	*15.70%*	*18.13%*	*16.61%*	*17.41%*
CRF 1A5 & 1B2b - Other Energy Sources	26.30	26.32	26.33	23.17	21.60	10.47	18.14	22.45	33.38	43.25	11.64
	0.20%	*0.20%*	*0.20%*	*0.17%*	*0.17%*	*0.10%*	*0.18%*	*0.24%*	*0.39%*	*0.48%*	*0.12%*
CRF 2 - Industrial Processes	1608.36	1530.51	1460.44	1438.23	1346.19	984.50	928.72	820.07	660.99	699.04	725.78
	12.47%	*11.38%*	*11.05%*	*10.79%*	*10.77%*	*9.67%*	*9.07%*	*8.60%*	*7.65%*	*7.71%*	*7.44%*
Other Sources (2)	14.64	14.06	13.32	12.62	11.66	12.16	12.18	12.11	11.33	11.11	9.99
	0.11%	*0.10%*	*0.10%*	*0.09%*	*0.09%*	*0.12%*	*0.12%*	*0.13%*	*0.13%*	*0.12%*	*0.10%*
CH_4 (3)	**461.51**	**471.95**	**462.68**	**466.72**	**460.99**	**469.59**	**473.25**	**468.33**	**467.24**	**475.18**	**467.14**
	3.58%	*3.51%*	*3.50%*	*3.50%*	*3.69%*	*4.61%*	*4.62%*	*4.91%*	*5.41%*	*5.24%*	*4.79%*
of which											
CRF 1 - Energy	48.23	51.47	51.87	51.65	50.53	50.12	52.42	51.19	50.83	51.60	52.74
	0.37%	*0.38%*	*0.39%*	*0.39%*	*0.40%*	*0.49%*	*0.51%*	*0.54%*	*0.59%*	*0.57%*	*0.54%*
CRF 4A+4B - Enteric Fermentation and Manure Management	340.02	345.66	335.77	340.56	338.31	349.81	353.53	350.74	351.33	360.49	352.54
	2.64%	*2.57%*	*2.54%*	*2.55%*	*2.71%*	*3.44%*	*3.45%*	*3.68%*	*4.06%*	*3.98%*	*3.61%*
Other Sources (4)	73.27	74.82	75.05	74.51	72.15	69.67	67.30	66.40	65.08	63.09	61.86
	0.57%	*0.56%*	*0.57%*	*0.56%*	*0.58%*	*0.68%*	*0.66%*	*0.70%*	*0.75%*	*0.70%*	*0.63%*
N_2O (5)	**476.11**	**489.64**	**503.35**	**488.96**	**478.77**	**480.68**	**488.88**	**485.97**	**482.69**	**484.10**	**481.37**
	3.69%	*3.64%*	*3.81%*	*3.67%*	*3.83%*	*4.72%*	*4.77%*	*5.10%*	*5.58%*	*5.34%*	*4.93%*
of which											
CRF 1 - Energy	54.44	65.48	74.89	77.92	82.19	77.36	80.92	86.95	89.00	89.79	91.41
	0.42%	*0.49%*	*0.57%*	*0.58%*	*0.66%*	*0.76%*	*0.79%*	*0.91%*	*1.03%*	*0.99%*	*0.94%*
CRF 4D - Agricultural Soils	361.81	370.21	377.84	360.39	347.21	353.21	358.48	350.69	345.95	351.03	345.10
	2.80%	*2.75%*	*2.86%*	*2.70%*	*2.78%*	*3.47%*	*3.50%*	*3.68%*	*4.00%*	*3.87%*	*3.54%*
Other Sources (6)	59.86	53.95	50.62	50.65	49.37	50.11	49.48	48.33	47.74	43.28	44.87
	0.46%	*0.40%*	*0.38%*	*0.38%*	*0.39%*	*0.49%*	*0.48%*	*0.51%*	*0.55%*	*0.48%*	*0.46%*
F-gases (7)	**13.14**	**13.22**	**13.50**	**14.30**	**15.14**	**17.14**	**17.62**	**19.05**	**21.95**	**26.01**	**30.78**
	0.10%	*0.10%*	*0.10%*	*0.11%*	*0.12%*	*0.17%*	*0.17%*	*0.20%*	*0.25%*	*0.29%*	*0.32%*
Total GHG excluding LULUCF	**12901.02**	**13446.74**	**13221.69**	**13333.84**	**12505.07**	**10177.48**	**10238.60**	**9534.50**	**8644.56**	**9062.53**	**9760.03**
	100.00%	*100.00%*	*100.00%*	*100.00%*	*100.00%*	*100.00%*	*100.00%*	*100.00%*	*100.00%*	*100.00%*	*100.00%*
LULUCF	**347.75**	**172.43**	**-195.75**	**-305.83**	**-135.96**	**-238.10**	**-410.64**	**-451.08**	**-195.50**	**-318.81**	**-385.41**

Gg (1000 t.) CO_2 equivalent	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012prov
CO_2	**9297.22**	**10057.77**	**10461.40**	**11834.49**	**12107.85**	**11969.26**	**11382.58**	**11209.10**	**10704.66**	**11255.34**	**11125.58**	**11175.13**
	90.62%	*91.13%*	*91.56%*	*92.15%*	*92.45%*	*92.44%*	*92.10%*	*91.97%*	*91.57%*	*91.86%*	*91.96%*	*91.92%*
of which												
CRF 1 - Energy	8618.22	9362.76	9826.51	11155.43	11437.08	11246.69	10669.85	10561.18	10124.52	10659.69	10518.21	10620.16
	84.00%	*84.83%*	*86.00%*	*86.86%*	*87.33%*	*86.86%*	*86.33%*	*86.66%*	*86.61%*	*87.00%*	*86.94%*	*87.36%*
CRF 1A1 - Fuel Combustion from Energy Industries	280.45	1026.00	1033.84	1259.19	1239.90	1303.67	1179.86	995.47	1190.99	1203.21	990.79	1035.43
	2.73%	*9.30%*	*9.05%*	*9.80%*	*9.47%*	*10.07%*	*9.55%*	*8.17%*	*10.19%*	*9.82%*	*8.19%*	*8.52%*
CRF 1A2 - Fuel Combustion from Manuf. Industries & Construction	1573.45	1494.99	1413.82	1584.47	1557.81	1627.49	1516.69	1403.63	1338.73	1408.03	1270.55	1217.52
	15.34%	*13.55%*	*12.37%*	*12.34%*	*11.90%*	*12.57%*	*12.27%*	*11.52%*	*11.45%*	*11.49%*	*10.50%*	*10.01%*
CRF 1A3 - Fuel Combustion from Transport	4997.46	5144.68	5579.80	6524.35	6919.22	6617.02	6352.36	6486.70	5937.12	6306.84	6760.34	6771.68
	48.71%	*46.61%*	*48.84%*	*50.80%*	*52.83%*	*51.11%*	*51.40%*	*53.22%*	*50.79%*	*51.48%*	*55.88%*	*55.70%*
of which, "fuel sales to non-residents" (1)	3453.74	3585.84	3950.50	4989.17	5396.30	4986.59	4692.49	4782.64	4207.63	4552.28	4961.41	4963.16
	33.66%	*32.49%*	*34.58%*	*38.85%*	*41.20%*	*38.51%*	*37.97%*	*39.24%*	*35.99%*	*37.16%*	*41.01%*	*40.82%*
CRF 1A4 - Fuel Combustion from Other Sectors	1743.69	1684.14	1795.96	1787.35	1720.08	1698.43	1620.88	1675.32	1657.61	1741.54	1496.47	1595.47
	17.00%	*15.26%*	*15.72%*	*13.92%*	*13.13%*	*13.12%*	*13.12%*	*13.75%*	*14.18%*	*14.21%*	*12.37%*	*13.12%*
CRF 1A5 & 1B2b - Other Energy Sources	23.19	12.96	3.09	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.06	0.06
	0.23%	*0.12%*	*0.03%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*
CRF 2 - Industrial Processes	667.88	683.72	623.60	665.82	657.91	710.42	699.74	635.71	568.81	586.18	596.56	543.13
	6.51%	*6.19%*	*5.46%*	*5.18%*	*5.02%*	*5.49%*	*5.66%*	*5.22%*	*4.87%*	*4.78%*	*4.93%*	*4.47%*
Other Sources (2)	11.12	11.28	11.29	13.24	12.86	12.14	12.98	12.21	11.33	9.47	10.81	11.83
	0.11%	*0.10%*	*0.10%*	*0.10%*	*0.10%*	*0.09%*	*0.11%*	*0.10%*	*0.10%*	*0.08%*	*0.09%*	*0.10%*
CH_4 (3)	**466.74**	**467.41**	**457.89**	**452.75**	**451.79**	**447.46**	**442.31**	**444.81**	**444.89**	**452.87**	**437.00**	**426.91**
	4.55%	*4.23%*	*4.01%*	*3.53%*	*3.45%*	*3.46%*	*3.58%*	*3.65%*	*3.81%*	*3.70%*	*3.61%*	*3.51%*
of which												
CRF 1 - Energy	55.57	66.46	66.53	71.40	69.31	70.08	64.22	61.47	61.21	64.25	56.37	57.52
	0.54%	*0.60%*	*0.58%*	*0.56%*	*0.53%*	*0.54%*	*0.52%*	*0.50%*	*0.52%*	*0.52%*	*0.47%*	*0.47%*
CRF 4A+4B - Enteric Fermentation and Manure Management	351.69	342.08	332.22	327.54	330.64	326.81	329.25	336.08	339.31	346.88	340.64	328.81
	3.43%	*3.10%*	*2.91%*	*2.55%*	*2.52%*	*2.52%*	*2.66%*	*2.76%*	*2.90%*	*2.83%*	*2.82%*	*2.70%*
Other Sources (4)	59.48	58.88	59.14	53.81	51.84	50.57	48.84	47.26	44.37	41.73	39.99	40.57
	0.58%	*0.53%*	*0.52%*	*0.42%*	*0.40%*	*0.39%*	*0.40%*	*0.39%*	*0.38%*	*0.34%*	*0.33%*	*0.33%*
N_2O (5)	**458.76**	**466.76**	**455.45**	**501.45**	**478.52**	**468.33**	**466.58**	**463.41**	**467.68**	**469.83**	**460.41**	**478.90**
	4.47%	*4.23%*	*3.99%*	*3.90%*	*3.65%*	*3.62%*	*3.78%*	*3.80%*	*4.00%*	*3.83%*	*3.81%*	*3.94%*
of which												
CRF 1 - Energy	95.26	100.73	119.34	129.40	129.41	122.20	118.43	114.34	112.78	115.41	114.09	114.95
	0.93%	*0.91%*	*1.04%*	*1.01%*	*0.99%*	*0.94%*	*0.96%*	*0.94%*	*0.96%*	*0.94%*	*0.94%*	*0.95%*
CRF 4D - Agricultural Soils	319.00	322.78	292.49	327.46	304.91	301.54	298.46	299.48	305.95	305.33	297.92	308.59
	3.11%	*2.92%*	*2.56%*	*2.55%*	*2.33%*	*2.33%*	*2.41%*	*2.46%*	*2.62%*	*2.49%*	*2.46%*	*2.54%*
Other Sources (6)	44.51	43.25	43.63	44.59	44.20	44.60	49.69	49.59	48.95	49.09	48.39	55.36
	0.43%	*0.39%*	*0.38%*	*0.35%*	*0.34%*	*0.34%*	*0.40%*	*0.41%*	*0.42%*	*0.40%*	*0.40%*	*0.46%*
F-gases (7)	**36.97**	**45.24**	**50.87**	**53.88**	**58.20**	**62.79**	**67.47**	**70.27**	**72.76**	**74.06**	**74.93**	**76.52**
	0.36%	*0.41%*	*0.45%*	*0.42%*	*0.44%*	*0.48%*	*0.55%*	*0.58%*	*0.62%*	*0.60%*	*0.62%*	*0.63%*
Total GHG excluding LULUCF	**10259.69**	**11037.18**	**11425.61**	**12842.57**	**13096.36**	**12947.84**	**12358.94**	**12187.60**	**11689.99**	**12252.09**	**12097.92**	**12157.45**
	100.00%	*100.00%*	*100.00%*	*100.00%*	*100.00%*	*100.00%*	*100.00%*	*100.00%*	*100.00%*	*100.00%*	*100.00%*	*100.00%*
LULUCF	**-451.56**	**-451.26**	**-459.74**	**-414.49**	**-385.65**	**-275.59**	**-273.18**	**-272.34**	**-296.43**	**-295.26**	**-294.20**	**NE**

Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2.

Notes: 2012 data are provisional data estimated by the Department of the Environment during the summer of 2013 for the EC and the European Environment Agency.

(1) estimation done using COPERT IV and the quantities of road fuels sold in Luxembourg *[→Section II.8.1]*.

(2) the other CO_2 sources are emissions from solvent and other product use (CRF 3).

(3) the methane emissions are converted in CO_2 equivalents by multiplying the emissions by 21, i.e. the global warming potential (GWP) value for methane based on the effects of GHG over a 100-year time horizon.

(4) the other CH_4 sources are emissions from solid waste disposal on land (CRF 6A), waste water handling (CRF 6B) and composting (CRF 6D).

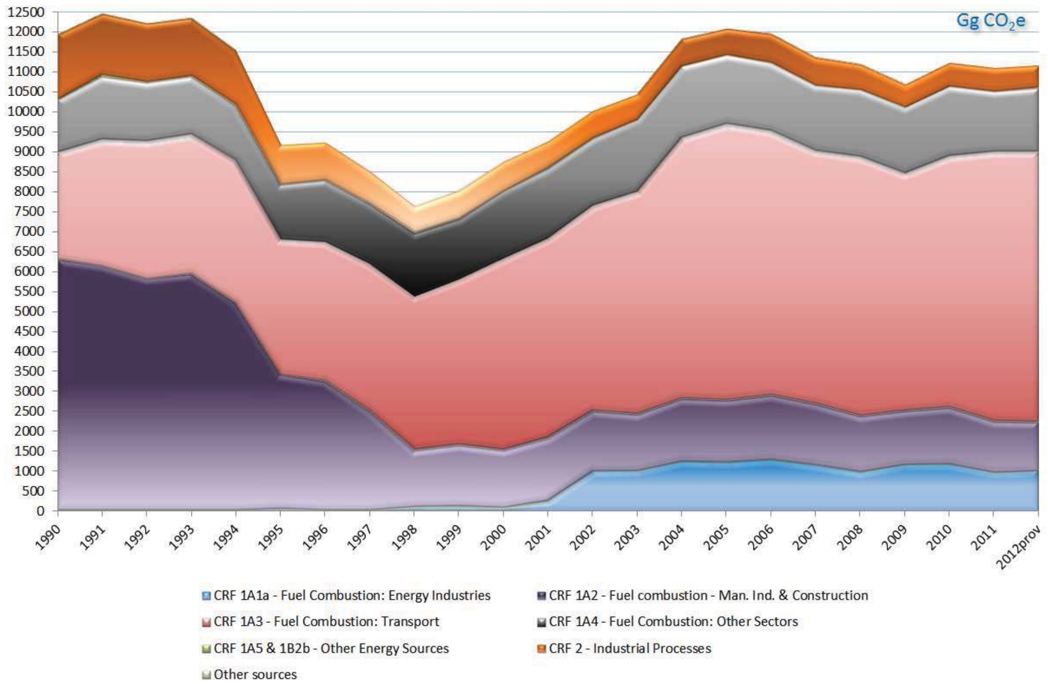
(5) the nitrous oxide emissions are converted in CO_2 equivalents by multiplying the emissions by 310, i.e. the global warming potential (GWP) value for nitrous oxide based on the effects of GHG over a 100-year time horizon.

(6) the other N_2O sources are emissions from anaesthesia (CRF 3D), manure management (CRF 4B), waste water handling (CRF 6B) and composting (CRF 6D).

(7) the F-gases are those not covered by the Montreal Protocol, i.e. the HFCs, PFCs and SF_6 expressed in CO_2 equivalents using the global warming potential (GWP) values based on the effects of GHG over a 100-year time horizon.

Figures III.1-4a – GHG emissions (excl. F-gases & LULUCF) – details by main gases: absolute values 1990-2012

CO_2

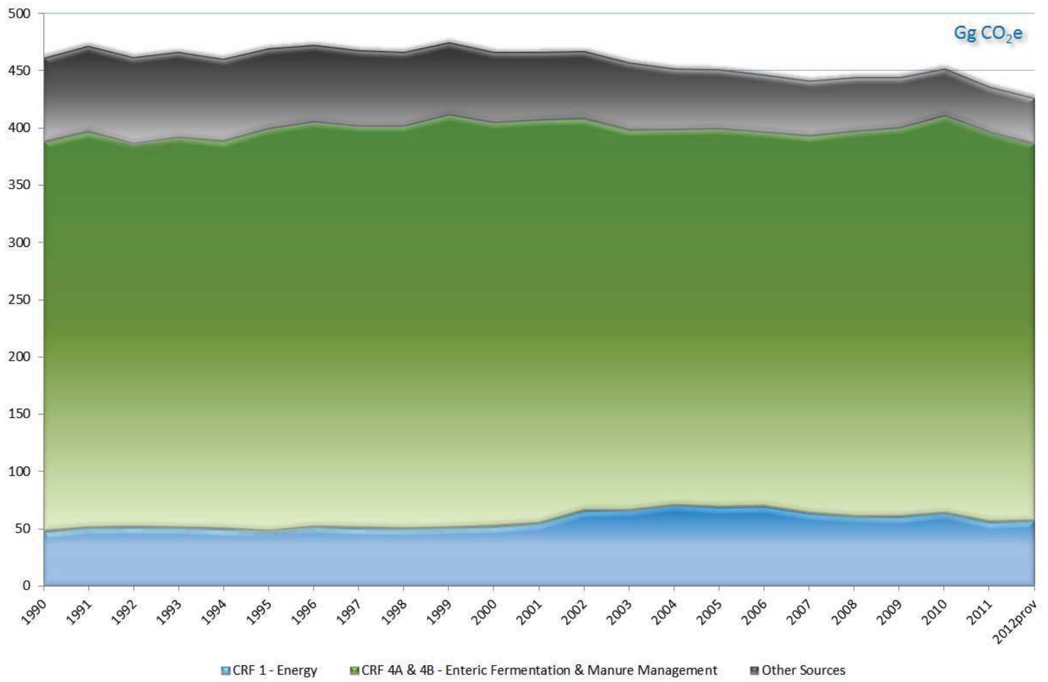


Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2.

Notes: (1) 2012 data are provisional data estimated by the Department of the Environment during the summer of 2013 for the EC and the European Environment Agency.

(2) the other CO_2 sources are emissions from solvent and other product use (CRF 3).

CH_4

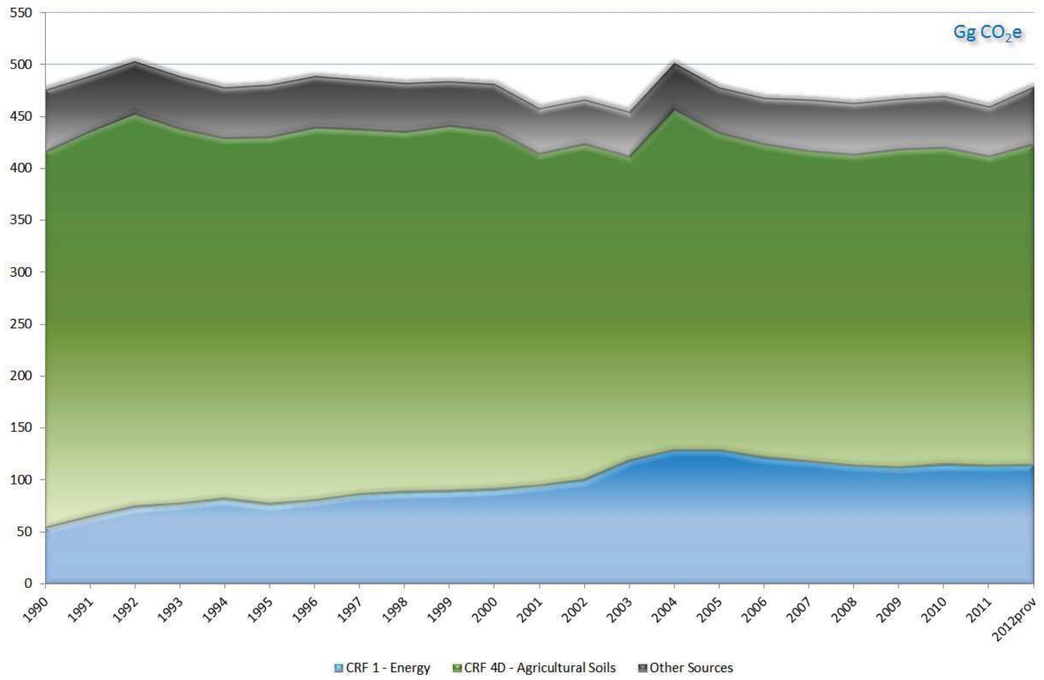


Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2.

Notes: (1) 2012 data are provisional data estimated by the Department of the Environment during the summer of 2013 for the EC and the European Environment Agency.

(2) the other CH_4 sources are emissions from solid waste disposal on land (CRF 6A), waste water handling (CRF 6B) and composting (CRF 6D).

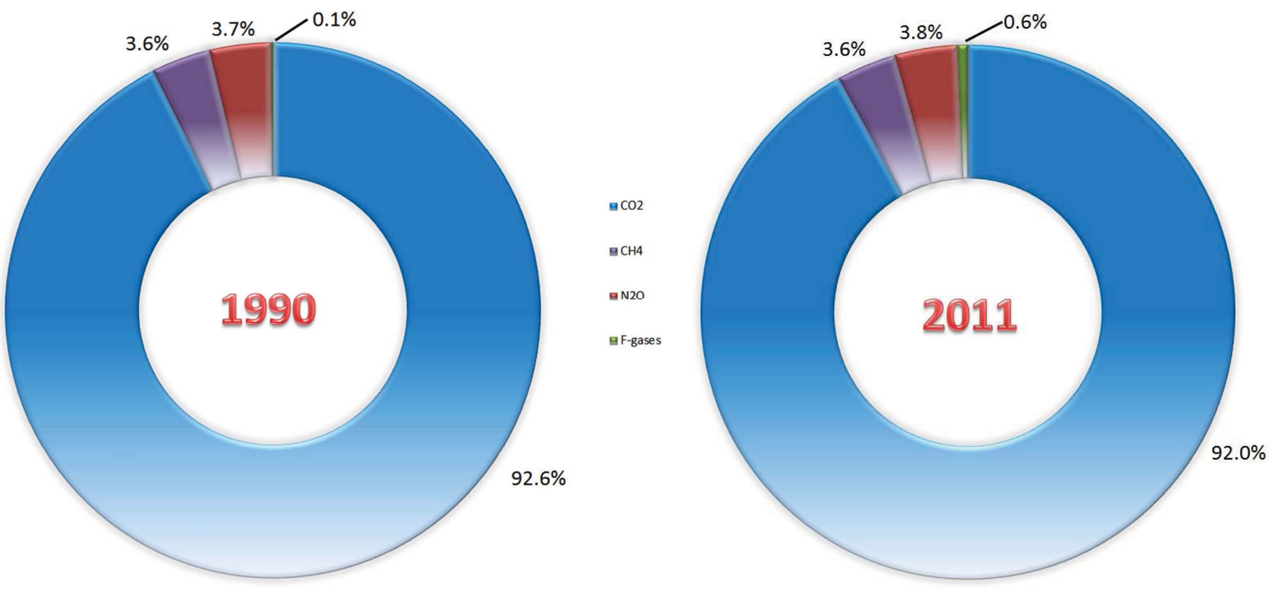
N_2O



Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2.

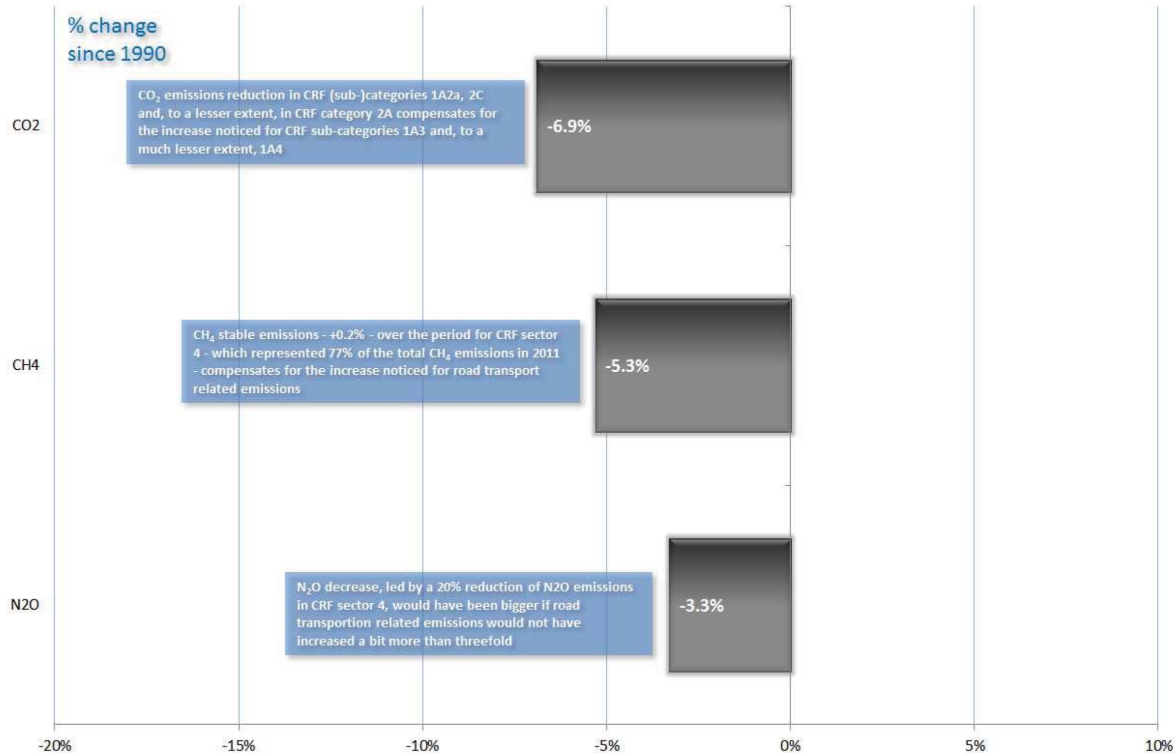
Notes: (1) 2012 data are provisional data estimated by the Department of the Environment during the summer of 2013 for the EC and the European Environment Agency.
(2) the other N_2O sources are emissions from anaesthesia (CRF 3D), manure management (CRF 4B), waste water handling (CRF 6B) and composting (CRF 6D).

FIGURES III.1-4b – GHG EMISSIONS (EXCL. LULUCF) – CONTRIBUTION OF EACH GAS TO TOTAL EMISSIONS: 1990 & 2011



Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2.

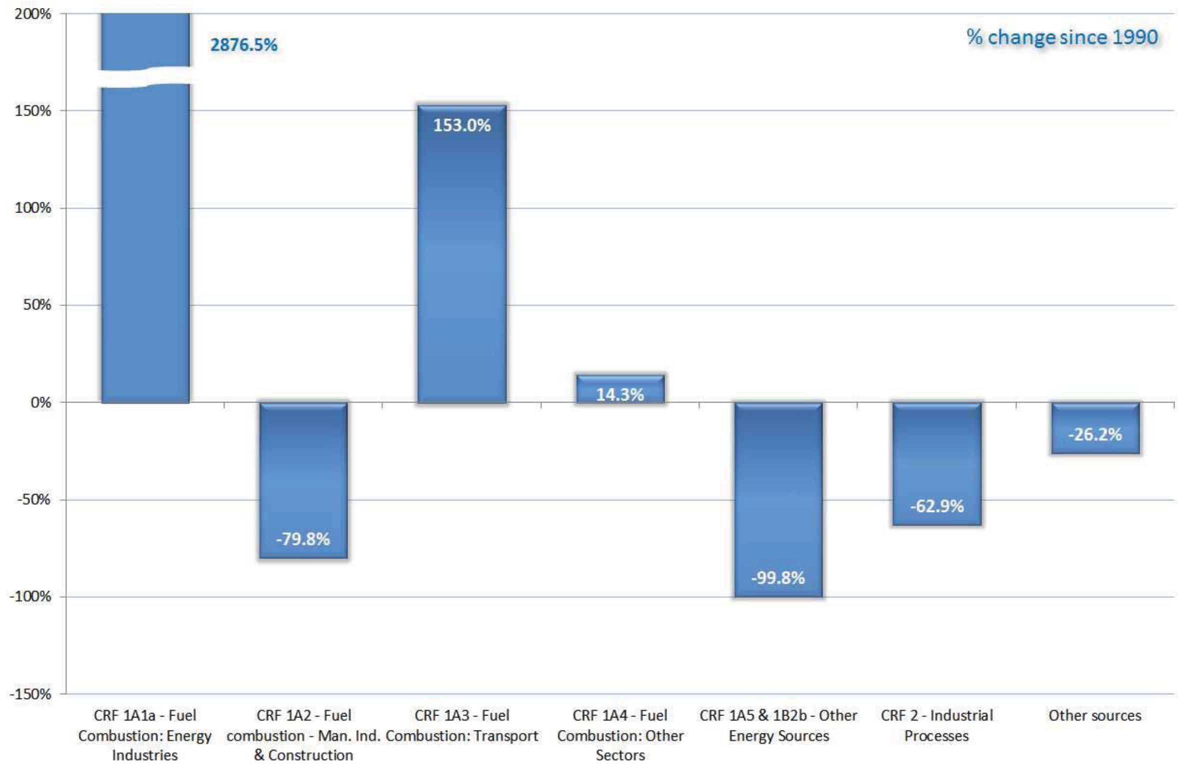
FIGURE III.1-4c – GHG EMISSIONS (EXCL. LULUCF) – OVERVIEW BY GAS: % CHANGE 1990-2011



Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2.

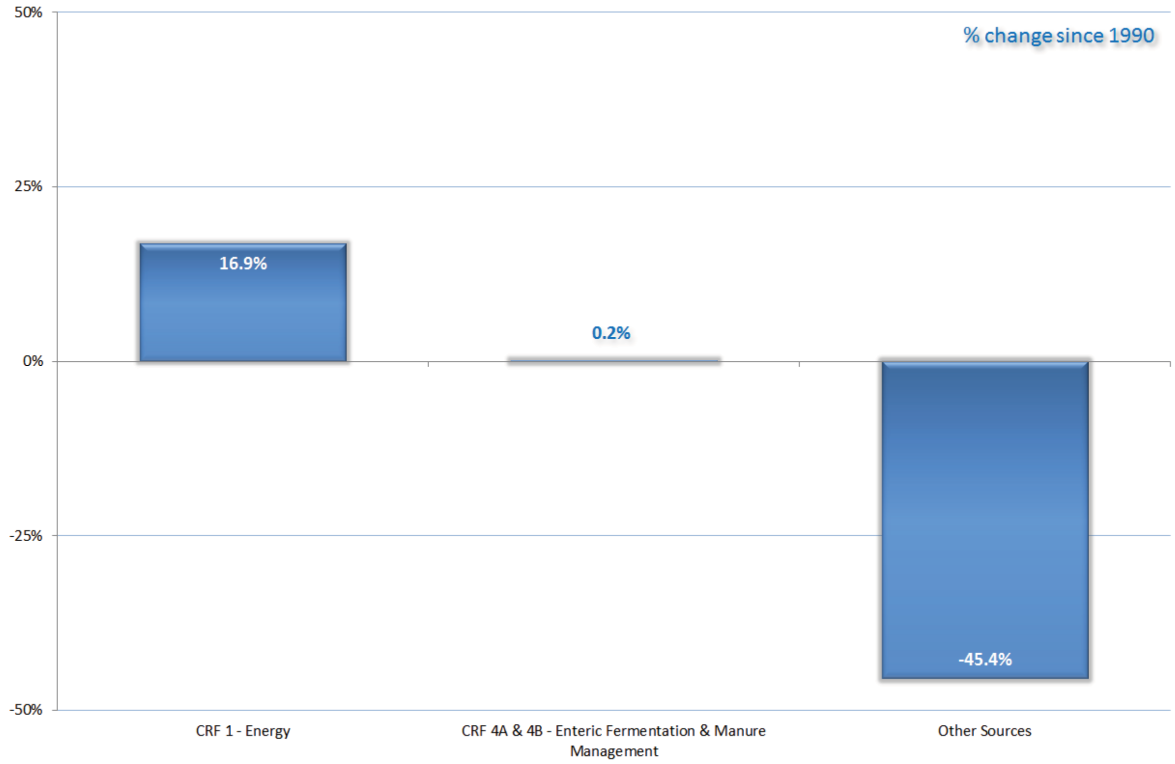
FIGURE III.1-4d – GHG EMISSIONS TRENDS (EXCL. LULUCF) – MAIN GASES' TRENDS: 1990-2011

CO_2



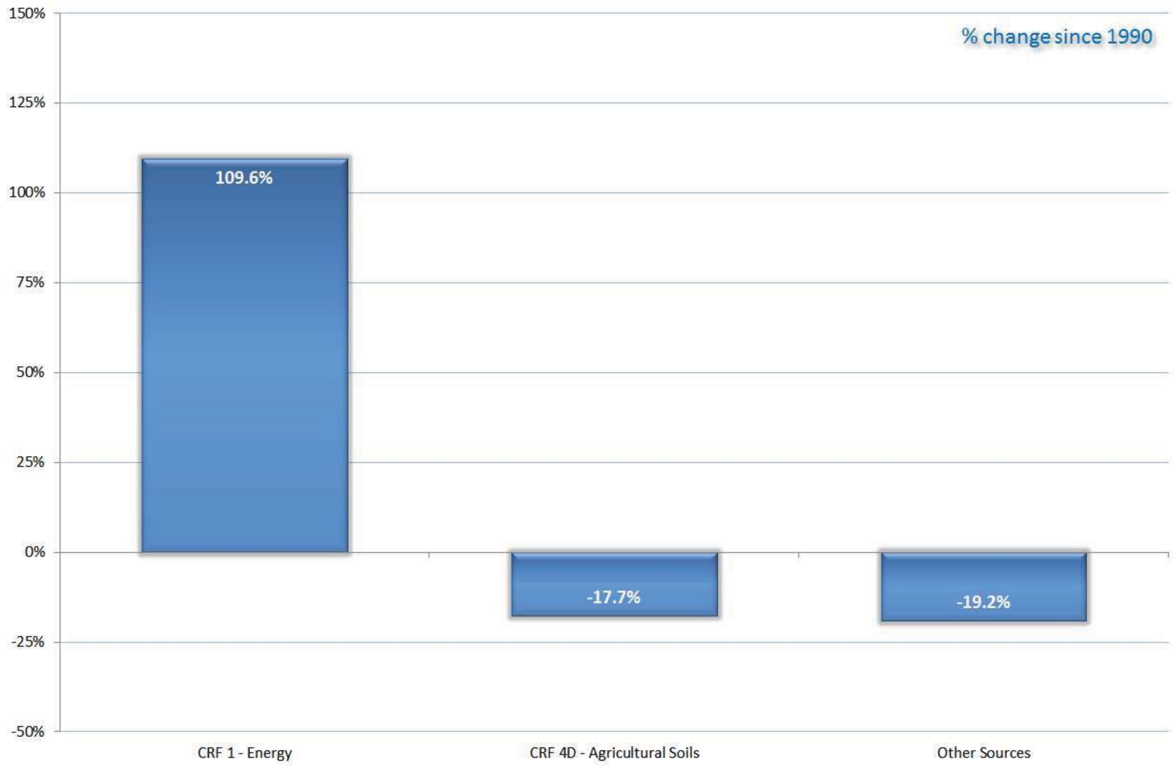
Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2.
Note: the other CO_2 sources are emissions from solvent and other product use (CRF 3).

CH₄



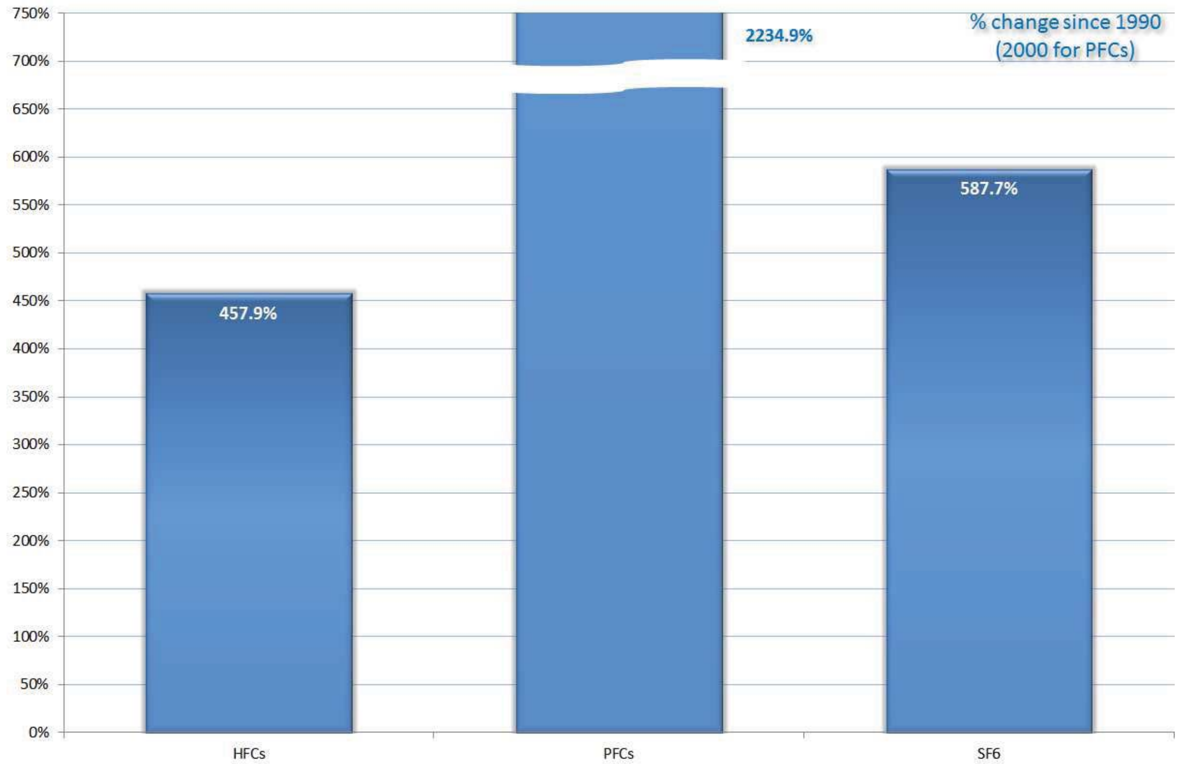
Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2.
Note: the other CH_4 sources are emissions from solid waste disposal on land (CRF 6A), waste water handling (CRF 6B) and composting (CRF 6D).

N_2O



Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2.
Note: the other N_2O sources are emissions from anaesthesia (CRF 3D), manure management (CRF 4B), waste water handling (CRF 6B) and composting (CRF 6D).

F-gases



Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2.

III.1.2. GHG emissions for Luxembourg remain very high per capita but are decoupling from GDP growth

Indicators on GHG intensity are commonly found in publications analysing GHG emissions. Intensity can be measured either with regard to population – GHG emissions per capita – or per unit of GDP – GHG intensity of GDP.[81]

For Luxembourg, these calculations are suggested for GHG emissions levels obtained using either the IPCC methodology – i.e. the emissions reported in GHG inventories – or corrected to reflect the “polluter pays” principle *[→ Section II.12.4]*. The two GHG intensities indicators – GHG emissions per capita and GHG emissions per unit of GDP – clearly went down over the period 1990-2012, whether the IPCC methodology or the “polluter pays” principle is chosen for total emissions *[→ Figures III.1-5]*.[82]

Whilst Luxembourg’s population increased by 39.7% between 1990 and end 2008 *[→ Section II.4.1]*, total GHG emissions declined by 5.8% using the IPCC methodology and by 23% according to the “polluter pays” principle. It is therefore not surprising to see a reduction of -32.5% or -44.9%

81 In the context of “green economy” and “green growth”, we now see more frequently the inverse relationship called “productivity”. For instance, GDP per unit of GHG emitted or, for a more economic analysis, sectoral value added per unit of (energy related) CO_2 or GHG emitted by sector – link with “NAMEA-Air” presented in Section II.12.5.

82 The series including GDP start in 1995 since data prior to 1995 are (and will not be) translated into the new European System of Accounts (ESA).

for GHG emissions per capita since 1990, respectively *[→ Figures III.1-5]*. Nevertheless, emissions level per capita – though they decrease from 33.6 (IPCC) and 37.3 ("polluter pays") tonnes per person in 1990 to 23 and 21.5 tonnes per person in 2011 (22.6 and 20.6 tonnes per person in 2012) – remains much higher than those in the other European countries. Countries with the highest emissions per capita after Luxembourg are – 2011 data – Estonia, Czech Republic and Finland with, respectively, 14, 10.9 and 10.5 tonnes per person. The EU-15 average was, in 2011, 7.5 tonnes per person – 7.4 tonnes per capita for the EU-28 average.[83] Correcting the resident population for the important workforce coming every working day from abroad to work in Luxembourg – the cross-border commuters – does not change radically the picture. If the yearly population is increased – by hypothesis – by half of the yearly average number of cross-border commuters,[84] the per capita ratio would drop to 20.1 in 2011 (19.7 in 2012, but 24.7 in 2005), i.e. to about 90% of the IPCC methodology per capita ratio. It is only if "road fuel sales to non-residents" related emissions are subtracted from the IPCC totals – i.e. without taking into account emissions generated abroad for the electricity consumption in Luxembourg – that Luxembourg's emissions per capita ranged between 13.5 and 17 tonnes since the turn of the 21st century, i.e. still at a rank that places the country amongst those, in Europe, with the highest emissions per person.

However, the main drivers behind emissions per capita have changed through time in Luxembourg: in the early 1990s, the steel industry activities were responsible for the high ratios recorded; nowadays it is rather road transportation fuel related consumption together with electricity and heating fuels needs that push the per capita emissions amongst the highest *[→ Section II.6.1]*.

Turning to emissions per unit of GDP (at constant price), in 2012, a reduction of 32.3% or 48.9% is observed since 1995 when using the IPCC methodology and the "polluter pays" principle in that order *[→ Figures III.1-5]*. More precisely, GHG intensity of GDP decreased from 540 or 650 tonnes/Mio. € in 1995 to 365 or 332 tonnes/Mio. € for the IPCC or the "polluter pays" approaches respectively. The figure also shows that a **relative decoupling** happened since 1995.

This decoupling, or efficiency gain, is the conjunction of two elements: firstly the increasing share of "road fuel sales to non-residents" in total GHG emissions *[→ Figure II.8-3 & Table III.1-3]* – which is more correlated to the overall GDP growth in (Western) Europe than to the national GDP growth, the latter being higher *[→ Section II.5]* – and, secondly, as described in *Section II.5.2*, the expansion of the tertiary sector at the expense of the industrial sector *[→ Table III.1-3]*. These observations should be analysed together with the conclusions drawn out in *Section II.5.4*, that is to say that GHG emissions trends in Luxembourg are not so much influenced by the economic

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83 Data extracted from EEA's greenhouse gas data viewer: http://www.eea.europa.eu/data-and-maps/data/data-viewers/greenhouse-gases-viewer.

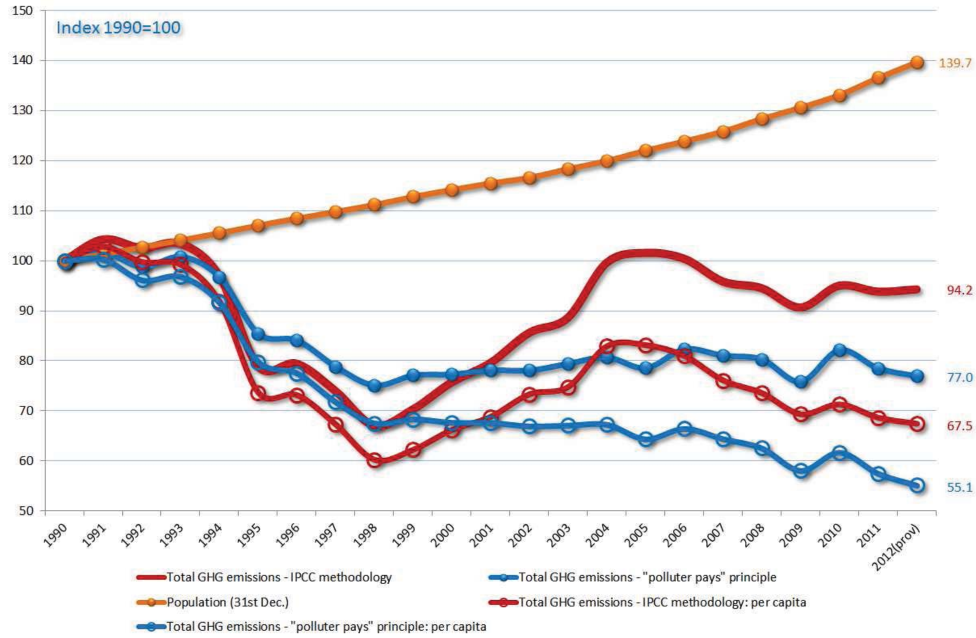
84 The hypothesis is therefore than one cross-border commuter = 0.5 resident, which is a sensible assumption that is also made when calculating waste water treatment plants related emissions [Ministry of Sustainable Development and Infrastructure, Environment Agency (2013), p. 406-407].

profile of the country but for the most part by the energy-mix, individual changes in the economic activity that could lead to structural changes and road transportation related fuel sales.

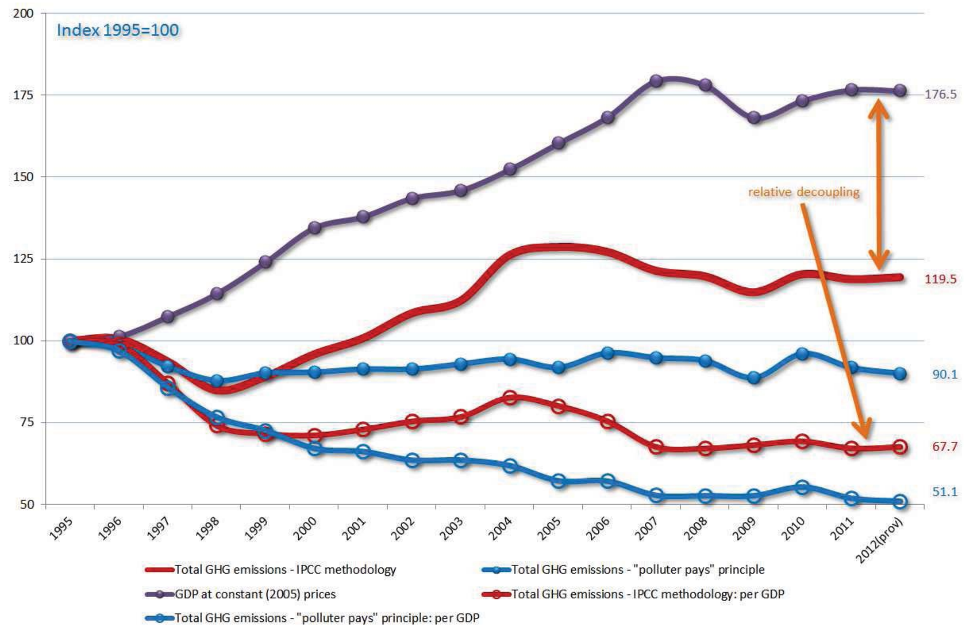
Figure III.1-6 wraps up the main variables discussed in this section by presenting their evolution **since 1995**.

FIGURES III.1-5 – GHG INTENSITIES (EXCL. LULUCF): 1990-2012

Population



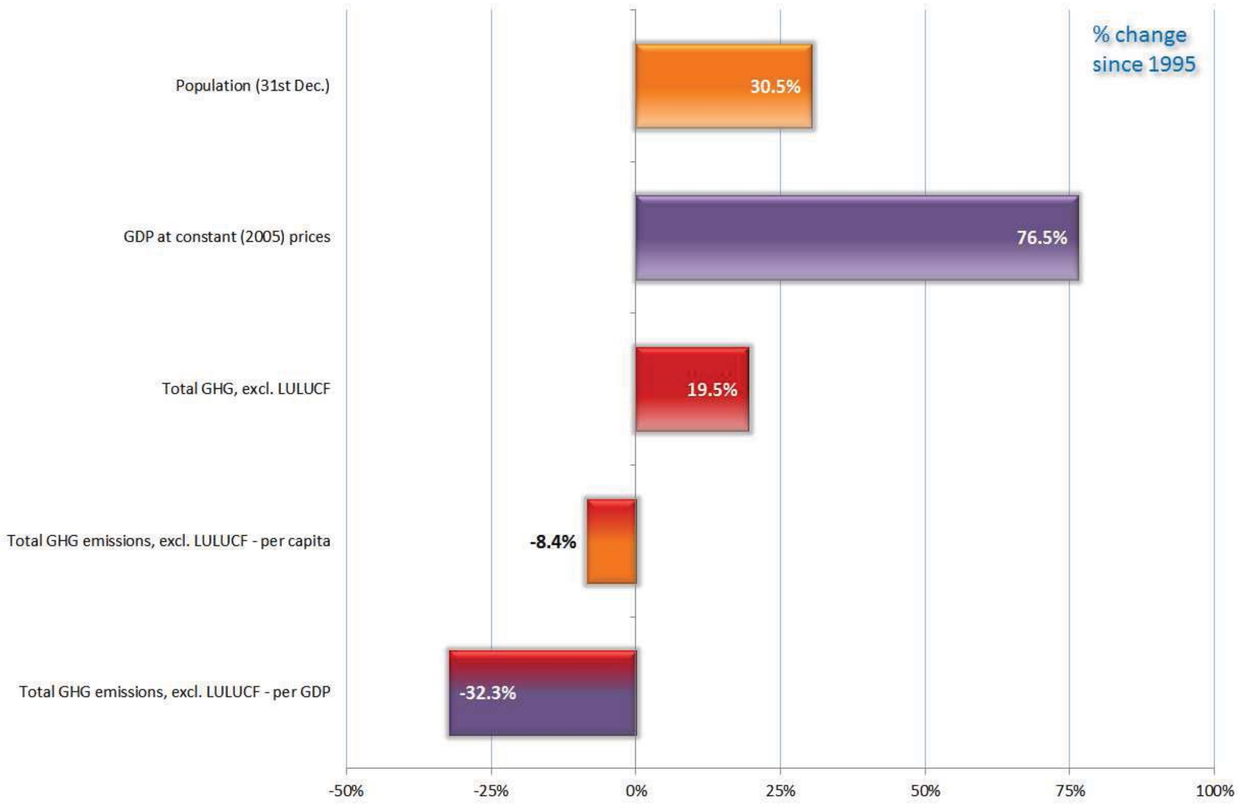
GDP at constant (2005) prices



Sources: GHG: Environment Agency and MDDI-DEV – Submission 2013v1.2.
population: STATEC, *Statistical Yearbook*, Table B.1100 (updated 18.04.2013).
http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=383&IF_Language=fra&MainTheme=2&FldrName=1
GDP: STATEC, *Statistical Yearbook*, Table E.2101 (updated 10.2013).
http://www.statistiques.public.lu/stat/TableViewer/document.aspx?ReportId=1497&IF_Language=fra&MainTheme=5&FldrName=2

Notes: (1) 2012 GHG data are provisional data estimated by the Department of the Environment during the summer of 2012 for the EC and the European Environment Agency.
(2) the "polluter pays" principle figures have been obtained from the total GHG emission according to the IPCC methodology by excluding emissions from "road fuel sales to non-residents" and for electricity generated that is exported, and by adding an estimate for electricity production emissions generated abroad for satisfying Luxembourg consumption (i.e. emissions relating to electricity imports):
emissions "polluter pays" principle = emissions IPCC methodology – emissions "road fuel sales to non-residents" + emissions electricity net imports

FIGURE III.1-6 – POPULATION, GDP & GHG EMISSIONS (IPCC METHODOLOGY): 1995 & 2012



Sources: GHG: Environment Agency and MDDI-DEV – Submission 2013v1.2.
population: STATEC, *Statistical Yearbook*, Table B.1100 (updated 18.04.2013).
http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=383&IF_Language=fra&MainTheme=2&FldrName=1
GDP: STATEC, *Statistical Yearbook*, Table E.2101 (updated 10.2013).
http://www.statistiques.public.lu/stat/TableViewer/document.aspx?ReportId=1497&IF_Language=fra&MainTheme=5&FldrName=2

III.1.3. GHG trends by gas: reduction for CO_2 and CH_4 emissions, rise for N_2O and F-gases

For the different GHG, trends over the period 1990-2011 (1990-2012) were as follows:

CO_2: .... -6.9% (-6.5%)

CH_4: .... -5.3% (-7.5%)

N_2O: .... -3.3% (+0.6%)

F-gases: .... +470.4%(+482.5%)

For carbon dioxide, the development between 1990 and 2011 hides a U-shape evolution over the period as well as important changes in the sources of CO_2 emissions: declining emissions in industrial combustion, increasing emissions from transport and natural gas fired power plants – as underlined in *Section III.1.1*. The first estimate for 2012 is very close to the amount calculated for 2011.

Methane emissions have declined over the period 1990-2011 (2012) due to the conjunction of reduced methane emissions in waste and waste water management (-45.4%) (-44.6%) that surpasses growing emissions in energy use (+16.9%) (19.3%). Methane emissions in agriculture remained stable (+0.2%), but declined by 3.3% if the year 2012 is considered.

Nitrous oxide emissions development is the result of declining emissions from the agriculture and various other sources such as anaesthesia, waste water handling and composting. Agricultural soils emissions dropped by 17.7% over the period 1990-2011 (by 14.7% if the year 2012 is considered) and the other sources by 19.2% (-7.5%). These decreases have more than balanced the sharp increase – +109.6% (111.1%) – recorded for fossil fuels related emissions from combustion activities (mainly for the road transportation and the other sectors).

The rather important differences reported for methane and nitrous oxide emissions changes over the period 1990-2011 or 2012 is also illustrative of the inherent volatility of the emissions for the "smaller" source categories due to the size of the activities concerned. This is typical of a small country and economy.

Finally, with regard to F-gases, HFC emissions were almost 6 times higher in 2011 and 2012 than in the base year, whereas SF_6 emissions showed almost a 7 fold increase.

These evolutions can be visualized in ***Table III.1-4***, which distributes, for each GHG, emissions amongst the main source categories, as well as in the associated ***Figures III.1-4a to III.1-4d***. These table and figures offer the opportunity to further analyse emission trends for each of the gases.

III.1.3.1. Carbon dioxide – CO_2

CRF (sub-)categories covered	1A1a, 1A2, 1A3, 1A4, 1A5, 1B2b, 2A1, 2A7, 2C1, 3A, 3B, 3C & 3D	
share in total GHG emissions, excl. LULUCF	***1990***	92.6% =11 950.26 Gg CO_2e
	2011	92.0% =11 125.58 Gg CO_2e
	2012prov	91.9% =11 175.13 Gg CO_2e

Throughout the period 1990-2011 (as well as 1990-2012), the main GHG has remained carbon dioxide, which accounted between 89% and 93% of the total GHG emissions. However, the structure of CO_2 emissions has evolved with an increase in fuel combustion, which accounted for 80% of total GHG emissions for the base year (1990) and climbed up to 86.9% in 2011 (87.4% in 2012), after having reached a maximum of 87.3% in 2005.

Road transport, and more precisely "road fuel sales to non-residents", is, with **electricity production**, one of the culprits for this development. Indeed, in 1990, fuel combustion from the transport sector (CRF sub-category 1A3 as a whole) accounted for 20.7% of total GHG emissions.

Then, with 6.8 Mio. t CO_2, this percentage reached 55.9% in 2011 (55.7% in 2012).[85] CO_2 emissions due solely to "road sales to non-residents" amounted to about 1.8 Mio. t in 1990 and reached 5 Mio. t in 2011 and 2012,[86] i.e. roughly a threefold increase (the same comparison shows only a twofold increase for road fuel consumed by the national vehicle fleet). In 2011 and 2012, "road fuel sales to non-residents" represented a bit more than 73% of CO_2 emissions of the transport sector and around 44.5% of the total CO_2 emissions.[87] In 1990, these percentages were, respectively, 65.5% and 14.6%.

Another important source of CO_2 is **industrial processes**, i.e., in the case of Luxembourg, mainly carbon oxidizing of pig iron from steel industry (basic oxygen furnace steel production) and decarbonisation of mineral input in clinker and glass industry. The steel production process change described above was the main driver behind declining emissions for this sector.

III.1.3.2. Methane – CH_4

CRF (sub-)categories covered	1A1a, 1A2, 1A3, 1A4, 1A5, 1B2b, 4A, 4B, 6A, 6B & 6D		
share in total GHG emissions, excl. LULUCF	***1990***	3.6% =	461.51 Gg CO_2e
	2011	3.6% =	437.00 Gg CO_2e
	2012prov	3.5% =	426.91 Gg CO_2e

Methane emissions originate above all from the agricultural sector, and more precisely from **enteric fermentation** and from **manure production and management**: from 73% to 78% of methane emissions over the period 1990-2011 (as well as 1990-2012). As these emissions have been rather stable, total methane emissions have not varied very much.

For the other methane emitting source categories, there is a decline in **waste and waste water management** related emissions (-45.4%) (-44.6%) and growing emissions in **energy use** (+16.9%) (19.3%). The decrease noted for waste is the result of reduced methane emissions from waste landfill sites. The increase observed for energy is mainly due to fugitive emissions from natural gas distribution and use.

85 The highest amount of emissions was recorded for the year 2005: 6.92 Mio. t CO_2 but "only" 52.8% of total GHG emissions. In fact, percentages are somewhat over-estimated in 2011 compared to the latest years for two reasons: (1) lower than "usual" emissions in electricity and heat production (CRF 1A1a) due to very low production for the TWINerg power plant for some months (maintenance) and (2) rather low – compared to the previous years – emissions in the other sectors (CRF 1A4).

86 5.4 Mio. t in 2005.

87 For 2005, these percentages were respectively 78% and 44.6%.

III.1.3.3. Nitrous oxide – N_2O

CRF (sub-)categories covered	1A1a, 1A2, 1A3, 1A4, 1A5, 3D, 4B, 4D, 6B & 6D		
share in total GHG emissions, excl. LULUCF	***1990***	3.7% =	476.11 Gg CO_2e
	2011	3.8% =	460.41 Gg CO_2e
	2012prov	3.9% =	478.90 Gg CO_2e

A large part of nitrous oxide emissions is caused by **agricultural soils** that drive the -3.3% decline observed for this gas over the period 1990-2011 (but +0.6% for the period 1990-2012). Another important source, generating increasing N_2O emissions since 1990, is **road transportation**, where incomplete NO_X reduction in catalytic converters of diesel oil motor vehicles leads to N_2O emissions that were multiplied by a factor 3 over the period, following the increasing share of diesel vehicles on the roads. Nevertheless, nitrous oxide emissions due to road transportation decreased and then capped from 2005 onwards. The drop in emissions observed for the **other sources** is principally the result of diminishing nitrous oxide emissions from manure management.

III.1.3.4. Hydrofluorocarbons – HFCs and sulphur hexafluoride – SF_6

CRF (sub-)categories covered	2F		
share in total GHG emissions, excl. LULUCF	***1990***	0.1% =	13.14 Gg CO_2e
	2011	0.6% =	74.93 Gg CO_2e
	2012prov	0.6% =	76.52 Gg CO_2e

The increase in **HFCs** emissions between 1990 and 2011 (2012) is explained by a more wide spread use of mobile and stationary cooling equipment as well as of aerosols.

The use of **PFCs** only appeared in 2000 and accounts for 0.18 Gg CO_2e, in 2011.

SF_6 emissions increased from 1990 onwards following a raising use of high voltage electrical devices and a higher amount of gas emitted from noise reduction windows.

III.1.4. GHG trends by sector: reductions in all sectors but one, energy

This section should be read together with *Chapter II*, where changes and developments that occurred since 1990 in the various sectors and the socio-economic profile of Luxembourg have been described and analysed with regard to their impacts on GHG emissions.

In 2011, the energy sector accounted for almost 88.4% of the total GHG emissions, excluding LULUCF. Two sectors represent between 5% and 6% of the total emissions, excluding LULUCF: industrial processes (5.6%) and agriculture (5.5%). The remaining sectors[88] (solvent and other

[88] The sector "other" is not reported for Luxembourg.

product use (0.13%), waste[89] (0.48%) were not even reaching 1% of the total GHG emitted in Luxembourg For 2012, first estimates – “nowcasts” – lead to almost identical percentages *[→ Table III.1-2 & Figure III.1-2c]*.

For the different sectors, trends over the period 1990-2011 (1990-2012) were as follows:

Energy:	+2.5%	(+3.5%)
Industrial Processes:	-58.6%	(-61.8%)
Solvent and Other Product Use:	-34.0%	(-31.6%)
Agriculture:	-10.7%	(-9.9%)
LULUCF:	-184.6%	(NE)
Waste:	-29.3%	(-28.4%)
Total GHG emissions:	***-6.2%***	***(-5.8%)***

Emission reductions observed in all sectors but one could balance the limited growth of energy use and production related emissions whose contribution to total GHG emissions ranged from 81% to 89% over the period 1990 to 2011 (2012).

III.1.4.1. CRF 1 – Energy

GHG covered	CO_2, CH_4 & N_2O	
share in total GHG emissions, excl. LULUCF	***1990***	80.8% =10 429.93 Gg CO_2e
	2011	88.4% =10 688.67 Gg CO_2e
	2012prov	88.8% =10 792.63 Gg CO_2e

Energy production and consumption related GHG emissions have increased by 2.5% between 1990 and 2011 from 10.43 Mio. t CO_2e in 1990 to 10.69 Mio. t CO_2e in 2011 (3.5% between 1990 and 2012 from 10.43 Mio. t CO_2e in 1990 to 10.79 Mio. t CO_2e in 2012). For carbon dioxide, methane and nitrous oxide, the changes over the period 1990-2011 were +1.8%, +16.9% and +109.6%, respectively (for 1990-2012, 2.8%, 19.3% and 111.1% in that order).

However, the overall trends at sector level hide very different developments at the CRF sub-category level. Within the energy sector, the fastest growing sub-sectors were **energy industries** (1A1) (due to the operational start of the TWINerg gas turbine in 2002) and **transportation** (1A3): +2698% and +152.7%, respectively between 1990 and 2011 (+2824% and +153.2%) with, as a result, shares in the total energy related GHG emissions rising from 0.3% to 9.3% (9.6%) and 25.9% to 64%(63.5%), respectively *[→ Figure III.1-7]*. For the other sub-sectors, the observed trends between

89 The waste sector covers only landfilled waste, wastewater handling and composting activities. Waste incineration, which is the main treatment method for municipal waste in Luxembourg, is carried out in the sole incinerator of the country where energy is recovered. Consequently, waste incineration related emissions are accounted for in CRF sector 1 – Energy.

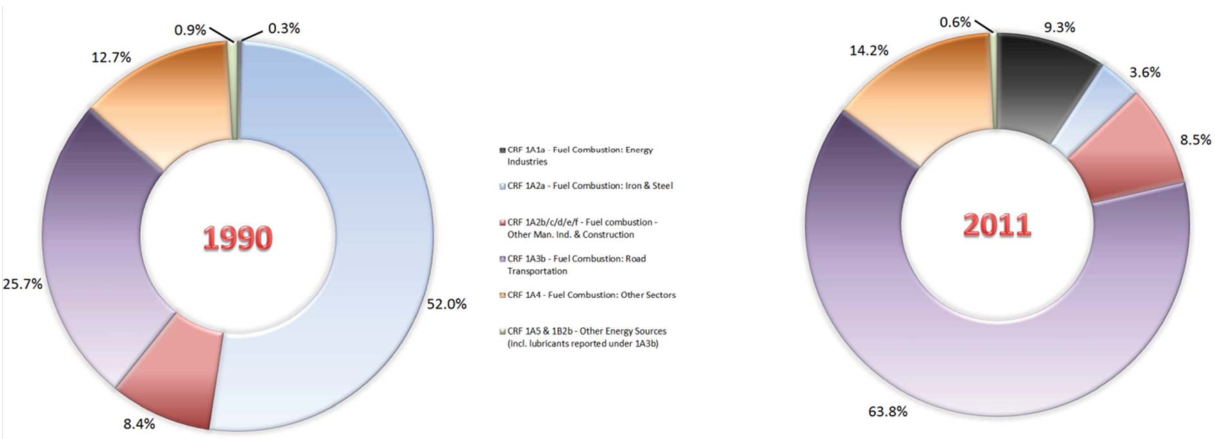
1990 and 2011 (2012) are -79.5% (-80.3%) for **manufacturing industries** (1A2), +14.3% (+21.9%) for the **other sectors** (1A4), and +141.2% (+145.6%) for **fugitive emissions from fuels** (1B).[90]

In fact, over the period, GHG emissions have been strongly influenced by varying fuel consumption levels in industry, in particular in the energy and the iron and steel industries, as well as in the road transport sector as percentage growths recorded for CRF sub-categories 1A1, 1A2 and 1A3 demonstrate. There are several industrial sites which had relatively high levels of GHG emissions, and which, therefore, have had a large impact on the national total of GHG emissions. The TWINerg power plant, and to a lesser extent several cogeneration (CHP) plants, also had an impact on the energy related GHG emissions, as already stressed in previous sections of this report. In the transport sector, road fuel consumption, and even more so road fuel sales, have a very important weight in the national energy balance, and, consequently, have also a very important impact on the total GHG emissions.

In the iron and steel industry, the passage from blast furnaces to electric arc furnaces allowed to significantly reducing GHG emissions between 1994 and 1998. Due to the importance of iron and steel industry in Luxembourg, this evolution hid many other emission trends between 1990 and 1998. After 1998, the increase of road fuel sales and, to a lesser extent, of electric energy production has led to a rather steep increase of GHG emissions in these sectors and, by extension, of the national total for GHG emissions.

All these changes briefly presented in the previous paragraphs – as well as in *Sections II.6, II.7 & II.8* – completely modified the pattern of the energy related GHG emissions with regard to CRF sub-categories share *[→ Figure III.1-7]* and to the "energy-mix" or fuel usage for energy production and consumption *[→ Tables & Figures II.6-1 & II.6-2]*.

FIGURE III.1-7 – CRF SUB-CATEGORIES SHARE IN GHG EMISSIONS FOR CRF 1 – ENERGY: 1990 & 2011



Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2.

90 Fugitive emission growth is closely linked to natural gas use in Luxembourg.

III.1.4.2. CRF 2 – Industrial Processes

GHG covered	CO_2 & F-gases	
share in total GHG emissions, excl. LULUCF	***1990***	12.6% = 1 621.50 Gg CO_2e
	2011	5.6% = 671.49 Gg CO_2e
	2012prov	5.1% = 619.65 Gg CO_2e

Industrial processes, previously the second largest sector in Luxembourg with regard to GHG emissions, is now the third one. It includes emissions from industrial installations and from consumption of halocarbons, perfluorocarbons and SF_6 (the fluorinated gases or F-gases). Leaving F-gases out, in Luxembourg, only 3 companies and their various production installations are part of CRF sector 2:

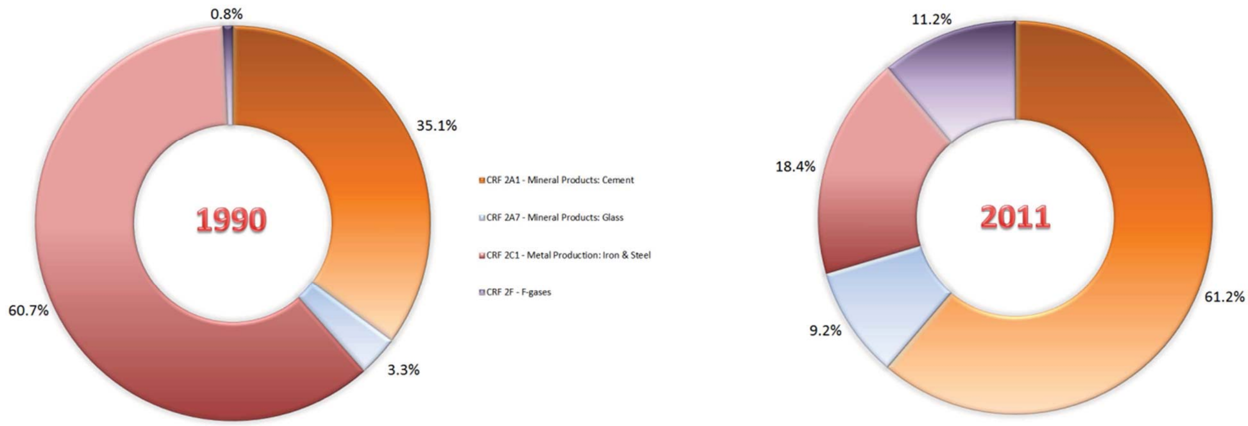
- CRF sub-categories 2A1 & 2A7: one cement works unit and one flat glass manufacturing company;
- CRF sub-category 2C1: the iron and steel manufacturing company Arcelor-Mittal.

Industrial process emissions show a declining trend between 1990 and 1998, then a relative stabilisation. This evolution was mainly driven by **process changes that occurred in the iron & steel industry**. As indicated above, this industry moved from blast to electric arc furnaces between 1994 and 1998. As a consequence, steel industry process emissions in CO_2e decreased by 87.4% (89.2%) over the period 1990-2011 (2012). Overall sector emissions in CO_2e fell by 58.6% (61.8%) between 1990 and 2011 (2012), reducing the weight of this sector in total GHG emissions from 12.6% to 5.6% (5.1%) over the period *[→ Figure III.1-2c]*. By gas, however, the picture is different. For carbon dioxide, the decrease over the period 1990-2011 (2012) was -62.9%: 2A1 = -27.9% (-33.8%), 2A7 = +15.0% (+10.4%) and 2C1 = -87.4% (-89.2%). F-gases emissions, on the contrary, increased regularly: +470.4% (+482.5%) over the period 1990-2011 (2012) but they remain rather minor compared to the total emissions *[→ Figure III.1-4b]*.

The striking increase of **F-gases emissions** is the consequence of supposedly growing use in the country, notably due to an increasing use of air conditioning and noise reduction windows *[→ Section III.1.3.4]*.

The emission trends briefly described in the previous paragraphs led to a significant change in the composition of industrial processes' GHG emissions *[→ Figure III.1-8]*.

FIGURE III.1-8 – CRF SUB-CATEGORIES SHARE IN GHG EMISSIONS FOR CRF 2 – INDUSTRIAL PROCESSES: 1990 & 2011



Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2.

III.1.4.3. CRF 3 – Solvent and Other Product Use

GHG covered	CO_2 & N_2O		
share in total GHG emissions, excl. LULUCF	***1990***	0.2% =	23.90 Gg CO_2e
	2011	0.1% =	15.77 Gg CO_2e
	2012prov	0.1% =	16.35 Gg CO_2e

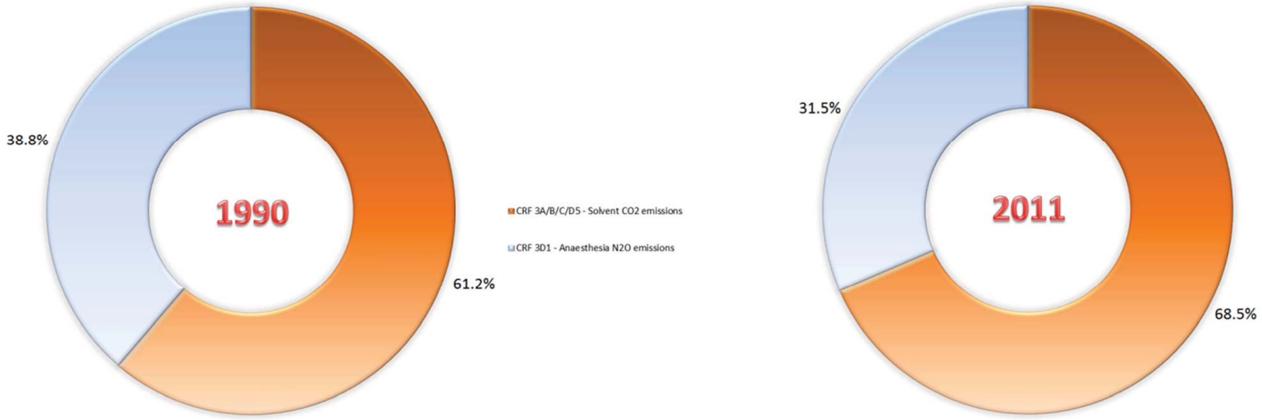
Carbon dioxide emissions from solvent use have been estimated from related NMVOC emissions. These NMVOC emanations have been calculated using both a bottom-up and a top-down approach. This is detailed in Ministry of Sustainable Development and Infrastructure, Environment Agency (2013b), section 5.2, p. 259-280. Nitrous oxide emissions reported for this sector are exclusively stemming from anaesthesia usage that have been estimated by combining reported emissions per capita in Germany with the relative population in Luxembourg [Ministry of Sustainable Development and Infrastructure, Environment Agency (2013b), section 5.3, p. 280-281].

Emissions decreased by 34% between 1990 and 2011,[91] due to decreasing solvent and N_2O emissions, as well as due to the positive impact of diverse enforced laws and regulations in Luxembourg.[92] The cut in emissions was sharper for **anaesthesia** (emissions almost divided by two) than for **solvent** leading to a reduced share of nitrous oxide emissions in the total emissions of CRF sector 3 *[→ Figure III.1-9]*.

91 For the period 1990-2012, the decrease reaches 31.6%. However, the various categories of this sector having been "nowcasted" using very simple methods, this reduction percentage does not make much sense.

92 These legal texts are listed in Ministry of Sustainable Development and Infrastructure, Environment Agency (2013), section 5.1, p. 257-258.

FIGURE III.1-9 – CRF SUB-CATEGORIES SHARE IN GHG EMISSIONS FOR CRF 3 – SOLVENT AND OTHER PRODUCT USE: 1990 & 2011



Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2.

III.1.4.4. CRF 4 – Agriculture

GHG covered	CH_4 & N_2O		
share in total GHG emissions, excl. LULUCF	***1990***	5.8% =	743.20 Gg CO_2e
	2011	5.5% =	663.65 Gg CO_2e
	2012prov	5.5% =	669.73 Gg CO_2e

Trends in agriculture were also favourable between 1990 and 2011 (2012): in general GHG emissions related to agricultural activities have decreased by 10.7% (-9.9%) (+0.2% (-3.3%) for methane and -19.9% (-15.4%) for nitrous oxide). Enteric Fermentation (4A) saw its emissions falling by 6.5% (-8.4%), whereas for agricultural soils (4D), the decrease reaches 17.7% (-14.7%). For manure management (4B), emissions remained quite stable between 1990 and 2011 (2012) (+1.2%) (+1.5%), though opposite variations are observed for the two GHG emitted by this activity: methane increased by 22.5% (+13.8%) and nitrous oxide declined by 39.4% (-21.9%).

However, the evolution of nitrous oxide emissions stemming from agricultural soils (4D) shapes the overall agriculture emission pattern. Indeed, for both the years 1990 and 2011 (2012), CRF category 4D is the biggest contributor to agriculture related emissions *[→ Figure III.1-10]*, though it is also, as for other Annex I Parties, the agriculture category that shows the highest uncertainty in the inventory. It is also worth noting that the shares of each CRF category under CRF sector 4 for which GHG emissions are reported have barely changed over the period *[→ Figure III.1-10]*.

Looking at each CRF category in more detail, the generally decrease in **enteric fermentation** related **methane** emanations over the period 1990-2011 (2012) is mainly the result from declining emissions generated by cattle – -15.3% (-16.3%) for dairy cattle and -0.8% (-3.4%) for non-dairy cattle – whilst increasing emissions were recorded for the other livestock categories, except rabbits.

With regard to cattle, its total population size declined throughout the period 1990-2011 (2012) driven by a decline in dairy cattle heads – non-dairy cattle population in 2011 (2012) is only 4% (6.2%) below its 1990 level. However, a shift did occur within the cattle population with a reduction for dairy cattle (-31.3%) (-32.3%) and an increase for female mature non-dairy cattle (+60.6%) (+54.7%). In fact, cattle population and its evolution are strongly influenced by changes in the agricultural policy and, more precisely, in the Common Agricultural Policy of the EU (*CAP*). Another factor influencing cattle population is, of course, meat and milk prices (which, themselves are affected by agricultural policy changes and targets).[93] Finally, if the dairy cattle population decreased by 31.3% (-32.3%) between 1990 and 2011 (2012), related methane emissions only declined by 15.3% (-16.3%). This is explained by increasing milk yield over the period that, in turn, led to an augmentation of the gross energy intake for dairy cattle and, consequently, of the methane implied emission factors.

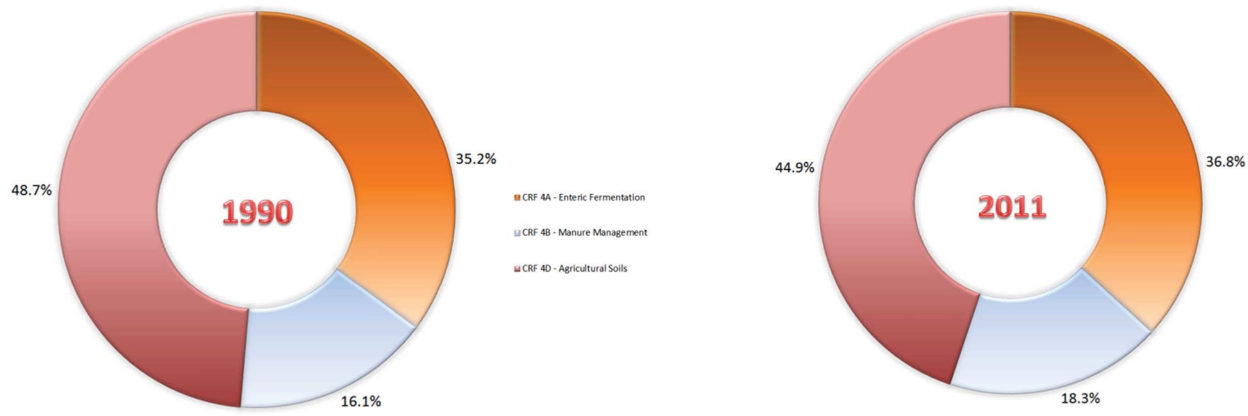
Looking at **methane** emissions from **manure management**, an increase by 22.5% (+13.8%) can be observed for the period 1990-2011 (2012). Animals who did contribute the most to these emissions were cattle and swine. As far as **nitrous oxide** emissions from **manure management** are concerned, a decrease of almost 39.4% (-21.9%) is observed for the period 1990-2011 (2012). These emissions are mainly due to cattle. However, if cattle were responsible for 94% of manure related N_2O emissions in 1990, this share dropped to around 88% in 2011 (2012). This evolution is the result of a declining (dairy) cattle population at the same time as other farm animal categories saw their number grow and as liquid system share in the animal waste management systems (AWMS) more than doubled at the expense of solid storage systems.

Finally, **nitrous oxide** emissions from **agricultural soils** are mainly driven by:

- nitrogen input to soils (such as application of synthetic fertilizers and manure) as well as nitrogen fixed by crops or crop residues (about 44% of category 4D emissions);
- nitrogen excretion on pasture, range and paddock (around 17%);
- by indirect soil emissions due to atmospheric deposition as well as to nitrogen from fertilizers and animals that is lost through leaching and run-off (about 39%).

93 As an example, the peak in the non-dairy cattle population observed in 1991 can be explained by a sharp price fall of the bovine meat price that year. This price fall led farmers to postpone slaughtering until early 1992.

FIGURE III.1-10 – CRF SUB-CATEGORIES SHARE IN GHG EMISSIONS FOR CRF 4 – AGRICULTURE: 1990 & 2011



Source: MDDI-DEV – Submission 2013v1.2.

III.1.4.5. CRF 6 – Waste

GHG covered	CH_4 & N_2O		
share in total GHG emissions, excl. LULUCF	***1990***	0.6% =	82.48 Gg CO_2e
	2011	0.5% =	58.33 Gg CO_2e
	2012prov	0.5% =	59.09 Gg CO_2e

In the waste sector, the main source of GHG was solid waste disposal on land (6A), but its weight decreased over the period 1990-2011 due to the combination of reduced amounts of waste disposed off in landfills and of increased emissions arising from composting activities (6D). However, GHG emission reduction for solid waste disposal on land between 1990 and 2011 (-56.1%) still drove a reduction for the overall waste sector despite composting rising emissions. Wastewater handling emissions (6B) experienced a 11.3% decline in emissions between 1990 and 2011. This decrease was driven by domestic and commercial wastewater treatment – and, more specifically methane related emissions – since industrial wastewater management remained fairly stable throughout the period.[94]

For **solid waste disposal on land**, methane emissions have been reduced due to:

- a decrease in the quantity of waste being stored in authorised landfill sites (two as of today, three in the early 1990s), notably through the development of recycling schemes and the expansion of both the numbers of and the various waste categories collected by recycling centres;
- the aerobic pre-treatment before storage in one of the two landfill sites;
- the recent installation of methane recovery systems at waste dumping sites.

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94 The various categories of this sector having been "nowcasted" using very simple methods, 2012 emission estimates are not presented in this text.

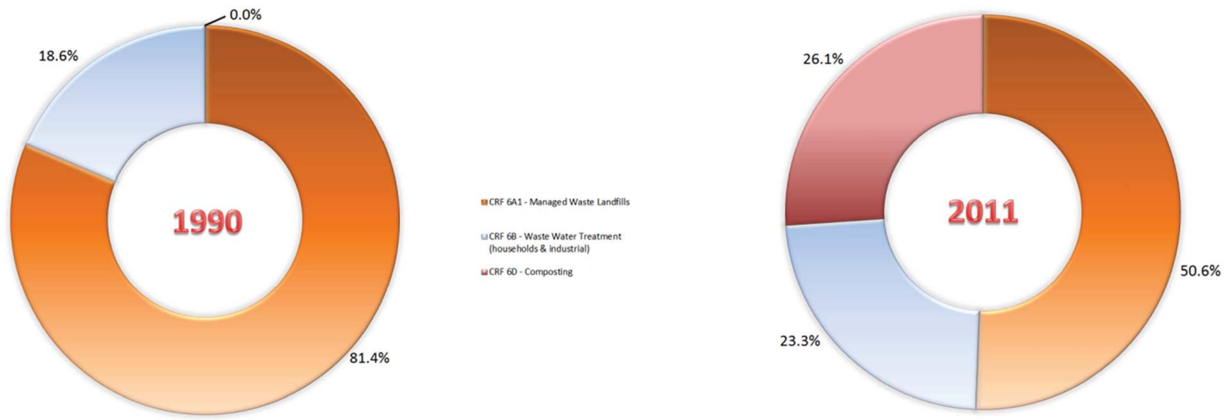
Wastewater treatment plant (WWTP) capacities expressed in population-equivalents have steadily grown since 1990. However, methane and nitrous oxide emissions decreased by 11.3% since 1990. Therefore, technical changes, with regard to wastewater treatment, have had an undeniable role too.

Concerning **compost production**, this activity started on an "industrial scale" only in the early 1990s. It experienced a steady growth from 1993 to 2003 and then more or less stabilizes. Nowadays, 7 composting installations operate in Luxembourg, plus one that co-compost sewage sludge.[95] The latter uses active ventilation and fully operates aerobically – without methane formation. The other plants operate in part under anaerobic conditions, with a residence time in the "composter" of a few weeks.

It is recalled that waste incineration related emissions are part of CRF sub-category 1A1a (public electricity and heat production) since energy is recovered in the sole incinerator of the country and injected in the network.

The emission trends briefly described in the previous paragraphs led to a significant change in the composition of waste related GHG emissions *[→ Figure III.1-11]*.

FIGURE III.1-11 – CRF SUB-CATEGORIES SHARE IN GHG EMISSIONS FOR CRF 6 – WASTE: 1990 & 2011



Sources: Environment Agency, Water Agency and MDDI-DEV – Submission 2013v1.2.

III.1.4.6. CRF sectors – overview

The fact that the iron and steel industry has abandoned blast furnaces between 1994 and 1998, that the TWINerg power plant started fully its operations in 2002, and that fossil fuel consumption as well as road fuel sales have experienced a continuous increase up to 2005, hide many other emission trends and, due to their importance in the national total GHG emissions, they shape the overall pattern of Luxembourg's GHG emissions trend. However, *Figure III.1-2d* summarized analyses presented in the previous sub-sections.

95 See Table 8-17 in Section 8.5.2.2.

More details for each CRF sector are available in Ministry of Sustainable Development and Infrastructure, Environment Agency (2013b).

III.1.5. LULUCF

In Luxembourg, LULUCF was a net sink every year, except in 1990 and 1991.[96] An important sub-category is forest land, in particular its sub-source forest land remaining forest land (5A1). This sub-category, as well as the sub-category land converted to forest land (5A2), are net sinks for CO_2, whereas other categories and sub-categories reported in the inventory are generally sources of emissions (both CO_2 and N_2O).

Luxembourg has chosen **to account for the activities under Article 3.3** of the Kyoto Protocol for the whole commitment period but **does not plan to account for net emissions and removals from activities under Article 3.4** of the same Protocol since, for the moment, there is a lack of reliable data allowing to produce realistic estimates of the activities covered under Article 3.4. Nevertheless, it is anticipated – expert judgment by the Nature and Forests Agency - that land or, at least, forestry would not contribute to Luxembourg's means of meeting its Kyoto commitment.[97] The latter would, therefore, be reached **only via national policies and measures and the use of "Kyoto flexible mechanisms"** and not via carbon sinks *[→ Section V.5.1]*.

With regard to the KP-LULUCF activities,[98] in 2011, CO_2 removals from **afforestation and reforestation** (AR) in Luxembourg amounted to 109.6 Gg CO_2. 20.73 Gg CO_2 resulted from cropland converted to forest land, 35.95 Gg CO_2 from grassland, 4.79 Gg CO_2 from wetland, 33.76 Gg CO_2 from settlement and 14.38 Gg CO_2 from other land.

Emissions from **deforestation** (D) activities amounted in 2011 to 140.45 Gg CO_2. Forest land converted to cropland amounted to 8.89 Gg CO_2, to grassland 87.04 Gg CO_2, to wetland 3.51 Gg CO_2, to settlement 40.35 Gg CO_2 and to wetland 0.31 Gg CO_2.

Due to the nature and permanence of ARD areas, there is from 1990 on:

- a steady increase in ARD areas, and related to that,
- a steady increase of removals and emissions, respectively, at these areas.

Consequently, LULUCF will not be discussed intensively in this National Communication and for more details on the emission trends and their calculation, reference is made to the National

96 Net emissions these two years are the consequence of the important storms that touched the country in early 1989-90 severely hitting Luxembourg's forests.

97 The latest submission (submission 2013v1.2) even predicts – on the basis of the years 2008 to 2011 – net emissions for about 205 Gg CO_2e for the first commitment period under the Kyoto Protocol: see KP-LULUCF reported tables – "Accounting" sheet.

98 See KP-LULUCF reported tables under submission 2013v1.2.

Inventory Report - NIR [Ministry of Sustainable Development and Infrastructure, Environment Agency (2013b), chapter 7, p. 337-383].

III.1.6. Additional information

III.1.6.1. Uncertainty analysis

Uncertainty estimates are an essential element of a complete inventory of GHG emissions and removals and requires a detailed understanding of the uncertainties of the respective input parameters. They should be derived for both the national level and the trend estimate, as well as for the component parts such as emission factors, activity data and other estimation parameters for each category.[99] Principally, two different Tiers for the estimation of combined uncertainties are presented in the *2000 IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*: Tier 1 uses simple error propagation equations, while Tier 2 uses Monte Carlo.

In autumn 2011, the Environment Agency contracted a second time *Austrian Research Centers GmbH – ARC*[100] to perform a detailed uncertainty analysis of Luxembourg's GHG inventory, using both Tiers approaches, based on submission 2011v1.3 and its associated NIR [Winiwarter et al (2011)]. This study was an update of the 2007 uncertainty analysis of Luxembourg's GHG inventory [Winiwarter et al (2008)]. As there have been major revisions to Luxembourg's inventory, it was worthwhile to revisit the calculations performed in 2007. For more details, consult the latest NIR [Ministry of Sustainable Development and Infrastructure, Environment Agency (2013b), section 1.7, p. 66-87]

For submission 2013v1.2, Tier 1 uncertainty analysis resulted in an overall combined uncertainty of total national emissions in 2010 of 2.40%, excluding LULUCF, and 3.36%, including LULUCF. Respective percentages for the uncertainty introduced into the trend in total national emissions were 0.97%, excluding LULUCF, and 3.10%, including LULUCF. For more details, refer to the latest NIR [Ministry of Sustainable Development and Infrastructure, Environment Agency (2013b), tables 1-10 & 1-11, p. 83-86].

III.1.6.2. Indirect GHG and SO_2

Indirect GHG – NO_x, CO, NMVOCs – and SO_2 emissions are not yet recorded in the inventory. Nevertheless, information is available from the inventories Luxembourg is compiling for the

[99] *2000 IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*, Chapter 6 ("Quantifying Uncertainties in Practice").

