NATIONAL
CLIMATE COMMISSION

2020

BELGIUM'S FOURTH BIENNIAL REPORT ON

CLIMATE CHANGE

Under the United Nations Framework Convention on Climate Change

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1. Preamble

The 4th Belgian Biennial report has been 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 3rd biennial report of Belgium (FCCC/IDR.7/BEL and FCCC/TRR.3/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 emissions reduction targets (Section 3);
- progress towards achieving quantified economy-wide emissions 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).

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) have been submitted to the UNFCCC through the electronic reporting facility provided by the UNFCCC Secretariat as required by UNFCCC decision 19/CP.18.

Belgium has adopted its National energy and climate plan 2021-2030 on 18 December 2019. As Belgium wished to reflect this important latest policy development in this Biennial Report, it was not possible to comply with the deadline of 1 January 2020. ■

2. Information on greenhouse gas emissions and trends

This section summarises the data on Belgian historical greenhouse gas (GHG) emissions since 1990.

Total GHG emissions in Belgium decreased by 21.9% between 1990 and 2017 (-32 047 kt CO_2 equivalent). These emissions exclude Land Use, Land-Use Change and Forestry (LULUCF).

The most important GHG by far is CO_2, which accounted for 85.2% of total Belgian emissions in 2017.

The energy transport sector accounted for most of the Belgium's GHG emissions in 2017 (22.5%), followed by industrial processes (17.2%) and the residential sector (13.3%).

2.1. Summary information on GHG emissions trends

The trends discussed below are based on the greenhouse gas emissions inventory published on 15 April 2019 on the UNFCCC website and covers the years 1990 to 2017. Global warming potentials and sector classification are based on the UNFCCC reporting guidelines under Decision 24/CP.19.

2.1.1. Overall greenhouse gas emissions trends

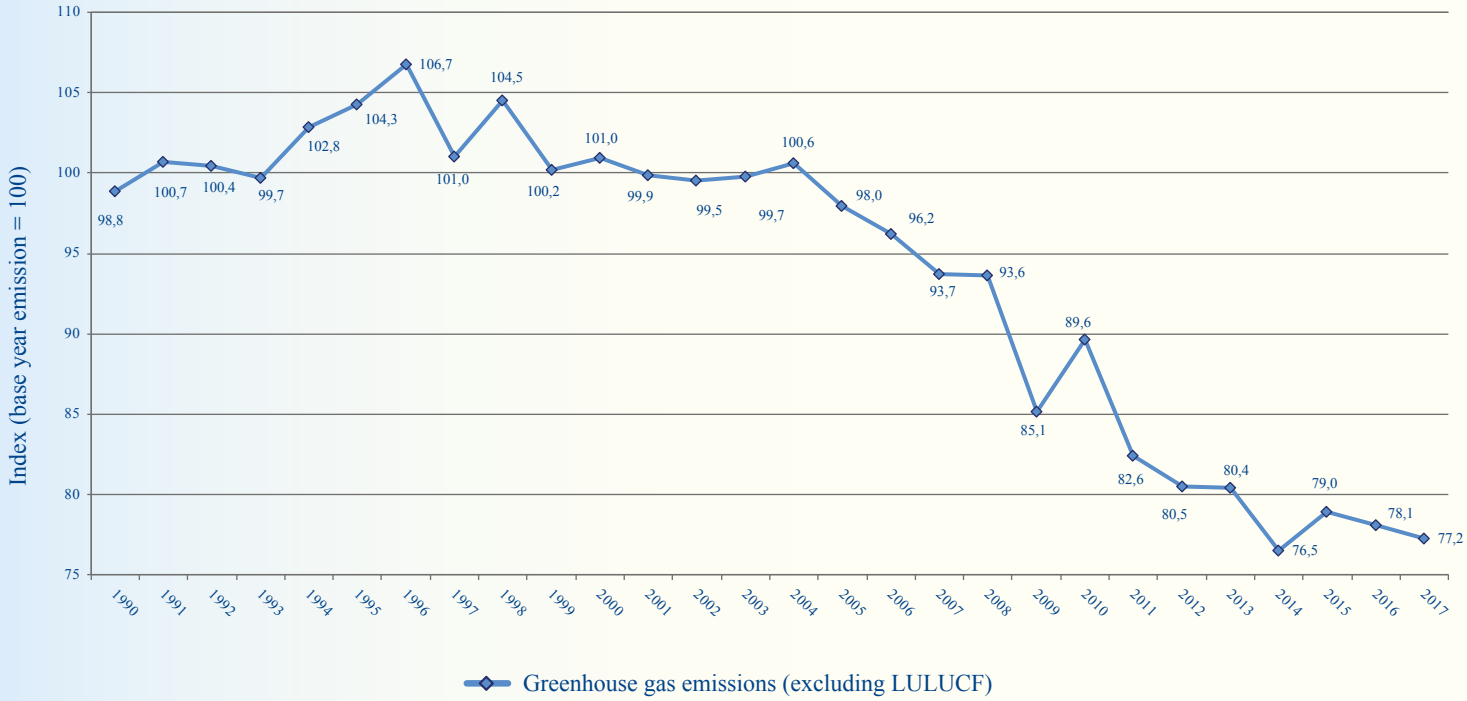
If Land Use, Land-Use Change and Forestry – LULUCF is excluded, Belgium reduced its total GHG emissions between 1990 and 2017 (see CTF Table 1) by 21.9% and 22.8% if you consider the base year for the fluorinated gases (1995). If LULUCF is included, the overall decrease since 1990 is 20.2% and 21.2% if you consider the base year for the fluorinated gases (1995).

In 2017, these emissions amounted to 114.5 million tonnes of CO_2 equivalent (excluding LULUCF) and to 114.3 million tonnes of CO_2 equivalent (including LULUCF).

Emissions (excluding LULUCF) per capita in Belgium dropped by 31.4% for the same period, from 14.8 tonnes of CO_2 equivalent/capita to 10.1 tonnes of CO_2 equivalent/capita.

When compared to Base Year Emissions (year 1990 for CO_2, CH_4 and N_2O and year 1995 for fluorinated gases), the reductions amount respectively to 22.8% (excluding LULUCF) and 21.2% (including LULUCF).

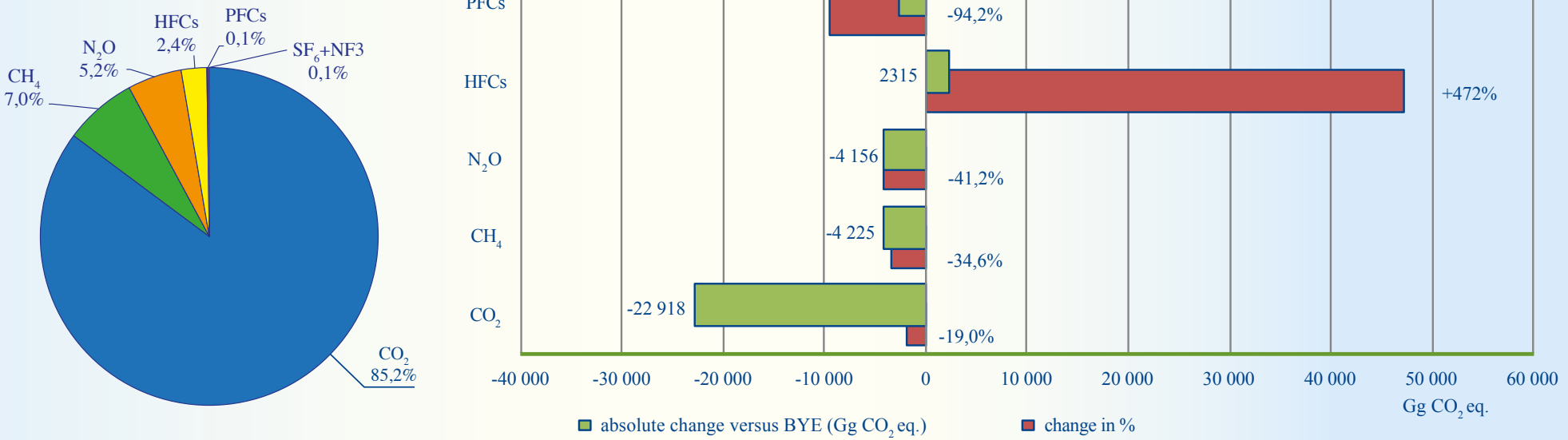
Figure 2.1 Belgium GHG emissions 1990-2017 (excluding LULUCF).
Unit: Index point (base-year emissions = 100).
For the fluorinated gases, the base year is 1995.



2.1.2. Emission trends by gases

The major greenhouse gas in Belgium is carbon dioxide (CO_2), which accounted for 85.2% of total GHG emissions in 2017. Methane (CH_4) accounted for 7.0%, nitrous oxide (N_2O) for 5.2%, and fluorinated gases for 2.6% (Figure 2.2). Emissions of CO_2 decreased by 19.0% over the period 1990-2017, while CH_4, N_2O and fluorinated gas emissions dropped to 34.6%, 41.2% and 44.7% respectively during the same period (F-gases are compared to 1995 emissions).

Figure 2.2 Share of greenhouse gases in Belgium (2017) and changes compared to base year (1990 for CO_2, CH_4 and N_2O; 1995 for F-gases)

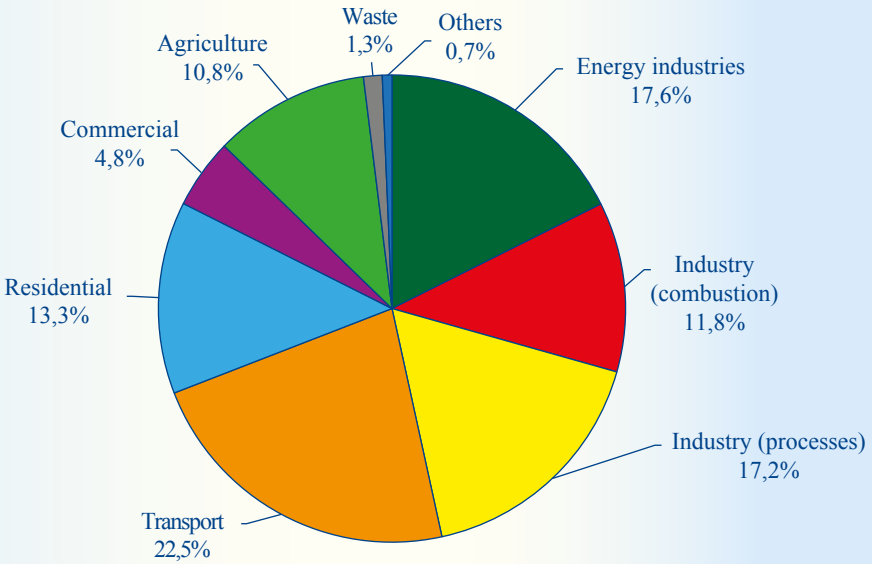


2.1.3. Emissions trends by main source and sink categories

An overview of the contribution of the main sectors to Belgium greenhouse gas emissions (excluding LULUCF) is shown in Figure 2.3. Transport, energy industries, manufacturing industry (processes) and space heating are the most important sectors as regards total GHG emissions in 2017.

Figure 2.3 summarises the impact of the main sectors on the national trend. It clearly shows the sharp increase in transport (mainly due to road), on the one hand, but also the increase in emissions from buildings in the commercial and institutional sectors, on the other. Since 1990, these two sectors together grew by 24% and have been responsible for a 4.2% increase in total emissions.

Figure 2.3a GHG emissions: share of main sectors in 2017 and changes from 1990 to 2017



Road transport emissions have increased continuously since 1990 due to the growing number of cars and intensification of traffic, although the increase in traffic has slowed down significantly in recent years. The number of employees in the tertiary and institutional sectors is still rising and is a good indicator of the increase in emissions in the commercial and institutional sector.

In 2017 the emissions in the residential sector increased slightly compared to 2014 (2014 is currently the mildest year recorded in Belgium) but remain far below those of 1990 (which was a relatively warm year as 2017 was) while the number of buildings and dwellings is still increasing, showing an improvement in energy efficiency in this sector.

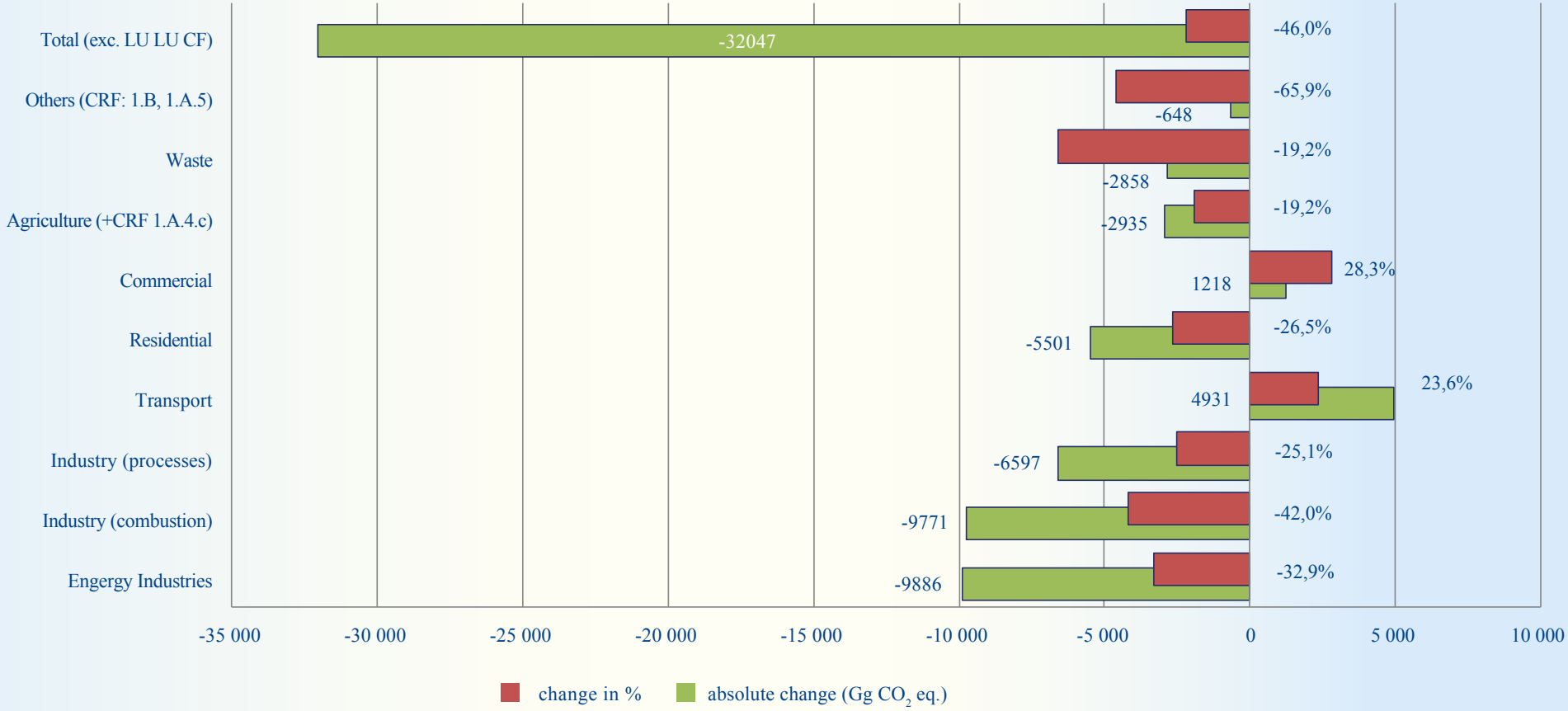
This 4.2% increase in total emissions is counterbalanced by the 31.5% decrease in the other sectors, particularly manufacturing industry (combustions and processes recorded a 33.0% decrease since 1990, accounting for 11.2% of the decrease in total emissions) and energy industries (emissions recorded a 32.9% decrease since 1990, accounting for 6.9% of the decrease in total emissions).

The main reasons are the switch from solid fuels to gaseous fuels observed in the electricity generation sector and industry, together with the development of biomass fuels in some sectors. This has resulted in a reduction in the CO_2 emission factor per unit of energy consumed. More rational use of energy is also developing but often goes hand in hand with increased electricity consumption, so its impact on actual emissions is generally more difficult to quantify. Finally, the closure of certain iron and steel works over the past few years has also led to lower emissions.

In agriculture, CH_4 and N_2O emissions are decreasing, reflecting a decline in the livestock population and certain changes in agricultural practices. In solid waste disposal, biogas recovery and use has resulted in a net reduction of CH_4 emissions.

For more information see the National Inventory Report 2019 (NIR).

