Second Biennial Report of Luxembourg under the United Nations Framework Convention on Climate Change

First draft

5 June 2016

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

Second Biennial Report of Luxembourg under the United Nations Framework Convention on Climate Change

First draft

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This report has been prepared, written and compiled by Eric De Brabanter, of the Department of the Environment of the Ministry of Sustainable Development and Infrastructure. Contributions by other authors are acknowledged accordingly in the text.

This report is presenting the situation in Luxembourg on the 15 April 2016.

Introduction

This report presents the Second Biennial Report (BR2) from Luxembourg, under decision 2/CP.17 of the United Nations Framework Convention on Climate Change (UNFCCC). It describes the information defined in the UNFCCC biennial reporting guidelines for developed country Parties.[1] Tabular information as defined in the common tabular format (CTF) are submitted using, the electronic reporting facility provided by the UNFCCC Secretariat.[2] The CTF tables are available following this link:
http://unfccc.int/files/national_reports/biennial_reports_and_iar/submitted_biennial_reports/application/pdf/lux_2016_v2.0_formatted.pdf

Since the export function embedded in the CTF interface does not correctly export footnotes – numbering is lost – screen captures have been compiled in an addendum to the CTF tables:
http://unfccc.int/files/national_reports/biennial_reports_and_iar/submitted_biennial_reports/application/pdf/dev_br2_addendum_footnotes_ctf_tables_160531.pdf

1 Annex I to Decision 2/CP.17.

2 UNFCCC Decision 19/CP.18.

Chapter 1

Information on Greenhouse Gas Emissions and Trends

The GHG emission and removal estimates contained within Luxembourg's Inventory are developed using methodologies consistent with the guidelines prescribed by the Intergovernmental Panel on Climate Change (IPCC). The inventory estimates include the gases carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulphur hexafluoride (SF_6), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and nitrogen trifluoride (NF_3) in the following five IPCC sectors: Energy, Industrial Processes and Product Use, Agriculture, Waste and LULUCF.

Historical emissions data reported in CTF Tables 1 are extracted from **submission 2016v4** generated on 17 May 2016, early evening, and might contain errors generated by persistent small bugs in CRF Reporter.

This Chapter is divided in three parts:

1. national circumstances framing GHG emissions developments since 1990;
2. an analysis of the GHG emissions developments since 1990, by gas and by sector;
3. a description of the national inventory arrangements.

1.1 NATIONAL CIRCUMSTANCES

This text is extracted from the National Inventory Report submitted on 15 April 2016. It has been written by Isabelle Naegelen and Marc Schuman (Environment Agency), and Eric De Brabanter (Department of the Environment).

1.1.1 The Grand-Duchy of Luxembourg

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 1-1). It is therefore a crossroad for international trade and related transport flows, the most dynamic source of its GHG emissions.

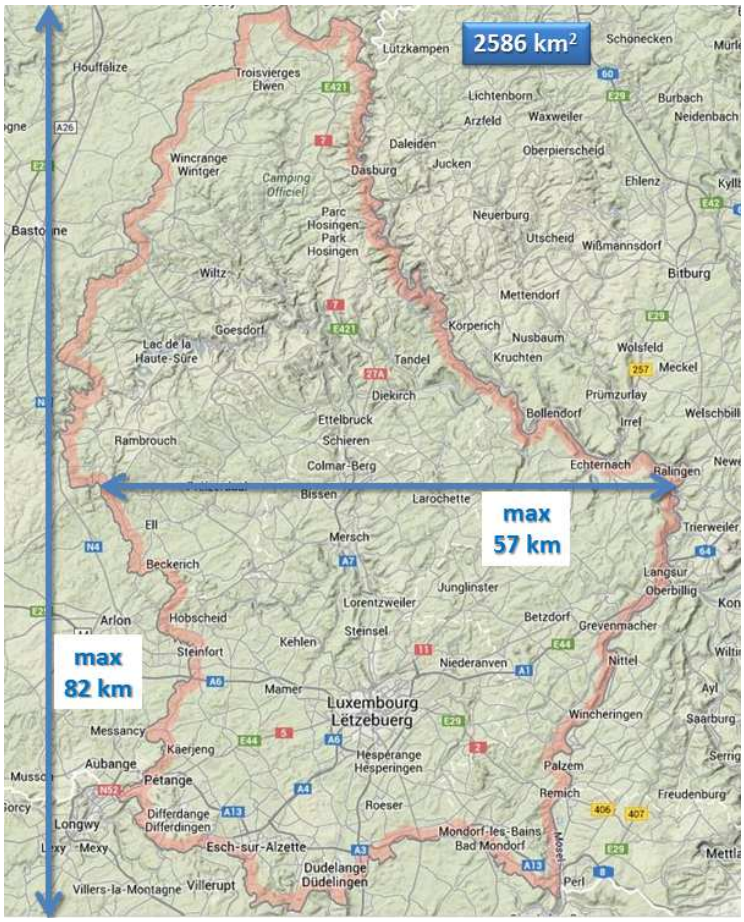
Luxembourg has a territory of 2 586 km². The maximum distance from North to South is some 82 km, from West to East about 57 km (Figure 1-2). In 2014, 85.3% of the total area of Luxembourg was agricultural land and land under forest – with around 51% for agriculture and 35% for forests. The built-up areas occupied 9.7% of the total surface and land covered by water and transport infrastructure about 5% (Table 1-1 & Figure 1-3).

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 (Sauer) river. 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. The most important rivers are the Moselle, the Sure, the Our – all three delimiting the border with Germany – and the Alzette.

Figure 1-1 – Geographic location of Luxembourg

Source: Google Maps.

Figure 1-2 – Luxembourg size



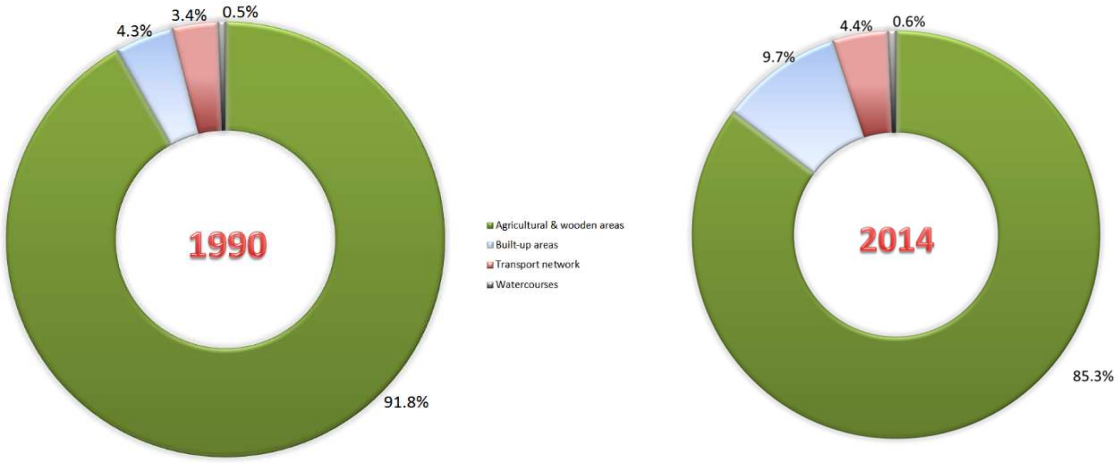
Source: Google Maps.

Table 1-1 – Land use in Luxembourg: 1972-2014

percentages	1972	1990	2000	2005	2010	2014
Total land	100.0	100.0	100.0	100.0	100.0	100.0
Agricultural & wooden area	93.2	91.8	87.4	86.5	85.7	85.3
Built-up area	3.1	4.3	8.1	8.7	9.3	9.7
of which industrial area & other	*n.a.*	*n.a.*	*2.7*	*2.8*	*3.0*	*3.1*
Transport network & sheets of water	3.2	3.4	3.9	4.2	4.4	4.4
Watercourses	0.5	0.5	0.6	0.6	0.6	0.6

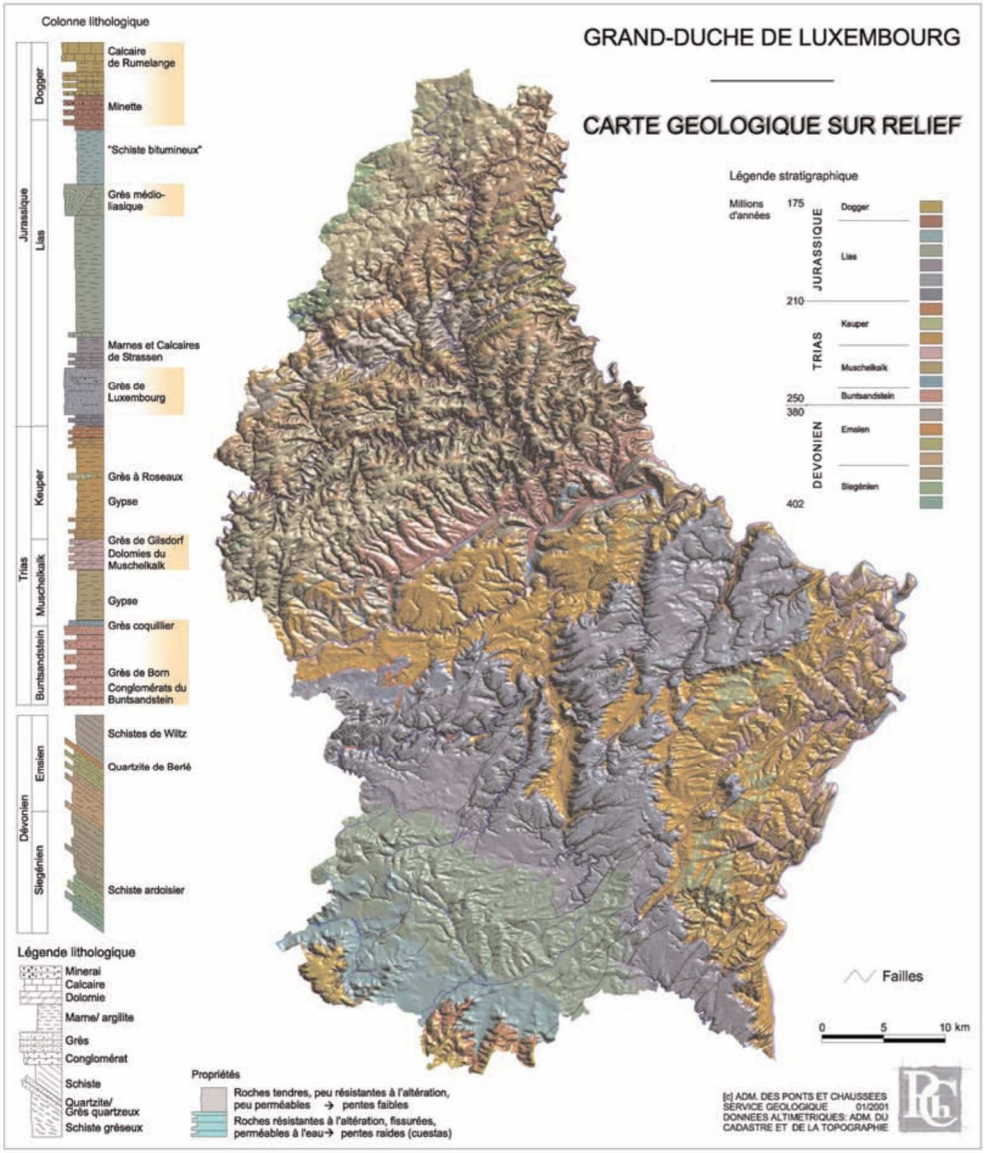
Source: STATEC, *Statistical Yearbook*, Table A.1101 (updated 5 April 2016): http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=137&IF_Language=fra&MainTheme=1&FldrName=1.

Figure 1-3 – Land use: 1990 & 2014



Source: STATEC, *Statistical Yearbook*, Table A.1101 (updated 5 April 2016): http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=137&IF_Language=fra&MainTheme=1&FldrName=1.

Figure 1-4 – 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.

1.1.2 Climate [3]

1.1.2.1 Situation: 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.

As shown by the long-term annual means (WMO reference period from 1971 to 2000) measured at the Findel-Airport meteorological station (Table 1-2),[4] 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 were -20.2°C (2 February 1956) and 37.9°C (8 and 12 August 2003).

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 and 9.2°C for the reference period 1981 to 2010 (see Table 1-2).[5]

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 average air temperatures, an increase in energy consumption related to a more frequent use of air conditioning systems could be expected.

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 1-3). Similar observations have been obtained in scientific studies on the climate in Luxembourg.[6] Concerning air temperatures, these studies show a clear positive trend from 1910 up to the 1950s, then about 3 decades of stabilisation, followed by several colder years. From 1990 onwards, annual mean air temperatures measured at the Findel-Airport meteorological station started to increase rather sharply to systematically be over the 1961-1990 mean value (Figure 1-5). Temperature highs have mostly been observed during the last 15-20 years (Figure 1-6).

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3 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*.

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

5 See also a graphic representation (http://meteolux.lu/fr/produits-et-services).

6 Ries, C. (éditeur) (2005), *Contribution à la climatologie du Luxembourg: analyses historiques, scenarios futurs* in Ferrantia 43, Musée National d'Histoire Naturelle, Luxembourg, 21-84, (http://ps.mnhn.lu/ferrantia/publications/Ferrantia43.pdf);
Pfister, L., Drogue, G., Poirier, C., and Hoffmann, L. (2005), *Evolution du climat et répercussions sur le fonctionnement des hydrosystèmes au Grand-Duché de Luxembourg au cours des 150 dernières années* in Ferrantia 43, Musée National d'Histoire Naturelle, Luxembourg, 85-100, (http://ps.mnhn.lu/ferrantia/publications/Ferrantia43.pdf).

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 1-3). However, the seasonal distribution of precipitation totals has shown substantial variability through the past 65 years (Figure 1-7). Most of this variability can be attributed to changes in the 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.[7]

Table 1-2 – 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	8.0	12.1	16.8	19.9	22.0	21.0	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 annual precipitation sum [mm]	71.2	61.7	70.0	61.2	81.2	82.2	68.4	72.3	70.0	74.6	83.2	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://meteolux.lu/fr/produits-et-services.

Table 1-3 – Mean values of air temperature (daily, mean, maximum & minimum) and precipitation for the Findel-Airport station for different time spans and individual years

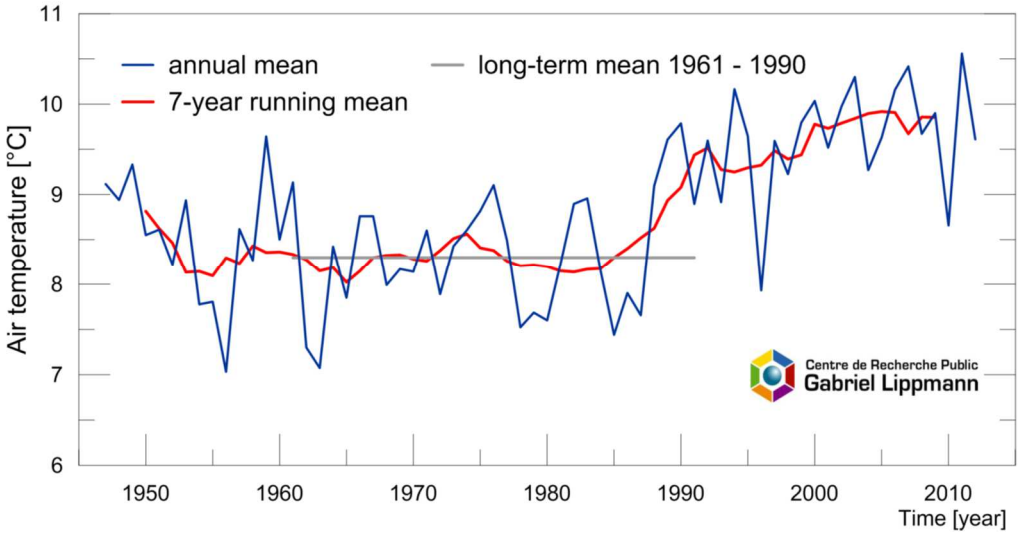
	1951-1980	1961-1990	1971-2000	1981-2010
Average air temperature [°C]	8.3	8.3	8.7	9.2
Mean minimum air temperature [°C]	4.6	4.7	5.1	5.6
Mean maximum air temperature [°C]	12.3	12.3	12.7	13.1
Mean yearly precipitation sum [mm]	819.6	874.5	862.4	869.9

	1990	2000	2005	2010	2011	2014
Average air temperature [°C]	9.8	10.0	9.6	8.7	10.6	10.8
Mean minimum air temperature [°C]	6.0	6.5	*n.a.*	5.0	6.6	5.9
Mean maximum air temperature [°C]	13.8	13.8	*n.a.*	12.4	14.8	13.5
Mean yearly precipitation sum [mm]	1020.5	1036.4	718.2	918.5	704.0	604.0

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://meteolux.lu/fr/produits-et-services.

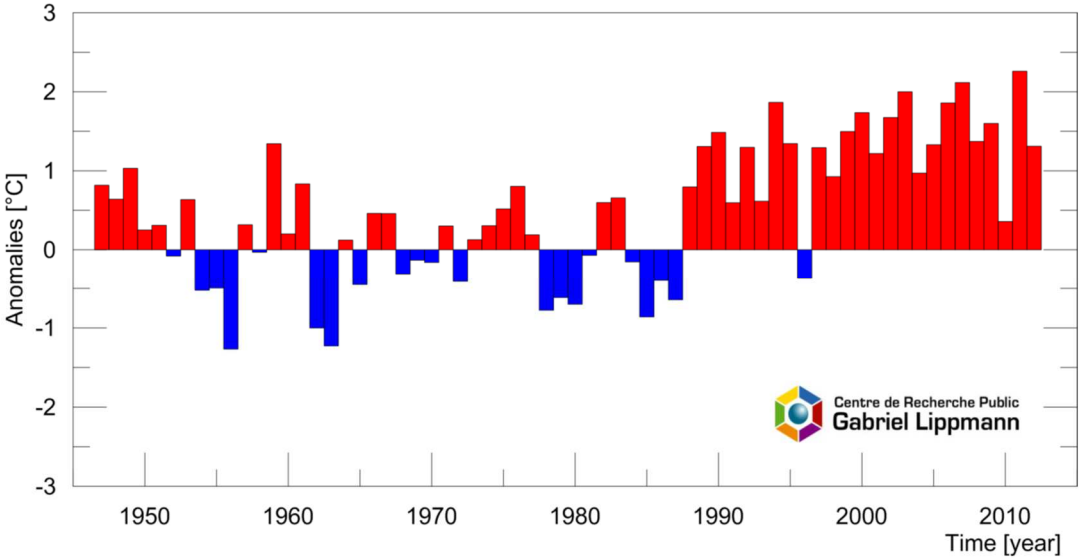
[7] Pfister, L., Hoffmann, L., and Humbert, J. (2000), *Recent Trends in Rainfall-Runoff Characteristics in the Alzette River Basin, Luxembourg* in Climatic Change, volume 45, Springer Netherlands, 323-337.
Pfister, L., Drogue, G., El Idrissi, A., Iffly, J.F., Poirier, C., and Hoffmann, L. (2004), *Spatial Variability of Trends in the Rainfall-Runoff Relationship: A Mesoscale Study in the Mosel Basin* in Climatic Change, volume 66, Springer Netherlands, 67-87.

Figure 1-5 – Average annual air temperature, 7-year running mean and long-term annual mean 1961-1990 for the Findel-Airport station: 1947-2014



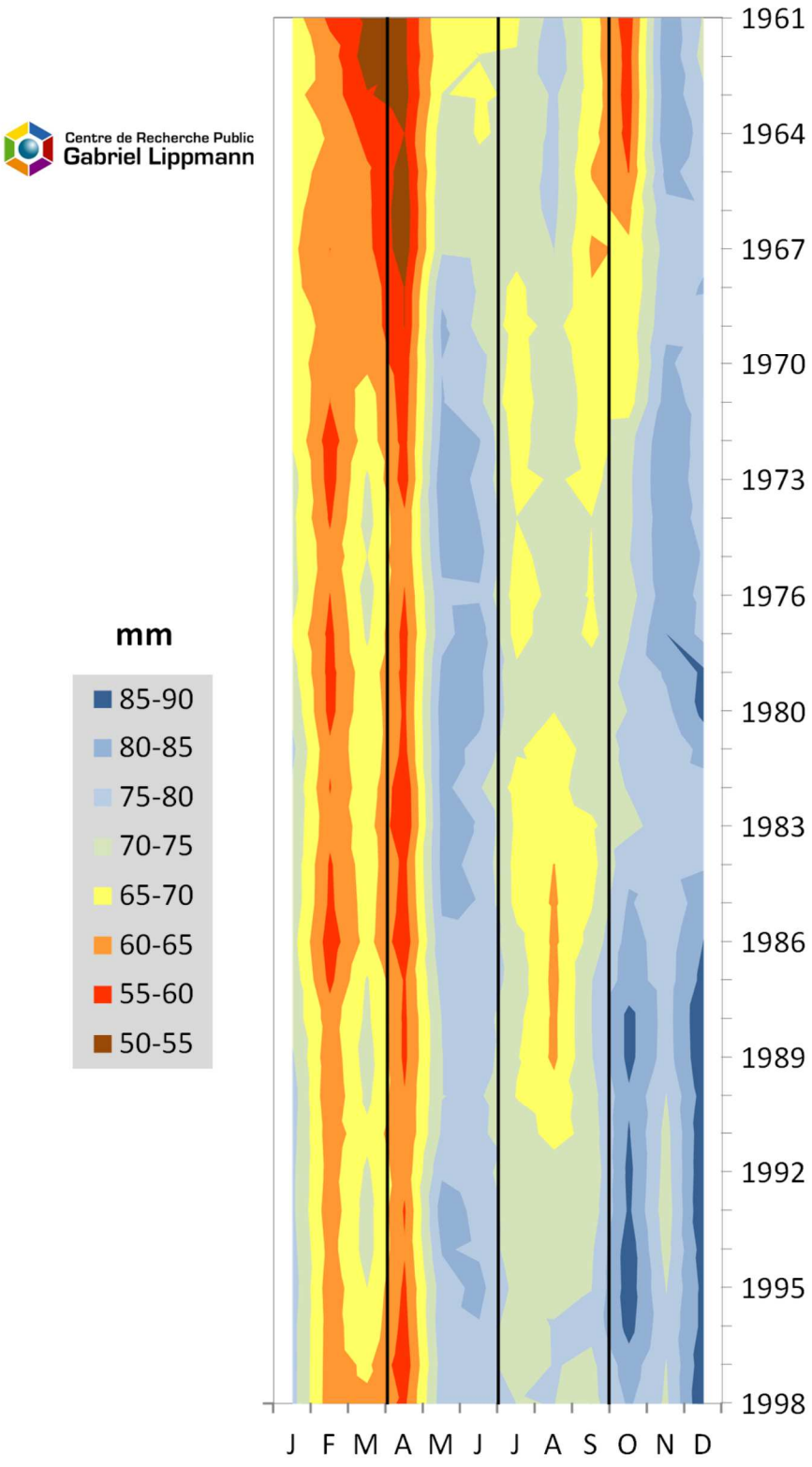
Source: Findel-Airport station (SMA) and *Luxembourg Institute of Science and TechnologyTechnology*, unpublished.

Figure 1-6 – Anomalies of annual air temperature from the reference period 1961-1990 for the Findel-Airport station: 1947-2014



Sources: Findel-Airport station (SMA) and *Luxembourg Institute of Science and Technology*, unpublished.
Note: Anomalies from the reference period 1961 till 1990: long-term mean: 8.3°C.

Figure 1-7 – Precipitation 30-year moving average: 1947-2014



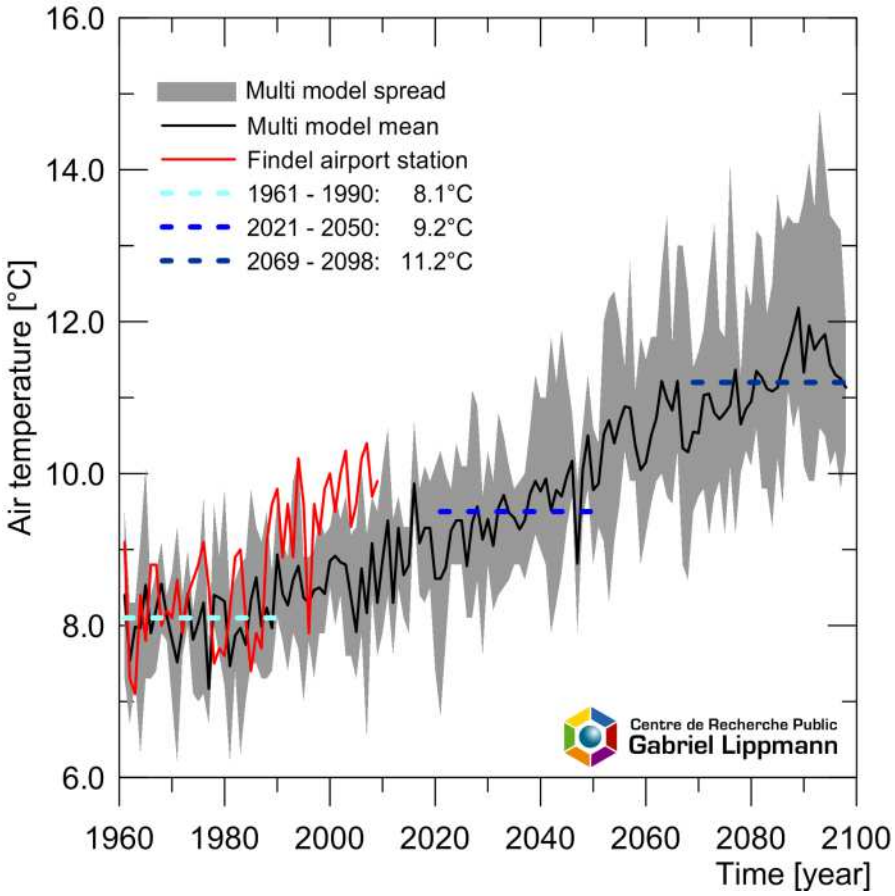
Sources: Findel-Airport station (SMA) and *Luxembourg Institute of Science and Technology*, unpublished.
Note: Values are given for middle of averaging period.

1.1.2.2 *Climate projections: continuing rise in air temperature*

Preliminarily results taken from a project from the Department "Environment and Agro-biotechnology" of the *Luxembourg Institute of Science and Technology* 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,[8] 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 1-8).

Preliminarily results concerning changes in precipitation suggest a relative stability in annual totals until 2100 (Figure 1-9). 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 1-10).

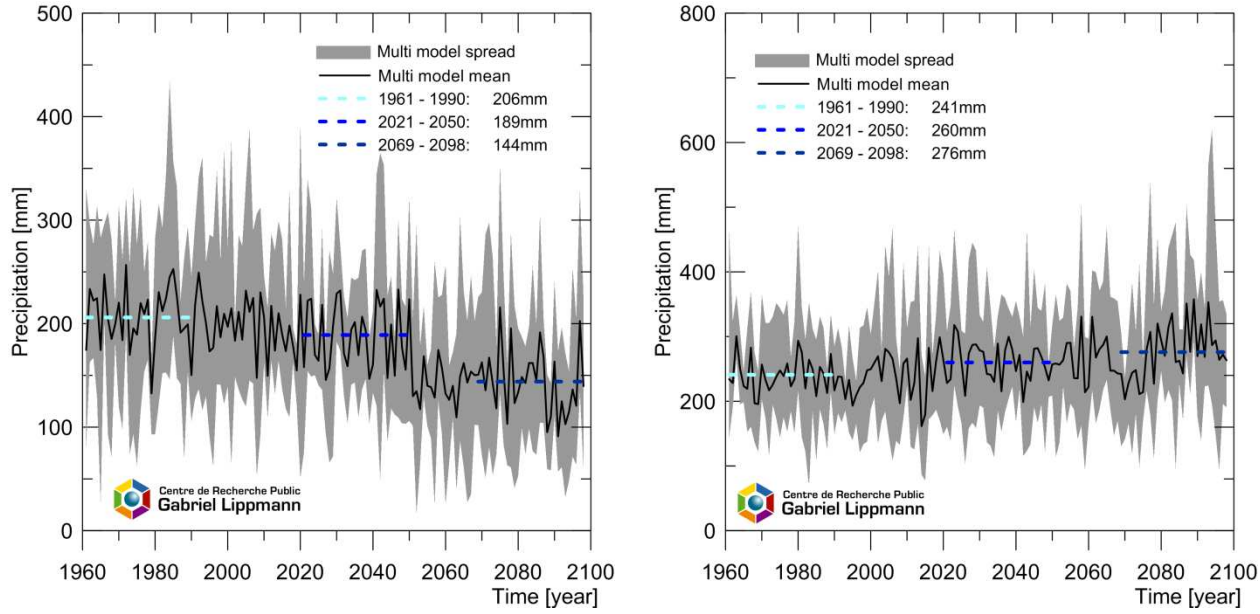
Figure 1-8 – Projections of mean annual air temperature



Source: *Luxembourg Institute of Science and Technology*, unpublished.
Notes: (1) based on selected ENSEMBLES data sets, A1B emission scenario.
(2) Anomalies from the reference period 1961 till 1970: long-term mean: 8.9°C.

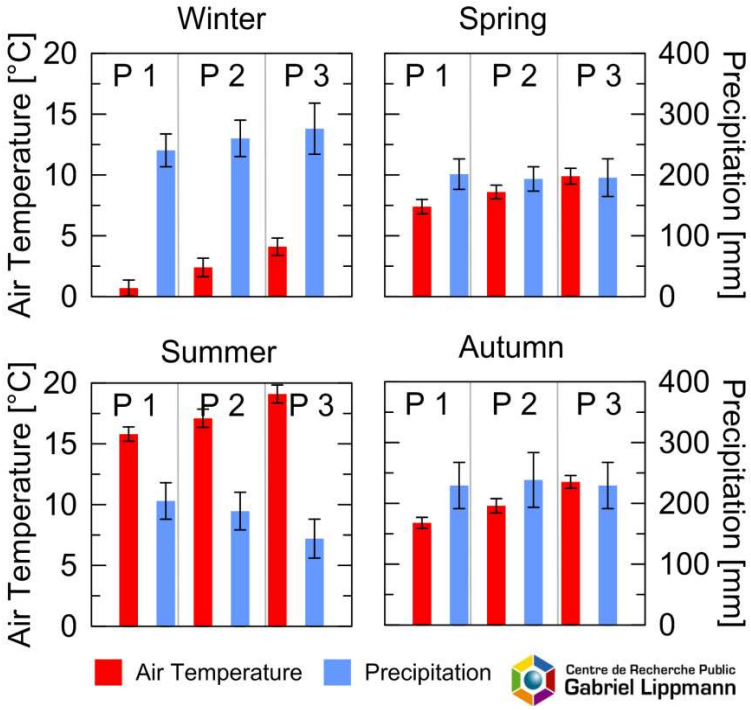
8 http://ensembles-eu.metoffice.com.

Figure 1-9 – Projections of precipitation sums for the meteorological seasons



Source: *Luxembourg Institute of Science and Technology*.
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 1-10 – Projections of mean annual air temperature and precipitation sums for the meteorological seasons



Source: *Luxembourg Institute of Science and Technology*: Goergen, K., Beersma, J., Hoffmann, L., and Junk, J. (2013), *ENSEMBLES-based assessment of regional climate effects in Luxembourg and their impact on vegetation*, in Climatic Change, volume 119, Springer Netherlands, 761-773.

Notes: (1) based on selected ENSEMBLES data sets, A1B emission scenario.
(2) Periods: P1 = 1961-1990 // P2 = 2021-2050 // P3 = 2069-2098.

1.1.2.3 *Expected impacts of climate change in Luxembourg: forests and water in the forefront*

According to a report published in 2012 by the EEA,[9] reproducing an EEA map based on IPCC reports showing key past and projected impacts and effects for the main bio-geographic regions of Europe, Luxembourg is part of the "Central & Eastern Europe" area (cf. Map TS.1, p. 27 & Table TS.2, p. 28 of the aforementioned report). The threats identified for this peculiar region are:

- increase in warm temperature extremes;
- decrease in summer precipitation;
- increase in water temperature;
- increasing risk of forest fire;
- decrease in economic value of forests.

Two of these threats are of main concern for Luxembourg, **those relating to forests**. **Temperatures extremes** and **summer precipitation reduction** are also causes for concern due to their impacts on human health, especially of the most fragile persons and the elderly (heat, air quality), and impacts on water quality in summer when rivers flows are usually at their lowest.

According to the researchers of the *Luxembourg Institute of Science and Technology*, the projected changes in air temperature are likely to induce a modification of the vegetation period in Luxembourg. The start of the vegetation period is defined as the exceeding of the 5°C daily mean temperature threshold in spring for at least 30 successive days; the end of the vegetation period corresponds to the undershooting of this threshold until the end of the year.[10]

In Luxembourg, the **vegetation period** is expected to be initiated earlier in spring and to last longer into autumn (Figure 1-11). During the early stages of the vegetation period this might cause an increased risk of frost damages to vegetation.[11]

The increase of temperatures, especially during the winter period, 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, three instead of two yearly cycles), but also on the **migratory behaviour of birds and insects** (*i.e.* species that now hibernate in Luxembourg migrated in former times 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

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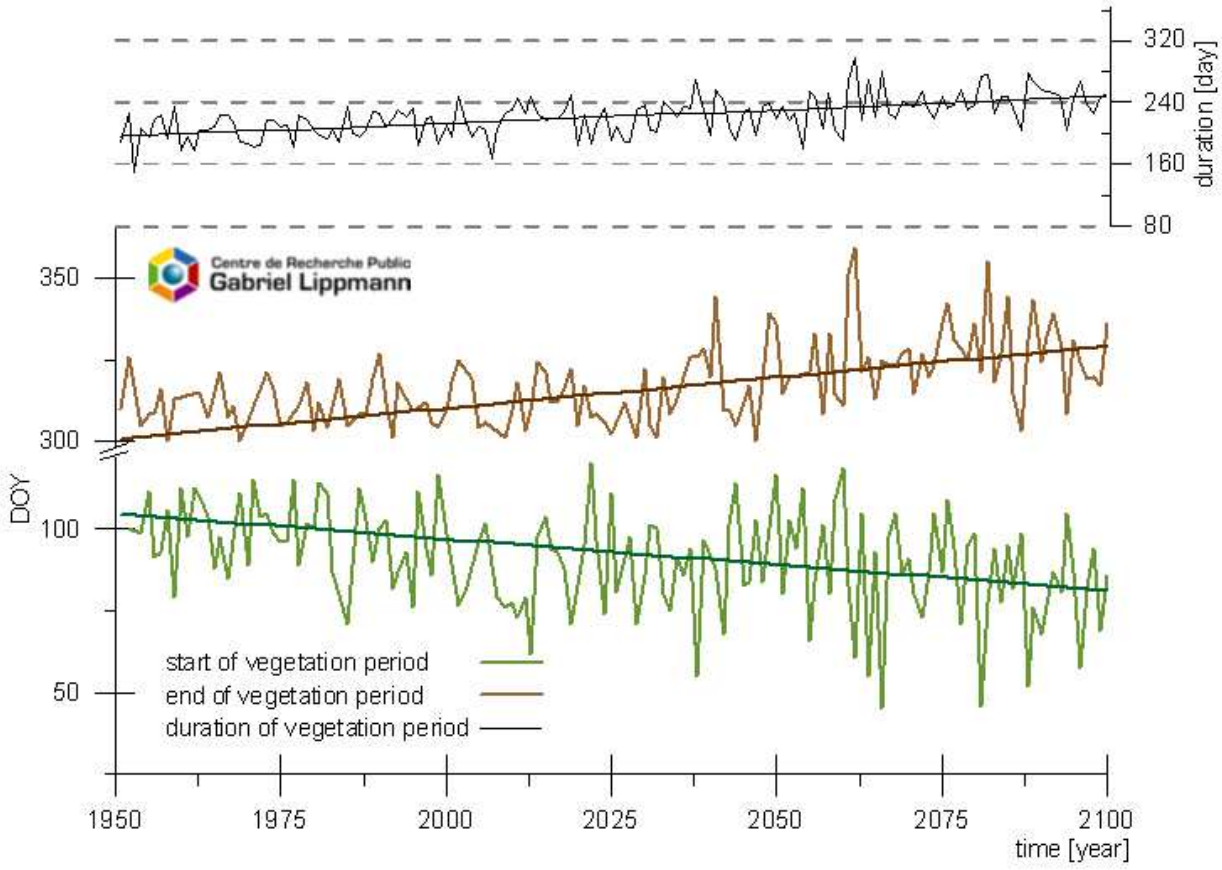
9 European Environment Agency, (2012), *Climate change, impacts and vulnerability in Europe 2012 – An indicator-based report*, EEA Report No 12/2012, Copenhagen (http://www.eea.europa.eu/publications/climate-impacts-and-vulnerability-2012).