[100] Now "AIT Austrian Institute of Technology GmbH": http://www.ait.ac.at/.

UNECE CLRTAP. Consequently, these emissions will not be discussed in this National Communication and including these emissions is part of our planned improvements.

III.2. NATIONAL SYSTEM[101]

III.2.1. Institutional arrangement for inventory preparation

III.2.1.1. Applicable international legal requirements

GHG inventories are depending on and regulated by various obligations, to which Luxembourg has to comply with:

- obligations under the UNFCCC. Relevant COP Decisions and Guidelines are:
  - Decision 3/CP.5 – Guidelines for the preparation of National Communications by Parties included in Annex I to the Convention, Part I: UNFCCC Reporting Guidelines on Annual Inventories (referring to Document FCCC/CP/1999/7) revised with Decision 18/CP.8 (referring to Document FCCC/CP/2002/8);
  - Decision 4/CP.5 – Guidelines for the preparation of National Communications by Parties included in Annex I to the Convention, Part II: UNFCCC Reporting Guidelines on National Communications (referring to Document FCCC/CP/1999/7) revised with Decision 19/CP.8 (referring to Document FCCC/CP/2002/8);
  - Document FCCC/CP/1999/7 – Review of the Implementation of Commitments and of other Provisions of the Convention – UNFCCC Guidelines on Reporting and Review revised with Document FCCC/CP/2002/8;
  - Decision 11/CP.4 – National communications from Parties included in Annex I to the Convention;
  - Document FCCC/CP/2001/13/Add.3 – Report of the Conference of the Parties on its seventh session, held at Marrakech from 29 October to 10 November 2001, Addendum, Part two: Action taken by the Conference of the Parties, Volume III (Decision 20/CP.7: Guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol; Decision 21/CP.7: Good practice guidance and adjustments under Article 5, paragraph 2, of the Kyoto Protocol; Decision 22/C.7: Guidance for the preparation of the information required under Article 7 of the Kyoto Protocol; Decision 23/CP.7: Guidelines for review under Article 8 of the Kyoto Protocol).
- annual obligations under Decision No 280/2004/EC of the European Parliament and of the Council of 11 February 2004 concerning a mechanism for monitoring Community GHG

101 Part of the text of this section (III.2.1 to III.2.4) has been written by Marc Schuman from the Environment Agency and is directly extracted from Ministry of Sustainable Development and Infrastructure, Environment Agency (2013), sections 1.2 to 1.6.

emissions and for implementing the Kyoto Protocol (known as the “Monitoring Mechanism Decision” - MMD) and Commission Decision 2005/166/EC of 10 February 2005 laying down rules implementing Decision 280/2004/EC; repealed by Regulation (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC (known as the “Monitoring Mechanism Regulation” – MMR).

- obligations laid down in Decision No 529/2013/EU of the European Parliament and of the Council of 21 May 2013 on accounting rules on greenhouse gas emissions and removals resulting from activities relating to land use, land-use change and forestry and on information concerning actions relating to those activities.

Some obligations provide, indirectly, information that can be used to produce GHG inventories:

- annual obligations under the UNECE Convention on Long-Range Transboundary Air Pollution (CLRTAP) and its Protocols (1979) comprising the annual reporting of national emission data on SO_2, NOx, NMVOCs, NH_3, CO, TSP, PM_{10} and $PM_{2.5}$ as well as on the heavy metals Pb, Cd and Hg and persistent organic hydrocarbons (PAHs), dioxins and furans and hexachlorobenzene (HCB);
- annual obligations under Directive No 2001/81/EC of the European Parliament and of the Council of 23 October 2001 on national emission ceilings for certain atmospheric pollutants, (known as the “NEC Directive”) comprising the annual reporting of national emission data on SO_2, NOx, NMVOCs and NH_3;
- obligation according to Article 15 of the European IPPC Directive 1996/61/EC to implement a European Pollutant Emission Register (EPER). EPER was displaced and up-graded by Regulation (EC) 166/2006 of the European Parliament and of the Council of 18 January 2006 concerning the establishment of a European Pollutant Release and Transfer Register (E-PRTR). EPER and E-PRTR are associated with Article 6 of the Aarhus Convention (United Nations: Aarhus, 1998) which refers to the right of the public to access environmental information and to participate in the decision-making process of environmental issues;
- obligations under the framework of the European Union Emissions Trading System (EU ETS) established by Directive No 2003/87/EC of the European Parliament and complemented by Commission Decision No 2006/780/EC.

III.2.1.2. National Inventory System

A Grand-Ducal Regulation[102] - hereafter the "Regulation" – designates a **Single National Entity**, the **National Inventory Compiler** and the **National GHG Inventory Focal Point**. It also defines and allocates specific responsibilities for the realization of the GHG inventories both within the Single National Entity and within the other administrations and/or services that will be involved in the inventory preparation in the future. Following the entry into force of the EU Regulation No 525/2013 (MMR), this national "Regulation" will be revised during the course of the year 2014 so to comply with new requirements this European text enforces, such as having a national system in place for GHG projections and the evaluation of policies and measures.

Single National Entity and other cross-cutting roles

The previously cited regulation designates the **Environment Agency** (*Administration de l'Environnement*)[103] as the "**Single National Entity with overall responsibility for the GHG Inventory**". Overall management of the Single National Entity (SNE) is assigned to one staff member of the Environment Agency that is nominated **GHG Inventory Focal Point**. The Agency also acts as **National Inventory Compiler** (NIC) compiling and checking the information and GHG emission estimates coming from sector experts working in other administrations or services *[→ Table III.2-1]*. The GHG Inventory Focal Point and the NIC are actually the same person.[104]

The Environment Agency has therefore the "technical" knowledge and responsibility for the GHG inventories, but the "political" responsibility is staying with the **Department of the Environment** acting as UNFCCC **National Focal Point** (NFP). Thus, it is the Department that officially submits the inventories and their related reports to the UNFCCC Secretariat and to the EC (see Article 8 of the Regulation).

Specific responsibilities for the GHG Inventory compilation and development process

Article 3 of the Regulation presents the tasks of the SNE. In a few words, the SNE – i.e. the Environment Agency – provides sector experts for all the CRF sectors except Agriculture, LULUCF and Wastewater Handling *[→ Table III.2-1]*. It is also the Agency that:

- manages the NIS and coordinates the work on GHG inventories by informing the experts of any changes and evolutions in the Guidelines;

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[102] *Règlement grand-ducal du 1er août 2007 relatif à la mise en place d'un Système d'Inventaire National des émissions de gaz à effet de serre dans le cadre de la Convention-cadre des Nations Unies sur le Changement Climatique* (http://www.legilux.public.lu/leg/a/archives/2007/1300708/1300708.pdf, p. 2318-2320).

[103] The Environment Agency is directly linked to the Department of the Environment and works under its supervision: http://www.environnement.public.lu/functions/apropos_du_site/mev/mev_attributions/index.html and the assignments of the Environment Agency: http://www.environnement.public.lu/functions/apropos_du_site/aev/aev_missions.html.

[104] Luxembourg being a small country, its administrations and public services are small too. Hence, it is frequent that its staff members wear different hats. Nevertheless, this conjunction of responsibilities makes sense.

- as National Inventory Compiler, compiles the GHG emissions estimates produced by sector experts;
- prepares the NIR (notably on the basis of chapters received from the sector experts), including the Key Category Analysis (KCA) and the calculation of the uncertainties;
- prepares and defines work plans to secure timely data supply;
- assists sector experts in their assignments and their training;
- defines and approves, together with sector experts, activity/background data (AD), emission factors (EF), methods to estimate GHG emissions;
- archives the relevant information on the inventories and the NIS;
- implements recommendations from the quality assurance/quality control (QA/QC) annual exercise *[→ Section III.2.6]*.

Article 4 describes the tasks that fall to sector experts:

- choice of the best methods to evaluate GHG emissions, using IPCC Guidelines (these methods have to be approved by the SNE as indicated above);
- collection of the necessary AD and EFs;
- calculation of emission estimates;
- recalculation of emission estimates when possible and desirable: new AD sources, new parameters, new methods, etc.;
- proceeding with first quality checks (using, inter alia, tools embedded in CRF Reporter that allow to verify completeness and consistency);
- preparation of the NIR relevant chapters.

Finally, Article 5 indicates that activity/background data providers have to transmit quality AD using formats, and respecting the deadlines, defined by the SNE.

TABLE III.2-1 – CRF SECTOR RESPONSIBILITIES WITHIN THE NIS

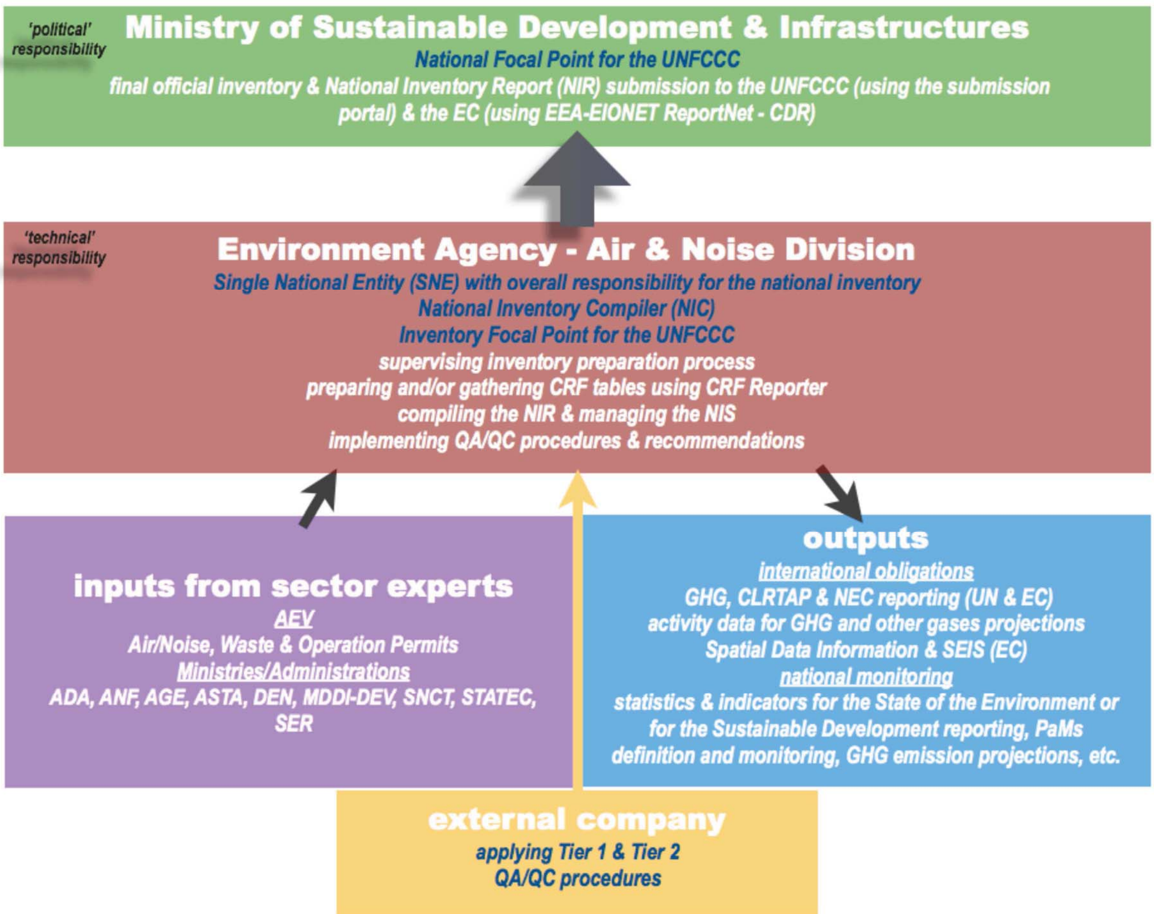
CRF sector	AD	Choice of EFs	Emissions estimation methods
Energy, excl. road transportation – CRF 1 except 1A3b	DEN – STATEC – AEV	AEV	AEV
Road Transportation – CRF 1A3b	DEN – STATEC – ADA – AEV – SNCT	AEV	AEV
Industrial Processes – CRF 2	AEV	AEV	AEV
Solvent and Other Product Use – CRF 3	AEV	AEV	AEV
Agriculture – CRF 4	ASTA – SER – STATEC – AEV	ASTA – SER – MDDI-DEV	ASTA – SER – MDDI-DEV
LULUCF – CRF 5	ASTA – SER – MDDI-DEV – AEV – ANF	ASTA – SER – ANF	ASTA – SER – AEV – ANF
Waste – CRF 6A, 6B & 6D	AEV (Waste Division)	AEV (Waste Division)	AEV (Waste Division)
Wastewater Handling – CRF 6B	AGE	AGE	AGE

Abbreviations used in Table III.2-1:
Ministry of Agriculture, Viticulture and Consumer Protection (*Ministère de l'Agriculture, de la Viticulture et de la Protection des consommateurs*): http://www.ma.public.lu/
ASTA = Agriculture Technical Services Administration (*Administration des Services Techniques de l'Agriculture*): http://www.asta.etat.lu/
SER = Agriculture Economic Service (*Service d'Economie Rurale*): http://www.ser.public.lu/
Ministry of the Economy (*Ministère de l'Economie*): http://www.eco.public.lu/
DEN = Energy Directorate (*Direction de l'Energie*): http://www.eco.public.lu/index.html
STATEC = National Statistical Institute: http://www.statec.public.lu/fr/index.html
Ministry of Finance (*Ministère des Finances*): http://www.mf.public.lu/
ADA: Customs & Excises Administration (*Administration des Douanes et Accises*): http://www.do.etat.lu/
Ministry of Sustainable Development and Infrastructure – Department of the Environment (*Ministère du Développement durable et des Infrastructures – Département de l'environnement* – MDDI-DEV): http://www.emwelt.lu/:
AEV = Environment Agency (*Administration de l'Environnement*): http://www.environnement.public.lu/functions/apropos_du_site/aev/index.html
AGE = Water Agency (*Administration de la Gestion de l'Eau*): http://www.eau.public.lu/
ANF = Nature & Forests Agency (*Administration de la Nature et des Forêts*): http://www.environnement.public.lu/functions/apropos_du_site/anf/index.html
Ministry of Sustainable Development and Infrastructure – Department of Transport (*Ministère du Développement durable et des Infrastructures – Département des Transports*): http://www.mt.public.lu/
SNCT = Vehicles Check Administration (*Société Nationale de Contrôle Technique*): http://www.snct.lu/snct/home.nsf

GHG reporting

Figure III.2-1 summarizes the organization of the GHG reporting in Luxembourg in accordance with the national Regulation for the setting-up of a National Inventory System (NIS).

FIGURE III.2-1 – LUXEMBOURG'S NIS ACCORDING TO THE REGULATION OF 1ST AUGUST 2007



It is worth noting that the Air/Noise Division of this Agency, is not only dealing with GHG reporting but also with reporting under the UNECE CLRTAP and under the "NEC Directive".

Luxembourg has, thus, adopted an **integrated approach** to avoid redundant and overlapping activities in different administrative services. This concentration of air emissions reporting in one department also allows an improved consistency between different reporting schemes. As an example, indirect GHG and SO_2 emissions that are to be recorded in the GHG inventory – and that, as indicated previously, need to be re-evaluated in the light of the revision of the inventories Luxembourg is compiling for the UNECE CLRTAP and under the "NEC Directive" – will be extracted and adapted from the CLRTAP/NEC reporting schemes.

With regard to inputs for the monitoring of GHG emissions, having E-PRTR and EU ETS managed by the Air/Noise Division of the Environment Agency ensures easy access to facilities' reported fuel and/or emissions that are subsequently integrated in GHG emissions calculations. The Environment Agency also gathers information from establishments and installations subordinated to operational permits to carry out certain activities, the so-called "*établissements classés*". There, too, valuable information for the inventories is found. More details on these AD and, sometimes, EF sources are presented in ***Section III.2.3***.

With regards to outputs from the Air/Noise Division, not only are they used for the various inventory reporting obligations (GHG, CLRTAP, NEC), but also for other reporting activities, such as those linked to Spatial Data Information (such as the EC INSPIRE Directive[105]) and under the Shared Environmental Information System.[106] Of course, these are also used for various national publications, as well as, for defining policies and measures (PaMs).

Finally, although the national regulation, setting up the NIS, only indicates that an agent, belonging to the Environment Agency, should develop, implement and maintain a QA/QC plan, it has been decided that QA/QC activities should be performed by an external company so to guarantee an independent review process ***[→ Section III.2.6]***.

Figure III.2-2 goes over the data flow process that is implied by the setting-up of the NIS. The Air/Noise Division of the Environment Agency not only collects and validates AD, EFs, parameters and emission estimates from sector experts, but also produces emission estimates. This flexibility is introduced in Luxembourg's system to ensure a better quality for the reporting of GHG emissions.

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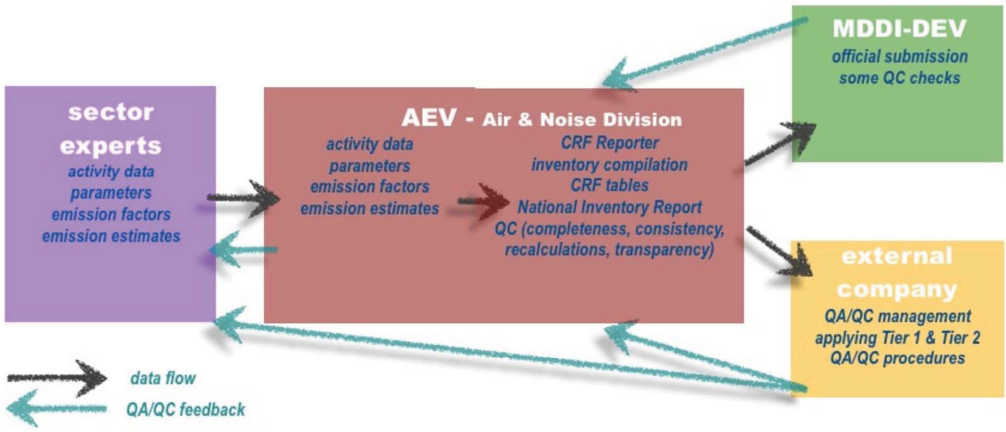
105 http://inspire.jrc.it/.

106 http://ec.europa.eu/environment/seis/index.htm.

FIGURE III.2-2 – THEORETICAL DATA FLOW ACCORDING TO LUXEMBOURG'S NIS



Luxembourg's emissions trading registry

Luxembourg's emissions trading registry has been operational since 2005 and serves both as registry for the EU Emissions Trading Scheme, and as the national registry for Luxembourg as a Party of the Kyoto Protocol.

Since July 2012, Luxembourg's national registry was migrated to a European based consolidated system operated by the European Commission. Please refer to *Section III.3* for more information on the consolidated system.

III.2.2. Inventory preparation process

III.2.2.1. Overview of inventory planning, preparation and management, including for supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol

GHG inventory submissions are produced under the provisions of the National Regulation for the setting-up of a NIS in Luxembourg *[→ Section III.2.1.2]*. That means, that the 3 usual stages for a GHG inventory preparation – i.e. (i) inventory planning, (ii) inventory preparation and (iii) inventory management – are applied.

The main planning of Luxembourg's GHG inventory is performed once a year during summer at the so called "**Decision Making Body**" meeting: a meeting between the Director of the Environment Agency, the Head of the Air/Noise Division, the quality manager, and the NIC.

During the meeting, the quality manager and the NIC present an overview of the activities throughout the previous reporting year, including information on audits and fulfilments of last year's "**Improvement Plan**". On the basis of this report, the "**Quality Management System**" (QMS) is judged by the Director and the Head of the Air/Noise division, in collaboration with the quality manager and the NIC. If required, measures to optimize the QMS are defined. Finally, the

"Improvement Plan" is elaborated on the basis of the previously conducted discussions. It consists of two parts:

- a **quality management improvement plan**: based on findings of internal and external audits; it also includes a training plan for sector experts;
- an **inventory improvement plan**: based on particular findings of reviews of the GHG inventory.

The "Decision Making Body" prioritises the recommended improvements (including a timeline and responsibilities) and cares for associated resources.

Table III.2-2 summarizes the **inventory preparation tasks**, whereas *Table III.2-3* gives an overview on the registry related tasks for providing the **supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol**. Both tables present a representative timeline.

TABLE III.2-2 – INVENTORY PREPARATION TIMELINE

Task	Description	Deadline
Decision Making Body meeting	a) evaluation of the fulfilment of the previous improvement plan b) preparation of a plan for QMS and inventory improvement, i.a. based on audit and review findings	Summer
Kick-Off	meeting of sector experts, quality manager and NIC; definition of a work plan	Summer
Activity data collection	collection of activity data, including contracting out studies	1st of November
Inventory preparation	estimation of emissions for all sources, including collection of background data	1st of December
Compilation of national inventory	stocking the database and transfer to CRF reporter ; key category analysis and uncertainty assessment	31st of December
Quality checks	Tier 1 and Tier 2 QA/QC activities *[→ Section III.2.6]*	December
Compilation of a report for the EC (the "Short-NIR")	compilation of an inventory report "Short NIR" and submission to the European Commission (Decision 280/2004/EC repealed by Regulation 525/2013)	15th of January
Preparation of the NIR	compilation of the National Inventory Report	January - March
EU Submission – NIR	submission of the National Inventory Report to the EC	15th of March
UNFCCC Submission – NIR	submission of CRF tables and of the National Inventory Report to the UNFCCC	15th of April
Archive submission	all relevant calculation and documentation files as well as the NIR are archived on CIRCALUX *[→ Sections III.2.2.2 & III.2.6]*	May

TABLE III.2–3– TIMELINE FOR REGISTRY RELATED TASKS

Task	Description	Deadline
Standard Electronic Format (SEF)	compilation of the SEF for the previous year	15th of January
Information on changes in the national registry	preparation of the chapter on the changes in the national registry, which is part of the NIR	15th of April
Information on accounting of Kyoto Protocol units	preparation of the chapter on information on the accounting of Kyoto Protocol units, which is part of the NIR. Compilation of the files for the Standard Independent Assessment Report (SIAR), which are submitted together with the NIR	15th of April

Finally, an official approval process has been established between the SNE – i.e. the Environment Agency – and the National Focal Point (NFP) for the UNFCCC – i.e. the Department of the Environment (MDDI-DEV) *[→ Figure III.2-1]*.[107] The SNE notifies the NFP, in writing, that the

107 Implementation of a recommendation from the 2008 in-country review [UNFCCC (2009), § 31(b)].

inventory has been compiled according to the rules established by the UNFCCC and uploads the submission onto the CIRCALUX data archive *[→ Section III.2.2.2.]*. The NFP informs the Minister in charge of the environment accordingly. Upon acceptance, the NFP uploads the submission from the CIRCALUX archive onto the UNFCCC Submission Portal and onto the European Central Data Repository hosted by the European Environment Agency (EEA).[108]

III.2.2.2. Inventory preparation

GHG inventory and KP-LULUCF inventory

Luxembourg's latest GHG inventory for the period 1990 to 2011 – submission 2013v1.2 – was compiled according to the recommendations for inventories set out in the UNFCCC Reporting Guidelines according to Decision 18/CP.8, the Common Reporting Format (CRF) (version 1.01), Decision 13/CP.9 and the new CRF for the Land Use Change and Forestry Sector. IPCC Guidelines have been applied as much as possible. These Guidelines are:

- the *Revised 1996 IPCC Guidelines for National GHG Inventories* (1996 IPCC-GL);
- the *2000 IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (2000 IPCC-GPG);
- the *2006 IPCC Guidelines for National GHG Inventories* (2006 IPCC-GL);
- the *2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry* (2003 IPCC-GPG-LULUCF).

Information on the methods and sources used for preparing the inventory are presented in details in Ministry of Sustainable Development and Infrastructure, Environment Agency (2013b). They are also summarized in ***Section III.2.3***.

During the inventory preparation process, sector experts collect activity data, emission factors and all relevant information needed for estimating the emissions. The sector experts also have specific responsibilities regarding the choice of methods, data processing and archiving and for contracting studies, if needed. As part of the QMS, the NIC approves the methodological choices. Sector experts are also responsible for performing quality control (QC) activities that are incorporated in the QMS. All data collected together with emission estimates are archived on a central archiving system *[→ Section III.2.6]*, together with detailed documented data sources in order to be able to perform future reconstructions of the inventory.

Supplementary information required under Article 7 of the Kyoto Protocol regarding KP-LULUCF is prepared by the same sector experts as for UNFCCC-LULUCF. Other Article 7 supplementary

108 See also article 8 of the National Regulation for the setting-up of a NIS in Luxembourg.

information is requested from Luxembourg's Emission Trading Registry, which is also located at the Environment Agency *[→ Section III.3]*.

Data collection, processing and storage, including for KP-LULUCF inventory

For estimating GHG emissions, Luxembourg mostly used Micro-soft Excel™ spreadsheets *[→ Table III.2-4]*. This way of proceeding is offering a very flexible system that can be easily adjusted to new requirements. It is only for the estimation of road transportation emissions, where a dedicated computer program developed for the EEA is employed: COPERT. COPERT IV v10.0 is a Microsoft Windows™ software tool for the calculation of emissions from road transport [Kouridis et al (2000)].[109] The emissions calculated include all major pollutants (CO_2, CO, CH_4, NOx, VOC, PM) and several more (N_2O, NH_3, SO_2, ...). Data produced is then transformed, using Microsoft Excel™ spreadsheets, into the UNFCCC CRF, according to the IPCC Guidelines, to comply with the reporting obligations under the UNFCCC.

TABLE III.2-4 – PROGRAMS AND SOFTWARE USED FOR GENERATING EMISSION ESTIMATES

CRF sector	Emissions calculated using ...
Energy, excl. road transportation – CRF 1 except 1A3b	MS Excel 2003
Road Transportation – CRF 1A3b	COPERT IV v10.0 and MS Excel 2003
Industrial Processes – CRF 2	MS Excel 2003
Solvent and Other Product Use – CRF 3	MS Excel 2003
Agriculture – CRF 4	MS Excel 2003
LULUCF – CRF 5	MS Excel 2003
Waste – CRF 6	MS Excel 2003

GHG estimates produced by the sector experts are then being centralized and verified by the SNE (i.e. the NIC – Environment Agency).

For the generation of the CRF tables and the XML submission file, Luxembourg used the latest version of the UNFCCC's CRF-Reporter, i.e. version 3.5.2. As a large number of GHG source categories are not occurring in Luxembourg *[→ Table III.1-1a]*, only around a hundred values per inventory year – other than notation keys – need to be transferred to the CRF-Reporter. This is why, so far, CRF Reporter has been "manually" populated by having recourse to "copy-paste" from Microsoft Excel™ inventory work files.

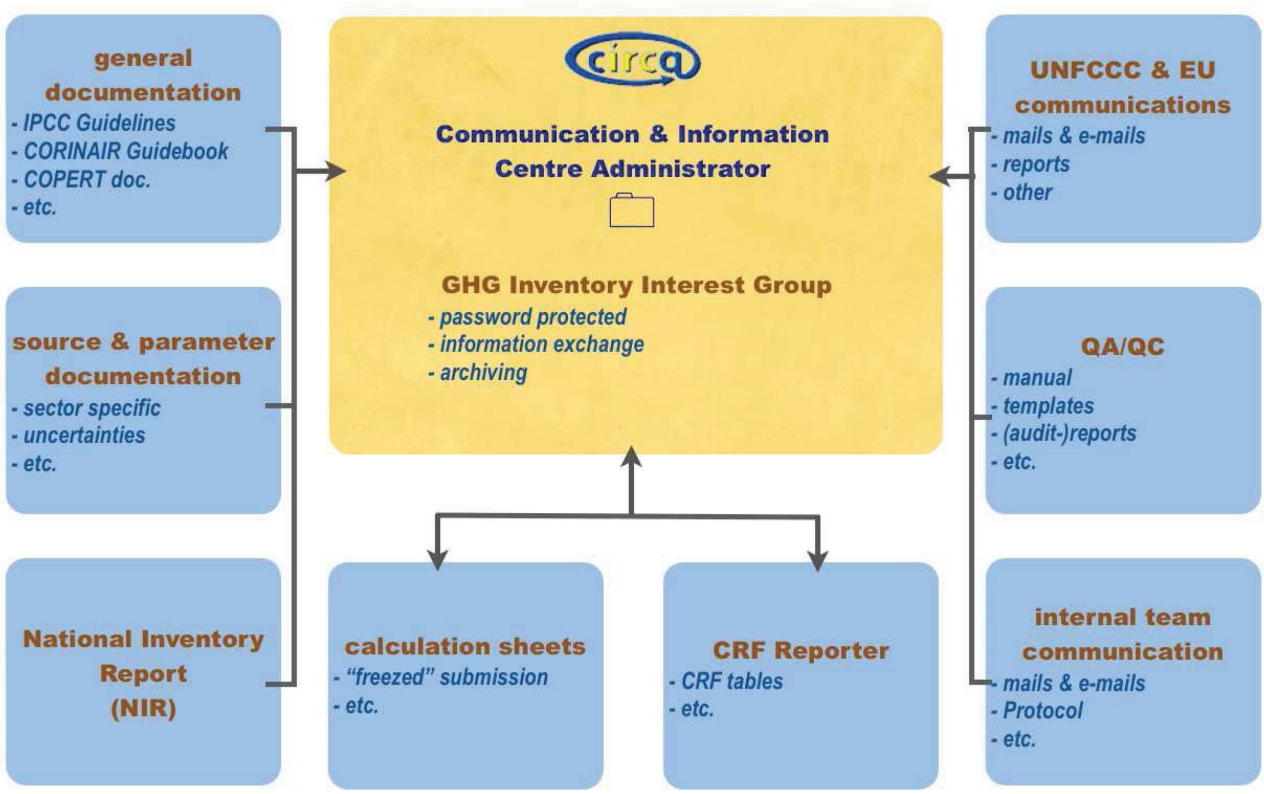
However, with the increasing number of LULUCF data, which needs to be transferred to the CRF-Reporter, this manual data transfer becomes prone to errors. Therefore, it is foreseen to integrate the emission estimates (and all the associated data such as emissions factors, activity data, documentation, etc.) in a centralised database. Specific software tools embedded in this database would then allow the automatic data transfer into the CRF-Reporter software, without the need of the "copy-paste" procedure. Currently, Luxembourg is in the process of switching to the centralised database, and it is expected that the automatic transfer will be used for a next

109 The COPERT software is continuously being improved and updated using the latest scientific data.

submission, probably in 2015. Nevertheless, this is not an absolute "must do" for Luxembourg since, as underlined above, yearly data to be included in CRF-Reporter are not numerous. Furthermore, "manually" populating CRF-Reporter offers concrete advantages compared to automated operations: mistakes and missing values can be directly identified, recalculations cross-checked, explanations for notation keys or recalculations not forgotten and documentation boxes filled accordingly when needed.

A centralised data management and archiving system (based on the European Data Exchange and Storage System CIRCA) has been implemented: **CIRCALUX** *[→ Figure III.2-3]*. This system is hosted by the National IT Administration, and access is password protected. This system enables sector experts to exchange and store data quickly and easily between administrations, which are not connected through a single network. The data stored on this system are backed up daily for the needs of data security. Furthermore, as part of the QMS, backups of the entire inventory information are made regularly on write-protected DVDs. This ensures the necessary documentation and archiving for future reconstruction of the inventory and for the timely response to requests during the review process.

FIGURE III.2-3 – DATA MANAGEMENT AND ARCHIVING SYSTEM (CIRCALUX)



Quality assurance/quality control (QA/QC) procedures and extensive review of the GHG inventory and the KP-LULUCF inventory

QA/QC procedures are performed as defined in the QMS plan *[→ Section III.2.6]*.

Quality assurance, control and plausibility assessments of the estimates are being performed through internal audits covering all sectors by the SNE in collaboration with the QA/QC manager.[110]. In addition, various checking procedures, included in the CRF-Reporter software are undertaken.

The NIR is circulated after publication to experts – as identified by the NIC and the QA/QC manager – that are involved in estimating GHG emissions in Luxembourg.

Comments received from experts are considered for the inventory improvement plan.

III.2.3. Methodologies and data sources used for submission 2013v1.2

III.2.3.1. GHG inventory

Table III.2-5 briefly presents the activity data (AD) sources, the types of emission factors (EFs) used, as well as the methods applied for estimating GHG emissions reported in submission 2013v1.2. A much more detailed table is provided in Annex A.I as an excerpt of summary tables of submission 2013v1.2.

Detailed information on data sources for activity and emission data, as well as for EFs used by sector, can be found in Ministry of Sustainable Development and Infrastructure, Environment Agency (2013b). A few general comments are, however, presented in the next paragraphs.

Activity and background data

Data used to produce the annual air emission (including GHG) inventories are mainly:

- taken from official statistics published by the National Statistical Institute (STATEC);
- extracted from statistical information received from other ministries (Ministry of the Economy for energy (IEA Joint Questionnaires), Administrations under the authority of the Ministry of Agriculture, Viticulture and Consumer Protection for agriculture, Nature and Forests Agency for LULUCF, etc.);
- coming from information supplied directly by facilities (annual reports, emission measurement reports);
- on occasion, from specific surveys or questionnaire and from expert judgements.

[110] Currently contracted from SEG-Umwelt Service GmbH (Mettlach, Germany).

TABLE III.2-5 – METHODOLOGIES, DATA SOURCES AND EFS USED BY LUXEMBOURG FOR SUBMISSION 2013V1.2 – MAIN CRF SECTORS

CRF Sector	CO_2			CH_4			N_2O		
	method applied	*AD*	*EF*	*method applied*	*AD*	*EF*	*method applied*	*AD*	*EF*
Energy, excl. road transportation – CRF 1 except 1A3b	Tier 1 Tier 2	NS PS Q TÜV	D CS PS	Tier 1	NS PS Q TÜV	D	Tier 1	NS PS Q TÜV	D
Road transportation – CRF 1A3b	CIV CS	NS SNCT	CS	CIV	NS SNCT	OTH	CIV	NS SNCT	OTH
Industrial Processes – CRF 2	Tier 2 CS	NS PS	CS PS	NA	NO	NA	NA	NO	NA
Solvent and Other Product Use – CRF 3	CS	NS PS	CS	NA	NA	NA	CS	NS PS	CS
Agriculture – CRF 4	NA	NA	NA	Tier 1 Tier 2	EJ NS	CS D OTH	Tier 1	EJ NS	D
LULUCF – CRF 5	Tier 1 Tier 2	NS EJ	CS D	NA	NA	NA	Tier 1	NS EJ	D
Waste – CRF 6	NA	NA	NA	Tier 1 Tier 2	NS Q PS	CS D	Tier 1	NS Q PS	PS D

Note: for F-gases (CRF category 2F) methods applied = CS; AD = NS & Q; EF = CS.

Abbreviations:
C = CORINAIR CS = Country Specific CIV = COPERT IV D = IPCC Default
EJ = Expert Judgement NS = National Statistics OTH = Other PS = Plant Specific Data
Q = Specific Questionnaire/Survey TÜV = TÜV Rheinland (1990), *Emissionskataster für das Großherzogtum Luxemburg*, Köln.

For large point sources – and after careful assessment of data plausibility – activity data that are reported by facilities are preferably used. Indeed, these data usually reflect the actual consumptions better than aggregated national statistics data, because the facility is supposed having the best information about its own emissions. Such plant specific data have been used for CRF sectors 1 and 2. Luxembourg's planned improvement for the future foresees to considerably extent the use of consumption and emission data provided by facilities either in the framework of the EU ETS and of the E-PRTR in its inventories.

Besides plant specific data collected under EU legal requirements, national obligations are also a source of activity and emission data for single facilities. This is the case under the law for "*établissements classés*" [111] that imposes regular reporting obligations to those units – the "*établissements classés*" – which, by their activities, could represent a risk with regards to security, public health and convenience for both the citizens and the workers occupied in these units, as well as regards the environment.[112] These "*établissements classés*" could be public or private industrial or commercial establishments and craft industries, as well as single specific equipment or processes within an installation.

111 http://www.environnement.public.lu/etablissements_classes/index.html.
112 "Permitting activities", i.e. activities subordinated to a permit.

Most of the plant specific data, whether they are collected for EU or national obligations, are actually transmitted and managed by the Environment Agency which eases a more systematic use of data provided directly by facilities. Thus, a more systematic use of facilities' data is currently being implemented. In particular, it is investigated whether it will be feasible, both technically and legally, that facilities would report only once for various purposes – such as EU ETS, E-PRTR, permitting activities, etc. – in order to avoid extra and unnecessary burden for them.

Emission factors

For EFs, besides plant specific factors derived from emission data transmitted by facilities (see above), it is mainly made use of default IPCC values published in the Revised 1996 or the 2006 IPCC Guidelines, as well as in the 2000 IPCC-GPG. Other sources for EFs are the EMEP/EEA air pollutant emission inventory guidebook — 2009[113] and national studies or calculations leading to country-specific EFs.

III.2.3.2. KP-LULUCF inventory

Land use and land use change data are based on satellite imagery, land cover maps held by the Nature and Forests Agency and on information on agricultural practices from the Agriculture Economic Service (SER). These two institutions are the main data providers for reporting on GHG in the framework of the KP-LULUCF inventory.

Accordingly, the area of forest land reported for Afforestation/Reforestation and Deforestation (ARD) under the Kyoto Protocol has the same basis as the area reported for land use changes from and to forests in the context of the UNFCCC GHG inventory taking the different time frame (ARD areas starting with 1990) as well as the permanence of ARD areas into account.

Furthermore, methods used to estimate emissions/removals from ARD activities are of the same tier method as those used for the UNFCCC reporting.

III.2.4. Key Category Analysis for submission 2013v1.2

The identification of key categories is described in the 2000 IPCC-GPG, Chapter 7 and in the 2003 IPCC-GPG-LULUCF, Chapter 5.4. It stipulates that a key category is one that is prioritised within the National System because its estimate has a significant influence on a country's total inventory of GHG in terms of the absolute level of emissions or removals, the trend in emissions or removals, or both. Actually, any category meeting the 95% threshold in any year of the Level Assessment (LA) or in the Trend Assessment (TA) is considered a key category. Then, whenever a method used for the estimation of emissions/removals of a key category is not consistent with the

[113] The guidebook is available here: http://www.eea.europa.eu/publications/emep-eea-emission-inventory-guidebook-2009.

requirements of the 2000 IPCC-GPG, the method will have to be improved in order to reduce uncertainty, which is considered in the emission inventory improvement programme.

All notations, descriptions of identification and results for key categories included in this section are based on the 2000 IPCC-GPG and the 2003 IPCC-GPG-LULUCF. The identification includes all reported GHG – CO_2, CH_4, N_2O, HFC, PFC and SF_6 – and all CRF categories.

The key category analysis was performed **using the Tier 1 approach** on the basis of submission 2013v1.2 to the UNFCCC. It comprises a LA for all years between 1990 and 2011, as well as a TA for the trend of the year 2011 with respect to base year emissions, i.e. 1990. As stipulated in the 2003 IPCC-GPG-LULUCF, key sources categories have been first identified excluding LULUCF categories and then repeated for the full inventory including LULUCF categories.

III.2.4.1. Key categories for Luxembourg – GHG inventory (including and excluding LULUCF)

This sub-section presents the results of Luxembourg's key category analysis, once excluding LULUCF categories, once including them.

Key categories analysis – excluding LULUCF

The key source categories comprise 11 784.13 Gg CO_2e in the year 2011, which is a share of 97.4% of Luxembourg's total GHG emissions, excluding LULUCF *[→ Table III.2-6]*.

TABLE III.2-6 – KEY CATEGORIES (LA), EXCLUDING LULUCF, BASED ON EMISSION DATA RECORDED IN SUBMISSION 2013V1.2

IPCC	IPCC source category	Fuel	Gas	2011 emissions Gg CO_2e	Share in 2011 national total GHG emissions (excl. LULUCF)
1A1a	Public Electricity and Heat Production	*gaseous*	CO_2	923.21	7.63%
1A1a	Public Electricity and Heat Production	*other*	CO_2	65.11	0.54%
1A2a	Public Electricity and Heat Production	*liquid*	CO_2	373.88	3.09%
1A2a	Iron and Steel	*gaseous*	CO_2	13.37	0.11%
1A2a	Iron and Steel	*liquid*	CO_2	NO	NO
1A2b	Iron and Steel	*solid*	CO_2	50.34	0.42%
1A2c	Non-Ferrous Metals	*gaseous*	CO_2	149.99	1.24%
1A2c	Chemicals	*gaseous*	CO_2	11.85	0.10%
1A2e	Chemicals	*liquid*	CO_2	14.67	0.12%
1A2f	Other	*gaseous*	CO_2	244.83	2.02%
1A2f	Other	*liquid*	CO_2	146.64	1.21%
1A2f	Other	*solid*	CO_2	188.80	1.56%
1A3b	Road Transportation	*diesel oil*	CO_2	5616.96	46.43%
1A3b	Road Transportation	*gasoline*	CO_2	1115.76	9.22%
1A3b	Road Transportation	*gasoline*	N_2O	67.23	0.56%
1A3b	Road Transportation	*diesel oil*	N_2O	11.65	0.10%
1A4a	Commercial/Institutional	*gaseous*	CO_2	342.72	2.83%
1A4a	Commercial/Institutional	*liquid*	CO_2	194.09	1.60%
1A4b	Residential	*gaseous*	CO_2	448.48	3.71%
1A4b	Residential	*liquid*	CO_2	457.80	3.78%
1A4c	Agriculture/Forestry/Fisheries	*liquid*	CO_2	51.07	0.42%

IPCC	IPCC source category	Fuel	Gas	2011 emissions Gg CO_2e	Share in 2011 national total GHG emissions (excl. LULUCF)
2A1	Cement Production	-	CO_2	411.12	3.40%
2A7	Other – Glass Production	-	CO_2	61.58	0.51%
2C1	Iron and Steel Production	-	CO_2	123.86	1.02%
2F	Emissions of F-gases	-	F-gases	74.93	0.62%
4A1	Enteric Fermentation – Cattle	-	CH_4	237.42	1.96%
4B1	Manure Management – Cattle	-	CH_4	59.38	0.49%
4D1	Agricultural Soils – Direct Soil Emissions	-	N_2O	126.40	1.04%
4D2	Agricultural Soils – Pasture, Range & Paddock Manure	-	N_2O	56.10	0.46%
4D3	Agricultural Soils – Indirect Emissions	-	N_2O	115.42	0.95%
6A1	Solid Waste Disposal on Land – Managed Waste Disposal on Land	-	CH_4	29.50	0.24%

Source: Environment Agency – Submission 2013v1.2.

Table III.2-7 indicates which source categories have been identified as key categories for every reported year from 1990 to 2011.

Key categories analysis – including LULUCF

The key categories comprise 10 880.59 Gg CO_2e in the year 2011, which is a share of 92.2% of Luxembourg's 2011 total GHG emissions, including LULUCF *[→ Table III.2-8]*.

TABLE III.2-8 – KEY CATEGORIES (LA), INCLUDING LULUCF, BASED ON EMISSION DATA RECORDED IN SUBMISSION 2013V1.2

IPCC	IPCC source category	Fuel	Gas	2011 emissions Gg CO_2e	Share in 2011 national total GHG emissions (incl. LULUCF)
1A1a	Public Electricity and Heat Production	gaseous	CO_2	923.21	7.82%
1A2a	Iron and Steel	gaseous	CO_2	373.88	3.17%
1A2a	Iron and Steel	solid	CO_2	NO	NO
1A2a	Iron and Steel	liquid	CO_2	13.37	0.11%
1A2c	Chemicals	gaseous	CO_2	149.99	1.27%
1A2c	Chemicals	liquid	CO_2	11.85	0.10%
1A2f	Other	gaseous	CO_2	244.83	2.07%
1A2f	Other	liquid	CO_2	146.64	1.24%
1A2f	Other	solid	CO_2	188.80	1.60%
1A3b	Road Transportation	diesel oil	CO_2	5616.96	47.59%
1A3b	Road Transportation	gasoline	CO_2	1115.76	9.45%
1A4a	Commercial/Institutional	gaseous	CO_2	342.72	2.90%
1A4a	Commercial/Institutional	liquid	CO_2	194.09	1.64%
1A4b	Residential	gaseous	CO_2	448.48	3.80%
1A4b	Residential	liquid	CO_2	457.80	3.88%
2A1	Cement Production	-	CO_2	411.12	3.48%
2C1	Iron and Steel Production	-	CO_2	123.86	1.05%
4A1	Enteric Fermentation – Cattle	-	CH_4	237.42	2.01%
4D1	Agricultural Soils – Direct Soil Emissions	-	N_2O	126.40	1.07%
4D3	Agricultural Soils – Indirect Emissions	-	N_2O	115.42	0.98%
5A1	Forest Land Remaining Forest Land	-	CO_2	-401.87	-3.40%
5A2	Land converted to Forest Land	-	CO_2	-67.32	-0.57%
5E2	Land converted to Settlements	-	CO_2	107.21	0.91%

Source: Environment Agency – Submission 2013v1.2.

Table III.2-9 indicates which source categories have been identified as key categories for every reported year from 1990 to 2011.

III.2.4.2. Key categories for Luxembourg – KP-LULUCF inventory

According to the 2003 IPCC-GPG-LULUCF, the key categories for Kyoto Protocol activities can be derived from the identified key categories for the UNFCCC inventory as follows: whenever a category is identified as key in the UNFCCC inventory, the associated activity under the Kyoto Protocol can be considered as key.

The key category analysis was performed **using the Tier 1 approach** on the basis of submission 2013v1.2 to the UNFCCC. It comprises a LA for all years between 1990 and 2011, as well as a TA for the trend of the year 2011 with respect to base year emissions, i.e. 1990. As stipulated in the 2003 IPCC-GPG-LULUCF, key categories have been identified, for the full inventory, including LULUCF categories.

In the case of Luxembourg, only CRF sub-category 5.A.1 – Forest Land Remaining Forest Land – is regarded as a key category in 2011 in the UNFCCC inventory. As neither AR (Afforestation and Reforestation) nor D (Deforestation) are corresponding Kyoto Protocol categories to IPCC category 5.A.1, none of the mandatory Article 3.3 activities Luxembourg opted for are identified as key according to the quantitative analysis.

TABLE III.2-7 – KEY CATEGORIES (QUALITATIVE), EXCLUDING LULUCF, OF SUBMISSION 2013V1.2: 1990-2011

IPCC	IPCC source category	Fuel	Gas	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2011
				LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	TA
1A1a	Public Electricity and Heat Production	*gaseous*	CO_2						X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1A1a	Public Electricity and Heat Production	*other*	CO_2									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1A1a	Public Electricity and Heat Production	*liquid*	CO_2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
1A2a	Iron and Steel	*gaseous*	CO_2	X	X	X	X	X	X	X	X	X	X		X	X										X
1A2a	Iron and Steel	*liquid*	CO_2	X	X	X	X	X	X	X	X															
1A2a	Iron and Steel	*solid*	CO_2															X		X						
1A2b	Non-Ferrous Metals	*gaseous*	CO_2			X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1A2c	Chemicals	*gaseous*	CO_2	X	X	X	X	X	X	X	X															X
1A2c	Chemicals	*liquid*	CO_2												X											
1A2f	Other	*gaseous*	CO_2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1A2f	Other	*liquid*	CO_2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1A2f	Other	*solid*	CO_2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1A3b	Road Transportation	*diesel oil*	CO_2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1A3b	Road Transportation	*gasoline*	CO_2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1A3b	Road Transportation	*diesel oil*	N_2O																						X	X
1A3b	Road Transportation	*gasoline*	N_2O									X	X	X	X	X										
1A4a	Commercial/Institutional	*gaseous*	CO_2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1A4a	Commercial/Institutional	*liquid*	CO_2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1A4b	Residential	*gaseous*	CO_2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1A4b	Residential	*liquid*	CO_2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1A4c	Agriculture/Forestry/Fisheries	*liquid*	CO_2											X	X	X	X				X		X	X		X
2A1	Cement Production	-	CO_2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2A7	Other – Glass Production	-	CO_2						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2C1	Iron and Steel Production	-	CO_2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2F	Emissions of F-gases	-	*F-gases*														X	X	X	X	X	X	X	X	X	X

IPCC	IPCC source category	Fuel	Gas	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2011
				LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	TA
4A1	Enteric Fermentation – Cattle	-	CH_4	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4B1	Manure Management – Cattle	-	CH_4				X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4D1	Agricultural Soils – Direct Soil Emissions	-	N_2O	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4D2	Agricultural Soils – Pasture, Range & Paddock Manure	-	N_2O	X						X	X	X	X	X	X	X	X	X	X			X				X
4D3	Agricultural Soils – Indirect Emissions	-	N_2O	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6A1	Managed Waste Disposal on Land	-	CH_4	X	X	X	X	X	X	X	X	X	X	X	X	X	X									

Source: Environment Agency – Submission 2013v1.2.

TABLE III.2-9 – KEY CATEGORIES (QUALITATIVE), INCLUDING LULUCF, OF SUBMISSION 2013V1.2: 1990-2011

IPCC	IPCC source category	Fuel	Gas	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2011
				LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	TA
1A1a	Public Electricity and Heat Production	*gaseous*	CO_2												X	X	X	X	X	X	X	X	X	X	X	X
1A1a	Public Electricity and Heat Production	*other*	CO_2																							X
1A2a	Iron and Steel	*gaseous*	CO_2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1A2a	Iron and Steel	*liquid*	CO_2		X																					
1A2a	Iron and Steel	*solid*	CO_2	X	X	X	X	X	X	X	X															
1A2b	Non-Ferrous Metals	*gaseous*	CO_2																							X
1A2c	Chemicals	*gaseous*	CO_2																							X
1A2c	Chemicals	*liquid*	CO_2	X	X																					
1A2f	Other	*gaseous*	CO_2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1A2f	Other	*liquid*	CO_2	X	X							X	X			X	X	X	X	X	X	X	X	X	X	X
1A2f	Other	*solid*	CO_2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1A3b	Road Transportation	*diesel oil*	CO_2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1A3b	Road Transportation	*gasoline*	CO_2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1A3b	Road Transportation	*diesel oil*	N_2O																							X
1A4a	Commercial/Institutional	*gaseous*	CO_2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

IPCC	IPCC source category	Fuel	Gas	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2011
				LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	LA	TA
1A4a	**Commercial/Institutional**	*liquid*	CO_2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					X	X	X
1A4b	**Residential**	*gaseous*	CO_2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1A4b	**Residential**	*liquid*	CO_2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1A4c	**Agriculture/Forestry/Fisheries**	*liquid*	CO_2																							X
2A1	**Cement Production**	-	CO_2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2C1	**Iron and Steel Production**	-	CO_2	X	X	X	X	X	X	X	X	X	X	X	X					X	X	X				X
2F	**Emissions of F-gases**	-	*F-gases*																							X
4A1	**Enteric Fermentation – Cattle**	-	CH_4	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4B1	**Manure Management – Cattle**	-	CH_4																							X
4D1	**Agricultural Soils – Direct Soil Emissions**	-	N_2O	X	X	X	X	X	X	X		X	X	X						X	X	X	X			X
4D3	**Agricultural Soils – Indirect Emissions**	-	N_2O	X	X	X		X	X																	X
5A1	**Forest Land Remaining Forest Land**	-	CO_2	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
5A2	**Land converted to Forest Land**	-	CO_2	X	X																					X
5E2	**Land converted to Settlements**	-	CO_2	X	X			X	X			X														X

Source: Environment Agency – Submission 2013v1.2.

III.2.5. Recalculation of data

Compiling an emission inventory includes data collection, data transfer and data processing. For Luxembourg's GHG inventory, data are collected from different sources, for instance national statistics, plant operators, studies, personal information or other publications. The provided data must be transferred from different data formats and units into a unique electronic format to be processed further. The calculation of emissions, by applying methodologies on the collected data, and the final computing of time series into a predefined format (CRF) are further steps in the preparation of the final submission. Finally, the submission must be delivered in due time. Even though the implemented QA/QC system should prevent or at least minimize potential errors *[→ Section III.2.6]*, it will remain necessary to make some revisions (called "recalculations") under the following circumstances:

- an emission source was not considered in the previous inventory;
- a source/data supplier has delivered new data. The causes might be that previous data were preliminary data or that methodology has been improved/modified;
- occurrence of errors in data transfer or processing: wrong data, unit-conversion, software errors, etc.;
- methodological changes: a new methodology must be applied to fulfil the reporting obligations because of one of the following reasons:
    - to decrease uncertainties;
    - an emission source becomes a key source;
    - consistent input data needed for applying the methodology is no longer accessible;
    - input data for more detailed methodology is now available;
    - the methodology is no longer appropriate.

In Luxembourg, recalculations of previously submitted inventory data are performed following the 2000 IPCC-GPG, Chapter 7 ("Methodological Choice and Recalculation") with, as the list above shows, the **unique purpose to improve the GHG inventory**. They are made **on an ad-hoc basis** by each sector experts and should be documented so that the NIC can cross-check and assess the rationale for any recalculation.[114] The procedures put in place for the QA/QC – such as checklists, e.g. – provides also a mean to present, justify and validate recalculations.

[114] The NIC is the only person who will populate, i.e. insert, delete, document data, in the "compiler" version of CRF Reporter, i.e. the version used for preparing an official submission (see Section III.2.2.2 on the submission preparation process).

III.2.6. Quality Assurance and Quality Control (QA/QC)[115]

The overall responsibility for the establishment and existence of a Quality Management System (QMS), in order to prepare the national inventory of GHG and air pollutants, lies with the SNE – i.e. the Environment Agency as designated by the national Regulation for the setting-up of a National Inventory System *[→ Section III.2.1.2]*[116]. Within the Agency, the Air & Noise Division supervises the inventory preparation process for various obligations as outlined in ***Section III.2.1.1*** and acts as both the NIC and the national inventory focal point *[→ Section III.2.1.2]*. The political responsibility lies with the Department of the Environment of the Ministry of Sustainable Development and Infrastructure (MDDI-DEV).

More precisely, the Air & Noise Division is responsible for the following tasks:

The National Inventory Compiler (NIC):

- supervises the inventory preparation process for various obligations as outlined below;
- is the national inventory focal point to the Ministry (MDDI-DEV).

The national, European and international obligations are:

- UNECE Convention on Long Range Transboundary Air Pollution and its Protocols;
- UNFCCC & Kyoto Protocol;
- European Union:
  - EU GHG Monitoring Mechanism (280/2004/EC & 2005/166/EC repealed
  - by Regulation (EU) No 525/2013);
  - NEC Directive (2001/81/EC);
  - Ambient Air Quality Directive (2008/50/EC).

III.2.6.1. Quality Policy

The quality policy is the central aspect of a QMS. It defines the under-standing of quality in relation to all topics of inventory preparation and specifies its basic principles.

The SNE has:

- to establish and maintain the quality policy and quality objectives regarding GHG inventories;

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115 This section has been prepared by the Environment Agency and *SEG Umwelt-Service GmbH*.

116 *Règlement grand-ducal du 1er août 2007 relatif à la mise en place d'un Système d'Inventaire National des émissions de gaz à effet de serre dans le cadre de la Convention-cadre des Nations Unies sur le Changement Climatique* (http://www.legilux.public.lu/leg/a/archives/2007/1300708/1300708.pdf, p. 2318-2320).

- to promote the quality policy and quality objectives regarding GHG inventories through-out the organisation to increase awareness, motivation and involvement;
- to ensure focus on the fulfilment of the Kyoto Protocol and the requirements of the IPCC GPG Chapter 8 QA/QC;
- to ensure that appropriate processes are implemented to enable requirements of the IPCC GPG Chapter 8 QA/QC (and other interested parties) to be fulfilled and quality objectives to be achieved;
- to ensure that an effective and efficient QMS is established, implemented and maintained in order to achieve these quality objectives;
- to ensure the availability of necessary resources;
- to review the QMS periodically;
- to decide on actions regarding the quality policy and quality objectives regarding GHG inventories;
- to decide on actions for the improvement of the QMS;
- to decide on actions for the improvement of national GHG inventories.

III.2.6.2. QMS build-up

The build-up of the QMS of the GHG emission reporting is currently outsourced and supervised by *SEG Umwelt-Service GmbH*.[117]

Luxembourg's QMS follows a "Plan-Do-Check-Act-Cycle" (PDCA-cycle)[118], which is an accepted model for pursuing a continual improvement of performance according to international standards and is in line with procedures described in decision 19/CMP.1 and in the IPCC Good Practice Guidance.

Due to Luxembourg's clear extent, its QMS deals with a manageable quantity of documents. Following are the specifications of Luxembourg's QMS:

- firm build-up with a quality manual consisting of a chart with all relevant documents, handling instructions and deadlines for check *[→ Figure III.2-4]*;
- good manageability (instead of a complex system);
- usable and effective quality control procedures (user-friendly, clearly arranged).

Since the QMS has been implemented in the year 2008, it has evolved continuously and many improvements have already been realised.

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117 SEG Umwelt-Service GmbH, Auf der Haardt 2, D – 66693 Mettlach, http://www.seg-online.de.
118 http://asq.org/learn-about-quality/project-planning-tools/overview/pdca-cycle.html.

The QMS shall ensure and continuously improve the quality (measured by transparency, accuracy consistency, comparability, completeness (TACCC) and timeliness) of Luxembourg's GHG Inventory in order to fulfil the party's obligations according to articles 3, 5 and 7 of the Kyoto Protocol. The QMS therefore supplies procedures to:

- check integrity, correctness and completeness of data;
- identify errors and omissions;
- reduce uncertainties of emission estimates;
- document and archive inventory calculation sheets and background data.

III.2.6.3. QMS Structure

Luxembourg's QMS of the GHG inventory is organised in three layers *[→ Figure III.2-4]*:

Performance processes

Performance processes directly concern the compilation of the GHG inventory. They comprise input data, data acquisition, calculations, and generation of CRF tables and NIR as well as quality control checks and the outcomes of the NIR and CRF tables.

Management processes

Management processes control the system's performance by defining quality objectives, responsibilities, quality assurance procedures, improvement plans and the personnel's qualifications and obligations.

Supporting processes

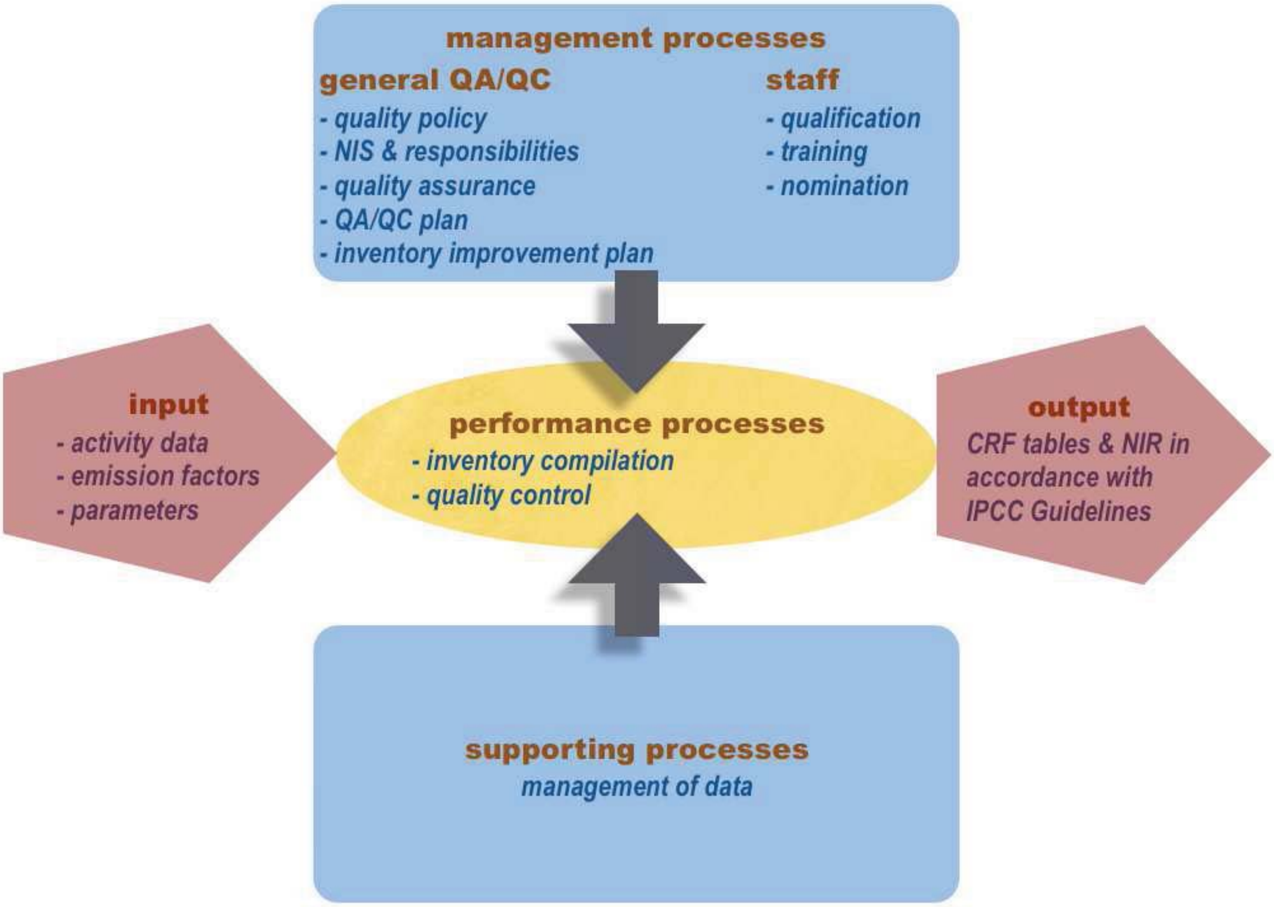
Supporting processes assist the system's performance by providing technical requirements and standards.

III.2.6.4. Quality Manual

The applied quality manual adopts the structure of the QMS and is divided in management, performance and supporting processes.

For each process, a list of related documents exists with information on content, handling, interval of document check and planned improvement. An extract of the quality manual is given below *[→ Figure III.2-5]*.

FIGURE III.2-4 – QMS STRUCTURE



III.2.6.5. Inventory Timetable

The inventory timetable gives several schedules to control the performance of inventory compilation, quality control and quality assurance procedures, implementation of inventory improvements and inventory publication *[→ Table III.2-2]*.

In addition, there are summaries of deadlines regarding EU and UNFCCC submissions.

Timetable for inventory planning and preparation

This schedule refers to general inventory work:

- yearly meetings of the inventory work group and the decision making body;
- key category analysis;
- uncertainty analysis;
- generation of CRF tables;
- NIR preparation and finalisation;
- NIR and CRF submission;

- publication and archiving of NIR;
- consideration and implementation of EU review recommendations;
- consideration and implementation of UNFCCC review recommendations;
- internal and external training;
- documentation and archiving.

Sector specific timetable for inventory planning and preparation

This schedule refers to sector specific compilation work and quality control checks:

- collection of activity data, emission factors and other parameters;
- calculation of emissions and removals;
- quality check of data, comparison with previous years, documentation of calculations and assumptions;
- uncertainty analysis;
- completion of checklists and other QC activities;
- documentation and archiving.

QA/QC timetable

This schedule especially refers to QA procedures:

- internal audit;
- implementation of internal review recommendations;
- yearly meetings of the inventory work group and the decision making body;
- QA/QC training for the NIC and the sector experts.

FIGURE III.2-5 – EXTRACT OF THE QA/QC MANUAL

	QA/QC procedure	purpose	document	content	handling	interval of document check
management processes	quality policy	basis of the implemented quality management system	quality policy	obligation to prepare and improve a GHG inventory according the demands resulting from UNFCCC, Kyoto protocol and other obligations	the head of administration, NIC and quality manager check validity of quality policy -> adjustment if necessary -> announcement	yearly before kick-off meeting
	general QA/QC	organisation of inventory work	definitions and list of abbreviations	explanation of important terms and abbreviations that are used	NIC and quality manager check validity -> adjustment if necessary	yearly before kick-off meeting
			Luxembourg's National Inventory System	organisation of Luxembourg's National System, organigram, position of QA/QC within the organisation, handling of submission	"Règlement grand-ducal du 1er août 2007 relatif à la mise en place d'un Système d'Inventaire national des émissions de gaz à effet de serre dans le cadre de la Convention-cadre des Nations Unies sur le Changement Climatique" (RGD) dictates handling of submission (AEV -> EIONET, MEV -> UNFCCC); NIC and quality manager check validity -> adjustment if necessary -> announcement	yearly before kick-off meeting
			responsibilities	personnel involved in inventory work (collection of activity data, selection of emission factors and methods, calculation of emissions, data compilation, uncertainties, recalculations, identification of key categories, etc.)	nomination of sector experts and data suppliers according RGD; NIC and quality manager check validity -> adjustment if necessary -> announcement	yearly before kick-off meeting
	personnel		nominations	nominations of sector experts and data suppliers according RGD	nomination by minister of environment; NIC and quality manager check validity -> information of ministry if necessary	yearly before kick-off meeting
			job specification and obligation for secrecy	description of job and tasks, request of data secrecy	NIC and quality manager check validity -> adjustment if necessary; announcement per mail	yearly before kick-off meeting
			personal file	proof of sector expert's qualification	sector experts complete their personal file	current
	quality assurance	to support and complete quality control measures	internal audit programm	checklist for performance of internal reviews (conformity with IPCCC Guidelines, target-performance comparison)	internal audit of general aspects by quality manager, of sector specific aspects by NIC -> internal audit report -> QA/QC plan	yearly before kick-off meeting
		check of formal aspects	internal audit report	audited sectors, observations, proposed improvements	report prepared by quality manager and NIC -> generation of QA/QC plan	current
		check of applicability & comparisons	external audit report	audited sectors, observations, proposed improvements	report prepared by external persons or organisations -> generation of QA/QC plan	current
			audit list	date, audit character, audited sectors, auditors, hence prepared audit reports and QA/QC plans	auditlist completed by NIC and quality manager	current
			inconsistencies	procedure for handling of inconsistencies (that are detected during compilation of inventory, in internal or external audits)	documenting and archiving of indication of inconsistency (audit report, annotation) -> informing of NIC and quality manager -> entry of proposals for improvement in QA/QC plan	yearly before kick-off meeting
	QA/QC plan	list of objectives and proposed actions in order to improve inventory's quality	QA/QC plan	general and sector specific improvement plan	result of internal and external audits; documenting of detected inconsistencies or possibilities for improvement in QA/QC plan by NIC and quality manager -> definition of deadlines -> check if objectives have been achieved during the following audits	current
performance processes	inventory		inventory timetable	general timetable with dates of submission; sector specific timetables; deadlines; timetable QA/QC	NIC, quality manager and sector experts check validity -> adjustment if necessary -> announcement per mail	yearly before kick-off meeting
			calculation sheets	calculated emissions; information on activity data, data suppliers (QA/QC), emission factors, calculation methods and special events; information on completeness, revisions and planned improvements of emission data	sector experts complete their calculation sheets -> transfer to NIC before deadline; check of document by NIC and quality manager; check of data content by sector expert	yearly before kick-off meeting
			documentation standard operating procedure	calculated emissions; information on activity data, data suppliers (QA/QC), emission factors, calculation methods and special events; documentation shall be replaced by calculation sheets as soon as possible	sector experts describe calculation of emissions -> transfer to NIC before deadline; check of document by NIC and quality manager; check of data content by sector expert;	yearly before kick-off meeting
			NIR and crf-tables	national greenhouse gas inventory	sector experts submit calculation sheets to NIC before deadline -> NIC generates crf-tables and compiles NIR -> submission of crf-tables and NIR to EU and UNFCCC	current according the deadlines
	quality control	activities to assess and maintain the quality of the inventory being compiled	data validation	Accuracy checks on data acquisition and calculations	performance by sector experts before submission; completion of checklists; archiving of checks; transmission of completed checklists in common with NIR data to NIC	yearly before kick-off meeting
supporting processes	data managemen	definition of data naming and archiving	data flow	cooperation between the competent authorities and organisations; exchange and archiving of data and information	sector experts calculate emissions and perform data validation checks -> submission of calculations to NIC -> NIC validates methods, activity data and emission factors, generates crf-tables and compiles NIR; NIC and quality manager perform internal audit on NIR compilation -> generation of a QA/QC plan including proposed improvements -> information of sector experts and implementation of improvements	yearly before kick-off meeting
			management of input data for multiple use	procedure for handling of input data that serve several sectors		yearly before kick-off meeting
			data management on CIRCA	instruction for data naming and archiving	NIC designates access authorisation	yearly before kick-off meeting

Sources: SEG Umwelt-Service GmbH and Environment Agency.

III.2.6.6. Quality Control and Quality Assurance procedures

The first steps to implement quality control and quality assurance procedures *[→ Figure III.2-6]* have already been undertaken but need further improvement. The current status and planned improvements are described in the following sub-sections.

FIGURE III.2-6 – QA/QC PROCEDURES

does NOT require knowledge of the emission source category	requires knowledge of the emission source category
general	source specific
QC procedures sector experts (1st party) performed throughout preparation of inventory	
TIER 1	**TIER 2**
data validation, calculation sheet (check of formal aspects)	preparation of NIR, comparison with Guidelines (check of applicability, comparisons)
QA procedures quality manager (2nd or 3rd party; staff not directly involved, preferably independent) performed after inventory work has finished	
TIER 1 basic, before submission	
	Internal audit / EU 'Initial check' **(Expert Peer Review)**
	evaluate if TIER2 QC is effectively performed (check if methodologies are applicable)
TIER 2 extensive	
System audit by Umweltbundesamt (Audit)	**ICR by UNFCCC (Expert Peer Review)**
evaluate if TIER 2 QC is effectively performed	evaluate if TIER 2 QC is effectively performed (Check if methodologies are applicable)

Sources: *Umweltbundesamt* Austria, *SEG Umwelt-Service GmbH* and Environment Agency.

Quality Control procedures

The following Quality Control procedures are conducted:

- yearly meeting of the "Decision Making Body" *[→ Section III.2.2.1]* in order to appoint responsibilities, priorities and schedules for inventory work;
- checklists for data supplier that have to be completed by external suppliers of input data in order to assure the reliability of the reported data;
- checklists for validation of data that have to be completed by sector experts until data are transmitted to the NIC. An example of a data validation checklist for a sector expert is given in *Figure III.2-7*.

FIGURE III.2-7 – DATA VALIDATION CHECKLIST

Data:	1990 - 2xxx																	
Source:	CRF	XXX		Snap	XX XX													
	Activity data			check done			Emission factor			check done			Emissions			check done		
Greenhouse gas	CO2	CH4	N2O	Remarks	Date	Person	CO2	CH4	N2O	Remarks	Date	Person	CO2	CH4	N2O	Remarks	Date	Person
Content check																		
Trend checks																		
For each category, current inventory estimates should be compared to previous estimates, if available. If there are significant changes or departures from expected trends, re-check estimates and explain any differences																		
Data plausible in comparison to other references																		
Check time series consistency																		
For each category check input data for temporal consistency in time series																		
Check methodological and data changes resulting in recalculations																		
Check that the effects of mitigation activities have been appropriately reflected in time series calculations																		
Check completeness																		
Confirm that estimates are reported for all categories and for all years from the appropriate base year to the period of the current inventory																		
For subcategories, confirm that entire category is being covered																		
Provide clear definition of "Other" type categories																		
Check that known data gaps that result in incomplete estimates are documented, including a qualitative evaluation of the importance of the estimate in relation to total emissions																		
Uncertainty estimation of data existent																		
data relying on a legal reporting commitment																		
Formal check																		
Collection of data is understandable																		
Check that assumptions and criteria for the selection of data are documented																		
Assumptions and criteria for the selection of data are documented																		
Cross-check descriptions of activity data, emission factors and other estimation parameters with information on categories and ensure that these are properly recorded and archived																		
Check for transcription errors in data input and reference																		
data correctly entered and transcribed																		
Confirm that bibliographical data references are properly cited in the internal documentation																		
Cross-check a sample of data from each source category (either measurements or parameters used in calculations) for transcription errors																		
Accurate data aggregation and correctness of calculations																		
Parameters and units are correctly recorded																		
Data fields are properly labelled																		
Data transmission of intermediate result is correct																		
Check that parameters and units are correctly recordedand that appropriate conversion factors are used																		
Units are properly labelled and correctly carried through from beginning to end of calculations																		
Conversion factors respectively temporal and spatial adjustment factors are correct																		
Data path and data coherence are understandable																		
Consistency given for the multiple use of data																		
Archiving of data and records ensured																		
Emissions complete																		
Uncertainty estimation of emissions existent																		
emission measurements in compliance with international accredited standards																		

	Uncertainties			check done		
Greenhouse gas	CO2	CH4	N2O	Remarks	Date	Person
Content check						
Check that uncertainties in emissions and removals are estimated and calculated correctly						
Check that qualifications of individuals providing expert judgement for uncertainty estimates are appropriate						
Check that qualifications, assumptions and expert judgements are recorded						
Formal check						
Designation of uncertainties is understandable						
Uncertainties complete						
documentation of fundamental assumption concerning expert judgement						
Archiving of data and records ensured						

Sources: *Umweltbundesamt* Austria, *SEG Umwelt-Service GmbH* and Environment Agency.

- checklists for verification of methods, activity data and emission factors that have to be completed by sector experts.
- checklist for the monitoring of internal and external reviews that has to be completed by the quality manager.

Note: checks for validation of data include:

- checks of activity data (trend checks, time series consistency, completeness, check of assumptions and criteria for activity data, check for transcription errors in data input and reference);
- checks of EFs (trend checks, time series consistency, completeness, check of correct recording of units and the use of appropriate conversion factors, check of documentation of assumptions and criteria for the selection of emission factors, check for transcription errors in data input and reference);
- checks of emissions (trend checks, time series consistency, completeness, check of documentation of assumptions and criteria for emissions, check for transcription errors in data input and reference, check of correct recording of units and the use of appropriate conversion factors);
- check of uncertainties (check of correct calculation and estimation of uncertainties in emissions and removals).

Quality Assurance procedures

The following Quality Assurance procedures are conducted:

- internal audit during NIR preparation time performed by the quality manager, the NIC and a consultant from *Umweltbundesamt* Austria. The internal review analyses every sector as well as the QMS system and checks:
  - whether inventory work and the inventory comply with Revised 1996 IPCC Guidelines, Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories and Good Practice Guidance for Land Use, Land Use Change and Forestry;
  - whether data acquisition, calculation, referencing and archiving is handled according to the defined methods;
  - whether there are enough resources for inventory work;
  - whether relevant data are available and if the reliability of external data is guaranteed;
  - whether the QMS system needs improvement;
  - whether recommendations of EU reviews, UNFCCC reviews and previous internal audits have been considered and implemented.
- QA/QC training for the sector experts and the NIC during execution of the internal audit;

- support by inventory experts from *Umweltbundesamt* Austria;
- external audits conducted by experts who provide support for inventory work, EU or UNFCCC.

Improvement plan

The results from internal and external audits are merged in the improvement plan. This plan lists the relevant sector, recommendations for improvement, responsibilities, deadlines and gives opportunity for attest.

The improvement plan is segmented in a QA/QC plan, that contains recommendations for the improvement of the QMS, and an inventory improvement plan, that contains recommendations for inventory improvement.

The "Decision Making Body" prioritises the recommended improvements and cares for associated resources.

Planned improvements

The following QMS improvements shall be implemented in 2013 and the following years:

- strengthening the implementation of the QMS in general;
- improvement of QC procedures in the LULUCF sector;
- strengthening the implementation of QA/QC procedures in KP-LULUCF;
- development of the four-eyes principle in inventory work;
- continuance in QA/QC training of NIC and sector experts.

III.2.6.7. Archiving and documentation

Within the inventory system, a system for transparent documentation of inventory data and related information (special circumstances, assumptions etc.) is implemented. Archiving takes place on the CIRCALUX server within the folder "*Inventaires gaz à effet de serre*".[119] The data is secure for at least fifteen years.

As a principle, every file shall be named clearly, shall be write/delete protected and supply relevant information concerning validity in the footer.

119 https://circalux.etat.lu/Members/irc/public/invges/home (only for members). See section III.2.2.2.

III.2.7. Procedures for official consideration and approval of the inventory

The process for the official consideration of the GHG inventory has been presented in *Section III.2.1.2* and *Figure III.2-1* where it is explained that the Environment Agency has the "technical" knowledge and responsibility for the GHG inventories, and that the Department of the Environment acting as UNFCCC National Focal Point (NFP) has the "political" responsibility. Thus, it is the Department that officially submits the inventories and their related reports to the UNFCCC Secretariat and to the EC (cf Article 8 of the Grand-Ducal Regulation[120] setting-up a National Inventory System in Luxembourg).

III.2.8. Additional information

According to Article 10, paragraph (f), of the Kyoto Protocol, Annex I Parties should include in their national communications information on programmes and activities undertaken pursuant to this Article. It is suggested, in the framework of the National System, to report on paragraph a of Article 10 dealing with "(…) **cost-effective** national and, where appropriate, regional **programmes to improve the quality of local EFs, activity data and/or models** which reflect the socio-economic conditions of each Party for the preparation and periodic updating of national GHG inventories (…)".

In this context, on-going activities one activity is worth to be briefly described. It touches upon "road fuel sales to non-residents".

As discussed in *Section II.8*, an unequivocal imbalance exists in Luxembourg between road fuel consumption by the resident population and the total road fuel sales. Due to its location, the usually cheaper prices as compared to the neighboring countries and the fact that the Luxembourg economy nearly doubles its workforce during the day through the effect of commuters coming from Belgium, France and Germany, a large part of road fuel sold in Luxembourg is also consumed beyond its borders. This is the concept of "road fuel sales to non-residents".

In line with relevant commitments taken internationally, it is necessary to determine **precisely** the domestic and foreign consumptions, respectively the emissions resulting from these consumptions. This is particularly important while, as underlined in *Section III.1.3.1*, and according to the COPERT model approach, "road fuel sales to non-residents" are estimated amounting to 41.4% of the total GHG emissions in 2011.

120 *Règlement grand-ducal du 1er août 2007 relatif à la mise en place d'un Système d'Inventaire National des émissions de gaz à effet de serre dans le cadre de la Convention-cadre des Nations Unies sur le Changement Climatique* (http://www.legilux.public.lu/leg/a/archives/2007/1300708/1300708.pdf, p. 2318-2320).

A current commissioned study on the determination of the "road fuel exports" and the appertained emissions from climate relevant gases and air pollutant emissions in Luxembourg aims at:

- determining passengers and goods traffic developments up to 2030 while distinguishing the associated road fuel consumption between the national vehicle fleet and the non-resident fleet;
- estimating the corresponding GHG emissions (CO_2, CH_4 & N_2O) and air pollutants emissions (NOx, NM-VOC, SO_2, NH_3, CO, PM_{10} & $PM_{2.5}$), as well as associated emission factors;
- developing scenarios taking into account the effects of the planned freight multi-modal installations "Eurohub" and "CFL-multimodal" on the transport related emissions.

The study will lead to a "business as usual" scenario and derived variants using several simulation models.

III.3. NATIONAL REGISTRY[121]

III.3.1. The Registry administrator

The **Environment Agency** acts as **Registry administrator** designated to maintain Luxembourg's National Registry.[122]

Contact information

Administration de l'Environnement (Environment Agency)
Registre des quotas d'émission de gaz à effet de serre
Martine Kemmer & Robert Schmit – authorised representatives of the Registry administrator
1, avenue du Rock'n'Roll
L-4361 Esch-sur-Alzette
e-mail: martine.kemmer@aev.etat.lu
robert.schmit@aev.etat.lu

III.3.2. A consolidated system

In June 2012, Luxembourg's National Registry (as well as all other European Registries) has been migrated towards the Consolidated System of EUropean Registries (CSEUR) that has been developed by Trasys on request of the European Commission (EC).

The EC is in charge of the hosting, development and maintenance of the CSEUR.

121 This section has been prepared by Martine Kemmer from the Environment Agency.

122 *Loi du 23 décembre 2004 1) établissant un système d'échange de quotas d'émission de gaz à effet de serre; 2) créant un fonds de financement des mécanismes de Kyoto; 3) modifiant l'article 13bis de la loi modifiée du 10 juin 1999 relative aux établissements classes*, Article 18 (http://www.legilux.public.lu/leg/a/archives/2004/0210/a210.pdf, p. 3792-3799)

III.3.3. Database structure and capacity

Since June 2012, the software used for Luxembourg's National Registry is the CSEUR developed by Trasys (currently version 5.4.2).

The complete description of the consolidated Registry was provided to the UNFCCC in the common readiness documentation and specific readiness documentation for the national registry of the European Union and all consolidating national registries.

III.3.4. Conformity with the DES standards

The CSEUR fully conforms to the DES standards. The CSEUR software was accredited by the ITL administrator (on June 1, 2012) to operate under Kyoto rules. During the certification procedure, the CSEUR was notably subject to connectivity testing, connectivity reliability testing, distinctness testing and interoperability testing to demonstrate capacity and conformance to the DES.

Since the beginning of 2009, annual SEF reports have been provided ensuring proper accounting of Kyoto units.[123]

III.3.5. Minimizing discrepancies in the Registry[124]

The overall change to the CSEUR also triggered changes to discrepancies procedures, as reflected in the updated manual intervention document and the operational plan. The ITL procedure for manual interventions has been included in the manual intervention procedure for the CSEUR.

Yearly the SEF report checks if there are no discrepancies between the records of Kyoto units in the various registry systems of Luxembourg, the UN and the EU. The 2009 SEF report from Luxembourg[125] – concerning the year 2008 – has been judged complete by the UNFCCC and showed no discrepancies.

III.3.6. Security measures in the Registry

The overall change to the CSEUR triggered changes to security, as reflected in the updated security plan. The software has been implemented so as to deter or forbid certain unwanted transactions (for instance, certain transactions can be blocked via a security matrix).

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[123] See, e.g., the Central Data Repository of the European Environment Agency: http://cdr.eionet.europa.eu/lu/eu/colrmdqvg/colsasnja.

[124] Discrepancies in the issuance, transfer, acquisition, cancellation and retirement of emission reduction units (ERUs), certified emission reductions (CERs), temporary certified emissions reductions (tCERs), long-term certified emission reductions (lCERs), assigned amount units (AAUs) and/or removal units (RMUs), and replacement of tCERS and lCERs, and of the steps taken to terminate transactions where a discrepancy is notified as well as in the steps taken to correct problems in the event of a failure to terminate the transactions.

[125] http://unfccc.int/files/kyoto_protocol/registry_systems/registry_status/application/pdf/2008_lu.pdf.

User access to the CSEUR is secured with username, password and an a one-time SMS-token. Additional security measures for user and administrator access are currently under discussion in the security working group.

Some additional security measures (trusted account lists and transaction delays) were implemented as well.

To request the opening of accounts, changes to the account data, etc., users need to send in completed and signed paper forms via registered mail using provided templates.

III.3.7. National Registry accesses and Internet addresses

Public reports are available at the general public website of the registry: http://www.climateregistry.lu.

Detailed reports on accounts, operators, legal entities, transactions and holdings are available on this public reports pages.

The secured access to the registry is: https://ets-registry.webgate.ec.europa.eu/euregistry/LU/index.xhtml.

III.3.8. Safeguarding, maintaining, recovering

Backups are made and a detailed disaster recovery procedure is in place to ensure that – in the worst case – the CSEUR can be recovered on a backup site with a minimized loss of data.

Every working day the Registry is manually tested on several checkpoints to ensure e.g. that the reconciliations and transactions ran without error and that there is no abnormal change in the number of accounts, users, failed logins, etc.

III.3.9. Results of test procedures

The CSEUR was tested according the ITL administrator accreditation test plan and was certified successfully on June1, 2012 to operate under the European and Kyoto rules. Test results of newly released versions of the CSEUR software still need to be provided.

Apart from this legally required testing, the registry software is tested by the EC as well as by the registry teams. Inconsistencies or bugs are fed into a JIRA bug-tracking system, and consistently classified, labelled and solved.

A tool is in place to check the availability of a few key pages of the CSEUR on regular intervals.

Table III.3-1 indicates how many minutes for each month of the reporting period the registry of Luxembourg was unavailable to its users (a) due to scheduled downtime, and (b) due to unforeseen problems.

TABLE III.3-1 – SCHEDULED AND UNSCHEDULED DOWNTIME OF THE LU REGISTRY IN 2012 (IN MINUTES PER MONTH)

Month 2012	Scheduled downtime [minutes]	Unscheduled downtime [minutes]
January	0	0
February	0	0
March	0	0
April	0	0
May	0	0
June*	17400 (migration towards and activation of the CSEUR)	0
July*	0	0
August*	360	934
September*	3240 (upgrade of the CSEUR software to v4.04)	0
October*	1980 (upgrade of the CSEUR software to v4.04)	0
November*	0	0
December*	120	120

Source: Environment Agency.
Note: the figures for the second half of 2012 are estimates based on the communications received from the CSEUR Service Desk.

Chapter IV

Policies and Measures

Chapter IV deals with policies and measures (P&Ms). It starts with the description of the overall policy context and of the policy-making process according to paragraphs 20 and 21 of the UNFCCC reporting guidelines *[→ Section IV.1]*. The domestic programmes pursuant to the implementation of the Kyoto Protocol, as required by paragraph 37 of the Kyoto Protocol reporting guidelines, are presented in the subsequent section *[→ Section IV.2]*, where information on Article 3.3 and 3.4 of the Kyoto Protocol and their relation with the conservation of biodiversity and the sustainable use of resources could be found (paragraph 38). Finally, P&Ms and their effects, as well as those which have expired or have been repealed, are succinctly discussed in the last section, which responds to UNFCCC reporting guidelines, paragraphs 13 to 17 and 23 to 26, as well as to Kyoto Protocol reporting guidelines, paragraphs 34 to 36 *[→ Section IV.3]*.

IV.1. POLICY-MAKING PROCESS

IV.1.1. International context: Kyoto and post-Kyoto

Luxembourg signed the **UNFCCC** on June 9, 1992 and ratified it on May 9, 1994 so that the Convention **entered into force on the 7th of August 1994**. As for the **Kyoto Protocol**, it has been signed by Luxembourg on April 29, 1998, ratified on May 31, 2002 and **entered into force**, concomitantly with other EU Annex I Member States, **on February 16, 2005**.[126] Pursuant to that Protocol and the terms of the European agreement distributing the burden among the, at the time, 15 Member States of the EU, Luxembourg undertook **to reduce its GHG emissions by 28% below their 1990 levels over the period 2008-2012**. This is the deepest cut of any agreed by the 15 Member States. In 2004, the government made a commitment that the bulk of its emission reductions under the Kyoto agreement would be achieved in Luxembourg itself, with limited resort to the Protocol's "flexible mechanisms". However this commitment has to cope with very peculiar national circumstances – amongst which size and "road fuel sales to non-residents" are the main driving forces – and the limited GHG reduction potentials within the country *[→ Section II.12]*.

At EU level, a post-Kyoto strategy has already been decided for a while. The "**Climate & Energy package**" adopted in 2008 is intended to contribute to a common energy policy and to combat climate change after 2012. Covering the period 2013-2020, this package intends to reduce GHG emissions of EU Member States by 20% below their 1990 levels,[127] which corresponds to a 14% reduction compared to 2005 emissions level – 2005 is the key year for the post-Kyoto engagements at EU level. The package also defines headline targets in the energy field for 2020: reach 20% of

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[126] Source: http://maindb.unfccc.int/public/country.pl?country=LU.

[127] The -20% target was proposed to be upgraded to -30% if other developed countries commit themselves to comparable emission reductions and economically more advanced developing countries contribute adequately to a global effort according to their responsibilities and respective capabilities. Nevertheless, these conditions having not yet been met, the target remains at -20%. Reminder: under the Kyoto Protocol, the EU countries have the objective of reducing their emissions by 8% compared to 1990.

clean, renewable energy sources in the final energy consumption, increase energy efficiency by 20% and, as part of the renewable energy effort, reach, in each Member State, a 10% share for sustainable produced biofuels and other renewable fuels in final energy consumption of the transport sector.[128] Following controversial discussions these last years on agricultural production dedicated to biofuels – fear of shortages and of increasing prices for food-related crops – the European Commission published, in October 2012, a proposal to limit global land conversion for biofuel production, and raise the climate benefits of biofuels used in the EU. The use of food-based biofuels to meet the 10% renewable energy target will be limited to 5%.

These three objectives of the Climate & Energy package" are now included in the "**Europe 2020 Strategy**", i.e. the EU's growth strategy for the coming decade that aims the EU to become a smart, sustainable and inclusive economy.[129]

The "Climate & Energy package" defines differentiated commitments and targets for each EU countries. For Luxembourg, it calls to:

- **reduce GHG emissions by 20% below their 2005 level** for sectors outside EU Emissions Trading System (EU ETS) – the "ESD target";[130]
- **achieve an 11% share of energy from renewable sources in all forms** in final energy consumption by 2020; and
- **achieve a 10% share of energy from renewable sources in all forms** in total transport by 2020.[131]

The Effort Sharing Decision No 406/2009/EC[132] (ESD), that establishes **binding annual GHG targets** for Member States **for the period 2013–2020**, concerns emissions from most sectors not included in the EU ETS, such as transport (except aviation and international maritime shipping), buildings, agriculture and waste.[133] Since the non EU ETS sectors were representing 83% of Luxembourg's total GHG emissions (excl. LULUCF) in 2011, the "ESD target" set for Luxembourg is very challenging and has been driving the revision of the first Action Plan for reducing CO_2 emissions in Luxembourg. The effects and procedures from the ESD objectives with regard to

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128 For more details on the "Climate & Energy package", see http://ec.europa.eu/clima/policies/package/index_en.htm.