Figure 2.3b GHG emissions: share of main sectors in 2017 and changes from 1990 to 2017



2.1.4. Split between Emission Trading Scheme (ETS) and non-ETS emissions

Total GHG emissions for Belgium (excluding LULUCF) are presented below with the respective verified emissions reported by installations and operators under Directive 2003/87/EC (Emission Trading Scheme).

For further details, please refer to CTF table 1 'Emission trends CO_2, CH_4, N_2O, HFCs, PFCs and SF_6'.

Total emissions 2017 (CO_2 - eq)

Category	Gas	Greenhouse gas inventory emissions [kt CO_2 eq]	Verified emissions under Directive 2003/87/EC [kt CO_2 eq]	Non-ETS sectoral emissions [kt CO_2 eq]	Ratio in % (Verified emissions/ inventory emissions)	Non-ETS objective in 2013 [kt CO_2 eq]
Greenhouse gas emissions (total emissions without LULUCF for the GHG inventory and without emissions from 1A3a Civil aviation, total emissions from installations under Article 3h of Directive (EU) 2018/410) without NF_3 emissions,	Total GHG	114 528	43 773	70 755	38.2	72 487
CO_2 emissions (total CO_2 emissions without LULUCF for the GHG inventory and without emissions from 1A3a Civil aviation, total emissions from installations under Article 3h of Directive (EU) 2018/410)	Total GHG	97 552	43 402	54 150	55.5	/

2.2. National inventory arrangements

2.2.1 Summary information on national inventory arrangements

The Belgian GHG inventory is the direct sum of regional emissions data given that the environment primarily falls under the aegis of the three Regions of Belgium (Walloon Region, Flemish Region and Brussels-Capital Region). The Belgian Interregional Environmental Agency (IRCEL-CELINE) operates as the national compiler of greenhouse gas emissions. It is responsible for collecting the regional estimates of GHG emissions/removals and for compiling the three sets of regional data into one national inventory. The National Climate Commission is the entity responsible for the approval of the Belgian national inventory report.

The main institutions involved in the compilation of the Belgian GHG inventory are:

- the Working Group on Emissions, under the Coordination Committee for International Environmental Policy (CCIEP), which plays a central role in the technical coordination of the national GHG inventory;
- the National Climate Commission, which is in charge of the approval of the inventory reports;
- the Directorate General for Energy of the Federal Public Service Economy, SMEs, Self-employed and Energy (FPS - DG Energy), which is responsible for top-down estimates of energy-related CO_2 emissions using the Intergovernmental Panel on Climate Change (IPCC) "reference approach" based on the national energy balance;
- the Climate Change section within the Directorate General for the Environment of the Federal Public Service Health, Food Chain Safety and Environment (FPS - DG Environment), which is involved in the national inventory system in its capacity as UNFCCC National Focal Point for Belgium, as a coordinator for the national reports;
- and, of course, the 3 regional agencies which are responsible for delivering their greenhouse gas inventories:
  - the Flemish Environment Agency (VMM) in the Flemish Region;
  - the Walloon Agency for Air and Climate (AWAC) in the Walloon Region;
  - the Brussels Environment Agency (Brussels Environment) in the Brussels-Capital Region.

The CCIEP is the principal body for coordinating international environmental policy. All technical aspects of the GHG inventory (methodological choices, emissions factors, uncertainty analysis, QA/QC, etc.), as well as organisational aspects of the preparation process, are coordinated through the working group of this body. In addition to CRF submissions, other reporting requirements, such as the National Inventory Report and responses to the review processes, are also prepared within this working group. The CCIEP-WG Emissions is also the forum for the process of improvement of the national inventory system.

More detailed information is provided in Section 1.1 of the National Inventory Report or in the National Inventory System.

2.2.2 Summary information on changes to national inventory arrangements since the last National Communication or Biennial Report

The national system in Belgium was previously updated for the NIR and CRF submission of April 15th 2017 to the UNFCCC-secretariat. No major changes were made at that time since the NIS which was submitted in April 2009. During this update, Belgium primarily focused on obtaining more transparency in the document to explain the responsibilities between the different institutions involved. The revised national system is in line with the developed QA/QC-plan. For the CRF and NIR submission of April 15th 2019 a further update of the NIS was made in Belgium:

- General update of all information included in the NIS (responsible persons, institutions, legislation, data sources, etc.).
- Link to the NIR where chapter 3.2.5 was further elaborated for the submission in 2019 in terms of showing the correlation between energy data reported in regional energy balances and in regional CRF-tables.

More detailed information is available in the NIS 2019 and the NIR 2019. ■

3. Quantified economy-wide emission reduction target

3.1. EU target under the Convention

In 2010, the EU made a pledge to reduce its GHG emissions by 20% by 2020, compared to 1990 levels (FCCC/CP/2010/7/Add.1). This target excludes the LULUCF sector but includes international aviation (outgoing flights). As this target under the Convention was only submitted by the EU-28 and not each Member State individually, there are no specified convention targets for individual Member States. As such, Belgium, as part of the EU-28, has taken on quantified economy-wide emissions reduction targets jointly with all Member States.

The 20% emissions reduction target by 2020 is unconditional and supported by legislation implemented in 2009 (Effort Sharing Decision EC/406/2009) (cf. chapter 3.2).

The EU also committed to raising this target to a 30% emissions reduction by 2020 compared with 1990 levels, provided that other developed countries also commit to achieving comparable emissions reductions, and that developing countries contribute adequately, according to their responsibilities and respective capabilities. This offer was reiterated in the submission to the UNFCCC by the EU-28 and Iceland on 30 April 2014[1].

The definition of the convention target for 2020 is documented in the revised note provided by the UNFCCC secretariat on the '*Compilation of economy wide emission reduction targets to*

[1] Submission by the European Union and its Member States and Iceland pursuant to paragraph 9 of decision 1/CMP.8

Table 3.1 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 emissions reductions and that developing countries contribute adequately according to their responsibilities and respective capabilities.

be implemented by Parties included in Annex I to the Convention'[2]. In addition, the EU provided additional information relating to its quantified economy-wide emissions reduction targets in a submission as part of the process of clarifying the developed-country Parties' targets in 2012[3]. In a workshop that likewise formed part of this clarification process, the EU also gave a presentation on its target in May 2012[4].

The EU clarified that accounting rules for its target under the UNFCCC are more ambitious than the rules under the Kyoto Protocol, including international aviation for example, and adding an annual compliance cycle for emissions under the Effort Sharing Decision or higher Clean Development Mechanism quality standards under the EU Emissions Trading System). Accordingly, the following assumptions and conditions apply to the EU's 20% target under the UNFCCC:

- The EU Convention pledge does not include emissions/removals from Land Use, Land Use Change and Forestry, but it is estimated to be a net sink over the relevant period. EU inventories also include information on emissions and removals from LULUCF in accordance with relevant reporting commitments under the UNFCCC. Accounting for LULUCF activities only takes place under the Kyoto Protocol.
- The target covers the gases CO_2, CH_4, N_2O, HFCs, PFCs and SF_6.
- The target refers to 1990 as a single base year for all covered gases and all Member States. Emissions from international aviation to the extent they are included in the EU ETS are included in the target[5].
- A limited number of CERs, ERUs and units from new market-based mechanisms may be used to achieve the target: in the ETS, the use of international credits is capped (up to

[2] FCCC/SB/2011/INF.1/Rev.1 of 7 June 2011

[3] FCCC/AWGLCA/2012/MISC.1 from 24 April 2012 "Additional information relating to the quantified economy wide emission reduction targets contained in document FCCC/SB/2011/INF.1/Rev.1"

[4] Presentation provided by Arthur Runge-Metzger on 'Clarification of developed country Parties pledges' at UNFCCC Workshop on clarification of the developed country Parties quantified economy-wide emission reduction targets and related assumptions and conditions (AWG-LCA 15) on 17 May 2012, available at: https://unfccc.int/files/bodies/awg-lca/application/pdf/02_eu.pdf

[5] In the EU, the sum of emissions covered by categories 1.A.3.a 'domestic aviation' and memo item 'international bunkers - aviation' go beyond the scope of the EU target, as emissions from international aviation are included in the EU Climate and Energy Package and the EU target under the UNFCCC to the extent to which aviation is part of the EU ETS.

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 LU-LUCF 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 being permitted to use an additional 1% from projects in Least Developed Countries or Small Island Developing States, subject to conditions.

– The Global Warming Potentials used to aggregate GHG emissions up to 2020 under EU legislation were those based on the Second Assessment Report of the IPCC when the target was submitted. In accordance with the CMP Decision to revise the GWPs to those from the IPCC Fourth Assessment Report, revised GWPs from AR4 were adopted for the EU ETS. The revised GWPs were taken into account for the revision of the ESD target. For the implementation until 2020, GWPs from AR4 are used consistently with the UNFCCC reporting guidelines for GHG inventories.

3.2. EU target compliance architecture

With the "2020 climate and energy package" the EU has set internal rules which underpin the implementation of the target under the Convention. The 2020 climate and energy package introduced a clear approach to achieving the 20% reduction of total GHG emissions from 1990 levels (the international reference year), which is equivalent to a 14% reduction compared to 2005 levels (2005 was the first year in which the ETS regulations were in force, and hence the first year for which Europe had sufficient data to make the classification).

This effort was divided between the sectors covered by the EU Emission Trading System (EU ETS) and sectors under the Effort Sharing Decision (ESD)[6]. Consequently, the EU 2020 Climate and Energy Package aims at:

– a 21% reduction target compared to 2005 for emissions covered by the ETS (including domestic and international aviation),
– and a 10% reduction target compared to 2005 for non-ETS sectors, shared between the 28 Member States through the differentiated national GHG targets included in the ESD.

Additionally, the package sets targets to increase the share of renewable energy in gross final energy consumption at EU level by 20%, and to improve energy efficiency at EU level by 20%.

Under the revised EU ETS Directive[7], one single EU ETS cap covers the EU Member States and the three participating non-EU Member States (Norway, Iceland and Liechtenstein), i.e. there are no further differentiated caps by country. For allowances allocated to the EU ETS sectors, annual caps have been set for the period from 2013 to 2020; these decrease by 1.74% annually, starting from the average level of allowances issued by Member States for the second trading period (2008–2012). The annual caps imply interim targets for emissions reductions in sectors covered by the EU ETS for each year until 2020. For further information on the EU ETS and for information on the use of flexible mechanisms in the EU ETS see EU-BR4.

Non-ETS emissions are addressed under the Effort Sharing Decision (ESD)[8]. The ESD covers emissions from all sources outside the EU ETS, except for emissions from international maritime, domestic and international aviation (which were included in the EU ETS from 1 January 2012) and emissions and removals from land use, land-use change and forestry (LULUCF). It therefore includes a diverse range of small-scale emitters in a wide range of sectors: transport (cars, trucks), buildings (in particular heating), services, small industrial installations, fugitive emissions from the energy sector, emissions of fluorinated

[6] Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community (OJ L 140, 05.06.2009, p. 63)

[7] Directive 2009/29/EC of the European Parliament and of the Council amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community

[8] Decision No 406/2009/EC

gases from appliances and other sources, agriculture and waste. Such sources currently account for about 60% of total GHG emissions in the EU.

While the EU ETS target is to be achieved by the EU as a whole, the ESD target was divided into national targets to be achieved individually by each Member State. The Effort-Sharing Decision (EC/406/2009) set national emissions targets for 2020, expressed as percentage changes from 2005 levels. These changes have been transferred into binding quantified annual reduction targets for the period from 2013 to 2020 (EC 2013)[9,10 11], expressed in Annual Emission Allocations (AEAs). Belgium has a commitment to reduce its greenhouse gas emissions in non-ETS sectors by 15% compared to 2005 emissions. The quantified annual reduction targets of Belgium are tightened from 78 379 825 tonnes of CO_2 equivalent in 2013, decreasing to 68 247 607 tonnes of CO_2 equivalent in 2020 (584 228 513 tonnes of CO_2 equivalent for the 2nd commitment period under the Kyoto Protocol).

If a gap occurs for one or more determined year(s) during the period, identified through an annual review process at EU level, there are rules in the ESD to restore or compensate for the trend.

In 2013, verified emissions of stationary installations covered under the EU-ETS in Belgium totalled 45 Mt of CO_2 equivalent (44 Mt in 2017). With total GHG emissions of 119 Mt of CO_2 equivalent (without LULUCF) (115 Mt in 2017), the share of ETS emissions is 38% (unchanged in 2017).

The monitoring process is harmonised for all European Member States, as laid down in the Monitoring Mechanism Regulation[12]. The use of flexible mechanisms is possible under the EU ETS and the ESD. For the use of CER and ERU under the ETS, please refer to the European BR4.

The ESD allows Member States to make use of flexibility provisions for meeting their annual targets, with certain limitations. There is an annual limit of 3% for the use of project-based credits for each Member State. If these

[9] Commission decision of 26 March 2013 on determining Member States' annual emission allocations for the period from 2013 to 2020 pursuant to Decision No 406/2009/EC of the European Parliament and of the Council (2013/162/EU)

[10] Commission Implementing Decision of 31 October 2013 on the adjustments to Member States' annual emission allocations for the period from 2013 to 2020 pursuant to Decision No 406/2009/EC of the European Parliament and of the Council (2013/634/EU)

[11] Decision 2017/1471/EU (OJ:L209/53/2017) amending Decision 2013/162/EU to revise Member States' annual emission allocations for the period from 2017 to 2020

[12] Regulation (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC

Table 3.2 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)

	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

are not used in any specific year, the unused part for that year can be transferred to other Member States or banked for own use until 2020.

As Belgium (together with Austria, Cyprus, Denmark, Ireland, Italy, Luxembourg, Portugal, Slovenia, Spain and Sweden) fulfils the additional criteria laid down in ESD Article 5(5), 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. These credits are not bankable and transferable.

Detailed information on the EU target compliance architecture as well as an overview table of EU targets (international commitments and EU domestic legislation) can be found in the 4th Biennial report of the EU (chapter 3).

Beyond 2020

Until 2030

To pursue its decarbonisation objective, the EU has established the 2030 EU Climate and Energy Framework, for the period 2021-2030. This framework, adopted by the European Council in October 2014, establishes a target for the EU to domestically reduce its GHG emissions by at least 40% by 2030 (compared to 1990 levels), as communicated in the EU INDC[13].

This target includes the following components to be achieved by 2030:

- Emissions under the EU ETS should be reduced by 43% (compared to 2005);
- Emissions in the Effort Sharing sectors should be cut by 30% (compared to 2005). The Belgian objective of reducing GHG emissions by 2030 in the non-ETS sectors is -35% compared to 2005;
- Member States have to ensure that the LULUCF sector does not create debits and thespecific accounting rules are set out in the LULUCF Regulation 2018/841[14] (Land Use, Land Use Change and Forestry are thereby for the first time included in the greenhouse gas mitigation framework)emissions and removals from the LULUCF sector are included in the EU's climate target for the first time through) ;

As part of the European Green Deal, the Commission aims to propose raising this target to at least 50% and towards 55% in a responsible way. The European Council invited the Commission in December 2019 to put forward, after a thorough impact assessment, its proposal for an update of the EU's nationally determined contribution (NDC) for 2030 in good time before COP26.

Also renewable energy and energy efficiency targets were set out as part of the 2030 Climate and Energy Framework. The Revised Renewable Energy Directive (2018/2001)[15] and Energy Efficiency Directive (2018/2002)[16] set a binding renewable energy target (at least 32% of final energy consumption) and a headline target for energy efficiency (at least 32.5% of final energy consumption) by 2030.

In accordance with the Regulation on the Governance of the Energy Union and Climate Action (2018/1999)[17], Belgium has finalised its integrated National Climate and Energy Plan (NECP) covering the period 2021-2030 (see chapter 4) as well as its "national forest accounting plan" (in accordance with article 8(3) of Regulation (EU) n°2018/841).

Until 2050

In December 2019, the European Council endorsed, in the light of the latest available science, the objective of achieving a climate-neutral EU by 2050, in line with the objectives of the Paris Agreement. This decision was taken after a year long extensive debate among the Member States, institutions, local and regional authorities, social partners, businesses, industry, stakeholders and the citizens, following the adoption of the 'Clean Planet for All'-Communication by the European Commission, which sets out a European strategic long-term vision for a prosperous, modern, competitive and

[13] Intended Nationally Determined Contribution of the EU and its Member States – March 2015

[14] Regulation (EU) 2018/841 of 30 May 2018 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework, and amending Regulation (EU) No 525/2013 and Decision No 529/2013/EU

[15] Directive (EU) 2018/2001 of 11 December 2018 on the promotion of the use of energy from renewable sources

[16] Directive (EU) 2018/2002 of 11 December 2018 amending Directive 2012/27/EU on energy efficiency

[17] Regulation (EU) 2018/1999 of 11 December 2018 on the Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council

climate neutral economy. The objective of a climate-neutral EU by 2050 forms the basis of the EU's long-term low greenhouse gas emission development strategy, as submitted to the UNFCCC by Croatia and the European Commission on behalf of the European Union and its Member States on 6 March 2020.

