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BELGIUM'S EIGHTH NATIONAL COMMUNICATION AND FIFTH BIENNIAL REPORT ON

CLIMATE CHANGE

Under the United Nations Framework Convention on Climate Change

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Introduction

This document represents the Belgium's 8th National Communication required under the United Nations Framework Convention on Climate Change, as reaffirmed by UNFCCC decision 9/CP.16 and UNFCCC decision 2/CP.17. It provides a comprehensive overview of climate change-related activity in Belgium. As defined in the UNFCCC reporting guidelines for National Communications (decision 6/CP.25), the information has been subdivided into:

- National circumstances relevant to greenhouse gas emissions and removals (section 2),
- Greenhouse gas inventory information (section 3),
- Policies and measures (section 4),
- Projections and the total effects of policies and measures (section 5),
- Vulnerability assessment, climate change impacts and adaptation measures (section 6),
- Financial, technological and capacity-building support (section 7),
- Research and systematic observation (section 8),
- Education, training and public awareness (section 9).

In accordance with the provisions of decision 6/CP.25, signatory nations that are developed country Parties were requested to submit their final biennial report (BR5) to the secretariat no later than 31 December 2022 as soon as the annual greenhouse gas inventory submission for inventory year 2020 is provided to the UNFCCC. As endorsed in UNFCCC decision 2/CP.17, Belgium has opted to submit its 5th Biennial Report as an annex to this 8th National Communication (Annex 2). The tables as defined in the common tabular format for the UNFCCC biennial reporting guidelines for developed country Parties (UNFCCC decision 19/CP.18) have been submitted to the UNFCCC by means of the electronic reporting facility provided by the UNFCCC secretariat as required by UNFCCC decision 19/CP.18.

In order to avoid unnecessary duplication of information, overlapping content between the 8th National Communication and the 5th Biennial Report has been limited as much as possible; sections of the 5th Biennial Report contain mainly references to the corresponding sections of the 8th National Communication's and/or CTF tables.

A summary table outlining the location of supplementary information required within this National Communication in accordance with Article 7, paragraph 2, of the Kyoto Protocol is provided in Annex 1.

1. Executive summary

National circumstances relevant to greenhouse gas emissions and removals

Belgium is a small country (30 689 km²) in north-western Europe. Belgium is highly urbanised and is the third most densely populated country in Europe (375 inhabitants/km² in 2021).

Belgium's temperate maritime climate is characterised by moderate temperatures. The evolution of temperatures in the past century reveals an upward trend, a phenomenon that has been accentuated in recent years.

Belgium is a federal state composed of three language-based communities and three regions, each with its own executive and legislative bodies.

Given Belgium's federal structure and the division of powers, several structures have been created to promote consultation and cooperation between the different levels of power and to ensure consistency in the action of the federal state and its entities. The central coordination body with regard to national climate policy is the National Climate Commission. The central coordination body for energy is CONCERE-ENOVER. The two are increasingly working together.

Belgium has a very open economy, situated at the heart of a zone of intense economic activity. The Belgian economy is dominated by the services sector. Exports of goods and services accounted for 80% of GDP in 2020 and imports 79%.

The gross domestic product amounted to EUR 456.893 billion in 2020, but recorded a growth rate of -5.7% in the past year due to the COVID-19 crisis. Prior to this, Belgium's gross domestic product had been constantly increasing since 1990 (with a small drop related to the financial crisis in 2008-2009). At the same time, GHG emissions were initially stabilised (1990-2005), followed by a decreasing trend up to the present (-26.9% in 2020, compared to 1990, but only -20.1% in 2019 compared to 1990). The main drivers for decoupling are: increased use of gaseous fuels (decreased use of liquid and solid fuels), higher energy efficiency, changes in the structure of the economy (fewer highly energy intensive industries such as the steel industry and more added value in sectors – services and commercial sectors – that are less energy-intensive).

In 2019, greenhouse gas emissions per GDP were 261 tons of CO_2-eq. per million euros at 2015 prices (Total UNFCCC excl. LULUCF (Land Use, Land-Use Change and Forestry)) and 253 in 2020.

Energy

Energy intensity has been following a downward trend since 1990, reflecting the decoupling of economic growth from primary energy consumption.

As far as the market share of the total final consumption is concerned, oil products remain the dominant energy source (46.1%), followed by natural gas (26.8%) and electricity (17.8%).

In 2020, the industrial sector was the main consumer of primary energy (26.3%), followed by the residential sector (20.8%) and transport (20.4%). The trend that took place in the transport sector was totally unprecedented however, its consumption decreasing by 15.8% compared to 2019.

Although the measures taken in the context of the fight against the coronavirus have had a particularly significant influence on the consumption of petroleum products, the share of these products in the country's total final consumption remains predominant (46.1% in 2020). Natural gas accounted for 26.8% of the country's final energy consumption in 2020. 89.8% of this gas was used for energy purposes, of which 33.8% was used in the residential sector.

Belgium has limited energy resources. Its total primary energy production represents approximately 35% of Belgium's total primary energy consumption. Belgium is consequently highly dependent on other countries to obtain its supplies. In 2020, 38.5% of Belgian energy production consisted of nuclear energy. The share of renewable fuels and waste amounts to 26.2%: during this decade, production has increased by 181% compared to 2011.

The dependency on fossil fuel imports to meet domestic demand is very high. In 2020, the ratio between net-imports and primary energy consumption stood at 78.1%.

Transport

Belgium is crisscrossed by an important network of waterways and a very dense communications network (roads and railways). Owing to Belgium's location as a transit country, transport is a growing sector. Road transport is the most energy-consuming means of transport in Belgium. The number of passenger cars is increasing continuously (the motorisation rate in Belgium is very high: one car for every two inhabitants). The majority of goods being relocated over land are still being transported using road transport. Demand for fossil fuels in the sector is expected to continue to rise.

Industry

Although the significance of the industrial sector (in particular heavy industry) within the economy has declined since the 1960s, it continues to be a relatively important component of Belgium's economic activity (almost 15% of GDP).

The main contributors towards greenhouse gas emissions are: energy combustion (mainly resulting from the production of electricity and heat, but also from oil refining), industrial processes (mainly within the chemical industry, mineral products industry and metallurgy) and energy transformation (iron and steel industry, chemical industry, food and beverage processing and cement plants).

Waste

Between 2004 and 2020, waste production increased by 28%. Significant improvements in waste treatment have helped bring about a sharp reduction in the amount of waste put into landfills.

Housing stock

Since 1995, the number of buildings has increased by 14.5%. Over the same period, the number of residences increased by 25.8%. Belgian housing stock is characterised by a high proportion of old buildings. Natural gas is the main heating source. The housing equipment rate of appliances using energy continues to rise.

Agriculture

The agriculture in Belgium specialises in market-garden and horticultural crops, cereals, potatoes, sugar beets, livestock and milk production. Although agricultural land occupies the greater part of the territory (44.5%), the number of farms has continued to decrease in recent years. The share of agriculture in the Belgian economy is continuing to decline and now accounts for less than 1% of GDP. Despite a high population density, forests and other natural areas remain relatively stable (23.9% of the territory).

Greenhouse gas inventory information

In Belgium, emissions of all gases have decreased by 26.9 % compared to 1990 and 27.8% using 1995 as the base year for the fluorinated gases (excluding 'land use, land use-change and forestry' - LULUCF) (see Figure 3.1). The largest contribution to total emissions is CO_2, which accounted for 84.9% in 2020. Emissions of CH_4 account for the next largest share, at 6.7%, and emissions of N_2O make up a further 5.1%.

In 2020, the energy sector contributed 72% to the total emissions (excluding LULUCF) (see Figure 3.3). Since 1990, these emissions have decreased by about 26%. Energy industries and manufacturing industries are both responsible for almost 79% of this decrease.

A switch from solid fuel to gaseous fuels can be observed in the electricity production sector and industry. This, together with the development of biomass fuels in some sectors, has resulted in a lower CO_2 emission factor for a given level of energy consumption. A more rational use of energy is also developing but it often is accompanied by an increase in the use of electricity, so its impact on actual emissions is generally harder to quantify. Finally, the closure of certain iron and steel works over the past few years has also led to a reduction in emissions.

Compared to recent years (with similar degree days values), emissions from the residential and tertiary sectors decreased in 2020 although a number of indicators are rising such as the increase in residences and a greater number of employees in the tertiary and institutional sectors. This is due to a switch of fuels, better insulation and milder years. However, the trend for the tertiary sector since 1990 continues to be a net increase in emissions, due to the development of activity in this sector.

Emissions caused by road transport have been increasing continually since 1990 on account of the increasing number of cars and of traffic that has become more intense. Traffic growth, however, has slowed significantly in recent years and emissions have stabilised since 2008 (maximum at 27 Mt CO_2 eq.). Of course, emissions in 2020 show a sharp decrease due to the COVID-19 crisis and its consequences on mobility.

Industrial processes and product use make up the second-largest source of greenhouse gases in Belgium, amounting to 18% of the national total in 2020. Emissions of all seven direct greenhouse gases have declined by 28% since 1990. All the sectors are involved but the metal industry has experienced the most significant decrease.

Agriculture represents 9% of the total emissions, mainly of CH_4 and N_2O. Some CO_2 emissions are caused by liming and urea consumption. Since 1990, emissions from this sector have decreased by 19%, due to a decline in emissions from enteric fermentation (this is connected with lower livestock numbers but also with the shift from dairy cattle to brood cattle) and from agricultural soils (reduced use of synthetic fertiliser and livestock reduction leading to less nitrogen being excreted on pasture).

Land Use, Land-use Change and Forestry contain sinks as well as sources of CO_2 emissions. LULUCF is a net sink in 2020 as it is for the complete time series but in constant decline since 1990. Emissions from this sector occur for CO_2, CH_4 and N_2O.

In 2020, the waste sector contributed around 1.1% to the national total. Emissions originated from waste incineration, solid waste disposal on land and wastewater handling. Emissions from this sector have steadily declined and were 72 % below 1990 levels in 2020, mainly due to the recovery and use of biogas from solid waste disposals.

Policies and measures

Within Belgium's federal system, responsibilities and policy-making powers are shared between the Federal State and the three Regions (the Walloon, Flemish and Brussels-Capital Regions). Climate change policies are therefore designed and implemented by the federal and regional governments, which have set up their own priorities and objectives within the scope of their powers.

Regions have major responsibilities in areas such as the rational use of energy, the promotion of renewable energy sources, public transport, transport infrastructure, urban and rural planning, agriculture and waste management. In the context of the 6th Belgian state reform, they have also obtained new fiscal responsibilities.

The Federal state is responsible for large parts of taxation policy. It is also responsible for product policies (standards, fuel quality, labelling and performance standards for household or industrial electrical goods…). It is responsible for ensuring the security of the country's energy supply and for nuclear energy. It also supervises Belgium's territorial waters, which implies that it is also responsible for the development of offshore wind farms.

Several instruments (strategies, plans) have been put in place to supervise Belgium's commitments in the medium term (2030) and long term (2050), with a view to achieving the European objective of climate neutrality.

The National Energy and Climate Plan 2021-2030, adopted in 2019, compiles the policies and measures elaborated by each of the 4 decision-making entities. This is the most detailed steering instrument available to carry out national climate policy. It will soon be revised to take into account the enhancement of European ambition.

Projections and the total effect of policies and measures

The projections described in the 8th National Communication are based on the 2021 Belgian submission to the European Commission in compliance with Article 18 of Regulation (EU) 2018/1999. All implemented and adopted (EU, federal, regional) policies and measures, considered until the end of 2019, have been taken into account in the 'with existing measures' (WEM) scenario. Planned policies and measures or targets have been integrated in a scenario with additional measures (WAM). Since Belgium's last biennial report and national communication, there have been some changes in the modelling tools used by the Walloon Region since the last reporting of the national communication and biennial report, due to the development and the first exploitation of "TIMES-Wal", which replaces EPM model. In addition, the input data for the other models was also updated.

Except for electricity production and bunker fuels, the reported projections are the sum of the projections of the three regions (Flanders, Wallonia, Brussels-Capital) which are calibrated on the regional energy balances. The regional approach starts from the demand side of the different sectors (industry, domestic, tertiary, transport, …) and results in sectoral energy projections. Within this approach, relations between energy consumption, activity levels and energy prices are assessed on a sectoral level. The electricity production and the bunker fuel emissions are modelled on a national level.

Sensitivity analyses have been performed in the case of some important parameters such as the number of degree-days and the importation of electricity.

The projection results presented in this report have been compared with the previous reports (7th national Communication and 4th Biennial Report). The main differences can be explained by the different sectoral assumptions, resulting in a more ambitious WAM scenario in this report.

There was a clear decrease between 1996 and 2019 in the total greenhouse gas emissions in the inventory (Figure 5.3) and in 2020, the inventory shows a sharp decline due to the impact of the COVID-19 crisis. However, the total emissions in the WEM scenario show a clear increase in the period 2021-2030, followed by a slight decrease in the period 2030-2040. The total emissions in the WAM scenario show a steady decrease in the period 2021-2040. These projections do not include emissions or removals from LULUCF.

Uncertainties concerning exogenous variables such as economic growth, climate conditions and electricity imports exist and their level will have an impact upon the resulting greenhouse gas emissions, notably in the sectors covered by the EU ETS.

The EU Effort Sharing Regulation, establishing binding annual greenhouse gas emission reductions by EU Member States from 2021 to 2030, mentions a target of -35% in 2030 compared to 2005 for Belgium. With the WEM scenario, the emission targets will be exceeded in all years of the period 2021-2030. In the WAM scenario, the non-ETS objectives will not be exceeded in any year. However, as the projections (AR4) and the non-ETS targets (AR5) are based on different GWP values, it should be noted that both datasets are not yet fully comparable.

Vulnerability assessment, climate change impacts and adaptation measures

In 2019-2020, Belgium reinforced its efforts to achieve a climate-resilient society and environment. During the past few years, Belgium has been confronted with the effects of climate change, namely some severe periods of drought, fluvial and pluvial flooding and prolonged heat waves, which has led to an increased sense of urgency to take action on climate change adaptation.

The federal level and the three Regions continued implementing the measures in their adaptation plan, complemented by the National Adaptation Plan which aims to strengthen the cooperation and develop synergies between the different entities with regard to adaptation. Efforts were made by the regions to support local governments in the development and implementation of their adaptation plans.

As gaps in the available data and assessments were detected and new insights led to new research questions, new research programmes were launched to improve the understanding of the effects of climate change and adaptation. The studies "Evaluation of the socio-economic impact of climate change in Belgium" and "Taking into account the impact of climate change and adaptation needs in the framework of the future National Environment and Health Action Plan (NEHAP)" have been published in connection with the implementation of the National Adaptation Plan.

Adaptation measures are already being implemented and mainstreaming is ongoing, that is in spatial planning, water management (drought and floods), coastal area (coastal safety master plan and long-term coastal vision), biodiversity (green-blue networks, calls, tools), agriculture (research, projects), forestry (resilient forests, observatories, expansion of forests), urban environment, transport, health,… Informing and raising awareness amongst Belgium's population continues to be an important aspect.

Further progress has been made in connection with the governance that takes place between the regional and local level: by providing funds and tools and facilitating the exchange of knowledge and good practices, regional governments encourage and support the cities and municipalities to sign the Covenant of Mayors, to develop local adaptation plans and to take action on climate change adaptation.

In the context of development cooperation, adaptation to climate change is one of the main focuses in the implementation of programmes and projects (climate-related factors to be taken into account during design and follow-up, climate actions and policy coherence) as well as in finance (Least Developed Countries Fund, Adaptation Fund, Global Environment Facility, Green Climate Fund and Flemish Climate Fund).

Financial resources and technology transfer

In 2019-2020, Belgium provided EUR 208 million of public support to developing country Parties (see CTF tables). This financial, technological and capacity-building support to non-Annex I Parties mainly focused on:

- Adaptation and cross-cutting activities as the predominant focus;
- Providing of bilateral and multilateral support under the form of grants;
- Contributions mainly directed towards Africa and Least Developed Countries (LDCs);
- Contributions to climate-specific multilateral funds (Green Climate Fund, Adaptation Fund, Least Developed Countries Fund, etc.) or specialised UN agencies;
- Contributions to bilateral projects mainly directed towards African partner countries and Least Developed Countries.

In parallel with its long-standing provision of public climate finance to developing countries, Belgium also supports the efforts of developing countries to implement low-emission, climate-resilient projects and programmes (i) by providing significant core funding to multilateral organisations and (ii) by mobilizing, through public means, private investments for climate-related projects in developing countries.

Research

The financial resources allocated to climate research in Belgium have increased considerably since 2017; Belgian research has been better and better embedded in international research initiatives; the number of publications has increased and more and more climate-related data have been produced and processed and are accessible today for further research or policy developments.

If basic research aiming at reducing uncertainties on climate evolution and involving academical scientists is still strongly supported in Belgium, an increase can be observed in the support provided for the development of solution-oriented research or policy-driven research conducted by scientific experts and policy experts.

Belgian research is addressing the whole spectrum of climate-related issues and encompasses all temporal and spatial scales.

Belgium is making an active contribution to plans, programmes and support for ground and space-based climate observing systems that form a key mission of several Federal Scientific Institutions.

Climate observation facilities are also being rolled out by coordinated networks of universities and research centres. These mainly perform measurements linked to the composition of the atmosphere, greenhouse gases and proxies.

Public awareness, education and training

This chapter is a non-exhaustive inventory of initiatives undertaken by (regional or federal) authorities, institutions (e.g. universities) and non-governmental organisations that successfully reached a rather large audience. In order to avoid a multitude of small-scale initiatives, actions undertaken by local communities, companies or private persons have not been added.

A short introduction to the enquiries into the degree of awareness among the general public is followed by a short description of 22 awareness-raising initiatives dealing solely with climate change, or with closely related themes such as energy saving, buildings, mobility and the environment in general. This classification may seem somewhat artificial, as climate change is a transversal issue, leading to overlaps between themes or activities.

The Education and training section describes 24 activities, split into three categories: educational projects (mainly aimed at primary and secondary schools), higher education, and international cooperation and education in southern countries.

Finally, 65 useful sources on the internet are listed and shortly described. ■

2. National circumstances relevant to greenhouse gas emissions and removals

A brief overview of Belgium

Population (on 1 January 2021)	11 521 238 inhabitants
Surface area	30 689 km²
Capital	Brussels
Head of State	HM King Philippe
Prime Minister	Mr Alexander De Croo
National languages	Dutch, French and German
Currency	Euro
GDP 2020 (current prices)	456.893 billion EUR
GDP growth rate 2020 (volume, variation from previous year)	-5.7%
Inactive population (2020) [1]	1 737 681
Agriculture (Gross added value by sector at current prices, 2020)	2 916 million EUR
Industry (Gross added value by sector at current prices, 2020)	67 409 million EUR
Construction (Gross added value by sector at current prices, 2020)	21 567 million EUR
Services (Gross added value by sector at current prices, 2020)	317 913 million EUR
Population density (on 1 January 2021)	375 inhabitants per km²
Highest point	Signal de Botrange (694 m)
Average temperature (Uccle, 2020) [3]	12.2° Celsius
Precipitation (Uccle, 2020)	732 mm
Hours of sunshine (Uccle, 2020)	1 838 hours

2.1 Institutional structure

2.1.1 Federal structure of the state

After becoming independent in 1830, Belgium gradually moved from a unitary to a federal structure. Today, Belgium is a federal state composed of three communities and three regions.

The three communities are the Flemish Community, the French Community and the German-speaking Community. The three regions are the Flemish Region, the Brussels-Capital Region and the Walloon Region. The communities and regions partially overlap. The French Community exercises its authority in the Walloon Region with the exception of German-speaking municipalities and in Brussels; the Flemish Community exercises its authority in the Flemish Region and in Brussels; the German-speaking Community exercises its authority in the German-speaking municipalities of the Walloon Region (Figure 2.1).

Each of the communities and regions has its own legislative and executive bodies. In Flanders, the community and regional institutions have merged, so that there is only one Flemish Parliament and one Flemish government (Figure 2.1).

The Federal state, Communities and Regions all enjoy equal legal status. They intervene on an equal footing but in different areas.

2.1.2 Division of powers

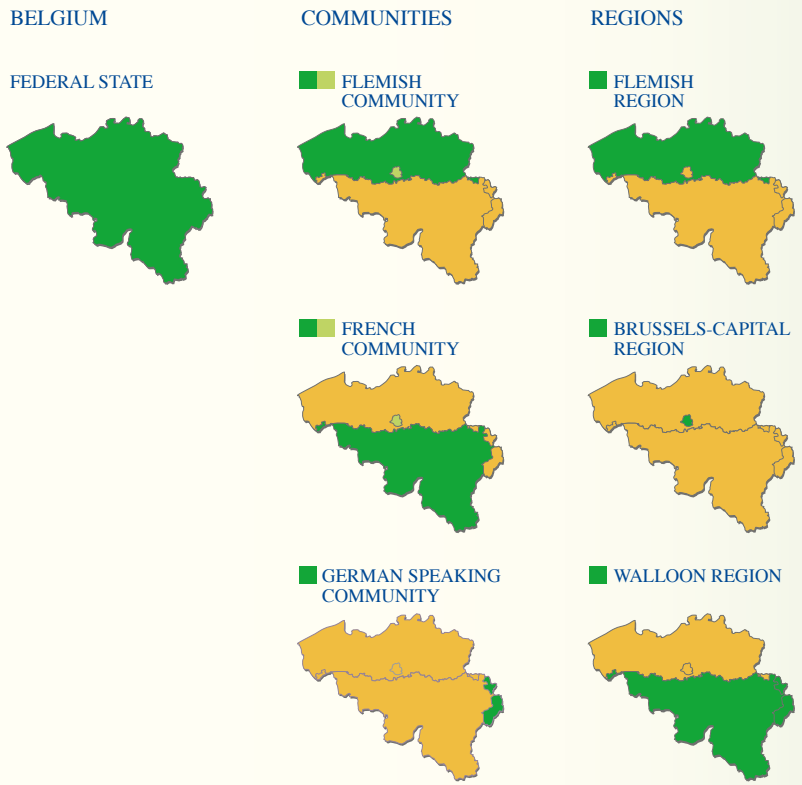
The Federal State is responsible for key policies such as foreign affairs (incl. development cooperation), defence, justice, finance, social security and a considerable part of public health matters and internal affairs. It also exercises competences in the following areas (which are 'mixed competences', being exercised both at federal and regional or community level): economy, transport, environment, energy, research, cities.

The powers of the communities concern matters relating to 'individuals': culture (theatre, libraries, audio-visual, etc.), education, use of languages and matters that can be 'personalised', including some aspects of health policy (preventive and curative medicine) and assistance to individuals (youth protection, social assistance, family assistance, reception of immigrants, etc.). Communities are also responsible for scientific research and international relations in the areas under their authority.

Regions have powers in 'territory-related' areas, in a broad sense. They are responsible for the economy, employment, agriculture, water policy, housing, public works, energy, transport (with the exception of the national railway, SNCB/NMBS and Infrabel), environment, town and country planning, rural revitalisation, nature conservation, credit, foreign trade, and provincial, municipal and intermunicipal administration. They are responsible for scientific research and foreign relations in the above-mentioned areas.

In the context of the sixth institutional reform, which entered into force in July 2014, new transfers of competence have taken place, leading to increased autonomy for the federated entities. They ac-

Figure 2.1 Belgium, a federal state



Source: FPS Chancellery of the Prime Minister

quired greater competences in the context of family allowances, employment policy, healthcare or caring for older people. Within this reform, large parts of fiscal matters were transferred from the federal authority to the Regions, which are notably now responsible for taxes on cars and transport and tax exemptions for rational use of energy (RUE) investments.

2.1.3 Coordination structures relating to climate policy

Given Belgium's federal structure and the division of powers, several structures have been created to promote consultation and cooperation between the different levels of power and to ensure consistency in the actions of the federal state and its entities. The central coordination body with regard to national climate policy is the National Climate Commission, which was established by the cooperation agreement of 14 November 2002. Energy policy is coordinated via a body known as ENOVER/CONCERE. These two structures are jointly in charge of the establishment and follow-up of the National Energy and Climate Plan and the execution of international and European reporting obligations. For more detailed information about these bodies and other institutional arrangements with regard to climate policy, please see chapter 2.1 of Belgium's 6th national communication and chapter 4.1.1.

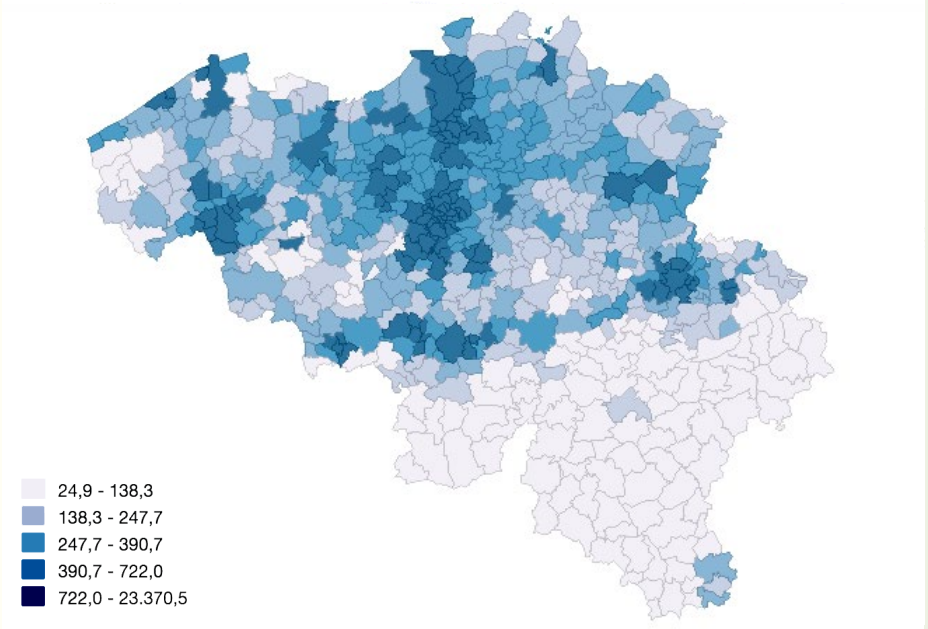
2.2 Population profile [1]

On 1 January 2021, the population of Belgium numbered 11 521 238 inhabitants. This represents 2.6% of the total population of the European Union (EU-27). (Belgium is the 8th most populated Member State of the European Union). Belgium is very densely populated. With an average density of 375 inhabitants/km² (2021), it is the third most densely populated country in Europe. However, that density varies from one part of the country to another, the north of the country being much more densely populated than the south. Currently, the Flemish Region makes up 57.7% of the population, the Walloon Region 31.7% and the Brussels-Capital Region 10.6%.

In 2020, the population of Belgium grew by 28 597 inhabitants, or 0.25%. This is half of what it was in previous years, when the growth rate was around 0.5%. Due to the COVID-19 pandemic, the natural balance – the difference between births and deaths – in Belgium was in negative figures for the first time since the 1940s (an increase in the number of deaths by 16.6% compared to 2019 and at the same time, a decrease in births by 2.9%). Net international migration was positive (+41 756), as in previous years. In 2020, there were therefore more immigrants than emigrants.

The declining birth rate, a marked improvement in medical care and a more selective immigration policy have gradually led to a reduction in natural growth and to the ageing of the population.

Figure 2.2 Population density by municipality on 1 January 2021



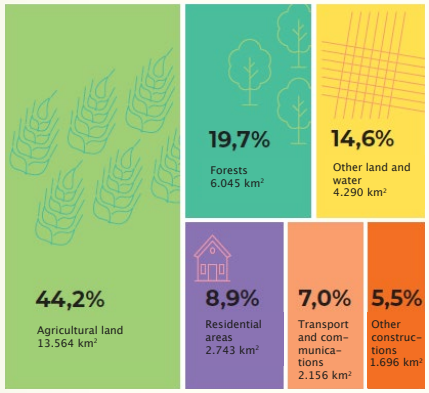
Source: FPS Economy – FPS Economy - Directorate-General Statistics and Economic Information [1]

Belgium GHG intensity in 2020 (9.5 tonnes CO_2-eq/capita – Total net emissions with international aviation (EU NDC); 10.5 tonnes CO_2-eq/capita in 2019) was significantly lower than in 1990 (14.6 tonnes CO_2-eq/capita in 1990). It remains higher than the CO_2 intensity in the EU-27, which decreased from 13.1 to 7.9 tonnes/capita between 1990 and 2020 (8.9 tonnes CO_2-eq/capita in 2019).

2.3 Geographical profile

This chapter provides general information concerning Belgium's geographical profile. For more information, please see chapter 2.3 of Belgium's 6th national communication.

Figure 2.3 Land use in Belgium in 2021 (%)



Source: FPS Economy – FPS Economy - Directorate-General Statistics and Economic Information [1]

2.3.1 Geographical situation and relief

Belgium is a small country (surface area of 30 689 km²) in north-western Europe and covers 3 454 km² of the North Sea. It has 1 482 km of borders with the Netherlands, Germany, Luxembourg, France and the North Sea (its coastline is 73.1 km long). The Walloon Region occupies the biggest part of the territory (55.1%), followed by the Flemish Region (44.4%) and the Brussels-Capital Region (0.5%). Belgium has three zones of elevation, oriented east-west and south-west: the coastal plain, the central plateau and the uplands. The highest points of the uplands constitute a ridge peaking at 694 metres at the 'Signal de Botrange'.

2.3.2 Ecosystems

Despite the small size of the country and its slight topographical gradient, the climate and geological conditions, together with long-standing human impact in land use, resulted in a diversity of habitats for such a small territory. The diversity of life forms in Belgium is estimated to comprise up to 55 000 species. The main vegetation types found in Belgium are deciduous and conifer forests, grasslands, heathlands, peat bogs, wetlands, lakes and rivers, and marine ecosystems in the North Sea. The distribution of these varies from region to region. For example, about 80% of the forested areas are found in the southern part of the country, while northern Belgium is noted for its semi-natural grasslands, wetlands, heathlands and coastal dunes. Recent observation data shows that many species are in decline or have even disappeared [2].

2.3.3 Land use

Agricultural land occupies the main part of the terrestrial surface (44%), followed by forests (20%). Built-up areas cover 9% of the territory while transport and telecommunications use 7% of the land (Figure 2.3). Built-up areas are increasing every year, mainly at the expense of agricultural land. Forests and other wooded areas remain relatively stable.

2.3.4 Climate profile

Our country is located in the middle latitudes of the northern hemisphere, on the western edge of the European continent. The seasonal cycle of insolation and the atmospheric dynamics of the mid-latitudes, as well as the proximity of the Atlantic Ocean, explain the main features of the climate in our regions. Our 'temperate' climate is normally characterised by relatively cool, wet summers and relatively mild, rainy winters.

Its latitude and the proximity of the sea warmed by the Gulf Stream give Belgium a temperate maritime climate characterised by moderate temperatures, prevailing southerly to westerly winds, abundant cloud cover and frequent precipitation. Summers are relatively cool and humid and winters relatively mild and rainy.

The monthly, seasonal and annual normals can be compared for the four different 30-year periods: 1961-1990, 1971-2000, 1981-2010 and 1991-2020. When comparing the average weather for the period 1991-2020 with the average weather for the period 1961-1990, it can be seen that the Belgian climate is changing (Figure 2.4).

Box 2.1 gives a summary of the main climatological trends and changes observed in Uccle and in Belgium.

Box 2.1 Climate trend observed

in Uccle

TEMPERATURE

- A warming of 2.1°C is observed as an annual average between the middle of the 19th century and the last three decades.
- The 6 warmest years occurred after 2005.
- Since 1981: significant annual warming of +0.38°C on average per decade.
- Most significant warming (+0.45°C per decade) in winter.
- Highest summer temperature trend upwards (+0.8°C per decade).
- A new all-time high of 39.7°C was set on 25 July 2019.
- The annual number of high night-time temperatures (at least 15°C) is also increasing (+3.9 days per decade since 1981).

HEAT WAVES

- More frequent since 1981 (+0.3 heat waves per decade).
- More frequent in recent years, with at least one heat wave per year since 2015.
- Tendency to be longer (+2 days per decade) and more intense (+1°C/day per decade).

PRECIPITATION

- A 9% increase in cumulative annual rainfall between the mid-19th century and the last three decades. Since 1981, there has been a slight upward trend, but it is not significant.
- In spring, a decrease since 1981 (-9 mm per decade). This trend is explained by relatively wet springs during the 1980s, and then by mostly dry, and sometimes dry, and sometimes very dry springs since the 1990s.
- In summer and annually, the frequency of heavy daily rainfall (at least 20 mm)) has increased since 1981 (+0.6 days and +0.5 days per decade respectively).
- The highest annual hourly precipitation amounts have increased since 1981 (+3 mm per decade).

SNOW

- Since the beginning of the 21st century: great variability from year to year, with the last six years being relatively snow-free.

DRYNESS

- The duration of spring droughts has been increasing since 1981 (+1.5 days per decade).
- Combining the increase in the duration of spring droughts with the observed decrease in cumulative rainfall during the same season, it can be concluded that the intensity of spring droughts must also have tended to increase since the warming observed in our country towards the end of the 1980s.

WIND

- Annual decrease of the average wind speed of -0.1 m/s per decade since 1981.

SUNSHINE

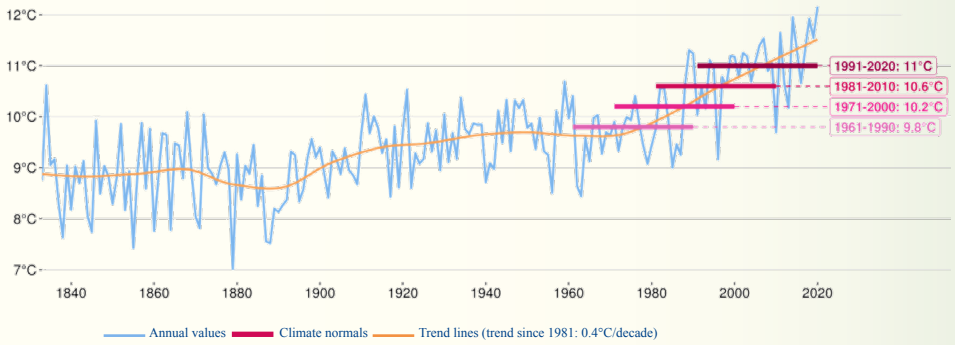
- Since 1981: trend towards an increase in annual sunshine duration (+58 hours per decade), spring (+35 hours per decade) and summer (+20 hours per decade).
- Since 1981: trend towards an increase in global solar radiation measured at the surface (+42 $kWhm^{-2}$ per decade). The improvement of the air quality in our regions, thanks to efforts to reduce the emission of pollutants, seems to be at least partly responsible for the increase in solar energy reaching the surface.

Source: Royal Meteorological Institute of Belgium

in Belgium

	**TEMPERATURE** – Since 1890: average annual increase of +1.9°C. – Since 1954: annual warming of between +0.27°C and +0.33°C per decade for the average temperature, depending on the region.
	**PRECIPITATION** – Since 1890: average increase in precipitation of around 15%.
	**SNOW** – Snowfall in the Ardennes has remained relatively low and stable since the 1990s, although from the mid-2000s onwards it seems to be showing a slight recovery.
	**WIND** – The average wind speed has tended to decrease over the last few decades and in particular since the beginning of the 21st century. – The intensity of storms, as well as their frequency, has not increased over the last three decades, but rather has tended to decrease.

Figure 2.4 Trend in average temperature (Uccle, 1833-2020)



Source: based on data from the Royal Meteorological Institute of Belgium

Focus on 2020: an exceptional year not only because of the COVID-19 crisis.

In 2020, the average temperature in Uccle was 12.2°C (normal: 10.6°C). This is a new absolute record since 1833 and for the first time the average annual temperature exceeds 12°C. The previous record (11.9°C) was set in 2018 and 2014.

The annual maximum temperature also reached a new all-time high: 16.1°C (normal: 14.2°C). The previous record was only set in 2018 (16.0°C). The annual average minimum temperature was 8.1°C, second only to the absolute record of 2014 (8.5°C). [3].

From 5 to 16 August, an intense heat wave was recorded. 8 August was the hottest day in Uccle, with a maximum of 35.9°C, the highest temperature ever measured at this station in August.

In Uccle, a total of 731.9 mm of rain fell (normal: 852.4 mm). This total amount fell in 169 days (normal: 198.7 days).

Although no monthly records were broken, the duration of sunshine was above normal values in most months. The first part of the year was particularly sunny. In spring, the duration of sunshine reached up to 740h 46 min in Uccle (normal: 463h 58 min); this is a new absolute record (measured since 1887). The previous record dates back only to 2011 (707h 16 min). Finally, the total sunshine duration over the year is 1838h 40min (normal: 1544h 35 min), which is the fourth sunniest year since 1981.

Other records were equalled or broken in 2020, but are not listed here.

The year 2021, on the other hand, had a slightly lower average temperature than normal (10.7°C compared to 11.0°C) and a normal duration of insolation and was very wet (7th since 1833).

For more information on observed past climate trends (heat waves, precipitation, evaporation, extreme events, etc.), please see chapter 6.

2.4 Economic profile

Belgium's GDP amounted to EUR 456.893 billion in 2020. Although the population of Belgium only represents about 2.6% of the total European population, its GDP at market prices represents 3.4% of the GDP of the European Union [1].

Services currently make up close to 70% of the added value of the different branches of economic activity (trade, transport and the hotel, restaurant and catering sector represent the largest share in 2020 with 22.8% of total production, followed on an equal footing by public administration and education and business services, each with 19.8%) [1].

Belgium has a very open economy, situated at the heart of a zone of intense economic activity. In addition, the port of Antwerp ranks second in Europe (after Rotterdam) and is one of the world's top 10. Export of goods and services represented 80.0% of the GDP in 2020 and imports nearly 78.6%, meaning that the country recorded a slight profit. This trade occurs in large part with the European market. About 43% of Belgium's exports are sold to Germany, France and the Netherlands and about one fifth to other EU Member States. Imports follow more or less the same proportions. This situation reflects Belgium's role as the hub of the European Union. [4]

Belgium also benefits from the presence of the EU institutions in its capital, along with a high concentration of international agencies and service companies. Other international organisations, such as NATO, are also headquartered in Belgium.

Greenhouse gas emissions per GDP were 261 tonnes CO_2-eq. per million euros at 2015 prices in 2019 (total UNFCCC excl. LULUCF) and 261 in 2020 (Data europa.eu).

2.5 Energy profile

2.5.1 Demand

2.5.1.1. Primary energy consumption [5]

The total primary energy consumption in 2020 amounted to 51.4 Mtoe.

This is a decrease of 8.3% compared to 2019. This level of primary energy consumption, the lowest since the early 1990s, is mainly the result of the coronavirus crisis. This caused a significant drop in the consumption of mainly petroleum products. Planned maintenance work in a blast furnace led to a decrease in the consumption of solid fossil fuels. In 2020, the consumption of nuclear energy fell slightly again. The share of renewables and waste has increased to 10.8% of primary energy consumption in 2020, up from 6.6% in 2011. Negative net electricity imports, recorded since 2019, cause the energy source "Other" to decrease compared to previous years, when net imports were positive (see Table 2.1).

Energy intensity (the ratio of primary energy consumption to GDP expressed in volume) measures the quantity of energy consumed by the economy to generate one production unit. It has been following a downward trend since 1990.

The primary energy intensity in Belgium is continuously higher than the European average. This can be explained by the presence of energy-intensive industries (oil refineries, cokes plants, concrete mixing plants).

2.5.1.2. Final energy consumption [5]

Final energy consumption, i.e. gross apparent energy consumption after deduction of processing activities and energy loss, amounted to 38.1 Mtoe in 2020.

Between 2011 and 2020, final energy consumption varied between 38.1 and 41.6 Mtoe. This is highly dependent on weather conditions. In years with colder winters, such as 2013, final fuel consumption for heating is higher. This impact is mainly observable in the consumption of natural gas. The strong decrease in 2020 is primarily due to a mild winter, but also to the measures taken to combat the coronavirus and their effect on energy use for transport, among others. As in the case of primary energy consumption, oil products were the most severely affected by the fall in final energy consumption [1].

In terms of market shares of total final consumption, oil products remain the dominant energy source, followed by natural gas and electricity (see Table 2.2).

Table 2.1 Primary energy consumption in Belgium in 2020 per energy source

Energy source	Mtoe	TJ	%
Oil and oil products	19.7	823 580	38.2
Natural gas	15.2	635 507	29.55
Solid fossil fuels	2.4	98 474	4.6
Nuclear energy	8.4	350 393	16.3
Renewable energy and waste	5.6	233 413	10.8
Other*	0.3	12 281	0.6
Total	**51.4**	**2 153 648**	

* "Other" includes net imports of electricity and heat as well as chemical process heat recovery.

Source: FPS Economy [5]

Table 2.2 Final energy consumption in Belgium in 2020 per energy source

Energy source	Mtoe	TJ	%
Oil products	17.6	736 732	46.1
Natural gas	10.2	428 391	26.8
Solid fossil fuels	0.8	31 746	2.0
Electricity	6.8	284 746	17.8
Heat	0.5	19 742	1.2
Renewable energy and waste	2.3	95 624	6.0
Total	**38.1**	**1 596 982**	

Source: FPS Economy [5]

The shares of the various energy sources in final energy consumption have remained relatively stable in recent years: the average share of oil products over the last decade is about 49%, natural gas 25%, electricity 18%, renewable energy and waste 5%, solid fossil fuels 2% and heat 1%.

Since 2011, the share of renewable energy and waste in final energy consumption has increased from 4.4% to 6.0%. This share does not include final consumption of green electricity.

Although the measures taken in the context of the fight against the coronavirus have had a particularly significant influence on the consumption of petroleum products, the share of these products within the country's total final consumption remains predominant (46.1% in 2020). The final consumption of petroleum products is divided up between energy uses (67.5%) and non-energy uses (32.5%). The transport sector accounts for 57.7% of their final energy consumption in 2020, which is about 5 percentage points less than in previous years. This highlights the very heavy impact that the measures to combat the coronavirus had on this sector.

Natural gas accounts for 26.8% of the country's final energy consumption in 2020. 89.8% of this gas is used for energy purposes, of which 33.8% is used in the residential sector. [5]

2.5.2 Supply [5]

2.5.2.1. Primary energy production

The production of primary energy from renewable energies and fuels has risen sharply from 2.5 Mtoe in 2011 (16.7% share) to 4.0 Mtoe in 2020 (29.9% share). This increase is mainly due to new installations of wind farms and solar panels. Between 2019 and 2020, wind generation increased by 30.9% and solar generation by 20.1%. Nuclear power generation decreased by 21.0% compared to 2019, due to a combination of scheduled maintenance at nuclear facilities and technical problems. [5]

2.5.2.2. Gross electricity production

In 2020, gross electricity production was 4.5% below its 2019 level, mainly due to a decrease in production from nuclear facilities (-20.9 % or -9.1 TWh). However, 2020 remains the third highest year of the last decade in terms of gross electricity production. During this decade, the most remarkable increase can be observed in renewable energy, where production rose by 180.9 % or 15.1 TWh compared to 2011. It can also be deduced that the use of oil products and solid fossil fuels has decreased significantly (-58.7% and -65.5% respectively over the past decade), mainly in favour of renewables. The last power plant using solid fossil fuels closed in

Table 2.3 Primary energy production in Belgium in 2020 per energy source

Energy source	Mtoe	TJ	%
Nuclear energy	8.4	350 393	62.8
Non-renewable waste	0.6	27 049	4.8
Renewable energy and fuels*	4.0	167 105	29.9
Other**	0.3	13 670	2.4
Total	**13.3**	**558 216**	

* "Renewable energy and fuels" includes hydro, excluding pumped storage, wind, solar, geothermal, solid and liquid biomass, biogas, renewable waste and ambient heat used by heat pumps.

** "Other" includes chemical process heat recovery and firedamp (coal mine gas).

Source: FPS Economy [5]

Table 2.4 Primary energy production in Belgium in 2020 per energy source

Energy source	TWh	%
Nuclear	34.4	38.5
Natural gas	26.8	30.0
Solid fossil fuels and steel gas	1.9	2.1
Oil products	0.1	0.1
Renewable energy	23.4	26.2
Other sources*	2.8	3.1
Total	**89.4**	

* "Other sources" includes pumped hydro, recovered heat, non-renewable waste and others.

Source: FPS Economy [5]

2016. The electricity still generated from this fuel group today comes from manufactured gases in the steel industry and small multi-fuel cogeneration plants. [5]

2.5.2.3. Gross electricity production from renewable energy sources

Renewable electricity production has increased significantly over the last decade. Solar-based electricity generation has seen marked growth for the third year in a row (+20.1%), after a few years of stagnation. Solid biomass production has recovered since the decline in 2014 and peaked in 2017 with 3.8 TWh. Between 2019 and 2020, wind generation increased by 30.9%. [5]

Wind power is the most important source of renewable electricity, partly due to offshore wind farms. These generated 7.0 TWh of electricity in 2020, equivalent to the consumption of about 1 990 000 households (assuming that an average household consumes 3 500 kWh of electricity per year). [5]

2.5.2.4. Production

The installed electricity capacity in Belgium increased from 20.7 GW in 2011 to 25.7 GW in 2020, an increase of 5.0 GW. Conventional thermal installations (non-nuclear thermal) have decreased by 2.2 GW, while renewable electricity generation capacity, mainly solar and wind, has increased considerably. The installed capacities of these two renewable energy sources represent 10.3 GW or 39.9% of the total installed electricity capacity.

As mentioned above, offshore wind power accounts for 54.6% of total wind generation, although it represents only 48.3% of installed wind capacity. Offshore wind farms therefore have a higher availability factor.

The first offshore wind energy zone in the Belgian part of the North Sea has been fully constructed. The latest wind farm in this area has been fully operational since December 2020. The total installed offshore capacity amounts to 2 261.8 MW.

A second offshore wind energy zone, the Princess Elisabeth zone, has already been defined. The first wind farm in this area is scheduled to come into operation in 2027-2028. A total installed capacity of between 3 150 and 3 500 MW is envisaged.

A closer look at the solar capacity shows that about 64.6% of it comes from small solar photovoltaic panels of less than 20 kW. This type of installation is mainly found in the residential sector, which demonstrates its importance.

The increase in total installed electricity capacity does not necessarily lead to an increase in electricity production, mainly due to the intermittency of solar and wind energy sources. [5]

The exploitation of Belgium's natural fossil energy resources is not sufficiently profitable. The last coal mine closed in 1992. Today, coal is only being recovered on a small scale from slag heaps. As a result, dependence on fossil fuel imports to meet domestic energy needs is very high. In 2020, energy dependence, which is the ratio of net imports to the sum of gross domestic consumption and international marine bunkers, stood at 78.1%. Diversification of importing countries and strategic stocks are the main ways to ensure security of supply. [5]

Table 2.5 Gross electricity generation from renewable energy sources

Electricity	TWh	%
Hydraulic	0.3	1.1
Solar	5.1	21.8
Wind	12.8	54.5
Renewable municipal waste	0.9	3.9
Solid biomass	3.3	14.2
Biogas	1.0	4.3
Liquid biomass	0.0	0.1
Total	**23.4**	

Source: FPS Economy [5]

2.5.3 Electricity and gas prices

An average Belgian household paid 5.0 eurocents/kWh for its natural gas in 2020, 13% less than in 2019. The price excluding taxes and levies, which includes energy, supply and network costs, represents 77.5% of the total price. The share of VAT and other taxes is 22.5%. The price decline that started slowly in 2019 accelerated in 2020, following, among other things, the decreases in wholesale prices caused by the coronavirus crisis. [5]

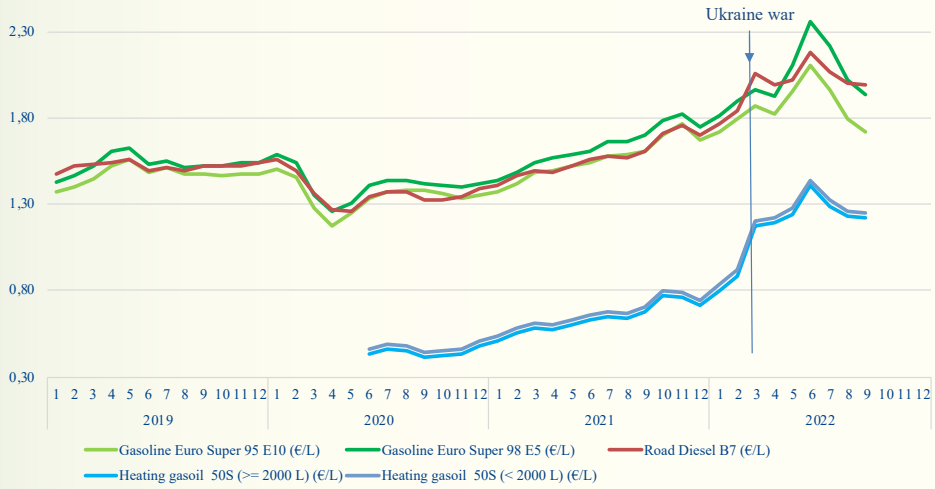
An average Belgian household paid 27.5 eurocents/kWh for its electricity in 2020, 3.6% less than in 2019. The cost of energy represented 28.6% of the total electricity bill in 2020. Network tariffs decreased slightly and accounted for 38.2%. The share of taxes reached 33.2% of the total bill. [5]

After a significant drop in average annual peak prices in 2020, petroleum product prices recovered during 2021 to their

pre-coronavirus level. Due in particular to a change in the tax policy applied to fuels, in 2018, for the first time, the average annual price of road diesel was higher than that of petrol. The significant decrease in 2020 is the result of the fall in prices on international markets due to the coronavirus crisis. [5]

The average official price of oil products per month (maximum price) has been rising steadily since April 2020 (see Figure 2.5). This is the result both of global demand following the recovery of the economy after the COVID-19 crisis and the war in Ukraine. The psychological threshold of EUR 2/L at the pump is almost reached: the increase since 2019 is around 33 %. For heating oil, the increase is over 60 %.

Figure 2.5 Average official oil price per month



Source: Statbel

2.5.4 Renewable energy

In 2020, the share of renewable energy in final energy consumption was 12.01 %. This is below the binding target of 13 % set in the Renewable Energy Directive 2009/28. In order to make up the shortfall, different amounts of energy from renewable sources were purchased from other Member States (Finland, Denmark and Lithuania). These purchases bring the share of renewable energy within final energy consumption to 13.00 %, thereby fulfilling the requirement of Directive 2009/28.

The current share is determined in accordance with the calculation rules imposed by the Renewable Energy Directive 2009/28. [5]

In 2020, the share of renewable energy in final energy consumption in transport amounted to 11.03 %, an increase of 4.2 percentage points compared to 2019. This increase is mainly due to the increase in the obligation to incorporate biofuels for 2020, as set out in the Royal Decree of 4 May 2018.

Renewable energy in transport comes mainly from biofuels blended into fuels (petrol and diesel). A limited share of renewable electricity is also used in transport (mainly rail). The target of 10 % by 2020 is imposed on all European Member States in the Renewable Energy Directive 2009/28. Belgium has also reached this binding target.

The determination of the current share is carried out in accordance with the calculation rules imposed by the Renewable Energy Directive 2009/28. [5]

2.6 Transport

2.6.1 General description

Belgium, which is densely populated and situated at the centre of Europe, is a major centre for transit. The country's economic activity, which is strongly export-oriented, requires a dense road and rail network (one of the densest in the European Union), and also relies on inland waterways. The expansion of the intra-European area has further increased transit traffic, resulting in constant growth of transport (particularly road and air).

The transport sector accounts for 57.7% of their final energy consumption in 2020, about 5 percentage points lower than in previous years. This highlights the very heavy impact of the coronavirus control measures on this sector. [5]

In 2020, consumption in this sector decreased by 15.8% compared to 2019. No other sector has experienced such a development. Consumption in the transport sector was dominated, as expected, by oil products (88.3%). [5]

2.6.2 Passenger transport

On 1 August 2022, there were 5 947 479 passenger cars in Belgium. The number of passenger cars has been increasing every year, except in 2020 due to the COVID-19 pandemic.

In 1991, Belgium had one car for every 2.51 inhabitants. In 2020 or in 2022, it is one car for every 1.95 inhabitants: so there are more and more vehicles on the roads. Since 1991, the car density - the number of private cars per 1 000 inhabitants - has increased by almost 29%. [1]

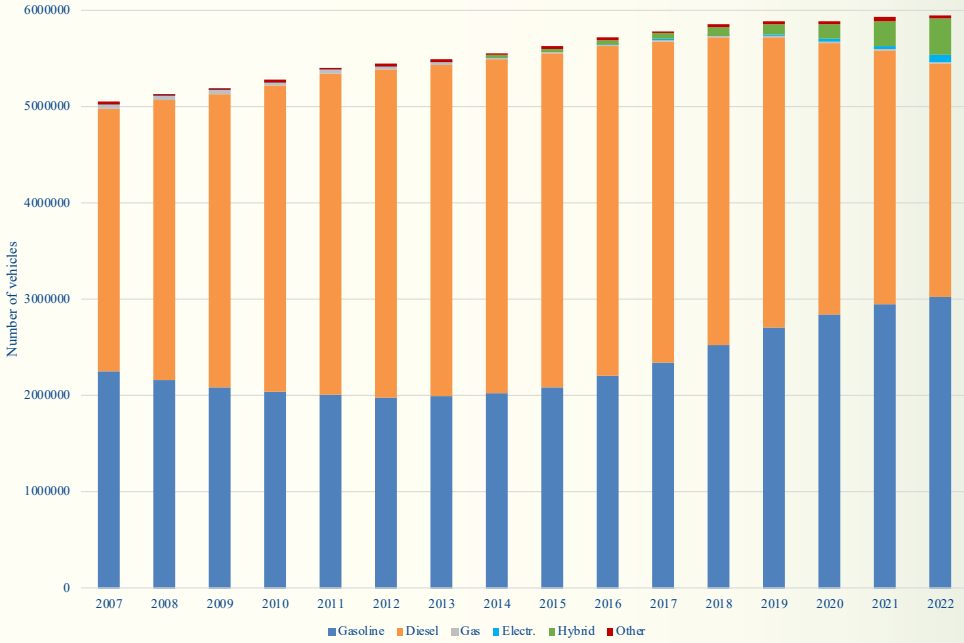
In 2020, the share of petrol passenger cars exceeded that of diesel vehicles.

The number of electric vehicles has particularly increased since 2019 although it still represents a small number of the total fleet. The proportion is even higher for hybrid vehicles.

In 2008, company cars represented 6.2% of the total fleet of personal cars (318 090 licence plates); in 2020, 9.6% (533 882 licence plates). [6]

In 2019, 80.4% of passenger transport in Belgium, measured in passenger-kilometres, was by car. To achieve the sustainable development goal by 2030, this figure should be reduced to 67.4% according to the sustainable development indicators of the Federal Planning Bureau. The Federal Planning Bureau's projections indicate that this objective will not be reached. Passenger transport by car is therefore developing unfavourably. [7]

Figure 2.6 Evolution in the total number of passenger cars registered in Belgium by fuel type (2007-2022)



Source: Statbel

The growing saturation of roads, moreover, is leading to an increase in fuel consumption (and therefore emissions).

In 2017, the average Belgian car driver spent 39 hours and 37 minutes in traffic jams. To achieve the sustainable development goal by 2030, this figure must decrease. Between 2014 and 2017, there is no clear trend. [7]

According to the Federal Planning bureau, the number of passenger kilometres will increase by 11% between 2012 and 2030 (+21.8% for cars, +9.1% for train, -26% for bus, +0.2% for trams, +16.7% for subway, +8.7% for walk/bike, +4% for motorcycles) [7].

Apart from motorised travel, there is increasing interest in micromobility. An online survey was therefore launched between 2 and 15 December 2019 [9]. The objectives of this questionnaire were to assess the following aspects: the use of these alternative modes, their advantages and disadvantages, safety aspects, and future potential. Due to the small sample size (2000 people), the interpretation of the results has to be cautious and only those for cycling could be analysed in more detail [10]. We learned that 41% of Belgians use a conventional bicycle for their trips (at least once a year) and 15.6% use an electrically assisted bicycle. In addition, more than 20% of respondents intend to buy an electrically assisted bicycle (EAB) (25 km/h or 45 km/h) and 7.8% an unassisted bicycle. It will be interesting to see in the future whether those intentions actually materialise.

2.6.3 Transport of goods

In 2020, just over 274 million tonnes of goods were transported by road by vehicles registered in Belgium (trucks and road tractors with a payload of at least one tonne). This is a decrease of 3.4% compared to 2019. [1]

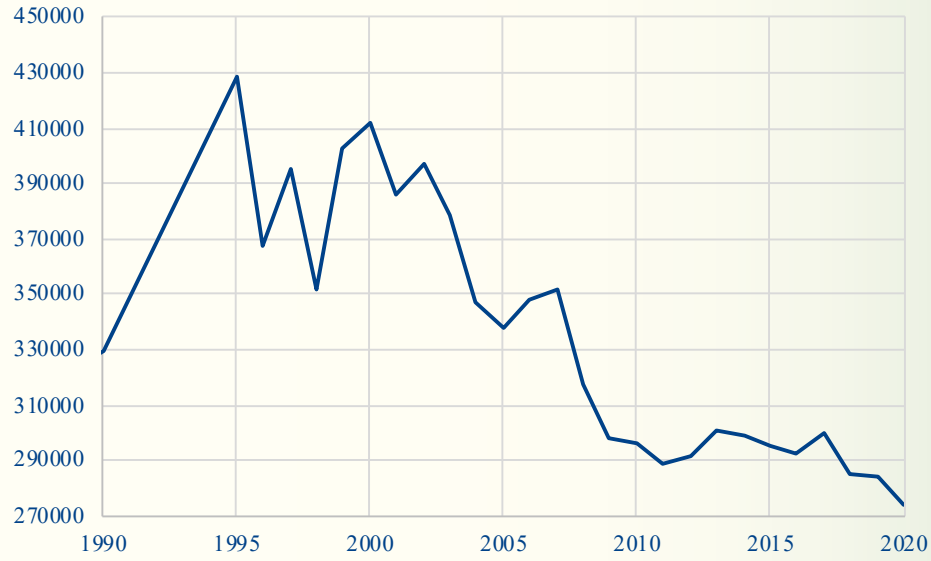
In 2019, the modal share of the road in freight transport, measured in tonne-kilometres, was 77.6% in Belgium. To achieve the sustainable development goal by 2030, this figure should be reduced to 63.7% according to the sustainable development indicators of the Federal Planning Bureau. The Federal Planning Bureau's projec-

Table 2.6 Evolution of motorised road mobility in 2017

	CARs	PUBLIC TRANSPORT (underground, tram, bus, coaches)	RAILWAY
RELATIVE SHARE of passenger transport (in passenger km) (%) in 2017	81.0%	11.2%	7.7%
in 2000	*77.7%*	*11.4%*	*5.8%*

Source: Federal planning bureau [8]

Figure 2.7 Evolution in freight transport by road in 1000 tons in the period 1990-2020



tions indicate that this objective will not be reached. The share of the road in freight transport is therefore developing unfavourably. [7]

In 2020, barges transported just over 156 million tonnes of goods on Belgium's waterways. This is about half a million tonnes more than in 2019. In 2019, the increase was still 3.8 million tonnes compared to 2018. Container transport by barge hovered around 21 million tonnes in 2020 and remained virtually stable compared to the previous year. [1]

Belgian ports clearly felt the impact of the COVID-19 crisis in 2020. The total quantity of goods landed fell by almost 10 million tonnes compared to 2019. The amount of cargo shipped remained almost the same. The number of seagoing vessels entering and leaving also fell sharply in 2020. Due to the pandemic, only 40 000 passengers were counted, whereas 2019 already showed historically low annual figures of 311 000 passengers. However, this does not include passengers from cruise ships calling at Belgian ports. [1]

2.7 Industrial sector

Although Belgium's economy has become mainly based on service sectors, its industrial sector continues to be a relatively important component of Belgium's economic activity (almost 15% of GDP). [1] Table 2.7 shows the progression of added value in the main branches of economic activity since 2015.

The sectors of industry that contribute most to greenhouse gas emissions are subdivided into three categories, according to the source of emissions:

- greenhouse gas emissions from energy combustion, mainly through the production of electricity and heat, but also from oil refining
- greenhouse gas emissions from industrial processes, mainly from the chemical industry (petrochemicals, but also production of nitric acid and ammonia), mineral products industry (including cement and lime production) and metallurgy.
- greenhouse gas emissions from energy transformation of the manufacturing industry distributed between the iron and steel industry, the chemical industry, food and beverage processing and cement plants.

For more information, we refer to chapter 2 of NC6 and chapter 3 of this report.

Table 2.7 GDP – Gross added value by economic activity, estimation at current prices (in EUR millions, gross data) [1]

							Growth	
	2015	2016	2017	2018	2019	2020	2020/2015	2020/2019
Agriculture, forestry, fishery	2 860	2 703	2 960	2 774	3 184	2 916	1.9%	-8.4%
Industry	62 671	63 277	65 457	65 328	69 207	67 409	7.6%	-2.6%
Construction	19 294	19 678	20 150	21 767	22 514	21 567	11.8%	-2.6%
Services	288 477	298 374	308 467	320 303	331 995	317 913	10.2%	-4.2%
Other components	43 400	46 053	48 016	49 854	51 260	47 089	8.5%	-8.1%
GDP at market price	416 701	430 085	445 050	460 029	478 161	456 893	9.6%	-4.4%

Source: Institut des comptes nationaux. NBB.Stat

2.8 Waste

Overall, waste generated in Belgium rose to 68 062 thousand tonnes (2020), a 28 % increase compared to 2004[1]. The major waste producers are industry (55.5 %) and construction (30.5 %) (Figure 2.8).

The quantity of municipal waste has increased until 2007. From 2007 to 2015, this figure dropped by 15 %. Between 2015 and 2020, the quantity stagnates or even increases slightly.

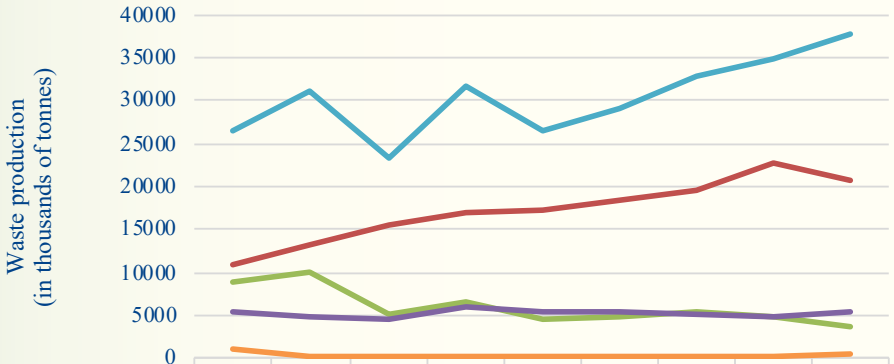
Municipal waste production per capita remained stable in 2020 at 418 kg per capita, as in 2019.

35 % of the 4 799 862 tonnes of waste collected in 2020 was recycled. 43 % was incinerated with energy recovery and less than 0.02 % without energy recovery. 19 % of the collected waste was composted or fermented. The remaining 3 % was landfilled or underwent some other form of treatment.

Significant improvements in waste treatment have helped to sharply reduce the amount of waste put into landfills. The distribution between the different waste treatment methods remains stable these last years (Figure 2.9). The problem of reducing waste production remains a priority issue for the authorities.

[1] 'Waste' means any substance or object which the holder discards or intends or is required to discard (art. 3 of EU directive 2008/98/EC on waste and repealing certain Directives).

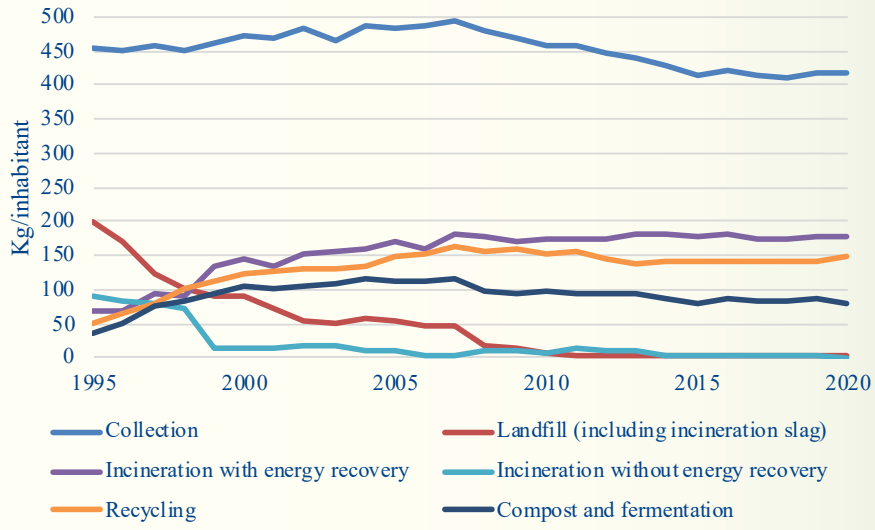
Figure 2.8 Waste production by economic activity (2004-2020)



	2004	2006	2008	2010	2012	2014	2016	2018	2020
Construction	11051	13090	15442	16853	17133	18347	19573	22658	20728
Services	8972	9959	5024	6698	4635	4840	5403	4850	3817
Households	5337	4745	4459	5866	5295	5419	5041	4885	5342
Industry	26467	31139	23410	31708	26611	29047	32866	34778	37758
Agriculture	1187	362	281	199	165	312	269	258	417

Source: Belgium statistics on surveys and administrative sources (OVAM (Public Waste Agency of Flanders), Brussels Environment, DGARNE (Directorate-General Agriculture, Natural Resources and the Environment) and models. Additional data and information: Eurostat

Figure 2.9 Distribution of municipal waste treatment methods



Source: Belgium statistics based on surveys and administrative sources

2.9 Housing stock [1] [11]

Belgium counted 4 573 099 buildings in January 2020. Since 1995, the number of buildings has increased by 14.5%. Over the same period, the number of dwellings increased by 25.8% (5 557 016 units). The Belgian housing stock remains old. The age of the buildings varies from one region to another. In Flanders, 32.2% of the buildings were built after 1981, compared to 21.4% in Wallonia and only 6.7% in the Brussels-Capital Region.

In 2020, 77.2% of households lived in a single-family house and 22.3% in a flat (source: EUROSTAT).

In 2019, 73.2% of the energy consumed by households is used for heating. The main energy sources used for heating are natural gas (48.0%) and fuel oil (36.7%); however, there are large differences between regions. The share of heating in household energy consumption varies with weather conditions, ranging from 70% to 77% since 2010. The rest of the energy consumed by households is used for lighting and electrical appliances (12.8%), water heating (11.9%) and cooking (1.7%). As Belgium is a temperate country, the use of energy for cooling is very low (0.1%). [5]

Private households spent on average 31.8% of their budget for housing in 2020 (only 30.3% in 2018), of which 4.5% is spent for gas (1.3%), electricity (2.3%) and other fuels (0.9%).[1]

2.10 Agriculture and forestry [12]

Agriculture in Belgium, which is favoured by fertile soil and a temperate climate, specialises in market garden and horticultural crops, cereals, potatoes, sugar beets, stock farming and milk production. Due to the country's short coastline, fishing has relatively limited importance as an economic activity. Although farmland covers most of Belgium (44.5% of the territory), its surface area is shrinking and giving way to buildings.

As in other industrialised countries, the share of the Belgian agricultural sector in gross value added has been eroded over the past decades (0.8% of GDP in 2020). Nevertheless, coupled with the food industry, the agricultural sector remains a key export market: agri-food accounted for 11.1% of Belgian exports in 2020. [12]

One of the characteristics of the Belgian agricultural sector is the structural decrease in the number of farms, leading to a concentration of land and means of production. In forty years, the agricultural sector has lost 68.3% of its holdings. During the same period, the average area per farm tripled from 12.5 ha to 38.0 ha. [12]

In 2020, 2 494 farms were under organic control. In relation to the total Belgian agriculture, this represents a little more than one in fifteen farms. In terms of area, the Useful Agricultural Area (UAA) under organic control corresponds to 7.2% of the Belgian UAA. This proportion is higher

Table 2.8 Forest cover in Belgium (1990-2020) in km²

	1990	2000	2010	2015	2020
Forest	6 774	6 673	6 899	6 893	6 893
Other wooded land	207	271	328	329	329
Other land	23 299	23 336	23 053	23 058	23 058
Total area	30 280	30 280	30 280	30 280	30 280

Sources: FAO [13]

in the south of the country: 12.2% of the UAA in Wallonia is under organic control.

In organic farming, it is the poultry sector that is doing well with a constant growth in its flock. This success is confirmed for both meat and egg production. The organic production of animal products is also supported by the increase in the number of dairy cattle, which has more than doubled in the last 10 years. While they represented 14.1% of the organic cattle population in 2010, dairy cows represented 21.7% in 2020. Finally, after a slight slowdown in the early 2010s, the pig sector is beginning to make its mark in organic production. It is developing, in particular, in the North of the country where a growth of 58.6% is noted between 2019 and 2020. [12]

Despite a high population density, forests and other natural areas remain relatively stable (23.9% of the territory). The distribution of forests in Belgium is shown in Table 2.8. ■

References

[1] Chiffres-clés 2021, STATBEL, la Belgique en chiffres (Key figures 2021, Statistics Belgium in figures) – FPS Economy - Directorate-General Statistics - Statistics Belgium)

[2] Sixth National Report of Belgium to the Convention on Biological Diversity, 2019

[3] Bilan climatologique annuel – Année 2020 (2020 Annual weather report), RMI (Summary)

[4] Belgium Exports By Country (tradingeconomics.com)

[5] ENERGY Key data 2022, FPS Economy, SMEs, Self-employed and Energy

[6] Chiffres clés de la mobilité en Belgique (Key figures for mobility in Belgium) - November 2021 – FPS Mobility and Transports - Directorate-General Policy of trans and sustainable mobility – Mobility direction – Statistics service.

[7] Indicators complementary to GDP - Federal planning bureau

[8] Transport Database of the Federal Planning Bureau, accessed on 12/05/2022.

[9] La micromobilité en Belgique – résultats complets (Micromobility in Belgium - complete results) – FPS Mobility and Transports, 2020.

[10] La micromobilité en Belgique – résultats par modes (Micromobility in Belgium - results by mode) – FPS Mobility and Transports, 2020.