10 Chmielewski, F.M., and Rötzer, T. (2001), *Response of tree phenology to climate change across Europe*. In Agricultural and Forest Meteorology, 108, 101-112.

11 Goergen, K., Beersma, J., Hoffmann, L., and Junk, J. (2013), *ENSEMBLES-based assessment of regional climate effects in Luxembourg and their impact on vegetation*, in Climatic Change, volume 119, Springer Netherlands, 761-773.

that some relict species of the last glaciation period (*e.g. Lycaena helle*) will disappear from Luxembourg with the expected temperature increase.

Figure 1-11 - Start, end and duration of the vegetation period



Source: *Luxembourg Institute of Science and Technology*, 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.

The climate projections for the second half of this century will also have significant impacts on the **bio-meteorological conditions** in Luxembourg. The higher air temperatures, especially stressful for humans during night in their recreation time, also increase the likelihood of extreme heat events such as the one that struck Europe in August 2003. Besides impact on the **human health**, this 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 forest – a rather "old" forest – show a sharp degradation – which seems to have stabilised nowadays – resulting, among other factors, from climate change. The ageing of the forest also increases the risk of outbreak of diseases and of infestation by insects as well as other parasites that could proliferate if more mild winters and overall general temperatures are recorded in Luxembourg.

With regard to **water**, the most analysed phenomena so far are floods. It is known that; due to major redistributions of winter rainfalls, essentially, a higher inundation frequency is being recorded since

the river systems have reacted to these changes with a statistically significant increase of maximum daily runoff during winter.[12] This is why an observation hydro-climatic network (*réseau d'observation hydro-climatologique*) has been put in place in the mid-1990s.[13] Its main functions consist in continuously (24/7) monitoring Luxembourg's water courses, and in the realization and the updating of an atlas of areas of the national territory subjected to swellings and floods. The network also suggests anti-flooding measures and participates to renaturation projects aiming at re-creating natural areas which have been used as natural reservoirs containing rising waters.[14]

1.1.3 Population and Workforce

1.1.3.1 A strong population growth driven by immigration

At the end of 2014, the **population of Luxembourg** amounted to 549 700 inhabitants. Within slightly more than 50 years, the residential population has grown by some 234 800 inhabitants or about 78.8% – 46.5% since 1990 (Table 1-4). The average annual growth rate of the resident population of Luxembourg is elevated compared to the rates of its neighbouring regions: between 1990 and 2014, the average annual growth rate for Luxembourg (1.5%) was about 4 times lower than its equivalent for the *Grande Région*.[15] It even reached 1.7% p. a. since 2000 (Figure 1-13).

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. At the end of 2014, 45.3% of the residential population did not have the citizenship of Luxembourg. This percentage was only around 30% in 1990, as depicted in Figure 1-12. The main driver behind these demographic trends is the economic restructuring and development of the country towards the tertiary sector coupled with attractive wages.

Since population projections are based on scenarios derived from past statistical data, 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 1-13).[16] 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

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12 Pfister, L., Drogue, G., Poirier, C., and Hoffmann, L. (2005), *Evolution du climat et répercussions sur le fonctionnement des hydrosystèmes au Grand-Duché de Luxembourg au cours des 150 dernières années* in Ferrantia 43, Musée National d'Histoire Naturelle, Luxembourg, 85-100. (http://ps.mnhn.lu/ferrantia/publications/Ferrantia43.pdf)

13 http://www.hydroclimato.lu.

14 For an example, look at http://www.luxnatur.lu/alzrena1.htm.

15 Refer to Box 1-1 for a presentation of the *Grande Région*.

16 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 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.

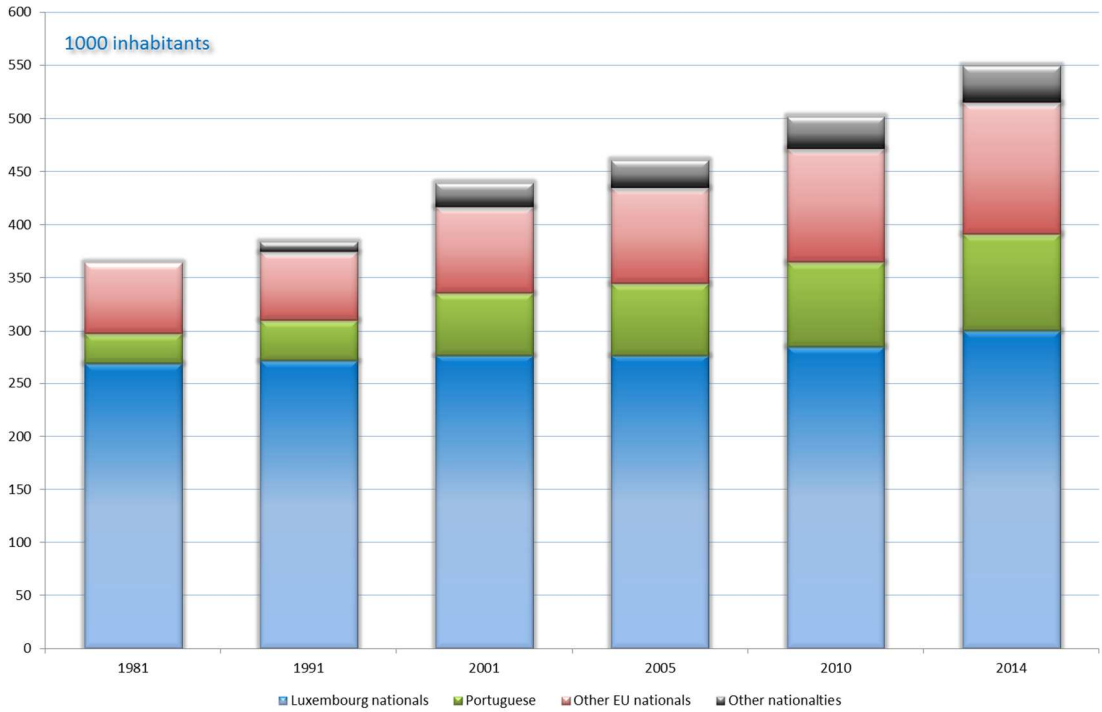
use, mainly in the housing and transportation sector, these forecasts illustrate the scale of one of the many challenges Luxembourg is facing in the definition of measures aiming at reducing its GHG emissions.

Table 1-4 – Population: 1960-2014

calculated on 31st December	1960	1990	1995	2000	2005	2010	2014
Resident population (x 1000)	314.9	379.3	405.7	433.6	469.1	502.1	549.7

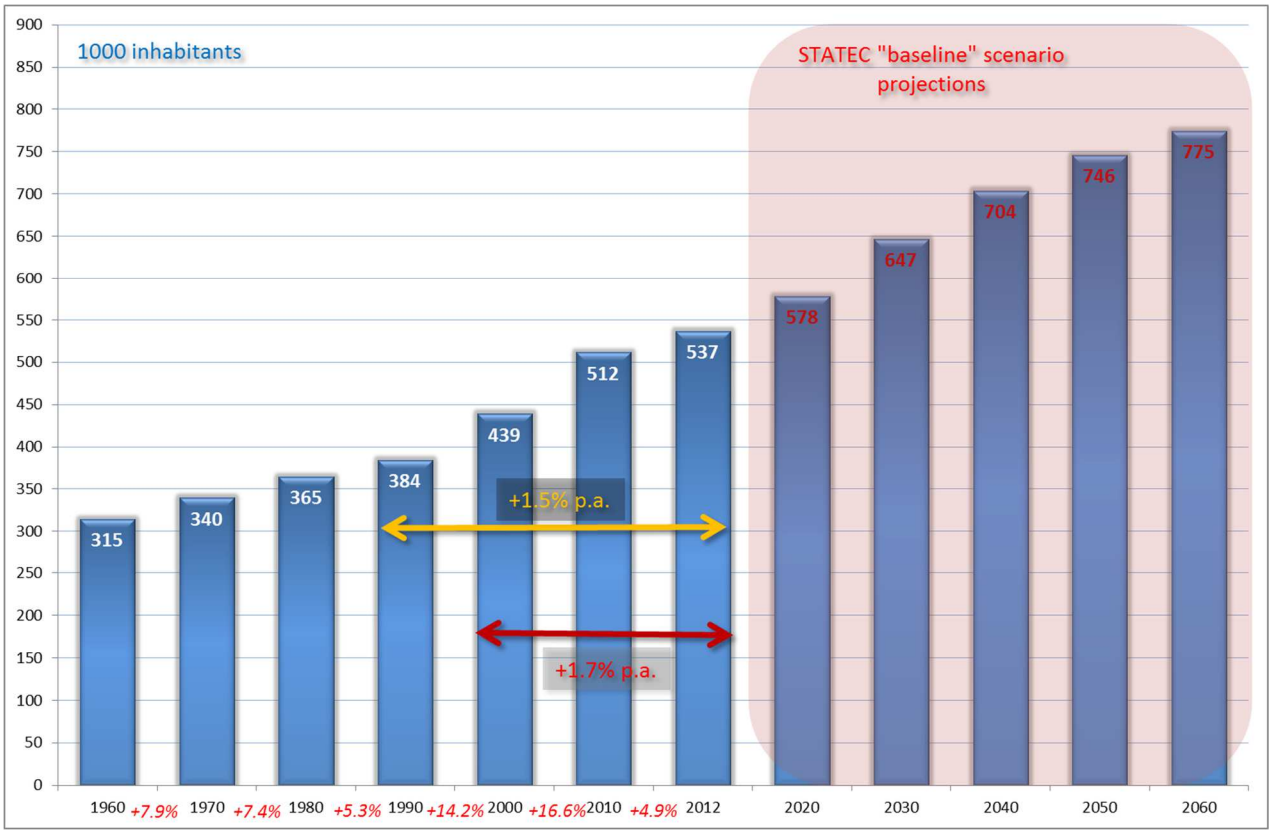
Source: STATEC, *Statistical Yearbook*, Table B.1100 (updated 4 April 2016): http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=383&IF_Language=fra&MainTheme=2&FldrName=1.

Figure 1-12 – Population structure on 31st December: 1981-2014



Source: STATEC, *Statistical Yearbook*, Table B.1101 (updated 25 February 2016): 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 1-13 – Population growth on 31st December: 1960-2060



Sources: STATEC, *Statistical Yearbook*, Table B.1100 (updated 4 April 2016):
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 October 2010):
http://www.statistiques.public.lu/fr/publications/series/bulletin-statec/2010/05-10-Projpop/index.html

Box 1-1 – 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 2014
	% 1990-2014	*% 1990-2014*	*% 1990-2014*	*1990=100*
BE-Wallonia	10.26%	4.41%	10.33%	4.94%
DE-Rheinland-Pfalz	7.91%	4.32%	6.97%	4.81%
DE-Saarland	-6.97%	3.72%	6.76%	4.39%
FR-Lorraine	1.82%	4.07%	6.93%	4.38%
Luxembourg	**44.92%**	**5.80%**	**19.86%**	**8.73%**

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

1.1.3.2 *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 140 400 in 2014, representing an average annual growth rate of only 2%. 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 89 900 in 2014 – an average annual growth rate of 3%. But, this was not enough. So the **cross-border commuters** came into play. Between 1995 and 2014, the number of cross-border workers increased from 56 900 to 165 300, at an average annual growth rate of 6% (Table 1-5).[17]

For 2014, among the persons employed, 49.7% of the commuters came from France, 25.2% from Germany and 25.1% from Belgium. In total, the commuters accounted for 42% of the total workforce in Luxembourg and for 39% (*i.e.* more than a quarter) of the residential population (Figure 1-14).[18] The commuting flows amongst the various regions of the *Grande Région* clearly show the economic attraction of Luxembourg (Figure 1-15).

A vast majority of workers from abroad commute by car.[19] 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.

Table 1-5 – Persons employed: 1995-2014

in thousand persons	1995	2000	2005	2010	2014
Resident workers – Lux. nationals *(B.3106 & E.2309)*	103.70	106.50	108.50	117.80	140.40
Resident workers – foreigners *(B.3106 & B.3107)*	54.90	67.20	77.90	89.70	89.90
Cross-border workers *(B.3107)*	56.90	90.30	121.20	151.90	165.30
Total workers/employment *(E.2309)*	215.50	264.00	307.60	359.40	395.60

Sources: Environment Agency calculations on the basis of STATEC, *Statistical Yearbook*, Table B.3106 (updated 28 October 2013), B.3107 (updated 24 February 2016) & E.2309 (updated 24 February 2016):
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.

17 Figures indicated in this paragraph are annual cumulative averages.

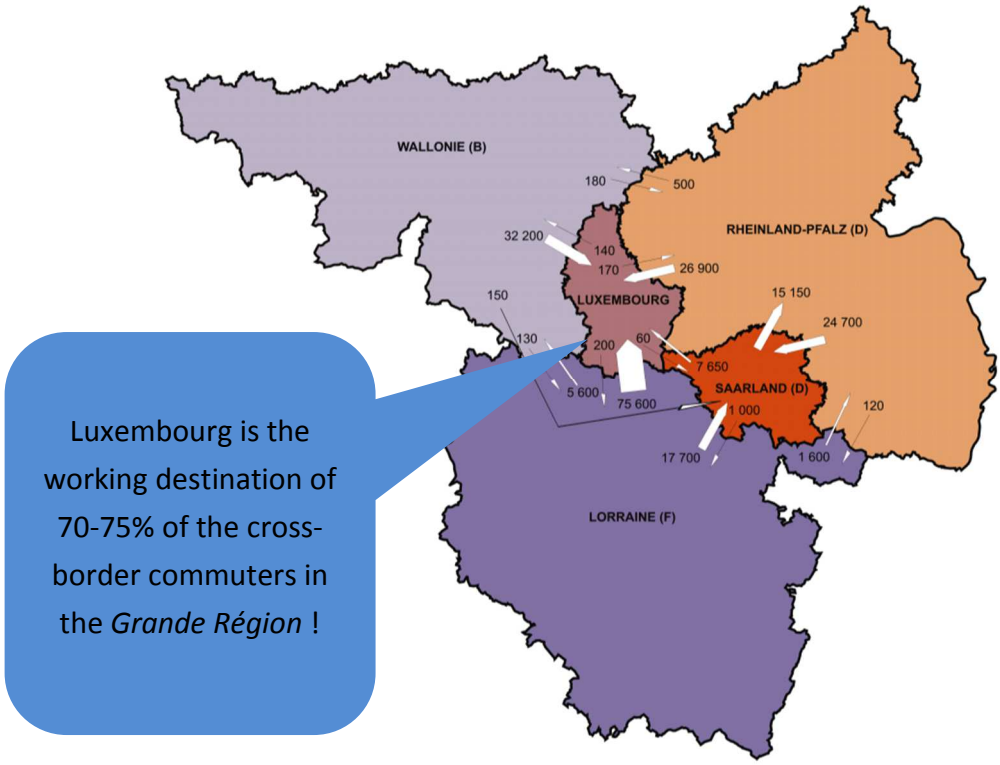
18 Calculated from STATEC, *Statistical Yearbook*, Table B.3107:
http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=494&IF_Language=fra&MainTheme=2&FldrName=3&RFPath=92.

19 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 1-14 – Cross-border commuters' growth: annual cumulative averages 1980-2014

Source: STATEC, *Statistical Yearbook*, Table B.3107 (updated 24 February 2016): http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=494&IF_Language=fra&MainTheme=2&FldrName=3&RFPath=92.

Figure 1-15 – 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..

1.1.4 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 ten years the amplitude of GDP variations in Luxembourg has diminished, as has the gap in relation to the European cycle.

The economic restructuring and development of the country towards the tertiary sector from the 1960s-70s, 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 at the end of 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.

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 46% in 2014.[20] While the commercial sector has maintained a constant share at about 18 to 17%, the share of the industry sector has decreased significantly from 15% in 1995 to less than 6.5% in 2014. Other service activities ranged between a share of 20 to 25% and construction kept a rather constant share in total gross value added between 7 and 6%. The contribution of the agricultural sector is negligible with less than 1% (Table 1-6 & Figure 1-16).

Nevertheless, 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): more on this in the next section;

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

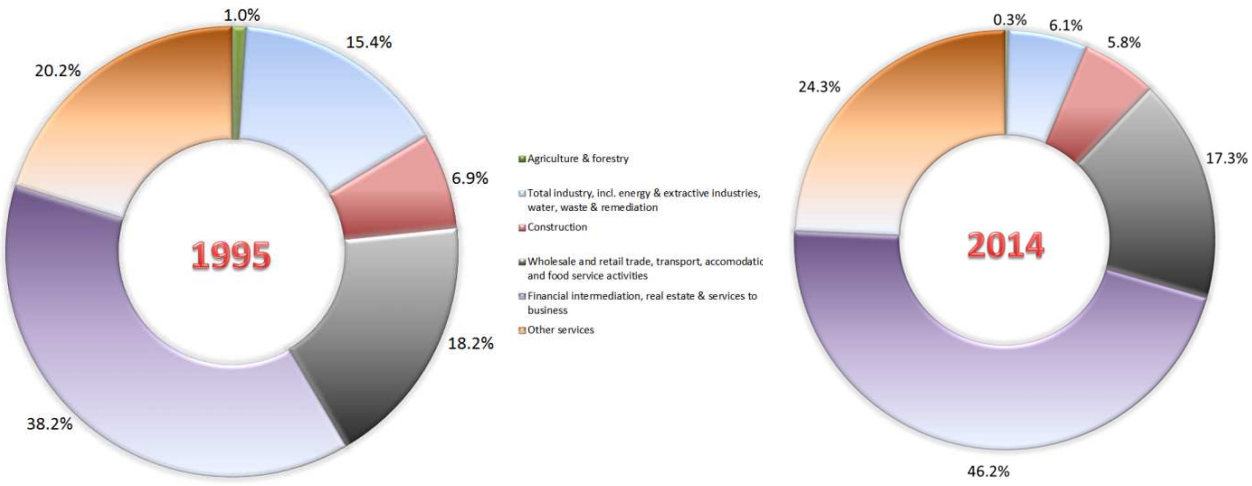
- due to its size and the size of its energy and industrial sector, structural changes in these sectors that could be initiated by a single entity;
- road transportation related fuel sales.

Table 1-6 – Sectoral gross value added at current prices: 1995-2014

mio. EUR		1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Agriculture, forestry & fishing (A)		140.6	143.6	106.8	114.3	152.3	118.9	93.0	100.0	107.3	157.8	122.5	130.0
	%	*1.0%*	*0.7%*	*0.4%*	*0.4%*	*0.5%*	*0.4%*	*0.3%*	*0.3%*	*0.3%*	*0.4%*	*0.3%*	*0.3%*
Total industry, including extractive industries, energy production & distribution, water supply, sewerage, waste management and remediation activities (B to E)		2103.5	2575.2	2877.2	2947.3	3582.7	3245.0	2299.3	2654.9	2702.9	2697.7	2620.2	2649.5
	%	*15.4%*	*12.4%*	*10.8%*	*9.8%*	*10.8%*	*9.6%*	*7.1%*	*7.4%*	*7.1%*	*6.9%*	*6.3%*	*6.1%*
Construction (F)		947.0	1242.3	1531.4	1670.3	1925.6	1937.0	1911.8	1943.2	2191.0	2080.2	2270.0	2529.8
	%	*6.9%*	*6.0%*	*5.8%*	*5.6%*	*5.8%*	*5.7%*	*5.9%*	*5.4%*	*5.8%*	*5.3%*	*5.4%*	*5.8%*
Wholesale and retail trade, transport, accomodation and food service activities (G to I)		2492.1	3530.5	4227.0	4713.9	4830.5	5793.9	5213.9	6040.5	6814.3	6823.8	7127.9	7546.5
	%	*18.2%*	*17.0%*	*15.9%*	*15.7%*	*14.6%*	*17.1%*	*16.0%*	*16.9%*	*17.9%*	*17.5%*	*17.1%*	*17.3%*
Financial and insurance activities; real estate activities; professional, scientific and technical activities; administrative and support service activities (K to N)		5225.0	9092.6	11765.8	14177.6	15558.2	15410.3	15327.6	16566.6	17205.8	17701.9	19429.5	20167.7
	%	*38.2%*	*43.7%*	*44.4%*	*47.1%*	*47.1%*	*45.5%*	*47.0%*	*46.4%*	*45.3%*	*45.3%*	*46.6%*	*46.2%*
Other services: information and communication; public administration, defence, education, human health and social work activities; arts, entertainment and recreation; Oher service activities; activities of household (J & O to U)		2764.9	4243.8	6010.5	6470.7	6985.6	7383.9	7755.7	8377.8	8996.2	9630.5	10166.0	10610.0
	%	*20.2%*	*20.4%*	*22.7%*	*21.5%*	*21.1%*	*21.8%*	*23.8%*	*23.5%*	*23.7%*	*24.6%*	*24.4%*	*24.3%*
Total: all NACE rev2 branches		**13672.9**	**20828.1**	**26518.7**	**30094.2**	**33034.9**	**33889.1**	**32601.5**	**35683.0**	**38017.4**	**39091.9**	**41736.0**	**43633.3**
Annual growth rate - current prices					**13.5%**	**9.8%**	**2.6%**	**-3.8%**	**9.5%**	**6.5%**	**2.8%**	**6.8%**	**4.5%**
Annual growth rate - constant prices/in volume					**5.6%**	**8.5%**	**-1.1%**	**-5.7%**	**6.0%**	**2.0%**	**-1.2%**	**4.2%**	**3.6%**

Source: STATEC, *Statistical Yearbook*, Tables E.2304 (current prices) & E.2305 (constant prices) (updated 24 February 2016): http://www.statistiques.public.lu/stat/TableViewer/document.aspx?ReportId=1497&IF_Language=fra&MainTheme=5&FldrName=2

Figure 1-16 – Sectoral gross value added at current prices: 1995 & 2014



Source: STATEC, *Statistical Yearbook*, Table E.2304 (updated 24 February 2016): http://www.statistiques.public.lu/stat/TableViewer/document.aspx?ReportId=1497&IF_Language=fra&MainTheme=5&FldrName=2

1.1.5 Energy

1.1.5.1 A total change in Luxembourg's energy-mix

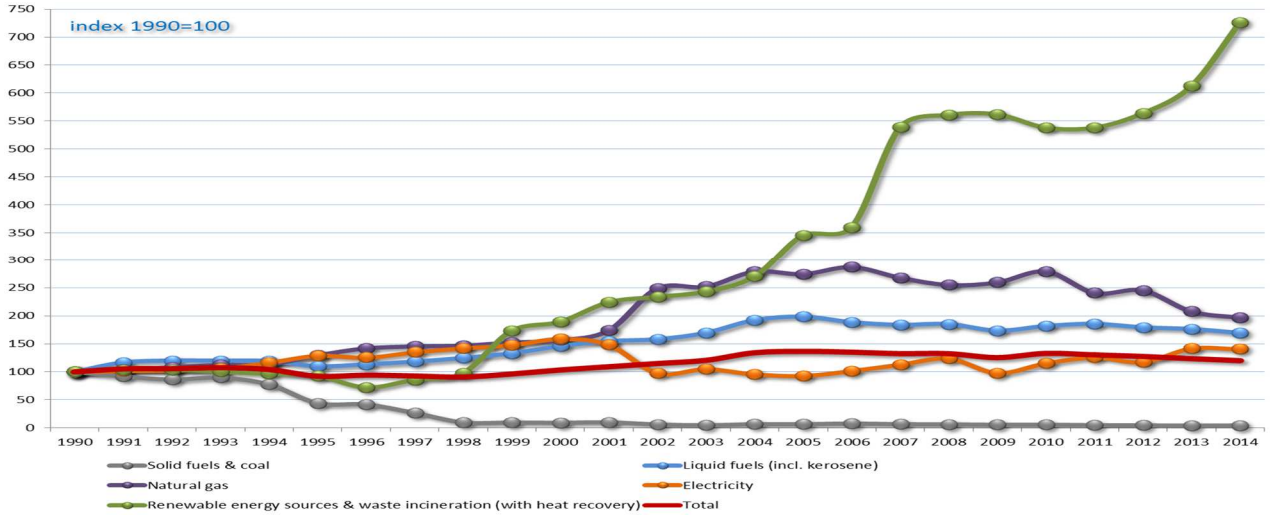
Primary and final energy consumption in Luxembourg experienced dramatic changes since 1990. Overall **primary energy consumption** increased by 19.9% between 1990 and 2014. Whereas solid fuels and coal declined by more than 95% over the period, liquid fuels (incl. kerosene) and natural gas consumptions increased by 169% and 196% respectively (Table 1-7 & Figure 1-17).

Table 1-7 – Primary energy consumption: 1990-2014

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%*	*13.56%*	*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	2128.82	2520.68
	0.75%	*0.74%*	*0.74%*	*0.70%*	*0.69%*	*0.75%*	*0.57%*	*0.69%*	*0.81%*	*1.35%*	*1.37%*	*1.54%*
Total	**150278.03**	**158073.31**	**158615.23**	**161324.82**	**156405.87**	**138411.36**	**141386.82**	**139066.58**	**136336.98**	**144454.91**	**155250.60**	**163912.04**

TJ	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
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	2005.86	2234.78
	1.79%	*1.31%*	*1.65%*	*1.58%*	*1.91%*	*1.65%*	*1.58%*	*1.49%*	*1.41%*	*1.25%*	*1.17%*	*1.08%*	*1.24%*
Liquid fuels (incl. kerosene)	104261.62	111789.85	126709.57	130884.49	124308.27	121227.03	122120.30	114419.02	119823.60	122367.06	118245.32	116275.75	111686.26
	60.42%	*61.74%*	*62.91%*	*63.82%*	*61.24%*	*60.92%*	*61.40%*	*60.75%*	*59.99%*	*62.53%*	*61.76%*	*62.65%*	*61.98%*
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	41398.28	39223.62
	28.76%	*27.74%*	*27.62%*	*26.68%*	*28.20%*	*26.85%*	*25.57%*	*27.48%*	*27.87%*	*24.54%*	*25.54%*	*22.31%*	*21.77%*
Electricity	12952.77	13931.02	12698.58	12323.47	13490.64	14981.85	16412.67	12987.43	15290.40	16677.00	15567.70	18791.88	18634.29
	7.51%	*7.69%*	*6.30%*	*6.01%*	*6.65%*	*7.53%*	*8.25%*	*6.90%*	*7.66%*	*8.52%*	*8.13%*	*10.13%*	*10.34%*
Heat	6.47	9.85	13.60	17.53	21.62	28.95	41.54	62.85	87.53	122.76	165.96	220.21	247.12
	0.00%	*0.01%*	*0.01%*	*0.01%*	*0.01%*	*0.01%*	*0.02%*	*0.03%*	*0.04%*	*0.06%*	*0.09%*	*0.12%*	*0.14%*
Renewable energy sources & waste	2630.06	2736.22	3041.45	3883.23	4049.26	6063.63	6310.98	6320.76	6052.85	6054.97	6343.76	6893.28	8175.12
	1.52%	*1.51%*	*1.51%*	*1.89%*	*1.99%*	*3.05%*	*3.17%*	*3.36%*	*3.03%*	*3.09%*	*3.31%*	*3.71%*	*4.54%*
Total	**172563.53**	**181074.09**	**201423.74**	**205077.78**	**202983.83**	**199007.92**	**198878.76**	**188343.07**	**199726.22**	**195686.34**	**191467.22**	**185585.25**	**180201.19**

Figure 1-17 –Primary energy consumption: 1990-2014



Source: STATEC, *Statistical Yearbook*, Table A.4200 (updated 24 February 2016):
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 the time-series between 1999 & 2000 (II).

Final energy consumption increased by 18% between 1990 and 2014. As for primary energy consumption, all the energy sources have seen their consumption increase over the period, except solid fuels and coal (Table 1-8 & Figure 1-18).

However, over the period 1990-2014, 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 2014, 81.07% of the **final energy consumption** was covered by fossil fuels – 64.9% by liquid fuels including the important volume of road fuels as well as kerosene,[21] 14.8% by natural gas and 1.3% by coal. The remaining 15.4% of the consumption were either electricity (13.17%) and heat (2.25%) or renewable energy sources, including organic waste incineration with energy recovery, biogas, and biofuels (3.5%). 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 1-8 & Figure 1-18). What did happen?

- Regarding **solid fuels and coal**, the important decline (-93.5%) 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 (+166.8%) 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;
- The 118% 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 2014 – and even first if "road fuel sales to non-residents" and kerosene are not considered.

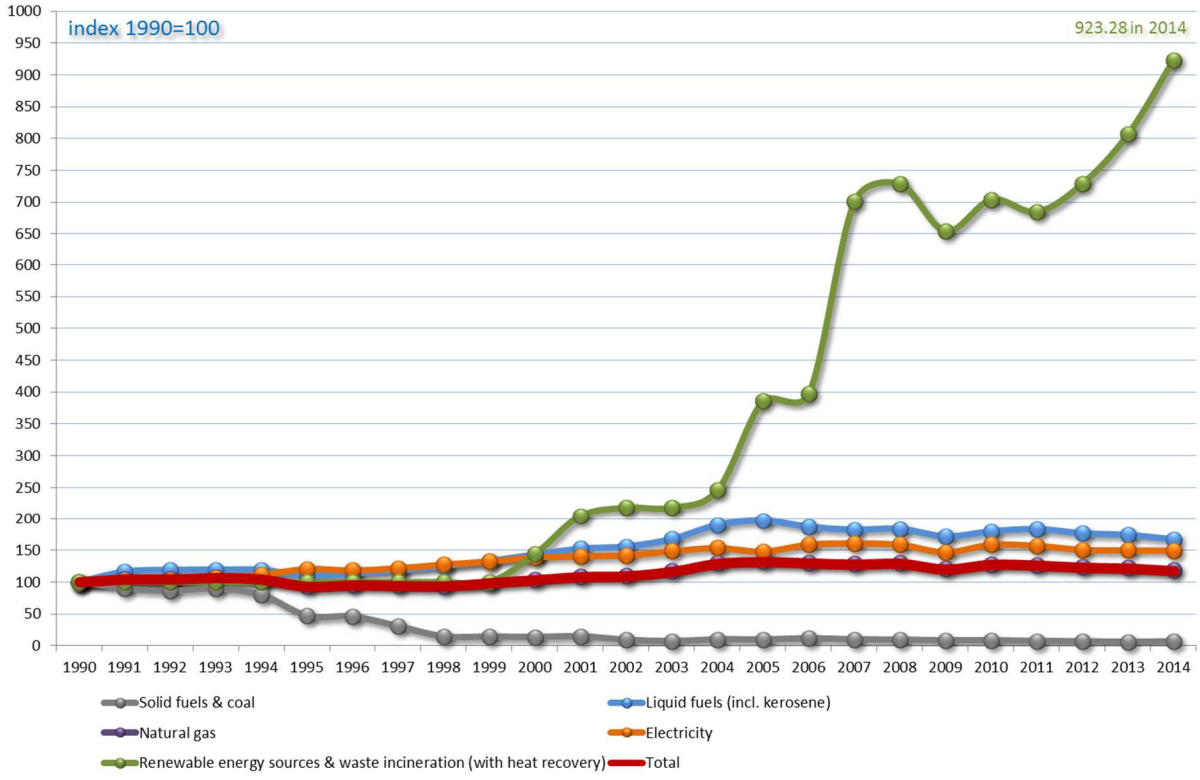
[21] Diesel being the first liquid fuel in terms of volumes sold. The liquid fuel consumption in Luxembourg is much lower than the level of fuel sales, because large amounts of road fuels are bought by foreign commuters and transit traffic passing through Luxembourg: see section 1.1.6 below.