In accordance with article 15 of Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action, in February 2020, Belgium finalised its long-term strategy (Fr / Nl), which does not include an overall objective for the reduction of greenhouse gas emissions by 2050, but sets out an expected emissions level for the sectors outside of the EU ETS of about -85 to -87% by 2050, compared to 2005. It also includes the main guidelines and preconditions/points of attention to be considered in order to achieve these objectives. It is based on the long-term strategies developed by the Flemish, Walloon and Brussels governments for their respective regions (which are annexed to Belgium's long-term strategy), as well as on some elements of the strategy document of the federal administration, 'Vision and strategic workstreams for a decarbonized Belgium by 2050'.

3.3. CTF tables

CTF Table 2: Description of the quantified economy-wide emissions reduction targets: Tables 2(a)-2(f)

Base year and target		
Base year/ base period	1990	**Comments:** Legally binding target trajectories for the period 2013-2020 are enshrined in both the EU-ETS Directive (Directive 2003/87/EC and respective amendments) and the Effort-Sharing Decision (Decision No 406/2009/EC). These legally binding trajectories not only result in a 20% GHG reduction in 2020 compared to 1990 but also define the EU's annual target pathway to reduce EU GHG emissions from 2013 to 2020. The Effort-Sharing Decision sets annual national emission targets for all Member States for the period 2013-2020 for those sectors not covered by the EU emissions trading system (ETS), expressed as percentage changes from 2005 levels. In March 2013, the Commission formally adopted the national annual limits throughout the period for each Member State. By 2020, the national targets will collectively deliver a reduction of around 10% in total EU emissions from the sectors covered compared with 2005 levels. The emission reduction to be achieved from the sectors covered by the EU ETS will be 21% below 2005 emission levels.
Emissions reductions target (% of base year/base period)		
Emissions reductions target (% of 1990)	20%	
Period for reaching target	By 2020	

Gases and sectors covered. GWP values				
Gases covered	Covered	Base Year	GWP reference source	Comments
CO_2	Yes	1990	IPCC AR4	As adopted in the UNFCCC reporting guidelines for national GHG inventories of Annex I Parties and as adopted under the EU Monitoring Mechanism Regulation
CH_4	Yes	1990	IPCC AR4	
N_2O	Yes	1990	IPCC AR4	
HFCs	Yes	1990	IPCC AR4	
PFCs	Yes	1990	IPCC AR4	
SF_6	Yes	1990	IPCC AR4	
NF_3	NO			Reporting on NF_3 takes place within the framework of the Kyoto Protocol

Sectors covered	Covered	Comments
Energy	Yes	
Transport	Yes	
Industrial processes	Yes	
Agriculture	Yes	
LULUCF	No	
Waste	Yes	
Aviation -out-going flights		In principle, the EU ETS should cover CO_2 emissions of all flights arriving at, and departing from, airports in all EU Member States, Norway, Iceland and Liechtenstein and closely related territories. However, since 2012, flights to and from airports from other countries have not been included in the EU ETS. This exclusion was taken in order to facilitate negotiation of a global agreement to address aviation emissions in the forum of the International Civil Aviation Organisation (ICAO). The EU has decided on a reduced scope in the 2013–2016 period (Regulation (EU) No 421/2014 of the European Parliament and of the Council of 16 April 2014). In light of the adoption of a Resolution by the 2016 ICAO Assembly on the global measure, the EU has decided to maintain the geographic scope of the EU ETS limited to intra-EEA flights from 2017 onwards (Regulation (EU) 2017/2392 of the European Parliament and of the Council of 13 December 2017). In the absence of an amendment, the EU ETS will revert back to its original full scope from 2024.
Role of LULUCF sector		
LULUCF in base year level and target	excluded	The EU pledge does not include emissions/removals from Land Use, Land-Use Change and Forestry to deliver its firm independent commitment to reduce greenhouse gas emissions by at least 20% compared to 1990 by 2020. The EU LULUCF sector is however estimated to be a net sink over that period.

Possible scale of contributions of market-based mechanisms		
Possible scale of contributions of market-based mechanisms under the convention		**Comment:** The 2020 Climate and Energy Package allows Certified Emission Reductions (CERs) and Emission Reduction Units (ERUs) to be used for compliance purposes, subject to a number of restrictions in terms of origin and type of project and up to an established limit. In addition, the legislation envisages the possible recognition of units from new market mechanisms. Under the EU ETS, the limit does not exceed 50% of the required reduction below 2005 levels. In the sectors not covered by the ETS, annual use will not exceed 3% of each Member States' non-ETS greenhouse gas emissions in 2005. Belgium may use an additional 1%, from projects in LDCs or SIDS, subject to conditions.
CERs		The use of these units under the ETS Directive and the Effort-Sharing Decision is subject to the limits specified above which do not distinguish between CERs and ERUs, but include additional criteria for the use of CERs.
ERUs		
AAUs		AAUs for the period 2013-2020 have not yet been determined. The EU expects to achieve its 20% target for the period 2013-2020 with the implementation of the ETS Directive and the ESD Decision in the non-ETS sectors, which do not allow the use of AAUs from non-EU Parties.
Carry-over units		The time-period of the Convention target is from 1990-2020, no carry-over units will be used to achieve the 2020 target
Other mechanism units under the Convention (specify)		There are general provisions in place in the EU legislation that allow for the use of such units provided that the necessary legal arrangements for the creation of such units have been put in place in the EU, which was not the case when this report was published.
Any other information:		In December 2009, the European Council reiterated the conditional offer of the EU 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 emissions reductions and that developing countries contribute adequately according to their responsibilities and respective capabilities.
Possible scale of contributions of other market-based mechanisms		Belgium does not recognise the use of market-based mechanisms other than those under the Convention for the achievements of quantified economy-wide emissions reduction targets.

4. Progress with achievement of quantified economy-wide emissions reduction targets and relevant information

4.1. Mitigation actions and their effects

4.1.1 The Belgian context

4.1.1.1 General context

Belgium is a federal state where decisional power is shared between a federal State and three Regions (Wallonia, Flanders and the Brussels-Capital Region), climate change policies and measures are developed by each of those four authorities.

However, coordination bodies have been set up to harmonise and create synergy between the policies implemented by the various authorities, among which the **National Climate Commission** (NCC) is directly concerned by the matters covered here.

In this context, a National Climate Plan 2009-2012 (NCP) was adopted by the NCC in April 2009 and extended until 2020.

In 2019, an update of the Belgian national system for policies and measures and projections was reported[1], which describes Belgium's PAMs and Projections systems and QA/QC programmes in application of the Monitoring Mechanism Regulation.

A **National Energy and Climate Plan** (NECP, cfr. chapter 4.1.3) 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 in the NECP. It was elaborated jointly by the energy

[1] National system for policies and measures and projections and the quality assurance and control (QA/QC) programme (March 2019)

policy coordination platform (CONCERE/ENOVER) and NCC. As part of the preparation of the NECP, a specific steering group, CONCERE-NCC NECP 2030, was set up to ensure coordination and steering. This steering group was composed of representatives of the climate and energy administrations of each Region and of the Federal state.

The primary aim of the NECP is to meet Belgium's commitments under the governance regulation including for climate the European Union's Effort-Sharing Regulation to achieve the 2030 objectives.

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 for the 2013-2020 period) which has not yet been the subject of an agreement.

4.1.1.2. Main elements of the NECP

Main objectives

See Table 4.1.

Main mitigation policies and measures

Federal state

- Incentivising greening Mobility and Transport : Investments in strengthening and optimizing rail transport for passengers and goods (€ 35 billion) (PAM 18), Adjustment / optimization of legal framework and greening of the fleet of company cars (PAM 16), Fiscal reform to promote sustainable mobility and intermodality (PAM 20)
- Encouraging renovation and improving energy efficiency in buildings (Public buildings PAM 10, reduced VAT on renovation (PAMs 6 and 7), Third Party Financing tools PAM 9)
- Renewable energy contributions: Offshore (PAM 1) & biofuel blending (PAM 2)
- Financing the transition: Green OLOs (PAM 30).

Flemish Region

- Energy policy agreements for agriculture and industry (PAMs 54 and 57)
- Encouraging the renovation of residential buildings after notarial transfer and requiring the renovation of non-residential buildings after notarial transfer (PAM 48)
- Reduce N_2O emissions from caprolactam production and F-gas emission reduction measures (PAMs 59 and 60)
- Accelerate asbestos protection of the roofs of homes and encourage reconstruction after demolition (PAM 49)
- Stimulate low-carbon vehicles and zero-emission vehicles among private individuals, company fleets and buses, provide charging infra-

Table 4.1 European framework

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 (Art 7 Energy Efficiency Directive)	185TWh	

structure and stimulate innovation for greening freight transport (PAM 46).

Wallon Region

- Implementation of measures linked to the energy renovation strategy of buildings (PAMs 72- 81 and 97 - 101)
- Implementation of FAST Vision measures (Mobility) (PAMs 86 - 89)
- Increasing the production capacity of electricity, heat and cold from renewable sources (PAMs 115-123)
- Specific measures in the sector of non-ETS industries (PAM 106)

Brussels Region

- Implementation of measures to reduce the environmental impact of buildings in Brussels in the 2030 and 2050 horizon and measures to make the buildings sector low in carbon (PAM 128)
- Implementation of Good Move Plan measures (Mobility) (PAM 172)
- Increased capacity for generating electricity, heat and cooling from renewable sources inside and outside the regional territory (PAMs 149-152)
- Progressive adjustment of the Low Emission Zone (LEZ) and progressive exit of the thermal motor (PAMs 191-194)

4.1.2 The Kyoto commitment

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. 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).

4.1.3 The European framework

4.1.3.1 2020 climate and energy package

As a Member State of the European Union, Belgium is committed to provide its contribution to the objectives of the 2020 climate & energy package by:

- Covering 13% of its gross final energy consumption with renewable energy sources by 2020
- Reducing GHG in non ETS sectors by 15 % in 2020 (from 2005 level). LULUCf is not included.
- Using energy more efficiently (indicative energy efficiency target of 18% reduction of primary energy compared to the projected gross inland energy consumption (Primes 2007) – excluding non energy uses – for 2020)

For more information we refer to chapter 3.2 (and chapter 4.1.2.2. of NC7).

4.1.3.2 2030 climate and energy framework

In 2014, the European Council agreed on the 2030 climate and energy policy framework for the EU and endorsed new EU targets on greenhouse gas emissions, renewable energy and energy efficiency for 2030:

- at least 40 % reduction (compared to 1990) of domestic greenhouse gas emissions.

  This target is divided between:

  - a target of -43 % (compared to 2005) for the ETS sector
  - a target of -30 % (compared to 2005) for the non ETS sector (translated into binding national targets for the Member States).
- minimum 32 % renewable energy share by 2030.
- reducing Europe's energy use by at least 32.5 % by 2030.

The effort sharing regulation allocates the 2030 targets among Member States. For Belgium, the GHG reduction is set at -35 % in 2030 compared to 2005. For each Member State the 2030 target is the end point of a linear reduction trajectory defining annual emission reductions for the years 2021-2030.The annual trajectory will be set out later in a Commission implementing act.

The 2030 targets are proposed to be revised as part of the European Green Deal.

The 2030 targets still need to be shared between the 4 authorities in a new 'burden sharing' agreement. between all 4 authorities .

The Regulation on the governance of the energy union and climate action (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 to 2030, It 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.

4.1.3.3 ETS

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

As a single EU-wide cap on emissions now applies since 2013 (allocation plans are now drawn up by the European Commission at European level and by sectors), Belgium manages and monitors the implementation of the ETS on its territory.

4.1.4 PAMS reported in the CTF table 3

The NECP is structured according to 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 internally to track them.

Major reduction measures

The vast majority of policies and measures address issues related 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 aim at the development of renewable energy sources (RES) and 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, only RES in Flanders but with a separate CHP certificates market). The promotion of offshore wind farms and biofuel blending also constitutes an essential tool for RES development.

Emission trading has a significant role also, but quota allocations were essentially performed with a view to new RES and CHP developments, rather than in expecting energy efficiency improvements in existing power plants.

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.

Mandatory preparation of an energy certificate for any building prior to a transaction (sale, rental) should offer, in the medium and long term, a way of giving added value to the most efficient buildings. The improvement of existing residential buildings can, among other things, benefit from regional subsidies and low interest loans.

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.

Transport

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

– Limiting road-traffic growth and incentivising the "modal shift" (towards rail or waterways) by improving public transport and upgrading infrastructure;
– Encouraging drivers to acquire and use low-carbon vehicles (information, tax incentives) and to optimise their use (eco-driving, car-sharing, etc.).

Emissions from the transport sector have been increasing with time until 2015. Particular efforts aim at promoting 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 high energy consuming models.

Belgium is also in the process of producing and distributing increasing quantities of bio-fuels.

Agriculture and forestry

Initiatives in the agricultural sector focus on reducing greenhouse gas emissions by improving agricultural practices (processing, storage and spreading of manure, waste recovery, 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 (ban on landfill, mandatory treatment of landfill gases, standards for incinerators) and the development of specific channels for waste recovery and treatment.

4.1.5 Impact of mitigation measures on emissions

Methodology for quantifying the impact of measures on GHG emissions

Many of the NECP measures are new and/or prolongated policies which require an in-depth evaluation of calculation methods and the establishment of reliable indicators. These improvements should be implemented in the next reporting exercise. Therefore for many PAMs no information is provided in CTF Table 3 on its impacts in term of GHG reduction. This does not mean that the impact is zero but the impact is not (yet) assessed. Reported estimations of GHG emission reductions at the federal level are limited to federal PAMs in place before the NECP that are still implemented or which still deliver effects in term of GHG reductions. Those PAMs where evaluated through an assessment carried out in 2017 ("Development of impact assessment methods for policies and measures carried out within the framework of the federal climate policy – Evaluation of emission reductions Report"). For more info on the methodologies used, we refer to full report of this assessment.

For Wallonia, expected impact are based in particular on the work carried out by a consultant, ECONOTEC, with the EPM model (technical-economic model) for the energy production, industry, residential and tertiary sectors. Transport sector projections have been modeled using the COPERT tool. These projections may be scalable, depending on the change of context or the existence of new tools. The TIMES model (optimization model) is being developed in Wallonia.

For the Flemish Region and the Brussels-Capital Region, the impact assessment is derived from the WEM and WAM projections as developed for the NECP.

Measures

CTF Table 3 provides a detailed overview of each measure and, where possible, estimates of the impact of these measures on greenhouse gas emissions.

The table gives these estimates for the 3 main areas: energy, industry, transport.

The structure of the main areas contained in the NECP has been slightly altered here in order to highlight the most salient facts. Accordingly, measures linked to the public authorities leading by example have been allocated to the different corresponding areas.

Total quantifiable mitigation impacts amount to 18 490 kt in 2020. 69% of that potential relates to the energy sector. 88% of those reductions are attributed to 5 PAMs:

– Promotion of off shore wind
– Promoting biofuels

– F-gases action plan
– Ecodesign : Promotion of energy efficient electrical appliances
– Financial support to rational use of energy (RUE) and renewable energy systems (RES) in the residential sector

The contribution of RES for electricity production amounts to around 25%.

Generally speaking, impacts presented in the table are only orders of magnitude. The uncertainties linked to the estimate of "ex ante" impacts can be very significant, due to the quality of statistics and the numerous assumptions that have to be stated.

Furthermore those figures need to be interpreted with care as the impact of many PAMs have not been assessed yet.

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 industry, specific measures taken to reduce N_2O emissions from industrial processes in 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 fluorinated gas leakages;
– In agriculture, managing nitrates to reduce N_2O emanations, and reducing CH_4 emissions from bovine livestock.

Long-term impacts

Many of the measures from the NECP concern support for investments whose effects will be sustained 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 the case for investment in infrastructure: building insulation, construction of new low-energy buildings and facilities, but also, for example, infrastructures that encourage modal shifts. Investments such as loading docks, broad gauge waterways, railway adaptations, and the purchase of rail machinery cover 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, average service life can be 20 years or more. This will also be the case for infrastructure that uses renewable energy sources, whose service life varies 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.