[11] Household budget survey, FPS Economy – Belgium statistics

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3. Greenhouse gas inventory information

3.1 Summary tables

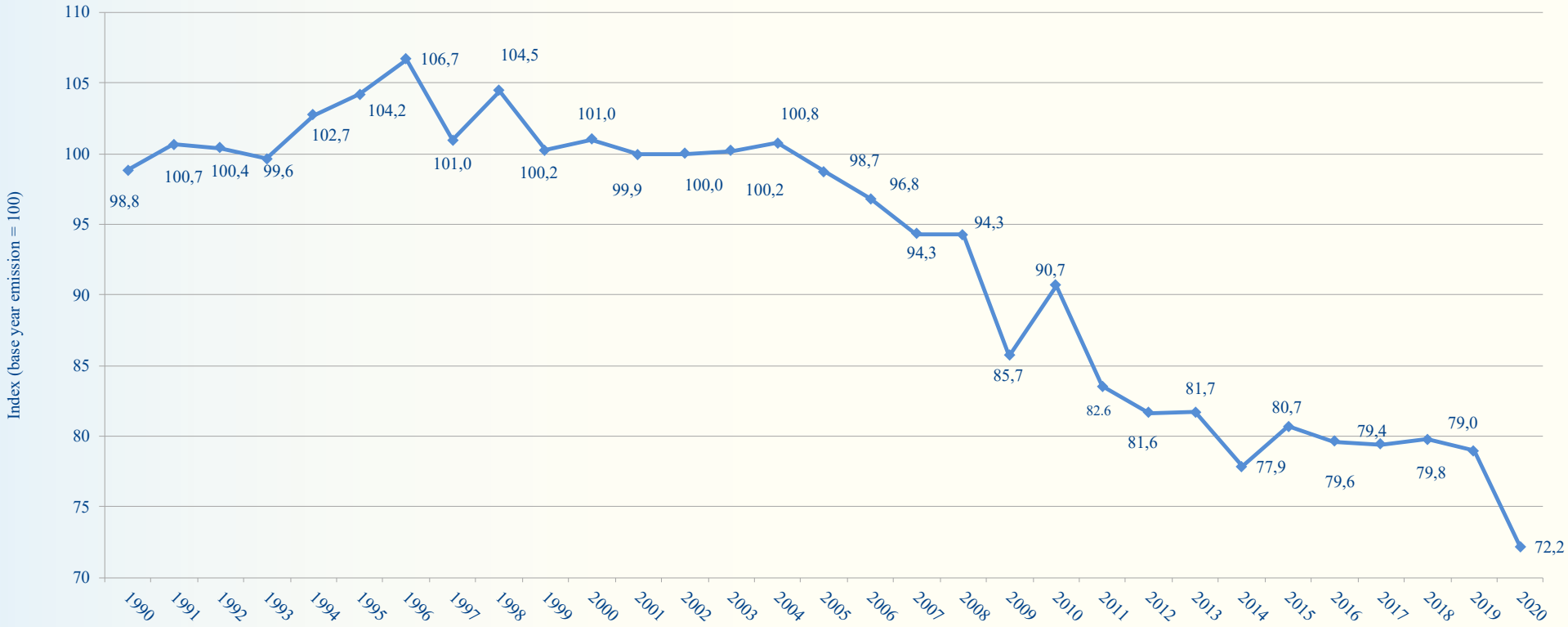
Inventory information presented in this chapter[1] is extracted from the 2022[2] submission following the UNFCCC recommendations (decision 6/CP.25 and Annotated Outline for Fifth National Communications of Annex I Parties under the UNFCCC, including Reporting Elements under the Kyoto Protocol). This inventory includes emissions data for the years 1990 to 2020.

Evolution of GHG emissions and removals as well as GHG emissions and removals in the main sectors from 1990 to 2020 are provided in CTF Table 1.

[1] Expressed as CO_2 equivalents, i.e. taking into account the overall warming effect of each of the gases, which is used to evaluate the relative contribution to global warming of the emission in the atmosphere of a kg of specific greenhouse gas, as opposed to the emission of a kg of CO_2 and taking into account their life spans and their respective radiation powers (CO_2= 1, CH_4 = 25 and N_2O = 298). A kg of CH_4 therefore has the same effect as 25kg of CO_2 over a 100-year period.

[2] The data correspond to the submission of May 2022.

Figure 3.1 Belgium GHG emissions 1990-2020 (excl. LULUCF). Unit: Index point (base year emissions = 100). For the fluorinated gases, the base year is 1995



3.2 Analysis of trends

3.2.1 General trends

Total greenhouse gas emissions (without LULUCF) in Belgium amounted to 106.4 Mt eq. CO_2 in 2020 (CTF Table 1) and to 106.1 Mt eq. CO_2 (with LULUCF). This represents a decrease of -26.9% compared to 1990 and -27.8% compared to Base year emissions (with 1995 for F-gases).

The major greenhouse gas in Belgium is carbon dioxide (CO_2), which accounted for 84.9% of total GHG emissions in 2020. Methane (CH_4) accounts for 6.7%, nitrous oxide (N_2O) for 5.1%, and fluorinated gases for 3.4% (Figure 3.2). Emissions of CO_2 decreased by 24.9% during 1990-2020, while CH_4, N_2O and fluorinated gas emissions have dropped with respectively 38.4%, 46.5% and 35.4%[3] during the same period.

An overview of the contribution of the main sectors to Belgium greenhouse gas emissions is given in Figure 3.3. Manufacturing industry, energy industries, transport and space heating (residential) are the most

[3] Compared to 1995 emissions

Figure 3.2 Share of greenhouse gases in Belgium (2020) – (without LULUCF)

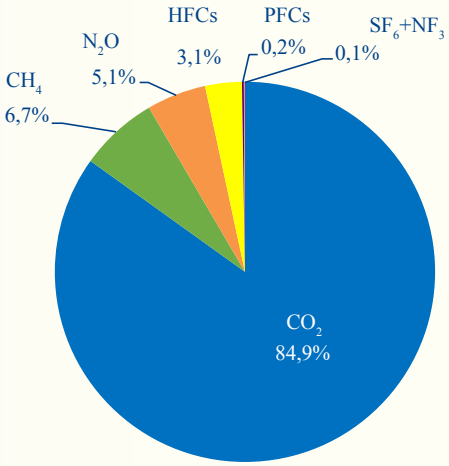
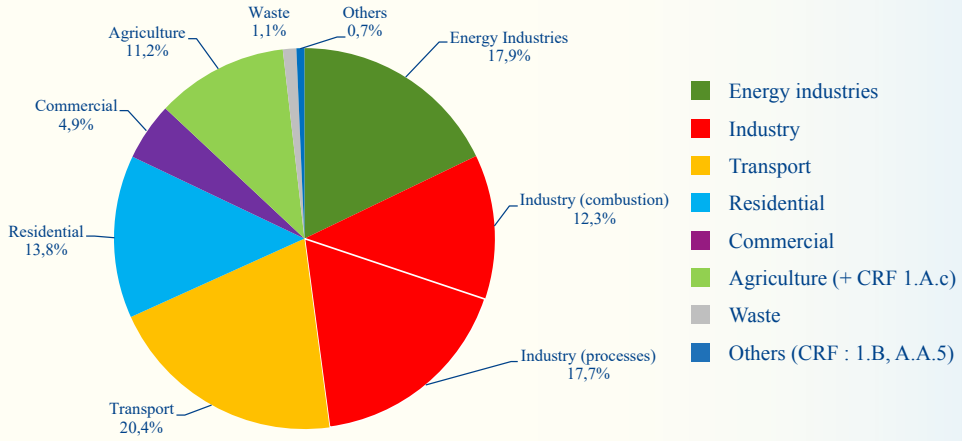


Figure 3.3 Share of the main sectors in 2020 (without LULUCF)

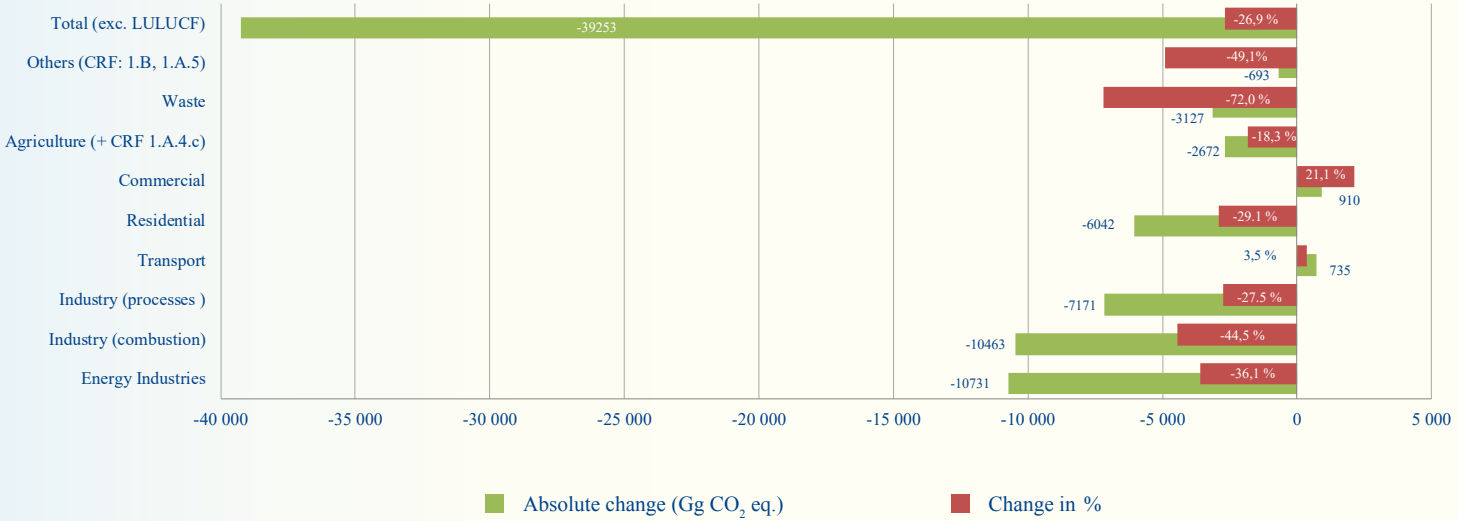


"Others" includes "Fugitive Emissions from Fuels", "Other Combustion" and "Solvent and Other Pro,duct Use". Combustion of agriculture are included in "Agriculture" sector.

Table 3.1 Total GHG emissions for Belgium (excluding LULUCF) in 2020 with the respective verified emissions reported by installations and operators under Directive 2003/87/EC (Emission Trading Scheme)

	2020 emission in Gg CO_2-eq
ETS emissions (Directive 2003/87/EC)	41 511.577
ESD emissions (Decision 406/2009/EC)	64 904.157
Other (NF_3 and CRF 1A3a Domestic aviation)	17.524
Total emissions without LULUCF	106 433.258

Figure 3.4 Impact of the main sectors on the global trend 1990-2020 (Gg CO_2 eq.)



"Others" includes "Fugitive Emissions from Fuels", "Other Combustion" and "Solvent and Other Product Use". Combustion of agriculture are included in "Agriculture" sector.

important sectors in the total GHG emissions in 2020.

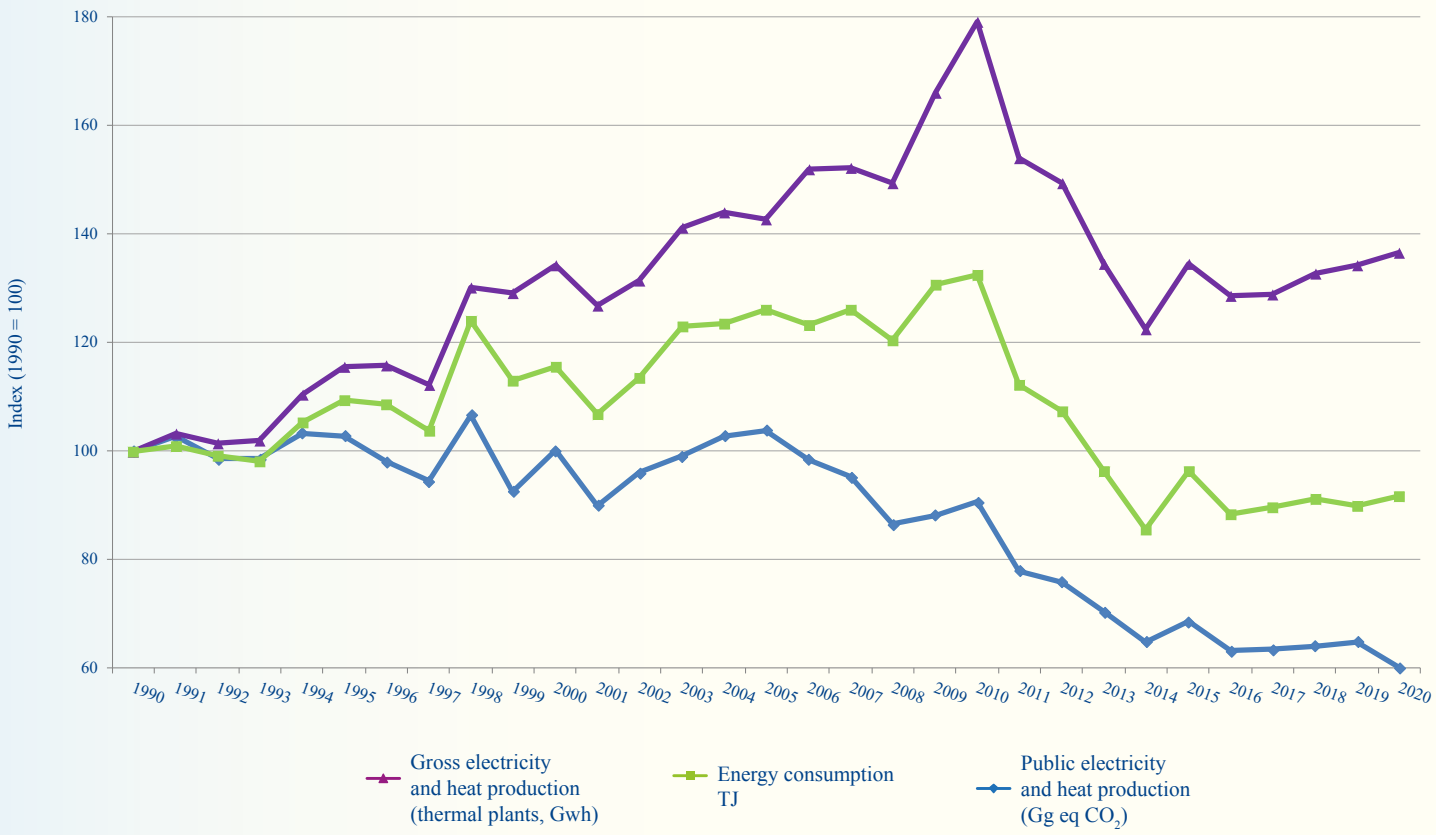
Figure 3.4 summarises the impact of the main sectors on the national trend. It shows the increase in transport on the one hand (much less spectacular than previous submissions due to the COVID-19 crisis and its consequences on mobility with lockdown, telework, etc.) but also the increase in emissions from buildings in the commercial sector on the other hand. Since 1990, those two sectors grew by 3.5% and 21% respectively and together have been responsible for a 1.1% increase in total emissions (but transport grew by +24% when comparing with 1990 emissions).

This trend is counterbalanced by the decrease in emissions in the other sectors, particularly manufacturing industry (combustion & processes recorded a 36% decrease since 1990, which explains a decrease of 12.1% in total emissions) and energy industries (emissions recorded a 36% decrease since 1990, which accounts for a decrease of 7.4% in total emissions).

The drivers of these trends will be analysed and commented on the following pages, sector by sector.

The split between emissions reported under the Effort Sharing Decision (EC/406/2009) and emissions covered by the Emission trading Scheme (Directive EC/2003/87) is presented in Table 3.1.

Figure 3.5 GHG emissions from public electricity and heat generation, in relation to gross electricity generation (excluding nuclear)



3.2.2 Energy production

The main source for this sector is public electricity and heat generation (1A1a), which accounted for 73.6% of sectoral emissions in 2020. Petroleum refining (1A1b) and the manufacturing of solid fuels (1A1c) accounted for 25.7% and 0.8% respectively.

Emissions from the manufacturing of solid fuels have decreased by 93% since 1990 (-1891 Gg CO_2 equivalent) due to the closure of six coke plants in 1993, 1995, 1997, 2000, 2005 and 2010. Emissions in 2020 from petroleum refining are 10% higher in comparison with 1990. Emissions in this sector can fluctuate depending on the general economic context and planned shutdowns for inspection, maintenance and renovation works. This was the case in 2011 for one of the biggest refineries, for example. But 2020 emissions are 14% under 2019 emissions.

As mentioned above, the main driver in this sector is still public electricity and heat generation although the sector has experienced a sharp decline since 2010. While electricity and heat production have risen by 36% between 1990 and 2020, emissions have decreased (-39%) due to technological improvements, an increase in the number of combined heat-power installations and the switch from solid fuels (coal) to gaseous fuels (natural gas) and renewable fuels. This is illustrated in Figure 3.5.

3.2.3 Manufacturing industries

In the manufacturing industries, added value[4] has increased by 45 % in 2015 since 1995, while greenhouse gas emissions (combustions) decreased by 40 % in the same period (only emissions from combustion are considered here).

As illustrated in Figure 3.6, fuel energy consumption decreased by 22 % between 1990 and 2020 (and by 26 % if we consider 2009). This strong decrease is obviously due to the impact of the economic crisis in the iron and steel sector. The apparent **decoupling of added value and energy consumption** can be attributed to various drivers according to sectors:

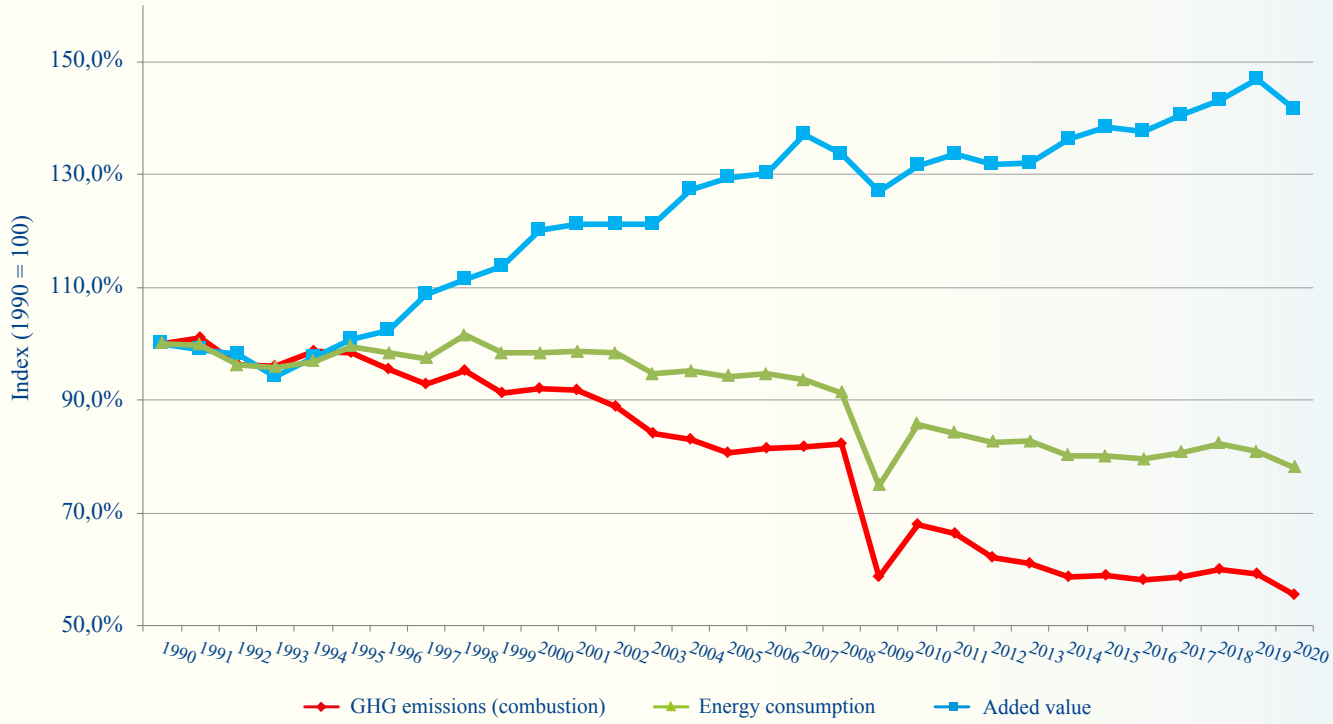
In the iron and steel industry, many plants have switched to electrically powered furnaces since 1990. For example, the share of iron and steel plants using electricity increased from 9 % in 1990 to 35 % in 2011. This is the main cause of the apparent decreasing energy consumption, while stable added value is observed in this sector. Because of the re-allocation between the energetic and the process emissions in the iron & steel sector since the 2015 submission, this sector now represents only 9 % of the energy consumption of manufacturing industries as a result of combustion in 2020 and consequently its impact on the global trend has decreased.

In the chemical sector, fuel consumption (non-energy use of fuels are excluded) has decreased by 15 % between 1990 and 2006, compared to an increase in added value growth of 65 %. This major decoupling is linked to both rational energy use and high added-value products. In 2020, this sector represented 28 % of energy consumption in the manufacturing industries.

Food processing and beverages represented 19 % of energy consumption in the manufacturing industries in 2020, but only 11 % of added value. The diversity of the plants in this sector does not allow a detailed analysis of the trend; only certain types of plants are commented upon here. In sugar plants, for example, some products with high added value, such as inulin and fructose, have been developed, but the main driver is still the sugar beet yield (quantity and sugar content), which is highly climate-dependent.

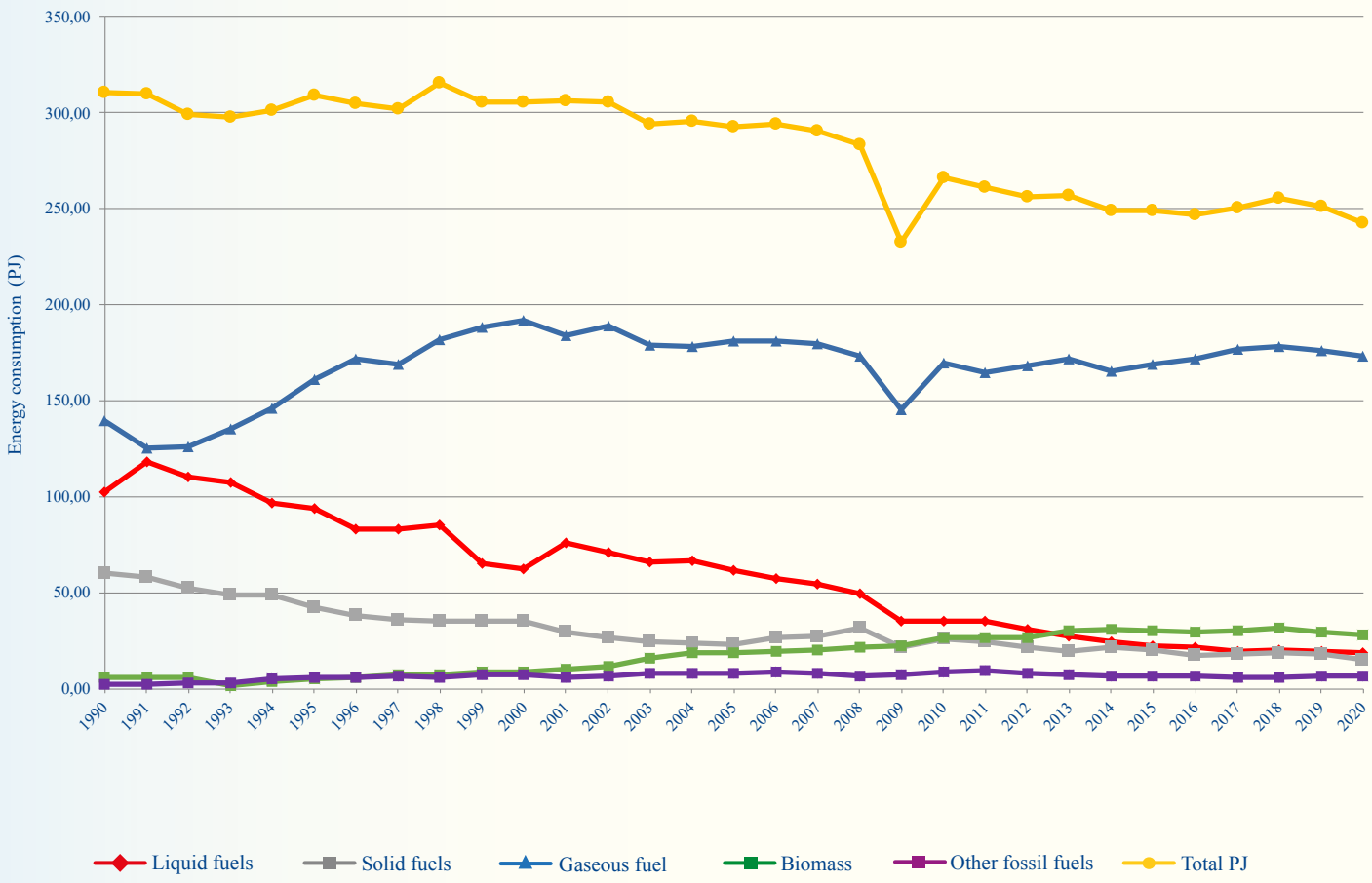
In cement plants, the decoupling between energy consumption and total production is linked to the production process: the dry process, which consumes consid-

Figure 3.6 Manufacturing industries: index of GHG emissions, energy consumption and added value



[4] Gross added value of sector 1A2, estimates in chained euros (reference year 2015) - Federal Planning Bureau

Figure 3.7 Type of fuels used in the manufacturing industries



erably less energy, is gradually replacing the wet process and is now (2020) used for 77% of clinker production compared to 57% in 1990.

Figure 3.6 also shows a decrease in greenhouse gas emissions for an equal level of energy consumption. One reason is the increasing use of gaseous fuels, coupled with a decrease in liquid and solid fuels observed across all sectors. This is illustrated in Figure 3.7.

The increasing use of 'other fuels' reflects that cement plants have been using more and more substitute fuels since 1990, such as impregnated sawdust, animal waste, tyres, etc. Those fuels accounted for 51% of their energy consumption in 2020 compared to 8% in 1990. The non-biomass fraction of these fuels is included in the 'other fuels' category. The biomass fraction of these fuels is included in biomass fuels; therefore, the CO_2 emissions are not accounted for in the national emissions.

More than the half of the biomass fuels used in Belgium in the manufacturing industries are used in the pulp and paper sector, where part of the woody raw material has always been used as fuel in pulp paper plants. The consumption increased by 128% from 1990 to 2020 in this sector while the increase is multiplied by almost 5 for all the manufacturing industries reflecting the development of this fuel since the 2000s.

3.2.4 Industrial processes

The 'industrial processes and F-gases' sector covers emissions from industrial activity, but not resulting from fossil fuel combustion. In 2020, these emissions of greenhouse gases were mainly caused by the chemical industry (47% of process emissions – of which 41% just for the petrochemical industry and 13% for ammonia production), mineral products (22% of process emissions of which 64% for cement and 29% for lime production), metal production (16% of emissions – sharply down from 2009 due to economic crisis). Besides, 19% of these process emissions are caused by the 'product used as ODS (Ozone-depleting substances) substitutes'.

3.2.4.1 Mineral products

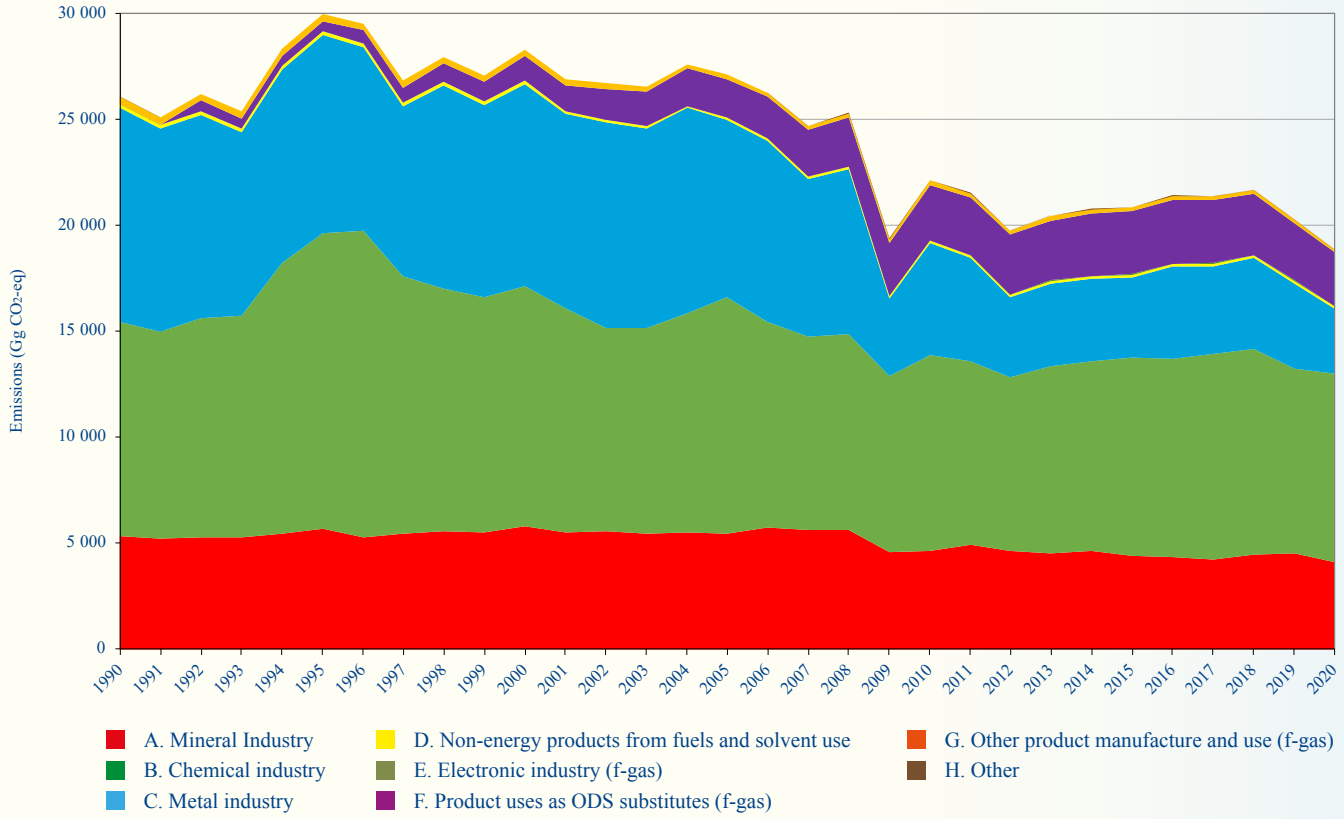
These emissions occur during the production of clinkers, lime and glass (decarbonation of calcium carbonates) and are closely linked to production levels, which are stable on the whole.

3.2.4.2 Chemicals

Despite the closure of two nitric acid plants (one in 1995 and another in 2000), the production of nitric acid in the two remaining plants increased by 54% in 2020 compared to 1990 (after a sharp decline in 2009). In parallel, these plants have taken measures to reduce emissions from their processes (use of catalysts since 2003 and recorded a drop in emissions in 2011 after introducing new catalysts in two installations at the end of 2010, emissions were reduced by 92% since 2002).

Due to a re-allocation of emissions of CO_2 from 1A2c/other fuels to category 2B8b, emissions of CO_2 become predominant. These emissions are the recovered fuels in the steam cracking units in the petrochemical industry, and others recovered in the chemical industry.

Figure 3.8 Greenhouse gas emissions in the industrial processes sector (Gg CO_2-eq)



3.2.4.3 Metal production

In the iron and steel sector, greenhouse gas emissions decreased by 70% in 2020 compared to 1990. This is in line with the economic crisis that has hit the iron and steel sector in 2009 with a decrease in activity of almost 50% in all sub-sectors.

3.2.4.4 Fluorinated gases

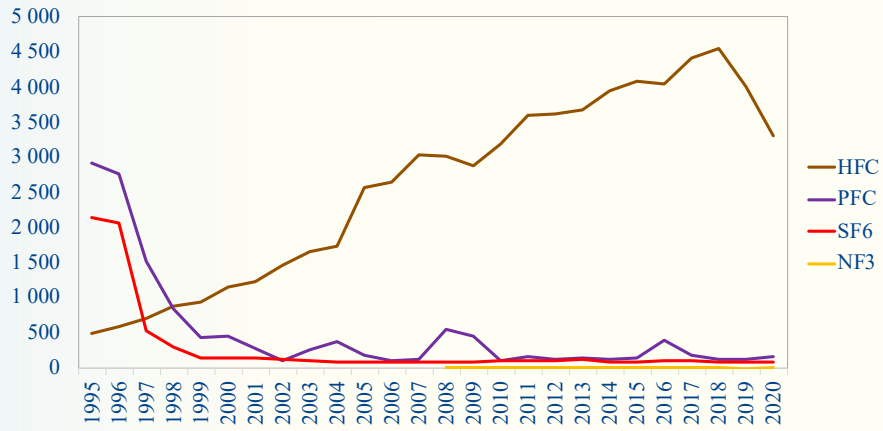
Emissions of fluorinated gases accounted for 3.4% of total greenhouse gas emissions without LULUCF in 2020. A distinction is made between 'production emissions', which are fugitive emissions during the production process, and 'consumption emissions', which are those occurring during the use or dismantling of existing equipment and products.

The sharp decrease in emissions from the production of HFC between 1996 and 1999 is due to the installation of a gas incinerator with an HF recovery unit (Fluoride Recuperation Unit) in the most important source identified, which is an electrochemical synthesis unit located in the Flemish region.

The growing consumption of HFC (Figure 3.9) is directly linked to the implementation of the Montreal Protocol and EU Regulation 2037/2000, which bans the use of ozone-depleting substances such as CFCs. The CFCs which were formerly used are now being replaced by HFCs in the majority of sectors like refrigerating and air conditioning installations, foam production and aerosols. The quantities of HFCs are nonetheless lower than those of CFCs, because in many cases CFCs have been replaced by non-fluorinated gases, like ammonia in refrigeration, pentane and CO_2 for rigid foams, etc.

SF_6 emissions originating from the production of acoustic double-glazing have been cut through the use of alternative products. The remaining SF_6 emissions from that source are those from dismantling of existing equipment.

Figure 3.9 Kyoto F-gas emissions per gas category in Belgium (kt CO_2-eq): changes from 1995 to 2020



3.2.5 Residential and commercial

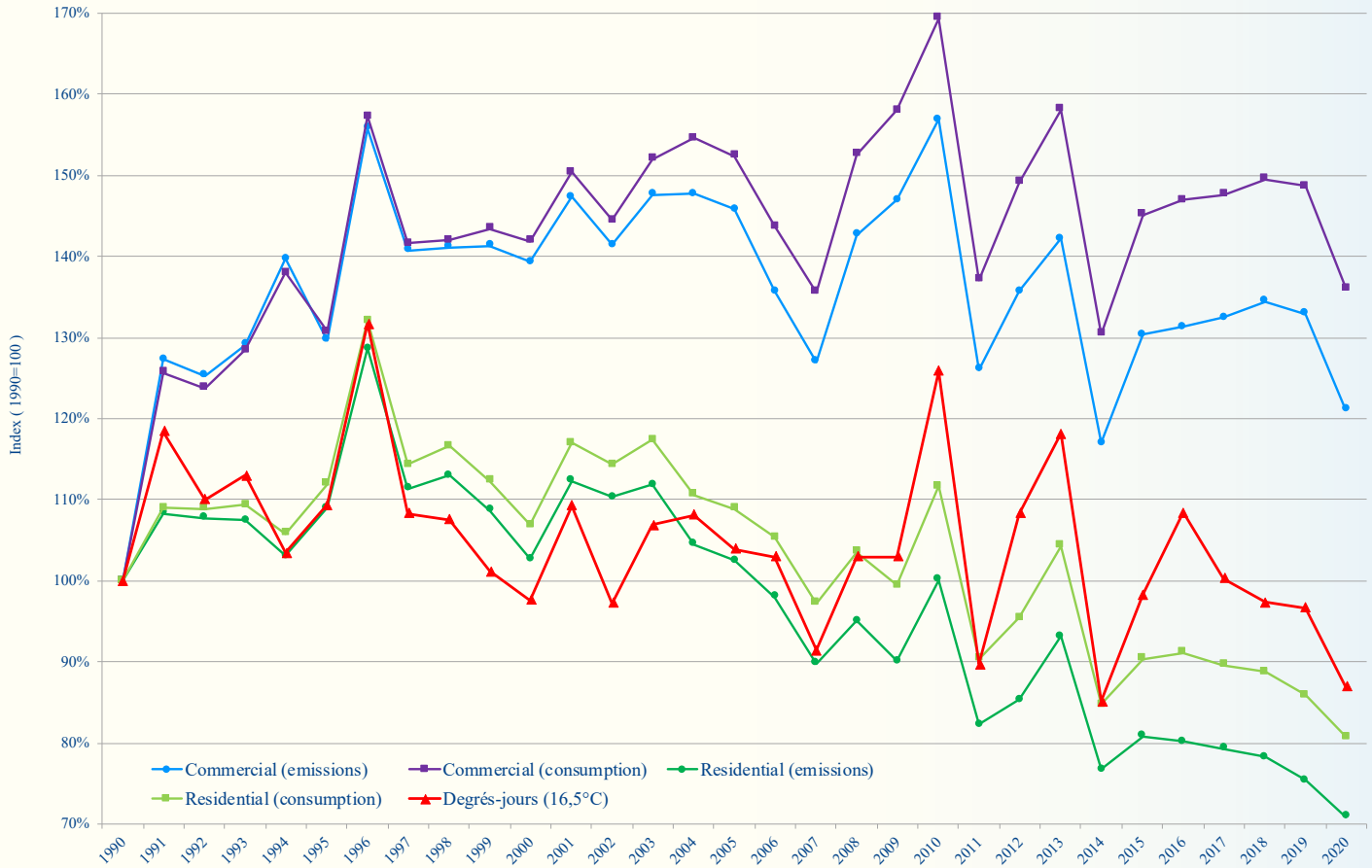
In the residential sector, fuel consumption increased by 17% between 1990 and 2003. This is mainly linked to the increasing number of dwellings (+26% between 1991 and 2001) since these two years were very similar from a climatic point of view. Annual fluctuations are of course climate-related with degree days[5], one of the key parameters used to analyse the sector energy consumption. This is particularly clear in the case of 1996 and 2010, which were cold years characterised by a marked peak in emissions from heating, but also for 2007, 2011, 2014 and 2020, four years with exceptionally mild winters, which caused a sharp drop in consumption. Recently, rising energy prices and improving building insulation have probably also contributed to reductions in consumption. We can observe this when comparing 1998 and 2016, two similar years from a climatic point of view. While the number of dwellings increased by 17%, energy consumption decreased by 21%. Since 1990, the consumption of gaseous fuels in the residential sector has increased (stationary combustion) from 34% to 53% of total energy consumption (without electricity and heat), coupled with a decrease in solid fuels and liquid fuels. Liquid fuels still account for 38%. One explanation is that the gas distribution network does not cover sparsely populated areas, hampering the switch from liquid to gaseous fuels, a development which is observed in other sectors.

[5] Degree day: the difference expressed in degrees centigrade between the average daytime temperature and a base temperature (15°C for the 15/15 base and 16.5°C for the 16.5/16.5 base). Average temperatures that are higher than the base temperature are not included. The total number of degree days over a given period (month or year, for example) are added together. Degree days enable heating requirements to be assessed.

In the commercial and institutional sector, fuel consumption has increased by 36% since 1990. Annual fluctuations are also climate-related but the overall trend is less affected than in the residential sector. One reason is the rising number of employees, which has increased by 35% (between 1993 and 2017). In the meantime, electricity consumption also increased by 183% (between 1990 and 2017), mainly due to the development of Information Technologies and the increased use of refrigerated areas and air conditioning. These increases have been partially counterbalanced by a clear switch from liquid fuels to gaseous fuels observed since 1995, natural gas now representing 80% of the sector's energy consumption (without electricity and heat).

For both sectors, other fuels and biomass were negligible but according to a new estimation of consumption of biomass fuels in the residential sector, biomass represents now 9%. In the commercial sector, a slow increase has been observed since 1998, but biomass represents only 3.4% of the sector's energy consumption (stationary combustion). The switch from solid and liquid fuels is reflected in the decoupling of energy consumption and GHG emissions (Figure 3.10).

Figure 3.10 Residential and commercial sector: GHG emissions index and Consumption Index (1990 = 100)



3.2.6 Transport

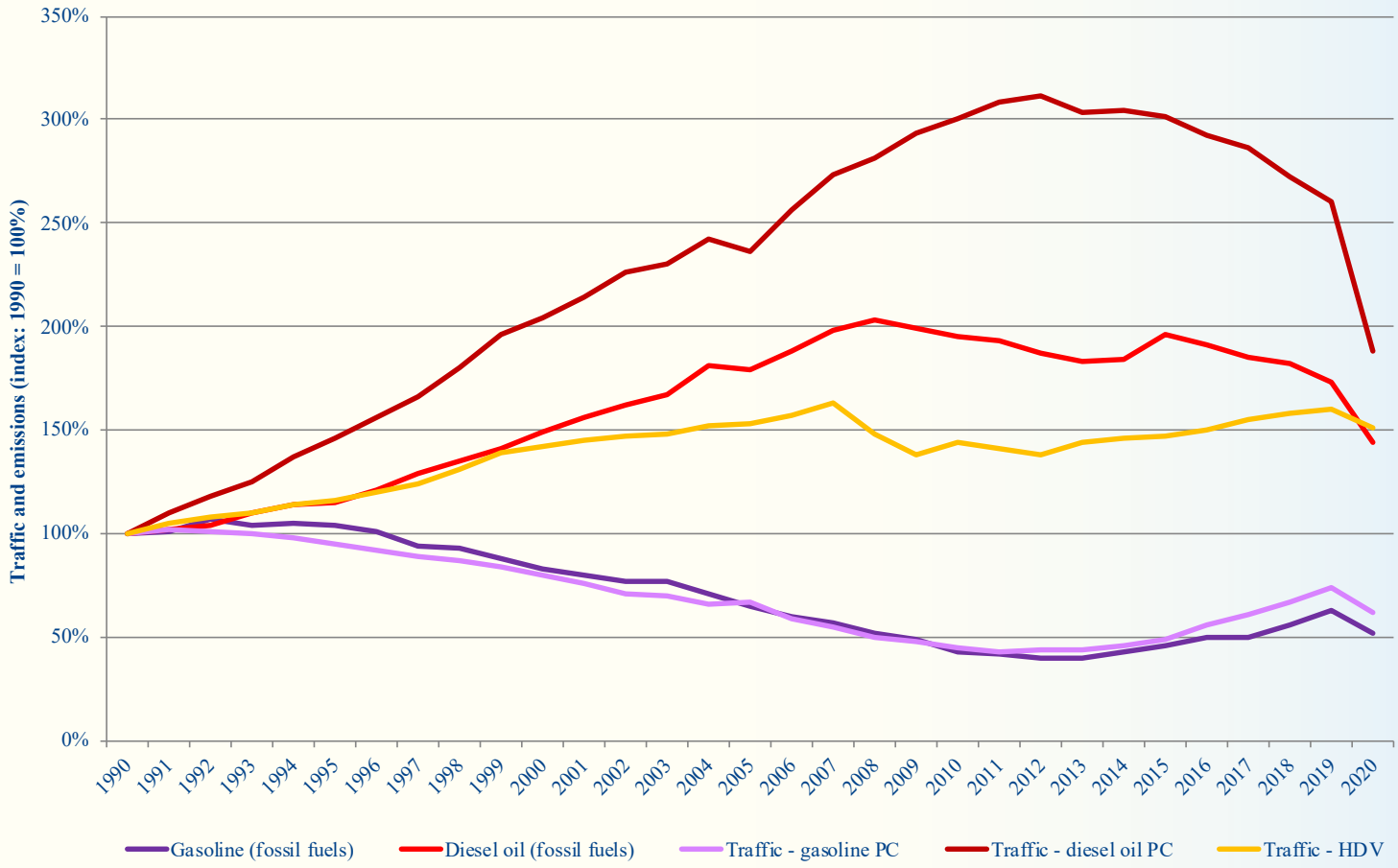
Transport emissions accounted for 14.4% of total GHG emissions in 1990 and 20.4% in 2020. This increasing share is due to road transport, which represents 96.0% of total emissions (included pipelines) by the sector in 2020.

Emissions from domestic navigation are fairly stable and represent almost 1.7% of total transport emissions in 2020. Emissions from railways (0.3% in 2020) seem to have decreased since 1990, but in fact this reflects the switch from diesel to electrical engines.

In the road transport sector, most indicators are increasing, even if 2020 emissions show a sharp decrease due to the COVID-19 crisis and its consequences on mobility: the number of vehicles has increased by 66% since 1990 (52% for passenger cars alone), together with traffic (vehicle km) which has risen in the meantime by 49% in 2019 but only by 17% in 2020 (COVID-19 crisis). During the same period, the freight traffic by road[6] grew by 112% (ton-kilometres 2020) while the number of passengers carried by cars increased by only 26% (2017).

There was a marked switch from petrol engines to diesel between 1990 and 2014 (the number of petrol engines (all vehicles) dropped between 1990 and 2014 (-15%) while the number of diesel engines tripled (+ 301%) for the same peri-

Figure 3.11 Road transport emissions (according to the "reference approach") and traffic index (index: 1990 = 100%)



[6] Road freight traffic of Belgian and foreign trucks carried out in Belgium

od), but this movement is being reversed since 2015 with the modification of excise duties on fuels as well as the widespread media coverage of the consequences of diesel vehicles on air pollution. Since 2015 petrol engines grew by 31%, while diesel engines dropped by 11% (2020). The main trend since 1990 is still reflected in the respective traffic figures for passenger cars (-26% for petrol engines and +261% for diesel engines in 2019 but respectively -38% and +188% in 2020) and in their respective emissions as well (Figure 3.11). Although the number of diesel cars has declined since 2015, they still account for the majority of cars on Belgium's roads.

The average engine capacity has also increased since 1995. One the one hand, this reflects the switch to diesel and on the other hand, the growing success of Sport Utility Vehicles and Multi-Purpose Vehicles. The average age of the cars has increased (improved rust protection and overall resistance), as has the average distance travelled, which is now becoming more stable.

Road transport is one of the most important key sources of greenhouse gas emissions in Belgium, both in terms of its level and in accordance with a trend analysis. With an increase in GHG emissions of 25% between 1990 and 2019 (only 4% between 1990 and 2020), road transport constitutes one of the main drivers of emissions trends. The absolute increase in CO_2 emissions from road transport diesel oil between 1990 and 2019 is the highest among the key sources for the trend assessment (+8012 Gg CO_2) (only +4755 Gg CO_2 between 1990 and 2020).

International air and maritime transport

In accordance with the UNFCCC guidelines, emissions from international air and maritime transport are not included in national emissions. In 2020, these emissions represent 30% of national emissions, with maritime transport representing the most important source (84% of this category). Emissions from international aviation have increased by 66% since 1990, while emissions from maritime transport have risen by 101%.

3.2.7 Agriculture

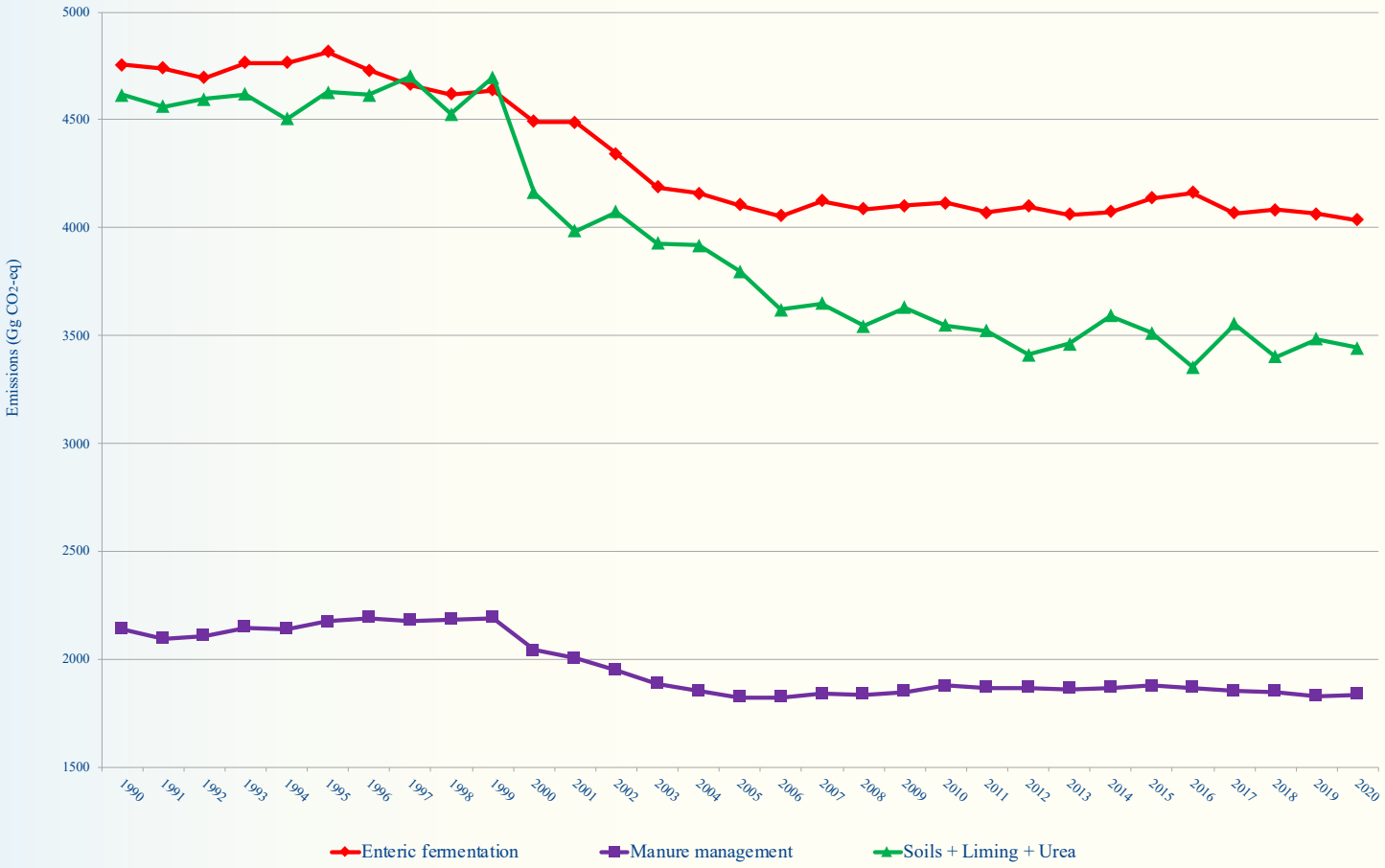
GHG emissions from agriculture (without fuels used) accounted for 8.8% of the total emissions in Belgium in 2020. Overall (including emissions from energy sector 1A4c), they decreased by 18% between 1990 and 2020.

43% of these emissions (without fuel used) were CH_4 emissions from enteric fermentation (category 3A) in 2020, cattle being responsible for 92% of these emissions. As can be seen in Figure 3.12, those (direct) emissions have decreased by 14% since 1990. This is mainly due to an overall reduction in livestock, but also to the shift from dairy cattle to brood cattle (which is a general EU trend linked to the Common Agriculture Policy), the latter generating smaller emissions.

In 2020, 20% of the emissions were emissions from manure management, of which pigs account for the largest part (59%). These emissions are driven by the livestock: the number of pigs increased between 1990 and 1999, but has been decreasing since then, its impact on the emissions being smoothed by the changes in cattle livestock explained above.

35% of the emissions in the agriculture originate from N_2O emissions from soils. Those have decreased by 27%, on the one hand as a result of the smaller quantities of nitrogen from mineral fertiliser applied to the land and as a result of the reduction in livestock (nitrogen excreted on pasture and from organic fertiliser applied) on the other. Both reductions also have an impact on indirect emissions.

Figure 3.12 Emission trends in the agricultural sector (Gg CO_2-eq)



3.2.8 Land-use, land-use change and forestry

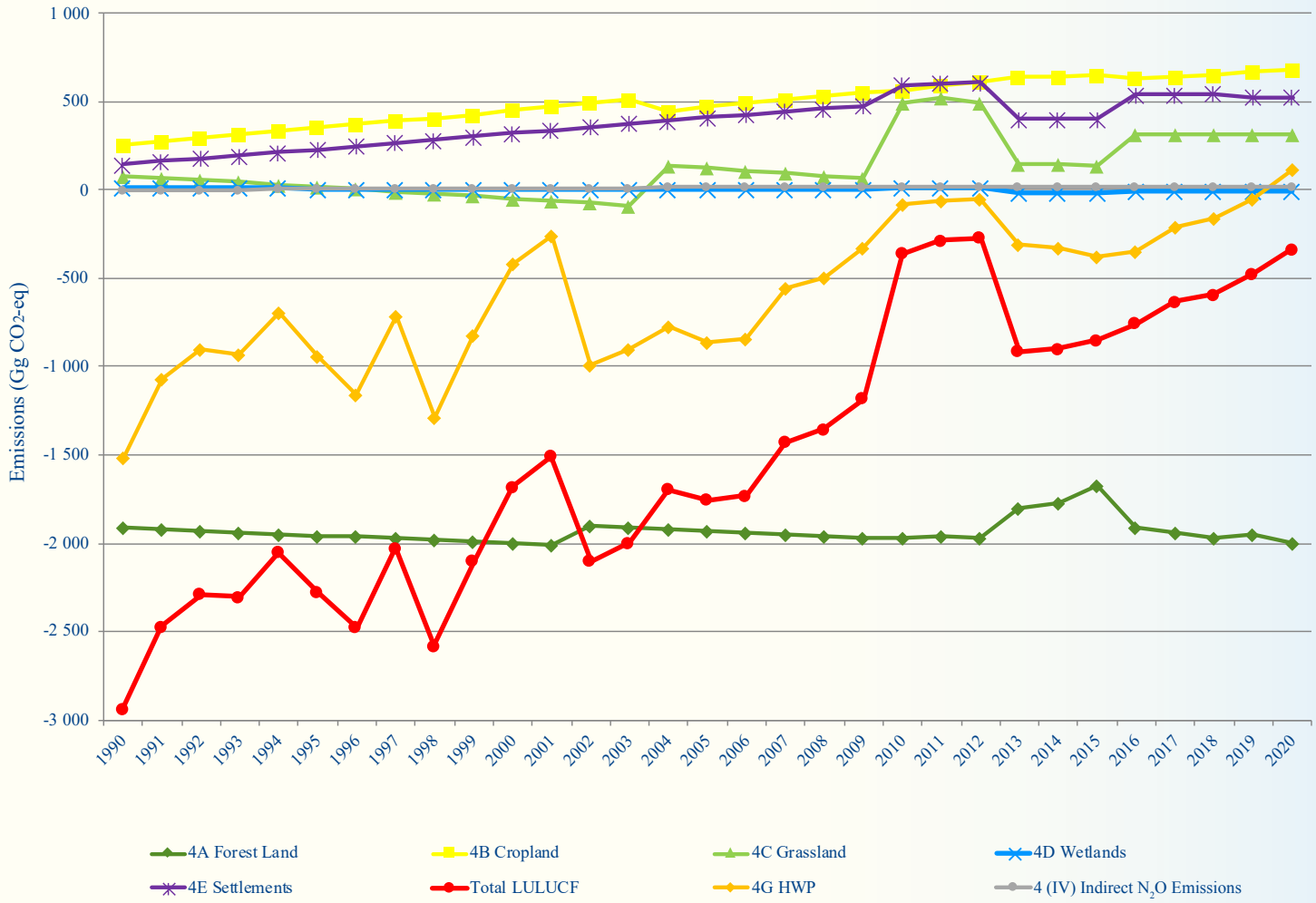
As illustrated in Figure 3.13, forests in Belgium are the largest sink of carbon with a major impact on the trend within the LULUCF sector. The level of this sink is related to some methodological aspects in carbon stock change. Grasslands is no longer a sink as before and Croplands are still a source. This is in line with the new data available (2020) for carbon stock in soils.

The area of settlements increased steadily since 1990. The increase in urbanised areas explains this growth and the conversion from lands to settlements is giving rise to emissions from carbon captured in the soil.

The HWP pool (Harvested wood products) shows a decrease of net removals, with significant impact on the overall trend. Cropland has been an increasing net source of emissions since 1990. The overall trend displays a decrease of net removals from the LULUCF sector.

Emissions of N_2O and CH_4 has been increasing steadily from 2-3 % in 1990 to about 7 % of total sector sources mainly because of Direct N_2O Emissions from N Mineralisation/Immobilisation (except in 1996, when the figure was 23.5 % as a result of fires).

Figure 3.13 Emission and removal trends in LULUCF sector

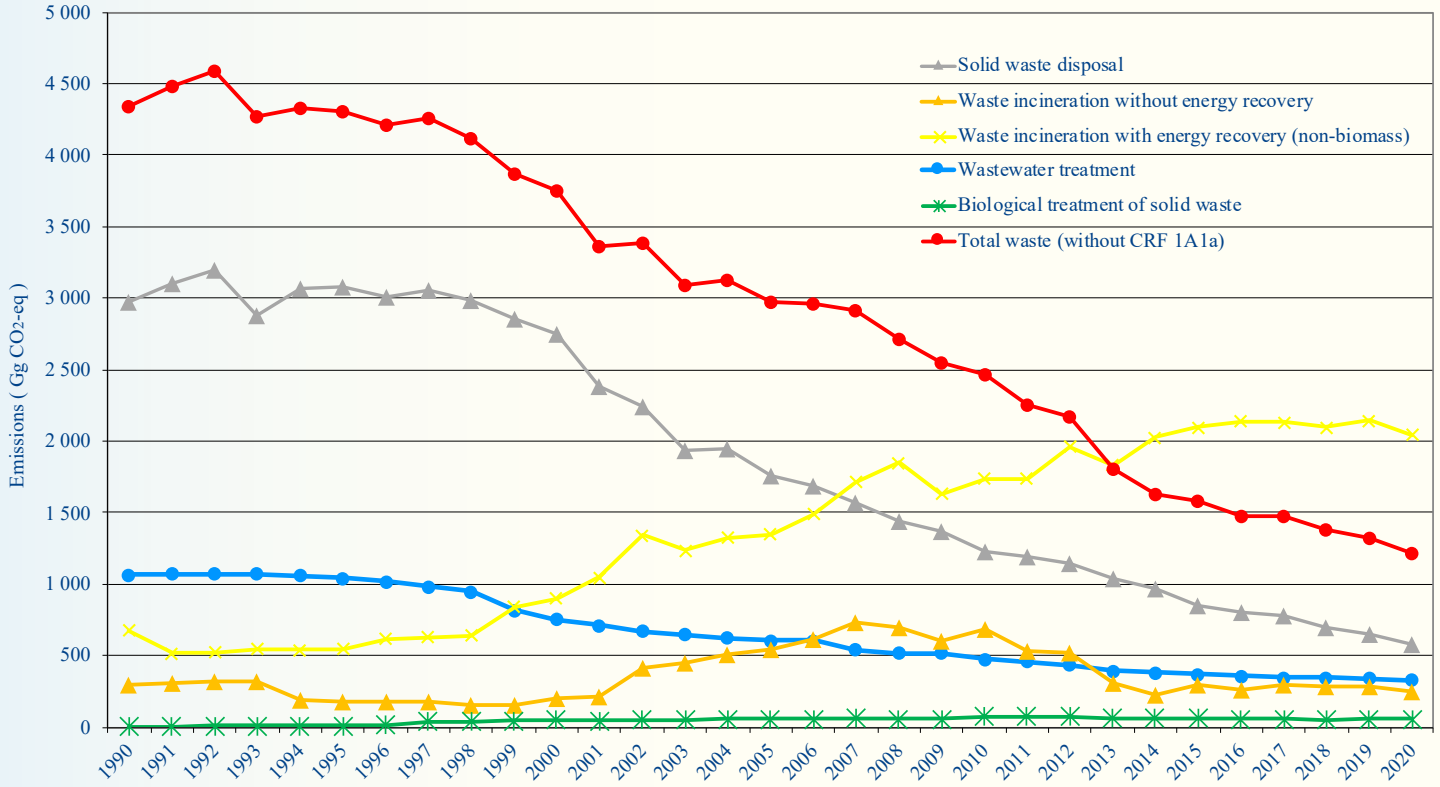


3.2.9 Waste

GHG emissions from waste (excluding waste incineration with energy recovery) accounted for 1.1 % of total national emissions in 2020, compared to 3.0 % in 1990. This decrease is mainly due to CH_4 emissions from solid waste disposal on land, which represents 47 % of total emissions from the waste sector in 2020. Emissions resulting from solid waste disposal on land have dropped by 81 % in 2020 since 1990. Biogas recovery in landfills by flaring or for energy purposes – depending on the richness of the landfill gas – has been developed on a wide scale since 1990 and is the main driver of the trend in this sector, together with a significant decrease in the amounts of waste disposed due to the shift from waste disposal to re-use, recycling, composting or incineration of waste.

The remaining 53 % of GHG emissions originates from three sources: waste incineration (21 % in 2020), wastewater treatment (27 %) and composting (5 %). Emissions from waste incineration (sector 5C) include mainly CO_2 emissions from flaring activities (and post-combustion activities) in the chemical industry, while emissions from municipal waste incineration without energy recuperation decrease significantly. Emissions of municipal waste incineration are mainly allocated in the energy sector (1A1a), as almost all municipal waste incineration plants are also electricity producers (except for some plants in the early nineties). Incineration of hospital waste is also included following the IPCC Guidelines. The non-biogenic CO_2 emissions from the municipal solid waste incineration with energy recovery (sector 1A1a) are shown separately in Figure 3.14 to give a complete overview of the greenhouse gas emissions associated with waste (kton CO_2 eq).

Figure 3.14 Emission trends (1990-2020) in the waste sector (CRF 5), and non-biogenic GHG emissions from MSW incineration (CRF 1A1ai)



3.3 National inventory system

Only small changes have occurred since the 7th National Communication and 4th Biennial report.

The national system in Belgium has been updated for the submission to the European Commission of 15 March 2022 and later for the submission to the UNFCCC-secretariat of 15 April 2022. During the previous updates, Belgium's main focus was on the jurisdictional changes in the Flemish region since January 2021:

1) The Flemish energy balance is being set up by the new Flemish Agency of Energy and Climate (VEKA) instead of the VITO in the past. At the same time, VEKA became responsible for the climate and energy policy in this region (instead of the Department of Environment (AEKG) which was responsible for climate policy before).
2) Some of the updates mainly focused on their organisation, their accreditation of the ETS-reporting and their approval of the Brussels energy balances.
3) Other more limited changes related to the names of certain bodies and the updating of persons responsible.

3.3.1 Overall responsibility for the Belgian national inventory

The agency designated as the "single national entity with overall responsibility for the national inventory" (national compiler) is the Belgian Interregional Environment Agency CELINE-IRCEL[7], established by the Cooperation Agreement of 18 May 1994 (modified by the Decision of 21 May 1995) on atmospheric emissions monitoring and data structuring. It includes members from the three regions.

3.3.2 Legal arrangements and regional agencies

In the Belgian federal context, major responsibilities related to environment lie with the regions. Compiling greenhouse gas emissions inventories is one of those responsibilities. Detailed information regarding legal arrangements and inventory preparation can be found in chapters 1.2, 1.3 and chapter 12 of the National Inventory Report.

Each region implements the necessary means to establish their own emission inventory in accordance with the IPCC guidelines. The emission inventories of the three regions are subsequently combined to compile the national greenhouse gas emission inventory. Since 1980, the three regions have been developing different methodologies (depending on various external factors) for compiling their atmospheric emission inventories. Important efforts were made to align these different methodologies, especially for the most important (key) sectors. At the same time, an effort was made to harmonise them, in order to ensure the consistency of the data and to establish the national inventory.

Coordination of the national inventory and the harmonisation of the methodologies are the ongoing tasks of the Working Group on «Emissions» of the *Coordination Committee for International Environmental Policy* (CCIEP), in which the different actors decide how the regional data will be aggregated into a national total, taking into account the specific characteristics and interests of each region as well as the available resources. This working group consists of representatives of the 3 regions and of the federal public services.

The *Belgian Interregional Environment Agency* (CELINE - IRCEL) is responsible for integrating the emission data from the inventories of the three regions and for compiling the national inventory. The National inventory report is than formally submitted for approval to the National Climate Commission, established by the Cooperation Agreement of 14 November 2002, before its submission to the secretariat of the United Nations Framework Convention on Climate Change and to the European Commission, under the European Parliament and Council Regulation (EU) No 525/2013 concerning a Mechanism for Monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC.

3.3.3 Overview of institutional, legal and procedural arrangements for compiling GHG inventory and supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol

The Inter-ministerial Conference for the Environment took a series of decisions that clarify the role and responsibilities of different entities, as regards the preparation of the national GHG inventory. These decisions are detailed in the NIS.

Entities responsible for the performance of the main functions of the Belgian Inventory System, as well as main institutional bodies involved in the decision-making process in relation to this system, are presented on next page.

[7] CELINE/IRCEL – Rue Gaucheret 92-94, 1030 Brussels +32 (0)2 227 57 02

As decided by the legal arrangements, the 3 regions are responsible for delivering their greenhouse gas inventories, which are later compiled to produce the Belgian GHG inventory. The main regional institutions involved are:

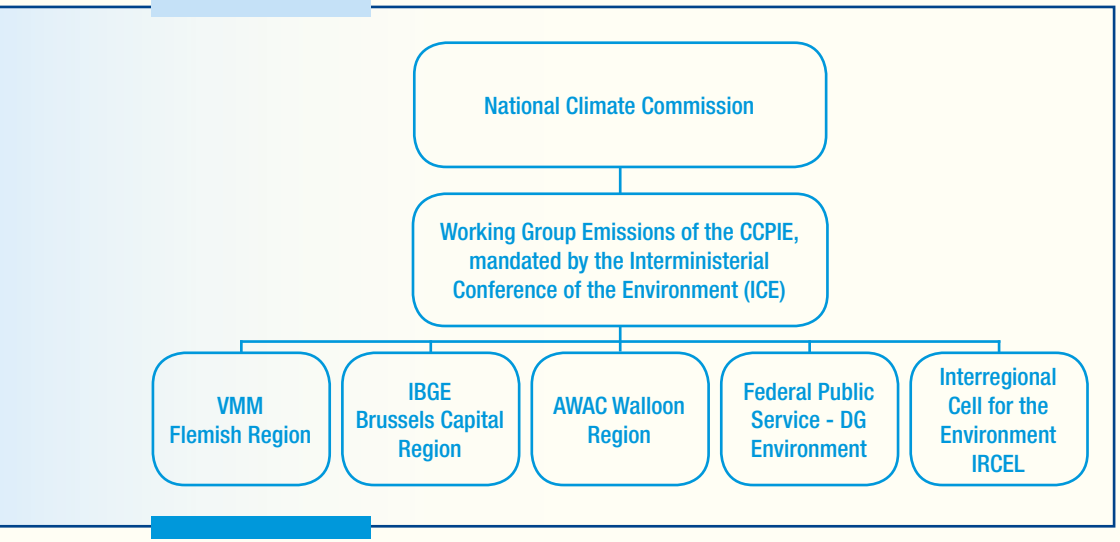
- The Department Air, Environment and Communication of the Flemish Environment Agency (VMM) in the Flemish Region;
- The Walloon Agency for Air and Climate (AWAC) in the Walloon Region;
- Brussels Environment (BIM-IBGE) in the Brussels Capital Region.

Each region has its own legal and institutional arrangements, which are detailed in the NIS.

The Directorate General Environment of the Federal Public Service for Health, Food Chain Safety and the Environment (FPS - DG Environment) is involved in its capacity of UNFCCC National Focal Point of Belgium and registry administrator.

The Directorate General Energy of the Federal Public Service Economy, SMEs, Self-employed and Energy (FPS - DG Energy) is responsible for the top-down estimation of energy-related CO_2 emissions using the IPCC 'reference approach'.

The Working group on Emissions of the Coordination Committee for International Environmental Policy (CCIEP) (referred to below as 'CCIEP-WG Emissions') plays a central role in the coordination of the national GHG inventory.



The Belgian Interregional Environment Agency (IRCEL-CELINE) is the single national entity with overall responsibility for the preparation of the Belgian GHG inventory. IRCEL-CELINE operates as national compiler of greenhouse gas emissions in Belgium.

The National Climate Commission is in charge of the approval of the inventory reports.

3.3.4 Process for the development of emission estimates

A general and detailed description of the methodologies can be found in the National Inventory Report submitted each year to the UNFCCC.

By intensively following regional, national and international workshops on estimating GHG emissions and sinks, the organisations responsible for establishing the emission inventory in Belgium keep in touch with all possible developments on that subject and try to optimise the emission inventory as efficiently as possible.

3.3.5 Key source identification

Key source categories are identified according to the Tier 1 methodology described in the IPCC 2006 Guidelines, Vol 1, Chap 4. Both a level assessment (contribution of each source category to the total national estimate) and a trend assessment (contribution of each source category's trend to the total trend) are conducted during each submission. A level assessment was performed for the years 1990, 2019 and 2020 and trend analysis was carried out for the years 1990-2019 and 1990-2020.

The key source analysis is realised on the basis of Table 4.1, page 4.8 of Volume 1 of the IPCC GPG 2006 guidelines. Each greenhouse gas emission from one single source category is considered separately. The key source analysis is performed by using CO_2-equivalent emissions calculated by means of the global warming potentials (GWPs) specified in the UNFCCC reporting guidelines on annual inventories. Because of its particular institutional situation (each region is responsible for the establishment of its own inventory), Belgium has decided to disaggregate the sectors to a greater extent than recommended in order to prevent some categories that could be of particular importance for a specific region being lost in the analysis.

The level assessment with LULUCF for 2020 results in the identification of 57 key sources, covering 95 %[8] of the total national aggregated emissions. These 57 key sources are to a large extent the same as those identified for the year 2019.

[8] This threshold (95 %) is recommended in the 2006 *IPCC Guidelines for National Greenhouse Gas Inventories*, for both the Level Assessment and the Trend Assessment; it was determined to be the level at which 90 % of the uncertainty in a 'typical' inventory would be covered by key source categories, for the Tier 1 method.

65 categories were identified as key source from the trend assessment with LULUCF 1990-2020 as those that contribute to 95 % to the trend of the inventory. There is a slight difference in amount between the trend assessments with LULUCF for the years 1990-2019 (61 key sources) and 1990-2020 and the key sources identified overlap to a large extent.

3.3.6 Recalculation

Recalculations of the GHG emissions in Belgium in accordance with the IPCC Good Practice Guidance and relevant decisions of the COP and/or COP/MOP, are carried out in the regional and national emission inventory. All recalculations of previous submitted estimates of GHG emissions by sources and removals by sinks are described yearly in the National Inventory Report (sections 3 to 10).