Table 1-8 – Final energy consumption: 1990-2014

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	929.70	1321.31
	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**	**149622.78**	**156701.39**

TJ	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
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	2005.86	2234.78
	1.95%	*1.41%*	*1.78%*	*1.70%*	*2.06%*	*1.77%*	*1.68%*	*1.61%*	*1.52%*	*1.34%*	*1.27%*	*1.14%*	*1.31%*
Liquid fuels (incl. kerosene)	103120.21	110821.65	125715.23	130171.42	123605.43	120541.81	121487.76	113538.02	118810.49	121233.69	116795.59	114950.05	110460.66
	65.15%	*65.80%*	*67.32%*	*68.31%*	*65.82%*	*65.17%*	*65.06%*	*65.31%*	*64.38%*	*66.33%*	*65.68%*	*65.37%*	*64.92%*
Natural gas (1)	28258.28	28673.98	29942.32	29338.04	30622.60	29822.71	30616.00	28658.82	31411.99	27916.40	28262.17	27789.82	25257.38
	17.85%	*17.02%*	*16.04%*	*15.39%*	*16.31%*	*16.12%*	*16.39%*	*16.49%*	*17.02%*	*15.27%*	*15.89%*	*15.80%*	*14.84%*
Blast furnaces gas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	NA	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
Electricity	21260.54	22252.42	23007.38	22149.43	23806.48	24097.50	23750.44	22004.89	23777.46	23502.59	22570.79	22432.42	22418.30
	13.43%	*13.21%*	*12.32%*	*11.62%*	*12.68%*	*13.03%*	*12.72%*	*12.66%*	*12.88%*	*12.86%*	*12.69%*	*12.76%*	*13.17%*
Heat (2)	1149.89	2906.68	3149.21	3172.87	3332.59	2696.05	3056.39	2622.47	3200.50	3276.46	3245.60	3466.70	3833.94
	0.73%	*1.73%*	*1.69%*	*1.66%*	*1.77%*	*1.46%*	*1.64%*	*1.51%*	*1.73%*	*1.79%*	*1.83%*	*1.97%*	*2.25%*
Renewable energy sources & waste Incineration (with heat recovery) (3)	1405.98	1406.76	1586.77	2489.86	2562.50	4518.54	4697.03	4219.33	4539.12	4414.70	4700.15	5202.83	5953.00
	0.89%	*0.84%*	*0.85%*	*1.31%*	*1.36%*	*2.44%*	*2.52%*	*2.43%*	*2.46%*	*2.42%*	*2.64%*	*2.96%*	*3.50%*
Total	**158278.52**	**168430.63**	**186729.46**	**190570.48**	**187806.38**	**184956.93**	**186744.19**	**173844.80**	**184546.18**	**182787.29**	**177823.89**	**175847.67**	**170158.06**

Figure 1-18 – Final energy consumption: 1990-2014



Source: STATEC, *Statistical Yearbook*, Table A.4300 (updated 24 February 2016):
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 there is a break in the time series (II);
(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 the time series between 1999 & 2000 (II).

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.[22] 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 installation was encouraged financially by the Government. This development was followed later by some industrial companies which installed gas turbines to produce electricity and heat simultaneously. In mid-2002, the ultra-modern TWINerg power plant started its commercial operation. Located in Esch-sur-Alzette, TWINerg is a gas and steam turbine power station running on natural gas, with an electrical output of 376 MWel (efficiency 55.7%).[23] There are plans for decoupling heat at a later stage (28 MWth) for remote heating of the new Belval-Ouest district project.[24] 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 1-7 and its associated Figure 1-17: electricity imports dropped and natural gas primary consumption increased. To complement this analysis, an energy balance for electric power is provided (Table 1-9 & Figure 1-19).

22 Then Arcelor and now, ArcelorMittal.

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

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

Table 1-9 – Energy balance for electric power: 1990-2014

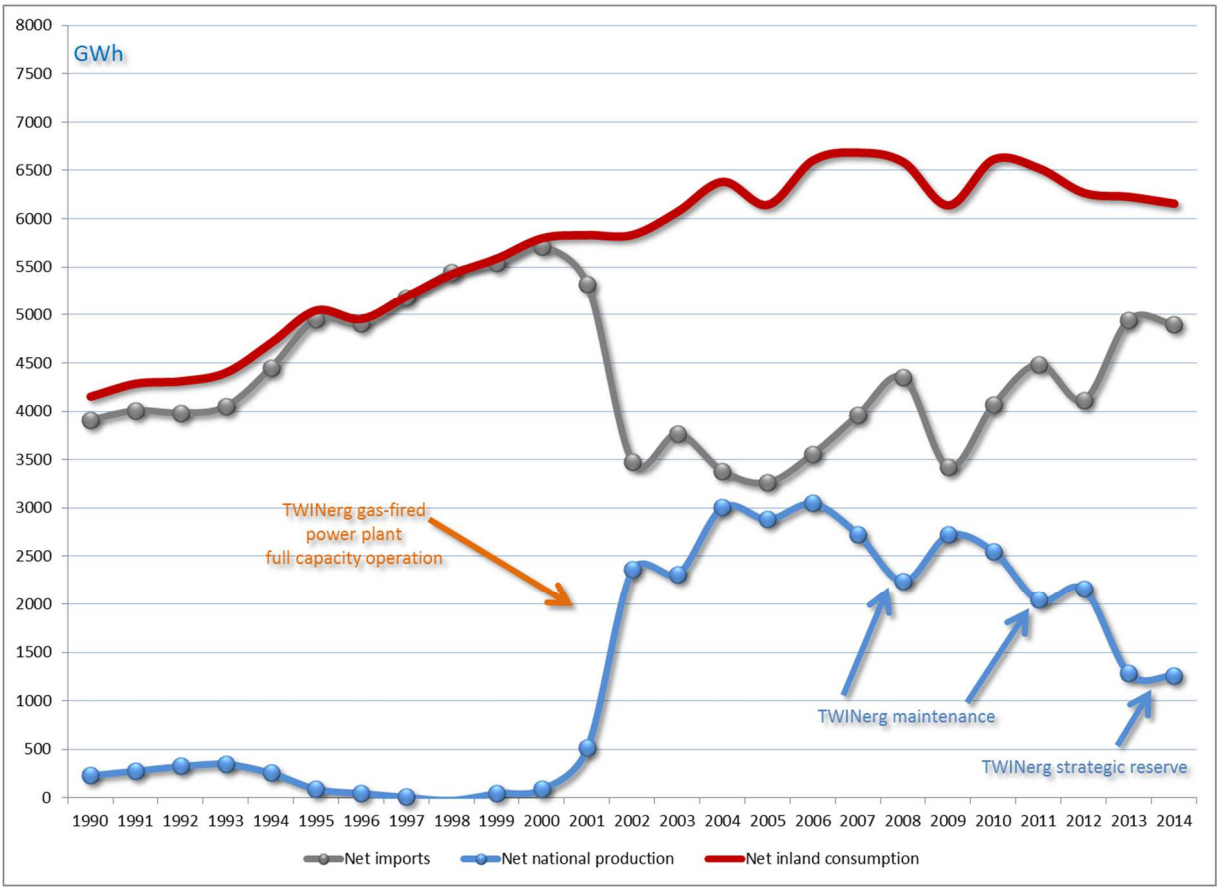
Imports		**4665.46**	**4718.45**	**4523.56**	**4440.97**	**5015.24**	**5693.47**	**5712.33**	**6026.52**	**6366.60**	**6193.53**	**6445.38**	**6383.25**
National production		**626.24**	**676.37**	**662.49**	**669.79**	**622.07**	**527.70**	**482.06**	**430.92**	**409.91**	**390.16**	**449.58**	**928.65**
	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
	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 landfill 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	2001
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 **(2)**	14930.83	15423.21	15511.74	15833.88	16944.89	18154.34	17835.79	18689.40	19527.64	20115.89	20875.02	20989.06
Net inland consumption in 1000 toe	356.62	368.38	370.49	378.19	404.72	433.61	426.00	446.39	466.41	480.46	498.59	501.32

GWh	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Imports	**6413.64**	**6562.18**	**6506.31**	**6391.61**	**6823.54**	**6846.58**	**6829.87**	**6022.47**	**7279.51**	**7096.00**	**6732.00**	**6852.00**	**6961.00**
National production	**2808.65**	**2784.36**	**3373.52**	**3336.93**	**3518.95**	**3190.23**	**2713.28**	**3142.69**	**3223.53**	**2648.00**	**2753.00**	**1845.00**	**1835.00**
cogeneration	341.50	382.28	421.57	417.92	438.09	362.39	378.35	337.12	383.70	393.00	380.00	359.00	300.00
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	1157.00	1224.00
hydro-electricity	99.73	73.94	95.64	85.03	102.67	107.19	121.23	97.02	100.25	61.00	97.00	117.00	105.00
wind	24.73	26.17	39.40	52.45	57.99	64.29	60.59	63.47	55.08	64.00	75.00	81.00	71.00
biomass & biogas	9.30	15.13	20.34	27.24	32.60	36.59	38.51	47.22	50.40	49.00	52.00	49.00	53.00
gas from WWTPs	NO	NO	NO	NO	NO	NO	5.32	5.85	5.14	6.00	6.00	7.00	7.00
gas from landfill sites	NO	NO	NO	NO	NO	NO	NO	0.26	0.41	0.00	1.00	1.00	1.00
photovoltaic	0.08	1.36	9.20	17.70	21.11	20.90	20.03	20.32	21.15	26.00	38.00	74.00	74.00
Total	**9222.29**	**9346.53**	**9879.83**	**9728.54**	**10342.49**	**10036.81**	**9543.15**	**9165.16**	**10503.04**	**9744.00**	**9485.00**	**8697.00**	**8796.00**
Exports	**2939.92**	**2799.41**	**3131.58**	**3131.31**	**3266.55**	**2886.84**	**2483.53**	**2604.45**	**3216.07**	**2614.00**	**2622.00**	**1908.00**	**2067.00**
Conversion uses and losses	**450.53**	**475.68**	**366.33**	**453.13**	**472.35**	**466.47**	**474.25**	**423.09**	**674.15**	**608.00**	**596.00**	**563.00**	**573.00**
Net inland consumption	**5831.84**	**6071.44**	**6381.92**	**6144.11**	**6603.59**	**6683.49**	**6585.37**	**6137.62**	**6612.82**	**6522.00**	**6267.00**	**6226.00**	**6156.00**
Total	**9222.29**	**9346.53**	**9879.83**	**9728.54**	**10342.49**	**10036.81**	**9543.15**	**9165.16**	**10503.04**	**9744.00**	**9485.00**	**8697.00**	**8796.00**

Summary in GWh	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Net imports	**3473.72**	**3762.77**	**3374.73**	**3260.30**	**3556.99**	**3959.74**	**4346.34**	**3418.02**	**4063.44**	**4482.00**	**4110.00**	**4944.00**	**4894.00**
Net national production (1)	**2358.12**	**2308.67**	**3007.19**	**2883.81**	**3046.60**	**2723.76**	**2239.03**	**2719.59**	**2549.38**	**2040.00**	**2157.00**	**1282.00**	**1262.00**
Net inland consumption	**5831.84**	**6071.44**	**6381.92**	**6144.11**	**6603.59**	**6683.49**	**6585.37**	**6137.62**	**6612.82**	**6522.00**	**6267.00**	**6226.00**	**6156.00**
Net inland consumption in Mio. MJ **(2)**	20994.63	21857.19	22974.91	22118.79	23772.92	24060.58	23707.33	22095.41	23806.15	23479.20	22561.20	22413.60	22161.60
Net inland consumption in 1000 toe	501.45	522.05	548.75	528.30	567.81	574.68	566.24	527.74	568.60	560.79	538.87	535.34	529.32

Figure 1-19 –Energy balance for electric power: 1990-2014



Sources: Compiled by the Environment Agency on 25 February 2016 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) 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.
(3) Provisional data for 2013 relates to gross national production, cogeneration, conversion process uses and losses, net inland consumption, and net national production.

1.1.6 Road transportation

1.1.6.1 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 1-15) 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 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 a policy of low taxed fuel (gasoline and diesel), 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 1-2.

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 1-21).

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 NEMO model.

Box 1-2 – "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 drinks, tobacco, *etc*.

In the subsequent chapters & sections, "road fuel sales to non-residents" is sometimes referred to as "(road) fuel exports".

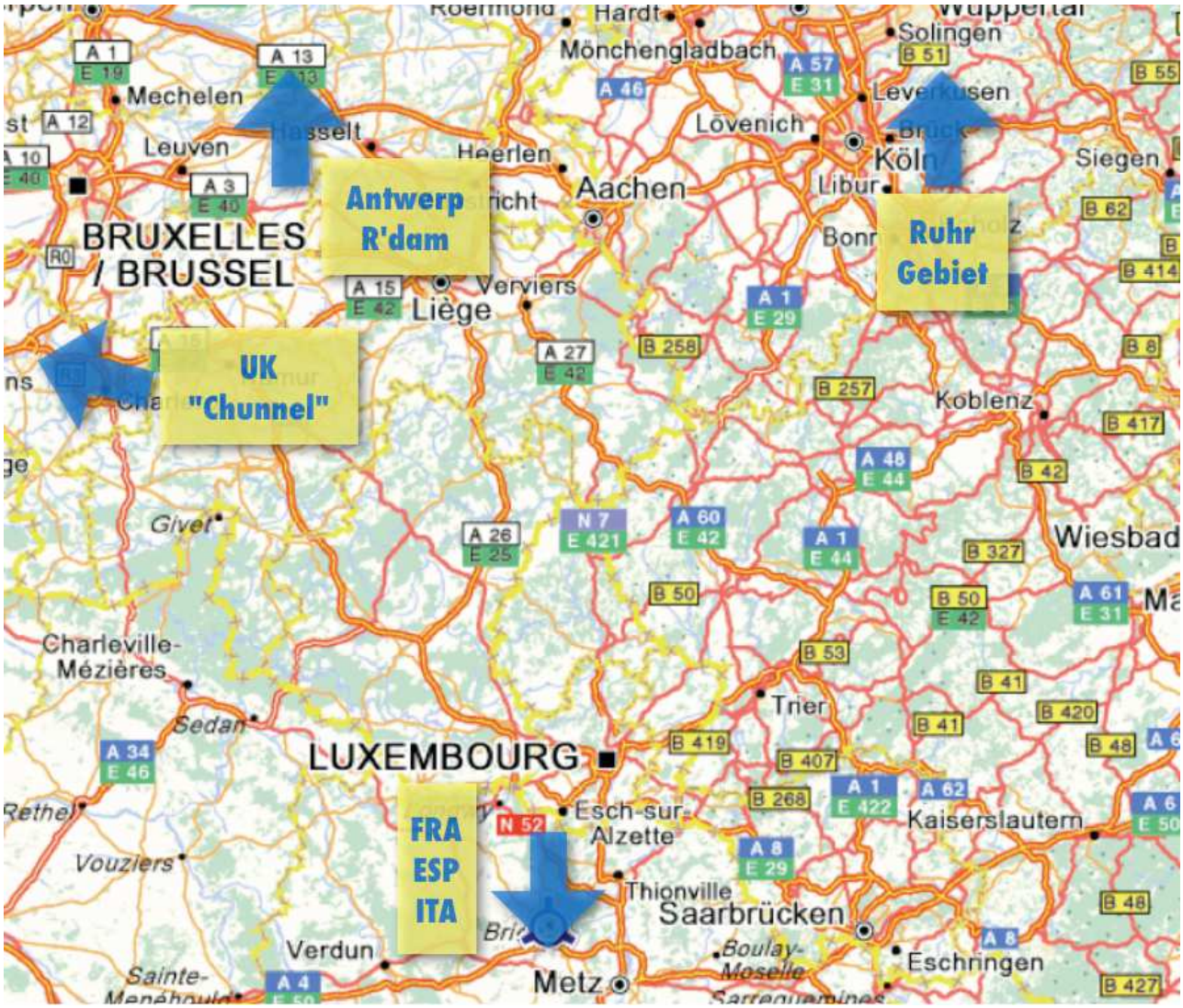
1.1.6.2 Effects on GHG emissions: an untypical situation

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 2014, some 6.04 Mio. t CO_2e were produced by the road transportation sector and out of these, 4.5 Mio. t CO_2e, corresponding to 74.9%, was the result of road fuels bought by non-residents and were, consequently, merely emitted abroad. That last amount represented around 42.1% of the total 2014 GHG emissions for Luxembourg (excluding LULUCF) while the whole CRF sub-category 1A3b accounted for 56.1% for of the total 2014 GHG emissions for Luxembourg (excluding LULUCF) (Figure 1-22).

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: +79.8% and +152.35%

respectively.[25] 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 661 passenger cars per 1000 inhabitants between 1990 and 2014, *i.e.* the highest rate within the EU[26]). 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 1-20 – Main road freight axes crossing Luxembourg

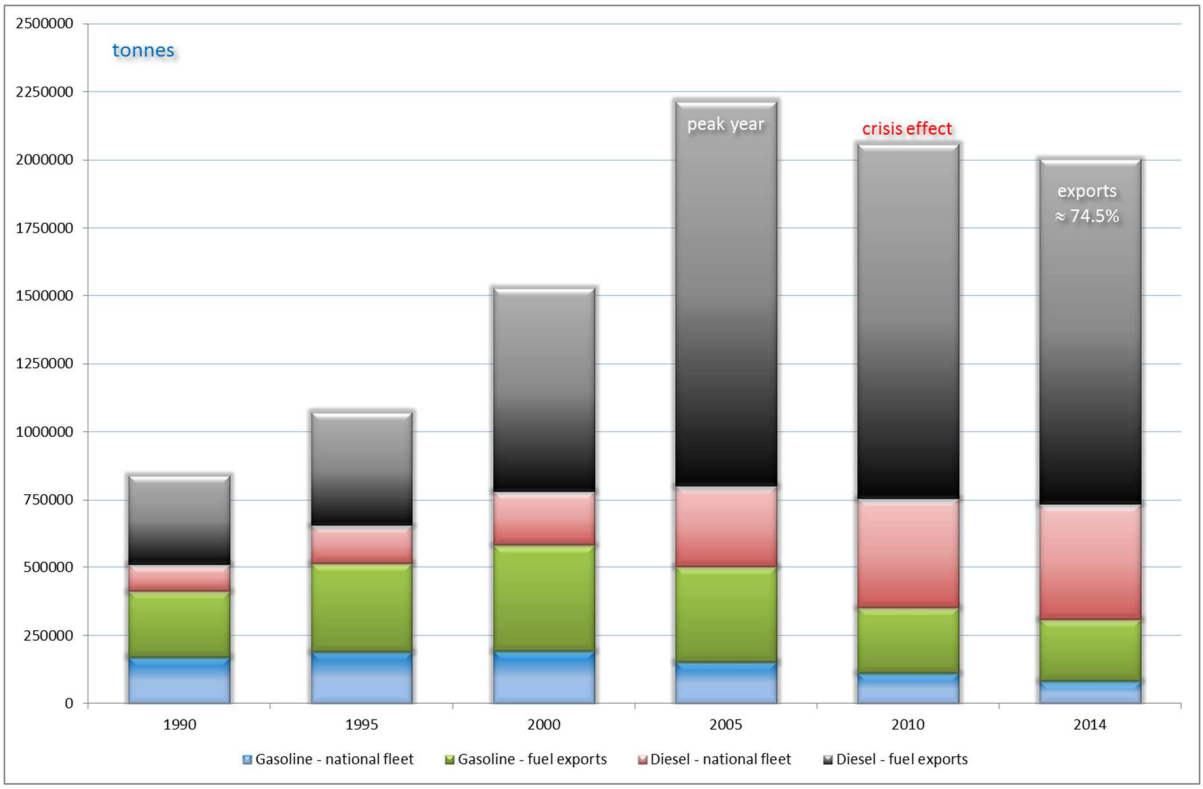


Source: ViaMichelin.

25 Corresponding percentages were +66.25% and +208% in 2005, the peak year with regard to road transportation related emissions. These percentages differ slightly from those reported under Table 3-52 since the latter includes CO_2 emissions from biomass which is not counted here.

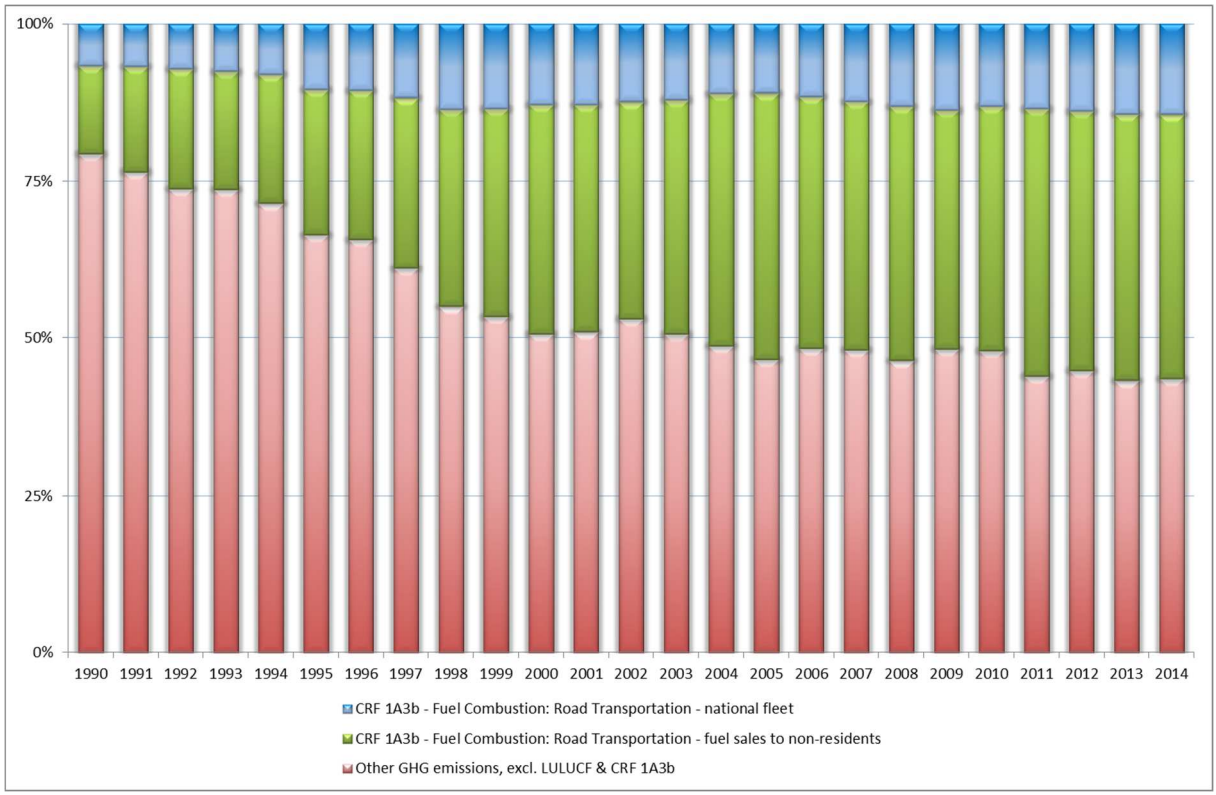
26 Data extracted from European Commission (DG MOVE), *EU Transport in figures – statistical pocketbook 2015*, p.84: http://ec.europa.eu/transport/facts-fundings/statistics/doc/2015/pocketbook2015.pdf.

Figure 1-21 – Road blended fuel sales: 1990-2014 in tonnes



Source: based on Table 3-51 in Section 3.2.8.3 of the 2016 NIR.

Figure 1-22 – GHG emissions for road transportation (CRF sub-category 1A3b): 1990-2014



Source: Submission 2016v4.
Note: CO_2 emissions from biofuels are excluded, and reported as "memo item".

1.1.7 UNFCCC and Kyoto Protocol: a demanding challenge for Luxembourg

1.1.7.1 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*" adopted in May 2013,[27] 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, the new Government that took office early December 2013 underlines in its programme 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. 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.[28] 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.

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27 http://www.environnement.public.lu/actualites/2013/05/plan_action_climat/index.html.

28 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.

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 neighbouring 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.

1.1.7.2 *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 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.

These last years, the construction of a single power station, the TWINerg gas and steam plant, represents a further illustrative example. 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 Scheme 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 operation of the TWINerg power plant in 2008 and 2011 demonstrates.

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

1.1.7.3 *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)[29] – total emissions from industry and electricity generation – *i.e.* largely the sectors covered by the EU-ETS – decreased to just 1.09 Mio. t CO_2e in 2014 – or 10% of total GHG emissions (excluding LULUCF) – coming from slightly more than 6.3 Mio. t CO_2e in 1990 - or about 49% of total GHG emissions (excluding LULUCF).[30]

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.[31] 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.[32] More precisely, CHP installations using renewable energies, biogas addition in distribution networks and the mobilization of wood resources will be favoured.

1.1.7.4 *The "origin" principle of the IPCC reporting Guidelines vs. "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.

Now, if the "polluter pays" principle is used as a yardstick, Luxembourg's assessment reveals that GHG emissions according to the IPCC Guidelines are about 2.4 Mio. t CO_2e different for 2014 (Figure 1-23).[33]

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29 Sum of CRF sub-categories 1A2a and 2C1. This percentage is 3.47% for 2014.

30 Sum of CRF sub-categories 1A1a, 1A2 and 2, excluding F-gases. The lowest share (18.3%) was obtained in 2013 – and the lowest absolute value (1.7 Mio. t CO_2e) in 1998.

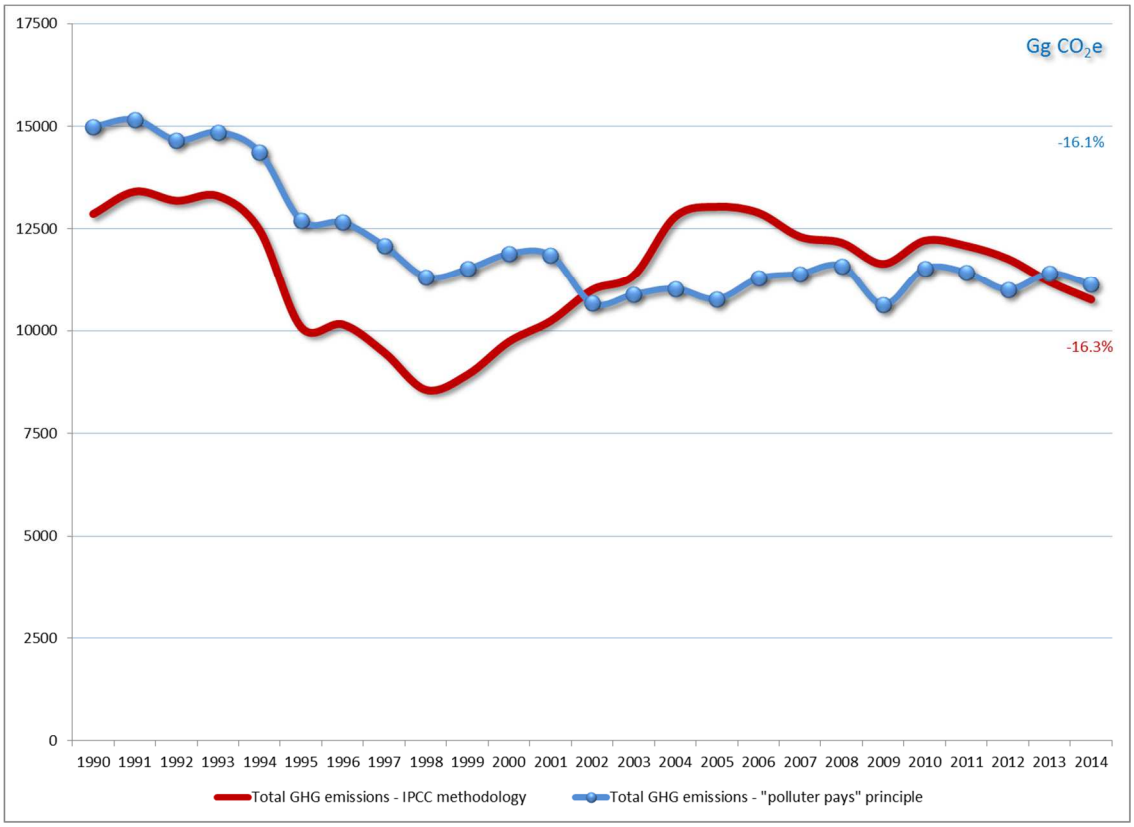
31 1 Mio. t CO_2e for the TWINerg and 0.2 Mio. t CO_2e for CHP installations.

32 See the second *Action Plan for Reducing CO_2 Emissions* (http://www.environnement.public.lu/actualites/2013/05/plan_action_climat/index.html).

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

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:[34] it has been estimated that electricity net imports – with, nowadays, an average emission factors of 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).

Figure 1-23 – Total GHG emissions, excluding LULUCF – two approaches: 1990-2014



Sources: Environment Agency and MDDI-DEV.
Notes: 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

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

[34] GEMIS stands for *Global Emission Model for Integrated Systems*: http://www.iinas.org/gemis-de.html.

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.

1.1.8 National circumstances: overview

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

- a country characterized 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 become quickly cross-border issues;
- **limited national** GHG emissions reduction potential.

Figure 1-24, Figure 1-25 and Figure 1-26 provide a quick overview of the trends of some key variables since 1990.

Figure 1-24 – Key variables trends – 1: 1990-2014

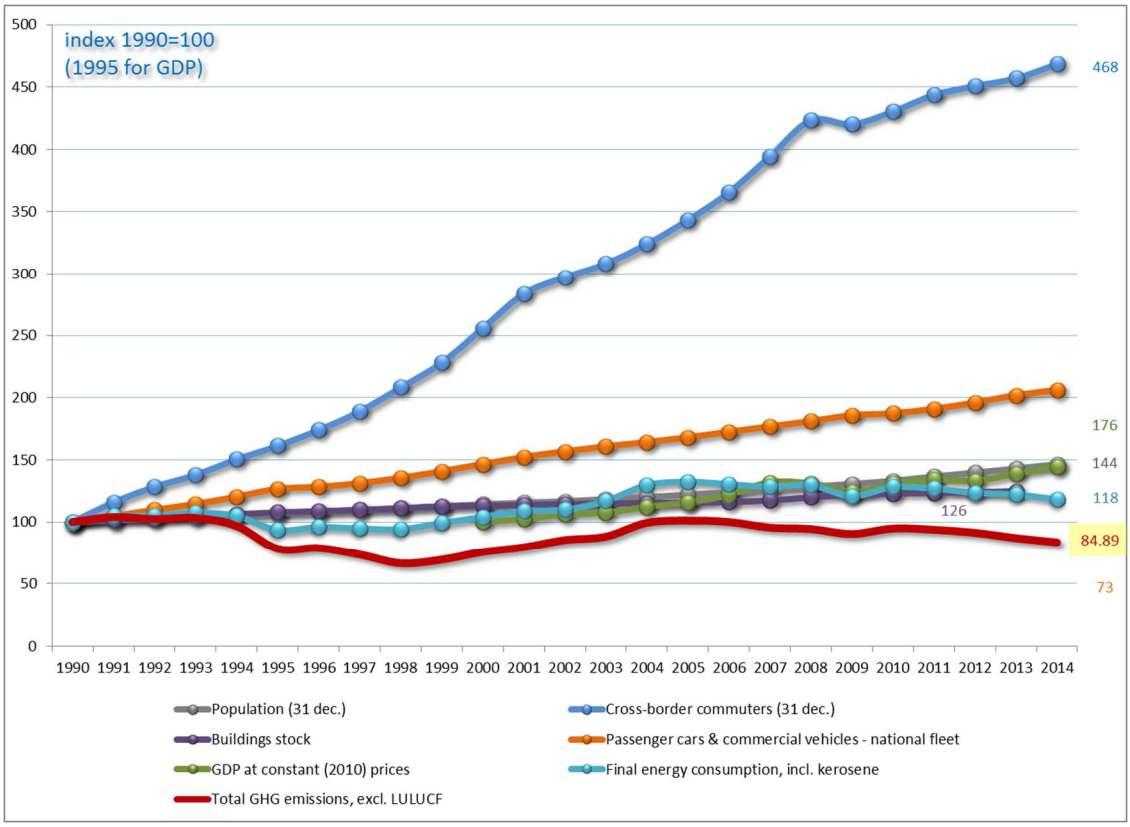


Figure 1-25 – Key variables trends – 1: 1990-2014 (excl. cross-border commuters)

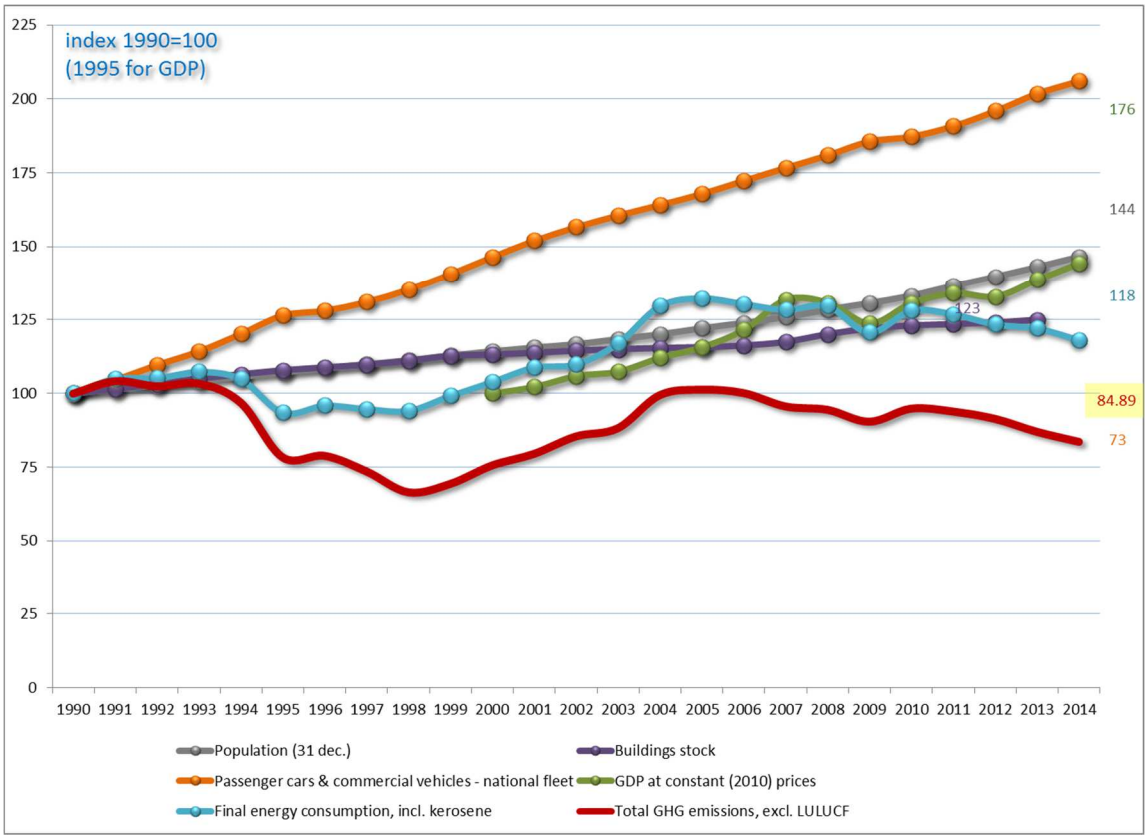
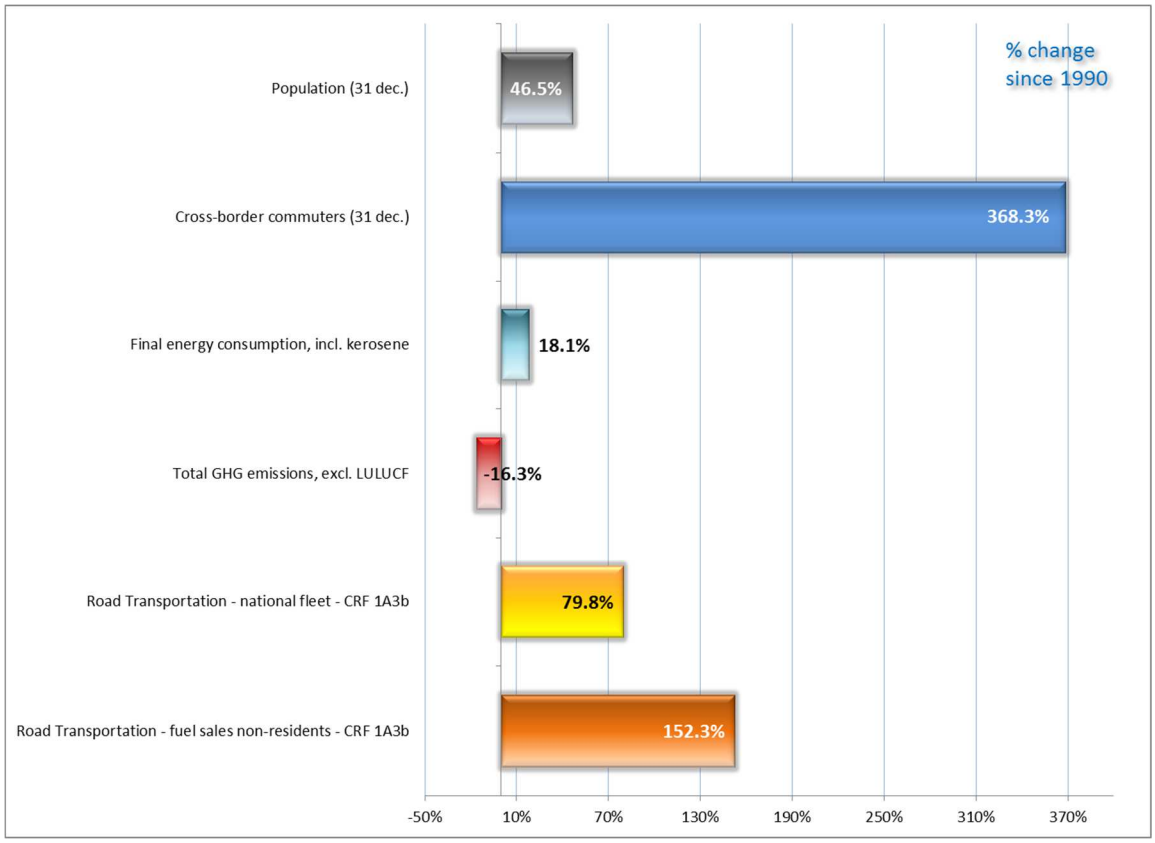


Figure 1-26 – Key variables trends – 2: 1990 & 2014



Sources: Population: STATEC, *Statistical Yearbook*, Table B.1100 (updated 21 March 2016).
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 25 October 2015).
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 13 January 2016).
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 13 January 2016).
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 November 2015).
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 2016v4.