Policies and measures that are no longer applied

Compared to the previous report, the following PAMS were deleted from the summary table (minor impact on GHG emission reduction and/or expired):

– SE-A01 : Climate Change Awareness : minor impact on GHG emission
– SE-A02 : Tools to promote rational energy use and renewable energy
– SE-A03 : Environmental awareness in schools
– TR-A01 : Mobility plans at local level
– AG-C02 : Preserve the ecological stability of forests (certification)
– AG-D04 : Quality standards for biofuels (wood pellets)
– WA-A01 : Minimise quantities of wastes dumped into landfills: The tax has been discontinued as of 1 January 2015 (Programme law of 19 December 2014)
– OB-C02 Promotion of alternative transport in public services
– TR-C02 : Promoting the purchase of clean vehicles* (Wallonia)
– TR-C04 : Specific support for the construction of clean vehicles*
– IP-C01 : Specific emission reduction agreement with nitric acid producer (Flemish Region)

Most other PAMs were maintained / broadened / enlarged in the context of the NECP, among others:

– EP-A03 : End of tax exemption on coal and heavy fuel
– EP-A05 : Action plan for renewable energy systems (RES)
– EC-B02 : Efficiency and emission regulation for boilers and stoves in the residential sector
– EC-B01: Financial support to rational use of energy (RUE) and renewable energy systems (RES) in the residential sector
– EC-B03: Specific support for rational use of energy (RUE) initiatives for people with low incomes
– EC-C01 : Third party financing in the public sector

- IP-A06 : Specific financial measures and ecology premiums for industry (PNEC 3.1.1.C)
- IP-A03: energy planning in industries (Flemish Region)
- TR-A02 : Improve and promote public transport (NECP (3.1.1.B))
- TR-A03 : Promote the use of bicycles
- TR-A04 : Promote multimodal freight transport
- TR-A05: Improve road transport efficiency (Flemish Region)
- TR-A08: Free public transport for commuters
- TR-B02 : Promotion of car sharing
- TR-D01 : Promoting bio-fuels (NECP 3.1.1. B and 3.1.2/ FECP 2.1.2 ii)
- OB-A01 : Sustainable public procurement
- OB-B01 : Rational Use of energy in public buildings
- OB-B02: Third Party Financing in public buildings
- OB-C03 : Promoting bicycle use in public services
- OB-C04 : Promoting telework in public services
- OB-C07 : Purchase of clean vehicles by public administrations
- Ecocheques
- Green loans
- reduction of the emissions of fluorinated greenhouse gases
- Revision company car framework
- Incentives for pedelecs
- Reduction energy use of railways (traction & non traction)
- Modification of fiscal regime for company cars

Impact of response measures

Many of the NECP measures are new and/or prolongated policies which require an in-depth evaluation, i.a. on 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 are thus globally reduced when Annex I countries (and Belgium among them) take measures aiming to reduce GHG emissions through energy savings and the promotion of renewable energy sources. Furthermore, most of those actions contribute to reduce air pollution related to the fossil fuels uses for the benefit of all countries.

As a Member State of the European Union, Belgium designs and implements most of its policies in the framework 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 actions aiming to address market imperfections and to better reflect externalities in energy/ CO_2 prices.

Various international bodies have identified areas where 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 aims achieving an equality of excises for diesel and gasoline has been implemented ("Royal Decree of 26 October 2015" and 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.

The NECP foresees a national inventory of all fossil fuel subsidies will be communicated to the EC by end of 2020.and an action plan will be put in place by the federal state by 2021 to phase out fossil fuel subsidies based on a step by step approach, taking into account the guarantee of the SoS. The plan will include concrete and social corrective steps in order to accompany the transition to a climate neutral society.

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

Belgium is in various ways actively involved in the promotion and protection of human rights, e.g.:

- Establishment of a solid legal and policy framework for combating gender- based discrimination ;
- Support of the Office of the High Commissionner for Human Rights as a partner organisation of multilateral cooperation.
- Focus on the rights of women in the programming cycles of cooperation activities.
- Recent decision to work out a national action plan on business and human rights which will ensure the implementation of social responsibility and the anchorage of human rights within the business sector;
- Commitment to develop a 2nd national plan to combat child poverty;
- etc.

For more info, we refer to the 1st Belgian National Voluntary Review on the Implementation of the 2030 Agenda ("Pathways to sustainable development").

Finally, the NECP alos foresees:

- The organisation of a "National dialogue on the just transition to a climate-neutral society" 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.
- The Belgian agricultural policies and the promotion of biofuels are developed within the European common policies. Concerning biofuels, 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 in particular include not supporting biofuels from land with 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 bleding respectively in 2030. A biannual study is excecuted 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, consumer costs as well as the availability of other renewable energy sources.

4.2. 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 Table 4(a)II in its 2020 submission, but not 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 for the first years under the ESD (2013-2017), Belgium did not make use of any international credits for annual ESD compliance. Therefore, CTF table 4 shows keynote 'NA'. ■

5. Projections

5.1. Projections

5.1.1 Introduction

The greenhouse gas projections with existing measures (WEM scenario) and with additional measures (WAM scenario) are consistent with the GHG projections of the final Belgian National Energy and Climate Plan submitted on 31/12/2019 to the European Commission.

The greenhouse gas emission projections were elaborated in the course of 2018-2019 based on the most recent information available on the macro-economic context and policy implementation (see chapter 4). For the reference year 2016, unadjusted emission data are used from the inventory submission in 2019 (dated 15/04/2019) taking into account the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

Except for electricity production and bunker fuels, the reported projections are the sum of the bottom-up projections of the three regions (Flanders, Wallonia, Brussels-Capital) which are calibrated on the regional energy balances. The bottom-up 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 at a sectoral level. The electricity production and the bunker fuel emissions are modelled at 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 kilometers, 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 is integrated in the projected emission figures.

Descriptions of the models used for the calculation of the regional and national projections are included in annex 1 of this report (Flemish energy and greenhouse gas emission simulation model, EPM and Energy and Atmospheric Emissions projection model for the Brussels-Capital Region for regional projections).

5.1.2 General projection Assumptions

The following general assumptions are used in the calculations of regional bottom-up emission projections (unless otherwise indicated).

All implemented and adopted (EU, federal, regional) policies and measures, considered until the end of 2018, have been taken into account in the 'with existing measures' (WEM) scenario. Planned policies and measures in the context of the final Belgian National Energy and Climate Plan have been integrated in a scenario with additional measures (WAM).

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

5.1.2.1 Emission factors

Emission factors reported in the 'Belgium's Greenhouse Gas Inventory (1990-2017) National Inventory Report' have been used for the calculation of the projections.

More specifically, the emission factors for the energy related CO_2 projections (CRF Cat 1A Fuel Combustion Activities) are presented in Table 51. The emission factors for coke, petroleum coke, coke oven gas, refinery gas and blast furnace gas are adjusted values based on inquiries with the sector, in contrary to the other factors which are IPCC default values. In the Brussels-Capital Region, waste emission factors are estimated based on measurements in the incinerator.

Table 5.1 Emission factors used for the energy related CO_2 emission projections

Fuel	Emission factor (kton CO_2/PJ)		
	Flanders	Wallonia	Brussels
Hard coal	94.6	94.6	94.6
Cokes	107.0	107	
Brown coal, lignite		101	
Other solids (waste, ...)	variable	variable	variable
Natural gas	56.1	56.1	56.1
Cokes oven gas	44.4		
Blast furnace gas	260.0		
Refinery gas	57.6		
Heavy fuel oil	77.4	77.4	77.4
Petroleum cokes	97.5	97.5	
Light fuel oil, gas oil	74.1	74.1	74.1
Gasoline	70.0	69.3	
LPG	63.1	63.1	63.1
Other petroleum products	73.3	73.3	

5.1.2.2 *Global Warming Potential*

CO_2 equivalent emissions and projected emissions 2016-2030 are calculated using the Global Warming Potential (GWP) values specified in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Table 5.2).

5.1.2.3 *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 2016-2030 is equivalent to the average degree-days of the 1991-2015 period. This average is equal to 1 870 degree-days (reference 15/15) and characterised a mild climate.

5.1.2.4 *Demographic evolution*

The demographic projections presented in Table 5.3 are based on the prospects by the Federal Planning Bureau. They were calculated per age, gender and district.

Table 5.2 Global warming potentials

Greenhouse Gas	GWP
CO_2	1
CH_4	25
N_2O	298

Table 5.3 Demographic evolution

	Statistics	Prospects		
	2016	2020	2025	2030
Population Belgium	11 267 910	11 511 172	11 772 648	11 995 359
Population Flanders	6 477 804	6 617 413	6 774 777	6 902 301
Population Wallonia	3 602 216	3 674 697	3 744 851	3 818 345
Population Brussels	1 187 890	1 219 062	1 253 020	1 274 713
Number of households Belgium	4 848 184	4 956 392	5 092 537	5 221 602
Number of households Flanders	2 748 019	2 836 976	2 917 709	2 990 172
Number of households Wallonia	1 554 771	1 609 572	1 657 863	1 709 548
Number of households Brussels	545 394	561 278	569 117	574 531
Average household size Belgium	2.32	2.32	2.31	2.30
Average household size Flanders	2.36	2.33	2.32	2.31
Average household size Wallonia	2.32	2.28	2.26	2.23
Average household size Brussels	2.18	2.17	2.20	2.22

5.1.3 Projections by sector

5.1.3.1 The power sector (electricity production) (CRF category 1A1a and autoproducers in other CRF categories)

The projections for the electricity production sector are modelled with the Flemish energy and greenhouse gas simulation model at national level. Projections for the electricity production consider:

- the evolution of the electricity demand (in some sectors);
- the evolution of the electricity production park and production efficiencies;
- the import of electricity;
- time slices (electricity demand is not equal in winter and in summer, neither during night or day).

Table 54 shows the demand and supply data of the electricity sector for Belgium (TWh) for both the WEM and WAM scenario.

The results in Table 5.4 show an increase of the electricity consumption between 2016 and 2030 with 6% in the WEM scenario and with 9% in the WAM scenario (i.e. respectively 0.4% and 0.6% per year on average). The trans-boundary electricity trading is considered exogenous in the modelling of the electricity production.

The net import levels in the Belgian projections up to 2030 are based on existing scenario reports of the Belgian power system. The actual evolution of the net-import will mainly depend on new trans-boundary transport capacities, commercial opportunities and the location of new production plants.

The WEM and WAM scenarios integrate the phase-out of nuclear energy in Belgium. On 31st January 2003, the Federal Government decided the progressive phase-out of the production of electricity using nuclear fission energy by limiting the operating lives of existing nuclear power plants to 40 years and prohibited the construction of new nuclear power plants. In July 2012, the Federal Government confirmed this timetable except for one nuclear unit, Tihange 1, whose operation lifetime was extended by 10 more years. This decision was confirmed in a law (18th December 2013). On 18th June 2015, another extension was approved (for

Table 5.4 Electricity demand and supply for Belgium (TWh)

		WEM			WAM		
	2016	2020	2025	2030	2020	2025	2030
Final consumption Belgium	84.3	82.9	86.1	89.1	82.9	86.9	91.5
Distribution losses and own use	7.2	5.6	5.4	5.7	5.1	6.9	8.3
Net import (balance export – import)	6.2	5.9	16.9	17.8	6.2	10.0	6.2
Gross production	85.3	82.5	74.6	77.0	81.8	83.8	93.6

Table 5.5 Nuclear phase out (according to the law of 18th June 2015)

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

the Doel 1 and Doel 2 units) through an amendment of the law of 31st January 2003. The timetable for the nuclear power phase-out between 2022 and 2025 mentioned in Table 5-5 (as inscribed in article 4 of this 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 5.6).

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

For the CO_2 emission projections originating from waste incineration each 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).

Flanders

The WEM and WAM projections with regard to electricity production from renewable sources, as mentioned in the final Flemish Energy and Climate Plan 2021-2030, haven been taken into account.

Wallonia

The impact of "green certificate" is taken into account until 2024 for the WEM scenario. Several measures (green certificate mechanism revision, regulation, …) increase electricity renewable energy targets in the WAM scenario around 10 TWh in 2030.

Brussels-Capital Region

WEM Scenario

Regarding energy production, the estimations are based on historic evolution of the waste incinerator based in the energy balances of the region; this is also the case for the waste water handling installations. In the case of the CHP (combined heat and power production system which are the cogeneration system), the estimation considers the average operating hours and the average annual evolution of the installed power between 2005 to 2015. The photovoltaic, thermal panels and the heat pumps production projections consider the "Note about the development of renewable energy until 2020" ; the objective in the note is the installation of 57MWc for the PV panels, 10GWh for thermal panels and 40GWh for heat pumps in 2020. For

Table 5.6 Offshore wind capacity WEM and WAM scenario (MW)

	2020	2025	2030
WAM scenario	2 261	2 261	4 011
WEM scenario	2 261	2 261	2 261

Table 5.7 Renewable electricity Flanders in WEM and WAM scenario (TWh)

	WEM			WAM		
	2020	2025	2030	2020	2025	2030
Solar	3.2	4.4	5.5	3.2	4.7	6.2
Wind onshore	2.7	2.7	2.7	2.7	3.9	5.0
Hydro	0.01	0.01	0.01	0.01	0.01	0.01
Biomass	2.9	1.7	0.5	2.9	1.7	0.5
Biogas	0.8	0.8	0.9	0.8	0.9	1.0
Total	9.7	9.7	9.6	9.7	11.2	12.8

the period 2021 to 2040 average evolution is considered.

WAM Scenario

Several measures are included in the energy production sector in the WAM scenario. The first one is the obligation of producing renewable energy equivalent at least at 15kWh/m².year for all new constructions (households or commercial buildings) starting in 2021 but effective from 2024. Half of the production is electricity (photovoltaic panels) and the other half is heat produced by thermal panels and heat pumps. In addition to this, the second measure is the continuation of the Solar Click project. It considers the additional production of 13GWh of electricity. It will take place from 2021 to 2025.

Regarding the waste water handling stations, the South station will modernise their installations implementing a small biomethanation plant while the Nord station will renew their CHP and boiler in order to reduce the use of the torch.

Finally, "Green certificates" will not be granted after 2030 meaning the end of the CHP production for the year 2040.

5.1.3.2 The (energy) conversion sector

5.1.3.2.1 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 2016. 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 for the Flemish region.

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

5.1.3.2.2 Coke production (CRF category 1A1c)

Flanders

In Flanders the WAM and WAM scenario assumes one coke production plant in steel industry operating at maximum capacity in the period 2016-2030 (Table 58), and equipped with a desulphurisation unit.

Wallonia

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

5.1.3.3 Oil transport (CRF category 1B2a3)

Flanders

Fugitive emissions of CO_2 and CH_4 from oil transport are assumed to remain constant at the 2016 level.

5.1.3.4 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 on the evolution of the

Table 5.8 Coke production

Coke production (Mton)	2016	2020	2025	2030
Flanders	1 085	1 085	1 085	1 085
Wallonia	0	0	0	0

Table 5.9 Activity assumptions for the industrial sector in Wallonia

Sector	Sub-sector	Activity variable		
		2015-2020	2020-2025	2025-2030
		(%/year)	(%/year)	(%/year)
Steel	Electric steel	0.0%	0.0%	0.0%
	Other steel enterprises	0.0%	0.0%	0.0%
Cement	Grey clinker dry process	4.03%	6.4%	0.0%
	Grey clinker wet process	8.5%	-100.0%	0.0%
	Cement production	2.3%	0.0%	0.0%
Lime	Lime production	3.3%	0.0%	0.0%
	Dolomite production	1.5%	0.0%	0.0%
	Other lime activities	0.0%	0.0%	0.0%
Glass	Flat glass	1.5%	1.6%	1.6%
	Hollow glass	2.3%	0.0%	0.0%
	Glass fiber and glass wool	2.6%	1.4%	1.4%
Chemical	Organic and inorganic chemicals	1.8%	1.5%	1.5%
	Nitric acid	1.0%	0.0%	0.0%
	Parachemicals	2.3%	2.3%	2.3%
	Ammonia	2.2%	0.0%	0.0%
	Other fertilisers (phosphates)	2.2%	0.0%	0.0%
	$O_x$ygen	1.8%	1.5%	1.5%
	Cogeneration	1.8%	1.5%	1.5%

Sector	Sub-sector	Activity variable		
		2015-2020	2020-2025	2025-2030
		(%/year)	(%/year)	(%/year)
Paper	Chemical pulp	0.0%	0.0%	0.0%
	Integrated graphic paper	0.0%	0.0%	0.0%
	Other graphic paper	-0.5%	-0.5%	-0.5%
	Household paper	0.5%	0.5%	0.5%
	Cogeneration	0.0%	0.0%	0.0%
Food industry		1.9%	1.5%	1.5%
Metal products		-4.8%	0.0%	0.0%
Non ferrous metals		0.0%	0.9%	0.9%
Other industries		1.2%	1.2%	1.3%

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

Calculation of CH_4 emissions from the distribution of natural gas in Wallonia is based on the assumption that the network does not experience further expansion. 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.