129 See http://ec.europa.eu/europe2020/europe-2020-in-a-nutshell/targets/index_en.htm.

130 That is to say, the highest reduction target amongst Member States, together with Denmark and Ireland: the criteria for defining targets having been GDP per capita. The targets regarding emissions are set in Decision 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020 (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0136:0148:EN:PDF).

131 The targets regarding renewable energy are set in Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:EN:PDF).

132 Decision No 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020 (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0136:0148:EN:PDF).

133 For Luxembourg, sectors outside EU ETS are road transport, buildings, services, agriculture, solvents, waste, and small industrial plants.

GHG emissions reduction will therefore be presented alongside the national Action Plans *[→ Section IV.1.2]*.

The Renewable Energy Directive No 2009/28/EC [134] (RED) establishes a common framework for the **production and promotion of energy from renewable sources**. Each Member State has a target calculated according to the share of energy from renewable sources in its gross final consumption for 2020. The RED states that Member States are to establish national action plans which set the share of energy from renewable sources consumed in transport, as well as in the production of electricity and heating, for 2020 – the National Renewable Energy Action Plans (NREAPs). These action plans must take into account the effects of other energy efficiency measures on final energy consumption and will also establish procedures for the reform of planning and pricing schemes and access to electricity networks, promoting energy from renewable sources. Latest estimates of the share of renewable energy sources in the total final energy consumption of Luxembourg amounted to 3.1% in 2012, i.e. well below the 11% goal to be reached by 2020.[135]

The Energy Efficiency Directive No 2012/27/EU[136] (EED) establishes a common framework of measures for the promotion of **energy efficiency** within the EU in order to ensure the achievement of the associated headline target. The EED also covers the obligation on each Member State to set an indicative national energy efficiency target in the form they prefer (e.g. primary/final savings, intensity, consumption). Luxembourg's provisional final energy consumption target for 2020 under Article 3(1) of the EED is 49 292 GWh. Luxembourg reserves the right to adjust these targets under the 2014 National Energy Efficiency Action Plan (NEEAP, third version) once the effects of the measures have been calculated more precisely.[137]

Here too, the goals set for and by Luxembourg in the framework of the RED and the EED will be particularly challenging, for the same reasons as those for the Kyoto Protocol, especially since the sectors outside EU ETS covers mainly emissions stemming from residential, commercial and institutional buildings and from road transportation.

Figure IV.1-1 below summarizes the “Climate & Energy package” related objectives for Luxembourg.

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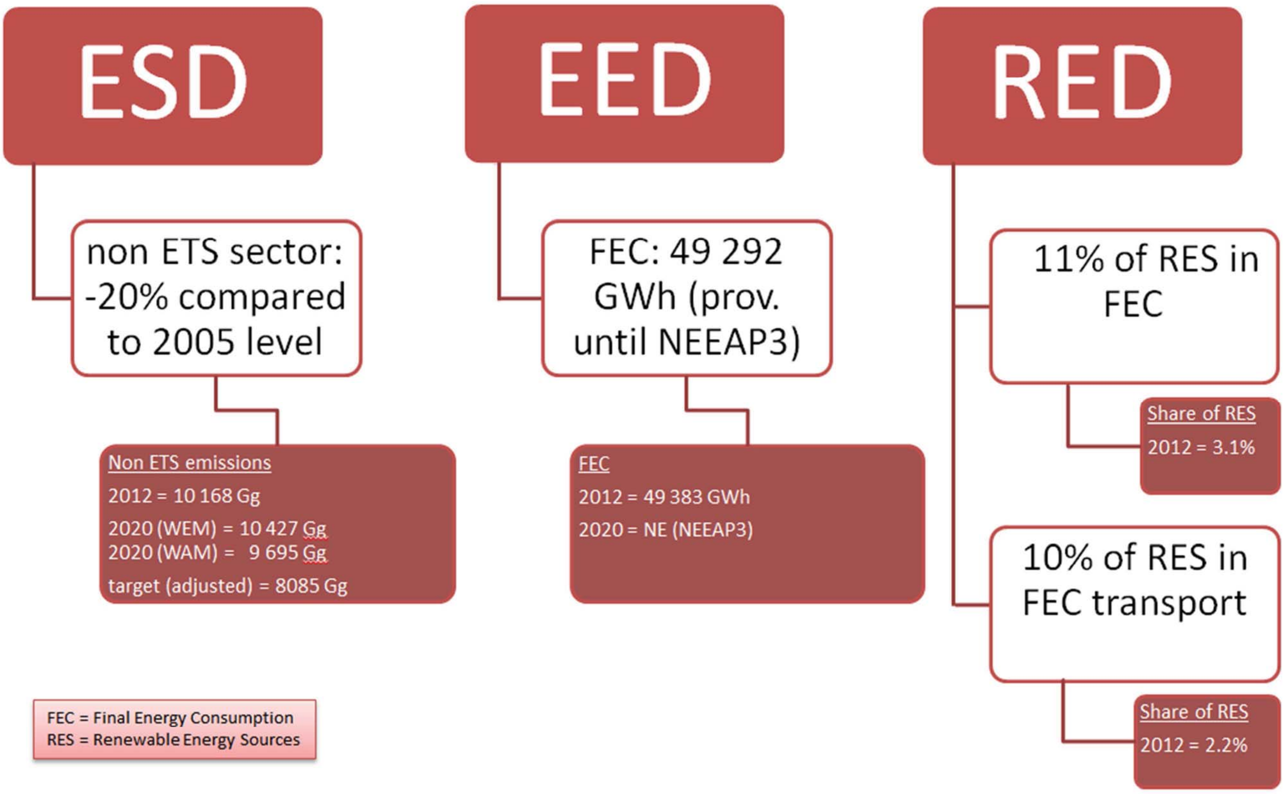
134 Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:EN:PDF).

135 Source: STATEC, energy statistics under Directive 2009/28/EC produced using the SHARES tool, unpublished (updated 19.11.2013).

136 Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:315:0001:0056:EN:PDF).

137 See Luxembourg’s report at http://ec.europa.eu/energy/efficiency/eed/reporting_en.htm. Latest energy statistics report a volume of 49 383 GWh for the final energy consumption in 2012 *[→ Table II.6-2 – TJ converted in GWh]*. Consequently, Luxembourg’s target under the EED is a relative stabilisation of the consumption to its current level. Analysing by sector the forecasts that lead to this 2020 objective, one can see increasing estimates for buildings – whether residential, commercial or institutional – and decreasing estimates for industries. Road transportation related consumption is expected to stabilise to its current level. Reminder: these are still provisional developments that might change when the 2014 NEEAP will be officially submitted to the EC (April 2014).

FIGURE IV.1-1 – "CLIMATE & ENERGY PACKAGE" – OVERVIEW OF LUXEMBOURG'S OBJECTIVES



Source: MDDI-DEV.

IV.1.2. National approach to climate change mitigation and adaptation: an historical overview since 1990 ...[138]

Climate change has been a policy issue of the highest importance in Luxembourg for many years.

The **first climate policy objectives for Luxembourg** were adopted in **1990** when the Government decided on a stabilization target for CO_2 emissions by 2000 at their level in 1990, and a 20% reduction target for CO_2 emissions by 2005.[139] The climate strategy has been gradually developed since then, primarily within the framework of policy decisions on the environment, energy and transport.

Many of the policy instruments in Luxembourg's climate policy have been introduced and gradually tightened up since the 1990's. A "**National Strategy for reducing GHG emissions**" was adopted in **May 2000** and outlined how Luxembourg intends to meet its reduction potentials. The strategy identified six areas for action: renewable energies, energy production efficiency, energy savings, "green taxation", transportation, and co-operation with developing countries and countries in transition. This was followed by regulations instituting subsidies for the rational use

[138] This section has benefited from contributions from Cherryl Dentzer from the Department of the Environement.

[139] If the intermediary target for 2000 was encountered and even exceeded, the 2005 goal was not reached, mainly because of road fuel sales and power generation (see Section III.1.1 for instance).

of energy and the promotion of renewable energy sources. A ministerial working group, headed by the Ministry of the Environment, was set up to evaluate progress of measures implemented at national and Community level.

The Ministry/Department of the Environment engaged, and still engages, consultants with expert skills to conduct some of the GHG inventory related tasks, reporting and other requirements in the area of climate change. During autumn 2005 till spring 2006, with the help of these consultants, workshops were organized by the Ministry of the Environment, with stakeholders' involvement, in order to evaluate Luxembourg's national GHG emissions reduction potentials and with the view to develop a new Action Plan.

This first national "**Action Plan for reducing CO_2 emissions**" was adopted by the Government in **April 2006**, and presented to the public in May 2006 [Ministry of the Environment (2006b)]. It outlines how Luxembourg intends to meet its emission reduction commitments under the Kyoto Protocol and identifies two major goals: (i) limiting dependence on fossil fuels, especially by accelerating their replacement through renewable energy sources (in particular, for thermal energy generation), and (ii) seeking energy savings by enhancing the energy efficiency of transportation, industry and buildings. It called for regulatory measures and also voluntary economic instruments, public awareness campaigns, training and counselling, as well as the use of the "flexible mechanisms".[140] To resort to "flexible mechanisms" cannot be avoided in Luxembourg – even at a rather large scale – since preparatory workshops concluded on the fact that the country presents limited national GHG reduction potentials: no power plants running old technologies or using carbon-intensive fuels that could be replaced, "road fuel sales to non-residents", etc. ***[→ Section II.12]***.

Alongside the "Action Plan for reducing CO_2 emissions", and in the wake of an initial "**National Allocation Plan for GHG emission allowances**" (NAP) covering the period **2005-07** [Ministry of the Environment (2004)], a second NAP was adopted for the period **2008-12**, pursuant to Directive 2003/87/EC, and was notified to the European Commission in 2006 [Ministry of the Environment (2006a)]. It proposed allocating 3.95 Mio. t CO_2e per year to the sectors covered by the emissions trading scheme (manufacturing and energy generation), but the Commission accepted a revised version of the plan in which the annual allocation for Luxembourg was set at 2.5 Mio. t CO_2e (or 20% of total GHG emissions in 2006); with the consequence than there are no reserve left for "new entrants" to the scheme. Allowances are allocated free of charge; and operators' use of credits resulting from projects (clean development mechanism and joint implementation) is limited to 10% of the allocated ceiling.

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[140] For more information on the first Action Plan, see Ministry of Sustainable Development and Infrastructure, Department of the Environment (2010), Box VI.1-1, p. 148.

The Government that came out from the general elections in **June 2009** had clearly indicated that climate change mitigation and adaptation remains a central issue. Under its term in office, two main activities were lead:

- as for other EU Member States, and further to the EC white paper on adaptation to climate change,[141] Luxembourg prepared a **national adaptation strategy on climate change** that has been adopted by the Government in June 2011 *[→ Section VI.3]*;
- to cope with the ambitious Kyoto and post-Kyoto targets and commitments decided for Luxembourg in the EU context *[→ Section IV.1.1]*, a **second** "**Action Plan for reducing CO_2 emissions**" has been presented in May 2013 [Ministry of Sustainable Development and Infrastructure, Department of the Environment (2013b)].

These two main actions have been co-ordinated by the Department of the Environment in conjunction with a **governmental task-force** gathering the competent Ministries and Administrations.

In its Programme, the 2009 Government also reiterated its intention to reduce the post-2012 GHG emissions by using national P&Ms but, due to its national circumstances, also "flexible mechanisms" and the exchange of emission permits between countries. With regard to "flexible mechanisms", Luxembourg wanted to accelerate the procedures of purchasing emission credits from the Clean Development Mechanism (CDM) and the Joint Implementation (JI) so to effectively meet its Kyoto and post-Kyoto targets *[→ Section V.5.1]*. The projects under CDM and JI had to comply with the ecological and social criteria established in the framework of the approval procedures of the UNFCCC and to the specific criteria defined by the committee in charge of managing the Kyoto Mechanisms Fund – the "Climate & Energy Fund" *[→ Section V.5.2]*. In order to facilitate emission rights transfers, Luxembourg also concluded deals with other EU countries ready to sell a part of their post-Kyoto emission rights and with host-countries of CDM and JI projects.

All these issues have been intensively discussed **since the beginning of 2010** in Luxembourg. On the basis of the consensus and dialogue approach favoured in Luxembourg *[→ Section II.1]*, the Minister for Sustainable Development and Infrastructure announced, end 2009, that it was foreseen to consult a vast number of stakeholders – Ministries, Administrations, local authorities, workers and businesses associations, NGOs – for discussing climate change and sustainable development in Luxembourg.

In **February 2010**, the Government Council gave its approval for the launch of the "***Partenariat pour l'Environnement et le Climat***" ("Environment and Climate Partnership"), bringing together

[141] *Adapting to climate change: towards a European framework for action* (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0147:FIN:EN:PDF).

several stakeholder representatives to discuss climate change and sustainable development issues. The objective of the "Environment and Climate Partnership" consisted in the elaboration of:

- a first "**National Adaptation Strategy on Climate Change**" *[→ Section VI.3]*;
- a "***Pacte Climat***" (Climate Agreement), ensuring the collaboration with municipalities on climate matters (see Box IV.3-4); and
- a second "**Action Plan for reducing CO2 emissions**" (see Box IV.1-2).

In order to cover the whole scope of intervention, five thematic working groups have been created under the Partnership with the aim of building a "Climate Change & Sustainable Development" package of P&Ms that could be accepted, hence implemented, by all stakeholders and citizens. The five themes were:

1. urban planning, housing & construction;
2. mobility;
3. energy & eco-technologies;
4. biodiversity, forest, water & agriculture; and
5. international aspects and impacts of climate change.

In **May 2011**, the "***Paquet Climat***" (Climate Package), consisting in a synthesis document summarising the work of the Partnership and a **catalogue of 35 priority measures**, has been adopted by the Government Council. The catalogue has been compiled by the Department of the Environment following a request from the Steering Group ("*Groupe de Pilotage*") of the "Environment and Climate Partnership". The Steering Group asked the Department of the Environment to compile proposals from the 5 working groups into one document in order to facilitate the objectives and content of the second national "Action Plan for reducing CO_2 emissions".

The selection of these 35 priority measures (details in Box IV.1-1.) rested upon two selection criteria. Firstly, measures that could impact the 2012 state budget and secondly, measures that would request some legal texts and arrangements and that, therefore, had to be initiated as soon as possible due to a legislative process that might be quite long.

Box IV.1-1 – 35 priority measures catalogue – *Paquet Climat*

Measures - urban planning, housing & construction

sub-theme construction

1. (1) combining & streamlining the financial subsidies for functional buildings; (2) adapting energy efficiency criteria; monitoring & checking of the financial subsidies efficiency; (3) increasing the means, both human & financial, for the improvement of the energy efficiency of public buildings.
2. promoting evaluation systems with regard to sustainable construction of functional buildings.
3. monitoring & disseminating the energy consumption of public & private buildings.

sub-theme housing **(1)**

4. in close cooperation with the construction sector, progressive strengthening of energy efficiency requirements for new residential buildings. The targets are: C/B energy norm in 2012, then reinforcement every two years to reach an "almost zero" energy consumption for new residential buildings by 2018. For the energy still needed, offering incentives to use renewable energy sources.

5. for both private and public developers, adapting financial subsidies & supports for high-energy efficient buildings construction, as well as for existing buildings energy efficiency improvement works (some of this measures are part of the "Housing Package"): (1) reinforcing links between subsidies schemes & the "energy efficiency certificate" (http://www.guichet.public.lu/fr/citoyens/logement/construction/performances-energie/demande-passeport-energetique/index.html & http://particuliers.myenergy.lu/fr/conseil/achat_vente/passeport_energetique/FAQ); (2) introducing an ecological certification on top of the "energy efficiency certificate"; (3) revising the social criteria for those households which are the most financially vulnerable and that therefore could benefit from zero-rate loans e.g. for improving the energy efficiency of their accommodation.

6. taxes: (1) linking the existing notarial deeds reductions – offered in case of a first purchase or construction of an accommodation by an individual – with the energy efficiency of the new or existing construction; (2) develop "green taxation" schemes.

7. defining & implementing a legal framework for the "Housing Sector Plan" (http://www.dat.public.lu/plans_caractere_reglementaire/plans_sectoriels/logement/index.html).

sub-theme urban development

8. streamlining municipal buildings regulations and links those with sustainable development criteria.

9. raising awareness on the objectives of a sustainable urban development at all levels.

10. creating a database grounded on the information collected via the PAP ("*Plans d'Aménagement Particuliers*" – local land-use planning) and linking this information with the existing overarching land-use planning instruments (sector plans: http://www.dat.public.lu/plans_caractere_reglementaire/plans_sectoriels/index.html & IVL: http://www.dat.public.lu/strategies_territoriales/ivl/index.html).

Measures – mobility **(2)**

11. streamlining land-use planning and mobility developments approaches.

12. increasing public transport infrastructure: tramway in Luxembourg-city, connection train-tramways in new suburban train stations to be constructed, increasing Park & Ride capacities, etc.).

13. implementing as soon as possible the concept of "parking places offer management" in urban areas: adapting parking places offered in new residential condominiums with the existing public transport offer.

14. continuing to promote non-motorized mobility ("*mobilité douce*" – "*MoDu*"), notably by subsidies to buy electrical bicycles e.g.

15. promoting electro-mobility (electrical cars): (1) subsidies for both households & enterprises; (2) starting pilot projects; (3) setting up a global concept for the electro-mobility.

16. promoting & setting-up car-sharing systems through pilot projects using low-emission vehicles, etc.

17. analysing whether carpooling could be further developed and promoted, especially through reserved parking places in Park & Ride.

18. going on with the offered subsidies for the acquisition of low-emission passenger cars – "CAR-e": http://www.car-e.lu/ **(3)**.

19. re-examining vehicle annual tax for high emitting passenger cars.

20. re-examining fiscal arrangements for company cars provided to the employees & workers (adaptation of the fiscal deductions to the CO_2 emissions of the vehicles).

21. gradually increasing road fuels excise rates following a cautious approach based on a better knowledge of the factors determining road fuel sales in Luxembourg that also takes into account the impacts on the public finances of the country.

Measures – energy & eco-technologies

<u>sub-theme energy</u>

22. examining and, if necessary, adapting the various subsidies & feed-in tariffs schemes in place with the view of a further development of energy savings & renewable energy use (households, enterprises, public sector, agriculture).
23. increasing the use of biomass as an energy source (wood, green waste & leftovers, sewage sludge, agricultural waste & leftovers).
24. examining further developments of tools such as eco-discount & eco-loans at a zero rate that are foreseen by the "Housing Package" (see also measure n° 5).
25. fighting against energy precariousness (landlords & tenants): (1) specific financial supports for people with a very low revenue; (2) accelerated fiscal depreciation opportunities for investments aiming at increasing energy efficiency of rented accommodations; (3) adaptation of the rental law (see also measure n° 5).
26. setting up pilot projects for "*Energieinsparcontracting*" and, if conclusive, promoting this tool.
27. enterprises: (1) increasing energy efficiency in the enterprises; (2) reflecting on the possibility to use part of the emission rights (EU ETS) auctioning revenues for that objective.

<u>sub-theme eco-technologies</u>

28. (1) increasing public subsidies for promoting eco-technologies & sustainable development in enterprises; (2) linking energy policy measures with industry policy measures with the aim of reinforcing the role of Luxembourg in the eco-technologies field; (3) helping & pushing enterprises towards international markets, and in participating to international projects oriented towards renewable energy production & GHG emissions reduction; (4) increasing & implementing sustainable development criteria in public procurements.

Measures - biodiversity, forests, water & agriculture

29. promoting & implementing a legal framework for agro-forestry.
30. optimising carbon sinks in forests & in derived products, notably by promoting forestry plantations which increase both carbon storage and the production of goods with a long term time span (woodwork, construction).
31. increasing soil quality for reducing soil erosion risks and, at the same time, increasing biogenic carbon storage.

Cross-cutting measures

32. information, awareness raising, advices & assistance, training (non-exhaustive):

    ► WG1 – (1) increasing information, awareness raising, advices & training with regard to energy efficiency & renewable energy sources; (2) reinforcing *myenergy* activities **(4)**; (3) setting up an assistance network at national level in collaboration with the municipalities; (4) increasing the communication to the citizens on the state subsidies offer; (5) developing pilot projects using "best-practices" guidelines; (6) creating an exchange platform to be used by the construction stakeholders; (7) extending the energy efficiency, renewable energy sources & ecological construction training offer, and adapting this offer to the targeted audience; (8) awareness raising programs on indirect effects (comfort, increased value of the good, etc.) of higher energy efficient buildings (new construction & renewal projects) targeted to supervisors & landlords.

    ► WG2 – (1) promoting public transport via targeted campaigns; (2) extending telematics systems for public transports (real time route information, setting up of an intermodal platform); (3) promoting car-sharing & carpooling; (4) proposing a mobility policy ecological label to enterprises; (5) including the theme "ecological transport modes" in the national Strategy on Education for Sustainable Development.

    ► WG3 – (1) extending information, awareness raising, advices & assistance on energy efficiency & renewable energy sources (see also suggested measures from WG1); (2) reinforcing the support to enterprises; (3) promoting pilot projects; (4) using further "green electricity" via awareness raising campaigns & a forerunner role played by the public sector.
33. to better evaluate the impacts of our PaMs, increasing & systemizing monitoring activities on energy consumption & GHG emissions from the various economic sectors & from the households.

34. following-up the implementation of the national "Action Plan for reducing CO_2 emissions", in association with the Steering Group.

Climate Agreement ("Pacte Climat") with the municipalities **(5)**

35. implementing this Agreement with the municipalities so to offer a legal, technical & financial reference framework which should help these municipalities to act against climate change: (1) carrying on the financial support scheme from the State to the municipalities for the achievement of projects relating to the environment, notably by adapting the criteria of the financial tool used by the State, i.e. the "*Fonds pour la Protection de l'Environnement*" ("Environment Protection Fund") and by increasing its resources (both will require a revision of the Law that created this tool); (2) applying a certification system – based on the "European Energy Award" – to evaluate & acknowledge the municipalities performances that will be used as a basis for offering extra financial resources (the latter requiring to precisely define, via a Regulation, the conditions under which the extra resources will be granted to the municipalities): http://www.pacteclimat.lu/.

(1) measures 11 to 17: see also Box IV.1-4 for the "MoDu" strategy.

(2) see also Box IV.3-1 for the "PRIMe House" scheme.

(3) "CAR-e" scheme: see Box IV.3-2.

(4) *myenergy*: see Box IV.1-8.

(5) *Pacte Climat*: see Box IV.3-4.

The above catalogue is the result of a close consultation between the Ministry of Sustainable Development and Infrastructure as well as the Ministries of Finance and Economy in order to simplify the set up of the second "Action Plan for reducing CO_2 emissions". After publication of this catalogue, the Government Council tasked the Minister and the delegated Minister for Sustainable Development and Infrastructure with:

- the organisation, together with the Commission of Sustainable Development of the Parliament, of a consultation debate in the Parliament (this debate took place in **June 2011**);
- the elaboration of the second Action Plan in reference to the synthesis document and the priority measures catalogue, further to the above mentioned debate;
- the immediate launch of the implementation of the priority measures in cooperation with the other concerned ministerial departments in consideration of the constrains of the budget calendar.

A first draft of the second Action Plan had been discussed by the Steering Committee of the Partnership in **October 2011**. Observations of other parties have mostly been incorporated in the document. The announcement of the Secretariat of the UNFCCC end of 2011, that Luxembourg's 5th National Communication would undergo an in-depth review by a group of experts, led the Department of the Environment to postpone the finalisation of the Action Plan in order to incorporate the recommendations of the review. The final version of **May 2013** [Ministry of Sustainable Development and Infrastructure, Department of the Environment (2013b)], is the result of a close consultation with other concerned ministerial departments. As details provided in Box IV.1-2 show, the second "Action Plan for reducing CO_2 emissions" focuses on the continuation of the P&Ms already put into place or planned in the context of the Kyoto commitment and on P&Ms that let Luxembourg complying with the EU "Climate & Energy package". Government future actions are mainly driven by increasing energy efficiency in all sectors as well as by promoting the use of renewable energy sources – in Luxembourg: biomass, solar energy, windmills, hydro-electricity, geothermic installations. These actions also took their place in the context of "green economy" and "green growth" that the 2009 Government advocated in its Programme.

Box IV.1-2 – the second "Action Plan for reducing CO2 emissions" – main measures & actions

1.1 – Reinforce production and implementation of renewable energies

01	Review and adaptation of existing financial support systems (new financial support "PRIMe House" **(1)**, achieving better visibility for subsidies directed to SMEs and industries).
02	Adaptation of compensation mechanisms for electricity supply from renewable energy sources through regulation, tariff adjustment and promotion of heat recovery.
03	Financial compensation for the supply of biogas in the natural gas grid through regulation.
04	Conception of a targeted promotion for the use of biomass.

1.2 – Increase energy efficiency and decrease energy consumption

05	Specification and implementation of a legal frame for the "Housing Sector Plan".
06	Redevelopment and simplification of the financial support system in case of old-building renovation and new constructions in the residential area, through fundamental assessment of measures for renovation and adjustment of financial support for new constructions **(1)**.
07	Encourage energy efficient renovation of public buildings by increasing financial means and transposing of the Energy Efficiency Directive No 2012/27/EU.
08	Monitoring energy consumption of public buildings through a measuring concept and data analysis.
09	Reinforce "construction standards" for new commercial and services buildings.
10	Implementing incentives to cover residual households' energy needs by renewable energy sources.
11	Standardisation of the provisions for deploying energy efficiency and the use of renewable energy sources in municipal buildings
12	Linking building construction and renovation to sustainable development criteria **(1)**.
13	Faster depreciation of the investments concerning energy efficient renovation through regulation.
14	Promoting and fostering electro-mobility through regulations, including financial support.
15	Promoting and fostering natural gas mobility.
16	Adjustment of "CAR-e" bonus for electro-cars **(2)**.
17	Increase energy efficiency in private companies through voluntary agreements, awareness rising, information and guidance, pilot projects.
18	Increase energy efficiency in companies under the EU ETS through a voluntary agreement scheme (FEDIL), and energy efficiency measures financed by EU ETS public revenues.
19	Application of sustainability criteria for public procurement and during the whole planning process through fixed guidelines and continuous monitoring.

2.1 – Focus on eco-technologies and R&D

20	Promoting eco-technologies in the fields of invention and innovation.

2.2 – Shape the mobility of tomorrow **(3)**

21	Integrative und structured spatial development through regulation, mobility strategy, sector roadmaps, government-municipalities conventions.
22	Promotion of cycling and walking ("*mobilité douce*") through regulation and integration in regional planning.
23	Reorganisation of the public transport as part of the national mobility strategy.

24	Development and improvement of the public transport infrastructure.
25	Management of parking space in urban regions.
26	Promotion of intermodal transport (private-public transport).
27	Improvement of transboundary mobility.
28	Promotion of alternatives to passenger cars.
2-3 – Reform the tax system in a sustainable way	
29	Analysis for a revision of car taxation.
30	Analysis for a revision of company car taxation.
31	Increase in excise duties taking into account impact on public finances.
2.4 – Development of efficient and socially equitable financial devices	
32	New forms of promotion/appeal devices (e.g. by implementing a "zero rate eco-loan").
33	Improve renovation opportunities for rented apartments through regulation **(1)**.
34	Analysis of environmentally harmful subsidies and setting-up of a regulatory framework for those subsidies.
2.5 – Improvement of information, communication and decision making	
35	Capacity adaptation at *myenergy* **(4)** through higher financial framework and additional communal climate experts.
36	Support of municipal capacities through higher financial framework and secondment of climate experts for implementing the Climate Agreement **(5)**.
37	Extend the "Environment and Climate Partnership" to a "Sustainability Commission" through regulation.
38	Improvement and systematisation of data collection concerning energy consumption and emissions development in diverse sectors.
39	Improvement and systematisation of data collection concerning energy consumption and emissions development in municipalities.
40	Evaluation of the second national "Action Plan for reducing CO_2 emissions".
41	Expansion of the offer for training and education on energy efficiency, renewable energies and ecological construction; in connection with additional specific possibilities for competencies certification (artisans, energy advisors).
42	Programmes on awareness rising and specific information for landlords and properties managers about the indirect advantages of energy efficient constructions and renovations (comfort, etc.) with the support of *myenergy* **(4)** and information campaigns.
43	Awareness rising for more energy efficient construction and renovation with support of *myenergy* **(4)**.
44	Pilot project targeting energy advisors who are supporting low income households in order to reduce their energy and water bills.
45	Use of new communication tools to increase attractiveness for public transport.
46	Installation and development of a traffic telematics system for public transport.
47	Introduction of an "ecological mobility label for companies.
48	Development of advices and support to industry and SMEs concerning energy efficiency and the usage of renewable energies.
2.6 – Reach an arrangement with municipalities with regard to the Climate Agreement	
49	Reach an arrangement with municipalities with regard to the Climate Agreement **(5)**.
2.7 – Develop a "National Adaptation Strategy on Climate Change"	

50	(amongst other things) Development and application of a legal frame for the promotion of agro-forestry.
51	(amongst other things) Optimisation of forest carbon storage and optimisation of carbon storage in cultivated (grown) land, increase of organic carbon resulting in a structural improvement of soil stability and a reduction of the risk of erosion

The whole document can be found under the following link, where measures and actions presented in this Box are listed on page 21 to 35: http://www.environnement.public.lu/actualites/2013/05/plan_action_climat/index.html. They are also repeated and detailed in ***Table IV.3-1*** below.

(1) see Box IV.3-1 for the "PRIMe House" scheme.
(2) "CAR-e" scheme: see Box IV.3-2.
(3) measures 21 to 27: see also Box IV.1-4 for the "MoDu" strategy.
(4) *myenergy*: see Box IV.1-8.
(5) *Pacte Climat*: see Box IV.3-4.

The second "Action Plan for reducing CO_2 emissions" is also the **main tool Luxembourg will have at its disposal to comply with the EU "Climate & Energy package" commitment** that was assigned to the country, the "ESD target" ***[→ Section IV.1.1]***. What is this target for Luxembourg, and how was it determined?

In the context of the ESD, **binding annual GHG targets for Member States for the period 2013–2020** have been set on the basis of Member States' relative wealth (measured by GDP per capita). These targets concerns emissions from most **sectors not included in the EU ETS** and are expressed as percentage changes from 2005 levels. They range from a 20% emissions reduction by 2020 (from 2005 levels) for the richest Member States to a 20% increase for the least wealthy one.[142] Luxembourg being the richest Member State if GDP per capita is used as a benchmark, it has to reduce its non-ETS emissions by 20% in 2020 compared to their level in 2005. The non-ETS sectors include transport (road and rail, but not aviation or international maritime shipping), buildings (in particular heating), services, small industrial installations, agriculture and waste.

The idea behind this approach is that, by 2020, the national targets will collectively deliver a reduction of around 10% in total EU emissions from the non-ETS sectors compared with 2005 levels. Together with a 21% cut in emissions covered by the EU ETS, this will accomplish the overall emission reduction goal of the "Climate & Energy package", namely a 20% cut below 1990 levels by 2020 – which is equivalent to an overall reduction of 14% compared with 2005. ***Figure IV.1-2*** illustrates how the objective of the "Climate & Energy package" is shared between Member States and the ETS sectors.

In the non-ETS sector, each Member States has been assigned "**Annual Emissions Allocations**" (AEAs) for the years 2013 to 2020. These allocations actually constitute a linear trajectory between these two years with 2020 level being the "ESD target" and 2013 level corresponding to the average

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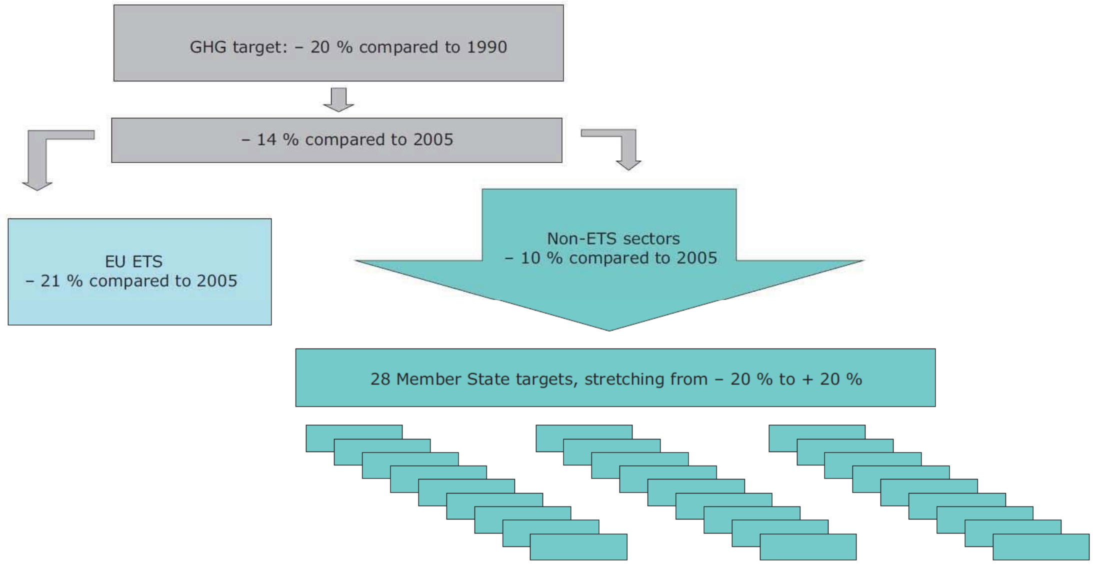
[142] See this graphic for individual Member State "ESD targets": http://ec.europa.eu/clima/policies/effort/images/2020_limits_en.png.

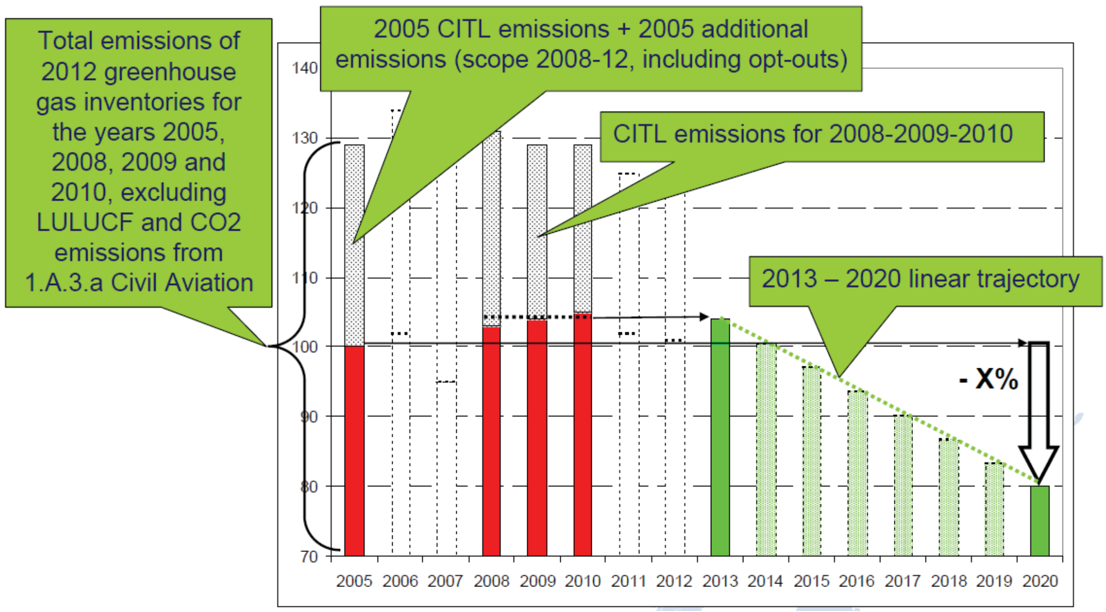
non-ETS emissions from the years 2008 to 2010 *[→ Figure IV.1-3]*. The national AEAs have been set in a Commission Decision published on 26 March 2013.[143]

FIGURE IV.1-2 – THE SHARED EFFORT BETWEEN THE SECTORS AND THE MEMBER STATES



Source: European Environment Agency (2013), p. 101.

FIGURE IV.1-3 – AEAS DEFINITION , INCL. THE "ESD TARGET"



Source: European Commission, DG CLIMA.
Note: the Community Independent Transaction Log (CITL) is a central transaction log, run by the EC, which checks and records all transactions taking place within the trading scheme. CITL emissions equals verified emissions, allowances and surrendered units under the EU ETS.

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143 Commission Decision No 2013/162/EU of 26 March 2013 on determining Member States' annual emission allocations for the period from 2013 to 2020 pursuant to Decision No 406/2009/EC of the European Parliament and of the Council (notified under document C(2013) 1708) (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:090:0106:0110:EN:PDF).

According to Article 10 of the ESD, the **AEAs have subsequently been adjusted** to take into account changes in the EU ETS scope between the periods 2008-2012 and 2013 onwards. This exercise was concluded during the 2013 Autumn and is set in a Commission Implementing Decision of 31 October 2013.[144]

All this process requires that Luxembourg's non-ETS emissions should reach 8 085 Gg CO_2e in 2020 in order to comply with the "ESD target" of minus 20% *[→ Figure IV.1-4]*. Moreover, from 2013 onwards, non-ETS emissions should remain below a linear trajectory, the turquoise line in *Figure IV.1-4*. If this is not the case, according to provisions in the ESD and in order to be compliant with the requirements of the ESD, Luxembourg:[145]

- may buy "unused" AEAs from other Member States. Two cases are foreseen by the ESD:
  - Member States with overachievement of AEAs in a year of the period 2013–2019 – i.e. with non-ETS emissions below their linear trajectory – may transfer their "surplus"[146] to other Member States, which may use this emission allocation until 2020. This is done after the ESD compliance of the "selling" Member State has been confirmed for a given year: ex-post transfer *(→ Art. 3(5) of the ESD)*;
  - Member States anticipating "surpluses" – i.e. overachievement of AEAs - in a year of or for the period 2013–2019 may transfer up to 5% of their AEAs to other Member States. The "buying" Member State may use these transferred emission allocation until 2020: ex-ante transfer *(→ Art. 3(4) of the ESD)*.[147]
- may use JI/CDM credits according to the following provisions:
  - the use of project-based emission credits[148] is capped on a yearly basis up to 3% of 2005 non-ETS emissions *(→ Art. 5(4) of the ESD)*;
  - may benefit from transfers from other Member States that do not use their 3% limit for the use of project-based credits or bank unused part of its project-based credits for own use until 2020. The "buying" Member State acquires rights, but not project-based emission credits per se that it will have to obtain subsequently *(→ Art. 5(6) of the ESD)*;

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144 Commission Implementing Decision No 2013/634/EU of 31 October 2013 on the adjustments to Member States' annual emission allocations for the period from 2013 to 2020 pursuant to Decision No 406/2009/EC of the European Parliament and of the Council (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:292:0019:0022:EN:PDF).

145 The three cases below are derived from European Environment Agency (2013), p. 102-103.

146 "Surplus" = AEAs minus verified non-ETS emissions for a given year.

147 Consequently, a "selling" Member State anticipates that it will not use all its AEAs for a given year, or over the period 2013-2019, and therefore decides to sell its AEAs in excess – with a limit of 5%of its total AEAs – to other Member States. Once these AEAs are transferred to the "buying" Member States, they cannot be reclaimed back by the "selling" Member State if it is finally missing its "ESD target".

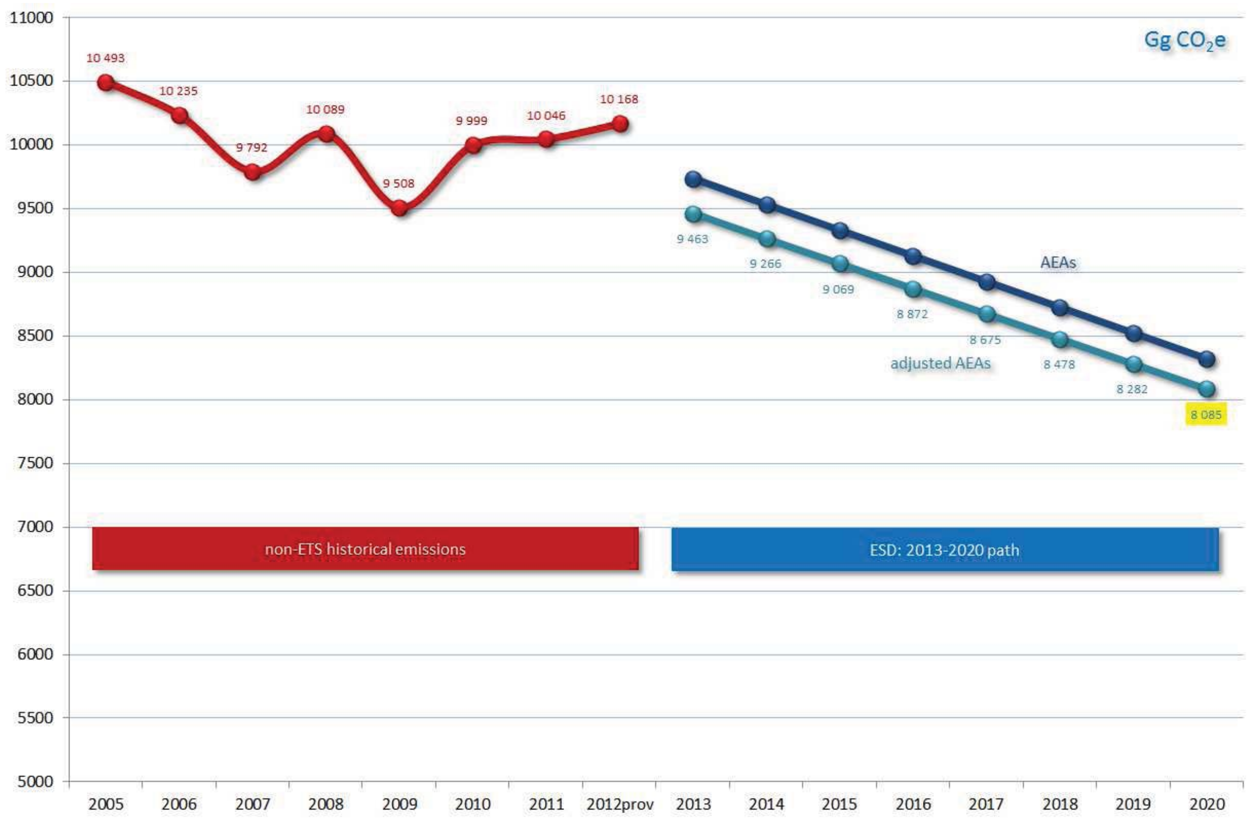
148 CERs, ERUs, tCERs, lCERs and other units as defined in Art. 5(1), 5(2) and 5(3) of the ESD.

- may use credits from projects in Least Developed Countries and Small Island Developing States (LDCs and SIDS) up to an additional 1% of its verified emissions in 2005 if it fulfils additional criteria considered in the ESD – which is the case of Luxembourg *(→ Art. 5(5)(c) of the ESD & Annex III)*. These credits are not bankable and transferable.

- could carry over any overachievement in a year of the period 2013–2019 to subsequent years, up to 2020. More precisely, an emission allocation of up to 5% during 2013–2019 may be carried forward from the following year *(→ Art. 3(3)§1 of the ESD)*.

Actual GHG projections ***[→ Section V.3]*** anticipate Luxembourg's non-ETS emissions to be above the linear trajectory, i.e. that Luxembourg will have to buy AEAs and/or project-based credits to comply with its "ESD target". ***Figure IV.1-5*** represents schematically the situation of a Member State with underachievement of AEAs and the possibilities offered to "fill the gap".

FIGURE IV.1-4 – ESD IMPLICATION FOR LUXEMBOURG – 2013-2020 TRAJECTORY FOR NON-ETS EMISSIONS



Source: MDDI-DEV.

FIGURE IV.1-5 – MEMBER STATE WITH UNDERACHIEVEMENT OF AEAS

Source: MDDI-DEV.

IV.1.3. … and plans ahead[149]

Whereas climate change is an inescapable truth, it is first of all a question of limiting the extent of these changes. The second "Action Plan for reducing CO_2 emissions", elaborated within the framework of the "Environment and Climate Partnership", constitutes the red wire of the national policy in this field. Without the intention to replace the fighting efforts against climate change in particular with regard to the reduction of GHG emissions, adaptation to climate change is an essential complement to prepare our societies for a changing climatic environment.

For that reason, besides the second "Action Plan for reducing CO_2 emission", the elaboration of a national "Climate Change Adaptation Plan" was planned under the outgoing 2009 Government. But before a concrete action plan could be put in place, it was necessary to develop a strategy with the objective to enable the country to face under the best possible conditions the consequences of climate change, to limit the vulnerability of the society and nature towards these changes and to benefit, if necessary, of opportunities which would rise from a changing environment. This is in this context that the first **national adaptation strategy on climate change** has been implemented by the "Environment and Climate Partnership" in May 2011 and adopted by the Council of Ministers in **June 2011** *[→ Section VI.3]*.

149 This section has benefited from contributions from Cherryl Dentzer from the Department of the Environement.

Additionally, the recently elected Government, appointed on the **4th of December 2013** ***[→ Section II.1]***, puts sustainable development in the frontline of their Governmental Programme [Government of the Grand Duchy of Luxembourg (2013), p. 4]. Political decisions at a sector level shall be in line with the principles of sustainability and comply with the priorities and objectives decreed particularly through the second "National Sustainable Development Plan" (see Box IV.1-3).

Concerning more particularly the climate and energy policies, the new 2013 Government intents (amongst other measures):

- to let Luxembourg become a pioneer in the matter of energy efficiency and renewable energies in the "*Grande Région*" (see Box II.4-1);
- to create a global concept for the promotion and the creation of "green jobs" based on an expertise of different economic sectors;
- to take initiatives in order to base electricity provision exclusively on renewable energies (see the note in Box IV.1-7);
- at EU level, to commit to ambitious and constraining objectives whether in the field of energy efficiency, renewable energies or climate protection – this will be a political priority during the 2015 Luxembourg's Presidency of the European Union ***[→ Section IV.1.1]***;
- to review the governance of the "Climate & Energy Fund" ***[→ Section V.5.2]*** as well as the policy for the acquisition of certificates through flexible mechanisms – the mission of the Fund will be to guaranty, besides adaptation and mitigation programmes, national measures in favour of climate protection;
- to implement as soon as possible the second "Action Plan for reducing CO_2 emissions" and to undergo its review in the coming three years (see Box IV.1-2);
- to assign revenues from road fuel sales to measures aiming at an energetic transition to a more sustainable economic model (instead of using them to cover current expenses) in order to step away from the "road fuel sales to non-residents" dependency;
- -to attend a share of 11% of renewable energies of the total national energy consumption until 2020, in line with the RED ***[→ Section IV.1.1]***;
- to optimise the creation of added value and employment in the field of renewable energy through financial aids and by supporting research and innovation;
- to attend a share of 10% of renewable energies of the total road fuel consumption until 2020, , in line with the RED ***[→ Section IV.1.1]***;
- to promote the use of "second generation" biofuels (cap of biofuels from first generation);
- to further develop the public transport infrastructure (e.g. implementation of the tramway in Luxembourg-City and development of the railway network) (see Boxes IV.1-4 & IV.1-5);

- to promote the development of cycling and walking ("*mobilité douce*"), e-mobility as well as car-sharing projects (see Box IV.1-4);
- to create an ambitious political, legal and financial frame in the framework of the transposition of the EED *[→ Section IV.1.1]*;
- to apply constraining norms for housing, commercial and institutional buildings and to prioritise the renovation of existing buildings in order to reduce the national energy consumption, but also to avoid an impoverishment of weakened populations by an increase of heating costs.

IV.1.4. Other plans and programmes

In addition to the actions and P&Ms presented in the two previous sections, there are also various public action plans, programmes or schemes which could have positive effects on GHG emissions reduction, though their primary aim is not GHG mitigation or adaptation. These are listed below (non exhaustive):

- the second "National Energy Efficiency Action Plan" (NEEAP) [Ministry of the Economy (2011)] already mentioned above. A third version of the NEEAP has to be delivered to the Commission by the 30th of April 2014. (http://www.eco.public.lu/documentation/rapports/Zweiter_nationaler_Energieeffizienzaktionsplan_Luxemburg_im_Rahmen_der_EU-Richtlinie___ber_Endenergieeffizienz_und_Energiedienstleistungen__2006-32-EG_.pdf , English version available here: http://ec.europa.eu/energy/efficiency/doc/end_use/2011_neeap_translated.zip);
- the "National Renewable Energy Action Plan" (NREAP) [Ministry of the Economy (2010)] that provide detailed roadmaps of how Luxembourg expects to reach its legally binding 2020 target for the share of renewable energy in its final energy consumption. (http://ec.europa.eu/energy/renewables/transparency_platform/doc/dir_2009_0028_action_plan_luxembourg.zip in both German and English).
- the "National Programme aiming at reducing air pollutants" – "*Programme National de Réduction Progressive des Emissions de Polluants Atmosphériques (SO_2, NOx, COV, NH_3)* " – that could have some co-benefits with regard to GHG mitigation. This Plan actually also covers the NEC Directive (Directive No 2001/81/EC)[150] that is currently being revised to include stringent national objectives for Member States to comply with by 2020. Latest discussions on this revision foresees the inclusion of CH_4 as one of the gases for which an objective could be set, though it is a GHG. The objectives for Luxembourg defined in this revision framework might be very difficult for the country to reach for some gases, particularly the NOx. Undoubtedly, reaching the NOx target is linked with fulfilling Luxembourg's commitments

150 See http://ec.europa.eu/environment/air/pollutants/ceilings.htm.

under the ESD *[→ Section IV.1.2]*.
(http://www.environnement.public.lu/air_bruit/dossiers/PA-PN_reduction_polluants_atmospheriques/index.html)

- the second "National Sustainable Development Plan" that as identified climate change as one out of 14 unsustainable trends in Luxembourg and, consequently, as one of the 18 main objectives of the Plan. More details in Box IV.1-3.
(http://www.developpement-durable-infrastructures.public.lu/fr/developpement-durable-infrastructures/plan-national/index.html)
- the "Sustainable Mobility Strategy" – "MoDu" for "*Mobilité Durable*" – that complements the PST; the latter offering the legal framework on which the strategy could be build. More details in Box IV.1-4.
(http://www.dat.public.lu/actualites/2012/04/1904_MODU/index.html)
- the "Transport Sector Plan" – "*Plan Sectoriel Transports – PST*" – which is one of the sector plans linked to the general long term planning concept of integrated spatial development and transports – the IVL for *Integratives Verkehrs-und Landesentwicklungskonzept* – that fixes objectives for the 2020 horizon. More details in Box IV.1-5.
(http://www.mt.public.lu/planification/plan_sectoriel/index.html)
(http://www.ivl.public.lu/de/index.html)
- the "Waste Prevention and Management Act" – "*Plan Général de Gestion des Déchets*" (PGGD) – which should lead to emission reductions from waste management activities by reducing waste generation, increasing waste recovery and reducing the negative impacts of waste disposal *[→ Section II.11]*.
(http://www.environnement.public.lu/dechets/dossiers/pggd/index.html)
- the "National Plan for Nature Preservation" - "*Plan National de Protection de la Nature*" – that provides a framework for national and European nature protection areas. By preserving biodiversity and protecting ecosystems, or restoring them, there are co-benefits for climate mitigation – for instance, through restoring wetlands that offer bigger carbon absorption possibilities than other types of land uses.
(http://www.environnement.public.lu/conserv_nature/dossiers/PNPN/index.html and http://www.environnement.public.lu/conserv_nature/Observatoire/).
- the "Landscapes and Forests Sector Plan" – "*Plan Sectoriel Grands Ensembles Paysagers et Massifs Forestiers – PSP*" – which is one of the sector plans linked to the general concept of IVL and that could contribute to climate change policies by preventing urban sprawling, for instance.
(http://www.environnement.public.lu/conserv_nature/dossiers/PSP/index.html)
- the "National Forests Programme" – "*Programme Forestier National*" – which should aim at restoring good quality forests in Luxembourg: nowadays, forests are characterized by high

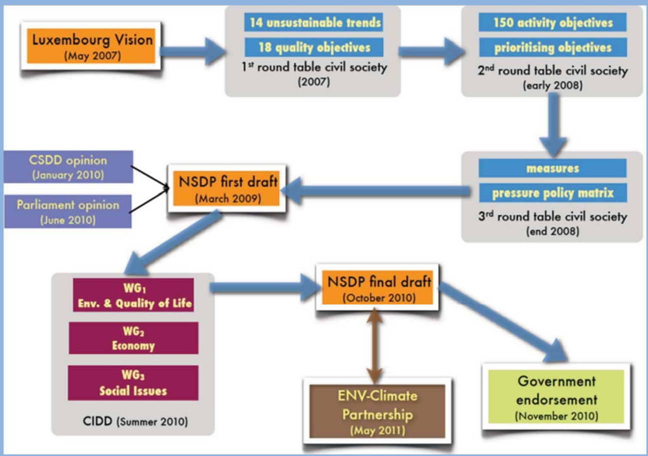
fragmentation, old species and trees and, sometimes, carelessness *[→ Section II.10]*.
(http://www.environnement.public.lu/forets/dossiers/pfn/index.html)

- the "Rural Development Programme" – "*Programme de Développement Rural*" – whose one of the four strategic axes is the improvement of the environmental conditions and of the rural space. Box IV.1-9 describes some actions led in the field of agricultural activities having possible co-benefits for climate mitigation.
(http://www.ma.public.lu/aides_financieres/aides_communautaires/aides_rural/index.html)
- the "Eco-technology Action Plan" – *Plan d'Action Eco-technologies – PAET* – and its "*EcoInnovation*" cluster. Through synergies with research centres and through logistic and financial support by the authorities, it is aiming at positioning Luxembourg in the "green economy" by stimulating the production of green products and services and to support research and development in the environmental technologies field. These activities could have spill-over effects that would be beneficial to both climate change adaptation and mitigation.
(http://www.eco.public.lu/attributions/dg7/d_newtech/ecotech/index.html and http://www.ecoinnovationcluster.lu/)

Box IV.1-3 – The second National Sustainable Development Plan – NSDP2

Luxembourg's NSDP2 has been adopted by the Government Council on 23 November 2010 and is available here: http://www.developpement-durable-infrastructures.public.lu/fr/developpement-durable-infrastructures/plan-national/index.html. The Plan benefited from comments and inputs from various stakeholders: citizens; NGOs; social, business and environmental organizations; High Council for Sustainable Development (*Conseil Supérieur pour le Développement Durable – CSDD*); Chamber of Deputies): see illustration 1.

Illustration 1 – NSDP2 overall process



The second NSDP has been constructed on the basis of 14 non-sustainable trends identified by an inter-departmental body – the CIDD for *Commission Interdépartementale du Développement Durable* – and on 18 quality objectives to be achieved by 2050. These objectives are intended to be responses to the non-sustainable trends and they come with 148 actions or activity objectives, which are break downed into 415 individual measures: see illustration 2.

Illustration 2 – NSDP2 sequence

Amongst the 14 non-sustainable trends, one relates to climate change – "GHG emissions that does not slow down due to an increasing energy use"**(1)** – and one to transport – "continuous growth of transport flows with adverse consequences on energy consumption, land use and road safety". Another non-sustainable trend that could be linked to climate change related issues is the "important land consumption leading to landscapes fragmentation (...)", which reduces GHG potential sinks. Responses to these trends – the quality objectives – are (i) climate protection by limiting the effects of climate change and its costs through mitigation and adaptation actions; (ii) decoupling between economic growth and transport flows, and (iii) a sustainable land planning.

Turning to actions and measures, NSDP2 makes Luxembourg's post-Kyoto objectives its own – reduce by 2020 GHG emissions by 20% below their 2005 for sectors outside EU ETS; achieve an 11% share of renewable energy in total energy consumption by 2020 – and indicates the first NEEAP objective of improving energy efficiency by 9% by 2016. Most of the NSDP2 measures are actually included in the second national "Action Plan for reducing CO_2 emissions". It also insists on the warning role that the State of Luxembourg could play in the domains of energy efficiency and of renewable energy sources: energetic improvement of state buildings, use of renewable energies in state buildings, new constructions following the "low-energy" and "passive" construction standards
→ http://www.developpement-durable-infrastructures.public.lu/fr/developpement-durable-infrastructures/plan-national/climat/objectifs-mesures/index.html

For economy-transport decoupling; NSDP2 lists various measures, some of them being included in the PST. Specific NSDP2 measures are, for instance, the setting-up of a transboundary mobility action plan or the reduction of cross-border commuters flows by encouraging moving in Luxembourg **(2)**.
→ http://www.developpement-durable-infrastructures.public.lu/fr/developpement-durable-infrastructures/plan-national/transport/objectifs-mesures/index.html

With regard to communication around the NSDP2, see ***Section IX.1.1***.

(1) nevertheless, GHG emissions recorded in the inventory are declining since 2005 (see Section III.1).
(2) this last measure is part of the "social cohesion" theme under the NSDP2.

Box IV.1-4 – "MoDu"

"MoDu" is a global strategy for sustainable mobility ("MoDu" for "*mobilité durable*") of residents and cross-border commuters.

The planning approach developed in the framework of the "MoDu" strategy is directed to an optimal co-ordination between spatial development, environmental constraints and the future organisation of transport networks. The approach aims at reducing potential conflicts between transport planning and the environment, and seeks for synergies between a sustainable land planning and the development of transport infrastructures and offer.

The need for a sustainable mobility strategy was stemming from the following observations with regard to Luxembourg's territorial development: (1) demographics have been extremely dynamic compared to other European countries, but it is in rural communities that the largest growths have been noticed (diffuse urbanisation); and (2) domestic employment has grown much stronger than in neighbouring countries and, therefore, the redundancy of workplaces had to be compensated by labour coming from outside ("new" residents and cross-border commuters) ***[→ Section II.4]***. Turning to mobility issues, it was observed that (4) in 2009, only 13% of the daily trips were the fact of pedestrians or cyclists although 40 % of the daily trips in Luxembourg are made on a distance of less than 3 km; (5) two thirds of the journeys by private cars and public transports happen during peak hours, which results in an overload of the transport network (train/bus/road); and (6) these bottlenecks, especially the ones on the roads, have a negative impact on the environment and the economy, lead to lower quality of life for residents and to a growing risk of accidents.

To answer to these six findings, four political objectives have been defined:

1. improve the links between regional development and mobility;
2. reach 25% of daily trips by non-motorized traffic ("*mobilité douce*") by 2020;
3. reach 25% of motorized trips by public transport by 2020;
4. promote an alternative use of the car: Park &Ride stations, car sharing, carpooling and electro-mobility.

It is anticipated that, together with actions on road fuel sales, the implementation of the "MoDu" strategy through the PST (see Box IV.1-5) will grant the biggest GHG reduction potential in the coming years through a likely reduction of cars journeys within the country and from cross-border commuters. Actually, the modal split objective of 25/75 by 2020 – i.e. 25% of the journeys by public transport and 75% by private vehicles – is one of the cornerstones of "MoDu", which proposes substantial investments in national and cross-border public transport infrastructures (the actual modal split is estimated at 17/83 by DG MOVE **(1)**). More precisely, "MoDu" lists the following measures and actions:

1. promote and favour urban development around the main railways axes;
2. reduce congested roads and bottlenecks that create vehicles lines, hence unnecessary emissions of various pollutants;
3. realisation of large railway projects at national, regional and cross-border levels (new stations; new lines, improving existing lines);
4. develop "multimodal" platforms for both private journeys (park & ride sites next to train stations, e.g.) and for fret (such as the Bettembourg-Perpignan rail speedway for trailers – the "*autoroute ferroviaire*");
5. create a maximum of bus reserved lanes and putting strong emphasis on the extension of the bus network for cross-border commuters;
6. promote cycling and walking ("*mobilité douce*").

In the context of "MoDu", it is worth mentioning a relatively recent project, which is also a very good example of collaboration between partners of the *Grande Région*: the cross-border mobility schemes SMOT – *schémas de mobilité transfrontalière*. Three SMOTs have been agreed so far, one with the Lorraine Region of France in 2009 (http://www.mt.public.lu/presse/actualite/2009/01/08_SMOT/index.html?highlight=SMOT), one with the Walloon Region of Belgium which is in preparation (http://www.mt.public.lu/presse/communiques/2013/01/22_smot/index.html?highlight=SMOT) and one with the neighbouring German Länder of Saarland Rhineland-Palatinate whose preparation will start soon. Due to the size of the important workforce that comes from abroad every working day (+-150.000 commuters), these types of cross-border projects are vital for Luxembourg's policies aiming at reducing environmental nuisances and their driving forces.

For more information on this ambitious strategy, see:

a) the complete global strategy (in French): http://www.dat.public.lu/actualites/2012/04/1904_MODU/1904_Strategie_pour_une_mobilite_durable_Version_integrale_MODU.pdf;
b) a summary of the strategy (in French): http://www.dat.public.lu/actualites/2012/04/1904_MODU/1904_Resume_MoDu.pdf;
c) the information leaflet (in both French and German): http://www.dat.public.lu/actualites/2012/04/1904_MODU/2305_Brochure_d_information_MoDu.pdf or http://www.dat.public.lu/actualites/2012/04/1904_MODU/2305_Informationsbroschuere_MoDu.pdf.;
d) the communication strategy ***[→ Section IX.1.2]***.

(1) Source: EEA, TERM 2013 report, Table A.5, p. 100 (http://www.eea.europa.eu/publications/term-2013).

Box IV.1-5 – Transport Sector Plan – PST

Whilst the "MoDu" strategy presented in Box IV.1-4 describes the integrated approach for the future organization of transport network, the primary sectoral plan for transport (PST - http://www.mt.public.lu/planification/plan_sectoriel/index.html) describes the different transport policy projects and defines measures that require a regulatory framework.

It defines legal instruments to introduce a parking management system for all urban areas and for the promotion of cycling and walking. It also reserves land corridors for new transport infrastructures and sets priorities for key infrastructural transport projects, with a special focus on public transport.

For prioritizing the projects, 3 criteria are used:

1. the potential complementarity between transport means;
2. practical impacts at local, regional, national and transnational levels;
3. potential damaging effects on the environment and contribution to climate change mitigation.

Next to public national action plans and programmes, there also exist local projects as well as private/corporate initiatives. Some of these are presented in Box IV.1-6 and IV.1-7.

Box IV.1-6 – Initiatives at local level

The *Climate Alliance of European Cities with the Indigenous Rainforest Peoples / Alianza del Clima e. V.* is Europe's largest city network for climate protection. It aims at reducing GHG emissions in the industrialised countries of the North, and conserving the rainforests in the South of the planet, more precisely in Amazonia. For achieving this goal, local climate strategies are developed and implemented, especially in the energy and transport sectors. Furthermore there are measures to raise the public's awareness for the protection of the rainforest and to abstain in municipal procurement from tropical timber derived from destructive logging (http://www.klimabuendnis.org/).

Luxembourg's branch of the Climate Alliance is *Klima-Bündnis Lëtzebuerg* (http://www.klimabuendnis.lu). It comprises 37 municipalities, out of 106 in Luxembourg (http://www.klimabuendnis.lu/de/Mitgliedsgemeinden-36.html). These 37 municipalities represent around 75% of the population of the country.

To reach the mitigation objectives they committed themselves to, municipalities can exchange experiences, as well as submitting projects and leading common actions with other municipalities.

Klima-Bündnis Lëtzebuerg also launched a project for helping its members to monitor their own mitigation actions and to build P&Ms scenarios. This project consists of using the ECORegion software tool developed by the Swiss company *Ecospeed*. The tool allows monitoring as well as to simulate the impact of policy measures on regional energy consumption and related CO_2 emissions (http://www.ecospeed.ch/). The tool has been implemented during the 2011 Summer, making Luxembourg the fourth country, after Germany, Italy and Switzerland, to put it in place.

Though the ECORegion tool certainly suffer from its limitation to energy related CO_2 emissions only and from some methodological drawbacks in the eyes of GHG inventory specialists and compilers, it might be a very useful way to further mobilize municipalities in their actions for limiting GHG emissions, as well as for informing and involving their inhabitants and local businesses.

Box IV.1-7 – Initiatives at corporate and business level

One of the actions retains in the list of existing P&Ms is the Voluntary Agreement of the Business Federation of Luxembourg – *FEDIL*: see measures 17 & 18 in ***Table IV.3-1*** below. This agreement concerns mainly industrial private companies.

On the 1st March 1996, the members of the FEDIL (http://www.fedil.lu/) agreed upon a voluntary agreement promoting the improvement of energy efficiency in the industrial sector that was substantially revised in April 2002. The agreement includes the establishment of energy management systems in order to enable companies to monitor their energetic performance. For this purpose, companies are committed to collect data on energy consumption and corresponding output figures in order to generate “energy efficiency indicators”. Moreover, energy audits shall be introduced to disclose energy efficiency potentials in the production processes. In cooperation with the Energy Agency (commercial name *Energieagence* – http://www.energieagence.lu/), the FEDIL agreed to conduct information campaigns to raise its members’ awareness of the issue of energy efficiency and renewable energy use.

In April 2005, a target for the improvement of energy efficiency in the industrial sector was introduced into the voluntary agreement. The FEDIL and the Ministry of the Economy as well as the Ministry of the Environment finally agreed upon the adoption of a minimum improvement of energy efficiency of 15% in the time period between 1990 and 2005. In February 2007, the voluntary agreement was amended again and new efficiency targets were introduced. According to the amended agreement FEDIL members accept an energy improvement target of 16% in the time period between 1990 and 2006 and 17% between 1990 and 2007. End 2008, the agreement was renewed again and comprises now a minimum improvement of energy efficiency of 20% in the time period between 1990 and 2010, target that was encountered.

Nowadays, the agreement covers the period 2011 to 2016 and reunites 56 medium or large manufacturing enterprises. All FEDIL member companies having a significant energy consumption – defined on certain criteria – can participate to the agreement. The common objective is to annually increase energy efficiency by 1%, calculated for all the participating enterprises (global objective, not an individual one). In order to reach this 1% goal, each participating company prepares a technical evaluation – or an energy audit – that will allow it to define and put in practice an action plan. The counterpart for the company is that it can benefit from several advantages, such as the support of *myenergy* **(1)** through a convention between the consultancy agency and the participating company (http://entreprises.myenergy.lu/grandes-entreprises-et-industries/accord-volontaire-fedil/).

But they are also initiatives in other economic domains. For instance, the national railway company *Chemins de Fer Luxembourgeois* – CFL, took a series of environmental commitments (http://www.cfl.lu/espaces/groupecfl/fr/le-groupe/nos-engagements/environnement). One of the most important decisions is that now trains are moved by “green electricity” only (all the network is electrified in Luxembourg): http://www.gouvernement.lu/768415/15-lux-cfl?context=519177.

Another example is the energy efficiency and energy reduction actions led by the postal and telephone company *Post Luxembourg*. The enterprise took the commitment to only buy “green electricity”, to promote sustainable low-energy buildings, to reduce fossil fuel consumption of the vehicle fleet (“eco-driving” guides for the staff, natural gas driven vehicles, etc.): http://www.postgroup.lu/fr/70.

These two cases covers public owned companies. However, they set an example and are in line with the Government views expressed in its Programme and in the “Action Plans for reducing CO_2 emissions”.

Note:
With regard to electricity, all the providers in Luxembourg propose “green electricity” to their clients:

a) the main provider is Enovos with its *Naturstroum* and *Nova Naturstroum* offers: http://www.enovos.lu/entreprise/electricite/produits/naturstroum;
b) the other (smaller) providers also offer different “green electricity” mixes: EIDA (http://www.eida.lu/fr/accueil), Electris (http://www.electris.lu/online/www/menu_vert2/10/32/39/FRE/index.html) and Sudstroum (http://www.sudstroum.lu/fr/Produits-et-tarifs/Sudstroum-TERRA).

Most of the electricity produced from renewable sources is imported, i.e. bought abroad since the capacities – especially in hydro-electricity – are limited in Luxembourg.

A similar scheme is in place for natural gas:

a) the main provider is Enovos with its *Naturgas* and *Nova Naturgas* offers http://www.enovos.lu/entreprise/gaz-naturel/produits/naturgas;
b) the other (smaller) provider is Sudgaz that also offer a "green" alternative with an extra-cost: http://www.sudgaz.lu/index.php?option=com_content&view=article&id=21&Itemid=181.

(1) *myenergy*: see Box IV.1-8.

In the implementation of energy-related policies and measures, ***myenergy*** is a key player: see Box IV.1-8.

Box IV.1-8 – *myenergy*

In 1991, an Energy Agency was created to promote renewable energy projects and to inform citizens, the economic sector as well as municipalities on a better use of energy, renewable energy sources and financial public support. During the course of 2008, this Agency was reformed and renamed *Energieagence* – http://www.energieagence.lu/. This Agency is a partnership grouping the Department of the Environment, the Ministry of the Economy, the electricity and natural gas distributing company Enovos (previously Cegedel) and the SEO (*Société Electrique de l'Our*). An Economic Interest Group (EIG) has been established in 2008 to serve as principal contact point for information and advices on energy consumption reduction and on the use or the domestic production of renewable energy sources. This EIG is named *myenergy* whose partners are the Department of the Environment, the Ministry of the Economy and the *Energieagence*. Later on, *myenergy* has also been supported by the Ministry of Housing ***[→ Section IX.1.1]***.
Finally, *myenergy* is also authorized to develop national or European projects in the fields of energy efficiency and of renewable energy sources – for instance, *myenergy* contributes to the third NEEAP to be delivered to the EC by end April 2014.
→ http://www.myenergy.lu/

As stressed above, there are measures and actions that could have positive effects on GHG emissions reduction, though their primary aim is not GHG mitigation or adaptation. This is the case in **agriculture** for instance: see Box IV.1-9.

Box IV.1-9 – *Agriculture*

Though the agricultural sector represented only 5.5% of the national total GHG emissions, excl. LULUCF (2011), it might contribute to climate change mitigation by putting in place a number of practices, such as, for instance:

a) maintaining and enhancing permanent grassland and promoting reduced or zero tillage practices – mulch-till or direct seeding – which will both favour carbon sequestration;
b) developing several agri-environmental schemes for arable land and pasture in protected areas – extensification measure;
c) promoting organic production measures, as well as measures to reduce livestock density – extensification measures;
d) favouring renewable energy sources production through slurry bonus for biogas production and the combustion of biomass
e) improving agricultural production methods, for instance by encouraging better application techniques for liquid manure.

IV.1.5. Inter-ministerial decision making process/bodies

Finally, if the overall coordination and implementation of the national climate change strategy, of the Action Plan and of the NAP are the responsibility of the Department of the Environment,

The overall coordination and implementation of:

- the national climate change strategy;
- the national adaptation strategy on climate change;
- the NAP; as well as
- the first and the second "Action Plans for reducing CO_2 emissions";

was/is under the responsibility of the Department of the Environment.

The implementation of measures at the sector level is, in general, the responsibility of the relevant Government departments and agencies.

IV.1.6. Monitoring and evaluating P&Ms

Achieving reduced emissions of GHG requires the implementation of a number of different measures, both technical measures and behavioural changes. Various policy instruments can be used to achieve this. The strategy followed by Luxembourg includes taxes, grants, regulations, information and a market-based system that mainly influence emissions within the energy and transport sectors ***[→ Sections IV.1.2 & IV.1.3]***. Policy instruments introduced in the waste and agricultural sectors, as well as to improve and transform mobility, also influence developments ***[→ Section IV.1.4]***. There are also linkages between national P&Ms and the "Common and Coordinated Policies and Measures" (CCPM's) of the EU ***[→ Table IV.3-1]***. CCPM's have different kind of impacts in Luxembourg, some reducing emissions beyond what is achieved by or possible with purely national policies (such as the agreement with car manufacturers at EU level and the biofuels Directive), others that do not lead to additional emission reductions beyond those generated by national policies.

At the moment, it is difficult to distinguish the effects of individual policy instruments from each other and from other driving forces in society, which makes it difficult to evaluate individual policy instruments. Moreover, with the recent adoption of the second "Action Plan for reducing CO_2 emissions", mitigation potentials from P&Ms that it includes **should be recalculated and/or updated**. Indeed, potentials presented in the 5th National Communication [Ministry of Sustainable Development and Infrastructure, Department of the Environment (2010), Sections IV.3.3 & IV3.4] are no longer valid and/or should be rearranged so to be consistent with the new Action Plan. Unfortunately, for various reasons, it has not been possible yet for Luxembourg to perform this work. One of these reasons is that the exercise of assessing new P&Ms – or reassessing previously existing P&Ms that are still included in the second Action Plan – will **capitalize on the different savings hypotheses and outcomes of the third NEEAP**. However, this work is not finalized yet as this document should be submitted to the EC by 30 April 2014.[151]

Consequently, in this 6th National Communication, **it is not possible to present mitigation potentials for those individual or groups of P&Ms** included in the second "Action Plan for reducing CO_2 emissions", as well as the information, either in text or tabular format, requested by paragraph 17 of the UNFCCC guidelines for the preparation of National Communications by Parties included in Annex I to the Convention, part II.[152] Nevertheless, in ***Section IV.3***, the long list of P&Ms of the Action Plan will be presented, aggregated by main topics and compared to the P&Ms included in the 5th National Communication.

Hence, **one of the major work foreseen in 2014 is to evaluate abatement potentials of P&Ms or groups of P&Ms** that form the core of the second "Action Plan for reducing CO_2 emissions", eventually completed by possible mitigation potentials triggered by measures and actions from other plans and programmes ***[→ Section IV.1.4]*** that are not considered in the second Action Plan.

Thus, it is **not yet possible to provide information on how Luxembourg believes its P&Ms are modifying longer-term trends in anthropogenic GHG emissions and removals**, consistent with the objective of the Convention (paragraph 25 of the UNFCCC guidelines for the preparation of National Communications by Parties included in Annex I to the Convention, part II). Nevertheless. However, this exercise is in any case complicated for Luxembourg, given its peculiar national circumstances ***[→ Chapter II]***

With regard to **GHG projections** ***[→ Chapter V]***, they are therefore **based on a "business as usual" scenario**, i.e. a "with existing measures" scenario. Only a few "additional measures" are considered, but they are rather alternatives than "additional measures" per se ***[→ Section V.2.2]***.

Finally, other research projects might also help to produce better projections and evaluations of P&Ms, such as the use of an economic general equilibrium model (CGE) ***[→ Section V.4]***.

151 See Commission Staff Working Document Guidance for National Energy Efficiency Action Plans of 22 May 2013 (SWD(2013)180 final) - http://ec.europa.eu/energy/efficiency/eed/doc/neep/20131106_swd_guidance_neeaps.pdf, p. 4.

152 Doc. FCCC/CP/1999/7.

IV.2. DOMESTIC PROGRAMMES PURSUANT TO THE IMPLEMENTATION OF THE KYOTO PROTOCOL[153]

In previous chapters and sections, the various institutions playing a role in climate change reporting and management in the context of the UNFCCC and the Kyoto Protocol have been pointed out. *Table IV.2-1* recapitulates the situation.

TABLE IV.2-1 – UNFCCC AND KYOTO PROTOCOL – RESPONSIBLE AUTHORITIES

Topic	Responsible or co-ordinating authority(ies)	Corresponding legal act or decision
UNFCCC National Focal Point	MDDI-DEV (responsibility)	Officially notified to the Convention Secretariat. Not defined as such in a national act, only mentioned in Art. 8, Regulation of 1st August 2007 *[→ Section III.2.1.2]*.
National Registry	AEV (responsibility)	Law of 23 December 2004 *[→ Section III.3]*
National Strategy and Action Plans, incl. NAP and Adaptation Strategy	MDDI-DEV (responsibility + co-ordination)	Government Programme & declaration.
Kyoto Protocol "flexible mechanisms"	MDDI-DEV (responsibility + co-ordination)	Law of 23 December 2004 *[→ Section V.5.2]*
"Climate & Energy Fund"	MDDI-DEV (responsibility + authority)	Law of 23 December 2004 *[→ Section V.5.2]*
GHG inventories ***Single National Entity*** ***National GHG Inventory Focal Point*** ***National Inventory Compiler*** ***official submission***	 AEV (responsibility + co-ordination) AEV (responsibility + co-ordination) AEV (responsibility + co-ordination) MDDI-DEV ("political" responsibility)	Regulation of 1st August 2007 *[→ Section III.2.1.2]*.
GHG projections	MDDI-DEV (responsibility + co-ordination)	Government internal decision.
Definitions of P&Ms	Diverse Ministries & Administrations but in a co-ordinated framework by the MDDI-DEV since most of them are linked to the National Strategy and Action Plans.	Government Programme & declaration.
Kyoto Protocol, Art. 3.3 (& 3.4)	ANF ("technical" responsibility)	Government internal decision.
Awareness raising, information	MDDI-DEV (responsibility)	Government internal decision.

Abbreviations used in Table IV.2-1:
MDDI-DEV – Ministry of Sustainable Development and Infrastructure – Department of the Environment (*Ministère du Développement durable et des Infrastructures – Département de l'environnement*): http://www.emwelt.lu/:
AEV = Environment Agency (*Administration de l'Environnement*): http://www.environnement.public.lu/functions/apropos_du_site/aev/index.html
ANF = Nature & Forests Agency (*Administration de la Nature et des Forêts*): http://www.environnement.public.lu/functions/apropos_du_site/anf/index.html
Note: following the entry into force of the EU Regulation No 525/2013 (MMR), the national Regulation of 1st August 2007 will be revised during the course of the year 2014.

The description of any institutional arrangements and decision-making procedures that are in place in Luxembourg to coordinate activities relating to participation in the mechanisms under Articles 6, 12 and 17 of the Kyoto Protocol, including the participation of legal entities, are provided in ***Section V.5.2***, where the "Climate & Energy Fund" is presented in detail. This **Fund is a key element in the strategy** put in place by Luxembourg to achieve its Kyoto emission reduction objective since "flexible mechanisms" are representing the primary way for meeting it ***[→ Section V.5.1]***.

With regard to Article 3.3 of the Kyoto Protocol actual calculations – submission 2013v1.2 – show that related activities could be net emitters and not carbon sinks. However, first calculations for the 2014 GHG inventory submission, based on more precise spatial data, tend now to show the

153 Due to its size, there are no regional programmes or legislative arrangements and enforcement in Luxembourg.

opposite. It has to be noted that Luxembourg did not elect any activity under Article 3.4 of the Protocol (see Box V.5-1).

IV.3. SECTORAL AND CROSS-SECTORAL P&MS[154]

This section should normally describe P&Ms which primary aim is GHG mitigation, i.e. which might have a significant impact on GHG emissions and removals as emphasized in section IV.C of the Outline and General Structure of the NC5. Paragraph 16 of the UNFCCC guidelines for the preparation of National Communications by Parties included in Annex I to the Convention, part II.[155] also indicates that Parties should report on action taken to implement commitments under Article 4.2(e)(ii) of the Convention, which requires that Parties identify and periodically update their own policies and practices which encourage activities that lead to greater levels of anthropogenic GHG emissions than would otherwise occur.

As explained in *Section IV.1.6* above, **it is not yet possible to present mitigation potentials for those individual or groups of P&Ms included in the second "Action Plan for reducing CO_2 emissions"**, as well as the information, either in text or tabular format, requested by paragraph 17 of the UNFCCC guidelines for the preparation of National Communications by Parties included in Annex I to the Convention, part II.

Nevertheless, the P&Ms of the second Action Plan will be listed and presented against the P&Ms reported in Luxembourg's consolidated 5th National Communication [Ministry of Sustainable Development and Infrastructure, Department of the Environment (2010), Sections IV.3.2 to IV3.4]: *Section IV.3.2*.

Those P&Ms which expired or were repealed during the reporting period between the 5th and the 6th National Communications are discussed in *Section IV.3.3*.

Some plans and policies which could have the effect to increase GHG emissions are indicated in *Section IV.3.4*.

Actions undertaken so as to minimize adverse effects of P&Ms – both national and according to Articles 6, 12 and 17 of the Kyoto Protocol – are briefly described in *Section IV.3.5*. Steps taken to promote and/or implement any decisions by the International Civil Aviation Organization and the International Maritime Organization in order to limit or reduce emissions of GHG not controlled by the Montreal Protocol from aviation and marine bunker fuels are presented in *Section IV.3.6*.

This section starts however with some preliminary general comments.

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154 This section of the NC5 covers sections IV.C and II.D of the Outline and General Structure of the NC5 according to IPCC reporting guidelines (para. 5).

155 Doc. FCCC/CP/1999/7.

IV.3.1. Preliminary remarks to P&Ms and GHG projections

IV.3.1.1. Energy: the keyword in Luxembourg's P&Ms set

As *Sections IV.1.3 & IV.1.4* show, and *Section IV.1.6* deduces, national P&Ms implemented or planned cover a goes over a rather large number of domains, from the overall policy regarding mobility to very specific grant schemes. However, actions are **mainly driven by increasing energy efficiency in all sectors as well as by promoting the use of renewable energy sources**. They take the form of **direct allowances and payments** for the installation of devices that offer the possibility to use renewable energy sources – such as solar energy equipment – or for the construction of low-energy ("passive") houses. The direct subsidies also cover cash-back schemes, or financial incentives, such as refunding partially the purchase of a low-energy electrical appliance or of low-CO_2 emitting vehicle. Actions also correspond to **subsidy schemes** for the production of "green" energy, such as a bonus – feed-in tariffs – offered for electricity production from windmills, hydraulic installations, biomass or biogas.

IV.3.1.2. Road transportation: "road fuel exports" share complicates the projection exercise

As underlined in *Section II.12.1*, the impact from "road fuel sales to non-residents" can hardly be controlled by unilateral adaptations in national tax-policy: as fuel sales attributed to "road fuel sales to non-residents" are mainly triggered by fuel price differentials (which are determined by differentials in excise rates *[→ Section II.4.3]*), Luxembourg would need to permanently coordinate its tax policy with the policy of all neighbouring states (Belgium, France and Germany). This would mean to accept a limitation of the scope of national tax design options. However, the Government intends to assign additional revenues from road fuel sales to measures aiming at an energetic transition to a more sustainable economic model (instead of using them to cover current expenses), in order to step away from the "road fuel sales to non-residents" dependency. It adds that "an economic feasibility study will be undertaken with the aim of determining the impacts of getting out of road fuel sales to non-residents" [Gouvernement du Grand-Duche de Luxembourg (2013), p. 84].

Nevertheless, the dominant influence of tax policy, but also other factors, as the expansion of road networks in neighbouring countries, which would allow a by-pass of the territory of Luxembourg, or the institution or increase of road use taxes in these same countries,[156] makes projection of fuel sales – and corresponding GHG emissions – a hard task. Technological developments also

[156] Road use taxes could be tolls to be paids on certain sections of motorways or other infrastructures, such as it is the case in France or specific taxes levied on specific vehicles categories, such as the "Eurovignette".
Like Belgium, and as well as the Netherlands, Denmark and Sweden, Luxembourg has, since 2001, been charging the "Eurovignette" on trucks using its highways following the so-called "Eurovignette Directive": http://europa.eu/legislation_summaries/internal_market/single_market_for_goods/motor_vehicles/interactions_industry_policies/l24045b_en.htm#Amendingacts. In Luxembourg this tax (or user fee) is based on pollutant emissions (EURO standards) and the truck's number of axles. It can be paid on a yearly, monthly, weekly or daily basis: see http://www.do.etat.lu/vehaut/eurovignette.htm.

complicate the exercise: for instance, what would be the impact of higher energy efficient engines in 5 to 10 years? – though EU regulations and planned EURO norms could help in this respect. Sometimes it is even impossible to predict now the influence of technological changes on road fuel sales since it depends on numerous indeterminate parameters such as the launch date of new types of vehicles driven by electricity, fuel cells or compressed air or the speed at which new concepts will be deployed, and adopted by the public: the electric car and the associated recharging/reloading network that some countries (France e.g.) are planning is a good example. These projections are, therefore, **associated with a high uncertainty that falls upon the overall GHG projections**.

IV.3.1.3. Promoting electricity generation from renewable energy source is not a P&M

Only a relatively small fraction of overall electricity consumption in Luxembourg was generated by installations in Luxembourg – especially since the generation from blast furnace gas was stopped. The natural gas fired TWINerg power plant, which was set into service in 2002, led to an increase of the share of domestically produced electricity, as did the numerous small CHP installations. Despite the increase in generation capacity, since 2002 the import dependency – measured as net imports divided by national consumption – remains on a high level of about 50 to 70%, compared to 94.3% in 1990 ***[→ Section II.6]***. The import dependency – mainly from the German network – has one major impact on the quantitative assessment of effects of P&Ms in the field of electricity generation from renewable energy sources: while most EU Member States – and by extension, most countries – own a "double dividend" from the encouragement of electricity generation from renewable ("carbon neutral") sources – by increasing the share of renewable energy in accordance with Directive No 2001/77/EC and, in addition, by lowering GHG emissions from electricity generation in the context of the Burden Sharing Agreement – Luxembourg only benefits from the increase in the share of renewable energy. As stressed in ***Section II.12.3***, electricity generated in Luxembourg from renewable sources does not substitute generation from fossil fuels, as it is the case in most other Member States, but replaces electricity imports, which are "carbon neutral" according to IPCC allocation rule of GHG emissions based on the territorial principle. Therefore the **promotion of electricity generation from renewable energy sources or from CHP does not have an impact on the GHG emissions** and are consequently **not considered as measures in this report** and are, **de facto**, **included in the baseline – or BAU - scenario**. Other renewable energy sources, which **substitute fossil fuel consumption** within Luxembourg (e.g. biomass or biogas for heating purposes or solar thermal installations), **do have**, instead, **a lowering effect on the GHG balance and are, therefore, considered as P&Ms**.

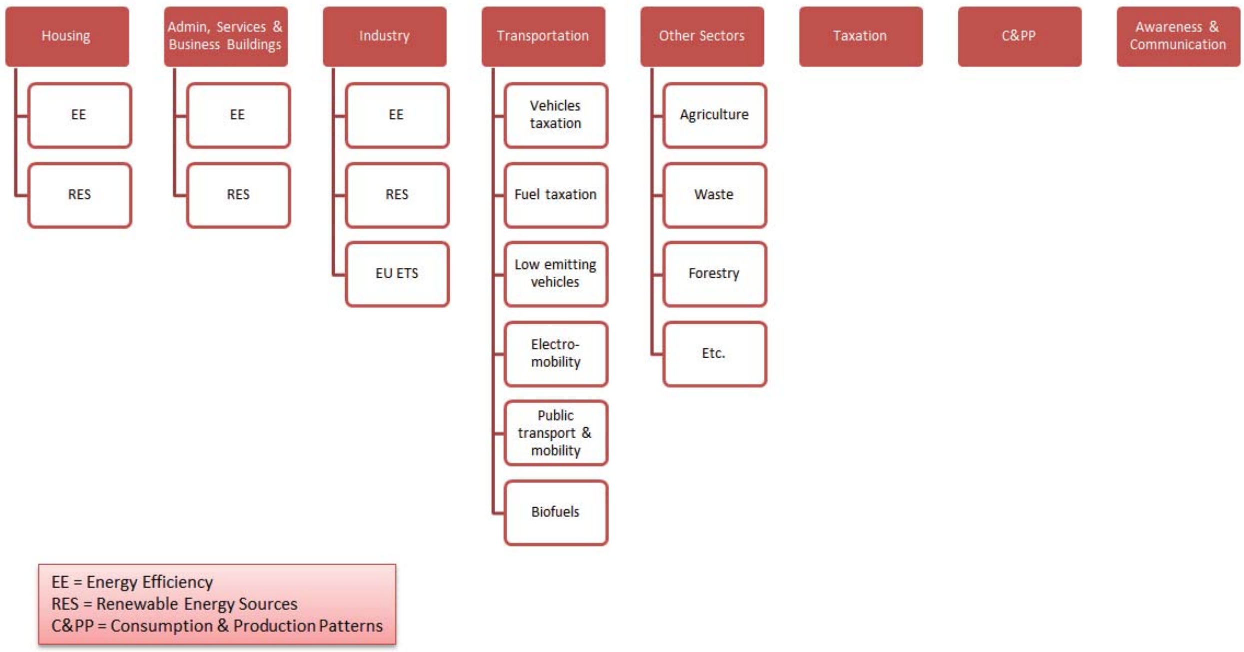
IV.3.1.4. Economy size increase uncertainty of GHG projections

The power generation and the iron and steel sectors give good examples of the difficulty to provide reliable long-run projections for the Luxembourg energy system. Single decisions at company level have a dominant impact on the structure of the overall national emissions development *[→ Section II.12.2]*. **As decisions at company level can hardly be anticipated appropriately**, **emissions projections** for both the power generation and the industrial sectors **need to be evaluated with care**.

IV.3.2. Policies and measures considered in the second national "Action Plan for reducing CO_2 emissions"

Box IV.1-2 above lists the 51 measures and actions that are part of the second national "Action Plan for reducing CO_2 emissions". As it can be seen from this list, lots of measures are complementing and even overlapping each other. In fact, they can be grouped under 8 main headings as *Figure IV.3-1* shows.