Notes: (1) Energy: there is a break in time series between 1999 & 2000.
(2) Buildings stocks = stock of permanently occupied dwellings.

1.2 GHG EMISSION IN 2014 AND DEVELOPMENTS SINCE 1990

This text is extracted from the National Inventory Report submitted on 15 April 2016. It has been written by Isabelle Naegelen and Marc Schuman (Environment Agency).

In 2014, carbon dioxide was the main source of GHG in Luxembourg. This source counted for 90.8% of the total GHG emissions calculated in CO_2e – total excluding LULUCF.[35] The second source of GHG was methane with 5.5% of the total GHG emissions. Nitrous oxide was the third source with

[35] In Section 1.2, "total (GHG) emissions" mean "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.

2.9%. Fluorinated gases only accounted for 0.72% of the total GHG emissions, with hydrofluorocarbons representing 0.6% of the total GHG emissions and sulphur hexafluoride representing 0.08% of the total GHG emissions *[→ CTF Tables 1]*.

In 2014, total GHG emissions amounted to 10.7 Mio. t CO_2e, 16.3% below their level in 1990 and 11.1% below the level retained for the base year under the Kyoto Protocol.[36] As Figure 1-27 shows, several phases can clearly be distinguished over the period 1990 to 2014:

- 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 around 13 Mio. t CO_2e is observed;
- a decrease occurred between 2006 and 2007 followed by a period of two years impacted by the financial and economic crisis.

The evolution during those 25 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.

[36] The level of emissions considered for the base year is 12.029 Mio. t CO_2e. 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 1-10 shows, F-gases emissions are no longer the same in 1990 and 1995.

Table 1-10 – Luxembourg's GHG emissions and removals – overview by main gases and CRF Sectors: 1990-2014

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	2012	2013	2014
CO_2 emissions, incl. net CO_2	12009.02	12257.56	11710.98	11738.37	11114.00	8606.19	8628.15	7860.84	7064.81	7334.42	8112.70	8612.88	9368.20	9781.05	11203.90	11507.21	11450.61	10932.90	10762.43	10266.95	11137.73	10901.49	10516.22	9763.63	9366.66
from LULUCF (1)	*92.93%*	*92.92%*	*92.66%*	*92.72%*	*92.49%*	*90.34%*	*90.28%*	*89.43%*	*88.37%*	*88.72%*	*89.73%*	*90.36%*	*91.04%*	*91.52%*	*92.40%*	*92.75%*	*92.78%*	*92.37%*	*92.17%*	*91.83%*	*92.29%*	*92.26%*	*92.18%*	*91.52%*	*90.85%*
CO_2 emissions, excl. net CO_2	11961.50	12487.28	12269.88	12392.33	11578.79	9174.05	9236.43	8551.85	7640.24	8007.56	8819.12	9331.52	10088.77	10464.78	11891.92	12150.18	12012.04	11414.96	11258.43	10740.17	11294.32	11179.89	10882.32	10305.28	9829.93
from LULUCF	*92.93%*	*93.07%*	*93.00%*	*93.11%*	*92.80%*	*90.93%*	*90.90%*	*90.24%*	*89.19%*	*89.62%*	*90.52%*	*91.08%*	*91.66%*	*92.06%*	*92.84%*	*93.14%*	*93.13%*	*92.70%*	*92.52%*	*92.19%*	*92.42%*	*92.46%*	*92.44%*	*91.95%*	*91.27%*
CH_4 (2) emissions, incl. net CH_4	619.80	626.98	616.94	615.90	597.71	610.49	616.39	613.87	609.06	612.21	604.65	604.11	601.27	587.29	581.06	577.28	571.85	581.27	588.27	588.39	597.34	571.20	559.23	563.36	570.12
from LULUCF (1)	*4.80%*	*4.75%*	*4.88%*	*4.86%*	*4.97%*	*6.41%*	*6.45%*	*6.98%*	*7.62%*	*7.41%*	*6.69%*	*6.34%*	*5.84%*	*5.50%*	*4.79%*	*4.65%*	*4.63%*	*4.91%*	*5.04%*	*5.26%*	*4.95%*	*4.83%*	*4.90%*	*5.28%*	*5.53%*
CH_4 (2) emissions, excl. net CH_4	619.80	626.98	616.94	615.90	597.71	610.49	616.39	613.87	609.06	612.21	604.65	604.11	601.27	587.29	581.06	577.28	571.85	581.27	588.27	588.39	597.34	571.20	559.23	563.36	570.12
from LULUCF	*4.82%*	*4.67%*	*4.68%*	*4.63%*	*4.79%*	*6.05%*	*6.07%*	*6.48%*	*7.11%*	*6.85%*	*6.21%*	*5.90%*	*5.46%*	*5.17%*	*4.54%*	*4.43%*	*4.43%*	*4.72%*	*4.83%*	*5.05%*	*4.89%*	*4.72%*	*4.75%*	*5.03%*	*5.29%*
N_2O (3) emissions, incl. net N_2O	293.39	306.03	295.82	289.82	287.75	290.01	291.17	291.55	294.95	292.10	292.52	278.89	282.50	277.48	296.62	278.43	272.02	269.80	271.24	268.99	273.96	281.28	268.30	272.46	298.84
from LULUCF (1)	*2.27%*	*2.32%*	*2.34%*	*2.29%*	*2.39%*	*3.04%*	*3.05%*	*3.32%*	*3.69%*	*3.53%*	*3.24%*	*2.93%*	*2.75%*	*2.60%*	*2.45%*	*2.24%*	*2.20%*	*2.28%*	*2.32%*	*2.41%*	*2.27%*	*2.38%*	*2.35%*	*2.55%*	*2.90%*
N_2O (3) emissions, excl. net N_2O	288.77	301.41	291.20	285.21	283.13	285.39	286.55	286.93	290.33	287.48	287.95	274.38	278.04	273.07	292.26	274.12	267.76	265.60	267.23	265.18	270.34	277.86	265.07	269.44	296.01
from LULUCF	*2.24%*	*2.25%*	*2.21%*	*2.14%*	*2.27%*	*2.83%*	*2.82%*	*3.03%*	*3.39%*	*3.22%*	*2.96%*	*2.68%*	*2.53%*	*2.40%*	*2.28%*	*2.10%*	*2.08%*	*2.16%*	*2.20%*	*2.28%*	*2.21%*	*2.30%*	*2.25%*	*2.40%*	*2.75%*
HFCs (4)	0.00	0.00	13.68	14.70	15.98	17.90	19.63	22.05	24.45	26.25	28.98	32.85	35.65	37.93	39.99	38.99	41.88	46.46	48.81	49.67	52.33	55.19	57.53	61.17	66.08
	0.00%	*0.00%*	*0.10%*	*0.11%*	*0.13%*	*0.18%*	*0.19%*	*0.23%*	*0.29%*	*0.29%*	*0.30%*	*0.32%*	*0.32%*	*0.33%*	*0.31%*	*0.30%*	*0.32%*	*0.38%*	*0.40%*	*0.43%*	*0.43%*	*0.46%*	*0.49%*	*0.55%*	*0.61%*
PFCs (4)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	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*
SF_6 (4)	0.88	0.98	1.08	1.19	1.30	1.39	1.56	1.70	1.74	1.83	1.93	2.54	3.15	3.73	4.28	4.85	5.27	5.69	6.10	6.49	6.87	7.31	7.68	8.05	8.23
	0.01%	*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%*	*0.03%*	*0.04%*	*0.04%*	*0.05%*	*0.05%*	*0.06%*	*0.06%*	*0.06%*	*0.07%*	*0.07%*	*0.08%*
1. Energy	10411.19	11023.26	10880.79	11026.95	10306.93	8260.47	8383.56	7810.85	7060.30	7387.73	8177.38	8753.33	9510.65	9953.48	11330.11	11607.81	11416.04	10820.78	10724.94	10271.69	10817.32	10680.15	10445.09	9887.16	9403.04
	80.89%	*82.16%*	*82.48%*	*82.85%*	*82.61%*	*81.87%*	*82.51%*	*82.42%*	*82.42%*	*82.68%*	*83.93%*	*85.44%*	*86.41%*	*87.57%*	*88.45%*	*88.98%*	*88.50%*	*87.87%*	*88.13%*	*88.17%*	*88.51%*	*88.33%*	*88.73%*	*88.22%*	*87.30%*
2. Industrial Processes	1648.46	1569.57	1511.54	1488.78	1396.74	1037.03	982.46	874.91	716.82	754.93	782.33	729.01	748.76	697.85	755.79	727.43	782.97	780.10	720.22	652.70	672.53	690.52	631.40	609.68	645.78
	12.81%	*11.70%*	*11.46%*	*11.19%*	*11.19%*	*10.28%*	*9.67%*	*9.23%*	*8.37%*	*8.45%*	*8.03%*	*7.12%*	*6.80%*	*6.14%*	*5.90%*	*5.58%*	*6.07%*	*6.34%*	*5.92%*	*5.60%*	*5.50%*	*5.71%*	*5.36%*	*5.44%*	*6.00%*
3. Agriculture	715.22	725.73	701.91	695.02	677.13	698.52	704.81	701.18	699.73	705.71	696.35	682.24	668.36	634.70	648.36	637.12	628.56	642.69	656.65	660.21	669.54	663.39	643.96	659.66	671.93
	5.56%	*5.41%*	*5.32%*	*5.22%*	*5.43%*	*6.92%*	*6.94%*	*7.40%*	*8.17%*	*7.90%*	*7.15%*	*6.66%*	*6.07%*	*5.58%*	*5.06%*	*4.88%*	*4.87%*	*5.22%*	*5.40%*	*5.67%*	*5.48%*	*5.49%*	*5.47%*	*5.89%*	*6.24%*
4. LULUCF	52.13	-225.11	-554.29	-649.35	-460.17	-563.24	-603.66	-686.40	-570.82	-668.53	-701.85	-714.13	-716.11	-679.32	-683.66	-638.66	-557.18	-477.85	-491.99	-469.41	-152.97	-274.98	-362.88	-538.62	-460.44
	0.41%	*-1.68%*	*-4.20%*	*-4.88%*	*-3.69%*	*-5.58%*	*-5.94%*	*-7.24%*	*-6.66%*	*-7.48%*	*-7.20%*	*-6.97%*	*-6.51%*	*-5.98%*	*-5.34%*	*-4.90%*	*-4.32%*	*-3.88%*	*-4.04%*	*-4.03%*	*-1.25%*	*-2.27%*	*-3.08%*	*-4.81%*	*-4.27%*
5. Waste	96.08	98.10	98.54	98.58	96.10	93.22	89.72	89.45	88.97	86.95	86.57	80.82	79.11	80.79	75.26	73.07	71.22	70.39	67.03	65.31	61.81	57.39	51.40	50.79	49.83
	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*
6. 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
	0.00%	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*
Total GHG including LULUCF	12923.08	13191.54	12638.49	12659.98	12016.74	9525.99	9556.90	8790.00	7995.01	8266.80	9040.78	9531.28	10290.77	10687.49	12125.85	12406.77	12341.62	11836.12	11676.85	11180.50	12068.22	11816.47	11408.96	10668.68	10310.14
	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%*	*100.00%*	*100.00%*
Total GHG excluding LULUCF	12870.95	13416.64	13192.78	13309.33	12476.91	10089.23	10160.56	9476.40	8565.82	8935.33	9742.63	10245.40	11006.87	11366.81	12809.52	13045.43	12898.80	12313.97	12168.84	11649.91	12221.20	12091.45	11771.84	11207.30	10770.58
	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%*	*100.00%*	*100.00%*

Source: Environment Agency and MDDI-DEV – submission 2016v4.

Notes: (1) These percentages are relative to the total GHG emissions, including LULUCF.

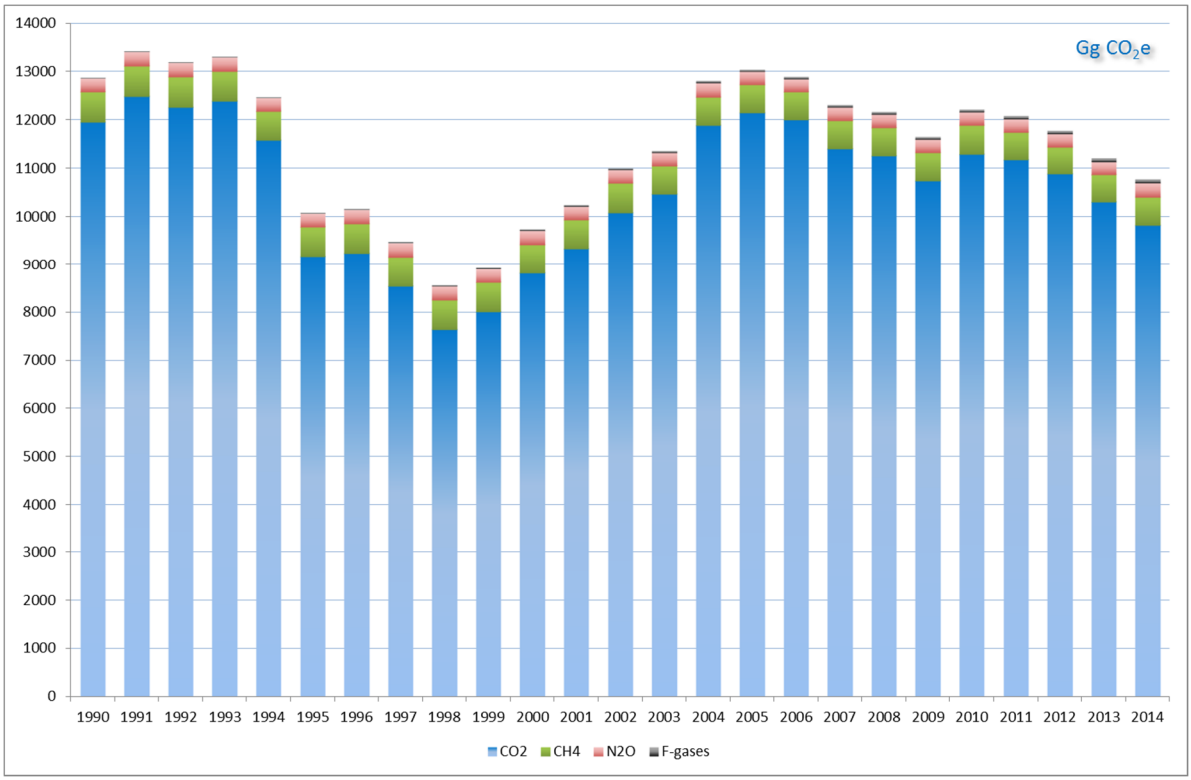
(2) The methane emissions are converted in CO_2 equivalents by multiplying the emissions by 25, *i.e.* the global warming potential (GWP) value for methane based on the effects of GHG over a 100-year time horizon.

(3) The nitrous oxide emissions are converted in CO_2 equivalents by multiplying the emissions by 298, *i.e.* the global warming potential (GWP) value for nitrous oxide based on the effects of GHG over a 100-year time horizon.

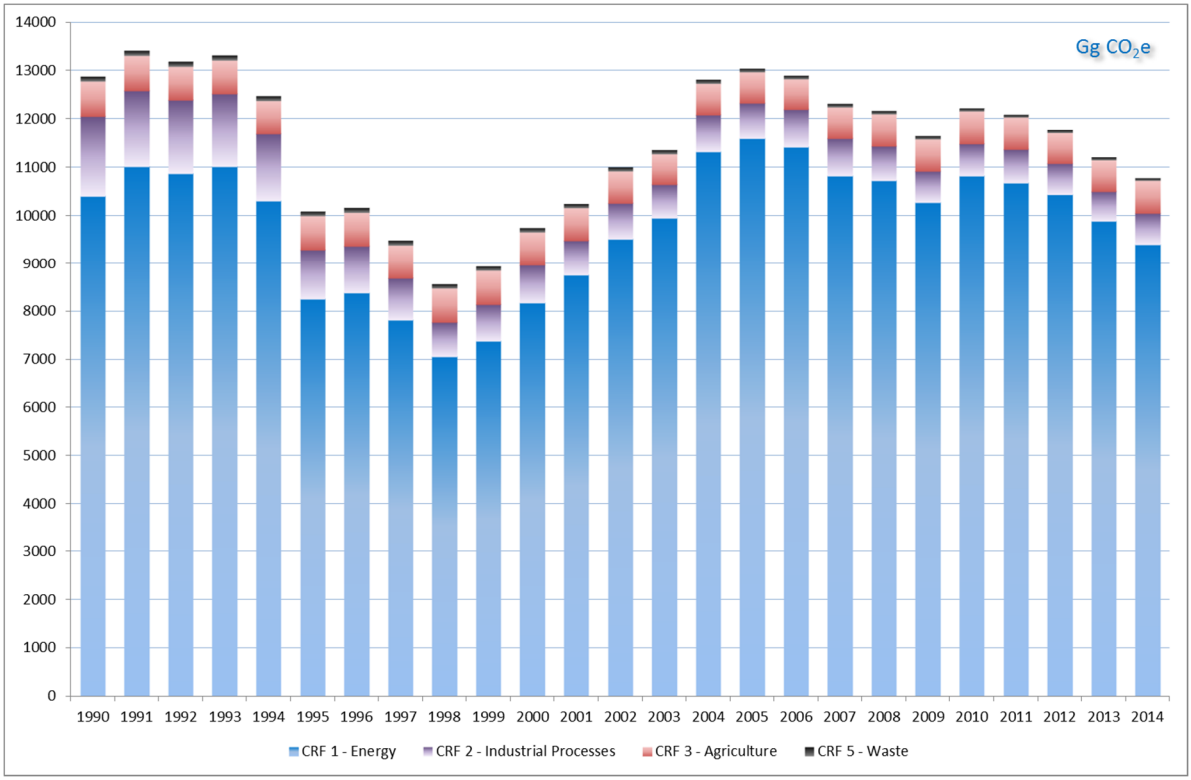
(4) The F-gases are those not covered by the Montreal Protocol, *i.e.* the HFCs, PFCs and SF_6 expressed in CO_2 equivalents using the global warming potential (GWP) values based on the effects of GHG over a 100-year time horizon.

Figure 1-27 – Luxembourg's GHG emissions (excl. LULUCF) – absolute values: 1990-2014

GHG



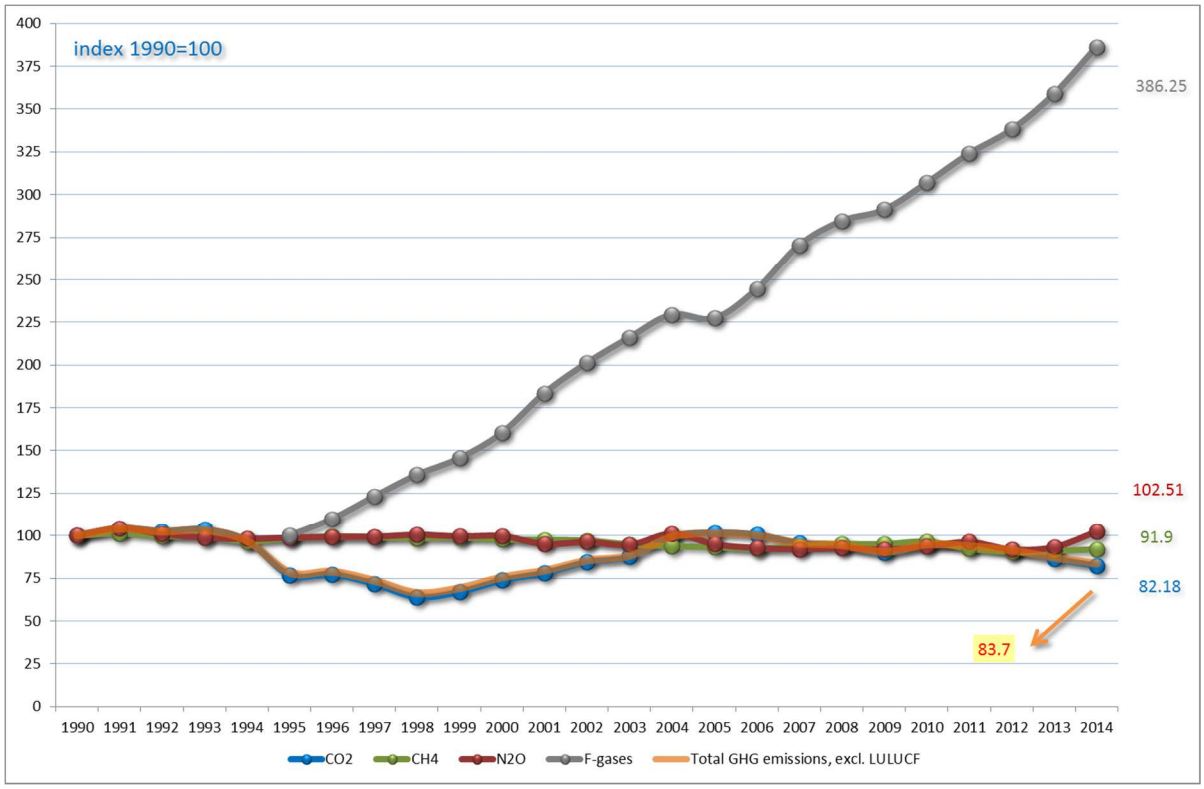
CRF Sectors



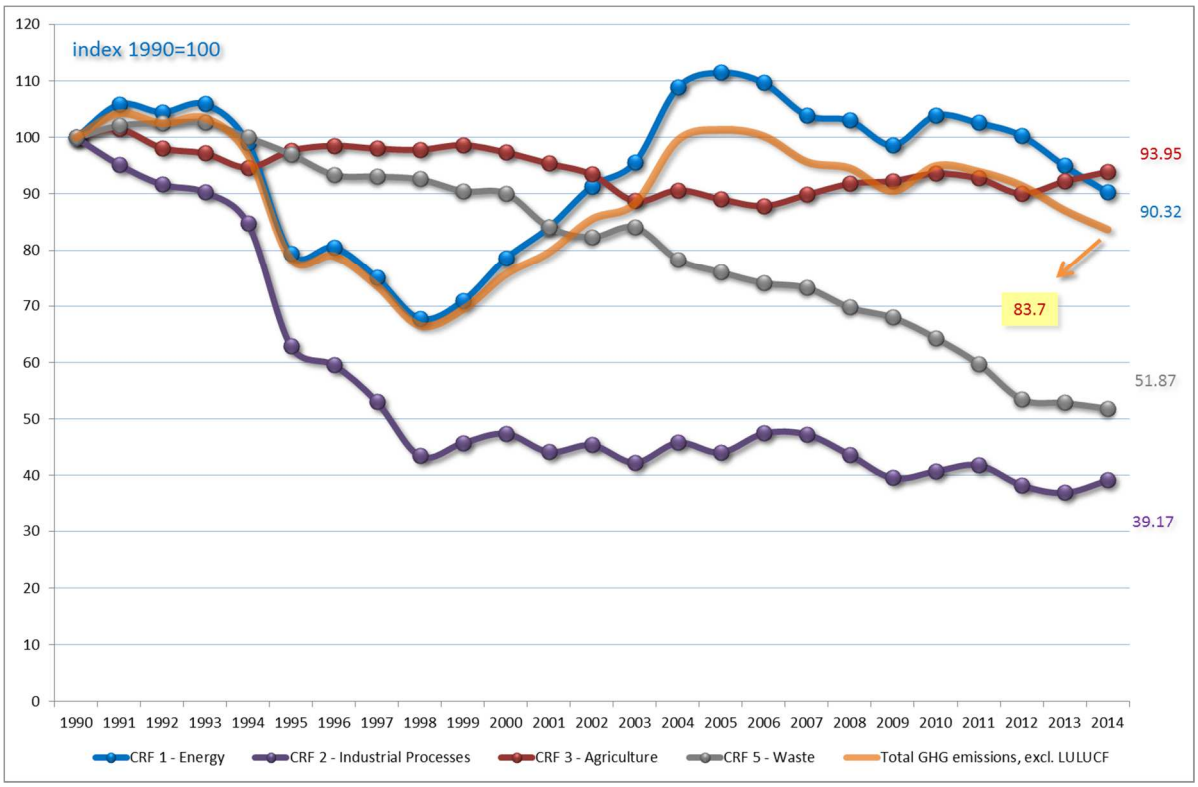
Sources: Environment Agency and MDDI-DEV.

Figure 1-28 – Luxembourg's GHG emissions (excl. LULUCF) – indexes: 1990-2014

GHG



CRF Sectors



Sources: Environment Agency and MDDI-DEV.

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. This process change was the main driver for the reduction in GHG emissions observed between 1994 and 1998. 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 for the years 2008, 2011 and 2012 when the main power plant of the country experienced maintenance or reduced activities which resulted in several months without substantial production.

More detailed explanations are provided in Sections 1.2.1 (dealing with gases) and 1.2.2 (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 7.7 Mio. t in 1990, CO_2e emissions from industrial processes and fuel combustion in industry accounted for 61.1% of total GHG emissions. They could eventually be reduced to 1.68 Mio. t in 1998 – *i.e.* 20.7% 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). 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. 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.

These considerations can easily be identified in Table 1-11 and Table 1-12, 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.

1.2.1 Description of Emission Trends by Gas

For the different GHG, trends over the period 1990-2014 (and 2013-2014) were as follows:

- CO_2: ..... -17.8% (-4.6%)
- CH_4: ..... -8.0% (+1.2%)
- N_2O: .....+2.5% (+9.8%)
- F-gases: .....+286.25% (+7.65%)

For carbon dioxide, the development between 1990 and 2014 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 the previous section.

Methane emissions have declined over the period due to the conjunction of reduced methane emissions in waste and waste water management (-47.3%) that surpasses growing emissions in energy use (+18.03%). Methane emissions in agriculture decreased slightly (-1.88%).

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 17.22% over the period 1990-2014. This decrease has more than balanced the sharp increase – +59.8% – recorded for fossil fuels related emissions from combustion activities (mainly for the road transportation and the other sectors).

Finally, with regard to F-gases, HFC emissions were about 3.7 times higher in 2014 than in the base year (1995), whereas SF_6 emissions showed a 6.07-fold increase. These evolutions can be visualized in Table 1-12, which distributes, for each GHG, emissions amongst the main source categories, as well as in the associated Figure 1-28 and Figure 1-29. These table and figures offer the opportunity to further analyse emission trends for each of the gases.

Table 1-11 – Luxembourg's GHG emissions (excl. LULUCF) –sector-based breakdown: 1990-2014

Gg (1000 t.) CO_2 equivalent	CRF Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Main Emitting Source Categories																										
Public Electricity & Heat Production	*1A1a*	35.64	36.41	37.19	35.38	34.61	33.06	26.45	38.78	69.48	81.03	120.17	282.26	1029.32	1037.21	1261.58	1243.98	1308.02	1184.14	999.75	1195.44	1207.30	1003.11	1039.49	686.10	721.42
		0.28%	*0.27%*	*0.28%*	*0.27%*	*0.28%*	*0.33%*	*0.26%*	*0.41%*	*0.81%*	*0.91%*	*1.23%*	*2.76%*	*9.35%*	*9.12%*	*9.85%*	*9.54%*	*10.14%*	*9.62%*	*8.22%*	*10.26%*	*9.88%*	*8.30%*	*8.83%*	*6.12%*	*6.70%*
Iron & Steel	*1A2a + 2C1*	6399.62	6091.86	5609.87	5851.34	4841.23	2786.27	2523.57	1633.72	451.44	493.16	487.44	548.43	530.66	460.93	561.24	532.45	673.88	662.73	616.00	510.66	579.31	444.32	442.94	431.38	373.46
(fuel combustion & processes)		*49.72%*	*45.41%*	*42.52%*	*43.96%*	*38.80%*	*27.62%*	*24.84%*	*17.24%*	*5.27%*	*5.52%*	*5.00%*	*5.35%*	*4.82%*	*4.06%*	*4.38%*	*4.08%*	*5.22%*	*5.38%*	*5.06%*	*4.38%*	*4.74%*	*3.67%*	*3.76%*	*3.85%*	*3.47%*
Other Manufacturing Industries &	*1A2b/c/d/e/f/g + 2A*	1515.56	1584.89	1671.67	1534.07	1732.36	1565.34	1631.00	1662.67	1646.51	1762.61	1691.47	1710.17	1670.46	1648.64	1743.45	1715.30	1692.95	1572.51	1477.04	1364.75	1428.00	1518.20	1333.57	1244.93	1234.50
Construction (fuel combustion & processes)		*11.78%*	*11.81%*	*12.67%*	*11.53%*	*13.88%*	*15.52%*	*16.05%*	*17.55%*	*19.22%*	*19.73%*	*17.36%*	*16.69%*	*15.18%*	*14.50%*	*13.61%*	*13.15%*	*13.12%*	*12.77%*	*12.14%*	*11.71%*	*11.68%*	*12.56%*	*11.33%*	*11.11%*	*11.46%*
Road Transportation - national fleet	*1A3b*	863.46	905.63	939.16	997.86	1000.85	1051.94	1073.45	1115.00	1167.82	1203.37	1248.62	1316.02	1364.43	1369.83	1412.44	1435.47	1494.92	1519.74	1596.23	1596.91	1599.66	1628.61	1627.34	1611.35	1552.34
		6.71%	*6.75%*	*7.12%*	*7.50%*	*8.02%*	*10.43%*	*10.56%*	*11.77%*	*13.63%*	*13.47%*	*12.82%*	*12.85%*	*12.40%*	*12.05%*	*11.03%*	*11.00%*	*11.59%*	*12.34%*	*13.12%*	*13.71%*	*13.09%*	*13.47%*	*13.82%*	*14.38%*	*14.41%*
Road Transportation - fuel export	*1A3b*	1795.67	2256.17	2515.28	2500.43	2559.03	2332.44	2411.16	2573.27	2689.65	2959.65	3563.74	3710.44	3807.72	4240.26	5155.23	5530.84	5171.09	4877.02	4925.61	4430.72	4758.11	5145.92	4872.95	4748.94	4531.34
		13.95%	*16.82%*	*19.07%*	*18.79%*	*20.51%*	*23.12%*	*23.73%*	*27.15%*	*31.40%*	*33.12%*	*36.58%*	*36.22%*	*34.59%*	*37.30%*	*40.25%*	*42.40%*	*40.09%*	*39.61%*	*40.48%*	*38.03%*	*38.93%*	*42.56%*	*41.40%*	*42.37%*	*42.07%*
Residential Fuel Combustion	*1A4b*	674.09	808.80	742.90	736.95	701.33	711.30	781.22	756.91	794.01	709.84	1076.16	1165.12	1108.80	1152.01	1232.81	1207.47	1195.49	1155.82	1188.92	1175.55	1154.05	1057.33	1076.01	1069.51	1001.63
		5.24%	*6.03%*	*5.63%*	*5.54%*	*5.62%*	*7.05%*	*7.69%*	*7.99%*	*9.27%*	*7.94%*	*11.05%*	*11.37%*	*10.07%*	*10.13%*	*9.62%*	*9.26%*	*9.27%*	*9.39%*	*9.77%*	*10.09%*	*9.44%*	*8.74%*	*9.14%*	*9.54%*	*9.30%*
Commercial & Institutional Fuel	*1A4a*	640.15	770.13	710.59	702.46	676.83	682.30	761.54	738.29	772.36	692.13	598.16	547.59	541.66	542.75	521.00	477.98	466.73	424.91	433.76	436.31	540.71	364.43	471.66	493.04	395.24
Combustion		*4.97%*	*5.74%*	*5.39%*	*5.28%*	*5.42%*	*6.76%*	*7.50%*	*7.79%*	*9.02%*	*7.75%*	*6.14%*	*5.34%*	*4.92%*	*4.77%*	*4.07%*	*3.66%*	*3.62%*	*3.45%*	*3.56%*	*3.75%*	*4.42%*	*3.01%*	*4.01%*	*4.40%*	*3.67%*
Agriculture (fuel combustion,	*1A4c+3*	732.79	746.79	722.94	712.55	698.17	716.06	725.84	725.80	724.37	737.64	746.30	738.65	724.12	693.88	705.32	694.56	687.22	702.03	716.28	726.78	737.53	717.04	699.22	719.63	730.84
livestock, crops, soils)		*5.69%*	*5.57%*	*5.48%*	*5.35%*	*5.60%*	*7.10%*	*7.14%*	*7.66%*	*8.46%*	*8.26%*	*7.66%*	*7.21%*	*6.58%*	*6.10%*	*5.51%*	*5.32%*	*5.33%*	*5.70%*	*5.89%*	*6.24%*	*6.03%*	*5.93%*	*5.94%*	*6.42%*	*6.79%*
Other Source Categories																										
Other Transport	*1A3a/c/d*	29.12	29.43	29.45	29.64	28.84	23.64	26.19	25.84	25.68	25.86	25.39	27.34	24.43	21.77	17.54	11.94	9.24	12.42	14.08	13.42	14.41	14.36	13.18	11.46	13.04
		0.23%	*0.22%*	*0.22%*	*0.22%*	*0.23%*	*0.23%*	*0.26%*	*0.27%*	*0.30%*	*0.29%*	*0.26%*	*0.27%*	*0.22%*	*0.19%*	*0.14%*	*0.09%*	*0.07%*	*0.10%*	*0.12%*	*0.12%*	*0.12%*	*0.12%*	*0.11%*	*0.10%*	*0.12%*
Other Energy Sources	*1A5 + 1B2b*	48.65	49.38	64.08	59.53	56.99	41.13	56.68	61.83	79.70	127.20	42.06	57.42	61.13	51.50	53.67	52.80	55.41	51.84	49.57	50.11	53.89	46.72	47.79	40.69	38.42
(incl. lubricants reported under 1A3b)		*0.38%*	*0.37%*	*0.49%*	*0.45%*	*0.46%*	*0.41%*	*0.56%*	*0.65%*	*0.93%*	*1.42%*	*0.43%*	*0.56%*	*0.56%*	*0.45%*	*0.42%*	*0.40%*	*0.43%*	*0.42%*	*0.41%*	*0.43%*	*0.44%*	*0.39%*	*0.41%*	*0.36%*	*0.36%*
Solvent use and Other product manufacture	*2D + 2G*	40.10	39.06	37.42	35.85	34.58	34.63	34.11	32.80	31.38	29.64	27.56	28.28	29.38	29.31	29.98	30.52	30.68	33.90	35.69	34.21	34.02	38.76	38.70	40.83	64.09
		0.31%	*0.29%*	*0.28%*	*0.27%*	*0.28%*	*0.34%*	*0.34%*	*0.35%*	*0.37%*	*0.33%*	*0.28%*	*0.28%*	*0.27%*	*0.26%*	*0.23%*	*0.23%*	*0.24%*	*0.28%*	*0.29%*	*0.29%*	*0.28%*	*0.32%*	*0.33%*	*0.36%*	*0.60%*
F-gases	*2F*	0.00	0.00	13.68	14.70	15.98	17.90	19.63	22.05	24.45	26.25	28.98	32.85	35.65	37.93	39.99	38.99	41.88	46.46	48.81	49.67	52.33	55.19	57.53	58.60	64.37
		0.00%	*0.00%*	*0.10%*	*0.11%*	*0.13%*	*0.18%*	*0.19%*	*0.23%*	*0.29%*	*0.29%*	*0.30%*	*0.32%*	*0.32%*	*0.33%*	*0.31%*	*0.30%*	*0.32%*	*0.38%*	*0.40%*	*0.43%*	*0.43%*	*0.46%*	*0.49%*	*0.52%*	*0.60%*
Municipal Waste Disposal on Land	*5A*	79.92	81.95	82.41	81.37	78.64	75.71	73.21	71.49	69.08	66.83	64.63	59.23	57.94	57.05	51.10	48.41	45.94	44.67	42.22	40.01	37.05	34.91	30.80	30.53	28.87
		0.62%	*0.61%*	*0.62%*	*0.61%*	*0.63%*	*0.75%*	*0.72%*	*0.75%*	*0.81%*	*0.75%*	*0.66%*	*0.58%*	*0.53%*	*0.50%*	*0.40%*	*0.37%*	*0.36%*	*0.36%*	*0.35%*	*0.34%*	*0.30%*	*0.29%*	*0.26%*	*0.27%*	*0.27%*
Waste Water Handling	*5D*	16.13	16.11	16.10	16.18	16.26	16.03	15.21	15.17	15.30	15.35	15.55	15.73	14.56	14.56	15.27	15.23	15.44	15.72	14.57	14.34	14.07	14.28	11.30	11.31	11.41
		0.13%	*0.12%*	*0.12%*	*0.12%*	*0.13%*	*0.16%*	*0.15%*	*0.16%*	*0.18%*	*0.17%*	*0.16%*	*0.15%*	*0.13%*	*0.13%*	*0.12%*	*0.12%*	*0.12%*	*0.13%*	*0.12%*	*0.12%*	*0.12%*	*0.12%*	*0.10%*	*0.10%*	*0.11%*
Composting	*5B*	0.00	0.00	0.00	1.00	1.16	1.44	1.26	2.76	4.58	4.76	6.38	5.85	6.59	9.14	8.87	9.40	9.82	9.98	10.23	10.95	10.67	8.20	9.28	8.94	9.55
		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 excluding LULUCF		12870.91	13416.61	13192.74	13309.29	12476.87	10089.20	10160.53	9476.36	8565.80	8935.31	9742.61	10245.39	11006.85	11366.79	12809.49	13045.33	12898.70	12313.88	12168.76	11649.83	12221.11	12091.37	11771.77	11207.24	10770.52
		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%*	*100.00%*	*100.00%*
Memo Items																										
International Bunkers - Aviation		405.23	423.55	409.48	404.98	513.73	582.36	632.79	757.03	917.70	1035.45	986.91	1067.43	1156.48	1204.77	1310.90	1332.01	1246.59	1339.90	1348.76	1292.14	1321.14	1240.67	1144.73	1150.47	1248.79
		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*
International Bunkers - Marine		0.08	0.09	0.08	0.11	0.09	0.09	0.09	0.09	0.09	0.09	0.10	0.11	0.11	0.11	0.11	0.15	0.15	0.13	0.14	0.11	0.11	0.13	0.13	0.11	0.12
		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*
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	163.83	163.75	181.66	200.80	294.95	301.06	441.68	456.67	429.35	446.59	465.53	453.91	496.72	570.64
		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*