Many recalculations have been conducted as a result of the reviews of national greenhouse gas inventory data pursuant to Article 19(1) of Regulation (EU) No 525/2013 (ESD-review). Details are given in chapter 9 of the NIR 2022.

3.3.7 Quality assurance and quality control plan

Belgium did submit an updated QA/QC plan of the Belgian national system to estimate anthropogenic greenhouse gas emissions by sources and removals by sinks in accordance with Article 5, paragraph 1, of the Kyoto Protocol in April 2017.

Belgium is a federal state in which the competences are divided between four entities (see chapter 2.1).

The activities of these four bodies, as regards the preparation of the national GHG inventory based on the three regional emission inventories and the implementation and development of the QA/QC plan, are coordinated by the "Working group on Emissions of the Coordination Committee for International Environmental Policy (CCIEP)" (referred to below as "CCIEP-WG Emissions").

This group plays a central role in the coordination of the national GHG inventory. It is a permanent platform for the exchange of information between the National Climate Commission, the Energy Observatory, the Belgian UNFCCC National Focal Point, the Interregional Environment Agency (IRCEL/CELINE) and the three regions. All methodological aspects of the GHG inventory as well as the implementation and improvement of the national system, including the QA/QC plan, are coordinated by means of the CCIEP-WG Emissions referred to above. This working group meets on a regular basis and is responsible for coordinating all emission inventory tasks in Belgium. This group proposes a national inventory to the National Climate Commission (e.g. the Belgian political level) that submits the inventory and related documents to the UNFCCC-secretariat.

More information on the various actors can be found in the Belgian National Inventory System that was updated on the occasion of the 2017 submission to the UNFCCC-secretariat.

3.3.8 Procedures for the official approval of the inventory

After the national inventory is compiled, under the CRF format, the Belgian CRF-submission is first approved by the CCIEP-WG Emissions. Then it is transmitted to the National Climate Commission. All the mandatory reports in the framework of the UNFCCC, the Kyoto protocol and the European regulation 525/2013/EC concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol are subject to approval by the National Climate Commission. The final drafts of these mandatory reports are communicated for approval to the National Climate Commission two weeks before the due date for submissions. These draft reports may be amended at the request of the National Climate Commission. At least one week before the due date for the submission, the National Climate Commission gives its approval of the documents, which are then submitted to the UNFCCC Secretariat via the UNFCCC National Focal Point or to the EU Commission.

Timeline for the approval and submission of inventory data (year 20XX as last year available) and other information related to GHG inventories:

- 01/01/20XX+2: submission of inventory data and supplementary information to the NCC for approval (submission to the European Commission: 15/01)
- 01/03/20XX+2: submission of the final versions of the national inventory data, the NIR and supplementary information to the National Climate Commission (submission to the European Commission: 15/03);
- 31/03/20XX+2: submission of the final versions of the national inventory data, the NIR and supplementary information to the National Climate Commission (submission to the UNFCCC: 15/04).

3.4 National registry

3.4.1 The Belgian registry

The Belgian registry remains to be maintained in the consolidated Union Registry operated by the European Commission. Apart from the Belgian registry, the Union Registry also ensures the operation of the national registries of the other EU Member States as well as the registries of Iceland, Liechtenstein and Norway in a consolidated manner in accordance with all relevant decisions applicable to the establishment of Party registries - in particular Decision 13/CMP.1 and Decision 24/CP.8. The Union Registry ensures that the following conditions are met:

- Each Party retains the organisation designated as its registry administrator to maintain the national registry of that Party and remains responsible for all the obligations of Parties to be fulfilled through registries;
- Each Kyoto unit issued by the Parties in such a consolidated system is issued by one of the constituent Parties and continues to carry the Party of origin identifier in its unique serial number;
- Each Party retains its own set of national accounts as required by paragraph 21 of the Annex to Decision 15/CMP.1. Each account within a national registry retains a unique account number comprising the identifier of the Party and a unique number within the Party where the account is maintained;
- Kyoto transactions continue to be forwarded to and checked by the UNFCCC Independent Transaction Log (ITL), which remains responsible for verifying the accuracy and validity of those transactions;
- The transaction log and registries continue to reconcile their data with each other in order to ensure data consistency and to facilitate the automated checks of the ITL;
- The requirements of paragraphs 44 to 48 of the Annex to Decision 13/CMP.1 on making non-confidential information accessible to the public is fulfilled by each Party by means of a publicly available web page hosted by the Union registry;
- All registries reside on a consolidated IT platform sharing the same infrastructure technologies. The chosen architecture implements procedures to ensure that the consolidated national registries are uniquely identifiable, protected and distinguishable from each other, notably:

a) With regard to the data exchange, each national registry connects to the ITL directly and establishes a secure communication link through a consolidated communication channel (VPN tunnel);
b) The ITL remains responsible for authenticating the national registries and takes the full and final record of all transactions involving Kyoto units and other administrative processes in such a way that those actions cannot be disputed or repudiated;
c) With regard to data storage, the consolidated platform continues to guarantee that data is kept confidential and protected against unauthorised manipulation;
d) The data storage architecture also ensures that the data pertaining to a national registry are distinguishable and uniquely identifiable from the data pertaining to other consolidated national registries;
e) In addition, each consolidated national registry retains a distinct user access entry point (URL) and a distinct set of authorisation and configuration rules.

The following changes to the national registry of Belgium have occurred since the last submission in 2017.

Reporting Item	Description
15/CMP.1 annex II.E paragraph 32.(a) Change of name or contact	The postal address has changed since the last submission (please see the next section for all contact details).
15/CMP.1 annex II.E paragraph 32.(b) Change regarding cooperation arrangement	No change of cooperation arrangement occurred during the period covered by the report.
15/CMP.1 annex II.E paragraph 32.(c) Change to database structure or the capacity of national registry	The versions of the EUCR released after 8.0.7 – the production version at the time of the last submission – introduced some changes to the structure of the database. Most changes were limited and only affected EU ETS functionality (current version 13.6.1). No change was required to the database and application backup plan or to the disaster recovery plan. No change to the capacity of the national registry occurred during the period covered by the report.
15/CMP.1 annex II.E paragraph 32.(d) Change regarding conformance to technical standards	Changes have been introduced since version 8.0.7 (current version 13.6.1). Each release of the registry is subject to both regression testing and tests relating to new functionality. These tests also include thorough testing against the DES and were successfully carried out prior to the relevant major release of the version to Production. No other change in the registry's conformance to the technical standards occurred for the period covered by the report.

Reporting Item	Description
15/CMP.1 annex II.E paragraph 32.(e) Change to discrepancies procedures	No change of discrepancy procedures occurred during the period covered by the report.
15/CMP.1 annex II.E paragraph 32.(f) Change regarding security	The use of soft tokens for authentication and signature was introduced for the registry's end-users.
15/CMP.1 annex II.E paragraph 32.(g) Change to list of publicly available information	No change to the list of publicly available information occurred during the period covered by the report.
15/CMP.1 annex II.E paragraph 32.(h) Change of Internet address	The registry internet address changed during the period covered by the report. The new URL is: https://unionregistry.ec.europa.eu/euregistry/BE/index.xhtml
15/CMP.1 annex II.E paragraph 32.(i) Change regarding data integrity measures	No change of data integrity measures occurred during the period covered by the report.
15/CMP.1 annex II.E paragraph 32.(j) Change regarding test results	Changes have been introduced since version 8.0.7 of the national registry. Both regression testing and tests on the new functionality were successfully carried out prior to release of the version to Production. The site acceptance test was carried out by quality assurance consultants on behalf of and with assistance from the European Commission.

The website address of the Belgian registry is:

https://unionregistry.ec.europa.eu/euregistry/BE/index.xhtml

Several public reports regarding the registry (accounting/SEF reports, project information,…) are made available on the registry's general public website:

https://www.climateregistry.be/en/links-reports/links-reports.htm#KYOTO

3.4.2 The registry administrator

The Belgian Federal Public Service of Public Health, Food Chain Safety and Environment has been designated as registry administrator by Belgium to maintain its national registry:

Federal Public Service of Public Health, Food Chain Safety and Environment
DG Environment - Climate Change Section
The Registry Administrator
Avenue Galilée 5/2, B-1210 Brussels
tel: +32 (0)2 524 95 44
e-mail: helpdesk@climateregistry.be
website: https://www.climateregistry.be

Three persons have been designated as authorised representative of the registry administrator:

- Pieter Baeten
  tel: +32 (0)2 524 96 99
  e-mail: pieter.baeten@health.fgov.be
- Henri Kevers
  tel: +32 (0)2 524 95 21
  e-mail: henri.kevers@health.fgov.be
- Peter Wittoeck
  tel: +32 (0)2 524 95 28
  e-mail: peter.wittoeck@health.fgov.be

The registry administrator performs a wide range of tasks, the details of which are defined in the EU Emissions Trading Directive, the EU Registry Regulation, the Belgian Royal Decree on the registry and specific cooperation agreements between the Belgian Federal Government and the three Belgian regions in this regard[9]. ■

[9] https://www.climateregistry.be/en/registry/legal-framework.htm

4. Policies and measures

4.1 Policy-making process

4.1.1 Overall policy context

In accordance with the distribution of competences in Belgium, climate change policies and measures are developed by the Federal State and the three regions (Wallonia, Flanders, Brussels-Capital Region). Belgian climate and energy policy is shaped within the framework of the European Climate Law (Regulation EU/2021/1119), which is directly applicable to Belgium.

Cooperation bodies have been set up to harmonise and foster synergies between the policies and measures implemented by the various authorities. The National Climate Commission (NCC), which was established by a cooperation agreement[1],plays a central role in this regard.

In March 2021, an update of the Belgian national system for policies and measures and projections was reported, which describes Belgium's PAMs and Projections systems and QA/QC programmes in application of Article 39 of the Governance Regulation. An update of the system is expected in March 2023, in the context of the first integrated National Energy and Climate Progress Report (cf. chapter 4.1.3).

A National Energy and Climate Plan (NECP, cf. chapter 4.1.2.5) for the period 2021-2030 was adopted by the concertation committee in December 2019. The energy and climate plans of the different Belgian entities have been integrated within the NECP. It was drawn up jointly by a steering group established for that purpose within the Belgian energy policy coordination platform (CONCERE/ENOVER) and the NCC, which is composed of representatives of the climate and energy administrations of the three regions and the Federal State.

The primary aim of the NECP is to meet Belgium's commitments under the Governance Regulation 2018/1999/EU. This includes climate objectives established under the European Union's Effort-Sharing Regulation EU/2018/842 as well as the contributions defined under the Energy Efficiency (EU/2018/2002) and Renewable Energy (EU/2018/2001) Directives. This plan will be updated in 2023-24, also in line with the provisions of the Governance Regulation.

Belgium's 2030 commitments will be subject to internal burden sharing among the three Belgian regions and the Federal State (comparable with the Burden Sharing agreement of 12 February 2018 for the

[1] Accord de coopération entre l'Etat fédéral, la Région flamande, la Région wallonne et la Région de Bruxelles-Capitale relatif à l'établissement, l'exécution et le suivi d'un Plan national Climat, ainsi que l'établissement de rapports, dans le cadre de la Convention-cadre des Nations Unies sur les Changements climatiques et du Protocole de Kyoto

2013-2020 period). Negotiations on the Burden Sharing agreement for 2021-2030 are still ongoing, but a first partial political agreement has already been concluded[2].

For the period up to 2050, Belgium has set its sights on achieving the European objective of climate neutrality as expressed in the European Climate Law that applies to Belgium (cf. chapter 4.1.2.4).

4.1.2 National targets for GHG mitigation and long-term mitigation strategies

4.1.2.1 UNFCCC commitment

Belgium ratified the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol and the Paris Agreement in 1996, 2002 and 2017 respectively.

2nd Kyoto commitment period: 2013-2020

For the second commitment period of the KP (2013-2020), EU countries (together with Iceland) have agreed to jointly meet a 20% reduction target compared to 1990 (in line with the EU's domestic target of 20% by 2020). The 20% emission reduction target by 2020 is unconditional and supported by legislation in place in the context of the EU Climate and Energy package 2020. This joint target has been shared between two sub-targets, for emissions in sectors covered by the EU Emission trading system (ETS), and for sectors outside the ETS. The reduction target for ETS was established for the EU as a whole, while national targets were set up for non-ETS sectors (see further details in section below).

4.1.2.2 European Climate and Energy framework

As a Member State of the European Union, Belgium is committed to provide its contribution to the objectives of EU:

Three processes to reinforce the objectives in these areas took place in 2009, 2014 and finally 2020.

The objectives are evolving, as shown in the tables presented in Tables 4.1 and 4.2.

In March 2021, an update of the Belgian national system for policies and measures and projections was reported, which describes Belgium's PAMs and Projections systems and QA/QC programmes in application of Article 39 of the Governance Regulation.

The Governance Regulation (EU) 2018/1999 entered into force on 24 December 2018. The governance mechanism is based on integrated NECPs covering ten-year periods, the first starting in 2021 and encompassing the period up to 2030. It

[2] This agreement relates to the distribution of the 2021 and 2022 revenues from the auctioning of the ETS system, the dissolution of the "climate responsibility mechanism" and the sharing of the amounts relating thereto, the guarantee of a minimum Belgian objective in terms of renewable energies and international climate finance for the period 2021-2024.

Table 4.1 Synthesis of European objectives

	2020 Climate and Energy package	2030 Climate and Energy framework	European Climate Law and proposed Fit for 55 package	Climate Law
Year of proposal [0]	2009	2014	2020	2020
Time horizon	2020	2030	2030	2050
Reference year	1990 or 2005	1990 or 2005	1990 or 2005	N/A
Total reduction of GHG emissions	-20% (1990)	-40% (1990)	-55% net (1990)	Climate neutrality
- ETS [1]	-21% (2005)	-43% (2005)	-61% (2005)	
- non ETS	-10% (2005) [2]	-30% (2005) [3]	-40% (2005)	
EU Reference	2009/28/EC 2009/29/EC 2009/31/EC 406/2009/EC 2003/87/EC	EU 2018/842 EU 2018/841 EU 2003/87		EU 2021/1119
RES [4]	20% [5]	-32%	40%	
LULUCF: removals	not included	no debit rule	310 Mt	
EE [6]	-20%	-32.5%	-36/39%	

[0] The year of the proposals is indicative because it is often at the start of a simple communication. The various objectives then evolve over the course of the effective decisions in the following years.
[1] European Emissions Trading System (Directives 2003/87/EC and 2009/29/EC). It constitutes a key instrument to help energy-intensive sectors to improve their energy efficiency while optimizing costs
[2] Effort Sharing Decision 406/2009/EC
[3] Regulation (EU) 2018/842 of the European Parliament and of the Council of 30 May 2018 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No 525/2013. The EU target includes the contribution of the United Kingdom.
[4] Part of renewable energy sources in gross final energy demand
[5] Renewable energy Directive 2009/28/EC
[6] Energy efficiency: compared to the projected gross inland energy consumption (Primes 2007)

Table 4.2 Synthesis of Belgian objectives

	2020 Climate and Energy package	2030 Climate and Energy framework	Proposal: Fit for 55	LT strategy
Time horizon	2020	2030	2030	2050
Total reduction of GHG emissions				No national objective yet
- ETS [1]	(No national objective)	(No national objective)	(No national objective)	(No national objective)
- non ETS	-15% (ref. 2005) [2]	-35% (ref. 2005)	-47% (ref. 2005)	-85%--87% (ref. 2005; projection)
EU Reference	2009/28/EC 2009/29/EC 2009/31/EC 406/2009/EC	EU 2018/2001 EU 2018/2002 EU 2018/841 EU 2018/842	EU 2021/1119	
RES [3]	13% [4]			
LULUCF: removals	not included	no-debit rule	increase of the sink by 320 kt	
EE	-18%	15% PEC, 12% FEC		

[1] An essential element of Belgium's climate policy relies upon the European Emissions Trading System (Directives 2003/87/EC and 2009/29/EC). It constitutes a key instrument to help energy-intensive sectors to improve their energy efficiency while optimising costs

[2] Effort Sharing Decision 406/2009/EC
[3] Part of renewable energy sources in gross final energy demand
[4] Renewable energy Directive 2009/28/EC

also includes the need for EU and national long-term strategies, as well as integrated reporting, monitoring and data publication. Member States had to submit their draft national energy and climate plans by the end of 2018 and their final plans by the end of 2019. An update of the NECPs is expected in by June 2023 (draft) and June 2024 (final version). The 2030 targets still need to be shared between the 4 authorities in a new 'burden sharing' agreement between all 4 authorities.

An essential element of Belgium's climate policy relies upon the European Emissions Trading System (Directives 2003/87/EC and 2009/29/EC). It constitutes a key instrument to help several key sectors to improve their energy efficiency while optimising costs namely energy intensive industry, electricity production and aviation.

A single EU-wide cap on ETS emissions applies since 2013. In Belgium, the regions are responsible for the implementation of the ETS and for monitoring of ETS emissions.

4.1.2.3 Belgian sustainable development strategies

Different strategies in relation to sustainable development have been adopted by the respective levels of power:

- Federal State: the *Long-term Vision for Sustainable Development* adopted in 2013 which identifies 55 long-term objectives and the *4th federal sustainable development plan* adopted the 1 October 2021 for the 5 next years;
- Flanders: in November 2021 the fourth Flemish strategy for sustainable development was adopted;
- Wallonia: the third Walloon strategy for sustainable development was adopted in September 2022;
- Brussels-Capital Region: the regional sustainable development plan;
- German-speaking Community: the second regional development plan.

4.1.2.4 Belgian long-term strategies

Following the European Climate Law, the climate neutrality target on the EU-level by 2050 also covers Belgium. In February 2020, Belgium submitted its national "long-term strategy" to the European Commission. This was communicated to the UNFCCC secretariat by 10 December 2020.

The strategy includes several emissions reduction objectives for 2050 and details a variety of supporting measures across the electricity, industry, building, transport, agriculture and waste sectors. The strategy is based on the long-term strategies of the regional governments and specifies several areas of action for the federal government. The Long-term Strategy of Wallonia aims to achieve carbon neutrality by 2050 through a reduction of GHG emissions by 95% compared to 1990, supplemented by Carbon Capture, Utilization, and Stor-

Table 4.3 Belgium's estimated emission reductions

Emission source	Reduction in 2050 versus 2005
Electricity	-100%
Transport	-100%
Industry (non-ETS)	-76% to -83%
Buildings	-89% to -91%
Agriculture	-45% to -51%
Waste	-95% to -98%
Total non-ETS	-85% to -87%

Table 4.4 Summary table of the main objectives, policies and measures of the BE NECP

Dimension	2030 objective	Remarks
Decarbonisation		
GHG-ESR	-35%	compared to 2005
LULUCF	No debit	
RES	17.5%	of gross final energy consumption
Energy efficiency		
Primary energy consumption	42.7 Mtoe	i.e. -15% compared to BAU Primes 2007 in 2030
Final energy consumption	35.2 Mtoe	i.e. -12% compared to BAU Primes 2007 in 2030
Cumulative amount of energy savings (Article 7 of the Energy Efficiency Directive)	185 TWh	

age (CCUS) and negative emissions. The Long-term Strategy of Flanders aims to reduce GHG emissions from non-ETS sectors by 85% by 2050 compared to 2005, with the ambition to move towards carbon neutrality. The Climate Ordinance of the Brussels-Capital Region aims to reduce GHG emissions by 90% by 2050 compared to 2005.

Table 4.3 summarises the (range of) estimated emission reductions at the national level.

Although the strategy is intended to put Belgium on a path that supports achievement of the Paris Agreement's goals, the strategy does not include an overall long-term national emission reduction target in 2050, as ETS is not included in all regional strategies.

The Consultation Committee ("Comité de concertation"/"Overlegcomité") considers the national strategy as a minimum commitment and has undertaken to update it on a regular basis. At this stage, no update has been scheduled.

4.1.2.5 Belgian National Energy and Climate Plan

NECP 2021-2030

In order to achieve its national target under the Effort Sharing Regulation of -35% (compared to 2005), as well as objectives regarding renewable energy and energy efficiency, Belgium adopted its NECP 2021-2030 in December 2019, the main objectives of which are shown in Table 4.4.

With the adoption of the EU Climate Law, the EU objective for 2030 was further increased to a net reduction of 55% compared to 1990. Negotiations on the Fit for 55 package of legislative proposals which implements this 55%-objective are still ongoing. The Belgian targets will therefore have to be modified and the PAMs will have to be strengthened in a revised NECP.

Federal State

In accordance with the Cooperation Agreement on the national burden-sharing 2013-2020, the federal government is committed to pursue existing policies and measures allowing a total emission reduction of 15 250 kt CO_2 eq for 2013-2020 and to implement new policies and measures resulting in an additional reduction of at least 7 000 kt CO_2 eq for the period 2016-2020. A set of new federal PAMs was identified, which includes following PAMs: positive mobility allocations, incentives for electric bicycles, energy saving in railways as well as the implementation of new EU legislative instruments in the field of product policy and fluorinated gases.

In the updates of the NECP, the federal government agreement expressed its commitment to align its contribution with the -55% target by 2030 by means of an action plan and, to that end, is taking the measures for which it is responsible.

In this context, the federal government wants to raise the level of ambition embodied within the federal climate policy and commits itself to:

1. Implement as soon as possible all policies and measures included in the federal contribution to the current NEPP 2021-2030.
2. Develop and implement enhanced and new policies and measures that aim to achieve additional emission reductions in the non-ETS sector. These strengthened or new policies and measures will include the greening of taxation (including the reform of the company car tax regime), the climate bonus (in line with European decision making), transport (including the development of a regime for carbon neutral fuels), buildings, and product standards;
3. Strengthen existing measures or develop new ones to support the reduction of emissions in the ETS sector during the period 2021-2030, in particular by increasing power generation capacity in the North Sea and phasing out fossil fuel subsidies, preferably in the European context;
4. Put in place enabling policies and measures that contribute to creating an enabling framework to fully realise the potential of the federal and regional emission reduction measures. These measures concern in particular the strengthening of the electricity transmission network, the establishment of a framework for developing hydrogen in the energy transition, the establishment of a sustainable financing strategy, the circular economy initiatives, etc.

As input to the revision of the federal contribution to the NECP, the general public will be consulted. A national public enquiry was already held during the preparation of the NECP 2021-2030. Once again, the choice will be made to organise a national public enquiry with the integration of a series of questions regarding federal matters. If not, a separate federal public enquiry will be set up. Selected stakeholders will be consulted by seeking recommendations from the representative advisory councils as well as by means of a multi-level climate and energy dialogue named climate round tables. These round tables will be organised on specific federal themes and will involve stakeholders, experts and the responsible administrations.

Flemish Region

In June 2013, the Flemish Government formally adopted its "Flemish Climate Policy Plan 2013-2020", or "Vlaams Klimaatbeleidsplan/VKP 2013-2020". The plan consisted of an overall framework and two separate but closely related sections:

– The Flemish Mitigation Plan (VMP): the purpose of the VMP was to reduce emissions of greenhouse gases in Flanders between 2013 and 2020 as a means of combating climate change.
– The Flemish Adaptation Plan (VAP): the purpose of the VAP was to address Flanders' vulnerability to climate change and subsequently improve its ability to defend against its effects.

An English summary of the VKP 2013-2020 is available online.

The VMP was a strategic policy plan with measures for the non-ETS sectors in the Flemish Region from all relevant Flemish policy fields and was linked to the Flemish government's broader policy. The plan contained actions from all the relevant areas of competence. It contained Flanders' contribution to the European and international commitments for the period 2013-2020.

For the period 2021-2030, the Flemish Government adopted the Flemish Energy and Climate Plan, which was then incorporated into the National Energy and Climate Plan. In November 2021, the Flemish Government agreed on a series of additional measures that would further reduce greenhouse gas emissions within the Flemish Region. The greenhouse gas reduction target was raised to a reduction of 40% by 2030 (compared to 2005), in the case of emissions not included within the EU's Emission Trading System.

The Flemish Energy and Climate Plan is recognised as a transversal policy programme. In December 2021, the Flemish Government adopted the Framework of Arrangements, which lays down how the plan will be implemented in the coming years. It also contains provisions regarding annual progress reports, the involvement of stakeholders and the upgrade planned in 2023-24. In March 2022, the Flemish Government took additional measures in relation to renewable energy as a response to the Russian invasion of Ukraine. These additional measures will be included in the update of the Flemish Energy and Climate Plan in 2023-24.

Walloon Region

In Wallonia, air quality and climate change policies are the object of a Walloon Air-Climate-Energy Plan notably aiming at the compliance with the commitments of Wallonia in the framework of the Kyoto Protocol. Measures are implemented and monitored by the respective administrations in charge of those plans. The Walloon Agency for Air and Climate is in charge of the coordination, covering all aspects of those plans in relation with air quality and climate change. Regional Ministers are regularly informed of implementations and progress.

The current plan adopted covered the period 2016-2022. A new Plan, covering the period 2021-2030 is under construction on the basis of the NECP, of citizens' proposals (an assembly of 50 randomly selected citizens, who made 168 proposals to the Walloon Minister of Climate) and various sectoral consultations.

Brussels Capital Region

a) Brussels National Energy & Climate Plan (NECP)

On the 24 October 2019, the Government of the Brussels Capital Region adopted its contribution to the Belgian National Energy and Climate Plan. This contribution, which is included in the Belgian NECP (see above, aims, by 2030, to achieve at least a reduction in final energy consumption of at least 21% (compared to 2005), and 40.8% of greenhouse gases emissions (also compared to 2005).

b) Brussels' climate ordinance and the Air-Climate-Energy Plan

To meet all the challenges related to energy consumption, renewable energy, climate change and air quality, the Brussels-Capital Region has developed an integrated approach which has already been expressed in a regulatory document (Brussels Air, Climate and Energy control Code – COBRACE; see NC7 for more details) and its related plan: the so-called Air-Climate-Energy Plan (ACEP).

The most recent modification of the COBRACE consists of the climate ordinance of 17 June 2021, which includes into the Code new ambitious binding climate objectives for 2030, 2040 and 2050, a new committee of independent climate experts, and defines the articulation between the air-climate energy plan and the National energy and climate plan (NECP – see above). These objectives are the following: a reduction of its total direct GHG emissions (i.e. ETS + non-ETS) of at least -40% for 2030, -67 % for 2040 and -90% for 2050, in comparison with 2005; a comparable reduction trajectory for its indirect emissions of GHG, i.e. emissions produced outside the regional territory by its activities, by 2050. The mission of the committee of climate experts, made up of scientific and independent experts, is to assess the adequacy of regional policies and measures with regard to climate objectives, through the drafting of an annual report evaluating the contribution of regional public policies to medium-term climate objectives.

The ACEP currently in force, which was adopted in 2016, recalls the Brussels-Capital Region objectives for 2025 and is intended to set up the measures to be implemented in 2020 with regard to energy (including renewable energy), climate change mitigation and adaptation and air quality. The plan defines 144 actions into 64 measures which are declined into 10 areas of focus: building, transportation, renewable energy, economy, global city planning, consumption, social dimension, climate change adaptation, air surveillance and international mechanisms. It is currently being revised and its ambition will be increased to contribute to the FF55 dynamics energy and climate; its content will be integrated into the update of the National Energy and Climate Plan to be delivered in June 2023 (draft) and June 2024 (final).

4.1.3 System for monitoring and evaluation of policies and measures

The national system for policies and measures and projections represents the institutional, legal, and procedural arrangements established for reporting on policies and measures and projections of anthropogenic emissions by sources and removals by sinks of greenhouse gases not controlled by the Montreal Protocol, in accordance with Article 39 of the EU Governance Regulation (2018/1999). It seeks to ensure the timeliness, transparency, accuracy, consistency, comparability and completeness of the information on policies and measures and projections reported by Belgium pursuant to Article 18(1)(a) and Article 18(1)(b) of the Governance Regulation (GovReg). A full and detailed description of the national system is given in the report of March 2021 "Reporting on national system for policies and measures, and projections" under Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action. An update of the system is expected in March 2023 in the framework of the first integrated National Energy and Climate Progress Report.

In accordance with the cooperation agreement of 14 November 2002, the Regions and the Federal State are committed to evaluating the progress and implementation of their policies and measures in a harmonised way, including by estimating their impact in terms of GHG emission reductions.

Methodologies vary depending on the domain targeted and the availability of data, but are harmonised as much as possible among the different entities, in order to ensure comparability and the ability to identify the most efficient measures.

To that end, the National Climate Commission has created an ad-hoc working group (WG PAMs), gathering representatives of each entity and various administrations concerned by elements of the NECP. In particular, the group integrates representatives of the energy administrations in charge of monitoring and reporting the energy efficiency action plan established in the framework of Directives 2006/32/EC 2012/27/EU and 2018/2001/EU relative to energy efficiency and services, to ensure a necessary harmonisation of methodologies, hypotheses and parameters between climate and energy policies quantifications.

Federal State

Successive studies have been commissioned to quantify the impact of federal measures in terms of greenhouse gas emission reductions. These studies evaluated the effect of the federal measures on expected emission reductions up to 2020 and estimated the remaining impact up to 2050 assuming the measure being withheld after 2020.[3] The socioeconomic impact of some federal PAMs has also been evaluated. The most recent study ("Update of

[3] See the different reports on http://ww.climat.be/evaluation-PAMs (FR) or http://ww.klimaat.be/evaluatie-PAMs (NL), reports are in EN

the impact assessment of federal Policies and Measures", ICEDD - Gauss - TML – VITO) was finalised in June 2021. The socio-economic aspect in that regard was not especially developed, as the priority was given to the methodology for estimating emission reductions from new PAMs and updating old ones. Future studies may provide further information in that regard.

In 2021, the Federal Government has put in place a governance framework with the objectives to confirm and operationalise the government's climate ambition, to mainstream climate within its public policy and to establish of a governance framework with half-yearly evaluation based on roadmaps. These roadmaps are drawn up in consultation between the ministers and departments concerned, according to an iterative process. The monitoring cycle seeks to provide a status of progress every 6 months, based on monitoring tables on the one hand and written progress reports on the other, which will lead to the drawing up of a public summary report that consolidates the content of those progress reports. The summary report is sent to the parliament and to advisory bodies and should serve as an input during a possible revision and/or reinforcement of the measures by the Council of Ministers three months after its publication. The first synthesis report 2022 is now available (FR/NL).

Flemish Region

By means of a progress report, the Flemish Government is informed annually about the progress of the Flemish Energy and Climate Plan (VEKP 2021-2030), the evolution of the Flemish greenhouse gas emissions and the progress of the objectives and measures.

The VEKP 2021 progress report (approved on 16 July 2021) is structured in two major parts:

- an analysis of the evolution of greenhouse gas emissions in the Flemish Region,
- a state of affairs regarding the substantive progress of the measures for non-ETS sectors and LULUCF from the Flemish Energy and Climate Plan 2021-2030 (VEKP). The appendix to the progress report contains more detailed information per VEKP measure, including the status, progress and outlook for the coming year.

A new progress report is being prepared in the autumn of 2022. It will serve as the basis for the Flemish contribution to the first integrated National Energy and Climate Progress Report in 2023.

Walloon Region

The Walloon region has recently acquired a centralised project management tool. Each project carried out by the Walloon administration may be described in the form of indicators. These indicators will be useful as a means of systematising and simplifying data collection. This should eventually make it possible for the measures and actions implemented in the Walloon region to be monitored more closely.

Brussels Region

The Climate Ordinance of 17 June 2021 significantly strengthens regional climate governance by integrating new provisions into COBRACE. These changes include setting targets for reducing direct and indirect regional greenhouse gas emissions and provides the region with a committee of climate experts. It provides reports assessing the contribution of regional public policies to climate objectives, including recommendations. This reports, once the committee in place, will be available to the Brussels government and parliament on 31 March each year.

4.2 Domestic and regional programmes and/or legislative arrangements and enforcement and administrative procedures

4.2.1 Description of domestic legislative arrangements to meet the Kyoto Protocol commitments

According to the Kyoto Protocol reporting guidelines (paragraph 37), Belgium must draw up a report describing all the domestic and regional legislative arrangements and all the enforcement and administrative procedures to be put in place, how they are implemented and which procedures apply for addressing cases of non-compliance under the Belgian legal framework.

4.2.1.1 Cooperation Agreement of 14 November 2002

The legal basis for the obligation to evaluate the policies and measures (PAMs) is the Cooperation Agreement of 14 November 2002 between the Federal State, the Flemish Region, the Walloon Region and the Brussels Capital Region, which provides that a National Climate Plan must be drawn up, executed, evaluated and reported to the UNFCCC under the Kyoto protocol.

This Agreement also originates from the obligation to apply European Decision 280/2004/EC (replaced by Regulation (EU) No 525/2013 or MMR, then by Regulation (EU) No 2018/1999 or Governance Regulation) establishing the mechanism for monitoring and reporting greenhouse gas emissions in the European Community and for implementing the Kyoto Protocol.

And precisely, as requested by Article 39 of the Governance Regulation, Belgium has set up a national system for policies and measures and projections.

4.2.1.2 Cooperation agreement 'Burden Sharing'

The cooperation agreement on the Burden Sharing (2013-2020) provides the legal basis for the decisions to be taken to honour the commitments entered into by Belgium under the 2013-2020 European Energy & Climate Package. The negotiations on the Burden Sharing 2021-30 are ongoing.

4.2.1.3 Mechanism for increasing awareness of climate responsibility among the Regions for the building sector

For more explanation, see chapter 4.2.1.3 in NC7.

The recent political agreement concluded on 14 September 2022 provides for the abolition of the mechanism, the effective implementation of which has proved impossible. A solution to distribute the amounts blocked so far has been found, which deviates from the distribution provided for by the mechanism.

4.2.1.4 Substitution right for international obligations under the UNFCCC and its Protocols

The 'substitution right' is a mechanism introduced into Belgium law, with the aim of ensuring Belgium's compliance with its international obligations. Under Belgian domestic law, competences that are attributed exclusively to an entity mean that it is competent for compliance with the obligations in the same field of competence at national, European and international level, to the exclusion of other entities. However, international public law does not allow federal states to withdraw from their international obligations on the basis of domestic law arrangements, as specified in Article 27 of the Vienna Convention on the Federal State vouches for international law violations on the part of federal entities. The right of substitution was introduced in order to remedy the contradiction between Belgium domestic law and international and European law. This right is now extended more specifically to Belgium's international obligations under the UNFCCC and its Protocols (Article 16(4) of the Special Institutional Reform Law of 8 August 1980). In principle, this right enables the Federal State, under strict conditions, to substitute its action for the non-action of a federal entity when it is the subject of a non-compliance assessment reported by a relevant body under the UNFCCC or its Protocols. This mechanism also applies to European law obligations aiming at implementing the UNFCCC and its Protocols.

4.2.2 Access to information

Public access to environmental information in Belgium, including legislative instruments, policies and measures developed under the Kyoto Protocol, is regulated at federal level and in the Regions by the legislation transposing European Directive 2003/4/EC on public access to environmental information (based on the first pillar of the Aarhus Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters). This has been reflected in various legislative and regulatory initiatives at both federal and regional levels.

The website of the National Climate Commission offers most of the relevant information on Belgian climate policy.

4.2.3 Participation in the Kyoto mechanisms

The repartition of competence concerning approval of project activities is stipulated in a Cooperation Agreement between the Federal Government and the 3 Regions of the country concerning the implementation of certain provisions of the Kyoto Protocol (19 February 2007).

4.2.3.1 Designation of DNA/DFP

On 8 March 2007, Belgium notified the UNFCCC that its National Climate Commission (NCC) had been legally designated as national Focal Point (FP) and Designated National Authority (DNA) for JI and CDM project activity approval.

The approval procedures are published on the website of the National Climate Commission.

4.2.3.2 Distribution of authority for the approval of project activities

According to Article 1, Section 27, of the 'Flex Mex' Cooperation Agreement project approval constitutes written authorisation enabling one or more persons to participate in a project activity.

Article 5 of this Agreement specifies the cases in which the federal or regional authorities are authorised to grant approval. According to Article 7, the activities not covered by any of these categories are approved by the National Climate Commission.

4.2.3.3 Approval procedures

The Regions, the Federal Government and the National Climate Commission have adopted their procedure and approval criteria.

4.2.4 Information on Articles 3(3) and 3(4) of the Kyoto Protocol

4.2.4.1 Trends

The LULUCF sector as a whole (CRF category 4) was a net removal of 335.86 kt CO_2 eq. in Belgium's submission of May 2022.

Regarding Art. 3.3, Afforestation, Reforestation and Deforestation, there is an overall balance between afforested and deforested areas (see the National Inventory Report, section 10.2.4), as confirmed by the stable forest area observed in forest inventories. However, due to accounting rules (instantaneous oxidation in the case of deforestation), this results in net emissions of 446.93 kt CO_2-eq. under Art 3.3.

Regarding Article 3.4, Belgium did not elect any activity, so Forest Management is the only relevant category. In 2020, Forest management resulted in a net sink of 1 578.43 kt CO_2-eq., compared to a current forest management reference level of 2 499 kt CO_2-eq. However, Belgium will only submit an account at the end of the commitment period and a technical correction of the FMRL (Forest management reference levels) of 1 010.17 kt CO_2-eq. was proposed in the NIR 2022 (section 10.5.4.4).

4.2.4.2 Forest management

In Wallonia, the Forest Code (Decree of 15 July 2008) has introduced a certain number of constraints in favour of forest conservation and the maintenance of ligneous materials and carbon, including: the abolition of inheritance duties on the stumpage value, which encourages more ecological forestry choices, restriction of clear-cutting; obligation to plant species suited to the site, creation of integral reserves; draining limitation. The designation of 1 500 km² of forests in Natura 2000 under special fixed rules of management also contributes to the various objectives of the Forest Code in Wallonia. Many areas are also certified under PEFC management standards.

In the Brussels Capital Region, the Sonian Forest (Forêt de Soignes/Zoniënwoud) is protected (no deforestation allowed) and FSC certified. Its management aims to ensure ecological stability and a long-term balance in the distribution of forest age, taking into account biodiversity, ecological and social aspects.

Forest policy in the Flemish Region focuses on the qualitative and quantitative dimensions of forests. A plan for forest expansion has been developed with the involvement of all stakeholders and aims at an increase of forest area with 3% by mid-2024 (baseline is 2019) and with 7% by 2030 (baseline of 2019). This exceeds the global target sets in the United Nations Strategic Plan on Forests (Global Forest Goal 1; target 1.1) The area of land occupied by forests will be increased by 3 per cent worldwide (until 2030) (based on the Global Forest Resources Assessment 2015). Insights with regard to the state of and changes within forest ecosystems in Flanders can be obtained when comparing results of the Flemish Forest Inventory. This is a policy-supporting monitoring network on a large spatial scale (Flanders) and on a large temporal scale (ten years). The first cycle was completed between 1997-1999. The second cycle ran from 2009 until 2018 and the third cycle began in 2019. A comparison of the results of the Flemish forest inventory shows that the volume of standing timber per hectare increased very markedly between the first two measurement cycles. The composition of tree species changed substantially between the first two measurement cycles. The share of hardwood tree species is increasing at the expense of coniferous wood. Homogeneous pine and poplar stands are being converted into mixed stands. The forest inventory shows that the proportion and volume of dead wood in forest has increased. Dead wood is an important parameter for biodiversity in forest ecosystems. The number of tree species per forest type has increased, but the number of herbaceous species has not. The number of herba-

ceous plants typically encountered in old forests is increasing, also in more recent and therefore younger forests. Calculated indices indicate that the naturalness of Flemish forests has increased. The Flemish forests are however darkening (which follows the trend that trees in forests are aging) but the share of species that react positively to influx of nitrogen increased. The impact of nitrogen on the species composition of herbaceous species is clearly visible: the number of nitrogen-loving species is increasing, and the effect is greater in the forest edge. In 2017 the system of forest management planning is integrated with the management planning system of biodiversity conservation areas. With this movement, biodiversity concerns are fully mainstreamed into forest management.

4.2.5 International transport

4.2.5.1 International aviation

Belgian climate policy measures for international aviation are mainly based on European and international (ICAO) policy.

Since 2012 the European Emissions Trading Scheme for aviation is operational in all EU Member States and limits the CO_2-emissions from flights within the European Economic Area (EEA) to 90% of the average emissions in the period 2004-2006.

From 2021 onwards, all EU Member States are participating – on a voluntary basis – in the pilot phase of CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation), the global market-based measure from ICAO which intends to reach global carbon neutral growth from 2019/2020 onwards. EU Member States also implement the technical measures and standards (e.g. CO_2 standard for aircraft, fuel and energy planning) adopted by ICAO, to limit fuel consumption by aircraft.

EU climate policy for aviation will be strengthened in the coming years, as part of the Fit for 55 legislative package proposed by the European Commission in July 2021 and is currently subject to the legislative procedures in the European Parliament and Council. Amongst other things, this includes the strengthening of the EU emissions trading scheme for aviation and measures to boost supply and demand of sustainable aviation fuels.

Belgium supports the ongoing revision of the Single European Sky aiming to improve its environmental performance. New projects were also initiated in order to improve the flight efficiency in Belgian airspace and facilitate the deployment of Sustainable Aviation Fuel at Brussels-National Airport.

As a first step to discourage short flights, a tax on boarding an aircraft when a passenger departs from an airport located in Belgium was recently introduced. With this measure, we want to encourage travellers to consider more sustainable alternatives for journeys of less than 500 kilometres.

4.2.5.2 International shipping

On 1 January 2018, MRV (Monitoring, Reporting and Verification of emissions from ships) entered into force. This introduces obligations for ships over 5000 gross tons that call at ports in the European Economic Area. Work on amending this Regulation is currently ongoing.

The first internationally agreed binding measure, the Ship Energy Efficiency Plan (SEEMP) guidelines for all ships over 400 gross tons are currently undergoing an update. Apart from this, new ships already have to comply with standards set out in the Energy Efficiency Design Index (EEDI), whilst existing ships will have to comply with standards set out in the Energy Efficiency Existing Ship Index (EEXI). Both documents are addressing the technical efficiency of ships. IMO has adopted a rating system addressing the operational efficiency for ships over 5000 gross tons in the form of an operational carbon intensity indicator (CII). The EEXI and CII measures will enter into force from 1 January 2023 onwards.

In 2016, the IMO adopted a Data Collection System similar to the European MRV. It is more inclusive but less ambitious with regard to certain aspects. Work on amending this system is currently ongoing.

In 2018, the IMO adopted the Initial Strategy on reduction of greenhouse gas emissions from ships. The Initial IMO Strategy indicates that a revised Strategy should be adopted in 2023 in line with the roadmap. Work on the revision of the strategy is currently ongoing.

As part of the Fit for 55-package proposed by the European Commission in July 2021, shipping between EU ports as well as (part of) international shipping will be covered under the EU Emission Trading System, thereby introducing a carbon cost for maritime transport. The details of the legislation are still being negotiated.

4.3 Policies and measures and their effects

4.3.1 Overview of the main PAMs - PAMs reported in the CTF Table 3

The NECP is structured in accordance with Annex 1 of Governance Regulation (EU) 2018/1999. CTF Table 3 summarise the PAMs identified in the NECP that contribute the reducing GHG emissions. Some measures from the previous climate plan are also included in CTF Table 3 insofar as they were not included in the new NECP and continue to produce effects in terms of emission reductions (see previous BR for more details).

A more extensive table of the PAMs is used to track them which corresponds to EU reporting under Article 18(1)(a) of the Governance Regulation available on Reportnet 3. The NECP consists of various measures, some of which reinforce each other.

As the list of Belgian PAMs is quite long, an overview of the main measures at sectoral level that deliver the largest reduction is set out below.

Although these measures lead to the largest emission reductions overall, not all of them have quantitative estimates. In CTF Table 3, the quantitative estimates concern 48 PAMs or clusters of PAMs, of which 8 deliver more than 70% of the emission reductions (PAMs n°1, 2, 29, 35, 46, 48, 206 and 207). See also section 5.2 for some other considerations and section 4.1.3 for the methodology. The vast majority of policies and measures address issues relating to energy conservation in all sectors. In particular, the following major measures are expected to provide essential emission reductions:

ENERGY

Energy production: Most of the PAMs are aimed at the development of renewable energy sources (RES) and some still focus on promoting high-efficiency Combined Heat and Power (CHP) systems to produce electricity. The main instruments implemented are markets of green certificates (covering both RES and CHP in Wallonia and Brussels, with a separate CHP certificates market in Flanders). For RES, Flanders uses subsidies for the promotion of solar and onshore wind energy. The promotion of offshore wind farms and biofuel blending also constitutes an essential tool for RES development.

The EU emission trading system, and the carbon price it includes for the electricity production, is also an important driver for the development of renewable energy.

Energy conservation in buildings: Measures to promote rational energy use and the use of renewable energy sources in buildings focus on transposing the European Directives on the energy performance of buildings and improving energy efficiency. These tools provide a timetable for the entry into force of increasingly stringent energy standards for new constructions and thorough renovations, including heating and hot water production facilities and financial support for upgrading the energy efficiency of existing buildings.

In the medium and long term, the mandatory preparation of an energy certificate for any building prior to a transaction (sale, rental) should offer a way of giving added value to the most efficient buildings. The improvement of existing residential buildings may, among other things, be eligible for regional subsidies and low-interest loans. In Flanders, a renovation obligation exists for residential and non-residential buildings with a low energy performance after ownership is transferred by a civil-law notary.

INDUSTRY / INDUSTRIAL PROCESSES

In industry, the European Emission Trading System (ETS) is a major tool for reducing greenhouse gas emissions in the most cost-efficient way. A second crucial tool is the sectoral agreements drawn up between the regional governments of Flanders and Wallonia (the industrial sector of Brussels being very small) and their industries to improve energy efficiency and reduce greenhouse gas emissions. These agreements also notably contain requirements paving the way for opportunities to use RES and CHP sources and (in Wallonia) develop "CO_2 mapping" of the activity of industrial sites or commodity chains. In addition, specific sectoral measures are taken to reduce other greenhouse gas emissions such as F-gas, CH_4 and N_2O emissions.

TRANSPORT

In the transport sector, the initiatives undertaken by the Federal and Regional Governments mainly focus on:

- Limiting road-traffic growth for freight transport, and incentivising the "modal shift" (towards rail or waterways) and by investing in greener freight transport (e.g. using low-carbon vehicles)
- Limiting car use by incentivising a "modal shift" for passenger transport, e.g. improving public transport and upgrading biking or pedestrian infrastructure;
- Encouraging drivers to acquire and use low-carbon vehicles (information, tax incentives, low emission zone across the entire territory of the Brussels-Capital Region, deployment of a charging infrastructure for electric vehicles) and to optimise their use (eco-driving, car-sharing, etc.). Following the proposed Fit for 55-package, the sale of new passenger vehicles and vans with an internal combustion engine will be banned in the EU by 2035. A more rapid phase-out is currently being considered by some Belgian governments.

Emissions from the transport sector have been increasing over time until 2015. Particular efforts are seeking to encourage modal shifts from road to rail or inland waterways transport, both for persons and goods. Since April 2016, the Kilometre Charging System for heavy goods vehicles of more than 3.5 tonnes in the Flemish, Walloon and Brussels Regions took effect.

Fiscal measures have enabled a significant improvement in energy efficiency of road vehicles, focusing on the support for very low-consumption models, while penalising models with a high energy consumption.

Belgium is also in the process of producing and distributing increasing quantities of biofuels.

AGRICULTURE AND FORESTRY

Initiatives in the agricultural sector focus on reducing greenhouse gas emissions by improving agricultural practices (reduction in the use of mineral fertilisers, the storage and spreading of manure, waste recovery, avoiding the ploughing up of permanent grassland, combating soil degradation, etc.) and energy efficiency in horticulture (mainly situated in Flanders). Reforestation and forest conservation are encouraged through specific legislation.

WASTE

The policies implemented to reduce the volume of waste and optimise its treatment are based on environmental taxation (promoting reusable packaging), stricter regulations (a ban on landfill, rules governing organic waste, the recovery and use of biogas from solid waste deposits for energy production, electricity production in waste incineration plants) and the development of specific channels for enhanced waste recovery and treatment.

AVIATION AND MARINE BUNKER FUELS

International shipping and aviation are not covered by the Member States' non-ETS climate target.

Taking into account the international character of shipping, measures should be taken on an international or at least at EU level. Policy is therefore largely organised on an international and EU level. For the maritime sector, at national level, a study was completed and published in March 2021 that analysed the reduction potential of various technical and operational measures for vessels smaller than 5000 GT. These vessels include domestic maritime navigation, international maritime navigation on Belgian territory, estuary shipping and recreational shipping. This study may be useful to stakeholders when considering investments in/decisions concerning GHG emission reduction technologies. Until final decisions are made regarding the scope of EU and IMO measures, the study can also serve as a basis on which to consider further national measures.

Similarly, Belgium insists that the aviation sector makes specific commitments and develops a roadmap to substantially reduce its greenhouse gas emissions. Currently, the low availability and high cost of alternative fuels are two of the obstacles to their deployment. In order to improve the accessibility of alternative fuels at Brussels Airport, Belgium is taking several actions: on one hand, the integration of clauses in the tender for the new refuelling contract to allow for a rapid transition to sustainable aviation fuels; and, on the other hand, the granting of subsidies for pilot projects facilitating the supply of those fuels at the airport with the aim of neutralising their current additional cost. Other initiatives have also been launched in order to reduce the use of kerosene at the airport and to deliver more sustainable air navigation services by means of optimised operations and environmental charging.

Then, as a first step to discourage short flights, a tax on boarding an aircraft whenever a passenger departs from an airport located in Belgium was recently introduced. With this measure, we want to encourage travellers to consider more sustainable alternatives when making journeys of less than 500 kilometres.

IMPACT PER GAS

The vast majority of these measures affect the CO_2 emissions of the sectors concerned. Exceptions to this are as follows:

- In the industrial sector, specific measures taken to reduce N_2O emissions from industrial processes during the production of caprolactam;
- In waste treatment, the recovery of landfill gases (CH_4) and its use as biogas to generate electricity;
- Measures to inspect and maintain refrigeration systems in order to limit leakages of fluorinated gas;
- In agriculture, managing nitrates to reduce N_2O emanations and reducing CH_4 emissions from bovine livestock.

LONG-TERM IMPACTS

Compared to BR4, emission reduction estimates have been extended to 2040.

Many of the measures from the NECP involve support for investments, the effects of which will last for several years, or even decades. The long-term impact of such measures is linked to the technical or economic service life of the equipment concerned.

This is especially true in the case of investment in infrastructure: building insulation, construction of new low-energy buildings and facilities, but also, for example, infrastructure that encourages modal shifts. Investments such as loading docks, broad gauge waterways, railway adaptations and the purchase of rail machinery concern facilities with a service life in excess of 50 years.

For measures to upgrade the energy efficiency of heating and domestic hot water production facilities, the average service life can be 20 years or more. This will also apply in the case of infrastructure that makes use of renewable energy sources,

the service life of which will vary, depending on the technology implemented.

In contrast, initiatives aimed at changing behaviour may need to be maintained or repeated over several years, at least until a real change in mentality across all sections of society is visible.

The revision of the NECP in 2023-24 should lead to a reinforcement of existing and already planned measures as well as new ones to accelerate emission reductions and move towards longer-term objectives.

4.3.2 Update on policies and measures

4.3.2.1 PAMs from the National Energy Climate Plan

Compared to the previous report, some measures have been renamed for clarity:

- 17. Company car regime ➤ Benefit in kind depending on CO_2 emissions for company cars
- 21. Federal strategy to promote cycling ➤ Federal strategy to promote bicycle use
- 23. Promotion of carsharing and teleworking ➤ Teleworking for federal civil servants
- 32. Renewable Energy for Public institutions ➤ Photovoltaic panels on roofs of Federal government buildings
- 40. Green loans ➤ Federal Green loans
- 96. Local production ➤ Local food production
- 103. Promoting sustainable energy sources for the "process" needs of tertiary buildings ➤ Promoting sustainable energy sources to serve the needs of tertiary buildings
- 145. Green loans ➤ Brussels Green loans
- 152. Green certificates ➤ Brussels Green certificates

In addition, the following new PAMs have been added:

- 206. Walloon Renovation Strategy: This is a cluster of PAMs 72, 73, 78, 97, 98, 99, 101, 102, 103 and 104 that have been combined to allow an estimate of overall emission reductions.
- 207. Fast Vision: This is a cluster of PAMs 86, 87, 88, 89, 90, 91, 92 and 93 that have been combined to allow an estimate of overall emission reductions.
- 210. Mobility and Fleet Facilitator for public services and companies
- 211. Renolab
- 212. Renoclick
- 213. Cash for cars and mobility budget
- 214. Tax free bicycle allowance
- 215. Promotion of carpooling
- 216. Rail non-traction: SNCB/NMBS & Infrabel
- 217. Energy taxation on fossil fuel used for energy production
- 218. Tax deductions for the purchase of new clean vehicles (private citizens)

There are no PAM 208 and 209 (and no 166 either: see 4.4).

The set of policies and measures to achieve the 2020 target are reflected in the federal and regional plans described in chapter 4.1.2.5.

4.3.2.2 Recent developments of PAMs (up to 2022)

Federal State

In the context of the governance system described under 4.1.3, the federal government took two decisions on 2 April and the 8 October with regard to its climate monitoring and ambition raising tools. The federal government envisages the development of roadmaps in ten domains, namely taxation and finance, over energy, transport, circular economy, public buildings, functioning of public companies, international climate cooperation, climate policy governance, adaptation and research. (cf. First synthesis report in FR and in NL).

Flemish Region

For the period 2021-2030, the Flemish Government adopted the Flemish Energy and Climate Plan, which was then incorporated into the National Energy and Climate Plan. In November 2021, the Flemish Government agreed on a series of additional measures in its Vision Paper on Additional Measures that would further reduce greenhouse gas emissions within the Flemish Region. The greenhouse gas reduction target was raised to a reduction of -40% by 2030 (compared to 2005) in the case of emissions not included within the EU's Emission Trading System.

The Flemish Energy and Climate Plan is recognised as a transversal policy programme. In December 2021, the Flemish Government adopted the Framework of Arrangements, which lays down how the plan will be implemented in the coming years. It also contains provisions regarding annual progress reports, the involvement of stakeholders and the upgrade planned in 2023-24.

In July 2021, the first progress report of the Flemish Energy and Climate Plan 2021-2030 was published. In addition to a sectoral overview of the greenhouse gas emissions, this progress report also included an overview of the progress of the individual measures that are included in the plan. A second progress report is being prepared in the autumn of 2022.

Finally, the Flemish Government adopted the Climate Strategy 2050 in 2019, which provides a long-term pathway for the reduction of emissions in sectors that do not form part of the EU Emission Trading System, with an overall objective to achieve a reduction of -85% by 2050 (compared to 2005). This strategy is being set out in more specific terms by drawing up sectoral strategies, such as the long-term renovation strategy, which was adopted in May 2020.

Walloon Region

Since the previous NC, the Walloon Government adopted a new Air Climate Energy Plan 2016-2022 on 21 April 2016. The Walloon contribution to the NECP was subsequently adopted as part of the future ACEP in December 2019.

Under the new Government, a group of citizens was set up to advise the Minister of Climate and Energy on new measures seeking to achieve a target of -55% GHG by 2030 (corresponding to the Fit For 55 proposals). These citizens submitted 168 proposals, prioritised on the one hand in terms of acceptability and on the other hand in terms of their potential impact on emissions. The regional renovation strategy has also been revised in line with the new European ambitions.

All these measures will be incorporated into the new version of AECP, which, according to the estimated timeline of the project, should be adopted by the end of 2023, a timing that aims to be aligned with the European deadlines for the submission of the revised NECP.

Brussels Capital Region

At the level of the Brussels Capital Region, the regional contribution to the National Energy and Climate Plan has considerably increased its objectives in terms of emission reductions by planning, among other things, to renovate the stock of buildings, to increase our renewable capacities and to improve the performance and energy efficiency of the transport sector. These measures are detailed in section 4.1.1.2 of BR4.

The Brussels-Capital Region is also working on its next Air-Climate-Energy Plan to contribute to the objectives proposed by the Fit for 55 package. The content relating to energy and climate will be incorporated into the update of National Energy and Climate Plan to be issued in June 2023 (draft) and June 2024 (final).

4.4 Policies and measures no longer in place

Compared to the previous report, the following PAMS were deleted from the summary table:

- 41 Incentive for pedelecs: policies that until 2021 were specifically targeting pedelecs (high-speed electric bicycles) have now been included within generic bicycle policies relating to commuting from home to work (PAM 214. Tax free bicycle allowance) / A new measure has been encoded under number 41, but is unconnected to the item previously listed under that number (41. EMAS certification)
- 166 Reduction of the emissions of fluorinated greenhouse gases (expired and already replaced by PAM 165)

The following PAMs are deemed to have expired, but are still delivering emission reductions (In the CTF 3 Table, they are always indicated as implemented): 36, 37, 40, 105, 146.

4.5 Minimising the adverse effects of response measures

This text has been revised in the context of the BR4 of Belgium and some even more recent developments. It is included in the NIR.

Under Article 3.14 of the Kyoto Protocol and UNFCCC Decision 31/CMP.1, Annex I Parties are invited to report on how they are striving to implement their commitment while minimizing adverse social, environmental and economic impacts on developing country parties.

Many of the NECP measures are new and/or prolonged policies that require an in-depth evaluation, amongst other things with regard to their economic and social consequences. These improvements should be improved in the next reporting exercise.

Actions taken are intended to contribute to preventing dangerous anthropogenic interference with the climate system. Adverse impacts of climate change will therefore be globally reduced if Annex I countries (and Belgium among them) take measures aiming to reduce GHG emissions by means of energy savings and the promotion of renewable energy sources. Furthermore, most of those actions will help to

reduce air pollution resulting from the use of fossil fuel, which will benefit all countries.

As a Member State of the European Union, Belgium designs and implements most of its policies in the context of EU directives, regulations, decisions and recommendations. For instance, Belgium has implemented the European liberalisation of electricity and natural gas markets and is involved in the European Emissions Trading Scheme, all of which are actions aiming to address market imperfections and to better reflect external factors affecting energy/CO_2 prices.

Various international bodies have identified areas in which progress could be made to decrease fossil fuel subsidies in Belgium.

Belgium has abolished subsidies supporting the use of coal and other fossil fuels for energy production and expects these measures to have a positive health impact on the long term.

A modification of taxes aimed achieving an equality of excises for diesel and gasoline has been implemented (the "Royal Decree of 26 October 2015" and the Law of 27 June 2016): the special excise duty for diesel for non-commercial use has been increased from 2015 to 2018. The primary objective of this PAM is to improve air quality.

However, various subsidies for fossil fuel consumption are still available in Belgium. The National Energy and Climate Plan (NECP) provided for the compilation of an inventory of all fossil fuel subsidies by the end of 2021. The federal Inventory of fossil fuel subsidies was finalised in May 2021[4]. A list of all energy subsidies (including those for fossil fuels) on a federal and regional level, was communicated to the European Commission at the beginning of 2021.

The NECP also provided for the adoption in 2021 of an action plan by the federal state to phase out fossil fuel subsidies by means of a step-by-step approach. The plan should include specific and socially corrective steps in order to assist the transition towards a climate-neutral society. The measures will form part of an overall tax reform based on a currently running study on environmental reforms in Belgium.

The respect and the promotion of human rights is and remains a priority for Belgium, both on a national level and in its relations with other countries.

Belgium is actively involved in the promotion and protection of human rights in a variety of ways, for example:

- The establishment of a solid legal and policy framework for combating gender-based discrimination;
- Support for the Office of the High Commissioner for Human Rights as a partner organisation of multilateral cooperation.
- A focus on the rights of women in the programming cycles of cooperation activities.
- A recent decision to develop a national action plan on business and human rights which will ensure the implementation of social responsibility and the embedding of human rights within the business sector;
- A commitment to develop a 2nd national plan to combat child poverty;
- etc.

For further information, please see the 1st Belgian National Voluntary Review on the Implementation of the 2030 Agenda ("PATHWAYS TO SUSTAINABLE DEVELOPMENT"). A 2nd National Voluntary Review is currently underway, in accordance with a decision by the Inter-ministerial Conference on Sustainable Development of 5 May 2022.

Finally, the NECP also provides for:

- The organisation of a "National dialogue on the just transition to a climate-neutral society" to be organised by the federal government in conjunction with all policy actors, governments and stakeholders. This dialogue will be supported by an analysis of the positive and negative effects of the transition to a climate-neutral society and will focus, among other things, on the identification of policy options while addressing the challenges in the areas of employment, social policy, reskilling and -economy.
- Belgian agricultural policies and the promotion of biofuels being developed within the European common policies. With regard to biofuels and acknowledging that their development could create pressures on food prices and on land and forest management, especially in developing countries, the EU has established strict sustainability criteria which include not supporting biofuels produced using land with a high biodiversity value (primary forest and wooded land, protected areas or highly bio-diverse grasslands), or from land converted from wetlands, peatlands or continuously forested areas. It will also be very cautious about any broader environmental and social aspects such as air, water and soil quality and labour conditions. Belgium foresees a biofuel blending percentage of 10.45% in real terms and 13.9% including double counting. This includes a 7% first gen blending throughout the period and a blending of 1.75% and 1.7% of part A & part B advanced biofuel blending respectively in 2030. Based on Articles 25-27 of that directive, the contributions of all eligible fuels amount to 23.7%. A biannual study is being executed to evaluate the technical feasibility, the availability of resources and advanced biofuels (recycled carbon fuels & technological evolutions), the environmental integrity, possible conflicts in their use, the costs to consumers and the availability of other renewable energy sources. ■

[4] Summary in EN: https://finance.belgium.be/sites/default/files/Statistieken_SD/Inventaris/FFS_2021_summary_EN.pdf

5. Projections and the total effect of policies and measures, and supplementarity relating to Kyoto protocol mechanisms

5.1 Projections

5.1.1 Introduction

The projections described below are based on the 2021 Belgian submission to the European Commission in compliance with Article 18 of Regulation (EU) 2018/1999. A detailed description of assumptions, parameters, sensitivity analyses and results is publicly available.

These projections were drawn up in the course of 2020, based on the most recent information available on the macro-economic context and policy implementation and using 2018 as the reference year. As these projections were developed in 2020, they could not yet take into account the expected impact of the COVID-19 crisis. For the reference year 2018, unadjusted emissions data from the inventory submission in 2022 (resubmission dated 23/05/2022) are presented in this chapter and in CTF Table 6, whereas in the preparation of the projections, the inventory as reported in 2020 was still used for the reference year 2018. Since 2020 is now also available as an inventory year, historical (and not projected) emissions for 2020 as included in the inventory submission in 2022 (resubmission dated 23/05/2022) are presented in this chapter and in CTF Table 6. Projections have been included on a quantitative basis, starting from the most recent inventory year (i.e. 2020) and for subsequent years that end in either a zero or a five, extending 15 years from the most recent inventory year (e.g. 2025, 2030, 2035 and 2040). In CTF Table 6, the time horizon was limited to 2030 due to CTF decision (19/CP.18), but in the present chapter, all available projections up to 2040 are included.

To ensure consistency with inventory reporting, emission projections relating to fuel sold to ships and aircraft engaged in international transport have been reported separately in the CTF tables and are not included in the national total (both in the CTF tables and in the tables and figures in this report).

Except for electricity production and bunker fuels, the reported projections are the sum of the projections of the three regions (Flanders, Wallonia, Brussels-Capital) which are calibrated against the regional energy balances. The regional approach starts from the demand side of the different sectors (industry, domestic, tertiary, transport, …) and results in sectoral energy projections. Within this approach, relations between energy consumption, activity levels and energy prices are assessed on a sectoral level. The electricity production and the bunker fuel emissions are modelled on a national level.

The regional energy related projections are based on regional energy statistics. Contrarily to the federal energy statistics (EUROSTAT) which consist of sales data,

the regional energy statistics are based on consumption data.

This is particularly important for the transport sector: the regional CO_2 emission projections for road transport are based on regional mobility data (vehicle kilometres, etc.) while the national top-down CO_2 emission projections for road transport are based on fuel sold. To ensure coherence between national emission inventory data and projected regional emission data, the sum of the regional transport emission data is recalibrated to coincide with the national inventory data. This recalibration has been incorporated into the projected emission figures.

For more information, see also the Belgian national system on projections report under Article 39 of Regulation (EU) 2018/1999.

Projections of the indirect GHGs are available from some projection models, but a consistent set of projections for all regions is lacking. For this reason, no projections of indirect GHGs have been included in the report.

5.1.2 Description of models

Descriptions of the models used in the calculation of the regional and national projections are included in Annex 3 to this report.

The main models used by the different entities are:

- Times: used by the Walloon Region;
- Flemish energy and greenhouse gas simulation model: used by the Flemish Region;
- Energy and Atmospheric Emissions projection model for the stationary sources and Transport Emission Projection model: used by the Brussels Capital Region;
- OFFREM model: used by all regions for off-road sectors;
- F-gas model: used by all regions for F-gases.

The models used by the Flemish Region and the Brussels-Capital Region are simulation models, of the "bottom-up" type, i.e. explaining energy consumptions and GHG emissions from activity variables expressed, as far as possible, in physical units, and containing a detailed representation of emission sources and the main determining factors of the evolution of energy demand and the various types of emissions. There are some minor differences with regard to the level of detail, the activity variables and parameters in these regional models. The projection results consist of the sum of the bottom-up projections. In order to avoid inconsistencies between the regions, the same general assumptions are used by the three regions for key parameters (climate assumptions, demographic evolution, …).

The strengths of these simulation models can be found in their ease of use, in the ease of understanding the results for decision makers, in their transparency, in the ability to evaluate the impact of individual measures, … However, some weaknesses can be mentioned, such as the fact that they offer no guarantee of an overall optimum, the difficulty in modelling complex (economic) interactions, the involvement of expert judgement to define input variables, etc.

A new model, called « TIMES-Wal » has been used for the first time for reporting purposes for the WEM scenario (previously, Wallonia used EPM (Energy/Emissions Projection Model)). TIMES is an optimisation model – it needs to satisfy all energy service demands and constraints while minimising the costs. In TIMES, perfect foresight (i.e. all future events within the defined temporal horizon are known) and competitive markets are assumed.

The strengths of this optimisation model can be found in its flexibility when taking into account variables and technologies coherent with regional specificities and data availability and in the highlighting of an economic optimum, taking into account interactions between sectors. However, some weaknesses can be mentioned such as the difficulty when modelling non-economic barriers and the sensitivity of the results to uncertain economic parameters.

5.1.3 General projection assumptions

Since Belgium's last biennial report and national communication, the input data has been updated. The following general assumptions are used in the calculations of and the regional bottom-up emission projections (unless otherwise indicated).

All implemented and adopted (EU, federal, regional) policies and measures, considered up to the end of 2019, have been taken into account in the 'with existing measures' (WEM) scenario. Planned policies and measures or targets have been incorporated in a scenario with additional measures (WAM). These measures are presented in more detail in the PAMs EU reporting template, an extended version of the CTF Table 3 and chapter 4 of the present report.

The section below summarises the general assumptions included in the WEM and WAM scenarios.

5.1.3.1 Emission factors

Emission factors reported in the 'Belgium's Greenhouse Gas Inventory (1990-2018) National Inventory Report have been used for the calculation of the projections.

5.1.3.2 Global Warming Potential

CO_2 equivalent emissions and projected emissions 2020-2040 are calculated using the Global Warming Potential (GWP) values specified in the 2006 IPCC Guide-

lines for National Greenhouse Gas Inventories (Table 5.1).

Table 5.1 Global warming potentials

Greenhouse Gas	GWP
CO_2	1
CH_4	25
N_2O	298

5.1.3.3 Climate assumptions

The regional and national projections for the residential and tertiary sector are calculated assuming that the number of degree-days for the period 2020-2040 is equivalent to the average number of degree-days of the 2010-2019 period. This average is equal to 1821 degree-days (reference 15/15) and characterised a mild climate.

5.1.3.4 Demographic evolution

The demographic projections presented in Table 5.2 are based on the prospects by the Federal Planning Bureau. They were calculated per age, gender and district. In addition to the Belgian population projections in CTF Table 5, the regional projections are also shown here.

Table 5.2 Demographic evolution

	Statistics	Prospect			
	2018	2025	2030	2035	2040
Population of Belgium	11 376 070	11 694 908	11 886 405	12 066 430	12 231 038
Population of Flanders	6 552 967	6 760 354	6 892 823	7 011 787	7 120 583
Population of Wallonia	3 624 377	3 698 747	3 748 498	3 790 082	3 822 110
Population of Brussels	1 198 726	1 235 807	1 245 084	1 264 561	1 288 345
Number of households in Belgium	4 867 842	5 071 957	5 202 022	5 322 528	5 421 649
Number of households in Flanders	2 792 444	2 926 908	3 012 654	3 091 235	3 159 025
Number of households in Wallonia	1 571 850	1 633 696	1 675 112	1 712 167	1 739 121
Number of households in Brussels	503 548	511 353	514 257	519 125	523 503
Average household size in Belgium	2.34	2.31	2.28	2.27	2.26
Average household size in Flanders	2.35	2.31	2.29	2.27	2.25
Average household size in Wallonia	2.31	2.26	2.24	2.21	2.2
Average household size Brussels	2.17	2.18	2.19	2.19	2.2

5.1.4 Sector-specific assumptions

The following sector-specific assumptions are used for the regional bottom-up projections.

5.1.4.1 The Power Sector (electricity production) (CRF category 1A1a and autoproducers in other CRF categories)

The projections for the electricity production sector are modelled using the Flemish energy and greenhouse gas simulation model at national level. Projections for electricity production take account of:

- trends with regard to electricity demand (in some sectors);
- changes electricity production facilities and production efficiencies;
- imports of electricity;
- the cost of fuel;
- time periods (electricity demand is not equal in winter and in summer, nor during night and day).

Table 5.3 shows the demand and supply data of the electricity sector for Belgium (TWh) in both the WEM and WAM scenario.

The results in Table 5.3 show an increase of the electricity consumption between 2018 and 2040 by 15% in the WEM-scenario and 16% in the WAM scenario (i.e. an average of 0.69% and 0.73% per year respectively). Cross-border electricity trading is considered exogenous in the modelling of the electricity production.

The net import levels in the Belgian projections up to 2040 are based on existing scenario reports of the Belgian power system. The actual trend with regard to net imports will mainly depend on new cross-border transportation capacities, commercial opportunities and the location of new production plants.