FIGURE IV.3-1 – MEASURES AND ACTIONS OF THE SECOND ACTION PLAN – A TYPOLOGY



Source: MDDI-DEV.
Note: actually, the second national "Action Plan for reducing CO_2 emissions" does not present any actions or measures in the field of waste management.

Table IV.3-1 lists the 51 P&Ms of the second Action Plan and presents them against the P&Ms reported in Luxembourg's consolidated 5th National Communication [Ministry of Sustainable Development and Infrastructure, Department of the Environment (2010), Sections IV.3.2 to IV3.4]. **This table is work in progress**. It constitutes a first step to the evaluation of the mitigation potentials of the second Action Plan's P&Ms that should be realised in the course of the year 2014 *[→ Section IV.1.6]*. This table is actually build upon CTF Table 3 requested for the 1st Biennial

Report and it covers therefore most of the information that is requested to be presented in a summary table by the UNFCCC Guidelines for the 5th National Communication.

Specific columns are:

- the columns (1) and (4) – "P&M – ID" and "Name of the P&M" – which repeat the 51 records presented in Box IV.1-2;
- the columns (2) and (3) – "P&M WEM NC5" and "P&M WAM NC5" – that link the actions and measures of the second Action Plan to those reported in the NC5;
- the CCPM column (7) that indicates which related "Common and Coordinated Policies and Measures" (CCPM) of the EU are linked to domestic P&Ms (not filled for this National Communication, being an EU reporting requirement only).

Defining which gases are affected – column (6) "GHG affected" – is not a straightforward task since many measures, though addressing primarily CO_2, can also reduce emissions of other GHG such as CH_4 and N_2O. In the table, the column provides the main gas targeted, which is in most of the case CO_2.

The 51 actions and measures presented in ***Table IV.3-1*** are, of course, correlated with the catalogue of 35 priority measures that has been adopted by the Government Council after the "Environment and Climate Partnership" delivered its conclusions in 2011 ***[→ Section IV.1.2*** & Box IV.1-1***]***. Consequently, a second table has been produced, which groups the 51 measures in 20 main themes (or sectors) that have been derived from their descriptions ***[→ Table IV.3-2]***.

Table IV.3-1 is therefore not describing all policies and measures in place that might help mitigating the effects of climate change or increase emissions at national level. It is limited to the sole P&Ms reported in the second national "Action Plan for reducing CO_2 emissions".

Table IV.3-2 is limited to the P&Ms presented in ***Table IV.3-1*** and, consequently, does not cover all the LULUCF, agriculture or waste management measures in place that might impact GHG emissions as requested by paragraph 17 of the UNFCCC guidelines for the preparation of National Communications by Parties included in Annex I to the Convention, part II.[157] Only the sectors energy, transport and industry are clearly identified in this table.

157 Doc. FCCC/CP/1999/7.

TABLE IV.3-1 – P&MS OF THE SECOND NATIONAL "ACTION PLAN FOR REDUCING CO_2 EMISSIONS" – LIST

P&M ID (1)	P&M WEM NC5 (2)	P&M WAM NC5 (3)	Name of the P&M (4)	Sector(s) affected (5)	GHG affected (6)	CCPM addressed (7)	Objective and/or activity affected (8)	Type (9)	Status of implement. (10)	Brief description (11)	Start year of implement. (12)	Implementing entity(ies) (13)	Mitigation potential (14)
01	EC01a EC01b EC02 EC04	EC11a EC11b EC12 (EC13) EC14	Review and adaptation of existing financial support systems for the use of RES	Energy (RES) consumption (all sectors)	CO_2		Better promote energy savings and the use of RES by the households, the enterprises, the farms and the public sector. Better adequacy between measures and objectives and better visibility of the financial support schemes for enterprises and SMEs.	regulatory information	adopted	This P&M aims at increasing the share of RES in energy final consumption. See further information in Box IV.3-1.	NE	MDDI-DEV MECE-DEN	NE
02	-	-	Adaptation of compensation mechanisms for electricity supply from RES	Energy (RES) production	CO_2		Reassessment and adaptation of the compensation mechanisms (tariffs) notably to promote heat generation. Promote alternative investments in existing installations.	regulatory	planned	This P&M aims at increasing the share of RES in the electricity networks; electricity from RES produced by households or enterprises. It aims also at developing heat generation (cogeneration) alongside electricity production from RES).	mid-2013	MECE-DEN	NE
03	-	ES11	Financial compensation for the supply of biogas	Energy (RES) production	CO_2		Launching a financial compensation for the supply of biogas, one for private producers and one for producers with a public participation.	economic regulatory	implemented	This P&M aims at developing the production of biogas and its addition in distribution networks.	NE	MECE-DEN	NE
04	-	(ES11)	Conception of a targeted promotion for the use of biomass	Energy (RES) production	CO_2		Elaborating new concepts for an increased use of biomass (wood, green waste, agricultural waste & sewage sludge). Better adequacy between planning tools, decision and public information.	information planning	planned	This P&M aims at increasing the use of biomass as energy source.	NE	MDDI_DEV MDDI-AEV MDDI-AGE MAVPC	NA
05	-	-	Specification and implementation of a legal frame for the "Housing Sector Plan"	Energy consumption (residential) LULUCF	CO_2 N_2O		Better planning for the development of new residential areas.	planning	adopted	This P&M covers the "Housing Sector Plan" that aims at avoiding urban sprawling and, therefore, reduce travelling distances. The Plan also promote a more sustainable development and use of land. These two elements have co-benefits with regard to GHG mitigation.	NE	MDDI-DEV MLOG	NA/NE
06	EC01a EC01b EC02 (EC04)	EC11a EC11b EC12 EC13 (EC14)	Redevelopment and simplification of the financial support system in case of old-building renovation and new constructions in the residential area	Energy consumption (residential)	CO_2		Adapting subsidies for residential buildings (new & renovated) to the energy efficiency performance of the construction.	regulatory	implemented	This P&M aims at increasing energy efficiency in the residential sector. See further information in Box IV.3-1.	2015	MDDI-DEV MECE-DEN	NE
07	EC05	EC15	Encourage energy efficient renovation of public buildings	Energy consumption (institutional)	CO_2	Directive EED	Renovating public buildings so that they become more energy efficient.	regulatory	implemented	This P&M aims at increasing energy efficiency of public buildings.	NE	MDDI-DEV MECE-DEN ABP	NE
08	(EC05)	(EC15)	Monitoring energy consumption of public buildings	Energy consumption (institutional)	CO_2		Elaborating a measuring concept and installation of smart meters in public buildings do to develop consumption data analyses.	other	adopted	This P&M aims at reducing final energy consumption of public buildings.	mid-2013	MDDI-DEV ABP	NA
09	EC05	EC15	Reinforce "construction standards" for new commercial and services buildings	Energy consumption (commercial)	CO_2		Progressive adaptation of energy standards for new commercial and services buildings so to reach "nearly zero" energy consumption for new constructions.	regulatory	implemented	This P&M aims at increasing energy efficiency of commercial and services buildings so to reach, by 2020, "near zero" passive buildings.	NE	MDDI-DEV MECE-DEN	NE
10	EC01a EC01b (EC02) (EC04)	EC11A EC11b (EC12) (EC14)	Implementing incentives to cover residual households' energy needs by RES	Energy (RES) consumption (residential)	CO_2		Adapting and expanding subsidies for the use of RES in residential buildings and revise those subsidies in 2015.	regulatory	implemented	This P&M aims at increasing the share of RES in energy final consumption.	NE and revision of subsidies in 2015	MDDI-DEV MECE-DEN MLOG	NE

P&M ID (1)	P&M WEM NC5 (2)	P&M WAM NC5 (3)	Name of the P&M (4)	Sector(s) affected (5)	GHG affected (6)	CCPM addressed (7)	Objective and/or activity affected (8)	Type (9)	Status of implement. (10)	Brief description (11)	Start year of implement. (12)	Implementing entity(ies) (13)	Mitigation potential (14)
11	EC05	EC15	Standardisation of the provisions for deploying energy efficiency and the use of RES in municipal buildings	Energy consumption (institutional)	CO_2		Improving energy efficiency and the use of RES in municipal buildings.	regulatory	implemented	This P&M aims at increasing energy efficiency of public buildings located in municipalities, as well as the use of RES. It is part of the Climate Agreement with municipalities (see Box IV.3-4).	2013	MDDI-DEV MECE-DEN	NE
12	EC01a EC01b EC02 EC04	EC11a EC11b EC12 (EC13) EC14	Linking building construction and renovation to sustainable development criteria	Energy consumption (residential)	CO_2		Making subsidies more environmentally-friendly for new constructions and renovations. Reinforcing minimum standards for obtaining subsidies.	regulatory	implemented	This P&M aims at increasing energy efficiency and the use of RES in the residential sector, as well as linking subsidies to "sustainable development" (SD) criteria, notably through the setting-up of a "sustainable development certificate" and more-stringent standards for the "energy passport". See further information in Box IV.3-1.	NE and 2014 for the SD criteria	MDDI-DEV MLOG	NE
13	-	-	Faster depreciation of the investments concerning energy efficient renovation	Energy consumption (residential)	CO_2		Ensuring a quicker depreciation of energy efficient investments when renovating residential buildings.	fiscal regulatory	implemented	This P&M aims at increasing energy efficiency for renovation projects in the residential sector through fiscal measures and the introduction of a reduced VAT rate.	NE	MDDI-DEV MECE-DEN MLOG MFIN MFIN-ACD	NE
14	-	-	Promoting and fostering electro-mobility	Transport	CO_2		Developing the use of electric and hybrid vehicles via regulatory decisions and financial incentives.	economic regulatory	implemented	This P&M aims at reaching a share of 10% for electric vehicles in the total number of passenger cars by 2020 (i.e. some 40 000 vehicles). The objective is also to install 850 electric charging stations.	NE	MDDI-DEV MECE-DEN ILR	NE
15	-	-	Promoting and fostering natural gas mobility	Transport	CO_2		Developing the use of gas powered vehicles via financial incentives.	economic	implemented	This P&M aims at developing, by 2020, a network of petrol stations offering natural gas.	2013	MDDI-DEV MECE-DEN	NE
16	TR02	-	Adjustment of "CAR-e" bonus for electro-cars	Transport	CO_2		Going on with the "CAR-e" scheme for electric and hybrid vehicles emitting less than 60g CO_2/km.	economic	implemented	This P&M continues the "CAR-e" scheme for electric and hybrid vehicles for the years 2013 and 2014, whereas the scheme for gasoline & diesel powered cars has been stopped that same year. This P&M will expire end 2014: no extension in 2015 whatsoever. Details under Box IV.3-2.	NE	MDDI-DEV MECE-DEN	NE
17	(IN01)	(IN11)	Increase energy efficiency in private companies	Energy consumption (industries, services, institutional)	CO_2	Directive 2012/27/EU	Developing of the use of cross-cutting technologies and their energy savings potential and promoting "energy contracting" to SMEs operating in the tertiary sector.	voluntary/ negotiated agreement information	implemented	This P&M aims at increasing energy efficiency in industries and SMEs of the tertiary sector, notably through a voluntary agreement (FEDIL: see Box IV.1-7) and the support of *myenergy* (energy performance standard agreement http://promotiondusecteur.myenergy.lu/). Municipalities are involved too via the promotion of the "energy contracting" for their own infrastructures.	NE	MDDI-DEV MECE-DEN CRTE *myenergy* *Luxinnovation* OAI *Klima-Bündnis*	NA
18	IN01 IN02	IN11	Increase energy efficiency in companies under the EU ETS	Energy consumption (industries)	CO_2	Directive 2012/27/EU	Assessing incentives to save energy and their effect on the EU ETS installations.	voluntary/ negotiated agreement	implemented	This P&M aims at analysing the impacts of the voluntary agreement (FEDIL: see Box IV.1-7) for those installations under the EU ETS. It also foresees the deployment of the "learning factory «initiative (http://www.enovos.lu/content/download/2666/27193/version/1/file/Learning+Factory+EN.pdf).	NE	MDDI-DEV MECE-DEN	NA/NE

P&M ID (1)	P&M WEM NC5 (2)	P&M WAM NC5 (3)	Name of the P&M (4)	Sector(s) affected (5)	GHG affected (6)	CCPM addressed (7)	Objective and/or activity affected (8)	Type (9)	Status of implement. (10)	Brief description (11)	Start year of implement. (12)	Implementing entity(ies) (13)	Mitigation potential (14)
19	-	-	Application of sustainability criteria for public procurement	Energy consumption (institutional)	CO_2		Promoting sustainable and environment-friendly public purchases and procurements, as well as in public planning.	information education planning	adopted	This P&M aims at establishing rules for sustainable public procurements and to monitor them.	NE	MDDI-DEV MECE-DEN	NA
20	-	-	Promoting eco-technologies in the fields of invention and innovation	Industry & industrial processes	CO_2		Examining potential policy actions and proposing concrete actions.	research	implemented	This P&M aims at a better use of public financial supports for the promotion and the use of eco-technologies, as well as supporting sectors and businesses operating in eco-technologies (fostering research projects and international developments).	NE	MDDI-DEV MECE-DEN MESR *Luxinnovation* Public Research Centres	NA
21	-	TR14	Integrative und structured spatial development	Transport (mobility)	CO_2		Ensuring an holistic approach of land planning so to reduce motorised transport needs by facilitating cycling, walking and the use of public transport: MoDu objectives of 25% of daily trips by non-motorized traffic ("mobilité douce") and 25% of motorized trips by public transport by 2020.	regulatory planning	planned	This P&M aims at a better planning for the development of the country with regard to the way new settlements are planned (less motorized journeys requirements, e.g.) as well as putting into practice the MoDu strategy recommendations and objectives. See further information in Box IV.1-4.	2014	MDDI-DAT MINT municipalities	NA
22	-	-	Promotion of cycling and walking ("*mobilité douce*")	Transport (mobility)	CO_2		Reaching the MoDu strategy objective of 25% of daily trips by non-motorized traffic (cycling and walking - "*mobilité douce*") by 2020.	regulatory planning	planned	This P&M aims at promoting cyclind and walking through various measures in infrastructures, in the fields of financial incentives, in land planning, etc. notably by putting into place an adequate legislation. See further information in Box IV.1-4.	2014	MDDI-DAT MINT CdT municipalities	NE
23	-	TR14	Reorganisation of the public transport	Transport (mobility)	CO_2		Reaching the MoDu strategy objective of 25% of motorized trips by public transport by 2020.	planning	planned	This P&M aims at reorganising the public transport network – mostly the buses network – as well as ensuring better intermodal connections between networks. The project of having a tramway in Luxembourg-City is included in this P&M. See further information in Box IV.1-4.	mid- to long-term and 2017 for the tramway	MDDI-DAT CdT municipalities CFL	NE
24	-	TR14	Development and improvement of the public transport infrastructure	Transport (mobility)	CO_2		Reaching the MoDu strategy objective of 25% of motorized trips by public transport by 2020.	planning	planned	This P&M aims at reorganising the public train & busses transport networks to increase intermodal connection, as well as increasing frequencies capacities for train & busses. See further information in Box IV.1-4.	mid- to long-term	MDDI-DAT municipalities CFL	NE
25	-	TR14	Management of parking space in urban regions	Transport (mobility)	CO_2		Reaching the MoDu strategy objectives of 25% of daily trips by non-motorized traffic (cycling and walking - "*mobilité douce*") and 25% of motorized trips by public transport by 2020.	regulatory planning	planned	This P&M aims at promoting cycling and walking, as well as the use of public transport through various measures ensuring that parking spaces encourage users to effectively use public transports or walk or bike. See further information in Box IV.1-4.	2014	MDDI-DAT MINT CdT municipalities	NA/NE
26	-	TR14	Promotion of intermodal transport	Transport (mobility)	CO_2		Reaching the MoDu strategy objective of 25% of motorized trips by public transport by 2020.	planning	planned	This P&M aims at promoting cycling and walking, as well as the use of public transport through various measures offering alternatives to the use of private cars and the further development of "Park & Ride" infrastructures See further information in Box IV.1-4.	2014	MDDI-DAT CdT CFL	NA/NE

P&M ID (1)	P&M WEM NC5 (2)	P&M WAM NC5 (3)	Name of the P&M (4)	Sector(s) affected (5)	GHG affected (6)	CCPM addressed (7)	Objective and/or activity affected (8)	Type (9)	Status of implement. (10)	Brief description (11)	Start year of implement. (12)	Implementing entity(ies) (13)	Mitigation potential (14)
27	-	TR14	Improvement of transboundary mobility	Transport (mobility)	CO_2		Reaching the MoDu strategy objective of 25% of motorized trips by public transport by 2020.	planning	planned	This P&M aims at reinforcing the use of public transport in cross-border journeys notably by ensuring the cooperation of neighbouring Regions: use and development of new SMOTs. See further information in Boxes IV.1-4 & 1-5.	mid- to long-term	MDDI-DAT CdT CFL foreign neighbouring Regions	NE
28	-	TR14	Promotion of alternatives to passenger cars	Transport (mobility)	CO_2		Changing the behaviour of road users in urban zones and in activity zones (mobility policies of the enterprises).	information education	planned	This P&M aims at promoting car pooling and car sharing as well as the use of self-service electric cars in conjunction with the use of public transports (train or bus + "e-car" schemes).	mid- to long-term	MDDI-DAT CdT municipalities	NA
29	TR01	-	Analysis for a revision of car taxation	Transport (taxation policy)	CO_2		Increasing energy efficiency of the vehicle fleet.	economic fiscal	planned	This P&M aims at re-evaluating the car tax with regard to the bonus offered when buying new cars respecting certain criteria. This might not be necessary anymore since the "CAR-e" scheme will be discontinued by end 2014 (see Box IV.3-2). This P&M aims also at examining if it would be relevant to apply an extra tax for high emitting vehicles.	mid-term	MDDI-DEV MFIN-ADA	NE
30	-	TR13	Analysis for a revision of company car taxation	Transport (taxation policy)	CO_2		Setting up an incentive for promoting an offer of company cars that is more environment-friendly.	economic fiscal	planned	This P&M aims at examining different options chosen in other countries to deal with the issue of company cars. Options could be incentives, taxation schemes according to the average emissions rate of a company vehicles fleet, etc.	mid-term	MDDI-DEV MFIN-ACD	NE
31	TR03	TR11	Increase in excise duties taking into account impact on public finances	Transport (taxation policy)	CO_2 CH_4 N_2O		Analyzing the impact of increases in excise rates on the public finances of the country.	fiscal	planned	This P&M aims at following a cautious approach based on a better knowledge of the factors determining road fuel sales in Luxembourg. It could be read together with the "Kyoto-cent" (see Box IV.3-3).	mid-term	MDDI-DEV MFIN-ADA	NE
32	-	-	New forms of promotion/appeal devices	Energy consumption (residential)	CO_2		Promoting sustainable residential constructions through financial incentives.	economic	implemented	This P&M covers the launching of "zero rate eco-loan" for the building or renovation of residential constructions foreseen in a draft law on the promotion of sustainable residential constructions.	NE	MDDI-DEV MECE-DEN MLOG MFIN	NE
33	EC01a EC01b EC02 EC04	EC11a EC11b EC12 EC13 EC14	Improve renovation opportunities for rented apartments	Energy consumption (residential)	CO_2		Making subsidies more environmentally-friendly for new constructions and renovations. Reinforcing minimum standards for obtaining subsidies.	regulatory economic	planned	This P&M aims at defining different scales for subsidies offered to landlords and tenants, according to their revenues. This P&M is linked to the draft law on the promotion of sustainable residential constructions. See further information in Box IV.3-1.	mid-term	MDDI-DEV MECE-DEN MLOG MFIN	NE
34	-	-	Analysis of environmentally harmful subsidies and setting-up of a regulatory framework for those subsidies	Energy consumption (all sectors)	CO_2		Setting up a legal framework for environmentally harmful subsidies.	regulatory	planned	This P&M suggests the analysis of the different subsidies in conjunction with their possible harmful impacts on the environment.	mid-term	MDDI_DEV MFIN	NA
35	EC07	-	Capacity adaptation at *myenergy*	Energy consumption (all sectors)	CO_2		Ensuring that *myenergy* can fulfil all its missions.	regulatory	implemented	This P&M aims at guaranteeing sufficient human and financial means to *myenergy* so that it can accomplishes its missions, notably with regard to the Climate Agreement with municipalities (see Box IV.3-4).	2013	MDDI-DEV MECE-DEN	NA

P&M ID (1)	P&M WEM NC5 (2)	P&M WAM NC5 (3)	Name of the P&M (4)	Sector(s) affected (5)	GHG affected (6)	CCPM addressed (7)	Objective and/or activity affected (8)	Type (9)	Status of implement. (10)	Brief description (11)	Start year of implement. (12)	Implementing entity(ies) (13)	Mitigation potential (14)
36	-	-	Support of municipal capacities	Energy consumption (all sectors)	CO_2		Nominating advisors so to help municipalities to implement the Climate Agreement.	regulatory	implemented	This P&M aims at ensuring that the municipalities have the human means and expertise to implement the Climate Agreement (see Box IV.3-4).	2013	MDDI-DEV	NA
37	-	-	Extend the "Environment and Climate Partnership" to a "Sustainability Commission"	All	All		Perpetuating the functioning and the synergies built up through the "Environment and Climate Partnership".	regulatory	adopted	This P&M aims at giving a future, clear perspectives and a legal framework to the work and functioning of the "Environment and Climate Partnership". This is a "good governance" action.	mid-term	MDDI-DEV all Ministries represented in the Partnership	NA
38	-	-	Improvement and systematisation of data collection concerning energy consumption and emissions development in diverse sectors	Energy consumption (all sectors)	CO_2		Increasing data collection and quality on energy consumption and related emissions in various sectors: buildings, industries, transportation, etc.	information	planned	This P&M covers the development of statistical and econometric work on energy consumption and related emissions: projections, ex ante & ex post evaluations of P&Ms (emissions, abatement costs), etc. This is a "good governance" action.	2014	MDDI-DEV MECE-DEN STATEC	NA
39	-	-	Improvement and systematisation of data collection concerning energy consumption and emissions development in municipalities	Energy consumption (all sectors)	CO_2		Making data collection compulsory with regard to energy consumption and related emissions covered by the Climate Agreement.	regulatory	implemented	This P&M aims at a thorough monitoring of the measures taken in the framework of the Climate Agreement (see Box IV.3-4), notably through the setting up of a database managed by the SIGI. This is a "good governance" action.	2013	MDDI-DEV SIGI	NA
40	-	-	Evaluation of the second national "Action Plan for reducing CO_2 emissions"	All	All		Monitoring and evaluating the implementation of the Action Plan on a regular basis.	other	planned	This P&M aims at a regular follow-up of the Action Plan so to initiate, if applicable, corrective or revised measures. This is a "good governance" action.	2014-2015	MDDI-DEV	NA
41	(EC07) (IN03)	-	Expansion of the offer for training and education on energy efficiency, RES and ecological construction	Energy consumption (buildings)	CO_2	Directive 2009/28/EC	Offering training schemes and certificates of competence to various actors potentially involved in energy efficiency and the use of RES in buildings (residential, commercial, institutional).	education	implemented	This P&M aims at proposing training programmes, notably the programme "build-up skills Luxembourg" that is initiated in the context of the EU project "Build up skills, energy training for builders" that is coordinated in Luxembourg by *myenergy* (http://luxbuild2020.myenergy.lu/) *[→ Section IX.3]*.	NE	MDDI-DEV MECE-DCM *myenergy* Chamber of Trades IFSB	NA
42	(EC07)	-	Programmes on awareness rising and specific information for landlords and properties managers	Energy consumption (residential)	CO_2		Promoting and diffusing information on energy efficient construction and renovation and their advantages.	information	implemented	This P&M aims at further developing *myenergy infopoints* (http://infopoint.myenergy.lu/), at organising *myenergy days* exhibitions (http://myenergydays.myenergy.lu/) and at publishing various documents on energy savings and the use of RES *[→ Section IX.1.1]*.	NE	MDDI-DEV MECE-DEN MLOG *myenergy*	NA
43	(EC07) (IN03)	-	Awareness rising for more energy efficient construction and renovation	Energy consumption (residential)	CO_2		Promoting and diffusing information on energy efficient construction and renovation and their advantages.	information	implemented	This P&M aims at strengthening awareness campaigns at regional or local level dealing with energy efficient constructions or renovation through the *myenergy days* and *myenergy infopoints [→ Section IX.1.1]*.	NE	MDDI-DEV MECE-DEN *myenergy*	NA
44	(EC07)	-	Pilot project targeting energy advisors	Energy consumption (residential)	CO_2		Educating advisors for giving energy consumption advices to families with low revenues so that they can reduce their expenses with regard to energy and water consumption.	education	adopted	This P&M aims at developing a pilot project for energy advisors working primarily with low revenues households.	NE	MDDI-DEV MECE-DEN MTEES MFIGR	NA

P&M ID (1)	P&M WEM NC5 (2)	P&M WAM NC5 (3)	Name of the P&M (4)	Sector(s) affected (5)	GHG affected (6)	CCPM addressed (7)	Objective and/or activity affected (8)	Type (9)	Status of implement. (10)	Brief description (11)	Start year of implement. (12)	Implementing entity(ies) (13)	Mitigation potential (14)
45	(EC07)	-	Use of new communication tools to increase attractiveness for public transport	Transport (mobility)	CO_2		Realising information and awareness campaigns for promoting an environment-friendly transport.	information	adopted	This P&M aims at promoting environment-friendly transportation related behaviours through information and awareness campaigns at national and regional level *[→ Section IX.1.2]*.	NE	MDDI-DAT CdT	NA
46	-	TR14	Installation and development of a traffic telematics system for public transport	Transport (mobility)	CO_2		Interlinking real near-time transportation related data to provide users with on-line information at any time.	information	planned	This P&M aims at developing near-real time information on the situation on the roads, in the public transport, on the parking availabilities, etc.) so that users can optimize their choices through an on-line service.	NE	MDDI-DAT CdT	NA
47	-	-	Introduction of an "ecological mobility" label for companies	Transport (mobility)	CO_2		Launching an "ecological mobility" label for enterprises using low consumption and emissions vehicles.	voluntary/ negotiated agreement	adopted	This P&M acts as an incentive for enterprises participating to the "*Mobilitéitspass*" initiative (M-pass: http://www.mobiliteit.lu/titres-transport/m-pass/) and which are using low consumption and emissions vehicles.	NE	MDDI-DAT CdT	NA
48	(EC07)	-	Development of advices and support to industry and SMEs concerning energy efficiency and the usage of RES	Energy consumption (industries)	CO_2		Developing a national structure of lifelong training; creating a new energy efficiency evaluation tool for SMEs; and deployment of the "learning factory" initiative.	education	adopted	This P&M covers various projects aiming at a better deployment of energy efficiency and RES projects in industries and SMEs through education. It covers the "learning factory" initiative (http://www.enovos.lu/content/download/2666/27193/version/1/file/Learning+Factory+EN.pdf).	NE	MDDI-DEV MECE-DEN	NA
49	(EC05)	(EC15)	Reach an arrangement with municipalities with regard to the Climate Agreement	Energy consumption (all sectors)	CO_2		Implementing and following-up the Climate Agreement.	regulatory	implemented	This P&M covers the Climate Agreement with the municipalities described in Box IV.3-4.	2013	MDDI-DEV MINT Syvicol	NA
50	-	-	Development and application of a legal frame for the promotion of agro-forestry	Forestry LULUCF	CO_2 N_2O		Developing agro-forestry activities which consist in mixing agricultural activities (crops, livestock) and trees so to combine economic(agriculture) and ecological (environment protection, climate change mitigation) conditions.	regulatory	planned	This P&M aims at developing a legal framework for agro-forestry activities and to consider it in the national "Rural Development Programme".	2014	MDDI-ANF MAVPC MAVPC-ASTA	NE
51	-	-	Optimisation of forest carbon storage and optimisation of carbon storage in cultivated (grown) land	Forestry LULUCF	CO_2		Implementing new findings and approaches so to increase the "carbon sink" role of the forests and of cultivated land, alongside with techniques aiming at reducing soil erosion. This requires developing mixed forests (several tree species) which are structured and geographically adapted, analysing soil erosion due to climate change; initiating pilot projects, etc.	research planning	planned	This P&M aims at increasing carbon storage by forests and in cultivated land.	2020	MDDI-ANF MAVPC	NE

Abbreviations used in Table IV.3-1:

MAVPC – Ministry of Agriculture, Viticulture and Consumer Protection (*Ministère de l'Agriculture, de la Viticulture et de la Protection des consommateurs*): http://www.ma.public.lu/
  ASTA = Agriculture Technical Services Administration (*Administration des Services Techniques de l'Agriculture*): http://www.asta.etat.lu/
MECO – Ministry of the Economy (*Ministère de l'Economie*): http://www.eco.public.lu/
  DCM = Medium and Small Businesses Directorate (*Direction des Classes Moyennes*): http://www.mcm.public.lu/fr/index.html
  DEN = Energy Directorate (*Direction de l'Energie*): http://www.eco.public.lu/index.html
  STATEC = National Statistical Institute: http://www.statec.public.lu/fr/index.html
MESR – Ministry of Higher Education and Research (*Ministère de l'Enseignement supérieur et de la Recherche*): http://www.mesr.public.lu/
MDDI-DAT – Ministry of Sustainable Development and Infrastructure – Department of Land Planning (*Ministère du Développement durable et des Infrastructures – Département de l'aménagement du territoire*): http://www.dat.public.lu/

MDDI-DEV – Ministry of Sustainable Development and Infrastructure – Department of the Environment (*Ministère du Développement durable et des Infrastructures – Département de l'environnement*): http://www.emwelt.lu/:
AEV = Environment Agency (*Administration de l'Environnement*): http://www.environnement.public.lu/functions/apropos_du_site/aev/index.html
AGE = Water Agency (*Administration de la Gestion de l'Eau*): http://www.eau.public.lu/
ANF = Nature & Forests Agency (*Administration de la Nature et des Forêts*): http://www.environnement.public.lu/functions/apropos_du_site/anf/index.html
MDDI-TP – Ministry of Sustainable Development and Infrastructure – Department of Public Works (*Ministère du Développement durable et des Infrastructures – Département des travaux publics*): http://www.mtp.public.lu/
ABP = Public Buildings Administration (*Administration des Bâtiments Publics*): http://www.abp.public.lu/
MFIGR – Ministry of Family Affairs, Integration and the Greater Region (*Ministère de la Famille, de l'Intégration et à la Grande Région*): http://www.mfi.public.lu/
MFIN – Ministry of Finance (*Ministère des Finances*): http://www.mf.public.lu/
ACD: Direct Tax Administration (*Administration des Contributions Directes*) http://www.impotsdirects.public.lu/
ADA: Customs & Excises Administration (*Administration des Douanes et Accises*): http://www.do.etat.lu/
MINT – Ministry of Home Affairs (Ministère de l'Intérieur): http://www.miat.public.lu/
MLOG – Ministry of Housing (*Ministère du Logement*): http://www.ml.public.lu/fr/index.html
MTEES – Ministry of Labour, Employment and the Social and Solidarity Economy (*Ministère du Travail, de l'Emploi et de l'Économie sociale et solidaire*): http://www.mte.public.lu/

CdT – Transport Community (*Communauté des Transports – Verkéiersverbond*): http://www.mobiliteit.lu/verkeiersverbond/role-missions/
CFL – Luxembourg Railways (*Société Nationale des Chemins de Fer Luxembourgeois*): http://www.cfl.lu/fr
CRTE – Resource Centre for Environmental Technologies (*Centre de Ressources des Technologies pour l'Environnement*): http://tudor.lu/en/departments/CRTE
IFSB – Training Institute for the building sector (*Institut de Formation Sectoriel du Bâtiment*): http://www.ifsb.lu/fr/
ILR – Luxembourg Institute of Regulation (*Institut Luxembourgeois de Régulation*): http://www.ilr.public.lu/
Klima-Bündnis (Lëtzebuerg) – see Box IV.1-6: http://www.klimabuendnis.lu
Luxinnovation – National Agency for Innovation and Research (*Agence nationale pour la promotion de l'innovation et de la recherché*): http://www.luxinnovation.lu/
myenergy – see Box IV.1-8: http://www.myenergy.lu/
OAI – Order of Architects and Consulting Engineers (*Ordre des Architectes et des Ingénieurs-Conseils*): http://www.oai.lu
SIGI – Inter-Communal Informatics Management Association (*Syndicat Intercommunal de Gestion Informatique*): http://www.sigi.lu/accueil
Syvicol – Association of Luxembourg Towns and Municipalities (*Syndicat des Villes et Communes Luxembourgeoises*): http://www.syvicol.lu/accueil-actualite/

RES = renewable energy sources

TABLE IV.3-2 – P&Ms OF THE SECOND NATIONAL "ACTION PLAN FOR REDUCING CO2 EMISSIONS" – GROUPING BY MAIN THEMES

Theme	P&M second Action Plan
Transport – road fuels	31
Transport – road fuels: biofuels	-
Transport – road fuels: alternative means of propulsion	14 to 16 47
Transport – vehicles taxation	29 & 30
Transport – public transport & cycling and walking ("*mobilité douce*")	21 à 28 45 to 47
Energy supply: alternatives & RES	02 to 04
Energy consumption – EE: housing	05 & 06 12 & 13 32 & 33 41 to 44
Energy consumption – RES: housing	01 10 12 32 & 33 41 to 44
Energy consumption – EE: public & commercial services, retail	07 to 09 11 17 41
Energy consumption – RES: public & commercial services, retail	01 11 41
Energy consumption – EE: manufacturing industries	17 & 18 41 48
Energy consumption – RES: manufacturing industries	01 41 48
EU-ETS	18
Municipalities (*Pacte Climat*)	11 36 39 49
Agriculture, land use & forestry	50 & 51
Innovation & research	20
Taxation (excl. road fuels)	34
Education, information, awareness, advices	35 41 to 45 48
Governance	37 to 40
Other measures	19

Box IV.3-1: "PRIMe House" & "Energy Passport"

Measures 01, 06, 12 & 33 are promoted by the Department of the Environment under the label "PRIMe House" and through various brochures. This information is put forward on the internet: http://www.guichet.public.lu/citoyens/fr/actualites/2012/09/18-aides-energie-prime-house-2013/index.html and, for the latest brochure http://particuliers.myenergy.lu/files/file/Flyers/Aides%20financieres_PRIMe%20House%202013-2016_V2.pdf.

"PRIMe House" is based on a Regulation of 21 December 2007 that has been repealed in April 2009 and again in 2012: *Règlement grand-ducal du 21 décembre 2007 instituant un régime d'aides pour des personnes physiques en ce qui concerne la promotion de l'utilisation rationnelle de l'énergie et la mise en valeur des énergies renouvelables* (http://www.legilux.public.lu/leg/a/archives/2007/0247/a247.pdf, p. 4560-4577). This Regulation has been repealed in 2009 by the *Règlement grand-ducal du 20 avril 2009 instituant un régime d'aides pour la promotion de l'utilisation rationnelle de l'énergie et la mise en valeur des énergies renouvelables* that terminated by end 2012 (http://www.legilux.public.lu/leg/a/archives/2009/0083/a083.pdf, p. 980-997). In 2012, the scheme was revised and prolonged up to 2016: *Règlement grand-ducal du 12 décembre 2012 instituant un régime d'aides pour la promotion de l'utilisation rationnelle de l'énergie et la mise en valeur des énergies renouvelables dans le domaine du logement* (http://www.legilux.public.lu/leg/a/archives/2012/0264/a264.pdf, p. 3470-3484).

Changes mainly concerned:

1. subsidies are adapted to the energy performance of the buildings: the more energy efficient a renovated building will be, the higher the financial support;
2. subsidies are adapted to the overall energy class of a new construction and maintained up to 31 December 2013 for BBB class constructions and 31 December 2014 for AAA class constructions;
3. an increase of the subsidies for wood-burning boilers and heat pumps installations;
4. a decrease in subsidies for solar installations;
5. an increase of the subsidies for energy advices when an household or a landlord decides to renovate its house.

Besides "PRIMe House", a Regulation of 30 November 2007 introduced the energy performance certificate or "energy passport" – *passeport énergétique* in French, *Energiepass* in German. This certificate is compulsory from the 1st January 2008 on for all new residential buildings and for refurbishment, renovation or extension work requiring a construction permit. Since the 1st January 2010, such a document should also be prepared for houses or apartments that are sold to a new homeowner or when a new tenant moves in. Moreover, started on 1st July 2012, it is now compulsory to indicate both the energy performance (primary energy consumption) and the thermal insulation (heating) classes in the ads for property sales or renting. The latest revision of the Regulation overlooking the "energy passport" is available here: http://www.legilux.public.lu/leg/a/archives/2012/0096/a096.pdf#page=2.

The certificate informs clearly and precisely on the energy performance of the residential building – house or apartment. It uses the colour pictograms common to electrical appliances with 9 energy-efficiency classes A to I. For new residential constructions, the energy performance class should now be at least B. The certificate also notifies other elements such as yearly energy needs and CO_2 emissions of the construction (taking into account the type of fuel used and how it reaches the construction), the type of heating and hot water systems installed as well as their consumption, proposals for improving energy efficiency (for existing buildings), etc.

The certificate can only be established by persons registered by the Ministry of the Economy and by architects and engineers member of the OAI (*Ordre des Architectes et des Ingénieurs-conseils du Grand-Duché de Luxembourg*). The certificate is not free and costs should be supported by the vendor or is included in the construction price for new buildings: according to the size of the construction, the cost may vary between 500 and 1 300 € and is covered, partially or totally, by the "PRIMe House" scheme.

Details are available on the following web pages:
http://www.energyefficient.lu/;
http://particuliers.myenergy.lu/fr/conseil/achat_vente/passeport_energetique/FAQ;
http://particuliers.myenergy.lu/files/file/Flyers/Passeport%20e%CC%81nerge%CC%81tique_V2_2012.pdf.

Box IV.3-2: "CAR-e" scheme and its Impacts in the field of transport – passenger cars

In December 2007, a Regulation introduced a financial incentive for the purchase of energy efficient cars by individuals. It came into force on the 1st of January 2008 and was applicable to eligible vehicles registered from the 1st of June 2007 on. This scheme has been revised several times and also, for a while, included a financial incentives for passenger vehicles taken off-road and replaced by energy efficient ones – the so-called "*prime à la casse*" ("CAR-e plus"). The program will be entirely terminated by 31 December 2014. ***Table IV.3-3*** below summarizes the evolution of the "CAR-e" scheme through time and the latest situation is available here: http://www.car-e.lu/.

The Department of the Environment regularly monitors the passenger cars market to assess its evolution, notably towards the incentives and measures put in place – "CAR-e" and vehicle tax reform **(1)**.

The latest evaluation was made at the beginning of the year 2013, including vehicles sales up to December 2012. The following results were obtained: 13.9% of the newly registered cars in 2012 were emitting les than 100 g CO_2/km (i.e. a share 17 times bigger than in 2009) and 37.2 % less than 120 g CO_2/km. The average emissions of newly registered cars was 138.4 g CO_2/km in 2012 (-16.6% compared to 2007) and the average emissions of all registered cars on 1st January 2013 was 156.6 g CO_2/km (-13.6% compared to the 1st January 2005).

Overall, on 1st January 2013, paid subsidies amounted to 22.5 Mio. € for the "CAR-e" scheme (24 300 cars subsidized) and 15.3 Mio. € for the "CAR-e plus" scheme (7 000 cars subsidized).

Of course, these results are not only the consequence of the P&Ms put into place – "CAR-e", "CAR-e plus", vehicles' annual tax based on CO_2 emissions **(1)**, public campaigns such as *Oekotopten* **(2)**.The trends could also be explained by various other factors, amongst which, higher fuel prices over the period, the ever increasing share of diesel vehicles, and the continuous technological improvements implemented by car manufacturers. No decomposition analysis has been produced yet in Luxembourg for isolating the role of each factor on the trend of passenger cars sales by CO_2 emissions categories.

It must also be stressed than the rapid changes in shares are perhaps the outcome of the main characteristic of Luxembourg's passenger cars market, i.e. its relatively young vehicles fleet. This is the consequence of the high standard of living of the population, of the population increase, of the employees' turnover in the tertiary sector, and of company owned cars for their employees (leasing).

(1) for the vehicle tax reform, see P&M TR01 in Ministry of Sustainable Development and Infrastructure, Department of the Environment (2010), p. 163.
(2) http://www.oekotopten.lu/?page=francais

TABLE IV.3-3 – OVERVIEW OF THE "CAR-E" & "CAR-E PLUS" SCHEME

g CO_2/km	vehicle category	subsidy	first registration date 01.06.07	01.06.08	01.01.09	01.01.10	31.07.10	31.12.10 01.01.11	31.07.11 01.08.11	31.12.11	01.01.12 31.12.12	01.01.13 31.12.14
"CAR-e"												
≤ 160	A & B	750 €									*	
≤ 120	A	750 €										
≤ 120	B	750 €										
≤ 110	A & B	750 €										
≤ 100	A & B	1500 €										
≤ 100	A & B	750 €										
≤ 90	A & B	1500 €										
≤ 60	A & B	3000 €										
≤ 60	A & B	5000 €										
NA	L7	1000 €										
NA	C	3000 €										
NA	C	5000 €										
"CAR-e plus"												
≤ 150	A & B	1500 €										
≤ 120	A & B	1750 €										

*under certain circumstances

Vehicle categories
A: passenger cars owned by individuals, incl. hybrid vehicles
B: passenger cars owned by legal entities, incl. hybrid vehicles
C: 100% electrical cars
L7: electrical quadricycles

Box IV.3-3: The "Kyoto-cent"

Increasing excise rates on road fuels lead to increases of the retail price of these fuels. Higher prices set an incentive for consumers to lower demand. By the 1st of January 2007, the excise rate on gasoline was increased by 2 ct€/litre. For diesel, the excise rate was increased in two stages: 1.25 ct€/litre on the 1st of January 2007 and another 1.25 ct€/litre on the 1st of January 2008. Actually, this autonomous addition to the existing excise rates was introduced to finance the "Kyoto Fund" – renamed "Climate & Energy Fund" since January 2011 – set up in Luxembourg to deal with the Kyoto "flexible mechanisms" *[→ Section V.5.2]* and it is labelled "climate change contribution" or "Kyoto-cent".

This P&M was evaluated in the previous National Communication as P&M TR03 [Ministry of Sustainable Development and Infrastructure, Department of the Environment (2010), p. 166-167].

<u>**Box IV.3-4: Climate Agreement with municipalities – *Pacte Climat***</u>

One of the main outcomes of the “Environment and Energy Partnership” is the Climate Agreement with the municipalities – the *Pacte Climat* that was presented in October 2012 and entered into operation on the 1st January 2013 – http://www.pacteclimat.lu/

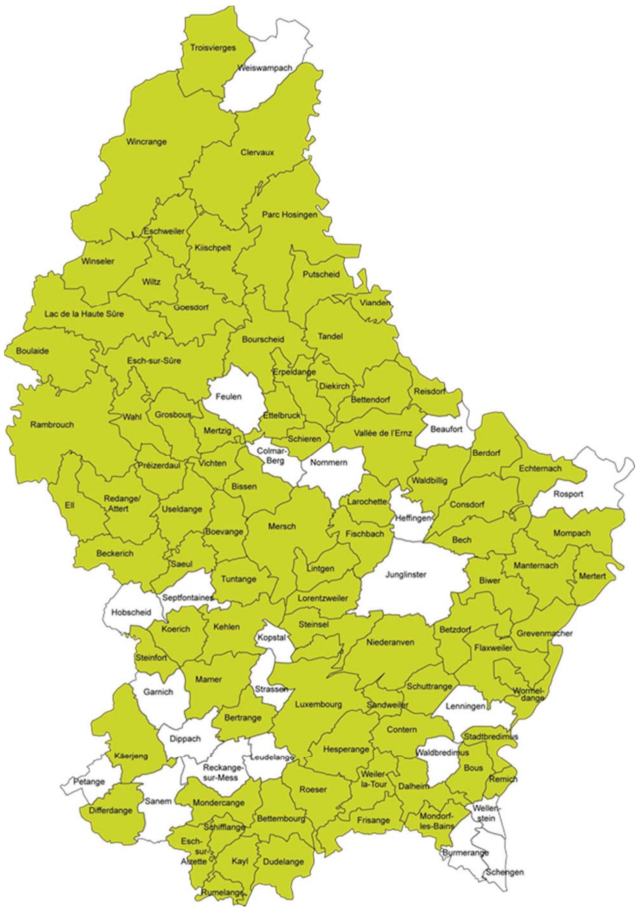
This Agreement reinforces the role of municipalities in the fight against climate change through a legislative, technical and financial framework set up in order to promote action against climate change by the municipalities. The *Pacte Climat* is basically an agreement (contract) between the State and the municipalities. Nowadays (as of February 24, 2014), 87 municipalities are engaged in the Agreement: see ***Figure IV.3-2***.

Under the Agreement, a municipality commits itself to implement a quality management system and the State provides financial and technical assistance.

The *Pacte Climat* is based on the EEA (“European Energy Award”), which:

1. supports communities that want to contribute to a sustainable energy policy and urban development through the rational use of energy and an increased use of renewable energies;
2. is a qualified instrument for steering and controlling communal energy policy in order to review systematically all energy-related activities;
3. allows municipalities to identify strengths, weaknesses and potential for improvement and implement effectively energy efficient measures. The success of a municipality's efforts is made visible by an award;
4. allows municipalities to share their experiences and expertise.

FIGURE IV.3-2 – MUNICIPALITIES THAT COMMITTED TO THE *PACTE CLIMAT*



Source: Pacte Climat website: http://www.pacteclimat.lu/

IV.3.3. P&Ms expired or repealed

Some of the measures that have been developed over the past years and that are well established have been adapted over time, in order to better achieve their definite goals. This is especially the case for the P&Ms dealing with energy use in buildings.

In this context, the "PRIMe House 2012", consisting in a financial aid in the case of building renovation or the use of renewable energies, has been renewed and extended for the period 2013 to 2016 (see Box IV.3-1). The following regulations have also been published in 2012:

- Grand-Ducal Regulation from 12th of December 2012 establishing an aid regime for the promotion of rational use of energy and the improvement of renewable energies in the area of housing;[158]
- Grand-Ducal Regulation from 15th of November 2012 changing the Grand-Ducal Regulation from 8th of February 2008 regarding electricity production based on renewable energy sources.[159]

Concerning premiums for the buying of new energy efficient cars, the "Prime CAR-e" has been renewed on a yearly basis but will be terminated by 31st December 2014 (see Box IV.3-2).

Consequently, for Luxembourg, since the consolidated 5th National Communication, i.e. January 2010 and end of December 2013, **no P&Ms have expired** and only the one dealing with excise duties on fuels for road transport could be mentioned. In fact, each year, the Regulation determining the excise rates, and notably the extra excises for an employment fund and for the "Climate & Energy Fund", is repealed and replaced by a new one fixing the various rates for the next period. However, strictly speaking, one cannot consider these revisions as a repeal of the measure.

IV.3.4. Plans and policies that could lead to increasing GHG emissions

Some plans and programmes might result in increasing GHG emissions.

For instance, the overall strategy for Luxembourg's economic development calls for the diversification of the economy. One of the diversification "clusters" pushed forward is on logistics, and more precisely for contract, air and rail freight-based logistics activities with a focus on value-added logistics. This might lead to some extra road or air transportation activities that might increase GHG emissions.

158 *Règlement grand-ducal du 12 décembre 2012 instituant un régime d'aides pour la promotion de l'utilisation rationnelle de l'énergie et la mise en valeur des énergies renouvelables dans le domaine du lodgement* (http://www.legilux.public.lu/leg/a/archives/2012/0264/a264.pdf#page=2, p. 3470-3484)

159 *Règlement grand-ducal du 15 novembre 2012 modifiant le règlement grand-ducal du 8 février 2008 relatif à la production d'électricité basée sur les sources d'énergie renouvelables* (http://www.legilux.public.lu/leg/a/archives/2012/0245/a245.pdf#page=2, p. 3194-3195)

The development of cogeneration plants in Luxembourg, presented in *Section II.12.3*, though increasing energy security and offering a less polluting electricity than the one imported, led to increasing GHG emissions. The response to this is now the development of cogeneration plants using biogenic fuels (biomass) that is considered as neutral with regard to CO_2 emissions (but not for the other GHG).

Various harmful subsidies act as incentives for GHG emitting activities. This is the case of a tax abatment in the income tax return offered for home-work journeys exceeding a given threshold.

This list is of course far from being exhaustive. Luxembourg would have to record the main programmes and plans, as well as fiscal and tax arrangements, not directly connected to climate change or energy issues but that could lead to increasing GHG or other air pollutants emissions.

IV.3.5. Minimizing adverse effects of response measures

A small economy such as Luxembourg is unlikely to generate significant negative impacts abroad via its policy choices. As already shown in the chapters before, Luxembourg has identified a broad diversification of measures to reduce national GHG emissions via its second national "Action Plan for reducing CO_2 emissions". Most of the identified measures have no direct or indirect negative effects on developing countries. Moreover, Luxembourg aligns with EU policies and its national PaMs mostly go beyond. The choice of project based mechanisms is in line with sustainability criteria. Luxembourg's cooperation aid is focused on LDC's and climate finance is additional to ODA. The country's cooperation is focused on several programmes of international financial institutions.

The following decisions take into account the minimization of adverse effects of P&Ms. Some of them are part of the 2013-2018 governmental programme of the recently elected Government [Government of the Grand Duchy of Luxembourg (2013)].

IV.3.5.1. Flexible mechanisms

The projects under Clean Development Mechanism (CDM) and the Joint Implementation (JI) should comply with the ecological and social criteria established in the framework of the approval procedures of the UNFCCC. In this context, Luxembourg has established specific procedures including sustainability check, initial project review, review and decision, term-sheet execution, due-diligence, etc. in order to evaluate the environmental, social and economic matters on the one hand, as well as the sustainability and cost-effectiveness of the projects on the other hand. Also, projects must not involve nuclear and LULUCF activities, large hydro projects have to demonstrate compliance with the recommendations of the World Commission on Dams and projects shall not be located in a prohibited host country. The list of prohibited host countries is provided by the Ministry of Finance or the Ministry of Foreign and European Affairs. Funding does not come from development-cooperation aid.

In this context, the 2013-2018 governmental programme states that "*The Government intends to review the governance of the climate & energy fund as well as the foreign emission rights acquisition policy in order to avoid bad quality certificates ("hot air") or the finance of environmentally harmful practices (e.g. coal extraction and production of HFCF-22)*".

IV.3.5.2. Biofuels

The promotion of biofuels is one policy having potential negative indirect effects on DCs as it could lead to the destruction of (or adverse shifts in) resources. EU legislation ensures that biofuels imported from such countries are produced in accordance with the principles of sustainable development. The conditions are set out in such a way that biofuels do not compete with food production and are not causing degradation of valuable ecosystems. Luxembourg supports relevant EU activities, such as the Directive on the Promotion of the Use of Energy from Renewable Sources & the Directive on Fuel Quality.

In this context, the 2013-2018 governmental programme states: "*As 1st generation biofuels have shown not to fulfil the requirements of sustainable development, the Government is determined to condition the promotion of biofuel through social and ecological criteria and to introduce a limitation (cap) on the use of 1st generation biofuels. In the Community framework, the Government consequently will commit to the promotion of 2nd generation biofuels*".

IV.3.5.3. Harmful subsidies and adverse incentives in tax system

Environmentally harmful subsidies and adverse incentives in the tax system are partially identified. The objective is a gradual elimination of such negative incentives. Fiscal deductions for commuting to work and the fiscal arrangements for company cars are two of such negative incentives. Tax exemptions for some "occupational" fuels, such as in agriculture, are another example of potential field of action.

In this context, the 2013-2018 governmental programme foresees the progressive decoupling of budgetary revenues from road fuel sales and ordinary expenses of the State. To the extent that the budget permits it, revenues will progressively be assigned to the financing of measures aiming at an energetic transition to a more sustainable model. To do so, an economic feasibility study will be realised.

IV.3.5.4. Emission Trading

Companies under the EU ETS Directive are faced with legal requirements which can bear additional costs (e.g. reduction of GHG emissions through investments, purchase of CO_2 quotas). In order to prevent industries from "carbon leakage" and to avoid the associated negative effects on countries underlying a less constraining regulation, free allocations have been delivered to companies falling under EU ETS regulation (e.g. cement, glass, steel and chemical industries). During the first Kyoto Commitment Period (2008-2012) about 14 installations were concerned (total of 12.44 million tonnes CO_2e of free allocations), whereas in the second period (2013-2020), 15 installations are beneficiating from approx. 10.25 million tonnes CO_2e.

IV.3.6. Steps relating to aviation and marine bunker fuels

Each Party included in Annex I shall, in pursuit of Article 2, paragraph 2, of the Kyoto Protocol, identify the steps it has taken to promote and/or implement any decisions by the International Civil Aviation Organization (ICAO) and the International Maritime Organization (IMO) in order to limit or reduce emissions of GHG not controlled by the Montreal Protocol from aviation and marine bunker fuels.

Luxembourg is of the view that there is an urgent need to agree on global emission reduction targets for both international aviation and maritime transport, consistent with the 2°C objective, and believes that work should be continued through the ICAO and the IMO to develop a global policy framework ensuring a level playing field.

Luxembourg is actively participating in the ICAO work, mainly through the Abis group, a common delegation to the ICAO representing the civil aviation authorities of seven European States (Austria, Belgium, the Netherlands, Luxembourg, Ireland, Portugal and Switzerland).

Luxembourg is of the view that the decision by the ICAO Assembly in October 2013 to design a global market-based measure by 2016 and for implementation from 2020 is a significant step forward.

In order to "facilitate" negotiations towards the definition of a global instrument, Luxembourg considers that the currently implemented so-called "stop the clock" derogation from the original full scope of the EU ETS directive should be prolonged until 2016.

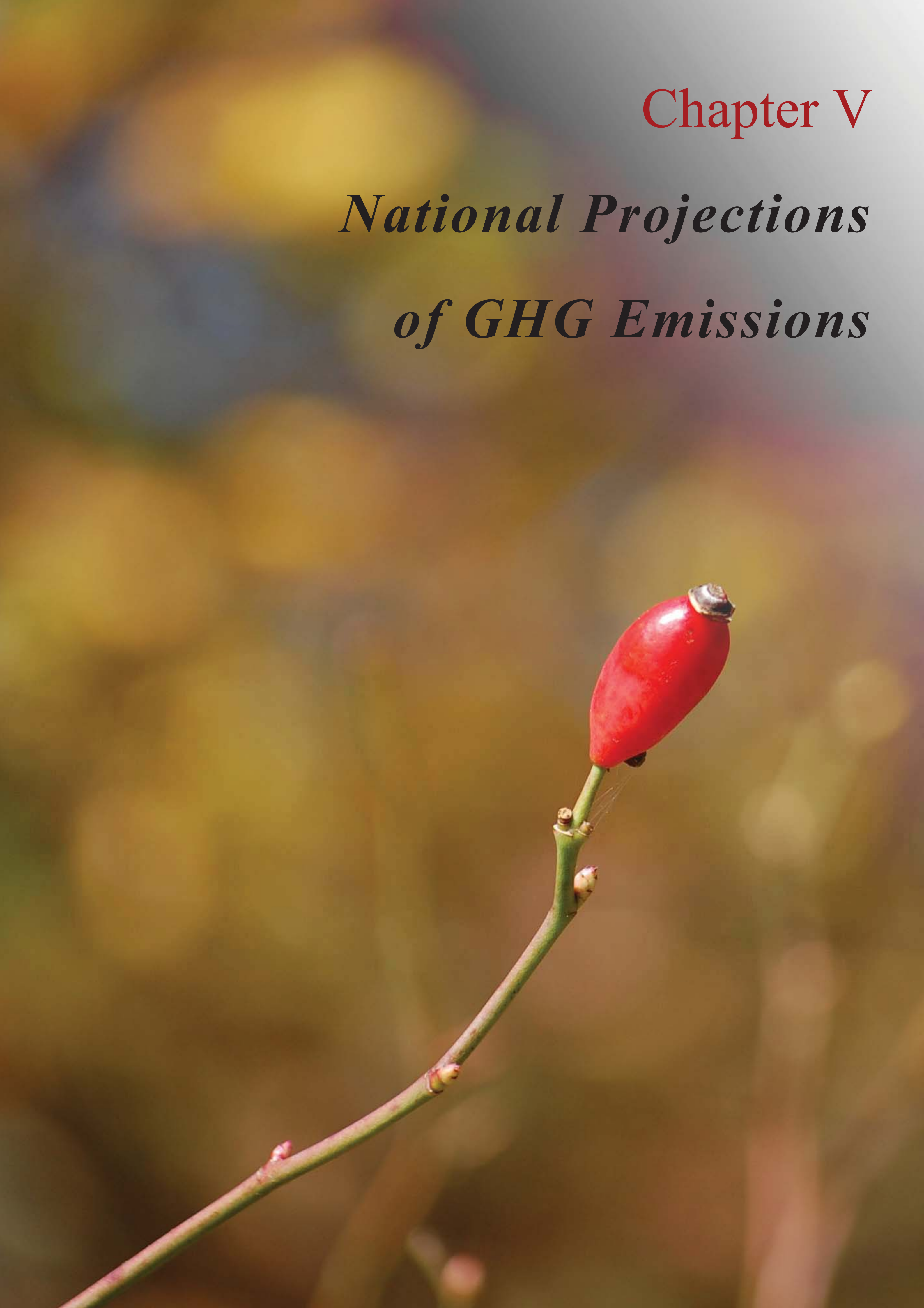
All aircraft operators administered by Luxembourg under the EU ETS are obliged to monitor their annual emissions and to submit a verified annual emission reports. Revenues regenerated through the auctioning of the allowances (15% will be auctioned) will be added to the "Climate & Energy Fund" *[→ Section V.5.2]*.

Furthermore, Cargolux, one of the leading cargo airlines worldwide based in Luxembourg, was the launch customer for the latest-generation of Boeing 747-8F (9 such Boeing 747-8F are currently in operation by Cargolux), which is even more fuel-efficient and produces lower noise disturbances than the widely used Boeing 747-400F, one of the most fuel-efficient and quietest long-range wide-body aircraft available. A fleet changeover program has been planned, allowing a complete switch to the 747-8F within six to seven years. In terms of reduced CO_2 emissions, the lower fuel burn translates into a 17% reduction in CO_2 per tonne-km. Applied to Cargolux's operations this represents a saving of up to 400 000 tonnes of CO_2 per year.

Luxembourg is also participating in the work undertaken by the IMO, and in particular the work of the Marine Environment Protection Committee. Luxembourg shares the general concern within the EU that the discussions in the IMO on the reduction of GHG emissions from ships, especially the discussions on market based measures, have so far not been very productive.

Chapter V

National Projections of GHG Emissions



Chapter V discusses GHG projections up to 2030 for two scenarios: with existing measures (WEM scenario), and with additional measures (WAM scenario). After short preliminary comments *[→ Section V.1]*, this chapter touches on the methodology underpinning the projections *[→ Section V.2],* as requested by paragraphs 42, 43 and 48 of the UNFCCC reporting guidelines. Then, results of the projection exercise are presented for a collection of sectors *[→ Section V.3]*. The projections are in line with most of the recommendations of the UNFCCC reporting guidelines, paragraphs 27 to 32 and 34 to 41, **with the exception of paragraphs 39 to 41 since the estimated and expected effects of individual policies and measures could not yet be performed** *[→ Section IV.3]*. Finally, after a brief discussion of possible improvements in the GHG projections methodology *[→ Section V.4]*, supplementarity relating to "flexible mechanisms" under Article 6, 12 and 17 of the Kyoto Protocol is discussed *[→ Section V.5]*.

V.1. PRELIMINARY REMARKS: PROJECTIONS ASSOCIATED TO HIGH UNCERTAINTY

This Communication has already emphasizes specific national circumstances of Luxembourg on several occasions. In introduction to *Section IV.3* on the implemented, adopted and planned P&Ms, a few key remarks were formulated *[→ Section IV.3.1]*, which were setting the limits of a GHG projections exercise for Luxembourg. The two main points are:

- with more than 55% of total GHG emissions (excl. LULUCF), stemming from road transport, and around 40% allocated to "road fuel sales to non-residents" *[→ Table III.1.3]*, emissions structure is dominated by one sub-category – namely CRF 1A3b – for which the future evolution will not only depend on national P&Ms, but also (i) on the international context, such as road fuel prices and taxation in the neighbouring countries, (ii) on options chosen with regard to mobility at EU level and, especially, in the neighbouring countries or regions (limitation of trucks circulation, introduction of road use fees or changes in the toll policy, etc.) or (iii) on technological developments (electric or hybrid cars, fuel cells vehicles, higher energy efficient engines, etc.). There is, therefore, a **high uncertainty** for the projected emissions due to road transport for both the WEM and WAM scenarios. These projections take into account national P&Ms implemented, adopted or planned and, to the extent possible, overall transport and traffic developments as appraised in European models;
- Luxembourg's and its economy sizes yield uncertainties in the projection since the opening, the closure or the breakdown of an industrial installation could have significant impacts on the total emissions, as the iron & steel move from blast furnaces to electric arc furnaces between 1994 and 1998, or the TWINerg power plant that started its operation in 2002 and faced long maintenance operations in 2008 and 2011, both demonstrate *[→ Sections II.12.2 & III.1.1]*.

V.2. Model and methodology[160]

V.2.1. Overall approach

GHG projections **for the years 2015, 2020, 2025 and 2030** have been performed at CRF category or sub-category levels so that it has been possible to fill in the *EmissionsProjections* sheet of version 7.1 of the MMRT.[161] The only sectors that have not been estimated are CRF 5 – LULUCF – and the memo item "international bunkers – marine" – which is insignificant for Luxembourg.

Beginning 2013, the Department of the Environment financed the Belgian energy and environmental consultants' office ECONOTEC for preparing GHG projections to be reported under Article 3, paragraph 2, of Decision 280/2004/EC [ECONOTEC Consultants (2013a)]. Due to financial and time constraints, but also with the view of further developing an advanced modelling and scenario tool for GHG projections,[162] the contract with ECONOTEC was **limited to update CO_2 projections in CRF sectors 1 and 2** from the previous emission projections exercise done in 2011 [ECONOTEC Consultants (2011)] and to include international aviation. In the fall of 2013, these **projections have been revised** for the preparation of the sixth National Communication [ECONOTEC Consultants (2013b)], mainly to:

- further refined manufacturing industries related emissions via direct contacts with the production units;
- further model the electricity sector;
- refine projections for both passengers and freight road transportation;
- adapt the tool used to forecast residential buildings emissions – the "Residential-Tertiary Tool" developed by ECONOTEC[163] – by including the first results of the latest population census of Luxembourg that has been led in 2011.

The two studies by ECONOTEC – written in French – are available upon request.

For the remaining emission sources (CO_2 emissions in CRF sectors 3, 4 and 6; CH_4, N_2O and F-gases emissions in all sectors) projected estimates **for the years 2015, 2020, 2025 and 2030**, assumptions or choices were made by the Department of the Environment. A colour coding has

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160 This section of the NC6 covers section V.D of the Outline and General Structure of the NC5 according to IPCC reporting guidelines (para. 5).

161 MMRT stands for "Monitoring Mechanism Reporting Template", a Microsoft™ Excel file to report policies and measures and projections to the European Commission (EC). It is provided by DG CLIMA and the European Topic Centre on Air pollution and Climate Change mitigation (ETC/ACM) of the European Environment Agency (EEA). The MMRT file could be provided on request.

162 These developments were planned to start in 2013 in the view of preparing Luxembourg's 6th National Communication to the UNFCCC but could not be performed following budget cuts. They are still planned for 2014 and subsequent years, providing funding will be available.

163 See ECONOTEC Consultants (2013c).

been used in the *EmissionsProjections* sheet of the MMRT in order to distinguish between the two "sets" of projections:

- **RED** – ECONOTEC's studies 2015, 2020, 2025 & 2030 projections;
- **ORANGE** – adjusted ECONOTEC's studies 2015, 2020, 2025 & 2030 projections to match with 2013v1.2 submission published figures (see ***Section V.2.2***);
- **BLUE** – Department of the Environment assumptions;
- **GREEN** – projections based on GAINS emissions projections for the baseline scenario, version of 25 June 2013[164]

2015 to 2030

Though the latest GHG inventory – submission 2013v1.2[165] – includes data on emissions up to the year 2011, **the starting historical year for the projections is 2010** as recommended by DG CLIMA for the 2013 reporting under Decision 280/2004/EC. In 2010, CO_2 emissions represented 91.9% of the total GHG emissions (excl. LULUCF). Energy related CO_2 emissions accounted for 87% of the total GHG emissions (excl. LULUCF). This percentage was 4.8% for industrial processes. Hence, **ECONOTEC's projections cover 91.8% of the total 2010 GHG emissions** (excl. LULUCF).

Finally, ECONOTEC provided **emission projections for the WEM and WAM scenarios**. The WEM scenario consists of a "Business as Usual" (BAU) or "reference" projections that includes the effects of the adopted and implemented P&Ms **up to the 1st January 2013**. For the WAM scenario, mitigation potentials of the additional P&Ms have been subtracted from the values obtained for the WEM scenario – this happened only for CRF categories 1A3b (road transportation) and 1A4a&b (commercial, institutional and residential buildings). Consequently, **there are no optional without measures (WOM) projections** produced yet for Luxembourg *[→ Section IV.1.6]*.

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164 See Box V.2-1 for details on GAINS.

165 http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/zip/lux-2013-crf-15apr.zip.

V.2.2. CO_2 emission projections in CRF sectors 1 & 2

Source ECONOTEC's final reports for the Department of the Environment of 28 February 2013 and 19 December 2013 [ECONOTEC Consultants (2013a) & (2013b)].

Coverage CO_2 emissions in CRF categories and sub-categories 1A1 to 1A4, 2A-D and memo item "international bunkers - aviation".

Historical data used submission 2013v1.2 of 15 March 2013 to both the EC and the UNFCCC.[166]

Reference/starting year for the projections 2010.

Adjustments the Department of the Environment performed a few adjustments to ECONOTEC's study projections so that emission estimates for 2010 correspond exactly to those of submission 2013v1.2. Indeed, the model used by ECONOTEC relies on official statistics' energy consumption data (STATEC) that were not always identical to corresponding energy consumption used for estimating GHG emissions under the so-called "sectoral approach" of the GHG inventory. Therefore, when applicable, historical emission levels in ECONOTEC's tables have been replaced by submission 2013v1.2 corresponding amounts, and projections have been adjusted so to allow consistency and comparability (figures in orange in the MMRT). The correction factor applied to projections is a simple rule of three:

corrected projection = 2013v1.2 value$_{2010}$ *x [projected value*$_i$ */ historical value*$_{2010}$*].*

with i= 2015, 2020, 2025 or 2030 and values into brackets = CO_2 values from the ECONOTEC study

Modelling tool ECONOTEC used its own model – called EPM[167] – to carry out the projections. This model is presented in detail in *Section V.2.4*.

Detailed assumptions for CO_2 emissions projections

The method for estimating GHG emission levels up to 2030 is making use of information on demographic, transport and housing developments in Luxembourg. Assumptions on future physical production in the various energy and industrial sectors are another input for the EPM. **GDP growth has not been taken into account while preparing the projections**. There are obvious reasons for not considering GDP implicitly in the projection exercise: firstly, GDP of Luxembourg is mainly driven by service activities and, more precisely, finance related activities. Moreover, a great share of the industrial production in Luxembourg is exported (small internal market, most of the big industrial installations are subsidiaries of foreign business concerns) and, finally, road freight transport, that is definitively correlated to GDP, is actually more correlated to an

166 http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/zip/lux-2013-crf-15apr.zip.

167 EPM stands for "Energy/Emissions Projection Model". Some explanations are available on ECONOTEC's website: http://www.econotec.be/conseils.html and in Section V.2.4.

aggregated GDP for various EU Member States than to the GDP of Luxembourg since its emissions are principally due to traffic in transit. **With regard to carbon and energy prices, no specific hypotheses have been made**. These prices are actually implicitly taken into account where results of the EC PRIMES 2013 baseline scenario exercise (see Box V.2-1) have been used [ECONOTEC Consultants (2013b), p. 9 and *Table V.2-1*]. Consequently, without explicit use of either GDP or energy and carbon prices, **no sensitivity analysis stricto sensu could have been performed so far on the projections** *[→ Section V.3.10]*.

Table V.2-1 summarizes the specific assumptions used in the EPM for each of the CRF (sub-)categories included in ECONOTEC's study for the WEM scenario. Details are provided in ECONOTEC Consultants (2013b), Chapter 4 & Section 8.2.

TABLE V.2-1 – MAIN ASSUMPTIONS FOR CO_2 PROJECTIONS IN CRF SECTORS 1 AND 2 IN THE ECONOTEC STUDY FOR THE WITH EXISTING MEASURES SCENARIO (WEM)

CRF (sub-)category	Projection assumptions by source in the EPM model
1A1a	**TWINerg power plant** – use of 2010 emissions level which corresponds to a "normal" annual activity of the plant. **ETS CHP installations** – use of 2010 emissions level, i.e. the same production capacities and effective production is assumed throughout the period. **other CHP installations** –extrapolations based on the last 5 historical years (2006-2010). **municipal solid waste incinerator with energy recovery** – 2015: based on an annual growth rate that suggests a return to the 2006-2011 emissions level by 2015; 2020 = 2015 level augmented by quantities diverted from landfills; 2025 & 2030 = 2015 emissions level.
1A2a	**reheating furnaces** – the actual supposedly temporarily closure of two installations is considered as definitive, by 2015 other installations come back to their pre-crisis level (2007 chosen as reference year), then PRIMES 2013 developments are applied for the subsequent years. **electric arc furnaces** – the actual supposedly temporarily closure of two installations is considered as definitive, by 2015 other installations come back to their pre-crisis level (2007 chosen as reference year), then effective production stability is assumed for the subsequent years. **other installations** – by 2020 the pre-crisis level (2008 chosen as reference year) is reached (linear interpolation), then effective production stability is assumed for the subsequent years.
1A2b	**aluminium plants** – use of the PRIMES 2013 developments. **secondary copper production** – by 2015 the pre-crisis level is reached (2007 chosen as reference year), then effective production stability is assumed for the subsequent years.
1A2c	**Ceduco power plant** – by 2015 the pre-crisis level (2006 chosen as reference year) is reached, then PRIMES 2013 developments are applied for the subsequent years. **Cegyco power plant** – this installation has been stopped in 2013. It is supposed that the closure is definitive though, at the moment, it is not yet clearly decided if it will be the case. **DuPont Power** – by 2015 the pre-crisis level (2007 chosen as reference year) is reached, then effective production stability is assumed for the subsequent years. **Good Year/Hyosung** – by 2015 the pre-crisis level (2008 chosen as reference year) is reached, then PRIMES 2013 developments are applied for the subsequent years. **other chemicals plants** – use of the PRIMES 2013 developments.
1A2d	**paper & pulp installations** – use of the PRIMES 2013 developments.
1A2e	**food, drink & tobacco installations** – use of the PRIMES 2013 developments.

1A2f	cement-based products – by 2015 the pre-crisis level (2007 chosen as reference year) is reached, then PRIMES 2013 developments are applied for the subsequent years. flat glass production – stability is assumed, i.e. 2015/20/25/30 = 2010 emissions level. Kronospan CHP installation – stability is assumed, i.e. 2015/20/25/30 = 2010 emissions level. **Kronospan wood & plywood panels' production** – 2015 = 2012 emissions level, then PRIMES 2013 developments are applied for the subsequent years. asphalt production – 2015 = 2012 emissions level, then PRIMES 2013 developments are applied for the subsequent years. **other industries** – 2015 = 2012 emissions level, then PRIMES 2013 developments are applied for the subsequent years.[168]
1A3a	**civil aviation (domestic)** – a combination of a European reference system ("EX-TREMIS") and Eurocontrol activity data [ECONOTEC Consultants (2013b), p. 16].
1A3b	**road transportation** – a combination of (i) hypothesis on future demand of road fuels according to fuel prices (price-elasticities), (ii) mobility developments, and (iii) expected changes in vehicles CO_2 emissions (technologies) and 'fuel mix' shares (diesel vs. gasoline). Passenger transportation is broken up into national/resident mobility, cross-border commuters, transit traffic and "fuel tourism" as such. Freight transportation is divided into national and transit traffic [ECONOTEC Consultants (2013b), p. 13-15].
1A3c	**railways** – use of the PRIMES 2013 developments.
1A3d	**inland navigation** – use of the PRIMES 2013 developments.
1A4a	**commercial & institutional buildings** – outputs from the specific "Residential-Tertiary Tool" developed by ECONOTEC for the MDDI-DEV [ECONOTEC Consultants (2013c)]: details in ECONOTEC Consultants (2013b), p. 21-22.
1A4b	**residential buildings** – outputs from the specific "Residential-Tertiary Tool" developed by ECONOTEC for the MDDI-DEV [ECONOTEC Consultants (2013c)]: details in ECONOTEC Consultants (2013b), p. 19-21.
1A4c	stability is assumed, i.e. 2015/20/25/30 = 2010 emissions level.
2A1	cement production – by 2015 the pre-crisis level (2007 chosen as reference year) is reached, then PRIMES 2013 developments are applied for the subsequent years.
2A7	flat glass production – stability is assumed, i.e. 2015/20/25/30 = 2010 emissions level.
2C1	electric arc furnaces – the actual supposedly temporarily closure of two installations is considered as definitive, by 2015 other installations come back to their pre-crisis level (2007 chosen as reference year), then effective production stability is assumed for the subsequent years.
international bunkers – aviation	a combination of a European reference system ("EX-TREMIS") and Eurocontrol activity data: traffic is broken up into passenger and freight air transportation [ECONOTEC Consultants (2013b), p. 16].

Note: sources indicated in red are those that are part of the EU Emissions Trading System (EU ETS).

For the **WAM scenario**, the following planned measures have been considered:[169]

- CRF 1A3b – road transportation – the 2020 target set for Luxembourg in the framework of the EU "Climate & Energy package" – i.e. a 10% share for sustainable produced biofuels and other renewable fuels in final energy consumption of the transport sector *[→ Section IV.1.1]* – is expected to be reached. More precisely, it is assumed a share of biofuels of 7.5% in 2015 and 10% in 2020 and subsequent years [ECONOTEC Consultants (2013a), p. 14];[170]

168 For construction activities, the hypothesis is 2015/20/25/30 = 2010 emissions level.

169 Actually, these measures are not "additional" stricto sensu since they are included in Action Plans and/or already embedded in national legislation. However, since they were not yet implemented by the 1st January 2013, they are included in the WAM scenario. For biofuels, the 10% objective is considered as "additional" because of the uncertainty surrounding this target.

170 For the updated projections prepared during the 2013 fall [ECONOTEC Consultants (2013b)], this additional measure has been deleted because of the overall uncertainty and debate surrounding biofuel uses for road transportation. It has, however, been kept for this Communication.

- CRF 1A3b – road transportation – the second national "Action Plan for reducing CO_2 emissions" foresees a 10% share of electric vehicles in the total number of passenger cars by 2020 – see P&M No 14 in ***Table IV.3-1***. This is equivalent to 40 000 cars. Calculations and hypothesis for this additional measure are presented in ECONOTEC Consultants (2013b), p. 16-19;[171]
- CRF 1A4a – commercial and institutional buildings – Directive 2010/31/EC requests that, by 31st December 2020, all new constructions should be "near zero emission buildings" (NZEB) – 31st December 2018 for public buildings – see P&M No 09 in ***Table IV.3-1***. It is assumed, as an additional measure, that new public constructions will be NZEB by 31st December 2018 and that new commercial and service constrictions will be NZEB by 31st December 2020;
- CRF 1A4b – residential buildings – in the context of Directive 2010/31/EC, it is assumed, as an additional measure, that all new housing constructions will be NZEB already by 31st December 2018 according to the national target to have only primary and heating energy classes "A" for new buildings by 2018 and, expectedly, "A+" by 31st December 2020.

Box V.2-1: PRIMES & GAINS 2013

The PRIMES model is a modelling system that simulates a market equilibrium solution for energy supply and demand in the EU28 and its Member States. The model determines the equilibrium by finding the prices of each energy form such that the quantity producers find best to supply matches the quantity consumers wish to use. The market equilibrium is achieved for each time period and the simulation is dynamic over time. The model is behavioural but also represents in an explicit and detailed way the available energy demand and supply technologies and pollution abatement technologies. The system reflects considerations about market economics, industry structure, energy/ environmental policies and regulation, which are conceived so as to influence market behaviour of energy system agents. The modular structure of PRIMES reflects a distribution of decision making among agents that act individually about their supply, demand, combined supply and demand, and prices. The market integrating part of PRIMES subsequently simulates market clearing.

PRIMES is a general purpose energy model; it is conceived for designing projections to the future, scenario building and policy impact analysis. It covers a medium to long-term horizon. Its modular structure allows either for integrating model use or for partial use.

Source: European Commission (2013), p. 10.

For the projections, the PRIMES 2013 results for the "baseline" scenario have been used. The "baseline" scenario is closer to a WEM state than the "reference" scenario since the former considers only enacted policies and measures whereas the latter supposes that Member States will meet legally binding EU "Climate & Energy package" 2020 targets.

The GAINS model – "baseline" scenario – has been used by the EC for non-CO_2 emissions and non-energy production or consumption source categories. For a description of GAINS, visit http://gains.iiasa.ac.at/gains/EUN/index.login?logout=1.

171 Indirect emissions presented in the ECONOTEC study (p. 18-19) are not considered since the extra quantity of electricity needed for electric vehicles could either be partially imported and/or coming from "green" sources. It is impossible to know, at this stage, which electricity mix could power the electric vehicles.

V.2.3. CO_2 emissions projections in CRF sectors 3, 4 & 6 and projections for non-CO_2 GHG

Source Department of the Environment.

Coverage CO_2 emissions in CRF categories & sub-categories 1B2b and 3; other GHG emissions in all CRF sectors but 5 – LULUCF and memo item "international bunkers - marine".

Historical data used submission 2013v1.2 of 15 March 2013 to both the EC and the UNFCCC.[172]

Reference/starting year for the projections 2010 to keep consistency with the ECONOTEC study.

Adjustments not applicable.

Modelling tool not applicable.

Detailed assumptions for non-CO_2 emissions and CRF sectors 3 to 6 projections

For those CRF (sub-)categories for which CO_2 emissions have been estimated in the ECONOTEC study, use was made of simple ratios for completing the projections with non-CO_2 GHG.

For CRF sectors 3 to 6 rather simple methods have been used, since they represented 6.1% of the total GHG emissions in 2010 (excl. LULUCF).

Table V.2-2 summarizes the specific assumptions made by the Department of the Environment in order to complete ECONOTEC's results.

TABLE V.2-2 – MAIN ASSUMPTIONS FOR GASES AND EMISSION SOURCES NOT COVERED BY THE ECONOTEC STUDY FOR THE WITH EXISTING AND ADDITIONAL MEASURES SCENARIOS (WEM & WAM)

CRF (sub-)category	2010 share in total GHG emissions, excl. LULUCF	Projection assumptions by sources
1A1a	NA (ECONOTEC)	**CH_4 & N_2O** – use of the average ratio CH_4 or N_2O/CO_2 for years 2002-2010, i.e. since the TWINerg power plant started its operations. 2008 & 2011 have been excluded due to maintenance activities performed by TWINerg that reported therefore reduced activity for these two years.
1A2a	NA (ECONOTEC)	**CH_4** – the CH_4/CO_2 ratio being rather stable for the last 5 historical years (2007-2011): use of a constant value derived from this stable ratio value. **N_2O** – use of the average ratio N_2O/CO_2 for the last 5 historical years (2007-2011).
1A2b	NA (ECONOTEC)	**CH_4 & N_2O** – the ratios CH_4 or N_2O/CO_2 being rather stable for the last 5 historical years (2007-2011) use of constant values derived from these stable ratio values.
1A2c	NA (ECONOTEC)	**CH_4 & N_2O** – the ratios CH_4 or N_2O/CO_2 change a lot during the last years: use of the highest ratio, for CH_4 & N_2O respectively, recorded over the last 5 historical years (2007-2011) – conservative approach.

172 http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/zip/lux-2013-crf-15apr.zip.

1A2d	NA (ECONOTEC)	**CH_4** – use of the average ratio CH_4/CO_2 for the last 5 historical years (2007-2011). **N_2O** – the ratio N_2O/CO_2 changes a lot during the last years: use of the highest ratio recorded over the last 5 historical years (2007-2011) – conservative approach.
1A2e	NA (ECONOTEC)	**CH_4 & N_2O** – use of the average ratio CH_4 or N_2O/CO_2 for the last 5 historical years (2007-2011).
1A2f	NA (ECONOTEC)	**CH_4 & N_2O** – use of the average ratio CH_4 or N_2O/CO_2 for the last 5 historical years (2007-2011).
1A3a	NA (ECONOTEC)	**CH_4 & N_2O** – the ratios CH_4 or N_2O/CO_2 are constant through time: use of these constant values.
1A3b	NA (ECONOTEC)	**CH_4** – the CH_4/CO_2 ratio shows a decreasing trend between 2000 and 2011. If this trend is continued, it would reach 0% by 2019 – if calculated on the basis of the last 5 historical years – or by 2014 – if calculated on the basis of the last 10 historical years (standard regression with OLS). As working hypothesis, to forecast CH_4 emissions, a ratio value of 0.04% has been used for the year 2015 and of 0.01% for the years 2020, 2025 & 2030. **N_2O** – use of the average ratio N_2O/CO_2 for the last 5 historical years (2007-2011).
1A3c	NA (ECONOTEC)	**CH_4 & N_2O** – use of the average ratio CH_4 or N_2O/CO_2 for the last 5 historical years (2007-2011).
1A3d	NA (ECONOTEC)	**CH_4** – the ratio CH_4/CO_2 changes a lot during the last years: use of the highest ratio recorded over the last 5 historical years (2007-2011) – conservative approach. **N_2O** – use of the average ratio N_2O/CO_2 for the last 5 historical years (2007-2011).
1A4a	NA (ECONOTEC)	**CH_4** – use of the average ratio CH_4/CO_2 for the last 5 historical years (2007-2011). **N_2O** – the ratio N_2O/CO_2 changes a lot during the last years: use of the highest ratio recorded over the last 5 historical years (2007-2011) – conservative approach.
1A4b	NA (ECONOTEC)	**CH_4** – the ratio CH_4/CO_2 changes a lot over the years: use of the highest ratio recorded over the last 10 historical years (2002-2011) – conservative approach. **N_2O** – use of the average ratio N_2O/CO_2 for the last 5 historical years (2007-2011).
1A4c	NA (ECONOTEC)	**CH_4** – the ratio CH_4/CO_2 being rather stable for the last 5 historical years (2007-2011): use of a constant value derived from this stable ratio value. **N_2O** – use of the average ratio N_2O/CO_2 for the last 5 historical years (2007-2011).
1A5	-	this sub-category is more a “statistical error” entry in the inventory than a proper GHG source: amounts are the result of statistical discrepancies obtained when combining bottom-up and top-down energy data. Hence, it has not been attempted to produce GHG projections for that sub-category.
1B2b	0.37%	**CO_2 & CH_4** – use of the forecasted natural gas gross inland consumption – see line 28 of the *ProjectionParameters* sheet of the MMRT – to calculate 2015-20-25-30/2010 ratios.
2A1	NA (ECONOTEC)	CH_4 & N_2O are not applicable.
2A7	NA (ECONOTEC)	CH_4 & N_2O are not occurring.
2C1	NA (ECONOTEC)	CH_4 & N_2O are not occurring or are not applicable.
2F	0.60%	**HFCs** – 2F1/2/4: use of a ratio HFCs/population (with population value in 2010 & national baseline population forecasts for 2015-20-25-30): this ratio stabilised during the last years, hence use of the highest ratio recorded over the last 5 historical years (2007-2011). This highest ratio is recorded for 2009, hence: $emissions_i = (emissions_{2009} / Pop_{2009}) \times Pop_i$ with i = 2015, 2020, 2025 or 2030. **PFCs** – 2F1: use of a ratio PFCs/population (with population value in 2010 & national baseline population forecasts for 2015-20-25-30): this ratio fluctuated during the last years, hence use of the average ratio recorded over the last 5 historical years (2007-2011),hence: $emissions_i = (emissions_{average\_2007-2011} / Pop_{average2007-2011}) \times Pop_i$ with i = 2015, 2020, 2025 or 2030. **SF_6** – 2F8/9: use of the average annual growth rate over the last 5 historical years (2007-2011), i.e. 4.73% per year.
3A	0.02%	**CO_2** – historical emissions generally varied between 2.5 & 3 Gg since 2000. A constant mean value of 2.75 Gg has been used for the projections.
3B	0.02%	**CO_2** – average value for the last 5 historical years (2007-2011).
3C	0.01%	**CO_2** – average value for the last 5 historical years (2007-2011).

3D1	0.04%	**N_2O** – the last historical years, the ratio of N_2O emissions per 1000 inhabitants equals 0.0095 (In CO_2e). This ratio has been applied to the national baseline population forecasts for 2015-20-25-30, hence *$emissions_i$ = 0.0095 x (Pop_i /1000)* with i = 2015, 2020, 2025 or 2030. *Note: GAINS baseline scenario projections up to 2050 have not been used because default values seemed to have been used (same 5-year growth rates than for CRF 6B e.g.).*
3D5	0.05%	**CO_2** – average value for the last 5 historical years (2007-2011).
4A	2.05%	**CH_4** – use of GAINS baseline scenario projections up to 2050: GAINS growth rates 2015-20-25-30/2010 have been applied to the 2010 historical values from submission 2013v1.2.
4B	0.99%	**CH_4 & N_2O** – use of GAINS baseline scenario projections up to 2050: GAINS growth rates 2015-20-25-30/2010 have been applied to the 2010 historical values from submission 2013v1.2.
4D	2.49%	**N_2O** – use of GAINS baseline scenario projections up to 2050: GAINS growth rates 2015-20-25-30/2010 have been applied to the 2010 historical values from submission 2013v1.2.
6A	0.26%	**CH_4** – use of GAINS baseline scenario projections up to 2050 for municipal solid waste: GAINS growth rates 2015-20-25-30/2010 have been applied to the 2010 historical values from submission 2013v1.2. *Note: GAINS projections decline for the future years. This is in line with the fact that one of the two landfill sites in Luxembourg will close around 2015.*
6B1	0.00%	**N_2O** – average value for the last 5 historical years (2007-2011). *Note: GAINS baseline scenario projections up to 2050 have not been used because default values seemed to have been used (same 5-year growth rates than for CRF 3D e.g.).*
6B2	0.11%	**CH_4** – use of GAINS baseline scenario projections up to 2050: GAINS growth rates 2015-20-25-30/2010 have been applied to the 2010 historical values from submission 2013v1.2. **N_2O** – average value for the last 5 historical years (2007-2011). *Note: GAINS baseline scenario projections up to 2050 have not been used for N_2O because default values seemed to have been used (same 5-year growth rates than for CRF 3D e.g.).*
6D	0.12%	**CH_4 & N_2O** – average values for the last 5 historical years (2007-2011). *Note: no GAINS baseline scenario projections up to 2050 for this sub-category.*
international bunkers – aviation	-	**CH_4 & N_2O** – the ratios CH_4 or N_2O/CO_2 are constant through time: use of these constant values.

V.2.4. The EPM model - a “bottom-up” simulation model[173]

EPM (Energy/Emissions Projection Model) is a projection model for energy demand and atmospheric emissions – CO_2, CH_4, N_2O, SO_2, NOx, and VOCs – that covers all relevant emission sectors (energy sector, industry, residential, commercial, transport). It has been developed progressively by ECONOTEC since 1993 in the framework of a number of studies carried out for public authorities, whether at regional or at national level.

Given the heterogeneity of some industrial sectors or of the residential sector, in order to realize a good prediction, it is necessary to take into account internal structural effects within these sectors. Therefore, EPM is capable to count for differences in sub-sectors or production processes developments over time when these sub-sectors have different levels of specific consumptions.

EPM is a **techno-economic simulation model**, of the “**bottom-up**” type, i.e. explaining energy consumptions and GHG emissions from activity variables expressed as far as possible in physical

173 The description of the EPM model comes from various reports published by ECONOTEC, and principally from ECONOTEC Consultants & VITO (2005).

units, and containing a detailed representation of a range of emission sources and of the main determining factors that influence the evolution of energy demand and of the various types of emissions.

This methodological option is based on the observation that there are no simple and homogeneous relationships between aggregated macroeconomic variables expressed in monetary value and actual energy consumption.

EPM also includes a techno-economic database on measures aiming at reducing energy use and emissions – i.e. P&Ms in the context of GHG mitigation actions. It is used in particular for:

- the construction of a BAU or "reference" scenario, representing the probable future developments in the absence of any new emission reduction policy;
- evaluating economic potentials for emissions reduction;
- constructing emission reduction scenarios taking into account a set of reduction measures with a marginal cost below a given threshold;
- constructing cost curves, providing either the marginal or the total cost as a function of the level of emission or energy consumption reduction;
- assessing the impact of existing or draft legislations on energy consumptions, emission levels and costs.