5.1.3.5 The industrial sector

5.1.3.5.1 Energetic CO_2 emission in the industrial sector (CRF category 1A2)

Projections of 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).

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) in category 1A2gvii.

Wallonia

Table 5.9 presents the assumptions made concerning the evolution of activity variables.

Rates of change of activities are based on statistics, estimates of market growths or perspectives of industrial sectors, investment projects and equipment closures that have occurred or have been announced.

Resulting rates are listed in the preceding table. After 2016, large installations are assumed to be maintained in activity. Expected structural changes are taken into account when known.

All major industries are involved in 'second generation' branch agreements whereby they are committed to improve their energy/CO_2 efficiency by 2020. For the period 2015-2020, it has been assumed that for each sector the improvement of energy efficiency and the reduction of specific CO_2 emissions up to 2020 will be those of the commitments contained in the sectoral

Table 5.10 Assumptions on energy efficiency improvements for the industrial sector in Wallonia

Sector	2015-2020	2021-2030
	(%/year)	(%/year)
Steel	-0.75%	-0.30%
Chemicals	-0.81%	-0.30%
Cement	-0.15%	-0.30%
Lime	-0.55%	-0.30%
Glass	-0.34%	-0.30%
Food	-1.18%	-0.30%
Pulp & paper	-0.69%	-0.30%
Textile, wood & furniture	-0.16%	-0.30%
Other industry	-0.50%	-0.30%

agreement. For the period 2020-2030, an improvement in energy efficiency of 0.3% per annum has been taken into account.

The assumptions on energy efficiency improvements are shown in Table 5.10.

For cogeneration, an improvement of specific consumption of fuel per MWhe of 0.5% per annum for the period 2015-2020 and of 0.3% per annum for the period 2021-2030 has been taken into account.

For the WAM scenario the same activity data were used. Several measures are included in the WAM scenario. There is an increase of renewable heat in the heat mix consumed in the Walloon industry. Two additional measures are considered in this scenario for non-ETS industry. There is a fuel switch from fossil fuels to electricity (7% compared to 2015) and a measure on energy efficiency (10% compared to 2015).

Brussels Capital Region

The projections are calculated on the basis of energy intensity. Industry sector in Brussels Capital Region faced an important decrease from the year 2000. Between 2008 and 2014, it has stabilised, representing approximately 3% of final energy consumptions in the region. The perspectives of a future expansion are very low. The projections assume that the gross added value will progress according to the middle term projections 2017-2022; from 2022 until 2030 this value remains constant.

The 8th December 2016 a new decree has been approved concerning energy audits obligations[1]. This decree is included in the WEM scenario. The objective of this decree is to diminish about 5% of total energy consumption of the biggest industrial companies located in the region. These companies consume approximately 50% of total industry energy consumption.

5.1.3.5.2 Process emissions of CO_2 (CRF category 2A, 2B, 2C)

Flanders

Main non-energetic uses of fuels in Flanders:

- natural gas for ammonia production (carbon converted to CO_2 emissions);
- natural gas for processes where 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 it concerns non-energetic use of fuel it is assumed that climate policy will not have an effect on the use of the fuels mentioned above. In addition, there are also several processes with 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, cyclohexanon, synthetic soda), in refineries, in the sector of non-metallic minerals, and during flaring and the desulphurisation of flue gasses.

As from the inventory submission in 2015 some emission categories have been re-allocated to CRF category 2 according to the IPCC 2006 guidelines:

- The emissions from the solid fuels (cokes gas, blast furnace gas, cokes grid and anthracite) have been re-allocated from the category 1A2a in previous submissions to the category 2C1a for the only big integrated steel plant in Flanders.
- The emissions from the production of ethylene are included in category 2B8b since the inventory submission in 2015. Until the inventory submission in 2014 these emissions were allocated to the category 1A2c (other fuels). These emissions cover the recovered fuels in the steam-cracking units in the petrochemical industry and other recovered fuels from the chemical industry.

The current inventory allocation method has been used for this projection report.

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-energetic uses of fuels in Wallonia:

- coal in the iron and steel industry and selected applications of engineering (metallic works);

[1] 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.

– 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 (Table 5.9).

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

5.1.3.5.3 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 5.1.3.5.1 above are assumed. The emission levels are directly linked with this same growth trend.

The N_2O emission originates from caprolactam (Flanders) and nitric acid (Flanders, Wallonia) production.

N_2O emission projections of caprolactam production are based on information from the concerned company 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.

N_2O emission projections of nitric acid production in Flanders is assumed to remain constant at the 2016 level. In Wallonia, N_2O emission projections of nitric acid projections are based on information from the concerned company 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.

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

Flanders

The emissions of non-energy products from fuels and solvent use are considered constant at the 2016 level for the entire projection period. This category includes:

– The CO_2 emissions from the use of lubricants (CRF category 2D1);
– The CO_2 emissions from the use of paraffin wax (CRF category 2D2);
– The CO_2 emissions from the urea used as a catalyst (CRF category 2D3).

Wallonia

The emissions of non-energy products from fuels and solvent have remained stable for 10 years around 35 kt CO_2. Those emissions are kept constant and equal to 32.48 kt CO_2 for the entire projection period for both WEM and WAM scenario.

Brussels-Capital Region

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

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

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

Flanders

N_2O emissions from this use in Flanders are kept constant at 2016 emission levels. Due to the lack of information about the evolution of consumption, the last historic value has been considered constant for the entire projection period.

Wallonia

N_2O emissions from this use in Wallonia are kept constant at 2015 emission levels. Due to the lack of information about the evolution of consumption, the last historic value has been considered constant for the entire projection period for both WEM and WAM scenario.

Brussels-Capital region

The use of N_2O as anaesthetic and aerosol cans is included in this cate-

gory. For Brussels Capital Region, the information on anaesthetic use is based on the regional sales of anaesthetic. Due to the lack of information about the evolution of anaesthetic consumption, the last historic value has been considered constant for the entire projection period.

Emissions due to the use of aerosol cans are also estimated in the RBC inventory considering a constant consumption per inhabitant. The emission projections of aerosol cans are based on population data from the Federal Planning Bureau (see section 5.1.2.4).

5.1.3.5.6 F-gas emissions (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 take into account a decrease of 50% of the emissions by 2030 compared to 2005. The following measures are considered:

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

In the **Flemish region**, the WAM scenario takes into account additional measures that are included in the final Flemish Climate Policy Plan for the period 2021-2030 and that aims 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.

5.1.3.6 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 5.1.2.4 above. Estimates are made on the number of new dwellings. Distinction is made between new and existing houses.

Flanders

Heating and equipment

New dwellings (WEM and WAM scenario):

As of 2016 it is assumed that the heat demand of all new single-family dwellings and apartments respect an E-level of 50 following the implementation of the EC directive on energy performance of buildings. This E-level tightens gradually to 30 as of 2021 (Table 5-11).

Existing dwellings:

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

- The average fuel consumption in an existing dwelling in 2016 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.

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;

Table 5.11 E-level pathway for the residential sector (2016-2021)

	2016	2018	2020	2021
E-level	50	40	35	30

– Optimization 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 evolution of the power consumption of electrical appliances and lighting has been simulated taking into account the results of the EU Reference scenario 2016. A yearly increase of 0.1% in the period 2015-2020 and 0.2% in the period 2020-2030 has been considered in this regard.

Off-road

The off-road emissions of the residential sector 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 residential sectors are allocated in category 1.A.4.b.ii (Off-road vehicles and other machinery).

Wallonia

WEM scenario

Heating

In the residential sector, the heat demand of all new dwellings takes into account the current EPB regulation in Wallonia, in force since 2012 with the different following requirements:

– 01.09.2011: $E_w = 80$; $E_{spec} = 130$ kWh/m²;
– 01.01.2017: $E_w = 65$; $E_{spec} = 115$ kWh/m²;
– 01.01.2021: $E_w = 45$; $E_{spec} = 85$ kWh/m².

where Ew is the "primary energy consumption level" and Espec is the "specific primary energy consumption level".

For existing dwellings, the decrease of specific energy consumption has been calculated based on energy savings per type of renovation and the number of annual renovations.

The number of renovations combined together with the energy savings per type of renovation lead to a decrease of the average specific consumption of existing housing of:

– 0.3% per year for houses and 0.1% per year for apartments between 2014 and 2020,
– 0.3% and 0.1% between 2021 and 2030.

The hot water consumption per dwelling is considered stable trough the period 2014-2030 which means that the hot water consumption per person increases slightly during the same period.

We consider the performance of electric boilers and gas water heaters to remain stable throughout the period. However, in the case of centralized production by the boiler, consumption for hot water production benefits from improved boiler performance. We estimated that the specific fuel consumption of this production mode decreased by 9% between 2012 and 2030.

The share of the use of electricity and fossil fuels to produce hot water is considered to remain stable over the projection period.

Electrical equipment

For equipment, it has been estimated that, in 2030, all of them will have specific consumption corresponding to the current best available technologies.

Fuel mix

The share of natural gas in fuel consumption is relatively constant over the

Table 5.12 Number of annual renovations by type

	Roofs	Walls	Floor	Windows
2016-2030	5 000	2 500	1 250	3 750

period 2014-2030 (about 35% for existing dwellings) while the share of fuel oil decreases slightly (51% in 2014 and 48% in 2030 for existing homes) to be compensated by wood (12% in 2014 to 15% in 2030).

WAM scenario

The WAM scenario for residential sector includes different measures:

- For new building, energy autonomy will go further (through voluntary measures and studying regulatory requirement strengthening).
- For all buildings, more heat is produced by renewable energy (biomass, heat pumps, ….).
- For existing buildings, the implementation of the "Renovation Strategy" will reduce the environmental impact of existing buildings. This strategy defines different objectives for energy efficiency of the envelope and the equipments of the existing buildings. This long-term strategy (2050), with intermediate objectives, already results in positive impact in 2030).
- Some behavioural changes.

Brussels-Capital Region

WEM scenario

Residential sector represented 38% of Brussels Capital Region total energy consumption in 2016.

The residential emission projections consider the historic trends between 2001 and 2014 on energy consumption, household size, and population. The projections also reflect the application of the Brussels Capital Region Government's Decree[2] regarding Energy Performance of Buildings. This decree will have an impact from 2018; it considers that all new buildings will be nearly passive (15kWh/m^2.yr) and 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.

The measures taken into account in the WEM scenario are related with the energy management and technical installations in buildings. The replacement of boilers is one of these measures. In fact, when a new boiler is installed, the entire heating system must be controlled by a certified technician; this action allows 20% reduction from heating consumption. Boiler replacement rate was estimated from the data provided by the Thermal Technique Belgian Association (ATTB, French acronym) and it was deduced from the boilers replaced with energy grants.

The second measure is also related to the heating installations. The mandatory control is applied for boilers that are part of a heating system with a nominal power higher than 20kW that uses non-renewable fuel, and whose heat transfer fluid is water. An annual control is established for oil boilers and every three years for natural gas boilers until 2018 and from 2019 natural gas boilers should have a control every two years. This control generates energy gains around 2% for gas boilers and 4% for oil ones. This measure lasts the whole projected period but the measures reaches only 5% 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 of 2009 to 2016 for building's isolation, double glazing implementation, heating regulation systems and boilers replacement. The energy gain is considered to last 20 years. This gain is multiplied by the annual budget; the WEM scenario considers a constant budget from 2016 to 2020 of 14.1 M€. After this period, the scenario considers the end of the grant system. According to the grant system report concerning the year 2013, residential sector benefits of 70% from total budget, this percentage was used to estimate the energy reduction of this sector and is kept constant between 2016 to 2020.

Moreover, the energy gains due to the household's support are also estimated. This measure considers a variety of actions realised by households thanks to the advice of the household's support. Actions like the change of the

[2] 21 December - 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.

traditional shower head towards an eco-shower, the isolation of pipes and hot water tank, and the installation of thermostat or regulator clocks, among others are considered. Each action has a specific energetic gain that allows determining an average gain. The final energy gain is estimated using the number of interventions (advices) during a year. The WEM scenario considers 1 750 interventions per year; this value is constant for the entire period (2015-2030). The gains are assumed to last 14 years which is the average lifetime of the considered actions.

Finally, Brussels Capital Region promoted from 2007 to 2013 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 taking place in the WEM scenario for the residential and tertiary sector. This is the case for the boiler's control, in the WAM scenario, the effectiveness of the measure increases to 25%. The energy grant system increases the budget progressively until 2030, for this year the budget will be 27M€. As in the WEM scenario, 70% of the grants go for the residential sector. Finally, the household's support also increases the number of interventions per year. The assumption for the WAM scenario is 3 500 interventions per year.

The phasing out of fossil fuels such as coal and gasoil is considered in the WAM scenario. Starting from 2021, it will not be allowed to install any equipment using coal as fuel. Whilst this will be the case for gasoil installations from 2025.

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 5 main measures of building renovation: Roof, walls, floor insulation, windows and boiler replacement. These actions are executed according to the phases established in it, so the energy reduction will increase progressively and the first results will start in 2027.

5.1.3.7 The tertiary sector (CRF category 1A4a)

Flanders

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

In the subsector office buildings and education buildings a tightening of the E-level is taken into account for new buildings (Table 5.13).

The WAM scenario also includes:

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

Wallonia

WEM scenario

The building stock having remained stable for the last three years, its growth until 2015 is assumed very moderate. For the whole projection period, its growth is 10.7%, slightly higher than the population growth (+9.9%).

It is assumed that 3% of existing buildings will be renovated annually, resulting in a saving of 20% of the fuel consumption between 2014 and 2020 and 10% between 2021 and 2030, and a saving of 10% of the electricity consumption over the whole period.

During the period 2014-2035, the shares of heating oil and natural gas are supposed to slightly decrease, from 31% to 27% for heating oil and from

Table 5.13 E-level pathway tertiary sector (2016-2021)

	2016	2018	2020	2021
E-level	55	50	45	40

64% to 63% for natural gas. Conversely, the share of wood is growing: to 6% in 2035.

WAM scenario

WAM scenario for tertiary sector includes different measures:

- For new building, energy autonomy will go further (through voluntary measures and studying regulatory requirement strengthening).
- For all buildings, more heat will be produced by renewable energy (biomass, heat pumps, ….).
- For existing buildings, the implementation of the "Renovation Strategy" will reduce the environmental impact of existing buildings. This strategy defines different objectives for energy efficiency of the envelope and the equipments of the existing buildings. This long- term strategy (2050), with intermediate objectives already results in positive impact in 2030).

Brussels-Capital Region

WEM scenario

Tertiary sector represents 36% of Brussels Capital Region total energy consumption in 2016. The main consideration for establishing projections is the expansion of building surface due to the increase of employment as well as the information available in the regional energy balance.

The implementation of the Brussels Energy Performance of Buildings Decree[3] is reflected in the projections. This measure is applied for office and education buildings; it starts in 2018. All new buildings are considered nearly passive (15kWh/m².yr) and all the heavy renovated buildings must reach a very low energy level (45kWh/m².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 big energy consumers. It contemplates the requirement of an energy audit in order to obtain the renewal of the environmental permit for establishments exceeding 3 500 m²[4]. The energy audit allows a reduction of 12.5% of final energy consumption.

The new decree concerning energetic audits has been approved the 8th December 2016[5]. According to this framework, the big companies, defined by the number of employees and its energy consumption, must do an energy audit starting on 2018, this means in average 9 additional audits per year. In addition, the target is enlarged for commercial establishments, starting from 2018; commercial establishments with a surface over 1 500 m² must do an energy audit.

In addition, there is the mandatory implementation of the local action and energy management plans (PLAGE, French acronym) in private buildings which surface exceeds 100 000 m² and public buildings with an area bigger than 50 000 m². The objectives of the PLAGE are to implement energy management measures, handle energy invoices, increase users comfort, improve air quality and reduce GHG emissions. This action starts on 2019. The first phase lasts 6 years and the subsequently phases have a duration of 4 years. The objective of the PLAGE is to obtain a reduction on final energy consumption of 10% per phase.

Moreover, there is the implementation of the NRClick project for supporting communal buildings in order to improve their energy consumption and energy efficiency. The goal of the project is to have a reduction of 63 GWh of fuel consumption as well as 6 GWh of electricity.

Three measures already described in the residential sector scenario (see section 5.1.3.6) are also applied in the tertiary sector. The first one is the technical control of heating systems which has the same hypothesis than 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 2013, tertiary sector uses 30% of total budget and it is kept constant between 2016 to 2020. 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 m² were constructed and renovated under this project between 2007 and 2013. The energy reduction obtained thanks to the

[3] 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.