The WEM and WAM scenarios include the phasing-out of nuclear energy in Belgium. On 31 January 2003, the Federal Government decided to proceed with a progressive phasing-out of electricity production using nuclear fission energy by limiting the service lives of existing nuclear power plants to 40 years and prohibiting the construction of new nuclear power plants. In July 2012, the Federal Government confirmed this timetable except for one nuclear unit, Tihange 1, whose service

Table 5.3 Electricity demand and supply for Belgium (TWh)

		WEM				WAM			
	2018	2025	2030	2035	2040	2025	2030	2035	2040
Final consumption Belgium	82.7	84.6	87.7	91.5	95.4	86.4	89.8	92.7	96.1
Distribution losses and own use	8.4	8.2	8.0	8.8	9.6	8.8	8.5	9.1	10.0
Net import (balance export – import)	17.3	8.1	13.0	13.0	13.0	7.3	8.4	9.0	9.2
Gross production	73.8	84.7	82.8	87.3	92.0	88.0	89.8	92.8	96.9

Table 5.4 Phasing-out of nuclear power (according to the Law of 18th June 2015)

Nuclear unit	Capacity (MW)	Closing date
Doel 1	433	15 February 2025
Doel 2	433	1 December 2025
Doel 3	1 006	1 October 2022
Doel 4	1 039	1 July 2025
Tihange 1	962	1 October 2025
Tihange 2	1 008	1 February 2023
Tihange 3	1 046	1 September 2025

Table 5.5 Offshore wind capacity – WEM and WAM scenario (MW)

	2020	2025	2030	2035	2040
WAM scenario	2261	2261	4011	4011	4011
WEM scenario	2261	2261	2261	2261	2261

life was extended by a further 10 years. This decision was confirmed in a law (of 18 December 2013). On 18 June 2015, another extension was approved (for the Doel 1 and Doel 2 units) by amending the Law of 31 January 2003. The timetable for the phasing-out of nuclear power between 2022 and 2025 mentioned in Table 5.4 (as inscribed in Article 4 of that law) has been taken into account in the WEM and WAM scenarios.

An increase in the offshore wind capacity after 2020 has been assumed in the WAM scenario (Table 5.5).

Table 5.6 shows the shares of nuclear, fossil fuel and renewables in total gross electricity production in the WEM and WAM scenarios. Until 2025, a large part of the base load demand is projected to be met by nuclear power plants, CHP installations and renewable energy (biomass). After 2025, nuclear power plants will be phased out and are projected to be mainly replaced by natural gas and increased imports. The share of renewables within total gross electricity production amounted to 24% in 2018 and will increase to 44% in 2040 in the WAM scenario. The policy and measures to support and promote renewable energy in the three regions and at federal level are described in the EU PAMs reporting template and in chapter 4 of this report.

The calculation of the CH_4 and N_2O emissions of the electricity production sector is performed by applying the CH_4 and N_2O emission factors on the final energy carriers. The burning of wood and other biomass materials is only taken into account in the projections of CH_4 emissions.

For the CO_2 emission projections originating from waste incineration, each

Table 5.6 Share of nuclear, fossil fuel and renewable in total gross electricity production (Source historical data: Eurostat database)

	Historical							WEM				WAM			
	1990	1995	2000	2005	2010	2015	2018	2025	2030	2035	2040	2025	2030	2035	2040
Nuclear energy	60%	56%	57%	56%	51%	38%	38%	21%	0%	0%	0%	20%	0%	0%	0%
Solids	24%	22%	15%	10%	4%	3%	0.1%	0.1%	0.1%	0.1%	0.0%	0.1%	0.1%	0.1%	0.0%
Oil (incl. refinery gas)	2%	2%	1%	2%	0.4%	0.3%	0.2%	0.2%	0.2%	0.2%	0.1%	0.2%	0.2%	0.2%	0.2%
Natural gas (including derived gases)	12%	17%	23%	28%	35%	35%	35%	45%	67%	69%	64%	46%	56%	56%	55%
Renewables	2%	2%	3%	4%	8%	22%	24%	32%	31%	30%	34%	32%	42%	43%	44%
Other fuels	1%	1%	1%	1%	1%	2%	2%	2%	1%	1%	1%	2%	1%	1%	1%

region applies its own methodology as specified in the National Inventory Report. The CO_2 emissions from waste incineration with energy recuperation are reported in the energy sector as 'other fuels' for the non-organic part and as 'biomass' for the organic part. The emissions from 1 industrial waste incinerator in the Flemish region (auto-generator) are allocated to CRF category 1A4a. CO_2 emissions originating from flaring activities in the chemical industry are allocated to the waste sector (CRF category 5C).

5.1.4.2 The (Energy) Conversion Sector

5.1.4.2.1 Refineries (CRF categories 1A1a, 1A1b, 1B2c, 1B2a4)

Flanders

Refining is an activity that only takes place in the Flemish region. The WEM and WAM emission projections assume that the capacity of the refineries in Belgium will not increase after 2018. As described in the Belgian National Inventory Report CO_2 emissions of the refineries are allocated to the sectors:

- 1A1a for the involved combined heat-power installations of the refineries;
- 1B2c for the flaring emissions;
- 1A1b for the total emissions excluding the emissions of the combined heat-power installations and excluding the emissions from flaring activities.

The N_2O and CH_4 emission projections from refining activities are estimated by applying emission factors to the final energy carriers. The CH_4 emissions have a diffuse character and include the flaring emission projections of the refineries in the Flemish region.

All CH_4 emissions of this sector (except the emissions of the combined heat-power installations which are allocated to sector 1A1a) are allocated to category 1B2a4 and all N_2O-emissions (except the emissions of the combined heat-power installations which are allocated to sector 1A1a) are allocated to category 1A1b. The emissions of CH_4 reported in the category 1B2a4 also include the flaring activities of refineries.

5.1.4.2.2 Coke production (CRF category 1A1c)

Flanders

In Flanders, the WEM and WAM scenarios assume one coke production plant in the steel industry operating at maximum capacity in the period 2018-2040 and equipped with a desulphurisation unit.

Wallonia

The last coke factory was closed in 2014 and it is not expected that a new plant will be built.

5.1.4.2.3 Oil transport (CRF category 1B2a3)

Flanders

Fugitive emissions of CO_2 and CH_4 from oil transport are assumed to remain constant at the 2018 level.

5.1.4.2.4 Gas transmission and distribution (CRF category 1B2b)

Flanders

Projections of fugitive CH_4 emissions from the distribution of natural gas in Flanders are calculated based on assumptions with regard to the evolution of the natural gas network and the gradual replacement of pig iron pipes by PE, PVC or steel. The expansion of the natural gas network in Flanders is estimated taking into account the increase of the number of households and the number of houses in residential areas with the possibility to connect to the natural gas distribution grid.

Wallonia

The calculation of CH_4 emissions from the distribution of natural gas in Wallonia is based on the assumption that the network expands slightly each year. The emissions are supposed to stay constant as pig iron pipes and asbestos cement pipes will continue to be replaced, all new distribution pipes being made of steel or PE/PVC.

Brussels-Capital Region

Fugitive emissions considered in Brussels-Capital Region are due to the distribution of natural gas; the emissions remain constant since the network will not be extended.

5.1.4.3 The industrial sector

Projections regarding energy use in the industry sector are based on assumptions of activities and also the energy intensity (amount of energy used per unit of activity).

5.1.4.3.1 CO_2 emissions from energy use in the industrial sector (CRF category 1A2)

Flanders

The energy consumption and CO_2 emissions in the industrial sector in the WEM have been modelled taking into account the expected energy efficiency improvement, based on current energy agreements, and activity projections. Increased energy efficiency and additional fuel shift assumptions have been considered in the WAM scenario.

The industrial off-road emissions are calculated by using the OFFREM-model with emission factors of the IPCC 2006 guidelines (CO_2 and CH_4) and EMEP/EEA guidebook (N_2O). Off-road emissions of the industrial sectors are allocated (incl. construction industry) to category 1A2g-vii.

Wallonia

The future evolution of demands for industry is driven by a simple hypothesis: each industrial sub-sector[1] level of activity in Wallonia will stay the same until 2040 as it was before (the industrial activity is defined as the average activity over the last years (2014-2018)). This hypothesis is dictated by the lack of prospective study in the case of the industrial sector in Wallonia in the long term and the uncertainties driven by the COVID-19 crisis. This hypothesis could be updated in the coming months. Investment projects and equipment closures that have taken place or have been announced have been considered.

All major industries are involved in 'second generation' sectoral agreements, under the terms of which they are committed to improve their energy/CO_2 efficiency by 2023. Until 2023, an improvement in energy efficiency of 0.95% per annum has been assumed (except in the case of CHP). After that, in the period up to 2040, a natural improvement of 0.29% per annum has been taken into account. For the development of CHP in the industrial sector, the assumptions are described in the power generation sector.

Wallonia is currently developing a new projection model (TIMES). The baseline scenario has been produced with this model. The WAM for the other sectors has been produced using an earlier projection tool used in the previous report. For the industry sector, it is not possible to use these previous tools because the working hypotheses (notably for activity drivers) between WEM and WAM are too different. Therefore, for these projections, the WAM has been assumed to be equal to the WEM.

Brussels Capital Region

The projections are calculated on the basis of energy intensity. The industrial sector in the Brussels Capital Region was confronted with a significant decrease from the year 2000. Between 2008 and 2018, it stabilised, representing approximately 3% of final energy consumption in the region. The prospects of a future expansion are very low. The projections assume that the gross added value will progress according to the medium-term projections 2020-2025; from 2025 until 2040, this value remains constant.

On 8 December 2016, a decree was approved concerning the obligation to conduct energy audits[2]. This decree is included in the WEM scenario. The objective is to reduce the total energy consumption of the biggest industrial companies located in the region. Companies consuming more than 28 GWh per year of primary energy must therefore conduct an energy audit.

5.1.4.3.2 Process emissions of CO_2 and non-energy use of fuels (CRF category 2A, 2B, 2C)

Flanders

Main non-energy-related uses of fuels in Flanders:

- natural gas for ammonia production (carbon converted to CO_2 emissions);
- natural gas for processes in which the carbon is fixed in the end-products;
- natural gas for the production of hydrogen and ethylene oxide
- naphtha and LPG in crackers and in other processes (carbon fixed in end-products);
- heavy fuel oil for production of carbon black; use of coal-tar in one company.

Because these concern the use of fuel for non-energy-related purposes, it is assumed that climate policy will not have an effect on the use of the fuels mentioned above. In addition, several processes also involve chemical reactions, in which carbonaceous products, generally not considered as fuels, are oxidised to CO_2. Such process emissions occur in the chemical industry (production of ethylene oxide, acryl acid, cyclohexanone, synthetic soda), in refineries, in the non-metallic minerals sector, during flaring and the desulphurisation of flue gases.

Projections of CO_2 process emissions are linked to activity assumptions which are mainly based on the results of the EU Reference Scenario 2016 for Belgium.

Wallonia

Main non-energy-related uses of fuels in Wallonia:

- coal in the iron and steel industry and selected applications of engineering (metallic works);
- petroleum products in several sectors, notably in the chemical industry;
- natural gas for ammonia production (carbon converted to CO_2 emissions)

Emissions from processes considered in Wallonia are the following:

- CO_2 produced by the decomposition of limestone in cement and lime productions;
- CO_2 produced by the decomposition of methane for the production of ammonia (and considered separately from CO_2 emitted by the actual combustion of methane)

Projections of CO_2 process emissions are linked to growth rates of activity and have therefore been kept constant.

The emissions have been considered the same in the WEM and the WAM scenarios.

[1] The industrial sector is divided into 20 subsectors : milk, sugar, transformed potatoes, other food industry, cement, lime, hollow glass,flat glass, bricks, ceramics, other non-metallic minerals, ammonia, other chemicals, wood industry, pulp and paper, iron and steel, non-ferrous metals, non-energy consumption (chemicals and others) and other industries

[2] Arrêté du Gouvernement de la Région de Bruxelles-Capitale relatif à l'audit énergétique des grandes entreprises et à l'audit énergétique du permis d'environnement approuvé en troisième lecture le 8 décembre 2016.

5.1.4.3.3 CH_4 and N_2O emissions in the industrial sector (CRF category 2)

The CH_4 and N_2O emission projections for the industrial sector are made using the emission inventory methodology reported in the National Inventory Report.

CH_4 emissions in the industrial sector originate mainly from the iron and steel sector in Flanders (sinter production). The same activity growth trend as mentioned in section 5.1.4.3.1 above are assumed. The emission levels are directly linked with this same growth trend.

The N_2O emission originates from the production of caprolactam (Flanders) and nitric acid (Flanders, Wallonia). N_2O emission projections from caprolactam production are based on information from the company concerned regarding activity data and implementation of reduction measures. In the WEM scenario the application of an end-of-pipe technique has been considered. Additional reduction measures which still require further research have been taken into account in the WAM scenario. It is assumed that projections of N_2O emissions from nitric acid production in Flanders will remain constant at the 2018 level.

In Wallonia, projections of N_2O emissions from nitric acid production are based on information from the company concerned regarding activity data and implementation of reduction measures. Reduction measures were implemented in 2011, resulting in a large decrease of N_2O emissions. The emissions have been considered the same in the WEM and the WAM scenario.

5.1.4.3.4 F-gas emissions in the industrial sector (CRF category 2)

WEM scenario

The F-gas emission projections are drawn up from the model developed by ECONOTEC Consultants and VITO in the context of a study commissioned by the Federal Department of the Environment on behalf of the National Climate Commission.

WAM scenario

In **Wallonia**, the WAM scenario considers a decrease in the emissions of 50% by 2030 compared to 2005. The following measures are considered:

- Voluntary agreement with the food distribution sector to reduce its GHG emissions;
- Support for companies to encourage the use of alternative refrigerant gases;
- Reinforcing training in the use of alternative refrigerants /alternative technologies.

In the **Flemish region,** the WAM scenario takes into account additional measures included in the final Flemish Climate Policy Plan for the period 2021-2030 and that aim at reducing the F-gas emissions to 0.6 Mton CO_2-eq in 2030 for the Flemish Region. The following additional measures are considered:

- Strengthening of the economic support instruments, particularly the Ecologiepremie+ subsidies (possible extension beyond 2020 and to other technologies);
- Support for new or existing training centres with adequate equipment;
- Fostering of a Green Deal with the retail sector to reduce its use of F-gases to practically nil and its emissions to a minimum in 2030.

5.1.4.4 The residential sector (CRF category 1A4b)

The climate regulations and measures considered for the WEM and WAM projections are presented in more detail in the PAMs reporting. The assumed evolution of the population and the number of households is discussed in section 5.1.3.4 above. Estimates are made on the number of new dwellings. A distinction is made between new and existing houses.

Flanders

Heating and equipment

- New dwellings:

From 2018 onwards and following the implementation of the EC directive on energy performance of buildings, it is assumed that the heat demand of all new single-family dwellings and apartments comply with an E-level of 40. This E-level tightens gradually to 30 as of 2021 (Table 5.7).

- Existing dwellings:

For existing dwellings, the projected fuel consumption in the WEM scenario is determined by:

- The average fuel consumption in an existing dwelling in 2018 and the evolution of the number of dwellings;
- The impact of renewable energy policies (solar boilers and heat pumps), autonomous boiler efficiency improvements and also thermal insulation measures based on the current subsidy system.

Table 5.7 E-level pathway for the residential sector (2018-2021)

	2018	2020	2021
E-level	40	35	30

The main additional measures included in the WAM scenario are listed below:

- ◊ Accelerated renewal of heating systems;
- ◊ Prohibition on new gas connections in new residential complexes;
- ◊ Optimisation of settings of existing heating systems;
- ◊ Demolition subsidy;
- ◊ Stimulating implementation of 3 out of 6 energy efficiency or renewable energy measures within a period of 3 years after acquisition of a dwelling;
- ◊ Reduction in VAT for renovations.

Fuel mix

The projected fuel mix of existing dwellings starts from the current distribution of energy carriers and takes into account the expected yearly fuel switch (installation switch from fuel oil to natural gas heating systems) and the number of heat pump installations. An increased number of heat pump installations has been assumed in the WAM scenario. The fuel mix for new dwellings depends on the E-level pathway.

Equipment

It is considered that 80% of the historic electricity was used for electrical appliances and lighting. The remaining 20% of the consumption is used for electric heating and sanitary hot water preparation. The changes in the power consumption of electrical appliances and lighting have been simulated taking into account the results of the EU Reference scenario 2016. A yearly increase of 0.1% in the period 2018-2020 and 0.2% in the period 2020-2040 has been considered in this regard.

Off-road

Off-road emissions of the residential sector are calculated using the OFFREM-model with emission factors of the IPCC 2006 guidelines (CO_2 and CH_4) and EMEP/EEA guidebook (N_2O). Off-road emissions of the residential sectors are allocated to category 1.A.4.b.ii (Off-road vehicles and other machinery).

Wallonia

WEM scenario

Space heating and hot water

For new dwellings, the heat demand takes into account the current EPB regulation in Wallonia with the following requirements from 2021: $E_w = 45$; $E_{spec} = 85$ kWh/m²/year (where E_w is the "primary energy consumption level" and E_{spec} is the "specific primary energy consumption level").

For existing dwellings, 20 different categories of existing buildings are taken into account. For each category, the surfaces and net needs are described. Retrofitting options (roof, wall, floor and window) are also differentiated according to the 20 categories of buildings defined above. A decrease in the specific energy consumption of existing housing is calculated based on energy savings per type of renovation and a number of annual renovations coherent with the results from energy grant system.

Concerning the fuel mix, a set of technologies is described in the model by means of standard parameters (efficiency, lifetime, …) which can evolve (improved performance, …). Switching an installation from fuel oil to natural gas heating systems[3] (so that the share of fuel oil in the total residential mix decreases from 46% in 2018 to 28% in 2030) and share of renewable energy (mainly biomass and heat pumps) slightly increases in the fuel mix (thanks to EPB requirements for new houses, …).

Other uses

The demand for other energy services for the residential sector including lighting, cooking, refrigeration and freezing, the washing and drying of clothes, dish washing, as well as for other electricity services, follows the evolution of the number of households.

For electric equipment, new technologies are described according to the best available technologies.

Off-road

The off-road emissions of the residential sector are calculated by using the OFFREM-model with emission factors from the IPCC 2006 guidelines (CO_2 and CH_4) and EMEP/EEA guidebook (N_2O). Off-road emissions from the residential sectors are allocated to category 1.A.4.b.ii (Off-road vehicles and other machinery).

WAM scenario

The WAM scenario for residential sector includes different measures:

- For new building, energy autonomy should go further (through voluntary measures or studying regulatory requirement strengthening, …).
- For all buildings, more heat must be produced by renewable energy (biomass, heat pumps, …), in accordance with targets of the Walloon contribution to National Energy and Climate Plan 2021-2030.
- For existing buildings, the targets of the "Long-term Renovation Strategy" and its intermediate objectives are taken into account. It will reduce the environmental impact of existing buildings. This strategy defines different objectives for energy efficiency of the envelope and the equipment of the existing buildings.
- Some behavioural changes.

This scenario will require the implementation of new measures or the improvement/widening of some measures taking place in the WEM scenario.

[3] Taking into account some limits linked to gas infrastructure, barriers to system change, …

Brussels-Capital Region

WEM scenario

The residential emission projections consider the historic trends between 2001 and 2018 on energy consumption, household size, and population. The projections also reflect the application of the Brussels Capital Region Government's Decree[4] regarding Energy Performance of Buildings. This decree considers that all new buildings will be nearly passive (15kWh/m^2.yr) and that heavy renovated buildings will consume 30kWh/m^2.yr.

In addition, the WEM scenario includes the measures adopted in the Brussels Code on Air, Climate and Energy Control (COBRACE, French acronym) and the Air, Climate and Energy plan (PACE, French acronym). The COBRACE reorganises the Brussels legislation in these areas with a cross-cutting approach. This Code includes measures assuring the improvement of air quality, energy performance of buildings, mobility evolution and citizens awareness. The PACE describes the Brussels Capital Region long-term objectives and measures to be implemented for the 5 forthcoming years concerning air, energy, climate change mitigation and adaptation. Finally, some measures that are sufficiently mature and are included in the PNEC are included in this scenario.

[4] 21 décembre 2007.- Arrêté du Gouvernement de la Région de Bruxelles – Capitale déterminant des exigences en matière de performance énergétique des bâtiments et du climat intérieur des bâtiments tel que modifié par l'arrêté du 5 mai 2011.

The measures taken into account in the WEM scenario are related to the energy management and technical installations in buildings. The technical reception of a new boiler installation is one of those measures. In fact, when a new boiler is installed, the entire heating system must be checked by a certified technician; this action enables a reduction in consumption of 25% to be achieved in the case of heating. The boiler replacement rate was estimated from the data provided by the Belgian Association of Heating Technology (ATTB, French acronym) and it was deduced based on the number of boilers replaced by means of energy grants.

The phasing-out of fossil fuels such as coal and gasoil is considered in the WEM scenario. From 2021 onwards, the installation of any equipment that uses coal as fuel will no longer be allowed. Whilst this will be the case for gasoil installations from 2025.

The third measure is also related to the heating installations. The mandatory checks apply in the case of boilers that are part of a heating system with a nominal power higher than 20kW that uses non-renewable fuel (gasoil and natural gas), and whose heat transfer fluid is water. An annual check is required in the case of oil-fired boilers and a regulation requiring natural gas boilers to be checked every two years has been in place since 2019. This check generates energy gains of around 1% in the case of gas boilers and 2% for oil-fired boilers. This measure lasts the whole projected period but the measures reach only 10% of the total target.

Another measure considered in the WEM scenario is the energy grant system. The energy gains are estimated considering the average gain from 2009 to 2018 achieved by means of a building's insulation, the use of double glazing, heating regulation systems and by the replacement of boilers. The energy gain is considered to last 20 years. This gain is multiplied by the annual budget; the WEM scenario considers the budget proposed by the Government from 2019 (EUR 16.9 million) to 2024 (EUR 38.7 million). After this period, the scenario considers the end of the grant system. According to the grant system report concerning the year 2018, the residential sector benefits by 91% of the total budget. This percentage was used to estimate the energy reduction of this sector and is kept constant.

Moreover, the energy gains achieved due to actions undertaken as a result of advice from household support are also estimated. This measure considers a variety of actions carried out by households thanks to the advice of the household's support. Actions such as changing the traditional shower head for an eco-shower, insulating pipes and the hot water tank and the installation of a thermostat or regulator clocks, among other things, are considered. Each action has a specific energetic gain that makes it possible to determine an average gain. The project came to an end in 2019, however, the gains are assumed to last 14 years, which is the average lifetime of the actions considered.

Finally, from 2007 to 2013, the Brussels Capital Region promoted the "Exemplary Buildings Project" (BatEx). The objective of the project was to promote ecological construction and passive buildings. The project allowed the construction and renovation of approximately 214 000 m^2 in the residential sector. The energy gain is estimated to last 20 years.

WAM scenario

The WAM scenario considers the improvement or the widening of some measures that take place in the WEM scenario for the residential and tertiary sector. One such measure is the checking of boilers. In the WAM scenario, the effectiveness of the measure increases to 25%. The budget for the energy grant system increases progressively until 2030. For this year, the budget will be EUR 45 million. As in the WEM scenario, 91% of the grants are awarded to the residential sector.

Finally, the strategy for reducing the environmental impact of existing buildings, known as "Renovation Strategy" is considered in this scenario. The assumptions are based on the implementation of the 4 main measures of building renovation: Roof, walls, floor insulation and the replacement of windows. These actions are executed according to the phases established in it, which means that the reduction in energy consumption will increase progressively and the first results will start in 2030.

5.1.4.5 The Tertiary Sector (CRF category 1A4a)

Flanders

In the WEM scenario, greenhouse gas projections are based on changes in activities and energy efficiency in line with the EU reference scenario 2016 and autonomous boiler efficiency improvements.

In the office buildings and education buildings subsector, a tightening of the E-level is taken into account for new buildings (Table 5.8).

The WAM scenario also includes:

- the implementation of additional energy saving measures as described in the reporting of the PAMS, resulting in an impact comparable with WAM measures in the residential sector
- the impact of renewable energy policies.

Wallonia

WEM scenario

Different energy services (heating, hot water, cooling, and other services including cooking, private and public lighting, refrigeration, and other electrical devices) and technologies are defined for 7 subsectors (education, health, culture and sports, shops, private offices, public offices, datacentres).

Changes in demand are linked to GDP growth[5].

Some renovations are assumed, according to the results from support policies (UREBA, …).

In the case of electrical equipment, new technologies are described according to the best available technologies.

During the period 2018-2040, the share of oil in final consumption is supposed to decrease slightly (from 17% to 13%), in favour of gas and renewable energy (the main increase involving an increasing share of biomass).

WAM scenario

The WAM scenario for the tertiary sector includes different measures:

- In the case of new buildings, energy autonomy will become more widespread (as a result of voluntary measures and studies for the purpose of strengthening regulatory requirements).
- In all buildings, more heat will be produced by renewable energy (biomass, heat pumps, ….), in accordance with targets of the Walloon contribution to National Energy and Climate Plan 2021-2030.
- In existing buildings, the targets of the "Long-term Renovation Strategy" and its intermediate objectives are taken into account. It will reduce the environmental impact of existing buildings. This strategy defines different objectives for energy efficiency of the envelope and the equipment of the existing buildings.

This scenario will require the implementation of new measures or the improvement/widening of some measures taking place in the WEM scenario.

Table 5.8 E-level pathway tertiary sector (2018-2021)

	2018	2020	2021
E-level	50	45	40

[5] GDP growth comes from regional projection (BFP *et al.*, 2020) for the short term and from European projections (recommended parameters provided by the European Commission for the mandatory reporting of national GHG projections) for the medium and long term.

Brussels-Capital Region

WEM scenario

The main consideration for establishing projections is the expansion of building surface due to the increase in employment as well as the information available in the regional energy balance.

The implementation of the Brussels Energy Performance of Buildings Decree[6] is reflected in the projections. This measure is applied for office and education buildings, starting from 2018. All new buildings are considered nearly passive (15kWh/m^2.yr) and all heavily renovated buildings must achieve a very low energy level (45kWh/m^2.yr).

As for the residential sector, the measures included in the COBRACE and the PACE are part of the WEM scenario. The first measure focuses on the major energy consumers. It contemplates the requirement of an energy audit in order to obtain the renewal of the environmental permit in the case of establishments exceeding 3500 m^2 [(7)]. The energy audit allows a reduction of 13% of final energy consumption.

The decree concerning energy audits was adopted on 8 December 2016[8]. According to this framework, big companies, defined by the number of employees and their energy consumption, must carry out an energy audit from 2018 onwards. This involves an average of 18 additional audits per year. In addition, the target is increased for commercial establishments, from 2018 onwards; commercial establishments with a surface area in excess of 1500 m^2 must perform an energy audit.

In addition, there is the mandatory implementation of local action and energy management plans (PLAGE, French acronym) in privately owned buildings with a floor area exceeding 100 000 m^2 and public buildings with an area greater than 50 000 m^2. The objectives of the PLAGE are to implement energy management measures, handle energy invoices, increase the degree of comfort experienced by users, improve air quality and reduce GHG emissions. This action got under way in 2019. The first phase will last for 6 years and the subsequent phases will continue for 4 years. The objective of the PLAGE is to achieve a reduction in final energy consumption of 10% per phase.

Three measures already described in the residential sector scenario (see section 5.1.4.4) are also applied in the tertiary sector. The first one is the carrying out of technical checks of heating systems. The theory underlining those checks are the same as the ones that apply the residential sector. The second one is the implementation of the energy grant system; the only difference is the proportion of the budget assigned to this sector; according to the grant system report concerning the year 2018, the tertiary sector uses 9% of total budget and it will be kept constant between 2019 and 2040. Finally, the BatEx project that promoted the energy and environmental performance, the profitability and reproducibility of the technologies and the architectural quality and urban integration of buildings was also applied in the tertiary sector. In fact, approximately 396 000 m^2 were constructed and renovated under this project between 2007 and 2013. It is assumed that the energy reduction obtained thanks to the construction characteristics is destined to last for 20 years.

WAM scenario

As mentioned before, some measures from the WEM scenario are upgraded in the WAM scenario. Two of them are implemented in the tertiary sector. The first one is the checking of boilers; in the WAM scenario, the effectiveness of the measure increases to 25%. The second one is the energy grant system that increases the budget progressively until 2030, the budget of which will be EUR 45 million for 2030. As in the WEM scenario, 9% of the grants are used by the tertiary sector.

Moreover, the strategy for reducing the environmental impact of existing buildings, known as "Renovation Strategy" is evaluated in this scenario. The same assumptions as for the residential sector are used.

5.1.4.6 The agricultural sector (CRF category 1A4c and 3)

Greenhouse gas emissions in the agricultural sector mainly consist of CH_4 and N_2O emissions originating from animal husbandry and emissions from agricultural soils.

The livestock numbers mentioned in CTF Table 5 were used in the projections.

Flanders

In 2018, energy consumption in the agricultural sector mainly originates from greenhouse heating systems (50%), non-stationary sources (fisheries, tractors, ...) (11%) and the heating of stables (22%).

Off-road emission projections are calculated using the OFFREM-model using emission factors from the IPCC 2006 guidelines (CO_2 and CH_4) and the EMEP/EEA guidebook (N_2O). Emission projections from sea-fishery are calculated using the EMMOSS model (Emissiemodel voor Scheepvaart en Spoor). Both models are also used for the greenhouse gas inventory.

The WEM projections for the greenhouse horticulture take into account an

6 21 décembre 2007.- Arrêté du Gouvernement de la Région de Bruxelles – Capitale déterminant des exigences en matière de performance énergétique des bâtiments et du climat intérieur des bâtiments tel que modifié par l'arrêté du 5 mai 2011.

7 30 janvier 2012.- Arrêté du Gouvernement de la Région de Bruxelles-Capitale relatif à un audit énergétique pour les établissements gros consommateurs d'énergie.

8 Arrêté du Gouvernement de la Région de Bruxelles-Capitale relatif à l'audit énergétique des grandes entreprises et à l'audit énergétique du permis d'environnement approuvé en troisième lecture le 8 décembre 2016.

extension of current subsidies for energy efficiency and renewable energy measures. In the WAM scenario additional energy agreements have been taken into account.

The CH_4 and N_2O emission projections take all policy measures, listed in the CTF Table 3, into account and new assumptions on the evolution of the animal herd: an overall decrease in the cattle herd, a stabilisation of the number of poultry and a slight decrease in the number of pigs due to new regulation on investment support for the purpose of manure management.

Wallonia

Energy related emissions in the agricultural sector in the Walloon Region, including the emissions from the gasoil of tractors and other mobile equipment, are limited (356 $ktCO_2e$ for the whole period).

CH_4 and N_2O emission projections take into account the recent evolutions of activity data:

- livestock: an overall decrease in cattle and an increase for all the other livestock categories;
- surface area used for agriculture: kept constant up to 2030;
- use of fertiliser: a reduction in the use of mineral fertilisers and an increase for the organic fertilisers.

For some parameters, the mean values in the past few years are carried forward up to 2030, in the absence of any other information (e.g. milk yield, crop residues).

The same figures are used in the WEM and WAM scenarios and calculations follow the methodology of GHG inventories, detailed in the National Inventory Report of the 2021 submission.

Brussels-Capital Region

Greenhouse gas emissions in agriculture mainly consist of CH_4 and N_2O emissions originating from animal husbandry (enteric fermentation and manure management) and direct and indirect emissions from managed soils. Agricultural emissions are very low in the Brussels Capital Region. The stabilisation of the sector is assumed since further expansion is not possible; therefore the values remain constant.

5.1.4.7 The Transport Sector (CRF category 1A3)

General remarks regarding road transport projections

Projections for the road transport sector are performed combining 3 regional bottom-up calculations ("fuel used" basis). The sum of the three regional values for the reference year (2018) is then compared to the top-down data (or the "fuel sold" basis as reported in the Belgian CRF inventory data). Subsequently, the aggregated growth in the bottom-up models is applied to the difference between the bottom-up and top-down calculations (the so-called surplus), which is then allocated to the regions on a proportional basis, according to their modelled emissions. Ultimately, the regional projections (including their respective shares of the surplus) are added to each other to obtain the overall Belgian projection.

Biofuels

The share of biofuels in transport fuels is one of the important factors determining the emission levels. The shares of biofuels used in the regional road transport models are harmonised on the basis of this federal PAM. Table 5.9 provides an overview of the assumed blends of biodiesel in diesel and bioethanol in gasoline in the WEM scenarios.

Apart from the harmonised shares of biofuels in road transport, the rest of the transport sector modelling takes place by means of specific regional models. These are described below.

Flanders

Different models were used for the various modes of transport (road transport, railway transport, inland shipping, maritime shipping and aviation). The models calculate the use of energy and the emissions based on the transport flows (volumes). In the case of road traffic, railway traffic and inland shipping, the specialised Flemish multimodal traffic model was used to calculate the transport flows.

Road transport

The calculation of atmospheric pollutants emissions and energy consumption for road transport is based on projection studies performed by VITO for the Flemish government using the Fastrace model (see Annex 3). Only motorised traffic (excl. pedestrians and cyclists) is included in the projections.

Table 5.9 Overview of the assumed volumetric and energetic shares of biofuels in transport fuels in the WEM and WAM scenarios

		% Net Calorific Value				
		2018	2025	2030	2035	2040
WEM	bioethanol	6.5	8.95	8.95	8.95	8.95
	biodiesel	5.3	8.95	8.95	8.95	8.95
WAM	bioethanol	6.5	10	10.45	10.45	10.45
	biodiesel	5.3	10	10.45	10.45	10.45

The GHG projections take 2018 as the base year. The confirmed policies and measures are taken into account in the WEM scenario. These include the national and regional planned improvements of the public transport network, the redesigning of some urban areas to promote soft modes of transport (walking, cycling) and the implementation of road pricing for heavy goods vehicles used for the transportation of freight. No new Flemish measures are assumed in the WEM scenario after 2019. From the base year 2018 onwards, the expected evolution of mobility and transport demand in Flanders in the WEM scenario was used to calculate the number of vehicle kilometres per vehicle type and fuel type for the period 2018-2040. The overall composition of Flemish vehicle fleet was modelled for the period 2018-2035, based on the fleet in 2018 and considering the composition of new vehicles (i.e. remaining stable at the 2018 level in the WEM scenario) and survival rates of the vehicles over the same period.

Additional measures to reduce the number of vehicle kilometres and aiming to achieve a significant shift to electric, plug-in hybrid or charge sustaining hybrid vehicles, have been taken into account in the WAM scenario. Additional measures are expected to reduce the number of vehicle kilometres compared with the WEM scenario. The Flemish Clean Power for Transport Plan 2020 and draft Vision 2030 will lead to a shift towards cleaner vehicles. This vision includes a target of 50% zero emission vehicles (new sales) in 2030.

Rail transport

Emissions of rail transport only include the emissions originating from diesel trains, while energy figures include energy use by electric trains as well. The applied growth in transported volumes determines train-kilometres, which in turn determine the evolution of the emissions. The shares of diesel and electric traction are considered constant over the projected period. The evolution of the transported volumes is based on one of the most plausible scenarios in the Flemish mobility plan, which is currently under development.

Inland Waterways and Short-sea Shipping

Emissions of inland waterways and short-sea shipping are based on the evolution of the transported volumes under the same scenario as rail transport.

Off-road emissions

Emission of off-road activities in harbours, airports and transhipment companies are allocated to CRF category 1A3e. The emissions projections are calculated using the country-specific OFFREM-model and using emission factors from the IPCC 2006 guidelines (CO_2 and CH_4) and EMEP/EEA guidebook (N_2O).

Pipeline transport

Emissions originating from the compression activities in the sector 'storage and transport of natural gas' are reported in CRF category 1A3e. The emissions are assumed to remain constant at 2018 levels.

Table 5.10 Repartition passenger cars (WEM scenario)

% Stock vehicle	2018	2030	2040
Electricity	0.0%	12.1%	26.0%
CNG	0.1%	0.5%	0.4%
Diesel	55.6%	39.1%	20.0%
Diesel hybrid	0.0%	0.0%	0.0%
Fuel cell electric vehicle	0.0%	0.7%	3.2%
LPG	0.2%	1.6%	0.9%
Petrol	43.1%	29.5%	17.2%
Petrol hybrid	1.0%	16.4%	32.3%

Wallonia

WEM scenario

Road transport

The projections of the overall mobility are calculated using the principle of mobility demand (projections of the Federal Planning Bureau[9]). The projections of the vehicle fleet are calculated using survival curves based on historic inventory data and on European legislations in force (Regulations 2019/631 and 2019/1242). The emission factors for existing vehicles are calculated from historic inventory data (year 2018) and emission factors for new technologies are estimated in the Sibyl baseline model.

In the case of passenger cars and despite an augmentation of electric and petrol hybrid vehicles, conventional vehicles remain the main technologies operating up to 2030. In 2040, the situation is different, in that there are more electric and hybrid petrol vehicles than conventional ones (see Table 5.10) due to the different European legislation in force.

In the case of heavy duty and light commercial vehicles, diesel conventional models remain dominant (respectively 87.7% and 80% of the stock in 2030 and 65% and 56% in 2040). The tonnes/km that exists today and will increase by 2040.

[9] For more information see: https://www.plan.be/databases/database_det.php?lang=fr&ID=41

Rail transport

An increase of the emissions due to the increase of transport by rail has been assumed.

Inland vessels

Navigation

The demand for the transportation of goods by inland vessels will increase.

Aviation

Demand for aviation is assumed to be related to the increase in households and population.

WAM scenario

WAM scenario includes the FAST vision and the regional strategy of mobility (passengers and freight). FAST vision identifies different objectives with regard to future mobility in Wallonia in 2030[10] and the strategy of mobility defines how these objectives will be achieved. This scenario will require the implementation of new measures or the improvement/widening of some measures taking place in the WEM scenario.

Road transport

In the case of passenger cars, demand decreases under the impulsion of a decreasing modal share of cars (from 83% in 2017 to 62% in 2030), a rise in the car occupancy rate (from 1.3 in 2017 to 1.5 in 2030) and a reduction of 5% of the overall demand for passenger transport. The stock of electric, petrol hybrid and CNG vehicles increases by 2030 (respectively to 21%, 20% and 20% in 2030).

Total demand for freight transport is kept constant for the whole period and the modal share by road is 77% in 2030 (84% in 2016).

Rail transport

The modal share of rail transport within the passenger transport as a whole increases up to 15.7% by 2030 (9% in 2017). In the case of freight transport, the modal share of rail transport increases by as much as 13% of overall freight transport by 2030 (9% in 2016).

Navigation

For navigation, the modal share for freight transport increases up to 10% of the total tonnes/km in 2030 (7% in 2016).

Aviation

As for the WEM scenario, demand for aviation is assumed to be related to the increase in households and population.

Wallonia is in a transition period and is currently developing new projection models to estimate transport (TIMES, Sibyl, see Annex 3). The baseline scenario has been produced with these models. The WAM has been produced with a previous projection tools used in the previous report. Ultimately, the idea is to perform all the scenarios with the same tool(s), while ensuring that the different models used are linked together in the most effective possible way. Regularly updating models on the basis on the best available data collected through studies or actors is an important point of attention.

Brussels-Capital Region

WEM scenario

Projections of transport emissions consider road and off-road transport, railways, inland navigation, and natural gas transport. Road transport emissions represent 94.3% of the total GHG emissions of transport (in 2018). The main hypotheses are described in the following paragraphs.

Road transport

The calculation of atmospheric pollutants emissions and fuel consumption for road transport is based on the European COPERT IV approach. The main input data required for COPERT simulations (vehicle fleet and mobility) comes from a regional transport model, developed on the basis of literature data TREMOVE projections and INRETS study[11]), and recalibrated to the actual situation in the Brussels-Capital Region using emission inventories and outputs from a detailed traffic model (MUSTI).

The policies and measures taken into account for the simulations refer to WEM scenario.

In the case of road transport, the WEM scenario also considers the implementation of a Low Emission Zone (LEZ) on a regional level, which implies that the vehicles that do not respect the established thresholds (based on fuel and EURO standards) are banned. This measure has a significant influence on some pollutants affecting local air quality, but a rather limited impact on GHG emissions and climate change.

Rail transport

For railways, the evolution of liquid fuel (gasoil) consumption is derived from the evolution in freight transport demand in Belgium as a whole. The starting point of the projections (2018) comes from the regional energy balance. The GHG emissions increase by about 26 t CO_2-eq. between 2015 and 2020, and reach 3.4 kt CO_2-eq in 2040. Passenger transport (trains, metro and tramways) is powered by electricity; the increase in electricity consumption projected between 2020 and 2040 is 34%, this figure having been estimated using the data provided by Bruxelles Mobilité.

Navigation

In the case of inland navigation, the evolution in liquid fuel (gasoil) consumption is derived from the developments in demand for freight transport on a Belgian level. The starting point of the projections comes from the regional energy balance. Projections show an increase in GHG emissions. In 2020, emissions from inland

[10] The 2030 results are kept constant until 2035.

[11] **INRETS.** *Transport routier - Parc, usage et émissions des véhicules en France de 1970 à 2025.* s.l. : Institut National de Recherche sur les Transports et leur Sécurité (INRETS), 2004.

navigation will be 1.98 kt CO_2-eq, and in 2040 they will be 2.23 kt CO_2-eq.

Natural gas transport

The emissions originating from natural gas transport are kept constant and equal to the emissions of year 2018 for the entire projection period since there are not available projections for this sector. It is important to mention that in 2018, this sector represented 0.05% of total natural gas consumption.

Off-road emissions

Projected off-road emissions for all sectors and vehicle categories come from the OFFREM model.

WAM scenario

Road transport

The "Good Move" Plan is the regional mobility plan. Developed on the basis of a dynamic and participatory process, Good Move defines the Region's mobility objectives and actions in the period between now and the year 2030. It focuses on six frames and is based on the implementation of fifty measures. According to preliminary estimates, the Good Move plan could help bring about a reduction in vehicle-kilometres covered by light vehicles in the Brussels Capital Region of 21% from 2018 to 2030. The priority objectives of Good Move Plan regarding energy and climate are to reduce the use and ownership of cars, to increase the modal shift and to green the fleet.

In addition to the "Good Move" Plan, the government of the Brussels Capital Region has decided to implement a progressive phasing-out of fossil fuel-based combustion engines in the Region. Diesel-powered light vehicles will be banned from 2030 onwards, and gasoline and GPL light vehicles from 2035 onwards.

5.1.4.8 The 'Other product manufacture and use' Sector (CRF category 2G)

Only the use of N_2O as an anaesthetic and in aerosol cans is included in this category.

Flanders

N_2O emissions from this use are kept constant at 2018 emission levels. The most recent historical value has been considered constant for the entire projection period.

Wallonia

N_2O emissions from this use in Wallonia are kept constant at 2018 emission levels. Due to the lack of information about the evolution of consumption, the most recent historical value has been considered constant for the entire projection period for both the WEM and the WAM scenario.

Brussels-Capital region

The use of N_2O as an anaesthetic and in aerosol cans is included in this category. The information on use is based on the regional sales. The most recent historic value has been considered constant for the entire projection period. Emissions due to the use of aerosol cans are also estimated in the BCR inventory considering a constant consumption per inhabitant. The emission projections of aerosol cans are based on population data from the FPB (see section 5.1.3.4).

5.1.4.9 Non-energy products from fuels and solvent use (CRF category 2D)

Flanders

The emissions of non-energy products resulting from fuels and solvent use are considered constant at the 2018 level for the entire projection period.

Wallonia

The emissions of non-energy products from fuels and solvent have remained stable for 10 years. Those emissions are kept constant for the entire projection period.

Brussels-Capital Region

The use of non-energy products is kept constant for the entire period.

5.1.4.10 The Waste Sector (CRF category 5)

Flanders

Projections of CH_4 emissions from the solid waste disposal on land (CRF category 5A) are calculated taking into account a ban on organic waste dumping since 2000. CO_2 emissions from the solid waste disposal on land sites originate when recovered emissions are used or flared via installations with energy recuperation. These emissions are reported in the energy sector (CRF category 1A1a and 1A4a).

CH_4 and N_2O emissions from wastewater handling in Flanders (CRF category 5D) are based on projections with respect to the evolution of population and of the number of people connected to wastewater handling systems until 2040.

CO_2 emissions from municipal wastewater treatment is set to zero in the projections because these emissions derive from biomass raw materials.

The waste incineration category includes the incineration of municipal and industrial waste, the incineration of hospital waste and the incineration of corpses. In Flanders, only the fraction of organic-synthetic waste is taken into consideration to estimate the CO_2 emissions originating from waste incineration. As mentioned in section 5.1.4.1, the projections for the waste incineration plants with energy recuperation are allocated to the energy sector.

CO_2 emissions from flaring in the chemical industry are allocated to the waste sector (CRF category 5C) and are assumed to remain constant at the 2018 level.

CH_4 emissions from composting (CRF category 5B) are kept constant at current emission levels.

Wallonia

Projections of CH_4 emissions from the solid waste disposal on land in Wallonia take into account the implementation of the Order of the Walloon Government of 18 March 2004 banning the dumping of municipal waste into landfills since 1 January 2008, which has yielded a decline in degradable organic carbon (DOC) content (municipal waste being mainly organic).

Nevertheless, the amount of **total** waste disposed is considered constant and equal to the latest available data (2019). The methodology used for calculation is the one described in the most recent 2006 IPCC guidelines and in the National Inventory Report of the 2021 submission. The recovery rate of landfill gas is assumed to remain constant at the level recorded in 2019 (the latest available data). CO_2 emissions from the solid waste disposal on land-based sites come from the use of recovered emissions that are used or flared via installations with energy recuperation. These emissions are reported in the energy sector.

CH_4 and N_2O emissions resulting from wastewater handling in Wallonia are kept constant at current emission levels. CO_2 emissions from municipal wastewater treatment are not included in the projections because the carbon derives from biomass raw materials.

The waste incineration category includes the incineration of municipal solid waste, the incineration of hospital waste and flaring in the chemical industry. The CO_2 emission projections originating from hospital waste incineration are integrated in the waste incineration sector. The emission projections of the municipal waste incineration plants (with energy recuperation) are allocated to the energy sector.

CH_4 and N_2O emissions from composting in Wallonia are kept constant at current emission levels.

The figures reported under WEM and WAM scenario are the same.

Brussels-Capital Region

The waste sector takes into account the emissions from water treatment plants, composting installations and waste incinerators. In the case of the wastewater handling emissions, only the N_2O emissions are considered in the projections since the biogas produced is used in a CHP installation. Projections are based on the population evolution (see section 5.1.3.4). The compost centre started in 2002 and emissions from composting are kept constant for the projected period. The waste incinerator in Neder-Over-Heembeek is not included in the waste sector due to the energy recovery process. This installation is included in the energy sector.

5.1.4.11 The Land-Use and Land-Use Change and Forestry Sector (CRF category 4)

The approach for the LULUCF WEM projections consists of extrapolating the recent trends of land use changes towards 2040 on the basis of the most recently integrated data of the Land Use Change Matrix in the LULUCF emission inventory. Both CO_2 and N_2O emissions are taken into account. No WAM scenario is available for LULUCF. The WAM scenario has therefore been equated with the WEM scenario in the reporting.

The trend is adjusted for specific land use categories, based on the following hypotheses:

- The land use change from grassland to cropland will stop from 2025 onwards
- The soil organic carbon in grassland will remain constant from 2030 onwards
- In Wallonia, the conversions to settlements are gradually being reduced, based on available projections regarding artificialisation of soils

The Flemish region did not account for the projected removals from 'managed forest land' due to a recent change of Carbon Uptake Factor in Flemish forests in the LULUCF emission inventory (submission 15 March 2021) which has not yet been integrated in the Forest Reference Level 2021-2025. A technical correction of the Forest Reference Level will be prepared before the final accounting for 2021-2025. Hence, no accounting exercise is made at Belgian level neither.

5.1.5 Differences in methodology and assumptions

There have been some changes in the modelling tools used by the Walloon Region since the last reporting of the national communication and biennial report, due to the development and the first exploitation of "TIMES-Wal" (supplemented by an Excel tool at this stage), which replaces EPM model.

The main differences in assumptions are:

- A new base year (2018 in NC8/BR5 versus 2014 in NC7 and 2016 in BR4);
- Different climate assumptions (1 821 degree-days in NC8/BR5 versus 1 807 degree-days in NC7/BR3 and 1 870 degree-days in BR4 using reference 15/15);
- More recent demographic projections based on prospects presented in 2020 by the Federal Planning Bureau (Table 5.11).

– Activity assumptions for industrial sectors were adapted to more recent economic projections;
– Assumptions for the buildings now include the new policy initiatives up to and including 2019;
– Livestock numbers have been adjusted based on more recent information (Table 5.12).

Table 5.11 Differences in demographic projections (NC8/BR5 versus NC7 and BR4)

	Demographic projections			
	2020	2025	2030	2035
NC7				
Population of Belgium (thousands)	11 756	11 989	12 208	11 519
Number of households in Belgium (thousands)	5 155	5 296	5 436	5 019
Average household size in Belgium	2.28	2.26	2.25	2.30
BR4				
Population of Belgium (thousands)	11 511	11 773	11 995	
Number of households in Belgium (thousands)	4 956	5 092	5 222	
Average household size in Belgium	2.32	2.31	2.30	
NC8/BR5				
Population in Belgium (thousands)	11 488	11 695	11 886	12 066
Number of households in Belgium (thousands)	4 941	5 072	5 202	5 323
Average household size in Belgium	2.32	2.31	2.28	2.27

Table 5.12 Differences in livestock numbers (NC8/BR5 versus NC7 and BR4)

Animal numbers (thousands)	2020	2025	2030	2035
NC7				
Dairy cattle	426	414	398	398
Non-dairy cattle	2 023	1 918	1 822	1 822
Sheep	113	101	138	138
Pigs	6 488	6 245	6 085	6 085
Poultry	39 414	39 618	40 506	40 506
BR4				
Dairy cattle	448	432	417	
Non-dairy cattle	2 022	1 938	1 859	
Sheep	117	115	113	
Pigs	6 451	6 380	6 310	
Poultry	44 752	48 404	52 190	
NC8/BR5				
Dairy cattle	475	457	439	427
Non-dairy cattle	1 935	1 856	1 782	1 725
Sheep	135	136	136	137
Pigs	6 379	6 291	6 204	6 219
Poultry	44 551	48 112	51 791	52 849

5.1.6 The 'with existing measures' greenhouse gas emission projections

Tables 5.13, 5.14 and 5.15 summarise the compiled 'with existing measures' projections for the period 1990-2040. For the period 1990-2020, this concerns inventory data.

More detailed information on these projections can be found in the projections template reported under Article 18 of Regulation (EU) 2018/1999. More aggregated projection results are included in CTF Table 6.

Table 5.13 Greenhouse gas emissions by policy sector (WEM scenario) Mt CO_2-eq

	1990	1995	2000	2005	2010	2015	2018	2020	2025	2030	2035	2040
Total excluding LULUCF	145.7	153.6	148.9	145.5	133.6	119.0	117.6	106.4	121.0	126.1	126.1	124.1
Total including LULUCF	142.8	151.3	147.2	143.8	133.3	118.1	117.0	106.1	119.8	124.7	124.8	122.8
EU ETS (in accordance with ETS scope 2013-2020)	n.a.	n.a.	n.a.	66.7	54.8	44.7	44.2	41.5	50.4	56.5	57.6	56.5
ESD (in accordance with ETS scope 2013-2020)	n.a.	n.a.	n.a.	78.6	78.8	74.2	73.4	64.9	70.6	69.6	68.4	67.6
LULUCF	-2.9	-2.3	-1.7	-1.8	-0.4	-0.8	-0.6	-0.3	-1.2	-1.4	-1.3	-1.3

Table 5.14 Greenhouse gas emissions by IPCC sector (WEM scenario) Mt CO_2-eq

	1990	1995	2000	2005	2010	2015	2018	2020	2025	2030	2035	2040
1 Energy	103.8	107.7	106.2	105.8	99.5	87	85.2	77.0	92.3	98.2	98.5	96.8
1A Fuel combustion	102.5	106.8	105.3	105	98.8	86.3	84.5	76.4	91.6	97.5	97.9	96.2
1A1 Energy industries	29.7	29.3	28.5	29.0	26.2	20.9	19.7	19.0	24.1	30.4	31.6	30.9
1A2 Manufacturing industries and construction	23.5	23.2	21.7	18.9	16	13.9	14.1	13.1	16.2	16.3	16.5	16.7
1A3 Transport	20.9	23	25	26.8	26.7	26.9	26.2	21.7	27.8	27.8	27.2	26.6
1A4 Other sectors	28.2	31.2	29.9	30.1	29.8	24.6	24.4	22.5	23.5	23	22.5	22
1A5 Other	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
1B Fugitive emissions from fuels	1.2	0.9	0.9	0.7	0.8	0.7	0.7	0.6	0.7	0.7	0.7	0.7
2 Industrial processes	26.1	30	28.3	27.1	22.1	20.9	21.7	18.9	18.6	18.1	17.9	17.9
3 Agriculture	11.5	11.6	10.7	9.7	9.5	9.3	9.3	9.3	9.1	9	8.8	8.7
4 LULUCF	-2.9	-2.3	-1.7	-1.8	-0.4	-0.8	-0.6	-0.3	-1.3	-1.4	-1.3	-1.3
5 Waste	4.3	4.3	3.8	3.0	2.5	1.6	1.4	1.2	1	0.9	0.8	0.8

Table 5.15 Greenhouse gas emissions by gas, excluding LULUCF (WEM scenario) Mt CO_2-eq

	1990	1995	2000	2005	2010	2015	2018	2020	2025	2030	2035	2040
CO_2	120.3	126.0	126.7	125.6	114.6	101.1	100	90.4	106.9	112.7	113.2	111.6
CH_4	11.5	11.3	10.2	8.6	8.2	7.6	7.3	7.1	6.8	6.5	6.4	6.2
N_2O	10.1	10.8	10.2	8.5	7.5	6.0	5.6	5.4	5.6	5.5	5.4	5.4
F-gases	3.8	5.5	2.1	2.8	4.3	4.3	4.8	3.6	1.9	1.3	1.1	1.0

Table 5.16 Greenhouse gas emissions by policy sector (WAM scenario) Mt CO_2-eq

	1990	1995	2000	2005	2010	2015	2018	2020	2025	2030	2035	2040
Total excluding LULUCF	145.7	153.6	148.9	145.5	133.6	119.0	117.6	106.4	111.7	105.4	99.5	94.3
Total including LULUCF	142.8	151.3	147.2	143.8	133.3	118.1	117.0	106.1	110.5	104.0	98.2	93.0
EU ETS (in accordance with ETS scope 2013-2020)	n.a.	n.a.	n.a.	66.7	54.8	44.7	44.2	41.5	51.3	54.6	54.6	54.5
ESD (in accordance with ETS scope 2013-2020)	n.a.	n.a.	n.a.	78.6	78.8	74.2	73.4	64.9	60.4	50.8	44.8	39.8
LULUCF	-2.9	-2.3	-1.7	-1.8	-0.4	-0.8	-0.6	-0.3	-1.2	-1.4	-1.3	-1.3

5.1.7 The 'with additional measures' greenhouse gas emission projections

The effect of the additional measures included in the WAM scenario results in the emission projections described in Tables 5.16, 5.17 and 5.18. For the period 1990-2020, this concerns inventory data.

More detailed information on these projections can be found in the projections template reported under Article 18 of Regulation (EU) 2018/1999. More aggregated projection results are included in CTF Table 6.

Table 5.17 Greenhouse gas emissions by IPCC sector (WAM scenario) Mt CO_2-eq

	1990	1995	2000	2005	2010	2015	2018	2020	2025	2030	2035	2040
1 Energy	103.8	107.7	106.2	105.8	99.5	87	85.2	77.0	83.8	79.2	73.7	69.0
1A Fuel combustion	102.5	106.8	105.3	105	98.8	86.3	84.5	76.4	83.1	78.6	73.1	68.3
1A1 Energy industries	29.7	29.3	28.5	29.0	26.2	20.9	19.7	19.0	24.8	27.9	28	27.9
1A2 Manufacturing industries and construction	23.5	23.2	21.7	18.9	16	13.9	14.1	13.1	15.4	15.4	15.2	15.2
1A3 Transport	20.9	23	25	26.8	26.7	26.9	26.2	21.7	22.5	18.3	16	14.2
1A4 Other sectors	28.2	31.2	29.9	30.1	29.8	24.6	24.4	22.5	20.3	16.8	13.7	10.9
1A5 Other	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
1B Fugitive emissions from fuels	1.2	0.9	0.9	0.7	0.8	0.7	0.7	0.6	0.7	0.7	0.7	0.7
2 Industrial processes	26.1	30	28.3	27.1	22.1	20.9	21.7	18.9	18.3	17.4	17.4	17.4
3 Agriculture	11.5	11.6	10.7	9.7	9.5	9.3	9.3	9.3	8.6	8	7.6	7.1
4 LULUCF	-2.9	-2.3	-1.7	-1.8	-0.4	-0.8	-0.6	-0.3	-1.2	-1.4	-1.3	-1.3
5 Waste	4.3	4.3	3.8	3.0	2.5	1.6	1.4	1.2	1	0.9	0.8	0.8

Table 5.18 Greenhouse gas emissions by gas, excluding LULUCF (WAM scenario) Mt CO_2-eq

	1990	1995	2000	2005	2010	2015	2018	2020	2025	2030	2035	2040
CO_2	120.3	126.0	126.7	125.6	114.6	101.1	100	90.4	98.5	93.8	88.6	83.9
CH_4	11.5	11.3	10.2	8.6	8.2	7.6	7.3	7.1	6.4	5.7	5.3	5.0
N_2O	10.1	10.8	10.2	8.5	7.5	6.0	5.6	5.4	5.1	4.8	4.6	4.5
F-gases	3.8	5.5	2.1	2.8	4.3	4.3	4.8	3.6	1.9	1.0	1.0	0.9

5.1.8 Sensitivity analysis

Sensitivity analyses are performed for some important parameters such as the number of degree-days and importing of electricity. Indirect effects, however, are not taken into account.

Two parameters were varied in a sensitivity analysis (see Table 5.19): the number of heating days and the net imports of electricity. This leads to four scenarios: 1) warm scenario (a low number of heating days as recorded in 2014), 2) cold scenario (a high number of heating days as recorded in 2013), 3) lower electricity import (–5 TWh compared to base scenario) and 4) higher electricity import (+5 TWh compared to base scenario). For the four scenarios, the total WEM and WAM emissions were calculated (see Table 5.20).

Table 5.19 Parameter values used for the sensitivity analyses

Scenario	Number of heating days (2020-2040)	Net electricity import WEM [TWh]				Net electricity import WAM [TWh]			
		2025	2030	2035	2040	2025	2030	2035	2040
Base scenario	1 821	8.1	13.0	13.0	13.0	7.3	8.5	9.0	9.3
1: Warm scenario	1 441	8.1	13.0	13.0	13.0	7.3	8.5	9.0	9.3
2: Cold scenario	2 145	8.1	13.0	13.0	13.0	7.3	8.5	9.0	9.3
3: Low electricity import	1 821	3.1	8.0	8.0	8.0	2.3	3.5	4.0	4.3
4: High electricity import	1 821	13.1	18.0	18.0	18.0	12.3	13.5	14.0	14.3

Table 5.20 Greenhouse gas emissions excluding LULUCF for the different scenarios of the sensitivity analysis, Mt CO_2-eq

Scenario	Total excl. LULUCF - WEM				Total excl. LULUCF - WAM			
	2025	2030	2035	2040	2025	2030	2035	2040
Base scenario	121	126	126	124	112	106	100	94
1: Warm scenario	118	123	123	121	110	104	98	93
2: Cold scenario	123	128	128	126	114	107	101	96
3: Low electricity import	123	128	128	126	114	107	101	96
4: High electricity import	119	124	124	122	110	104	98	93

5.1.9 Comparison with previous projection results

The projection results presented in this report are compared with the previous reports (NC7 and BR4) in Figure 5.1 and Figure 5.2. The main differences can be explained by the different sectoral assumptions as described in chapter 5.1.4., resulting in a more ambitious WAM scenario in this report.

Figure 5.1 Comparison of total GHG emissions excluding LULUCF (projections in this report versus projections in NC7 and BR4), Mt CO_2-eq

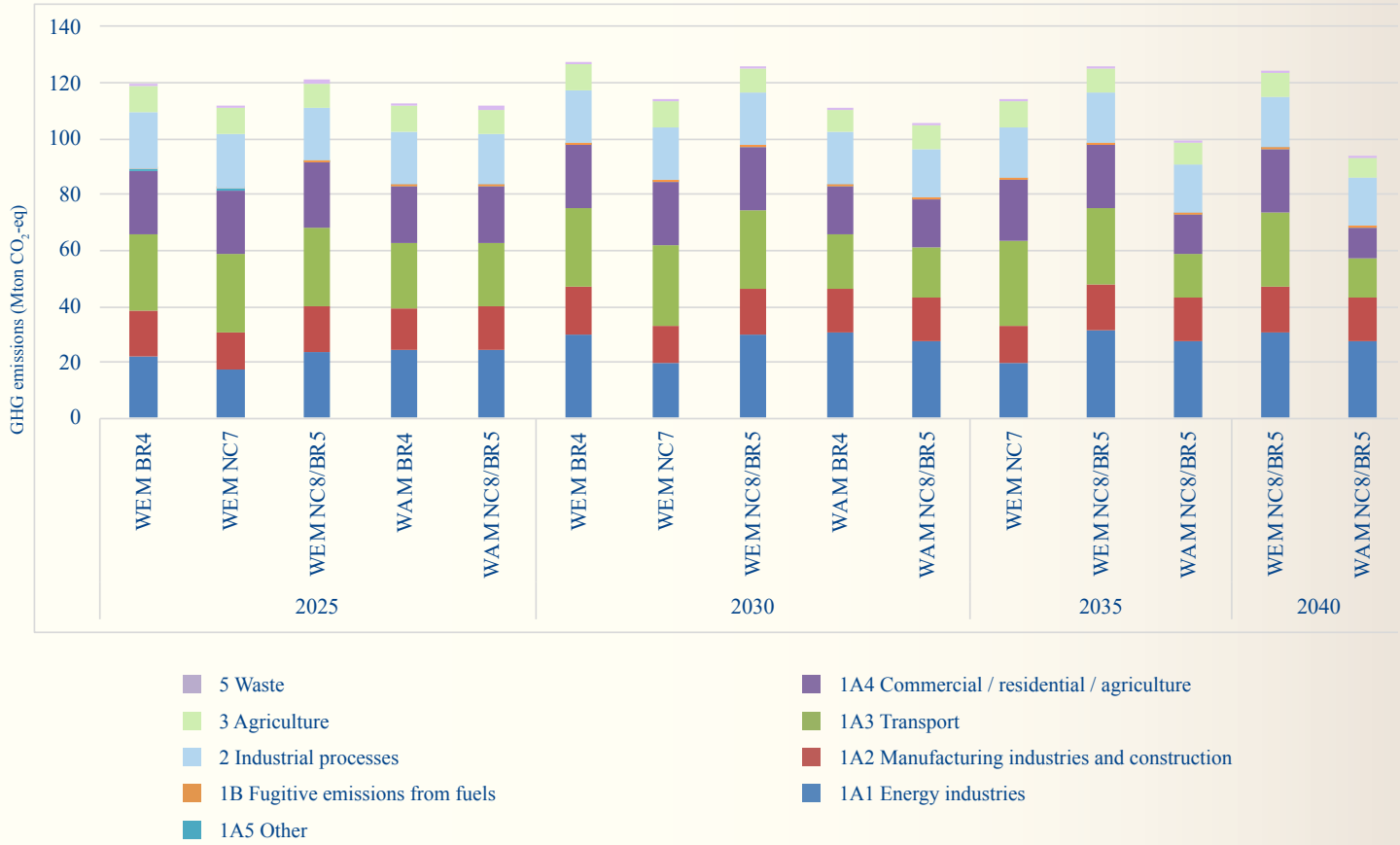
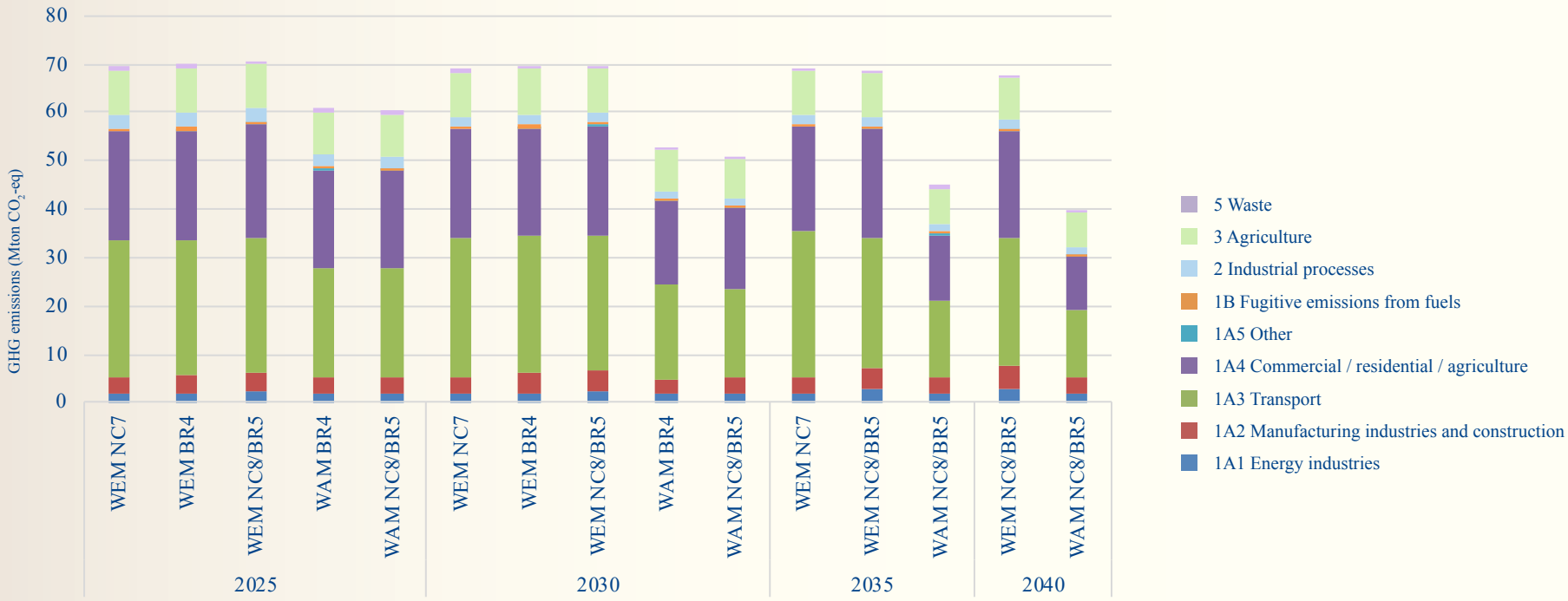


Figure 5.2 Comparison of non-ETS GHG emissions excluding LULUCF (projections in this report versus projections in NC7 and BR4), Mton CO_2-eq



5.1.10 Conclusion

5.1.10.1 Overall emission levels

There is a clear decrease between 1996 and 2019 in the total greenhouse gas emissions in the inventory (Figure 5.3) and, in 2020, the inventory shows a sharp decline due to the impact of the COVID-19 crisis. However, the total emissions in the WEM scenario show a clear increase in the period 2021-2030, followed by a slight decrease in the period 2030-2040. The total emissions in the WAM scenario show a steady decrease in the period 2021-2040. These projections do not include emissions or removals from LULUCF.

Uncertainties concerning exogenous variables such as economic growth, climate conditions and electricity imports exist and their level will influence the resulting greenhouse gas emissions, notably in the sectors covered by the EU ETS.

The EU Effort Sharing Regulation, establishing binding annual greenhouse gas emission reductions by EU Member States from 2021 to 2030, mentions a target of -35% in 2030 compared to 2005 for Belgium. The non-ETS target for the period 2021-2030 as shown in Figure 5.3 has been taken from Commission Implementing Decision (EU) 2020/2126. However, as the projections (AR4) and the non-ETS targets (AR5) are based on different GWP values, it should be noted that both datasets are not yet fully comparable.

Figure 5.3 GHG emissions excluding LULUCF, Mton CO_2-eq

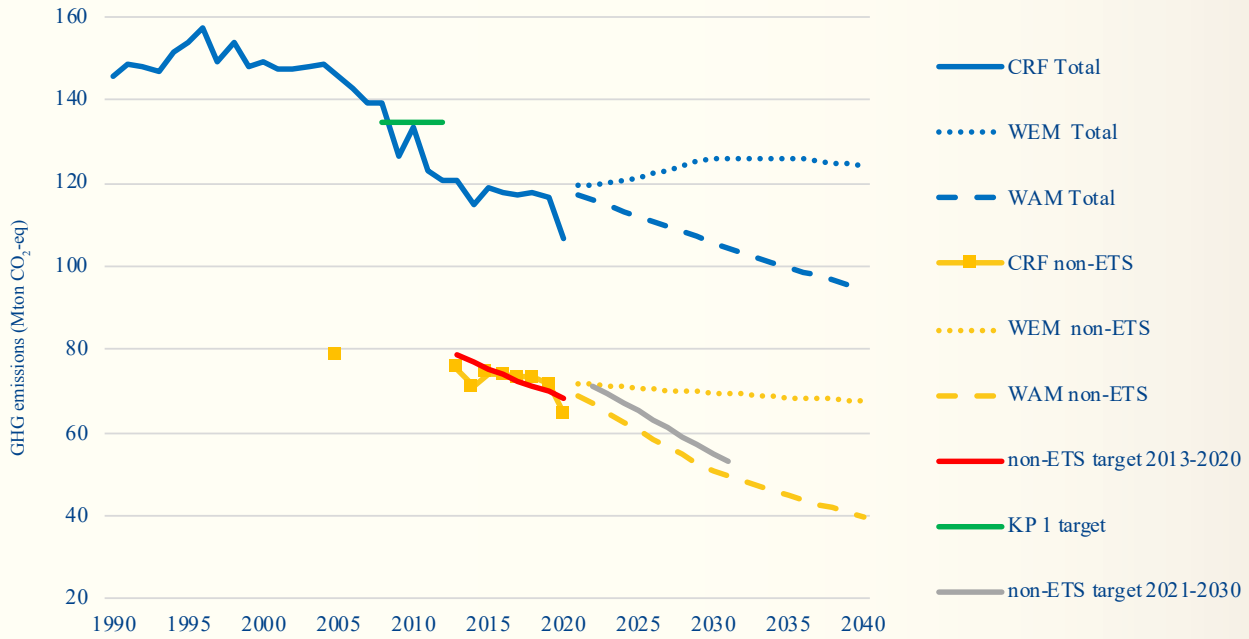
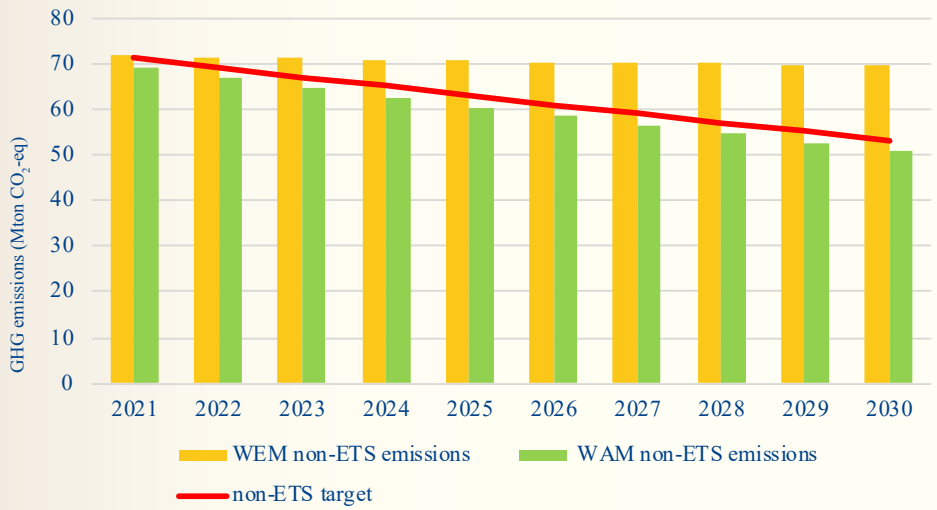


Figure 5.4 Comparison of WEM and WAM non-ETS projections with non-ETS target (2021-2030)



5.1.10.2 Comparison with the Effort Sharing Decision Target (2021-2030)

In Figure 5.4, the non-ETS emission projections from the WEM and the WAM scenario are compared with the Effort Sharing Regulation targets from Commission Implementing Decision (EU) 2020/2126. Interpolation was used to determine emissions in the years 2021-2024 and 2026-2029. In the case of the WEM scenario, the emission targets are exceeded in all years of the period 2021-2030. In the WAM scenario, the non-ETS objectives are not exceeded in any year. However, as the projections (AR4) and the non-ETS targets (AR5) are based on different GWP values, it should be noted that both datasets are not yet fully comparable.