Sources: Environment Agency and MDDI-DEV – submission 2016v4.

Notes: (1) These percentages are relative to the total GHG emissions, excluding LULUCF.

(2) The methane emissions are converted in CO_2 equivalents by multiplying the emissions by 25, *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 298, *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.

Table 1-12 – Luxembourg's GHG emissions and removals – details by main gases: 1990-2014

Gg (1000 t.) CO_2 equivalent	1990 (base year)	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
CO_2	**11961.50**	**12487.28**	**12269.88**	**12392.33**	**11578.79**	**9174.05**	**9236.43**	**8551.85**	**7640.24**	**8007.56**	**8819.12**	**9331.52**	**10088.77**	**10464.78**	**11891.92**	**12150.18**	**12012.04**	**11414.96**	**11258.43**	**10740.17**	**11294.32**	**11179.89**	**10882.32**	**10305.28**	**9829.93**
	92.93%	*93.07%*	*93.00%*	*93.11%*	*92.80%*	*90.93%*	*90.90%*	*90.24%*	*89.19%*	*89.62%*	*90.52%*	*91.08%*	*91.66%*	*92.06%*	*92.84%*	*93.14%*	*93.13%*	*92.70%*	*92.52%*	*92.19%*	*92.42%*	*92.46%*	*92.44%*	*91.95%*	*91.27%*
of which																									
CRF 1 - Energy	10322.24	10926.56	10780.50	10926.40	10205.55	8162.48	8281.12	7705.85	6953.89	7285.54	8071.40	8640.83	9381.17	9810.88	11182.60	11466.96	11277.72	10688.81	10595.59	10144.25	10680.38	10550.40	10314.36	9761.99	9280.34
	80.20%	*81.44%*	*81.72%*	*82.10%*	*81.80%*	*80.90%*	*81.50%*	*81.32%*	*81.18%*	*81.54%*	*82.85%*	*84.34%*	*85.23%*	*86.31%*	*87.30%*	*87.90%*	*87.43%*	*86.80%*	*87.07%*	*87.08%*	*87.39%*	*87.26%*	*87.62%*	*87.10%*	*86.16%*
CRF 1A1 - Fuel Combustion from Energy Industries	33.29	34.01	34.73	33.04	32.32	30.87	24.76	36.77	67.01	78.19	117.37	279.33	1025.62	1033.38	1257.24	1239.93	1303.70	1179.86	995.52	1191.11	1203.27	999.04	1035.44	682.30	717.70
	0.26%	*0.25%*	*0.26%*	*0.25%*	*0.26%*	*0.31%*	*0.24%*	*0.39%*	*0.78%*	*0.88%*	*1.20%*	*2.73%*	*9.32%*	*9.09%*	*9.81%*	*9.50%*	*10.11%*	*9.58%*	*8.18%*	*10.22%*	*9.85%*	*8.26%*	*8.80%*	*6.09%*	*6.66%*
CRF 1A2 - Fuel Combustion from Manuf. Industries & Construction	6287.64	6127.18	5800.53	5927.43	5207.86	3350.99	3208.90	2458.49	1419.07	1544.83	1440.66	1575.41	1496.91	1445.79	1586.49	1559.96	1629.40	1512.43	1438.73	1291.59	1404.80	1352.33	1229.98	1155.07	1079.88
	48.85%	*45.67%*	*43.97%*	*44.54%*	*41.74%*	*33.21%*	*31.58%*	*25.94%*	*16.57%*	*17.29%*	*14.79%*	*15.38%*	*13.60%*	*12.72%*	*12.39%*	*11.96%*	*12.63%*	*12.28%*	*11.82%*	*11.09%*	*11.49%*	*11.18%*	*10.45%*	*10.31%*	*10.03%*
CRF 1A3 - Fuel Combustion from Transport	2657.87	3155.68	3445.11	3488.30	3547.23	3368.66	3470.55	3673.16	3842.73	4147.97	4795.61	5012.76	5157.80	5593.71	6547.30	6942.54	6641.74	6373.47	6496.43	6001.40	6328.05	6738.39	6462.51	6320.41	6044.32
	20.65%	*23.52%*	*26.11%*	*26.21%*	*28.43%*	*33.39%*	*34.16%*	*38.76%*	*44.86%*	*46.42%*	*49.22%*	*48.93%*	*46.86%*	*49.21%*	*51.11%*	*53.22%*	*51.49%*	*51.76%*	*53.39%*	*51.51%*	*51.78%*	*55.73%*	*54.90%*	*56.40%*	*56.12%*
of which, "road fuel export"(1)	1795.67	2256.17	2515.28	2500.43	2559.03	2332.44	2411.16	2573.27	2689.65	2959.65	3563.74	3710.44	3807.72	4240.26	5155.23	5530.84	5171.09	4877.02	4925.61	4430.72	4758.11	5145.92	4872.95	4748.94	4531.34
	13.95%	*16.82%*	*19.07%*	*18.79%*	*20.51%*	*23.12%*	*23.73%*	*27.15%*	*31.40%*	*33.12%*	*36.58%*	*36.22%*	*34.59%*	*37.30%*	*40.25%*	*42.40%*	*40.09%*	*39.61%*	*40.48%*	*38.03%*	*38.93%*	*42.56%*	*41.40%*	*42.37%*	*42.07%*
CRF 1A4 - Fuel Combustion from Other Sectors	1316.90	1583.16	1458.87	1441.49	1384.54	1396.44	1548.80	1504.80	1575.56	1420.50	1705.68	1749.24	1687.41	1734.80	1791.50	1724.45	1702.81	1622.98	1664.84	1660.08	1744.19	1460.58	1586.37	1604.16	1438.38
	10.23%	*11.80%*	*11.06%*	*10.83%*	*11.10%*	*13.84%*	*15.24%*	*15.88%*	*18.39%*	*15.90%*	*17.51%*	*17.07%*	*15.33%*	*15.26%*	*13.99%*	*13.22%*	*13.20%*	*13.18%*	*13.68%*	*14.25%*	*14.27%*	*12.08%*	*13.48%*	*14.31%*	*13.35%*
CRF 1A5 & 1B2b - Other Energy Sources	26.51	26.51	41.23	36.12	33.56	15.49	28.08	32.59	49.49	94.01	12.05	24.04	13.37	3.13	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	0.21%	*0.20%*	*0.31%*	*0.27%*	*0.27%*	*0.15%*	*0.28%*	*0.34%*	*0.58%*	*1.05%*	*0.12%*	*0.23%*	*0.12%*	*0.03%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*
CRF 2 - Industrial Processes	1638.68	1560.01	1488.55	1464.98	1371.87	1010.45	954.32	844.54	684.33	720.90	745.82	688.40	704.70	651.09	706.90	679.31	731.27	723.07	659.98	591.84	609.76	624.60	562.90	537.48	543.78
	12.73%	*11.63%*	*11.28%*	*11.01%*	*11.00%*	*10.02%*	*9.39%*	*8.91%*	*7.99%*	*8.07%*	*7.66%*	*6.72%*	*6.40%*	*5.73%*	*5.52%*	*5.21%*	*5.67%*	*5.87%*	*5.42%*	*5.08%*	*4.99%*	*5.17%*	*4.78%*	*4.80%*	*5.05%*
Other Sources (2)	30.32	29.50	28.11	26.76	25.68	25.96	25.59	24.47	23.34	21.86	20.04	20.52	20.97	20.49	21.09	21.40	20.85	23.32	24.27	23.03	23.57	28.04	27.73	27.23	26.46
	0.24%	*0.22%*	*0.21%*	*0.20%*	*0.21%*	*0.26%*	*0.25%*	*0.26%*	*0.27%*	*0.24%*	*0.21%*	*0.20%*	*0.19%*	*0.18%*	*0.16%*	*0.16%*	*0.16%*	*0.19%*	*0.20%*	*0.20%*	*0.19%*	*0.23%*	*0.24%*	*0.24%*	*0.24%*	*0.25%*
CH_4 (3)	**619.80**	**626.98**	**616.94**	**615.90**	**597.71**	**610.49**	**616.39**	**613.87**	**609.06**	**612.21**	**604.65**	**604.11**	**601.27**	**587.29**	**581.06**	**577.28**	**571.85**	**581.27**	**588.27**	**588.39**	**597.34**	**571.20**	**559.23**	**563.36**	**570.12**
	4.82%	*4.67%*	*4.68%*	*4.63%*	*4.79%*	*6.05%*	*6.07%*	*6.48%*	*7.11%*	*6.85%*	*6.21%*	*5.90%*	*5.46%*	*5.17%*	*4.54%*	*4.43%*	*4.43%*	*4.72%*	*4.83%*	*5.05%*	*4.89%*	*4.72%*	*4.75%*	*5.03%*	*5.29%*
of which																									
CRF 1 - Energy	46.57	49.64	49.38	49.07	47.50	48.16	49.75	49.45	49.02	49.18	49.75	53.11	66.32	66.72	72.49	71.18	73.23	68.35	66.13	66.44	70.55	61.20	63.36	57.30	54.96
	0.36%	*0.37%*	*0.37%*	*0.37%*	*0.38%*	*0.48%*	*0.49%*	*0.52%*	*0.57%*	*0.55%*	*0.51%*	*0.52%*	*0.60%*	*0.59%*	*0.57%*	*0.55%*	*0.57%*	*0.56%*	*0.54%*	*0.57%*	*0.58%*	*0.51%*	*0.54%*	*0.51%*	*0.51%*
CRF 3A+3B - Enteric Fermentation and Manure Management	486.01	488.26	478.21	478.13	464.32	479.39	486.53	485.38	482.56	487.92	481.27	483.23	468.18	453.36	447.62	447.71	442.53	458.02	469.84	471.78	479.83	466.18	455.58	466.39	476.87
	3.78%	*3.64%*	*3.62%*	*3.59%*	*3.72%*	*4.75%*	*4.79%*	*5.12%*	*5.63%*	*5.46%*	*4.94%*	*4.72%*	*4.25%*	*3.99%*	*3.49%*	*3.43%*	*3.43%*	*3.72%*	*3.86%*	*4.05%*	*3.93%*	*3.86%*	*3.87%*	*4.16%*	*4.43%*
Other Sources (4)	87.22	89.07	89.34	88.70	85.89	82.94	80.12	79.05	77.47	75.10	73.63	67.77	66.76	67.22	60.94	58.38	56.09	54.90	52.29	50.17	46.96	43.82	40.28	39.67	38.28
	0.68%	*0.66%*	*0.68%*	*0.67%*	*0.69%*	*0.82%*	*0.79%*	*0.83%*	*0.90%*	*0.84%*	*0.76%*	*0.66%*	*0.61%*	*0.59%*	*0.48%*	*0.45%*	*0.43%*	*0.45%*	*0.43%*	*0.43%*	*0.38%*	*0.36%*	*0.34%*	*0.35%*	*0.36%*
N_2O (5)	**288.77**	**301.41**	**291.20**	**285.21**	**283.13**	**285.39**	**286.55**	**286.93**	**290.33**	**287.48**	**287.95**	**274.38**	**278.04**	**273.07**	**292.26**	**274.12**	**267.76**	**265.60**	**267.23**	**265.18**	**270.34**	**277.86**	**265.07**	**269.44**	**296.01**
	2.24%	*2.25%*	*2.21%*	*2.14%*	*2.27%*	*2.83%*	*2.82%*	*3.03%*	*3.39%*	*3.22%*	*2.96%*	*2.68%*	*2.53%*	*2.40%*	*2.28%*	*2.10%*	*2.08%*	*2.16%*	*2.20%*	*2.28%*	*2.21%*	*2.30%*	*2.25%*	*2.40%*	*2.75%*
of which																									
CRF 1 - Energy	42.39	47.05	50.90	51.48	53.88	49.83	52.69	55.56	57.38	53.01	56.22	59.39	63.15	75.89	75.01	69.66	65.09	63.63	63.22	60.99	66.39	68.55	67.36	67.87	67.74
	0.33%	*0.35%*	*0.39%*	*0.39%*	*0.43%*	*0.49%*	*0.52%*	*0.59%*	*0.67%*	*0.59%*	*0.58%*	*0.58%*	*0.57%*	*0.67%*	*0.59%*	*0.53%*	*0.50%*	*0.52%*	*0.52%*	*0.52%*	*0.54%*	*0.57%*	*0.57%*	*0.61%*	*0.63%*
CRF 3D - Agricultural Soils	189.54	198.41	185.44	178.70	175.05	179.12	177.87	175.14	176.18	177.86	175.56	159.39	161.65	143.15	163.86	151.15	149.67	147.68	149.30	149.87	150.72	158.64	150.41	153.39	154.49
	1.47%	*1.48%*	*1.41%*	*1.34%*	*1.40%*	*1.78%*	*1.75%*	*1.85%*	*2.06%*	*1.99%*	*1.80%*	*1.56%*	*1.47%*	*1.26%*	*1.28%*	*1.16%*	*1.16%*	*1.20%*	*1.23%*	*1.29%*	*1.23%*	*1.31%*	*1.28%*	*1.37%*	*1.43%*
Other Sources (6)	56.85	55.95	54.86	55.03	54.20	56.44	55.98	56.24	56.76	56.61	56.17	55.60	53.23	54.03	53.39	53.31	53.00	54.29	54.72	54.32	53.23	50.67	47.30	48.18	73.79
	0.44%	*0.42%*	*0.42%*	*0.41%*	*0.43%*	*0.56%*	*0.55%*	*0.59%*	*0.66%*	*0.63%*	*0.58%*	*0.54%*	*0.48%*	*0.48%*	*0.42%*	*0.41%*	*0.41%*	*0.44%*	*0.45%*	*0.47%*	*0.44%*	*0.42%*	*0.40%*	*0.43%*	*0.69%*
F-gases (7)	**0.88**	**0.98**	**14.76**	**15.88**	**17.28**	**19.29**	**21.19**	**23.74**	**26.19**	**28.07**	**30.91**	**35.39**	**38.80**	**41.67**	**44.28**	**43.85**	**47.15**	**52.15**	**54.91**	**56.17**	**59.20**	**62.50**	**65.21**	**69.22**	**74.52**
	0.01%	*0.01%*	*0.11%*	*0.12%*	*0.14%*	*0.19%*	*0.21%*	*0.25%*	*0.31%*	*0.31%*	*0.32%*	*0.35%*	*0.35%*	*0.37%*	*0.35%*	*0.34%*	*0.37%*	*0.42%*	*0.45%*	*0.48%*	*0.48%*	*0.52%*	*0.55%*	*0.62%*	*0.69%*
Total GHG excluding LULUCF	**12870.95**	**13416.64**	**13192.78**	**13309.33**	**12476.91**	**10089.23**	**10160.56**	**9476.40**	**8565.82**	**8935.33**	**9742.63**	**10245.40**	**11006.87**	**11366.81**	**12809.52**	**13045.43**	**12898.80**	**12313.97**	**12168.84**	**11649.91**	**12221.20**	**12091.45**	**11771.84**	**11207.30**	**10770.58**
	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%*	*100.00%*	*100.00%*
LULUCF	**52.13**	**-225.11**	**-554.29**	**-649.35**	**-460.17**	**-563.24**	**-603.66**	**-686.40**	**-570.82**	**-668.53**	**-701.85**	**-714.13**	**-716.11**	**-679.32**	**-683.66**	**-638.66**	**-557.18**	**-477.85**	**-491.99**	**-469.41**	**-152.97**	**-274.98**	**-362.88**	**-538.62**	**-460.44**

Sources: Environment Agency and MDDI-DEV – submission 2016v4.

Notes: (1) The methane emissions are converted in CO_2 equivalents by multiplying the emissions by 25, *i.e.* the global warming potential (GWP) value for methane based on the effects of GHG over a 100-year time horizon.

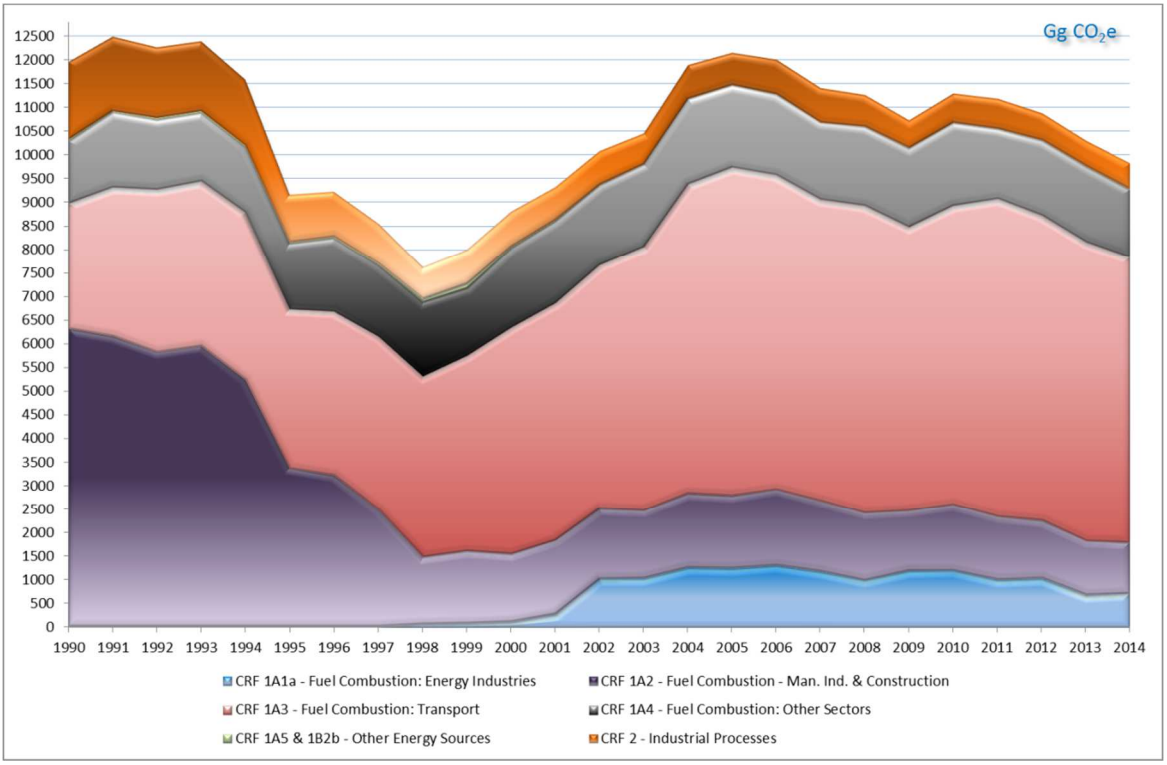
(2) The nitrous oxide emissions are converted in CO_2 equivalents by multiplying the emissions by 298, *i.e.* the global warming potential (GWP) value for nitrous oxide based on the effects of GHG over a 100-year time horizon.

(3) The F-gases are those not covered by the Montreal Protocol, *i.e.* the HFCs, PFCs and 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.

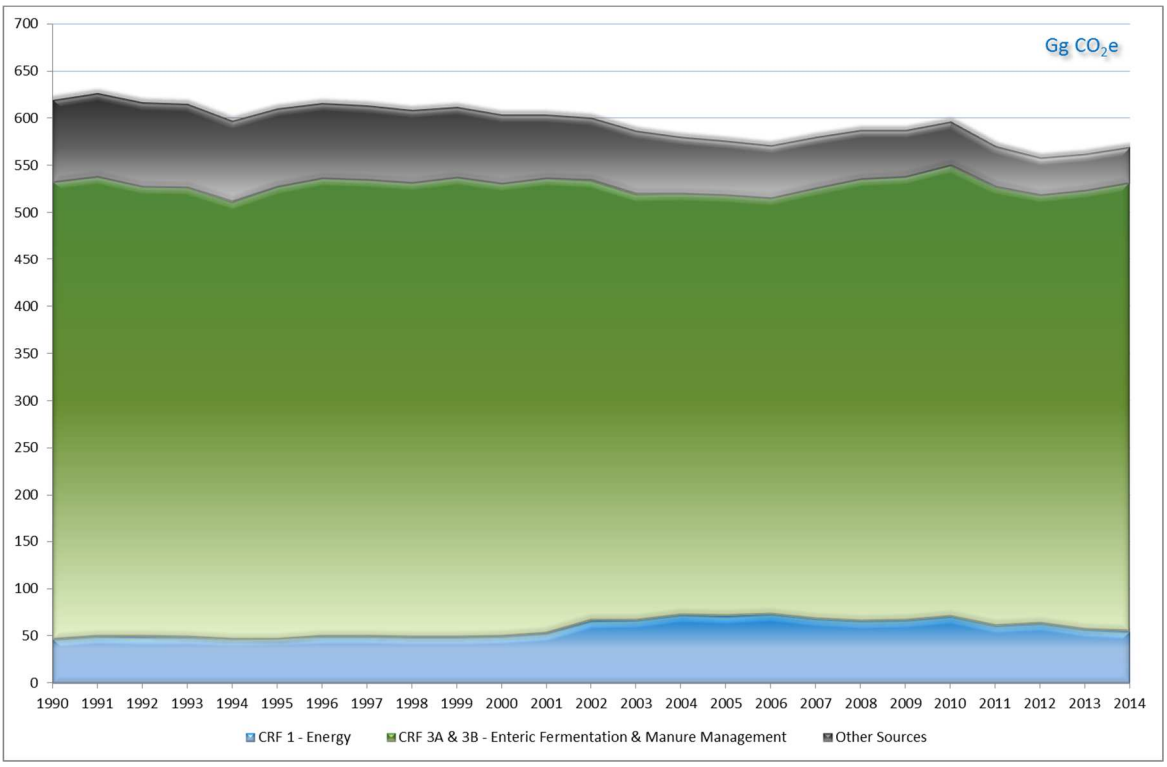
(4) CRF 1A4a&b: there are breaks in time series between 1999 & 2000: the two CRF 1A4 sub-categories had a very similar level because national energy statistics does not allow for distinguishing these two sub-categories before 2000. Hence, a 50-50 distribution was carried out in the inventories.

Figure 1-29 – Luxembourg's GHG emissions (excl. F-gases & LULUCF) – details by main gases: 1990-2014

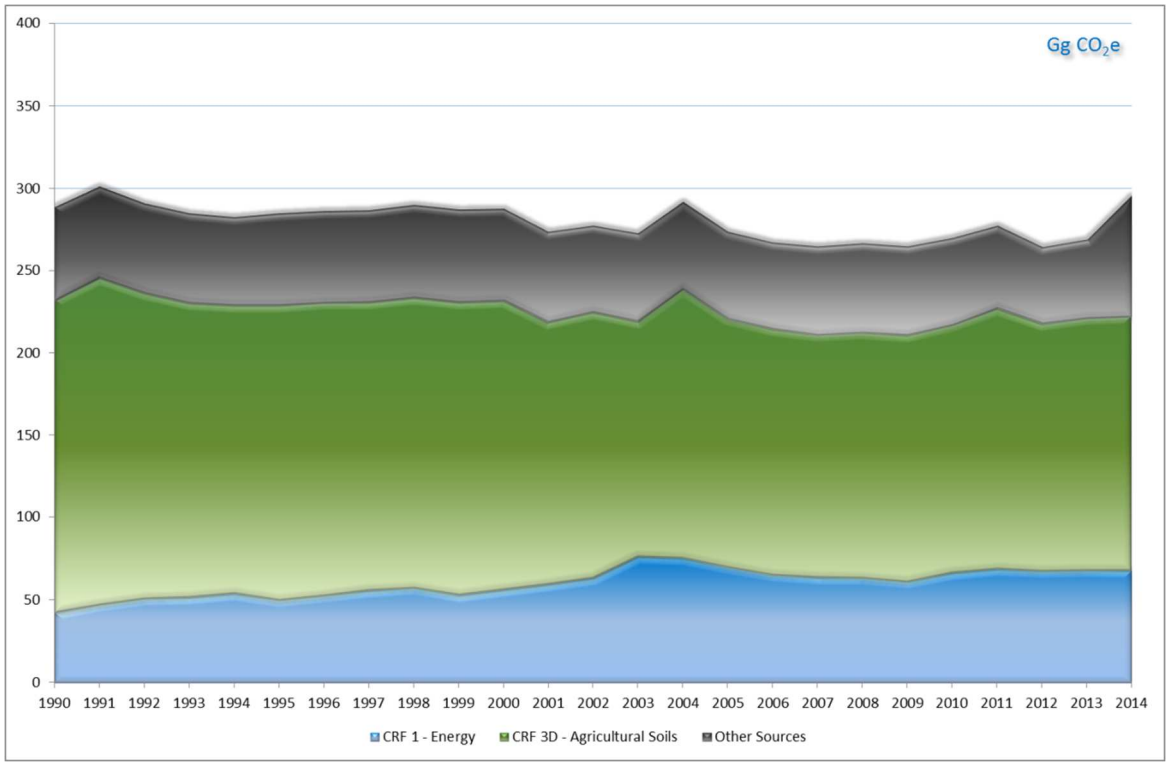
CO_2



CH_4



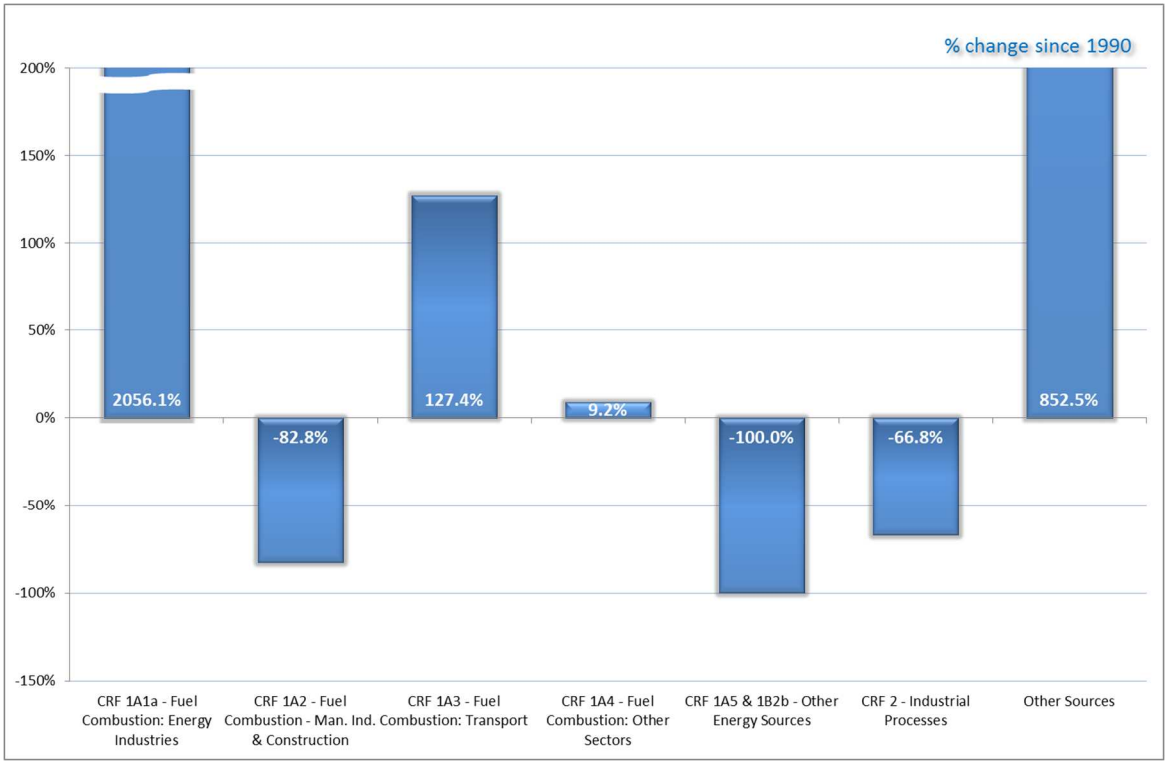
N_2O



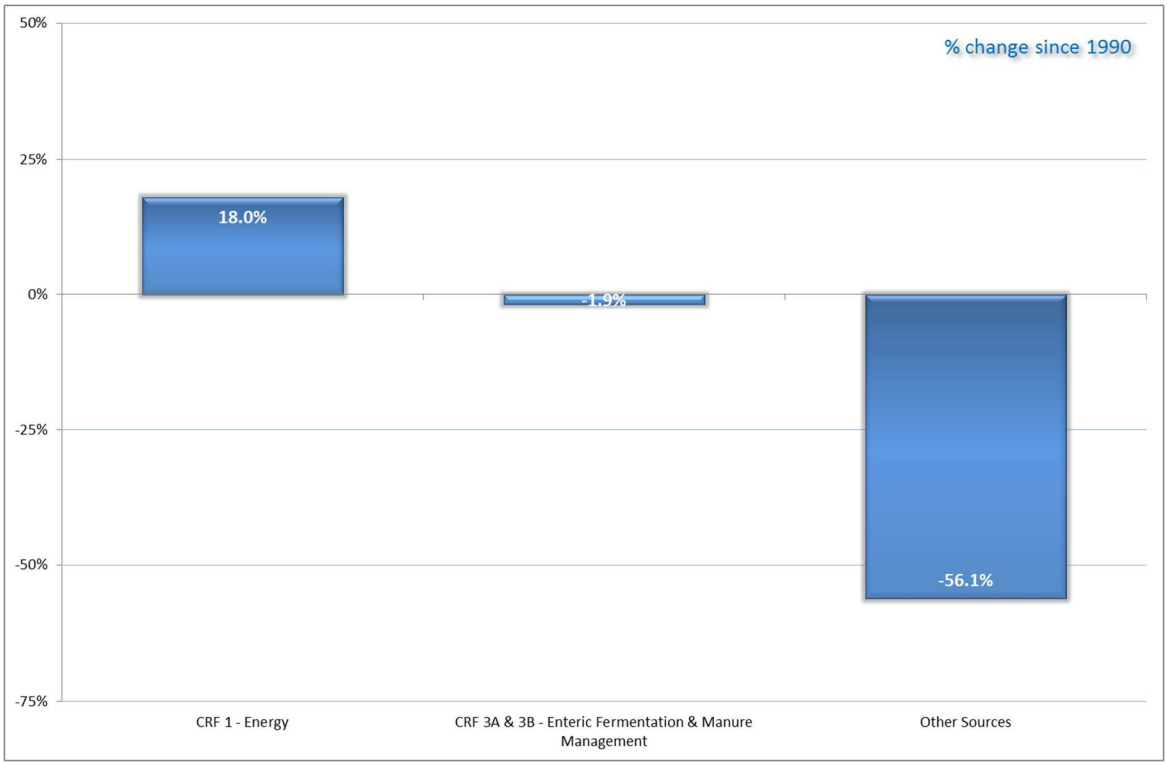
Sources: Environment Agency and MDDI-DEV.