The BAU or "reference" scenario is defined on the basis of energy consumption levels for a reference year (corrected for yearly climatic variations) as well as on a set of hypothesis on the evolution of activity variables, on the development of specific consumption and market shares of various energy sources and on emission factors. Two emission categories are considered: emissions linked to energy consumption and "process" emissions.

In the EPM, **industry** is usually represented by about a hundred activity variables (pig iron production, oxygen steel production, ethylene production, clinker production, flat glass production…). The large energy consumption branches are modelled in a more detailed way than the others. For example, iron & steel production is analysed per installation type (agglomeration, blast furnace, oxygen steel production, etc.) and for the chemical industry, about twenty basic products are distinguished. Such details, however, are not necessary for Luxembourg where the industrial sector comprises only 25 to 30 main emitting installations (or "large point sources") and where, in the steel industry, e.g., a limited number of processes – in this case, electric arc furnaces – are present.

For the **residential sector**, EPM usually considers existing and new houses, existing and new apartments (electric and non electric heated), domestic water heating and 10 specific uses of electricity (cooking, refrigerators, washing machines, dryers, etc.). The heat load is estimated using a separate module made of 14 type-dwellings. In this module, energy consumptions are calculated taking into account the respective performances of 15 heat production, distribution or emission systems.

In the **tertiary sector**, about 30 sub-sectors are grouped into 8 categories, and 5 energy uses are distinguished (heating, ventilation, cooling, lighting and other electric uses). The activity variable is the floor area of the buildings.

For this exercise, ECONOTEC also used **a specific "Residential-Tertiary Tool"** for both the residential and the tertiary sectors: see ECONOTEC Consultants (2013c) for details.

In the **transportation sector**, the distinction is made between road transportation of persons, road transportation of goods, rail transportation, inland water transportation and air transportation of passengers and freight. For road transportation, the modelling is carried out in a separate module calculating emission levels as a function of the average specific energy consumptions of vehicles at the time of their first use and taking into account (European) regulations on polluting emissions applicable at that time as well as general predicted traffic evolutions as reported in TREMOVE,[174] EX-TREMIS[175] and SULTAN[176] European projects – see ECONOTEC Consultants (2013b), p. 13-15, for details.

Nevertheless, it is important to stress the fact that EPM is not an "off-the-shelf" model but rather a flexible tool that is adapted each time to reflect the available background information as well as the objectives that are pursued by the use of the model. Consequently, for Luxembourg, the model version was not as detailed as it is described above for the different sectors: assumptions made for the BAU scenario are presented in ECONOTEC Consultants (2009a).

For more details on the EPM model in general, and on results it can provide as well as on analytic possibilities it offers, refer to ECONOTEC Consultants (2000), ECONOTEC Consultants (2002) and ECONOTEC Consultants & VITO (2005).

174 http://ec.europa.eu/environment/air/pollutants/models/tremove.htm.
175 http://www.ex-tremis.eu/.
176 http://www.eutransportghg2050.eu/cms/illustrative-scenarios-tool/.

V.2.5. *Synthesis of the projection exercise for GHG emissions in Luxembourg*

This section recapitulates the different points discussed in previous sections with regard to the particular projection exercise completed for this sixth National Communication and first Biennial Report.

Step 1

For each source category, fuel consumptions have been aggregated for the reference year 2010. The source category considered here are those covered by ECONOTEC in its studies for the Department of the Environment, i.e. (sub-)categories and installations pertaining to CRF sectors 1 and 2. Tables in annex to the latest ECONOTEC report [ECONOTEC Consultants (2013b), section 8] list the various (sub-)categories and installations for which emission projections have been calculated.

Step 2

For each source category, future total energy consumptions have been estimated by applying to the 2010 data the expected evolutions of the activity variable and of the specific source category consumption. The specific source category consumption evolution takes on board anticipated technical developments as well as the replenishment of the production installations, which both lead logically to a reduction of this specific consumption through time, even without any particular P&Ms implemented. These activity variable and specific consumption evolutions are exogenous and are expressed either in annual average growth rates (in percentages) for a given period of time or based on level assumptions for a certain year ***[→ Tables V.2-1]***.

Step 3

For each source category, future consumption by fuel type has been obtained by applying "market shares" to the future total energy consumption obtained at step 2. These "market shares" are also exogenous variables, which are specific to each source category. The EPM model uses, as a default, the reference year – i.e. 2010 – "market shares" – see, e.g., "market shares" for the residential and the commercial & institutional sectors in ECONOTEC Consultants (2013b), p. 21 and 22.

Step 4

For each source category, and each fuel type, emissions have been obtained by multiplying the consumption levels by the corresponding EFs.

This step is the final one for the WEM scenario projections.

Step 5

For the WAM scenario, the anticipated effects of the P&Ms have been applied to the WEM projections. In fact, additional measures are "simply" subtracted from the WEM projected estimates.

Step 6

Steps 1 to 5 have been performed by ECONOTEC. However, the Department of the Environment performed an adjustment where the discrepancy between official energy statistivs and those used for the "sectoral approach" of the GHG inventory were seen as too important. 2010 emissions levels in ECONOTEC's tables have been replaced by submission 2013v1.2 corresponding amounts where relevant, and projections have been adjusted so to allow consistency and comparability. The correction factor applied to projections is a simple rule of three:

$$\textit{corrected projection} = \textit{2013v1.2 value}_{2010} \times [\textit{projected value}_i \,/\, \textit{historical value}_{2010}].$$

with i= 2015, 2020, 2025 or 2030 and values into brackets = CO_2 values from the ECONOTEC study

The projections in the 2 scenarios have then been adapted accordingly.

Step 7

ECONOTEC projections covering only a subset of the emission source categories, the Department of the Environment produced the missing projections – CH_4 and N_2O, CRF sectors 3, 4 & 6 and (sub-)categories 1B2b & 2F – using basic assumptions and simple methods. Indeed, the sources not covered by ECONOTEC represented only 8.1% of the total 2010 GHG emissions of Luxembourg (excl. LULUCF) ***[➔Table V.2-2]***.

V.3. PROJECTIONS[177]

Detailed projections results are available in the MMRT (*EmissionsProjections* sheet).[178] Consequently, this chapter only presents the projections in an aggregated way and in CO_2e.

For the presentation of the results, the following CRF sectors, categories and sub-categories are distinguished:

- "public electricity & heat production" (1A1a) – including waste incineration;
- "iron and steel plants" (1A2a & 2C1);
- "other manufacturing industries" (1A2b to f & 2A);
- "road transportation" (1A3b) – including lubricants to be reported under 1A3b;
- "commercial and institutional combustion" (1A4a);
- "residential combustion" (1A4b);
- "agriculture" (1A4c & 4);
- "other miscellaneous sources" (1A3a/c/d, 1A5, 1B2b, 2F, 3 & 6).

Historical data in the following tables and graphs (1990 to 2011) are extracted from the GHG inventory, submission 2013v1.2 of 15 March 2013 to both the EC and the UNFCCC.[179] 2012 estimates are "nowcasts" produced by the Department of the Environment during the 2013 summer ***[→ Section III.1 & Box III.1-1]***. Projected emissions are estimated on the basis of the year 2010 ***[→ Section V.2.1]***.

In ***Tables V.3-1 to V.3-9***, data are presented both in 1000 tonnes of CO_2e (Gg) and in indices (with 1990 being equal to 100). The two scenarios – **WEM** & **WAM** – are presented for the projected years. ***Figures V.3-1 to V.3-9*** only display indices with 1990=100.

V.3.1. Public electricity & heat production (1A1a)

TABLE V.3-1 – HISTORICAL AND PROJECTED EMISSIONS FOR PUBLIC ELECTRICITY & HEAT PRODUCTION

Gg (1000 t.) CO_2 equivalent	CRF Categories	1990	1995	2000	2005	2010	2011	2012prov	2015	2020	2025	2030	
Public Electricity & Heat Production	1A1a	35.56	93.23	120.01	1243.79	1207.08	994.69	1039.61	1220.43	1241.45	1251.64	1262.61	WEM
									1220.43	1241.45	1251.64	1262.61	WAM
		100.00	*262.20*	*337.51*	*3498.08*	*3394.84*	*2797.50*	*2923.84*	*3432.39*	*3491.49*	*3520.17*	*3551.02*	WEM
									3432.39	*3491.49*	*3520.17*	*3551.02*	WAM

Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2
MDDI-DEV – 2012 nowcasts & projections.

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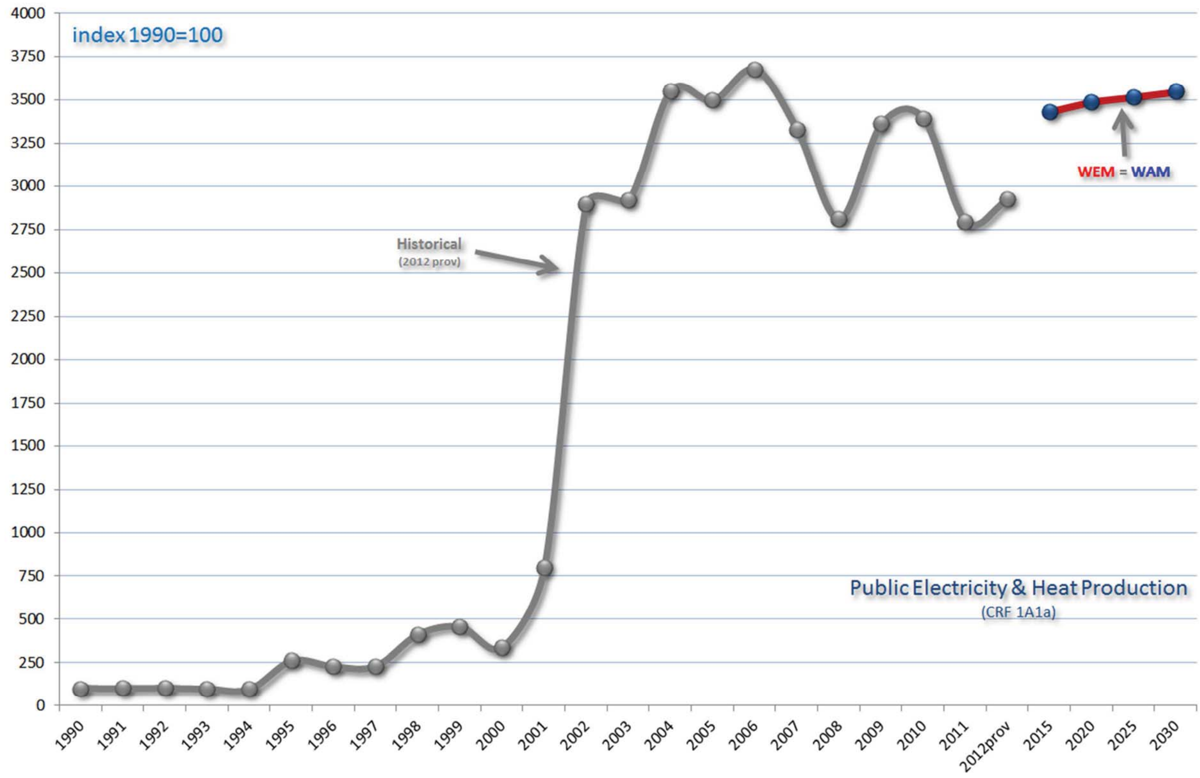
177 This section of the NC5 covers sections V.A, V.B and parts of V.D not discussed in Section V.2 of the Outline and General Structure of the NC5 according to IPCC reporting guidelines (para. 5). International aviation projections are not presented in this NC.

178 Detailed projections are also available in ECONOTEC Consultants (2013b). However they do not cover the full spectrum of requested data and have been corrected by the Department of the Environment to reflect the latest GHG inventory submission (cf previous section).

179 http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/zip/lux-2013-crf-15apr.zip.

FIGURE V.3-1 – HISTORICAL AND PROJECTED EMISSIONS FOR PUBLIC ELECTRICITY & HEAT PRODUCTION



Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2
MDDI-DEV – 2012 nowcasts & projections.

Projected emissions are identical for the two scenarios. Indeed, there are no additional P&Ms identified so far.

The projections do not take into account any possible start-up of new power plants in Luxembourg – the rationale being that the development of further CHP installations using fossil fuels or natural gas is not favourable to Luxembourg with regard to the accounting of GHG emissions in inventories *[→ Sections II.12.3, II.12.4 & IV.3.1.3]*. It is also supposed that the biggest installations will operate near their highest production levels reported for the last years. Finally, the diversion, by 2020, of waste from landfills to the incinerator is accounted for *[→ Table V.2-1]*. The latter explains why the slope is a little bit steeper between 2015 and 2020 than for the subsequent years.

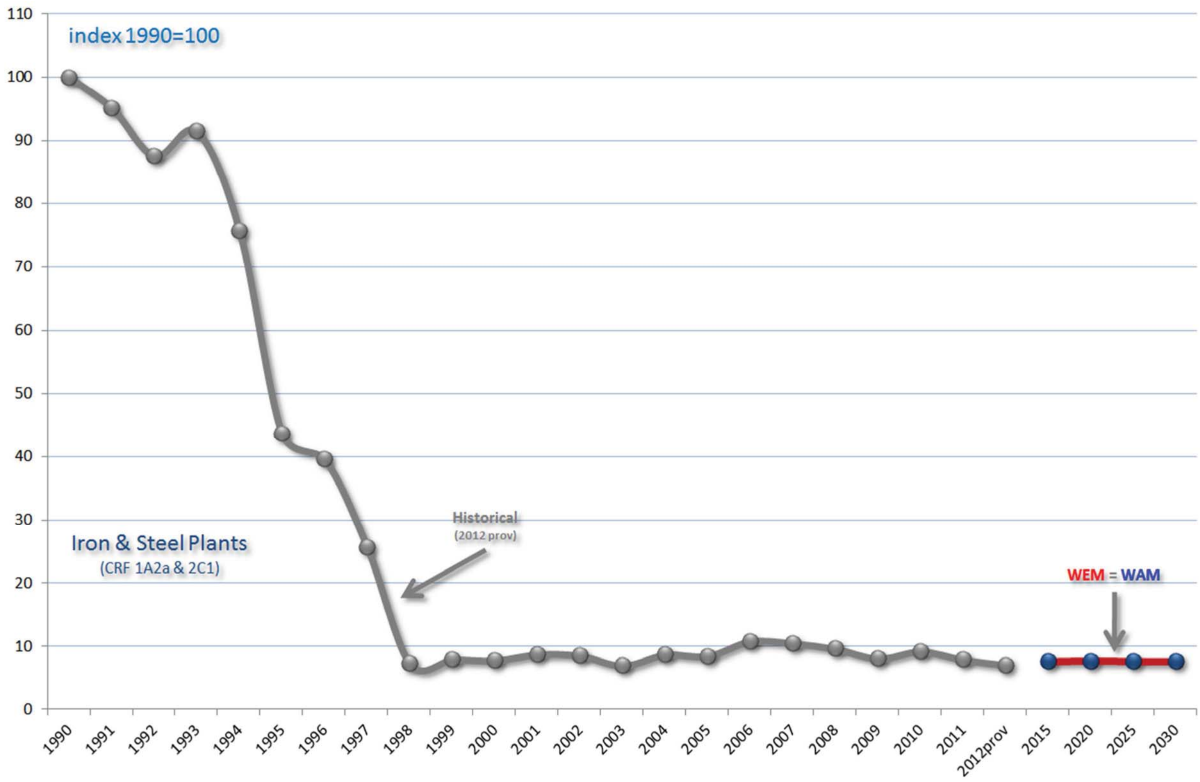
V.3.2. Iron and steel plants (1A2a & 2C1)

TABLE V.3-2 – HISTORICAL AND PROJECTED EMISSIONS FOR IRON AND STEEL PLANTS

Gg (1000 t.) CO_2 equivalent	CRF Categories	1990	1995	2000	2005	2010	2011	2012prov	2015	2020	2025	2030	
Iron & Steel Plants	*1A2a*	6411.26	2803.08	505.30	549.98	594.84	512.54	457.63	494.64	498.72	494.73	490.85	WEM
	2C1								494.64	498.72	494.73	490.85	WAM
		100.00	*43.72*	*7.88*	*8.58*	*9.28*	*7.99*	*7.14*	*7.72*	*7.78*	*7.72*	*7.66*	WEM
									7.72	*7.78*	*7.72*	*7.66*	WAM

Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2
MDDI-DEV – 2012 nowcasts & projections.

FIGURE V.3-2 – HISTORICAL AND PROJECTED EMISSIONS FOR IRON AND STEEL PLANTS



Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2
MDDI-DEV – 2012 nowcasts & projections.

As for public electricity & heat production, projected emissions are identical for the two scenarios since there are no planned measures for the iron and steel industry in Luxembourg.

For the projections, the "temporary" closure of two producing installations is considered as final and it is assumed that activity will resume to its pre-crisis level by 2015 and then stabilise or slightly increase in line with the PRIMES 2013 assumptions, hence the rather "flat" projection *[→ Table V.2-1]*.

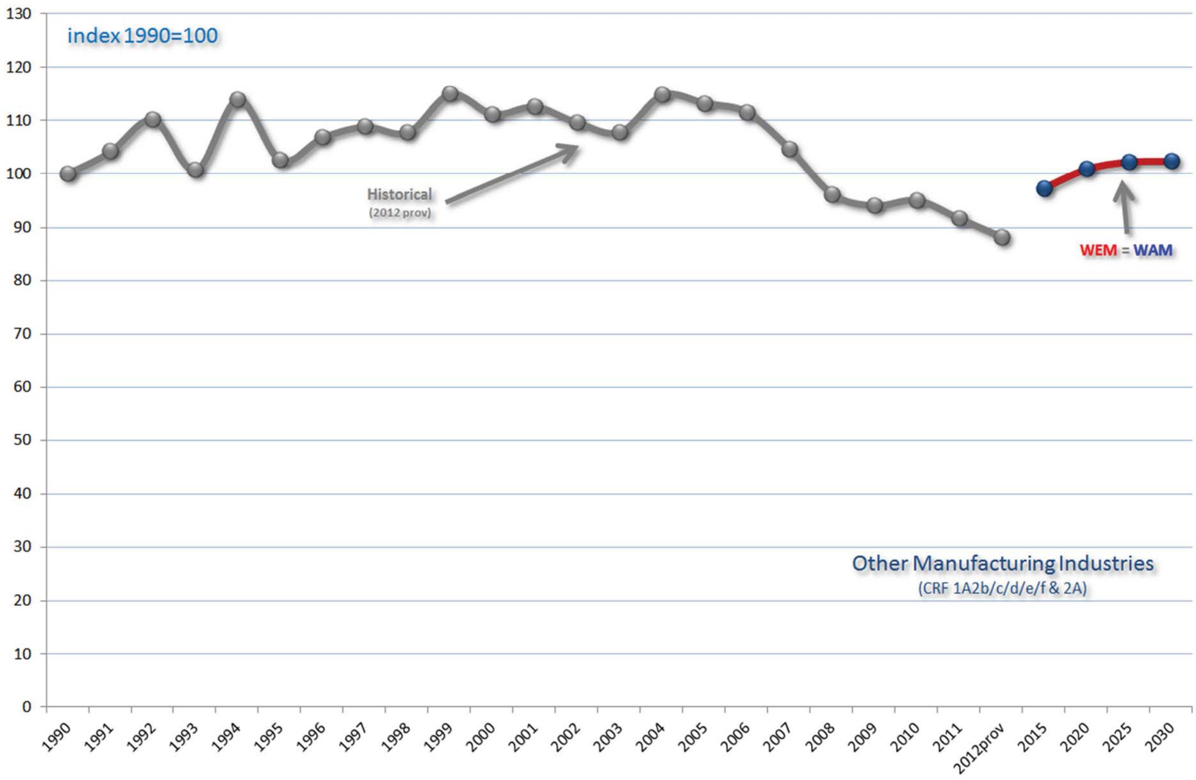
V.3.3. Other manufacturing industries (1A2b to f & 2A)

TABLE V.3-3 – HISTORICAL AND PROJECTED EMISSIONS FOR OTHER MANUFACTURING INDUSTRIES

Gg (1000 t.) CO_2 equivalent	CRF Categories	1990	1995	2000	2005	2010	2011	2012prov	2015	2020	2025	2030	
Other Manufacturing Industries	1A2b to f 2A	1501.81	1541.49	1670.89	1701.39	1428.75	1377.17	1325.85	1461.98	1516.78	1537.38	1539.13	WEM
									1461.98	1516.78	1537.38	1539.13	WAM
		100.00	102.64	111.26	113.29	95.14	91.70	88.28	97.35	101.00	102.37	102.49	WEM
									97.35	101.00	102.37	102.49	WAM

Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2
MDDI-DEV – 2012 nowcasts & projections.

FIGURE V.3-3 – HISTORICAL AND PROJECTED EMISSIONS FOR OTHER MANUFACTURING INDUSTRIES



Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2
MDDI-DEV – 2012 nowcasts & projections.

Again projected emissions are identical for the two scenarios since there are no planned measures for the industry as a whole in Luxembourg. Moreover, the main existing measures in this sector are the EU ETS and the voluntary agreement under the aegis of FEDIL (see Box IV.1-7 and P&Ms No 17 & 18 in *Table IV.3-1*).

Projected emissions via EPM are based on various hypotheses that, for CO_2, rely mostly on PRIMES 2013 assumptions. It is also supposed that one CHP installation (auto-producer), which stopped in 2013, will no longer operate in the coming years *[→ Table V.2-1]*. Nevertheless, estimates anticipate increasing emissions up to 2030 predominantly for cement-based goods and, to a lesser extent, for combined chemical-textile products.

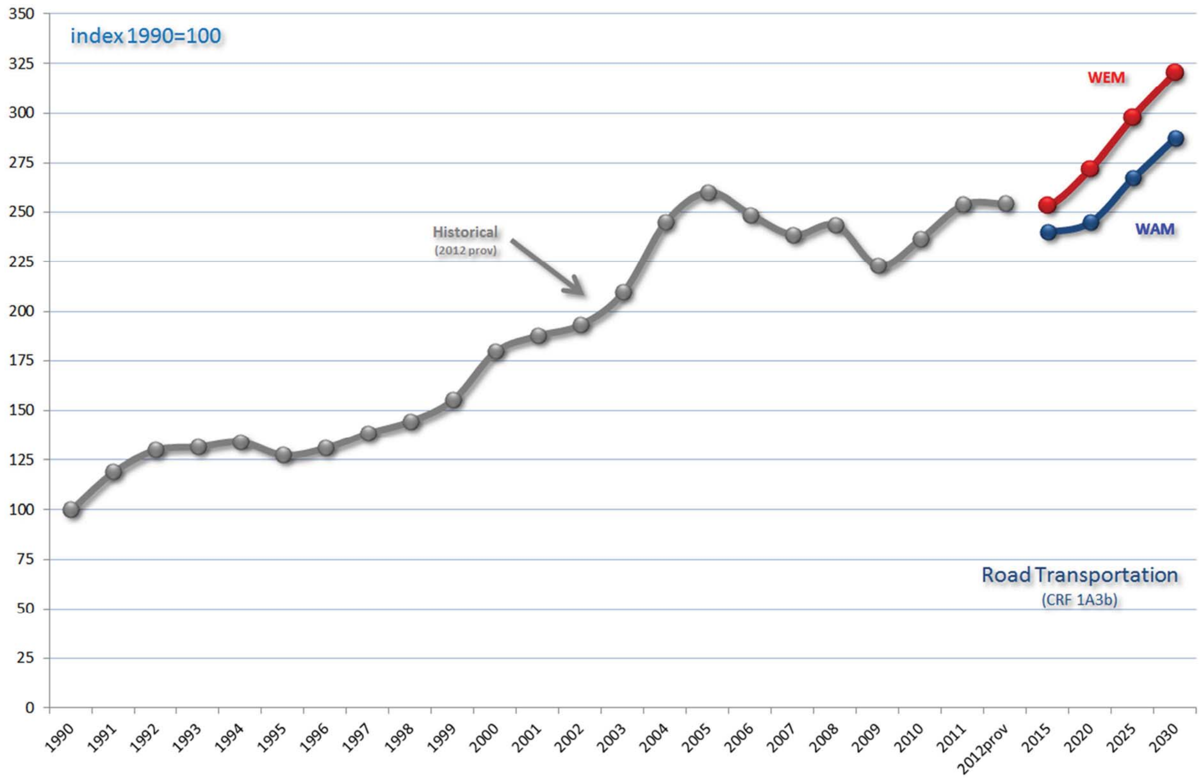
V.3.4. Road transportation (1A3b)

TABLE V.3-4 – HISTORICAL AND PROJECTED EMISSIONS FOR THE ROAD TRANSPORTATION SECTOR

Gg (1000 t.) CO_2 equivalent	CRF Categories	1990	1995	2000	2005	2010	2011	2012prov	2015	2020	2025	2030	
Road Transportation	*1A3b*	2692.02	3429.22	4839.99	7004.04	6373.75	6834.63	6846.04	6821.53	7327.64	8019.45	8636.85	WEM
(incl. lubricants reported under 1A3b)									6465.75	6595.86	7194.51	7741.74	WAM
		100.00	*127.38*	*179.79*	*260.18*	*236.76*	*253.88*	*254.31*	*253.40*	*272.20*	*297.90*	*320.83*	WEM
									240.18	*245.02*	*267.25*	*287.58*	WAM

Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2
MDDI-DEV – 2012 nowcasts & projections.

FIGURE V.3-4 – HISTORICAL AND PROJECTED EMISSIONS FOR THE ROAD TRANSPORTATION SECTOR



Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2
MDDI-DEV – 2012 nowcasts & projections.

For the road transportation sector, projected emissions have been obtained using, for CO_2, the EPM specific module combining various sources of information and, for CH_4 and N_2O, simplistic assumptions from the Department of the Environment *[→ Tables V.2-1 & V.2-2]*.

Since projections do not take into account a possible narrowing of road fuel price differentials between Luxembourg and its neighbouring countries, forecasted emissions are on the rise up to 2030. Indeed, technological developments benefits in terms of emissions that lead to always more energy efficient vehicles would totally be offset by increasing traffic flows anticipated by European and other model results used in the EPM.

The difference between the WEM and WAM projections is explained by a higher share of biofuels and by the development of the electro-mobility in Luxembourg (electrical vehicles). For biofuels, the WEM scenario considers a stable share of 3.8% in fuel sales [ECONOTEC Consultants (2013b), p. 15], whereas the WAM scenario assumes that Luxembourg will progressively reach its 2020 goal of 10% renewable energy sources in transportation by selling blended fuels with a 10% content of biofuels [ECONOTEC Consultants (2013a), p. 14]. The ambitious target for electro-mobility – a 10% share of electric vehicles in the total number of passenger cars by 2020 (see P&M No 14) – is only included in the WAM scenario.

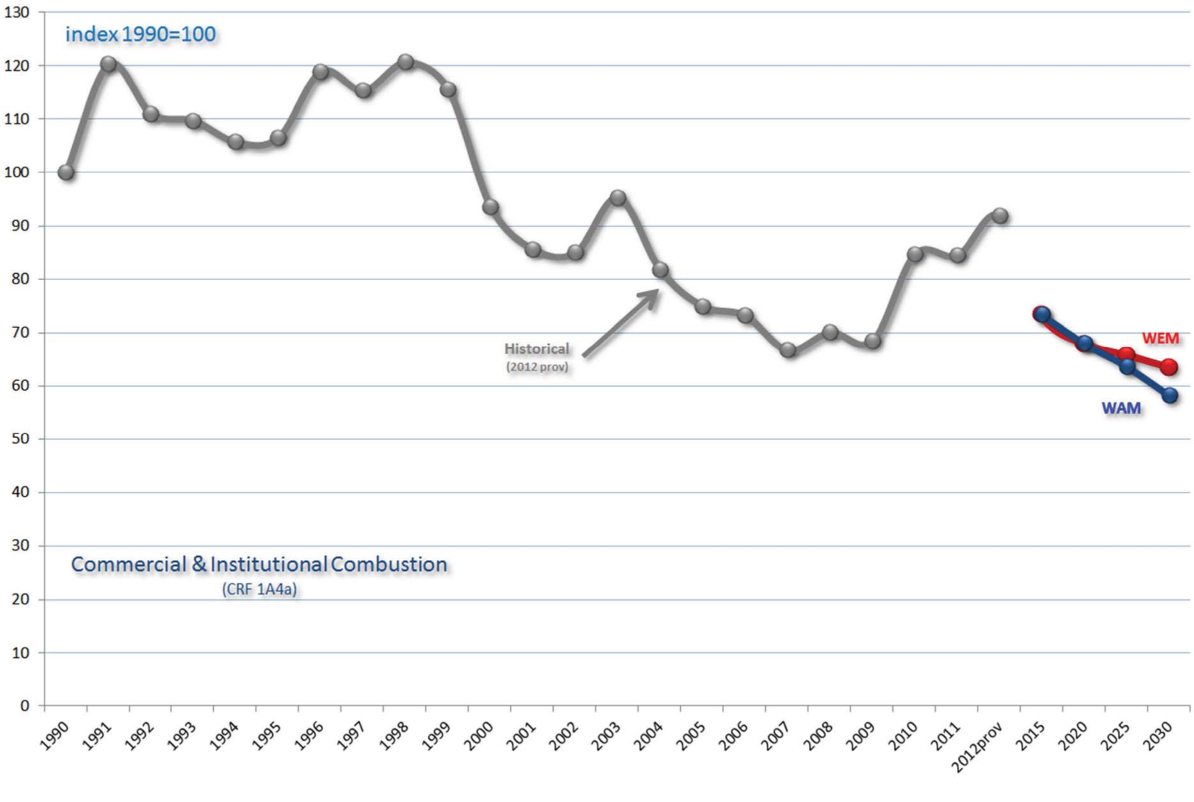
V.3.5. Commercial and institutional combustion (1A4a)

TABLE V.3-5 – HISTORICAL AND PROJECTED EMISSIONS FOR COMMERCIAL AND INSTITUTIONAL COMBUSTION

Gg (1000 t.) CO_2 equivalent	CRF Categories	1990	1995	2000	2005	2010	2011	2012prov	2015	2020	2025	2030	
Commercial & Institutional Combustion	1A4a	636.78	678.85	596.39	477.56	540.08	538.61	585.56	467.41	433.08	419.10	404.85	WEM
									467.41	433.08	405.56	371.04	WAM
		100.00	*106.61*	*93.66*	*75.00*	*84.81*	*84.58*	*91.96*	*73.40*	*68.01*	*65.82*	*63.58*	WEM
									73.40	*68.01*	*63.69*	*58.27*	WAM

Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2
MDDI-DEV – 2012 nowcasts & projections.

FIGURE V.3-5 – HISTORICAL AND PROJECTED EMISSIONS FOR COMMERCIAL AND INSTITUTIONAL COMBUSTION



Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2
MDDI-DEV – 2012 nowcasts & projections.

For these sectors, CO_2 projections are the results of EPM simulations relying on the "Residential-Tertiary Tool" developed by ECONOTEC [ECONOTEC Consultants (2013c)]. These projections have been completed by simplistic assumptions made by the Department of the Environment for the other two GHG *[→ Tables V.2-1 & V.2-2]*.

The additional measures are expected to yield return in terms of emissions mitigation only from 2020 on. Indeed, these measures are those covering the construction of "near zero emission buildings" (NZEB) by the end of this decade. Nevertheless, P&M already in place are expected to reduce emissions by around 20% by 2020 and by some 25% by 2030 compared to their 2010 level.

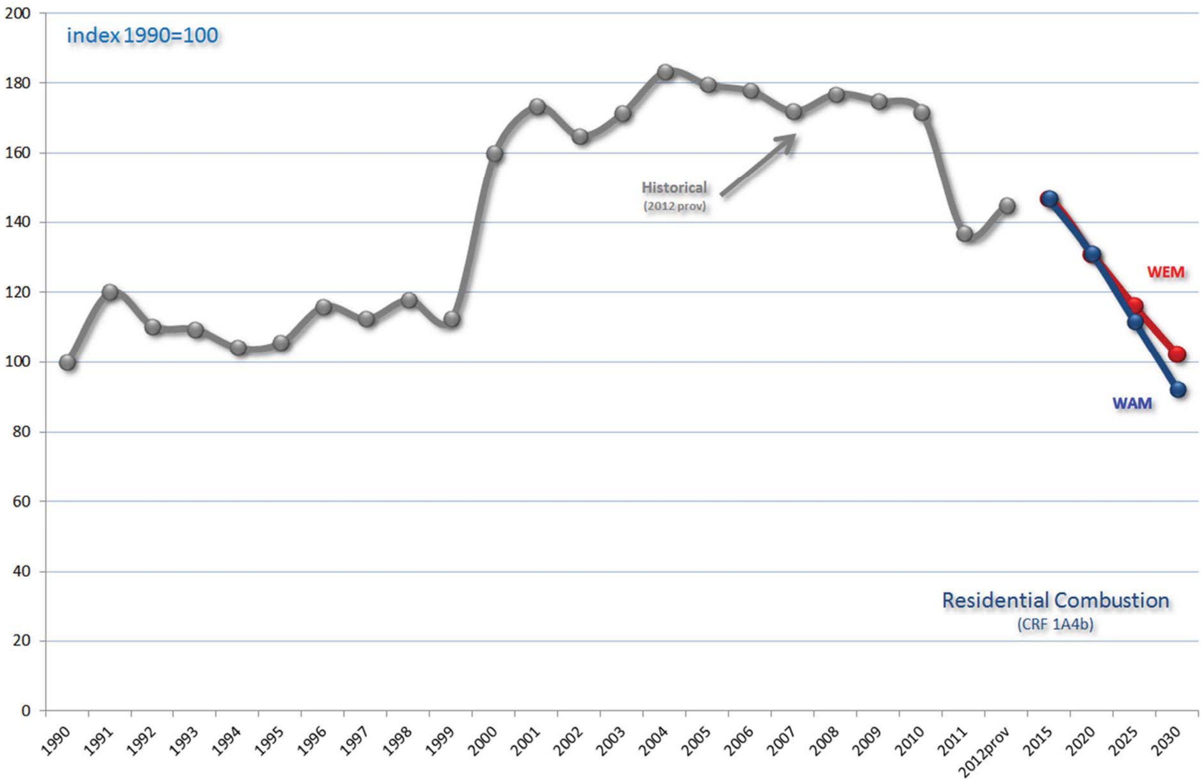
V.3.6. Residential combustion (1A4b)

TABLE V.3-6 – HISTORICAL AND PROJECTED EMISSIONS FOR RESIDENTIAL COMBUSTION

Gg (1000 t.) CO_2 equivalent	CRF Categories	1990	1995	2000	2005	2010	2011	2012prov	2015	2020	2025	2030	
Residential Combustion	*1A4b*	669.65	706.86	1070.27	1202.34	1149.19	916.54	969.42	982.75	877.80	777.61	684.95	WEM
									982.75	877.80	747.85	618.03	WAM
		100.00	*105.56*	*159.83*	*179.55*	*171.61*	*136.87*	*144.76*	*146.76*	*131.08*	*116.12*	*102.28*	WEM
									146.76	*131.08*	*111.68*	*92.29*	WAM

Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2
MDDI-DEV – 2012 nowcasts & projections.

FIGURE V.3-6 – HISTORICAL AND PROJECTED EMISSIONS FOR RESIDENTIAL COMBUSTION



Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2
MDDI-DEV – 2012 nowcasts & projections.

As for the commercial and institutional sectors, CO_2 projections are the results of EPM simulations relying on the "Residential-Tertiary Tool" developed by ECONOTEC [ECONOTEC Consultants (2013c)]. These projections have been completed by simplistic assumptions made by the Department of the Environment for the other two GHG *[→ Tables V.2-1 & V.2-2]*.

Here too, additional measures are expected to yield return in terms of emissions mitigation only from 2020 on since they are also covering the construction of "near zero emission buildings" (NZEB) by the end of this decade. P&M already in place are expected to reduce emissions by a bit less than 24% by 2020 and by some 40% by 2030 compared to their 2010 level. Indeed, numerous measures are taken in Luxembourg to promote energy efficiency and the use of renewable energy sources in housing *[→ Table IV.3-2]*. This goes from setting new energy standards for new and existing buildings, as well as households financial supports through the "PRIMe House" scheme (see Box IV.3-1).

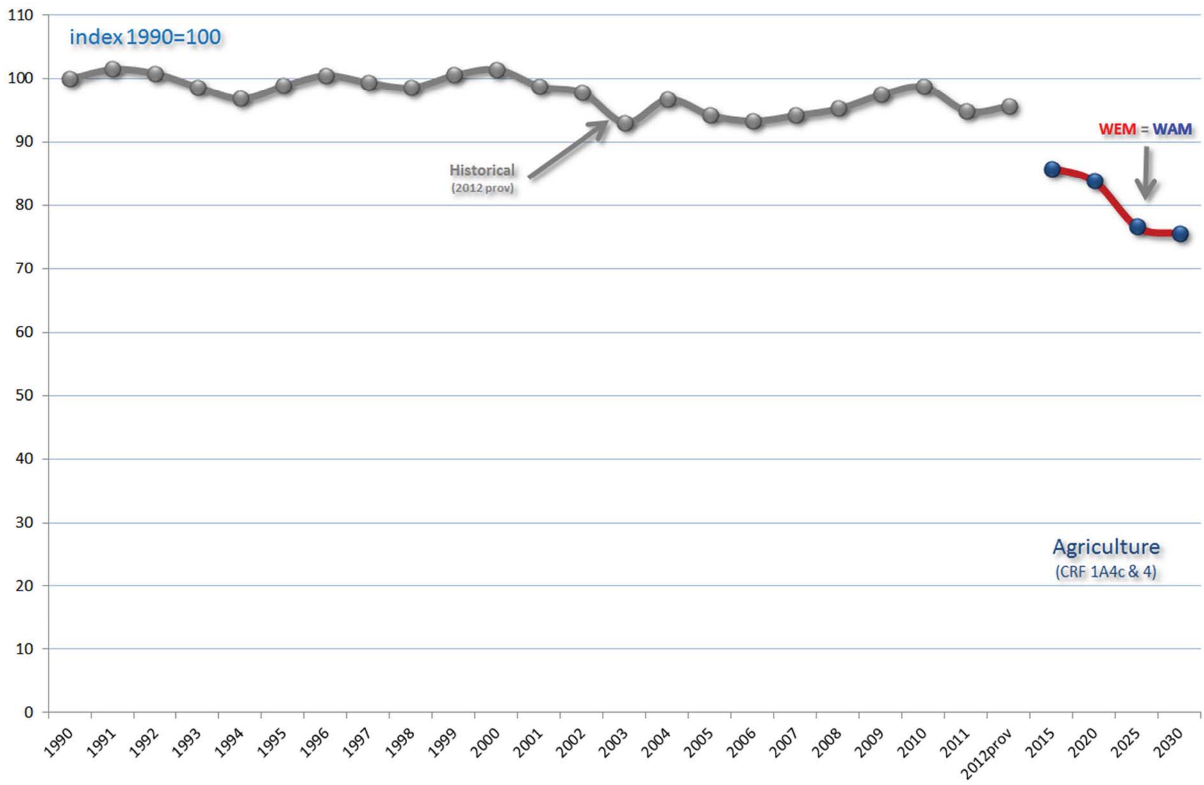
V.3.7. Agriculture (1A4c & 4)

TABLE V.3-7 – HISTORICAL AND PROJECTED EMISSIONS FOR AGRICULTURE

Gg (1000 t.) CO_2 equivalent	CRF Categories	1990	1995	2000	2005	2010	2011	2012prov	2015	2020	2025	2030	
Agriculture	1A4c	759.95	751.39	771.23	716.04	750.07	721.08	727.04	652.21	637.19	582.50	574.87	WEM
	4								652.21	637.19	582.50	574.87	WAM
		100.00	98.87	101.48	94.22	98.70	94.88	95.67	85.82	83.85	76.65	75.65	WEM
									85.82	83.85	76.65	75.65	WAM

Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2
MDDI-DEV – 2012 nowcasts & projections.

FIGURE V.3-7 – HISTORICAL AND PROJECTED EMISSIONS FOR AGRICULTURE



Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2
MDDI-DEV – 2012 nowcasts & projections.

Projected emissions are identical for the two scenarios since there are no planned measures for the agriculture sector in Luxembourg.

Expected future emissions for agriculture related activities (combustion, animal husbandry, cultivation, and soils related emissions) have been estimated by the Department of the Environment using basic assumptions based on the 2013 GAINS exercise *[→ Table V.2-2 & Box V.2-1]*. In the absence of national projections on agricultural practices and activities, it is not possible to cross-check GAINS assumptions and, therefore, to explain the decreasing trends that is forecasted up to 2030.

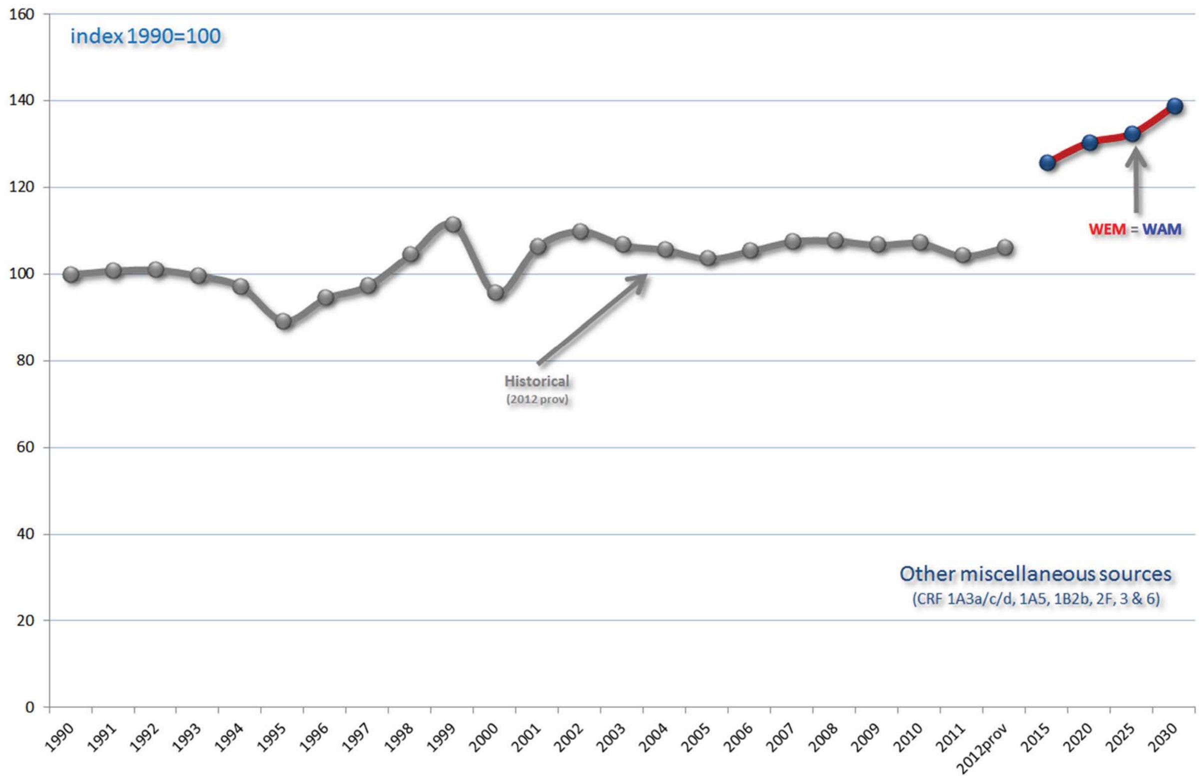
V.3.8. Other miscellaneous sources (1A3a/c/d, 1A5, 1B2b, 2F, 3 & 6)

TABLE V.3-8 – HISTORICAL AND PROJECTED EMISSIONS FOR OTHER MISCELLANEOUS SOURCES

Gg (1000 t.) CO_2 equivalent	CRF Categories	1990	1995	2000	2005	2010	2011	2012prov	2015	2020	2025	2030	
Other miscellaneous sources	*1A3a/c/d & 1A5*	194.00	173.36	185.94	201.23	208.33	202.65	206.30	244.15	253.10	257.05	269.44	WEM
	1B2b, 2F, 3 & 6								244.15	253.10	257.05	269.44	WAM
		100.00	*89.36*	*95.85*	*103.73*	*107.39*	*104.46*	*106.34*	*125.85*	*130.46*	*132.50*	*138.89*	WEM
									125.85	*130.46*	*132.50*	*138.89*	WAM

Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2
MDDI-DEV – 2012 nowcasts & projections.

FIGURE V.3-8 – HISTORICAL AND PROJECTED EMISSIONS FOR OTHER MISCELLANEOUS SOURCES



Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2
MDDI-DEV – 2012 nowcasts & projections.

Projected emissions are identical for the two scenarios since there are no planned measures for these miscellaneous source categories. Most projections have been calculated on the basis of simple assumptions by the Department of the Environment, which were sometimes based on the 2013 GAINS projections *[→ Table V.2-2]*. For CO_2 related emissions in the transportation sector, PRIMES 2013 calculations were used for the EPM module *[→ Table V.2-1]*.

Out of the various emission source categories grouped under this heading, increasing emissions over the period 2010-2030 are reported for all categories, except those related to waste: stability for CRF sub-categories 6B (waste water handling) and 6D (composting), and decreasing emissions for sub-category 6A (waste landfills) – which is in line with the assumption made for waste incineration *[→ Section V.3.1]*.

Emissions rise up to 2030 is largely due to anticipated growing emissions stemming from F-gases uses and from natural gas transmission and distribution (1B2b). The latter is the result of an anticipated extension of the national gas network, as well as its more and more widespread use.

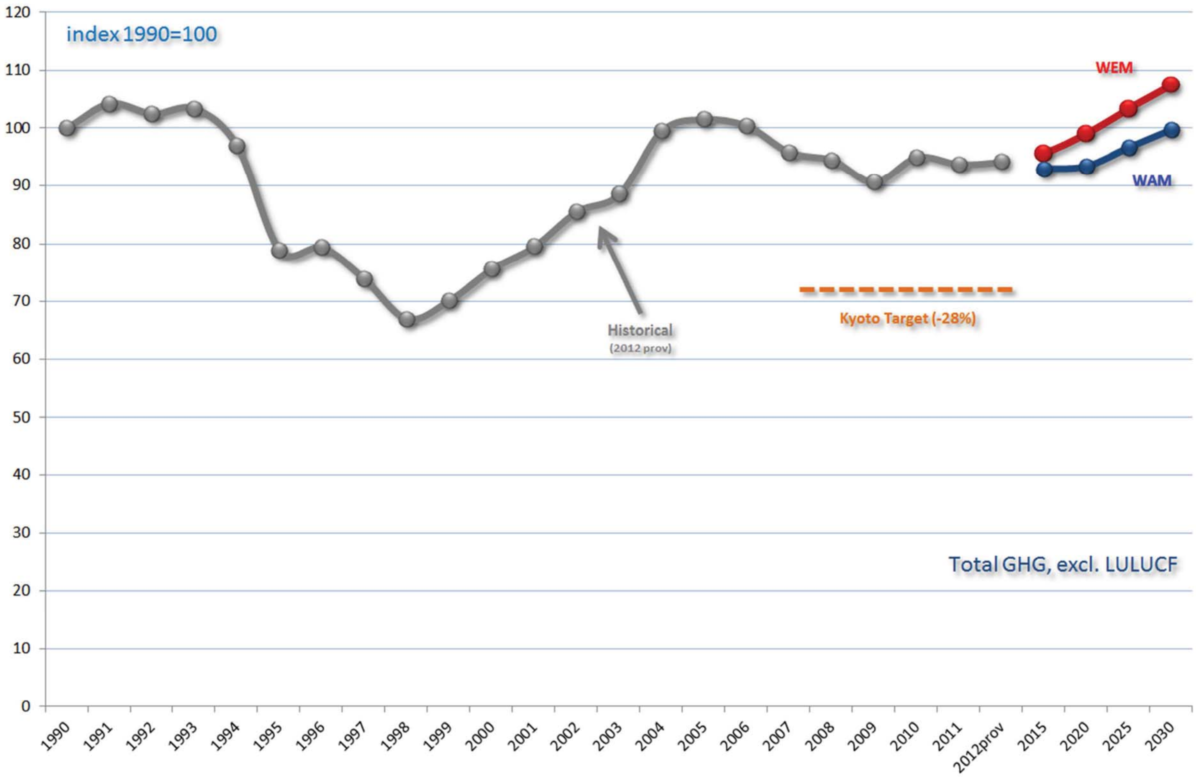
V.3.9. Total GHG, excl. LULUCF

TABLE V.3-9 – HISTORICAL AND PROJECTED EMISSIONS FOR TOTAL GHG, EXCL. LULUCF

Gg (1000 t.) CO_2 equivalent	CRF Categories	1990	1995	2000	2005	2010	2011	2012prov	2015	2020	2025	2030	
Total GHG, excl. LULUCF	*1 to 4*	12901.02	10177.48	9760.03	13096.36	12252.09	12097.92	12157.45	12345.11	12785.74	13339.46	13863.56	WEM
	6								11989.33	12053.97	12471.22	12867.72	WAM
		100.00	*78.89*	*75.65*	*101.51*	*94.97*	*93.77*	*94.24*	*95.69*	*99.11*	*103.40*	*107.46*	WEM
									92.93	*93.43*	*96.67*	*99.74*	WAM

Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2
MDDI-DEV – 2012 nowcasts & projections.

FIGURE V.3-9 – HISTORICAL AND PROJECTED EMISSIONS FOR TOTAL GHG, EXCL. LULUCF



Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2
MDDI-DEV – 2012 nowcasts & projections.

For the WEM scenario, results of the projections exercise show that, in 2020, emissions level would be almost identical to the level for 1990. However, 2030 emissions would be 7.5% higher than in 1990. Compared to the last historical year (i.e. 2011), these percentages would however reach +5.7% and +14.6%, respectively.

Additional measures would trigger GHG savings of about 356 kt CO_2e in 2015, 732 kt CO_2e in 2020, 868 kt CO_2e in 2025 and 996 kt CO_2e in 2020.[180] These reduction potentials differ from those

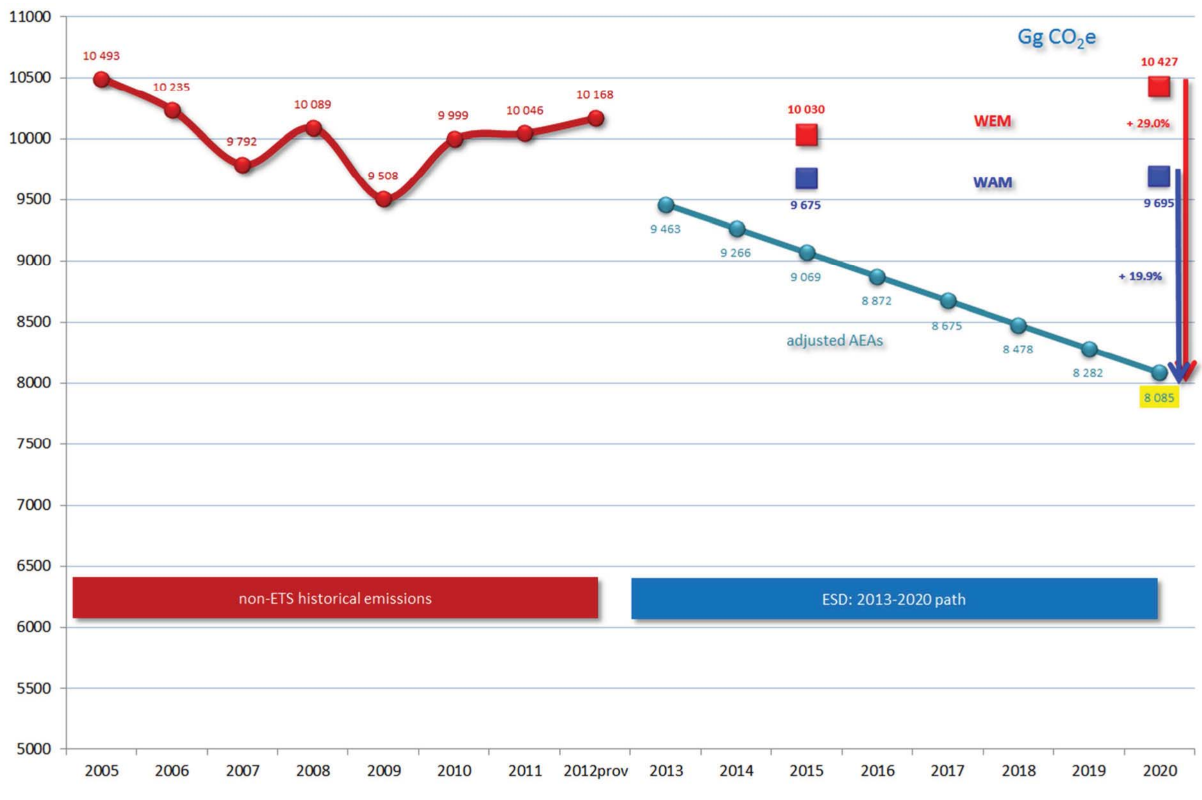
180 kt = 1000 tonnes = Gg.

indicated in ECONOTEC (2013a) and 2013(b) because the expected effects of P&Ms on CO_2 have been "extended" to the other GHG when the Department of the Environment estimated them. Indeed, since CH_4 and N_2O have mostly been estimated by using ratios over CO_2 for CRF sub-categories 1A3b, 1A4a and 1A4b *[→ Table V.2-2]*, the mitigation potential of a P&M has "automatically" been reported to these gases.

The WAM scenario therefore yields 2020 emissions 6.6% lower than in 1990. They are almost identical to 1990 for 2030. When compared to the last historical year, WAM projections for 2020 are almost identical to the 2011 emissions, whereas 2030 projected emissions would be 6.4% higher.

But, what is crucial now for Luxembourg is that it respects its **binding annual GHG targets for the period 2013-2020 as set under the ESD** *[→ Section IV.1.2]*. The figure below completes *Figure IV.1-4* by including the projected emissions in both 2015 and 2020 for the two scenarios, WEM and WAM.

FIGURE V.3-10 – ESD IMPLICATION FOR LUXEMBOURG – NON-ETS EMISSIONS – 2013-2020 TRAJECTORY AND 2015 & 2020 PROJECTED EMISSIONS



Sources: Environment Agency and MDDI-DEV – Submission 2013v1.2
MDDI-DEV – 2012 nowcasts & projections.

Figure V.3-10 clearly demonstrates that with P&Ms in place, but also considering further use of biofuels and electro-mobility,[181] Luxembourg will not reach its non-ETS target. There might be an

181 Additional measures in the construction sector – NZEB – are not considered here because it is anticipated that their mitigation effects will only be measurable after 2020.

overachievement of the 2020 target by 29% for the WEM scenario (2.3 Mio. t CO_2e) and almost 20% for the WAM scenario (1.6 Mio. t CO_2e).

Consequently, to "fill the gap", Luxembourg will have to turn to the various possibilities offered by the ESD *[→ Section IV.1.2]*.

V.3.10. Sensitivity analysis

It is not straightforward to produce a sensitivity analysis for the projections. Indeed, such an exercise is made **complex by the extremely high sensitivity of the projections to internal or external parameters**. Luxembourg is a small country and economy where, for instance, a single industrial project – internal parameter – or changes in relative road pricing or VAT differences compared to neighbouring countries – external parameters – could strongly influences the projected emissions.

Thus, if a large company discontinues its activities or a new one settles in Luxembourg, that could have significant impact on the GHG emissions, hence on their projections. The same holds if the Government decides to build a second gas and heat plant or if it chooses to stop subsidizing combined heat-power plant running either on fossil fuels or natural gas. In industry, changes in processes in existing units could also lead to noticeable changes in the emissions (if, for instance, the steel industry decides to use old tyres as a facilitating product for melting iron scrap in electrical arc furnaces instead of anthracite e.g., emission factors might change in such a way that projections could be severely impacted) *[→ Sections II.12.2, III.1.1 & IV.3.1.4]*.

For external parameters, changes in the policy of a neighbouring country might have a strong impact on national GHG emissions since "road fuel sales to non-residents" is responsible of about 41.5% of the total GHG emissions (excl. LULUCF) in Luxembourg *[→ Sections II.8.2, III.1.1 & IV.3.1.2]*.

However, we have tried to evaluate uncertainties of the projections for each of the GHG source categories analysed in the WOM, WEM and WAM scenarios *[→ Table V.3-10]*. It is not, strictly speaking, a sensitivity analysis but it gives, at least, an indication of the level of confidence for these projections.

TABLE V.3-10 – LEVEL OF UNCERTAINTY OF THE PROJECTIONS

Source category	WEM	WAM
Public electricity & heat production	fair (if no new units start to operate, otherwise high)	NA
Manufacturing industry	high	NA
Road Transportation	high	very high (biofuels use and future legislation)
Residential, commercial & institutional combustion	fair	high
Agriculture	fair	NA
Other miscellaneous sources	high	NA

Source: MDDI-DEV own appraisal.

As planned improvements, options could be to analyse the impacts on the emissions of industrial projects (e.g., building a second gas and steam plant) or of cessation of activities (e.g., the closing of the cement production unit). Scenarios for the road transportation sector should also be regarded as an option for a sound sensitivity analysis Luxembourg's emissions projections. Finally, it should be investigated whether or not it would be possible to play with various hypotheses on population growth, prices of fuels, taxes and other fiscal instruments. For testing these hypotheses, the use of an equilibrium model could be a plus in this respect *[→ Section V.4]*.

V.4. IMPROVEMENT OF METHODOLOGIES[182]

The sixth National Communication reports the sixth GHG emission projections exercise led in Luxembourg.

For **2005**, projections were based on an ad-hoc energy balance set up by the Ministry of the Economy, the FiFo-Köln and the Ministry of the Environment Luxembourg. This balance did not fulfil the requirements on data quality defined by the CRF and the Decision 280/2004/EC. Projected emissions were obtained using the MS™ Windows based TRAMO-SEATS software for time series analysis [Ministry of the Environment (2008a)].

For **2007**, data from the GHG inventory submission of January 2008 could be used and that helped to significantly increase the quality of the projections. Moreover, for the quantitative assessment of impacts of measures on GHG emissions projections, the results from the NEEAP submissions of February 2008 could be applied as well as results from a study by Thöne (2008) analysing the specific feature of "road fuel sales to non-residents". Baseline projected emissions were obtained using the PRIMES baseline from July 2007 as basis [National Technical University of Athens (2007)]. However, PRIMES projections were modified if necessary, and for the transport sector two framing scenarios were introduced [Ministry of the Environment (2009)].

The **2009** exercise relies on detailed data from the GHG inventory submissions of May 2009 – submission 2009v1.4. As for the 2007 exercise, most of the impacts of the various P&Ms identified

182 This section of the NC5 covers part of section V.D of the Outline and General Structure of the NC5 according to IPCC reporting guidelines (para. 5).

are coming from the NEEAP and from the study by Thöne (2008). Baseline projected emissions for the main gas (CO_2) and sectors (CRF 1A, CRF 2A-C) are obtained using ECONOTEC's EPM tool [Ministry of Sustainable Development and Infrastructure, Department of the Environment (2009)].

The projections performed in **2011** were mostly updating the results obtained in 2007, but using submission 2011v1.3 as a basis for the reference year. The effects of the P&Ms were identical to those reported for the 2009 exercise [Ministry of Sustainable Development and Infrastructure, Department of the Environment (2011)].

In **2013**, projections were realised in two stages. A "quick" update of the 2011 projections was performed early 2013 to allow Luxembourg to be compliant with Decision 280/2004/EC [Ministry of Sustainable Development and Infrastructure, Department of the Environment (2013a) and ECONOTEC Consultants (2013a)]. Then, this first report has been updated and completed during the fall so to present projections offering a better quality in this Communication [ECONOTEC Consultants (2013b)] ***[→ Sections V.2 & V.3]***.

Already a possibility back in 2010, it is still foreseen to develop a specific air emissions projection tool for Luxembourg.[183] At the Luxembourg Statistical Office, a Computable General Equilibrium model (CGE model) is being developed: **LuxGEM**. CGE models are widely employed for economic policy analysis and are built upon economic general equilibrium theory. The abstract modelling structure is combined with detailed micro-data on, e.g. relevant production processes, assumptions on supply and demand behaviour or the market structure. Hence, CGE models allow analysing the impact of structural changes, e.g. in input prices, taxes or other framework conditions on several markets of an economy. The model is currently being extended by a specific "energy & environment module", that will allow the assessment of certain P&Ms in the Luxembourg energy market and, therefore, their corresponding impact on GHG development. Nevertheless, CGE models alone could not lead to appropriate GHG projections since their predictive power lies more in the interaction between economic parameters – "general equilibrium" – than in an accurate technological representation – CGE models are "top-down" models. Consequently, it is recommended to use the CGE approach as a framework model that will look at cross-sectoral effects of measures that would be better estimated using "bottom-up" technology driven models, though the latter do not encompass the impacts of measures in one sector on all the other sectors. As technology driven model, the Department of the Environment used the EPM tool via its successive contracts with ECONOTEC Consultants.

One of the projects presented in the consolidated fifth National Communication – **LUXEN** [Ministry of Sustainable Development and Infrastructure, Department of the Environment (2010), p. 221-222] – did not yield the expected results. Indeed, the idea of investigating the economic and

183 For various reasons, amongst which human and financial resources scarcities, as well as the anticipated LUXEN projects outcomes (see below), the specific projection tool development was on hold these last years. It was expected to rejuvenate it in 2014 but new budget cuts might prevent its realization.

environmental consequences of future energy demand-supply scenarios in Luxembourg by coupling the "top-down" model LuxGEM along with a "bottom-up" model, ETEM – extended with LCA data assessing the environmental impacts generated by the energy usages over their lifecycle[184] – did not succeed: it has not been possible to couple both models so that they converge and, therefore, offer consistent forecasts.

However, Luxembourg still believes that the **"bottom-up" and "top-down" approaches are complementary**. The move to a more elaborated system for GHG projections would also offer better opportunities to realize relevant projections sensitivity analyses.

V.5. SUPPLEMENTARITY RELATING TO MECHANISMS UNDER ARTICLE 6, 12 AND 17 OF THE KYOTO PROTOCOL

V.5.1. Bridging the gap – target assessment 2008-2012

Luxembourg has ratified the Kyoto Protocol on the 31st of May 2002, together with the other (then) 14 EU Member States. Luxembourg is having the highest quantified emission reduction obligations pursuant to Annex II to Decision 2002/358/EC: the burden sharing target for the trading period – i.e. between 2008 and 2012 – is set at 28% beyond the base year level of emissions. This corresponds to a disposable volume of 9.48 Mio. t CO_2e per year for the period between 2008 and 2012.[185]

As shown in ***Table V.5-1***, historical emissions for 2008-2011 and nowcasted emissions for 2012 are above the assigned amount of 9.48 Mio. t CO_2e, which can be disposed off annually in the first commitment period of the Kyoto Protocol. Moreover, Luxembourg could not count on carbon sinks over the period 2008-2012 (Article 3.3 activities under the Kyoto Protocol): based on the 2013v1.2 submission covering 2008-2011, Luxembourg would rather present net emissions and therefore could not issue Removal Units (RMUs – line VI of the table).[186] Consequently, closing the gap between the volume of Assigned Amount Units (AAUs – line II of the table) and the volume of emissions according to IPCC rules will require the acquisition of additional emission permits, either by making use of project based mechanisms (Joint Implementation – JI and Clean Development Mechanisms – CDM) or by purchasing permits on the international emissions trading market, pursuant to Articles 6, 12 and 17 of the Kyoto Protocol.

[184] ETEM is a techno-economic model of the MARKAL type. LCA stands for "life-cycle analyses".

[185] Burden sharing exact value is 9 480 599 tonnes.

[186] If calculations reported in this Communication – submission 2013v1.2 – show that Article 3.3 related activities could be net emitters and not carbon sinks, first calculations for the 2014 GHG inventory submission, based on more precise spatial data, tend to show the opposite.

TABLE V.5-1 – KYOTO COMPLIANCE OVERVIEW FOR LUXEMBOURG

Line	Category	Operation	2008	2009	2010	2011	2012	Average 2008-2012	Sum 2008-2012	Source/Notes
0	Base-year emissions		13.167	13.167	13.167	13.167	13.167	**13.167**	-	*UNFCCC review report of initial report under KP.*
I	Total GHG emissions		12.188	11.690	12.252	12.098	12.157	12.077	60.385	*2008-2011: 2013v1.2 inventory submission to the EC and the UNFCCC (http://cdr.eionet.europa.eu/lu/eu/ghgmm/envuumpzw); 2012: GHG proxy inventory submitted to the EC on the 24.07.2013.*
II	Initial assigned amount (AAUs)		9.481	9.481	9.481	9.481	9.481	9.481	47.403	
III	Verified emissions under the EU ETS Allowances surrendered under the EU ETS		2.099	2.182	2.253	2.052	1.990	2.115	10.575	*CITL / EEA viewer (http://www.eea.europa.eu/data-and-maps/data/data-viewers/emissions-trading-viewer).*
IV	Allowances issued under the EU ETS		2.488	2.488	2.488	2.488	2.488	2.488	12.441	*CITL / EEA viewer & MDDI (http://www.environnement.public.lu/air_bruit/ETS_etat_conformite.pdf). 2012: the figure takes into account the fact that the Luxlait allowances not used after the closure of the Belair plant (0.003883 Mt) have been sold, and therefore cannot be counted as surrendered by the installation.*
V	**Difference between AAUs and GHG emissions**	**(II) - (I)**	**-2.707**	**-2.209**	**-2.771**	**-2.617**	**-2.677**	**-2.596**	**-12.982**	
VI	Expected net carbon sequestration from LULUCF activities (RMUs)		-0.051	-0.051	-0.051	-0.051	-0.051	-0.051	-0.257	*See KP_LULUCF file KP-LUX-2013-2011-v1.2.xls, sheet "Accounting" (attached to this file).*
VII	**Difference between AAUs and GHG emissions, including effect of carbon sequestration**	**(V) + (VI)**	**-2.758**	**-2.261**	**-2.823**	**-2.669**	**-2.728**	**-2.648**	**-13.239**	
VIII	**Difference between allowances surrendered and issued under the EU ETS**	**(III) - (IV)**	**-0.389**	**-0.307**	**-0.236**	**-0.436**	**-0.499**	**-0.373**	**-1.866**	*This line shows the "surplus" of allowances to the ETS installations. This should be considered as AAUs.*
IX	**AAUs & RMUs balance**	**(VII) + (VIII) or [(II - (I)] + (VI) + [(III) - (IV)]**	**-3.148**	**-2.567**	**-3.059**	**-3.105**	**-3.227**	**-3.021**	**-15.106**	*These differences take into account the fact that not all allowances have been used by the ETS installations. These allowances that have not been used are "lost" for the Government, hence for the calculation of the differences.*
X	Planned use of Kyoto mechanisms by government (net transfer of AAUs + purchase of CERs + ERUs)	- (IX)	3.148	2.567	3.059	3.105	3.227	3.021	15.106	*Under the hypothesis that Luxembourg will cover its "Kyoto deficit" by using FlexMex, the expected uses of Kyoto mechanisms for each year are reported here.*
XI	Emission reduction units (ERUs) issued under JI projects		0.000	0.000	0.000	0.000	0.000	0.000	0.000	*Luxembourg did not issue ERUs.*
XII	**Difference between target and GHG emissions (non-ETS, including plans on Kyoto mechanisms and carbon sinks)**	**(IX) + (X) - (XI)**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	
XII'	***Percentage gap***	***(XII) / (0)***	***0.00%***	***0.00%***	***0.00%***	***0.00%***	***0.00%***	***0.00%***	-	

Source: MDDI-DEV based on a revised and updated table published by the EEA in Chapter 9 of the *Greenhouse gas emission trends and projections in Europe 2012 report*, page 77 (http://www.eea.europa.eu/publications/ghg-trends-and-projections-2012.

Notes: 2 = also "allowances surrendered under the EU ETS" since ETS operators are legally bound to surrender to their Government an amount of allowances equivalent to their emissions.
2 = the 2008-2012 sum is divided as such: surrendered allowances (EUAs) - 9.77771 Mt ; surrendered CERs - 0.789223 Mt & surrendered ERUs - 0.008066 Mt (source: http://www.eea.europa.eu/data-and-maps/data/data-viewers/emissions-trading-viewer).
8 = an approximation of the annual RMUs based on 4 reporting years (2008-2011). In the file KP-LUX-2013-2011-v1.2.xls, sheet "Accounting", take the sum of A1 & A2, column "Accounting quantity" and divide it by 4: (-357.93+563.80)/4 = 51.4675 Gg or 0.0514675 Mt.

According to historical and nowcasted emission estimates for the Kyoto commitment period 2008-2012, usage of Kyoto mechanisms would reach 3.02 Mio. t CO_2e on average per year (line X of the table, column "Average 2008-2012"). Over the whole period, **the gap would reach 15.11 Mio. t CO_2e** (line X of the table, column "Sum 1998-2012").

Since Luxembourg cannot count on activities under Articles 3.3 and 3.4 of the Kyoto Protocol (see Box V.5-1), the gap between the AAUs and anticipated emissions during the Kyoto commitment period **will only be offset by the use of "Kyoto flexible mechanisms"**. The CDM is expected to provide about 45% of the emission reductions, JI between 10 to 15% and IET the remaining part. However, this distribution could change with time, depending on the development of prices and schemes, notably with regard to Luxembourg's contribution to carbon funds of international financial institutions.

For Luxembourg, the projects under CDM and JI had to comply with the ecological and social criteria established in the framework of the approval procedures of the UNFCCC and to the specific criteria defined by the committee in charge of managing the Kyoto Mechanisms Fund – the "Climate & Energy Fund" *[→ Section V.5.2]*. In order to facilitate emission rights transfers, Luxembourg also concluded deals with other EU countries ready to sell a part of their post-Kyoto emission rights and with host-countries of CDM and JI projects.

Box V.5-1: Articles 3.3 & 3.4 of the Kyoto Protocol

Luxembourg has not yet performed proper quantitative projections for anthropogenic GHG emissions and removals from forestry activities under Article 3.3 of the Kyoto Protocol though it has chosen to account for the afforestation, reforestation and deforestation activities under this Article for the whole commitment period.

It was actually foreseen that these activities would not result in significant net sinks. Consequently, in the absence of quantitative projections for LULUCF activities, it was considered being a fair estimate to assume that annual reductions, as a result of carbon sinks in the period 2008-2012, equal to zero. Nevertheless, the latest inventory submission to the UNFCCC (2013v1.2) concludes that there might be (small) net emissions over the period.

In fact, Luxembourg's relative forests surface is rather high (almost 35% of the territory). Consequently, there is no strong demand for reforestation or afforestation. On the contrary, one might fear some deforestation in the years to come notably due to the fact that extra built-up surfaces might be needed (strong demographic increase, very high prices for building ground in Luxembourg) and to the fact that renaturation work sometimes leads to the cutting down of non-native pine trees to re-create original habitats, which is not a forest in the sense of the TBFRA2000 methodology and the definitions of the FAO. In a word, there is more probability that Luxembourg will keep its actual forests surface or see it slightly decline than the contrary.

Luxembourg's forests cannot fix appreciable quantities of CO_2 because of their age, and consequently slow growth, associated with frequently neglectful management *[→ Section II.10.1]*. Afforestation by the plantation of young trees might even lead to emissions rather than to removals since new trees usually stock less carbon than mature ones. Nevertheless, there is a lack of reliable data for evaluating this phenomenon that could be compensated according to Article 3.4 of the Kyoto Protocol. Hence, Luxembourg decided not to account for net emissions and removals from activities under Article 3.4 for meetings its obligations under the first commitment period of the Kyoto Protocol.

V.5.2. How financing the use of "Kyoto flexible mechanisms"? – the "Climate & Energy Fund"

By a law of 23rd December 2004, Luxembourg has set up a fund to finance the Kyoto mechanisms (the "Kyoto Fund").[187] In January 2011, this Fund has been renamed "Climate & Energy Fund" to reflect the fact that from that year onward it is also used to finance projects in the domains of energy efficiency and renewable energy sources following the objectives set out for Luxembourg in the context of the EU "Climate & Energy package". The Department of the Environment remains in charge of the "Kyoto" side of the "Climate & Energy Fund" and decision-making responsibility for CDM and JI rests with the same Department. According to the Law, an inter-departmental committee (Cooperation Development Directorate of the Ministry of Foreign and European Affairs, Ministry of the Economy, Department of the Environment, Ministry of Finance) advices the Environment Minister. Various types of instruments will be deployed by the Government in order to acquire Certified Emission Reductions units (CERs) and Emission Reduction Units (ERUs). Firstly, voluntary and non binding Memoranda of Understanding with some potential host countries. Secondly, for the selection of projects and the purchase of CERs and ERUs, various intermediary organizations will be contracted along the following tracks:

- participation in carbon funds of multilateral and regional financial institutions;
- facilities with private international banks;
- bilateral purchase agreements.

The annual current budget of the "Kyoto Fund" (2005-2010) / "Climate & Energy Fund" (from 2011) is as follows:

- 2005 – 5.00 Mio €;
- 2006 – 10.00 Mio €;
- 2007 – 10.00 Mio €;
- 2008 – 10.50 Mio €;
- 2009 – 11.00 Mio €;
- 2010 – 11.00 Mio €;
- 2011 – 11.00 Mio €;
- 2012 – 5.00 Mio €;
- 2013 - 0.00 Mio €.[188]

[187] *Loi du 23 décembre 2004 1) établissant un système d'échange de quotas d'émission de gaz à effet de serre; 2) créant un fonds de financement des mécanismes de Kyoto; 3) modifiant l'article 13bis de la loi modifiée du 10 juin 1999 relative aux établissements classés* (http://www.legilux.public.lu/leg/a/archives/2004/0210/a210.pdf, p. 3792-3799).

[188] The exact amount is 100 €, i.e. it has been decided that the Fund will be financed only by taxation revenues.

Additionally to this budgetary grant, 40% of the CO_2-based vehicle tax [Ministry of Sustainable Development and Infrastructure, Department of the Environment (2010), P&M TR01, p. 163-164] and 100% of the "Kyoto-cent" Ministry of Sustainable Development and Infrastructure, Department of the Environment (2010), P&M TR03, p. 166-167] represent extra source of revenues for the Fund. Thus, for the "Kyoto-cent" a supplemental annual income of 62 to 65 Mio € has been recorded for the years 2008 to 2012. For the CO_2-based vehicle tax, the annual income ranged between 24 and 29 Mio € for the years 2008 to 2012, with the higher revenues at the beginning of the period translating the fact that the vehicle fleet in Luxembourg is moving towards less emitting cars, notably through a higher share of "small" cars in the fleet.

As of today (and since 2005), Luxembourg committed about 173 Mio € to the use of project based mechanisms, through the Fund:

- International Emission Trading (IET), permitting countries to transfer parts of their "assigned amount units" (AAUs);
- Clean Development Mechanism (CDM), allowing emission-reduction projects that assist in creating sustainable development in developing countries to generate "certified emission reductions" (CERs) for use by the investor;
- Joint Implementation (JI), allowing countries to claim credit for emission reductions that arise from investment in other industrialized countries, which result in a transfer of equivalent "emission reduction units" (ERUs) between the countries.

A share of 43 Mio €has been committed to the participation in multilateral funds; the other part is directed at bilateral purchase agreements (CDM projects and Green Investment Schemes – GIS).

For the years 2011 to 2017, commitments in the framework of the "Climate & Energy Fund" amount to 256.9 Mio €. Besides commitments presented above, there are also projected expenditures for the coming years that are not yet committed. For the 5-year period 2013 to 2017, they represent 596.7 Mio € for the climate part of the Fund – there are no projected expenditures for the energy part of the Fund: the 117 Mio € foreseen for the 2013 to 2017 period are already committed.

As already indicated before, Luxembourg participates in various **carbon funds of international financial institutions** covering ERPAs pertaining to CDM and JI projects Expenditures presented in the previous paragraphs include these contributions to the:

- "Biocarbon Fund" of the World Bank;
- "Community Development Carbon Fund" of the World Bank;
- "Multilateral Carbon Credit Fund" of the European Bank for Reconstruction and Development;
- "Carbon Fund for Europe" of the European Investment Bank and the World Bank;

- "Asian Pacific Carbon Fund" of the Asian Development Bank.

Moreover, two Assigned Amount Units Purchase Agreements (AAUPAs) have been initiated, one with Estonia and one with Lithuania under the name of "**Green Investment Scheme**" (GIS). Funds will be used to increase energy efficiency in apartment buildings and residential houses (Estonia) and in the public sector, for the renovation of schools and hospitals (Lithuania).

Finally, The Government has signed nine **bilateral Emission Reduction Purchase Agreements** (ERPAs), all concerning CDM projects *[→ Table V.5-2]*.

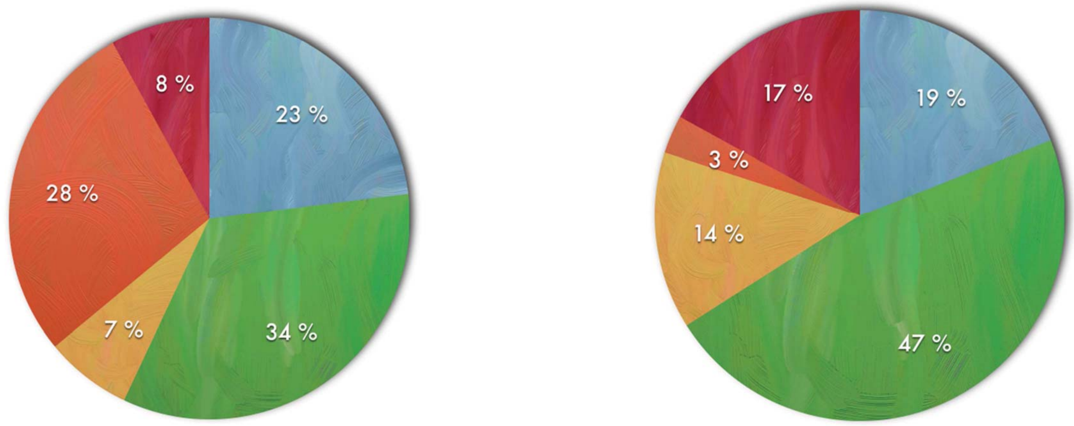
TABLE V.5-2 – BILATERAL PURCHASE AGREEMENTS – CDM

Country	Project Name	Type	UNFCCC registr. nr.	Contracted total CERs [tCO2e] by Luxbrg.	Delivered total CERs [tCO2e] to Luxbrg.
1 El Salvador	Landfill Gas to Energy Facility at the Nejapa Landfill Site	Landfill gas capture & energy generation	167	325'000	325'000
2 China	• Guohua Inner Mongolia Huitengliang Wind Farm • Liaoning Changtu Wind Farm • Zhejiang Cixi Wind Farm	Wind energy generation	1261, 883, 1837	1'644'019	1'028'998
3 Mexico	Milpillas Landfill Gas Recovery Project	Landfill gas capture & flaring	1944	693'393	-
4 India	6 MW Renewable Energy Generation Project by Varam Power	Biomass based energy generation	697	105'090	105'090
5 Brazil	Landfill Gas to Energy Project 10 MW at Lara Landfill, Mauá	Landfill gas capture & flaring (energy generation)	91	96'000	96'000
6 Ecuador	Massive introduction of compact fluorescent lamps (CFL) to households	Energy efficiency demand side	4056	1'320'000	75'739 (delivered on 02/01/2014)
7 Brazil	Santa Candidi Bagasse, Campo Florido Bagasse, Iturama Bagasse Cogeneration Projects	Bagasse based electricity cogeneration	65, 208, 212	193'040	193'040
8 India & Other	Guaranteed CER mix	Mainly wind, energy efficiency, no nuclear, no LULUCF, no big hydro project		370'000	370'000
9 Thailand	Bangna Starch Gold Standard project	Wastewater Treatment and Biogas Utilization Project	2556	12'877	12'877
TOTAL				**4'759'419**	**2'206'744**

Source: MDDI-DEV.

Anticipated emission reductions from these projects are stemming from wind projects, energy-efficiency, biogas recovery from waste landfill and biomass use. Unfortunately, projects in Mexico and Ecuador did not yield the expected performance. This underperformance explains the difference between the contracted and delivered CERs *[→ Figures V.5-1 & V.5-2]*.

FIGURE V.5-1 – BILATERAL PURCHASE AGREEMENTS – TYPE OF CDM PROJECTS



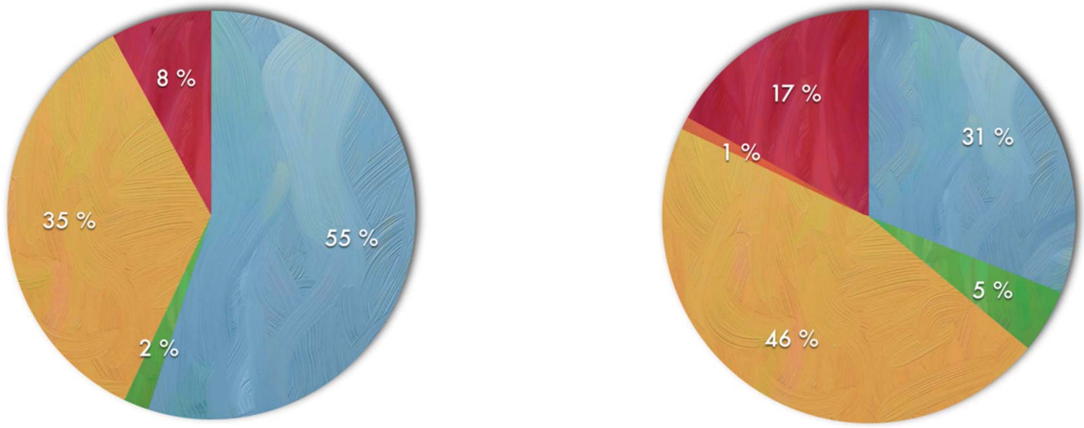
Contracted CERs *Delivered CERs*

Landfill gas capture flaring/energy generation
Wind energy
Biomass renewable energy
Energy efficiency demand side
Other

Source: MDDI-DEV.
Notes: "Other" mainly refers to wind and energy efficiency projects (n°8).

The figures below give an indication about the geographical distribution of the nine Bilateral Purchase Agreements.

FIGURE V.5-2 – BILATERAL PURCHASE AGREEMENTS – GEOGRAPHICAL CDM DISTRIBUTION



Contracted CERs *Delivered CERs*

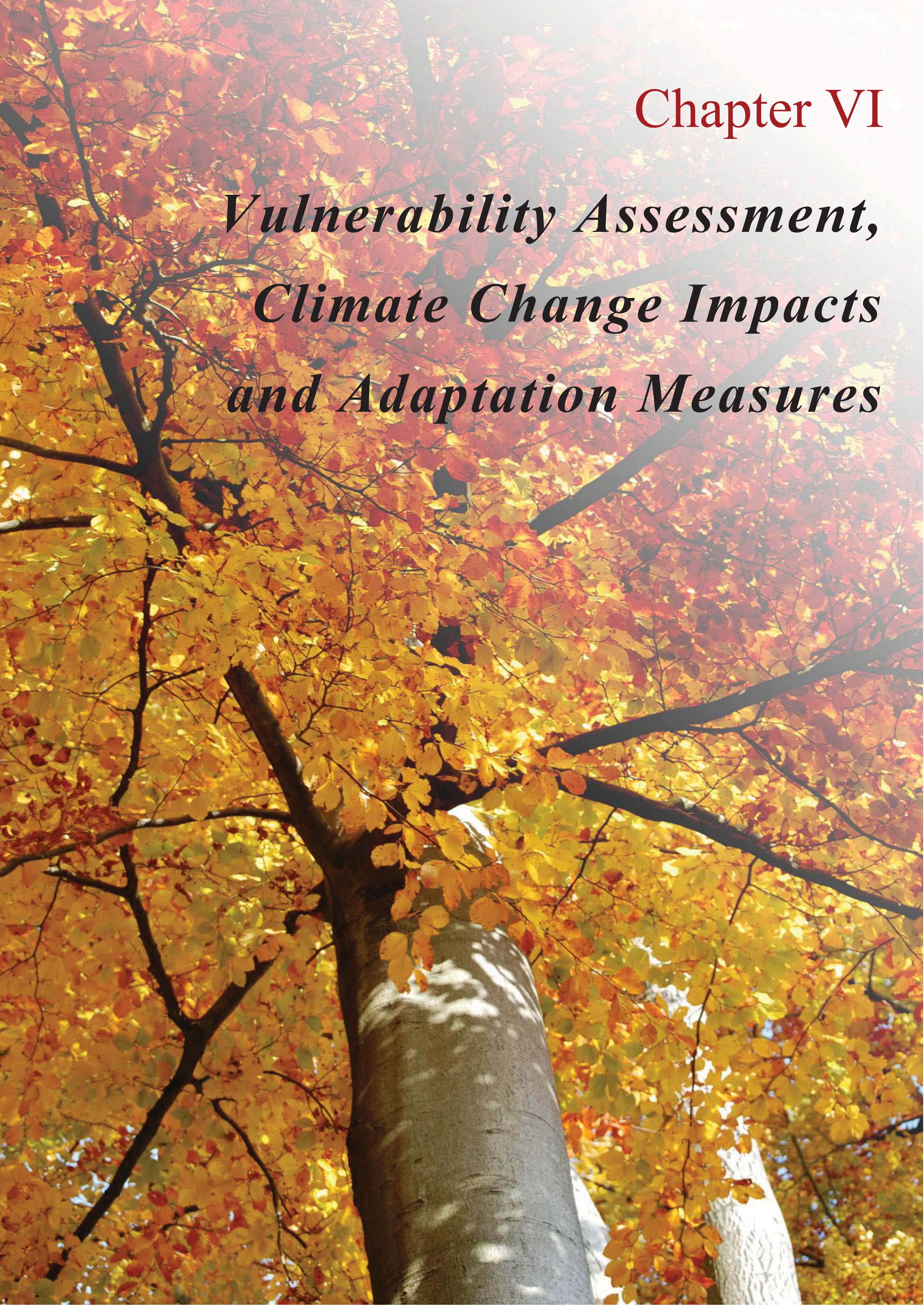
Latin America & Caribbean
South Asia
East Asia
Southeast Asia
Other

Source: MDDI-DEV.
Notes: "Other" refers to project n°8.

For confidentiality reasons, it is not possible for Luxembourg to provide more details in this report. In case this information is needed, please contact us in a formal way in order to examine what could be provided without impairing confidential information on these projects.

Chapter VI

Vulnerability Assessment, Climate Change Impacts and Adaptation Measures



In line with the recommendations of the UNFCCC reporting guidelines, paragraph 49, Chapter VI presents the expected impacts of climate change in Luxembourg *[→ Section VI.1]*, whereas vulnerability assessment is analysed through the prism of water *[→ Section VI.2]*. Since the consolidated 5th National Communication, Luxembourg has developed a "National Adaptation Strategy on Climate Change" that is presented in this Chapter *[→ Section VI.3]*.

This chapter is usefully supplemented by the description of the climatic circumstances in Luxembourg *[→ Section II.3]*.

VI.1. Expected impacts of climate change in Luxembourg: vegetation and water in the forefront[189]

VI.1.1. Vegetation

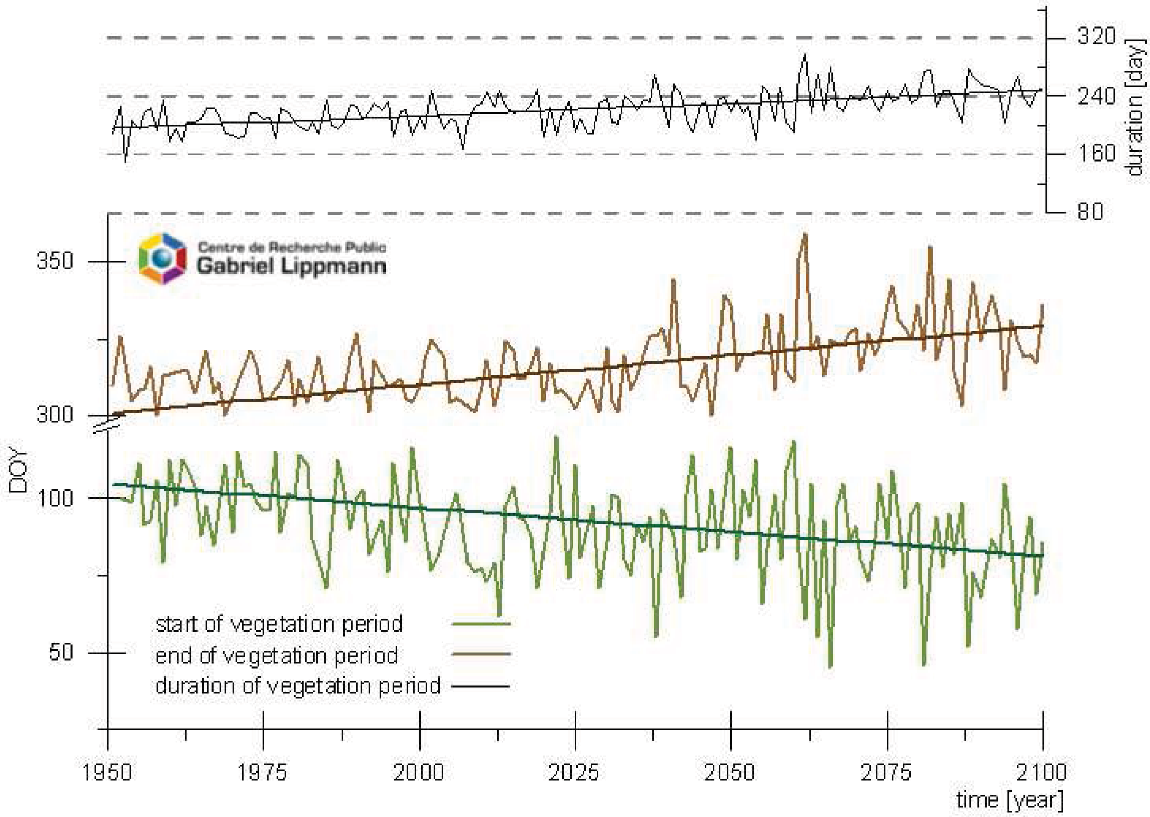
The projected changes in air temperature *[→ Section II.3.2]* are likely to induce a modification of the vegetation period in Luxembourg. The start of the vegetation period is defined as the exceedance of the 5°C daily mean temperature threshold in spring for at least 5 successive days; the end of the vegetation period corresponds to the undershooting of this threshold until the end of the year [Chmielewski & Rötzer, 2001].