5.1.10.3 Future developments

By 30 June 2023, Belgium must submit to the Commission a draft update of the latest notified integrated national energy and climate plan (followed by a final version of this update by 30 June 2024) in accordance with Article 14 of the EU Governance Regulation. As a result of this update, Belgium will also develop updated projections that will take into account the latest policy insights. On some points, this may lead to substantial differences compared to the projections presented in this document. Reference can be made in this respect to a recent decision of the federal government, including an extension of the service-life of two nuclear power plants (2GW of nuclear capacity) and the accelerated construction of the offshore capacity.

5.2 Assessment of aggregated effects of policies and measures

As mentioned in chapter 4, several NECP measures have not (yet) been estimated. Indeed, efforts are still needed to improve or develop the calculation methods and to establish reliable indicators.

Numerical evaluations could be attributed to 48 PAMs. The majority concerns the energy sector (25), and the transport sector (15).

In relation to the BR4, impact estimates up to 2040 have been completed as far as possible which allows for a better estimation of long-term trends. The figures for the Federal State were updated following the iteration of its studies. For the Flemish Region, the PAMs that had been estimated in the past (BR4) for 2020 are no longer estimated for 2020, but for the subsequent years. For Brussels, some measures are now estimated, as well as for the Walloon Region, but the latter has preferred to estimate PAMs as a group (cluster of PAMs).

New estimates are likely to be provided in the context of the NECP progress report in 2023. That same report should make it possible to collect more information on the costs of PAMs, which are currently still very incomplete.

New measures are also expected in 2023/2024 when the NECP is reviewed and the implementation status of several may change.

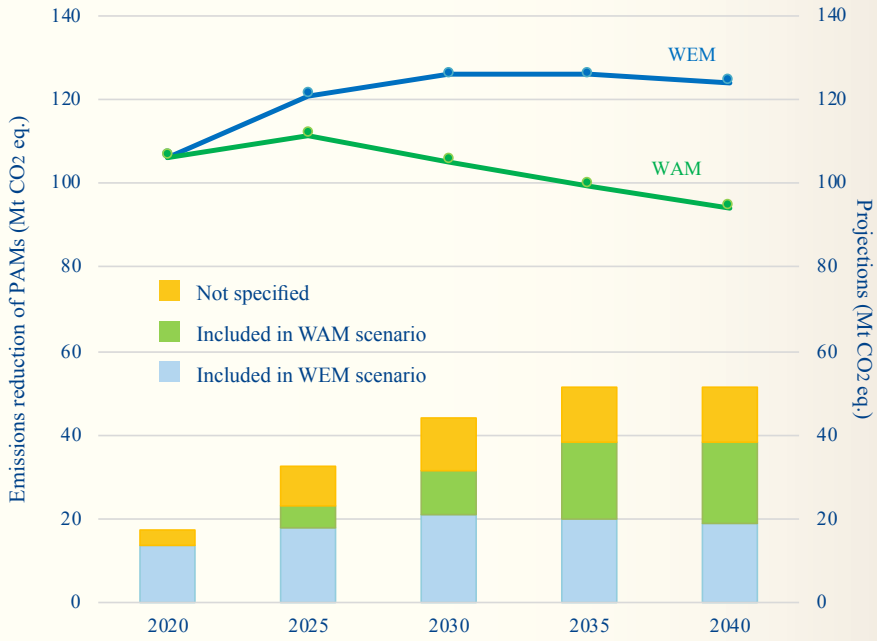
As recommended, measures are classified as far as possible into 2 categories:

– WEM: Measures that are adopted or implemented and taken into consideration to establish a scenario "with existing measures" (WEM scenario);
– WAM: Measures which are planned and will be considered to establish a scenario "with additional measures" (WAM scenario).

However, some measures are not linked to either of these two scenarios, either because they are essentially dependent on the federal government and are not taken into account by the projections of the regions, or because the implementation modalities or the definitions of the measures are still too imprecise.

Figure 5.5 compiles the expected reductions.

Figure 5.5 Putting into perspective the GHG reduction emissions of the Policies with regard to the projection scenarios.



5.3 Supplementarity relating to mechanisms under article 6, 12 and 17, of the Kyoto protocol

In general, in the EU, the use of flexible mechanisms can take place on the one hand by operators in the EU ETS, on the other hand by governments for the achievement of ESD targets.

A limited number of international credits may be used to achieve the targets:

- In the ETS, the use of international credits is capped (up to 50% of the reduction required from EU ETS sectors by 2020). Quality standards also apply to the use of international credits in the EU ETS, including a ban on credits from LULUCF projects and certain industrial gas projects.
- In the ESD sectors, the annual use of international credits is limited to up to 3% of each Member State's ESD emissions in 2005, with a limited number of Member States (including Belgium) being permitted to use an additional 1% from projects in Least Developed Countries (LDCs) or Small Island Developing States (SIDS), subject to conditions.

5.3.1 Regarding the ETS

Since 2013, it is no longer possible to track the use of flexible mechanisms in the EU ETS directly via information on EUTL public website because CERs and ERUs are no longer surrendered directly but are exchanged into EUAs. These exchanges will become public on installation level after three years, with the first information reflecting the use in 2013 available in 2016. For information on the use of flexible mechanisms in the ETS, please refer to the 2nd,3rd, 4th and 5th BR of the European Union.

5.3.2 Regarding the ESD

There is an annual limit of 3% for the use of project-based credits for each Member State (MS). This amounts to approximately 750 Mt of international credits that can be used during the period from 2013 to 2020 in the ESD.

For Belgium, the number of credits that can be used between 2013 and 2020 is 2.51 Million CERs and ERUs per year. If these are not used in any specific year, the unused part for that year can be transferred to other Member States or be banked for the country's own use until 2020.

In addition to this limit of 3%, some Member States fulfil additional criteria as laid down in ESD[12] Article 5(5). Belgium (together with Austria, Cyprus, Denmark, Finland, Ireland, Italy, Luxembourg, Portugal, Slovenia, Spain and Sweden) fulfils these criteria and therefore, an additional use of credits is possible from projects in Least Developed Countries (LDCs) and Small Island Developing States (SIDS) up to an additional 1% of Belgium's verified emissions in 2005. For Belgium, the yearly additional number of credits that can be used is 0.84 Million CERs and ERUs from LDC and SIDS. These credits are not bankable nor transferable.

An overview of Belgium's compliance use of AEAs and project-based credits under the ESD during the period 2013-2020 is provided below.

- For 2013: 74 264 633 AEAs were retired, and zero project-based credits (CERs, ERUs).
- For 2014: 70 054 910 AEAs were retired, and zero project-based credits.
- For 2015: 72 719 520 AEAs were retired, and zero project-based credits.
- For 2016: 74 063 149 AEAs were retired, and zero project-based credits.
- For 2017: 70 824 562 AEAs were retired, and zero project-based credits.
- For 2018: 74 253 859 AEAs were retired, and zero project-based credits.
- For 2019: 72 013 554 AEAs were retired, and zero project-based credits.
- For 2020: 64 904 157 AEAs must be retired. Although the 2020 ESD compliance cycle at EU level will only be completely finalized by mid-March 2023, the required AEAs are available and hence no project-based credits will need to be retired.

In conclusion, for the complete period 2013-2020 – and although the compliance of the year 2020 still has to be finalized yet – Belgium will have met its yearly target under the ESD for each year of the entire period, without using any project-based credits or other MS's AEAs. ■

[12] Decision No 406/2009/EC

6. Vulnerability assessment, climate change impacts and adaptation measures

6.1 Introduction

6.1.1 European context

The first EU strategy on adaptation to climate change was adopted by the European Commission on 16 April 2013. The overall aim of the EU Adaptation Strategy is to contribute to a more climate-resilient Europe.

To achieve this, the strategy focuses on 3 key aspects:

- promoting initiatives at Member State level;
- better-informed decision-making;
- taking better account of adaptation in the most vulnerable sectors ('climate proofing').

The European Commission adopted its new EU strategy on adaptation to climate change on 24 February 2021. The new strategy sets out how the **European Union can adapt to the unavoidable impacts of climate change** and become **climate-resilient by 2050.** The Strategy has four principal objectives: to make adaptation **smarter, swifter and more systemic,** and **to step up international action on adaptation to climate change.** The new strategy builds on the 2018 evaluation of the first strategy.

6.1.2 National context

In 2010, Belgium adopted its National Adaptation Strategy. The strategy describes the main climate change impacts, the existing adaptation responses, a roadmap to a future National Adaptation Plan (NAP) and some policy guidelines for an adapted future.

The National Adaptation Plan (2017-2020) was adopted on 19 April 2017 by the National Climate Commission. In accordance with the decision of the National Climate Commission of 27 June 2013, this plan aims to: provide clear and concise information on adaptation policies and their implementation in Belgium; identify national measures to strengthen cooperation and develop synergies between different governments (federal, regional) on adaptation. It identifies specific adaptation measures that need to be taken on a national level in order to strengthen cooperation and develop synergies between the different entities on adaptation. The Plan addresses 6 sectors and transversal issues: biodiversity, crisis management, energy, health, research and international cooperation.

The first mid-term evaluation (FR and NL) of this plan was completed in February 2019 and reflected an initial positive trend for adaptation. The subsequent final evaluation (FR and NL) in late 2020, focusing

on the final implementation, indicated that the positive trend was sustained. In addition to the positive progress, remaining work items came into focus which may lay at the base of a possible follow-up. Based on the final evaluation, a new national adaptation plan is in process of development.

Since its 7th National Communication, Belgium has made significant progress in the field of adaptation. The regional and the federal governments are all developing new adaptation plans, each in their own area of competence:

– The Flemish Climate Policy Plan 2013-2020, including a section on adaptation known as the Flemish Adaptation Plan (VAP). The primary goals were understanding Flanders' vulnerability to climate change and improving its ability to defend itself against the effects of climate change. The concurrent pursuit of these goals can be described as the "climate reflex". The 11 involved Flemish governmental departments maintain responsibility for the actions in their policy domain and they will bear the cost of these actions using their usual financial resources. In 2015, Flanders developed a first progress report 2013 – 2015 on climate change, including a section on adaptation. A second progress report 2016-2017 on climate change adaptation was published in 2017.

  In July 2020, the Flemish Government presented its Blue Deal to combat water scarcity and drought. The Blue Deal is based on 6 principles:

  - Public administrations give a good example and provide the appropriate legislation
  - Circular water use becomes the rule
  - Agriculture and nature as part of the solution
  - To raise awareness amongst individuals and to stimulate de-pavement
  - To increase the security of supplies
  - Together, we invest in innovation in order to create a smarter, more resilient and sustainable water system

  The Flemish Blue Deal forms part of the Flemish Recovery plan "Flemish Resilience" funded by the EU Recovery Fund.

  After the summer of 2022, the Flemish Government adopted a new Flemish Adaptation Plan 2030. It aims to create a resilient Flanders against the effects of climate change on the short and the long term (2050) with nature based solutions and technological innovation as the most important allies. The Flemish adaptation policy searches for maximal synergies with other policies like climate change mitigation, biodiversity and spatial planning. He Flemish climate adaptation plan is based on 6 strategies. Each of these strategies consists of several action points with concrete measures that will facilitate the elaboration and implementation of the plan.

  1. Flanders builds and connects greenblue infrastructure, always and everywhere
  2. Water availability and water use
  3. Space for water in function of water security and prevention of drought
  4. Restoration and climate smart nature and forest management
  5. Climate adaptive policy on health
  6. Cooperation and coordination

– A new Integrated Air-Climate-Energy Plan of the Brussels-Capital Region for the period 2023-2027 is being adopted. It includes detailed adaptation measures in several sectors with a focus on nature based solutions. Other thematic plans with adaptation measures are the regional water management plan adopted on 26 January 2017 for the period 2016-2021, which completely integrates the theme flood; a new water management plan, which is being adopted for the period 2022-2027 and addresses not only the topic of flooding but also addresses droughts and water scarcity and contains a specific chapter on adaptation; the new "*Forêt de Soignes*" (Sonian Forest) management plan for the period 2019-2043 (2019) and its Nature Plan (2016).

– In January 2014, the Walloon government adopted its "Climate Decree" giving a legal framework to climate policy in Wallonia. The main implementation instrument is the "Air-Climate-Energy Plan" (PACE), which is a part of a dynamic process that provides for public participation upstream and an annual report to the Government and Parliament downstream, which allows it to be adapted. The first PACE, PACE 2016-2022, was adopted after a public consultation in 2016 and contains a section on adaptation. This section summarises the impacts & vulnerability assessments and the detailed adaptation actions in several sectors and includes about 20 adaptation measures. PACE 2016-2022 is followed by PACE 2030, which includes new policies and measures to achieve set out in the European Union's Energy Union framework for energy, climate and for air quality. Besides the sectoral actions, the financial and technical support to the local level (municipalities) is still present with dedicated budget and call to projects to create and develop green areas to adapt to impacts such as floods, droughts and heat waves in the Walloon municipalities.

  After the severe floods of July 2021, Walloon Government created a special commission to coordinate the studies and the work to rebuild in a sustainable way the areas affected by the floods. A lot of resources have been released to provide a support service to the vic-

tims. The work is still on course to gain a more effective understanding of how flooding occurs, how it can be avoided in the future and how to rebuild in a sustainable way.

– On 28 October 2016, the federal government adopted the Federal Contribution to the National Adaptation Plan (available in FR and NL) which identifies federal adaptation actions in crisis management and transport, and additional transversal measures related to the integration of adaptation in different domains/policies and to awareness-raising. Measures included in this contribution were submitted to a public survey in 2014. The draft Federal Contribution to the National Adaptation Plan was submitted to the Federal Council for Sustainable Development and regional advisory bodies (CERBC, CESRBC, CWEDD, CESW, Minaraad and SERV) in December 2016. Their joint opinion on the draft plan was published in 13 February 2017.

At the end of 2021, the federal government started working on a coherent list of federal adaptation measures "Towards a Climate Resilient Society by 2050 - Federal Adaptation Measures 2023-2026". This list consists of 29 measures spread across 8 sectors and is formulated in accordance to the new EU adaptation strategy of 2021, the European Climate Act and the EU Regulation 2018/1999 on the Governance of the Energy and Climate Action Union.

6.2 Forecast impacts of climate change in Belgium

6.2.1 Observed past trends

In 2018, the Flemish Environmental Agency (VMM) launched its Climate Portal https://klimaat.vmm.be/. This portal site provides data, figures and information on climate change and the effects and impact on people, environment and society. Those data are regularly updated.

In 2019 the site Adapt2climate was developed by the National Climate Commission as part of the implementation of the National Adaptation Plan. This national portal aims to make available existing information on climate change impacts, vulnerability assessments and adaptation in Belgium.

The Royal Meteorological Institute (RMI) published a new climate report in 2020 based on their climatological observations.

An overview of the main conclusions of both sites and report is provided below, supported by a few figures 6.1, 6.2, 6.3 and 6.4.

6.2.1.1 Temperature and heat

Belgium (Uccle) is now 2.4°C warmer than in the pre-industrial period. 'For more information on observed temperature trend, see chapter 2.3.4 'climate profile' ('national circumstances'). Heat waves and other temperature extremes – The vulnerability of people and nature to climate change is determined not only by changing annual and seasonal averages, but also, and even more so, by changing extremes. Moreover, extreme temperatures also increase exposure to various harmful substances such as tropospheric ozone and particulate matter. When we look at the occurrence of the number of days with (extremely) high or low temperatures, a significant, linearly increasing trend is found only for the number of tropical days (Tmax ≥ 30°C). At the measuring point in Uccle we count, per 14 years, one extra tropical day in a year. The equally increasing trend for the number of summer days (Tmax ≥ 25°C) in a year is not statistically significant. The figures for the number of frost days (Tmin < 0°C) and ice days (Tmax < 0°C) indicate a downward trend, but this trend too does not appear to be significant. The most harmful climate effects in Europe are expected to come from the increased frequency and intensity of extreme events such as heatwaves. In Belgium, the number of heat waves shows great variability between years. A trend analysis produces a wavy pattern with an increase that has been sustained since the 1970s. In 2016, the number of heat waves was significantly higher than in the beginning of the 20th century. The frequency of heatwaves has increased from an average of one every three years to one per year. In addition to the number of heat waves, it is important to consider the length (number of days during heatwaves in a year), the severity (the extent to which the temperature exceeds 25°C) and the intensity (ratio between severity and length) of the heat waves.

An analysis for the period 1833-2019 also reveals a wavy pattern for these three parameters, with an ascending trend line since the 1970s. Figure 6.1 shows peaks of 7.0°C in 1879 and 11.9°C in 2014 and 2018. The 7 other warmest years are 2011 (11.6°C), 2007 and 2019 (11.5°C), 2006 (11.4°C), 1989, 2015 and 2017 (11.3°C). The 6 warmest years all occurred after 2005 and the 22 warmest years after 1988, so in the latest 31 years.

Impact of urbanisation

Urbanisation of the landscape causes a change in the local wind climate and involves the use of materials that capture the heat more effectively, such as concrete and asphalt. This leads, especially at night, to the creation of heat islands, characterised by the fact that the city cools off more slowly than the surrounding countryside. On average, this difference amounts to a few degrees, but also days with peaks of up to 7 to 8°C and more are recorded. This so-called urban heat island (UHI) effect

Figure 6.1 Yearly average temperature in Brussels (RMI)

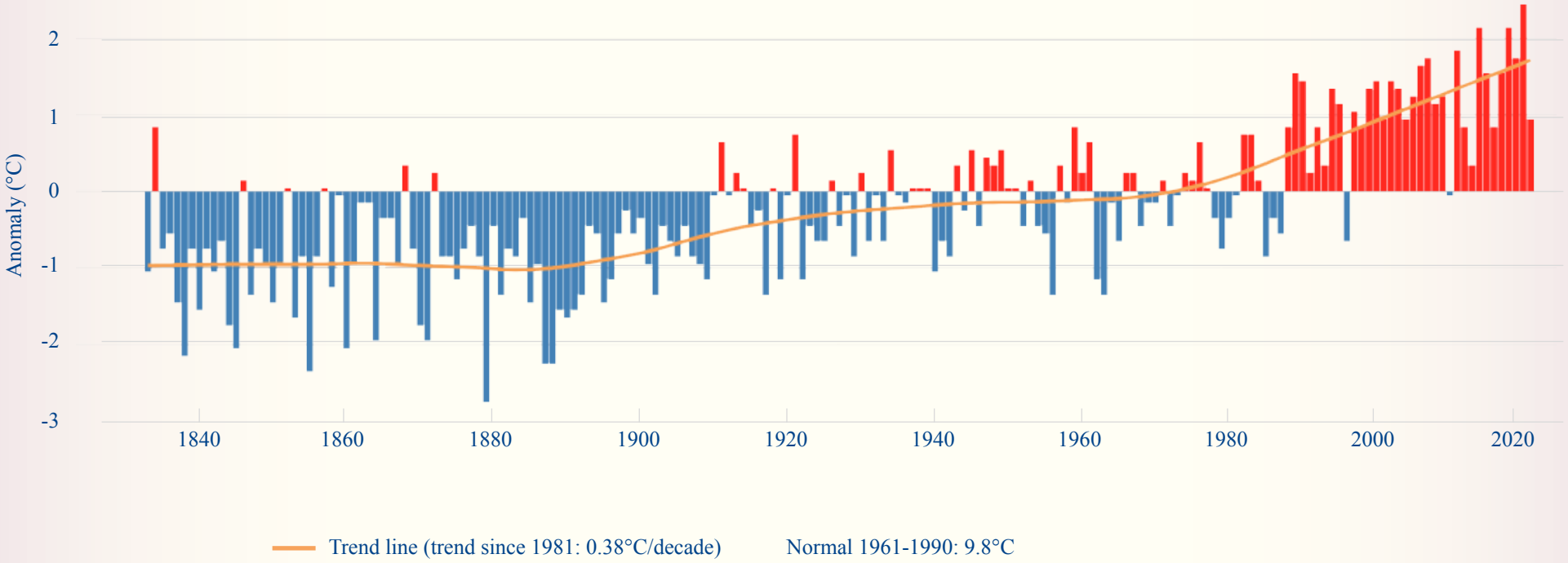
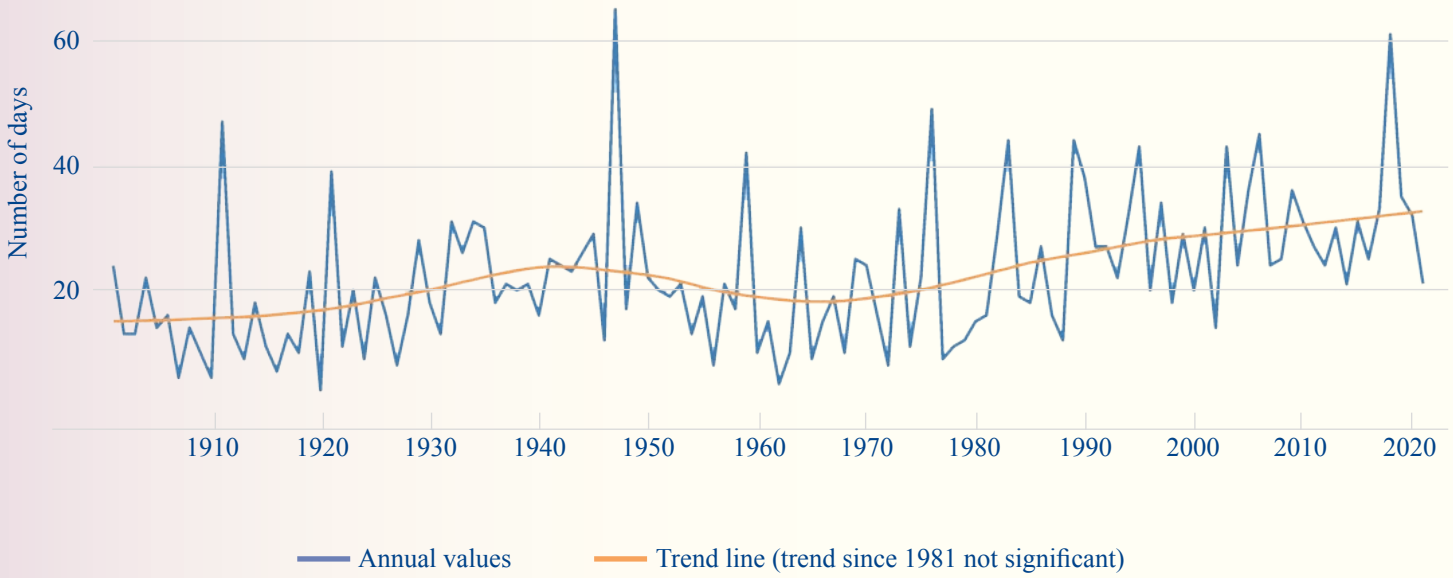


Figure 6.2 Yearly number of days with maximum temperature of minimum 25°C (RMI)



is further accentuated during heat waves under the influence of atmospheric conditions such as a cloudless sky and low wind speeds that often accompany heat waves. This leads to additional mortality, especially among the elderly and children. Furthermore, the urban heat island phenomenon also influences energy use (an increase due, among other things, to the use of air conditioning), and promotes the growth of algae in surface water. In the winter, by contrast, the mortality in cities is lower due to reduced exposure to cold temperatures. Analyses by the RMI, KU Leuven and VITO show that the temperature increase in Uccle may, to some extent, also have been caused by the so-called heat island effect. A quarter of the annual average temperature increase in summer, recorded in Uccle between 1960 and 1999, has therefore been attributed to the intensification of the urban effect in the Brussels Capital Region (RMI, 2015). The urban heat island effect can be translated into figures by means of the indicator 'heat wave degree days'. This indicator provides a composite picture of the total duration and the severity of heat waves in a year. The indicator is calculated for both an urban and a nearby rural location to highlight the urban effect. The indicator has been extended and validated by the VMM in 2018 https://www.vmm.be/publicaties/uitbreiding-en-validatie-indicator-hitte-eilandeffect. New model maps for Flanders show a doubling of the exposure to heat above the health thresholds by 2030.

6.2.1.2 *Precipitation and flooding*

The average annual precipitation in Belgium increases slowly but significantly. Winters become wetter and summers drier but with more frequent heavy rainfall and storms with increase the risk on flooding. During the summer of 2021, many European countries, including Belgium, were affected by severe flooding caused by very heavy rainfall. The speed and power of the water took a heavy human toll and caused a huge amount of socio-economic damage, mainly in the Walloon Region.

Climate change will lead to more frequent flooding in a broader area. The high-impact scenario shows an increase of the risk of flooding with a factor 5 to 10 by 2100. The floodable area, the flood depth and consequently the human and socio-economic damage will increase.

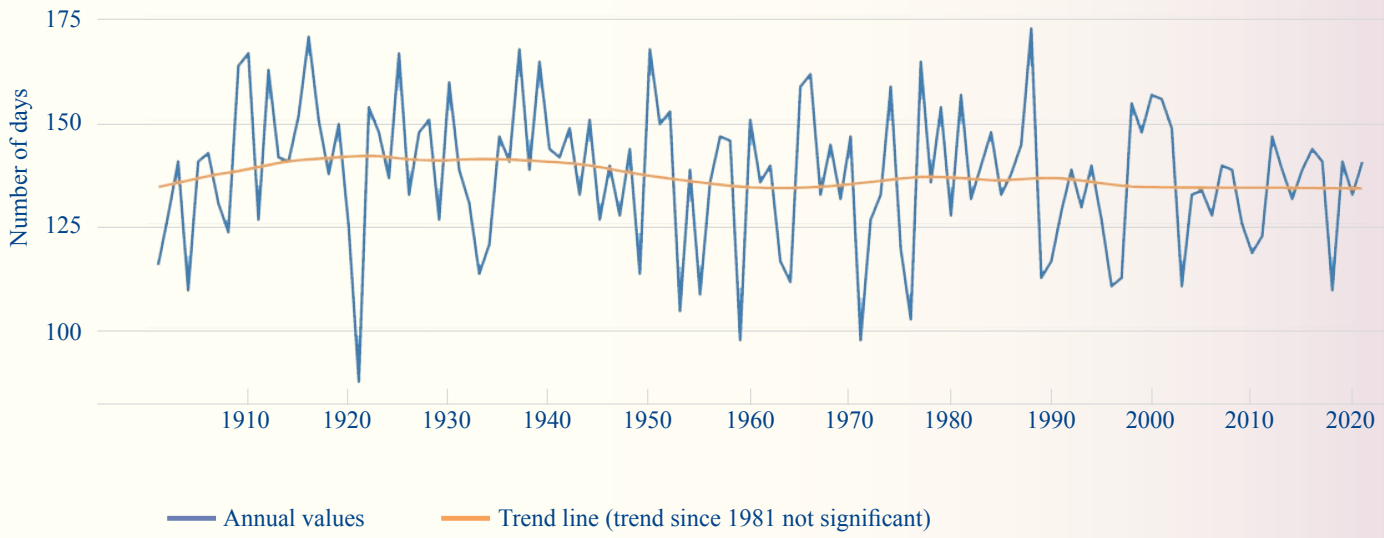
6.2.1.3 *Drought and water shortages*

Belgium is facing more and more problems due to more frequent and longer periods of drought. As we look at the meteorological drought (shift in the balance between precipitation and evaporation), the high impact scenario for Flanders shows that the summer precipitation can decrease from an average of 194 mm in the current climate to 157 mm (-19%) by 2050. Moreover, the potential evaporation can increase in the same period from 252 to 279 mm (+11%). This combination leads to an increase in the precipitation deficit during summer. Also, the duration of drought periods (contiguous days without significant precipitation) will increase. Trend analysis by the RMI lead to the conclusion that there is a significant increase of this parameter during spring since 1981, with an average increase of +1.5 days per decennium.

This trend can lead to problems in agricultural production, vulnerable ecosystems, rivers as well as a shortage of water supplies in other sectors.

The impact in Flanders on the ground water level is extremely high due to the high soil sealing level. 16 % of the soil area is sealed and this prevents water seeping in the ground, increasing the risk of flooding and causing problems with replenishment of the groundwater table. Many of the rivers and streams have been straightened and canalised in the past and agricultural areas are drained by ditches, so the water flows away as fast as possible and doesn´t have a chance to seep in the ground. The high soil sealing rate, the lack of space for water and the fast drainage of water reinforce the problems of drought.

Figure 6.3 Yearly number of days with less than 1 mm of precipitation during spring (RMI)



6.2.1.4 Sea Level

Due to the effects of climate change, the sea level is rising. Peak water levels during storm surges are getting higher, causing coastal erosion and an incrementation of flood risk in the coastal area. The annual average of the global sea levels has increased in the past century by 1.7 mm/y and by 3.0 mm/y since the early 1990s, causing the sea level in the North Sea to be 20 cm higher since 1925. Sea level rise is a relatively slow process due to the fact that it responds to the melting ice caps and glaciers and the warming of the seas. Because of that, the increase in sea level will continue long after the stabilisation of temperature on earth.

Climate scenarios are predicting an increase of the storm surge level of 30 cm by 2050 within mid-scenario and by 80 cm by 2100. The global climate scenarios of the IPCC predict that the sea level rise will continue after 2100, causing an increase of 2 metres or even more in the longer term.

A 1000-yearly storm surge can reach a water level of 7 mTAW (reference level for sea level measurements at the Belgian coast). But due to climate change and sea level rise, the 1000-yearly storm surge could increase to 7.5 mTAW by 2075 and 8.0 mTAW by 2115.

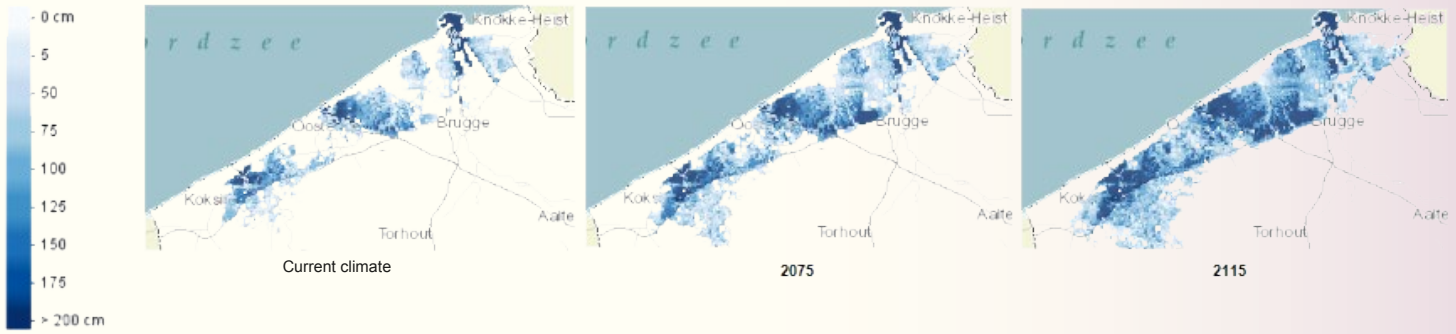
6.2.1.5 Seawater temperature, salinity, wave height and wind speed at sea

In all the sub-areas of the North Sea (not only the Belgian part), the seawater temperature is rising. Moreover, a natural variability appears to occur over a period of seven to eight years. In the area closest to the Belgian coast, the increase is approximately 0.034°C per year or 3.4°C per century. No datasets are currently available that enable a long-term analysis to be carried out into the influence of the climate on the salinity of our sea water. Regarding the wave height, the historical dataset in and near the Belgian part of the North Sea only suggests a natural variability over a period of approximately seven years. There is also a seasonal cycle: on average, there are higher waves in winter and lower waves in the summer months. A clear climate trend could not be demonstrated in the historical wave height and wind speed datasets.

6.2.2 Climate projections

Since the previous national communication, no new climatic projections have been built for the Belgian territory in the framework of the Belgian CORDEX.be project which aims to combine regional downscaling expertise in Belgium. This project, funded by BELSPO (Belgian Science policy), started in 2015 and ended in September 2017 and brought together the different Belgian climate modelling groups. As part of the list of federal adaptation measures, a Climate knowledge centre will be founded, which will focus on, among other things, high resolution climate projections for Belgium.

Figure 6.4 Depth of water in 1000-year storm surge (VMM)



6.3 Vulnerability assessment and climate-change adaptation measures

Impact, vulnerability and adaptation assessments have been funded and piloted at regional and federal level. These preliminary studies were the first step before starting the development of regional and federal adaptation plans. Besides these trans-sectoral studies, several specific impact assessments have also been funded by Belgium in different sectors (coastal zones, forestry, agriculture...).

The study "Evaluation of the socio-economic impact of climate change in Belgium" commissioned by the National Climate Commission, was published in 2020. According to this report, global climate change in Belgium will mainly be felt through heat waves, floods and droughts. Warmer and drier summers and milder and wetter winters are becoming normal. This impact will affect a large number of sectors, resulting in major costs but also benefits, with costs dominating strongly. These costs relate to damage to infrastructure, increased mortality and morbidity, reduced production and losses in the forestry sector, the loss of biodiversity and the degradation of ecosystems, a reduction of labour efficiency, losses in the energy sector, and import/export related changes. In addition to the sectoral impacts, this report shows that groups in society, which are already vulnerable, will often also be the most vulnerable to these climate-related impacts. This strongly reflects the importance of well-considered and fair adaptation measures.

Following measure 8 of the National Adaptation Plan (2017-2020) "Taking into account the impact of climate change and adaptation needs in the framework of the future National Environment and Health Action Plan (NEHAP)", the FPS Public Health, Food Chain Safety and Environment published a study on the effects of climate change on human health systems in Belgium in August 2021. The study includes an inventory and assessment of current and planned measures to improve the resilience of health systems in Belgium. The focus is, among other things, on the evaluation of the effectiveness, the degree of implementation and the limitations. Based on these results, combined with the identification of current risks and medium- and long-term risks, 61 recommendations for adaptation measures were proposed to mitigate or avoid the adverse effects of climate change. These recommendations concern data availability, legislation, communication, control measures and land use planning, research, etc. They are addressed in particular to decision-makers and health sector actors, with special attention to vulnerable populations (low-income groups, people with outside employment, the elderly, the chronically ill, etc.). These adaptation measures provide an adequate response to the climate risks identified for the health system and will be further studied and developed in future adaptation plans.

A brief description of the major impacts and vulnerabilities is given in Table 6.1 for various sectors impacted by climate change in Belgium (adapted from the different regional vulnerability studies).

An in-depth description of impacts and vulnerabilities and adaptation measures in water management, coastal management, biodiversity, agriculture, forestry, fishery, infrastructure, transport, industry and services, energy, tourism, health is available in the 6th National Communication. Updated information on implementation is provided in Table 6.2.

Table 6.1 Summary of the main impacts and their severity expected in Belgium (adapted from regional impact assessments studies)

Wet Projections		2030	2050	2085						
Mean Projections		2030	2050			2085				
Dry Projections				2030				2050	2085	
Temperature rising (°C)	0,5	1	1,5	2	2,5	3	3,5	4		
Agriculture	↗ in erosion risk due to heavy rain ↗ in loss of soils due to heavy rain Variability of crop production and breeding (↗ in the frequency of extreme events) ↗ pressure from diseases, parasites, weeds and invasions ↗ in water needs and risk of water stress ↗ in yields or production of certain crops Limiting factors (photoperiod, water, fertility) and reversal of the trend									
Coastal Areas	↗ risks of breaking of natural (mostly sand and dunes) coastal defences ↗ risks of breaking of man-made (dykes, wave-breakers, ...) coastal defences ↗ risks of higher storm-related flooding damage caused by changes to wind patterns anw wave height reduction of upper layer of fresh water in polders (salt intrusion) affecting natural systems and infrastructures									
Fisheries	changes in the quantity and distribution of marine species, inclusive commercial fish stocks Appearance of new commercial species (migration from south to north) appearance of new harmful species ↗ vulnerability of highly specialised fishery sector									
Land planning / Infrastructures	↗ in flood risk Risk of disruption to transport by waterways (more low-water periods) Impact of heatwaves and amplification by heat islands damage to infrastructure due to high temperatures (buckling of rails, etc.) Risk of disruption of road and rail transport and damage to infrastructure due to snow and frost Shrinkage and swelling of clay Karstic Risk Damage due to the possible increase in storm frequency									
Forests	Modification of the range of forest species (harmful to wood production) More frequent invasions ↗ in damage due to climatic variations (fire, storms, droughts) frost damage ↗ frequency of outbreaks ↗ growth followed by limited increase due to soil fertility and drought Changes to phenology									

Wet Projections		2030	2050	2085						
Mean Projections		2030	2050			2085				
Dry Projections				2030				2050	2085	
Biodiversity	Added pressure on already vulnerable areas (peatlands, etc.) changes in distribution areas Increase in invasions Phenological changes									
Energy	↗ in energy consumption (cold chain/ air conditioning in summer) Integrity and capacity of production and transport installations Problem of cooling of nuclear plants 1 Management of the network and electricity consumption 2 ↘ in heating-related energy consumption Seasonal modifications of photovoltaic, wind and hydraulic production and biomass productivity									
Health	↗ in mortality due to heatwaves and diseases linked to food contamination ↗ of respiratory diseases and allergies (pollens..) ↘ mortality in winter Sanitary risks due to air quality (summer) sanitary risks due to air quality (winter) ↗ in diseases linked to water contamination ↗ in vector-borne diseases									
Water Resources and Management	Pollution of ground water by leaching Decrease in surface water quality (floods, streaming, low-flows) Variation in river flows can lead to pollution increased rainfall in winter recharges grondwater Reduction of ground water in summer									
Tourism	Longer periods of favourable conditions for low-season tourism Favourable conditions for summer tourism but risks for nautical activities during dry summers Energy consumption for heating Energy consumption for cooling									
Industry & services	Impact on production processes (e.g. water shortages, cooling of power plant, etc.), direct (flooding, high winds, etc.) and indirect (supply problems) damages More frequent and/or intensive weather-related disasters will challenge insurance systems									
Legend	very serious serious not very serious opportunities impact difficult to assess 1. Changes to the facilities (complete closure of Tihange site expected in 2025) should significantly decrease the pressure on surface water. Note: there is also a risk in inter-connected facilities and a direct risk in Wallonia. 2. The changes to the facilities will lead to changes in electricity management methods (very high costs)									

The top of the table gives an idea of the uncertainties by using different projections: according to the projections, the change in temperature will be more or less quick and extensive

Table 6.2 Adaptation measures implemented by sector

Sector	Adaptation measures
Water management	A widespread information campaign to encourage water savings. Specific measures (including nature-based solutions) in order to protect Belgium against severe droughts (Flemish Blue Deal 2020, project of new water management plan for the Brussels-Capital-Region, Walloon Integrated Drought Strategy July 2022). Citizen science project "*Curieuze neuzen in de tuin*" measuring drought and heat in Flemish gardens and public spaces, 2021 and 2022. New concept of rainwater management in the Brussels-Capital Region called " integrated rainwater management (GIEP)", which uses NBS to remove rain from the sewerage network and reintegrate it into its natural cycle and provides series of ecosystem services, in particular in the fight against floods and against urban heat islands. Prospective analysis for the drinking water supply of the Brussels-Capital Region, called Water Quantity Plan (ongoing) which already provides results on balance for the short term (horizon 2025). Valuing water as biodiversity vector and temperance element of the urban microclimate. Water as part of green-blue infrastructure to temper the urban heat island effect. Flood Risks prevention and management framework (new regional plans). Creation of a Special Commission for Rebuilding in Wallonia to coordinate the studies and the actions after the July 2021 floods in Wallonia. Creation of an expert panel on flood protection in Flanders 2022.
Coastal areas	Implementation of the coastal safety master plan (on going). Coastal defence allowing for the coast's natural dynamic. Based on new scientific data, the measures of the coastal safety masterplan won't be enough to protect Belgium after 2050 against flooding caused by rising sea levels. Therefore the Flemish government decided to develop a Coastal Vision with a long-term approach to protect the coastal region.
Biodiversity	Guidelines for adaptive nature management in Flanders. Mainstreaming of adaptation in the National Biodiversity strategy. Mainstreaming of climate change in the programme of measures (2015) to achieve good environmental status of marine waters (2020). Tool to monitor and objectify the biological value of the areas making up the Brussels-Capital territory (the Brussels biological assessment map). Development and promotion of a tool for evaluating the ecological potential of a plot, called "Biodiversity Potential Coefficient by Area" (the CBS+ tool). The Flemish tool "*groenblauw peil*" (green-blue arrow) enabling citizens to make their house and garden more adaptive to climate change based on green-blue measures. Call for projects "Green and blue networks" in the Walloon and in the Flemish region in 2022. The objective is to reinforce and restore the green (nature) and blue (waterways) networks in urban and rural territories, making it possible to link habitats and strengthen ecosystems. 'Yes we plant, an ambitious revegetation project in Wallonia: 4000 km of hedge and 1 million trees between 2019 and 2024. Flemish plan on forest expansion 2021 with the aim to create 10 000 hectares of extra forests by 2030.
Agriculture	Publication of good practices guidance to avoid soil erosion, mudflows and floods in agricultural and rural areas by the dedicated research and technical unit 'GISER' in Wallonia. Participation of Belgium to the EU project EJP-Soil to promote good adaptation practices for more resilient agricultural soils (projects i-SoMPE, CLIMASOMA , …) Flemish Centre of Expertise on Agriculture and Climate: research into climate-adaptive agriculture.

Sector	Adaptation measures
Forests	Observatory and permanent inventory of the health of the Sonian Forest (*Forêt de Soignes/Zoniënwoud*) woodland area (monitoring changes in beech trees) Greater diversification of the species of the Sonian Forest and improvement of the structure of its stands to increase its resilience to climate change (Sonian Forest management plan for the period 2019-2043). Launch in 2021 of the Walloon project 'Resilient forests' to increase the resilience of the forests, with financial supports and diffusion of recommendations for forest managers in the Walloon region. Ongoing preparation of a Regional Forestry Programme by July 2023, in the context of '*Les Assises de la forêt*', a strategic document focusing on the development and management of the wooded heritage of the Walloon Region for the years to come. Continuous monitoring of the health of the forests through the Walloon Observatory of the Health of the Forests
Fishing	Research and monitoring of the effects of climate change on the fish populations (ILVO, Flemish region).
Infrastructures and urban environment	Adoption of climate change adaptation measures for infrastructures and the urban environment (combating the consequences of soil seal, increased revegetation in the urban environment, etc.). IVB interregional project, "Future Cities – urban networks to face climate change", aiming at adapting urban structures to the likely effects of climate change. Impact studies on the impact of climate change on urban heat stress and urban environment performed in the context of CORDEX.be. Mapping of the islands of freshness in the Brussels area. Mapping of urban heat islands in the Flemish region (VMM-MIRA). Climate Portal Flanders (VMM): effects of climate change at municipal level. Call "Heat resistant cities" in Flanders. Online support tools for the design of Sustainable Neighbourhoods in the Brussels Capital Region (2020; https://besustainable.brussels/) Brussels Capital Goodsoil Strategy which aims, amongst other things, to preserve and strengthen the ecosystem services they provide in terms of adaptation; tool for assessing soil quality to integrate this factor into the design of urban development project (the Brussels Soil Quality Index (BSQI-PRO).

Sector	Adaptation measures
Infrastructures and urban environment	Promotion of the use of schoolyards as green hubs for neighbourhoods to counter the urban heat island effect in the Brussels-Capital Region (Operation Re-Creation). LIFE UrbanGreeningPlans project (2021-2023) working on greening urban areas through implementing better management practices and Nature Based Solutions (project leader: Brussels Environment). CLEARING HOUSE project (2021 – 2023) bringing together 26 partners in Europe and China, will provide evidence and tools that facilitate the mobilisation of the full potential of urban forest-based solutions (UF-NBS) for rehabilitating, reconnecting and restoring urban ecosystems. Promotion of the "*Adapte ta commune*" (Adapt your municipality) tool to allow Walloon municipalities to concretely implement local climate change adaptation strategies. It now uses cartographic media as well as a web platform with action sheets. The tool is promoted in new thematic calls for projects in the Wallonia between 2021 and 2024 to create green spaces that participate in the adaptation to climate change (flood prevention, fight against heat island, …) and that guarantee easy access to quality green space for all by involving citizens and local actors.
Transport	Identification of transport infrastructure located in flood hazard zones on regional flood risk maps Taking into account adaptation to climate change in Belgium's air safety plan (Extreme weather conditions) - *Federal contribution to the National Climate Adaptation Plan (2016 - 2020).* Mapping railroad vulnerabilities (drainage, fallen trees) - *Federal contribution to the National Climate Adaptation Plan (2016 - 2020).* Taking into account the expected effects of climate change in the long-term planning of railroads - *Federal contribution to the National Climate Adaptation Plan (2016 - 2020).*
Industry & Services	Interreg Flanders – The Netherlands project 2BE Connect on biodiversity in business parks. Flanders Green Deal on businesses and biodiversity.
Energy	
Tourism	

Sector	Adaptation measures
Health	Identification of hospitals and nursing homes located in flood hazard zones on regional flood risk maps. Adaptation of sensitive infrastructure (hospitals, crèches, etc.) located in flood-prone areas (water management plan). "Impact of climate change on the healthcare system in Belgium" study: see section Research for more details. Flemish action plan on heat. Monitoring on ticks, exotic mosquitos, airborne allergens, …
Disaster Risk Management	Take into account the expected impacts of climate change in risk and impact analyses - *Federal contribution to the National Climate Adaptation Plan (2016 - 2020).* Take into account the expected impacts of climate change associated with defence activities on a national level in the context of natural disaster crisis management - *Federal contribution to the National Climate Adaptation Plan (2016 - 2020).* Enhanced cooperation among Member States for crisis management in natural disasters - *Federal contribution to the National Climate Adaptation Plan (2016 - 2020).* Long-term analysis of the need for additional capacity to prepare for crisis management for natural disasters - *Federal contribution to the National Climate Adaptation Plan (2016 - 2020).*
Research	VITO and Witteveen and Bos, 2020, "Impact van 'nature-based solutions' on the exposure of urban residents to air pollution, noise or high temperatures – Overview of the general knowledge and recommendations for the Brussels-Capital Region" https://document.environnement.brussels/opac_css/elecfile/NatureBasedSolutions "Impact of climate change on the healthcare system in Belgium", a study assessing the impact of climate change on the healthcare system in Belgium was published in 2021. For different health sector related threats, the current situation as well as expected changes were identified for different health sectors and existing and planned measures were inventoried and evaluated. Possible gaps were identified leading to the proposal of adaptation measures and recommendations that can ensure the healthcare system to continue its health-protective and curative role in the context of a changing climate.

Sector	Adaptation measures
Research	"Evaluation of the socio-economic impact of climate change in Belgium" study was published in 2020, providing an overview of the socio-economic impact of climate change in Belgium. This study results from a literature-based study conducted between November 2019 and July 2020. Cost benefit analysis of adaptation measures in Flanders, study performed by VITO commissioned by the Department of Environment and Spatial Development, 2022. Study on monitoring of adaptation based on indicators, performed by Kenter commissioned by the Flemish Department of Environment and Spatial Development, 2018. Study on green-blue spaces as stepping stones towards resilient and healthy living environments, 2021. Study on green-blue networks in Flanders, 2020.
Transversal issues and collaboration	Take climate change adaptation into account when developing federal policy - *Federal contribution to the National Climate Adaptation Plan (2016 - 2020).* Take climate adaptation into account when evaluating Nationally Appropriate Mitigation Actions (Nationally Appropriate Mitigation Actions - NAMAs) and CDM projects (Clean Development Mechanism) (provided support to projects directly related to climate change adaptation in partner countries.) - *Federal contribution to the National Climate Adaptation Plan (2016 - 2020).* Organisation of sectoral information sessions on adaptation to climate change (thematic session on climate change) - *Federal contribution to the National Climate Adaptation Plan (2016 - 2020).* Increase information relating to adaptation to climate change (National platform on adaptation) - *Federal contribution to the National Climate Adaptation Plan (2016 - 2020).* "Climate Action" call for projects which supports the development of Local Climate Action Programmes at municipal level (mitigation and adaptation) and their operationalisation through the implementation of ambitious projects beneficial to the climate and biodiversity, in line with regional priorities (Brussels-Capital Region)

6.4 Cooperation on adaptation

6.4.1 Development cooperation

Belgian development cooperation

Belgian development cooperation has explicitly included the fight against climate change as a priority in its policy since 2008. This is because the consequences of climate change on developing countries is a significant source of instability in terms of food safety, the degradation of biodiversity, migration, public health and tensions that sometimes even culminate into conflicts. These countries are the first victims of climate change because they bear less responsibility for its consequences and have fewer resources in their fight against it. The Belgian Development Cooperation Act, published on 19 March 2013, includes the protection of the environment and natural resources, as well as the fight against climate change, as one of two important transversal priorities. Failing to take the possible impact of climate change into consideration could further partially or fully cancel out all the efforts to combat poverty and the achievement of the Sustainable Development Goals. Belgian development cooperation focuses its support on Least Developed Countries. In the case of climate actions, Belgium focuses its international finance on adaptation, through funds such as the Least Developed Countries Fund and Adaptation Fund, on top of its contribution to the Global Environment Facility and the Green Climate Fund.

Our approach can be summarised in three workstreams, as follows:

1) Systematically include a climate lens in the design and follow-up of development cooperation programmes and projects, both in the design of project proposals, the implementation by Enabel, non-governmental cooperation and our cooperation at the European and multilateral level;
2) Give even more attention to climate actions via our specific tools, by providing support for climate funds, but also in the field of research, the role of the private sector and the synergy with humanitarian aid;
3) Focus on policy coherence, in particular through deeper cooperation with the various actors at different levels.

Further details on financial resources and capacity building through international cooperation are discussed further in this national communication. Belgian development cooperation contributes towards greater public awareness of climate-related problems by means of publications and other awareness activities.

Flemish Climate Fund

By providing international climate financing Flanders aims to support developing countries in taking climate action and reaching their climate goals from the climate agreement. That is why Flanders commits itself, together with the international community, to offer financial and technical support to the developing countries in order to enable them to follow a low-carbon development path and to enhance their resilience to the consequences of climate change in their community.

Flemish development cooperation is operational in developing countries and has the expertise needed to identify, fund, monitor and report international climate projects. This cooperation is mainly targeted on Southern Africa, with a specific focus on building resilience to climate in the concentration sectors of agriculture, job creation, disaster prevention and health.

Together, all countries want to reserve an annual sum of 100 billion dollars for international climate finance by 2020. Flanders is committed to earmarking EUR 14.5 million each year for this purpose in the period from 2016 to 2020.

An overview of the international climate finance of the Government of Flanders.

With the contribution of EUR 7 050 000, the Flemish Minister for the Environment and the Flemish Government made an effort in 2020 to support the Flemish engagement of EUR 72.5 million for 2016-2020. Through a project call, support was provided for 11 projects in the South, amongst others in Lesotho, the Democratic Republic of Congo, Ecuador, Bolivia and Colombia. These projects set out to achieve the international climate goals but also try to link to other policy fields such as biodiversity, energy, health, water, research, agriculture, technology and forestry.

6.4.2 International scientific research

Belgium supports international agricultural research, inter alia by means of the Consultative Group on International Agricultural Research (CGIAR). This group supports 15 research centres aiming to ensure improved food safety, improved human nutrition and health, a higher income for the poor and improved management of natural resources, on the basis of scientific findings. New crop varieties, knowledge and other research products are made available to individuals and organisations dealing with sustainable agricultural development throughout the world. Around one-third of the research programmes are included within the scope of the fight against climate change and its impact. Centres such as IITA, CIAT (International Center for tropical Agriculture), ICRISAT, ICARDA and WARDA (West Africa Rice Development Association) carry out research into modified agricultural crops. The World Agroforestry Centre, ICRISAT, ICARDA and IITA are carrying out research into adapted agricultural techniques and are identifying innovations at institu-

tional and policy level, in order to enable more effective agricultural management in response to climate change. The aspect of capacity building is obviously an important motivation for Belgian support to a research environment such as CGIAR. Belgium is also collaborating with different partners at European level. Especially with regard to the impacts, vulnerability and adaptation assessment, Belgian institutions, universities and research centres are represented within a variety of European research networks and platforms such as the DG CLIMAT-EEA Climate Adaptation Platform Climate-ADAPT, the Urban climate Cities ; the DG RDT Joint Programming Initiative JPI Climate; the H2020 co-fund initiatives (ERA4CS, AXIS, ECCA), the DG ENV LIFE Nature based solution projects (e.g. H2020 Clearing House, LIFE UrbanGreeningPlans (see chapter 8).

6.4.3 Benelux collaboration

In 2014, the collaboration between Belgium, the Netherlands and Luxemburg got under way in the form of a working group piloted by the Benelux General Secretariat on the themes of health, transport, energy and crisis management in relation to climate change. Several workshops and meetings are organised regularly in order to ensure the sharing of experiences between the three countries on thematic issues. ■

7. Provision of Financial Resources and Transfer of, or Access to Technologies

7.1 Introduction

In 2019-2020, Belgium provided EUR 208 million of public support to developing country Parties (see CTF tables). This financial, technological and capacity-building support to non-Annex I Parties mainly focused on:

- Adaptation and cross-cutting activities;
- The provision of bilateral and multilateral support in the form of grants;
- Contributions mainly directed towards Africa and Least Developed Countries (LDCs);
- Contributions to climate-specific multilateral funds (Green Climate Fund, Adaptation Fund, Least Developed Countries Fund, etc.) or specialised UN agencies;
- Contributions to bilateral projects mainly directed towards African partner countries and Least Developed Countries.

At the UNFCCC conference of the parties in December 2015, Belgium announced its intention to contribute EUR 50 million yearly to international climate finance. Since then, support for climate action has significantly exceeded this target. On average, Belgian climate finance amounted to EUR 90 million yearly in 2015-2020.

In parallel to its long-standing provision of public climate finance to developing countries, Belgium also supports the efforts of developing countries to implement low-emission, climate-resilient projects and programmes (i) by providing significant core funding to multilateral organisations and (ii) by mobilising, through public means, private investments for climate-related projects in developing countries.

Figure 7.1 Trend in climate finance 2013-2020

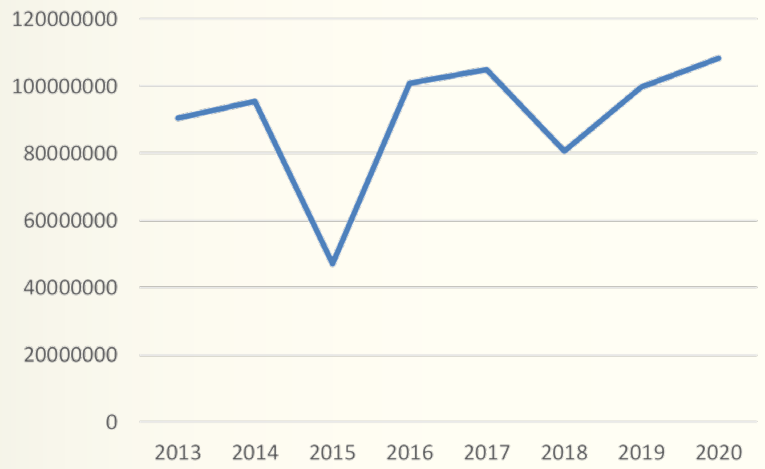


Figure 7.2 Belgian Climate Finance in 2019-2020, distribution per type of support

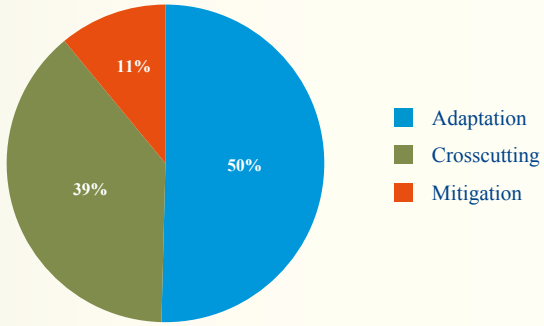
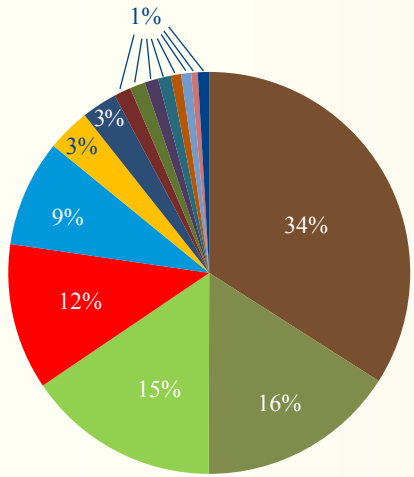


Figure 7.3 Belgian Climate Finance in 2019-2020, distribution by sector



- Cross-cutting/multisector
- Agriculture, forestry, fishing
- Environment
- Energy
- Water and sanitation
- Humanitarian Aid
- Education/capacity building
- Disaster reduction and prevention
- Job creation
- Health
- Awareness raising
- Banking and financial services
- Rural Development
- Government and civil society
- Other

7.2 Legislative and institutional framework of climate change policies and programmes

Belgium is a federal state and, given this institutional context, several federal and regional level government departments are involved in the development and implementation of climate change policies.

As the regional governments have competencies in fields that are connected with their region or territory (water policy, the environment, nature conservation, etc.) and have powers relating to international relations in those fields, they are also playing an active role in the international aspects of climate change, such as providing and mobilising climate finance.

A cooperation agreement on the internal burden sharing of Belgium's climate and energy objectives for the 2013-2020 period enables Belgium to respect its European and international commitments in climate and energy policy by 2020. It focuses on greenhouse gas emissions reduction targets for non-ETS sectors, the share of renewable energies in final energy consumption and the contribution to international climate finance. Regarding the contribution to international climate finance, an internal distribution ratio was agreed to meet Belgium's announcement to contribute annually EUR 50 million in 2016-2020:

- Federal government: EUR 25 million
- Government of Flanders: EUR 14.5 million
- Government of Wallonia: EUR 8.25 million
- Government of Brussels-Capital Region: EUR 2.25 million

Since then, each entity committed to at least maintain this level of contribution, in line with the continuation of the existing collective mobilisation goal through 2025, as agreed at the 21st UNFCCC COP in Paris, France.

The federal part of the Belgian climate finance is mainly delivered by means of the budget for development cooperation. The Law on development cooperation of 19 March 2013 sets out the goals and priorities of Belgium's international cooperation. This law stipulates that in its programmes and activities of development cooperation, Belgium must strive to achieve sustainable and inclusive economic development and poverty alleviation. Furthermore, this law lays down the protection of the environment and natural resources, including the fight against climate change, desertification and global deforestation, as matters of priority. Overall policy coherence for development is an important priority within Belgium's development cooperation.

In the coalition agreement (2019-2024), it is stipulated that the Government of Flanders continues to highlight international climate ambition by providing international climate finance, preferably through projects in which Flemish organisations contribute.

7.3 Provision of international climate finance through official Development Assistance and Other Official Flows

7.3.1 Financial contributions to multilateral institutions and programmes

As a long-standing donor in terms of climate finance, Belgium's federal and regional governments contribute to the Green Climate Fund (GCF), the Global Environment Facility (GEF), the Least Developed Countries Fund (LDCF) and the Adaptation Fund. Other contributions towards multilateral climate action are also reported in CTF Tables 7a (Irena, African Climate Change fund, Climate and Clean Air Coalition). The provision of this climate-specific funding is in addition to non-earmarked contributions to multilateral institutions and specialised UN agencies. Climate-specific funding, earmarked for a specific country, in partnership with a multilateral actor is included in CTF Tables 7b (bilateral funding).

The majority of multilateral funds come from Belgium's federal development cooperation budget, which has sustainable development and poverty alleviation as its most important goals.

In 2009, Belgium adopted a strategic core policy towards its multilateral partner organisations. This means that most contributions are not earmarked and are preferably multi-annual to allow for stable, secure and predictable funding and to increase transparency and efficiency.

In 2016, new Framework Arrangements (FAs) were signed between the Belgian government and its 15 multilateral partner organisations. These FAs are used to underline the commitment to work jointly to implement the 2030 Agenda for Sustainable Development and as a basis for long-term cooperation.

Belgian partner organisations such as the Food and Agriculture Organization (FAO), United Nations Development Programme (UNDP) and United Nations Environment Programme (UNEP) are contributing significantly to the fight against climate change through the programmes and projects in their portfolios. Belgium also supports CGIAR by providing core resources. Agricultural research is indispensable to help secure food and nutrition security in vulnerable countries and to improve farmers' livelihoods. Through research and innovation, CGIAR aims to contribute, to implement all National Adaptation Plans and Nationally Determined Contributions to the Paris Agreement, equip 500 million small-scale producers to be more resilient to climate shocks, with climate adaptation solutions available through national innovation systems, turn agriculture and forest systems into a net sink for carbon by 2050, with emissions from agriculture decreasing by 1 Gt per year by 2030 and reaching a floor of 5 Gt per year by 2050.

Other multilateral partners of Belgium such as the World Bank Group play an important role in mobilising international climate finance. Of course Belgium also contributes to the different funding instruments that form part of the European international cooperation (through the EU budget, the European Development Fund and European Investment Bank), which fund several programmes and activities to mitigate climate change and support countries in their adaptation efforts. For example, 27% of the Global Public Goods Programme of the EU Development Cooperation Instrument is dedicated to climate change and other environmental issues. An overview of core contributions to these organisations is included in CTF Table 7a, but these are not reported as specific climate finance.

During the reporting period, Belgium provided EUR 30 million to the Global Environment Facility, an operating entity of the financial mechanism under the UNFCCC. This contribution is also un-earmarked.

Considering the needs of the most vulnerable countries, Belgium therefore focused its support on financing adaptation activities and on strengthening the resilience of least developed countries. The Least Developed Countries Fund was a significant channel through which Belgium provided large parts of its international climate finance (EUR 25.6 million).

In the reporting period, Belgium also provided EUR 18.4 million EUR to the Adaptation Fund, which finances projects and programmes that help vulnerable communities in developing countries adapt to climate change.

Figure 7.4 Climate specific funding through multilateral channels in 2019-2020 (core funding excluded)

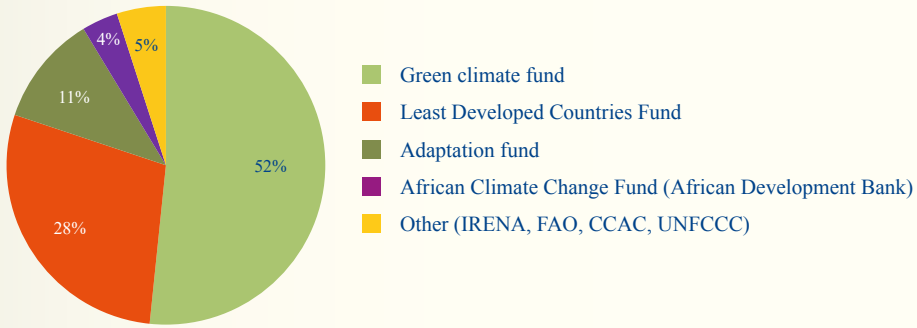
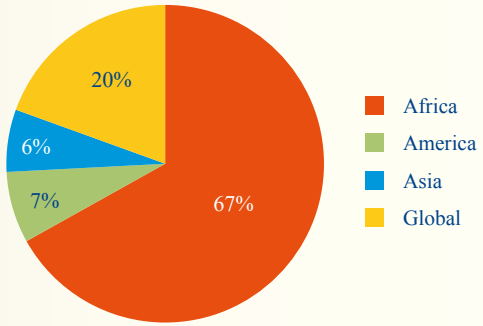


Figure 7.5 Belgian Climate Finance in 2019-2020, distribution per region of recipient country (only bilateral climate finance)



7.3.2 Bilateral and Regional Financial Contributions

Climate finance through bilateral channels includes disbursements in the context of an agreed partnership programme with a partner country. Programmes and projects in this context can be implemented by the Belgian Development Agency "Enabel", by a multilateral organisation, by another donor (delegated cooperation), by civil society organisations or by national or local partners in the South.

Belgium ensures that the resources provided effectively address the needs of developing country Parties with regard to climate change adaptation and mitigation through different means.

- Belgium focuses mainly on the adaptation needs of LDCs.
- The portfolios of bilateral programmes and projects are negotiated with partner countries to ensure that support meets their needs and reflects their priorities.
- All programmes and projects have evaluation systems and results frameworks for assessing effectiveness.
- An evaluation on Belgian federal climate finance[1] found that financed interventions correspond to needs of partner countries and their populations. The use of NDC's and NAPs as a basis for cooperation on climate action can and will be improved.

All climate relevant activities that are implemented through civil society organisations are also reported under this chapter.

In 2015, Belgium renewed its list of partner countries and decided to focus most of its support on 14 countries: Benin, Burkina Faso, Burundi, DR Congo, Guinea, Mali, Morocco, Mozambique, Niger, Palestinian Territories, Rwanda, Senegal, Tanzania and Uganda. These **partner countries** of governmental cooperation were selected on the basis of their degree of poverty, aspects of good governance and Belgium's potential for providing meaningful support.

In parallel to the bilateral support provided to these, Belgium also supports civil society organisations that operate in a wider range of developing countries[2].

The Walloon Region has supported development cooperation projects in areas of its competencies such as education, agriculture, water management, job creation, environment.

In addition to developing projects with certain partner Regions of the Brussels

[1] Climate Finance Evaluation

[2] South-Africa, Bangladesh, Benin, Bolivia, Bresil, Burkina Faso, Burundi, Cambodia, Cameroun, Colombia, Côte d'Ivoire, Cuba, El Salvador, Ecuador, Ethiopia, Guatemala, Guinee, Haiti, Honduras, India, Indonesia, Kenya, Laos, Madagascar, Mali, Morocco, Mauretania, Mozambique, Nepal, Nicaragua, Niger, Ouganda, Palestinian Territories, Peru, Phillippines, DR Congo, Rwanda, Senegal, Suriname, Tanzania, Togo, Vietnam, Zambia, Zimbabwe.

Capital Region (BCR),[3] the BCR has developed projects in the Palestinian territories, Mozambique, Rwanda and Uganda as part of a partnership with Enabel.

The Government of Flanders has cooperation agreements with South Africa, Mozambique and Malawi. Flemish funding is focused on specific climate policy measures, in line with mutually agreed sectoral focus areas, which are job creation, health and agriculture & food security.

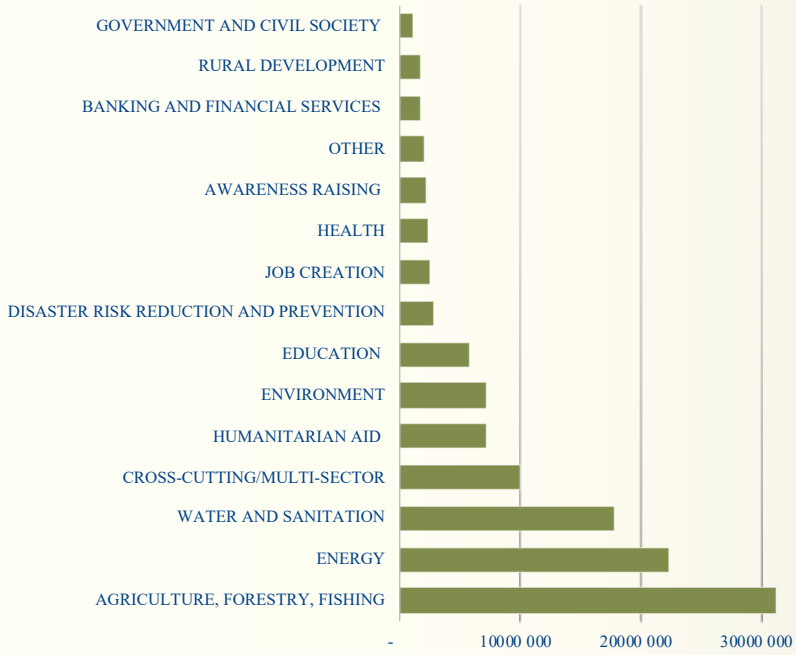
The Flemish Region launched a call for projects in 2020, focusing on including Flemish organisations in international climate finance. This project call led to the selection of 11 projects for a total amount of 7.05 million EUR, as part of the 14.5 million commitment made by the Government of Flanders.

The Belgian Investment Company for Development Cooperation (BIO) is another important actor in providing funds for climate investments. Their climate portfolio mainly consists of projects in the renewable energy sector, mostly by providing loans and equity. In 2019-2020 BIO received an additional capital contribution of 50 million EUR to be invested in climate projects. Only new investments for the period and for loans, only the grant equivalents, are reported in the CTF tables. The active portfolio of BIO in the renewable energy sector amounted to 190 million EUR in the reporting period, from earlier and new commitments provided in loans and equity towards investments for solar, wind, geothermal energy and hydropower and for investments in energy efficiency.

In the reporting period, **118 million EUR was provided through these different types of bilateral cooperation** with a focus on Africa, least developed countries and climate change adaptation. The following sectors were targeted most: agriculture, water and sanitation and energy.

[3] Brussels development cooperation focuses its efforts on four partner regions: the Region of Rabat-Salé-Kénitra in Morocco, the City-Province of Kinshasa in the Democratic Republic of Congo, the Municipality of Chennai in India and the District of Paramaribo in Suriname.

Figure 7.6 Belgium Climate Finance through programs and projects of bilateral cooperation (direct and indirect), by sector, in 2019-2020



7.4 Looking ahead

Belgium will continue to support climate action around the globe through multilateral and bilateral funding. Already planned provisions for the period 2021-2026 amount to over 450 million EUR. While not part of the BR5 data, Belgium has committed to increasing its international climate finance from 2021 onwards, to be reported on in the BTR1.