Figure 1-30 – Luxembourg's GHG emission trends in % (excl. LULUCF) – details by main gases: 1990-2014

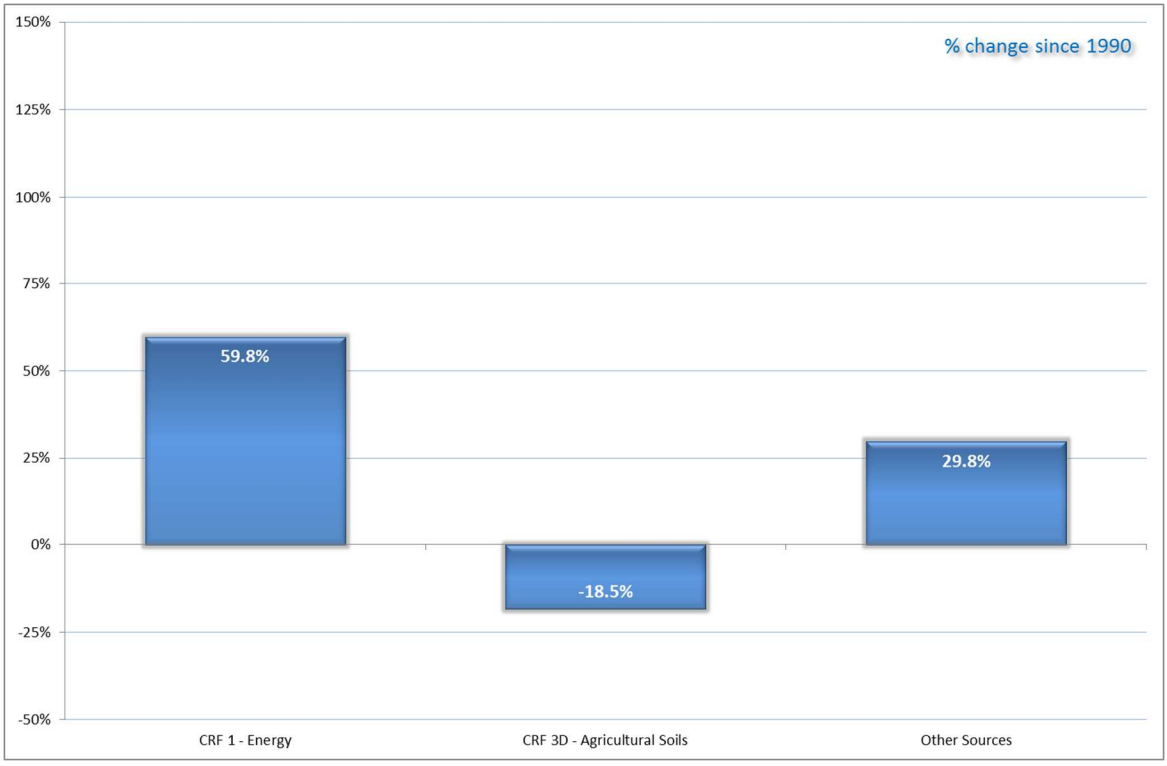
CO_2



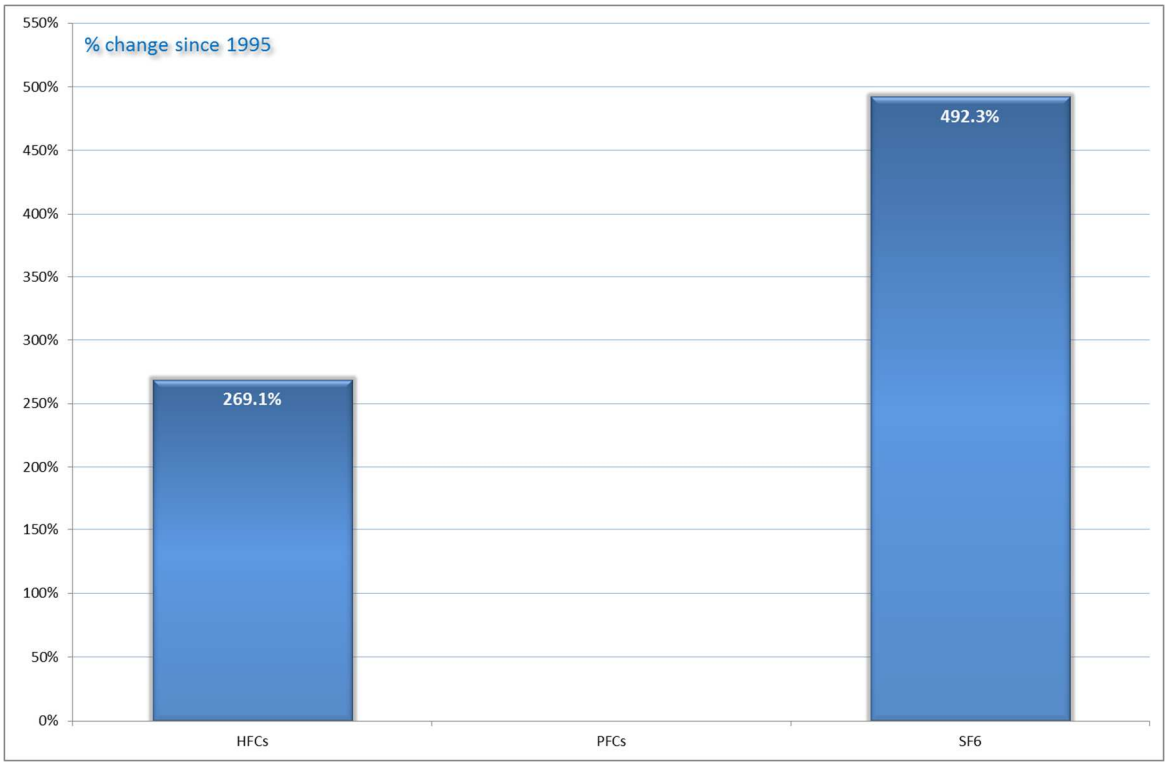
CH_4


% change since 1990
50%
25%
0%
-25%
-50%
-75%
18.0%
-1.9%
-56.1%
CRF 1 - Energy
CRF 3A & 3B - Enteric Fermentation & Manure Management
Other Sources

N_2O


% change since 1990
150%
125%
100%
75%
50%
25%
0%
-25%
-50%
59.8%
-18.5%
29.8%
CRF 1 - Energy
CRF 3D - Agricultural Soils
Other Sources

F-gases



Sources: Environment Agency and MDDI-DEV.

1.2.1.1 *Carbon dioxide – CO_2*

CRF (sub-) categories covered	1 (1A1, 1A2, 1A3, 1A4, 1A5, 1B2b), 2	
Share in total GHG emissions, excl. LULUCF	***1990***	92.9% = 11 961.50 Gg CO_2e
	2014	91.3% = 9 829.93 Gg CO_2e

Throughout the period 1990-2014, the main GHG has remained carbon dioxide, which accounted between 92.9% and 91.3% of the total GHG emissions. However, the structure of CO_2 emissions has evolved with an increase in fuel combustion, which accounted for 80.2% of total GHG emissions for the base year (1990) and climbed up to 86.16% in 2014, after having reached a maximum of 87.9 % 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 accounted for 20.65% of total GHG emissions. Then, with 6.08 Mio. t CO_2, this percentage reached 56.5% in 2014.[37] CO_2 emissions due solely to "road fuel sales to non-residents" amounted to about 1.8 Mio. t in 1990 and reached 4.5 Mio. t in 2014,[38] *i.e.* roughly a threefold

[37] The highest amount of emissions was recorded for the year 2005: 7.33 Mio. t CO_2 but "only" 54.6% of total GHG emissions. In fact, percentages are somewhat over-estimated in 2014 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 and (2) rather lower – compared to the previous years – emissions in the other sectors (CRF 1A4).

[38] 5.45 Mio. t in 2005.

increase (the same comparison shows only a twofold increase for road fuel consumed by the national vehicle fleet). In 2014, "road fuel sales to non-residents" represented 74.5% of CO_2 emissions of the transport sector and 42.1% of the total CO_2 emissions.[39] In 1990, these percentages were 67.5% and 14%, respectively.

Another important source of CO_2 in Luxembourg is **industrial processes**, 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.

1.2.1.2 *Methane – CH_4*

CRF (sub-) categories covered	1, 3A, 3B, 5A, 5B, 5D		
Share in total GHG emissions, excl. LULUCF	***1990***	4.8% =	619.80 Gg CO_2e
	2014	5.53% =	570.12 Gg CO_2e

Methane emissions originate above all from the agricultural sector, and more precisely from **enteric fermentation** and from **manure production and management**: around 83.6% of methane emissions over the period 1990-2014. 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 (-47.3%) and growing emissions in **energy use** (+18.03%). 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.

1.2.1.3 *Nitrous oxide – N_2O*

CRF (sub-) categories covered	1, 2G, 3B, 3D, 5B and 5D		
Share in total GHG emissions, excl. LULUCF	***1990***	2.27% =	288.77 Gg CO_2e
	2014	2.9% =	298.84 Gg CO_2e

A large part of nitrous oxide emissions is caused by **agricultural soils** that drive the -18.5% decline observed for this gas over the period 1990-2014. 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 almost multiplied by a factor 3 over the period, following the increasing share of diesel vehicles on the roads. The drop in emissions observed for the **other sources** is principally the result of diminishing nitrous oxide emissions from manure management.

[39] For 2005, these percentages were respectively 78.8% and 45.1%.

1.2.1.4 *Hydrofluorocarbons – HFCs, perfluorocarbons – PFCs, sulphur hexafluoride – SF_6 and of nitrogen trifluoride – NF_3*

CRF (sub-) categories covered	2D, 2F, 2G		
Share in total GHG emissions, excl. LULUCF	***1990***	0.01% =	0.08 Gg CO_2e
	2014	0.69% =	74.52 Gg CO_2e

The increase in **HFCs** emissions between 1990 and 2014 is explained by a wider spread use of mobile and stationary cooling equipments as well as of aerosols.

No use of **PFCs** and of **NF_3** is reported.

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.

1.2.2 Description of Emission Trends by Category

In 2014, the energy sector accounted for almost 87.3% of the total GHG emissions, excluding LULUCF. Two sectors represent between 6% and 6.5% of the total emissions, excluding LULUCF: industrial processes (6%) and agriculture (6.24%). The remaining sector[40] (waste[41] (0.46%) was not even reaching 1% of the total GHG emitted in Luxembourg: see Table 1-10 and Figure 1-27 and Figure 1-28.

For the different sectors, trends over the period 1990-2014 (and 2013-2014) were as follows:

- Energy: .....-9.7% (-4.9%)
- Industrial Processes: .....-60.9% (+5.9%)
- Agriculture: .....-6.0% (+1.86%)
- LULUCF:.....-983.21% (-14.51%)
- Waste: .....-48.1% (-1.9%)

1.2.2.1 *CRF 1 – Energy*

GHG covered	CO_2, CH_4 & N_2O	
Share in total GHG emissions, excl. LULUCF	***1990***	80.9% = 10 411.19 Gg CO_2e
	2014	87.3% = 9 403.04 Gg CO_2e

Energy production and consumption related GHG emissions have decreased by 9.7% between 1990 and 2014 from 10.4 Mio. t CO_2e in 1990 to 9.4 Mio. t CO_2e in 2014. For carbon dioxide, methane and

40 The sector "Others" is not reported for Luxembourg.

41 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 (details in Chapters 3 and 8 respectively).

nitrous oxide, the changes over the period 1990-2014 were -10.09%, +18.03% and +59.81%, respectively.

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 2001) and **transport** (1A3): +1923.98% and +126.79%, respectively between 1990 and 2014 (+5.15% and -4.32% from 2013 to 2014) with, as a result, shares in the total energy related GHG emissions rising from 0.28% to 6.7% and 20.89% to 56.61%, respectively. For the other sub-sectors, the observed trends between 1990 and 2014 are -82.71% for **manufacturing industries and construction** (1A2), +9.31% for the **other sectors** (1A4), and +98.45% for **fugitive emissions from fuels** (1B). [42]

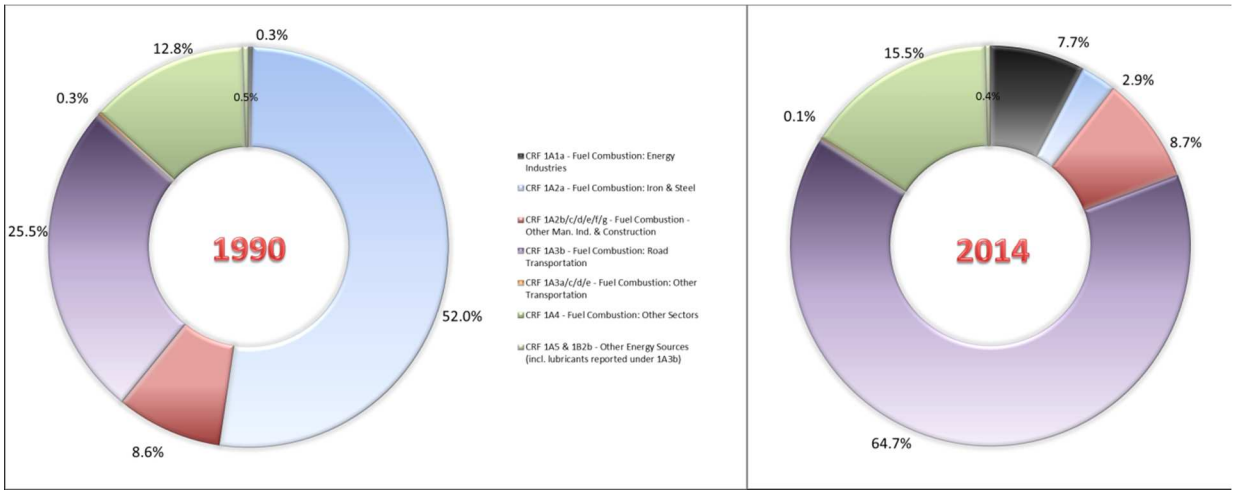
In fact, over the period, GHG emissions have been strongly influenced by varying fuel consumption levels in industry, in particular in the energy and the iron and steel industries, as well as in the road transport sector as percentage growths recorded for CRF sub-categories 1A1, 1A2 and 1A3 demonstrate. 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 paragraphs. 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 completely modified the pattern of the energy related GHG emissions with regard to CRF sub-categories share (Figure 1-31) and to the "energy-mix" or fuel usage for energy production and consumption (Table 1-7 and Table 1-8; Figure 1-17 and Figure 1-18).

[42] Fugitive emission growth is closely linked to natural gas use in Luxembourg.

Figure 1-31 – CRF sub-categories share in GHG emissions for CRF 1 – Energy: 1990 & 2014



Sources: Environment Agency and MDDI-DEV.

1.2.2.2 *CRF 2 – Industrial Processes and Product Use*

GHG covered	CO_2 & F-gases	
Share in total GHG emissions, excl. LULUCF	***1990***	12.8% = 1 648.46 Gg CO_2e
	2014	6% = 645.78 Gg CO_2e

Industrial processes and product use represent the third largest sector in Luxembourg with regard to GHG emissions. The sector includes emissions from industrial installations and from consumption of halocarbons, perfluorocarbons and SF_6 (the fluorinated gases or F-gases). In Luxembourg, when leaving F-gases out, only 3 companies and their various production installations are part of CRF sector 2:

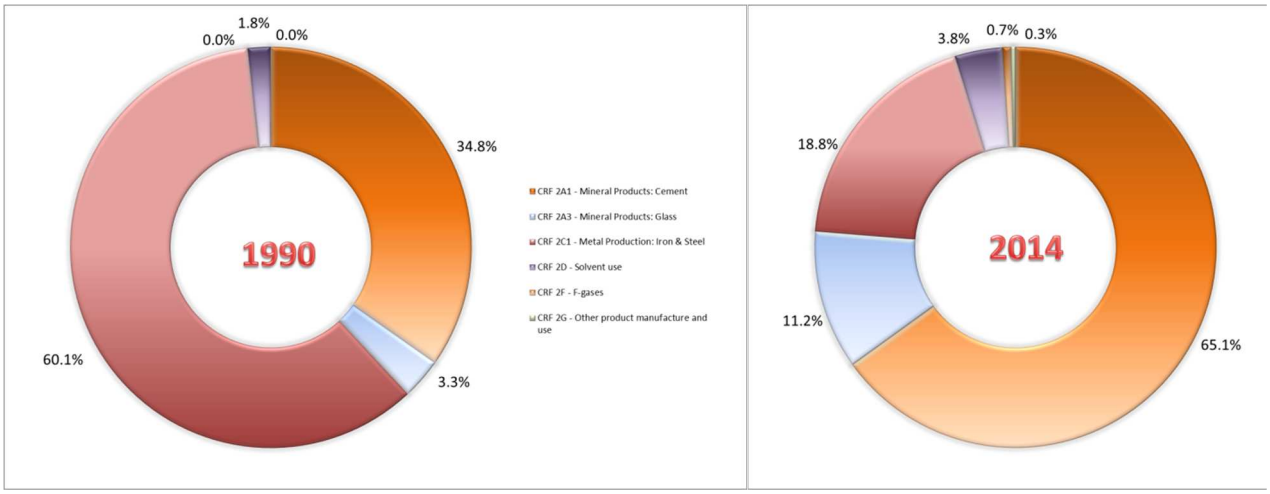
- CRF sub-categories 2A1 & 2A3: one cement works unit and one flat glass manufacturing company;
- CRF sub-category 2C1: the iron and steel manufacturing company ArcelorMittal.

Emissions from industrial processes 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 89.6% over the period 1990-2014. Overall sector emissions in CO_2e fell by about 66.8% between 1990 and 2014, reducing the weight of this sector in total GHG emissions from 12.7% to 5.5% over the period. By gas, however, the picture is different. For carbon dioxide, the decrease over the period 1990-2014 was -66.8%: -37.9% for 2A1, +14.01% for 2A3 and -89.6% for 2C1. F-gases emissions, on the contrary, increased regularly: +286.25% over the period 1995-2014 but they are minor compared to the total emissions as Figure 1-31 shows.

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.

The emission trends briefly described in the previous paragraphs led to a significant change in the composition of industrial processes' GHG emissions: see Figure 1-32.

Figure 1-32 – CRF sub-categories share in GHG emissions for CRF 2 – Industrial Processes and Product Use: 1990 & 2014



Sources: Environment Agency and MDDI-DEV.

1.2.2.3 *CRF 3 – Agriculture*

GHG covered	CH_4 & N_2O		
Share in total GHG emissions, excl. LULUCF	***1990***	5.56% =	715.22 Gg CO_2e
	2014	6.24% =	671.93 Gg CO_2e

Trends in agriculture were also favourable between 1990 and 2014: in general GHG related to agricultural activities have decreased by 6.1% (-1.9% for methane and -17.2% for nitrous oxide). Enteric Fermentation (3A) saw its emissions declining by 4.18%, whereas for agricultural soils (3D), the decrease reaches 18.49%. For manure management (3B), emissions remained quite stable between 1990 and 2014 (+5.13%), though opposite variations are observed for the two GHG emitted by this activity: methane declined by -1.9% and nitrous oxide increased by 18.5%.

- However, the evolution of nitrous oxide emissions stemming from agricultural soils (3D) shapes the overall agriculture emission pattern. Indeed, for both the years 1990 and 2014, CRF category 3D is the biggest contributor to agriculture related emissions, 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 3 for which GHG emissions are reported have barely changed over the period: see nitrogen input to soils (such as application of synthetic fertilizers and manure) as well as nitrogen fixed by crops or crop residues;

- nitrogen excretion on pasture, range and paddock;
- 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.

Figure 1-33.

Looking at each CRF category in more detail, generally the decrease in **enteric fermentation** related **methane** emanations over the period 1990-2014 is mainly the result from declining emissions generated by cattle – -9.7% for dairy cattle and -12.9% 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 1990-2014 driven by a decline in dairy cattle heads – non-dairy cattle population in 2014 is only 13% below its 1990 level. However, a shift did occur within the cattle population with a reduction for dairy cattle (-21%) and an increase for female mature non-dairy cattle (+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).[43] Finally, if the dairy cattle population decreased by 21% between 1990 and 2014, related methane emissions only declined by 9.7%. 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.

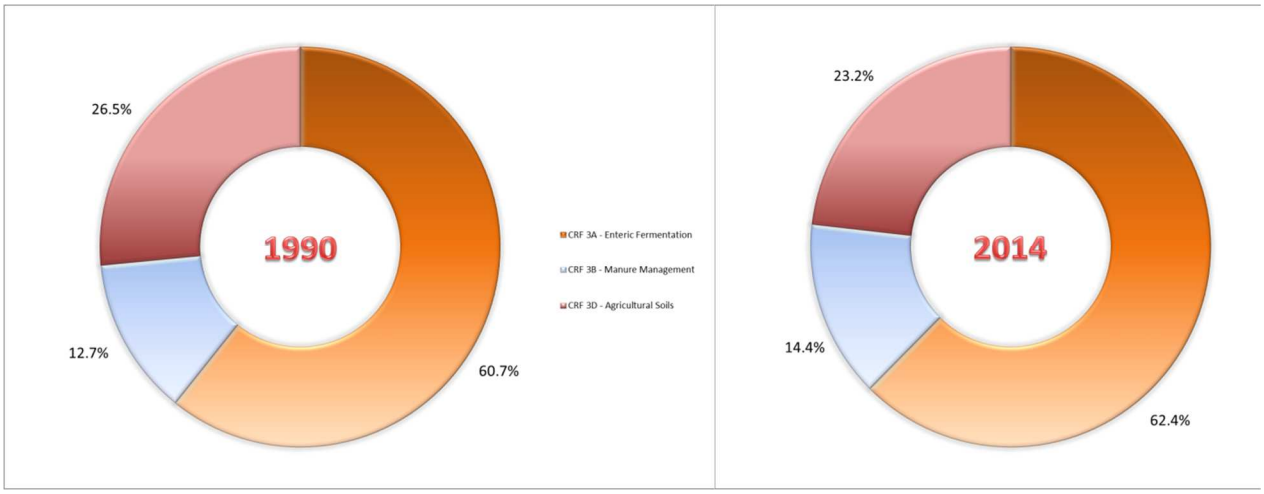
Looking at **methane** emissions from **manure management**, an increase by 17.3% can be observed for the period 1990-2014. Animals who did contribute the most to these emissions were cattle and swine. As far as **nitrous oxide** emissions from **manure management** are concerned, a decrease of 11.1% is observed for the period 1990-2014. 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 a bit less than 88% in 2014. 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;
- nitrogen excretion on pasture, range and paddock;
- 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.

[43] 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 1-33 –CRF sub-categories share in GHG emissions for CRF 3 – Agriculture: 1990 & 2014



Source: MDDI-DEV.

1.2.2.4 *CRF 5 – Waste*

GHG covered	CH_4 & N_2O		
Share in total GHG emissions, excl. LULUCF	***1990***	0.75% =	96.08 Gg CO_2e
	2014	0.46% =	49.83 Gg CO_2e

In the waste sector, the main source of GHG was solid waste disposal on land (5A), but its weight decreased over the period 1990-2014 due to the combination of reduced amounts of waste disposed off in landfills and of increased emissions arising from composting activities (5D). However, GHG emission reduction for solid waste disposal on land between 1990 and 2014 (-63.8%) still drove a reduction for the overall waste sector despite composting rising emissions. Wastewater handling emissions (5D) experienced a 29.38% decline in emissions between 1990 and 2014. 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.

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.

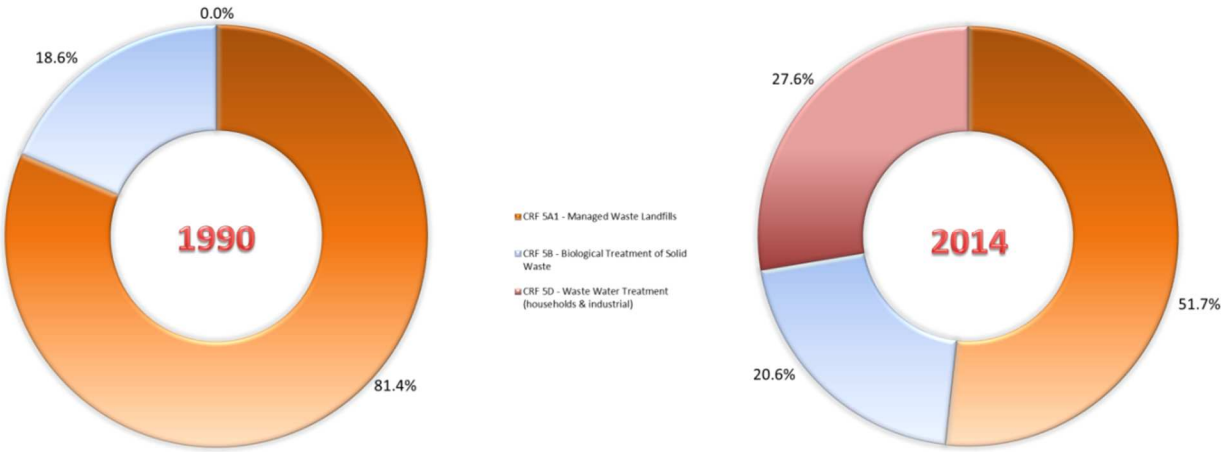
Wastewater treatment plant (WWTP) capacities expressed in population-equivalents have steadily grown since 1990. However, methane and nitrous oxide emissions decreased by 47.3% since 1990. Therefore, technical changes, with regard to wastewater treatment, have had an undeniable role too.

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. 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: see Figure 1-34.

Figure 1-34 – CRF sub-categories share in GHG emissions for CRF 5 – Waste: 1990 & 2014



Sources: Environment Agency, Water Agency and MDDI-DEV.

1.2.2.5 *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.

1.3 NATIONAL INVENTORY ARRANGEMENTS

This text is extracted from the National Inventory Report submitted on 15 April 2016. It has been written by Nora Becker and Marc Schuman (Environment Agency).

1.3.1 Institutional, legal and procedural arrangements

1.3.1.1 Overview of Luxembourg's obligations

Some obligations are directly linked with GHG emission reporting:

- Annual obligations under Regulation 525/2013/EC 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 (known as Monitoring Mechanism Regulation, MMR) and repealing Decision 280/2004/EC of the European Parliament and of the Council of 11 February 2004 concerning a mechanism for monitoring Community GHG emissions and for implementing the Kyoto Protocol and Commission Decision 2005/166/EC of 10 February 2005 laying down rules implementing Decision 280/2004/EC;
- 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).

- Decision 24/CP.19 - Revision of the UNFCCC reporting guidelines on annual inventories for Parties included in Annex I to the Convention – introducing the 2006 IPCC Guidelines.

Some 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 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 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;
- Obligations under the European Pollutant Emission Register (EPER), which was the first Europe-wide register for emissions from industrial facilities both into air and water. The legal basis of EPER is Article 15 of the IPPC Directive (EPER Decision 2000/479/EU), which stipulates that information on environmental pollution has to be provided to the public. The reporting years under EPER were 2001 or 2002 and 2004. EPER was replaced by the European Pollutant Release and Transfer Register (E-PRTR) in 2007, which was established by the E-PRTR Regulation No 166/2006.
- Obligations under the framework of the European Union Emission Trading Scheme (EU-ETS) established by Directive 2003/87/EC of the European Parliament. It includes heavy energy-consuming installations in power generation and manufacturing. The activities covered are energy activities, the production and processing of ferrous metals, the mineral industry and some other production activities. From 2012 onwards, CO_2 emissions from aviation have also been included. For the trading period 2013–2020 the scope of the EU ETS has been further extended to include additional installations from the metal and chemical industry and compressor stations.

1.3.1.2 *Luxembourg's National Inventory System*

A Grand-Ducal Regulation [44] 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

[44] *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).

"Regulation" will be revised during the course of the year 2016 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.

1.3.1.2.1 Single National Entity and other cross-cutting roles

The previously cited regulation designates the Environment Agency (*Administration de l'Environnement, AEV*)[45] as the "Single National Entity with overall responsibility for the GHG Inventory". Overall management of the Single National Entity 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" compiling and checking the information and GHG emission estimates coming from sector experts working in other administrations or services.

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 of the Ministry of Sustainable Development and Infrastructures – hereafter designated as MDDI-DEV – acting as UNFCCC National Focal Point. Thus, it is the Ministry that officially submits the inventories and their related reports to the UNFCCC Secretariat and the European Commission (see Article 8 of the Regulation).

Figure 1-35 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).

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 LRTAP Convention and under the "NEC Directive".

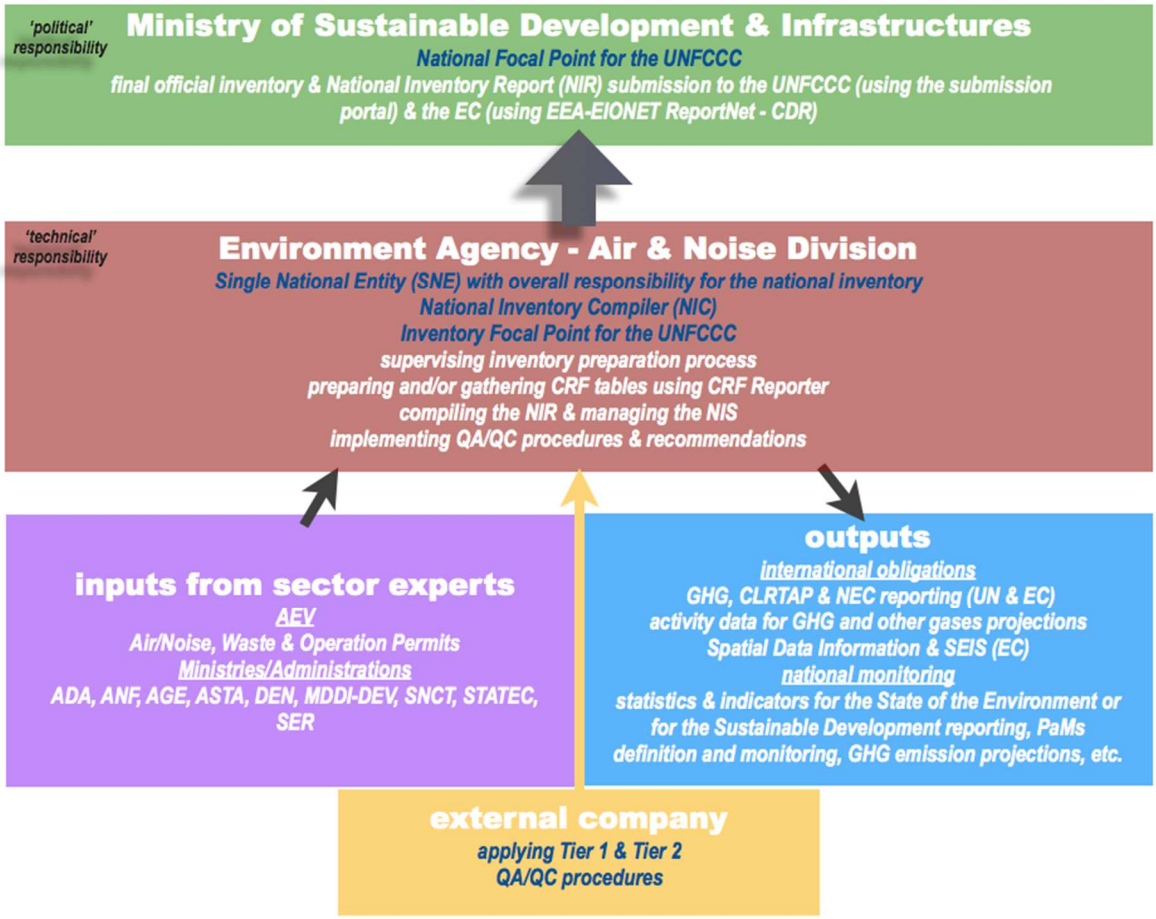
Luxembourg has, thus, adopted an "integrated approach" to avoid redundant and overlapping activities in different administrative services. This concentration of air emissions reporting in one department also allows an improved consistency between different reporting schemes. As an example, indirect GHG 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" – are 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 an

[45] The Environment Agency is directly linked to the Ministry of Sustainable Development and Infrastructures and works under its supervision: see http://www.environnement.public.lu/functions/apropos_du_site/mev/attributions_MEV/index.html and the assignments of the Environment Agency: http://www.environnement.public.lu/functions/apropos_du_site/aev/Missions_aev.html (in French).

operational permit to carry out certain activities, the so-called "*établissements classés*". There, too, valuable information for the inventories is found.

Figure 1-35 – Luxembourg's NIS according to the Regulation of 1st August 2007



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[46]) and under the Shared Environmental Information System.[47] 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.