In Luxembourg, the **vegetation period** is expected to be initiated earlier in spring and to last longer into autumn *[→ Figure VI.1-1]*. During the early stages of the vegetation period this might cause an increased risk of frost damages to vegetation [Goergen et al., 2013].

The increase of temperatures, especially during the winter period *[→ Section II.3.1]*, already has significant impacts on the **phenology of plants** (earlier flowering dates) and animals (e.g. earlier breeding dates of birds, advancement of life cycle of insects [Junk et al., 2012; Eickermann et al. 2014], three instead of two yearly cycles), but also on the **migratory behaviour of birds and insects** (i.e. species now winter in Luxembourg that in former times migrated to Spain or northern Africa). Furthermore, the temperature changes have an impact on the **bio-geography of plants and animals**, with new species with a Mediterranean distribution, formerly unknown in Luxembourg, which recently appeared in the country fauna (e.g. *Nomophila noctuella*, *Udea ferrugalis*, *Brenthis daphne*) and flora (some moss species). Bio-climatic approaches also indicate that some relict species of the last glaciation period (e.g. *Lycaena helle*) will disappear from Luxembourg with the expected temperature increase.

189 The texts of Sections VI.1.1 to VI.1.3, and VI.1.4 first paragraph, have been prepared by Pfister, L., Junk, J., Ferrone, A., Hoffmann, L. of the *Centre de Recherche Public-Gabriel Lippmann*. The text of the other paragraphs under Section VI.1.4 has been prepared by the Water Agency (AGE).

FIGURE VI.1-1 – START, END AND DURATION OF THE VEGETATION PERIOD



Source: *Centre de Recherche Public-Gabriel Lippmann*, unpublished.
Notes: (1) based on selected ENSEMBLES data sets, A1B emission scenario.
(2) end and duration of the vegetation period as defined by Chmielewski & Rötzer (2001).
(3) DOY = day(s) of year.

Box VI.1-1: The ENSEMBLES model

The data used in most of the presented impact studies in this NC were taken from the FP6 ENSEMBLES project. Within this project, only a dynamical downscaling approach was used. Data from different Global Climate Models (GCMs) were used as input data for different Regional Climate Models (RCMs). An overview of the GCM RCM combination as well as the institution that run the projections is given in table 1; a more detailed description is given by Junk et al. (2014). Local references were only used for the bias correction of the RCM output. Therefore, single stations within the country were not used but rather the E-OBS (www.ecad.eu) data set, which includes gridded data of air, temperature, precipitation, relative humidity, and pressure.

Table 1 – Regional climate change projection datasets from the ENSEMBLE project

Model ID used as abbreviations	GCM	Institution running the GCM	RCM	Institution running the RCM
E01	HadCM3Q16	METO-HC	RCA3	C4I
E03	ARPEGE_RM5.1	CNRM	ALADIN	CNRM
E04	ECHAM5r3	MPI-MET	DMI-HIRHAM5	DMI
E05	ARPEGE	CNRM	HIRHAM5	DMI
E06	BCM	UIB	HIRHAM5	DMI
E07	HadCM3Q0	METO-HC	CLM	ETHZ
E08	IPSL	IPSL	CLM	GKSS
E09	HadCM3Q0	METO-HC	HadRM3Q0	METO-HC
E10	HadCM3Q3	METO-HC	HadRM3Q3	METO-HC
E11	HadCM3Q16	METO-HC	HadRM3Q16	METO-HC
E12	ECHAM5r3	MPI-MET	RegCM	ICTP
E13	ECHAM5r3	MPI-MET	RACMO	KNMI
E16	ECHAM5r3	MPI-MET	REMO	MPI-M
E18	BCM	UIB	RCA3	SMHI
E19	ECHAM5r3	MPI-MET	RCA3	SMHI
E20	HadCM3Q3	METO-HC	RCA3	SMHI

During the upcoming years the *Centre de Recherche Public-Gabriel Lippmann* will concentrate on the detailed analyses of the high resolution COSMO-CLM projections for Luxembourg. Up to now, no bias corrections was applied to this data set that and this task is foreseen for the near future.

Additionally, it is intended to include the data provided by the CORDEX project (the successor of the ENSEMBLES project, spatial resolution 25 km and 7 km), in the analyses. Within in this project, the number of ENSEMBLES members were extended again and in addition, different new IPCC RCP emission scenarios were taken into account.

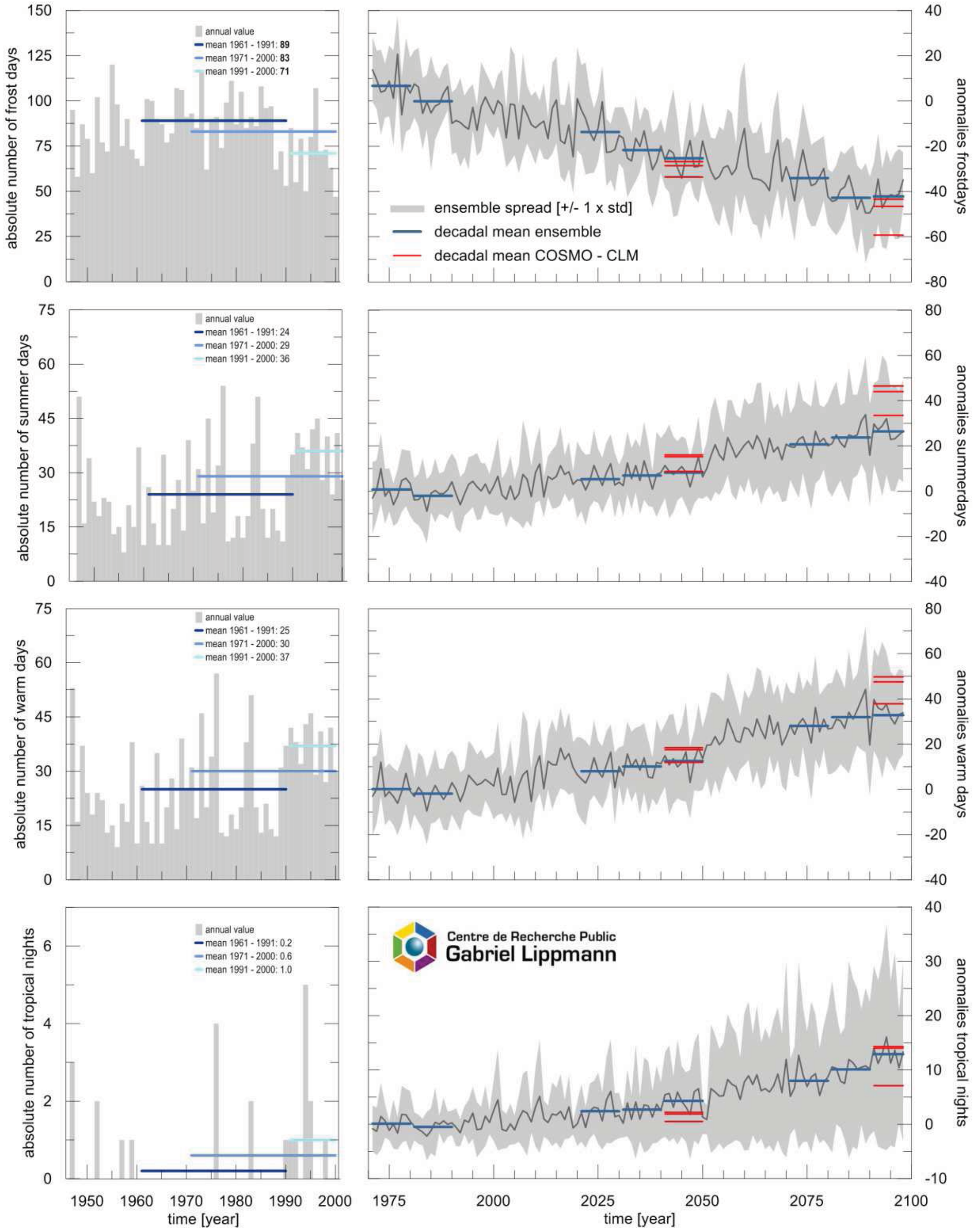
The exact timeline and extend of these tasks are dependent of the acquired funding by the research institute.

VI.1.2. Human health

The climate projections for the second half of this century will also have significant impacts on public health conditions in Luxembourg. The thermal environment is a relevant parameter for human health because of the close interaction between the thermoregulatory mechanism of the human body and the circulatory system. The danger of **increasing heat exposure** for the population in Luxembourg is most severe in urban areas with high building densities due to the increased thermal storage capacity and night-time thermal emissions. The higher air temperatures, especially during night times (important recreation time for humans) also increase the likelihood of extreme heat events such as the one that struck Europe in August 2003 [Matzarakis et al., 2013]. Even relatively moderate levels of heat stress could be associated with adverse health impacts, and characteristically temperature-mortality relationships could be established for air temperatures below 30°C. The greatest health threat to humans will be the projected increase in extreme events especially in the frequency and intensity of heat waves. Climate indices developed by the *World Climate Research Programme's Expert Team on Climate Change Detection and Indices* were used to analyse data from (i) a long-term measurements site (Findel-Airport station) and (ii) different regional climate models to assess potential health effects for Luxembourg.

The four air temperature based climate indices: frost days, summer days, warm days and tropical nights were calculated for the observational data of the Findel-Airport site for the period from 1971 until 2000, as well as for the results of the multi-model ENSEMBLE *[→ Figure VI.1-2]*.

FIGURE VI.1-2 – ABSOLUTE NUMBER OF EVENTS FROM DIFFERENT CLIMATE INDICES BASED ON OBSERVATIONAL DATA AND ON THE MULTI MODEL ENSEMBLE DATA SET



Source: Junk et al., 2014.

Notes: Absolute number of events from different climate indices based on observational data from the Findel-Airport station for the period from 1947 until 2000 (left side of the panel). Blue lines indicate mean values for different timespans. Anomalies of the same indices based on the multi model ENSEMBLE data set for the period from 1971 until 2098 with respect to 1991 until 2000 are shown on the right side of the panel. Lines: decadal mean values of the anomalies of the ensemble data set (blue) and for the three selected artificial sites of the COSMO – CLM data set (red).

In general the climate indices reflect the trend of increasing air temperature. The observed decreasing trend in the absolute number of frost days based on the measurements on the Findel-Airport site is sustained in the projections. Until the end of this century the general frost risk will almost disappear except for single events in areas with higher frost potential, e.g. due to cold drainage air flows. Higher air temperature during the cold season decreases the future cold stress and would potentially reduce the short term increases in mortality, mainly from thrombotic and respiratory disease during the winter season.

The **number of summer days** increased considerably up to the year 2000 based on the observed air temperatures. This trend is also visible in the future projections. For the direct health effect the number of tropical nights is even more important, because the lack of regeneration due to heat-stress conditions at night has been identified to be particularly dangerous to human health. According to the observational data set these events were rare events in the past. On average less than one **tropical night** is observed per year in the last century. The transient multi model projections revealed an average increase to 4.3 days in the near (2041 - 2050) and 12.9 days in the far future (2089 - 2098) [Junk et al. 2014].

VI.1.3. Agriculture and forestry

Besides impact on the human health, the trends observed with regard to summer days and tropical nights will also lead to more frequent and more stringent stress conditions for **agricultural plants and forestry**, most severely impacting perennial forest trees. Observations on the phytosanitary state of Luxembourg forests – rather "old" forests – show a sharp degradation – which seems to have stabilised nowadays – resulting, among other factors, from climate change ***[→ Section II.10.1]***. The ageing of the forest also increases the risk of disease outbreaks and of infestation by insects and other parasites that could proliferate if milder winters and overall higher air temperatures are recorded in Luxembourg.

With regard to **crops**, a higher yield variability is noticed these last years with "extreme" events repeating themselves more frequently (dry year, late springtime, longer raining periods, etc.). Consequently, harvests are more irregular. However, even if Luxembourg is small, the above findings are an average and disparities occur between the regions of the country.[190]

For the Luxembourgish **grape and associated wine production**, late frost represents a significant hazard. Increasing air temperatures due to climate change might advance grape budburst and later frost events in spring. So far it is unclear if both trends will have the same magnitude, or if one will be more pronounced than the other, thus resulting in an increase/decrease of the risk of late frost damages. In order to assess the future frost risk in the Luxembourgish winegrowing region, the combined impact of simulated future climate conditions on budburst and last frost dates were considered.

Due to increasing spring temperatures budburst and the date of last frosts will advance ***[→ Figure VI.1-3]*** [Molitor et al., 2013]. This trend will be more pronounced for last frost events than for budburst. Projections based on an ensemble of regional climate models coupled to a phenological

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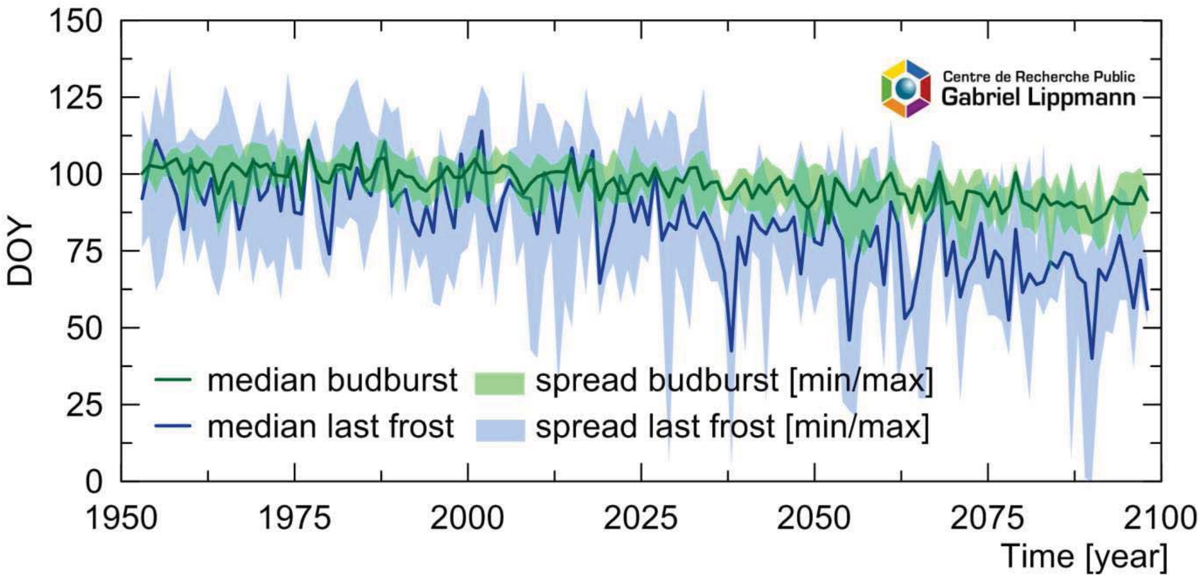
[190] Expert judgement from the ASTA (Agriculture Technical Services Administration of the Ministry of Agriculture, Viticulture and Consumer Protection).

model for budburst of grapevine showed that the frequency of spring frost damages in the Luxembourgish winegrowing region will decrease, without completely excluding them for the near (2021 to 2050) or the far future (2069 to 2098).

FIGURE VI.1-3 – MEDIAN OF ANNUAL BUDBURST DATES OF THE VARIETY MÜLLER-THURGAU AND DATES OF THE LAST FROST EVENTS



Source: Molitor et al., 2013.
Notes: (1) based on selected ENSEMBLES data sets, A1B emission scenario.
(2) median of annual budburst dates of the variety Müller-Thurgau (green line) and dates of the last frost events (blue line), both in day of year (DOY) for Remich/Luxembourg for the period 1961 to 2098.

VI.1.4. Water

With regard to water, the most analysed phenomena so far are **floods**. It is known that, due to major redistributions of, essentially, winter rainfalls *[→ Section II.3.1]*, a higher inundation frequency has been documented. The river systems have indeed reacted to these shifts in winter precipitation by a statistically significant increase of maximum daily runoff during winter [Pfister et al. (2005a)]. Consequently, a hydro-climatic monitoring network (*réseau d'observation hydro-climatologique*) has been implemented in the mid-1990s.[191] Its main purpose consists in continuously (24/7) monitoring Luxembourg's river network. All recorded data are freely available and published yearly via the "*Atlas hydro-climatologique du Grand-Duché de Luxembourg*". The monitoring network also serves for the design of flood protection measures and river restoration projects.[192]

According to a scenarios study on the discharge regime of the Rhine,[193] published by the "International Commission for the Protection of the Rhine" (ICPR)[194] in July 2011, by the middle

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191 http://www.hydroclimato.lu/.

192 For an example, look at http://www.luxnatur.lu/alzrena1.htm.

193 http://www.iksr.org/index.php?id=342&L=3.

of the century, up to 20% higher discharges are to be expected during winters in the Rhine catchment and up to 10% lower discharges are expected during summers, while regional variations may occur. The study presents discharge projections at representative gauging stations on the Rhine and the Moselle for the near future (up to 2050) as well for the remote future (up to 2100).

According to these projections, the development until 2050 is characterized by a continuous rise in temperature which, for the period 2021 to 2050 compared to the present (1961-1990) will amount to an average of +1 to +2°C for the entire Rhine catchment. As far as precipitation is concerned, no considerable changes are to be noted in summer. For the winter, moderate increases are projected which, for the entire Rhine, will vary between 0% and +15%. These developments are accompanied by mostly moderate changes of the discharge pattern. Compared to the present, the mean and lower discharges (MQ and NM7Q) in summer remain almost unchanged. Increased precipitation in winter which, due to rising temperatures increasingly occurs as rainfall, will lead to a rise of the mean discharges and low flow in winter by about 10% of the median of spreads. Partly, the evaluations result in slightly differing findings for the tributaries under consideration. Along the Moselle, a trend towards less precipitation in summer is recorded.

Under the assumption of continued increasing atmospheric greenhouse concentrations until the end of the 21st century, changes compared to the present (1961-1990) will be obvious. A rise in temperature of +2°C to +4°C (until 2100) is projected. The regionally differing tendencies – stronger rise in temperature in the south than in the north – will remain unchanged compared to the "near" future. Also, the rise in temperature is stronger in summer than in winter. Unlike the changes in precipitation stated until 2050, precipitation in the Rhine catchment will considerably fall during the summer months, mostly by -10% and – 30%. On this basis, falling mean runoff and low flow in summer is simulated in comparable orders of magnitude. The increase in precipitation during the winter months projected until 2100 for the entire Rhine mostly ranges between + 5% to + 20%. It lies above the values pointed out for the near future (0% to 15%). The increase of the mean runoff and of low flow in winter largely corresponds to that of area precipitation.

Under the overall control of the "International Commissions for the Protection of the Moselle and the Saar" (ICPMS) [195] and with the participation of Rhineland-Palatinate, the Saarland, Luxembourg and France, the Interreg VI-A Project Flow MS (Flood and Low Water Management in the Moselle-Saar basin)[196] was launched in early 2009 and is being carried through, until the end of 2013, in the Moselle and Saar catchment. Among others, the aim of the project is to investigate eventual impacts of climate change on flooding and low flows on a transboundary

194 http://www.iksr.org/index.php?id=58&L=3&cHash=455fdab52ce6eafbf6f72632159564bf.

195 http://www.iksms-cipms.org/servlet/is/392/.

196 http://www.iksms-cipms.org/servlet/is/60262/.

basis and to develop adjustment strategies.[197] The results of existing climate scenarios serve as the basis for analysis using available hydrological balance models (such as LARSIM).

According to a study[198] carried out within the Flow MS project, the projected precipitations for the Moselle-Saar catchment area for the period 2021 to 2050 will change in the following way compared to the period 1971 to 2000: the average precipitations during the winter period will increase in-between +4 % and +20%, which results in an average increase of about +12.5% over the whole region. While the precipitations will rise during the winter period, the average precipitations during the summer period will decrease in-between -13% and +2% resulting in an average decrease over the whole region by -7.5%.

Based on the above projected calculations of the precipitations, different runoff values for the projected period 2021 to 2050 have been calculated. During the winter period, which is the period with the highest runoff values, the average value of the MoMHQ will rise in the projected period for all runoff measuring points taken into account. The increase will vary between + 5% and +24%. Compared to the winter period, the same runoff value will change in the summer period from -13% to +8%. The projected values of the MoMQ show a similar evolution as the MoMHQ values. The values for the MoMNQ show a slight increase in-between +5% and +15%. In the summer period, which is the period with the lowest runoff values, the change will be towards slightly lower values in the future. The changes for this period will vary from -13% to +5% depending on the runoff measuring point.

The study shows that for the period from 2021 to 2050, the values for the HQ10 will remain either unchanged or will slightly increase for the Moselle region. The simulation shows a more mixed situation for the HQ100 values. For some of the runoff measuring points which show increasing HQ10 values, the values for the HQ100 will decrease but overall the HQ100 values show a trend to higher values for the 2021 to 2050 period throughout the Moselle-Saar region.

VI.2. VULNERABILITY ASSESSMENT: THE CASE OF WATER[199]

Vulnerability refers to the risk of adverse impacts from climate change, such as extreme weather events, droughts or floods, on both natural and human systems. In Luxembourg, **a thorough vulnerability assessment has not been done yet**. The following text focuses on water related aspects of vulnerability to climate change and a more holistic view on vulnerability is provided in *Table VI.3-1* below.

VI.2.1. Drought and drinking water supply

197 http://www.iksms-cipms.org/servlet/is/3183/.

198 http://www.iksms-cipms.org/servlet/is/3183/Brochure_Changement-Climatique.pdf?command=downloadContent&filename=Brochure_Changement-Climatique.pdf.

199 The text of this Section has been prepared by the Water Agency (AGE).

A lack of precipitations over an extended period may lead to a hydrological drought which results in a decrease of available water reserves in aquifers, lakes and groundwater sheets. A projected increase in the number of dry periods and the number of days within a dry period may result in an increased risk of drought for Luxembourg. In addition, droughts can endanger aquatic ecosystems.[200]

If a drought period coincides with a period of increased demands for drinking water, it is possible that the needs of the population can no longer be satisfied and restrictions or prohibitions regarding drinking water use have to be declared (e.g. watering gardens, filling swimming pools). Adaptation measures to ensure security of drinking water supply are in that case necessary, especially with regard to the fact that the drinking water consumption in Luxembourg is likely to increase up to +141% in 2040 due to the demographic development.

VI.2.2. Infrastructure and economy

The high soil sealing due to the demographic pressure is causing a reduction of the water infiltration potential of the soil, which increases the discharges and the risk of floods. Besides, the increase in winter precipitations is likely to generate a swelling of the average flow in winter as well as to increase the risk of floods. An increased flood frequency and intensity may affect human safety and human health and cause environmental damages, damages to property and infrastructures and a still-standing of economic activities.

On the other side the decrease in summer precipitations increases the risk of pronounced low water during the summer. The hydrological regime of water courses in Luxembourg changes and tends towards a Mediterranean regime with more pronounced seasons. Even during dry periods, trafficability of navigation routes must be ensured and the natural water purification system present in rivers and the survival of aquatic biotopes be guaranteed.

Hydropower production will be affected by the time shift of precipitations, especially during summer or due to the multiplication of heat waves during which energy consumption increases. Consumers have to be encouraged to not increase their demand for energy during periods of high heat and the use of alternatives should be considered.

VI.2.3. Preservation of aquatic ecosystems

Increased rainfall may lead to a deterioration of the groundwater and surface water quality due to reinforced soil erosion and faster water infiltration into the soil. The risk of deteriorating surface water quality is intensified by increasing water temperatures which are a consequence of the projected increasing air temperatures. The increase in stream water temperatures and the decrease

[200] http://www.iksr.org/index.php?id=190&L=3&tx_ttnews[tt_news]=809&cHash=8a48afd7fb931b5c223987d3038d20ef.

in their flow rate risk to lead to quality problems as the available water can no longer sufficiently dilute pollutants and the low oxygen levels threaten the survival of fish.

Even though groundwater resources are less affected by drought periods in summer as the groundwater recharge is essentially taking place between end of autumn and beginning of spring (October to March), a shift in the precipitations during the winter months can affect the recharge regime of groundwater systems.

VI.2.4. Human health

Health risks associated with drinking water insecurity and shortages which may result from the increased number of dry periods and of days within a dry period, just as the degradation of its quality are undeniable. Changes in the water cycle could therefore increase public health risks related to water quality and water scarcity.

It should also be noted that a few waters are used in Luxembourg as freshwater bathing waters.[201] As reduced flow rates and increased water temperatures can promote the growth of algae in lakes and rivers, the bathing water quality will also be impacted and deteriorated if these are used for bathing purposes.

The increased flood probability and their expected increased intensity are likely to affect human health. The preparation of flood hazard maps and flood risk maps,[202] flood evacuation plans and early warning systems,[203] as well as maintaining a "risk aware culture" are essential to built and raise public awareness.[204]

VI.3. ADAPTATION MEASURES: TOWARDS AN ACTION PLAN

VI.3.1. Overview

In its consolidated 5th National Communication, Luxembourg informed on the country's intention to prepare a "National Climate Change Adaptation Plan" to be adopted by the Government by the end of 2011 [Ministry of Sustainable Development and Infrastructure, Department of the Environment (2010), p. 233]

Since submitting its 5th National Communication, Luxembourg has generated an extensive amount of information on the expected national impacts of climate change and the country's vulnerability to climate change, as the two previous Sections now illustrates *[→ Sections VI.1 & VI.2]*. Detailed

201 http://www.eau.public.lu/actualites/2013/05/Baignade_actuel/index.html.
202 http://www.eau.public.lu/publications/brochures/hochwasser/hochwasser.pdf.
203 http://www.inondations.lu/.
204 http://www.eau.public.lu/publications/brochures/hochwasserfibel/brochure_hochwasserfibel.pdf.

information on national projections of future climatic conditions, such as temperature, precipitation, extreme climate events and the evolution of event days have been assembled. Luxembourg has also carried out a thorough analysis of national climate change impacts, including the expected impacts on vegetation, agriculture, viticulture, forests, biodiversity and the water cycle. Notably, in June 2011, Luxembourg's Council of Ministers adopted a "**National Adaptation Strategy on Climate Change**", which prioritizes (i) biodiversity, (ii) water, (iii) agriculture and (iv) forestry and provides a framework for adaptation to the impacts of climate change in Luxembourg.

Whilst ***Section VI.3.2*** will focus more precisely on water related adaptation measures, ***Table VI.3-1*** summarizes the information on **vulnerability** and **adaptation** to climate change by sector as it has been used to define the national strategy. It is derived from UNFCCC (2012), p. 23-24, as not much changes happened since the review of the 5th National Communication.

TABLE VI.3-1 – VULNERABILITY AND ADAPTATION – A SECTOR-BASED APPROACH

Vulnerable area	Sector-based information on vulnerability and adaptation to climate change
Biodiversity (and natural ecosystems)	*Vulnerability*: changing climatic conditions are expected to lead to species range shifts, in particular a south to north migration of species. Projected temperature changes could also have an impact on the biogeography of flora ***[→ Section VI.1.1]***. *Adaptation*: the "National Adaptation Strategy on Climate Change" includes the following measures: o vulnerability analysis; o the establishment of protected areas and green corridors; o agro-forestry; o regional implementation and the planning of measures, conservation and restoration of wetlands and permanent grassland; o green infrastructure and architecture; o the monitoring of biodiversity; combating invasive alien species; o a study on the economics of ecosystem services and biodiversity; o additionally, the "River Basin Management Plan" (2009–2015) includes measures to re-establish river morphology and a natural river dynamic that should help to preserve and re-establish biological continuity ***[→ Section VI.3.2.3]***.
Water	*Vulnerability*: projections indicate future changes in the water cycle, such as an increase in rainfall with increasing discharges in winter and a decrease in rainfall with reduced runoff in summer by 2050 ***[→ Section VI.1.4]***. *Adaptation*: the "National Adaptation Strategy on Climate Change" includes measures in the water resources sector, such as ***[→ Section VI.3.2]***: o a monitoring network; o riverbank restoration, water retention, water loss reduction, production water recycling, rainwater use and anti-erosion measures, among others.
Agriculture (and food security)	*Vulnerability*: projected changes in air temperatures are likely to induce a modification of the vegetation period in Luxembourg and could cause an increased risk of frost damage to vegetation. The projected increase in temperature is also expected to have an impact on the life cycle of insects. Projections also show that the number of dry periods, as well as the days within a dry period, could increase, causing drier conditions. These factors, as well as the fact that Luxembourg has very little agricultural surface area using irrigation, could lead to significant impacts on the agriculture sector ***[→ Section VI.1.3]***. Nevertheless, Luxembourg does not identify climate change as an imminent threat to national food security, as the it is already a net importer of food. *Adaptation*: the "National Adaptation Strategy on Climate Change" includes the agriculture sector and identifies four specific objectives and measures in this area: o to protect against soil degradation and the maintenance of its production potential; o to protect animals against heat and potential new diseases; o to adapt plant production to climate change; and o to manage risks through multirisk insurance and the existing rural development policy.
Forestry	*Vulnerability*: projected overall yearly temperature increases could lead to a decline in Luxembourg's forest health, owing to the increased risk of the outbreak of diseases and insect or parasite infestation ***[→ Section VI.1.3]***. *Adaptation*: the "National Adaptation Strategy on Climate Change" specifically targets forests and proposes adaptation measures for forests that include certification, conservation and the use of wood as a renewable energy resource, among others. Luxembourg also monitors the health of forests and is planning to institutionalize this monitoring with legislation. These measures will be integrated into the country's 10-year forest management plans.
Drought	*Vulnerability*: a projected increase in the number of dry periods and the number of days within a dry period demonstrates an increased risk of drought for Luxembourg ***[→ Section VI.2.1]***. *Adaptation*: the Water Agency has identified potential adaptation measures, including the prohibition of certain water uses to guarantee the water supply ***[→ Section VI.3.2.1]***.

Human health	*Vulnerability*: a projected increase in temperature in all seasons and an increase in the number of dry periods and the number of days within a dry period could increase the risk of heat waves and have an effect on air quality ***[→ Section VI.1.2]***. Changes in the water cycle could increase public health risks related to water quality and water scarcity ***[→ Section VI.2.4]***. *Adaptation*: at this time, the "National Adaptation Strategy on Climate Change" does not address the area of human health, although it is planned to include additional sectors, such as health, to the strategy within the next two years. Plans are under way for additional water intake points in emergency cases (by 2024) and the resizing of the drinking water infrastructure ***[→ Section VI.3.2.1]***.
Infrastructure and economy	*Vulnerability*: projections for an increase in rainfall with increasing discharges in winter, show that there could an increase in the frequency of inundations ***[→ Section VI.2.4]***. Luxembourg is currently participating in a regional study to assess the eventual consequences of climate change for floods and low water flow in the Moselle and Saar catchments and to develop adjustment strategies ***[→ Section VI.1.4]***. *Adaptation*: Luxembourg has carried out a preliminary flood risk assessment and has prepared flood hazard maps and flood risk maps, and is planning to establish flood risk management plans by 2015 ***[→ Section VI.2.4]***. Luxembourg also has a flood warning service (http://www.hydroclimato.lu/) operated by the Water Agency, the Agriculture Technical Services Administration of the Ministry of Agriculture, Viticulture and Consumer Protection and the *Centre de Recherche Public-Gabriel Lippmann* ***[→ Section VI.1.4]***.

In addition to the "National Adaptation Strategy on Climate Change", and in the absence of a "National Climate Change Adaptation Plan", some measures have already been foreseen in the second "Action Plan for reducing CO_2 emissions", especially concerning agro-forestry: see P&Ms 50 and 51 in ***Table IV.3-1***.

VI.3.2. Adaptation in the water sector[205]

VI.3.2.1. Drought and drinking water supply

In order to guarantee a water quality suitable for human consumption and secure the drinking water supply, water preservation measures (water quantity and quality) have to be adopted. In 2008 the "*Plan de Sensibilisation et de Restriction*" aiming at ensuring drinking water supply during periods of scorching heat has been put in place (warning plan regarding the use of water intended for human consumption). This plan is divided into three phases namely the yellow phase ("*phase jaune*") meant to raise consumer awareness, the orange phase ("*phase orange*") meant to put in place first restrictive measures in order to avoid the red phase and the red phase ("*phase rouge*") meant to put in place restrictive measures in order to avoid the breaking off of water supply. In case of drinking water shortage during warm and dry summer seasons, the municipal authorities are informed by the responsible Minister that the orange phase or the red phase of the warning plan has been launched at national level. The municipal authorities then set by an emergency municipal regulation the measures to be taken immediately in order to temporarily reduce the drinking water consumption so as to guarantee that enough water resources for the drinking water supply of the population remain available. Such measures may include temporary tap water use restrictions such as the filling of private swimming pools, cleaning of cars, watering of gardens, spraying of sidewalks are set up by municipal regulations.

Soil erosion and rapid water infiltration may cause a change in the pollution load (nutrients, organic matter, micro pollutants, drug residues) towards surface water and groundwater used for

205 The text of this Section has been prepared by the Water Agency (AGE).

drinking water supply. These phenomena therefore require the adaptation of preventive measures (e.g. prohibitions, regulations, permits within drinking water safeguard zones[206]) and curative measures (e.g. drinking water treatment plants).

Flow rate fluctuations as well as fluctuations in peak water demands may lead to variations of the residence time of the water in the drinking water distribution system. A consequence of this are deteriorations in securing the drinking water supply and in the quality of the distributed water. Therefore the resizing of drinking water infrastructures (e.g. increase storage capacities) has to be considered as an adaptation measure to climate change.

VI.3.2.2. Infrastructure and economy

In order to maintain or improve water infiltration into soil, measures limiting soil sealing and soil compaction should be promoted.[207] It is also important to reactivate the natural flood retention capacity of rivers and restore them where possible.[208]

According to article 4 of the EU floods Directive (Directive No 2007/60/EC),[209] Member States had to proceed with a preliminary flood risk assessment by the end of 2011 and according to Article 5 Member States are required to identify, on the basis of the preliminary flood risk assessment, those areas for which a potential significant flood risk exist or might be considered likely to occur. As the flood risk[210] had already been assessed within the Interreg IIIB project TIMIS Flood (Transnational Internet Map Information System on Flooding),[211][212] Luxembourg made use, by the end of 2010, of Article 13, para. 1a and Article 13, para. 2 of the floods Directive and has thus not proceeded with any preliminary assessment.[213][214]

For the areas for which a potential significant flood risk exist, Member States have to prepare by the End of 2013 flood hazard maps and flood risk maps.[215] On the basis of these maps, Member States have to establish by the End of 2015 flood risk management plans which shall address all aspects of flood risk management focusing on prevention, protection, preparedness, including flood forecasts and early warning systems and taking into account the characteristics of the

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206 http://www.eau.public.lu/publications/brochures/ba_ZP_eau_potable/ZP_eau_potable_fr.pdf.
207 http://www.eau.public.lu/publications/brochures/Regenwasserleitfaden2/Leitfaden_2013_pdf.pdf.
208 http://www.eau.public.lu/publications/brochures/Renaturation/Brochure_Bunusevac.pdf.
209 http://www.eau.public.lu/publications/brochures/a_eist_waasser_2013/eist_waasser_2013.pdf, Chapter 4.
210 http://eau.geoportail.lu/?lang=fr.
211 http://www.europaforum.public.lu/fr/temoignages-reportages/2008/11/reportage-timis-flood/index.html.
212 http://www.eau.public.lu/publications/brochures/hochwasser/hochwasser.pdf.
213 http://www.iksr.org/fileadmin/user_upload/Dokumente_en/Reports/FD-1st_report_01.pdf.
214 http://www.iksms-cipms.org/servlet/is/392/Rapport%20application%20articles%204%20et%205%20DI.pdf?command=downloadContent&filename=Rapport%20application%20articles%204%20et%205%20DI.pdf.
215 http://eau.geoportail.lu/?lang=fr.

particular river basin or sub-basin. Flood risk management plans may also include the promotion of sustainable land use practices, improvement of water retention as well as the controlled flooding of certain areas in the case of a flood event.

Navigation risks to be affected by prolonged and recurrent periods of low water but also by floods which are likely to occur more frequently. In order to keep its capacity and competitiveness, navigation must be guaranteed throughout the year on the main waterways. The adaptation strategy includes several points, such as advanced boat technologies, logistics and infrastructural facilities.

VI.3.2.3. Preservation of aquatic ecosystems

In order to maintain the biodiversity of aquatic environments, it is advisable to restore the natural morphological conditions of the river systems and a natural river dynamic. Variations in the depth of the water, the flow rate as well as the water temperature support the development of a rich aquatic flora and fauna.

The development of sustainable land and soil uses, such as the conversion from arable land to permanent grassland which leads to an increased storage of CO_2 would contribute on the one hand to climate change mitigation measures and on the other hand to the protection of water resources (soil protection against erosion, reduced inputs of fertilizers and pesticides).

VI.3.2.4. Human health

In order to guarantee a fast containment of pollution in drinking water and information of the concerned citizens, a crisis management group composed of all concerned actors in a case of drinking water pollution is installed.

VI.3.2.5. Monitoring

Considerable uncertainties remain with regard to climate monitoring and climate simulations. As gaps in the monitoring networks and measurement errors affect observation data as well as the models based on them, it is important to further extend existing monitoring networks in order to better track changes taking place and to improve their interpretation.

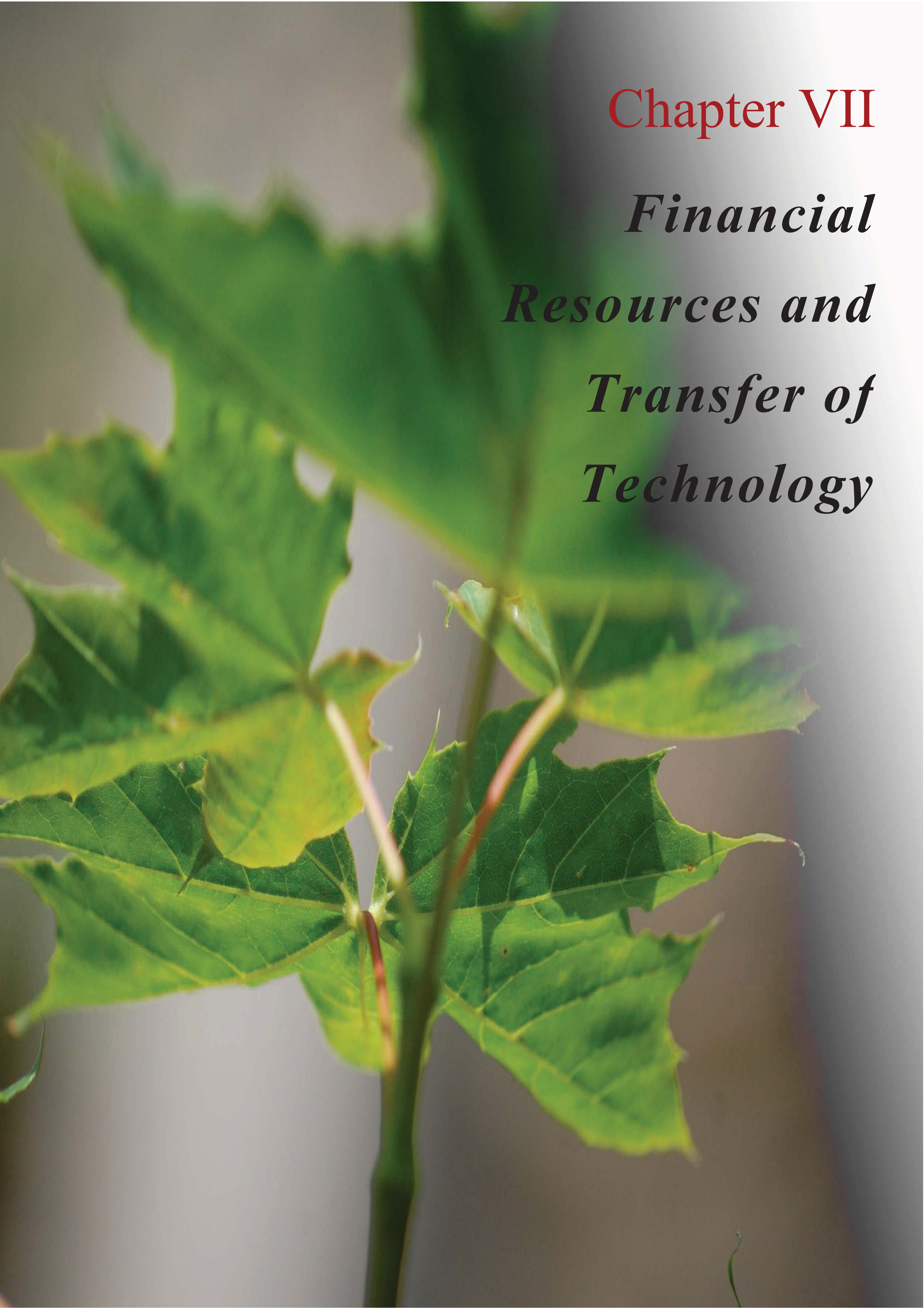
VI.3.2.6. Adapting consumer behaviour

It is only through raising public awareness and setting good examples that consumer behaviour can change. It is therefore advisable to promote research and development in the field of saving water, both in terms of infrastructures and devices as well as constructions. However, it is important to note that inappropriate tap water savings may, in some cases, induce negative effects such as the degradation of the quality of the water used for human consumption. In this context campaigns promoting the consumption of tap water as well as awareness raising campaigns to inform the public about the risks associated with the use of pesticides, particularly in urban areas[216] (e.g. use of pesticides in gardens, public areas) are to be planned.

[216] http://www.environnement.public.lu/sanspesticides/.

Chapter VII

Financial Resources and Transfer of Technology



After introductory notes on Luxembourg's development cooperation, partly in line with paragraph 50 of the UNFCCC reporting guidelines *[→ Section VII.1]*, some information will be given on the provision of "new and additional" resources: GEF and LDC's Trust Fund accordingly to paragraph 51 of the UNFCCC reporting guidelines *[→ Section VII.2]*. With regard to paragraph 52 of these guidelines, Luxembourg reports on its cooperation policy paper on environment and climate change *[→ Section VII.3]*. Provision of financial resources – paragraph 53 – is somehow provided, including for Article 11 of the Kyoto Protocol – paragraph 43 of the Kyoto Protocol reporting guidelines *[→ Section VII.4]*. Activities related to transfer of technology – paragraphs 54 to 56 of the UNFCCC reporting guidelines – are briefly discussed too *[→ Section VII.5]*. Finally, as recommended by paragraph 39 of the Kyoto Protocol reporting guidelines, a table is indicating where information on the implementation of Article 10 is presented throughout the Communication *[→ Section VII.6]*.

This whole Chapter has been prepared by the Development Cooperation Directorate of the Ministry of Foreign and European Affairs and edited by the Department of the Environment to be in line with the UNFCCC reporting guidelines.[217]

VII.1. LUXEMBOURG'S DEVELOPMENT COOPERATION

The primary objective of the "Luxembourg Development Cooperation" is the **eradication of poverty**, notably in least developed countries. Its activities are conceived with respect to the principles of sustainable human development, in its social, economic and environmental aspects.

In the section discussing Luxembourg's development cooperation, the 2013-2018 Governmental Programme states that "*the Government will continue its quantitative effort in percentage of gross national income – 1% of the GNI – especially in harsh times where tensions and crises, and the misery they generate, touch a growing number of individuals, including those living to the gateways to Europe*". It stresses too that "*additional actions put in place by the Government to prevent climate change in third countries will not affect the budgetary means dedicated to poverty eradication and humanitarian assistance*" [Government of the Grand Duchy of Luxembourg (2013), p. 197]. In 2012, Luxembourg's Official Development Assistance (ODA) amounted to 310.45 Mio. EUR (432.14 Mio. USD) and represented 1% of the GNI.[218] Luxembourg thus confirms **its position among the top five donors** who meet the commitment made in 1970 at the UN General Assembly to allocate at least 0.7% of their GNI to development cooperation – Luxembourg even ranked first in 2012.[219] As in the past, this ODA

[217] http://cooperation.mae.lu/fr.

[218] In 2011, ODA amounted to 294.32 Mio. EUR (409.24 Mio. USD), representing 0.97% of the GNI.

[219] Sources: Ministry of Foreign and European Affairs, Directorate for Development Cooperation, "*Luxembourg's Development Cooperation*", annual report 2012, pages 16-17 (http://www.cooperation.lu/_dbfiles/lacentrale_files/500/598/MAE-RA_2012-1col-EN_def-web.pdf) ; OECD – DAC via the Aidflows.org tool (http://www.aidflows.org/) and Eurostat's Sustainable Development Indicator tsdgp100 (http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tsdgp100).

consists of grants only (no loans) and is implemented through the instruments of bilateral and multilateral cooperation, technical cooperation and cooperation with development NGOs.

From a geographic point of view, and in order to maximise its effectiveness and impact, Luxembourg's development cooperation follows a policy of targeted intervention in a limited number of **partner countries**, which are chosen primarily by taking into account the composite human development index (HDI) of the UNDP. Nowadays, five out of these nine partner countries, , are among the Least Developed Countries (LDCs) and are all located in sub-Saharan Africa.[220] All nine of them are concerned by the negative effects of climate change. Development cooperation activities with these countries are distinguished by a heightened sense of partnership with both public authorities and the civil society. This spirit of partnership, which is achieved through actual ownership of the programmes and projects by the beneficiaries themselves, is the cornerstone of the multi-annual cooperation programmes, the "**Indicative Cooperation Programmes**".

Luxembourg's general strategy for development cooperation sees **climate change as one of the global and interdependent challenges** and identifies sustainable development as a common global cause to strive for. Luxembourg's approach concerning the protection of the environment in development cooperation is essentially focused on Millennium Development Goal (MDG) No 7 and, notably, its first two targets: (i) integrating the principles of sustainable development into country policies and programmes and reversing the loss of environmental resources and (ii) reducing biodiversity loss. In this regard, particular attention is attached to the necessity to protect natural resources from the negative effects of climate change.

In order to improve reporting of ODA statistics to the OECD's Development Assistance Committee (DAC), Luxembourg is currently **mainstreaming the DAC policy marker system in all projects and programmes**. This system includes an "Aid to Environment" marker, as well as the four so-called "Rio markers", covering biodiversity, combat against desertification, mitigation and adaptation.

VII.2. PROVISION OF "NEW AND ADDITIONAL" RESOURCES

Luxembourg obeys to the **principle of "additionnality" between ODA and climate finance**. Indeed, the poverty eradication challenge is made more complex due to climate change impacts, especially in developing countries, and therefore calls for additional financial means on top of existing ODA commitments. Consequently, "new and additional" means that the resources that we commit to deliver are not taken over from earlier commitments and are thus new. "Additional"

[220] The 5 sub-Saharan countries are Burkina Faso, Cape Verde, Mali, Niger and Senegal. The 4 other countries are El Salvador, Laos, Nicaragua and Vietnam.

means that they come "on top of" Luxembourg's ODA commitments and thus are not "double counted" or draining on other resources dedicated to poverty eradication.

As regards **Fast Start Finance 2010-2012**, Luxembourg's Prime Minister pledged a contribution of 9 Mio. EUR on top of the country's ODA commitment, to be provided by the "Climate & Energy Fund" *[→ Section V.5.2]*. These 9 Mio. EUR were disbursed for both adaptation and mitigation actions in developing countries – comprising, among others, contributions to UN REDD, the Adaptation Fund, the GFDRR, IUCN (project on RES, involving 6 SIDS) – as well as for various bilateral projects. So far, only 8.85 Mio. EUR could have been firmly commited *[→ Table VII.2-1]*.

TABLE VII.2-1 – LUXEMBOURG'S FAST START CONTRIBUTIONS 2010, 2011 & 2012 IN EUR

Projects	Fast Start Finance 2010-2012	Thematic area	Commitment
GFDRR	Support of integrated climate risk management and adaptation	Adaptation	2 000 000
UN-REDD Programme Fund	Core contribution	REDD+	2 000 000
Adaptation Fund	Core contribution	Adaptation	2 000 000
IUCN SIDS	Pacific SIDS EESLI (Energy, Ecosystems and Sustainable Livelihoods Initiative) - Managing the Ecosystem and Livelihood Implications of Energy Policies in the Pacific Island States	Renewable Energies / Mitigation	1 000 000
Yasuni National Park	Saving Yasuni National Park in Ecuador*	Adaptation / Mitigation	1 000 000
Bilateral programmes in partner countries	LuxDev / Solartec - Cap-Vert Project Electric installation at the professional training center for renewable energy and industrial maintenance	Renewable Energies / Mitigation	681 000
	"Action Solidarité Tiers Monde" / ARFA - Burkina Faso Project Promotion and construction of adaptation and mitigation devices against the effects of climate change and creation of village risk prevention mechanisms in the North and East of Burkina Faso	Renewable Energies / Mitigation	67 196
	Scoping Study for the elaboration and implementation of a NAMA	Mitigation	103 413
Total:			**8 851 609**

Source: MDDI-DEV.
Notes: Yasuni: restitution of the funds due to the stop of the project in 2013.

Luxembourg is furthermore represented in the **GEF** by its Ministry of Finance and has been a member of the GEF since 1997. For the last three years, Luxembourg's contributions are depicted below *[→ Table VII.2-2]*.

TABLE VII.2-2 – LUXEMBOURG'S FINANCIAL CONTRIBUTIONS TO THE GEF FOR THE YEARS 2010, 2011 & 2012 IN EUR

	2010	2011	2012
Global Environment Facility	1 334 200	1 373 400	1 474 475

Source: Ministry of Foreign and European Affairs, Directorate for Development Cooperation.

Through the Development Cooperation Directorate of the Ministry of Foreign and European Affairs, Luxembourg made a contribution of 4.12 Mio. USD to the **Least Developed Countries Trust Fund** (LDCF) for the years 2005 to 2008. An additional contribution of 1 Mio. EUR came in 2007. These last 3 years (2010-2012), however, no contributions were made to the LDCF.

VII.3. ASSISTANCE TO DEVELOPING COUNTRY PARTIES THAT ARE PARTICULARLY VULNERABLE TO CLIMATE CHANGE

In 2009, the Development Cooperation Directorate of the Ministry of Foreign and European Affairs elaborated a policy paper on environment and climate change. This paper is part of a set of 11 thematic position papers steering Luxembourg's development cooperation policy and has been discussed with civil society organisations. An update was completed in 2012 and led to a "**strategy for environment and climate change action**" [Ministry of Foreign and European Affairs, Development Cooperation Directorate (2012)].[221]

This "strategy for environment and climate change action" states the following:

"Luxembourg's Development Cooperation aims to ensure better integration of environmental concerns and climate policy acquisition and promote sustainable energy, clean technology and technology transfer, as well as access to environmental information".

More precisely, as regards technology transfer, it specifies that:

"Luxembourg's Development Cooperation also supports developing countries in the introduction of technologies, processes, services and goods that are environmentally friendly and have low levels of greenhouse gases emissions. Luxembourg's cooperation can accept a certain "trade-off", i.e. the costs of investment in a new clean and sustainable technology are often higher than the costs of investing in a non-sustainable conventional technology, while operating costs associated to renewable technologies tend to decrease in time whereas those associated to conventional technologies tend to rise with the increasing scarcity of fossil fuels. When the life cycle of products, equipment or materials is taken into account, Luxembourg's Development Cooperation may examine the possibility to finance the additional investment in sustainable and low carbon equipment, processes or technology, for the long-term benefit of the target populations".

Furthermore, the following environmental and climate change related clause is to be inserted in all 3rd generation "Indicative Cooperation Programmes":

"With reference to the Kyoto Protocol (1997), the seventh Millennium Development Goal (2000) and the Durban Decisions (2011), both parties agree to promote policies for the conservation of natural resources, sustainable development, environmental taxation and the regulation of pollution.

To this end, Luxembourg's "strategy for environment and climate change action" will be considered at all levels of the project / program cycle management; that is to say at the levels of identification, formulation, instruction and implementation of projects / programs.

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[221] The themes are (i) agriculture and food safety, (ii) humanitarian relief, (iii) local development, (iv) water and sewing, (v) education, (vi) environment and climate change, (vii) gender issue, (viii) governance, (ix) micro-finance, (x) health, and (xi) fragile states (http://cooperation.mae.lu/fr/Politique-de-Cooperation-et-d-Action-humanitaire/Strategies-et-orientations). The "environment and climate change" strategy (in French) is available here: http://cooperation.mae.lu/fr/content/download/32204/245656/version/1/file/S_Environnement_final.pdf.

Luxembourg's Development Cooperation will assist the (partner countries) to identify interventions that preserve natural resources and are part of efforts to adapt to climate change. It may also support the (partner countries) in terms of capacity-building, particularly at institutions responsible for Clean Development Mechanisms (CDM).

Pooling resources and sharing of environmental information will be given priority so as to promote interventions that generate the highest environmental and social benefits in terms of local and global public goods. Depending on the respective national laws, it may be useful to conduct a specific strategic environmental assessment or environmental impact studies.

Luxembourg's Development Cooperation will work to integrate environmental concerns and climate policy acquisition and promote sustainable energy, clean technology and technology transfer and access to environmental information. Collaboration with research centres may be considered for this purpose."

VII.4. PROVISION OF FINANCIAL RESOURCES

VII.4.1. Overall multilateral financial flows

Cooperation with multilateral partners is an important component of Luxembourg's development cooperation policy, notably in the context of achieving the MDGs. In order to achieve a high degree of predictability, multilateral aid is delivered through multi-annual framework agreements.

Luxembourg fully adheres to the **principles of the Paris Declaration on Aid Effectiveness** and **the Accra Agenda for Action** regarding predictability of funds:

- in its bilateral cooperation with partner countries, the Development Cooperation Directorate of the Ministry of Foreign and European Affairs signs multiannual "Indicative Cooperation Programmes" that fix the amount to be invested over a period that generally covers 4-5 years and that set the frame for activities to be conducted within these programmes (priority sectors, etc.);
- the Directorate also mostly signs multiannual framework agreements with multilateral agencies;
- regarding the collaboration with the NGOs, there is a clear tendency towards multiannual framework agreements (in 2012, they represented 42,71% of all the funds attributed to NGOs).

In 2012, the share of **multilateral cooperation in the total ODA** – i.e. 310.45 Mio. EUR – was 40.6% *[→ Table VII.4-1]*.

TABLE VII.4-1 – OVERALL MULTILATERAL COOPERATION FOR THE YEAR 2012

Institution	Total in Mio. EUR	% of multilateral ODA	% of total ODA
United Nations (Agencies, Programmes, etc.)	36.00	28.57 %	11.60 %
European Union	24.00	19.05 %	7.73 %
World Bank	22.00	17.46 %	7.09 %
Regional Development Banks	3.00	2.38 %	0.97 %
Other	41.02	32.54 %	13.21 %
Total	126.02	100.00 %	40.60%

Source: Ministry of Foreign and European Affairs, Directorate for Development Cooperation.

The table on the next page *[→ Table VII.4-2]* synthesises **Luxembourg's overall financial contributions to multilateral institutions and programmes**. This table is produced according to the format suggested for Table 4 of the guidelines for the preparation of National Communications by Parties in Annex I to the Convention [UNFCCC (1999)].

Table VII.4-2 – Overall multilateral cooperation: financial contributions according to "Table 4" format for the years 2010, 2011 & 2012 in EUR

Institution or Programme	2010	2011	2012
European Union			
EC Budget	14.512.691	15.966.434	13.530.260
European Development Fund (EDF)	10.846.000	9.111.030	7.832.000
European investment Bank (EIB)	1.900.000	1.350.000	1.440.000
United Nations			
FAO	2.220.904	2.592.668	1.418.519
UNDP	11.787.398	9.637.335	12.360.078
UNEP	500.000	500.000	500.000
UNICEF	5.997.310	7.653.451	7.641.982
International Financial Institutions			
World Bank	6.303.750	3.937.573	4.339.000
International Development Association (IDA)	13.275.000	12.830.000	16.305.000
International Bank for Reconstruction and Development (IRBD) incl. GEF/CGIAR	2.120.580	2.298.400	2.174.475
European Bank for Reconstruction and Development (EBRD)	1.500.000	1.500.000	1.500.000
Asian Development Bank (ADB)	1.500.000	1.500.000	798.000
Other Multilateral Institutions			
OECD	350.000	389.000	450.000

Source: Ministry of Foreign and European Affairs, Directorate for Development Cooperation.

VII.4.2. Climate change related financial flows to developing country Parties to the UNFCCC

As indicated above *[→ Section VII.1.]*, five out of Luxembourg's nine partner countries are among the LDCs and are located in sub-Saharan Africa. They are all affected by the negative effects of climate change.

Table VII.4-3 is taken from the "Provision of public financial support" tables as defined in Decision 19/CP.18 on a Common Tabular Format (CTF) for "UNFCCC biennial reporting guidelines for developed country Parties". It reproduces table 7(a) for the years 2011 and 2012. The 3 CTF tables 7, 7(a) and 7(b) as requested for the first Biennial Report are presented in Annex to this NC.

This table reports ODA's financial flows and contributions managed by the Development Cooperation Directorate of the Ministry of Foreign and European Affairs, other official flows coming from the Fast Start Finance 2010-2012 and the contributions to the Global Environment Facility (GEF) which are under the responsibility of the Ministry of Finance *[➔ Section VII.2]*. As it can be seen from the table, Luxembourg's ODA relating to climate change is **essentially made of bilateral contributions as well as of co-financing and framework agreements with NGOs**. The bilateral contributions under the PMA, AOSIS and "Other" are managed by Luxembourg's executing agency for development cooperation, LuxDev.[222]

With regard to AOSIS, it is worth mentioning that Cape Verde is one of Luxembourg's partner countries and is currently implementing the "Indicative Cooperation Programme 2011-2015" to which Luxembourg is contributing the sum of 60 Mio. EUR.

Luxembourg reserves 5% of its humanitarian aid to **disaster risk reduction and prevention activities**. Among these funds, regular contributions to the UNISDR and GFDRR have to be mentioned, as it was the case, e.g., in 2010 for the UNISDR.

Resilience building activities are playing an increasingly important role in Luxembourg's ODA. Acknowledging that preventing catastrophes and addressing the causes of recurrent crises rather than responding only to disasters are not only investments in the best interest of the beneficiaries but also more cost-efficient, Luxembourg tries to facilitate the transition between humanitarian aid and development aid, with resilience building activities at its intersection. Contributions to the GFDRR, UNISDR, BCPR and various NGO projects reflect Luxembourg's commitment in this regard.

222 See http://luxdev.lu/en/home.

TABLE VII.4-3 – PROVISION OF CLIMATE CHANGE RELATED PUBLIC FINANCIAL SUPPORT: SUMMARY INFORMATION FOR THE YEARS 2010, 2011 & 2012 IN EUR

Table 7(a) LUX_BR1_v1.0

Provision of public financial support: contribution through multilateral channels in 2011[a]

Donor funding	Total amount				Status[b]	Funding source[f]	Financial instrument[f]	Type of support[f, g]	Sector[c]
	Core/general[d]		Climate-specific[e]						
	European euro - EUR	USD	European euro - EUR	USD					
Total contributions through multilateral channels			7,402,189.00						
Multilateral climate change funds[g]			3,373,400.00						
1. Global Environment Facility			1,373,400.00		Provided	ODA	Grant	Cross-cutting	Cross-cutting
2. Least Developed Countries Fund									
3. Special Climate Change Fund									
4. Adaptation Fund			2,000,000.00		Committed	OOF	Grant	Adaptation	Cross-cutting
5. Green Climate Fund									
6. UNFCCC Trust Fund for Supplementary Activities									
7. Other multilateral climate change funds									
Multilateral financial institutions, including regional development banks			1,428,795.00						
1. World Bank									
2. International Finance Corporation									
3. African Development Bank									
4. Asian Development Bank									
5. European Bank for Reconstruction and Development									
6. Inter-American Development Bank									
7. Other			1,428,795.00						
Mekong River Commission			428,795.00		Provided	ODA	Grant	Adaptation	Water and sanitation
GFDRR			1,000,000.00		Provided	OOF	Grant	Adaptation	Cross-cutting
Specialized United Nations bodies			2,599,994.00						
1. United Nations Development Programme			2,000,000.00						
UN-REDD			2,000,000.00		Provided	OOF	Grant	Mitigation	Cross-cutting
2. United Nations Environment Programme									
3. Other			599,994.00						
UN - WFP			599,994.00		Provided	ODA	Grant	Adaptation	Cross-cutting

Table 7(a) LUX_BR1_v1.0

Provision of public financial support: contribution through multilateral channels in 2012[a]

Donor funding	Total amount				Status [b]	Funding source [f]	Financial instrument [f]	Type of support [f, g]	Sector [c]
	Core/general [d]		Climate-specific [e]						
	European euro - EUR	USD	European euro - EUR	USD					
Total contributions through multilateral channels			6,490,206.00						
Multilateral climate change funds [g]			1,474,475.00						
1. Global Environment Facility			1,474,475.00		Provided	ODA	Grant	Cross-cutting	Cross-cutting
2. Least Developed Countries Fund									
3. Special Climate Change Fund									
4. Adaptation Fund									
5. Green Climate Fund									
6. UNFCCC Trust Fund for Supplementary Activities									
7. Other multilateral climate change funds									
					Provided				
Multilateral financial institutions, including regional development banks			3,308,464.00						
1. World Bank									
2. International Finance Corporation									
3. African Development Bank									
4. Asian Development Bank									
5. European Bank for Reconstruction and Development									
6. Inter-American Development Bank									
7. Other			3,308,464.00						
Mekong River Commission			428,795.00		Provided	ODA	Grant	Adaptation	Water and sanitation
GFDRR			1,000,000.00		Committed	OOF	Grant	Adaptation	Cross-cutting
IUCN - SIDS			1,000,000.00		Provided	OOF	Grant	Mitigation	Energy
ASTM / ARFA			67,169.00		Provided	OOF	Grant	Cross-cutting	Agriculture, Water and sanitation
Climate Focus / 4climate			100,000.00		Committed	OOF	Grant	Mitigation	Cross-cutting
ICRC			312,500.00		Provided	ODA	Grant	Adaptation	Cross-cutting
GFDRR			400,000.00		Provided	ODA	Grant	Adaptation	Agriculture, Water and sanitation
Specialized United Nations bodies			1,707,267.00						
1. United Nations Development Programme			1,000,000.00						
UNDP Yasuni			1,000,000.00		Provided	OOF	Grant	Cross-cutting	Forestry
2. United Nations Environment Programme									
3. Other			707,267.00						
UN Women			157,267.00		Provided	ODA	Grant	Adaptation	Cross-cutting
UNISDR			250,000.00		Provided	ODA	Grant	Adaptation	Cross-cutting
UNHCR			300,000.00		Provided	ODA	Grant	Adaptation	Cross-cutting

[➔ see Annex for additional details on the total ODA (not only climate change related) per sector for the year 2012]

VII.5. ACTIVITIES RELATED TO TRANSFER OF TECHNOLOGY

The following projects and programmes illustrate the efforts of Luxembourg's Development Cooperation as regards technology transfer:

- **Cape-Verde**: project **CVE/071** – 12.54 Mio. EUR – 2008-2013 – Luxembourg's Development Cooperation supported the knowledge transfer in the area of energy efficient public building designs. Luxembourgish architectural and engineering teams have designed a sustainable building for the *Vocational Training Centre for Renewable Energies and Industrial Maintenance* in Praia. With funding from the "Climate & Energy Fund" *[➔ Section VII.2]*, and in collaboration with Solartec – a Luxembourg-based company specialized in photovoltaic containers – a container will be provided to the *Vocational Training Centre for Renewable Energies and Industrial Maintenance* *[→ Table VII.5-1]*.

- **Tunisia**: project **TUN/016** – 2 Mio. EUR – end of the 1990s to 2003 – Luxembourg's Development Cooperation supported the setting up of the CITET – *Centre International des Technologies de l'Environnement de Tunis* (International Tunis Centre for Environmental Technologies) *[→ Table VII.5-1]*.[223]
- **Tunisia**: project **TUN/009** – 1.6 Mio. EUR – 1995-1999 – transport and storage of waste oils and oil filters from 30 petrol stations in the Hamman Sousse and Tunis areas.
- **Vietnam**: project **VIE/020** – 1 Mio. EUR – 2006-2009 – collaboration between LuxDev and the *Centre de Recherche Public Gabriel Lippmann* (CRP-GL) for the evaluation of a water hyacinths / biogas project.

All activities described above are publicly financed (respectively co-financed to at least 66% as far as regards NGO projects). As a public administration, primarily concerned with development policies and ODA management, the Ministry of Foreign and European Affairs, Directorate for Development Cooperation, does not report on private sector's investments.

This said, for publicly funded (bilateral or NGO) projects in the field of technology transfer, the Ministry does rely on the private sector as a skilled and specialized technical partner. In this context, the following examples illustrate how Luxembourg encouraged private sector activities:

- capacity building activities in Cape Verde's Energies Training Centres will create an incentive for private sector investment in clean technologies in these countries;

223 Luxembourg's Public Research Center Henri Tudor continues a sporadic collaboration (capacity building workshops, etc.) with the CITET.

- collaboration with companies that provide solar panels or more complex solar container systems: either LuxDev chooses these companies through a tendering process or NGOs choose these companies for collaboration and the Ministry co-finances such projects.

TABLE VII.5-1 – DESCRIPTION OF SELECTED PROJECTS OR PROGRAMMES THAT PROMOTED PRACTICABLE STEPS TO FACILITATE AND/OR FINANCE THE TRANSFER OF, OR ACCESS TO, ENVIRONMENTALLY-SOUND TECHNOLOGIES

Project / programme title: *Vocational Training Centre for Renewable Energies and Industrial Maintenance* in Praia, Cape Verde (project CVE/071).			
Purpose: • Energy efficient public building designs; • Capacity-building; • Renewable energy production.			
Recipient country	**Sector**	**Total funding**	**Years in operation**
Cape-Verde	• Energy efficient building; • Renewable (solar) energy production.	13.221 Mio. EUR = 12.54 Mio. EUR (ODA) + 681 000 EUR (Climate Finance)	2008 – 2013
Description: The building has been designed by Luxembourgish architectural and engineering teams selected after a competition. The Vocational Training Centre serves as a centre for specialized capacity-building in the field of renewable energies. With funding from the "Climate & Energy Fund" and in collaboration with Solartec – a Luxembourg-based company specialized in photovoltaic containers – a container will be provided to the *Vocational Training Centre for Renewable Energies and Industrial Maintenance*. It (1) acts as a demonstration tool for trainings on the maintenance of photovoltaic and battery installations; (2) complements the Training Centre's electricity needs; and (3) feeds the surplus into the public grid (which has become possible thanks to a new legislation in Cape Verde)			
Indicate factors which led to project's success: Holistic approach for the Vocational Centre that: - is built following energy efficient standards; - serves as a centre for capacity building in the field of renewable energies; - produces itself solar energy to run the centre and feed the surplus in the grid. Context: Cape Verde's public policy to switch to 50% of renewable energy sources until 2020. Collaboration with the private sector (Solartec)			
Technology transferred: • Energy efficient public building designs; • Capacity-building; • Renewable energy production (photovoltaic container).			
Impact on greenhouse gas emissions/sinks (optional): not applicable.			

Project / programme title: *Mise en place du CITET - Centre international des Technologies de l'Environnement de Tunis* (project TUN/016).			
Purpose: Environmental capacity-building and awareness raising			
Recipient country	**Sector**	**Total funding**	**Years in operation**
Tunisia	Renewable energy sources / photovoltaic	2 Mio. EUR (ODA)	end of the 1990s to 2003
Description: From the end of the 1990s to 2003, Luxembourg's Development Cooperation supported the setting up of the CITET - *Centre International des Technologies de l'Environnement de Tunis* (International Tunis Centre for Environmental Technologies). The budget of the project TUN/016 amounted to 2 Mio. EUR. Improved waste management tools, decontamination of soil polluted by fuel on an experimental site, and environmental awareness raising were some of the outcomes. Luxembourg's *Centre de Recherche Public Henri Tudor* (CRP-HT) and *Luxcontrol* were in charge of knowledge and technology transfer between Luxembourg and Tunisia.			
Indicate factors which led to project's success: • Project part of a vaster bilateral cooperation between Luxembourg and Tunisia; • Collaboration with the private sector (Luxcontrol) and the academic sector (CRP-HT).			
Technology transferred: • Improved waste management tools; • Soil decontamination.			
Impact on greenhouse gas emissions/sinks (optional): not applicable.			

In 2013, the Ministry of Sustainable Development and Infrastructure engaged in a scoping study on the potential for a **Nationally Appropriate Mitigation Action** (NAMA) in 6 of the Luxembourg's development cooperation partner countries: El Salvador, Nicaragua, Tunisia, Montenegro, Laos and Vietnam. The study is supported by Luxembourg's contribution to "fast start financing". LuxDev is in charge of mobilising the local expertise for the study entrusted to an international climate experts' consortium. In July 2013, Phase 1 of the assignment concluded that Laos, Montenegro and Vietnam would be the most promising candidates. Throughout 2013, subsequent phases will deepen analysis on capacity and readiness, set priorities, and evaluate costs, before recommending, by the end of 2013, a single country ready for Luxembourg NAMA support. In close cooperation with a host country Government and Luxembourg's officials, the overall aim is to prepare, , a "Project Idea Note" (PIN) for one specific NAMA country that may qualify for further support from Luxembourg with "fast start" or other funds.

In 2012, Luxembourg financed a study to explore the **potential of renewable energy sources** (RES) **in Cape Verde**, in view of the fulfilment of the country's policy to switch to 50% of RES until 2020. As a follow-up to the study, a mission to explore opportunities for economic cooperation by attracting potential investors or technical partners (companies active in the field of RES) from Luxembourg and Germany took place in 2013. Further workshops and conferences are planned in order to clarify the legal environment necessary for a transition from fossil to RES, as well as to set up a financing model.

With regard to the **types of technologies to be transferred by companies from Luxembourg to developing countries**, there are companies specialized in photovoltaic slabs and containers, others specialized in biogas installations and yet others constructing thermo-solar boilers.

The following examples illustrate how Luxembourg encourages private sector activities:

- capacity-building activities in Cape Verde's or Tunisia's RES Training Centres will create an incentive for private sector investment in clean technologies in these countries;
- collaboration with companies that provide solar panels or more complex solar container systems. These collaborations are organized as follows: either LuxDev chooses the companies through a tendering process (see Box VII.5-1) or NGOs choose the companies and the Development Cooperation Directorate of the Ministry of Foreign and European Affairs co-finances such projects (up to 66% or 75% depending on the supported country).

In the field of agriculture and through bilateral programmes as well as through NGO projects, Luxembourg supports farmer organisations that promote **endogenous capacities**, try to divulge these technologies and organise trainings and awareness raising seminars on this purpose (e.g., ASTM's[224] collaboration with ARFA[225] and *Jonggbaueren a Jongwënzer*[226] - field labour with donkeys).

Box VII.5-1: Integration of environment and climate change into LuxDev procurements

General Regulations of LuxDev's acquisition process

The award of contracts of goods, services and works financed (...) by the Government (...) of Luxembourg and for which LuxDev is the Awarding Authority translates the development policy of the Government, according to which the environment must imperatively be taken into account for any development that aims to be sustainable.

(...) LuxDev acting as Awarding Authority can require that particular conditions related to environmental protection and climate change are included in the tender dossiers.

These clauses will aim at promoting sustainable energies and clean technologies as well as the transfer of these technologies and the access to environmental information in the partner countries.

Consequently, the award of contracts might be refused if a given contract is likely to have a negative impact on the environment and the ecosystems of the partner country; this in order to contribute avoiding all interventions that could prove harmful to the environment.

With regard to Biennial Report's Tables 8 (Provision of technology development and transfer support), and 9 (Provision of capacity-building support), as Luxembourg's does not have an OECD marker for technology development, this information is difficult to disaggregate from the existing statistics. As regards capacity building, however, the information can be retrieved following the capacity building marker.[227]

[224] ASTM stands for *Action Solidarité Tiers-Monde* – http://astm.lu/.

[225] ARFA stands for *Association de Recherche et de Formation Agro-écologique* – http://astm.lu/projets-de-solidarite/afrique/association-de-recherche-et-de-formation-agro-ecologique-arfa/.

[226] http://jongbaueren.lu/.

[227] This information could therefore be delivered in the coming weeks.

VII.6. INFORMATION UNDER ARTICLE 10 OF THE KYOTO PROTOCOL

Information on activities, actions and programmes undertaken in fulfilment of the commitments under Article 10 of the Kyoto Protocol are given in various parts of the 6th National Communication. *Table VII.6-1* below provides an overview, where this information is located.

TABLE VII.6-1 - INFORMATION UNDER ARTICLE 10 OF THE KYOTO PROTOCOL – CORRESPONDENCE TABLE

Art. 10.a	National system for the development and continuous improvement of the national inventory	*Section III.2*
Art. 10.b	Domestic (and regional) programmes aimed at mitigating climate change	*Section IV.2*
	Domestic adaptation strategies and measures	*Section VI.3*
Art. 10.c	Activities related to transfer of technology transfer	*Section VII.5*
Art. 10.d	Research and systematic observation	*Chapter VIII*
Art. 10.e	Education, training and public awareness	*Chapter IX*

Other requested information is presented below.

VII.6.1. Elements of success of Luxembourg's bilateral adaptation and mitigation programmes

The following "success stories" are worth mentioning:

- in general, the capacity building of the projects YUG/012 (Strengthening Institutions for Sustainable Forest Management in Montenegro, 2007 – 2013) and BKF/017 (Improvement of Livestock and Sustainable Pastoral Resources Management, Azawak Zebu, 2010-2015) can be highlighted as being particularly successful components of these projects. In the same line of thoughts, the awareness raising that took place within the projects YUG/012, BKF/017 and its predecessor BKF/012 (both of them following Burkina Faso's concept of "*eco-citoyenneté*") needs to be rightly appreciated;
- as regards NIC/024 (Sustainable Eco Tourism in Nicaragua), the innovative approach that made Luxembourg stand out in this sector in Nicaragua can be considered to be a success;
- as regards YUG/012, on might consider its biggest success the establishing of a national forest inventory and information system and the improving of the forests' sink & CO_2 sequestration capacities;
- VIE/028 (Western Nghe An Rural Development Project in Vietnam) has made a considerable effort to integrate sustainability in the design of the new Tuong Duong Vocational Center Dormitory and Kitchen (insulated envelope should allow a comfort temperature without air-conditioning, solar water heating, vegetation, rainwater use, energy saving bulbs, …) as well

as to promote domestic biogas production from pig effluents and household waste. Additional 100 units are planned to be installed before the end of the project in 2014.

VII.6.2. Lessons learnt from these programmes

As a "failure story", Luxembourg has so far to register poor results on helping its partner countries identify, formulate, register or implement CDM projects. This component was for instance foreseen in YUG/012, but was eventually dropped, due also to a lack of commitment from the Montenegrin side. For BKF/017, it is still too early to predict whether a CDM/LULUCF component might eventually develop. On the 5th of January 2012, the UNFCCC has accepted the BKF/017 CDM project outline for prior consideration, under the title "Reforestation of denuded grass land in Sahel region of Burkina Faso".

ANNEX – LUXEMBOURG'S ODA PER SECTOR (2012)

Sectorial allocation of bilateral & multilateral ODA	Bilateral ODA	%	Multilateral ODA	%	Total by sector	%
Infrastructures and social services	**91 000 632.10 €**	**72.37%**	**14 053 994.90 €**	**15.47%**	**105 054 627.00 €**	**33.60%**
Education	**31 837 808.91 €**	**14.35%**	**2 450 000.00 €**	**2.70%**	**34 287 808.91 €**	**10.97%**
Education level non-specified	4 677 439.74 €	2.11%	1 700 000.00 €	1.87%	6 377 439.74 €	2.04%
Basic education	4 708 360.74 €	2.12%	750 000.00 €	0.83%	5 458 360.74 €	1.75%
Secondary education	21 828 464.37 €	9.84%	-	0.00%	21 828 464.37 €	6.98%
Post-secondary education	623 544.06 €	0.28%	-	0.00%	623 544.06 €	0.20%
Health	**27 770 282.51 €**	**12.52%**	**4 050 000.00 €**	**4.46%**	**31 820 282.51 €**	**10.18%**
General health	10 732 754.59 €	4.84%	1 250 000.00 €	1.38%	11 982 754.59 €	3.83%
Basic health	17 037 527.92 €	7.68%	2 800 000.00 €	3.08%	19 837 527.92 €	6.34%
Population / health and fertility policy	**3 008 099.37 €**	**1.36%**	**6 340 000.00 €**	**6.98%**	**9 348 099.37 €**	**2.99%**
Water distribution and sanitation	**11 756 285.91 €**	**5.30%**	**-**	**0.00%**	**11 756 285.91 €**	**3.76%**
Government and civil society	**9 898 020.06 €**	**4.46%**	**1 213 994.90 €**	**1.34%**	**11 112 014.96 €**	**3.55%**
General government and civil society	8 958 016.04 €	4.04%	831 436.96 €	0.91%	9 789 453.00 €	3.13%
Conflicts, peace and security	940 004.02 €	0.42%	382 557.94 €	0.42%	1 322 561.96 €	0.42%
Infrastructure and diverse social services	**6 730 135.34 €**	**3.03%**	**-**	**0.00%**	**6 730 135.34 €**	**2.15%**
Infrastructure and economic services	**18 502 619.53 €**	**8.34%**	**606 536.28 €**	**0.67%**	**19 109 155.81 €**	**6.11%**
Transport and warehousing	-	0.00%	-	0.00%	-	0.00%
Communication	186 237.98 €	0.08%	-	0.00%	186 237.98 €	0.06%
Energy production and distribution	4 973 931.18 €	2.24%	56 536.28 €	0.06%	5 030 467.46 €	1.61%
Banks and financial services	12 962 525.82 €	5.84%	550 000.00 €	0.61%	13 512 525.82 €	4.32%
Enterprises and other services	379 924.55 €	0.17%	-	0.00%	379 924.55 €	0.12%
Production	**13 066 250.19 €**	**5.89%**	**1 800 000.00 €**	**1.98%**	**14 866 250.19 €**	**4.75%**
Agriculture, forestry and fishing	11 635 234.40 €	5.25%	980 000.00 €	1.08%	12 615 234.40 €	4.03%
Manufacturing, mining, construction	192 089.15 €	0.09%	820 000.00 €	0.90%	1 012 089.15 €	0.32%
Commercial policy and regulation	-	0.00%	-	0.00%	-	0.00%
Tourism	1 238 926.64 €	0.56%	-	0.00%	1 238 926.64 €	0.40%
Multisectorial or transversal destination	**19 447 917.66 €**	**17%**	**2 928 795.25 €**	**3.22%**	**22 376 712.91 €**	**7.16%**
Environmental protection	1 255 647.48 €	0.57%	1 078 795.25 €	1.19%	2 334 442.73 €	0.75%
Other multi-sectors	18 192 270.18 €	8.20%	1 850 000.00 €	2.04%	20 042 270.18 €	6.41%
Multisectorial aid	11 178 636.20 €	5.04%	1 550 000.00 €	1.71%	12 728 636.20 €	4.07%
Urban development and management	48 000.00 €	0.02%	300 000.00 €	0.33%	348 000.00 €	0.11%
Rural development	6 313 769.20 €	2.85%	-	0.00%	6 313 769.20 €	2.02%
Non-agricultural alternative development	-	0.00%	-	0.00%	-	0.00%
Multisectorial education and training	645 129.77 €	0.29%	-	0.00%	645 129.77 €	0.21%
Scientific and research institutions	6 735.01 €	0.00%	-	0.00%	6 735.01 €	0.00%
Developmental food aid / food safety	**800 000.00 €**	**0.36%**	**-**	**0.00%**	**800 000.00 €**	**0.26%**
Humanitarian aid	**40 738 223.66 €**	**33.79%**	**650 000.00 €**	**0.72%**	**41 388 223.66 €**	**13.24%**
Emergency intervention	34 216 513.44 €	15.43%	400 000.00 €	0.44%	34 616 513.44 €	11.07%
Material assistance and emergency services	27 956 018.17 €	12.60%	-	0.00%	27 956 018.17 €	8.94%
Emergency food aid	1 710 700.88 €	0.77%	-	0.00%	1 710 700.88 €	0.55%
Relief coordination and support and protection services	4 549 794.39 €	2.05%	400 000.00 €	0.44%	4 949 794.39 €	1.58%
Reconstruction and restoration	4 319 661.67 €	1.95%	-	0.00%	4 319 661.67 €	1.38%
Disaster prevention and preparation for their occurrence	2 202 048.55 €	0.99%	250 000.00 €	0.28%	2 452 048.55 €	0.78%
Donors' administrative costs	**16 183 537.43 €**	**7.30%**	**-**	**0.00%**	**16 183 537.43 €**	**5.18%**
Awareness raising	**2 458 239.83 €**	**1.11%**	**-**	**0.00%**	**2 458 239.83 €**	**0.79%**
Aid to refugees in the donor country	**25 000.00 €**	**0.01%**	**-**	**0.00%**	**25 000.00 €**	**0.01%**
Unassigned / unspecified	**19 576 606.00 €**	**8.83%**	**70 831 860.58 €**	**77.95%**	**90 408 466.58 €**	**28.91%**
Total bilateral & multilateral aid broken down by sector	**221 799 026.40 €**	**100.00%**	**90 871 187.02 €**	**100.00%**	**312 670 213.41 €**	**100.00%**

Source: Ministry of Foreign and European Affairs, Development Cooperation Directorate (2013), p. 13-15.

Chapter VIII

Research and Systematic Observation

Chapter VIII describes actions undertaken in Luxembourg in the fields of research and systematic observation and tries to stick with UNFCCC reporting guidelines, paragraphs 57 to 64. It is, however, not yet possible for Luxembourg to provide relevant and complete information related to Articles 10d and 10f of the Kyoto Protocol.

VIII.1. General policy on research and systematic observation[228]

MeteoLux, the national weather service in Luxembourg, a department of the Aviation Administration (*Administration de la navigation aérienne* - ANA) of the Ministry of Sustainable Development and Infrastructure,[229] operates one meteorological synoptic station and one aeronautical meteorological station, both located at Luxembourg Airport. These stations are monitoring key climate and aviation weather parameters with a high-quality and their number will not change in the near future. The synoptic station is part of the WMO **Global Observing System** (GOS), and is reporting under WMO station identifier 06590 under the World Weather Watch (WWW) program. Further to this, the station is an integral part of the **Global Climate Observing System** (GCOS) and the GCOS Surface Network (GSN). MeteoLux is currently taking the responsibilities for the GCOS and, as such, is **the official contact point in Luxembourg**. The synoptic data, and especially Essential Climate Variables (ECV-data) like temperature and precipitation, are available in electronic form for data going back up to the 1st January 1947. CLIMAT-codes are distributed on a monthly basis via the WMO GTS. The quality of the codes for precipitation is monitored by the GSN Monitoring Centre at the *Deutscher Wetterdienst* (DWD) in Germany, which is the lead centre for GCOS data in WMO region VI, and air temperature at the JMA in Japan. This data is used to support climate monitoring applications and are also used in the analyses of the Intergovernmental Panel on Climate Change (IPCC). The final quality flagged data is **available at the GSN Monitoring Centre** (GSNMC) and is **forwarded**, on a monthly basis, **to the World Data Centre** (WDC) **A for Meteorology** in Asheville, NC, USA. This transfer is only realised once a quality control of the CLIMAT temperature and precipitation data has been completed. From December 2013 on, MeteoLux satisfies to the standards of the WMO WIS (WMO Information System) and EU INSPIRE Directive for metadata and data.

All meteorological services to be provided for international aviation are determined in accordance with the **standards of ICAO Annex 3**. The aeronautical station (ELLX) provides information at intervals required for operational planning, flight operations, the protection of aeronautical equipment on the ground, and for various other aeronautical uses. At the airport there is a statutory requirement for manual observations which are made by means of instruments and visual estimation. In addition to the standard meteorological instrumentation, automatic sensors for base of cloud height, runway visual range, visibility, present weather are in operation. To meet

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228 The text of this Section has been prepared by Freyermuth, A., Bareiss, J., Reckwerth, M. of MeteoLux.

229 http://www.meteolux.lu/ et http://www.ana.public.lu/fr/index.html.

the safety needs for aviation a second back-up station – with identical instrumentation as the one installed at the meteorological synoptic station – is located at the airport.

Luxembourg is a member of the **European National Meteorological Services Network** (EUMETNET). Meteorological data from the synoptic station are provided to the EUMETNET Composite Observing System (EUCOS) surface land station network, satisfying the main user requirements for general forecasting and NWP, and improving data quality within Europe.

Luxembourg contributes to space-based observations through membership of the **European Space Agency** ESA (2005) as well as to the **European meteorological satellite agency** for monitoring weather, climate and the environment EUMETSAT. The Meteorological Service at the airport has facilities for receiving real-time satellite data as well as historical satellite products of ECVs via the EUMETSAT Satellite Application Facility (SAF) on climate monitoring.

VIII.2. RESEARCH[230]

Concerning research, activities are led by the *Centre de Recherche Public-Gabriel Lippmann* (CRP-GL), for which some examples and findings have been presented in ***Section II.3*** and ***Section VI.1***. The CRP-GL centralizes data covering the complete Luxembourgish territory from its **own hydro-climatic monitoring network** ***[→ Section VI.1]*** as well as from **observation stations** operated and maintained by the Water Agency (*Administration de la gestion de l'eau* – AGE), the Civil Defence Service (*Administration des services de secours* from the Ministry of Home Affairs), the Agriculture Technical Services Administration (*Administration des Services Techniques de l'Agriculture* – ASTA), and MeteoLux. A complete list of observational sites, variables and measurement time-steps, can be found in the "*Atlas hydro-climatologique du Grand-Duché de Luxembourg*". All data are brought into a common format and subject to an evaluation procedure at the CRP-GL.

The validated data are freely available and published yearly via the "*Atlas hydro-climatologique du Grand-Duché de Luxembourg*". The resulting database serves as a basis for different research activities but also for operational measures, a.o. for the design of flood protection measures and river restoration projects.

VIII.3. SYSTEMATIC OBSERVATION[231]

MeteoLux is operating a meteorological station network at the Luxembourg Airport. Measurements and visual observations started in October 1946. The stations are manned and operate 24/7 throughout the year.

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[230] The text of this Section has been prepared by Pfister, L., Junk, J., Ferrone, A., Hoffmann, L of the *Centre de Recherche Public-Gabriel Lippmann*.

[231] The text of this Section has been prepared by Freyermuth, A., Bareiss, J., Reckwerth, M. of MeteoLux.

As per a law of 21 December 2007 on the ANA, missions of Luxembourg's Meteorological Service (MeteoLux) are defined as follows: *the core task is to provide meteorological assistance for safeguarding of aviation. Additional main tasks are the archiving and dissemination of climatological data as well as providing meteorological service and warnings of meteorological hazards for the general public and national authorities. This includes the provision of high temporal resolution hydro-meteorological/climatic data like precipitation, temperature etc.*

The **meteorological station is a synoptic station** (WMO 06590) under the WMO World Weather Watch (WWW) program ***[→ Section VIII.1]***. SYNOP-messages (FM-12) are issued on an hourly-basis via Belgium into the GTS. The key climate parameters reported in SYNOP messages are:

- the hourly air temperature;
- the 6-hourly amount of precipitation;
- the hourly 10-minute mean wind speed and direction;
- the maximum wind speed gust;
- the maximum 10-minute wind speed.