[4] 30 janvier 2012.- Arrêté du Gouvernement de la Région de Bruxelles-Capitale rélatif à un audit énergétique pour les établissements gros consommateurs d'énergie.

[5] 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.

construction characteristics is assumed to remain for 20 years.

WAM scenario

As mention 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 boiler's control, 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, for 2030 the budget will be 27M€. As in the WEM scenario, 30% of the grants is 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.

5.1.3.8 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 Table 514 were used in the projections.

Flanders

In 2016 energy consumption in the agricultural sector mainly originates greenhouse heating systems (45%), non-stationary sources (fisheries, tractors, ...) (16%) and the warming of stables (22%).

Off-road emission projections 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). Emission projections of sea-fishery are calculated with the EMMOSS model. Both models are also used for the greenhouse gas inventory.

The WEM projections for the greenhouse horticulture take into account an 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 PAMs reporting, into account and assumptions on the evolution of the animal herd: a general decrease of the cattle herd, stabilisation of the number of poultry and slight decrease of swine due to new regulation on investment support subject to manure management.

Wallonia

Energy related emissions, including the emissions from the gasoil of tractors and other mobile equipment, in the agricultural sector in the Walloon region are limited (< 3.5 PJ).

CH_4 and N_2O emission projections take into account the evolutions of livestock (all animal categories), agricultural area and mineral & organic fertilizer uses in Wallonia. For some parameters, the mean values of the last years are maintained up to 2030, in absence of any other information (e.g. milk yield, crop residues, ...).

The same figures are used in the WEM and the WAM scenario.

Brussels-Capital Region

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

Table 5.14 Livestock numbers used in the projections

Animal numbers (thousands)	2016	2020	2025	2030
Dairy Cattle	458	448	432	417
Non-dairy Cattle	2 100	2 022	1 938	1 859
Sheep	122	117	115	113
Swine	6 500	6 451	6 380	6 310
Poultry	42 050	44 752	48 404	52 190

5.1.3.9 The transport sector (CRF category 1A3)

General remarks regarding road transport projections

Projections for the road transport are performed combining 3 regional bottom-up calculations ("fuel used" basis). The sum of the three regional values for the reference year (2016) 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 proportionally 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 harmonized on the basis of this federal PAM. Table 515 provides an overview of the assumed blends of biodiesel in diesel and bioethanol in gasoline in the WEM and WAM scenarios.

Apart from the harmonized shares of biofuels in road transport, the rest of the transport sector modelling occurs through specific regional models. These are described below.

Table 5.15 Overview of the assumed volumetric and energetic shares of biofuels in transport fuels in the WEM and WAM scenarios

2016		% Net Calorific Value			
		2020	2025	2030	
WEM	bioethanol	2.7	8.95	8.95	8.95
	biodiesel	5.5	8.95	8.95	8.95
WAM	bioethanol	2.7	8.95	10.0	10.45
	biodiesel	5.5	8.95	10.0	10.45

Flanders

The transport sector includes road transport, railway transport, inland shipping, maritime shipping and air transport. Different models were used for the various transport modes. The models calculate the use of energy and the emissions starting from the transport flows (volumes). For road traffic, railway traffic and inland shipping a specialised traffic model was used to calculate the transport flows, the Flemish multimodal model.

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 in 2019 using the Fastrace model. Only motorized traffic (excl. pedestrians and cyclists) is included in the projections.

The GHG projections take 2016 as 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 redesign of some urban areas to promote soft transport modes (walking, cycling), and the implementation of trucks freight transport pricing. No new Flemish measures are assumed in the WEM scenario after 2018. Starting from the base year 2016, the expected evolution of mobility and transport demand in Flanders in the WEM scenario was used to calculate the number of vehicle kilometers per vehicle type and fuel type for the period 2016-2030. The total Flemish fleet composition was modelled for the period 2015-2030 starting from the fleet in 2016 and considering the composition of new vehicles (i.e. remaining stable at the 2016 level in the WEM scenario) and survival rates of the vehicles over the same period.

Additional measures to reduce the number of vehicle kilometers and aiming at 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 kilometers 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-kilometers, 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 of the Flemish mobility plan, which is currently still 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 with the country-specific OFFREM-model with emission factors of 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. These emissions are assumed to remain constant at the 2016 level.

Wallonia

WEM scenario

Road transport

The Walloon projections for road transport are established on the principle of:

"emission = mobility (vkm) x emission factor (t/vkm)"

where:

- The projections of the overall mobility are calculated using the principle of mobility demand (projections of the Federal Planning Bureau)
- The projections of the vehicle fleet are calculated using survival curves based on the historic inventory data.
- The emission factors are calculated from the historic inventory data (year 2014)
- Emission factors for new technologies are established assuming improvements expressed in % with regards to existing technologies.

Conventional vehicles remain the main technologies operating up to 2030.

The repartition of passenger cars by 2030 is mentioned in Table 5-16.

For heavy duty vehicles, diesel conventional models remain totally dominant (98-99% of the sales all through the projections). The tones.km between 2014 and 2030 will increase of 34% for heavy duty vehicles and 43% for light commercial vehicles.

Rail transport

GHG emissions from rail transport are essentially due to the transport of goods, representing some 60% of the fuel consumption in 2015. They have decreased from some 70 kt CO_2 in 2006 down to 10 kt CO_2 in 2015. We assume an increase of the emissions due to the

Table 5.16 Repartition passenger cars by 2030 (WEM scenario)

Vehicle	% stock
CNG	0.37%
Diesel	65.1%
Petrol	15.4%
Petrol hybrid	13.4%
Electric	5.6%

increase of transport of goods by rail in 2030 (increase of 60% in 2030 compared with 2015).

Inland vessels

GHG emissions from inland vessels have been relatively constant for the last 8 to 10 years, around 45-55 kt CO_2/year. They are assumed to increase by 60 % following a modal shift of the transport of goods to waterway transport.

WAM scenario

Road transport

WAM scenario for road transport includes the FAST program. This program identifies different objectives for the future mobility in Wallonia. In those objectives, there are the estimation of the evolution of the mobility (pkm and tkm) and of the repartition of passengers cars and heavy duty vehicles. The repartition of passenger cars also evolve compared to WEM (more electric vehicles, less diesel conventional vehicles, …).

Rail transport

GHG emissions from rail transport are essentially due to the transport of goods, representing some 60% of the fuel consumption. They have decreased from some 70 kt CO_2 in 2006 down to 10 kt CO_2 in 2015. We assumed they would stabilize at that level until 2030.

Inland vessels

GHG emissions from inland vessels have been relatively constant for the last 8 to 10 years, around 45-55 kt CO_2/year. They are assumed to increase by 400% in 2030 compared with 2015.

Brussels-Capital Region

WEM scenario

Transport sector represents 22% of Brussels Capital Region total energy consumption in 2016. Projections of transport emissions consider road and off-road transport, railways, inland navigation, and natural gas transport. Road transport emissions represent 98.5% of the total (direct) GHG emissions of transport (in 2016). The main hypotheses are described in the following paragraphs.

Road transport

Projections of road transport emissions are calculated using a bottom-up approach (fuel used basis). The correction to fuel sold is applied as final step, according to the methodology described in chapter 5.1.1.

The calculation of atmospheric pollutants emissions and fuels consumption for road transport is based on the European COPERT IV approach. The main input data required for COPERT simulations (vehicles fleet and mobility) comes from a regional transport model, developed on the basis of literature data (TREMOVE projections and INRETS study[6]), and recalibrated to the actual situation in the Brussels 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. The measures include the planned improvements of the public transport network, the redesign of some city areas to promote soft transport modes (walking, cycling), and the implementation of trucks freight transport pricing.

For road transport, the WEM scenario also considers the implementation of a Low Emission Zone (LEZ), at the 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 GHGs emissions and climate change.

The companies with more than 100 employees in the same site must also elaborate a mobility plan for their employees, which must be updated every 3 years. The objective is to promote the shift to more sustainable transportation modes and to reduce the traffic and traffic jam. Finally, the last measure considered in the WEM scenario is the promotion of car sharing, as alternative to personal car ownership. There are various systems of car sharing: round trip, one way or free floating. The PACE established an objective of 20000 clients in BCR at the 2020 horizon which implies the availability of 800 cars.

Rail transport

For railways, the evolution of liquid fuel (gasoil) consumption is derived from the evolution of freight transport demand. The GHG emissions increase of about 195 t CO_2 eq. between 2015 to 2020, and reach 4 kt CO_2-eq in 2035. Passengers transport (trains, metro and tramways) is driven by electricity; the transport supply (and the correspond-

[6] 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.

ing electricity consumption) increases then by 70% between 2012 and 2025, together with the expected finalization of the express regional network (RER, French acronym).

Navigation

For inland navigation, the evolution of liquid fuel (gasoil) consumption is derived from a reference scenario of transport demand for Belgium19. The starting point of the projections comes from the regional energy balance. Projections show an increase of GHG emissions. In 2020, emissions from inland navigation will be 2.30 kt CO_2-eq, and in 2035 they will be 2.86 kt CO_2-eq.

Natural gas transport

The emissions originating from natural gas transport are kept constant and equal to the emissions of year 2016 for the entire projection period since there are not available projections for this sector.

Off-road emissions

The projections of off-road emissions for all sectors and vehicles categories are calculated with the OFFREM model. This model has been developed for the 3 Regions in Belgium on the basis of a detailed bottom-up approach.

In addittion to the « Good Move » Plan, the gouvernment of the Brussels Capital Region established the end of thermal motors in the region. The objective is to avoid diesel cars by 2030 and gasoline cars by 2035.

WAM scenario

Road transport

The "Good Move" Plan is the next regional mobility plan with a regulatory value. Developed through a dynamic and participatory process, Good Move defines the Region's mobility objectives and actions for the 2018-2028 period. It focuses on six frames and is based on the implementation of fifty measures. According to preliminary estimates, which will still have to be clarified in its environmental impact report, the Good Move plan could contribute to a 21% reduction of vehicle-kilometers of light vehicles in the Brussels Region in 2030. The priority objectives of Good Move in link with energy and climate are to reduce the use and possession of cars, and green the fleet.

5.1.3.10The waste sector (CRF category 5)

Flanders

Projections of CH_4 emissions from the solid waste disposal on land in Flanders (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 waste water 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 waste water handling systems until 2030.

CO_2 emissions from municipal waste water treatment are set to zero in the projections because these emissions derive from biomass raw materials.

The waste incineration category includes incineration of municipal and industrial waste, 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 5.1.3.1 the projections of 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 2016 level.

CH_4 emissions from composting in Flanders (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 takes into account the implementation of the Order of the Walloon Government of 18 March 2004 banning the dumping of municipal waste into landfills since January 1st 2008, yielding a decline of degradable organic carbon (DOC) content (municipal waste being mainly organic).

Nevertheless, the amount of total waste disposed is considered constant and equal to the average of the 2010-2015 period (conservative hypotheses).

The methodology used for calculation is the one described in the last 2006 IPCC guidelines. The recovery rate of landfill gas is assumed to remain constant at its level of the average of the period 2010-2016. 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.

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

The waste incineration category includes incineration of municipal solid waste, 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

Waste sector takes into account the emissions from water treatment plants, composting installations, and waste incinerators. For the waste water 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 5.1.2.4). The compost centre started in 2002 and the emissions from composting process are kept constant for the projected period. The waste incinerator of Neder-Over-Heembeek is not included in the waste sector due to the energy recovery process; this installation is included in the energy sector.

5.1.3.11 The land-use and land-use change and forestry sector (CRF category 4)

The projections for the LULUCF sector are based on the 2016 version of the EU Reference scenario prepared for the Directorate-General for Energy, the Directorate-General for Climate Action and the Directorate-General for Mobility and Transport for CO_2-emissions and sinks. For N_2O emissions, the 2014 levels were used for the entire projection period.

5.1.4 Aggregated projections

5.1.4.1 The 'with existing measures' greenhouse gas emission projections

The following tables summarise the compiled 'with existing measures' projections for the period 2016-2030.

Table 5.17 Greenhouse gas emissions by policy sector (WEM scenario) $MtCO_2$-eq

	1990	1995	2000	2005	2010	2015	2016	2020	2025	2030
Total excluding LULUCF	146.6	154.7	149.7	145.3	132.9	117.1	115.8	113.3	119.6	127.5
Total including LULUCF	143.3	152.0	148.0	143.7	132.6	116.8	115.5	112.6	118.7	126.3
EU ETS (in accordance with ETS scope 2013-2020)	n.a.	n.a.	n.a.	66.6	54.8	44.7	43.7	42.3	49.8	58.1
ESD[1] (in accordance with ETS scope 2013-2020)	n.a.	n.a.	n.a.	78.6	78.1	72.4	72.1	71.0	69.8	69.4
LULUCF	-3.3	-2.6	-1.8	-1.5	-0.3	-0.3	-0.3	-0.7	-0.9	-1.2

[1] ESD for the period 2013-2020; ESR for the period 2021-2030.

Table 5.18 Greenhouse gas emissions by IPCC sector (WEM scenario) $MtCO_2$-eq

	1990	1995	2000	2005	2010	2015	2016	2020	2025	2030
1 Energy	103.7	107.7	106.0	105.5	98.8	85.7	84.0	81.9	89.6	98.3
1A Fuel combustion	102.5	106.8	105.2	104.8	98.0	85.1	83.4	81.3	89.0	97.7
1A1 Energy industries	30.1	29.6	28.7	29.4	26.5	21.2	20.0	16.5	22.0	29.9
1A2 Manufacturing industries and construction	23.2	22.9	21.5	18.5	15.6	13.6	13.4	14.4	16.5	17.0
1A3 Transport	20.9	22.9	24.9	26.6	26.4	26.7	26.4	26.9	27.5	28.3
1A4 Other sectors	28.1	31.2	29.9	30.0	29.3	23.4	23.5	23.4	22.9	22.4
1A5 Other	0.2	0.2	0.2	0.2	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	0.6	0.6	0.6	0.6
2 Industrial processes	26.3	30.2	28.4	26.4	21.5	19.8	20.4	20.3	19.6	19.2
3 Agriculture	12.2	12.3	11.3	10.3	10.2	10.0	9.9	9.8	9.4	9.2
4 Lulucf	-3.3	-2.6	-1.8	-1.5	-0.3	-0.3	-0.3	-0.7	-0.9	-1.2
5 Waste	4.3	4.5	3.9	3.1	2.5	1.6	1.5	1.3	1.0	0.8

Table 5.19 Greenhouse gas emissions by gas, excluding LULUCF (WEM scenario) $MtCO_2$-eq

	1990	1995	2000	2005	2010	2015	2016	2020	2025	2030
CO_2	120.5	126.1	126.8	125.5	113.8	99.8	98.4	97.2	105.0	113.8
CH_4	12.2	12.1	11.0	9.3	8.8	8.1	8.1	7.5	6.9	6.6
N_2O	10.1	10.9	10.2	8.4	7.6	6.0	5.7	5.7	5.7	5.7
F-gases	3.8	5.5	1.7	2.1	2.8	3.3	3.6	2.9	2.0	1.5

5.1.4.2 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 the following tables.