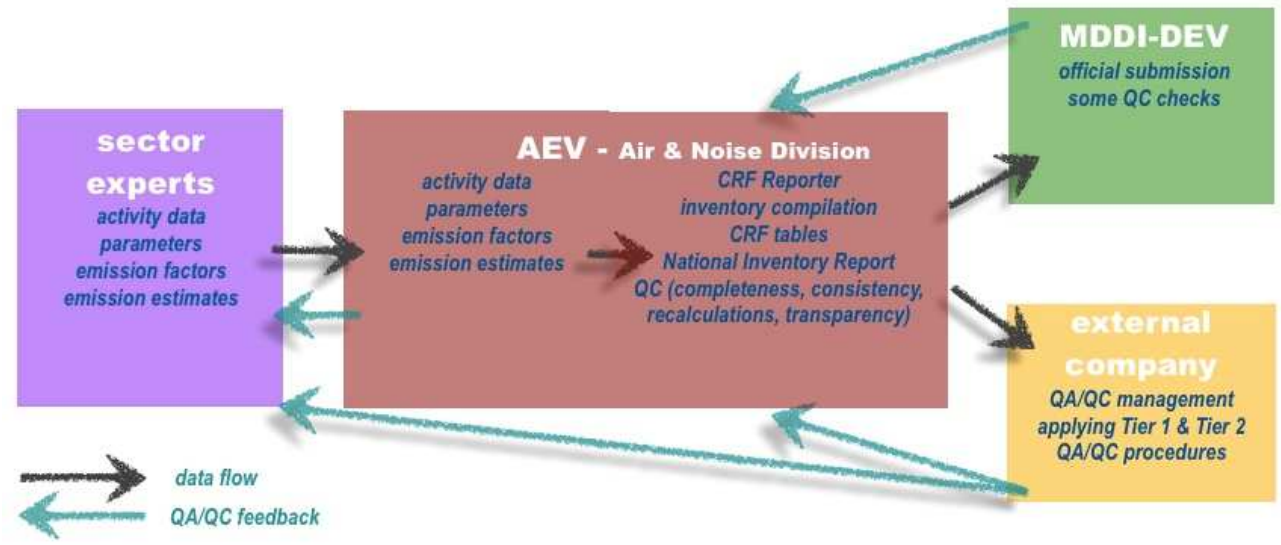
Figure 1-36 goes over the data flow process that is implied by the setting-up of the NIS. The Air/Noise Division of the Environment Agency not only collects and validates AD, EF, parameters

46 See http://inspire.jrc.it/

47 See http://ec.europa.eu/environment/seis/index.htm

and emission estimates from sector experts and compiles the inventories, but also produces emission estimates. This flexibility is introduced in Luxembourg's system to ensure a better quality for the reporting of GHG emissions.

Figure 1-36 – Theoretical data flow according to Luxembourg's NIS



1.3.1.2.2 Specific responsibilities for the GHG Inventory compilation and development process

Article 3 of the Regulation presents the tasks of the Single National Entity. In a few words, the Single National Entity – *i.e.* the Environment Agency – provides sector experts for all the IPCC Sectors except Agriculture, LULUCF and Wastewater Handling (see Table 1-13). 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;
- as National Inventory Compiler (NIC), 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.

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 Single National Entity 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 Single National Entity.

Table 1-13 – CRF Sector responsibilities within the NIS

CRF Sector	AD	Choice of EFs	Emissions estimation methods
Energy, excl. road transportation – CRF 1 except 1A3b	AEV – STATEC	AEV	AEV
Road transportation – CRF 1A3b	AEV – STATEC – SNCT	AEV	AEV
Industrial Processes – CRF 2	AEV	AEV	AEV
Agriculture – CRF 3	ASTA – SER	ASTA – SER	ASTA – SER
LULUCF – CRF 4	ANF – SER – ASTA - AEV	ANF – SER – ASTA - AEV	ANF – SER – ASTA – AEV
Waste – CRF 5A, 5B & 5D	AEV	AEV	AEV
Wastewater Handling – CRF 5B	AGE	AGE	AGE

Abbreviations used in Table 1-13:

Ministry of Agriculture:

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 Economic Affairs & External Trade:

STATEC = National Statistical Institute: http://www.statec.public.lu/fr/index.html

Ministry of Sustainable Development and Infrastructures (MDDI): http://www.emwelt.lu/:

ANF = Nature & Forestry Administration (*Administration de la Nature et des Forêts*)

AEV = Environment Agency (*Administration de l'Environnement*)

AGE = Water Management Administration (*Administration de la Gestion de l'Eau*): http://www.eau.public.lu/

Ministry of Transport:

SNCT = Technical Vehicle Inspection Administration (*Société Nationale de Contrôle Technique*): http://www.snct.lu/snct/home.nsf

1.3.1.2.3 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 2013, Luxembourg's national registry was migrated to a European based consolidated system operated by the European Commission.

1.3.2 Overview of inventory planning, preparation and management

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 national inventory compiler.

During the meeting, the quality manger and the national inventory compiler present an overview of the activities, during 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 national inventory compiler. 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:

- Quality management improvement plan: bases on findings of internal and external audits; it also includes a training plan for sector experts.
- Inventory improvement plan: bases 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 1-14 gives an overview on the tasks of inventory preparation together with a typical timeline.

Table 1-14– Inventory preparation timeline

Task	Description	Deadline
Decision making body meeting	Evaluation of the fulfilment of the previous improvement plan 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 national inventory compiler; definition of a work plan	Summer
Activity data collection	Collection of activity data, including contracting out studies.	November 1st
Inventory preparation	Estimation of emissions for all sources, including collection of background data.	December 1st
Compilation of national inventory	Stocking the database and transfer to CRF reporter ; key category analysis and uncertainty assessment	December 31
Quality checks	Tier 1 and Tier 2 QA/QC activities	December
Compilation of report (Short-NIR)	Compilation of an inventory report "Short NIR" and submission to the European Commission (Decision 280/2004/EC)	January 15
Preparation of NIR	Compilation of the National Inventory Report	January - March
EU Submission NIR	Submission of the National Inventory Report to the EC	March 15
UNFCCC Submission NIR	Submission of the National Inventory Report to the UNFCCC	April 15
Archive submission	All relevant calculation and documentation files as well as the NIR are archived on CIRCALUX	May

Table 1-15 gives an overview on the registry related tasks for providing the supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol including a timeline.

Table 1-15– Timeline for registry related tasks

Task	Description	Deadline
Standard Electronic Format (SEF)	Compilation of the SEF for the previous year	January 15
Information on changes in the national registry	Preparation of the chapter on the changes in the national registry, which is part of the NIR	March 15
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.	March 15

Finally, an official approval process has been established between the Single National Entity (SNE, Environment Agency) and the UNFCCC National Focal Point (NFP, MDDI). Thus, the SNE notifies the NFP, in writing, that the inventory has been compiled according to the rules established by the UNFCCC and uploads the submission onto the CIRCALUX data archive. The NFP informs the Minister in charge of environmental affairs 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 EEA.[48]

[48] See also article 8 of the Grand-Ducal Regulation of August 1st, 2007 relative to the implementation of the NIS.

Chapter 2

Economy-wide Emission Reduction Target

2.1 FIRST KYOTO COMMITMENT PERIOD

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** – the so-called "burden sharing" EU target. This is the deepest cut of any agreed by the 15 Member States for the first Kyoto commitment period. This corresponds to a disposable volume of 9.48 Mio. t CO_2e per year for the period between 2008 and 2012.[49]

As shown in Table 2-1, historical emissions for 2008-2012 are above the assigned amount of 9.48 Mt CO_2e, which can be disposed of annually during the first commitment period of the Kyoto Protocol (CP1). Since the annual reduction as a result of carbon sinks in the period 2008-2012 is yielding only 0.075 Mt CO_2e (line 8 of the table), closing the gap between the volume of AAUs (line 4 of the table) and the volume of emissions according to IPCC rules requires the acquisition of additional emission permits, either by making use of project based mechanisms (JI and CDM) or by purchasing permits on the international emissions trading market, pursuant to Articles 6, 12 and 17 of the Kyoto Protocol.[50]

According to the inventory submission 2014v3.1 of 17 November 2014, which is the one to be considered for the final calculation of the first commitment period under the Kyoto Protocol since it matches recommendations and adjustments requested by the UNFCCC experts review team on the 2014 submission, historical emission estimates for the first Kyoto commitment period 2008-2012, usage of Kyoto mechanisms reach 2.84 Mt CO_2e on average per year (line 10 of the table, column Average 2008-2012). Over the whole period, the gap reaches 14.20 Mt CO_2e (line 10 of the table, column Sum 2008-2012). Together, CDM and JI are expected to provide about 37% of the emission reductions and IET (AAUs) the remaining part. However, this distribution could change depending on the latest on-going development of prices and schemes, notably with regard to Luxembourg's final contribution to carbon funds of international financial institutions that cover a mix of CERs, AAUs and ERUs.

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49 Burden sharing exact value is 9 480 599 tonnes.

50 Luxembourg did not plan to account for net emissions and removals from activities under Article 3.4 of the Kyoto Protocol.

Table 2-1 – Calculation of progress towards the Kyoto Protocol (CP1) – 2nd AR GWPs

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.*
1	Total GHG emissions		12.199	11.690	12.260	12.128	11.838	12.023	60.116	*2008-2012: 2014v3.1 inventory submission to the EC and the UNFCCC (http://cdr.eionet.europa.eu/lu/eu/ghgmm/envvgb4ia/)*
2	Verified emissions 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).*
3	Non-ETS GHG emissions	(1) – (2)	10.101	9.508	10.008	10.076	9.849	9.908	49.541	
4	Initial assigned amount (AAUs)		9.481	9.481	9.481	9.481	9.481	9.481	47.403	
5	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/dossiers/CC-systeme_d_echange_de_quotas_ETS/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.*
6	Non-ETS target	(4) – (5)	6.992	6.992	6.992	6.992	6.992	6.992	34.962	
7	**Difference between target and GHG emissions (non-ETS, domestic)**	**(6) – (3)**	**-3.108**	**-2.516**	**-3.016**	**-3.084**	**-2.856**	**-2.916**	**-14.579**	*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.*
8	Expected net carbon sequestration from LULUCF activities (RMUs)		0.075	0.075	0.075	0.075	0.075	0.075	0.373	*See KP_LULUCF file KP-LUX-2014-2012-v3.1.xls, sheet "Accounting".*
9	**Difference between target and GHG emissions (non-ETS, domestic), including effect of carbon sequestration**	**(7) + (8)**	**-3.034**	**-2.441**	**-2.941**	**-3.009**	**-2.782**	**-2.841**	**-14.206**	*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.*
10	Planned use of Kyoto mechanisms by government (net transfer of AAUs + purchase of CERs + ERUs)	[(4) - (1)] + (8) + [(2) - (5)]	3.034	2.441	2.941	3.009	2.782	2.841	14.206	*Under the hypothesis that Luxembourg will cover its "Kyoto CP1 deficit" by using FlexMex, the expected uses of Kyoto mechanisms for each year are reported here.*
11	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.*
12	**Difference between target and GHG emissions (non-ETS, including plans on Kyoto mechanisms and carbon sinks)**	**(7) + (8) + (10) – (11)**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	
12'	***Percentage gap***	***(11) / (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 = estimates of annual RMUs based on 5 historical reporting years (2008-2012). In the file KP-LUX-2014-2012-v3.1.xls, sheet "Accounting", take the sum of A1 & A2, column "Accounting quantity" and divide it by 5: (-606.41+233.13)/5 = -74.6559 Gg or 0.0746559 Mt CO_2e.

These calculations take into account the "losses" induced by EU ETS related allowances finally not used by the beneficiaries,[51] which represent 14.7% of the difference between the recorded total GHG emissions and the total AAUs for the CP1 period.

2.2 SECOND KYOTO COMMITMENT PERIOD

For the commitment period 2013-2020, the EU Member States have committed themselves to collectively deliver, by 2020, 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 EU "Climate & Energy package", namely a 20% cut below 1990 levels by 2020 – which is equivalent to an overall reduction of 14% compared with 2005. This minus 20% objective covers the 7 GHG taken into account for the second Kyoto commitment period, i.e. CO_2, CH_4, N_2O, HFCs, PFCs, SF_6 and NF_3, and the following sectors: Energy, Industrial Processes and Product Use, Agriculture, Waste, as well as Domestic Aviation and Maritime emissions (which are both negligible for Luxembourg) *[→ CTF Table 2(b)]*. All this is framed under the so-called "Effort Sharing Decision" No 406/2009/EC (ESD).[52]

In CTF Tables 2, the quantified economy-wide emission reduction target reported by each EU Member State is therefore the EU commitment of a 20% cut below 1990 levels by 2020 *[→ CTF Table 2(a)]*.

However, for Luxembourg, within the EU context, the main objective of the policies and measures put in place will be to cope with its non EU ETS target. In Luxembourg, 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. **Binding annual GHG targets for Member States for sectors not included in the EU ETS for the period 2013–2020** – the "ESD targets" – have been set on the basis of Member States' relative wealth (measured by GDP per capita). These targets 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.[53] 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**.

All this process requires that Luxembourg's non-ETS emissions should reach 8 145 Gg CO_2e in 2020 in order to comply with the "ESD target" of minus 20% *[→ Figure 2-1]*. Moreover, from 2013

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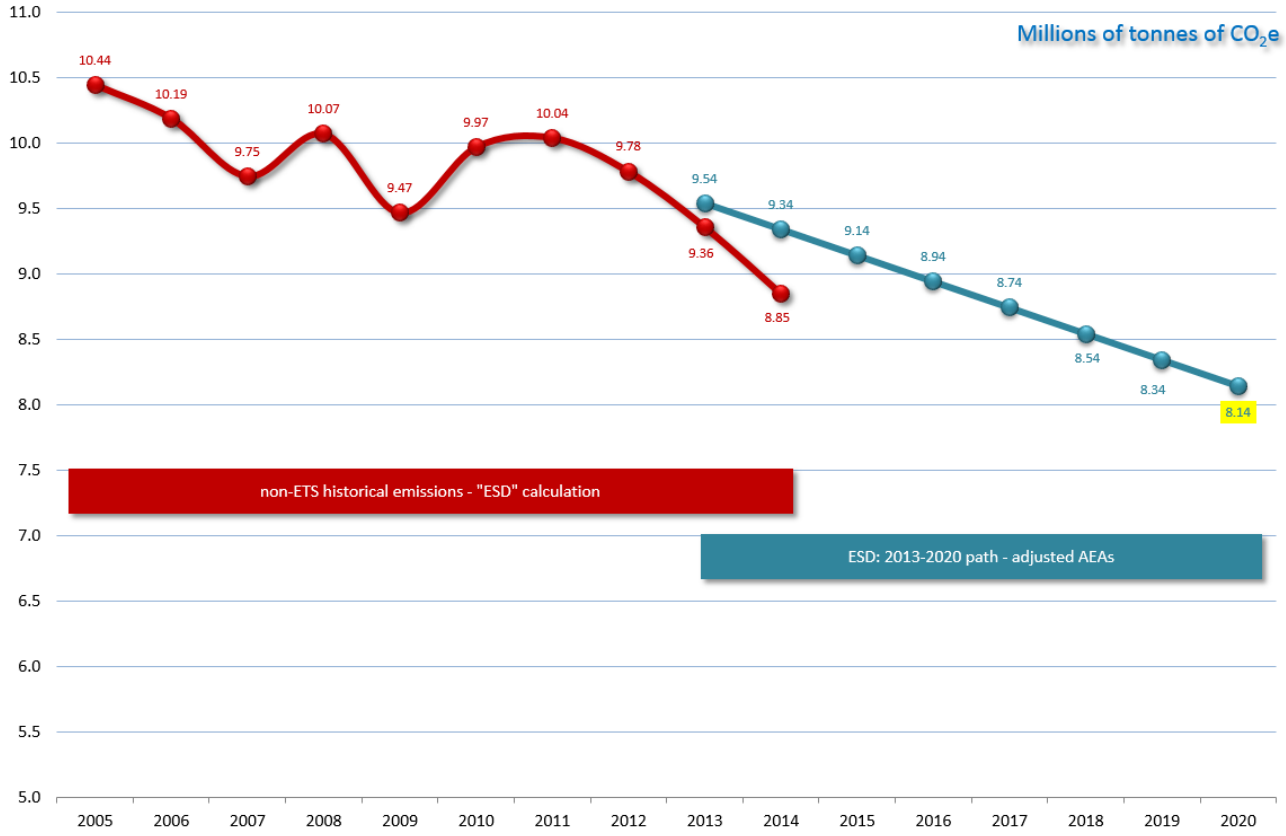
51 These "losses" equal 1.87 Mt CO_2e (line 5 minus line 2 in Table 1, column *Sum 2008-2012*).

52 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).

53 See this graphic for individual Member State "ESD targets": http://ec.europa.eu/clima/policies/effort/images/2020_limits_en.png.

onwards, non-ETS emissions should remain below a linear trajectory, the turquoise line in Figure 2-1.

Figure 2-1 – ESD implication for Luxembourg – 2013-2020 trajectory for non-ETS emissions – 4th AR GWPs



Source: MDDI-DEV.

Notes on CTF Tables 2

Table 2(d) – for Luxembourg, no national projections of the LULUCF related emissions have been produced so far since this sector is not part of the EU binding annual GHG targets for Member States for the period 2013-2020. Nevertheless, a Decision has been adopted in May 2013[54] which requests to implement action plans that will act on LULUCF related emissions. More precisely, Art. 10 of this Decision stresses that Member States shall draw up and transmit to the Commission information on their current and future LULUCF actions to limit or reduce emissions and maintain or increase removals resulting from the following activities: afforestation, reforestation, deforestation, forest management, cropland management, grazing land management, revegetation, as well as wetland drainage and rewetting.

54 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 (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:165:0080:0097:EN:PDF).

Tables 2(e) – Luxembourg cannot yet report on the use of the market-based mechanisms for the second Kyoto commitment period. However, it is already known that Luxembourg would probably make use of the provisions foreseen by the ESD (see Chapter 4 on GHG emission projections).

Chapter 3

Progress in Achievement of Quantified Economy-wide Emission Reduction Targets and Relevant Information

The second "Action Plan for reducing CO_2 emissions" is the **main tool Luxembourg will have at its disposal to comply with the EU "Climate & Energy package" commitment** by 2020 that was assigned to the country, the "ESD target" *[→ Section 2.2]*. Adopted in **May 2013**, it lists **51 implemented, adopted or planned measures and actions** of a regulatory, fiscal, economic, information, training, awareness raising or land planning nature.[55]

Other plans and programmes may have co-benefits in terms of climate change mitigation though this is not their first concern. They mostly deal with energy efficiency and the use of renewable energy sources, air pollutants emissions and concentrations, road transportation and mobility, agriculture, land planning and preservation of eco-systems.

3.1 MONITORING AND EVALUATING POLICIES AND MEASURES (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. Policy instruments introduced in the waste and agricultural sectors, as well as to improve and transform mobility, also influence developments. There are also linkages between national P&Ms and the "Common and Coordinated Policies and Measures" (CCPM's) of the EU *[→ Table 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

55 See Ministry of Sustainable Development and Infrastructure, Department of the Environment (2014) and http://www.environnement.public.lu/actualites/2013/05/plan_action_climat/index.html.

instruments. As a result, only a few P&Ms have been evaluated with regard to their ex-ante mitigation potential, as it can be seen in CTF Table 3.

3.1.1 Energy: the keyword in Luxembourg's P&Ms set

National P&Ms implemented or planned 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.

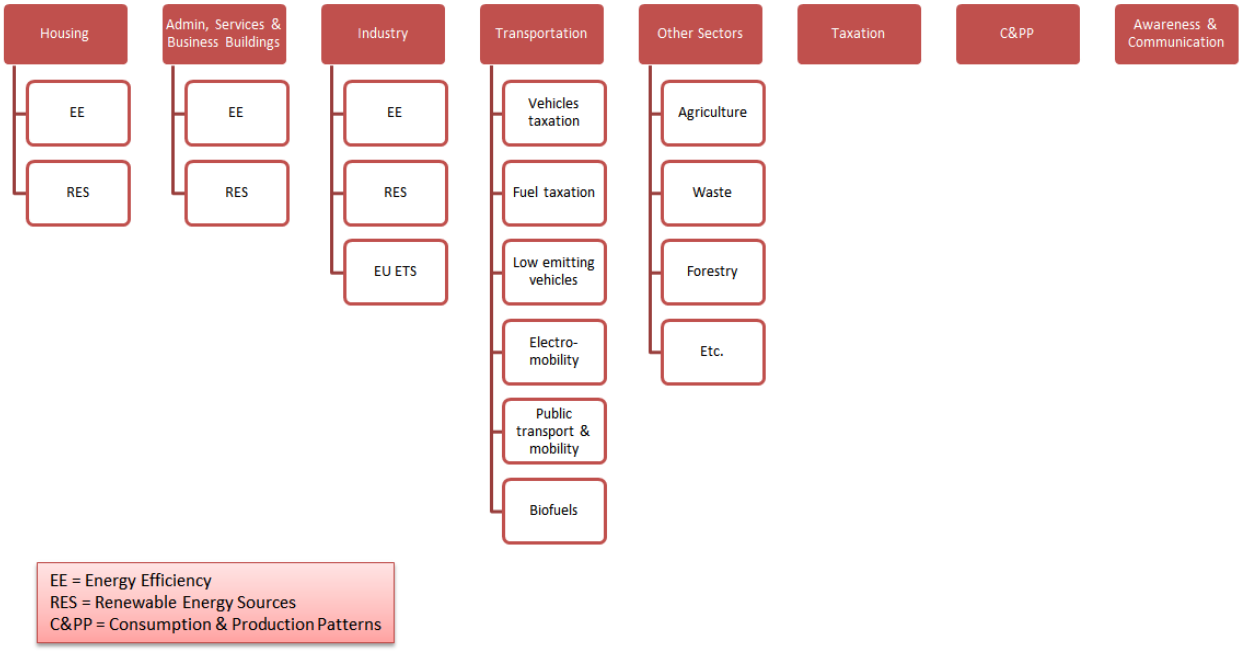
3.1.2 Promoting electricity generation from renewable energy sources is not a P&M

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. 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. So, 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**.

3.2 POLICIES AND MEASURES CONSIDERED IN THE SECOND NATIONAL "ACTION PLAN FOR REDUCING CO2 EMISSIONS"

Box 3-1 below 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 3-1 shows.

Figure 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 3-1 lists the 51 P&Ms of the second Action Plan and presents them against the P&Ms reported in Luxembourg's previous submissions on P&Ms and projections.

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 3-1;
- the columns (2) and (3) – "P&M WEM PS" and "P&M WAM PS" – that link the actions and measures of the second Action Plan to those reported in previous submissions (PS);
- 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 yet).

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.

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 3-2].*

Table 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 3-2 is limited to the P&Ms presented in Table 3-1 and, consequently, does not cover all the LULUCF, agriculture or waste management measures in place that might impact GHG emissions. Only the sectors energy, transport and industry are clearly identified in this table, which serve as the basis for CTF Table 3.

Box 3-1 – 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 compensations 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 3-1 below.

(1) see Box 3-2 for the "PRIMe House" scheme.
(2) "CAR-e" scheme, now terminated for low emitting vehicles and redirected only for electrical or hybrid cars emitting less than 60g CO_2/km.
(3) measures 21 to 27 are extracted from the "MoDu" strategy: see Box 3-4.
(4) *myenergy*: see Box 3-5.
(5) *Pacte Climat*: see Box 3-6.

Table 3-1 – P&Ms of the second national "Action Plan for reducing CO2 emissions" – list

P&M ID (1)	P&M WEM PS (2)	P&M WAM PS (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)
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
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
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
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
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
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
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
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
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
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

P&M ID (1)	P&M WEM PS (2)	P&M WAM PS (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)
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.	2013	MDDI-DEV MECE-DEN
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"..	NE and 2014 for the SD criteria	MDDI-DEV MLOG
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
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
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
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.	NE	MDDI-DEV MECE-DEN
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) 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*
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) 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
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

P&M ID (1)	P&M WEM PS (2)	P&M WAM PS (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)
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
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.	2014	MDDI-DAT MINT municipalities
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 cycling 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.	2014	MDDI-DAT MINT CdT municipalities
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.	mid- to long-term and 2017 for the tramway	MDDI-DAT CdT municipalities CFL
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.	mid- to long-term	MDDI-DAT municipalities CFL
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.	2014	MDDI-DAT MINT CdT municipalities
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..	2014	MDDI-DAT CdT CFL
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.	mid- to long-term	MDDI-DAT CdT CFL foreign neighbouring Regions
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

P&M ID (1)	P&M WEM PS (2)	P&M WAM PS (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)
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. 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
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
31	TR03	TR11	Increase in excise duties taking into account impact on public finances	Transport (taxation policy)	CO_2 CH_4 N_2O		Analysing 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".	mid-term	MDDI-DEV MFIN-ADA
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
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.	mid-term	MDDI-DEV MECE-DEN MLOG MFIN
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
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.	2013	MDDI-DEV MECE-DEN
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.	2013	MDDI-DEV
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
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

P&M ID (1)	P&M WEM PS (2)	P&M WAM PS (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)
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, notably through the setting up of a database managed by the SIGI. This is a "good governance" action.	2013	MDDI-DEV SIGI
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
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/)	NE	MDDI-DEV MECE-DCM *myenergy* Chamber of Trades IFSB
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.	NE	MDDI-DEV MECE-DEN MLOG *myenergy*
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*.	NE	MDDI-DEV MECE-DEN *myenergy*
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
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.	NE	MDDI-DAT CdT
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
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

P&M ID (1)	P&M WEM PS (2)	P&M WAM PS (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)
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
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.	2013	MDDI-DEV MINT Syvicol
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
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

Abbreviations used in Table II.2-1:

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 3-2 – P&Ms of the second national "Action Plan for reducing CO_2 emissions" – grouping by main themes

[→ CTF Table 3]

Theme	P&M second Action Plan	Mitigation potential kt CO_2e
Transport – road fuels	31	NE
Transport – road fuels: biofuels	-	550.60
Transport – road fuels: alternative means of propulsion	14 to 16 47	172.65
Transport – vehicles taxation	29 & 30	NE
Transport – public transport & cycling and walking ("*mobilité douce*")	21 à 28 45 to 47	NE
Energy supply: alternatives & RES	02 to 04	10.18
Energy consumption – EE: housing	05 & 06 12 & 13 32 & 33 41 to 44	102.37
Energy consumption – RES: housing	01 10 12 32 & 33 41 to 44	IE
Energy consumption – EE: public & commercial services, retail	07 to 09 11 17 41	1.17
Energy consumption – RES: public & commercial services, retail	01 11 41	IE/NE
Energy consumption – EE: manufacturing industries	17 & 18 41 48	NE
Energy consumption – RES: manufacturing industries	01 41 48	NE
EU-ETS	18	NE
Municipalities (*Pacte Climat*)	11 36 39 49	NE
Agriculture, land use & forestry	50 & 51	NE
Innovation & research	20	NA
Taxation (excl. road fuels)	34	NA
Education, information, awareness, advices	35 41 to 45 48	NA
Governance	37 to 40	NA
Other measures n.i.e.	19	NA

3.3 DESCRIPTION OF SOME KEY POLICIES AND MEASURES

Box 3-2: "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 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" and it is labelled "climate change contribution" or "Kyoto-cent".

Box 3-4 – "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). 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 national "Transport Sector Plan" 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.

(1) Source: EEA, TERM 2013 report, Table A.5, p. 100 (http://www.eea.europa.eu/publications/term-2013).

Box 3-5 – *myenergy*

In 1991, an Energy Agency was created to promote energy efficiency and the use of renewable energy sources in the commercial, financial and housing areas. During the course of 2008, this Agency was reformed and split into two different structures. The first one named *energieagence* continued its commercial activity on the energy advice market as a corporation, whereas a second structure, named *myenergy* was as created as an Economic Interest Group (EIG) in order to provide a national and neutral contact point for information and advice on energy matters.

myenergy's missions consist in the information, the support and the education of private persons, municipalities, companies and experts towards the development of sustainable and energy efficient constructions and the use of renewable energy sources.

myenergy's main activity is the free and neutral energy advice offered to private consumers by telephone or by appointment in its various regional *infopoints*, operated in cooperation with municipalities. The basic energy advice is meant:

1. to offer targeted guidance on the numerous products and services available on the market;
2. to clarify the advantages and disadvantages of measures;
3. to optimize the energy efficiency, the sustainability and the costs of a project;
4. to encourage the house builder to use renewable energies;
5. to offer information on the state subsidy programs.

myenergy has also introduced a voluntary certification programme (*myenergy certified*) for the experts working in the area of energy efficiency and renewable energies. The professionals meeting the criteria defined by *myenergy* and demonstrating consolidated skills obtain a quality label and are added to a list, which is actively distributed by *myenergy* to guide the consumers searching for an expert.

In addition to general advice and information activities destined to the municipalities and companies, *myenergy* has assisted the Ministry of Sustainable Development and Infrastructure with the implementation of the *Pacte Climat* and is now in charge of the project management ***[→ Box 3-6].***

myenergy also develops and manages national and European projects in the fields of energy efficiency, renewable energy sources and sustainable constructions and supports the Government for the national implementation of European Directives in the area of energy efficiency and renewable energies.

myenergy is supported by the Luxembourg Government, represented by the Ministry of Economy, the Ministry of Sustainable Development and Infrastructure and the Ministry of Housing.
→ http://www.myenergy.lu/

Box 3-6: Climate Agreement with municipalities – *Pacte Climat*

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/

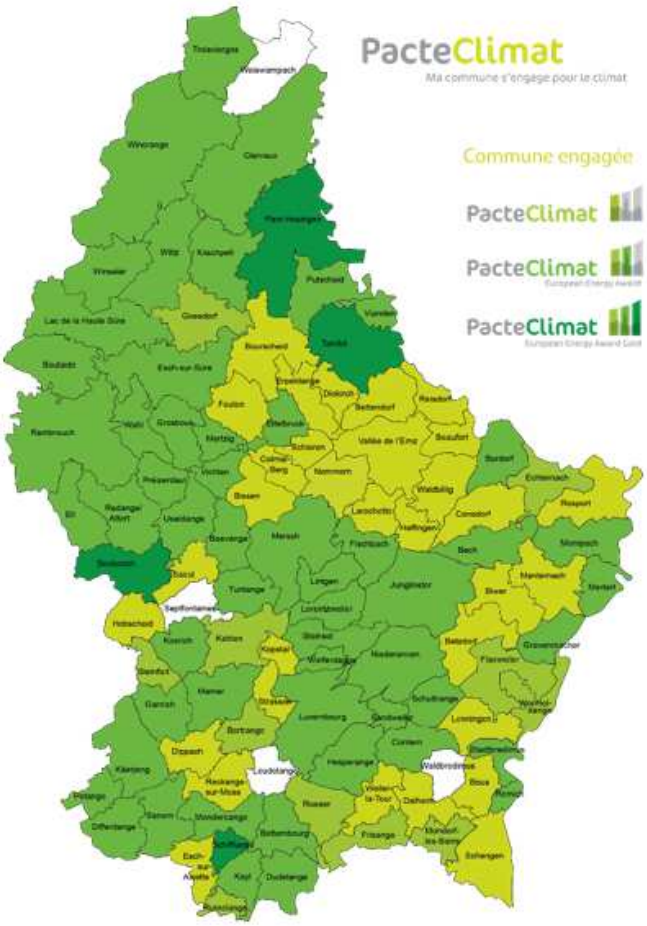
This Agreement reinforces the role of municipalities in the fight against climate change through a legislative, technical and financial framework set up in order to promote action against climate change by the municipalities. The *Pacte Climat* is basically an agreement (contract) between the State and the municipalities. Nowadays (as of May 12, 2016), 101 municipalities out of 105 are engaged at different certification level in the Agreement: see Figure 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 3-2 – Municipalities that committed to the Pacte Climat



Source: Pacte Climat website: http://www.pacteclimat.lu/

3.3 REPORTING ON PROGRESS – ESTIMATE OF ANTICIPATED EMISSION MITIGATION FROM LULUCF ACTIVITIES

Luxembourg has chosen to account for the activities under Article 3.3 of the Kyoto Protocol for the whole first 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.

A CTF Table summarizes the situation according to submission 2016v4 for the years 2013 and 2014 only *[→ CTF Table 4(a)II]*. Indeed, at the time of drafting this report, it is not yet possible to submit the anticipated contribution of the LULUCF sector to the second commitment period target since Luxembourg has not yet performed projections for that sector.

Finally, as a Kyoto Protocol Party, Luxembourg filled in Table 4(a)II, but not Table 4(a)I.

3.4 REPORTING ON PROGRESS – ESTIMATE OF ANTICIPATED EMISSION MITIGATION FROM MARKET-BASED MECHANISMS

Since 2013, it has no longer been possible to track the use of flexible mechanisms in the EU ETS directly through information on the EUTL public website: CERs and ERUs are exchanged into EUAs and cannot be further tracked after that exchange. These exchanges will become public at installation level only two years after transfers have been conducted. Consequently, 2013 and 2014 exchanges and transfers could only be reported in 2016 or 2017 respectively. The use of flexible mechanisms under the ESD cannot be quantified either at this moment. Indeed, as the compliance assessment for the first year under the ESD (i.e. 2013) will only take place in 2016, any potential use of units for meeting the ESD target in 2013 or 2014, or being transferred to another Member State in 2013 or 2014, could only be reported in 2016 or 2017 respectively. As a consequence, NE is reported in CTF Table 4(b).

Chapter 4
GHG Emission Projections

Luxembourg has **specifically updated its GHG projections up to the year 2030 for a resubmission of CTF Tables done on 31 May 2016**.

4.1 ABOUT THE DIFFICULTY TO PRODUCE PROJECTIONS FOR A COUNTRY SUCH AS LUXEMBOURG

4.1.1 Economy size increase uncertainty of GHG projections

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. These 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. **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**.

4.1.2 Road transportation: "road fuel sales to non-residents" share complicates the projection exercise

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", 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. 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**.

More precisely, 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), 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.

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,[56] makes projection of fuel sales – and corresponding GHG emissions – a hard task. Technological developments also 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.

4.2 PROJECTIONS – METHODOLOGY FOR THE REVISED BR2 SUBMISSION

For this submission, various methods and data sources have been used.

Firstly, these GHG projections up to 2030 are limited to a "with existing measures" (WEM) scenario and have been performed at an aggregated level, i.e. in CO_2-equivalent (CO_2e) and for all F-gases and other product use together – no NF_3 emissions in Luxembourg. For some source categories (agriculture, waste e.g.) projections were performed at an aggregated level and not by sub-categories. Finally, no projections are provided for the LULUCF sector as well as for memo items – except international aviation, but not international aviation under the EU ETS. Secondly, the latest inventory submitted to the UNFCCC has been used for the historical years, i.e. submission 2016v4. Some of the former projections – based on former submissions than 2016v4 – have been adjusted applying a "rule of three", i.e. the projected trend has been kept but the level revised. It is however not the case for all the forecasted CRF (sub-) categories *[→ CTF Table 6(a)]*.

[56] Road use taxes could be tolls to be paid 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 up to recently, 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.

Table 4.1 below summarizes briefly how projections have been calculated for each (sub-) category for which they have been produced. A distinction between ETS and non ETS (ESD) is indicated when relevant, since this is of high significance for EU member countries.