Further to this, **hydro-climatic data is disseminated** on a daily and monthly basis to national research institutes (e.g. CRP-GL) and other national administrative authorities. The meteorological station is also part of the GCOS-GSN and CLIMAT-reports are distributed on a monthly basis via the WMO GTS ***[→ Section VIII.1]***. For aviation matters key climate and aviation weather parameters are reported in the form of the METAR message (FM-15):

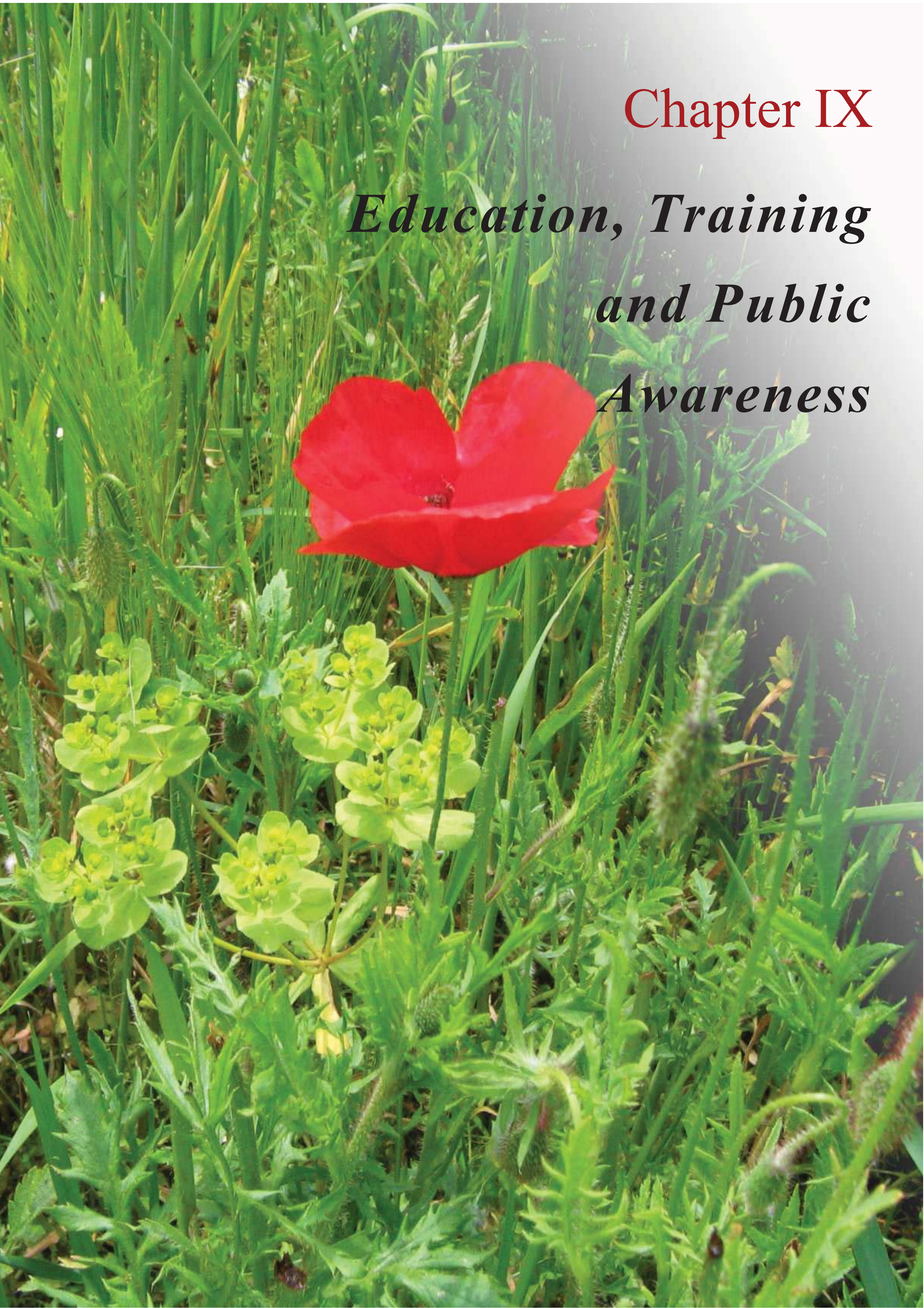
- the prevailing horizontal visibility;
- the 10-minute mean wind speed and direction;
- significant weather conditions;
- cloud coverage and base height;
- air temperature and dew point temperature;
- atmospheric pressure.

Observations of meteorological conditions (instruments and visual estimation) are used for landing and take-off, en-route navigation and flight performance, and as a basis for forecasting. Those observations used primarily for aircraft operations are called "OPMET information" while those used primarily for forecasting purposes are considered to be "basic meteorological data". Basic meteorological data include synoptic surface. MeteoLux is also responsible for aeronautical climatology and provides monthly statistics of low visibilities and ceiling.

In 2011 a new **Climate Data Management System** was implemented at MeteoLux, called CLISYS. CLISYS has been developed by *Météo-France International* in compliance with WMO and GCOS guidelines, and in the frame of a tight collaboration with *Météo-France*. The system benefits from regular upgrades and permits e.g. historical data import, quality controls, customized production of reports, summaries, and time series. It is planned to further improve the data quality control and to start a Data Rescue Program in 2013/2014 in order to digitize additional historical meteorological data that is available on an hourly basis since 1946.

Chapter IX

Education, Training and Public Awareness



Chapter IX describes actions undertaken in Luxembourg in the fields of education, training and public awareness in line with UNFCCC reporting guidelines, paragraphs 65 and 66. This chapter is divided in four sections: public information and awareness *[→ Section IX.1]*, education *[→ Section IX.2]*, training programmes *[→ Section IX.3]*, and involvement of the "civil society" *[→ Section IX.4]*.[232]

IX.1. PUBLIC INFORMATION AND AWARENESS

IX.1.1. Operations led by or involving the Department of the Environment

The Department of the Environment conducts regular awareness and information campaigns on environmental issues; with biodiversity, waste, climate change and energy savings being the most recurrent themes. Campaigns are more and more supported by the online media.

Different actions and/or campaigns are linked to the issue of climate change – they are presented thematically and chronologically below from 2010 onwards.[233]

In the context of the Luxembourg ecological fair "Oekofoire", organized annually by the NGOs *Mouvement Ecologique* and *Oekozenter Pafendall [→ Section IX.4]*,[234] the Department of the Environment launches every year an awareness campaign on the basis of a specific theme.

In particular, the fair stands in the years **2010** and **2011** were related to the climate change issue. During these two years, the Department of Environment presented the "***Partenariat pour l'Environnement et le Climat***" ("Environment and Climate Partnership") initiative *[→ Section IV.1.2]* with the aim of promoting civil society involvement in the climate change issue.

(http://www.environnement.public.lu/actualites/2010/09/Oekofoire/index.html)

(http://www.developpement-durable-infrastructures.public.lu/fr/actualites/communiques/2011/09/16_Oekofoire2011/index.html)

The two illustrations below are examples of information panes displayed at the fair.

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232 This Chapter has benefited from extensive contributions from Karin Riemer from the Department of the Environement.

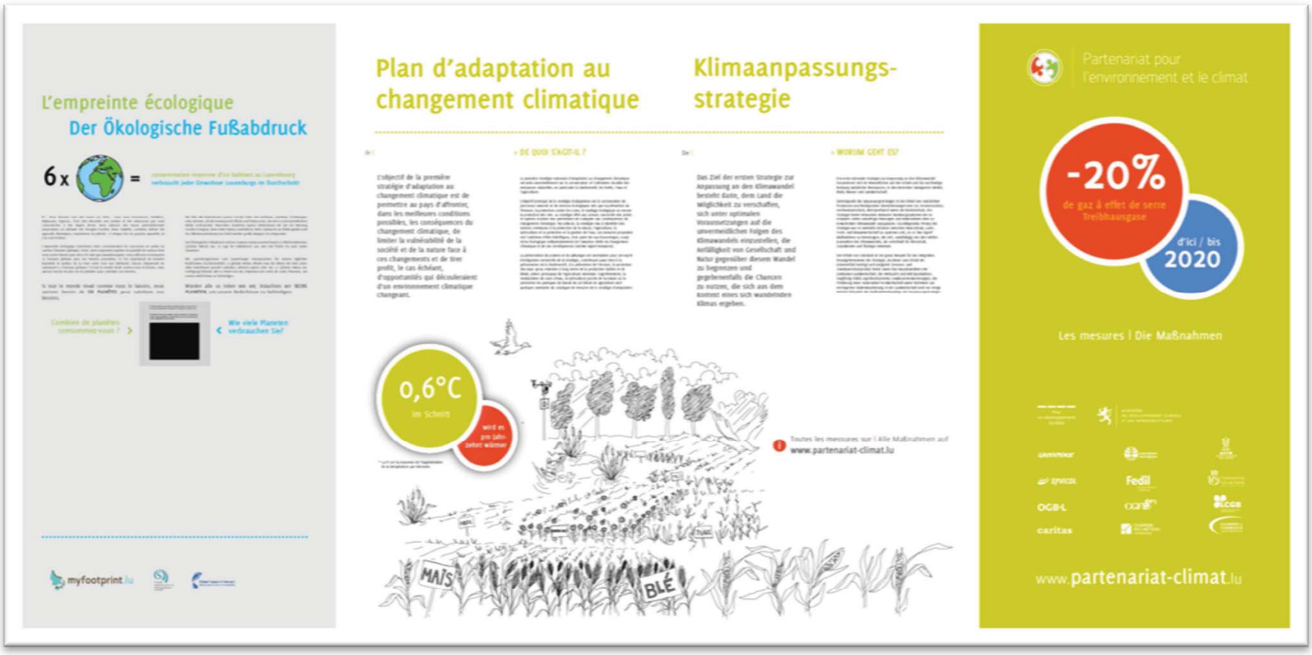
233 For older operations and campaigns, refer to Ministry of Sustainable Development and Infrastructure, Department of the Environment (2010), p. 244-247.

234 http://www.oekofoire.lu/.

2010


STADTENTWICKLUNG,
WOHNUNGSBAU & GEBÄUDE
CO_2
SETZEN SIE EIN ZEICHEN!
PARTENARIAT FÜR UMWELT- & KLIMASCHUTZ
LEISTEN SIE EINEN AKTIVEN BEITRAG ZUM KLIMASCHUTZ

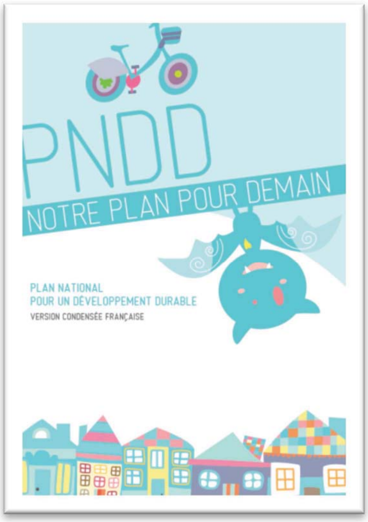
2011


L'empreinte écologique
Der Ökologische Fußabdruck
Plan d'adaptation au changement climatique
Klimaanpassungs-strategie
L'objectif de la première stratégie d'adaptation au changement climatique est de permettre au pays d'affronter, dans les meilleures conditions possibles, les conséquences du changement climatique, de limiter la vulnérabilité de la société et de la nature face à ces changements et de tirer profit, le cas échéant, d'opportunités qui découleraient d'un environnement climatique changeant.
Das Ziel der ersten Strategie zur Anpassung an den Klimawandel besteht darin, dem Land die Möglichkeit zu verschaffen, sich unter optimalen Voraussetzungen auf die unvermeidlichen Folgen des Klimawandels einzustellen, die Anfälligkeit von Gesellschaft und Natur gegenüber diesem Wandel zu begrenzen und gegebenenfalls die Chancen zu nutzen, die sich aus dem Kontext eines sich wandelnden Klimas ergeben.
0,6°C
MAÏS
BLÉ
Partenariat pour l'environnement et le climat
-20%
d'ici / bis
2020
Les mesures | Die Maßnahmen
www.partenariat-climat.lu

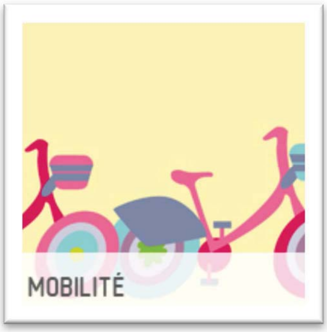
Adopted by the Government Council on 23 November 2010, the **Second National Plan for a Sustainable Development** (NSDP2) (see Box IV.1-3) has been presented to the public in **May 2011**. A printed brochure (available on request) and its web-based version were issued – the brochure is an abstract of the full NSDP2. The climate issue is presented alongside topics such as biological diversity, social cohesion, mobility and others.

(http://www.developpement-durable-infrastructures.public.lu/fr/developpement-durable-infrastructures/plan-national/index.html)

Brochure



Web visuals (examples)



In **October 2012** the Department of Environment, in cooperation with *Emweltberodung asbl* *[→ Section IX.4]*, produced a short video clip (1 min.) and a documentary (16 min.) in relation to **energy savings in every day life**. These videos were presented on the website of the Department of Environment, as well as on *vimeo* and *Facebook*.

(http://www.environnement.public.lu/actualites/2012/09/SchaltEm/index.html)

Video clips

Oekotopten.lu is a consumer-oriented online search tool set up and jointly developed by the Ministry of Sustainable Development and Infrastructure and the two NGOs *Mouvement Ecologique* and *Oekozenter Pafendall*. It presents "best products" for various categories. The key criteria for differentiating such products are energy efficiency, impact on the environment, health and quality. In January 2013, an updated presentation of the website was proposed, as well as its mobile version. Oekotopten.lu is co-funded by the *Intelligent Energy Europe* programme of the European Union.[235]

(http://www.oekotopten.lu/)

From **October to November 2013**, the Government, represented by the Department of Environment, the Ministry of Housing, the Ministry of the Economy and *myenergy*, launched a multimedia campaign (print ads, web banner, TV & cinema video clip, radio spots) to promote **energy efficiency and the use of renewable energy sources**. The focus was set on the advantages for households of energy modernisation (more comfort and fewer costs) and on the various subsidies and grants offered by the Government for the renovation of existing buildings aiming at energy efficiency gains. In order to recall print and online ads made in the last years, as well as the role of *myenergy* as the main counselling reference regarding energy efficiency and renewable energy sources, the "**PRIMe House**"[236] visual was re-used and put in a new and broader context.

235 http://ec.europa.eu/energy/intelligent/.

236 See Box IV.3-1 as well measures No 01, 06, 12 & 33 of the second "Action Plan for reducing CO_2 emissions – Table IV.3-1.

New visuals for "PRIMe House"

As explained in Box IV.1-8, ***myenergy*** was created to promote renewable energy projects and to inform citizens, the economic sector as well as municipalities on a better use of energy, renewable energy sources and financial public support. Therefore, *myenergy*, whose public partners are the Department of the Environment, the Ministry of the Economy and the Ministry of Housing, is the national focal point put in place to inform and raise awareness in all energy matters.[237] With its team of advisers, *myenergy* provides services in the following domains:

- how to reduce energy consumption in existing buildings and how to refurbish them consequently?
- how to ensure low energy and/or energy efficient new constructions?
- how to develop the use of renewable energy sources?
- how to save energy in every day life?
- what are the financial incentives offered by the Government?
- what is the regulation with regard to the energy balance of housing?

Thus, *myenergy* may be defined as the **national energy advice structure**, supported by the Luxembourg Government. As such, the web site of *myenergy* also acts as an information gateway to all these issues.

(http://www.myenergy.lu)

[237] Numerous actions and measures of the second national "Action Plan for reducing CO_2 emissions" refer directly or indirectly – via the "PRIMe House" scheme for instance – to *myenergy* activities: measures 01, 06, 12, 17, 33, 35, 41, 42 & 43 in Table IV.3-1.

Since its started operating back in 2008, *myenergy* has developed one of its main activities, which is free energy advices offered to households or businesses by telephone or by appointment. In order to improve this service, *myenergy*, in cooperation with either municipalities or municipality associations, has started developing regional advice centres: ***myenergy infopoints***.[238] Nowadays, 75 municipalities share energy advices with the support of *myenergy* in 31 offices disseminated throughout the country. Approximately 80% of the population has an access to *infopoints*, the other 20% having always the possibility to go to the main premise of *myenergy* in Luxembourg-City. (www.myenergyinfopoint.lu)

In addition to advices, *myenergy* has developed numerous **informative tools** for different target groups:

- thematic leaflets for households and businesses (http://particuliers.myenergy.lu/fr/t%C3%A9l%C3%A9chargement/d%C3%A9pliants%20th%C3%A9matiques);
- a website for private consumers, municipalities, companies and experts providing complete and targeted information (http://www.myenergy.lu);
- an exhibition stand with general technical information and theme exhibitions on passive houses and energy renovation intended for municipalities;
- specific material addressing the children;
- an electricity measurement device that may be borrowed for free in the *myenergy infopoints*;
- *myenergy home*: an online simulator for the energy performance of buildings, with the cooperation of the Portuguese Energy Agency (www.myenergyhome.lu).

Finally, *myenergy* is behind the **launch of numerous actions and events**:

- *Passive House Week*: since 2010, with an exhibition on passive housing, conferences aiming at a private and professional public, guided tours of passive houses in Luxembourg;
- *myenergy days*: annual event, first edition of this national fair specialized on energy renovation in May 2011 with the aim of creating a new and until then non-existing exchange platform for professionals and private persons to increase the energy efficiency of the national housing sector; the number of exhibitors (from 45 in 2011 to 100 in 2013) and visitors is steadily growing (www.myenergydays.lu);[239]
- general and theme cross-media advertising campaigns, the campaigns being either general image promotion campaigns for *myenergy* itself or the *myenergy infopoints* network, or focusing on specific themes like energy modernisation or public subsidies ("PRIMe House", etc.);

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238 See also measure No 43 of the second "Action Plan for reducing CO_2 emissions – Table IV.3-1.

239 Ibid.

- editorial contribution to the national and regional press on a regular basis, either to present or promote projects and events, but also to deliver technical and practical information on energy efficiency, renewable energy sources and public subsidies;
- thematic conferences on the same topics as those covered by the thematic leaflets presented above. These presentation packages are held by *myenergy* advisors and are meant for private persons. Companies, municipalities and other associations nevertheless may book them too;
- awareness raising amongst children, *myenergy* having participated in 2010, 2011 and 2013 in the organization of an awareness raising action ("*Galileo Science Bus*") with the "*Musée national d'histoire naturelle*". This action took place in the "*Energiepark Remerschen*" and offered a daily program of activities and presentations for school classes. In 2012, *myenergy* also developed a package of presentations and demonstrations for children that can be booked by school classes and other associations.

IX.1.2. Other operations[240]

Some initiatives aiming at a more environmental friendly behaviour can also be connected to the climate change thematic.

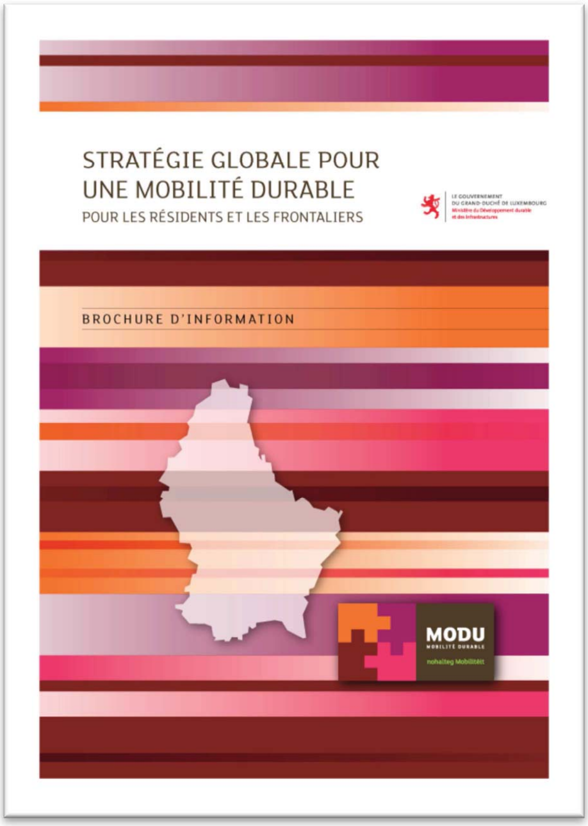
The Ministry of Sustainable Development and Infrastructure, with the cooperation of the Transport Community (CdT – "*Verkéiersverbond*"), a public institution under the Ministry, regularly participates in the **European Week of Mobility**.

(http://www.developpement-durable-infrastructures.public.lu/fr/actualites/communiques/2010/09/16_Semaine_mobilite/index.html)

240 For operations and campaigns prior to 2010, refer to Ministry of Sustainable Development and Infrastructure, Department of the Environment (2010), p. 247-249.

In **June 2010**, the Department of the Environment presented the **Ecological Footprint of Luxembourg**. This tool is intended to raise awareness and to promote modification of non ecological attitudes. A Technical Report of the Ecological Footprint of Luxembourg was made by the Research Centre for Environmental Technologies (CRTE) and the Public Research Center Henri Tudor.
(http://www.myfootprint.lu/)

In **June 2012**, the Department of Transport of the Ministry of Sustainable Development and Infrastructure initiated "**MoDu**", Luxembourg's global strategy for a sustainable mobility.[241] "MoDu" is an integrative approach favouring public transport, in particular cycling and walking ("*mobilité douce*"), and defining the infrastructure priorities of Luxembourg for the next years. The "MoDu" concept was presented at the Springtime Fair 2012. A brochure in German and French was sent to all Luxembourg's secondary schools.
(http://www.dat.public.lu/actualites/2012/04/1904_MODU/index.html)



[241] See Box IV.1-5 as well measures No 21 to 27 of the second "Action Plan for reducing CO_2 emissions – Table IV.3-1.

IX.2. EDUCATION[242]

A range of actions and initiatives exist in Luxembourg to make children and students conscious of various environmental issues as well as familiar to the concept of sustainable development. Examples of such activities can be read in a distinct section of the environmental web portal.
(http://www.environnement.public.lu/kanner/theme_du_mois/index.html)

With regard to climate change in particular, the following actions of **Climate Alliance Luxembourg** – *Klima-Bündnis Lëtzebuerg* [243] – a network regrouping almost half of the municipalities in Luxembourg, may be noteworthy to mention:

- in the years **2010-2013**, many children from primary school have visited the interactive exhibition "*Klima, Kanu, Quetschekraut*". It has given over 5000 kids an insight of how our climate system works and what the impacts of climate change are, especially with regard to the rain forest regions (http://www.klimabuendnis.lu/de/document/Klima-kanu-quetschekraut-1891-0-70--.html);
- through the promotion of the German project "*Geoscopia Klimaexpedition*", Luxembourg schoolchildren aged 11-12 years old could discover live satellite pictures of different parts of the world like the pole caps or tropical forests and compare them to historical pictures of the same areas (http://germanwatch.org/klima/ke.htm);
- the "*Op Kannerféiss duerch d'Welt*" operation led in **2011 and 2013**, invited children and their parents to let the family car in the garage and to walk, bike or take the bus to go to school during at least one week. For each trip not taken by car, the kids would collect "green miles" that were handed over to the Minister for the Environment prior to the COPs in Durban and Warsaw
(http://www.klimabuendnis.lu/de/news/Op-Kannerfiss-duerch-dWelt-2013---Grne-Meilen-wurden-an-Minister-M--Schank-berreicht-1968-0.html).

"***Action Solidarité Tiers Monde***" (ASTM)[244] – in its role as responsible NGO for imparting knowledge on "North-South" issues – and **Climate Alliance Luxembourg** both support – amongst others – grass-roots organisations in the Global South, whose local projects are closely linked to climate impacts so to make the public aware of the fact that climate change is a global concern. In this context, ASTM constantly develops educational material such as exhibitions, booklets or workshop concepts. One example, linked to waste management in India, is the work of the partner organisation CHINTAN. The municipality members of Climate Alliance Luxembourg use such educational material to regularly organize awareness raising projects.
(www.chintan-india.org & http://astm.lu/wp-content/uploads/2011/01/Brochure-Chintan-aou%CC%82t-2012.pdf)

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242 For initiatives prior to 2010, refer to Ministry of Sustainable Development and Infrastructure, Department of the Environment (2010), p. 253.

243 See BoxIV.1-6: http://www.klimabuendnis.lu.

244 http://astm.lu/.

Besides, awareness raising initiatives, especially among children and students, aim at giving ideas on how to (re)act or at presenting possible alternatives that can be taken. Motivating this target group to take action in climate protection is the central objective.

In this context Climate Alliance launched the project "***GO(al) for fair development!***" intended for football youth clubs as it focused on the first international football tournament which was held in South Africa in 2010. Youngsters from eight different youth clubs in Luxembourg were asked to choose one of the 32 world cup teams/countries they would represent in their own tournament at the end of the three-month project. But first they had to develop specific presentations on these respective countries. The presentations had to deal with racism, culture, climate change, migration, among others, all these themes being linked to the issue "development". For most of them this was the first active confrontation with this thematic.
(http://astm.lu/goal-for-fair-development/)

IX.3. TRAINING PROGRAMMES

Training programmes in Luxembourg in connection with the climate change problematic are **mostly vocational training initiatives in the field of energy efficiency in buildings**. Several bodies, mainly professional associations or Orders, organizes such trainings. For example:

- the OAI with its "Energy & Construction "cycle;[245]
- the *Energie fir d'Zufunft* label of the *Chambre des Métiers* (chamber of trades) that requires vocational trainings for enterprises;[246]
- the "build-up skills Luxembourg" programme that is initiated in the context of the EU project "Build up skills, energy training for builders" and that is coordinated in Luxembourg by *myenergy*.[247]

In 2011, **Climate Alliance** together with the **National Institute of Public Administration** (INAP) conducted a **training programme for municipality staff on sustainable procurement** ("*Formation pour agents communaux sur l´approvisionnement durable*"). Since then, the training programme has been offered once a year and gives information about the principles of sustainable procurement but also recommendations on the implementation within the municipality structures.
(http://cercle.lu/agenda/formation-pour-agents-communaux-approvisionnement-durable/)

245 http://www.oai.lu/fr/162/oai/accueil/formations-continues/oai/.
246 http://www.cdm.lu/news/2012/09/das-neue-weiterbildungsprogramm-energie-fir-d-zukunft-.
247 See measure No 41 of the second "Action Plan for reducing CO_2 emissions – Table IV.3-1 – and http://luxbuild2020.myenergy.lu/.

An important online tool set up by **Climate Alliance Luxembourg** in **2011** is the so called **ECORegion** which allows the member municipalities to establish their CO_2-Balance, thus giving them better understanding of how much energy is spent where and by whom.[248]
(http://www.klimabuendnis.lu/fr/Bilans-co2-57.html)

In **2012**, **Climate Alliance Luxembourg** launched **training programmes related to the climate change issue** (e.g. to guide visitors round an exhibition). To optimise the access to its target groups in Climate Alliance, ASTM developed and conducted trainings for community staff and volunteers (committees), i.e. members of the target groups within the municipalities themselves. These participants afterwards not only organise activities for their own municipalities but they also strengthen the networking between the members of Climate Alliance by operating in other municipalities.

The initiative "***Klima-Bündnis Betriebe***", launched in **2013** by **Climate Alliance Luxembourg** aims to help small and medium sized businesses in energy efficiency and mobility issues.

Finally, Climate Alliance Luxembourg organized many other conferences and workshops on issues like local energy concepts, energy cooperatives, mobility concepts, etc.

IX.4. "CIVIL SOCIETY" INVOLVEMENT

As emphasized in ***Section IV.1.2***, "civil society" – i.e. stakeholders such as NGOs, professional associations, etc. – have been involved in the setting up of the second national "Action Plan for reducing CO_2 emissions" [Ministry of Sustainable Development and Infrastructure, Department of the Environment (2013b)] via the "***Partenariat pour l'Environnement et le Climat***" ("Environment and Climate Partnership") for which participation of the "civil society" was the prime aspect ***[→ Sections IV.1.2 & IX.1.1]***. That was also the case in 2007, when the first Action Plan has been evaluated ***[→ Section IV.1.2]***.[249]

Among the Luxembourg NGOs acting in favour of the climate change protection, **Climate Alliance Luxembourg** and **ASTM** may be mentioned in the first place. The other important NGOs are the ***Mouvement Ecologique***,[250] the main Luxembourg nonprofit organization for the protection of the environment, and ***Oekozenter Pafendall***,[251] which acts more specifically for a sustainable development. Both NGOs have already been mentioned in ***Section IX.1.1***. Finally, **EBL**

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248 See also Box IV.1-6.

249 A one day forum was organized (*Klimaschutz schaaft Chancen*) opened to contributions from various stakeholders: http://www.environnement.public.lu/actualites/2007/04/index.html.

250 http://www.meco.lu/.

251 http://mouvement.oeko.lu/oekozenter.

("*Emweltberodung Lëtzebuerg*")[252] is an advisory structure on all ecological issues mainly, but not exclusively, for municipalities.

Among the specific climate change campaigns initiated by Luxembourg NGOs, several are worth some explanations.

"**Energy-light**", was the name of a campaign led during the years **2010–2012** under the aegis of **EBL** to reduce energy spending of the municipal administrations through information and motivation of the employees.
(http://www.ebl.lu/site/Projekte/Energie-light)

With the campaign "**Culinary Climate Protection**" (**2009**), led by **Climate Alliance Luxembourg**, the links between nutrition and climate issues were highlighted to a large public inside the municipalities. Guidelines were established for the purchase of food and beverages and workshops were organized for cooks and managers of restaurants.
(http://www.klimabuendnis.lu/de/document/Klimaschutz-geht-durch-den-magen-1160-30-54--.html)

252 http://www.ebl.lu/.

"**EnergyBridges**" – **a campaign for energy justice** (**2008-2010**) is a EuropeAid co-financed project that has built public awareness for the energy inequality between North and South. Since 2008, the partners in the Climate Alliance – European cities and municipalities and Indigenous Peoples in the Amazon rainforests – have been lobbying for a fair use of energy through public education campaigns, lobbying and concrete project support. They focused on the following goals:

- contributing to widen access to eco-friendly and renewable energies to reduce poverty;
- contributing to the sustainable use of the natural resources in the Amazon region;
- working towards achieving the Millennium Development Goals (MDGs);
- helping to initiate responsible energy production and use in industrialized countries.

Project partners of "EnergyBridges" were the Climate Alliance European Secretariat (lead), **ASTM**, **Climate Alliance Luxembourg**, Protect the Future Hungary, the Czech Environmental Partnership Foundation and, as southern partners, *Frente de Defensa de la Amazonía* (Ecuador), *Programa de Formación de Maestros Bilingües de la Amazonía Peruana and Centro de documentacion e informacion* (Bolivia).

(http://www.energybridges.eu/)

"**Local Authorities acting for the MDGs: Europe for more development**" (**2013-2015**) is an EU project which intends to contribute to the achievement of the Millennium Development Goals (MDGs). It will help to better integrate development issues into the work of local authorities. Together with the cities of Munich (Germany), Nuremberg (Germany), Tirgu Mures (Romania), Ostopovice (Czech Republic), Nagykanizsa (Hungary) and the long-term partners **ASTM** and **Climate Alliance Luxembourg**; Climate Alliance Austria, Reflex Hungary and other partner organizations from Romania and the Czech Republic Climate Alliance (European Secretariat) will develop a wide range of materials and activities both for decision makers and citizens.

(http://action-for-mdgs.eu/)

"**From Overconsumption to Solidarity**" (**2013-2015**) is another project financed by EuropeAid. Three exhibitions are central to the project, "People in a changing climate" being the most important. In this exhibition, people from around the world will report on their current and future challenges and appeal to the responsibility of each individual. In addition to the show, the member municipalities will be offered a package of activities, such as trainings for decision makers and administration, seminars, films, art actions, theatre, etc. **ASTM is the lead organization** and the European project partners are Climate Alliance (European Secretariat), Climate Alliance Austria, Védegylet Egyesület (Hungary), Nadace Partnerstvi (Czech Republic), Priatelia Zeme-CEPA (Slovakia) and CROSSING BORDERS (Denmark).

(http://www.overconsumption.eu/)

Another example for aware raising activities around climate change issues took place in **March 2012** at the "*Festival des migrations*" where **ASTM** arranged a viewing of Yann-Arthus Bertrand´s film "**7 billion others**", followed by a discussion with the attendees.

(http://astm.lu/29e-edition-du-festival-des-migrations/)

On their side, the ***Mouvement Ecologique*** and ***Oekozenter Pafendall*** are responsible for the following campaigns:

- "***Energiewochen – Semaine de l'Energie***" – energy weeks are organized every year during three weeks to show house owners concrete examples of energy efficient construction and/or renovation. Environmental friendly materials are also a topic of these energy weeks. During the visits, participants may ask questions to architects, engineers and owners and can exchange experiences.

  (http://www.meco.lu/mouvement-ecologique_Aktionen.313-2.html)

- "***Gréng Hausnummer***" – the green number for green buildings – is a distinction awarded by the two NGOs in collaboration with the Ministry of Housing. In this way house owners ensuring a reduction of their CO_2 emissions by the choice of the right materials and the respect of energy criteria are publicly rewarded.

  (http://mouvement.oeko.lu/hausnummer_oekozenter.301-2.html)

- "**Green meetings – green festivities**" – a project from *Oekozenter Pafendall* with partners with a mainly cultural background, intends to reduce CO_2 emissions during festivities and meetings. (http://mouvement.oeko.lu/index.php?idnavigation=413&fidlanguage=3&lang=de&idusergroup2&doc_titre=greenevents&doc_content=&cbdate=&demois=12&deannee=2013&amois=12&aannee=2013&iddoccateg=&search_fiauteur=&doc_ishome=&iddossier=&start=0&limit_search=5&showdetails=true&iddoc=1931)

Oekozenter Pafendall advises hotels, camping grounds, youth hostels in how to respect ecological criteria, with a strong focus on energy saving. The project "**Ecolabel**" is organized together with the Ministry of Sustainable Development and Infrastructure and the (former) Ministry of Tourism. (http://mouvement.oeko.lu/ecolabel_oekozenter.286-2.html)

Oekozenter Pafendall together with the organization of young farmers "***Jongbaueren a Jongwenzer***" also gives recommendations to farmers and carries through pilot projects like growing soya beans in Luxembourg instead of importing them from far away. The aim is to give new opportunities to farmers and to reduce the ecological and climate impact of food imports to Luxembourg.
(http://mouvement.oeko.lu/oekozenter_Unsere-arbeit.165-3.html)

For the local elections in **2011** and the national elections in **2013**, ***Mouvement Ecologique*** developed concrete suggestions concerning climate and energy policies and transmitted them to a broad public and political parties, published articles in newspapers and organized round tables. In preparation of the local elections, a seminar was held to help new candidates to get a certain basic knowledge in key themes like energy and mobility.
(http://www.oeko.lu/mouvement-ecologique_Document.2429-52-3.html)
(http://www.oeko.lu/mouvement-ecologique_Document.1757-67-3.html)
(http://www.meco.lu/mouvement-ecologique_Einstiegsveranstaltungen-2010-2011.369-3.html)

ASTM, besides its cooperation with Climate Alliance Luxembourg, conducts every two years information campaigns on its own that are closely linked to the issue of climate change. Since 2010, the following campaigns have been undertaken:

- **November 2011**: "***Leurs minerais, notre richesse***" was a campaign about the excessive exploitation of natural resources in development countries for consumer electronics, harming at the same time indigenous people, the environment and the climate, and thus evoking a public discussion on consumerism, climate change and climate justice. A web page, bulk mailings, artist's workshops[253], leaflets, school workshops, a photo exhibition[254] and public

253 http://www.mywort.lu/grund/classifieds-housing-rental/13779316.html?referrer=ic_municipality_centre.
254 http://www.mywort.lu/gare/classifieds-housing-rental/13106314.html?referrer=ic_municipality_grund.

conferences[255] formed part of the campaign. All national newspapers, television and radio reported in full. The video clip produced for this campaign is still available online.[256]

- **November 2013**: "*La grande braderie des terres*" was a campaign which tried to make the public aware of the impacts of transnational land deals for agriculture in the Global South. A significant number of multinationals – as well as financial institutions across Europe appear to be involved in financing land grabs and food speculation directly or indirectly. This purchasing or leasing land, and securing water rights for agricultural production has devastating impacts on the local population in the respective countries (human rights/working conditions/food sovereignty) as well as on the environment and the climate (e.g. monocultures for energy plants). A detailed program of the campaign activities, a web documentary on three case studies as well as background information and scientific studies can be found on the web page.[257]

As part of a consortium of Luxembourg-based NGOs named "*Cerealkiller*" ASTM campaigns for sustainable societies and for the protection of climate and environment in the context of the industrial production of agrofuels.
(http://cerealkiller.lu/)

Finally, municipalities as well as professional associations such as the FEDIL – the Business Federation of Luxembourg – also regularly organize seminars and information sessions that touch upon climate change, renewable energy sources, energy efficiency, mobility, etc.

IX.5. EFFORTS AND ACTIONS FOR SUPPORTING DEVELOPING COUNTRIES

Four NGOs under a framework agreement have a cross-cutting "sustainable development" thematic which is of course more broad than the one on climate change, but which is difficult to differentiate in these projects.

255 http://dev.rotondes.lu/agenda/details/event/leurs-minerais-notre-richesse/.
256 http://www.youtube.com/watch?v=u42CFp4Egn8.
257 http://www.solidarite.lu/.

TABLE IX.5-1 – OVERVIEW OF THE NGOS ACTIVITIES RELATING TO AWARENESS RAISING, FORMATION AND EDUCATION IN DEVELOPING COUNTRIES

NGO	Framework Agreement	Objective of the Framework Agreement	Indicative envelope 2013	Particular remarks
Frères des hommes	Framework Agreement	Contribute to a change of mentality to face sustainable development challenges in the North and the South.	64,000.00 €	
SOS Faim	Framework Agreement	One of the objectives of this Agreement is to promote a sustainable rural development relying on a priority support for family agriculture.	137,347.92 €	The responsible rural development theme is cross-cutting to the Framework Agreement (in this case, the envelope is for the whole Framework Agreement).
Caritas	Framework Agreement	The objective of the Framework Agreement "*Plaidons responsable*" is the promotion of the participation of the Luxemburgish population in the elaboration of a post-2015 agenda for a socially fair and ecologically responsible future.	192,156.14 €	
ASTM	Framework Agreement	ASTM contributed to a global sustainable development by promoting the economic, social and cultural rights and their realization in the South.	2,351,526.54 €	ASTM is one partner of "Klimabündnisgemeng" (Climate Alliance): envelope for actions related to climate change.
		Total	**2,745,030.60 €**	

Source: Ministry of Foreign and European Affairs, Directorate for Development Cooperation.

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Commission Decision of 13 July 2007 concerning the amendment to the national allocation plan for the allocation of greenhouse gas emission allowances notified by Luxembourg in accordance with Article 3(3) of Commission Decision C/2006/5614 final of 29 November 2006 concerning the national allocation plan for the allocation of greenhouse gas emission allowances notified by Luxembourg in accordance with Directive 2003/87/EC of the European Parliament and of the Council.

Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

Regulation No 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC.

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Annex A.I – Summary tables on emission trends

Excerpts from Luxembourg's 2013v1.2 GHG inventory submission to the UNFCCC secretariat [Ministry of Sustainable Development and Infrastructure, Environment Agency (2013a)]. The complete inventory is available on:

http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/zip/lux-2013-crf-15apr.zip.

See Also tables III.1-2, III.1-3 & III.1-4 and the associated figures for details *[→ Section III.1]*.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2011
Submission 2013 v1.2
LUXEMBOURG

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 (1)	CH_4	N_2O	HFCs (2)	PFCs (2)	SF_6 (2)	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) (1)	**10 828.84**	**437.00**	**462.95**	**67.00**	**0.18**	**7.75**	**11 803.72**
1. Energy	**10 518.21**	**56.37**	**114.09**				**10 688.67**
A. Fuel Combustion (Sectoral Approach)	10 518.15	17.14	114.09				10 649.38
1. Energy Industries	990.79	1.37	2.53				994.69
2. Manufacturing Industries and Construction	1 270.55	1.96	20.65				1 293.16
3. Transport	6 760.34	6.64	81.99				6 848.96
4. Other Sectors	1 496.47	7.17	8.93				1 512.58
5. Other	NO	NO	NO				NO
B. Fugitive Emissions from Fuels	0.06	39.23	NA,NO				39.29
1. Solid Fuels	NO	NO	NO				NO
2. Oil and Natural Gas	0.06	39.23	NA,NO				39.29
2. Industrial Processes	**596.56**	**NA,NO**	**NA,NO**	**67.00**	**0.18**	**7.75**	**671.49**
A. Mineral Products	472.70	NO	NO				472.70
B. Chemical Industry	NO	NO	NO	NA	NA	NA	NA,NO
C. Metal Production	123.86	NA,NO	NA	NA	NA,NO	NA,NO	123.86
D. Other Production	NO						NO
E. Production of Halocarbons and SF_6				NA,NO	NA,NO	NA,NO	NA,NO
F. Consumption of Halocarbons and SF_6 (2)				67.00	0.18	7.75	74.93
G. Other	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	**10.81**		**4.97**				**15.77**
4. Agriculture		**340.64**	**323.01**				**663.65**
A. Enteric Fermentation		244.30					244.30
B. Manure Management		96.34	25.09				121.43
C. Rice Cultivation		NA,NO					NA,NO
D. Agricultural Soils (3)		NA,NE	297.92				297.92
E. Prescribed Burning of Savannas		NA	NA				NA
F. Field Burning of Agricultural Residues		NO	NO				NO
G. Other		NA	NA				NA
5. Land Use, Land-Use Change and Forestry (1)	**-296.74**	**NE,NO**	**2.54**				**-294.20**
A. Forest Land	-469.19	NO	NO				-469.19
B. Cropland	24.02	NO	2.54				26.56
C. Grassland	31.19	NO	NO				31.19
D. Wetlands	9.62	NO	NO				9.62
E. Settlements	107.21	NE	NE				107.21
F. Other Land	0.41	NO	NO				0.41
G. Other	NE	NE	NE				NE
6. Waste	**IE,NA,NO**	**39.99**	**18.34**				**58.33**
A. Solid Waste Disposal on Land	NA,NO	29.50					29.50
B. Waste-water Handling		3.04	10.58				13.61
C. Waste Incineration	IE	IE	IE				IE
D. Other	NO	7.45	7.76				15.21
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

Memo Items: (4)							
International Bunkers	1 219.01	0.18	10.57				1 229.76
Aviation	1 218.88	0.18	10.57				1 229.63
Marine	0.13	0.00	0.00				0.13
Multilateral Operations	**NO**	**NO**	**NO**				**NO**
CO_2 Emissions from Biomass	**443.39**						**443.39**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	12 097.92
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	11 803.72

TABLE 10 EMISSION TRENDS
CO_2
(Part 1 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	**10 327.26**	**10 927.36**	**10 768.39**	**10 913.01**	**10 192.31**	**8 213.42**	**8 317.96**	**7 728.97**	**7 000.37**	**7 367.10**
A. Fuel Combustion (Sectoral Approach)	10 327.23	10 927.34	10 768.36	10 912.99	10 192.28	8 213.38	8 317.92	7 728.93	7 000.33	7 367.06
1. Energy Industries	33.29	34.01	34.73	33.04	32.32	91.07	79.62	80.46	144.48	159.47
2. Manufacturing Industries and Construction	6 285.43	6 121.42	5 795.50	5 921.31	5 201.13	3 343.75	3 201.46	2 450.11	1 412.48	1 523.45
3. Transport	2 672.53	3 170.77	3 460.24	3 501.54	3 560.39	3 379.01	3 477.92	3 678.89	3 842.35	4 135.64
4. Other Sectors	1 309.70	1 574.84	1 451.59	1 433.96	1 376.88	1 389.12	1 540.82	1 497.06	1 567.67	1 505.30
5. Other	26.28	26.29	26.30	23.14	21.57	10.43	18.10	22.42	33.34	43.21
B. Fugitive Emissions from Fuels	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04
2. Industrial Processes	**1 608.36**	**1 530.51**	**1 460.44**	**1 438.23**	**1 346.19**	**984.50**	**928.72**	**820.07**	**660.99**	**699.04**
A. Mineral Products	623.45	592.76	607.15	515.03	575.35	519.11	512.12	525.97	520.30	551.34
B. Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal Production	984.91	937.74	853.29	923.19	770.83	465.38	416.60	294.10	140.69	147.70
D. Other Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Production of Halocarbons and SF_6										
F. Consumption of Halocarbons and SF_6										
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	14.64	14.06	13.32	12.62	11.66	12.16	12.18	12.11	11.33	11.11
4. Agriculture										
A. Enteric Fermentation										
B. Manure Management										
C. Rice Cultivation										
D. Agricultural Soils										
E. Prescribed Burning of Savannas										
F. Field Burning of Agricultural Residues										
G. Other										
5. Land Use, Land-Use Change and Forestry[(2)]	**344.90**	**169.58**	**-198.60**	**-308.68**	**-138.81**	**-240.95**	**-413.49**	**-453.93**	**-198.35**	**-321.66**
A. Forest Land	126.20	-49.24	-417.54	-527.74	-358.29	-460.19	-632.59	-673.51	-418.49	-540.90
B. Cropland	34.47	34.59	34.71	34.83	35.26	35.01	34.87	35.35	35.91	35.01
C. Grassland	31.64	31.64	31.64	31.64	31.64	31.64	31.64	31.64	31.64	31.64
D. Wetlands	12.27	12.27	12.27	12.27	12.27	12.27	12.27	12.27	12.27	12.27
E. Settlements	138.93	138.93	138.93	138.93	138.93	138.93	138.93	138.93	138.93	138.93
F. Other Land	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**
A. Solid Waste Disposal on Land	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
B. Waste-water Handling										
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total CO_2 emissions including net CO_2 from LULUCF	**12 295.16**	**12 641.51**	**12 043.55**	**12 055.18**	**11 411.36**	**8 969.12**	**8 845.37**	**8 107.21**	**7 474.34**	**7 755.59**
Total CO_2 emissions excluding net CO_2 from LULUCF	**11 950.26**	**12 471.93**	**12 242.15**	**12 363.86**	**11 550.17**	**9 210.07**	**9 258.86**	**8 561.14**	**7 672.68**	**8 077.25**
Memo Items:										
International Bunkers	**394.47**	**412.31**	**398.61**	**394.26**	**500.14**	**566.92**	**615.99**	**736.93**	**893.35**	**1 007.92**
Aviation	394.41	412.24	398.54	394.16	500.06	566.83	615.91	736.85	893.27	1 007.83
Marine	0.07	0.07	0.07	0.09	0.08	0.08	0.08	0.08	0.08	0.09
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass	159.05	160.93	163.73	159.33	157.46	153.78	135.56	146.84	139.67	148.82

TABLE 10 EMISSION TRENDS
CO_2
(Part 2 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	**8 044.96**	**8 618.22**	**9 362.76**	**9 826.51**	**11 155.43**	**11 437.08**	**11 246.69**	**10 669.85**	**10 561.18**	**10 124.52**
A. Fuel Combustion (Sectoral Approach)	8 044.92	8 618.18	9 362.70	9 826.45	11 155.36	11 437.01	11 246.62	10 669.79	10 561.12	10 124.46
1. Energy Industries	117.30	280.45	1 026.00	1 033.84	1 259.19	1 239.90	1 303.67	1 179.86	995.47	1 190.99
2. Manufacturing Industries and Construction	1 438.07	1 573.45	1 494.99	1 413.82	1 584.47	1 557.81	1 627.49	1 516.69	1 403.63	1 338.73
3. Transport	4 778.73	4 997.46	5 144.68	5 579.80	6 524.35	6 919.22	6 617.02	6 352.36	6 486.70	5 937.12
4. Other Sectors	1 699.22	1 743.69	1 684.14	1 795.96	1 787.35	1 720.08	1 698.43	1 620.88	1 675.32	1 657.61
5. Other	11.60	23.15	12.90	3.03	NO	NO	NO	NO	NO	NO
B. Fugitive Emissions from Fuels	0.04	0.04	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.07
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	0.04	0.04	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.07
2. Industrial Processes	**725.78**	**667.88**	**683.72**	**623.60**	**665.82**	**657.91**	**710.42**	**699.74**	**635.71**	**568.81**
A. Mineral Products	579.74	513.12	528.32	471.66	513.37	504.99	500.63	496.26	466.41	440.16
B. Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal Production	146.05	154.76	155.40	151.94	152.45	152.92	209.79	203.49	169.30	128.66
D. Other Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Production of Halocarbons and SF_6										
F. Consumption of Halocarbons and SF_6										
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	9.99	11.12	11.28	11.29	13.24	12.86	12.14	12.98	12.21	11.33
4. Agriculture										
A. Enteric Fermentation										
B. Manure Management										
C. Rice Cultivation										
D. Agricultural Soils										
E. Prescribed Burning of Savannas										
F. Field Burning of Agricultural Residues										
G. Other										
5. Land Use, Land-Use Change and Forestry[(2)]	**-388.23**	**-454.36**	**-454.03**	**-462.48**	**-417.22**	**-388.35**	**-278.26**	**-275.82**	**-274.96**	**-299.03**
A. Forest Land	-557.07	-623.71	-624.13	-632.61	-587.07	-559.81	-448.98	-446.69	-445.73	-471.13
B. Cropland	31.32	30.85	30.59	29.63	28.37	28.98	27.25	26.41	25.32	25.66
C. Grassland	7.67	9.81	11.95	14.09	16.23	18.36	20.50	22.64	24.78	26.92
D. Wetlands	10.77	10.67	10.56	10.46	10.35	10.25	10.14	10.04	9.94	9.83
E. Settlements	118.35	117.34	116.32	115.31	114.30	113.29	112.27	111.26	110.25	109.23
F. Other Land	0.72	0.69	0.66	0.64	0.61	0.58	0.55	0.52	0.49	0.46
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**
A. Solid Waste Disposal on Land	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
B. Waste-water Handling										
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total CO_2 emissions including net CO_2 from LULUCF	**8 392.51**	**8 842.86**	**9 603.74**	**9 998.92**	**11 417.27**	**11 719.50**	**11 691.00**	**11 106.76**	**10 934.14**	**10 405.63**
Total CO_2 emissions excluding net CO_2 from LULUCF	**8 780.74**	**9 297.22**	**10 057.77**	**10 461.40**	**11 834.49**	**12 107.85**	**11 969.26**	**11 382.58**	**11 209.10**	**10 704.66**
Memo Items:										
International Bunkers	**960.64**	**1 039.00**	**1 125.70**	**1 172.70**	**1 275.99**	**1 296.51**	**1 213.34**	**1 304.18**	**1 312.81**	**1 257.71**
Aviation	960.53	1 038.90	1 125.59	1 172.59	1 275.88	1 296.37	1 213.19	1 304.06	1 312.68	1 257.60
Marine	0.10	0.10	0.11	0.11	0.11	0.14	0.15	0.12	0.13	0.11
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass	149.63	163.83	163.75	181.66	201.03	295.32	301.33	446.75	460.47	446.95

TABLE 10 EMISSION TRENDS
CO_2
(Part 3 of 3)

Inventory 2011
Submission 2013 v1.2
LUXEMBOURG

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2010	2011	Change from base to latest reported year
	(Gg)	(Gg)	%
1. Energy	**10 659.69**	**10 518.21**	**1.85**
A. Fuel Combustion (Sectoral Approach)	10 659.62	10 518.15	1.85
1. Energy Industries	1 203.21	990.79	2 876.48
2. Manufacturing Industries and Construction	1 408.03	1 270.55	-79.79
3. Transport	6 306.84	6 760.34	152.96
4. Other Sectors	1 741.54	1 496.47	14.26
5. Other	NO	NO	-100.00
B. Fugitive Emissions from Fuels	0.07	0.06	141.19
1. Solid Fuels	NO	NO	0.00
2. Oil and Natural Gas	0.07	0.06	141.19
2. Industrial Processes	**586.18**	**596.56**	**-62.91**
A. Mineral Products	452.57	472.70	-24.18
B. Chemical Industry	NO	NO	0.00
C. Metal Production	133.61	123.86	-87.42
D. Other Production	NO	NO	0.00
E. Production of Halocarbons and SF_6			
F. Consumption of Halocarbons and SF_6			
G. Other	NA	NA	0.00
3. Solvent and Other Product Use	9.47	10.81	-26.16
4. Agriculture			
A. Enteric Fermentation			
B. Manure Management			
C. Rice Cultivation			
D. Agricultural Soils			
E. Prescribed Burning of Savannas			
F. Field Burning of Agricultural Residues			
G. Other			
5. Land Use, Land-Use Change and Forestry[(2)]	**-297.83**	**-296.74**	**-186.04**
A. Forest Land	-470.16	-469.19	-471.79
B. Cropland	24.89	24.02	-30.32
C. Grassland	29.05	31.19	-1.41
D. Wetlands	9.73	9.62	-21.56
E. Settlements	108.22	107.21	-22.83
F. Other Land	0.44	0.41	-70.84
G. Other	NE	NE	0.00
6. Waste	**IE,NA,NO**	**IE,NA,NO**	**0.00**
A. Solid Waste Disposal on Land	NA,NO	NA,NO	0.00
B. Waste-water Handling			
C. Waste Incineration	IE	IE	0.00
D. Other	NO	NO	0.00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**0.00**
Total CO_2 emissions including net CO_2 from LULUCF	**10 957.51**	**10 828.84**	**-11.93**
Total CO_2 emissions excluding net CO_2 from LULUCF	**11 255.34**	**11 125.58**	**-6.90**
Memo Items:			
International Bunkers	**1 285.94**	**1 219.01**	**209.02**
Aviation	1 285.83	1 218.88	209.04
Marine	0.10	0.13	86.87
Multilateral Operations	NO	NO	0.00
CO_2 Emissions from Biomass	467.17	443.39	178.77

TABLE 10 EMISSION TRENDS
CH_4
(Part 1 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	2.30	2.45	2.47	2.46	2.41	2.39	2.50	2.44	2.42	2.46
A. Fuel Combustion (Sectoral Approach)	1.52	1.65	1.63	1.59	1.53	1.39	1.40	1.32	1.29	1.29
1. Energy Industries	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.04	0.05
2. Manufacturing Industries and Construction	0.16	0.16	0.15	0.15	0.15	0.10	0.10	0.08	0.06	0.07
3. Transport	0.90	0.98	1.00	0.95	0.94	0.83	0.86	0.79	0.77	0.77
4. Other Sectors	0.43	0.48	0.44	0.44	0.41	0.42	0.41	0.41	0.42	0.40
5. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	0.77	0.80	0.84	0.87	0.88	1.00	1.09	1.12	1.13	1.17
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	0.77	0.80	0.84	0.87	0.88	1.00	1.09	1.12	1.13	1.17
2. Industrial Processes	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**
A. Mineral Products	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal Production	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
D. Other Production										
E. Production of Halocarbons and SF_6										
F. Consumption of Halocarbons and SF_6										
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use										
4. Agriculture	**16.19**	**16.46**	**15.99**	**16.22**	**16.11**	**16.66**	**16.83**	**16.70**	**16.73**	**17.17**
A. Enteric Fermentation	12.45	12.41	11.91	12.00	11.90	12.23	12.39	12.14	12.01	12.00
B. Manure Management	3.74	4.05	4.08	4.22	4.21	4.42	4.45	4.57	4.72	5.17
C. Rice Cultivation	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
D. Agricultural Soils	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
E. Prescribed Burning of Savannas	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F. Field Burning of Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Land Use, Land-Use Change and Forestry	**NE,NO**	**NE,NO**	**NE,NO**	**NE,NO**	**NE,NO**	**NE,NO**	**NE,NO**	**NE,NO**	**NE,NO**	**NE,NO**
A. Forest Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Cropland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Settlements	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
F. Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**3.49**	**3.56**	**3.57**	**3.55**	**3.44**	**3.32**	**3.20**	**3.16**	**3.10**	**3.00**
A. Solid Waste Disposal on Land	3.20	3.28	3.30	3.25	3.15	3.03	2.93	2.86	2.76	2.67
B. Waste-water Handling	0.29	0.28	0.28	0.27	0.26	0.26	0.25	0.24	0.23	0.22
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	NO	NO	NO	0.02	0.03	0.03	0.03	0.06	0.11	0.11
7. Other ***(as specified in Summary 1.A)***	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total CH_4 emissions including CH_4 from LULUCF	**21.98**	**22.47**	**22.03**	**22.22**	**21.95**	**22.36**	**22.54**	**22.30**	**22.25**	**22.63**
Total CH_4 emissions excluding CH_4 from LULUCF	**21.98**	**22.47**	**22.03**	**22.22**	**21.95**	**22.36**	**22.54**	**22.30**	**22.25**	**22.63**
Memo Items:										
International Bunkers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
Aviation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
Marine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass										

TABLE 10 EMISSION TRENDS
CH_4
(Part 2 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	2.51	2.65	3.16	3.17	3.40	3.30	3.34	3.06	2.93	2.91
A. Fuel Combustion (Sectoral Approach)	1.31	1.31	1.26	1.23	1.25	1.19	1.12	0.98	0.94	0.91
1. Energy Industries	0.04	0.05	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.07
2. Manufacturing Industries and Construction	0.07	0.08	0.07	0.07	0.08	0.11	0.11	0.11	0.10	0.09
3. Transport	0.79	0.76	0.73	0.69	0.69	0.62	0.54	0.44	0.39	0.35
4. Other Sectors	0.41	0.42	0.39	0.40	0.41	0.40	0.39	0.36	0.38	0.40
5. Other	0.00	0.00	0.00	0.00	NO	NO	NO	NO	NO	NO
B. Fugitive Emissions from Fuels	1.20	1.33	1.91	1.94	2.15	2.11	2.22	2.07	1.98	2.00
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	1.20	1.33	1.91	1.94	2.15	2.11	2.22	2.07	1.98	2.00
2. Industrial Processes	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**
A. Mineral Products	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal Production	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
D. Other Production										
E. Production of Halocarbons and SF_6										
F. Consumption of Halocarbons and SF_6										
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use										
4. Agriculture	**16.79**	**16.75**	**16.29**	**15.82**	**15.60**	**15.74**	**15.56**	**15.68**	**16.00**	**16.16**
A. Enteric Fermentation	11.84	11.90	11.56	11.22	11.11	11.09	10.98	11.38	11.63	11.73
B. Manure Management	4.94	4.84	4.73	4.60	4.49	4.66	4.58	4.30	4.37	4.43
C. Rice Cultivation	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
D. Agricultural Soils	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
E. Prescribed Burning of Savannas	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F. Field Burning of Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Land Use, Land-Use Change and Forestry	**NE,NO**	**NE,NO**	**NE,NO**	**NE,NO**	**NE,NO**	**NE,NO**	**NE,NO**	**NE,NO**	**NE,NO**	**NE,NO**
A. Forest Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Cropland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Settlements	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
F. Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**2.95**	**2.83**	**2.80**	**2.82**	**2.56**	**2.47**	**2.41**	**2.33**	**2.25**	**2.11**
A. Solid Waste Disposal on Land	2.52	2.43	2.36	2.32	2.07	1.97	1.87	1.81	1.70	1.61
B. Waste-water Handling	0.21	0.21	0.20	0.19	0.19	0.18	0.18	0.18	0.16	0.15
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	0.21	0.20	0.24	0.31	0.30	0.32	0.36	0.34	0.39	0.35
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total CH_4 emissions including CH_4 from LULUCF	**22.24**	**22.23**	**22.26**	**21.80**	**21.56**	**21.51**	**21.31**	**21.06**	**21.18**	**21.19**
Total CH_4 emissions excluding CH_4 from LULUCF	**22.24**	**22.23**	**22.26**	**21.80**	**21.56**	**21.51**	**21.31**	**21.06**	**21.18**	**21.19**
Memo Items:										
International Bunkers	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Aviation	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Marine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass										

TABLE 10 EMISSION TRENDS
CH_4
(Part 3 of 3)

Inventory 2011
Submission 2013 v1.2
LUXEMBOURG

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2010	2011	Change from base to latest reported year
	(Gg)	(Gg)	%
1. Energy	3.06	2.68	16.87
A. Fuel Combustion (Sectoral Approach)	0.90	0.82	-46.38
1. Energy Industries	0.07	0.07	79.11
2. Manufacturing Industries and Construction	0.10	0.09	-41.46
3. Transport	0.32	0.32	-64.69
4. Other Sectors	0.42	0.34	-20.49
5. Other	NO	NO	-100.00
B. Fugitive Emissions from Fuels	2.16	1.87	141.19
1. Solid Fuels	NO	NO	0.00
2. Oil and Natural Gas	2.16	1.87	141.19
2. Industrial Processes	**NA,NO**	**NA,NO**	**0.00**
A. Mineral Products	NO	NO	0.00
B. Chemical Industry	NO	NO	0.00
C. Metal Production	NA,NO	NA,NO	0.00
D. Other Production			
E. Production of Halocarbons and SF_6			
F. Consumption of Halocarbons and SF_6			
G. Other	NA	NA	0.00
3. Solvent and Other Product Use			
4. Agriculture	**16.52**	**16.22**	**0.18**
A. Enteric Fermentation	11.96	11.63	-6.53
B. Manure Management	4.56	4.59	22.51
C. Rice Cultivation	NA,NO	NA,NO	0.00
D. Agricultural Soils	NA,NE	NA,NE	0.00
E. Prescribed Burning of Savannas	NA	NA	0.00
F. Field Burning of Agricultural Residues	NO	NO	0.00
G. Other	NA	NA	0.00
5. Land Use, Land-Use Change and Forestry	**NE,NO**	**NE,NO**	**0.00**
A. Forest Land	NO	NO	0.00
B. Cropland	NO	NO	0.00
C. Grassland	NO	NO	0.00
D. Wetlands	NO	NO	0.00
E. Settlements	NE	NE	0.00
F. Other Land	NO	NO	0.00
G. Other	NE	NE	0.00
6. Waste	**1.99**	**1.90**	**-45.42**
A. Solid Waste Disposal on Land	1.49	1.40	-56.06
B. Waste-water Handling	0.15	0.14	-50.53
C. Waste Incineration	IE	IE	0.00
D. Other	0.35	0.35	100.00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**0.00**
Total CH_4 emissions including CH_4 from LULUCF	**21.57**	**20.81**	**-5.31**
Total CH_4 emissions excluding CH_4 from LULUCF	**21.57**	**20.81**	**-5.31**
Memo Items:			
International Bunkers	0.01	0.01	208.76
Aviation	0.01	0.01	209.04
Marine	0.00	0.00	86.88
Multilateral Operations	NO	NO	0.00
CO_2 Emissions from Biomass			

TABLE 10 EMISSION TRENDS
N_2O
(Part 1 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	**0.18**	**0.21**	**0.24**	**0.25**	**0.27**	**0.25**	**0.26**	**0.28**	**0.29**	**0.29**
A. Fuel Combustion (Sectoral Approach)	0.18	0.21	0.24	0.25	0.27	0.25	0.26	0.28	0.29	0.29
1. Energy Industries	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01
2. Manufacturing Industries and Construction	0.05	0.05	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05
3. Transport	0.10	0.13	0.16	0.17	0.18	0.18	0.19	0.20	0.20	0.21
4. Other Sectors	0.01	0.02	0.02	0.01	0.02	0.01	0.02	0.02	0.02	0.01
5. Other	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01
B. Fugitive Emissions from Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2. Industrial Processes	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**
A. Mineral Products	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. Other Production										
E. Production of Halocarbons and SF_6										
F. Consumption of Halocarbons and SF_6										
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02
4. Agriculture	**1.30**	**1.31**	**1.32**	**1.27**	**1.22**	**1.24**	**1.26**	**1.23**	**1.21**	**1.21**
A. Enteric Fermentation										
B. Manure Management	0.13	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.09	0.08
C. Rice Cultivation										
D. Agricultural Soils	1.17	1.19	1.22	1.16	1.12	1.14	1.16	1.13	1.12	1.13
E. Prescribed Burning of Savannas	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F. Field Burning of Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Land Use, Land-Use Change and Forestry	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**
A. Forest Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Cropland	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Settlements	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
F. Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**0.03**	**0.03**	**0.03**	**0.03**	**0.03**	**0.03**	**0.03**	**0.04**	**0.04**	**0.04**
A. Solid Waste Disposal on Land										
B. Waste-water Handling	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	NO	NO	NO	0.00	0.00	0.00	0.00	0.00	0.01	0.01
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total N_2O emissions including N_2O from LULUCF	**1.55**	**1.59**	**1.63**	**1.59**	**1.55**	**1.56**	**1.59**	**1.58**	**1.57**	**1.57**
Total N_2O emissions excluding N_2O from LULUCF	**1.54**	**1.58**	**1.62**	**1.58**	**1.54**	**1.55**	**1.58**	**1.57**	**1.56**	**1.56**
Memo Items:										
International Bunkers	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.02**	**0.02**	**0.02**	**0.02**	**0.03**
Aviation	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03
Marine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass										

TABLE 10 EMISSION TRENDS
N_2O
(Part 2 of 3)

Inventory 2011
Submission 2013 v1.2
LUXEMBOURG

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	**0.29**	**0.31**	**0.32**	**0.38**	**0.42**	**0.42**	**0.39**	**0.38**	**0.37**	**0.36**
A. Fuel Combustion (Sectoral Approach)	0.29	0.31	0.32	0.38	0.42	0.42	0.39	0.38	0.37	0.36
1. Energy Industries	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
2. Manufacturing Industries and Construction	0.04	0.04	0.06	0.11	0.11	0.11	0.10	0.10	0.08	0.09
3. Transport	0.23	0.23	0.23	0.24	0.26	0.27	0.25	0.24	0.25	0.23
4. Other Sectors	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
5. Other	0.00	0.00	0.00	0.00	NO	NO	NO	NO	NO	NO
B. Fugitive Emissions from Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2. Industrial Processes	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**
A. Mineral Products	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. Other Production										
E. Production of Halocarbons and SF_6										
F. Consumption of Halocarbons and SF_6										
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.02
4. Agriculture	**1.19**	**1.11**	**1.11**	**1.02**	**1.13**	**1.06**	**1.04**	**1.05**	**1.05**	**1.07**
A. Enteric Fermentation										
B. Manure Management	0.08	0.08	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08
C. Rice Cultivation										
D. Agricultural Soils	1.11	1.03	1.04	0.94	1.06	0.98	0.97	0.96	0.97	0.99
E. Prescribed Burning of Savannas	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F. Field Burning of Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Land Use, Land-Use Change and Forestry	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**
A. Forest Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Cropland	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Settlements	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
F. Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**0.05**	**0.05**	**0.05**	**0.05**	**0.06**	**0.06**	**0.06**	**0.06**	**0.06**	**0.06**
A. Solid Waste Disposal on Land										
B. Waste-water Handling	0.03	0.04	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.02	0.03	0.03
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total N_2O emissions including N_2O from LULUCF	**1.56**	**1.49**	**1.51**	**1.48**	**1.63**	**1.55**	**1.52**	**1.51**	**1.50**	**1.52**
Total N_2O emissions excluding N_2O from LULUCF	**1.55**	**1.48**	**1.51**	**1.47**	**1.62**	**1.54**	**1.51**	**1.51**	**1.49**	**1.51**
Memo Items:										
International Bunkers	**0.03**	**0.03**	**0.03**	**0.03**	**0.04**	**0.04**	**0.03**	**0.04**	**0.04**	**0.04**
Aviation	0.03	0.03	0.03	0.03	0.04	0.04	0.03	0.04	0.04	0.04
Marine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass										

TABLE 10 EMISSION TRENDS
N_2O
(Part 3 of 3)

Inventory 2011
Submission 2013 v1.2
LUXEMBOURG

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2010	2011	Change from base to latest reported year
	(Gg)	(Gg)	%
1. Energy	**0.37**	**0.37**	**109.57**
A. Fuel Combustion (Sectoral Approach)	0.37	0.37	109.57
1. Energy Industries	0.01	0.01	67.91
2. Manufacturing Industries and Construction	0.09	0.07	29.73
3. Transport	0.24	0.26	175.67
4. Other Sectors	0.04	0.03	100.45
5. Other	NO	NO	-100.00
B. Fugitive Emissions from Fuels	NA,NO	NA,NO	0.00
1. Solid Fuels	NO	NO	0.00
2. Oil and Natural Gas	NA,NO	NA,NO	0.00
2. Industrial Processes	**NA,NO**	**NA,NO**	**0.00**
A. Mineral Products	NO	NO	0.00
B. Chemical Industry	NO	NO	0.00
C. Metal Production	NA	NA	0.00
D. Other Production			
E. Production of Halocarbons and SF_6			
F. Consumption of Halocarbons and SF_6			
G. Other	NA	NA	0.00
3. Solvent and Other Product Use	0.02	0.02	-46.40
4. Agriculture	**1.07**	**1.04**	**-19.89**
A. Enteric Fermentation			
B. Manure Management	0.08	0.08	-39.37
C. Rice Cultivation			
D. Agricultural Soils	0.98	0.96	-17.66
E. Prescribed Burning of Savannas	NA	NA	0.00
F. Field Burning of Agricultural Residues	NO	NO	0.00
G. Other	NA	NA	0.00
5. Land Use, Land-Use Change and Forestry	**0.01**	**0.01**	**-10.72**
A. Forest Land	NO	NO	0.00
B. Cropland	0.01	0.01	-10.72
C. Grassland	NO	NO	0.00
D. Wetlands	NO	NO	0.00
E. Settlements	NE	NE	0.00
F. Other Land	NO	NO	0.00
G. Other	NE	NE	0.00
6. Waste	**0.06**	**0.06**	**98.98**
A. Solid Waste Disposal on Land			
B. Waste-water Handling	0.03	0.03	14.79
C. Waste Incineration	IE	IE	0.00
D. Other	0.02	0.03	100.00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**0.00**
Total N_2O emissions including N_2O from LULUCF	**1.52**	**1.49**	**-3.34**
Total N_2O emissions excluding N_2O from LULUCF	**1.52**	**1.49**	**-3.30**
Memo Items:			
International Bunkers	**0.04**	**0.03**	**209.02**
Aviation	0.04	0.03	209.04
Marine	0.00	0.00	86.88
Multilateral Operations	NO	NO	0.00
CO_2 Emissions from Biomass			

TABLE 10 EMISSION TRENDS
HFCs, PFCs and SF_6
(Part 1 of 3)

Inventory 2011
Submission 2013 v1.2
LUXEMBOURG

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
Emissions of HFCs[(3)] - (Gg CO_2 equivalent)	**12.01**	**12.01**	**12.21**	**12.93**	**13.68**	**15.59**	**15.91**	**17.17**	**19.99**	**23.96**
HFC-23	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-32	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0.00	0.00	0.00	0.00	0.00
HFC-41	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-43-10mee	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-125	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0.00	0.00	0.00	0.00	0.00
HFC-134	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-134a	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
HFC-152a	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-143	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-143a	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0.00	0.00	0.00	0.00	0.00
HFC-227ea	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-236fa	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-245ca	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Unspecified mix of listed HFCs[(4)] - (Gg CO_2 equivalent)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Emissions of PFCs[(3)] - (Gg CO_2 equivalent)	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**
CF_4	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C_2F_6	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C_3F_8	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C_4F_{10}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
$c\text{-}C_4F_8$	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C_5F_{12}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C_6F_{14}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Unspecified mix of listed PFCs[(4)] - (Gg CO_2 equivalent)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Emissions of SF6[(3)] - (Gg CO_2 equivalent)	**1.13**	**1.21**	**1.29**	**1.37**	**1.46**	**1.55**	**1.71**	**1.87**	**1.97**	**2.05**
SF_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE 10 EMISSION TRENDS
HFCs, PFCs and SF_6
(Part 2 of 3)

Inventory 2011
Submission 2013 v1.2
LUXEMBOURG

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
Emissions of HFCs(3) - (Gg CO_2 equivalent)	**28.62**	**34.15**	**41.86**	**46.76**	**49.18**	**53.01**	**56.91**	**61.11**	**63.46**	**65.54**
HFC-23	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-41	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-43-10mee	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-125	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
HFC-134	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-134a	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
HFC-152a	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-143	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-143a	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-227ea	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-236fa	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-245ca	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Unspecified mix of listed HFCs(4) - (Gg CO_2 equivalent)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Emissions of PFCs(3) - (Gg CO_2 equivalent)	**0.01**	**0.01**	**0.01**	**0.02**	**0.11**	**0.15**	**0.17**	**0.21**	**0.24**	**0.22**
CF_4	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C_2F_6	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C_3F_8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C_4F_{10}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
$c\text{-}C_4F_8$	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C_5F_{12}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C_6F_{14}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Unspecified mix of listed PFCs(4) - (Gg CO_2 equivalent)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Emissions of SF6(3) - (Gg CO_2 equivalent)	**2.15**	**2.82**	**3.37**	**4.09**	**4.60**	**5.04**	**5.71**	**6.15**	**6.57**	**7.00**
SF_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE 10 EMISSION TRENDS
HFCs, PFCs and SF_6
(Part 3 of 3)

Inventory 2011
Submission 2013 v1.2
LUXEMBOURG

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2010	2011	Change from base to latest reported year
	(Gg)	(Gg)	%
Emissions of HFCs[3] - (Gg CO_2 equivalent)	**66.47**	**67.00**	**457.88**
HFC-23	NA,NO	NA,NO	0.00
HFC-32	0.00	0.00	100.00
HFC-41	NA,NO	NA,NO	0.00
HFC-43-10mee	NA,NO	NA,NO	0.00
HFC-125	0.01	0.01	100.00
HFC-134	NA,NO	NA,NO	0.00
HFC-134a	0.03	0.03	173.54
HFC-152a	0.00	0.00	442.39
HFC-143	NA,NO	NA,NO	0.00
HFC-143a	0.00	0.00	100.00
HFC-227ea	NA,NO	NA,NO	0.00
HFC-236fa	NA,NO	NA,NO	0.00
HFC-245ca	NA,NO	NA,NO	0.00
Unspecified mix of listed HFCs[4] - (Gg CO_2 equivalent)	NA,NO	NA,NO	0.00
Emissions of PFCs[3] - (Gg CO_2 equivalent)	**0.20**	**0.18**	**100.00**
CF_4	NA,NO	NA,NO	0.00
C_2F_6	NA,NO	NA,NO	0.00
C_3F_8	0.00	0.00	100.00
C_4F_{10}	NA,NO	NA,NO	0.00
$c-C_4F_8$	NA,NO	NA,NO	0.00
C_5F_{12}	NA,NO	NA,NO	0.00
C_6F_{14}	NA,NO	NA,NO	0.00
Unspecified mix of listed PFCs[4] - (Gg CO_2 equivalent)	NA,NO	NA,NO	0.00
Emissions of SF6[3] - (Gg CO_2 equivalent)	**7.39**	**7.75**	**587.66**
SF_6	0.00	0.00	587.66

TABLE 10 EMISSION TRENDS
SUMMARY
(Part 1 of 3)

GREENHOUSE GAS EMISSIONS	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)
CO_2 emissions including net CO_2 from LULUCF	12 295.16	12 641.51	12 043.55	12 055.18	11 411.36	8 969.12	8 845.37	8 107.21	7 474.34	7 755.59
CO_2 emissions excluding net CO_2 from LULUCF	11 950.26	12 471.93	12 242.15	12 363.86	11 550.17	9 210.07	9 258.86	8 561.14	7 672.68	8 077.25
CH_4 emissions including CH_4 from LULUCF	461.51	471.95	462.68	466.72	460.99	469.59	473.25	468.33	467.24	475.18
CH_4 emissions excluding CH_4 from LULUCF	461.51	471.95	462.68	466.72	460.99	469.59	473.25	468.33	467.24	475.18
N_2O emissions including N_2O from LULUCF	478.96	492.49	506.20	491.81	481.62	483.53	491.72	488.82	485.54	486.95
N_2O emissions excluding N_2O from LULUCF	476.11	489.64	503.35	488.96	478.77	480.68	488.88	485.97	482.69	484.10
HFCs	12.01	12.01	12.21	12.93	13.68	15.59	15.91	17.17	19.99	23.96
PFCs	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
SF_6	1.13	1.21	1.29	1.37	1.46	1.55	1.71	1.87	1.97	2.05
Total (including LULUCF)	**13 248.77**	**13 619.16**	**13 025.94**	**13 028.02**	**12 369.12**	**9 939.39**	**9 827.97**	**9 083.42**	**8 449.06**	**8 743.72**
Total (excluding LULUCF)	**12 901.02**	**13 446.74**	**13 221.69**	**13 333.84**	**12 505.07**	**10 177.48**	**10 238.60**	**9 534.50**	**8 644.56**	**9 062.53**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)
1. Energy	10 429.93	11 044.32	10 895.15	11 042.59	10 325.04	8 340.89	8 451.30	7 867.11	7 140.20	7 508.49
2. Industrial Processes	1 621.50	1 543.72	1 473.95	1 452.53	1 361.33	1 001.64	946.35	839.11	682.94	725.05
3. Solvent and Other Product Use	23.90	22.98	21.88	20.85	19.57	19.74	19.42	19.00	17.88	17.30
4. Agriculture	743.20	751.50	746.10	732.99	716.24	734.71	744.12	731.74	726.01	735.77
5. Land Use, Land-Use Change and Forestry (5)	347.75	172.43	-195.75	-305.83	-135.96	-238.10	-410.64	-451.08	-195.50	-318.81
6. Waste	82.48	84.21	84.61	84.89	82.89	80.52	77.43	77.53	77.54	75.93
7. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total (including LULUCF)(5)	**13 248.77**	**13 619.16**	**13 025.94**	**13 028.02**	**12 369.12**	**9 939.39**	**9 827.97**	**9 083.42**	**8 449.06**	**8 743.72**

TABLE 10 EMISSION TRENDS
SUMMARY
(Part 2 of 3)

GREENHOUSE GAS EMISSIONS	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)
CO_2 emissions including net CO_2 from LULUCF	8 392.51	8 842.86	9 603.74	9 998.92	11 417.27	11 719.50	11 691.00	11 106.76	10 934.14	10 405.63
CO_2 emissions excluding net CO_2 from LULUCF	8 780.74	9 297.22	10 057.77	10 461.40	11 834.49	12 107.85	11 969.26	11 382.58	11 209.10	10 704.66
CH_4 emissions including CH_4 from LULUCF	467.14	466.74	467.41	457.89	452.75	451.79	447.46	442.31	444.81	444.89
CH_4 emissions excluding CH_4 from LULUCF	467.14	466.74	467.41	457.89	452.75	451.79	447.46	442.31	444.81	444.89
N_2O emissions including N_2O from LULUCF	484.19	461.56	469.54	458.20	504.17	481.21	471.01	469.22	466.03	470.28
N_2O emissions excluding N_2O from LULUCF	481.37	458.76	466.76	455.45	501.45	478.52	468.33	466.58	463.41	467.68
HFCs	28.62	34.15	41.86	46.76	49.18	53.01	56.91	61.11	63.46	65.54
PFCs	0.01	0.01	0.01	0.02	0.11	0.15	0.17	0.21	0.24	0.22
SF_6	2.15	2.82	3.37	4.09	4.60	5.04	5.71	6.15	6.57	7.00
Total (including LULUCF)	**9 374.62**	**9 808.13**	**10 585.93**	**10 965.88**	**12 428.07**	**12 710.71**	**12 672.25**	**12 085.76**	**11 915.26**	**11 393.55**
Total (excluding LULUCF)	**9 760.03**	**10 259.69**	**11 037.18**	**11 425.61**	**12 842.57**	**13 096.36**	**12 947.84**	**12 358.94**	**12 187.60**	**11 689.99**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)
1. Energy	8 189.11	8 769.05	9 529.95	10 012.38	11 356.22	11 635.80	11 438.98	10 852.50	10 736.99	10 298.52
2. Industrial Processes	756.56	704.85	728.96	674.47	719.70	716.11	773.21	767.21	705.99	641.57
3. Solvent and Other Product Use	15.81	16.54	16.76	15.09	17.39	16.65	16.25	17.48	16.90	16.11
4. Agriculture	721.34	694.40	687.42	647.66	677.83	657.76	649.53	653.65	661.28	670.65
5. Land Use, Land-Use Change and Forestry[(5)]	-385.41	-451.56	-451.26	-459.74	-414.49	-385.65	-275.59	-273.18	-272.34	-296.43
6. Waste	77.20	74.85	74.09	76.02	71.42	70.04	69.87	68.09	66.44	63.14
7. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total (including LULUCF)[(5)]	**9 374.62**	**9 808.13**	**10 585.93**	**10 965.88**	**12 428.07**	**12 710.71**	**12 672.25**	**12 085.76**	**11 915.26**	**11 393.55**

TABLE 10 EMISSION TRENDS
SUMMARY
(Part 3 of 3)

Inventory 2011
Submission 2013 v1.2
LUXEMBOURG

GREENHOUSE GAS EMISSIONS	2010	2011	Change from base to latest reported year
	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	(%)
CO_2 emissions including net CO_2 from LULUCF	10 957.51	10 828.84	-11.93
CO_2 emissions excluding net CO_2 from LULUCF	11 255.34	11 125.58	-6.90
CH_4 emissions including CH_4 from LULUCF	452.87	437.00	-5.31
CH_4 emissions excluding CH_4 from LULUCF	452.87	437.00	-5.31
N_2O emissions including N_2O from LULUCF	472.39	462.95	-3.34
N_2O emissions excluding N_2O from LULUCF	469.83	460.41	-3.30
HFCs	66.47	67.00	457.88
PFCs	0.20	0.18	100.00
SF_6	7.39	7.75	587.66
Total (including LULUCF)	**11 956.83**	**11 803.72**	**-10.91**
Total (excluding LULUCF)	**12 252.09**	**12 097.92**	**-6.23**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2010	2011	Change from base to latest reported year
	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	(%)
1. Energy	10 839.35	10 688.67	2.48
2. Industrial Processes	660.24	671.49	-58.59
3. Solvent and Other Product Use	14.34	15.77	-34.00
4. Agriculture	677.94	663.65	-10.70
5. Land Use, Land-Use Change and Forestry (5)	-295.26	-294.20	-184.60
6. Waste	60.21	58.33	-29.29
7. Other	NA	NA	0.00
Total (including LULUCF)(5)	**11 956.83**	**11 803.72**	**-10.91**

Tables below details methodologies, data sources and emission factors used by Luxembourg for submission 2013v1.2. This is a copy of table Summary 3 of the CRF.

SUMMARY 3 SUMMARY REPORT FOR METHODS AND EMISSION FACTORS USED
(Sheet 1 of 2)

Inventory 2011
Submission 2013 v1.2
LUXEMBOURG

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
1. Energy	**T1,T2,T3**	**CS,D,PS**	**T1,T3**	**D,OTH**	**T1,T3**	**D,OTH**						
A. Fuel Combustion	T1,T2,T3	CS,D,PS	T1,T3	D,OTH	T1,T3	D,OTH						
1. Energy Industries	T2	CS,D	T1	D	T1	D						
2. Manufacturing Industries and Construction	T1,T2	CS,D,PS	T1	D	T1	D						
3. Transport	T1,T2,T3	CS,D	T1,T3	D,OTH	T1,T3	D,OTH						
4. Other Sectors	T1,T2	CS,D	T1	D	T1	D						
5. Other	NA	NA	NA	NA	NA	NA						
B. Fugitive Emissions from Fuels	T1	D	T1	D	NA	NA						
1. Solid Fuels	NA	NA	NA	NA	NA	NA						
2. Oil and Natural Gas	T1	D	T1	D	NA	NA						
2. Industrial Processes	**CS,T2**	**CS,PS**	**NA**	**NA**	**NA**	**NA**	**CS**	**CS**	**CS**	**CS**	**CS**	**CS**
A. Mineral Products	CS,T2	CS,PS	NA	NA	NA	NA						
B. Chemical Industry	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C. Metal Production	CS,T2	CS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. Other Production	NA	NA										
E. Production of Halocarbons and SF_6							NA	NA	NA	NA	NA	NA
F. Consumption of Halocarbons and SF_6							CS	CS	CS	CS	CS	CS
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Use the following notation keys to specify the method applied:

D (IPCC default) **T1a, T1b, T1c** (IPCC Tier 1a, Tier 1b and Tier 1c, respectively) **CR** (CORINAIR)
RA (Reference Approach) **T2** (IPCC Tier 2) **CS** (Country Specific)
T1 (IPCC Tier 1) **T3** (IPCC Tier 3) **OTH** (Other)

If using more than one method within one source category, list all the relevant methods. Explanations regarding country-specific methods, other methods or any modifications to the default IPCC methods, as well as

Use the following notation keys to specify the emission factor used:

D (IPCC default) **CS** (Country Specific) **OTH** (Other)
CR (CORINAIR) **PS** (Plant Specific)

Where a mix of emission factors has been used, list all the methods in the relevant cells and give further explanations in the documentation box. Also use the documentation box to explain the use of notation OTH.

SUMMARY 3 SUMMARY REPORT FOR METHODS AND EMISSION FACTORS USED
(Sheet 2 of 2)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
3. Solvent and Other Product Use	**M**	**M**			**CS**	**CS**						
4. Agriculture			**T1,T2**	**CS,D,OTH**	**T1,T1a,T1b**	**D**						
A. Enteric Fermentation			T1,T2	CS,D,OTH								
B. Manure Management			T1,T2	CS,D,OTH	T1	D						
C. Rice Cultivation			NA	NA								
D. Agricultural Soils			NA	NA	T1,T1a,T1b	D						
E. Prescribed Burning of Savannas			NA	NA	NA	NA						
F. Field Burning of Agricultural Residues			NA	NA	NA	NA						
G. Other			NA	NA	NA	NA						
5. Land Use, Land-Use Change and Forestry	**T1,T2**	**CS,D**	**NA**	**NA**	**T1**	**D**						
A. Forest Land	T1,T2	CS,D	NA	NA	NA	NA						
B. Cropland	T1	CS,D	NA	NA	T1	D						
C. Grassland	T1	CS,D	NA	NA	NA	NA						
D. Wetlands	T1	CS,D	NA	NA	NA	NA						
E. Settlements	T1	CS,D	NA	NA	NA	NA						
F. Other Land	T1	CS,D	NA	NA	NA	NA						
G. Other	NA	NA	NA	NA	NA	NA						
6. Waste	**NA**	**NA**	**T1,T2**	**CS,D**	**T1**	**D,PS**						
A. Solid Waste Disposal on Land	NA	NA	T2	D								
B. Waste-water Handling			T1	CS	T1	D,PS						
C. Waste Incineration	NA	NA	NA	NA	NA	NA						
D. Other	NA	NA	T1	D	T1	D						
7. Other (as specified in Summary 1.A)	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

Use the following notation keys to specify the method applied:

D (IPCC default) **T1a, T1b, T1c** (IPCC Tier 1a, Tier 1b and Tier 1c, respectively) **CR** (CORINAIR)
RA (Reference Approach) **T2** (IPCC Tier 2) **CS** (Country Specific)
T1 (IPCC Tier 1) **T3** (IPCC Tier 3) **OTH** (Other)

If using more than one method within one source category, list all the relevant methods. Explanations regarding country-specific methods, other methods or any modifications to the default IPCC methods, as well as information regarding the use of different

Use the following notation keys to specify the emission factor used:

D (IPCC default) **CS** (Country Specific) **OTH** (Other)
CR (CORINAIR) **PS** (Plant Specific)

Where a mix of emission factors has been used, list all the methods in the relevant cells and give further explanations in the documentation box. Also use the documentation box to explain the use of notation OTH.

Annex A.II– Summary of reporting of the Supplementary Information under Article 7, paragraph 2, of the Kyoto Protocol

SUPPLEMENTARY INFORMATION UNDER THE KYOTO PROTOCOL – CORRESPONDENCE TABLE

Information reported under Article 7, paragraph 2	NC5 Section
National systems in accordance with Article 5, paragraph 1	*Section III.2*
National registries	*Section III.3*
Supplementarity relating to the mechanisms pursuant to Articles 6, 12 and 17	*Section V.5*
Policies and measures in accordance with Article 2	*Section IV.3*
Domestic and regional programmes and/or legislative arrangements and enforcement and administrative procedures	*Chapter IV.2*
Information under Article 10 Art. 10a Art. 10b Art. 10c Art. 10d Art. 10e	 *Section III.2* *Section IV.2* *Section VII.5* *Chapter VIII* *Chapter IX*

Annex A.III– First Biennial Report – CTF Tables

Table 1 LUX_BR1_v1.0

Emission trends: summary (1)
(Sheet 1 of 3)

CRF: LUX_CRF__ v1.2

GREENHOUSE GAS EMISSIONS	Base year[a]	1991	1992	1993	1994	1995	1996	1997	1998
	kt CO_2 eq	*kt CO_2 eq*	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq
CO_2 emissions including net CO_2 from LULUCF	12,295.16	12,641.51	12,043.55	12,055.18	11,411.36	8,969.12	8,845.37	8,107.21	7,474.34
CO_2 emissions excluding net CO_2 from LULUCF	11,950.26	12,471.93	12,242.15	12,363.86	11,550.17	9,210.07	9,258.86	8,561.14	7,672.68
CH_4 emissions including CH_4 from LULUCF	461.51	471.95	462.68	466.72	460.99	469.59	473.25	468.33	467.24
CH_4 emissions excluding CH_4 from LULUCF	461.51	471.95	462.68	466.72	460.99	469.59	473.25	468.33	467.24
N_2O emissions including N_2O from LULUCF	478.96	492.49	506.20	491.81	481.62	483.53	491.72	488.82	485.54
N_2O emissions excluding N_2O from LULUCF	476.11	489.64	503.35	488.96	478.77	480.68	488.88	485.97	482.69
HFCs	12.01	12.01	12.21	12.93	13.68	15.59	15.91	17.17	19.99
PFCs	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
SF_6	1.13	1.21	1.29	1.37	1.46	1.55	1.71	1.87	1.97
Total (including LULUCF)	13,248.77	13,619.16	13,025.94	13,028.02	12,369.12	9,939.39	9,827.97	9,083.42	8,449.06
Total (excluding LULUCF)	12,901.02	13,446.74	13,221.69	13,333.84	12,505.07	10,177.48	10,238.60	9,534.50	8,644.56

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[a]	1991	1992	1993	1994	1995	1996	1997	1998
	kt CO_2 eq	*kt CO_2 eq*	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq
1. Energy	10,429.93	11,044.32	10,895.15	11,042.59	10,325.04	8,340.89	8,451.30	7,867.11	7,140.20
2. Industrial Processes	1,621.50	1,543.72	1,473.95	1,452.53	1,361.33	1,001.64	946.35	839.11	682.94
3. Solvent and Other Product Use	23.90	22.98	21.88	20.85	19.57	19.74	19.42	19.00	17.88
4. Agriculture	743.20	751.50	746.10	732.99	716.24	734.71	744.12	731.74	726.01
5. Land Use, Land-Use Change and Forestry[b]	347.75	172.43	-195.75	-305.83	-135.96	-238.10	-410.64	-451.08	-195.50
6. Waste	82.48	84.21	84.61	84.89	82.89	80.52	77.43	77.53	77.54
7. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total (including LULUCF)	13,248.77	13,619.16	13,025.94	13,028.02	12,369.12	9,939.39	9,827.97	9,083.42	8,449.06

Note: All footnotes for this table are given on sheet 3.