Table 5.20 Greenhouse gas emissions by policy sector (WAM scenario) $MtCO_2$-eq

	1990	1995	2000	2005	2010	2015	2016	2020	2025	2030
Total excluding LULUCF	146.6	154.7	149.7	145.3	132.9	117.1	115.8	109.9	112.5	111.4
Total including LULUCF	143.3	152.0	148.0	143.7	132.6	116.8	115.5	109.3	111.6	110.1
EU ETS (in accordance with ETS scope 2013-2020)	n.a.	n.a.	n.a.	66.6	54.8	44.7	43.7	41.6	51.7	58.7
ESD[1] (in accordance with ETS scope 2013-2020)	n.a.	n.a.	n.a.	78.6	78.1	72.4	72.1	68.3	60.8	52.7
LULUCF	-3.3	-2.6	-1.8	-1.5	-0.3	-0.3	-0.3	-0.7	-0.9	-1.2

[1] ESD for the period 2013-2020; ESR for the period 2021-2030

Table 5.21 Greenhouse gas emissions by IPCC sector (WAM scenario) $MtCO_2$-eq

	1990	1995	2000	2005	2010	2015	2016	2020	2025	2030
1 Energy	103.7	107.7	106.0	105.5	98.8	85.7	84.0	79.2	83.6	84.0
1A Fuel combustion	102.5	106.8	105.2	104.8	98.0	85.1	83.4	78.6	83.0	83.4
1A1 Energy industries	30.1	29.6	28.7	29.4	26.5	21.2	20.0	16.3	24.3	30.8
1A2 Manufacturing industries and construction	23.2	22.9	21.5	18.5	15.6	13.6	13.4	13.8	15.5	15.4
1A3 Transport	20.9	22.9	24.9	26.6	26.4	26.7	26.4	25.4	22.8	19.5
1A4 Other sectors	28.1	31.2	29.9	30.0	29.3	23.4	23.5	23.0	20.3	17.6
1A5 Other	0.2	0.2	0.2	0.2	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	0.6	0.6	0.6	0.6
2 Industrial processes	26.3	30.2	28.4	26.4	21.5	19.8	20.4	20.0	19.1	18.3
3 Agriculture	12.2	12.3	11.3	10.3	10.2	10.0	9.9	9.5	8.9	8.2
4 Lulucf	-3.3	-2.6	-1.8	-1.5	-0.3	-0.3	-0.3	-0.7	-0.9	-1.2
5 Waste	4.3	4.5	3.9	3.1	2.5	1.6	1.5	1.3	1.0	0.8

Table 5.22 Greenhouse gas emissions by gas, excluding LULUCF (WAM scenario) $MtCO_2$-eq

	1990	1995	2000	2005	2010	2015	2016	2020	2025	2030
CO_2	120.5	126.1	126.8	125.5	113.8	99.8	98.4	94.4	98.9	99.5
CH_4	12.2	12.1	11.0	9.3	8.8	8.1	8.1	7.3	6.5	5.8
N_2O	10.1	10.9	10.2	8.4	7.6	6.0	5.7	5.6	5.2	5.0
F-gases	3.8	5.5	1.7	2.1	2.8	3.3	3.6	2.6	1.8	1.0

5.1.4.3 Comparison with previous projection results

The projection results presented in this report are compared with the previous report (BR3) in Figure 5.1 and 5.2. The main differences can be explained by the different sectoral assumptions:

- CRF category 1A1: lower import assumptions are the main factor in explaining the higher emission projections in BR4 (both in WEM and WAM projections);
- CRF category 1A3 and 1A4: more ambitious policies and measures in the WAM projections lead to a decrease in emission projections towards 2030;
- CRF category 1A2: an increase of activity assumptions in BR4 based on more recent economic forecast is the main explanation of higher emission projections in BR4.

Figure 5.1 Comparison of total GHG emissions excluding LULUCF (CRF inventory/ WEM and WAM projections in this report versus WEM projections in BR3)

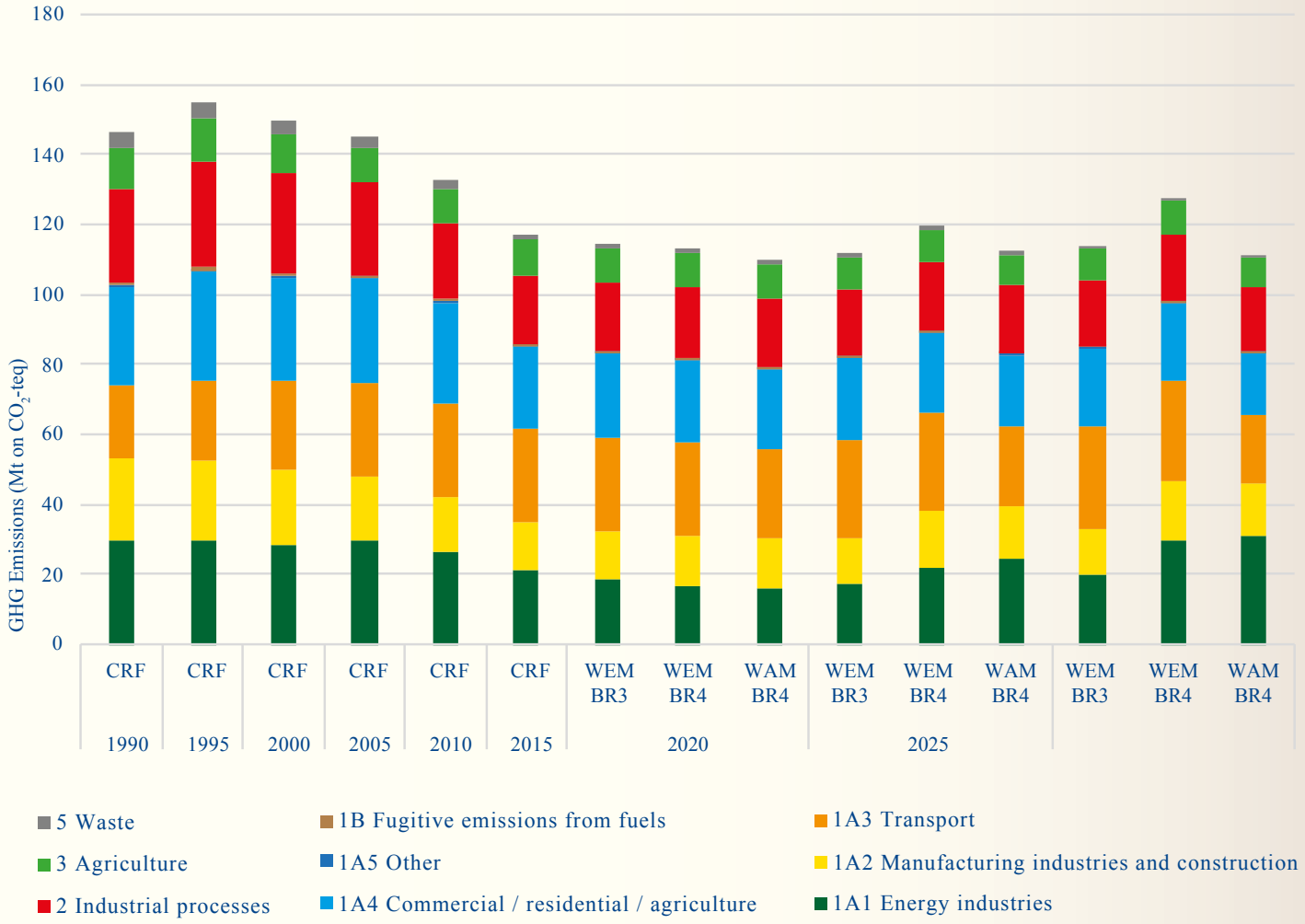
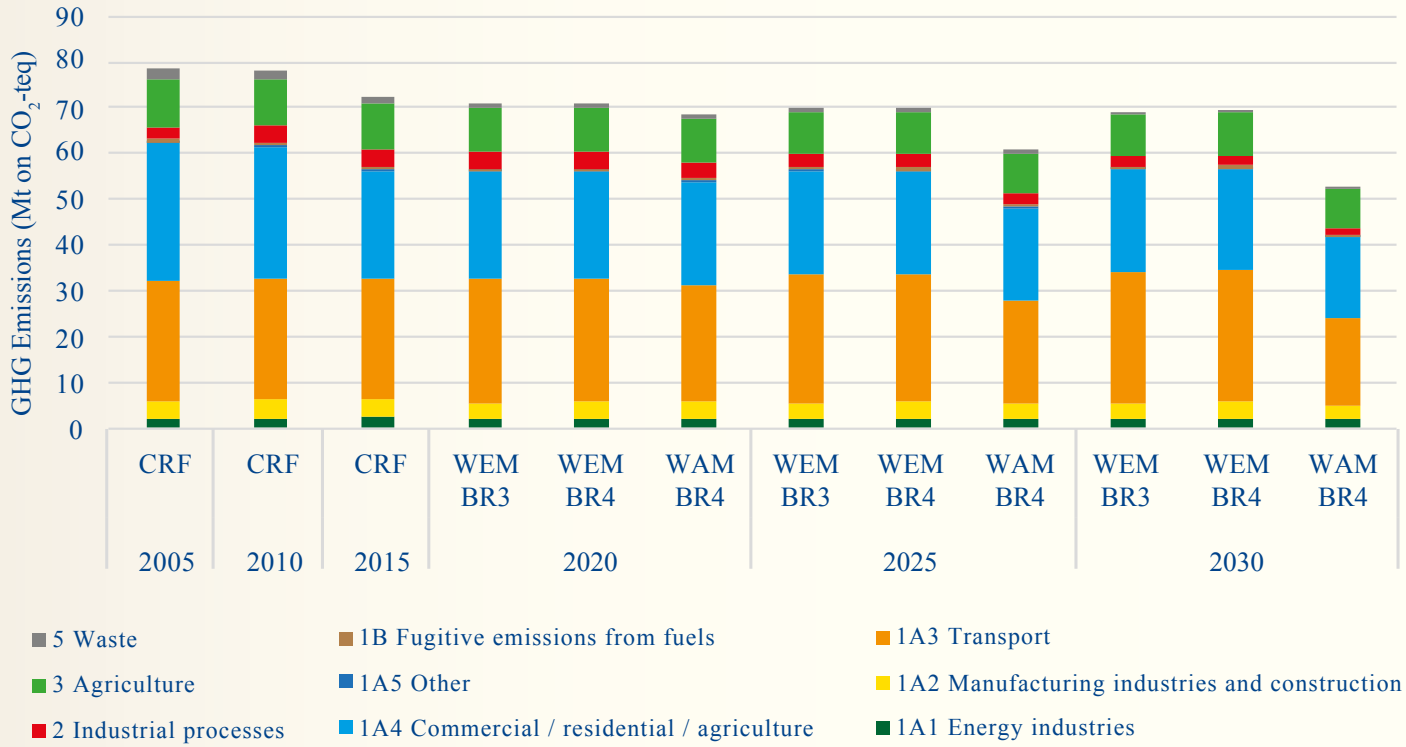


Figure 5.2 Comparison of non-ETS GHG emissions excluding LULUCF
(CRF inventory/WEM projections in this report versus WEM projections in BR3)



5.1.5 Conclusion

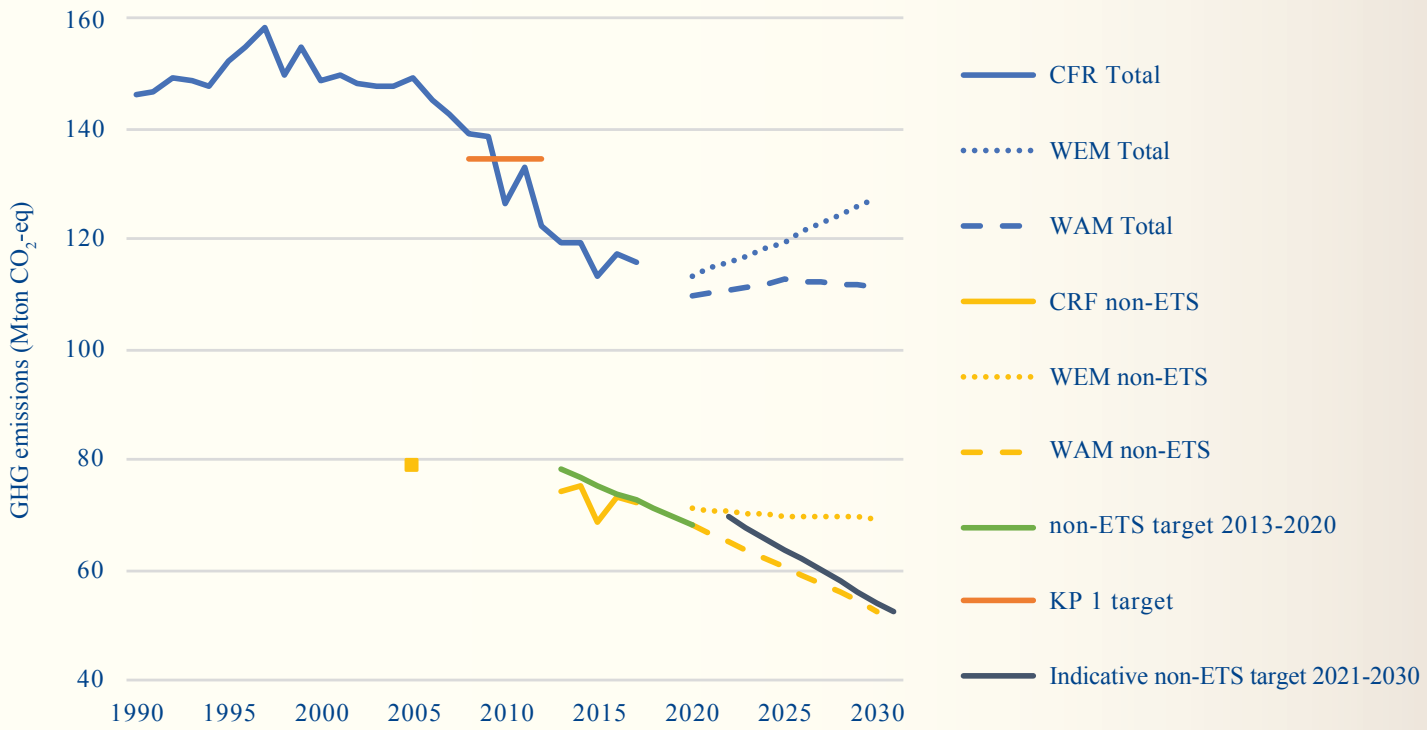
5.1.5.1 Overall emission levels

There is a clear decrease between 1996 and 2017 in the total greenhouse gas emissions in the inventory (figure 5.5). However, the total emissions in the WEM scenario show a clear increase in the period 2020-2030. The total emissions in the WAM scenario show a slight increase between 2020 and 2025 followed by a slight decrease in the periode 2025-2030. These projections do not include emissions nor 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.

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 indicative non-ETS target for the period 2021-2030 as shown in Figure 5-3 has been taken from EEA Report No 16/2018.

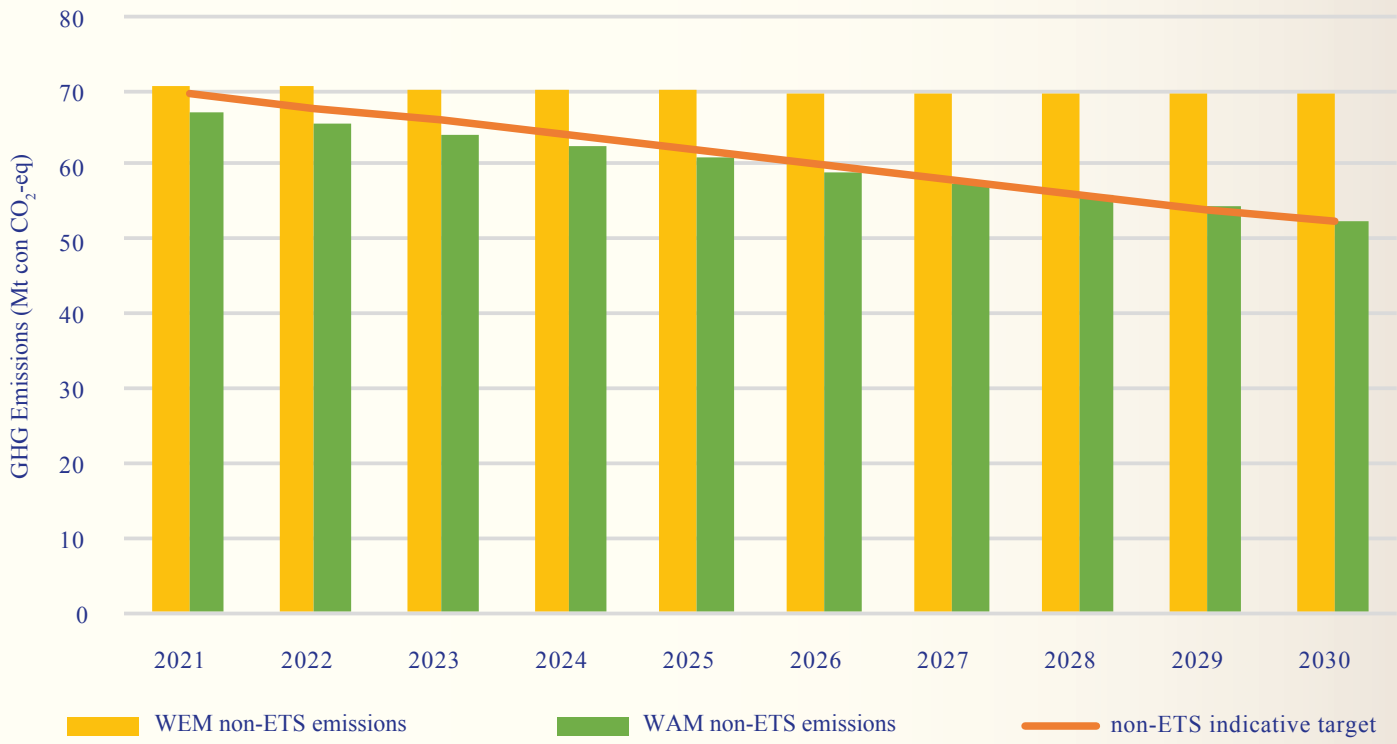
Figure 5.3 GHG emissions excluding LULUCF



5.1.5.2 Comparison with the Effort Sharing Regulation target (2021-2030)

In Figure 5.4, the non-ETS emission projections from the WEM and the WAM scenario are compared indicatively with the Effort Sharing Regulation targets as (provisionally) determined by the EEA. Interpolation was used to determine emissions in the years 2021-2024 and 2026-2029. With the WEM scenario, the emission targets are exceeded in all years of the period 2021-2030. In the WAM scenario, the non-ETS objectives in the years 2029-2030 are exceeded to a limited extent. Accumulated over the period 2021-2030, the non-ETS targets are respected with a cumulated surplus of 11 Mton CO_2-eq.