Table 4.1 – Projections methods/sources use for the revised BR2 submission

Existing CRF (sub-)category in LU	Projections method or source
1A1a – ETS	ECONOTEC adjusted projections
1A1a – ESD	ECONOTEC projections
1A2 – ETS	ECONOTEC adjusted projections
1A2 – non ETS	ECONOTEC projections
1A3a	ECONOTEC adjusted projections
1A3b	2015-2020: MDDI-DEV based on Ministry of Finance forecasted road fuel sales (March 2016); 2020-2035: MDDI-DEV based on STATEC NEAM's forecasts & Komobile u. FVT Graz adjusted projections
1A3c	Komobile u. FVT Graz adjusted projections
1A3d	Komobile u. FVT Graz adjusted projections
1A4a	2015: MDDI-DEV based on STATEC liquid fuel deliveries for the year 2015; 2020-2035: ECONOTEC adjusted projections
1A4b	2015: MDDI-DEV based on STATEC liquid fuel deliveries for the year 2015; 2020-2035: ECONOTEC adjusted projections
1A4c	ECONOTEC projections
1B2	IE (estimated together with 1A1a)
1C	NE
2A – ETS	ECONOTEC projections
2A – ESD	ECONOTEC projections
2C – ETS	ECONOTEC projections
2C – ESD	ECONOTEC projections
2D	adjusted gapfilled data by the European Topic Center on Air Pollution and Climate Change Mitigation (ETC/ACM) of the EIONET network
2F	IE (estimated together with 2D)

2G	IE (estimated together with 2D)
3	adjusted gapfilled data by the European Topic Center on Air Pollution and Climate Change Mitigation (ETC/ACM) of the EIONET network
4	NE
5A/B/D	adjusted gapfilled data by the European Topic Center on Air Pollution and Climate Change Mitigation (ETC/ACM) of the EIONET network
5C	IE (estimated together with 1A1a)
IB – navigation	NE
IB - aviation	2015: MDDI-DEV based on STATEC liquid fuel deliveries for the year 2015; 2020-2035: adjusted gapfilled data by the European Topic Center on Air Pollution and Climate Change Mitigation (ETC/ACM) of the EIONET network
CO_2 emissions biomass	NE (embedded in upper CRF sub-categories)
CO_2 captured	NE
Long-term storage of C in waste disposal sites	NE
Indirect N_2O	NE
International aviation in the EU ETS	NE

Sources:

ECONOTEC Consultants, *Projections d'émissions de CO_2, CH_4, N_2O,NOx et $PM_{2.5}$ à l'horizon 2035 au Luxembourg*, rapport final, July 2015.

Komobile und FVT Graz, *BAU-Prognose zum Kraftstoffexport und der zugehörigen Emissionen von klimarelevanten Gasen und Luftschadstoffen des Verkehrssektors in Luxemburg von 2015 - 2030 und Ausblick bis 2050*, Endbericht, December 2014.

Ministry of Finance, road fuel sales, incl. projections up to 2020, not published.

STATEC, liquid fuels deliveries up to 2015 (file of 7 March 2016) and NEAM baseline assumptions up to 2035 (file of 22 March 2016), not published.

ETC/ACM gapfilled projections transmitted to Luxembourg on 3 July 2015 based on PRIMES & GAINS 2013 reference scenarios.

Note: "adjusted" means that the emission trend reported by the "source" has been kept (annual growth rates) but adjusted to take into account the latest inventory data – "rule of three"

Since Luxembourg's projections mostly rely on a "bottom-up" approach, only a few key parameters have been used, namely population anticipated growth and projections of energy demand by main sectors. Though reported, GDP developments have not been used in the projections exercise because GDP 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). Finally, road freight

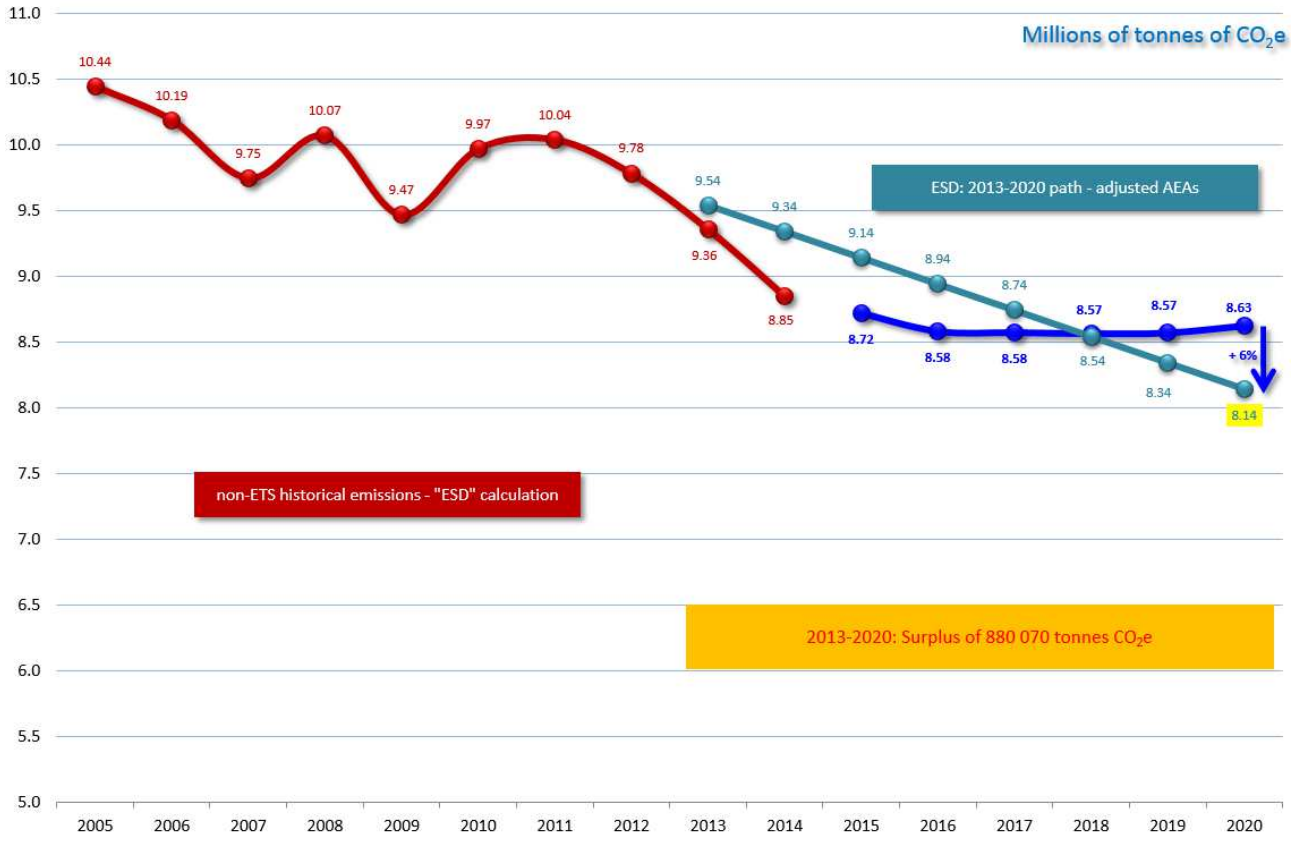
transport, which represents an important share of Luxembourg's total GHG emissions and is definitively correlated to GDP, is actually more correlated to an aggregated GDP for various EU Member States than to the GDP of Luxembourg since its emissions are principally due to traffic in transit. With regard to carbon and energy prices, no specific hypotheses have been made *[→ CTF Table 5]*.

4.3 PROJECTIONS – ANALYSIS

For the WEM scenario, results of the projections exercise show that in 2030, emission level, excluding LULUCF, would be 20% lower compared to the base year. Compared to the year 2013, they would be 8% lower.

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 2.2]*. The figure below completes Figure 2-1 by including the projected emissions.

Figure 4.1 – ESD implication for Luxembourg – non-ETS emissions – 2013-2020 trajectory and 2015-2020 projected emissions



Sources: Environment Agency and MDDI-DEV – Submission 2016v4
MDDI-DEV – 2015-2020 projections.

Figure 4-1 clearly demonstrates that with P&Ms in place, Luxembourg will not reach its non-ETS target. There might be a 6% overachievement of the 2020 target for the WEM scenario (490,000 t CO_2e). Nevertheless, over the whole period 2013-2020, Luxembourg might generate a surplus of some 880, 000 t CO_2e and might, therefore, not need to turn to the various possibilities and flexibilities offered by the ESD to "fill" a deficit gap.

Looking further, up to 2030, it can be observed that ESD and per capita emissions in Luxembourg – including road fuel sales to non-residents – have substantially decreased and are expected to further decrease:

- 2005-2015: -14.36% & -30.28%;
- 2005-2020: -15.27% & -37.89%;
- 2005-2030: -15.30% & -49.89%;
- 2005-2035: -14.49% & -53.83%;
- 2015-2030: -1.10% & -28.12%;
- 2020-2030: -0.03% & -19.31%.

The potential decrease of ESD emissions after 2015 is slightly lower than for the last decade 2005-2015. This is the result of the assumptions made for the road transportation sector (conservative approach after 2020).

However, with the anticipated strong increase of the resident population, ESD emissions per capita experienced and should experience a remarkable reduction up to 2030, a year for which, according to the latest population projections, the country should hold 70% more inhabitants than in 2005. Consequently, stabilizing the ESD emissions from 2015 onwards is already quite a challenge, knowing that the population might grow by 33% during the 2 decades between now and 2030.

As underlined above, the road transportation sector has a considerable weight in the ESD emissions. Any change in the assumptions may therefore have a significant impact on the projected ESD emissions. For this submission, it has been chosen to report "central" scenarios developed for both 2015 to 2020 and 2020 to 2030.

Chapter 5

Provisions of Financial, Technological and Capacity Building Support to Developing Country Parties

This text has been prepared by Cherryl Dentzer and Eric De Brabanter (Department of the Environment). It relies on information prepared by the Development Cooperation Directorate of the Ministry of Foreign and European Affairs – http://www.cooperation.lu/2014/.

5.1 PROVISION OF FINANCIAL SUPPORT TO DEVELOPING COUNTRIES

Section 5.1.1 gives an overview of Luxembourg's development cooperation objectives and policies. *Section 5.1.2* depicts the multilateral financial flows directed to developing countries by Luxembourg's development cooperation activities. This section, therefore, exceeds the climate change related financial assistance since **it describes all the financial flows to cooperation partner countries**. *Section 5.1.3* provides several tables summarizing financial flows to developing country Parties of the UNFCCC.

5.1.1 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 2014-2018 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 jointly with partner countries to prevent climate change will not affect the budgetary means reserved for the eradication of poverty or humanitarian aid*" and that "*Luxembourg will assert its leading role at international level to continue providing untied aid*" [Government of the Grand Duchy of Luxembourg (2013), p. 197]. In 2014, Luxembourg's Official Development Assistance (ODA) amounted to 318.35 Mio. EUR (422.38 Mio. USD) and represented 1.06% of the GNI. 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. As in the past, this ODA 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.[57] 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 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 2014 and led to a "**strategy for environment and climate change action**" [Ministry of Foreign and European Affairs, Development Cooperation Directorate (2014a)].[58]

This "strategy for environment and climate change action" states the following:

"Luxembourg's Development Cooperation aims to generate environmental and climatic benefits in developing countries, by mainstreaming environment and climate change in its interventions, by backing national

[57] 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.

[58] 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. The "strategy for environment and climate change action" (in French) is available here: http://www.gouvernement.lu/4555736/environnement-changement-climatique-2014.pdf.

sustainable development goals and the preservation of natural resources of these countries, by supporting specific activities in the field of natural resources management, sustainable agriculture, energy and the fight against climate change.

More precisely, as regards technology transfer, it specifies that:

Cooperation can work with the private sector in Luxembourg and in developing countries, in areas where the sector has adapted environmental expertise. Such cooperation with the private sector should be framed so as to provide a real benefit to the population, by ensuring that companies respect environmental and social standards and that their activities take into account the needs of the economy of the recipient country and of local communities, in accordance with the Council conclusions of the European Union of 23 June 2014 on the role of the private sector in development.".

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 Cancun Agreement (2010), 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.

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 (CDMs).

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.

In synergy with Luxembourg's Development Cooperation Directorate, its Ministry for Sustainable Development and Infrastructures, in charge of the management of the Climate and Energy Fund, may make available to the partner country additional funds to public development aid, to implement projects against climate change in the areas of adaptation and mitigation, including emissions reductions through the use of market mechanisms."

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.

5.1.2 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 2014, they represented 54.78% of all the funds attributed to NGOs).

In 2014, the share of **multilateral cooperation in the total ODA** – i.e. 318.35 Mio. EUR – was 27.90% *[→ Table 5-1]*.

Table 5-1 – Overall multilateral cooperation for the year 2014

Institution	Total in Mio. EUR	% of multilateral ODA	% of total ODA
United Nations (Agencies, Programmes, etc.)	36,92	41,17 %	11,59 %
European Union	25,36	28,28 %	7,96 %
World Bank	17,02	18,98 %	5,34 %
Regional Development Banks	6,87	7,66 %	2,15 %
Other	3,50	3,90 %	1,09 %
Total	89,67	100.00 %	27,90 %

Source: Ministry of Foreign and European Affairs, Directorate for Development Cooperation.

The table below *[→ Table 5-2]* 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 5-2 – Overall multilateral cooperation: financial contributions according to "Table 4" format for the years 2012, 2013 and 2014 in EUR

Institution or Programme	2012	2013	2014
European Union			
EC Budget	13 530 260	16 391 578	16 140 598
European Development Fund (EDF)	7 832 000	10 690 000	8 509 199
European investment Bank (EIB)	1 440 000	1 440 000	1 406 998
United Nations			
FAO	1 418 519	1 176 862	1 102 570
UNCCD	6 451	6 804	5 826
UNDP incl. thematic contribution to the Environment Trust Fund (500k)	12 360 078	13 745 713	15 790 444
UNEP	500 000	500 000	250 000
UNICEF	7 641 982	8 228 142	7 334 767
International Financial Institutions			
World Bank	4 339 000	889 000	2 300 000
International Development Association (IDA)	16 305 000	15 100 000	11 365 000
International Bank for Reconstruction and Development (IRBD) incl. GEF/CGIAR	2 174 475	1 716 700	2 522 700
European Bank for Reconstruction and Development (EBRD)	1 500 000	2 611 000	2 000 000
Asian Development Bank (ADB)	798 000	2 628 000	2 834 546
Other Multilateral Institutions			
OECD	450 000	620 000	460 000

Source: Ministry of Foreign and European Affairs, Directorate for Development Cooperation.

5.1.3 Climate change related financial flows to developing country Parties to the UNFCCC

As indicated above, five out of Luxembourg's nine partner countries are among the LDCs and are located in sub-Saharan Africa. The negative effects of climate change affect them all.

The table on the next page *[→ Table 5-3]* is derived from the "Provision of public financial support" tables 7(a) and 7(b) as defined in Decision 19/CP.18 on a Common Tabular Format (CTF) for "UNFCCC biennial reporting guidelines for developed country Parties". It contains only provided financial support, not amounts that have been pledged such as an annual contribution of 5 Mio. EUR to the Green Climate Fund (GCF).

This table reports **ODA's financial flows and contributions** managed by the Development Cooperation Directorate of the Ministry of Foreign and European Affairs, **contributions to the Global Environment Facility** (GEF) which are under the responsibility of the Ministry of Finance, and **other official flows** (OOF) **coming from the EU Fast Start Finance scheme** managed through the "Climate & Energy Fund" *[→ Section 5.2]*.

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 are chiefly managed by Luxembourg's executing agency for development cooperation, LuxDev.[59]

With regard to recipient countries, it is worth mentioning that Least Developed Countries receive a high share of total climate related ODA – Burkina Faso, Niger, Mali, Senegal and Laos being among Luxembourg's privileged partner countries. Cabo Verde – as a SIDS, member of AOSIS – is another privileged partner country of Luxembourg's Development Cooperation. The priority sectors – water & sanitation, renewable energies – align very well with the country's mitigation ambitions and adaptation needs.

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.

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

59 See http://luxdev.lu/en/home.

GFDRR, UNISDR, BCPR and various NGO projects reflect Luxembourg's commitment in this regard. Contributions to these activities are partly reported in Table 5-3.

5.2 PROVISION OF NEW AND ADDITIONAL FINANCIAL 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 Luxembourg commits to deliver are not taken over from earlier commitments and are thus new. "Additional" 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 stated in the 2014-2018 Governmental Programme "*additional actions put in place by the Government jointly with partner countries to prevent climate change will not affect the budgetary means reserved for the eradication of poverty or humanitarian aid*" [Government of the Grand Duchy of Luxembourg (2013), p. 197].

As regards **Fast Start Finance 2010-2012**, Luxembourg pledged a contribution of 9 Mio EUR on the top of the country's ODA commitment, to be provided by the "Climate and Energy Fund" *[→ box 5-1 below]*. So far, 8.86 Mio. EUR have been firmly committed *[→ Table 5-4]* and effective disbursements are still taking place in 2015.

Table 5-4 – 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	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	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
	ASTM/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	Renewable Energies / Mitigation	67 196
	Scoping Study for the elaboration and implementation of a NAMA	Mitigation	112 262
Total:			8 860 458

Source: Ministry of Sustainable Development and Infrastructure, Department of the Environment.
Note: Yasuni: restitution of the funds due to the stop of the project in 2013.

Table 5-3 – Provision of climate change related public financial support: summary information for the year 2014 – in EUR

ODA	Mitigation			Adaptation			Cross-cutting		
Allocation channels	2012	2013	2014	2012	2013	2014	2012	2013	2014
Total contributions through multilateral channels	NO	NO	NO	1 848 562.00	2 073 795.00	1 389 078.00	1 474 475.00	1 016 700.00	872 700.00
Multilateral climate change funds	NO	NO	NO	NO	NO	NO	1 474 475.00	1 016 700.00	872 700.00
Global Environment Facility (GEF)	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*1 474 475.00*	*1 016 700.00*	*872 700.00*
Other multilateral climate change funds	NO	NO	NO	NO	NO	NO	NO	NO	NO
Multilateral financial institutions, incl. regional development banks	NO	NO	NO	1 141 295.00	728 795.00	1 141 170.00	NO	NO	NO
Global Facility for Disaster Reduction and Recovery (GFDRR) (1)	*NO*	*NO*	*NO*	*400 000.00*	*300 000.00*	*300 000.00*	*NO*	*NO*	*NO*
International Committee of the Red Cross	*NO*	*NO*	*NO*	*312 500.00*	*NO*	*412 375.00*	*NO*	*NO*	*NO*
Mekong River Commission (MRC)	*NO*	*NO*	*NO*	*428 795.00*	*428 795.00*	*428 795.00*	*NO*	*NO*	*NO*
Specialized UN bodies	NO	NO	NO	707 267.00	1 345 000.00	247 908.00	NO	NO	NO
UN High Commissioner for Refugees (UNHCR) (2)	*NO*	*NO*	*NO*	*300 000.00*	*300 000.00*	*NO*	*NO*	*NO*	*NO*
UN International Strategy for Disaster Reduction (UNISDR)	*NO*	*NO*	*NO*	*250 000.00*	*250 000.00*	*NO*	*NO*	*NO*	*NO*
UN World Food Programme (UN-WFP)	*NO*	*NO*	*NO*	*NO*	*550 000.00*	*NO*	*NO*	*NO*	*NO*
UN Entity for Gender Equality and the Empowerment of Women (UN-Women)	*NO*	*NO*	*NO*	*157 267.00*	*245 000.00*	*247 908.00*	*NO*	*NO*	*NO*
Total contributions through bilateral, regional and other channels	10 369 570.32	13 694 150.67	6 041 385.00	20 184 476.43	22 546 342.76	5 963 395.00	NO	NO	19 373 506.00
PMA (Burkina Faso, Mali, Niger, Sénégal & Laos) (3)	2 575 535.65	5 914 739.00	4 872 987.00	6 758 250.32	9 833 360.00	1 926 051.00	NO	NO	13 437 037.00
AOSIS (Cape Verde)	4 682 620.43	3 938 345.00	9 591.00	4 632 416.48	3 938 345.00	NO	NO	NO	NO
Other (Kosovo, Montenegro, Vietnam, Nicaragua) (4)	1 581 704.33	916 406.00	NO	3 440 994.66	2 602 920.00	1 603 058.00	NO	NO	3 267 780.00
Other channels - NGOs (co-financing, framework agreements, support for humanitarian actions in the field of resilience & disaster risk reduction)	1 529 709.91	2 924 660.67	1 158 807.00	5 352 814.97	6 171 717.76	2 434 286.00	NO	NO	2 668 689.00
Total	10 369 570.32	13 694 150.67	6 041 385.00	22 033 038.43	24 620 137.76	7 352 473.00	1 474 475.00	1 016 700.00	20 246 206.00

Source: Ministry of Foreign and European Affairs, Directorate for Development Cooperation.

Notes

All the amounts reported in this table are managed by the Directorate for Development Cooperation (Ministry of Foreign and European Affairs) with the exception of the GEF contributions which are managed by the Ministry of Finance.
2014: the main difference as compared to previous years is the high amount allocated to the category "cross-cutting", due to an improved accounting system. Also linked to this new accounting system is the now available detail on projects, countries and executing partners.
NO: not occuring & IE: indicated elsewhere.
(1) the GFDRR is managed by the World Bank.
(2) grants provided for disaster preparedness.
(3) 2014 - Mali no longer a recipient country.
(4) 2014 - Montenegro no longer a recipient country.

[➔ see Annex for additional details on the climate related ODA projects – in French]

OOF	Mitigation				Adaptation				Cross-cutting			
Allocation channels	2012	2013	2014	Committed	2012	2013	2014	Committed	2012	2013	2014	Committed
Total contributions through multilateral channels	NO	3 000 000.00	0.00	NO	NO	NO	NO	3 000 000.00	1 000 000.00	NO	NO	NO
Multilateral climate change funds	NO	NO	NO	NO	NO	NO	NO	2 000 000.00	NO	NO	NO	NO
Adaptation Fund	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*2 000 000.00*	*NO*	*NO*	*NO*	*NO*
Other multilateral climate change funds	NO	NO	NO		NO	NO	NO	NO	NO	NO	NO	NO
Multilateral financial institutions, incl. regional development banks	NO	1 000 000.00	NO	NO	NO	NO	NO	1 000 000.00	NO	NO	NO	NO
Global Facility for Disaster Reduction and Recovery (GFDRR) (1)	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*1 000 000.00*	*NO*	*NO*	*NO*	*NO*
International Union for Conservation of Nature - Small Islands Developing States (IUCN - SIDS)	*NO*	*1 000 000.00*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*
Specialized UN bodies	NO	2 000 000.00	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
UN collaborative initiative on Reducing Emissions from Deforestation and forest Degradation in developing countries (UN-REDD) (2) (FAO, UNDP, UNEP)	*NO*	*2 000 000.00*	*NO*	*NO*	*NO*	*NO*	*NO*	*NO*	*1 000 000.00*	*NO*	*NO*	*NO*
Total contributions through bilateral, regional and other channels	NO	730 011.78	63 250.18	NO	NO	NO	NO	NO	NO	67 196.09	NO	NO
ASTM / ARFA (3)	NO	NO	NO	NO	NO	NO	NO	NO	NO	67 196.09	NO	NO
LuxDev/Solartec (4)	NO	681 000.00	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Scoping study elaboration & implementation of a NAMA (5)	NO	49 011.78	63 250.18	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total	NO	3 730 011.78	63 250.18	NO	NO	NO	NO	3 000 000.00	1 000 000.00	67 196.09	NO	NO

Sources: Ministry of Foreign and European Affairs, Directorate for Development Cooperation and Ministry of Sustainable Development and Infrastructure, Department of the Environment.

Notes

All the amounts reported in this table relate to actions supported by the EU Fast Start Finance scheme and are managed through the "Climate & Energy Fund" (see Section III below).
NO: not occuring
This table does not report the contribution provided for Yasuni National Parc project in Ecuador since it has been stopped in 2013. Funding has been returned.
(1) the GFDRR is managed by the World Bank.
(2) UN-REDD agencies are the FAO, UNDP & UNEP.
(3) grant provided to ASTM / ARFA: Burkina Faso projects led by Luxembourg's NGO *Action Solidarité Tiers-Monde* (ASTM) - see §38 below.
(4) grant provided for project CVE/071 in Cape Verde - see Table IV-1 below.
(5) 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 - see §34 below.

Furthermore, during the United Nations Sustainable Development Summit, that took place in New York in September 2015, Luxembourg's Prime Minister announced that Luxembourg will provide a total amount of 120 Mio. EUR for **International Climate Finance (ICF)** from 2014-2020. This amount includes an annual contribution of 5 Mio. EUR to the **Green Climate Fund (GCF)**, representing a total of 35 Mio. EUR.

Table 5-5 – Luxembourg's financial contributions to ICF for the years 2014-2020 in EUR

	2014	2015*	2016	2017	2018	2019	2020
ICF	1 000 000	17 000 000	12 000 000	15 000 000	20 000 000	25 000 000	30 000 000

Source: Ministry of Sustainable Development and Infrastructure, Department of the Environment.
Note: the 2015 budget includes the 2014 5 Mio. EUR contribution to the GCF which was pledged in 2014 and disbursed in 2015.

1. 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 5-6]*.

Table 5-6 – Luxembourg's financial contributions to the GEF for the years 2012, 2013 & 2014 in EUR

	2012	2013	2014
Global Environment Facility	1 474 475	1 016 700	872 700

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. Since 2010, however, no contributions were made to the LDCF.

BOX 5-1 – THE "CLIMATE AND ENERGY FUND"

By a law of 23rd December 2004, Luxembourg has set up a fund to finance the Kyoto mechanisms (the "Kyoto Fund").[60] In January 2011, this Fund has been renamed "Climate and 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 and Energy package". The Department of the Environment remains in charge of the "Kyoto" side of the "Climate and Energy Fund" and decision-making responsibility for CDM and JI rests with the same Department. According to the Law, the Minister in charge of the environment is advised by an inter-departmental committee made up of representatives of the Development Cooperation Directorate of the Ministry of Foreign and European Affairs, of the Ministry of the Economy, of the Department of the Environment of the Ministry of Sustainable Development and Infrastructure, and of the Ministry of Finance.

60 *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).

TABLE – CURRENT ANNUAL BUDGET OF THE "KYOTO FUND" (2005-2010) / "CLIMATE AND ENERGY FUND (2011-2014) IN MIO. EUR

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013*	2014*
Budget	5.00	10.00	10.00	10.50	11.00	11.00	11.00	5.00	0.00	0.00

**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 and 100% of the "Kyoto-cent" represent extra sources of revenues for the Fund. The "Kyoto-cent" is an additional tax on every gasoline and diesel litre sold in Luxembourg (2 & 2.5 euro-cents per litre respectively). In 2014, the CO_2-based vehicle tax contributed an amount of 27 Mio. EUR to the "Climate and Energy Fund", whereas the "Kyoto-cent" generated an income of 60 Mio. EUR. These two policies & measures are notably described in the Sixth National Communication of Luxembourg under the UNFCCC (Table IV.3-1 – P&Ms of the second national "Action plan for reducing CO2 emissions" – List: P&M ID 29 and 31, p.181)[61].

As of today (since 2005), Luxembourg committed about 176 Mio. EUR 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. EUR has been committed to the participation in multilateral funds: Luxembourg participates in various carbon funds of international financial institutions covering ERPAs pertaining to CDM and JI projects. Committed expenditures presented in the above include these contributions to the:

- "Biocarbon Fund" of the World Bank;
- "Community Development Carbon Fund" of the World Bank;
- "Carbon Fund for Europe" of the European Investment Bank and the World Bank;
- *"Multilateral Carbon Credit Fund" of the European Bank for Reconstruction and Development (terminated);*
- *"Asian Pacific Carbon Fund" of the Asian Development Bank (terminated).*

At the end of 2014, some 112 Mio EUR have been disbursed for the use of project based mechanisms (AAUs, CERs and ERUs). Around 22% of these expenses are allocated to multilateral purchases and 78% to bilateral purchase agreements. The counterpart of these payments represents 13.99 Mt CO2e, i.e. below the anticipated CP1 gap of 14.20 Mt CO2e.

61 http://unfccc.int/files/national_reports/annex_i_natcom/submitted_natcom/application/pdf/dev_nc6_final.pdf.

For the years 2014 to 2020, commitments for the acquisition of emission rights (AEAs, CERs and ERUs) in the framework of the "Climate and Energy Fund" amount to a total of 142.23 Mio. EUR.

TABLE – LUXEMBOURG'S 2014-2020 COMMITMENTS FOR THE PURCHASE OF EMISSION RIGHTS (IN MIO. EUR)

Year	2014	2015	2016	2017	2018	2019	2020
Annual emission allowances (AEAs)	/	10	10	10	10	10	10
Certified emission reduction units (CERs) / Emission reduction units (ERUs)	4.23	14	14	14	12	12	12

5.3 SUPPORT FOR MITIGATION, ADAPTATION, CAPACITY-BUILDING AND TECHNOLOGY TRANSFER TO DEVELOPING COUNTRIES

In this Chapter, Luxembourg reports some information on activities related to **transfer of technology**. Nevertheless, with regard to CTF Table 8 (Provision of technology development and transfer support) and CTF Table 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. Consequently, for this Biennial Report, Luxembourg does not report CTF Tables 8 & 9.

The following projects and programmes illustrate the efforts of Luxembourg's Development Cooperation as regards technology transfer (non exhaustive list):

- **Cape-Verde**: project **CVE/071** – 12.54 Mio. EUR – 2008-2015 – 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 and Energy Fund" *[→ Section 5.2]*, 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 5-7]*.

- **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 5-7]***.

- **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;
- 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 5-7 – 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 – 2015
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 and 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 the EU Fast Start Finance scheme. 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 deepened analysis on capacity and readiness, set priorities, and evaluated costs, before recommending, by the end of 2013, a single country ready for Luxembourg NAMA support, i.e. **Vietnam**. In close cooperation with the selected NAMA host country Government and Luxembourg's officials, the overall aim is to prepare a "Project Idea Note" (PIN) 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 and to 100% of RES in the longer term. 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. The study's final report was presented in October 2013 and is meant to feed into the Government's Master Plan for its planned energy transition.

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. It is worth mentioning that the majority of those companies operating in the field of energy, environment and sustainable development are regrouped within the "EcoInnovation Cluster" of Luxinnovation, an agency linked to the Ministry of Economy. This Cluster focuses on the following three topics: Circular Economy, Mobility, Sustainable Cities and Smart Technologies.[62] From 2013 on, the contacts between the EcoInnovation Cluster and Luxembourg's Directorate for Development Cooperation have intensified in order to encourage Luxembourg's companies to engage in developing countries and, more specifically in the case of RES, in Cape Verde, where concrete opportunities and needs have been identified. It is important however to note that given the untied nature of Luxembourg's ODA, no subsidies or public tender advantages can be given by Luxembourg companies through ODA grants.

62 For more information, please consult: http://www.ecoinnovationcluster.lu.

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 *[→ box 5-2 below]* 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[63] collaboration with ARFA[64] and *Jonggbaueren a Jongwënzer*[65] - field labour with donkeys).

BOX 5-2 – 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.

63 ASTM stands for *Action Solidarité Tiers-Monde* – http://astm.lu/.

64 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/.

65 http://jongbaueren.lu/.

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5.4 ANNEX TO CHAPTER 5 – LUXEMBOURG'S ODA PER SECTOR (2014)

VENTILATION SECTORIELLE DE L'APD BILATERALE & MULTILATERALE	TOTAL PAR SECTEUR	%
INFRASTRUCTURE ET SERVICES SOCIAUX	121 111 115,80 €	37,60%
Education	**42 230 640,61 €**	**13,11%**
dont éducation, niveau non spécifié	6 187 242,02 €	1,92%
dont éducation de base	17 932 050,49 €	5,57%
dont éducation secondaire	17 758 124,01 €	5,51%
dont éducation post-secondaire	353 224,09 €	0,11%
Santé	**41 369 324,03 €**	**12,84%**
dont santé, général	13 809 290,19 €	4,29%
dont santé de base	27 560 033,84 €	8,56%
Politique en matière de population/santé et fertilité	**7 842 923,39 €**	**2,44%**
Distribution d'eau et assainissement	**9 875 703,51 €**	**3,07%**
Gouvernement et société civile	**12 682 435,91 €**	**3,94%**
dont Gouvernement et société civile - général	11 120 809,07 €	3,45%
dont politique fiscale et soutien à l'administration fiscale	*500 041,93 €*	0,16%
dont participation démocratique et société civile	*1 331 507,92 €*	0,41%
dont Conflits, paix et sécurité	1 561 626,84 €	0,48%
Infrastructure et services sociaux divers	**7 110 088,35 €**	**2,21%**
INFRASTRUCTURE ET SERVICES ECONOMIQUES	19 791 989,93 €	6,15%
Transports et entreposage	260 000,00 €	0,08%
Communications	2 197 537,28 €	0,68%
Production et distribution d'energie	3 125 763,14 €	0,97%
Banques et services financiers	14 208 689,50 €	4,41%
Entreprises et autres services	- €	0,00%
PRODUCTION	14 554 369,54 €	4,52%
Agriculture, sylviculture et pêche	10 310 140,93 €	3,20%
Industries manufacturières, ind. extractives, construction	2 824 259,53 €	0,88%
Politique commerciale et réglementations	- €	0,00%
Tourisme	1 419 969,08 €	0,44%
DESTINATION PLURISECTORIELLE OU TRANSVERSALE	19 111 603,41 €	5,93%
Protection de l'environnement	2 892 495,18 €	0,90%
Autres multi secteurs	16 219 108,23 €	5,04%
dont aide plurisectorielle	7 873 198,58 €	2,44%
dont développement et gestion urbaine	347 480,39 €	0,11%
dont Développement rural	6 856 491,04 €	2,13%
dont développement alternatif non agricole	- €	0,00%
dont éducation et formation plurisectorielles	1 141 938,22 €	0,35%
dont institutions scientifiques et de recherche	- €	0,00%
AIDE ALIMENTAIRE DEVELOPMENTALE/SECURITE ALIMENTAIRE	2 253 662,96 €	0,70%
AIDE HUMANITAIRE	40 430 662,08 €	12,55%
Intervention d'urgence	34 274 669,78 €	10,64%
dont assistance matérielle et services d'urgence	29 385 465,66 €	9,12%
dont aide alimentaire d'urgence	28 925,00 €	0,01%
dont coordination des secours et services de soutien et de protection	4 860 279,12 €	1,51%
Reconstruction et réhabilitation	3 417 469,16 €	1,06%
Prévention des catastrophes et préparation à leur survenue	2 738 523,14 €	0,85%
FRAIS ADMINISTRATIFS DES DONNEURS	18 208 704,08 €	5,65%
SENSIBILISATION	2 408 560,71 €	0,75%
Aide aux réfugiés dans le pays donneur	- €	0,00%
NON AFFECTE / NON SPECIFIE	84 209 829,21 €	26,15%
	- €	0,00%
TOTAL AIDE BILATERALE & MULTILATERALE VENTILABLE PAR SECTEUR	**322 080 497,72 €**	**100,00%**

Source: Ministry of Foreign and European Affairs, Directorate for Development Cooperation.

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