7.5 Activities relating to transfer of and access to technologies and capacity building

An overview of activities related to technology transfer and capacity building can be found in CTF Tables 8 and 9.

Capacity building and to some extent technology transfer are always an essential component of all bilateral programmes and projects. In the tables, some of the more concrete examples related to mitigation and adaptation are listed.

The Belgian Development Cooperation supports both the VLIR (Flemish inter-university council) and CIUF (Interuniversity Council of the French Community) to establish partnerships between Belgian universities and university colleges and their counterparts in the South. These partnerships generate – among other projects – initiatives related to climate change.

In the reporting period, Belgium also established the Academic Research Platforms for Policy Support (ACROPOLIS) which provide policy support for development cooperation, based on quality academic research. One of these platforms – KLIMSEC – supported the Belgian government in developing policy on climate security, with a specific focus on the Great Lakes region. It fits within the efforts of universities and university colleges to support research and higher education in developing countries.

The Flemish Water for Development Partnership – involving over 90 members, ranging from NGOs, public water companies, private firms over local authorities and regional administrations to academic and research institutions active in the water sector – implements sustainable water and sanitation projects in the global South. The climate support through this Partnership is reflected in CTF Table 7(b), but these projects also foster the transfer of expertise to southern partners. To date, these projects benefited over one million southern citizens in terms of access to water.

The Belgian Federal Climate Change Service has supported the partner countries of Rwanda and Niger in the development and operationalisation of national GHG inventory systems, with the goal of strengthening institutional capacities.

7.6 Methodological Approach for tracking of the provision of financial, technological and capacity-building support to non-Annex I Parties

7.6.1 The use of Rio markers to quantify climate-relevance of projects/ programmes

Belgium uses the Rio markers to report to the Development Assistance Committee of the Organisation for Economic Cooperation and Development (OECD-DAC) about the official development assistance that has been spent on activities to support the goals of the United Nations Conventions on biodiversity, climate change and desertification (respectively UNCBD, UNFCCC and UNCCD). These are policy markers that indicate donors' policy objectives in relation to each aid activity. In its reporting to the UNFCCC, Belgium uses these markers to identify the relevant programmes and projects in its portfolio. The Directorate General for Development Cooperation and Humanitarian Aid (DGD), takes all Rio markers (climate, biodiversity and desertification) into consideration to be able to determine the coefficients used to estimate the amount of the project budget that can be considered climate finance. For instance, if a project is marked 2 for climate adaptation, as well as for biodiversity, only 50% of the budget would be considered climate finance. For projects that have one or more markers 1, the coefficients (in %) are determined on the basis of their subsector code, also avoiding double counting. To avoid double counting, the sum of coefficients for each project never exceeds 100%. The Government of Flanders also uses the Rio markers. Accounting for "Rio marker 2" actions is simply 100% of the action budget. For accounting for the contributions of actions under Rio marker 1 a coefficient of 40% is used. To prevent double counting, a "Rio Marker 2" on both mitigation and adaptation does not result in climate reporting of 200% of the project budget, but counts as 100% of the project budget. The same principle is applied to a "Rio Marker 1" on both mitigation and adaptation, which results in a climate reporting of 40% of the project budget.

Belgium recognises the shortcomings of using the Rio Markers for quantification as the purpose of the Rio Markers is to indicate donors' policy objectives in relation to each aid activity, and not to lead to a quantification of support delivered. Unfortunately, there is no better system available that will lead to more precise estimation, without posing an undue burden on Parties' reporting. To overcome this hurdle, Belgium reports in the most transparent manner (e.g. publicly available databases) on its climate finance, so future adjustments can be made.

In this regard, all efforts of the Federal Government, and Governments of Flanders, Wallonia, and Brussels Capital Region towards international climate finance are made publicly available on the following websites, respectively:

- The Department of Foreign Affairs of Flanders: https://www.fdfa.be/en/sustainable-development/development-cooperation
- The Walloon Agency for Air and Climate (AWAC): http://www.awac.be/index.php/thematiques/politiques-actions/les-politiques-changement-clim/politique-wallonne/financement-climat-international
- Brussels Environment: https://environnement.brussels/nos-actions/projets-et-resultats/financement-climatique-international
- Federal Government: www.openaid.be

7.6.2 Key concepts of the methodological approach

See the "Documentation Box" under CTF Table 7 for more details.

Use of exchange ratio

Belgium decided to use the currency exchange of the OECD DAC statistical table: Annual Exchange Rates for DAC Countries from 1960 to 2020 to comply with this recommendation in the most transparent way.

7.6.3 New and additional financial resources

Belgium provided 30 million EUR to the Global Environment Facility during the reporting period. This funding is reported as core funding in CTF Table 7a.

The GEF, as operating entity of the UNFCCC Financial Mechanism, provides resources for the preparation of biennial update reports and national communications and has established the Capacity Building Initiative on Transparency (CBIT). Belgium's contribution to the GEF is therefore in accordance with its commitment to provide new and additional financial resources to meet the agreed full costs incurred by developing country Parties in complying with their obligations under Article 12, paragraph 1, of the Convention.

These are the new and additional financial resources that have been provided by Belgium pursuant to Article 4, paragraph 3, of the Convention.

Both the financial architecture as well the commitments by Parties have changed significantly since the Convention, especially with milestones such as the Copenhagen Accord, the Cancun Agreements and the Paris Agreement.

While developed country Parties are required to continue the provision of financial resources to assist developing country Parties with respect to both mitigation and adaptation in line with the existing obligations under the Convention, these Parties are also requested, as part of a global effort, to take the lead in mobilizing climate finance from a wide variety of sources, instruments and channels, noting the significant role of public funds, through a variety of actions, including supporting country-driven strategies, and taking into account the needs and priorities of developing country Parties (Article 9, paragraphs 1 and 3, of the Paris Agreement). So, financial support to climate action in developing countries does not only flow through the operating entities of the Financial Mechanism.

Over the years, there are also significant changes regarding the involvement of Belgium in international climate finance. While the federal government, through its Directorate Development Cooperation, remains the main donor, the Regional governments are now also playing an active role, especially since the Copenhagen Accord (2009). There are also more ministries, departments or entities involved, besides Development Cooperation.

This development of greater involvement within Belgium, as well as the complexity of the climate finance architecture, makes it difficult to give a clear-cut description of "new and additional" financial resources as there is such a wide variety of sources. A dynamic and flexible concept of "new and additional" is required, even more so due the lack of an internationally agreed definition of this concept. For these reasons, Belgium puts a lot of emphasis on transparency of its use of reporting methodologies.

Belgium honours its commitments on international climate finance in the context of the Paris Agreement, including on the principle of new and additional. Belgium describes its financial support as new and additional, since it comprises:

- Provisions in line with Article 4, paragraph 3, of the Convention;
- Contributions which would not have existed without the financial commitments stemming from the Copenhagen Accord;
- Budget lines on top of the annual budget for bilateral development cooperation;
- Only the climate-specific or climate-relevant part of projects and programmes. Based on our methodology (see above), Belgium does not report the full amount of the projects/programmes if these are only partly relevant to climate action;
- Only climate-related projects in developing countries additional to the previous reporting period;
- Contributions from the revenues obtained from auctioning greenhouse gas emission allowances.

Climate and development assistance are strongly interdependent, as climate should be mainstreamed in development finance as an overriding priority. From this perspective, Belgium is convinced of the importance of climate-proofing support to developing countries to ensure sustainable development and the crucial role of development finance for climate actions in developing countries, especially for adaptation and mitigation projects, technology transfer and building institutions and capacity to implement climate policy in developing countries. Any climate-related support that meets agreed ODA definition is reported as such in a transparent way. ■

8. Research and systematic observation

8.1 Research

8.1.1 General trends of climate research since 2017

Climate-related questions and challenges are too large and too complex to be addressed by a single country, agency, or discipline. Belgian climate research is framed in a worldwide coordinated effort.

The financial resources allocated to climate research in Belgium have increased considerably [see Figure 8.1] since 2017, Belgian research has been better and better embedded in international research initiatives, the number of publications has increased, and more and more climate related data have been produced, processed and are accessible today for further research or policy developments [see 8.1.7 and systemic observation chapter 8.2].

If basic research aiming at reducing uncertainties on climate evolution and involving academical scientists is still strongly supported in Belgium, an increase is observed of support towards the development of solution-oriented research or policy driven research involving both scientific experts and policy experts. [see 8.1.7]

Moreover, strong investment is dedicated to research and innovation in the energy sector as part of the implementation of the Belgian National Plan on Energy and Climate, launched in 2019. This includes the R&I supporting the achievements of the decarbonisation, renewables and energy efficiency ambitions; low- carbon technology, circular economy, all with benefits in terms of GHG emissions reduction.

Because studying the linked problems of energy sustainability and climate change requires an integrated science that extends beyond the domain of engineering (e.g. renewable energy) or economics (e.g. circular economy) it was decided to try to circumscribe the present chapter to investment in climate science and science at the crossroads of climate and energy only.

Belgian research addresses the whole spectrum of climate related issue and spans over all temporal and spatial scales.

The research operators, namely the public scientific institutions, the universities and other research centres contribute to different elements of this spectrum, depending on their own missions, the instruments, and sources of funding available. [see 8.1.3]

Despite the relative increase of climate related research within a total R&D envelop and the shift observed regarding the nature of research carried out in Belgium, the climate research landscape remains very fragmented, and there is scope for increasing the synergies between actors. [see 8.1.5]

Based on this observation the Secretary of State in charge of Scientific Policy, initiated the creation of a climate centre at federal level, joining the efforts of several institutions. The climate centre will pursue three main objectives: (i) gathering and strengthening the resources for climate research and develop a strategic climate research agenda in Belgium (ii) establishing a structural cooperation between scientific operators and (iii) developing climate services in response to the needs of policy makers and sectors. The climate centre will be launched in 2022.

8.1.2 The categories of climate-related research

Research carried out in Belgium can be categorised as follows: [see details in 8.1.7]

- ***Fundamental research***: seeks to understand how the **climate system** is working ; how global, regional, and local climates are maintained as well as the processes by which they change over time. It investigates causal relations of climate change, both in the past (based on historical data) and in the future (through modelling). This research is generally implemented through networks at a Pan-European or international level but also through national small-scale networks or even by individual post-doc researcher.
- ***Strategic research***: seeks to understand the impacts and associated risks of climate change: rising global temperatures causes sea-level rise, alters biodiversity, forests, crop yields and water supplies. Changing climate also affects human and animal health and their ability to exist in certain ecosystems. This research is generally implemented through national or international networks in which academic Belgian high-level scientists are involved. Research focuses on policy-development or policy implementation at International, European, national or regional level.
- ***Response based/solution-oriented research***: includes mitigation and adaptation related research. This type of research generally seeks to adopt transdisciplinary approaches where both stakeholders (sectoral practitioners, including private sectors) and scientists are involved. Such 'co-production' of knowledge is becoming more prevalent. Development of so-called Climate Services falls under this research category.
- ***Building blocks of research infrastructures***: are developed for **observations purpose**. They refer to the development of a specific institutional setting to deliver specific services to scientific users, relying on components or assets of several decentralised climate related infrastructures (from ESFRI roadmap in particular).

8.1.3 The R&D funding sources and instruments

Climate research relies on many different sources of funding, some of which (e.g. institutional funding in larger organisations – see Chapter 7.3.1) are very difficult to estimate or attribute to climate research with any precision. European, Federal, regional and community levels of authorities, all contribute to the total mix. Total Belgian direct R&D expenditure (GBAORD - government budget appropriations or outlays for R&D, see NC7) increased from EUR 846 million (1990) to EUR 3 255 million (2019) in constant prices.

The relative distribution of this between the different federated entities was in 2019: federal government 17.9%, Flanders Government 59.6 %, French-speaking Community 12.1%, Walloon Region 8.7%, Brussels-Capital Region 1.6%[1].

Sources and quantities of competitive funding for research related to the climate are more easily identifiable. Hence, this section will attempt to provide information on overall state of relevant funding sources and provide information on trends where reliable information is available.

1 Source: http://www.belspo.be/belspo/organisation/Publ/pub_ostc/BRISTI/MINIPUBL_2009-2019i_nf.pdf.

At the Federal level

BELSPO, ***the federal administration for science policy***, directly supports climate research via several funding mechanisms: projects funding via national and pan-european calls; R&D activities outside EU through bi-lateral or multilateral cooperation; funding for Belgian and EU research infrastructure.

While they are currently undergoing a review and changes are possible, the federal tax incentives for R&D are significant for all R&D in Belgium, public as well as private (https://www.nbb.be/doc/ts/publications/economicreview/2020/ecorev-ii2020_h4.pdf).

In Flanders Region and the Flemish Community

Matters of Economy, Science and Innovation policy in the Flemish Government are under the responsibilities of the Department of Economy, Science and Innovation (Dept. ***EWI***), the Agency Flanders Innovation & Entrepreneurship (***VLAIO***) – a one-stop shop for all R&D funding for companies – and the Research Foundation – Flanders (***FWO***) funding research in universities and other regional research institutions.

An overview of this system is described in 'STI in Flanders': Science, Technology & Innovation. Brief Overview 2022. (https://ewi-vlaanderen.be/sites/default/files/sti_overview_brochure_2022.pdf)

In the Walloon Region

In Wallonia, science, technology and innovation (STI) are managed by several directorates general of the Walloon Public Service (SPW). The Walloon Region primarily finances research, development and innovation activities with a view to developing economic and industrial activities, as well as research aimed at developing specific expertise within its areas of competence. The Operational Directorate-General for the Economy, Employment and Research (DGO6) has primary responsibility for drafting and implementing policy, through its Competitiveness and Innovation, Technological Development and Research Programmes departments.

Other SPW operational general directorates manage smaller budgets and actions to support STI activities in their specific areas of competence: natural resources and the environment, social and health programmes, town and country planning, equipment and transport, sustainable energy and buildings, etc.

Research participants are mainly companies, universities, higher education institutes, research centres and public research bodies.

In the Federation Wallonia-Brussels

Funding from the Federation Wallonia-Brussels to its universities is mainly managed by the F.R.S.-FNRS ("*Fonds de la recherche Scientifique*").

During the last 5 years, climate change research has been granted through different instruments: grants and fellowships, credits and projects, the FRIA calls (Industry and agriculture) the EOS call (the joint fundamental research promoted between the Flemish and the French speaking community).

In the Brussels Region

INNOVIRIS, the Brussels Region innovation institution, is managing a range of different funding tools on R&I, covering different types of scientific collaboration as well as different stages of Technology Readiness Level.

Some programmes focus specifically on sustainability and urban resilience, including face to climate change:

- Co-Creation programme: this is a programme that funds R&I projects which makes "traditional" researchers collaborate with citizens.
- Experimental Platforms programmes: these fund the experimentation and testing of innovative projects targeting sustainable transition.
- Prospective research: projects to identify future social, economic and environmental challenges for the city, which lead to policy recommendations and therefore provide a concrete example of evidence-based policy making.

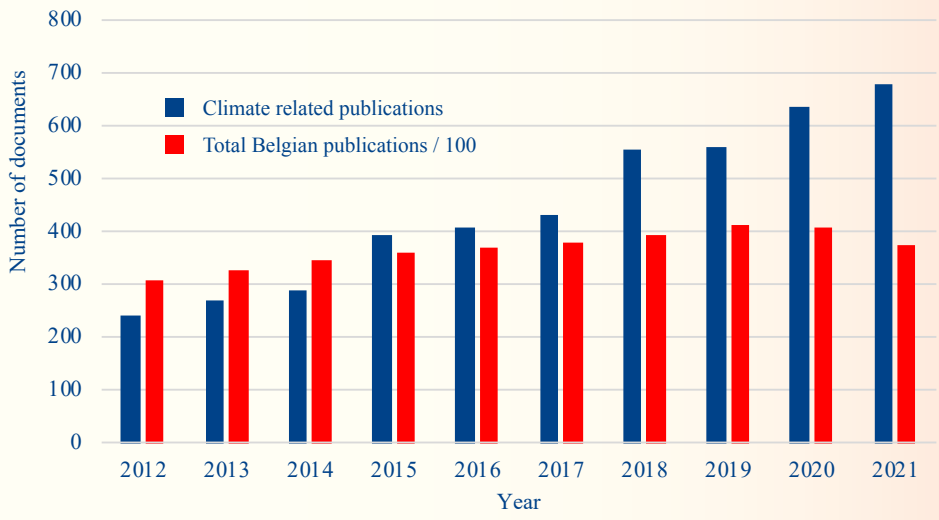
From the European Commission

European funding sources have also been made available to the Belgian scientific community through the Horizon 2020 programme and its predecessor Framework Programme FP7 which developed varied types of action and funding schemes calls including climate components such as the ERA-net co-fund actions, the Coordination & Support Action, Research & Innovation Actions; European Joint Programmes; Research Infrastructures.

8.1.4 Evolution of climate research in Belgium: bibliometric analysis

In the Web of Science, the platform that provides access to multiple databases of reference and citation data, all publications with at least one Belgium-based author were selected. The number of climate related publications was then estimated by narrowing down this selection with a further search for the terms "climate change", "global warming", "climate research" or "climate model" in the title, the abstract or the keywords of these publications.

Figure 8.1. shows the evolution of the share of climate related publications in the total Belgian output



8.1.5 Expenditure for climate research in Belgium

Because there is no single common R&D database shared between resources providers in Belgium, the distribution of climate research funding mentioned in 8.1.3 among the various Belgian actors active in this domain can be approximately characterised by combining available data by sector, time period, Belgian entities and by cross-checking information retrieved from the following sources of information or databases: The FRIS research portal, the FNRS-FRS Base de données 'SPI' and from INNOVIRIS (Brussels Region) with federal databases 'FEDRA' (the research actions database funded by BELPSO) and the CORDIS/ECORDA, the primary source of results from the EU-funded projects.

The EU H2020 programme funded approximately 5000 research projects involving one or more Belgian participant. Of these, 240 were related to climate science 230 of which took place during the last quinquennial period.

The FRIS research portal has been created over the last few years by the Flemish authorities and research organizations as an open data tool on research in Flanders. Although there are a few relevant organizations for which project data is not (yet) included in this system (notably VITO), the available data are sufficiently comprehensive to make a comparison between the situation as it would have been reported in NC7 (the five-year period 2012-2016) and the most recent five-year period for which data is available (2017-2021). In the analysis, total project funding is assigned to the starting year of the project.

Table 8.1 shows the amount of budget distributed by funding source [see 8.1.3] and climate research category [see 8.1.2], during the recent quinquennium (and where comparable data are available, in comparison with the last reporting period). Where available, the table indicates the number of projects carried out by the main research performing operators in Belgium (e.g. Universities and Research Centres) as well as the total of their funding, for each of the federated entities of Belgium.

FLANDERS

Research on climate change in Flanders has increased significantly from about EUR 10 million per year in 2012-2016 to about EUR 20 million per year in 2017-2021 (budget doubled, number of projects nearly tripled). It now represents about 3% of all research in Flanders. About 1% of the number of projects reported in Table 8.1 has additional co-funding from other sources (BELSPO and EU). The co-funding is excluded from the funds reported in the Table 8.1.

More than 80% of this climate research is fundamental, the rest is more applied or related to policy report. Research on climate change in Flanders is situated mostly in fields of Natural Sciences (Biological Sciences, Earth Sciences and Environmental Sciences) and Engineering and Technology (Civil and Building Engineering). The discipline distribution remains fairly stable over time, however during the most recent period there is a slight increase in Social Sciences (especially Political Sciences).

BRUSSELS CAPITAL REGION (BCR)

Just like the actors of the other Belgian Regions, INNOVIRIS only supports research carried out in an economical applied framework. Research is solution oriented. A total amount of EUR 44.4 million has been invested in climate-related R&D during the last quinquennium.

The funding programmes operate around open and thematic calls, and often involve collaboration between academia and the industrial sector.

The major portion of investment comes from: experimental Platforms (EUR 11.9 million), Joint R&D (EUR 9.2 million), Co-creation programs (EUR 8.2 million) and Prospective Research (EUR 3.5 million). Remaining support is derived from a bottom-up R&D&I programme in support of companies; the Region part of co-funding calls; a research platform of an academic programme of TRL 2-3; vouchers innovation, an applied PhD and the creation of a spin-off.

The Joint R&D and the R&D schemes fund projects that are collaborative and multidisciplinary and tackle areas that have been identified as strategic in the Regional Innovation Plan. The Joint R&D is supported through a thematic call while R&D schemes hold a bottom-up approach.

Experimental Platforms and Co-Creation programmes are more focused on testing and experimentation while involving end-users in the process.

WALLOON REGION

Fundamental research is managed by the Federation Wallonia Brussels and applied research is managed by the Walloon and Brussels regions, according to their specific competences.

The expenditures reported in Table 8.1 refers mainly to energy related projects. In the projects, the energy theme may be exclusive or partial (for example, considering a project to develop a new machine that will consume less energy at use and whose maintenance cost will be reduced).

The reported R&D budget is only for the part of the projects related to energy efficiency and low-carbon technologies.

WALLONIA BRUSSELS FEDERATION

An estimation of the budget for the climate research projects of the French Community can be obtained by summing up the contributions from the following three funding parties: the FRS-FNRS, the H2020 programme and BELSPO.

FRS- FNRS funds basic research in climatology, paleoclimatology, paleoecology. During the last five years (2017-2021),

Table 8.1 Expenditure for climate research in Belgium

ENTITY	Category of R&D	Previous reporting period 2012-2016 (~ NC7)		Recent quinquennium 2017-2021 (NC8)	
		number of projects	budget in EUR millions	number of projects	budget in in EUR millions
FLANDERS climate research for which metadata is available in FRIS, with Flemish funding		235	53	610	107
	Climate Fundamental	80%	83%	92%	88%
	Climate Solution oriented (applied and policy oriented)	16%	17%	7%	12%
	All research	13 413	2 730	20 652	3 900
	Climate vs all research	1.8%	1.9%	3.0%	2.8%
BRUSSELS REGION		/	/	237	44.4
	Climate Fundamental	/	/	0%	0%
	Climate Solution oriented (applied and policy oriented)	/	/	100%	100%
	All research	/	/	1 793	227.8
	Climate vs all research	/	/	13.2%	20.9%
WALLOON REGION		989	230	648	164
	Climate Fundamental	0%	0%	0%	0%
	climate Solution oriented (applied and policy oriented- energy efficiency	100%	100%	100%	100%
	All research	7 664	1 695	5 046	1 465
	Climate vs all research		13.6%		14.5%

ENTITY	Category of R&D	Previous reporting period 2012-2016 (~ NC7)		Recent quinquennium 2017-2021 (NC8)	
		number of projects	budget in EUR millions	number of projects	budget in in EUR millions
WALLONIE BRUSSELS FEDERATION		/	/	128	38.2
Funder: FNRS	Climate Fundamental	/	/	88	23
	Climate vs all research	/	/	2.8 %	3.2%
Funders H2020 + BELSPO	Climate (Solution oriented applied and policy oriented)	/	/	40	15.2
FEDERAL		/	/	27	6.03
Climate research for which metadata is available in FEDRA with BELSPO funding				11	3.10
	Climate Fundamental	/	/	10%	10%
	Strategic/ Solution oriented (applied and policy oriented)	/	/	90%	90%
Climate strategic research for which metadata is available in e-CORDA with EU funding				16	2.93
	Climate / all research			25%	10%

Note: Some discrepancies appear in the Table 8.1 between the figures reported by the different Regions, in particular in Brussels and Wallonia, where, unlike Flanders, projects (or parts of projects) dealing with e.g. energy efficiency are included in the table in relation to investment in applied research.

88 grants (40 during the Grants and Fellowships calls, 28 during the Credits & Projects calls, 17 during the FRIA calls and 3 during the EOS calls) were included within the topic of climate accounting for 2.8% of the total number of grants over the period considered.

In total, the 88 climate-related grants over the past five years represent an estimated budget of EUR 23.22 million, or 3.2% of the total budget for the period considered.

Finally, among the 393 permanent researchers of the F.R.S.-FNRS in 2021, 14 are conducting climate-related research as defined here which represents an estimated amount of approximately EUR 1.47 million per year (accounting for 3.4% of the entire budget dedicated to FNRS permanent researchers).

In addition to fundamental research, strategic or solution oriented are carried out in the French-speaking universities. These are (co-)funded by H2020 (34 projects- EUR 14 million) and funded by BELSPO (6 projects – EUR 1.2 million)

FEDERAL LEVEL

Through the multi-annual research programme for Earth Observation, STEREO, forms part of the Belgian space strategy. Additionally, BELSPO has allowed Belgian organisations to develop leading expertise in remote sensing, satellite imagery and generally in the use of remote sensing data. STEREO projects have used remote sensing capabilities for monitoring the interactions and dynamics of land, sea or air within a context of climate change. The new phase (STEREO IV - 2022-2027) just launched its first call specially addressing the Impact of climate change on terrestrial and marine environments (data exploitation, monitoring, modelling, mitigation strategies).

The FED-tWIN programme is a BELSPO programme to support sustainable cooperation between the ten Federal Scientific Institutions (FSI) included within Belgian Science Policy (BELSPO) and the eleven Belgian universities. The aim of the programme is to develop sustainable joint research activities between the FSI and the universities. To this end, research profiles are jointly elaborated by an FSI and a university, to be implemented by a post-doctoral researcher who is employed part-time at the FSI and part-time at the university. Eleven post-doc researchers are carrying out climate related research within the FSIs mentioned below and different universities.

The main part of BELSPO's investment in climate research has been allocated through the multi-year research programme BRAIN.BE 20. Projects of fundamental and strategic types generally involve an average of 3 research institutes, together with linking universities and Federal scientific Institutions (FSI) in Belgium. Numbers indicated in Table 8.1 cover research performed in the following five Federal Scientific Institutions in which climate research capacities have been developed to varying degrees.

- The *Royal Belgian Institute of Meteorology (RMI),* whose mission is to deliver permanent services that provide information to ensure the security of the population based on meteorology, climatology, geophysics and related sciences. "Pure" climate-change activities represent roughly 40% of all scientific and engineering resources.
- The *Belgian Institute of Aeronomy (BISA),* whose main tasks research and public service in space aeronomy are, which is the physics and chemistry of the atmosphere of the Earth and other planets, and of outer space. "Pure" climate-change activities represent roughly 30% of all scientific and engineering resources.
- The *Royal Belgian Institute for Natural Sciences (RBINS)* which studies present and past biodiversity both from a fundamental viewpoint and in support of the sustainable management of natural resources.
- The *Royal Museum of Central Africa (MRAC),* where climate change is embedded within several core research activities carried out by the Africa Museum, such as the study of natural hazards, the tropical forest as carbon stock and tropical diseases.
- The *Royal Observatory of Belgium* carries out geodesy for measuring vertical land movements: to assess flood hazards in low-lying countries such as Belgium and, in Antarctica, to assess the ice mass balance.

8.1.6 Coordination between Belgian entities and operators

NETWORKING

Both within and between Belgian universities, several interdisciplinary networks are set-up, bringing together climate or environmental-related expertise in a coordinated manner. Examples include Leuven Sustainable Earth at KU Leuven; the Centre for Sustainable Development at Ghent University; the Interfacultary Center for Marine Research at the ULiège; the Global Change Ecology Excellence Center at the UAntwerp; the Centre for Environmental Sciences at UHasselt; Earth System Science, an interdisciplinary research group at VU Brussels; KLIMOS-ACROPOLIS: an interdisciplinary and interuniversity research platform that aims at generating capacity to enable the necessary transition to a sustainable society through research for development (see Chapters 6.4.1 and 7).

Initiatives coordinated on a European level (e.g. EU-Africa-EU LAC; joint programming initiatives (JPI)) and participation in global programmes provide further mechanisms that foster networking among scientists.

Bilateral cooperation outside Europe forms another such mechanism (such as with China, South Africa). Finally, multilateral science programmes (e.g. UNESCO-related: MAB; IHP, IOC) have an increasing focus on climate resilience (see Chapter 8.1.7).

SCIENCE-POLICY INTERFACING

The science-policy interface is multi-faceted; an important aspect of it is the programmatic and thematic preparation of (funding for) further research activities and systematic observation, as well as the translation of research findings into policy-relevant information.

BELSPO hosts the ***Central Secretariat of the JPI Climate***. This ensures the overall coordination and day-to-day management of the initiative. The JPI Climate has developed a strategic research agenda with three challenges (i) Understanding the processes and consequences of climate change (ii) Improving knowledge of climate-related decision-making processes and measures (iii) Researching sustainable societal transformation in the context of climate change. Alongside the Strategic Research Agenda, the JPI Climate has developed a strategic mechanism to connect people, problems and solutions in a systemic approach.

Other relevant joint programming initiatives (JPI) to which Belgium contributed significantly in the five-year period under review are the ***JPI Urban Europe, the Joint Programming Initiative on Agriculture, Food Security and Climate Change (FACCE), the JPI Oceans and BiodivERsA***. Belgian researchers have been successful in participating in climate-related calls and other actions in these contexts [see 8.1.7]

BELSPO funds and manages the ***Belgian Biodiversity platform biodiversity*** and is the coordinator of ***Biodiversa+ the Horizon Europe Partnership on biodiversity***, the first such partnership under Horizon Europe Cluster 6 Food, Bioeconomy, Natural Resources, Agriculture and Environment.

As the host country of both the Central Secretariat of JPI Climate and the Coordinator of Biodiversa+, Belgium facilitates the exchange of information and collaboration between these two initiatives in the field of biodiversity and climate change (e.g. the establishment of the upcoming Knowledge Hub on Biodiversity and Climate Change).

POLICY-LEVEL COORDINATION: THE COMMISSIONS OF THE INTERMINISTERIAL CONFERENCE FOR SCIENCE POLICY

The Interministerial Conference for Science Policy (IMCSP), uniting all relevant ministers across the competent federated entities, takes the overall responsibility for the cooperation, coordination, and consultation of their services. Beneath it, two permanent committees, the International Cooperation Commission (CIS) and the Federal Cooperation Commission (CFS) manage the formulation of decisions and positions related to research policy.

The CIS has different thematic subgroups.

The CIS-Climate, Energy & Mobility *(CIS-CLIMENMOB)*: identifies the Belgian positions and prepares input to Horizon Europe to Cluster 5 Climate, Energy and Mobility.

The CIS-IPCC, an ad-hoc group of CIS-CLIMENMOB provides an opportunity for Belgian policymakers at different levels and ensures the preparation of coherent, integrated, and representative Belgian positions and contributions to the IPCC. Its work is supported by the ***Belgian IPCC Focal Point***, hosted by BELSPO, that also provides an annual financial contribution to the IPCC Trust fund (~EUR 70k/year) and facilitates active contribution to the work programme by Belgian experts (travel and accommodation expenses).

For the IPCC's Sixth Assessment Cycle (AR6), 18 experts nominated by Belgium were selected to contribute to the various reports, which allowed them to integrate their expertise in a broader and international context.

The regular exchange of information between the Belgian Focal Points to the IPCC and to the UNFCCC ensures the coordination and alignment of Belgian positions and contributions to these bodies. This process is facilitated by exchanges between the CIS-IPCC and the Greenhouse Effect Coordinating Work Group (*Coördinatiewerkgroep Broeikaseffect/Groupe de Coordination Effet de Serre* (CGBKE/CGES)) which reports to ministers of energy and climate.

A Walloon Platform for the IPCC works in synergy with the Belgian IPCC focal point to coordinate the French-speaking experts' contribution to the IPCC assessments, to maintain register of experts and to participate to outreach climate related activities. The Walloon Platform for IPCC supports the Walloon climate decree and collaborates with the Walloon Air and Climate Agency (AWAC).

The ***CIS-INFRA*** prepares coordinated Belgian positions related to governance and the development of research infrastructures in the context of the European Strategy Forum on Research Infrastructures (ESFRI), such as the "Integrated Carbon Observation System" (ICOS) and the "Pan-European Research Infrastructure on Short-lived Atmospheric Constituents" (ACTRIS).

8.1.7 Distribution of climate-related research along a value chain from upstream to downstream activities

In the present national communication where the question is to assess how and to what extent Belgian research has helped to develop knowledge support towards the objectives stated at the latest COPs, Belgian research effort can be schematically presented as a set of activities implemented by scientists and stakeholders alongside a research continuum from upstream, midstream to downstream activities.

Upstream/midstream activities refer to large-scale observation and modelling generally performed on an international, Eu-

ropean, or Pan-European scale and calling for fundamental/strategic research.

Downstream research refers to the response of various sectors to climate changes. These take place at pan-European level, on a national and local scale and calls for domestic (co)funded research.

Details of the value chain and the Belgian operators involved along that value chain are set out below.

UPSTREAM ACTIVITIES

Upstream activities embrace the following:

Hardware infrastructure: refers to the development and maintenance of all types of observational instruments for measurements in space, air, land or sea, such as a pluviometer, weather balloon or satellite. [see sub-chapter 8.2]

Systematic observations: refers to all activities needed for the collection, generation and provision of all types of observations (space, airborne, land-based, sea), including the retrieval and quality-control of the observational data. [see sub-chapter 8.2]

Model development of global, regional as well as downstream impact models. The model development includes research into the ***physical processes*** (for example for climate models the effect of greenhouse gases on the Earth's temperature, the relationship between the temperature of the air and water vapour) and on how these physical processes should be translated into mathematical equations in the model that make up the computer code.

The developments are aligned with strategies developed at international level. In particular:

The WMO-***World Climate Research Programme (WCRP)***, which is centred around four core projects that support climate research on the different components of the Earth's climate system: global atmosphere, oceans, the cryosphere, and the land surface as well as interactions and exchanges between them.

Future Earth - ***Global Atmospheric Chemistry Project (IGAC)*** whose mission is to facilitate atmospheric chemistry research towards a sustainable world. This is achieved through IGAC's four focal activities: advancing knowledge, fostering community, building capacity, and engaging society.

The Future Earth - ***Integrated Land Ecosystem-Atmosphere Processes Study (iLEAPS***) programme which acts as a communication hub and coordinator of worldwide scientific research. Their focus is on land-atmosphere systems that include important feedbacks in the areas of urban land, managed land, forests, arctic and mountain regions, arid and semi-arid regions.

As far as large-scale modelling is concerned, two universities are running a global model (i.e. UCLouvain and VU Brussels).

MIDSTREAM ACTIVITIES

Midstream activities embrace the followings:

Production of ***global model data***: refers to all types of modelled data on a global scale, describing the long-term evolution of the components of the Earth System (= carbon cycle, greenhouse gas emissions, land-use, all frozen parts of the Earth, ocean, ecosystems, atmosphere). Global model data is needed as input for the regional models to obtain data with more spatial and temporal detail.

Production of downscaled or ***regional model data***: refers to the production of modelled data on a regional scale. Similar to the global data, this data describes the long-term evolution of the components of the Earth system, but on a regional scale (for example the temperature evolution until 2100 for Belgium at a grid of 4 km or the evolution of the Greenland ice sheet until the end of the century).

Midstream activities at the international level are mostly linked to model data production. In that regard, the World Climate Research Programme (WCRP) coordinates international initiatives on the production of research datasets such as the ***Coupled Model Intercomparison Project (CMIP)*** for global climate data, the ***Coordinated Regional Downscaling Experiment (CORDEX)*** for regional climate data and the ***Inter-Sectoral Impact Model Intercomparison Project (ISIMIP)*** for impact/sectoral data.

Belgian actors participate in international development: the regional climate model simulations by RMI (ALARO-0) contribute to the Coordinated Regional Downscaling Experiment (CORDEX)

Only a few universities are active in model development (e.g. the regional climate model MAR at ULiège, or the Earth System Model LOVECLIM at UCLouvain). The COSMO-CLM model used at KU Leuven and UCLouvain is developed in the framework of an international consortium.

Belgian universities are mostly active in both the ***application of regional models*** as well ***as impact models***. More specifically, UCLouvain, KU Leuven and ULiège use a regional climate model (respectively COSMO-CLM and MAR). The regional models are used to obtain past, present and future data on the components of the Earth System (e.g. carbon cycle, greenhouse gas emissions, frozen parts of the earth, ocean, biosphere, atmospheric dynamics and composition…).

Most universities and research groups have access to the high-performance computing infrastructure needed for their modelling activities (e.g. regional climate modelling or impact modelling). In Flanders, the high-performance computing infrastructure is organised through a partnership between the five Flemish universities and their university associations (i.e. Vlaams Supercomputer Centrum - VSC).

DOWNSTREAM ACTIVITIES

Downstream activities embrace the followings:

Climate data provision: includes the activities linked to the provision of data for the past, present and future climate, as well as climate projections under different emission scenarios. The provision is mostly targeted to a scientific audience in need of data for research purposes.

Sectoral impacts: all activities (including climate data collection, modelling with an impact model, analyses of the results) linked to the effects of climate (change) on different sectors (e.g. agriculture, ecosystems, urban), resulting in value-added sectoral data and information. For example, meteorological parameters from regional climate model calculations are used as input to an agricultural model to quantify the evolution of crop yields in the future.

End-user interaction: refers to the preparation of tailored products such as maps, graphs, web portals and climate indicators for which additional development, processing or expertise is needed. Products are developed on request of a user to answer their specific needs, mainly in support of decision making for mitigation and adaptation strategies and thus targets public administrations as well as private stakeholders (e.g. future impact of heat waves on nuclear installations).

Outreach: refers to all communication activities to inform and engage non-scientists in the climate problem. Examples are media appearances, development of schoolbooks, production of educational videos for social media, creation and collaboration in exhibitions, etc.

Belgian operators contribute to downstream activities at International EU, National or Regional (=local) scales.

Table 8.2 highlights the main ***EU climate-data provision and sectoral research initiatives*** in which Belgian operators are involved.

At **the national/regional/local scales** , through the funding instruments described above, the universities and scientific institutions ***use output data from regional models*** (either data from their own regional model applications, or regional data available through other initiatives), as ***input to be used with impact models*** that allow them to study the impacts of climate (change) relevant for a broad range of sectors: i.e. terrestrial, aquatic and marine ecosystems, hydrology and water resources, chemical composition of the atmosphere, agriculture, land degradation, urban, ice sheets and glaciers, migration, renewables, energy consumption of buildings.

Several universities are involved in end-user interactions to translate the research results from impact modelling into valuable information. The service provided by the universities is mainly targeted at public authorities on a regional level in support of adaptation or mitigation strategies.

Table 8.2 EU-climate-data and (pan-)European research initiatives involving Belgian scientific community

ACTIVITIES	PROJECTS	ACTORS
PLATFORMS		
EU data platforms for operational services	the EU Atmosphere Copernicus Monitoring Service (CAMS)	[see 8.2]
	Copernicus Climate Change Service (C3S)	[see 8.2]
	European Institute of Innovation and Technology Climate-Knowledge and Innovation Community (EIT Climate-KIC)	incl . KU Leuven
European Technology Platforms (ETPs):	The Water Supply and Sanitation Technology Platform (WssTP)	
JOINT PROGRAMMING INITIATIVES (EU H2020)		
JPI Climate	H2020 ***ERA4CS*** ERA-net for Climate services	RMI, BIRA, ULBruxelles, VUBrussel
	H2020 ***AXIS*** ERA-net: Cross(X) sectoral climate Impacts and pathways for Sustainable transformation	VUBrussel, UNamur, ULiège
	SOLSTICE "Enabling Societal Transformation in the Face of Climate Change in 2019" (UAntwerp, UCLouvain)	UAntwerp, UCLouvain)
	EU Coordinated supporting action_ ***SINCERE*** Widening international cooperation activities on climate adaptation and mitigation" Flagship Actions: Africa and Latin America	JPI Climate Central Secretariat
JPI Urban ; Knowledge hub for urban transitions	Co-fund action Smart Urban Futures Call ***ENSUF*** , Making Cities Work and Positive Energy District	INNOVIRIS
JPI Ocean	Joint Action with JPI Climate	RMI, UCLouvain, ULiège
BiodivERsA	ERA-net BIODIVCLIM addressing issues at the crossroad between climate and biodiversity.	coordination BELSPO - Belgian Biodiversity platform UGent, UAntwerp, UCLouvain

Examples include:

- The climate portal of Vlaamse Milieumaatschappij through collaboration with KULeuven
- Reports by HIVA of KULeuven on policy-relevant research
- Contribution of ULBruxelles, ULiège, UCLouvain to the study report on climate change adaptation in Wallonia

Furthermore, given the specialised sectoral expertise of the ***research institutes***, they are active in climate consulting to answer more specialised questions from both public administrations and private stakeholders (e.g. the ongoing ***KLIMREK*** project 'KLImaatMaatRegelen mét Economische Kansen op het landbouwbedrijf' with ILVO and VITO as partners, the aim of which is to consult and support farmers in the transition to more climate-friendly and climate-resilient farming practices; policy informing note coordinated by Flemish Maritime Institute together with several universities and RBINS on the importance of the ocean-climate interaction).

The public administrations active along the value chain are all situated at the downstream part, except for the Vlaamse Milieumaatschappij, Agence Wallonne de l'Air et du Climat (AWAC) and Brussels Environment who are also situated in the upstream part as they possess observational infrastructure to monitor atmospheric parameters (both at surface parameters as well as atmospheric composition). AWAC is a stakeholder/end-user in the project world-emissions, funded by the ESA, which aims to provide an enhanced global emission monitoring service by developing top down emissions estimates based on satellite data [see 8.2]

The role of the public administrations consists of translating the scientific outcomes and results from observational and modelling research into comprehensive information that is relevant for policy-making purposes, such as adaptation/mitigation plans or reports.

The administrations are in close contact with actors from the research side (i.e. universities or the research institutes) and those actors are regularly consulted for the purpose of carrying out specific research studies or assessment or to provide specialised scientific expertise (e.g. by means of their presence in follow-up committees, task forces and on expertise panels). Examples of such interactions are the "evaluation of the socio-economic impact of climate change "in the context of the implementation National Adaptation Plan and "the impact of climate change and adaptation needs" in the framework of the future National Environment and Health Action Plan (NEHAP)" ordered by the SPF Federal Public Service Health, Food Chain Safety and Environment (see chapter 6).

We must also not forget the regional climate portals "*Klimaatportaal Vlaanderen*", the "*AWAC études*"; scientific inputs on measures for the climate adaptation plans; advice and expertise to the national risk analyses of the Crisis Center (FPS Interior affairs) and more specifically, the impact of climate change on risk scenarios; research results based on projects funded by the FPS Economy, SME, Self-employed and Energy.

The role of the ***Federal Public Services*** in response to the need for climate consulting is mostly that of a 'passthrough' towards private stakeholders from sectors experiencing the risk/effects of climate change (e.g. energy, transport, insurance, infrastructure).

Private stakeholders refer to private companies from sectors linked to climate (e.g. energy, transport, insurance, infrastructure, water, agriculture), non-governmental organisations (e.g. Bond Beter Leefmilieu, WWF, Greenpeace) and the media. So far, they are mainly situated at the very end of the value chain in the interaction and outreach part. Similar to the public administrations, the private stakeholders act as a 'passthrough' that conveys the results of research-based climate consulting to their users (outside the value chain). Examples of formats of their outreach are reports, leaflets, articles, concrete adaptation/mitigation measures for companies and handbooks.

8.1.8 The open data and open science policy

The current federal government agreement (30 September 2020) promotes an open data policy, with an enhanced access to public data. Belgium actively participates in EU and global developments and their implementation regarding 'open science' (e.g. Unesco 2021). Federated entities have a joint information exchange platform on open science: https://openaccess.be/. The open science policy considers that data and information processed in publicly funded research can bring about a greater impact if these are treated 'FAIR' (i.e. Findable, Accessible, Interoperable, and Reusable). Public services make available, for reuse by citizens, researchers, companies and governments, the information that they have in the context of their assignments. By providing their own information, companies and institutions can process and further enrich their own information to market new products and services. All these initiatives can be important in the development of climate services.

In general opportunities for free and open exchange of data and information increase in all fields:

- all the data and information generated by public institutions, such as meteorological measurements and observations of carbon (example: ICOS RI data policy, "ICOS Data is public data open to all Data Users. ICOS data will be available for the Data Users via [the] Car-

bon Portal." which can feed scientific analysis;
- data that accompany and underpin specific scientific publications and should be documented in a way that allows for experimental replication (example: network of 'data stewards' established in universities and research institutes in Flanders under the Flemish Open Science Board since 2020 and funded through the Research Foundation Flanders (FWO));
- scientific publications themselves (for example: since September 2018, researchers working in universities or scientific institutions of the Wallonia-Brussels Federation in Belgium are mandated by decree to make their articles available in Open Access).

8.2 Systematic observation

The following is a summary of information on the current status of national plans, programmes and support for ground- and space-based climate observing systems.

Climate-related activities are included in the core or key missions of five Federal scientific Institutions. In the case of systematic observations, these are first and foremost the Royal Meteorological Institute (KMI-IRM); the Belgian Institute for Space Aeronomy (BIRA-IASB); the Royal Belgian Institute for Natural Sciences (RBINS); the Africa Museum (RMCA) , and the Royal Observatory (ORB-KSB).

In recent times, climate observational facilities have also been rolled out by the universities. They mainly perform measurements linked to atmospheric composition, greenhouse gases and proxies.

8.2.1 Atmospheric climate observing systems

Earth Radiation Budget

Space-based climate monitoring has been continued as part of the Belgium's involvement in different international activities, particularly in relation to the Earth Radiation Budget (ERB) and the Essential Climate Variable (ECV). The data from the 4 Geostationary Earth Radiation Budget instruments on the Meteosat Second Generation satellites (EUMETSAT) have been processed, quality-checked, archived and distributed to users. As part of its involvement in the Climate Monitoring SAF of EUMETSAT, Belgium has contributed to the development of Climate Data Records of TOA Radiation. BELSPO contributed to this activity by providing PRODEX funding. Belgian is also contributing to the Copernicus Climate Change Service (C3S) by providing satellite-based ERB data for publication in the C3S's Climate Data Store (CDS).

Altius

Belgium is the primary stakeholder of the ALTIUS mission, an element of ESA's Earth Watch programme. The scientific objectives of ALTIUS (Atmospheric Limb Tracker for the Investigation of the Upcoming Stratosphere) are the monitoring of the evolution of the stratospheric ozone layer at all latitudes (including the polar regions), and the measurement of other variables of relevance to stratospheric chemistry and/or climate forcing (NO_2, H_2O, BrO, OClO, NO_3, aerosols, temperature).

ALTIUS is a passive limb instrument, meaning that its geophysical products will have a high vertical resolution, giving insight into the coupling of the different atmospheric layers and the altitude-dependent photochemical state of the atmosphere. Its measurements will sense the atmosphere both under daylight, and at night, thanks to a combination of solar, stellar, lunar, and planetary occultations, and air-scattered solar light.

The mission is being developed with a launch target for mid-2025 and a mission duration of 3-5 years. By that time, the number of limb sounders will have dramatically reduced, putting a higher value on the high-resolution stratospheric concentration profiles delivered by the mission. Belgium is supporting the development through its participation the Earth Watch programme (space and ground segments industrial activities), and through PRODEX (scientific support).

Atmospheric Constituents

Belgium is contributing to the ground-based monitoring of many atmospheric constituents, including short- and long-lived greenhouse gases, ozone, and aerosol, in the context of international networks, namely the Total Carbon Column Observing Network (TCCON), the Network for the Detection of Atmospheric Composition Change (NDACC) and two European Research Infrastructures, namely the Integrated Carbon Observation System (ICOS -ERIC [see next point]) and Aerosol, Cloud and Trace Gases Research Infrastructure (ACTRIS). The data are openly available from the associated data centres. Long-term data records are also submitted to the Copernicus Climate Data Store. Moreover, the data are used as reference data for the validation of Earth Observation satellite data and Copernicus Atmospheric Monitoring Service (CAMS) products and support assessments of the state of the atmosphere and the climate, such as the IPCC reports.

In addition, Belgium is involved in the key European satellite missions dedicated to the monitoring of the atmospheric com-

position in support of the Copernicus programme, namely the Sentinel-5 Precursor mission, in addition to the future Sentinels 4 and 5 to be launched in early 2024. Belgian scientists are likewise involved in the activities of the EUMETSAT Atmospheric Composition Monitoring Satellite Application Facility (AC SAF), which supports the generation and quality assessment of atmospheric data products from the series of GOME-2 and IASI sensors operated onboard the successive Metop-A, B and C platforms. Data products from these sensors are also generated under ESA PRODEX and as part the ESA Climate Change Initiative (CCI) programme. The Belgian contributions to these programmes include the development of retrieval algorithms addressing a number of air quality and climate-related trace gas and aerosol data products, the coordination of validation activities, and also including providing direct support to operational processing entities. Atmospheric composition data products from Sentinels and Metop IASI/GOME-2 sensors are assimilated or used as an input for Copernicus services on atmospheric (CAMS) as well as climate change (C3S) monitoring.

ICOS

Belgium is founder member of the Integrated Carbon Observation System European Research Infrastructure (ICOS ERIC). The aim of that infrastructure is to gather high-quality and highly standardised in-situ greenhouse gas observations for the three different components of the European Greenhouse Budget (Terrestrial, Ocean and Atmosphere). The infrastructure in total involves 12 member countries and more than 140 observation stations. It is currently fully operational and data are distributed via the ICOS Carbon Portal with an open data licence (CC BY - Creative Commons Attribution licence). In total, Belgium hosts stations across the three components.

The terrestrial stations constitute of eddy covariance towers that measure net greenhouse gas exchange between the ecosystem and the atmosphere on a half-hourly timescale.

Currently operational stations:

- Brasschaat: a mature Scots pine forest close to Antwerp (hosted by University of Antwerp)
- Lochristi: a short rotation coppice biomass plantation (hosted by University of Antwerp)
- Maasmechelen: a heathland (hosted by University of Antwerp)
- Lonzee: a cropland (hosted by University of Liège)
- Vielsalm: a mixed forest (hosted by University of Louvain)
- Dorine: A grassland (hosted by University of Liège)
- Congoflux: a mature topical forest in Democratic Republic of Congo (hosted by University of Ghent)

In addition, Belgium operated three ocean stations [see 8.2.2]. These station measure ocean surface water and atmospheric CO_2 concentrations, along with a variety of additional parameters (pH, turbidity, temperature,

- Thornton: a buoy (hosted by VLIZ)
- Simon Stevin: a research vessel (hosted by VLIZ)
- Belgica: a research vessel (hosted by RBINS)

Belgium also hosts one atmospheric station that is used to measure high-accuracy GHG concentration in the atmosphere. These measurements are typically made on tall towers or at high altitude (mountains).

- La Réunion: station on top of a volcano in La Réunion (hosted by BIRA)

Global Navigation Satellite Systems

Observation system: Global Navigation Satellite Systems (GNSS) such as GPS, Galileo, and GLONASS

Ground-based GNSS observation networks are used to remotely sense atmospheric water vapour, a key parameter for reliable weather prediction. After contributing to operational meteorology (e.g. E-GVAP) for two decades, Belgium now also uses GNSS data to improve the understanding of the Earth's climate. It uses GNSS to study climate variability, validate climate models, or perform multi-instrument comparisons. These trans-disciplinary activities are carried out in close collaboration with international initiatives, such as the IAG ICCC.

As a next step, Belgium plans to create the first Open Data portal for Belgian GNSS-based atmospheric water vapour data collections. The portal will provide access to curated and quality control data sets, enriched with statistical characterisation and visualisation capabilities, to facilitate (re)use, interpretation, and valorisation, the whole being guided by the FAIR data principle.

Finally, Belgium also contributes to the terrestrial climate observing systems (e.g. ground deformation) through its deep involvement in various international initiatives such as the IGS (International GNSS Service), EUREF, and EPOS.

Ozone and UV radiation measurements

Belgium operates two ground-based Brewer UV spectrophotometers at Uccle (Brewer#016 since 1984 and Brewer#178 since 2002). They measure the total ozone content of the atmosphere and apply the measurement principle of differential absorption of solar light by ozone in the UV (between 280 and 330 nm). The total ozone data of these spectrophotometers are used to monitor the state of the ozone layer. The Brewer instrument also measures the UV irradiance, and the actual UV index is derived in an operational context. The instruments are calibrated on a regular basis and the data is incorporated into the EUBREWNET, WOUDC and NDACC databases.

Since 2020, a Pandora instrument (#162) retrieves the concentrations of several trace gases (O_3, NO_2) in the atmosphere by applying the ground-based Differential Optical Absorption Spectroscopy (DOAS) technique. It is operated in collaboration with the Royal Belgian Institute for Space Aeronomy and forms part of the PANDONIA network.

Ozone sondes since 1969 in Belgium and soon in Nigeria

Since 1969, Belgium has monitored the vertical profile of ozone concentrations at Uccle by launching ozone sondes 3 times a week, with financial support from the Solar-Terrestrial Centre of Excellence. In collaboration with the National Space Research and Development Agency of Nigeria, Belgium also plans to launch ozone sondes Abuja, twice a month, from autumn 2022 onwards. In its role as the WMO-GAW Quality Assurance – Science Activity Centre for Ozone profiles, Belgium oversees the data quality of the entire ozone sonde network, in collaboration with the panel for the Assessment of Standard Operation Procedures for Ozone Sondes (ASOPOS). On a regular basis and in conjunction with the Research Centre Jülich, Belgium will organise ozone sonde intercomparison campaigns in the simulation chamber in Jülich. . To ensure data availability and archiving, Belgium also represents the ozone sonde network within the Network for the Detection of Atmospheric Composition Change (NDACC).

LIDAR measurements

Up to now, Belgium has operated an automatic LIDAR-ceilometer (ALC) network in Belgium, consisting of 5 ALC (CL51 VAISALA) located in its synoptic station network at Uccle, Zeebrugge, Humain, Diepenbeek and Arlon. Each ALC operates up to 15 km with a vertical resolution of 10 metres and a temporal resolution of 6s. The ALC data are recovered every five minutes. With its high sensitivity, the ALC network offers the opportunity to monitor the cloud base height, the early stage of radiation fog formation, the vertical profile of aerosols and the mixing layer height on a continuous temporal scale. Its activities are not only of benefit to aviation, but also to weather forecasters (especially when predicting fog), to the monitoring of air pollution dispersion and to the monitoring of the aerosol clouds such as volcanic ash cloud.

In the context of the development of a coordinated system for ALC observation in Europe, Belgium is involved in European projects aiming to make available the measurements of its future ALC network to the European meteorological community in near real time. In EUMENET, Belgium (member) participates in the E-PROFILE programme to develop an operational ALC network by exchanging ALC data in a standard format and by maintaining an archive of communicated data and metadata for all systems connected to the networks.

Aerosol measurements

At its site, Belgium currently operates two aerosol in-situ instruments: the aethalometer and the nephelometer. The multi-wavelength aethalometer (MageeSci. AE31) measures the aerosol absorption coefficient at seven wavelengths (370, 450, 520, 590, 660, 880, 950 nm) and the mass concentration of light-absorbing aerosol at those seven wavelengths. It has been operational since 2014. The nephelometer (TSI model 3563) measures the total scattering coefficient and the backscatter coefficient at 450, 550 and 700 nm. The instrument will be put in operational mode in 2022. In addition to these two instruments and in the context of ACTRIS, Belgium will install a mobility particle sizer, an aerodynamic particle sizer and a total particle counter in 2022/23. The data of these instruments will then be incorporated into the EBAS and ACTRIS data repositories, with respective data quality control and assurance.

8.2.2 Ocean climate observing systems

Belgium has two National Oceanographic Data Centres:

- http://www.bmdc.be/NODC/index.xhtml
- https://www.vliz.be/en/data-centre-division

Belgium's marine data centres are actively involved in making their data FAIR and accessible through portals such as EMODnet (whose secretariat and central portal is supported by Flanders and the Flanders Marine Institute VLIZ).

Both the RBINS and VLIZ operate observation systems in the context of the EU Research Infrastructure ICOS ERIC (Integrated Carbon Observation System) with three ocean stations: These stations measure ocean surface water and atmospheric CO_2 concentrations, along with a variety of additional parameters (pH, turbidity, temperature, etc.).

- Thornton: a buoy (hosted by VLIZ)
- Simon Stevin: a research vessel (hosted by VLIZ)
- Belgica: a research vessel (hosted by RBINS)

The R.V. Belgica is equipped with an Autonomous Underway Measurement System (AUMS), which operates like a Ferrybox and measures several variables on a permanent basis (pH, dissolved oxygen, salinity, temperature) and others discontinuously but frequently (flushing, sampling, adding reagents, measuring, cleaning in a ca. cycle): nutrients, but soon also Total Alkalinity (TA) and Dissolved Inorganic Carbon (DIC), as these parameters were optimised on a Continuous Flow Analyzer and will be brought to accreditation.

A pCO_2 sensor is to be installed as well and measurements will be cross-calibrated with lab measurements to achieve optimal performance. The results will be expanded with other information on primary production, as this process has a profound impact on the dissolved inorganic carbon.

On board the R.V. Belgica, a space is available suitable for air sampling, but it still is under discussion about the most effective way to enable this to become part of the sampling routine.

With regard to sea level data, it is notable that in the context of GLOSS (https://gloss-sealevel.org/) and on behalf of the UNESCO Intergovernmental Oceanographic Commission (IOC), the VLIZ operates the 'real-time' Sea Level Station Monitoring Facility that includes GLOSS core stations (http://www.ioc-sealevelmonitoring.org/index.php). This provides a web-based global sea level station monitoring service that can be used in order to view sea-level data received in real-time from different network operators primarily via the GTS, but also by means of other communications channels. The service provides information about the operational status of GLOSS stations by carrying out a quick inspection of the raw data stream. The sea level station monitoring system also runs a web-service for direct data access. The sea level station catalogue system developed and maintained at VLIZ links sea level station metadata repositories.

8.2.3 Terrestrial climate observing systems

Land Surface Heat Fluxes

As part of its involvement in the Land Surface Analysis and Climate Monitoring SAFs of EUMETSAT, Belgium has contributed to the development of Climate Data Records of land surface heat fluxes (which is a new GCOS ECV). BELSPO FF contributed to this activity by providing PRODEX funding.

Seismology-Gravimetry

The Operational Directorate Seismology-Gravimetry of the Royal Observatory of Belgium monitors time-varying gravity continuously at two sites in Belgium, using superconducting gravimeters. This makes it possible to carry out research into the hydrological cycle and, in particular, into evapotranspiration, the groundwater mass balance and the long-term climatic effects on gravity. Concurrently, it uses two other geodetic techniques, GNSS and PSInSAR (Persistent Scatterer Interferometry), to investigate the hydrological loading that deforms the Earth's crust or vertical land movements caused by groundwater withdrawal. It also uses the GRACE satellite data for investigating long-periodic mass changes at the continental and global scales.

Ground-based UV-VIS solar global irradiance

As part of its involvement, which began in the 1990s by participating in European projects (CAMSSUM, SUSPEN, EDUCE, SUVDAMA, PAUR II, QASUME, ...), BIRA-IASB developed a 6-station network for the climatology of the ground-based UV-VIS solar global irradiance (including UV index measurements).

This network is currently being upgraded to improve the quality assurance of systematic solar observations, in close collaboration with the World Radiation Center and EURAMET (by means of a contribution to the new project 21GRD02/v17 BIOSPHERE: Green deal - Metrology for Earth Biosphere).

Weather Radars and Lightening Detection

Belgium operates 4 weather radars and a lightning detection network. These systems allow observation and nowcasting of precipitation and thunderstorms and are mainly used for operational meteorological and hydrological services.

Lightning data have been produced and archived since 1993. Weather radar data have been available since 2002. The quantity and the quality of the data have progressively increased such that in 2022, the network provides excellent coverage of the entire territory of Belgium. Such long-term datasets can be used in climate studies, for example to characterise the occurrence of severe rainfall events and thunderstorms. Belgium regards guaranteeing the continuity of these observational data as an essential mission.

Climatological Stations

In Belgium, the official climatological network started in 1870s. Mainly relying on volunteers, the main climatic information collected over time are the daily precipitation amount (RR) and the daily maximum (TX) and minimum (TN) temperature. RR, TX and TN, for the previous 24 hours, are recorded at 8.00 am local time. The network currently counts about 170 thermometric stations (including 70 automated stations) and 200 pluviometric stations (including 33 automated stations) and is completed by 110 automated rain gauges from regional observation networks. As a result of the Minamata Convention on Mercury, the network is transitioning away from the use of mercury-filled thermometers and temperature measurements are progressively being automated. Forty-three additional automated rain gauges that form part of a regional observation network are expected to be taken into account for the production of data quality-controlled, gridded products in the future.

Thanks to recent digitisation projects, RMI has undertaken the digitisation of the climate observations carried out since 1880 in the Belgian climatological network. Exploitation of these data has made it possible to establish quality-controlled and homogenised thermometric and pluviometric series for several places in the country. As

far as temperature is concerned, the reference series consists of 46 long series covering the period 1954-2019 and 13 historical series starting before 1931, including 8 covering the time period 1880-2019. In the case of precipitation, 110 reference series have been produced for the period 1951-2019 and 18 series starting before 1912, including nine covering the time period 1880-2019. A new/updated set of reference climate series is expected to be produced in the forthcoming years.

Automatic Weather Stations

In the 1990s, Belgium started to replace its conventional "manual" meteorological network with Automatic Weather Stations (AWS). Belgium currently operates around fifteen fully equipped synoptic AWSs that perform a complete set of meteorological observations. These deliver high-quality information (known uncertainty) and robust communications (little to no downtime) on which users can rely. They provide accurate and quantitative climate data based on meteorological observations.

Weather observation data are currently used for the real-time preparation of weather analyses, forecasts and severe weather warnings, for the study of climate, for local weather-dependent operations, for hydrology and agricultural meteorology, and for research in meteorology and climatology. All these applications need these high-quality measurements to be carried out.

Copernicus-related activities

With regard to terrestrial climate observing systems, Belgium is responsible for the following Copernicus-related activities:

- Terrascope, which is the Belgian Collaborative Ground segment to ESA, provides data quality control, analysis-ready data, value-added products and services, in addition to a wide range of Copernicus Sentinel data.
- Development, operational generation and quality control of bio-geophysical parameters and 100 m Land Cover maps in the context of the Copernicus Global Land Service component, including dissemination activities.
- Development, operational generation and quality control of bio-geophysical parameters in the context of the Copernicus Climate Change Service component, including dissemination activities.
- Leadership of the ESA CCI VEGETATION parameters project to define the next generation biophysical parameters (LAI - Leaf Area Index, FAPAR - Fraction of Absorbed Photosynthetically Active Radiation), including implementation and long-term processing over multiple different sensors.
- Quality control, distribution and long-term preservation of the SPOT-VEGETATION, PROBA-V time series, including continuity with Sentinel-3 SYN-VGT products, providing a consistent time series on Vegetation data since 1998.
- Worldcover, the new baseline global land cover product at 10 m resolution for 2020, based on Sentinel-1 and 2 data. Soon to be completed with the 2021 version of the Worldcover map.
- Worldcereal, the development of an efficient, agile and robust EO-based system for timely global crop monitoring at field scale.

8.2.4 Cryosphere climate observing systems

Princess Elisabeth Antarctica research station (PEA) – Aerosol in-situ measurements

Since 2010, Belgium has operated several instruments for the purpose of carrying out atmospheric aerosol in-situ measurements at the Belgian Princess Elisabeth Antarctic research station. The station is situated in Eastern Antarctica (71.95° S, 23.35° E, 1390 m ASL). The following instruments are installed: a multi-wavelength aethalometer measuring the aerosol absorption coefficient at seven wavelengths (370, 450, 520, 590, 660, 880, 950 nm) and the mass concentration of light-absorbing aerosol at the seven wavelengths (operational since 2010); a nephelometer (Ecotech Aurora 3000), measuring the total scattering coefficient at 450, 525 and 635 nm (operational since 2012); a condensation particle counter measuring the total particle number(operational since 2012); an optical particle sizer measuring the particle number size distribution (operational since 2012) and a TEOM-FDMS, measuring the total particle mass concentration (operational since 2011). All instruments are regularly calibrated.

Princess Elisabeth Antarctica research station (PEA) – Ozone, UV, radiation and radio soundings

Belgium operates one ground-based Brewer UV spectrophotometer at PEA (Brewer#100 since 2011). It measures the total ozone content of the atmosphere, applying the measurement principle of differential absorption of solar light by ozone in the UV (between 280 and 330 nm). Brewer@100 is only operational during the austral summer (November to February) since PEA is only inhabited during that time. The Brewer instrument also measures the UV irradiance and the actual UV index is derived. The instrument is regularly calibrated and the data is integrated in the EUBREWNET, WOUDC and NDACC databases.

In collaboration with the International Polar Foundation, Belgium also performs radio soundings at PEA during austral summers (November to February). The soundings started in the austral summer of 2013/2014 and have been conducted each season since then (except in 2016/17) and will be continued. The data is distributed to the GTS system.

8.2.5 Support for developing countries to establish and maintain observing systems and related data and monitoring systems

Ozone sondes in Nigeria

In collaboration with the National Space Research and Development Agency of Nigeria, RMI also plans to launch ozone sondes as well in Abuja, twice a month, from autumn 2022 onwards.

Flux towers in Democratic Republic of the Congo

As part of the European YPS project (Yangambi, pôle scientifique au service de l'homme et des forêts), which is financed by the DGD (Directorate General for Development Cooperation and Humanitarian Aid) Belgium, the University of Ghent is scientifically responsible for setting up the very first eddy covariance flux tower in the tropical forest of the Congo Basin in Man and in the Biosphere reserve of Yangambi (DRC). Once fully operational (from 2022 onwards) the CongoFlux site will deliver the first accurate and continuous data concerning the exchange of greenhouse gases in the atmosphere ecosystem that will include CO_2, N_2O, CH_4 and H_2O in the Congo Basin forest. [see chap. 6.4.1]

8.2.6 Other climate-related observation systems

Solar Radiation

Historically, but also in the present day, Belgium possesses a regional reference centre for solar radiation measurements. At its site in Uccle, there is a solar tower containing a number of solar instruments or pyrheliometers that make continuous measurements of direct solar radiation. In addition, there are pyranometers that measure the global solar radiation. This involves both direct radiation (directly from the sun) and indirect solar radiation (scattered by the atmosphere).

Through the use of reference instruments that are calibrated against the World Radiometric Reference, Belgium ensures the quality of all solar instruments that are used in its observation network.

Belgium has a Total Solar Irradiation instrument aboard the SOHO mission that has been carrying out measurements for over 25 years.

Sunspots

Belgium is hosting the Sunspot Index and Long-term Solar Observations (SILSO) World Data Center for the production, preservation and dissemination of the international Sunspot Number (SN). The SILSO is part of the Solar Influences Data Center (SIDC) and of the Solar-Terrestrial Center of Excellence (STCE).

The sunspot number series (SN and group numbers, GN) are arguably the most intensely used time series in all of astrophysics and have been identified as the "longest-running scientific experiment" [Owens, 2013]. For climate science, a record of annual mean SN number is available from 1700 to the present, while the GN is available from 1610 onwards. Both have undergone a major revision in 2015 that was the subject of a topical issue of Solar Physics [Clette *et al.*, 2016]. In a recent study [Dewitte *et al,* 2022] – see https://www.sidc.be/observations/tsi – the SN record has been used for a centennial reconstruction of the Total Solar Irradiance (TSI), making it possible to quantify the solar influence on climate change on earth since 1700. ■

9. Public awareness, education and training

9.1 Introduction

This chapter reports on the actions taken in Belgium to raise public awareness of climate change and on education and training relating to this issue. It essentially presents the activities organised or financed by the public sector, but also actions undertaken by certain organisations of civil society or the private sector that were made possible by public funds. It is therefore not an exhaustive list. Finally, a list is provided of relevant internet sites.

The latest (fifth) **public survey** was launched by the Federal Climate Change Service in 2021, in order to gain a better understanding (and how this changed since 2005) of the knowledge of the general public about the problem of climate change (such as its causes and consequences), of the subjective interpretation (urgency, government efforts, possibility of personal contribution, etc.) and of personal attitudes (the willingness of each person to do something about it).

Amongst other things, the 2021 survey indicated that climate change remains 'uppermost in people's minds': 80% of Belgians see climate change as a problem that requires urgent action. Six Belgians out of ten are convinced that the EU and Belgium must reduce their greenhouse gas emissions by 55% by 2030 and become climate-neutral by 2050. They expect better cooperation between the authorities, a coordinating role for the federal government, a 'Council of Wise Men', a climate law, etc. Scientists, authorities and the education sector are considered to be the most reliable sources of information. The results of this survey are available via climat.be/enquete and klimaat.be/enquete.

In addition, the Flemish Department of Environment and Spatial Planning (PBM division) awarded a public research contract for the launch of a **monitoring instrument to map out Flemish citizens' support for the transition to a climate neutral and climate proof society**. The basis is a hypothetical behavioural model that aims to understand and predict people's behavioural intentions and actual behavioural changes in the shift towards a climate neutral society. By carrying out a periodic survey of Flemish citizens, this support monitor aims to:

- map the current support among the Flemish population for the transition to a climate-neutral and climate-resilient society (baseline measurement).
- detect and understand variations in the support for the climate transition within the Flemish population and to identify policy-relevant segments within the Flemish population.
- detect and understand evolutions (long-term trends) in this support base.
- provide insights for target group-focused policy and communication strategies to strengthen support for the climate transition.

9.2 Raising awareness

In order to raise public awareness, activities addressing the global warming issue directly or indirectly – by making reference to specific themes such as energy savings, energy efficient buildings, environmentally friendly mobility, or broader themes such as the environment and sustainable development – are organised every year across the country. These large-scale initiatives are supplemented by more specific efforts at awareness-raising or by easily applicable practical solutions intended for certain target groups such as the young, energy managers in companies or other professional groups (architects, heating technicians, mobility managers, etc.).

In **Flanders**, the Department of Environment and Spatial Planning (PBM Division) aims to translate insights from the behavioural sciences into climate policy. In this way, knowledge is built on effective climate communication by searching, together with Flemish partners/climate communicators, for climate-related messages that will motivate the Flemish population. In cooperation with its partners, the Flemish government will test different (existing and new) climate messages to find out what kind of frames and narratives work and which ones work less well with different target groups.

RAISING AWARENESS OF GLOBAL WARMING

9.2.1 Awareness raising by the federal and regional governments

Communication from the **federal authorities** to the public is undertaken by the Climate Change Service of the Federal Public Service Health, Food Chain Safety and Environment. The cornerstone of its communication is the climate website climat.be / klimaat.be, which provides sections addressing the causes and effects of climate change, the policy put in place on an international, European and Belgian level, Belgium's emissions, IPCC reports, international cooperation, etc., along with sections devoted to federal campaigns, actions to be taken by individuals, education etc. A news section regularly draws attention to the latest developments (the results of COPs, published reports and actions taken).