[1] The common tabular format will be revised, in accordance with relevant decisions of the Conference of the Parties and, where applicable, with decisions of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol."

Table 1 LUX_BR1_v1.0

Emission trends: summary (1)

(Sheet 2 of 3) CRF: LUX_CRF__ v1.2

GREENHOUSE GAS EMISSIONS	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq
CO_2 emissions including net CO_2 from LULUCF	7,755.59	8,392.51	8,842.86	9,603.74	9,998.92	11,417.27	11,719.50	11,691.00	11,106.76	10,934.14
CO_2 emissions excluding net CO_2 from LULUCF	8,077.25	8,780.74	9,297.22	10,057.77	10,461.40	11,834.49	12,107.85	11,969.26	11,382.58	11,209.10
CH_4 emissions including CH_4 from LULUCF	475.18	467.14	466.74	467.41	457.89	452.75	451.79	447.46	442.31	444.81
CH_4 emissions excluding CH_4 from LULUCF	475.18	467.14	466.74	467.41	457.89	452.75	451.79	447.46	442.31	444.81
N_2O emissions including N_2O from LULUCF	486.95	484.19	461.56	469.54	458.20	504.17	481.21	471.01	469.22	466.03
N_2O emissions excluding N_2O from LULUCF	484.10	481.37	458.76	466.76	455.45	501.45	478.52	468.33	466.58	463.41
HFCs	23.96	28.62	34.15	41.86	46.76	49.18	53.01	56.91	61.11	63.46
PFCs	NA, NO	0.01	0.01	0.01	0.02	0.11	0.15	0.17	0.21	0.24
SF_6	2.05	2.15	2.82	3.37	4.09	4.60	5.04	5.71	6.15	6.57
Total (including LULUCF)	8,743.72	9,374.62	9,808.13	10,585.93	10,965.88	12,428.07	12,710.71	12,672.25	12,085.76	11,915.26
Total (excluding LULUCF)	9,062.53	9,760.03	10,259.69	11,037.18	11,425.61	12,842.57	13,096.36	12,947.84	12,358.94	12,187.60

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq
1. Energy	7,508.49	8,189.11	8,769.05	9,529.95	10,012.38	11,356.22	11,635.80	11,438.98	10,852.50	10,736.99
2. Industrial Processes	725.05	756.56	704.85	728.96	674.47	719.70	716.11	773.21	767.21	705.99
3. Solvent and Other Product Use	17.30	15.81	16.54	16.76	15.09	17.39	16.65	16.25	17.48	16.90
4. Agriculture	735.77	721.34	694.40	687.42	647.66	677.83	657.76	649.53	653.65	661.28
5. Land Use, Land-Use Change and Forestry[b]	-318.81	-385.41	-451.56	-451.26	-459.74	-414.49	-385.65	-275.59	-273.18	-272.34
6. Waste	75.93	77.20	74.85	74.09	76.02	71.42	70.04	69.87	68.09	66.44
7. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total (including LULUCF)	8,743.72	9,374.62	9,808.13	10,585.93	10,965.88	12,428.07	12,710.71	12,672.25	12,085.76	11,915.26

Note: All footnotes for this table are given on sheet 3.

Table 1 LUX_BR1_v1.0

Emission trends: summary [(1)]
(Sheet 3 of 3) CRF: LUX_CRF__ v1.2

GREENHOUSE GAS EMISSIONS	*2009*	2010	2011	Change from base to latest reported year
	kt CO_2 eq	*kt CO_2 eq*	kt CO_2 eq	(%)
CO_2 emissions including net CO_2 from LULUCF	10,405.63	10,957.51	10,828.84	-11.93
CO_2 emissions excluding net CO_2 from LULUCF	10,704.66	11,255.34	11,125.58	-6.90
CH_4 emissions including CH_4 from LULUCF	444.89	452.87	437.00	-5.31
CH_4 emissions excluding CH_4 from LULUCF	444.89	452.87	437.00	-5.31
N_2O emissions including N_2O from LULUCF	470.28	472.39	462.95	-3.34
N_2O emissions excluding N_2O from LULUCF	467.68	469.83	460.41	-3.30
HFCs	65.54	66.47	67.00	457.88
PFCs	0.22	0.20	0.18	100.00
SF_6	7.00	7.39	7.75	587.66
Total (including LULUCF)	11,393.55	11,956.83	11,803.72	-10.91
Total (excluding LULUCF)	11,689.99	12,252.09	12,097.92	-6.23

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	*2009*	2010	2011	Change from base to latest reported year
	kt CO_2 eq	*kt CO_2 eq*	kt CO_2 eq	(%)
1. Energy	10,298.52	10,839.35	10,688.67	2.48
2. Industrial Processes	641.57	660.24	671.49	-58.59
3. Solvent and Other Product Use	16.11	14.34	15.77	-34.00
4. Agriculture	670.65	677.94	663.65	-10.70
5. Land Use, Land-Use Change and Forestry[b]	-296.43	-295.26	-294.20	-184.60
6. Waste	63.14	60.21	58.33	-29.29
7. Other	NA	NA	NA	0.00
Total (including LULUCF)	11,393.55	11,956.83	11,803.72	-10.91

Notes :

(1) Further detailed information could be found in the common reporting format tables of the Party's greenhouse gas inventory, namely "Emission trends (CO_2)", "Emission trends (CH_4)", "Emission trends (N_2O)" and "Emission trends (HFCs, PFCs and SF_6)", which is included in an annex to this biennial report.

(2) 2011 is the latest reported inventory year.

(3) 1 kt CO_2 eq equals 1 Gg CO_2 eq.

Abbreviation: LULUCF = land use, land-use change and forestry.

[a] The column "Base year" should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the Conference of the Parties. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

[b] Includes net CO_2, CH_4 and N_2O from LULUCF.

Table 1 (a)

LUX_BR1_v1.0

Emission trends (CO_2)

(Sheet 1 of 3)

CRF: LUX_CRF__ v1.2

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year [a]	1991	1992	1993	1994	1995	1996	1997	1998
	kt	kt	kt	kt	kt	kt	kt	kt	kt
1. Energy	10,327.26	10,927.36	10,768.39	10,913.01	10,192.31	8,213.42	8,317.96	7,728.97	7,000.37
A. Fuel Combustion (Sectoral Approach)	10,327.23	10,927.34	10,768.36	10,912.99	10,192.28	8,213.38	8,317.92	7,728.93	7,000.33
1. Energy Industries	33.29	34.01	34.73	33.04	32.32	91.07	79.62	80.46	144.48
2. Manufacturing Industries and Construction	6,285.43	6,121.42	5,795.50	5,921.31	5,201.13	3,343.75	3,201.46	2,450.11	1,412.48
3. Transport	2,672.53	3,170.77	3,460.24	3,501.54	3,560.39	3,379.01	3,477.92	3,678.89	3,842.35
4. Other Sectors	1,309.70	1,574.84	1,451.59	1,433.96	1,376.88	1,389.12	1,540.82	1,497.06	1,567.67
5. Other	26.28	26.29	26.30	23.14	21.57	10.43	18.10	22.42	33.34
B. Fugitive Emissions from Fuels	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04
2. Industrial Processes	1,608.36	1,530.51	1,460.44	1,438.23	1,346.19	984.50	928.72	820.07	660.99
A. Mineral Products	623.45	592.76	607.15	515.03	575.35	519.11	512.12	525.97	520.30
B. Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal Production	984.91	937.74	853.29	923.19	770.83	465.38	416.60	294.10	140.69
D. Other Production	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Production of Halocarbons and SF6									
F. Consumption of Halocarbons and SF6									
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	14.64	14.06	13.32	12.62	11.66	12.16	12.18	12.11	11.33
4. Agriculture									
A. Enteric Fermentation									
B. Manure Management									
C. Rice Cultivation									
D. Agricultural Soils									
E. Prescribed Burning of Savannas									
F. Field Burning of Agricultural Residues									
G. Other									
5. Land Use, Land-Use Change and Forestry	344.90	169.58	-198.60	-308.68	-138.81	-240.95	-413.49	-453.93	-198.35
A. Forest Land	126.20	-49.24	-417.54	-527.74	-358.29	-460.19	-632.59	-673.51	-418.49
B. Cropland	34.47	34.59	34.71	34.83	35.26	35.01	34.87	35.35	35.91
C. Grassland	31.64	31.64	31.64	31.64	31.64	31.64	31.64	31.64	31.64
D. Wetlands	12.27	12.27	12.27	12.27	12.27	12.27	12.27	12.27	12.27
E. Settlements	138.93	138.93	138.93	138.93	138.93	138.93	138.93	138.93	138.93
F. Other Land	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO
A. Solid Waste Disposal on Land	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
B. Waste-water Handling									
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
7. Other (as specified in the summary table in CRF)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total CO2 emissions including net CO2 from LULUCF	12,295.16	12,641.51	12,043.55	12,055.18	11,411.36	8,969.12	8,845.37	8,107.21	7,474.34
Total CO2 emissions excluding net CO2 from LULUCF	11,950.26	12,471.93	12,242.15	12,363.86	11,550.17	9,210.07	9,258.86	8,561.14	7,672.68
Memo Items:									
International Bunkers	394.47	412.31	398.61	394.26	500.14	566.92	615.99	736.93	893.35
Aviation	394.41	412.24	398.54	394.16	500.06	566.83	615.91	736.85	893.27
Marine	0.07	0.07	0.07	0.09	0.08	0.08	0.08	0.08	0.08
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO2 Emissions from Biomass	159.05	160.93	163.73	159.33	157.46	153.78	135.56	146.84	139.67

Note: All footnotes for this table are given on sheet 3.

Table 1 (a)

LUX_BR1_v1.0

Emission trends (CO_2)

(Sheet 2 of 3)

CRF: LUX_CRF__ v1.2

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt
1. Energy	7,367.10	8,044.96	8,618.22	9,362.76	9,826.51	11,155.43	11,437.08	11,246.69	10,669.85	10,561.18
A. Fuel Combustion (Sectoral Approach)	7,367.06	8,044.92	8,618.18	9,362.70	9,826.45	11,155.36	11,437.01	11,246.62	10,669.79	10,561.12
1. Energy Industries	159.47	117.30	280.45	1,026.00	1,033.84	1,259.19	1,239.90	1,303.67	1,179.86	995.47
2. Manufacturing Industries and Construction	1,523.45	1,438.07	1,573.45	1,494.99	1,413.82	1,584.47	1,557.81	1,627.49	1,516.69	1,403.63
3. Transport	4,135.64	4,778.73	4,997.46	5,144.68	5,579.80	6,524.35	6,919.22	6,617.02	6,352.36	6,486.70
4. Other Sectors	1,505.30	1,699.22	1,743.69	1,684.14	1,795.96	1,787.35	1,720.08	1,698.43	1,620.88	1,675.32
5. Other	43.21	11.60	23.15	12.90	3.03	NO	NO	NO	NO	NO
B. Fugitive Emissions from Fuels	0.04	0.04	0.04	0.06	0.06	0.07	0.07	0.07	0.07	0.07
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	0.04	0.04	0.04	0.06	0.06	0.07	0.07	0.07	0.07	0.07
2. Industrial Processes	699.04	725.78	667.88	683.72	623.60	665.82	657.91	710.42	699.74	635.71
A. Mineral Products	551.34	579.74	513.12	528.32	471.66	513.37	504.99	500.63	496.26	466.41
B. Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal Production	147.70	146.05	154.76	155.40	151.94	152.45	152.92	209.79	203.49	169.30
D. Other Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Production of Halocarbons and SF6										
F. Consumption of Halocarbons and SF6										
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	11.11	9.99	11.12	11.28	11.29	13.24	12.86	12.14	12.98	12.21
4. Agriculture										
A. Enteric Fermentation										
B. Manure Management										
C. Rice Cultivation										
D. Agricultural Soils										
E. Prescribed Burning of Savannas										
F. Field Burning of Agricultural Residues										
G. Other										
5. Land Use, Land-Use Change and Forestry	-321.66	-388.23	-454.36	-454.03	-462.48	-417.22	-388.35	-278.26	-275.82	-274.96
A. Forest Land	-540.90	-557.07	-623.71	-624.13	-632.61	-587.07	-559.81	-448.98	-446.69	-445.73
B. Cropland	35.01	31.32	30.85	30.59	29.63	28.37	28.98	27.25	26.41	25.32
C. Grassland	31.64	7.67	9.81	11.95	14.09	16.23	18.36	20.50	22.64	24.78
D. Wetlands	12.27	10.77	10.67	10.56	10.46	10.35	10.25	10.14	10.04	9.94
E. Settlements	138.93	118.35	117.34	116.32	115.31	114.30	113.29	112.27	111.26	110.25
F. Other Land	1.40	0.72	0.69	0.66	0.64	0.61	0.58	0.55	0.52	0.49
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO
A. Solid Waste Disposal on Land	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
B. Waste-water Handling										
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
7. Other (as specified in the summary table in CRF)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total CO2 emissions including net CO2 from LULUCF	7,755.59	8,392.51	8,842.86	9,603.74	9,998.92	11,417.27	11,719.50	11,691.00	11,106.76	10,934.14
Total CO2 emissions excluding net CO2 from LULUCF	8,077.25	8,780.74	9,297.22	10,057.77	10,461.40	11,834.49	12,107.85	11,969.26	11,382.58	11,209.10
Memo Items:										
International Bunkers	1,007.92	960.64	1,039.00	1,125.70	1,172.70	1,275.99	1,296.51	1,213.34	1,304.18	1,312.81
Aviation	1,007.83	960.53	1,038.90	1,125.59	1,172.59	1,275.88	1,296.37	1,213.19	1,304.06	1,312.68
Marine	0.09	0.10	0.10	0.11	0.11	0.11	0.14	0.15	0.12	0.13
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO2 Emissions from Biomass	148.82	149.63	163.83	163.75	181.66	201.03	295.32	301.33	446.75	460.47

Note: All footnotes for this table are given on sheet 3.

Table 1(a) LUX_BR1_v1.0

Emission trends (CO_2)

(Sheet 3 of 3)

CRF: LUX_CRF__ v1.2

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2009	2010	2011	Change from base to latest reported year
	kt	kt	kt	%
1. Energy	10,124.52	10,659.69	10,518.21	1.85
A. Fuel Combustion (Sectoral Approach)	10,124.46	10,659.62	10,518.15	1.85
1. Energy Industries	1,190.99	1,203.21	990.79	2,876.48
2. Manufacturing Industries and Construction	1,338.73	1,408.03	1,270.55	-79.79
3. Transport	5,937.12	6,306.84	6,760.34	152.96
4. Other Sectors	1,657.61	1,741.54	1,496.47	14.26
5. Other	NO	NO	NO	-100.00
B. Fugitive Emissions from Fuels	0.07	0.07	0.06	141.19
1. Solid Fuels	NO	NO	NO	0.00
2. Oil and Natural Gas	0.07	0.07	0.06	141.19
2. Industrial Processes	568.81	586.18	596.56	-62.91
A. Mineral Products	440.16	452.57	472.70	-24.18
B. Chemical Industry	NO	NO	NO	0.00
C. Metal Production	128.66	133.61	123.86	-87.42
D. Other Production	NO	NO	NO	0.00
E. Production of Halocarbons and SF6				
F. Consumption of Halocarbons and SF6				
G. Other	NA	NA	NA	0.00
3. Solvent and Other Product Use	11.33	9.47	10.81	-26.16
4. Agriculture				
A. Enteric Fermentation				
B. Manure Management				
C. Rice Cultivation				
D. Agricultural Soils				
E. Prescribed Burning of Savannas				
F. Field Burning of Agricultural Residues				
G. Other				
5. Land Use, Land-Use Change and Forestry	-299.03	-297.83	-296.74	-186.04
A. Forest Land	-471.13	-470.16	-469.19	-471.79
B. Cropland	25.66	24.89	24.02	-30.32
C. Grassland	26.92	29.05	31.19	-1.41
D. Wetlands	9.83	9.73	9.62	-21.56
E. Settlements	109.23	108.22	107.21	-22.83
F. Other Land	0.46	0.44	0.41	-70.84
G. Other	NE	NE	NE	0.00
6. Waste	IE, NA, NO	IE, NA, NO	IE, NA, NO	0.00
A. Solid Waste Disposal on Land	NA, NO	NA, NO	NA, NO	0.00
B. Waste-water Handling				
C. Waste Incineration	IE	IE	IE	0.00
D. Other	NO	NO	NO	0.00
7. Other (as specified in the summary table in CRF)	NA	NA	NA	0.00
Total CO2 emissions including net CO2 from LULUCF	10,405.63	10,957.51	10,828.84	-11.93
Total CO2 emissions excluding net CO2 from LULUCF	10,704.66	11,255.34	11,125.58	-6.90
Memo Items:				
International Bunkers	1,257.71	1,285.94	1,219.01	209.02
Aviation	1,257.60	1,285.83	1,218.88	209.04
Marine	0.11	0.10	0.13	86.87
Multilateral Operations	NO	NO	NO	0.00
CO2 Emissions from Biomass	446.95	467.17	443.39	178.77

Abbreviations : CRF = common reporting format, LULUCF = land use, land-use change and forestry.

[a] The column "Base year" should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the Conference of the Parties. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

[b] Fill in net emissions/removals as reported in CRF table Summary 1.A of the latest reported inventory year. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

Table 1(b) LUX_BR1_v1.0

Emission trends (CH_4)

(Sheet 1 of 3) CRF: LUX_CRF__ v1.2

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year [a]	1991	1992	1993	1994	1995	1996	1997	1998
	kt	kt	kt	kt	kt	kt	kt	kt	kt
1. Energy	2.30	2.45	2.47	2.46	2.41	2.39	2.50	2.44	2.42
A. Fuel Combustion (Sectoral Approach)	1.52	1.65	1.63	1.59	1.53	1.39	1.40	1.32	1.29
1. Energy Industries	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.04
2. Manufacturing Industries and Construction	0.16	0.16	0.15	0.15	0.15	0.10	0.10	0.08	0.06
3. Transport	0.90	0.98	1.00	0.95	0.94	0.83	0.86	0.79	0.77
4. Other Sectors	0.43	0.48	0.44	0.44	0.41	0.42	0.41	0.41	0.42
5. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	0.77	0.80	0.84	0.87	0.88	1.00	1.09	1.12	1.13
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	0.77	0.80	0.84	0.87	0.88	1.00	1.09	1.12	1.13
2. Industrial Processes	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
A. Mineral Products	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal Production	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
D. Other Production									
E. Production of Halocarbons and SF6									
F. Consumption of Halocarbons and SF6									
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use									
4. Agriculture	16.19	16.46	15.99	16.22	16.11	16.66	16.83	16.70	16.73
A. Enteric Fermentation	12.45	12.41	11.91	12.00	11.90	12.23	12.39	12.14	12.01
B. Manure Management	3.74	4.05	4.08	4.22	4.21	4.42	4.45	4.57	4.72
C. Rice Cultivation	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
D. Agricultural Soils	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE
E. Prescribed Burning of Savannas	NA	NA	NA	NA	NA	NA	NA	NA	NA
F. Field Burning of Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Land Use, Land-Use Change and Forestry	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
A. Forest Land	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Cropland	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Settlements	NE	NE	NE	NE	NE	NE	NE	NE	NE
F. Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	3.49	3.56	3.57	3.55	3.44	3.32	3.20	3.16	3.10
A. Solid Waste Disposal on Land	3.20	3.28	3.30	3.25	3.15	3.03	2.93	2.86	2.76
B. Waste-water Handling	0.29	0.28	0.28	0.27	0.26	0.26	0.25	0.24	0.23
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	NO	NO	NO	0.02	0.03	0.03	0.03	0.06	0.11
7. Other (as specified in the summary table in CRF)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total CH4 emissions including CH4 from LULUCF	21.98	22.47	22.03	22.22	21.95	22.36	22.54	22.30	22.25
Total CH4 emissions excluding CH4 from LULUCF	21.98	22.47	22.03	22.22	21.95	22.36	22.54	22.30	22.25
Memo Items:									
International Bunkers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
Aviation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
Marine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO2 Emissions from Biomass									

Note: All footnotes for this table are given on sheet 3.

Table 1(b) LUX_BR1_v1.0

Emission trends (CH_4)

(Sheet 2 of 3) CRF: LUX_CRF__ v1.2

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt
1. Energy	2.46	2.51	2.65	3.16	3.17	3.40	3.30	3.34	3.06	2.93
A. Fuel Combustion (Sectoral Approach)	1.29	1.31	1.31	1.26	1.23	1.25	1.19	1.12	0.98	0.94
1. Energy Industries	0.05	0.04	0.05	0.06	0.06	0.07	0.07	0.07	0.07	0.07
2. Manufacturing Industries and Construction	0.07	0.07	0.08	0.07	0.07	0.08	0.11	0.11	0.11	0.10
3. Transport	0.77	0.79	0.76	0.73	0.69	0.69	0.62	0.54	0.44	0.39
4. Other Sectors	0.40	0.41	0.42	0.39	0.40	0.41	0.40	0.39	0.36	0.38
5. Other	0.00	0.00	0.00	0.00	0.00	NO	NO	NO	NO	NO
B. Fugitive Emissions from Fuels	1.17	1.20	1.33	1.91	1.94	2.15	2.11	2.22	2.07	1.98
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	1.17	1.20	1.33	1.91	1.94	2.15	2.11	2.22	2.07	1.98
2. Industrial Processes	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
A. Mineral Products	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal Production	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
D. Other Production										
E. Production of Halocarbons and SF6										
F. Consumption of Halocarbons and SF6										
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use										
4. Agriculture	17.17	16.79	16.75	16.29	15.82	15.60	15.74	15.56	15.68	16.00
A. Enteric Fermentation	12.00	11.84	11.90	11.56	11.22	11.11	11.09	10.98	11.38	11.63
B. Manure Management	5.17	4.94	4.84	4.73	4.60	4.49	4.66	4.58	4.30	4.37
C. Rice Cultivation	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
D. Agricultural Soils	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE
E. Prescribed Burning of Savannas	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F. Field Burning of Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Land Use, Land-Use Change and Forestry	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
A. Forest Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Cropland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Settlements	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
F. Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	3.00	2.95	2.83	2.80	2.82	2.56	2.47	2.41	2.33	2.25
A. Solid Waste Disposal on Land	2.67	2.52	2.43	2.36	2.32	2.07	1.97	1.87	1.81	1.70
B. Waste-water Handling	0.22	0.21	0.21	0.20	0.19	0.19	0.18	0.18	0.18	0.16
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	0.11	0.21	0.20	0.24	0.31	0.30	0.32	0.36	0.34	0.39
7. Other (as specified in the summary table in CRF)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total CH4 emissions including CH4 from LULUCF	22.63	22.24	22.23	22.26	21.80	21.56	21.51	21.31	21.06	21.18
Total CH4 emissions excluding CH4 from LULUCF	22.63	22.24	22.23	22.26	21.80	21.56	21.51	21.31	21.06	21.18
Memo Items:										
International Bunkers	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Aviation	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Marine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO2 Emissions from Biomass										

Note: All footnotes for this table are given on sheet 3.

Table 1(b) LUX_BR1_v1.0

Emission trends (CH_4)

(Sheet 3 of 3) CRF: LUX_CRF__ v1.2

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2009	2010	2011	Change from base to latest reported year
	kt	kt	kt	%
1. Energy	2.91	3.06	2.68	16.87
A. Fuel Combustion (Sectoral Approach)	0.91	0.90	0.82	-46.38
1. Energy Industries	0.07	0.07	0.07	79.11
2. Manufacturing Industries and Construction	0.09	0.10	0.09	-41.46
3. Transport	0.35	0.32	0.32	-64.69
4. Other Sectors	0.40	0.42	0.34	-20.49
5. Other	NO	NO	NO	-100.00
B. Fugitive Emissions from Fuels	2.00	2.16	1.87	141.19
1. Solid Fuels	NO	NO	NO	0.00
2. Oil and Natural Gas	2.00	2.16	1.87	141.19
2. Industrial Processes	NA, NO	NA, NO	NA, NO	0.00
A. Mineral Products	NO	NO	NO	0.00
B. Chemical Industry	NO	NO	NO	0.00
C. Metal Production	NA, NO	NA, NO	NA, NO	0.00
D. Other Production				
E. Production of Halocarbons and SF6				
F. Consumption of Halocarbons and SF6				
G. Other	NA	NA	NA	0.00
3. Solvent and Other Product Use				
4. Agriculture	16.16	16.52	16.22	0.18
A. Enteric Fermentation	11.73	11.96	11.63	-6.53
B. Manure Management	4.43	4.56	4.59	22.51
C. Rice Cultivation	NA, NO	NA, NO	NA, NO	0.00
D. Agricultural Soils	NA, NE	NA, NE	NA, NE	0.00
E. Prescribed Burning of Savannas	NA	NA	NA	0.00
F. Field Burning of Agricultural Residues	NO	NO	NO	0.00
G. Other	NA	NA	NA	0.00
5. Land Use, Land-Use Change and Forestry	NE, NO	NE, NO	NE, NO	0.00
A. Forest Land	NO	NO	NO	0.00
B. Cropland	NO	NO	NO	0.00
C. Grassland	NO	NO	NO	0.00
D. Wetlands	NO	NO	NO	0.00
E. Settlements	NE	NE	NE	0.00
F. Other Land	NO	NO	NO	0.00
G. Other	NE	NE	NE	0.00
6. Waste	2.11	1.99	1.90	-45.42
A. Solid Waste Disposal on Land	1.61	1.49	1.40	-56.06
B. Waste-water Handling	0.15	0.15	0.14	-50.53
C. Waste Incineration	IE	IE	IE	0.00
D. Other	0.35	0.35	0.35	100.00
7. Other (as specified in the summary table in CRF)	NA	NA	NA	0.00
Total CH4 emissions including CH4 from LULUCF	21.19	21.57	20.81	-5.31
Total CH4 emissions excluding CH4 from LULUCF	21.19	21.57	20.81	-5.31
Memo Items:				
International Bunkers	0.01	0.01	0.01	208.76
Aviation	0.01	0.01	0.01	209.04
Marine	0.00	0.00	0.00	86.88
Multilateral Operations	NO	NO	NO	0.00
CO2 Emissions from Biomass				

Abbreviations : CRF = common reporting format, LULUCF = land use, land-use change an

[a] The column "Base year" should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the Conference of the Parties. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

Table 1(c) LUX_BR1_v1.0

Emission trends (N_2O)

(Sheet 1 of 3) CRF: LUX_CRF__ v1.2

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[a]	1991	1992	1993	1994	1995	1996	1997	1998
	kt	kt	kt	kt	kt	kt	kt	kt	kt
1. Energy	0.18	0.21	0.24	0.25	0.27	0.25	0.26	0.28	0.29
A. Fuel Combustion (Sectoral Approach)	0.18	0.21	0.24	0.25	0.27	0.25	0.26	0.28	0.29
1. Energy Industries	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01
2. Manufacturing Industries and Construction	0.05	0.05	0.06	0.05	0.05	0.05	0.05	0.05	0.05
3. Transport	0.10	0.13	0.16	0.17	0.18	0.18	0.19	0.20	0.20
4. Other Sectors	0.01	0.02	0.02	0.01	0.02	0.01	0.02	0.02	0.02
5. Other	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01
B. Fugitive Emissions from Fuels	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
2. Industrial Processes	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
A. Mineral Products	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal Production	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. Other Production									
E. Production of Halocarbons and SF6									
F. Consumption of Halocarbons and SF6									
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02
4. Agriculture	1.30	1.31	1.32	1.27	1.22	1.24	1.26	1.23	1.21
A. Enteric Fermentation									
B. Manure Management	0.13	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.09
C. Rice Cultivation									
D. Agricultural Soils	1.17	1.19	1.22	1.16	1.12	1.14	1.16	1.13	1.12
E. Prescribed Burning of Savannas	NA	NA	NA	NA	NA	NA	NA	NA	NA
F. Field Burning of Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Land Use, Land-Use Change and Forestry	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
A. Forest Land	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Cropland	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Settlements	NE	NE	NE	NE	NE	NE	NE	NE	NE
F. Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04
A. Solid Waste Disposal on Land									
B. Waste-water Handling	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	NO	NO	NO	0.00	0.00	0.00	0.00	0.00	0.01
7. Other (as specified in the summary table in CRF)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total N2O emissions including N2O from LULUCF	1.55	1.59	1.63	1.59	1.55	1.56	1.59	1.58	1.57
Total N2O emissions excluding N2O from LULUCF	1.54	1.58	1.62	1.58	1.54	1.55	1.58	1.57	1.56
Memo Items:									
International Bunkers	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02
Aviation	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02
Marine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO2 Emissions from Biomass									

Note: All footnotes for this table are given on sheet 3.

Table 1(c) LUX_BR1_v1.0

Emission trends (N_2O)

(Sheet 2 of 3) CRF: LUX_CRF__ v1.2

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt
1. Energy	0.29	0.29	0.31	0.32	0.38	0.42	0.42	0.39	0.38	0.37
A. Fuel Combustion (Sectoral Approach)	0.29	0.29	0.31	0.32	0.38	0.42	0.42	0.39	0.38	0.37
1. Energy Industries	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
2. Manufacturing Industries and Construction	0.05	0.04	0.04	0.06	0.11	0.11	0.11	0.10	0.10	0.08
3. Transport	0.21	0.23	0.23	0.23	0.24	0.26	0.27	0.25	0.24	0.25
4. Other Sectors	0.01	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
5. Other	0.01	0.00	0.00	0.00	0.00	NO	NO	NO	NO	NO
B. Fugitive Emissions from Fuels	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
2. Industrial Processes	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
A. Mineral Products	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. Other Production										
E. Production of Halocarbons and SF6										
F. Consumption of Halocarbons and SF6										
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.02
4. Agriculture	1.21	1.19	1.11	1.11	1.02	1.13	1.06	1.04	1.05	1.05
A. Enteric Fermentation										
B. Manure Management	0.08	0.08	0.08	0.07	0.07	0.07	0.07	0.07	0.08	0.08
C. Rice Cultivation										
D. Agricultural Soils	1.13	1.11	1.03	1.04	0.94	1.06	0.98	0.97	0.96	0.97
E. Prescribed Burning of Savannas	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F. Field Burning of Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Land Use, Land-Use Change and Forestry	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
A. Forest Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Cropland	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Settlements	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
F. Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	0.04	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06
A. Solid Waste Disposal on Land										
B. Waste-water Handling	0.03	0.03	0.04	0.03	0.03	0.04	0.04	0.04	0.04	0.04
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.02	0.03
7. Other (as specified in the summary table in CRF)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total N2O emissions including N2O from LULUCF	1.57	1.56	1.49	1.51	1.48	1.63	1.55	1.52	1.51	1.50
Total N2O emissions excluding N2O from LULUCF	1.56	1.55	1.48	1.51	1.47	1.62	1.54	1.51	1.51	1.49
Memo Items:										
International Bunkers	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.03	0.04	0.04
Aviation	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.03	0.04	0.04
Marine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO2 Emissions from Biomass										

Note: All footnotes for this table are given on sheet 3.

Table 1(c) LUX_BR1_v1.0

Emission trends (N_2O)

(Sheet 3 of 3) CRF: LUX_CRF__ v1.2

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2009	2010	2011	Change from base to latest reported year
	kt	kt	kt	%
1. Energy	0.36	0.37	0.37	109.57
A. Fuel Combustion (Sectoral Approach)	0.36	0.37	0.37	109.57
1. Energy Industries	0.01	0.01	0.01	67.91
2. Manufacturing Industries and Construction	0.09	0.09	0.07	29.73
3. Transport	0.23	0.24	0.26	175.67
4. Other Sectors	0.03	0.04	0.03	100.45
5. Other	NO	NO	NO	-100.00
B. Fugitive Emissions from Fuels	NA, NO	NA, NO	NA, NO	0.00
1. Solid Fuels	NO	NO	NO	0.00
2. Oil and Natural Gas	NA, NO	NA, NO	NA, NO	0.00
2. Industrial Processes	NA, NO	NA, NO	NA, NO	0.00
A. Mineral Products	NO	NO	NO	0.00
B. Chemical Industry	NO	NO	NO	0.00
C. Metal Production	NA	NA	NA	0.00
D. Other Production				
E. Production of Halocarbons and SF6				
F. Consumption of Halocarbons and SF6				
G. Other	NA	NA	NA	0.00
3. Solvent and Other Product Use	0.02	0.02	0.02	-46.40
4. Agriculture	1.07	1.07	1.04	-19.89
A. Enteric Fermentation				
B. Manure Management	0.08	0.08	0.08	-39.37
C. Rice Cultivation				
D. Agricultural Soils	0.99	0.98	0.96	-17.66
E. Prescribed Burning of Savannas	NA	NA	NA	0.00
F. Field Burning of Agricultural Residues	NO	NO	NO	0.00
G. Other	NA	NA	NA	0.00
5. Land Use, Land-Use Change and Forestry	0.01	0.01	0.01	-10.72
A. Forest Land	NO	NO	NO	0.00
B. Cropland	0.01	0.01	0.01	-10.72
C. Grassland	NO	NO	NO	0.00
D. Wetlands	NO	NO	NO	0.00
E. Settlements	NE	NE	NE	0.00
F. Other Land	NO	NO	NO	0.00
G. Other	NE	NE	NE	0.00
6. Waste	0.06	0.06	0.06	98.98
A. Solid Waste Disposal on Land				
B. Waste-water Handling	0.04	0.03	0.03	14.79
C. Waste Incineration	IE	IE	IE	0.00
D. Other	0.03	0.02	0.03	100.00
7. Other (as specified in the summary table in CRF)	NA	NA	NA	0.00
Total N2O emissions including N2O from LULUCF	1.52	1.52	1.49	-3.34
Total N2O emissions excluding N2O from LULUCF	1.51	1.52	1.49	-3.30
Memo Items:				
International Bunkers	0.04	0.04	0.03	209.02
Aviation	0.04	0.04	0.03	209.04
Marine	0.00	0.00	0.00	86.88
Multilateral Operations	NO	NO	NO	0.00
CO2 Emissions from Biomass				

Abbreviations: CRF = common reporting format, LULUCF = land use, land-use change an

[a] The column "Base year" should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the Conference of the Parties. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

Table 1(d) LUX_BR1_v1.0

Emission trends (HFCs, PFCs and SF_6)

(Sheet 1 of 3) CRF: LUX_CRF__ v1.2

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	*Base year [a]*	1991	1992	1993	1994	1995	1996	1997	1998
	kt	kt	kt	kt	kt	kt	kt	kt	kt
Emissions of HFCsc - (kt CO2 eq)	12.01	12.01	12.21	12.93	13.68	15.59	15.91	17.17	19.99
HFC-23	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
HFC-32	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	0.00	0.00	0.00	0.00
HFC-41	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
HFC-43-10mee	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
HFC-125	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	0.00	0.00	0.00	0.00
HFC-134	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
HFC-134a	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
HFC-152a	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-143	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
HFC-143a	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	0.00	0.00	0.00	0.00
HFC-227ea	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
HFC-236fa	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
HFC-245ca	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
Unspecified mix of listed HFCsd - (kt CO_2 eq)	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
Emissions of PFCsc - (kt CO2 eq)	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
CF_4	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
C_2F_6	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
C 3F8	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
C_4F_{10}	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
c-C_4F_8	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
C_5F_{12}	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
C_6F_{14}	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
Unspecified mix of listed PFCs(4) - (Gg CO_2 equivalent)	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
Emissions of SF6(3) - (Gg CO2 equivalent)	1.13	1.21	1.29	1.37	1.46	1.55	1.71	1.87	1.97
SF_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: All footnotes for this table are given on sheet 3.

Table 1(d) LUX_BR1_v1.0

Emission trends (HFCs, PFCs and SF_6)

(Sheet 2 of 3) CRF: LUX_CRF__ v1.2

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt
Emissions of HFCsc - (kt CO2 eq)	23.96	28.62	34.15	41.86	46.76	49.18	53.01	56.91	61.11	63.46
HFC-23	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
HFC-32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-41	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
HFC-43-10mee	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
HFC-125	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
HFC-134	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
HFC-134a	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
HFC-152a	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-143	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
HFC-143a	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-227ea	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
HFC-236fa	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
HFC-245ca	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
Unspecified mix of listed HFCsd - (kt CO_2 eq)	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
Emissions of PFCsc - (kt CO2 eq)	NA, NO	0.01	0.01	0.01	0.02	0.11	0.15	0.17	0.21	0.24
CF_4	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
C_2F_6	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
C 3F8	NA, NO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C_4F_{10}	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
c-C_4F_8	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
C_5F_{12}	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
C_6F_{14}	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
Unspecified mix of listed PFCs(4) - (Gg CO_2 equivalent)	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
Emissions of SF6(3) - (Gg CO2 equivalent)	2.05	2.15	2.82	3.37	4.09	4.60	5.04	5.71	6.15	6.57
SF_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: All footnotes for this table are given on sheet 3.

Table 1(d) LUX_BR1_v1.0

Emission trends (HFCs, PFCs and SF_6)

(Sheet 3 of 3) CRF: LUX_CRF__ v1.2

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	*2009*	2010	2011	Change from base to latest reported year
	kt	kt	kt	%
Emissions of HFCsc - (kt CO2 eq)	65.54	66.47	67.00	457.88
HFC-23	NA, NO	NA, NO	NA, NO	0.00
HFC-32	0.00	0.00	0.00	100.00
HFC-41	NA, NO	NA, NO	NA, NO	0.00
HFC-43-10mee	NA, NO	NA, NO	NA, NO	0.00
HFC-125	0.01	0.01	0.01	100.00
HFC-134	NA, NO	NA, NO	NA, NO	0.00
HFC-134a	0.02	0.03	0.03	173.54
HFC-152a	0.00	0.00	0.00	442.39
HFC-143	NA, NO	NA, NO	NA, NO	0.00
HFC-143a	0.00	0.00	0.00	100.00
HFC-227ea	NA, NO	NA, NO	NA, NO	0.00
HFC-236fa	NA, NO	NA, NO	NA, NO	0.00
HFC-245ca	NA, NO	NA, NO	NA, NO	0.00
Unspecified mix of listed HFCsd - (kt CO_2 eq)	NA, NO	NA, NO	NA, NO	0.00
Emissions of PFCsc - (kt CO2 eq)	0.22	0.20	0.18	100.00
CF_4	NA, NO	NA, NO	NA, NO	0.00
C_2F_6	NA, NO	NA, NO	NA, NO	0.00
C 3F8	0.00	0.00	0.00	100.00
C_4F_{10}	NA, NO	NA, NO	NA, NO	0.00
c-C_4F_8	NA, NO	NA, NO	NA, NO	0.00
C_5F_{12}	NA, NO	NA, NO	NA, NO	0.00
C_6F_{14}	NA, NO	NA, NO	NA, NO	0.00
Unspecified mix of listed PFCs(4) - (Gg CO_2 equivalent)	NA, NO	NA, NO	NA, NO	0.00
Emissions of SF6(3) - (Gg CO2 equivalent)	7.00	7.39	7.75	587.66
SF_6	0.00	0.00	0.00	587.66

Abbreviations : CRF = common reporting format, LULUCF = land use, land-use change and forestry.

[a] The column “Base year” should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the Conference of the Parties. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

[c]Enter actual emissions estimates. If only potential emissions estimates are available, these should be reported in this table and an indication for this be provided in the documentation box. Only in these rows are the emissions expressed as CO2 equivalent emissions.

[d]In accordance with the “Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories”, HFC and PFC emissions should be reported for each relevant chemical. However, if it is not possible to report values for each chemical (i.e. mixtures, confidential data, lack of disaggregation), this row could be used for reporting aggregate figures for HFCs and PFCs, respectively. Note that the unit used for this row is kt of CO2 equivalent and that appropriate notation keys should be entered in the cells for the individual chemicals.)

Table 2(a) LUX_BR1_v1.0

Description of quantified economy-wide emission reduction target: base year[a]

Party	*Luxembourg*	
Base year /base period	1990	
Emission reduction target	% of base year/base period	% of 1990 [b]
	-20.00	-20.00
Period for reaching target	BY-2020	

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

[b] Optional.

Table 2(b) LUX_BR1_v1.0

Description of quantified economy-wide emission reduction target: gases and sectors covered[a]

Gases covered		*Base year for each gas (year):*
CO_2		1990
CH_4		1990
N_2O		1990
HFCs		1990
PFCs		1990
SF_6		1990
NF_3		1990
Other Gases (specify)		
Sectors covered[b]	Energy	Yes
	Transport[f]	Yes
	Industrial processes[g]	Yes
	Agriculture	Yes
	LULUCF	No
	Waste	Yes
	Other Sectors (specify)	

Abbreviations : LULUCF = land use, land-use change and forestry.

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

[b] More than one selection will be allowed. If Parties use sectors other than those indicated above, the explanation of how these sectors relate to the sectors defined by the IPCC should be provided.

[f] Transport is reported as a subsector of the energy sector.

[g] Industrial processes refer to the industrial processes and solvent and other product use sectors.

Table 2(c) LUX_BR1_v1.0

Description of quantified economy-wide emission reduction target: global warming potential values (GWP)[a]

Gases	*GWP values* [b]
CO_2	2nd AR
CH_4	2nd AR
N_2O	2nd AR
HFCs	2nd AR
PFCs	2nd AR
SF_6	2nd AR
NF_3	2nd AR
Other Gases (specify)	

Abbreviations : GWP = global warming potential

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

[b] Please specify the reference for the GWP: Second Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) or the Fourth Assessment Report of the IPCC.

Table 2(d) LUX_BR1_v1.0

Description of quantified economy-wide emission reduction target: approach to counting emissions and removals from the LULUCF sector[a]

Role of LULUCF	LULUCF in base year level and target	Excluded
	Contribution of LULUCF is calculated using	

Abbreviation : LULUCF = land use, land-use change and forestry.

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

Table 2(e)I LUX_BR1_v1.0

Description of quantified economy-wide emission reduction target: market-based mechanisms under the Convention[a]

Market-based mechanisms under the Convention	*Possible scale of contributions (estimated kt CO_2 eq)*
CERs	NE
ERUs	NE
AAUs[i]	NE
Carry-over units[j]	NE
Other mechanism units under the Convention (specify)[d]	

Abbreviations : AAU = assigned amount unit, CER = certified emission reduction, ERU = emission reduction unit.

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

[d] As indicated in paragraph 5(e) of the guidelines contained in annex I of decision 2/CP.17 .

[i] AAUs issued to or purchased by a Party.

[j] Units carried over from the first to the second commitment periods of the Kyoto Protocol, as described in decision 13/CMP.1 and consistent with decision 1/CMP.8.

Table 2(e)II LUX_BR1_v1.0

Description of quantified economy-wide emission reduction target: other market-based mechanisms[a]

Other market-based mechanisms	*Possible scale of contributions*
(Specify)	*(estimated kt CO_2 eq)*

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

Table 3 LUX_BR1_v1.0

Progress in achievement of the quantified economy-wide emission reduction target: information on mitigation actions and their effects

Name of mitigation action[a]	Sector(s) affected[b]	GHG(s) affected	Objective and/or activity affected	Type of instrument[c]	Status of implementation[d]	Brief description[e]	Start year of implementation	Implementing entity or entities	Estimate of mitigation impact (not cumulative, in kt CO_2 eq) 2015	2020	2025	2030
Transport - road fuels	Transport	CO_2	Reducing road fuel sales.	Fiscal	Planned	Reduce the price differential between Luxembourg and its neighbouring countries with regard to road fuels whilst taking into consideration the impacts on the public finance and the economy in general.	mid-term	MDDI-DEV / MFIN-ADA	NE	NE	NE	NE
Transport - road fuels: biofuels	Transport	CO_2	Increasing the share of biofuels in road fuel sales.	Regulatory	Planned	Increased share of second generation biofuels in road fuel sales so to help achieving the mandatory EU 2020 objective in renewable energy sources assigned to Luxembourg, i.e. 10% renewables in the transportation sector.	2007	MECO-DEN	345.33	550.60	590.20	633.60
Transport – road fuels: alternative means of propulsion	Transport	CO_2	Developing the use of electric and hybrid vehicles as well as of gas powered vehicles / Going on with the "CAR-e" scheme for electric and hybrid vehicles emitting less than 60g CO2/km / Launching an "ecological mobility" label for enterprises using low consumption and emissions vehicles.	Economic|Regulatory|Voluntary Agreement	Implemented	Reaching a share of 10% for electric vehicles in the total number of passenger cars by 2020 (i.e. some 40 000 vehicles). The 2020 objective is also to install 850 electric charging stations and to develop a network of petrol stations offering natural gas / Pursuing the "CAR-e" scheme for electric and hybrid vehicles for the years 2013 and 2014, and terminate it by 2015.	NE	MDDI-DAT / MDDI-DEV / MECO-DEN / ILR / CdT	6.20	172.65	225.12	251.08
Transport – vehicles taxation	Transport	CO_2	Increasing energy efficiency of the vehicle fleet / Setting up an incentive for promoting an offer of company cars that is more environment-friendly.	Other (Fiscal)	Planned	Re-evaluating the car tax with regard to the bonus offered when buying new cars respecting certain criteria. This might not be necessary any more since the "CAR-e" scheme will be discontinued by end 2014 / Examining if it would be relevant to apply an extra tax for high emitting vehicles / Examining different options chosen in other countries to deal with the issue of company cars. Options could be incentives, taxation schemes according to the average emissions rate of a company vehicles fleet, etc.	NE	MDDI-DEV / MFIN-ACD / MFIN-ADA	NE	NE	NE	NE
Transport – public transport & cycling and walking	Transport	CO_2	MoDu Plan objectives of 25% of daily trips by non-motorized traffic (walking & cycling) and 25% of motorized trips by public transport by 2020 / Interlinking real near-time transportation related data to provide users with on-line information at any time.	Regulatory|Information|Voluntary Agreement|Other (Planning)	Implemented	Set of measures aiming at changing the actual mobility patterns towards an increased use of public transportation and non-motorized traffic: land planning, infrastructures, reorganising the public train & busses transport networks to increase intermodal connection, increasing the capacities of public transport (places, frequencies), car-pooling & sharing, favour cycling & walking, raising awareness, providing better & faster information, etc. Always with a trans-border aspect due to the high number of cross-border commuters.	NE	MDDI-DAT / MINT / CdT / CFL / municipalities / foreign neighbouring Regions	NE	NE	NE	NE
Energy supply: alternatives & renewable energy sources	Energy	CO_2	Increasing the share of renewable energy sources, with a focus on the use of biomass, in the electricity and gas networks, whether it is produced by households or enterprises / Developing heat generation (cogeneration) from renewable energy sources.	Economic|Regulatory|Other (Planning)	Implemented	Promoting the supply of renewable energy sources with a focus on biomass (wood, green waste, agricultural waste & sewage sludge), notably via the launch of a financial compensation for the supply of biogas / Reassessment and adaptation of the compensation mechanisms (tariffs) notably to promote heat generation / Better adequacy between planning tools, decision and public information.	NE	MDDI_DEV / MDDI-AEV / MDDI-AGE / MECO-DEN / MAVPC	NE	NE	NE	NE
Energy consumption – energy efficiency: housing	Energy	CO_2	Increasing energy efficiency in the residential sector: old and new constructions / Progressive strengthening of energy efficiency requirements for new residential buildings; the targets are: C/B energy norm in 2012, then reinforcement every two years to reach an "almost zero" energy consumption for new residential buildings by 2018.	Economic|Fiscal|Regulatory|Education|Information|Other (Planning)	Implemented	Better planning for the development of new residential areas / Adapting subsidies and other fiscal measures for residential buildings (new & renovated), notably to the energy efficiency performance of the construction and to sustainable development criteria.	NE	MDDI-DEV / MECO-DEN / MLOG / MFIN / MFIN-ACD / MTEES / MFIGR / myenergy	0.00	0.00	29.50	66.34
Energy consumption – renewable energy sources: housing	Energy	CO_2	Increasing the share of renewable energy sources in the residential sector related energy final consumption.	Economic|Regulatory|Education|Information	Implemented	Adapting subsidies and other fiscal measures for residential buildings (new & renovated), notably to sustainable development criteria, and reinforcing minimum standards for obtaining subsidies.	NE	MDDI-DEV MECO-DEN MLOG MFIN MTEES MFIGR myenergy	NE	NE	NE	NE
Energy consumption – energy efficiency: public & commercial services, retail	Energy	CO_2	Increasing energy efficiency in the commercial/institutional sector: old and new constructions with the aim of reaching "near zero" passive buildings by 2020.	Regulatory|Voluntary Agreement|Education|Information|Other (Monitoring)	Implemented	Renovating public buildings so that they become more energy efficient, notably by elaborating a measuring concept and the installation of smart meters / Progressive adaptation of energy standards for new commercial and institutional buildings so to reach "nearly zero" energy consumption for new constructions / Promoting "energy contracting" to SMEs operating in the tertiary sector / See also the "Climate Agreement" with municipalities.		MDDI-DEV / MECO-DEN / ABP / CRTE / myenergy / Luxinnovation / OAI / Klima-Bündnis	0.00	0.00	13.50	33.70
Energy consumption – renewable energy sources: public & commercial services, retail	Energy	CO_2	Increasing the share of renewable energy sources in the commercial/institutional sector related energy final consumption.	Regulatory|Education|Information	Implemented	Increasing the use of renewable energy sources in public buildings located in municipalities / See also the "Climate Agreement" with municipalities.		MDDI-DEV / MECO-DEN / myenergy	NE	NE	NE	NE
Energy consumption – energy efficiency: manufacturing industries	Industry/industrial processes	CO_2	Increasing energy efficiency in the manufacturing industry sector.	Voluntary Agreement|Education|Information	Implemented	Developing of the use of cross-cutting technologies and their energy savings potential / Assessing incentives to save energy and their effect on the installations / Various projects aiming at a better deployment of energy efficiency projects in industries and SMEs through education / Voluntary agreement FEDIL - State.	NE	MDDI-DEV / MECO-DEN / MECO-DCM / CRTE / myenergy / Luxinnovation / OAI / Klima-Bündnis	NE	NE	NE	NE
Energy consumption – renewable energy sources: manufacturing industries	Industry/industrial processes	CO_2	Increasing the share of renewable energy sources in the manufacturing industry sector related energy final consumption.	Regulatory|Education|Information	Implemented	Increasing the use of renewable energy sources in manufacturing industries (combustion, processes).	NE	MDDI-DEV / MECO-DCM / MECO-DEN / myenergy	NE	NE	NE	NE
EU ETS	Industry/industrial processes	CO_2	Increasing energy efficiency in companies under the EU ETS.	Voluntary Agreement	Implemented	Assessing incentives to save energy and their effect on the installations / Voluntary agreement FEDIL - State.	1996	MDDI-DEV / MECO-DEN	NE	NE	NE	NE
Municipalities ("Pacte Climat" - "Climate Agreement")	Energy	CO_2	Improving energy efficiency and the use of renewable energy sources in municipal buildings.	Regulatory	Implemented	Increasing energy efficiency of public buildings located in municipalities, as well as the use of renewable energy sources / Nominating advisers so to help municipalities to implement the "Climate Agreement" / Implementing and following-up the "Climate Agreement", notably by making data collection compulsory with regard to energy consumption and related emissions.	2013	MDDI-DEV / MECO-DEN / MINT / SIGI / Syvicol	NE	NE	NE	NE
Agriculture, land use & forestry	Agriculture, Forestry/LULUCF	CO_2, N_2O	Increasing carbon storage by forests and in cultivated land.	Regulatory|Other (Research)|Other (Planning)	Planned	Developing agro-forestry activities which consist in mixing agricultural activities (crops, livestock) and trees so to combine economic (agriculture) and ecological (environment protection, climate change mitigation) conditions / Implementing new findings and approaches so to increase the "carbon sink" role of the forests and of cultivated land, alongside with techniques aiming at reducing soil erosion.	2014	MDDI-ANF / MAVPC / MAVPC-ASTA	NE	NE	NE	NE
Innovation & research	Cross-cutting	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3	Promoting eco-technologies in the fields of invention and innovation.	Other (Research)	Implemented	Suggesting a better use of public financial supports for the promotion and the use of eco-technologies, as well as supporting sectors and businesses operating in eco-technologies.	NE	MDDI-DEV / MECE-DEN / MESR / Luxinnovation / Public Research Centres	NA	NA	NA	NA
Taxation (excl. road fuels)	Cross-cutting	CO_2, CH_4, N_2O	Setting up a legal framework for environmentally harmful subsidies.	Regulatory	Implemented	Analysing the different subsidies in conjunction with their possible harmful impacts on the environment.	2013	MDDI-DEV / MFIN	NA	NA	NA	NA
Education, information, awareness, advices	Energy, Transport	CO_2	Training, education and awareness rising in the fields of energy efficiency, renewable energy sources and transportation.	Regulatory|Education|Information	Implemented	Promoting and diffusing information, notably on energy efficient and ecological construction and renovation, and on their their advantages / Development of advices and support to industry and SMEs concerning energy efficiency and the usage of renewable energy sources / Enhancing capacities and knowledge amongst the construction companies through various learning schemes / Ensuring that myenergy can fulfil all its missions. Use of new communication tools to increase attractiveness for public transport.	NE	MDDI-DAT / MDDI-DEV / MECO-DEN / MECO-DCM / MLOG / MTEES / MFIGR / CdT / myenergy	NA	NA	NA	NA
Governance	Cross-cutting	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3	Increasing the governance of the energy and climate change related activities in Luxembourg: "good governance" actions.	Regulatory|Information|Other (Monitoring)	Implemented	Giving a future, clear perspectives and a legal framework to the work and functioning of the "Environment and Climate Partnership" / Regular follow-up of the Action Plan so to initiate, if applicable, corrective or revised measures / Thorough monitoring of the measures taken in the framework of the "Climate Agreement" / Development of statistical and econometric work on energy consumption and related emissions: projections, ex ante & ex post evaluations of P&Ms (emissions, abatement costs), etc.	2013	MDDI-DEV / MECO-DEN / STATEC / SIGI	NA	NA	NA	NA
Other measures	Energy, Transport	CO_2	Promoting sustainable and environment-friendly public purchases and procurements, as well in public planning.	Information|Education|Other (Planning)|Other (Monitoring)	Implemented	Establishing rules for sustainable public procurements and to monitor them.	2013	MDDI-DEV / MECO-DEN	NA	NA	NA	NA

Note: The two final columns specify the year identified by the Party for estimating impacts (based on the status of the measure and whether an ex post or ex ante estimation is available).

Abbreviations: GHG = greenhouse gas; LULUCF = land use, land-use change and forestry.

[a] Parties should use an asterisk (*) to indicate that a mitigation action is included in the 'with measures' projection.

[b] To the extent possible, the following sectors should be used: energy, transport, industry/industrial processes, agriculture, forestry/LULUCF, waste management/waste, other sectors, cross-cutting, as appropriate.

[c] To the extent possible, the following types of instrument should be used: economic, fiscal, voluntary agreement, regulatory, information, education, research, other.

[d] To the extent possible, the following descriptive terms should be used to report on the status of implementation: implemented, adopted, planned.

[e] Additional information may be provided on the cost of the mitigation actions and the relevant timescale.

[f] Optional year or years deemed relevant by the Party.

Custom Footnotes

Abbreviations in the column "Implementing entity or entities" are described under Table IV.3-1 of the NC6 (p. 178-179).

Table 4 LUX_BR1_v1.0

Reporting on progress[a, b]

	Total emissions excluding LULUCF	*Contribution from LULUCF*[d]	*Quantity of units from market based mechanisms under the Convention*		*Quantity of units from other market based mechanisms*	
Year[c]	*(kt CO_2 eq)*	*(kt CO_2 eq)*	*(number of units)*	*(kt CO_2 eq)*	*(number of units)*	*(kt CO_2 eq)*
(1990)	13,167.50	NA	NA	NA		
2008	12,187.60	64.54	NO	NO		
2009	11,689.99	63.38	NO	NO		
2010	12,252.09	47.11	4,280,589.00	4,280.58		
2011	12,097.92	30.84	2,252,662.00	2,252.65		
2012	12,157.45	NE	2,052,211.00	2,052.20		

Abbreviation : GHG = greenhouse gas, LULUCF = land use, land-use change and forestry.

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

[b] For the base year, information reported on the emission reduction target shall include the following: (a) total GHG emissions, excluding emissions and removals from the LULUCF sector; (b) emissions and/or removals from the LULUCF sector based on the accounting approach applied taking into consideration any relevant decisions of the Conference of the Parties and the activities and/or land that will be accounted for; (c) total GHG emissions, including emissions and removals from the LULUCF sector. For each reported year, information reported on progress made towards the emission reduction targets shall include, in addition to the information noted in paragraphs 9(a–-c) of the UNFCCC biennial reporting guidelines for developed country Parties, information on the use of units from market-based mechanisms.

[c] Parties may add additional rows for years other than those specified below.

[d] Information in this column should be consistent with the information reported in table 4(a)I or 4(a)II, as appropriate. The Parties for which all relevant information on the LULUCF contribution is reported in table 1 of this common tabular format can refer to table 1.

Table 4(a)I LUX_BR1_v1.0

Progress in achieving the quantified economy-wide emission reduction targets – further information on mitigation actions relevant to the contribution of the land use, land-use change and forestry sector in 2011 [a,b]

As KP Party, Luxembourg filled in Table 4(a)II, but not Table 4(a)I.

Table 4(a)II

Progress in achievement of the quantified economy-wide emission reduction targets – further information on mitigation actions relevant to the counting of emissions and removals from the land use, land-use change and forestry sector in relation to activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol[a,b,c]

GREENHOUSE GAS SOURCE AND SINK ACTIVITIES	*Base year* [d]	*Net emissions/removals* [e]					*Accounting parameters* [h]	*Accounting quantity* [i]
		2008	2009	*2010*	*2011*	Total[g]		
	(kt CO_2 eq)							
A. Article 3.3 activities								
A.1. Afforestation and Reforestation								-357.93
A.1.1. Units of land not harvested since the beginning of the commitment periodj		-76.51	-78.00	-93.80	-109.61	-357.93		-357.93
A.1.2. Units of land harvested since the beginning of the commitment periodj								NO
A.2. Deforestation		141.05	141.38	140.92	140.45	563.80		563.79625
B. Article 3.4 activities								
B.1. Forest Management (if elected)		NA	NA	NA	NA	NA		NA
3.3 offset[k]							205.86918	NA
FM cap[l]							183.33333	NA
B.2. Cropland Management (if elected)	0	NA	NA	NA	NA	NA	0	0
B.3. Grazing Land Management (if elected)	0	NA	NA	NA	NA	NA	0	0
B.4. Revegetation (if elected)	0	NA	NA	NA	NA	NA	0	0

Note: 1 kt CO_2 eq equals 1 Gg CO_2 eq.

Abbreviations: CRF = common reporting format, LULUCF = land use, land-use change and forestry.

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

[b] Developed country Parties with a quantified economy-wide emission reduction target as communicated to the secretariat and contained in document FCCC/SB/2011/INF.1/Rev.1 or any update to that document, that are Parties to the Kyoto Protocol, may use table 4(a)II for reporting of accounting quantities if LULUCF is contributing to the attainment of that target.

[c] Parties can include references to the relevant parts of the national inventory report, where accounting methodologies regarding LULUCF are further described in the documentation box or in the

[d] Net emissions and removals in the Party's base year, as established by decision 9/CP.2.

[e] All values are reported in the information table on accounting for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, of the CRF for the relevant inventory year as reported in the current submission and are automatically entered in this table.

[f] Additional columns for relevant years should be added, if applicable.

[g] Cumulative net emissions and removals for all years of the commitment period reported in the current submission.

[h] The values in the cells "3.3 offset" and "Forest management cap" are absolute values.

[i] The accounting quantity is the total quantity of units to be added to or subtracted from a Party's assigned amount for a particular activity in accordance with the provisions of Article 7, paragraph 4, of the Kyoto Protocol.

[j] In accordance with paragraph 4 of the annex to decision 16/CMP.1, debits resulting from harvesting during the first commitment period following afforestation and reforestation since 1990 shall not be greater than the credits accounted for on that unit of land.

[k] In accordance with paragraph 10 of the annex to decision 16/CMP.1, for the first commitment period a Party included in Annex I that incurs a net source of emissions under the provisions of Article 3 paragraph 3, may account for anthropogenic greenhouse gas emissions by sources and removals by sinks in areas under forest management under Article 3, paragraph 4, up to a level that is equal to the net source of emissions under the provisions of Article 3, paragraph 3, but not greater than 9.0 megatonnes of carbon times five, if the total anthropogenic greenhouse gas emissions by sources and removals by sinks in the managed forest since 1990 is equal to, or larger than, the net source of emissions incurred under Article 3, paragraph 3.

[l] In accordance with paragraph 11 of the annex to decision 16/CMP.1, for the first commitment period of the Kyoto Protocol only, additions to and subtractions from the assigned amount of a Party resulting from Forest management under Article 3, paragraph 4, after the application of paragraph 10 of the annex to decision 16/CMP.1 and resulting from forest management project activities undertaken under Article 6, shall not exceed the value inscribed in the appendix of the annex to decision 16/CMP.1, times five.

Table 4(b) LUX_BR1_v1.0

Reporting on progress[a, b, c]

Units of market based mechanisms			Year 2011	Year 2012
Kyoto Protocol units[d]	Kyoto Protocol units	(number of units)	2,252,662.00	2,052,211.00
		(kt CO_2 eq)	2,252.65	2,052.20
	AAUs	(number of units)	2,065,018.00	1,810,479.00
		(kt CO2 eq)	2,065.01	1,810.47
	ERUs	(number of units)	NO	NO
		(kt CO2 eq)	NO	NO
	CERs	(number of units)	187,644.00	241,732.00
		(kt CO2 eq)	187.64	241.73
	tCERs	(number of units)	NO	NO
		(kt CO2 eq)	NO	NO
	lCERs	(number of units)	NO	NO
		(kt CO2 eq)	NO	NO
Other units[d,e]	Units from market-based mechanisms under the Convention	(number of units)		
		(kt CO_2 eq)		
	Units from other market-based mechanisms	(number of units)		
		(kt CO_2 eq)		
Total		(number of units)	2,252,662.00	2,052,211.00
		(kt CO_2 eq)	2,252.65	2,052.20

Abbreviations : AAUs = assigned amount units, CERs = certified emission reductions, ERUs = emission reduction units, lCERs = long-term certified emission reductions, tCERs = temporary certified emission reductions.

Note: 2011 is the latest reporting year.

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

[b] For each reported year, information reported on progress made towards the emission reduction target shall include, in addition to the information noted in paragraphs 9(a-c) of the reporting guidelines, on the use of units from market-based mechanisms.

[c] Parties may include this information, as appropriate and if relevant to their target.

[d] Units surrendered by that Party for that year that have not been previously surrendered by that or any other Party.

[e] Additional rows for each market-based mechanism should be added, if applicable.

Custom Footnotes

1 unit = 1 t CO2 eq / Disaggregation of use of KP units at annual level is not relevant for the first commitment period of the KP. Hence, NA in the "Comments" column.

Table 5 LUX_BR1_v1.0

Summary of key variables and assumptions used in the projections analysis[a]

Key underlying assumptions		*Historical*[b]							Projected			
Assumption	*Unit*	*1990*	*1995*	2000	2005	2010	2011	2012	2015	2020	2025	2030
Population	*thousands*	384.40	411.60	439.00	469.10	511.80	524.90	537.00	541.11	578.10	600.36	646.74
Total gross inland energy consumption	PJ	144.04	134.63	149.62	190.57	184.55	182.68	177.78	186.44	194.93	205.84	215.60
Energy demand - energy industries	PJ	NE	NE	NE	NE	NE	NE	NE	21.97	22.42	22.64	22.87
Energy demand - industry	PJ	NE	NE	30.60	32.73	32.34	28.92	26.38	22.26	22.63	22.76	22.69
Energy demand - commercial (tertiary)	PJ	NE	NE	17.85	17.49	19.34	18.20	23.52	8.74	8.26	8.16	8.06
Energy demand - residential	PJ	NE	NE	20.09	22.82	22.47	21.01	18.84	16.15	14.83	13.46	12.15
Energy demand - transport	PJ	NE	NE	80.94	117.29	110.03	114.18	108.70	116.71	126.25	138.34	149.41
Net electricity import	*GWh*	3,910.54	4,949.32	5,708.52	3,260.30	4,063.44	4,482.00	4,110.00	3,745.21	3,864.59	3,978.64	3,833.47

[a] Parties should include key underlying assumptions as appropriate.

[b] Parties should include historical data used to develop the greenhouse gas projections reported.

Custom Footnotes

For energy related assumptions, a detail by fuel type is available in the template used by EU Member States to report to the EC on GHG projections and P&Ms. This template is available upon request.

Table 6(a) LUX_BR1_v1.0

Information on updated greenhouse gas projections under a ‘with measures’ scenario[a]

	GHG emissions and removals[b]							GHG emission projections	
	(kt CO_2 eq)							(kt CO_2 eq)	
	Base year (1990)	1990	1995	2000	2005	2010	2011	2020	2030
Sector[d,e]									
Energy	2,636.68	1,404.16	1,528.03	1,873.37	3,026.39	3,013.80	2,546.55	2,696.23	2,494.06
Transport	2,778.54	2,721.07	3,452.79	4,865.33	7,015.96	6,388.14	6,848.96	7,346.75	8,659.28
Industry/industrial processes	6,945.82	7,950.10	4,381.45	2,222.79	2,326.22	2,111.99	1,980.42	2,121.30	2,155.00
Agriculture	756.93	743.20	734.71	721.34	657.76	677.94	663.65	562.33	500.01
Forestry/LULUCF	NA	347.75	-238.10	-385.41	-385.65	-295.26	-294.20	NE	NE
Waste management/waste	49.53	82.48	80.52	77.20	70.04	60.21	58.33	59.13	55.21
Other (specify)									
Gas									
CO_2 emissions including net CO_2 from LULUCF	NA	12,295.16	8,969.12	8,392.51	11,719.50	10,957.51	10,828.84	NA	NA
CO_2 emissions excluding net CO_2 from LULUCF	12,219.20	11,950.26	9,210.07	8,780.74	12,107.85	11,255.34	11,125.58	11,862.76	12,975.36
CH_4 emissions including CH_4 from LULUCF	NA	461.51	469.59	467.14	451.79	452.87	437.00	NA	NA
CH_4 emissions excluding CH_4 from LULUCF	460.04	461.51	469.59	467.14	451.79	452.87	437.00	419.76	376.57
N_2O emissions including N_2O from LULUCF	NA	478.96	483.53	484.19	481.21	472.39	462.95	NA	NA
N_2O emissions excluding N_2O from LULUCF	471.14	476.11	480.68	481.37	478.52	469.83	460.41	414.36	404.20
HFCs	14.21	12.01	15.59	28.62	53.01	66.47	67.00	75.73	84.72
PFCs	NO	NA, NO	NA, NO	0.01	0.15	0.20	0.18	0.24	0.27
SF_6	2.91	1.13	1.55	2.15	5.04	7.39	7.75	12.89	22.43
Other (specify)									
Total with LULUCF[f]	17.12	13,248.77	9,939.38	9,374.62	12,710.70	11,956.83	11,803.72	88.86	107.42
Total without LULUCF	13,167.50	12,901.02	10,177.48	9,760.03	13,096.36	12,252.10	12,097.92	12,785.74	13,863.55

Abbreviations : GHG = greenhouse gas, LULUCF = land use, land-use change and forestry.

[a] In accordance with the “Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part II: UNFCCC reporting guidelines on national communications”, at a minimum Parties shall report a ‘with measures’ scenario, and may report ‘without measures’ and ‘with additional measures’ scenarios. If a Party chooses to report ‘without measures’ and/or ‘with additional measures’ scenarios they are to use tables 6(b) and/or 6(c), respectively. If a Party does not choose to report ‘without measures’ or ‘with additional measures’ scenarios then it should not include tables 6(b) or 6(c) in the biennial report.

[b] Emissions and removals reported in these columns should be as reported in the latest GHG inventory and consistent with the emissions and removals reported in the table on GHG emissions and trends provided in this biennial report. Where the sectoral breakdown differs from that reported in the GHG inventory Parties should explain in their biennial report how the inventory sectors relate to the sectors reported in this table.

[c] 20XX is the reporting due-date year (i.e. 2014 for the first biennial report).

[d] In accordance with paragraph 34 of the “Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part II: UNFCCC reporting guidelines on national communications”, projections shall be presented on a sectoral basis, to the extent possible, using the same sectoral categories used in the policies and measures section. This table should follow, to the extent possible, the same sectoral categories as those listed in paragraph 17 of those guidelines, namely, to the extent appropriate, the following sectors should be considered: energy, transport, industry, agriculture, forestry and waste management.

[e] To the extent possible, the following sectors should be used: energy, transport, industry/industrial processes, agriculture, forestry/LULUCF, waste management/waste, other sectors (i.e. cross-cutting), as appropriate.

[f] Parties may choose to report total emissions with or without LULUCF, as appropriate.

Custom Footnotes

Base year data corresponds to those used for defining Luxembourg's Assigned Amount under the Kyoto Protocol (CP1). These values are extracted from the "Report of the review of the initial report of Luxembourg" (doc. FCCC/IRR/2007/LUX of 14 December 2007 and its associated GHG inventory - submission 2007v3.1). The base year is 1990 except for HFCs, PFCs and SF6 for which the base year is 1995.

CRF 3 is included in "Industry/industrial processes" since it is not possible to enter data for the row "Other (specify)"
!

Table 6(c) LUX_BR1_v1.0

Information on updated greenhouse gas projections under a ‘with additional measures’ scenario[a]

	GHG emissions and removals[b]							GHG emission projections	
	(kt CO_2 eq)							(kt CO_2 eq)	
	Base year (1990)	1990	1995	2000	2005	2010	2011	2020	2030
Sector[d,e]									
Energy	2,636.68	1,404.16	1,528.03	1,873.37	3,026.39	3,013.80	2,546.55	2,696.23	2,393.33
Transport	2,778.54	2,721.07	3,452.79	4,865.33	7,015.96	6,388.14	6,848.96	6,614.98	7,764.17
Industry/industrial processes	6,945.82	7,950.10	4,381.45	2,222.79	2,326.22	2,111.99	1,980.42	2,121.30	2,155.00
Agriculture	756.93	743.20	734.71	721.34	657.76	677.94	663.65	562.33	500.01
Forestry/LULUCF	NA	347.75	-238.10	-385.41	-385.65	-295.26	-294.20	NE	NE
Waste management/waste	49.53	82.48	80.52	77.20	70.04	60.21	58.33	59.13	55.21
Other (specify)									
Gas									
CO_2 emissions including net CO_2 from LULUCF	NA	12,295.16	8,969.12	8,392.51	11,719.50	10,957.51	10,828.84	NA	NA
CO_2 emissions excluding net CO_2 from LULUCF	12,219.20	11,950.26	9,210.07	8,780.74	12,107.85	11,255.34	11,125.58	11,139.51	11,990.64
CH_4 emissions including CH_4 from LULUCF	NA	461.51	469.59	467.14	451.79	452.87	437.00	NA	NA
CH_4 emissions excluding CH_4 from LULUCF	460.04	461.51	469.59	467.14	451.79	452.87	437.00	419.69	375.99
N_2O emissions including N_2O from LULUCF	NA	478.96	483.53	484.19	481.21	472.39	462.95	NA	NA
N_2O emissions excluding N_2O from LULUCF	471.14	476.11	480.68	481.37	478.52	469.83	460.41	405.91	393.66
HFCs	14.21	12.01	15.59	28.62	53.01	66.47	67.00	75.73	84.72
PFCs	NO	NA, NO	NA, NO	0.01	0.15	0.20	0.18	0.24	0.27
SF_6	2.91	1.13	1.55	2.15	5.04	7.39	7.75	12.89	22.43
Other (specify)									
Total with LULUCF[f]	17.12	13,248.77	9,939.38	9,374.62	12,710.70	11,956.83	11,803.72	88.86	107.42
Total without LULUCF	13,167.50	12,901.02	10,177.48	9,760.03	13,096.36	12,252.10	12,097.92	12,053.97	12,867.71

Abbreviations : GHG = greenhouse gas, LULUCF = land use, land-use change and forestry.

[a] In accordance with the “Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part II: UNFCCC reporting guidelines on national communications”, at a minimum Parties shall report a ‘with measures’ scenario, and may report ‘without measures’ and ‘with additional measures’ scenarios. If a Party chooses to report ‘without measures’ and/or ‘with additional measures’ scenarios they are to use tables 6(b) and/or 6(c), respectively. If a Party does not choose to report ‘without measures’ or ‘with additional measures’ scenarios then it should not include tables 6(b) or 6(c) in the biennial report.

[b] Emissions and removals reported in these columns should be as reported in the latest GHG inventory and consistent with the emissions and removals reported in the table on GHG emissions and trends provided in this biennial report. Where the sectoral breakdown differs from that reported in the GHG inventory Parties should explain in their biennial report how the inventory sectors relate to the sectors reported in this table.

[c] 20XX is the reporting due-date year (i.e. 2014 for the first biennial report).

[d] In accordance with paragraph 34 of the “Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part II: UNFCCC reporting guidelines on national communications”, projections shall be presented on a sectoral basis, to the extent possible, using the same sectoral categories used in the policies and measures section. This table should follow, to the extent possible, the same sectoral categories as those listed in paragraph 17 of those guidelines, namely, to the extent appropriate, the following sectors should be considered: energy, transport, industry, agriculture, forestry and waste management.

[e] To the extent possible, the following sectors should be used: energy, transport, industry/industrial processes, agriculture, forestry/LULUCF, waste management/waste, other sectors (i.e. cross-cutting), as appropriate.

[f] Parties may choose to report total emissions with or without LULUCF, as appropriate.

Table 7 LUX_BR1_v1.0

Provision of public financial support: summary information in 2011[a]

Allocation channels	*Year*									
	European euro - EUR					*USD*[b]				
	Core/ general[c]	*Climate-specific*[d]				*Core/ general*[c]	*Climate-specific*[d]			
		Mitigation	*Adaptation*	*Cross-cutting*[e]	*Other*[f]		*Mitigation*	*Adaptation*	*Cross-cutting*[e]	*Other*[f]
Total contributions through multilateral channels:		2,000,000.00	4,028,789.00	1,373,400.00						
Multilateral climate change funds[g]			2,000,000.00	1,373,400.00						
Other multilateral climate change funds[h]										
Multilateral financial institutions, including regional development banks			1,428,795.00							
Specialized United Nations bodies		2,000,000.00	599,994.00							
Total contributions through bilateral, regional and other channels		4,641,230.45	15,781,119.31							
Total		6,641,230.45	19,809,908.31	1,373,400.00						

Abbreviation: USD = United States dollars.

[a] Parties should fill in a separate table for each year, namely 2011 and 2012, where 2014 is the reporting year.

[b] Parties should provide an explanation on methodology used for currency exchange for the information provided in table 7, 7(a) and 7(b) in the box below.

[c] This refers to support to multilateral institutions that Parties cannot specify as climate-specific.

[d] Parties should explain in their biennial reports how they define funds as being climate-specific.

[e] This refers to funding for activities which are cross-cutting across mitigation and adaptation.

[f] Please specify.

[g] Multilateral climate change funds listed in paragraph 17(a) of the "UNFCCC biennial reporting guidelines for developed country Parties" in decision 2/CP.17.

[h] Other multilateral climate change funds as referred in paragraph 17(b) of the "UNFCCC biennial reporting guidelines for developed country Parties" in decision 2/CP.17.

Table 7 LUX_BR1_v1.0

Provision of public financial support: summary information in 2012[a]

Allocation channels	Year									
	European euro - EUR					*USD[b]*				
	Core/ general[c]	*Climate-specific[d]*				*Core/ general[c]*	*Climate-specific[d]*			
		Mitigation	*Adaptation*	*Cross-cutting[e]*	*Other[f]*		*Mitigation*	*Adaptation*	*Cross-cutting[e]*	*Other[f]*
Total contributions through multilateral channels:		1,100,000.00	2,848,562.00	2,541,644.00						
Multilateral climate change funds[g]				1,474,475.00						
Other multilateral climate change funds[h]										
Multilateral financial institutions, including regional development banks		1,100,000.00	2,141,295.00	67,169.00						
Specialized United Nations bodies			707,267.00	1,000,000.00						
Total contributions through bilateral, regional and other channels		11,050,570.32	20,184,476.43							
Total		12,150,570.32	23,033,038.43	2,541,644.00						

Abbreviation: USD = United States dollars.

[a] Parties should fill in a separate table for each year, namely 2011 and 2012, where 2014 is the reporting year.

[b] Parties should provide an explanation on methodology used for currency exchange for the information provided in table 7, 7(a) and 7(b) in the box below.

[c] This refers to support to multilateral institutions that Parties cannot specify as climate-specific.

[d] Parties should explain in their biennial reports how they define funds as being climate-specific.

[e] This refers to funding for activities which are cross-cutting across mitigation and adaptation.

[f] Please specify.

[g] Multilateral climate change funds listed in paragraph 17(a) of the "UNFCCC biennial reporting guidelines for developed country Parties" in decision 2/CP.17.

[h] Other multilateral climate change funds as referred in paragraph 17(b) of the "UNFCCC biennial reporting guidelines for developed country Parties" in decision 2/CP.17.

Table 7(a) LUX_BR1_v1.0

Provision of public financial support: contribution through multilateral channels in 2011[a]

Donor funding	Total amount				Status [b]	Funding source [f]	Financial instrument [f]	Type of support [f, g]	Sector [c]
	Core/general [d]		Climate-specific [e]						
	European euro - EUR	USD	European euro - EUR	USD					
Total contributions through multilateral channels			7,402,189.00						
Multilateral climate change funds [g]			3,373,400.00						
1. Global Environment Facility			1,373,400.00		Provided	ODA	Grant	Cross-cutting	Cross-cutting
2. Least Developed Countries Fund									
3. Special Climate Change Fund									
4. Adaptation Fund			2,000,000.00		Committed	OOF	Grant	Adaptation	Cross-cutting
5. Green Climate Fund									
6. UNFCCC Trust Fund for Supplementary Activities									
7. Other multilateral climate change funds									
Multilateral financial institutions, including regional development banks			1,428,795.00						
1. World Bank									
2. International Finance Corporation									
3. African Development Bank									
4. Asian Development Bank									
5. European Bank for Reconstruction and Development									
6. Inter-American Development Bank									
7. Other			1,428,795.00						
Mekong River Commission			428,795.00		Provided	ODA	Grant	Adaptation	Water and sanitation
GFDRR			1,000,000.00		Provided	OOF	Grant	Adaptation	Cross-cutting
Specialized United Nations bodies			2,599,994.00						
1. United Nations Development Programme			2,000,000.00						
UN-REDD			2,000,000.00		Provided	OOF	Grant	Mitigation	Cross-cutting
2. United Nations Environment Programme									
3. Other			599,994.00						
UN - WFP			599,994.00		Provided	ODA	Grant	Adaptation	Cross-cutting

Abbreviations: ODA = official development assistance, OOF = other official flows.

[a] Parties should fill in a separate table for each year, namely 2011 and 2012, where 2014 is the reporting year.

[b] Parties should explain, in their biennial reports, the methodologies used to specify the funds as provided, committed and/or pledged. Parties will provide the information for as many status categories as appropriate in the following order of priority: provided, committed, pledged.

[c] Parties may select several applicable sectors. Parties may report sectoral distribution, as applicable, under "Other".

[d] This refers to support to multilateral institutions that Parties cannot specify as climate-specific.

[e] Parties should explain in their biennial reports how they define funds as being climate-specific.

[f] Please specify.

[g] Cross-cutting type of support refers to funding for activities which are cross-cutting across mitigation and adaptation.

Provision of public financial support: contribution through multilateral channels in 2012[a]

Donor funding	Total amount				Status[b]	Funding source[f]	Financial instrument[f]	Type of support[f, g]	Sector[c]
	Core/general[d]		Climate-specific[e]						
	European euro - EUR	USD	European euro - EUR	USD					
Total contributions through multilateral channels			6,490,206.00						
Multilateral climate change funds[g]			1,474,475.00						
1. Global Environment Facility			1,474,475.00		Provided	ODA	Grant	Cross-cutting	Cross-cutting
2. Least Developed Countries Fund									
3. Special Climate Change Fund									
4. Adaptation Fund									
5. Green Climate Fund									
6. UNFCCC Trust Fund for Supplementary Activities									
7. Other multilateral climate change funds									
					Provided				
Multilateral financial institutions, including regional development banks			3,308,464.00						
1. World Bank									
2. International Finance Corporation									
3. African Development Bank									
4. Asian Development Bank									
5. European Bank for Reconstruction and Development									
6. Inter-American Development Bank									
7. Other			3,308,464.00						
Mekong River Commission			428,795.00		Provided	ODA	Grant	Adaptation	Water and sanitation
GFDRR			1,000,000.00		Committed	OOF	Grant	Adaptation	Cross-cutting
IUCN - SIDS			1,000,000.00		Provided	OOF	Grant	Mitigation	Energy
ASTM / ARFA			67,169.00		Provided	OOF	Grant	Cross-cutting	Agriculture, Water and sanitation
Climate Focus / 4climate			100,000.00		Committed	OOF	Grant	Mitigation	Cross-cutting
ICRC			312,500.00		Provided	ODA	Grant	Adaptation	Cross-cutting
GFDRR			400,000.00		Provided	ODA	Grant	Adaptation	Agriculture, Water and sanitation
Specialized United Nations bodies			1,707,267.00						
1. United Nations Development Programme			1,000,000.00						
UNDP Yasuni			1,000,000.00		Provided	OOF	Grant	Cross-cutting	Forestry
2. United Nations Environment Programme									
3. Other			707,267.00						
UN Women			157,267.00		Provided	ODA	Grant	Adaptation	Cross-cutting
UNISDR			250,000.00		Provided	ODA	Grant	Adaptation	Cross-cutting
UNHCR			300,000.00		Provided	ODA	Grant	Adaptation	Cross-cutting

Abbreviations: ODA = official development assistance, OOF = other official flows.

[a] Parties should fill in a separate table for each year, namely 2011 and 2012, where 2014 is the reporting year.

[b] Parties should explain, in their biennial reports, the methodologies used to specify the funds as provided, committed and/or pledged. Parties will provide the information for as many status categories as appropriate in the following order of priority: provided, committed, pledged.

[c] Parties may select several applicable sectors. Parties may report sectoral distribution, as applicable, under "Other".

[d] This refers to support to multilateral institutions that Parties cannot specify as climate-specific.

[e] Parties should explain in their biennial reports how they define funds as being climate-specific.

[f] Please specify.

[g] Cross-cutting type of support refers to funding for activities which are cross-cutting across mitigation and adaptation.

Table 7(b) LUX_BR1_v1.0

Provision of public financial support: contribution through bilateral, regional and other channels in 2011[a]

Recipient country/ region/project/programme[b]	*Total amount*		*Status[c]*	*Funding source[g]*	*Financial instrument[g]*	*Type of support[g, h]*	*Sector[d]*	*Additional information[e]*
	Climate-specific[f]							
	European euro - EUR	*USD*						
Total contributions through bilateral, regional and other channels	20,422,349.76							
LDCs / PMA	5,595,782.95		Provided	ODA	Grant	Adaptation	Cross-cutting	
LDCs / PMA	771,559.41		Provided	ODA	Grant	Mitigation	Cross-cutting	
Cape Verde / AOSIS	2,322,893.17		Provided	ODA	Grant	Adaptation	Energy	
Cape Verde / AOSIS	2,322,893.17		Provided	ODA	Grant	Mitigation	Energy	
Kosovo, Montenegro, Vietnam, Nicaragua, Namibia / Other bilateral supports	2,397,992.00		Provided	ODA	Grant	Adaptation	Cross-cutting	
Kosovo, Montenegro, Vietnam, Nicaragua, Namibia / Other bilateral supports	11,921.13		Provided	ODA	Grant	Mitigation	Cross-cutting	
Various countries / Other channels - NGOs	1,243,758.16		Provided	ODA	Grant	Adaptation	Cross-cutting	
Various countries / Other channels - NGOs	485,954.03		Provided	ODA	Grant	Adaptation	Cross-cutting	
Various countries / Other channels - NGOs	231,897.86		Provided	ODA	Grant	Mitigation	Cross-cutting	
Various countries / Other channels - NGOs	3,734,739.00		Provided	ODA	Grant	Adaptation	Cross-cutting	
Various countries / Other channels - NGOs	1,302,958.88		Provided	ODA	Grant	Mitigation	Cross-cutting	

Abbreviations: ODA = official development assistance, OOF = other official flows; USD = United States dollars.

[a] Parties should fill in a separate table for each year, namely 2011 and 2012, where 2014 is the reporting year.

[b] Parties should report, to the extent possible, on details contained in this table.

[c] Parties should explain, in their biennial reports, the methodologies used to specify the funds as provided, committed and/or pledged. Parties will provide the information for as many status categories as appropriate in the following order of priority: provided, committed, pledged.

[d] Parties may select several applicable sectors. Parties may report sectoral distribution, as applicable, under "Other".

[e] Parties should report, as appropriate, on project details and the implementing agency.

[f] Parties should explain in their biennial reports how they define funds as being climate-specific.

[g] Please specify.

[h] Cross-cutting type of support refers to funding for activities which are cross-cutting across mitigation and adaptation.

Table 7(b)

Provision of public financial support: contribution through bilateral, regional and other channels in 2012[a]

Recipient country/ region/project/programme[b]	Total amount: Climate-specific[f]: European euro - EUR	Total amount: Climate-specific[f]: USD	Status[c]	Funding source[g]	Financial instrument[g]	Type of support[g, h]	Sector[d]	Additional information[e]
Total contributions through bilateral, regional and other channels	31,235,046.75							
LDCs / PMA	6,758,250.32		Provided	ODA	Grant	Adaptation	Cross-cutting	
LDCs / PMA	2,575,535.65		Provided	ODA	Grant	Mitigation	Cross-cutting	
Cape Verde / AOSIS	4,632,416.48		Provided	ODA	Grant	Adaptation	Energy	
Cape Verde / AOSIS	4,682,620.43		Provided	ODA	Grant	Mitigation	Energy	
Kosovo, Montenegro, Vietnam, Nicaragua, Namibia / Other bilateral supports	3,440,994.66		Provided	ODA	Grant	Adaptation	Cross-cutting	
Kosovo, Montenegro, Vietnam, Nicaragua, Namibia / Other bilateral supports	1,581,704.33		Provided	ODA	Grant	Mitigation	Cross-cutting	
Cape Verde / AOSIS	681,000.00		Provided	OOF	Grant	Mitigation	Energy	
Various countries / Other channels - NGOs	1,272,935.00		Provided	ODA	Grant	Adaptation	Cross-cutting	
Various countries / Other channels - NGOs	1,073,993.52		Provided	ODA	Grant	Adaptation	Cross-cutting	
Various countries / Other channels - NGOs	118,553.91		Provided	ODA	Grant	Mitigation	Cross-cutting	
Various countries / Other channels - NGOs	3,005,886.45		Provided	ODA	Grant	Adaptation	Cross-cutting	
Various countries / Other channels - NGOs	1,411,156.00		Provided	ODA	Grant	Mitigation	Cross-cutting	

Abbreviations: ODA = official development assistance, OOF = other official flows; USD = United States dollars.

[a] Parties should fill in a separate table for each year, namely 2011 and 2012, where 2014 is the reporting year.

[b] Parties should report, to the extent possible, on details contained in this table.

[c] Parties should explain, in their biennial reports, the methodologies used to specify the funds as provided, committed and/or pledged. Parties will provide the information for as many status categories as appropriate in the following order of priority: provided, committed, pledged.

[d] Parties may select several applicable sectors. Parties may report sectoral distribution, as applicable, under "Other".

[e] Parties should report, as appropriate, on project details and the implementing agency.

[f] Parties should explain in their biennial reports how they define funds as being climate-specific.

[g] Please specify.

[h] Cross-cutting type of support refers to funding for activities which are cross-cutting across mitigation and adaptation.

Luxembourg does not report yet Tables 8 & 9.