A subsidiary website (climatechange.be/2050 - climat.be/2050 - klimaat.be/2050) provides information relating to the work being carried out in order to bring about the transition to a climate-neutral society in Belgium by 2050. The core of this project is the study of different transition scenarios, based on an online calculator that allows the possible scenarios and their implications to be visualised in the form of graphics. This work is being complemented by educational activities (available in English, French and Dutch): an educational "My2050" web tool (see 9.3.4) and "climate coaches" (see 9.3.5).

Since July 2019, a national website on the subject of adaptation to climate change has been available online. It provides existing information on climate change impacts, vulnerability assessments and adaptation in Belgium (adapt2climate).

The regions are also taking initiatives that are bringing the situation of the living environment in general and the data concerning climate change in particular into focus.

Flanders publishes these data in the MIRA annual indicator reports and in the online catalogue of indicators that are updated annually and accessible on https://omgeving.vlaanderen.be/mira-milieurapport-vlaanderen. MIRA also published a detailed report about what climate change means (or will mean) for Flanders and Belgium specifically in the "MIRA Climate Report 2015: about observed and future climate changes in Flanders and Belgium" (with an accompanying video summary and infographic). The English version of the report is available at https://researchportal.be/en/publication/climate-report-2015.

In the **Brussels-Capital Region**, the environmental administration 'Bruxelles-Environnement' (Brussels Environment) is continuing to publish and disseminate environmental information via its website, magazines, brochures and leaflets, by organising the annual Environment Festival (to raise public awareness to environmental issues in a festive atmosphere) and through the organisation of communication campaigns (television ads, posters, announcements in the press) on climate change, rational use of energy, promoting energy-saving investments and on ecomobility. In 2018, the Region opened a permanent exhibition space on the climate and the cities of tomorrow, which addresses the various climate issues in an interactive way for schoolchildren. This exhibition is part of an "educational continuum" that provides an opportunity to establish links with school programmes and offer activities before and after the visit (environnement.brussels/www.belexpo.brussels – see 9.3.6).

In **Wallonia**, the Walloon Agency for Air and Climate (Agence wallone de l'Air et du Climat - AwAC) makes available to individuals, businesses, municipalities and event organisers a carbon footprint calculator carbon footprint calculators, which can be used to assess one's carbon emissions in order to raise awareness of the impact of carbon emissions and to help prioritise climate actions. In 2017, the AwAC launched an online adaptation platform for municipalities. A vulnerability evaluation tool and several action sheets have been designed

to assist municipalities in developing their local adaptation plans as part of their commitment to the Covenant of Mayors.

In April 2016, the Walloon Government adopted the Walloon Air-Climate-Energy Plan. A public awareness campaign called "*Les Wallons ne manquent pas d'air*" (The People of Wallonia are not short of air) highlighted 142 measures aiming to reduce greenhouse gas emissions and other air pollutants, to improve air quality and to adapt to climate change impacts. A website was created for that purpose, containing a list of actions to be implemented by individuals, businesses, schools and municipalities. Visitors to the website are also invited to post their own initiatives. About 400 initiatives have been posted since the website was put online in October 2016. An Air-Climate-Energy summit also took place during the campaign and brought together various Walloon stakeholders to participate in thematic workshops.

Furthermore, Wallonia launched a communication campaign on the subject of our climate, "Super Héros Carbone" and "L'Agence2degrés" (a gaming project with several ranges of challenges aiming to mobilise young people to make practical and daily efforts to benefit our climate).

Wallonia is also subsidising numerous non-profit organisations in order to stimulate action by means of climate awareness campaigns.

In 2019, the Walloon Government created the "Walloon Platform for the IPCC" to facilitate the participation of Walloon scientists in the activities of the IPCC and the dissemination of its assessments to the various decision-makers and stakeholders, including citizens. The Platform facilitates the understanding of the issues and the implementation of solutions to climate change. It publishes regular newsletters, addressing many aspects of climate change, its impacts, and ways to limit how much worse it can become by covering substantive topics in the form of thematic issues.

A climate change awareness campaign started in October 2017. This campaign was mainly conducted online via social media and was mainly targeted at individuals at home, at work and in society.

9.2.2 Earth Hour

For some years, the WWF has been calling on all public authorities, cities, businesses and citizens to turn out the lights at the same time for 1 hour in the early evening on a weekend day in March to show their support for combating climate change. This awareness-raising action, known as 'Earth Hour', forms part of an international campaign launched by the WWF to combat climate change. The participants, through this symbolic action, are calling upon governments to take more action, but also to roll up their own sleeves as well.

In 2022, 192 countries and territories took part, landmarks switched off their lights and millions of individuals, businesses and organisations across seven continents stepped forward to modify climate change.

RAISING AWARENESS OF ENERGY SAVINGS AND RENEWABLE ENERGIES

9.2.3 Avoiding energy guzzlers at home: EnergyWatchers

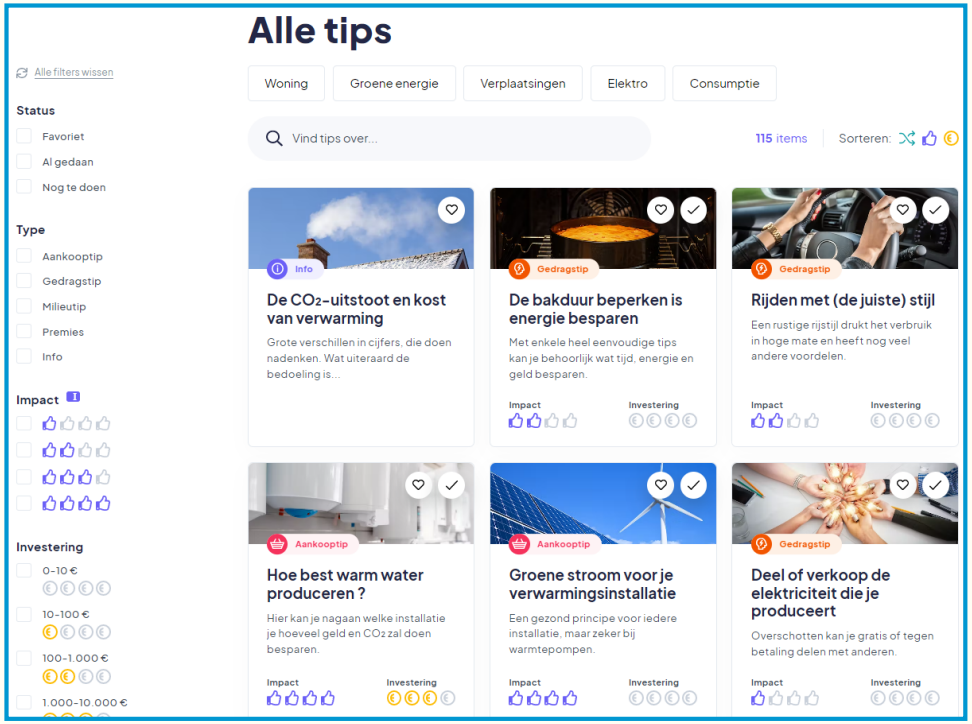
The federal Climate Change and Product Policy Services continued to invest in the website energivores.be / energievreters.be. This website, whose databases were updated monthly, contained several calculators, dealing with insulation (windows, roof, walls), household appliances, lighting and cars. It offered the possibility to make a personalised choice among all models of appliances or insulation materials available on the Belgian market, and calculated their energy consumption or heat losses, the corresponding CO_2 emissions and cost, payback time, subsidies, etc.

The website was promoted at regular intervals at public meetings (fairs) and through eye-catching advertisements showing over-consuming, big fat appliances. More information on the website and the campaign is available at climat.be/nos-campagnes / klimaat.be/onze-campagnes.

In early 2022, this website was replaced by a totally new concept: energywatchers.be, offering a wide range of practical tips and calculation modules that provide a wealth of information on the subject of reducing one's energy consumption and CO_2 emissions. Those who want to take up the challenge can win badges and share them with friends and family. The site also contains a CO_2 guide for new cars as required by Directive 1999/94/CE.

9.2.4 The TopTen website

TopTen is a website (topten.be) which allows the most energy efficient products for heating and cooling to be found quickly and easily. It offers an overview of a whole series of products (comfort fans, air conditioners, heat pumps, solid fuel boilers, local space heaters, electric water heaters, taps & showers and circulation pumps) of the most energy-efficient models on the Belgian market. The website is an initiative run by GoodPlanet Belgium vzw with the support of the Flemish Region and the European Union's Horizon 2020 research and innovation programme.



9.2.5 Energy saving investments

Some premiums are available to the public or to firms for energy-saving investments and for the installation of photovoltaic or thermal panels or heat pumps on a regional level or even a provincial and municipal level. The systems vary depending on regional policy. The Regions make 'facilitators', information desks and websites available to the public to promote these premiums.

Flanders uses several tools and campaigns to raise awareness about energy savings and to convince citizens to take action:

- The campaign 'ik BENOveer' ('I renovate better'), the aim of which is to stimulate the thorough energy renovation of existing dwellings, with a view to reaching the long-term renovation target that is necessary if we are to achieve the 2050 climate and energy goals. (www.energiesparen.be/ikBENOveer)
- The campaign 'reNUveer' ('renovate NOW'), which sets out to encourage the energy renovation of existing dwellings. Every house will need to have an A-label in 2050 in order to achieve an energy-efficient housing landscape in Flanders. The Flemish government is now making additional budget available to accelerate the construction and renovation of energy-efficient homes. (www.energiesparen.be/reNUveer).
- The campaign 'Mijn VerbouwPremie: vraag uw verbouwpremies aan op 1 plaats' (My renovation grant – a one-stop shop to apply for renovation grants), which is intended to encourage the energy renovation of existing dwellings by promoting grants for citizens and companies in order to facilitate the renovation process.
- The campaign 'Mee met de stroom: maak uw huis klaar voor de toekomst' (Following the current: get your house ready for the future), which aims to promote the use of renewable energy and campaigns against the use of fossil fuels, in order to create a sustainable and resilient society in Flanders.
- The 'Woningpas' ('house passport') is an online tool that is used to collect relevant information and documentation about a property, bringing it together on a single website in order to facilitate the renovation process of old, energy-inefficient buildings, homes and properties. Woningpas also facilitates the construction of new housing projects. (https://woningpas.vlaanderen.be)
- The tool 'Test-uw-EPC' (Test your EPC) provides an indication of the en-

ergy performance certificate (EPC) of your home. The tool also provides tips on how to improve the energy-efficiency of your home. (https://www.energiesparen.be/test-uw-epc-tool)

- A rapid online calculation tool for the most worthwhile energy-saving investments. The calculators take account of the usual investment costs, energy prices and energy premiums. (www.energiesparen.be/energiewinst)
- In 2021, all new dwellings have to be nearly zero-energy buildings. The campaign "BEN je mee" (Are you on board?) aims at convincing citizens who plan to build a new dwelling before 2021 to go beyond the current obligations and build a zero-energy building. This principle is still used in communication campaigns.
- The 'sun map': the government of Flanders conducted a thorough analysis of 2.5 million roofs in Flanders to determine whether they are suitable for solar panels and/or boilers. The results are available via an online tool that gives detailed interactive results for each roof, along with cost calculations. (www.energiesparen.be/zonnekaart)

The **Brussels-Capital Region** has undertaken similar initiatives:

- The 'Renolution' campaign to promote the renovation of homes: https://renolution.brussels
- The 'sun map' to determine which roofs are suitable for solar panels and/or boilers: www.cartesolaire.brussels

The following initiatives were undertaken by the **Walloon Region:**

- Monquickscan: this free web tool allows you to quickly assess the energy performance of a dwelling without the help of a professional. The tool provides standardised recommendations for improvements to achieve energy performance label A. To go further and obtain personalised advice and an in-depth analysis of their building, citizens can have a housing audit carried out. This provides a detailed and costed roadmap of the work to be carried out to make the building efficient by 2050.
- Since 1 January 2021, all new buildings must be near zero-energy consumption. Wallonia has named these new standards "the QZEN requirements". A campaign of the same name was carried out to promote this new regulation.
- To carry out a continuous work of information towards the citizens as well on the technical aspects as on the advantages of using renewable energies or energy savings, the Walloon Region regularly establishes media partnerships (in newspapers, on television, on radio, digital campaigns).

9.2.6 Assistance to disadvantaged groups of residents

In the **Flemish Region**, 29 organisations in the social economy are taking part in the '*Energiesnoeiersproject*' ('Energy Savers project') (www.energiesnoeiers.net). KOMOSIE vzw (the umbrella organisation for environmental entrepreneurs in the social economy) is the umbrella organisation for all these energy-saving firms. Energy Savers are low-skilled workers in the social economy who are trained to carry out energy-saving measures, preferably for socially and financially vulnerable target groups. To guarantee the necessary quality and professionalism in implementation, the Energy Savers are employed and guided by a social economy organisation: the '*Energiesnoeiersbedrijf'* (Energy-saving firm). The main activities carried out are: free energy scans, the insulation of roofs, walls and floors and the performance of a package of 'small energy-saving measures'. Major partners in the project include municipalities, public social assistance centres, building firms, provinces, distribution network managers, social rental agencies and social housing corporations.

In the **Brussels-Capital Region**, a versatile social guidance project in the energy sector, known as 'Centre d'appui social Energie', is run by the Federation of Social Service Centres. It acts as a point of reference for social workers working for associations who have questions regarding energy, with the intention of enabling them to deal with these problems and to respond adequately to the various needs of their users with regard to energy (internet site, newsletters, publications, training sessions, a telephone and e-mail helpdesk, customised support, etc.). The actions of these centres focus on vulnerable households and add a social aspect to household guidance in relation to the guidance offered by Homegrade, which is intended for the general public (see 9.2.9). The independent service "*Info GazElec*" helps people choose an energy supplier and is also relevant point of contact for any information on social measures relating to energy access.

In **Wallonia**, since 2017, the Public Social Action Centres (*centres publics d'action sociale - CPAS*) can submit projects in order to develop municipal Prevention Action Plans in the field of Energy (*plans d'action préventive en matière d'énergie - PAPE*). The PAPEs inform the public on rational energy use, consumption management and existing energy assistance and premiums. The PAPE actions also encourage individual support in three steps: the energy balance of the household, identification of possible solutions and supporting the household in the implementation thereof.

Énergie Info Wallonie (EIW) is a support service for energy consumers in Wallonia, especially disadvantaged members of the public. EIW is a project of the Walloon Network for Sustainable Access to Energy (RWADE) that is supported by the Walloon Government. EIW aims to sup-

port and inform social intermediaries and Walloon citizens free of charge on any difficulty or question relating to energy: Can a supplier claim reminder costs in the event of late payment? Should a property owner install individual meters for each dwelling? Who can benefit from the social tariff?...

9.2.7 Energy consultants

In the **Flemish Region** and with government support, energy consultants are made available to various sector federations and non-commercial organisations to raise awareness among their target groups and to inform and guide them in the field of energy-saving and renewable energy production. There are energy consultants who focus on building professionals, families, SMEs, farmers, immovable property, the tourist sector, etc.

The **Brussels-Capital Region** has set up a series of free and personalised support programmes for different audiences – private individuals, professionals, public authorities (see 9.2.9 and 9.2.10) – to meet their technical, administrative, financial or human needs in the most effective way, to support them in their efforts to reduce the energy consumption of their buildings (energy renovation and rational energy use) and to invest in the development of renewable energy sources.

Since 2009, **Wallonia** has introduced facilitators for project holders, schools, companies etc., in the field of rational energy use and production technologies. Their basic mission is to provide first-line support by telephone and e-mail and to facilitate the information flow between project holders and administrations. They also support the administrations by drawing up balances, projections, studies, surveys and lists of premium admissible materials etc. They train future auditors, support companies in their "pre-checks", offer guidance and organise sectorial practice sharing, etc.

Subsequently, according to their role, their missions become more specific:

- The facilitators specialising in rational energy use work with the industrial sector, the tertiary sector, the non-profit sector and the self-employed. They stimulate the reflection on energy consumption reduction.
- The technological facilitators (renewable energy only) are subdivided into three groups: electrical technologies/cogeneration, hot technologies and biomass. Their task, among others, is to perform feasibility pre-studies and to compute statistics for their sectors.
- The educational sector consultants make it possible to integrate energy notions into the primary and secondary school curriculum.

9.2.8 Raising awareness of energy in the agricultural sector

In **Flanders**, Enerpedia is the agricultural energy encyclopaedia. It gives answers to questions about energy saving and renewable energy relevant to agriculture. In short, Enerpedia raises awareness and advises farms about how to handle energy efficiently. They give tailor-made advice and organise demo sessions, workshops, info and study days. Enerpedia is a collaboration of 15 agricultural research centres in Flanders and all of their knowledge, study days, news on energy in agriculture and horticulture have been brought together on one website: enerpedia.be.

In **Wallonia**, different websites provide information on energy efficiency and production in this sector, and about biomass or renewable energy. The DECIDE tool is available to estimate climate and energy impacts of a farm and suggest pathways to improve it.

RAISING AWARENESS OF ENERGY EFFICIENT BUILDINGS

9.2.9 Guidance for consumers

In **Flanders**, energy advice is given by energy houses that are operated by local authorities in a large number of municipalities. Additionally, there are provincial and urban support centres for sustainable living and building. These centres are local network organisations that help to translate the principles of sustainable living and building into practice. They disseminate good examples, exchange experiences and provide information tailored to different target groups. Citizens receive information and customised building advice. Local governments receive support and advice with regard to major construction and renovation projects within their own territory. Training and information sessions are also organised for construction professionals (architects, contractors).

Introduced in the early 2000s, the main aim of the Energy info points in **Wallonia** is to provide all citizens interested with neutral, objective information and personal advice, free of charge, on energy efficiency and renewable energy sources. There are 16 Energy info points, optimally distributed throughout the region.

In the **Brussels-Capital Region**, Homegrade is a help desk to meet the need for proactive, full guidance to be given to all Brussels' households to provide specific assistance in undertaking sustainable action regarding their homes, whether in terms of behaviour, installation management or investment and finance. Homegrade offers the same services for Brussels households as the old Energy House (see their descriptions in 9.4.9 in the 6th National Communication). (homegrade.brussels)

Apart from Homegrade, Brussels Environment continues to support local and regional initiatives for the information and guidance of households, via subsidies (see the previous National Communication).

9.2.10 Guidance for professionals

Training and information sessions are organised by the **Brussels-Capital Region** for construction professionals:

Call for projects 'Be.Exemplary '

The Brussels-Capital Region continues each year to launch a call for projects to design and construct exemplary buildings in terms of energy and environment, which is receiving increasing international acclaim. The purpose of the Exemplary Buildings competition is to show that it is possible to achieve very high environmental efficiency in new or renovated constructions (for further details, see the previous National Communication).

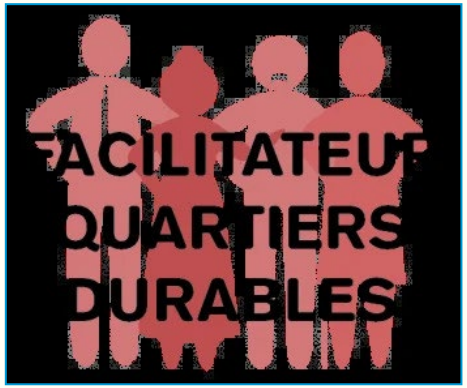
The Awareness Kit for voluntary 'PLAGE' projects

The programme 'Plan Local d'Actions pour la Gestion Energétique' (PLAGE - Local Action Plan for Energy Management', described in the previous National Communication) has been a compulsory programme since 2018 for those responsible for certain building stocks (building stock of the regional and federal administrations and large building stocks for the private sector and other public authorities). Its aim is to improve the energy efficiency of the building stock for the benefit of the environment and the finances of the institution. The Region continues to encourage organisations not subject to this obligation to set up a PLAGE on a voluntary basis. A PLAGE awareness kit is available to anyone wishing to set up a voluntary PLAGE within his/her organisation, which includes a series of action sheets to create support for these approaches.

Facilitators

The Brussels-Capital Region offers various facilitator services:

– The **Sustainable Building Facilitator Service**, which consists of a network of energy specialists recognised for their expertise resulting from the implementation of a large number of projects both in Brussels and abroad. Their task is to guide developers and building managers independently, impartially and for free with regard to the control of energy consumption, the rational use of energy and the promotion of renewable energy sources at all stages of progress of a project (more details in the 6th National Communication);



– The **Pack Energy**, which consists of a free energy coaching for small and medium-sized enterprises up to 250 FTE and for the social profit sector (non-commercial) in order to improve the energy efficiency of their building and reduce their energy consumption;

– The **RenoClick programme**, which supports the municipal and regional public authorities of the Brussels-Capital Region in the deep renovation of their buildings (such as schools, nursing homes, nurseries, offices, sports halls, cultural centres, etc.) to reduce their energy consumption.

As outlined under point 9.2.7, thematic facilitators are made available in **Wallonia** for project holders or professionals from the sectors concerned. In that way, Wallonia offers a full range of services to support industrial designers etc.

Wallonia also carried out several successive calls for tenders for the renovation of public buildings, the so-called UREBA (or exceptional UREBA) calls. The UREBA programme aims to support certain bodies willing to reduce the energy consumption of their buildings. The UREBA calls generally concern heat insulation work to walls and the replacement and improvement of heating and lighting systems.

Wallonia also grants accreditations to people fulfilling certain conditions. This concerns AMURE and UREBA accreditations. These allow the public concerned to validate the skills of the technicians they turn to. The UREBA accreditation concerns energy audits or pre-feasibility studies in the public sector, while the AMURE accreditation relates to the same activities in the industrial sector.

BE REEL! Training courses for professionals

The LIFE integrated project Belgium Renovates for Energy Efficient Living! (BE REEL!) has created several courses for professionals in Flanders, Wallonia and Brussels. For renovation advisors in Flanders, BE REEL! has created a basic training course of 15 modules to cover all the different aspects of the job and give new advisors a total package to ensure they can do their job properly. The goal was to set a baseline to ensure that the quality of renovation advice in Flanders improves. This online training was launched on 1 December 2021 and has about 250 active participants to date.

BE REEL! has also created technical courses for construction professionals and contractors. These courses are offered both in Dutch (300 participants) and in French

(200 participants). To date, there are three courses on the subject of interior insulation, humidity in buildings, and the renovation of heritage buildings. BE REEL! intends to keep all these courses up to date with the most recent changes and to add new modules if new subjects are identified.

All of these training courses are available online on the website of BE REEL!: https://www.be-reel.be/courses-en.

9.2.11 Pixii – A knowledge platform for energy-neutral construction & The Passive House Platform

Pixii - Knowledge platform for carbon neutral construction (*Kennisplatform koolstofneutraal Bouwen*) & PMP asbl (*Plateforme Maison Passive*/PMP) are two independent, neutral organisations encouraging authorities, professionals and the general public to construct buildings with very low energy requirements, based on the concept of the passive building. They distribute information (website, newsletter, brochures, calculating tools, etc.) and provide training, expert evaluations and guidance to professionals and private individuals as well as governmental organisations. Pixii and PMP are certification bodies for passive buildings in Belgium. Pixii also organises multiple Expert days and events for professionals, while PMP develops tools to help designers (the thermal bridge service and the hygrothermal service). Pixii and PMP contribute actively to establishing standards related to energy in buildings and carry out cutting-edge research (procedures and tools for high-quality energy renovations, thermal bridges, tertiary sector, life-cycle analyses, etc.). pixii.be, maisonpassive.be, ponts-thermiques.be, pmp-hygrothermie.be.

9.2.12 Energy efficiency certificates and audits

Since 2009, it has been compulsory for an energy efficiency certificate to be drawn up on the sale or renting out of housing. This certificate contains a great deal of information concerning the main energy-saving measures that are possible in the dwelling.

In the **Flemish Region**, everyone can enter their certificate score on the website energiesparen.be/testuwepc, which explains how well or how badly their dwelling scores compare to other dwellings.

In **Wallonia**, information on the audit and certification processes is available online (energie.wallonie.be/fr/certificat-peb-quoi-quand-comment.html?IDC=8787).

9.2.13 Eco-construction

The **Belgian Regions** and the construction sector have undertaken to draw up a benchmark for the labelling and certification of sustainable buildings that will quantify the sustainability of buildings in the form of thematic scores and will allow an overall score to be calculated for the building. The purpose of this labelling and certification is to put an end to 'green-washing' and to assist the general public in differentiating between buildings with genuine sustainable achievements from those where the sustainability is confined to sales arguments.

The Belgian Regions have created an interregional reference tool for the sustainability of buildings and support a common tool: the GRO. It is a tool intended for construction professionals (architects, public and private project owners, etc.) to help them design/renovate more sustainable buildings (orient, optimise and evaluate). The GRO tool will soon be accessible via gro-tool.be.

As a reminder, the **Brussels-Capital Region** also offers a dynamic support of exchange and information in the eco-construction sector (see the 6th National Communication). Special tools have been developed to keep professionals from the building sector informed about sustainable construction, such as guidebatimentdurable.brussels - gidsduurzamegebouwen.brussels.

From 2015 to 2019, Brussels Environment has been leading an EU-funded project (Horizon 2020), "Buildings as Material Banks" (BAMB). This project brought 15 partners from 7 European countries together for one purpose – to enable a systemic shift in the building sector by creating circular solutions. The project is developing and integrating tools that will enable the shift – Materials Passports and Reversible Building Design – and these are supported by new business models, policy propositions and management and decision-making models. These tools help the construction sector to take action for the climate. Reversible building design makes buildings adaptable and resilient.

In the **Flemish Region**, a transition arena that is more widely known as DUWOBO is active in the area of sustainable living and building. DUWOBO consists of stakeholders such as banks and other financiers, housing producers, the authorities, NGOs, knowledge centres and research institutes, federations and producer organisations. This very interactive platform has the task of tracing out an innovation course in the field of sustainable living and building for the next 20 years.

In the **French-speaking community**, the non-profit association Ecoconso has, for the past 25 years, encouraged environmental and health-friendly consumer choices and behaviour. Being sufficiently informed and critical to make a conscious choice regarding what you buy, and taking environment and health into account, is complex. What is the best way to weigh up whether a particular claim represents genuine qualities or is simply advertising discourse? Ecoconso has therefore decided to create a shopping guide that will serve as an effective and objective "shortcut" for consumers. Known as suivezleguide.be, its focus lies upon eco-building materials and ultimately aims to include a wide range of products from a variety of sectors. The Employment Environment Alliance in Wallonia, whose objective was to promote

the construction sector's transition to sustainable development, provided the opportunity to make this guide a reality, starting with the theme of eco-building materials.

RAISING AWARENESS AS A MEANS OF ENSURING ENVIRONMENTALLY FRIENDLY MOBILITY

9.2.14 Promotion of sustainable mobility

In the **Flemish Region**, active efforts are being made in awareness-raising and communication to bring about a change in behaviour with regard to people's choices of transport. In many cases with assistance from the public authorities, all kinds of campaigns have been devised, such as the annual Mobility Week (http://www.weekvandemobiliteit.be), car-free Sundays, citizen-science projects like Telraam (https://www.mobiel21.be/telraam) Sam de Verkeersslang (Sam the Traffic Snake) (http://www.verkeersslang.be/), projects involving car and bike sharing, the Flemish Bicycle Week, and campaigns promoting the use of public transport (bus, train and tram), etc. In addition, the Pendelfonds (Commuting Fund) subsidises projects promoting sustainable home-to-work journeys.

The **Brussels-Capital Region** continues to organise the following actions of raising awareness of mobility, already described in the previous National Communication, with a view to reducing pollution generated by road transport, to encourage alternatives to cars and to improve the environmental performance of the vehicle:

- The Bike for Brussels campaign (http://www.bike.brussels)
- Mobility Week, containing a car-free Sunday
- Campaigns on the subject of walking, shared mobility and public transport
- Projects encouraging cycling: The bike project for companies, Cairgobike for families and cycle-logistics, Bike Experience
- The car scrapping subsidy "Prime Bruxell'air"
- Guidance for schools in drawing up a school mobility plan
- The compulsory Company Mobility Plan: companies of more than 100 employees are required to organise yearly awareness raising campaigns.

Wallonia strives to achieve more sustainable mobility through numerous actions, including:

- Support to companies, schools and administrations in organising their mobility, including (among other things) the drawing up of mobility diagnoses "home to school" and "home to work".
- The implementation of a regional mobility centre in collaboration with local mobility centres in order to meet the citizens' needs in any situation.
- Promoting carpooling in Wallonia.
- Dressing and implementing the "Cyclable Wallonia Plan" (Plan Wallonie cyclable) aiming to promote the use of bikes in the educational context amongst other settings, by projects

such as “vélo éducation” and “brevet du cycliste” and by promoting the electrically assisted bike by means of a project making these bikes available to citizens for a 15-day period.

– Training mobility consultants, mobility and road safety advisers in the school environment, and company mobility managers.
– The mobility documentation centre.
– The organisation of campaigns to raise awareness on the subject of sustainable mobility, including the Mobility Week and spreading mobility information on the portal site mobilité.wallonie.be.

In 2021, **Wallonia** supported a private campaign of the Sun Trip Association called “The Sun Trip” (Solar Bikes Adventures) – promoting actions in favour of the climate, renewable energy and sustainable mobility (solar bikes). This grant aimed more specifically at supporting outstanding Belgian adventurers, and included in particular a press briefing in Seraing and a public meeting in Namur. (https://www.thesuntrip.com/ste-prologue-lyon-bruxelles).

9.2.15 Eco-driving

Training is proposed to promote a driving style that is respectful of the environment.

Eco-driving is part of both the practical and theoretical driving exam in **Flanders**. Specific courses are available for professional drivers. All professional drivers working for the Flemish public authorities or the Flemish public transport company De Lijn followed an eco-driving training and receive periodic follow-up trainings. Public transport buses are equipped with driving style meters.

In the **Brussels-Capital Region**, information stands on eco-driving are organised during events and training sessions on eco-behaviour are part of the training of bus drivers of the Brussels transport company STIB.

9.2.16 The purchase of energy-efficient vehicles

The **Federal** Climate Change Service updates monthly the database of its online **CO_2 Guide for New Cars**, enabling citizens who wish to purchase a new vehicle to compare the various models available on the Belgian market. The guide allows a quick search and lists for each model amongst others the CO_2 emissions, the corresponding category (from A to G) and fuel consumption. The guide was available via the energy guzzlers website (energievreters.be/energivores.be), but is now available on the EnergyWatchers website (NL / FR).

In the **Flemish Region**, information regarding energy consumption and vehicle emissions is disseminated by means of regular information and awareness-raising campaigns, as well as by means of training for car sellers. The Ecoscore of a vehicle (a scale from 0 to 100) gives the overall environmental score, independently of the technology, taking account of the emissions released in the fuel or electricity production and taking account of greenhouse gas emissions, air-polluting emissions and engine noise. ecoscore.be

Specific campaigns also promote environmentally friendly technologies such as electric, plug-in hybrid, fuel cell (hydrogen) and compressed natural gas vehicles. www.vlaanderen.be/milieuvriendelijke-voertuigen

Since 2018, the entire territory of the **Brussels-Capital Region** became a Low Emission Zone (LEZ). The first stage of that process means that the oldest diesel and petrol cars are no longer allowed to drive on the region’s roads. In 2030, the Region will ban diesel cars and in 2035 petrol cars, thereby encouraging the transition towards electric vehicles. A special website (lez.brussels) provides information

about the LEZ and its expected impacts on climate, and promotes alternative mobility options available in the Brussels Region.

9.2.17 Logistics consultants

In the **Flemish Region**, logistics consultants have been made available free of charge to firms. The adviser works with the company to examine the possibilities concerning co-modality, green logistics, the combining of goods flows, bulk consignment, optimising transport movements over time, etc.

RAISING AWARENESS OF THE ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

9.2.18 Corporate social responsibility

Corporate Social Responsibility is an improvement process in which businesses, on a voluntary basis, systematically and consistently include social, environmental and economic considerations in their business management, in consultation with their stakeholders (customers, staff, suppliers).

The **Flemish government** has set up the Corporate Social Responsibility Knowledge Centre (http://www.mvovlaanderen.be/) to inform and inspire businesses.

Brussels Environment organises a large number of information and training sessions on environmental themes (energy, eco-construction, mobility, etc.). The seminars, colloquiums and guided visits are intended to inform professionals about the current legislation and the latest technological developments, to pass on technical advice from specialists and feedback from other bodies and to allow them to become familiar with exemplary installations. The training is organised in cycles which take place over several months and usually end with an evaluation leading to a certificate. The training is intended for a specialised public wishing to acquire specific knowledge in the technical field.

9.2.19 Sustainable Neighbourhoods

In 2009, Brussels Environment published its first "sustainable neighbourhood memorandum" for the **Brussels-Capital Region**, in order to identify the key questions for the design of an exemplary neighbourhood from a sustainability point of view. In 2017, in order to better integrate this approach into the practices of designers, project owners (public and private) and urban planning and planning and urban development administrations, Brussels Environment launched a new process involving the collaborative construction of a Brussels repository of sustainable districts. This collaborative approach between several administrations made it possible to put the besustainable.brussels platform online in 2019. In 2020, the Government took note of this toolbox and asked its administrations to use these tools for all major urban projects. With the help of a sustainable neighbourhood facilitator, Brussels Environment has organised numerous training sessions, visits, events, and project guidance. Little by little, new sustainability clauses are also being taken into account in the context of public contracts, in order to put these new ambitions for more resilient, more united, more circular neighbourhood projects into practice.

In the **French-speaking Community**, « Streets in transition » (« Rues en transition ») are groups of 6 to 10 people/families, living on the same street. Participants choose low-cost, easy-to-implement actions in order to reduce their bills (energy, water, fuel,…) and their ecological footprint. The support of the group creates an enthusiastic and effective dynamic. An individual street is an accessible level on which to bring about change. Recreating social ties with our neighbours helps people to break out of solitude and put an end to individualism, thereby making a first step towards better living in our neighbourhoods. www.ruesentransition.be

Wallonia co-funds dozens of projects in collaboration with other countries/regions and with Europe (structural funds). Projects such as CAN (Climate Active Neighbourhoods) aim to allow renovation in deprived neighbourhoods, or ACE-retrofitting (Accelerating Condominium Energy Retrofitting) aiming at lowering the normative barriers in order to increase energy renovation in co-owned buildings.

In **Flanders**, the Department of Environment and Spatial Planning, the Flemish Energy and Climate Agency and the Flemish Government's Architect Team have developed the Climate Districts (*Klimaatwijken*) project. These projects aim to integrate various renovation, climate and sustainability targets on a local scale. A multidisciplinary research team assists by providing expertise on design, energy, local participation, real estate, financing and legal knowledge.

9.2.20 The 'Eco-dynamic Entreprise' label and 'Resilient coaching'

The 'Eco-dynamic Enterprise' label (*Entreprise éco-dynamique / Ecodynamische onderneming* - coordinated by Brussels Environment) is a regional public certificate conferred upon organisations (companies, associations, administrations), which voluntarily undertake to implement an environmental management system based on the principle of ongoing improvement in all aspects of the environment, including energy, mobility and the circular economy (for more details, see the previous National Communication).

The Resilience coaching is a personalised support programme offered to VSEs and SMEs in Brussels so that they can integrate sustainability and circularity into their core business.

9.2.21 Youth empowerment and the voice of youth

There are several organisations in **Flanders** bringing together young people to become change agents or/and to capture and transmit the voice of children and young people on topics such as climate change to Flemish and international policy makers.

The Flemish Youth Council is the official advisory body of the Flemish Government on all matters concerning children and young people. This organisation has issued advice on several occasions on climate policy. These recommendations always are the result of an extensive participatory process.

Act4change (https://www.act4change.be/) brings young people (18-35 years) together to become change agents of a sustainable world through peer learning and strengthening their ESD-competences. Globelink (https://www.globelink.be/) is an organisation that works with young people in their free time to set up projects from a global, sustainable perspective, an example of which is the Road to Glasgow.

The *Forum des Jeunes* is the official representative body of young people in the **Wallonia-Brussels community**, recognised by decree, to whom the governments can address requests for official advice regarding young people. Following surveys amongst young people, it has published official advice on topics such as food transition, young people and climate, the experience of young people in the pandemic and environment courses in the school curriculum. These opinions and surveys are usually supported by workshops offered to schools and youth organisations across the French-speaking community. They also represent the voice of young people at international conferences, such as the COP Climate Change Conference.

9.2.22 HERA Programme

In **Wallonia**, thanks to the support of AWAC, the Foundation for Future Generations has been running an education and support programme for students in higher education for two years. This concerns students in their final year of a master's degree programme and beyond, at the start of their professional life. The objective is to select and support initiatives that are part of a new low-carbon economy. This support can relate to end-of-study work (HERA programme) or to prototypes thought up by student entrepreneurs. The assistance takes the form of financial support, assistance with promotion to the general public and networking via a nascent Alumni Community.

9.3 Education and training

Educational projects and policies

In Belgium, education comes under the jurisdiction of the Communities: the French, Flemish and German-speaking Communities.

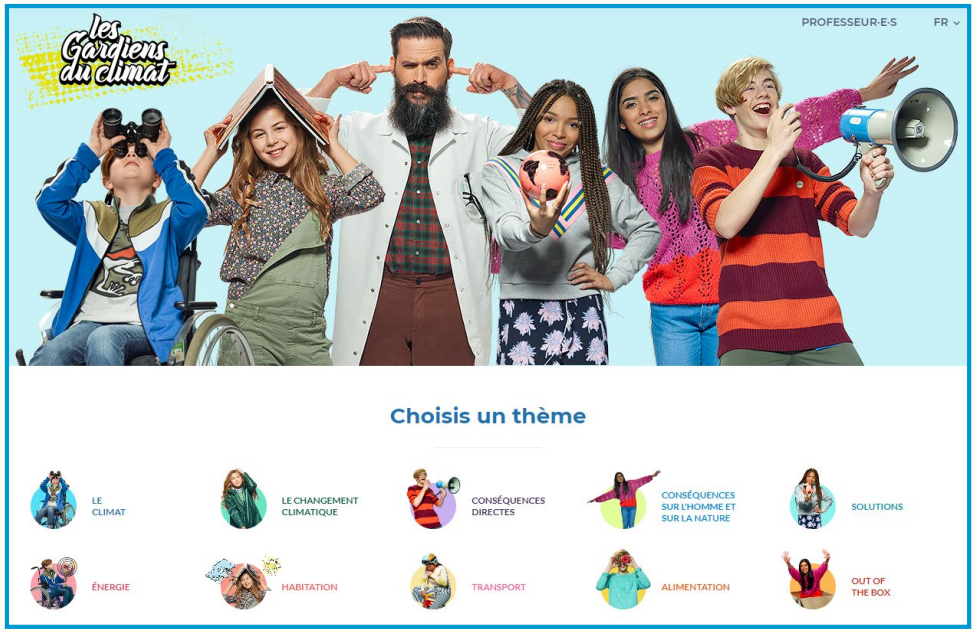
In the official primary and secondary education system, the theme of climate change is generally treated in a transversal manner, incorporated into the broader programmes relating to nature and environment, sustainable development or sciences. Nature and environmental education are now firmly embedded in the different Belgian educational systems. The pedagogical objectives are based on four stages: discovery, understanding, assessment and action.

Some education for sustainable development activities, both inside and outside the school, are conducted by a growing number of actors within society.

9.3.1 Climate education websites

In 2019, the **Federal** Climate Change Service and the WWF launched an interactive educational platform: klimaatopschool.be / ecoleduclimat.be. Through 10 themes, it offers lesson materials, quizzes, multimedia, practical assignments, etc. explaining the causes and consequences of climate change and focusing on solutions. The platform contains two websites with similar content, each aimed at a different age group:

- klimaatbrigade.be / gardiensduclimat.be (10-14 years): The teachers get their own section containing background information on the themes, lesson objectives, related educational objectives and ready-to-print documents. The icing on the cake is that the teacher can create sets of exercises per theme and will automatically receive the results on her/his screen as soon as the students complete these exercises.
- climatechallenge.be (15-18 years): It is a remake of a website that the project partners launched together a few years earlier. It focuses more on the social dimensions of the north-south problem that is linked to climate change. This website also contains an "administration section" for teachers.



In 2020, the first year after the launch, klimaatbrigade.be / gardiensduclimat.be has been visited more than 21 000 times, and climatechallenge.be almost 35 000 times.

In **Flanders**, Klascement is an educational resources network for teachers and educational organisations, managed by the Department of Education and Training. MOS Flanders screens, bundles and shares educational resources on climate change (amongst other sustainability topics) through that platform.

9.3.2 Climate workshops in school

In order to help pupils of the third grade of primary schools and the first grade of secondary schools (10-14 years) to discover the causes and consequences of climate change in an active way, climate scientists from the universities of Antwerp and Liège have worked out scientific experiments adapted to this age group. Interested schools can apply by sending an original and convincing slogan. A climate scientist will then visit the selected schools, offering two-hour workshops. These workshops are part of a broader partnership between the Federal Climate Change Service and the WWF and are offered free of charge thanks to funding from the federal government. The project started in September 2018. By June 2022, 115 workshops had been organised, which is less than originally planned due to COVID-19.

9.3.3 "Climate Challenge @ School" conferences

The Federal Climate Change Service, WWF and Studio Globo (a North-South NGO) launched the idea of organising climate conferences on school premises. During these events, pupils simulate international climate negotiations. They are assigned a country in advance which they have to represent during the meeting. The preparatory work in class allows them to discover the economic, ecological and geographical situation of "their" country and to obtain a good insight into the challenges at stake in the negotiations they will be conducting.

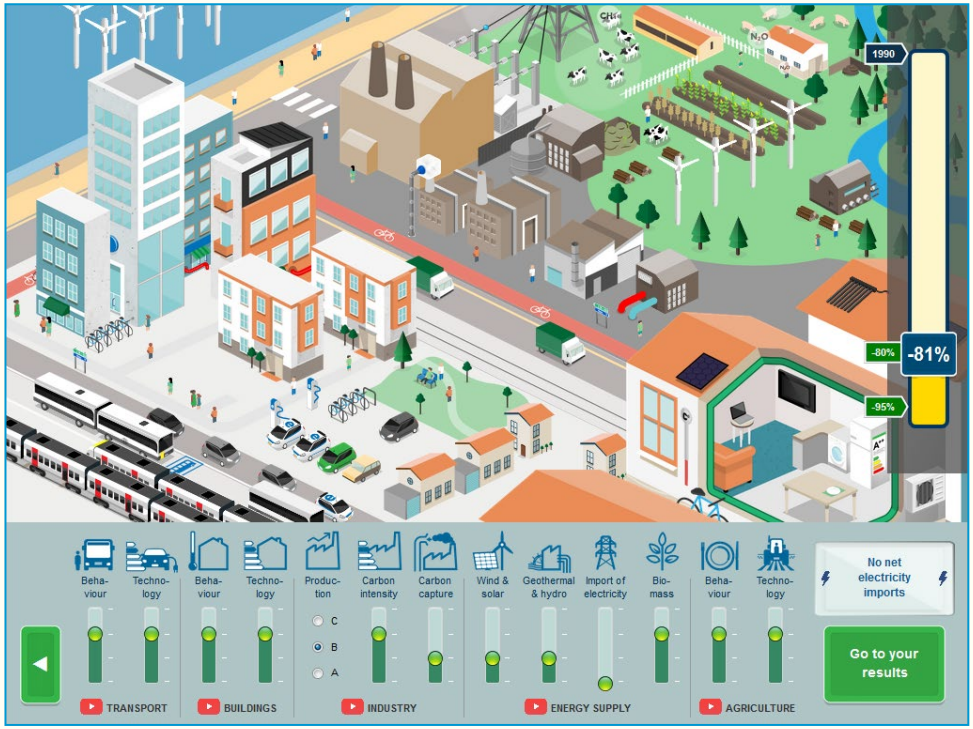
After this preparation period, the representatives from the different (types of) countries meet around the table to reach an agreement on 3 concrete resolutions in the field of aviation, food and a general climate agreement. In the course of the discussions, views are put forward, amendments drawn up and alliances are formed between countries. A fascinating experience in a realistic setting that aims to make young people reflect on climate issues. Between September 2018 and June 2022, some 80 conferences were arranged, which is less than originally planned due to the COVID-19 pandemic.

9.3.4 The My2050 web tool

This interactive educational web tool (www.my2050.be), launched in October 2016, aims to encourage a debate with all citizens – and pupils of the 3rd grade secondary (aged 16-18) in particular – on how we can make our society evolve towards a low-carbon society by 2050.

My2050...

- provides an insight into possible changes in transport, buildings, industry, energy supply and agriculture.
- allows users to develop their own transition scenario by selecting an ambition level for the various "levers" in these sectors. Each choice is immediately visible, as it initiates a change in the virtual landscape.
- immediately calculates the emission reduction of this scenario for Belgium in 2050.
- analyses this scenario with regard to emission reductions, energy demand and net electricity import and export, and also calculates its costs.
- provides clear information through 7 video animations and an info sheet for each lever.
- provides the teacher with a manual to optimise the use of the tool in class.
- provides the possibility to save, compare and share one's scenario.



Available in English, French and Dutch, "My2050.be" is an initiative of the Federal Climate Change Service in collaboration with Climact (calculation model), Climate Media Factory (web tool development), Cronos/Legioen (animations) and the WWF (manual for teachers).

9.3.5 Invite a climate coach into your (secondary) school

In order to promote the My2050 web tool (see previous item) and to help teachers and students use it in class, the Federal Climate Change Service sent out a dozen of "climate coaches" in 2017. These climate coaches (young university graduates or young professionals) were selected, trained and managed in collaboration with the partner organisation GoodPlanet Belgium.

As of early 2017, teachers in secondary schools (3rd grade) can invite climate coaches into their classroom. The coaches encourage them to get an understanding of the challenges in different sectors, discuss possible ambition levels of behavioural or technological changes in these different sectors, and evaluate the results of their preferred transition scenario. This personal coaching also aims to "teach the teacher", allowing them to use the web tool independently afterwards.

Between February 2017 (the start of the project) and June 2022 (the end of the

2021-2022 school year), approximately 1 350 sessions were given (free of charge) and attended by about 25 000 students. In the last 2 school years, the number of sessions dropped due to the COVID-19 crisis, but the situation has recovered. This project will be pursued.

9.3.6 Belexpo – Wanted: Climate Heroes

"Your mission? Change the city! Equipped with a digital bracelet, you will carry out missions for a better life in the city." The **Brussels** initiative BELEXPO offers visitors an interactive adventure trail covering 750m². It invites young people, their teachers and their families to think in a fun and positive way about lifestyles that reduce emissions and adapt to climate change: mobility, food, housing, consumption, work, green spaces, etc. The digital bracelet compiles the results. An assessment of the visit is made available on the basis of the results, and teachers have the opportunity to use them for educational purposes. The visitors are led by a team of climate coaches. Belexpo has been open since September 2018 and welcomes 20 000 visitors per year.

9.3.7 Training for teachers

The Regions and Communities support in-service training for teachers on climate issues. These are delivered by expert associations such as APERe (now Energie Commune), COREN and GOODPLANET. The training courses focus on understanding climate and energy issues and on effective teaching techniques and tools to raise pupils' awareness.

In the **Brussels Region**, 3 to 4 training sessions take place annually and bring together about twenty teachers each. The region also published the following teaching books and tools about climate and energy:

- "Be smart with your phone"
- "I'm committed to the planet"
- "Memory": a memory game about good energy saving habits
- "Cost-Conso": a game about energy efficiency, 12-18 years
- "Paper casserole": a game about good housekeeping practices

- Energy saving awareness posters, late primary and secondary

9.3.8 Initiatives addressing energy efficiency in schools

In **Wallonia**, the project '*Génération Zéro-Watt'*, coordinated as of 2010 by the educational energy facilitator, strives to increase pupils' awareness by involving them in participative audits. This is a true contest, allowing an average electricity consumption reduction of 20% to 60% per educational institution. The pupils are directly involved in actions promoting both behaviour and consumption changes. In addition, this allows schools to make low-cost changes in order to improve the energy efficiency of the heating systems in their buildings. This way, fine-tuning the heating has allowed to save 10 to 20% of energy per school site over the period concerned. (https://www.educationenergie.be)

Furthermore, "Hypothèse asbl" developed several pedagogical tools that are spread and used in schools today. They are meant to increase pupils' awareness with regard to the rational use of energy, but with regard to the importance of insulation and system efficiency. (https://www.hypothese.be/index.php/projet-isolation).

From 2003 onwards, Wallonia co-funded awareness-raising workshops about the environment, nature and energy organised by "Vent d'Houyet académie", in order to make the public aware of the importance of preserving the environment thanks to rational energy use, based on a real-life field experience. (https://www.ventsdhouyetacademie.be)

In the **Brussels-Capital Region,** Brussels Environment is coordinating an offer of support for schools that combines raising pupils' awareness of climate change, an audit and simple actions to reduce consumption. A link with advice to schools via a sustainable buildings facilitator and low-level financial support has also been proposed. However, the COVID-19 crisis greatly reduced the impact and implementation of this action. Some twenty schools were supported over the period 2018-2021.

To encourage the construction of (almost) energy-neutral school buildings in **Flanders**, the project "Energy efficient school" was started. It brings together advice on energy use, heating, lighting, and ventilation/insulation specifically for school buildings. The project is managed by the Flemish Department for Education and Training.

There are several government programmes for schools to make school buildings more energy efficient, such as providing interest-free loans for installing solar panels on school buildings. In the future, more energy loans will be possible for schools which means that phased and combined investments will be possible.

9.3.9 The MOS project (Respect for the environment at school)

Duurzaam Educatiepunt is an expertise centre on Sustainability Education of the Department of Environment and Spatial Planning of the Flemish government, with programmes for formal education (such as MOS Flanders), local authorities, organisations and citizens.

"*Milieuzorg Op School*" - MOS (www.mosvlaanderen.be) is a partnership between the Flemish government, the Flemish provinces and the Flemish Community Commission. The main focus of this project lies on supporting schools to work in an integrated way on sustainability and sustainability education at school. In order to achieve this, local trajectory guidance of schools, involving the whole school community and more thematic trajectories on topics such as climate education and greening of the school yard is being offered. Apart from tailored-made trajectories, schools information and inspiration, capacity building and networking opportunities,… MOS belongs to a worldwide network of schools that are pursuing care for the environment and sustainability (www.ecoschools.global).

Specifically with regard to climate change, the MOS and the Duurzaam educatiepunt are providing a broad educational offer for schools:

- Climate trajectories for primary and secondary education
- A digital tool to calculate the CO_2-emissions of your school: CO_2-calculator
- More Educational resources on climate change, for example climate explorations around your school (bike and walking tours), climate games and workshops in the EE-centres of the Flemish government

9.3.10 Cooperation Agreement on education concerning the environment, nature and sustainable development

The 2017-2021 programme of the Walloon Region, the Brussels-Capital Region and the 'Fédération Wallonie-Bruxelles' focused on the integration of climate in the new reference systems and on in-service training for teachers. A scientific and pedagogical committee also analysed several climate-related educational tools: "*Drôle de planète*", energy notebooks and a smartphone tool. The 2021-2024 programme has been validated by the various governments and includes the setting up of a working group on energy efficiency in schools. (coopere.be)

9.3.11 Raising environmental awareness in schools

Brussels Environment continues the actions of raising environmental awareness in Brussels' schools. From 2018 to 2021, each year, 100 classes received a cycle of activities offered by Brussels Environment and organised by specialised activity leaders in order to put in place an activity that combines acquisition of knowledge with actions to improve the environment, actions involving the children or young people and coaching or training for the teachers. It aims to empower the schools. The topics are: food, vegetables gardens, energy, zero waste and consumption and biodiversity, etc., all of which are linked to climate change.

With its non-profit partner COREN, the Brussels Capital Region takes part in the Eco-Schools programme and its international label which rewards the ongoing work of schools in environmental education and environmental management. During this period, 15 schools became Eco-schools and developed their project.

Following a survey that revealed the low level of knowledge about our climate amongst young people between the ages of 18 and 20 and students from technical and professional backgrounds and the most disadvantaged young people in particular, another project has also been developed by

Brussels Environment: the verbal jousts. Young people from different classes learn to speak on a climate-related topic: climate justice, technical or political solutions, jobs, etc. The process includes work on self-esteem, knowledge of the subject, teamwork, empathy and listening skills, and public speaking. Since 2020, over 250 young people have participated in this peer-to-peer learning programme.

Finally, the network of Brussels' schools in action for the environment, denominated Bubble, enable active teachers to share and exchange their practice and experience. Meetings are organised on a regular basis (thematic meetings with deepening of the subject and discovery of educational tools, pedagogical and methodological trainings, visits to school projects, events). (bubble.brussels).

Apart from the services it offers directly, the Directorate for Raising Environmental Awareness of the **Walloon Region** is continuing its collaboration with a range of associated partners who perform specific assignments providing information and are active in the area of nature and environmental education.

The Walloon Region commissions the writing of pedagogical materials by associations that specialise in nature and environmental education. The majority of the documents are also downloadable on the site environnement.wallonie.be.

In the Walloon Region and within the framework of the campaign "Schools for Tomorrow" (*Ecoles pour demain*), the non-profit organisation COREN supports schools that are carrying out environmental actions for sustainable development. This campaign provides schools an opportunity to build and to carry out environmental actions and projects around themes such as the living environment, eco-consumption and waste management, climate change and energy saving, mobility, food waste and water management.

COREN is also supported by the Walloon Region for the "Agenda 21" school initiative, the objective of which is to help schools develop a sustainable development education strategy combining sustainable resource management, participatory dynamics and the education of young people in the area of sustainable development. The "Agenda 21" approach is based on a series of clear and precise steps, the fundamental components of which are the constitution of a steering committee, the realisation of a diagnosis, the drawing up of an action plan and the planned evaluation of the approach's implementation. If the school meets all the requirements stipulated in the specifications, a label is awarded. It recognises the dynamic that has been put in place and promotes the approach as well as all the actions carried out.

In 2013, AwAC and the '*Journal des Enfants'* have worked together to publish a dossier on climate for pupils in years 5 and 6. The kit is composed of 6 booklets illustrating 6 major climate themes (What is climate?, Climate variations, How our climate is changing, Climate change in the world, What can we do to save the planet?, From fossil fuels to renewable energies). Each is composed of short texts illustrated with photos and diagrams, providing a summary of the information on these themes. The 7th booklet offers educational games (crossword puzzles, true or false, crafts, etc.).

In Wallonia, the non-profit organisation La leçon verte A.S.B.L., supported by the Walloon Agency for Air and Climate, launched in-school workshops in order to increase climate and environmental awareness and educate young children (elementary and primary school). Indeed, at La Leçon Verte, they have been convinced for 24 years now that the climate issue is a priority. They offer activities around different subjects linked to climate to pupils in around fourteen classes a year and aged 6 to 12 years. The knowledge about the concept of global warming is limited. The purpose of our activities is to fill the knowledge gap, to raise awareness about the diversity and fragility of our environment and to put pupils into action, so they can take the best decisions for our planet.

9.3.12 The network of Regional Centres of Initiation to the Environment (CRIE)

Alongside their normal tasks as a public service for information, awareness-raising and nature and environmental education, the 11 regional environmental initiation centres (*Centres Régionaux d'Initiation à l'Environnement – CRIE*) of the Walloon Region provide an activity-based methodology and didactic scientific material

for the general public. Their main activities include activities in schools, training courses, activities for families and holiday courses.

9.3.13 Ener'jeunes

Ener'jeunes is an operation intended for 10 to 12-year-olds who are members of a Children's Town Council. Objectives: to make young people aware of sustainable development and invite them to set up projects on the subject within their municipality.

9.3.14 Idea Network

The Idea Network (Réseau IDée, for "Information and Diffusion about Environmental Education") is the main centre of information for nature and environmental education (EE) within the French-speaking part of Belgium (**Wallonia and Brussels**). The network now has more than 120 member associations and its main objective is to inform and strengthen ties between all actors involved: teachers and educators at all levels, community education workers, parents, environmental advisers, etc.

All parties involved are offered a wide range of pedagogical tools, a documentation centre, a database, internet sites and personalised support. Réseau IDée also organises exchange meetings and reflection days. It promotes the strategic positions of EE through dialogue with public authorities. It prioritises people who regularly offer activities and tools to raise awareness of the interdependence between environment, social progress and economy. Its magazine "Symbioses" is also sent to all French-speaking schools in Wallonia and Brussels.

Several editions have a link with climate:

- no. 132/2021 - Floods: understanding and acting
- no. 131/2021 - Mobility: changing habits
- no. 130/2021 - Daring to ask lively questions
- no. 124/2019 - Climate demonstrations, and after?
- no. 122/2019 - Educational paths to transition
- no. 120/2018 - What place for emotions?
- no. 116/2017 - Migration

9.3.15 GoodPlanet

Since 2018, the GoodPlanet Climate Programme has developed a variety of projects. Since 2020, it has organised the "**Youth Parliament**" for primary schools, where children dream about a better place to live and a world that is more respectful of the climate. After sessions of information and work on Wednesday afternoon (themes: energy, food, mobility), the students propose feasible recommendations to the decision-makers of their municipality in order to invite them to put them into practice.

Another project for primary schools is "**The Climate Kid**" (since 2018), a course composed of different workshops in which a friendly character "from the future" explains what climate change means to younger pupils and encourages them to contribute to a climate-neutral school, city or community. In this project, the organisation has encouraged the use of the "**GoodSchool Digitool**" to collect practical and concrete data and translate them into pedagogical language for children.

Since 2021 and in partnership with the FEE (Foundation for Environmental Education), GoodPlanet has organised and coordinated the "Young Reporter for the Environment", a national competition to encourage young people between the ages of 11 to 25 years to make their voice heard for the climate.

9.3.16 Going to school by bike

In the **Flemish Region**, efforts are being made to promote this campaign in the form of the campaign "*Sam de Verkeersslang*" (Sam the traffic snake) (http://www.verkeersslang.be/).

Mon école à vélo / Mijn school op de fiets is a great common challenge launched by Pro Velo for elementary and junior high school students, their teachers, school directorates and parents to maximise the use of bike during a period of 2 weeks. Already offered since 2013 in **Wallonia** with the support of the Walloon region, the challenge was expanded to the **Brussels Region** from 2016 onwards and thousands of children have already taken up the challenge. 20% of the 5th year pupils in primary schools were awarded the "Brevet du cycliste" (Cyclist's certificate), the aim of which is to make the children independent when using their bike to make a familiar journey. In addition, the project "*Objectif vélo*" (Objective bike) intends to stimulate a modal shift towards cycling as a means of travelling between home and school, which may add up to 30% of the modal share.

9.3.17 Thick Jumper Day

The *Dikke truiendag* (Thick jumper Day) initiative (www.dikketruiendag.be) was launched on 16 February 2005 – the day on which the Kyoto Protocol entered into force – under the aegis of MOS (see 9.3.9) and the Flemish Government. On that day, the heating was lowered by 1°C to remind us of Belgium's commitments in terms of reducing greenhouse gas emissions and symbolically, pupils or employees of participating companies put on warm pullovers.

The Thick Jumper Day has been organised since then every year in February. Originally, this campaign was dedicated to energy saving, but later on it was expanded to include additional climate themes such as hidden consumption, insulation, biodiversity and sustainable mobility. In addition to this broadening in content, Thick Jumper Day has also been aimed at

a broader target group since 2007. Not only schools, but also companies, associations and local authorities were invited to organise climate actions.

From 2023 onwards, the campaign will be given a new focus that is more in keeping with the social challenges of today. Thick Jumper Day will be a stimulating climate campaign that calls upon as many people as possible, from toddlers to CEOs, to set up impactful climate actions and to place them in the spotlight in a playful manner. By sharing recognisable and inspiring stories about relevant climate actions for different target groups, many people can show how they care about the climate and play their part. It calls on everyone to pay attention to the major challenges of climate change. The campaign mainly aims to lead to the creation of simple energy-saving measures which can subsequently be maintained in a structural way. MOS Flanders uses this day as start and end point for their more comprehensive climate trajectories.

This day corresponds to the Good-Planet Action '*Baisse les Watts'*, in the French-speaking part of Belgium.

9.3.18 Association for the promotion of renewable energy (REnouvelle)

The mission of "REnouvelle" (formerly the 'Association pour la Promotion des Energies Renouvelables' -APERe) is to support citizens and communities in their appropriation of energy towards a 100% renewable, sustainable and solidary system (https://www.renouvelle.be).

Recognised as a "permanent education" organisation by the Wallonia-Brussels Federation, Renouvelle conducts education and counselling on the basis of projects (campaigns, information, training, facilitators, studies of collective interest) and field activities (stands, conferences, animations), around four working areas: Prosumers, Cooperatives, Territories and Observatory.

Renouvelle brings innovation in their field of expertise by communicating with citizens in a positive and engaging way about renewable energy. Among others things, the association has had renewable energy indicators included in the weather forecast, has helped more than 200 Walloon municipalities to join the Covenant of Mayors and has created a one-stop website to invest in renewable energy cooperatives (www.coopalacarte.be). Renouvelle is also the point of reference for statistics regarding renewable energy in Belgium. With its members and partners, Renouvelle is also a network that brings together academic expertise and the specialisms within associations in Wallonia and Brussels.

9.3.19 Training for building professionals

Brussels Environment is coordinating the training policy 'City and sustainable buildings' operated by the **Brussels-Capital Region**. The aim of this policy is to develop the skills of professionals in the field of sustainable city and buildings, to enable them to achieve progress in moving the Brussels building stock and the city in general in the direction of the policy objectives of Brussels in this field. Its main priorities are described in the 6th National Communication.

In **Flanders**, training for construction professionals and other trades in the construction sector is also being undertaken and is being provided to pupils still attending secondary school, students in higher education and professionals already in the field.

HIGHER EDUCATION

9.3.20 Awareness-raising at university

In **Flanders**, colleges and universities organise regular awareness-raising actions, which include making use of the offerings of Duurzaam Educatiepunt for higher education (the **Ecocampus project)**. With this project, the Flemish Region urges colleges and universities to embed sustainability education in their education. The main focuses within the programme are:

For lecturers and authorities:

- Capacity building, such as by means of an online module on Education for Sustainable Development (ESD) in the curricula for lecturers or international conferences
- Educational resources, such as a section on ESD competences
- Tailor-made coaching pathways
- Networking/exchange

For students: encouraging students to work on ESD through support for student-led initiatives on ESD such as the Green offices, a contest for the most sustainable thesis, support for Community Service Learning. https://omgeving.vlaanderen.be/nl/hoger-onderwijs

9.3.21 Education about the Environment and Sustainable Development

In the field of Education for the Environment and Sustainable Development (hereafter referred to as EESD/Éducation relative à l'Environnement et au Développement durable, ErE DD), the Citizenship Unit of the **Wallonia-Brussels Federation** wants amongst other things to enhance, strengthen and coordinate existing initiatives. That is why it organises meetings, leads events and develops synergies with different partners working on citizens and environmental themes.

9.3.22 Summer university dedicated to climate and climate incubator

Organised by the ASBL ACTES (Acting for the Climate and the Ecological and Solidarity Transition) team, this Summer University brings together enthusiastic students each year, provides them with intensive and high-quality training in two weeks, leading to the launch of innovative projects in favour of reducing greenhouse gas emissions.

Indeed, in addition to the 18 courses and the 8 thematic debates, the University

includes the launch of 10 entrepreneurial projects which are social economy initiatives to mitigate global warming and limit its societal and environmental impacts.

To support participants who have decided to make their entrepreneurial projects a reality following the Summer University, the ASBL ACTES mobilises a network of partners who constitute a genuine "partnership incubator" that is tailor-made to help them achieve the objectives and ambitions they have set themselves. http://www.climactes.org

9.3.23 Commitment programme to reduce students' individual carbon footprint

Many universities in Belgium have established a dedicated green office, with the aim of reducing greenhouse gas emissions and incorporating broader concerns regarding sustainability into their day-to-day operations.

For example, in Wallonia, The Green Office of the University of Liège is developing a commitment programme to reduce students' individual carbon footprint by 50% by 2030, in accordance with the Paris Agreement. This programme is integrated into 4 pillars:

1. **Awareness-raising** to provide information about sustainable development, climate change and carbon footprint;
2. **Integration** to encourage students to share their opinions and ideas;

3. **Communication** to mobilise the majority of the student community
4. **Action** to adopt new low-carbon habits in the form of 30 challenges regarding housing, mobility, food, IT and shopping habits. For each **challenge**, students can see the **carbon emissions they have avoided** on their profile on a collaborative platform.

Moreover, the Green Office is creating a toolbox to help other higher education institutions to replicate the programme quickly and easily. The toolbox gives concrete points of orientation (slides and recordings of training sessions, a library of challenges, etc.) to install the four pillars. The pilot phase of the replication was a success with the twinning of two challenges in spring 2022 with partners from the Wallonia-Brussels Federation. You can also see the video (3').

INTERNATIONAL COOPERATION AND TRAINING IN SOUTHERN COUNTRIES

9.3.24 Federal initiatives

Table 9.1 provides an overview of capacity building events organised by the Belgian Federal Climate Change Service in close cooperation with the respective national entities in charge.

Belgium has supported countries in the context of the NDC Partnership since 2017. The initiative is a global coalition that aims to drive transformational climate action while enhancing sustainable development by providing support for the implementation of NDCs. In the period from 2018 to 2020, the Federal Climate Change Service provided financial support for national facilitators who play a key role in the implementation of NDC Partnership Plans.

Besides its bilateral actions, the Belgian Federal Climate Change Service also makes a financial contribution to and actively participates in multilateral initiatives and partnerships (Table 9.2).

Table 9.1 Capacity building events organised by the Belgian Federal Climate Change Service

Theme	Country / national entity	Year	Objectives
Climate finance / capacity-building	Rwanda	2019	Financing of national facilitator, in charge of operating as a liaison between the country and the NDC Partnership and coordinating the implementation of NDC Partnership Plans (https://klimaat.be/klimaatbeleid/belgisch/internationale-samenwerking/ndc-partnership)
Climate finance / capacity-building	Burkina Faso	2019	Financing of national facilitator, in charge of operating as a liaison between the country and the NDC Partnership and coordinating the implementation of NDC Partnership Plans (https://klimaat.be/klimaatbeleid/belgisch/internationale-samenwerking/ndc-partnership)
Climate Finance / capacity-building	Niger	2018	Financial support through the Belgian Federal NDC Support Initiative to develop Niger's National GHG Inventory System (https://klimaat.be/klimaatbeleid/belgisch/internationale-samenwerking/internationale-ondersteuning)
Technological transfer	Niger	2020	Support for data collection to enhance national GHG inventory of Niger Integration of F-gases in the GHG inventory system Memorandum of Understanding for data collection National GHG inventory system for emissions from energy sector
Capacity-building	Mali	2020	Capacity-building on environment and climate change for Environmental and Sustainable Development Direction and Supervisory staff of the Malian Textile Development Company Manual on climate change for the use of Supervisory staff Workshops on climate change adaptation in the cotton sector (https://climat.be/doc/mali-manueldeformation-cmdt-fr.pdf)

9.3.25 Walloon initiatives

Wallonia has developed several capacity building initiatives (events, trainings, webinars) in developing countries. The majority of these are located in Africa and are managed by Wallonie-Bruxelles International (WBI)/APEFE (Association for the Promotion of Education and Training Abroad). These include The Great Green Wall for the Sahara and the Sahel Initiative, the AWEX-WBI Carbon Offset, the Jesac: Sahelian youth for climate action) and managed by Eclosio A.S.B.L. (methodological traineeships, the development of methodological supports…), etc.

Table 9.2 Federal contributions to multilateral initiatives and partnerships

Initiative / Partnership	Contribution / period	Activities
Francophone cluster of the International Partnership on Mitigation and MRV (now renamed as the Partnership on Transparency in the Paris Agreement)	Financial and organisational contribution, in cooperation with Germany (GIZ), France (Ministry of Environment and CITEPA) and Switzerland. Since 2013.	Support for a Q&A service for francophone countries on MRV systems and GHG inventories (https://transparency-partnership.net/news/qa-service-francophone-countries-mrv-systems-and-ghg-inventories) Financing of a translation into French of an online course on the IPCC 2006 guidelines and a user manual for the inventory software (https://klimaat.be/klimaatbeleid/belgisch/internationale-samenwerking/partnership-for-transparency-in-the-paris-agreement) and financing of organisation of workshop on implementation of IPCC guidelines in 2018 (https://transparency-partnership.net/news/9th-regional-workshop-cluster-francophone)
Lusophone cluster of the Partnership on Transparency in the Paris Agreement	Financial and organisational contribution, in cooperation with Germany (GIZ), Portugal (Ministry of Environment) and Brazil (Ministries of Foreign Affairs and Environment). Since 2017.	Financing of a translation into Portuguese of the MRV manual (https://klimaat.be/doc/mrv-manual-pt-final.pdf) and financing of workshop on MRV systems in 2018 (https://transparency-partnership.net/news/lusophone-countries-discuss-transparency-and-mrv)

9.4 Sources of information on the internet

Several references have been made to websites in this chapter. A list of these and other sites is given for more information on climate change, energy savings, buildings, mobility, the environment and sustainable development, and on the main environmental actors and networks (non-exhaustive list).

GLOBAL WARMING

climat.be / klimaat.be

This federal site provides information on the causes and impacts of climate change, the policy at different levels, the situation in Belgium, recent data on GHG emissions, daily actions, campaigns, educational projects, etc. The site also includes a news section and a multimedia library.

climatechange.be/2050 / climat.be/2050 / klimaat.be/2050

A separate trilingual section highlights Belgium's transition to a low-carbon society by 2050, giving access to the results of the transition scenarios studies and their macroeconomic impacts, the calculator for experts and the educational My2050 web tool, etc.

adapt2climate.be

A national website for adaptation to climate change, making available the existing information on climate change impacts, vulnerability assessments and adaptation in Belgium.

klimaatopschool.be / ecoleduclimat.be

An educational platform on climate change, developed by the Federal Climate Change Service and the WWF, containing two websites: klimaatbrigade.be / gardiensduclimat.be (10-14 y.) and climatechallenge.be (15-18 y.). Teachers are provided with their own administration section.

my2050.be

This educational web tool of the Federal Climate Change Service aims to encourage a debate with all citizens (and pupils of the 3rd year of secondary school in particular) on how we can make our society evolve towards a low-carbon society by 2050.

energywatchers.be

This website of the Federal Climate Change Service offers a wide range of practical tips and calculation modules that provide a wealth of information for reducing CO_2 emissions. Those who want to take up the challenge can win badges and share them.

omgeving.vlaanderen.be

This official website of the Environment Department of the Flemish Government presents the policy of the Flemish administration with regard to the environment and other issues.

omgeving.vlaanderen.be/mira-milieurapport-vlaanderen

The Flemish Department of Environment and Spatial Planning provides through the Environmental Reporting Service (MIRA) provides a state of the environment and an evaluation of the environmental policy carried out so far, executes projections and regularly publishes indicator reports, research reports, news items, etc. It also published the "MIRA Climate Report 2015: about observed and future climate changes in Flanders and Belgium".

energiesparen.be

The official website of the Flemish Energy and Climate Agency (VEKA), which presents the policy of the Flemish administration with regard to climate and energy. It includes information on climate policies, policy progress reports as well as information on greenhouse gas statistics.

vmm.be

The website of the Flemish Environment Agency (VMM) includes information on the impact of climate change on Flanders as well as information on climate adaptation.

leefmilieu.brussels/het-leefmilieu-een-stand-van-zaken/volledige-versie/klimaat / environnement.brussels/lenvironnement-etat-des-lieux/en-detail/climat

These webpages of Brussels Environment describe the evolution of the climate in the Brussels-Capital Region, the challenges faced by the region as a result of climate changes and the main axes of Brussels' climate policy.

belexpo.brussels/fr / belexpo.brussels/nl

Belexpo is the website about the permanent exhibition space "Belexpo" on the climate and the cities of tomorrow, which addresses the various climate issues in an interactive way for schoolchildren and offers activities before and after the visit and educational support for the teachers.

awac.be

This is the official site for climate and air quality policies in Walloon Region.

leswallonsnemanquentpasdair.be

This website highlights 142 measures aiming to reduce greenhouse gas emissions and other air pollutants, to improve air quality and to adapt to climate change impacts. It contains a list of actions to be implemented by individuals, businesses, schools and municipalities. Visitors to the website are also invited to post their own initiatives.

agence2degres.be

This "Agence2degrés" campaign, created by AWAC, engages citizens in action by means of a fun competition that launches missions for participants to take up to reduce their carbon footprint on a daily basis. This platform offers a certain number of challenges to achieve in order to become a Carbon Super Hero and thus rank among different honorary titles, depending on the level of ambition of the challenges achieved.

leswallonssadaptent.be

« Les wallons s'adaptent » is a platform that proposes adaptation actions and examples of actions for the Walloon municipalities.

educapoles.org

EducaPoles is the educational site of the International Polar Foundation (IPF). It aims at raising awareness among young people and the educational world of the importance of the Polar Regions and of climate change by offering adapted educational tools and projects.

ENERGY

economie.fgov.be

The website of the Federal Public Service Economy, SMEs, Self-employed and Energy provides information about its areas of competence relating to energy, including renewable energy (technologies, actors, financial regulations, legislation, statistics, links, etc.).

emis.vito.be

EMIS, the *Information System on Energy and the Environment,* is a project of the Flemish Region. This system collects and processes a wide range of information relating to energy and the environment which it divides into 4 major categories: energy figures, a guide for enterprises, environmental technology and legislation.

homegrade.brussels

In the Brussels-Capital Region, Homegrade manages an information desk which provides advice to the general public on possibilities for saving energy and for recourse to renewable energy. It also offers residential energy audits free of charge.

brugel.be

BRUGEL (standing for BRUxelles Gaz Electricité/ Brussels Gas and Electricity) is the regulator of the energy market in the Brussels-Capital Region. Its tasks include advising the public authorities on the organisation and operation of the regional energy market, verification of application of legislation and providing general information to the public.

generationzerowatt.be

The website of the project "*Génération Zéro-Watt*", pioneering energy challenges in primary schools following a proven pedagogic methodology (in French and in German).

energie.wallonie.be/

This website of the Walloon administration in charge of energy provides extensive information about energy: policy, energy offices, energy saving and building renovation methods and subsidies, brochures, specialised manuals, etc.

topten.be

This website allows the most energy-efficient products for heating and cooling to be found quickly and easily. It offers an overview of a whole series of products (comfort fans, air conditioners, heat pumps, solid fuel boilers, local space heaters, electric water heaters, taps & showers and circulation pumps) and of the most energy-efficient models on the Belgian market.

renouvelle.be (energiecommune.be)

This website of Renouvelle (formerly 'Association for the promotion of renewable energy' APERe) provides information about the different renewable sources and their production in Belgium, as well as about its projects, campaigns and educational activities promoting renewable energy, organised around four work fields: Prosumers, Cooperatives, Territories and Observatory.

ode.be

The *Organisation for Sustainable Energy* (ODE) is the central vector of information on renewable energy in Flanders to both households and to enterprises. It has a permanent secretariat that is open to the public, it publishes brochures and it monitors the share of renewable energy within overall energy consumption in Flanders.

BUILDINGS

portailconstructiondurable.be / portaalduurzaambouwen.be

Website centralising information about sustainable building, intended for construction professionals.

guidebatimentdurable.brussels / gidsduurzamegebouwen.brussels

Practical support developed by Brussels Environment with the assistance of specialised offices, intended for professionals who want to design a sustainable building or to perform a sustainable renovation of an existing building.

beexemplary.brussels

Call for projects to design and construct exemplary buildings in terms of energy and the environment, which is receiving increasing international acclaim.

bbri.be / wtcb.be / cstc.be

This website of the Belgian Building Research Institute provides information on legislation, regulations, subsidies and the procedures to follow in the matter of thermal insulation and ventilation of buildings.

renoclick.be

This site is dedicated to the sustainable energy renovation programme for the Brussels public authorities, called "Renoclick".

pixii.be

The official website of Pixii / Passive House Platform with news, backgrounding, technical information, support and tools.

MOBILITY

mobilit.belgium.be

The site of the Federal Public Service Mobility and Transport explains how the issue of mobility fits into the federal policy on sustainable development. It also makes it possible to check the level of CO_2 emissions of various models of vehicles.

statbel.fgov.be

The portal of the *National Institute of Statistics* offers all studies, numbers and statistics linked to traffic and mobility. See in particular the sections on 'mobility and the environment' and 'climate and the greenhouse effect'.

vlaanderen.be/departement-mobiliteit-en-openbare-werken

This website of the Department of Mobility and Public Works of the Flemish Region site informs the population about various aspects of the mobility issue: it contains a lot of information about the possibilities of public transport, freight traffic, travel between home and the workplace, mobility policy at the various levels of government, statistics, etc.

mobimix.be

Mobimix.be is a digital platform that offers information about eco-driving, sustainable fleet management, taxation, mobility budget and smart mobility management. It is an initiative by the Flemish Government, the Flemish Institute for Technological Research (VITO), the Flemish Foundation for Traffic Knowledge (VSV), Mobiel 21 and the Society for a Better Environment (Bond Beter Leefmilieu).

mobilite-mobiliteit.brussels

Brussels Mobility (AED - Administration for Equipment and Travel of the Brussels-Capital Region) takes care of equipment on the road network and public transport infrastructure in the Brussels Region. Amongst other things, its objectives include improving mobility, promoting public transport and integrating all users into the travel policy.

bikeexperience.brussels

The Bike Experience campaign raises awareness and encourages the staff of Brussels businesses to come to work by bike, by borrowing bikes and the possibility for those who are not yet used to cycling in town, to receive assistance from a coach who accompanies them and gives them good advice for a few days.

lez.brussels

This website provides information about the Low Emission Zone in Brussels.

mobilite.wallonie.be

Site used by the Walloon Region to publicise its policy on mobility and to inform the public about all mobility-related topics.

ecoscore.be

The method of Ecoscore allows you to measure the environmental score of vehicles of all brands. It gives an indication of the overall environmental performance of your vehicle or of the one you want to buy.

mobilite-entreprise.be

This website of the Mobility Unit of the UWE, the Walloon Union of Enterprises provides information about company mobility plans, the various means of transport, the role of 'mobility' coordinators within enterprises, teleworking, etc.

ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

vmm.be

The *VMM* (Flemish Environment Agency) is one of the public administrations charged with the task of designing and adapting environmental policy in the Flemish Region. It also reports on the quality of the environment in general and that of air and water in particular.

irceline.be

The website of the Belgian Interregional Environment Agency (IRCEL-CELINE) provides information about the quality of ambient air in the country's regions and a daily ozone bulletin based on information gathered in various measuring stations, as well as on data archives.

environnement.brussels / leefmilieu.brussels

This is the website of Brussels Environment, the administration for the environment and energy of the Brussels-Capital Region. It provides information on all environmental topics and on the actions of the Brussels Region in this field.

besustainable.brussels

This internet platform contains reference tools to support sustainable neighbourhood projects and information our existing sustainable neighbourhoods in the Brussels-Capital Region and facilitating exchanges of experience and contacts between the sustainable neighbourhoods.

environnement.wallonie.be

This is the portal of the Walloon Region for environmental questions. The 'Analytical Report on the State of the Walloon Environment' and the 'Walloon Environment Scoreboard' published each year include a specific chapter relating to climate change.

MAIN EDUCATIONAL ACTORS AND NETWORKS

klimaat.be/educatie / climat.be/education

Webpage describing the climate-related educational activities and materials developed by the Federal Climate Change Service in collaboration with different project partners.

omgeving.vlaanderen.be/nl/homepage-duurzaam-educatiepunt

Duurzaam Educatiepunt (Sustainable Education Point) is an expertise centre on ESD of the Department of Environment and Spatial Planning of the Flemish government, with programmes for formal education, local authorities, organisations and citizens.

mosvlaanderen.be

Milieuzorg Op School (Environmental care at school) is a network of the Flemish authorities, assisting schools to create an environmentally friendly and sustainable environment.

bubble.brussels

Bubble is a network of schools in action for the environment in the Brussels Region, enabling active teachers to share and exchange their practice and experience.

crie.be

Network of 11 regional environmental initiation centres in the Walloon Region, providing school animations, training courses, activities for families and holiday courses.

reseau-idee.be

The 'Idea Network' (NGO) has 120 member associations and is the main centre of information for nature and environmental education within the Brussels Region and the Walloon region.

coren.be

COREN (Coordination Environnement) is an NGO developing environmental projects and programmes in the schools of the Brussels Region and the Walloon region.

wwf.be/nl/scholen / wwf.be/fr/ecoles

The NGO WWF developed several climate related educational activities and materials for schools.

goodplanet.be/goodplanet-challenges

The NGO GoodPlanet organises several climate-related actions in schools and acts as a network for schools in the Brussels Region and the Walloon Region.

djapo.be

Djapo is an educational organisation working on sustainability topics such as climate, water, waste, and fair trade, paying special attention to the North-South relationships.

leconverte.org

This website of the non-profit organisation 'Leçon verte' ('green lesson') raises the awareness of children and adults to a greater respect for the nature and the environment.

green-office.uliege.be

The Green Office is a sustainable development platform run by and for University of Liège students. It informs, connects and supports students in the development of specific projects.

climactes.org

This is the website to promote the annual French-speaking summer university dedicated to climate and climate incubator organised by the ASBL ACTES.

The authors of the participative audits and of awareness raising actions to renewable energy:

– Emprunte asbl
http://www.empreintes.be

– Science Infuse
https://uclouvain.be/fr/decouvrir/scinfuse

– Hypothèse
http://www.hypothese.be

– La Besace
http://www.besace.be

Annexes

Annex 1. Supplementary information under Article 7(2) of the Kyoto Protocol – Correlation table

Information reported under Article 7(2)	Chapter of the 8th National Communication
National systems pursuant to Article 5(1)	3.3
National registry	3.4
Supplementarity relating to mechanisms under Articles 6, 12 and 17	5.3
Policies and measures pursuant to Article 2	4.3
Domestic and regional programme; legislative arrangements, enforcement and administrative procedures	4.2
Information under Article 10 Article 10a Article 10b Article 10c Article 10d Article 10e	 3.3 4.3 & 6.3 7.3 8 9.2 & 9.3
Financial resources	7.2

Annex 2. 5th biennial report

1 Preamble

This Annex 2 to the Belgium's 8th National Communication under the UNFCCC constitutes the 5th Biennial Report of Belgium drawn up in accordance with the United Nations Framework Convention on Climate Change (UNFCCC) biennial reporting guidelines for developed-country Parties contained in Decision 2/CP.17, and takes into account recommendations formulated by the expert review team in the context of the technical review of the 7th national communication and 4th biennial report of Belgium (FCCC/IDR.7/BEL and FCCC/TRR.4/BEL).

In line with UNFCCC biennial reporting guidelines for developed-country Parties, the information is structured as follows:

- Information on greenhouse gases (GHG) emissions and trends (Section 2);
- Quantified economy-wide emission reduction target (Section 3);
- progress towards the achievement of quantified economy-wide emission reduction targets (Section 4);
- Projections (Section 5);
- Provision of financial, technological and capacity building support to developing-country Parties (Section 6);
- Other reporting matters (Section 7).

As requested (Decision 19/CP.18 - Document: FCCC/CP/2012/8/Add.3), the Common Tabular Format (CTF) (annexed to this report) has also been input into the BR-CTF electronic reporting application.

Tabular information as defined in the common tabular format (CTF) for the UNFCCC biennial reporting guidelines for developed country Parties (UNFCCC decision 19/CP.18) has been submitted to the UNFCCC through the electronic reporting facility provided by the UNFCCC Secretariat as required by UNFCCC decision 19/CP.18.

2 Information on greenhouse gas emissions and trends

2.1 Summary information on GHG emission trends

Belgium reduced its total GHG emissions between 1990 and 2020 by 26.9%. These emissions amounted 106.4 Mt eq. CO_2 in 2020 (excluding LULUCF) and 106.1 Mt eq. CO_2 (including LULUCF).

For further information on emissions trends, please refer to chapter 3.2 and CTF Table 1.

The trends discussed below are based on the greenhouse gas emissions inventory published on 23 May 2022 on the UNFCCC website and covers the years 1990 to 2020. Global warming potentials and sector classification are based on the UNFCCC reporting guidelines under Decision 24/CP.19.

2.2 National inventory arrangements

Small changes have occurred since the 7th Belgian National Communication and 4th Biennial Report. Belgium focused mainly on the jurisdiction changes in the regions and details are provided in chapter 3.3 of NC8.

3 Quantified economy wide emission reduction target

3.1 EU target under the Convention

The EU target for 2020 has been fully described in the BR4 and recalled in chapter 4 of the NC8. Table A recalls the key facts.

Description of national targets is provided in chapter 4.1.2.

Description of the quantified economy wide emission reduction target is provided in CTF Table 2.

Under the UNFCCC, the EU and its Member States committed to achieving a joint quantified economy-wide greenhouse gas emission reduction target of 20 per cent below the 1990 level by 2020 ("the Cancun pledge"). It is therefore a joint pledge with no separate targets for Member States under the Convention. The UK remains part of the joint EU 2020 target together with the 27 EU Member States.

3.2 EU target compliance architecture

The EU has jointly fulfilled its UNFCCC target and implemented it internally through EU legislation in the 2020 EU Climate and Energy Package. In the package, the EU introduced a clear approach to achieving the 20% reduction in total GHG emissions from 1990 levels, by dividing the effort between the sectors covered by the EU Emissions Trading System (EU ETS) and the sectors under the Effort Sharing Decision (ESD). Binding national targets were set for Member States under the Effort Sharing Decision. The achievement of EU internal compliance under the 2020 Climate and Energy Package including the national targets under the ESD is not subject to the UNFCCC assessment of the EU's joint commitment under the Convention.

3.3 Beyond 2020

Chapter 4.1.2.2 of the NC8 describes the targets that the EU has already committed to up to 2030 and 2050.

On 18 December 2020, the European Commission together with Germany, which held the Presidency of the Council of the EU, submitted the first revised NDC on behalf of EU and Member States to the UNFCCC under the Paris Agreement. The submission contains an updated and enhanced target involving a net reduction in greenhouse gas emissions of at least 55% by 2030 compared to 1990.

Specific objectives for Belgium under the European legislation are also described in Chapter 4.1.2.

3.4 CTF tables

CTF Table 2: Description of the quantified economy-wide emissions reduction targets: Tables 2(a)-2(f).

Table A Key facts of the Convention target of the EU-28

Parameters	Target
Base Year	1990
Target Year	2020
Emissions Reduction target	-20% in 2020 compared to 1990
Gases covered	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6
Global Warming Potential	AR4
Sectors Covered	All IPCC sources and sectors, as measured by the full annual inventory, international aviation to the extent it is included in the EU ETS
Land Use, Land-Use Change, and Forestry (LULUCF)	Excluded
Use of Flexible Mechanisms	Possible to a certain extent under the EU ETS and the ESD
Other	Conditional offer to move to a 30% reduction by 2020 compared to 1990 levels as part of a global and comprehensive agreement for the period beyond 2012, provided that other developed countries commit themselves to comparable emission reductions and that developing countries contribute adequately according to their responsibilities and respective capabilities.

4 Progress regarding the achievement of quantified economy wide emission reduction targets and relevant information

4.1 Introduction

The EU has substantially overachieved its reduction target under the Convention, which means that its Member States and the United Kingdom have also fulfilled their emission reduction obligations. As stated in the 2022 EU GHG inventory submission to the UNFCCC, total GHG emissions, excluding LULUCF and including international aviation, decreased by 34% in the EU-27 + UK compared to the base year 1990 or 1.94 billion tons of CO_2e (carbon dioxide equivalent).

Because of the achievement of the EU target as a whole, Belgium is deemed to have achieved its target also, regardless of whether it has achieved its own target under the ESD.

However, for the sake of completeness and transparency in relation to previous BRs, we report here on Belgium's commitments under the ESD. Table B shows that Belgium, in accordance with the EU mechanisms in place, has been able to meet its annual targets by drawing on its banked surpluses from previous years as needed, without recourse to any other flexibility. The COVID-19 crisis contributed significantly to the overachieving of the target in 2020, even though the trend was rather unfavourable just before and even though the accumulated surpluses could probably have made up the shortfall. However, the recovery of emissions after the crisis puts Belgium on an unfavourable trajectory in view of the more ambitious targets expected for the coming period from 2021 to 2030 and beyond.

Table B Belgian Annual Emission Allocation for the years 2013 to 2020 calculated by applying global warming potential values from the fourth IPCC assessment report (in tonnes of carbon dioxide equivalent), Belgian ESD verified emissions for the years 2013 to 2020 and cumulative emission surplus until 2020

	2013	2014	2015	2016	2017	2018	2019	2020
2017/1471/EU	82 376 327	80 774 027	79 171 726	77 569 425	76 190 376	74 703 759	73 217 143	71 730 526
2013/634/EU	3 996 502	3 923 133	3 849 764	3 776 395	3 703 026	3 629 657	3 556 288	3 482 919
Final target	78 379 825	76 850 894	75 321 962	73 793 030	72 487 350	71 074 102	69 660 855	68 247 607
ESD verified emissions	74 264 633 (2016/2132/EU)	70 054 910 (2017/1015/EU)	72 719 520 (2017/2377/EU)	74 063 149 (2018/1855/EU)	70 824 562 (2019/2005/EU)	74 253 859 (2020/1834/EU)	72 013 554 (2021/1876/EU)	64 904 157 (2022/1953/EU)
Cumulative emission surplus	4 115 192	10 911 176	13 513 618	13 243 499	14 906 287	11 726 530	9 373 831	12 717 281

4.2 Mitigation actions and their effects

A description of policy making process is provided in NC 8 chapter 4.1.

A description of domestic and regional programs, legislative arrangements, enforcement and administrative procedure is provided in chapter 4.2.

A description of mitigation policies and measures and their effects is provided in chapter 4.3.

Information on mitigation actions and their effects on the achievement of the quantified economy wide emissions reduction target is provided in CTF Table 3.

Estimates of the impact of the main PAMs is provided in chapter 4.3.1 (at sectoral level and by gas). The total assessment of aggregated effect is provided in chapter 5.2.

Methodology for quantifying the impact of measures on GHG emissions is provided in chapter 4.1.3.

4.3 Estimates of emission reductions and removals and the use of units from the market-based mechanisms and land-use change and forestry activities

The development of GHG emissions is reported in CTF Table 4 for Belgium. As a KP Party, Belgium supplemented CTF Table 4(a)II in its 2022 submission, but not CTF Table 4(a)I. Emissions in the LULUCF sector are not included under the Convention target, therefore they are not included in CTF Table 4.

Under the compliance assessment under the ESD, Belgium did not make use of any international credits for annual ESD compliance. CTF Table 4 therefore shows keynote 'NA'.

Figures on the use of market mechanisms in CTF Table 4 relate exclusively to the Belgian part of the EU target.

In general, in the EU, the use of flexible mechanisms can take place on the one hand by operators in the EU ETS, on the other hand by governments for the achievement of ESD targets. For information on the limits and the types of international credits that can be used under the ETS and under the ESD, please see chapter 5.3 of NC8. For information on the use in the ETS please see the 3rd BR of the European Union.

5 Projections for 2020 & 2030

Information on projections is provided in chapter 5.

A summary of key variables and assumptions used in the projections is provided in CTF Table 5.

Information on updated greenhouse gas projections is provided in CTF Table 6a and 6c. Belgium did not provide CTF Table 6b as no 'without measures' scenario is available.

6 Provision of financial, technological and capacity-building support to developing-country Parties

6.1 Introduction

In 2019-2020, Belgium provided EUR 208 million of public support to developing country Parties (see CTF Table 7). This financial, technological and capacity-building support to non-Annex I Parties mainly focused on:

- Predominantly adaptation and cross-cutting activities;
- Provision of bilateral and multilateral support under the form of grants;
- Contributions mainly directed towards Africa and Least Developed Countries (LDCs);
- Contributions to climate-specific multilateral funds (Green Climate Fund, Adaptation Fund, Least Developed Countries Fund, etc.) or specialised UN agencies;
- Contributions to bilateral projects mainly directed towards African partner countries and Least Developed Countries.

At the UNFCCC conference of the parties in December 2015, Belgium announced it would contribute 50 million yearly to international climate finance. Since then, support for climate action has significantly exceeded this target. On average, Belgian climate finance amounted to EUR 90 million yearly in 2015-2020.

In parallel to its long-standing provision of public climate finance to developing countries, Belgium also supports the efforts of developing countries to implement low-emission, climate-resilient projects and programmes (i) by providing significant core funding to multilateral organisations and (ii) by mobilizing, through public means, private investments for climate-related projects in developing countries.

See also Figures 7.1, 7.2 and 7.3.

6.2 Legislative and institutional framework of climate change policies and programmes

Belgium is a federal state and, given this institutional context, several federal and regional level government departments are involved in the development and implementation of climate change policies.

Regarding the contribution to international climate finance, an internal distribution ratio was agreed to meet Belgium's announcement to contribute an annual amount of EUR 50 million in 2016-2020:

- Federal government: EUR 25 million
- Government of Flanders: EUR 14.5 million
- Government of Wallonia: EUR 8.25 million
- Government of Brussels-Capital Region: EUR 2.25 million

Since then, each entity committed to at least maintain this level of contribution, in line with the continuation of the existing collective mobilisation target for 2025, as agreed at the 21st UNFCCC COP in Paris, France.

We further refer to chapter 7.2.

6.3 Provision of international climate finance through official Development Assistance and Other Official Flows

6.3.1. Financial contributions to multilateral institutions and programmes

As a long-standing donor of climate finance, Belgium's federal and regional governments contribute to the Green Climate Fund (GCF), the Global Environment Facility (GEF), the Least Developed Countries Fund (LDCF) and the Adaptation Fund. Other contributions towards multilateral climate action are also reported in CTF Table 7a (Irena, African Climate Change fund, Climate and Clean Air Coalition). The provision of this climate-specific funding is in addition to as well as provide non-earmarked contributions to multilateral institutions and specialised UN agencies. Climate specific funding, earmarked towards a specific country, in partnership with a multilateral actor is included in CTF Table 7b (bilateral funding). During the reporting period, Belgium contributed in total 89.86 million EUR to multilateral institutions and programmes.

See also Figure 7.4.

For further details, we refer to chapter 7.3.1.

6.3.2. Bilateral and Regional Financial Contributions

In the reporting period, EUR 118 million was provided through different types of bilateral cooperation with a focus on Africa, least developed countries and climate change adaptation. The following sectors were targeted most: agriculture, water and sanitation and energy.

Belgium ensures that the resources provided effectively address the needs of developing country Parties with regard to climate change adaptation and mitigation through different means.

- Belgium focuses mainly on the adaptation needs of LDCs.
- The portfolios of bilateral programmes and projects are negotiated with partner countries to ensure that support meets their needs and reflects their priorities.
- All programmes and projects have evaluation systems and results frameworks for assessing effectiveness.

An evaluation of Belgian federal climate finance[1] found that financed interventions correspond to needs of partner countries and their populations. The use of NDC's and NAPs as a basis for cooperation on climate action can and will be improved.

See also Figure 7.5.

For further details, we refer to chapter 7.3.2.

[1] Evaluation du Programme des Micro-interventions – Projet de Rapport final (belgium.be)

6.4 Activities relating to transfer of and access to technologies and capacity building

An overview of activities related to technology transfer and capacity building can be found in the CTF Tables 8 and 9.

Capacity building and to some extent technology transfer are always an essential component of all bilateral programmes and projects. In the tables, some of the more specific examples related to mitigation and adaptation are listed.

For further details, please refer to chapter 7.5.

6.5 Methodological Approach for tracking of the provision of financial, technological and capacity-building support to non-Annex I Parties

See chapter 7.6.

7 Other reporting matters

Belgium's domestic arrangements related to self-assessment of compliance with emission reduction commitments at European and international levels, as well as the establishment of national rules for taking local action against domestic non-compliance with emission reduction targets, include:

- The special law establishing a climate accountability mechanism for increasing awareness of climate responsibility among the Regions for the building sector (see BR4, chapter 4.2.1.3)
- A right of substitution for international obligations under the UNFCCC and its Protocols (see BR4, chapter 4.2.1.4)
- The cooperation agreement of 12 February 2018 between the Federal state and the three regions on the sharing of the Belgian climate and energy objectives for the period 2013-2020, which provides the legal basis for the decisions to be taken to respect Belgium's commitments under the European "Climate & Energy Package". Chapter 2 (Section 6) of this cooperation agreement addresses regional and federal compliance rules, including the possibility for the Regions to use credits and the provision of financial compensation by the Federal state to the Regions in case of non-compliance with the objectives. The second progress report (FR/NL) on the implementation of the cooperation agreement was published on 20 July 2022. Negotiations on a new cooperation agreement for the period 2021-2030 are under way. ■

Annex 3. Description of models used

I Flemish energy and greenhouse gas simulation model

A new Flemish simulation model was developed in 2014 (and has been continuously updated since) to construct short-term projections for Flanders.

The simulation model is a projection model for energy demand, greenhouse gas emissions and emissions of air pollutants (SO_2, NO_x, PM and VOC) that covers most of the relevant emission sectors (energy sector, industry, waste, agriculture, residential and commercial buildings).

This simulation model works as a "bottom-up" type, i.e. explaining energy consumptions and emissions from activity variables expressed as far as possible in physical units, and the main determining factors of the evolution of energy demand and emissions.

The model, which includes a database on the energy consumption, emission factors, activity data and reduction effects of climate & energy and air quality policy measures, can be used in particular for:

- the construction of a reference scenario (business as usual), representing the expected future evolution in the absence of any new emission reduction policy based on expected economic and demographic evolutions;
- constructing emission reduction scenarios, based on the implementation of a combination of reduction measures;
- assessing the impact of existing or draft legislations on energy consumption and emission levels.

The model starts from reference year data:

- energy demand per industrial sector;
- emissions per industrial sector;
- large combustion plants and all electricity producing plants are included at installation level (energy consumption, electricity production and emissions);
- detailed information on the evolution of the installed power for electricity generation (including electricity import);
- a representation of the structure of the residential heating (type and age) and of residences (idem for the heating of tertiary buildings).
- The share of the emissions, per sector, that comes from processes (and is therefore not related to fuel consumption).
- For the agricultural emissions (dust, greenhouse gases and ammonia emissions coming from stables and from manure), the starting point is the number of animals (detailed per animal category and per type of stable) and the amount of manure that is spread out.

For the residential sector, projections are driven by assumptions on degree days in the future, the share of new residences and the lifetime of existing installations. Policies on energy efficiency and on eco-design are taken into account.

For industry, major assumption are the evolution of industrial activity and energy efficiency (yearly growth rate per sector), the share of CHP per sector and the service life of installations (since new installations can mostly respect lower emission levels than the existing ones). This leads to a projection on energy consumption and electricity.

Electricity demand from all sectors (including transport) is the main driver for the electricity part of the model. The model searches for the most cost optimal mix of electricity generating installations (including import) to produce the necessary electricity, taking into account different time periods (electricity demand is not equal in winter and in summer, neither during the night or during the day), based on production efficiencies and fuel cost. The model has the possibility to install additional production capacity (CCGT or gas turbine).

For all energy consuming sectors, energy consumption is translated into emission projections through emission factors (per fuel) that reflect policy (either current policy or additional measures). For industry and electricity production, current emission factors are compared to the emission factors based on policy and the lowest of both is used (installations that already comply with future emission standards don't need to realise additional reductions). For the residential sector, the emission factors take into account the use of different types of boilers and stoves.

For the agricultural sector, the predicted number of animals is multiplied with animal specific emission factors (both for the greenhouse gasses as for ammonia and dust). These emission factors are lower for the new low emission stables. The amount of manure that is spread out is multiplied with specific emission factors.

II FASTRACE[2] (Road transport in the Flemish Region)

FASTRACE is a software tool implemented by VITO to calculate spatially disaggregated emissions (online segments) from road transport for a region of interest. The output of FASTRACE is designed for use as input to urban scale air pollution models.

FASTRACE starts from a detailed break-down of the vehicle fleet on the one hand (number of vehicles per vehicle type, annual mileage per vehicle type) and from geographically explicit vehicle counts per road segment on the other hand (number of passing vehicles per road segment and the associated speed). This data is often provided by a software tool that can simulate the flow of traffic (e.g. VISUM).

The emissions within FASTRACE are estimated based on country or region specific emission factors extracted from COPERT, the software used worldwide to calculate emissions from road transport. As the vehicle speed determines the emission factor to a large extent, FASTRACE also takes this parameter into account and employs speed dependent emission factors. FASTRACE offers numerous flexibilities in calculating detailed geographically distributed emissions for road transport, both for small and large regions.

III Modelling tools in the Walloon Region

1 TIMES-Wal

A new model, called « TIMES-Wal » has been developed for Wallonia since 2016. The model is used for the first time for reporting purposes for ***WEM scenario*** (previously, Wallonia used EPM (Energy/Emissions Projection Model)). The TIMES-Wal model has been built in close collaboration between public (the Public Service of Wallonia) and private actors (ICEDD and E4SMA).

The TIMES model generator was developed by IEA-ETSAP (International Energy Agency-Energy Technology Systems Analysis Program). TIMES belongs to the "bottom-up" energy system models: it is based on a detailed technological set with associated costs and technical parameters. TIMES is an integrated model: one change in a sector can impact any other sector. TIMES is an optimisation model: it must satisfy all energy service demands and constraints while minimising the costs. In TIMES, perfect foresight (i.e. all future events within the defined temporal horizon are known) and competitive markets are assumed.

The model is calibrated in order to best reflect the energy consumption data provided in the regional energy balance and the emission inventories. For all energy consuming sectors, energy consumption is translated into emission projections through emission factors (per fuel). At this stage, the model is fully calibrated for the year 2014, and 2018 data is integrated through additional constraints, demand evolution, …

TIMES-Wal is a single region model. The interactions with other regions and countries are modelled through exogenous import and export processes. The temporal horizon is 2050.

TIMES-Wal does not include all the regional emissions. The model considers only the combustion emissions of the main regional sectors described in the model (which account for most of the combustion emissions).

For reporting purposes, specific sectoral discount rates are considered.

The energy system is divided into 7 main sectors: residential, commercial, industrial, transport, agricultural (only combustion), supply and electricity generation. The model uses very detailed regional data coming from regional studies.

Residential

The residential sector modelling is based on a comprehensive typology of buildings (20 categories of existing buildings depending on the period of construction and on the number of façades, and distinguishing between apartments and houses). For each category, building surfaces are described and net needs for space heating and hot water are differentiated.

The evolution of demand for new buildings is defined according to the expected growth in the number of households. For those new buildings, specific net needs take into consideration that new buildings are more and more efficient according to the existing regional regulation.

In addition to hot water and space heating, other energy services are defined: lighting, cooking, refrigeration and freezing, clothes washing and drying, dish washing and other electricity services.

To satisfy all the demands, a set of technologies is described using the standard parameters: type of commodity, stock, efficiency, availability factor, lifetime, etc.

[2] https://vito.be/en/product/fastrace-traffic-emission-model

The model can choose to invest in four types of retrofitting options (walls, roof, windows, and ground renovation). The retrofitting options are differentiated according to the 20 categories of buildings.

Commercial

The evolution of demands is linked to GDP growth.

The commercial sector is divided into 7 subsectors: education, health, culture and sports, shops, private offices, public offices, datacentres. Different energy services are defined: heating, hot water, cooling, and other services including cooking, private and public lighting, refrigeration, and other electrical devices.

Demands are defined here in PJ (detailed data on surfaces for the commercial sector are not available). The structure of the sector is very similar to the residential one: the base year technologies and new technologies are defined, and retrofitting options are also included.

Industry

The future evolution of demands is driven by hypotheses on economic activity.

The industrial sector is divided into 20 subsectors: milk, sugar, transformed potatoes, other food industry, cement, lime, hollow glass, flat glass, bricks, ceramics, other non-metallic minerals, ammonia, other chemicals, wood industry, pulp and paper, iron and steel, non-ferrous metals, non-energy consumption (chemicals and others) and other industries.

The industrial sector is modelled using data on each specific sub-sector (costs, temporal availability of new technologies, …) and accurate data on production processes.

Transport

With regard to road transportation, demands are described in terms of passenger-kilometres or in tonnes-kilometres. For the other transport modes, the demand is simply described in terms of energy demand.

As in typical TIMES models, individual modal travel demand is exogenously defined over the time horizon of the model. While technologies can compete within modes based on technical parameters and cost, there is no competition between modes.

The TIMES-Wal transport sector includes a stock of technologies, in competition, that contribute to meet each exogenously defined modal travel demand. Regarding aviation, railways and domestic navigation, only one generic technology is described.

Agriculture

For the agriculture sector, only the combustion-related part is included in TIMES-Wal model. Different energy services are defined: electric appliances, house heating and off-road.

Electricity generation

Electricity demand from all sectors is a main driver for the electricity part of the model.

Every year is divided into 24 representative time slices in order to best reflect variations in the load curve for electricity demand and intermittent energy sources. Each representative day is divided into multiple periods in order to consider different day and night times.

The electricity generation sector is described in detail and brings together all the main activity producers, that is, those generating electricity (and heat) for sale to third parties via the grid. Three main types of producers are brought together separately: the nuclear, renewable and thermal power plants.

Concerning new technologies, the model can make its choice on a varied list of new plants (gas power plants, renewable energy plants, …) based on technical parameters and costs.

At this stage, “TIMES-Wal” isn’t used for ***WAM scenario***. This scenario is modelled through a specific Excel tool developed in the context of the Walloon contribution to the national Energy and Climate Plan 2021-2030. The tool operates on the basis of a series of exogenously defined assumptions but does not make any choice endogenously (optimisation, etc.). This scenario considers the targets of the Plan.

Wallonia is in a transition period. Ultimately, the idea is to perform all the scenarios with the same tool(s), while linking the different models used in the most effective possible way. Regularly updating models on the basis of the best available data, collected through studies or actors, is an important point of attention.

2 Sibyl baseline

For road transportation, projections for the WEM scenario are estimated by the « Sibyl baseline » model developed by Emisia. This baseline scenario is fully compatible with COPERT, used by the Walloon Region to calculate the GHG inventories and also developed by Emisia. For historical years, Sibyl uses data from GHG inventories calculated by COPERT (for example: age and mobility distributions). Sibyl is used in a complementary way to TIMES-Wal (see above). Indeed, the electricity demand resulting from Sibyl's results is integrated into the energy demand estimated by TIMES-Wal. For future years, Sibyl uses the same assumptions as TIMES-Wal model to estimate the evolution of parameters (passenger.km or tons.km of cars, trucks, buses, etc.). For the development of new technologies, the different assumptions are consistent with European regulations. To define those new technologies and vehicle categories that are not available in the standard version of COPERT, the « Command Line Interface » (CLI) is used.

3 Excel tools

- Excel tools are used by Wallonia to estimate some sectors not included in TIMES-Wal or in Sibyl: agriculture (excluding energy) and waste. For agriculture, different parameters are used to estimate the evolution of activity data (for example: livestock, agricultural area and fertiliser uses). For waste, the analysed parameters are the amount of **total** waste disposed, the recovery rate of landfill, CH_4 and N_2O emissions of wastewater handling, etc.
- For **WAM scenario**, a previous Excel tool used in the context of the Walloon Energy and Climate Plan is used to estimate energy, residential, commercial and transport sectors.

Wallonia is in a transition period. Ultimately, the idea is to perform all the scenarios using the same tool(s), while linking the different models used in the most effective possible way. Regularly updating models on the basis on the best available data collected through studies or actors is an important point of attention.

IV Energy and Atmospheric Emissions projection model for Brussels Capital Region

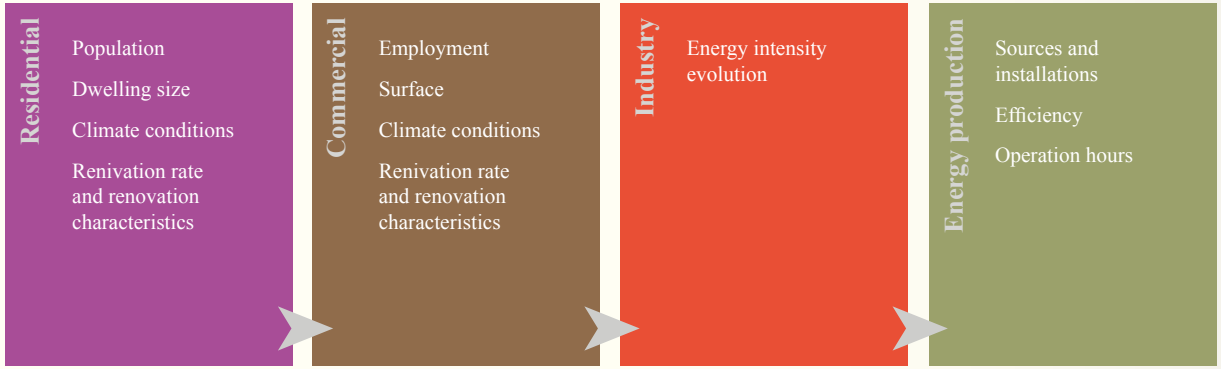
Brussels Environment has developed an energy and emission projection model for the Brussels Capital Region. The model is developed in Excel and it is a bottom-up type model. It is composed of 4 main sectoral modules: Industry, Residential, Tertiary and Energy Production. The model has been calibrated for each sector with the regional annual energy balances from 2000 to 2018. The modelled energy consumptions have then been converted into atmospheric emissions through emission factors, the ones used to establish the emission inventories. The model produces information for several energy carriers such as: natural gas, light oil, propane/butane, coal, electricity, wood, heat; and for several pollutants: CO_2, CH_4, N_2O, NO_x, NMVOC, SO_x, NH_3, $PM_{2.5}$.

The model also takes into account the direct emissions that are not related to energy consumption: i.e. the fugitive methane emissions from natural gas delivery, emissions from industrial processes and product use and emissions from waste (e.g. at composting plants and water purification plants).

This model is a dynamic one. It allows new future available data to be integrated (for instance future energy balances) as well as new assumptions reflecting new studies and new phenomena (in the fields of regulation, technological change, through awareness campaigns, incentives, or the evolution of energy costs, among others.

Each sector is defined by different parameters that impact the future development as show in Figure A.

Figure A Key parameters for projections



V Transport Emission Projection model for Brussels-Capital Region

The calculation of atmospheric pollutants emissions and fuel consumption for road transport is based on the European COPERT IV approach. The main input data required for COPERT simulations (vehicle fleet and mobility) is taken from a regional transport model, developed on the basis of literature data (TREMOVE projections and INRETS study[3]), and recalibrated to the actual situation in the Brussels Region using emission inventories and outputs from a detailed traffic model (MUSTI).

The Multimodal strategic displacement model for BCR (MUSTI) allows the mathematical modelling of passengers' behaviour in the BCR during a regular working day. The model is based on surveys and traffic surveys that provide a precise view of the mobility situation in the region. MUSTI is calibrated using a variety of observations. The traffic surveys show, as precisely as possible, the displacement per road section, per vehicle type and per hour as well as the chosen itineraries. The model calculates the mileage focusing in the rush hours (morning 6h-10h and evening 15h-19h).

Pollutant emissions calculations with COPERT have been processed using the same software version and hypotheses as for the UNFCCC 2015 GHG inventory preparation. Fuel consumption is detailed for gasoline, diesel, LPG and CNG. In Belgium, biofuels are mixed with gasoline and diesel in public fuel tank stations (blends). The CO_2 emissions from the biogenic part of fuels (bioethanol or biodiesel) are calculated in post-treatment, on the basis of the composition of blends, which may vary from year to year.

For railways, the evolution of liquid fuel (gasoil) consumption is derived from the evolution of freight transport demand in Belgium as a whole. The starting point of the projections (2018) is taken from the regional energy balance. Pollutants emissions are calculated by combining fuel consumptions with emission factors from IPCC 2006 Guidelines for national emission inventories.

In the case of inland navigation, the evolution of liquid fuel (gasoil) consumption is derived from the evolution of freight transport demand in Belgium as a whole. The starting point of the projections comes from the regional energy balance. Pollutants emissions are calculated by combining fuel consumptions with emission factors from IPCC 2006 Guidelines for national emission inventories.

[3] **INRETS.** *Transport routier - Parc, usage et émissions des véhicules en France de 1970 à 2025.* s.l. : Institut National de Recherche sur les Transports et leur Sécurité (INRETS), 2004.

VI Off-Road Emission model (OFFREM)

The emissions from off-road are estimated using the OFFREM model (OFF-Road Emission model), which is used by the three regions. This makes it possible to report emissions for Belgium in a coherent manner in the context of mandatory international reporting.

Both exhaust and non-exhaust emissions by non-road mobile machinery are calculated for each sector separately, based on statistical data. Emissions are estimated based on detailed energy consumptions of non-road mobile machines and vehicle kilometres of non-road vehicles, according to following methodology:

Exhaust emissions

Technology related pollutants (NO_x, VOC, NMVOC, CH_4, CO, N_2O, NH_3, PM and benzene)

- Mobile machines: emission factors from EMEP/EEA for non-road mobile machinery are used (EMEP/EEA 2017).
- Non-road vehicles: emission factors are derived COPERT IV (version 11.4) calculations for speeds of 15 km/h.
- Emission factors for passenger cars on CNG are added, based on COPERT IV calculations. Euro 4 up to Euro 6 are available. For Euro 6DTemp and Euro 6 the emission factor for Euro 6 is kept.
- EC emissions are added. f-BC (fraction of BC within PM) reported in the EMEP/EEA methodology is used for machinery. For vehicles, the f-EC (fraction of EC within PM2.5) is calculated based on COPERT IV (version 11.4) for speeds of 15 km/h.

Fuel related pollutants (SO_2, CO_2, heavy metals)

- Biofuels: from 2009 onwards, biofuels are mixed into commercially available fuels. Within the offroad sector, equipment on diesel is assumed to use red diesel, and thus no biofuels are present. For equipment on petrol the Belgian fuel mix for road transportation is assumed. The fuel mix in weight percentage can be adapted per year, sector, fuel type and machine vs vehicle.
- SO_2 and Pb emissions depend on the sulphur and lead content of the fuels used. For this purpose, the parameters used in the COPERT runs for the Belgian emission calculations for road transport are applied.
- CO_2 emissions depend on the fuel type. IPCC emission factors are applied.

– Heavy metals also depend on the fuel consumption. Tier 1 emission factors per fuel type from EMEP/EEA for non-road mobile machinery (2017, Table 3-1) are used. For CNG and LPG, emission factors derived from COPERT IV are applied.

PAH/POP:

– Mobile machines: Tier 1 emission factors in mg/kg fuel from the EMEP/EEA Air Pollutant Emission Inventory Guidebook for non-road mobile sources and machinery are applied (EMEP/EEA 2017, Table 3-1).
– Non-road vehicles: bulk emission factors in µg/km for the EMEP/EEA Air Pollutant Emission Inventory Guidebook for road transportation are applied (EMEP/EEA 2016a, Table 3-75). Note that these emission factors are no longer based on the fuel consumption, as was the case in OFFREM I.

Non-exhaust emissions: emissions of PM (brakes, tyres, road surface, clutches, chassis and shovel) are included.

– Mobile machines: non-exhaust emission factors of CARBOTECH are implemented (Carbotech, 2000).
– Non-road vehicles: EMEP/EEA Tier 2 non-exhaust emission factors and size distributions are applied for PM emissions, as used in calculating road transport emissions in the Belgian emission inventory (EMEP/EEA 2016b, Tables 3-4 and 3-5 for tyre wear, Tables 3-6 and 3-7 for brake wear and 3-8 and 3-9 for road surface wear). For heavy vehicles (trucks and buses) a load factor of 100% is assumed. To calculate the emission of non-exhaust heavy metals, the mean value of the weight fraction in Table 3-12 is implemented.
– Only resuspension emissions for the sector 'agriculture' are included.

VII F-gas projections

F-gas projections are made by means of separate study assignments. In the most recent projection study, the methodology per sector is explained in detail. In general, it can be stated that the projection of F-gases is based on the same methodology as the emission inventory. It also uses assumptions consistent with those of this inventory. The projections have been established simultaneously for Belgium and for each of the three Regions on a harmonised basis (regarding methodology and assumptions), in the same way as for the emission inventory. This means that when there is uncertainty on a parameter, as long as there is no evidence of a difference between regions on the value of that particular parameter, a common value has been chosen.

All calculations have been performed by extrapolating into the future the calculation models of the emission inventory, year by year, from 2017 up to 2035, which allows to consider changes in parameters occurring between the 5 yearly projection years, as well as the dynamic aspects of yearly stock changes.

It should be stressed that there are many uncertainties. The projections are not meant to be forecasts, they are based on many assumptions and should be considered as a possible future, given the anticipated legislative context. In the context of these uncertainties, a conservative approach has generally been pursued, i.e. the assumptions made generally tend to overestimate rather than underestimate the emissions.

The calculation method is specific to each sector. All sectors of the emission inventory have been considered, even the smallest ones, which ensures complete consistency with the inventory.

Annex 4. Description of selected projects or programmes that promoted practicable steps to facilitate and/or finance the transfer of, or access to, environmentally-sound technologies

1. Sustainable agriculture in Kigoma (stone bridges)

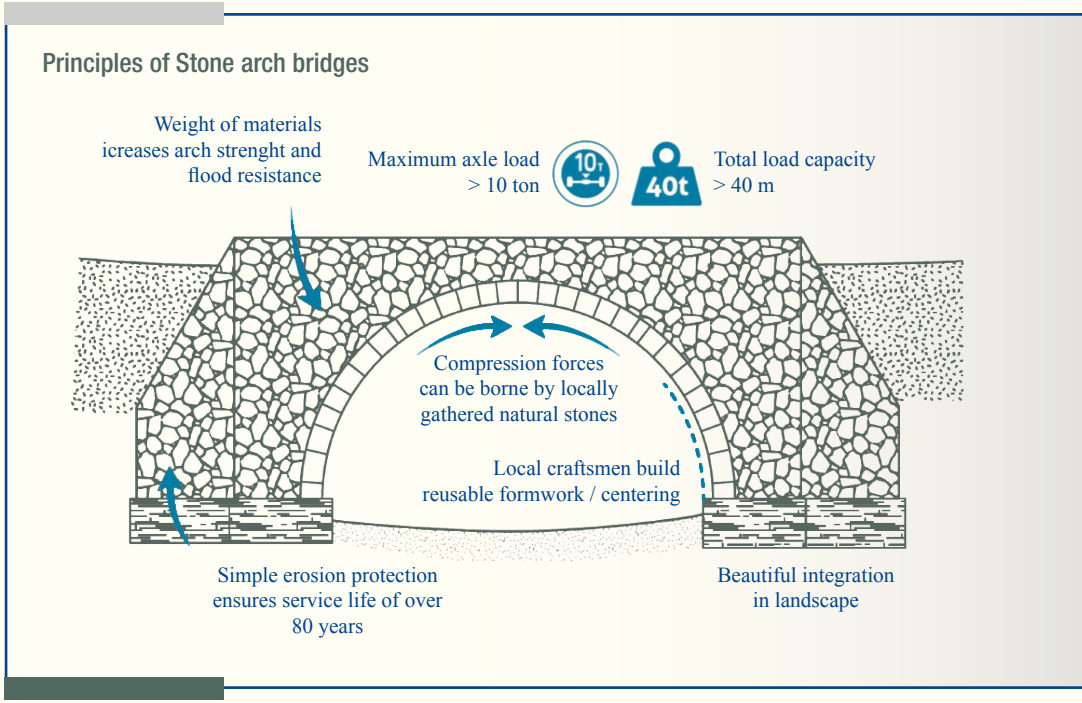
Recipient Country
Tanzania
Sector
Agriculture
Total Funding
Total budget of project (€) 4 285 333 euros Federal Government
Years in operation
4 years (2018-2021)

Description

In the context of a broader programme to support sustainable agriculture in Kigoma, Enabel, the Belgian Development Agency, provides technical support to the districts to improve Rural communities' access to schools, hospitals, markets and jobs via on difficult river crossings. Safe yearround crossing on a stone arch bridge is in these communities a foundation for sustainable development. The technology chosen (stone arc bridges instead of reinforced concrete or steel ones) offers advantages both in terms of mitigation as well as adaptation and disaster risk reduction.

Indicate factors which led to project's success

– Much needed infrastructure projects using conventional techniques, such as steel and reinforced concrete, are often very expensive. The tried and tested technology of stone arch bridges allows for a decentralised approach embedded within local government structures. This cost effective method with high local ownership guarantees a long-lasting upgrade of rural roads for only one fifth of the financial and



environmental burdens compared to conventional structures. The stone arch bridge technology has been extremely cost efficient. With a limited construction budget of <1 million euro, the project will build more than 70 bridges and make a substantial contribution to the road network in Kigoma region.

- Stone arch bridges also avoid some of the disadvantages of conventional technology, such as steel or concrete culverts. These frequently break during rough transport over bad roads from industrial centres and, because they are relatively light, they run the risk of being washed away during floods. Stone arch bridges are an environmental friendly option (locally sourced materials), which also offers strengthened resilience for rural communities against the impacts of climate change.
- There is large scale bean production situated around an irrigation scheme in Kigoma region. This is 12 km away from the nearest market in Nyakitontovillage. Before the construction of stone arch bridges, the farmers had to travel 25 km to reach the market. Now, their route is reduced by 50% to 12 km to the market village of Nyakitonto. The arch bridges reduced transportation costs from the fields to the market by half. There was also a spectacular increase in traffic on market days, both in terms of motorized transport as in terms of active modes of transportation (bicycles).
- Before the construction of the bridges, the road condition didn't allow trucks to cross the river, while now 40 trucks carry produce from the fields to the market.
- Compared to conventional bridges, stone arches emit 50 -80% less carbon. Masonry requires a fraction of the cement required to make concrete and requires no steel at all. The remaining materials, like natural stone, are locally sourced which considerably reduces transport related emissions.
- Involvement of local communities is very strong. The village involvement includes the supply of stones, sand, water, poles, but the most important contribution is that of casual labour. This transforms the appreciation of the bridge from a government intervention to a long term community asset.
- Both the design and execution rely on design parameters that have been tried and tested throughout time. Different types of arches allow for the adaptation to different terrain types. The design depends on the slopes of the river banks, the load bearing capacity of the subsoil, the width of the river and the highest floodline.
- Thanks to close collaboration with TARURA, the stone arch technique has been promoted on national level. Several projects managed by TARURA outside of Enabel's intervention area in the Kigoma region have started.

Failures:

- No significant failures related to the technology have been registered during the implementation of this project.
- Factors that impacted efficiency:
  - The mobilization of local contribution adds value to the success of the project but has, however, been time-consuming and, in some cases, led to implementation delays.
  - Alignment of public procurement processes to the production and marketing dynamics of smallholder farmers on the ground is challenging. This often-delayed the supply of inputs or made credit unavailable at the critical moments when most needed.
- Not a failure but a challenge: the smallholder approach requires a lot of capacity building, patience and dealing with inefficiencies. The project has not been in the position to directly support the private sector. Medium-scale commercial farmers and processors with the capacity to co-fund investments and create economies of scale fall outside the project target group.
- Some intervention areas were rather remote, which impacts the monitoring and ability to provide sufficient oversight and support

Technology transferred:

- Technical support to provide stone arc bridges at large scale in rural communities:
  - Solid, Time-Tested Technology
  - 80% Cost Reduction
  - Mobilisation of Local Resources
  - Community Ownership
  - Reduced carbon footprint

Impact on greenhouse gas emissions/ sinks (optional)

50-80% emissions reductions compared to steel or concrete bridges.

2. Climate-smart development in Mozambique: using renewable energy for sustainable access to safe and affordable drinking water in Gaza Province

Recipient Country
Mozambique
Sector
Energy
Total Funding
Total budget (€) 1 087 706 euros Government of Flanders (€) : 1 000 000 Bilateral project water gaza and study fund (€): 87 706 + pm
Years in operation
30 months (2019-2021)

Description

Contributing to climate resilient social and economic development of vulnerable populations in Gaza Province by improve sustainable access to safe and affordable drinking water through a systemic approach, encompassing renewable energy, healthy living, empowerment of communities and local economic stakeholders.

Indicate factors which led to project's success

- The main success of the project is its impact on improving access to safe drinking water for 6,393 people in an area with brackish water sources and/or designated resettlement areas for climate migrants.This has been achieved through the construction of water supply infrastructure which was been accompanied by a comprehensive programme of community education which included rational water use and management, sanitation, hygiene and climate resilience.
- By removing the majority of the salt from the water in the boreholes, the desalinators have a positive impact on long-term community health. Water quality is now well within the World Health Organisation recommended limits for drinking water.
- The project has significantly reduced the time that women and girls spend collecting and transporting water to their homes, giving them more time to rest, study, or carry out their numerous daily tasks.
- The project has been successful in increasing gender equality and empowering women and girls. Women hold leadership posts in all 58 CAS, where they have significant decision-making power. 1 628 out of a total 2 417 persons that received training through the PEC are women or teenage girls – 67% –. The results are measured by the large number of latrines, bathrooms, rubbish pits, hand-washing facilities and drying tables constructed through the PEC, in which women and girls were fully involved.

Failures:

- No significant failures have been registered during the implementation of this project. However, it was expected that 33% of water users would pay using digital money transfer systems. But this did not so far happen because of a lack of enabling conditions in the target villages where there are no agents of the money transfer systems operators.
- There was an 8-month overrun in project execution, mostly because of the impact of COVID-19 on supply chains for water infrastructure equipment imported from France that caused major delays in arrival of the materials in Mozambique. It should be noted that an overrun of 6 months was included in the implementation plan in the Project Proposal, anticipating possible delays with works, tenders etc. Despite the delays that occurred as a result of the unforeseen circumstances, the flexibility of the donor, Flanders government, in granting a no cost extension mitigated major impacts to the intervention. Thus, the intervention successfully managed to realise the main activities as outlined in the project document, while adapting to a challenging context.
- The Chiaquelane water supply system intervention was unable to reach the initially estimated 8 000 beneficiaries due to budget restrictions and project design as explained above in section 7.3.2. Nonetheless, the project executive design was reviewed to allow the project to be built in 3 phases, thereby allowing expansion of the system (by Enabel or other agencies) when funds become available. This was an effective mitigation approach to allow part of the population to benefit from clean access to water.

Technology transferred:

- AKVO app/SINASS
- Database updated in real-time
- 100% solar powered desalination
- New 'smart' pumps

Impact on greenhouse gas emissions/ sinks (optional)

More information: MOZ19001 Climate Smart Development in Mozambique -project Flanders 20190415.doc - Google Drive

3. Strengthening Environmental and Community Resilience to Climate Change (RREC)

Recipient Country
Burundi
Sector
hygiene, sanitation, water supply and preventive health, agriculture, agroforestry and market gardening
Total Funding
Total budget (€) 241 970 Wallonia (€) : 181 644
Years in operation
2019 – 2021 (36 months)

Description

The specific objective of the RREC program is to improve the resilience of both the environment and the communities of Gihanga and Mutimbuzi most exposed to the effects of climate change.

This program is clearly part of a global ambition to adapt family farming to environmental constraints accentuated by global warming (including livestock issues, the fight against soil erosion and agricultural water management), and the fight against deforestation and the management of forest areas (including mangroves and the fight against deforestation by optimizing or reducing the use of wood for fuel)

Indicate factors which led to project's success

With regard to the schedule put in place since the beginning of the project, we note with satisfaction that all the activities planned within the framework of the RREC project have been implemented, carried out within the deadline and have largely impacted the living conditions of the beneficiary population of Gihanga and Mutimbuzi.

At the family level :

- a total of 5 045 people attended an animation on good hygiene and sanitation practices throughout the duration of the project
- In total 1 254 latrines were built (577 Arborloo and 677 Ecosan) out of the 800 planned during the project formulation of the project. This overachievement of the target was possible thanks to an additional source of source of funding in the intervention zone.
- a total of 1 126 handwashing systems, 2 050 dryers, and 1 136 compost bins were installed in households.
- Watermelon and amaranth fields were installed by the Hygiene and Sanitation Committees of each hill to demonstrate the use of EcoSan derivatives and biopesticides. EcoSan derivatives and biopesticides were used as basic inputs during the vegetative cycle of these two crops and good results were observed during harvesting. At the same time, model maize fields were set up in 5 hills of Gihanga commune to serve as demonstration fields.
- Germoirs of Neem, Melia and Artemisia were installed in the 5 hills of the intervention zone with the objective of multiplying these miraculous plants that have shown good results in the fight against crop pests (Neem and Melia) and against malaria (Artemisia).
- production of vetiver saplings planted along the entire along the Kajeke riverbed to protect the banks from collapse.
- in collaboration with the Commune of Gihanga and Mutimbuzi 10 000 plants were produced, including 5 000 bamboo plants and 5 000 sisal plants. The plants produced were transplanted by the commune on the banks of the Kajeke River to fight against the damage caused by this river.

At the community level :

- technical training on biopesticides in order to build their capacity and to participate in sensitizing other households on the use of biopesticides.
- Hygiene and Sanitation Committees were actively involved in the analysis and dissemination of the action research data.
- Having benefited from the leadership training, the Hygiene and Sanitation Committees continue to mentor and support households in activities that promote good hygiene and basic sanitation practices in the community.
- The Hygiene and Sanitation Committees have also strengthened households in the production of improved stoves. In total, 1 106 stoves were built over the course of the project, which shows the interest of households in this innovation that helps limit This shows the interest of households in this innovation that limits wood consumption.

At the communal level :

- Training was organized in Mutimbuzi for farmers, zonal and communal agronomists, and agricultural instructors from this commune. A total of 40 participants were trained on the use of biopesticides (Neem and Melia). This training is part of the organization's strategy to strengthen the skills of field actors and especially to provide them with tools and techniques to better support the project's beneficiary households.
- At the communal level, capacity building of communal actors (responsible for sanitation activities) on the use of EcoSan by-products and biopesticides (zonal and communal agronomists, agricultural monitors) has allowed these partners to find a framework for exchange and collaboration on environ-

mental and community resilience issues. The workshops facilitated closer communication for synergistic work. The field missions with the commune administration were an effective approach to cooperation and identification of possible needs of the commune and the progress of the project. Direct requests from households for support in terms of building materials, biopesticides and/or fruit trees attracted the attention of the participants of these missions.

Failures:

- No significant failures were recorded during the implementation of this project. However, the lack of rain for the season did not allow us to achieve our objectives for the development of action research and the distribution of fruit plants.
- After a gradual start in 2019, the project faced a challenging health context mid-project with the emergence of Covid19 in March 2020. The project team had to adapt to this new reality and reframe the interventions while respecting the barrier measures.
- This resulted in progressive results in the first four semesters. The development of research-action, which began timidly at the beginning of 2020, quickly gained momentum with the arrival of the agronomist and the recruitment of the local agronomist: work to upgrade the experimental field, soil analysis of the field, grouping of the different crops according to the type of crop repetition, setting up of nurseries, etc. of the different crops in relation to the type of crop repetition, setting up of nurseries for potentially resilient crops with high added value, setting up of the Kizéo software for household agronomic surveys, taking Ecosan compost samples from latrines for submission to the laboratory All these activities have been carried out in succession and have made the project progress at a rapid pace.

Technology transferred:

- Latrines ecosan

Ecosan dehydration latrines separate faeces from urine and allow the waste to be transformed into compost (faeces) or liquid fertilizer (urine) that can be used to fertilize soil or crops. These latrines have two pits built above the ground, which are covered by a slab. This slab is specially designed to allow separate collection and disposal of faeces and urine underneath.

- improved cookstoves

Annex 5. Acronyms

ACEP	Air-Climate-Energy Plan
ACROPOLIS	Academic Research Platforms for Policy Support
ACTRIS	Pan-European Research Infrastructure on Short-lived Atmospheric Constituents
AEA	Annual Emission Allowances
AED	Administration for Equipment and Travel of the Brussels Capital Region
ALC	automatic LIDAR-ceilometer
ALTIUS	Atmospheric Limb Tracker for the Investigation of the Upcoming Stratosphere
AR4/5/6	4th/5th/ 6th Assessment Report of IPCC
AWAC	Walloon Agency for Air and Climate
BatEx	Exemplary Buildings Project
BCR	Brussels Capital region
BELSPO	BELgian Science POlicy
BE REEL!	Belgium Renovates for Energy Efficient Living!
BIO	Belgian Investment Company for Developing Countries
BiodivERsA	European Biodiversity Partnership supporting excellent research on biodiversity with an impact for society and policy
BIRA	Belgian Institute for Space Aeronomy
BISA	Belgian Institute for Space Aeronomy
C3S	Copernicus Climate Change Service
CAMS	Copernicus Atmospheric Monitoring Service
CCGT	Combined-cycle gas power plant
CCI	Climate Change Initiative
CCIEP	Coordination Committee for International Environmental Policy
CDM	Clean Development Mechanism
CELINE	Belgian Interregional Cell for the Environment
CER	Certified Emission Reduction
CFC	chlorofluorocarbon
CGIAR	Consultative Group on International Agricultural Research
CH_4	Methane
CHP	combined heat and power
CII	carbon intensity indicator
CIS	International Cooperation Commission
CNG	Compressed Natural Gaz
CO	Carbon monoxide
CO_2	Carbon dioxide
COBRACE	Brussels Air, Climate and Energy control Code
CONCERE	Concertation between the federal state and the regions about energy
COP	Conference Of the Parties
COPERT	EU standard vehicle emissions calculator
CORDEX	Coordinated Regional Downscaling Experiment
CORDIS	Community Research and Development Information Service
COREN	Coordination Environnement
COSMO-CLM	regional climate simulation model
COVID-19	Coronavirus disease
CRF	Common reporting format
CRIE	Regional center for ecology initiation
CTF	Common Tabular Format
DG	Directorate-general
DGD	Directorate General Development Cooperation and Humanitarian Aid
DNA	Designated National Authority
EC	European Commission
ECV	Essential Climate Variable
EEA	European Economic Area
EEA	European Environment Agency
EEXI	Energy Efficiency Existing Ship Index
EIW	Energy Info Wallonia
ENOVER	Concertation between the federal state and the regions about energy
EOS	Excellence of Science
EPB	Energy performance of buildings
EPM	Energy/Emissions Projection Model
ERB	Earth Radiation Budget
ERIC	European Research Infrastructure (on carbon?)

ERU	Emission Reduction Unit
ESA	European Space Agency
ESD	Effort Sharing Decision
ESFRI	European Strategic Forum on Research Infrastructures
ESR	Effort Sharing Regulation
ETS	Emission Trading Scheme
EU	European Union
EUA	European Union Allowances
EUCR	Union Registry for Emissions Trading
EUMETSAT	Meteosat Second Generation satellites
EUROSTAT	statistical office of the European Union
EWI	Economy, Science and Innovation Department
FA's	Framework Arrangements
FAIR	Findable, Accessible, Interoperable, and Reusable
FAO	Food and Agriculture Organization (of the United Nations)
FASTRACE	Software tool to calculate spatially disaggregated emissions from road transport
FED	Federal Government
FEDRA	research actions database funded by BELPSO
FP	Focal Point
FPB	Federal Planning Bureau
FPS	Federal public service
FRIA	Fund for Research in Industry and agriculture
FRIS	Flanders Research Information Space
FRS-FNRS	(National) Fund for Scientific Research
FSI	Federal Scientific Institutions
FWO	Fund for Scientific Research Flanders
GCF	Green Climate Fund
GCOS	Global climate observation system
GDP	Gross domestic product
GEF	Global Environment Facility
Gg	Gigagramme
GHG	Greenhouse gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit

GLONASS	Russian high orbit satellite navigation system
GNSS	Global Navigation Satellite Systems
GPS	Global Positioning System
GRACE	Gravity Recovery and Climate Experiment
GTS	Global Telecommunication System
GW	Gigawatt
GWP	Global Warming Potential
HF	Hydrogen fluoride
HFC	hydrofluorocarbon
IASB	Belgian Institute for Space Aeronomy (BIRA)
ICAO	International Civil Aviation Organization
ICEDD	Institut de Conseil et d'Etudes en Développement Durable (Institute of Consulting and Studies in Sustainable Development)
ICARDA	International Center for Agricultural Research in the Dry Areas
ICOS	Integrated Carbon Observatory System
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IITA	International Institute of Tropical Agriculture
IOC	Intergovernmental Oceanographic Commission
ILVO	Institute for Agricultural and Fisheries Research
IMO	International Maritime Organization
INNOVIRIS	Brussels Institute for Research and Innovation.
INRETS	Institut National de Recherche sur les Transports et leur Sécurité (National Institute for Transport and Safety Research)
IOC	Intergovernmental Oceanographic Commission
IPCC	Intergovernmental Panel on Climate Change
IRCEL	Belgian Interregional Cell for the Environment
ITL	International transaction log
JI	Joint Implementation
JPI	Joint programming initiative
KLIMOS	Research Platform Climate Change and Development Cooperation
KP	Kyoto Protocol
KULeuven	Catholic university of Leuven
kW	kiloWatt
kWh	kiloWatthour
LDCs	Least Developed Countries

LDCF	Least Developed Countries Fund
LEZ	Low emission zone
LIDAR	Light Detection and Ranging
LIFE	EU's funding instrument for the environment and climate action
LOVECLIM	Earth System Model
LPG	liquefied petroleum gas
LULUCF	Land Use, Land-Use Change end Forestry
MAR	regional climate model
MIRA	Environmental report Flanders
MOP	Meeting Of the Parties
MOS	Environmental protection at school
MRV	Monitoring, Reporting, Verification
MS	Member State
MUSTI	Multimodal strategic displacement model
MW	Megawatt
N2O	Nitrous oxide
N/A	Not applicable
NAPs	National Adaptation Plans
NATO	North Atlantic Treaty Organization
NBB	National Belgian Bank
NBS	Nature based solution
NCC	National Climate Commission
NDACC	Network for the Detection of Atmospheric Composition Change
NDC	nationally determined capacity
NECP	National energy and climate plan
NEHAP	National Environment and Health Action Plan
NGO	Non-governmental organization
NIR	National inventory report
NIS	National Inventory System
NMBS	National Railway Company of Belgium
NOx	Nitrogen Oxides
ODA	Official Development Assistance
OECD-DAC	Development Assistance Committee of the Organization for Economic Cooperation and Development

OFFREM	OFF-Road Emission model
PACE	Air-Climate-Energy Plan
PAH	polycyclic aromatic hydrocarbon
PAMs	Policies and measures
PAPE	Prevention Action Plans in the field of Energy
PE	polyethylene
PEA	Princess Elisabeth Antarctica research station
PEFC	Programme for the Endorsement of Forest Certification
PFC	Perfluorocarbon
PLAGE	Local Programme of Action for Energy Management / Local Action Plan for Energy Management
POP	Persistent Organic Pollutants
PM	Particule matter
PMP	Passive house platform
ppm	parts per million
PRODEX	PROgramme for the Development of scientific EXperiments
PVC	polyvinylchloride
QA/QC	Quality Assurance / Quality Control
QASUME	Quality assurance of spectral ultraviolet measurements in Europe through the development of a transportable unit
R&D	Research & Development
R&I	Research & Innovation
RBINS	Royal Belgian Institute of Natural Sciences
RES	Renewable energy sources
RMI	Royal Meteorological Institute
SAF	Satellite Application Facility
SEF	Standard electronic format
SERV	Social and Economic Council of Flanders
SF6	sulphur hexafluoride
SIDS	Small Island Developing States
SILSO	Sunspot Index and Long-term Solar Observations
SINCERE	Widening international cooperation activities on climate adaptation and mitigation
SME	Small and medium-sized enterprises
SNCB	National Railway Company of Belgium

SOHO	Solar & Heliospheric Observatory
SPW	Walloon Public Service
STEREO	Earth observation by satellite research programme
STI	Science, Technology and Innovation
STIB	Brussels transport society
TEOM-FDMS	Tapered Element Oscillating Microbalance – Filter Dynamics Measurement System
TOA	Terrestrial, Ocean and Atmosphere
TML	Transport & Mobility Leuven
TREMOVE	policy assessment model to study the effects of different transport and environment policies on the emissions of the transport sector
TRL	technology readiness level
TSI	Total Solar Irradiance
UAA	Useful Agricultural Area
UAntwerp	University of Antwerpen
UCLouvain	Catholic university of Louvain-la-Neuve
UGent	University of Gent
UHasselt	University of Hasselt
ULiège	University of Liège
UN	United Nations
UNCBD	United Nations Convention on Biological Diversity
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNEP	United Nations' Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNESCO	United Nations Educational, Scientific and Cultural Organization

UREBA	Rational Use of Energy in Buildings
URL	Uniform Resource Locator
UV	Ultraviolet
UV-VIS	Ultraviolet–visible
VAP	Flemish Adaptation Plan
VAT	Value added tax
VEKA	Flemish Energy and Climate Agency
VEKP	Flemish Energy and Climate Plan
VITO	Flemish Institute for Technological Research
VLAIO	Agency Flanders Innovation & Entrepreneurship
VLIR	Flemish Interuniversity Council
VLIZ	Flanders Marine Institute
VMM	Flemish Environment agency
VMP	Flemish Mitigation plan
VOC	Volatile Organic compound
VPN	Virtual Private Network
VUBrussel	Free University Brussels
WCRP	World Climate Research Programme
WAM	With additional measures
WBI	Wallonia-Brussels International
WCRP	World Climate Research Programme
WEM	With Existing Measures
WG	Working group
WMO	World Meteorological Organisation
WOUDC	World Ozone and Ultraviolet Radiation Data Centre
WWF	World Wide Fund for Nature

NATIONAL CLIMATE COMMISSION

federal public service
HEALTH, FOOD CHAIN SAFETY AND ENVIRONMENT

brussels environment
.brussels

Air Climat
agence wallonne de l'air & du climat

Flanders
State of the Art

Belgian Science Policy Office
belspo

economie
FPS Economy, S.M.E.s, Self-employed and Energy

Federal Public Service
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THE BELGIAN DEVELOPMENT COOPERATION .be

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