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



5.2 Assessment of national policies and measures

5.2.1. Monitoring the implementation of the National Climate and energy Plan

The NECP (2021-2030) aims at fulfilling Belgium's European and international commitments. It has been adopted on the 18th December 2019 (for more information we refer to chapter 4.1).

Successive studies have been commissioned to undertake evaluation of PAMs identified in the previous plan (national climate plan), the objective of which was to quantify, ex-ante and, when possible, ex-post, the impact of federal measures in terms of greenhouse gas emission reductions for the period 2008-2012. Moreover, the studies provided an evaluation of the effect of the federal measures on expected emission reductions up to 2020 and estimated the remaining impact up to 2035, assuming the measure concerned being abolished after 2020[7]. An update is foreseen by the Federal Public Service Health, Food chain safety and Environment in 2020.

The three Regions and the Federal State will regularly evaluate the impact of the new PAMs identified in the NECP by estimating the GHG emission reductions that the implementation of measures should or would deliver. Methodologies have not been (fully) developed yet and will depend on the domain targeted and the availability of data. The three Regions and the Federal State will strive to harmonise the methodologies in order to ensure comparability and the ability to identify the most efficient measures.

5.2.2. Impact of measures of the NECP

As stated in chapter 4, many of the NECP measures are new and/or prolongated policies which require an in-depth evaluation of calculation methods and the establishment of reliable indicators. These improvements should be implemented in the next reporting exercise. Therefore for many PAMs no information is provided in CTF Table 3 on its impacts in term of GHG reduction.

As recommended, measures are classified 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).

As already mentioned, Belgium has recently been in a transitional position. Many new measures are considered as "planned" since they have not been implemented by their respective governments.

The complete list of measures appears in CTF Table 3 in Chapter 4 with a brief description, their objectives and an identification of the authority and the body which should implement the measure, as well as the indicators used to track the progress of emission reductions.

PAMs are not always specifically implemented from a climate mitigation perspective alone; they can serve many other policy goals at the same time. Hence, it is less relevant to calculate and compare their cost from a climate perspective. Therefore a specific cost of PAMs compared to their effectiveness in reducing GHG-emissions is generally not available.

In the WAM scenario, total greenhouse gas emissions are expected to decrease (excluding LULUCF) between 2015 and 2030 to reach 112 Mt CO_2-eq (-23% compared to 2005). A decrease in ESD emissions is observed

[7] See the last report https://climat.be/doc/Evaluation_federal_PAMs_July_2017_corr.pdf.

between 2015 and 2030, from 72 Mt CO_2-eq to 53 Mt CO_2-eq. Emissions from EU ETS increase to 59 Mt CO_2-eq (compared to 58 Mt CO_2-eq in the WEM), mainly as a result of increased emissions from electricity generation. In the WAM scenario, the emission projections for LULUCF don't differ from the scenario WEM.

In the WAM scenario, at the sectoral level, energy-related emissions are expected to decrease by 2030. Especially the emissions of the energy industry sub-sector still increase from 21 to 31 Mt CO_2-eq between 2015 and 2030 mainly as a result of an increase in emissions from electricity production. The completion of the nuclear exit in 2025 is expected to lead to a compensation of the electricity production by nuclear power plants by an increase in production by gas-fired power stations. The most pronounced reductions occur in the transport and energy sectors. Emissions in buildings sector, with a reduction of 27% and 41% respectively in 2030 compared to 2005.

Emissions from industrial processes show relatively limited reductions between 2015 and 2030. In the agricultural sector, the planned additional measures will lead to a 20% reduction in 2030 (compared to 2005) (10% in the WEM scenario). Emissions from waste continue to decrease.

For more information, we refer to Chapter 5 of the NECP (part B). ■

6. Provision of financial, technological and capacity-building support to developing-country Parties

6.1. Introduction

Over the period 2017-2018, Belgium provided €185.6 million of public support to developing-country Parties (see CTF table 7). This financial, technological and capacity-building support to non-Annex I Parties primarily 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 specialized UN agencies;
- Contributions to bilateral projects mainly directed towards African partner countries and Least Developed Countries.

At the Conference of the Parties in December 2015, Belgium announced that it would contribute €50 million on an annual basis to international climate finance. According to a negotiated internal distribution ratio, the federal state accounts for half of this annual commitment. The regions provide the other half, as follows: €14.5 million from the Flemish region, €8.25 million from the Walloon region and €2.25 million from the Brussels-Capital region.

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 programs by (i) providing significant core funding to multilateral organizations and (ii) mobilizing, via public resources, private investments for climate-related projects in developing countries.

Table 6.1 Evolution of total Belgian Climate Finance in €

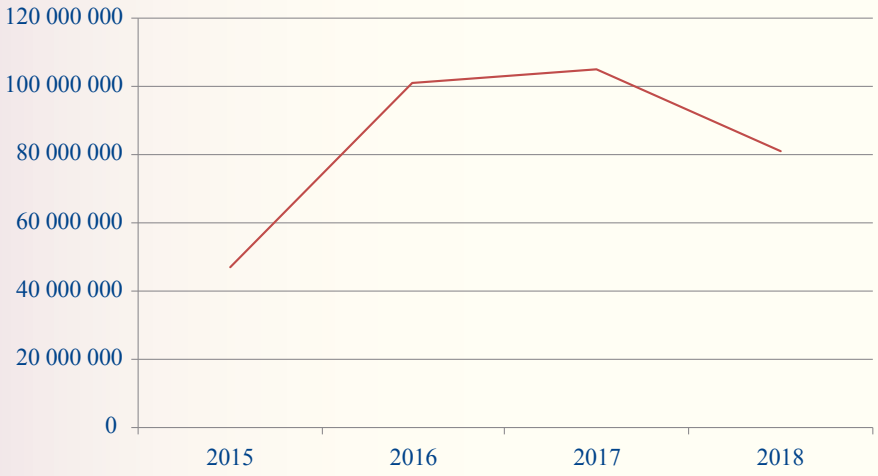


Table 6.2 Climate Finance 2017-2018 by type of support

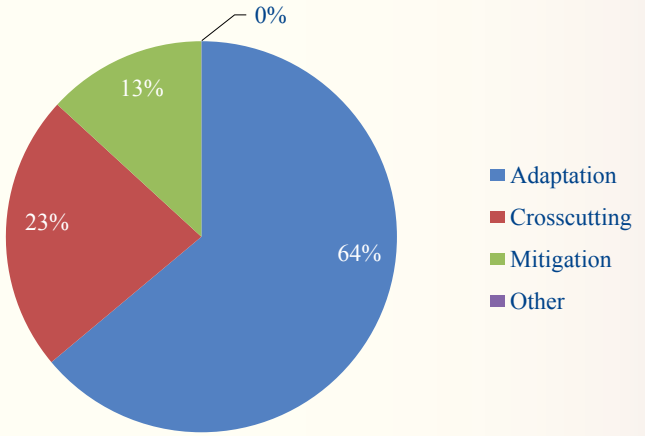
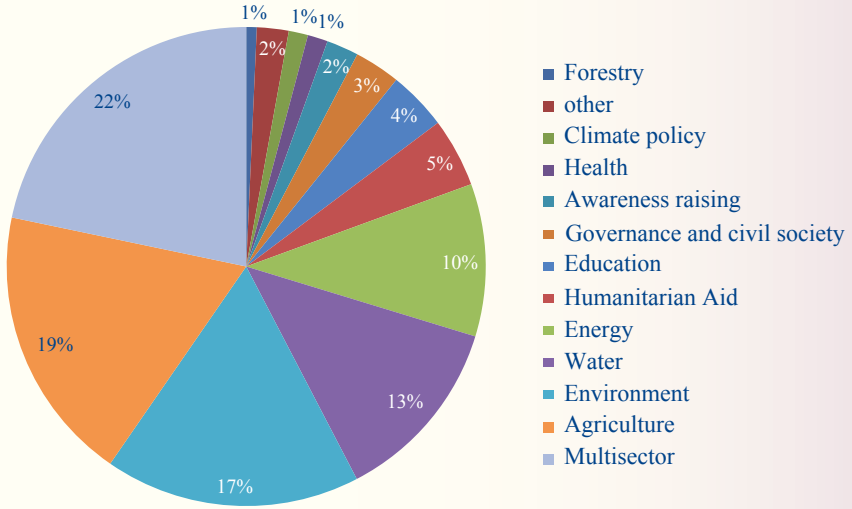


Table 6.3 Climate Finance 2017-2018 by sector



6.2. Legislative and institutional framework of climate change policies and programs

Belgium is a federal state, and as a result of this institutional context, several federal and regional level government departments are involved in developing and implementing 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 also play an active role in the international aspects of climate change, such as providing and mobilizing climate finance.

A cooperation agreement on the internal burden sharing of Belgium's climate and energy objectives for the period 2013-2020 was concluded in October 2016. This agreement should enable 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 has been agreed to meet Belgium's announcement to contribute €50 million annually over the period 2016-2019:

- Federal state: €25 million
- Flanders: €14.5 million
- Wallonia: €8.25 million
- Brussels-Capital Region: €2.25 million

The federal part of the Belgian climate finance is primarily allocated through the budget for development cooperation. The law on development cooperation of 19th March 2013 sets out the goals and priorities for Belgium's international cooperation. This law stipulates that in its programmes and activities of development cooperation Belgium strives towards sustainable and inclusive economic development and poverty alleviation. Furthermore, the law gives priority to the protection of the environment and natural resources, including the fight against climate change, desertification and global deforestation. Overall policy coherence for development is an important priority of Belgium's development cooperation.

6.3. Provision of international climate finance through official Development Assistance and Other Official Flows

6.3.1 Financial contributions to multilateral institutions and programs

As a long-standing donor in the area 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, and also provide non-earmarked contributions to multilateral institutions and specialized UN agencies.

The majority of multilateral funds come from Belgium's federal development cooperation budget, which has sustainable development and poverty alleviation as the most important goals.

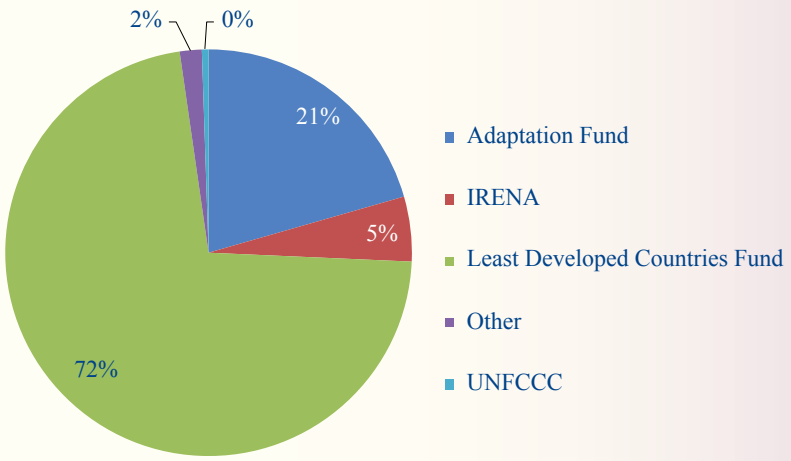
In 2009, Belgium adopted a strategic core policy vis-à-vis its multilateral partner organizations. This means that most contributions are non-earmarked and preferably multiannual to allow for stable, secure and predictable funding and to increase transparency and efficiency.

In 2016, new Framework Arrangements (FA) were signed between the Belgian government and its 15 multilateral partner organizations. These FAs are intended to underline the commitment to work jointly towards implementing the 2030 Agenda for Sustainable Development, and as a basis for long-term cooperation.

Organizations such as the Food and Agriculture Organization (FAO), United Nations Development Programme (UNDP) and United Nations Environment Programme (UNEP) contribute significantly to the fight against climate change through the programmes and projects in their portfolios. Belgium also supports the Consultative Group on Agricultural Research with core resources. Agricultural research is indispensable in helping secure food and nutrition security in vulnerable countries and improve farmers' livelihoods. In implementing their new strategy, CGIAR plans to devote 60% of their resources towards research in the areas of mitigation, resilience to climate shocks and adaptation.

Other multilateral partners of Belgium, such as the World Bank Group, play an important role in mobilizing international climate finance. Of course Belgium also contributes to the various funding instruments of 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 In-

Table 6.4 Multilateral Climate Finance 2017-2018



strument is dedicated to climate change and other environmental issues. An overview of core contributions to these organizations is included in CTF table 7a, but these are not reported as specific climate finance.

During the reporting period, Belgium provided €33.6 million to the Global Environment Facility, an operating entity of the financial mechanism under the UNFCCC. This contribution is also non-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 (€29.2 million).

In the reporting period Belgium also provided €8.3 million to the Adaptation Fund, which finances projects and programmes that help vulnerable communities in developing countries adapt to climate change.

6.3.2 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 framework can be implemented by the Belgian Development Agency "Enabel", by a multilateral organization, by another donor (delegated cooperation), by civil society organizations or by national or local partners in the South.

All climate relevant activities that are implemented through civil society organizations are also reported under this chapter.

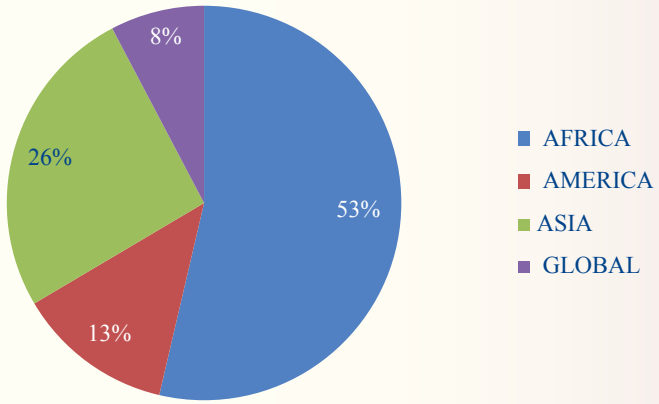
In 2015, Belgium renewed its list of partner countries and decided to focus most of its support on 14 countries: Benin, Burkina Faso, Burundi, DR Congo, Guinea, Mali, Morocco, Mozambique, Niger, Palestinian Territories, Rwanda, Senegal, Tanzania and Uganda. These partner countries of governmental cooperation were selected on the basis of their degree of poverty, aspects of good governance and Belgium's potential for providing meaningful support. In addition, the Flemish government 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. Alignment with the focus areas enhances the effectiveness and predictability of this funding.

In parallel to the bilateral support provided to these, Belgium also supports civil society organizations that operate in a wider range of developing countries.

The Walloon Region has supported development cooperation projects in areas of its competencies such as education, agriculture, water management, job creation, and environment.

The Brussels Capital Region jointly launches calls for projects with Brussels International for Belgian civil society organizations (CSOs) to carry out projects in the most vulnerable developing countries, in an urban or semi-urban context and also has a partnership

Table 6.5 Bilateral Climate Finance per region 2017-2018



agreement with Enabel, Belgian development agency to carry out four mitigation and adaptation projects.

The Belgian Investment Company for Development Cooperation (BIO) is another important actor in providing funds for climate investments. Their climate portfolio primarily consists of projects in the renewable energy sector, mostly by providing loans and equity. In 2017-2018 BIO received an additional capital contribution of €30 million to be invested in climate projects. Only the grant equivalent of investments is reported in the tables.

In the reporting period **€145 million** 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 as a priority: agriculture, health, water and energy.

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 CTF tables 8 and 9.

Capacity building, and to some extent technology transfer, are always an essential component of any bilateral programme and project. 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 (Conseil Interuniversitaire de la Communauté française de Belgique) to establish partnerships between Belgian universities and university colleges and their counterparts in the South. Along with other projects, these partnerships develop initiatives related to climate change.

During 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 – KLIMOS- focuses on environmental sustainability and climate change. Its main goal was to build capacity for the sustainability transition. Through this research platform, the government provides seed money that is used to (i) conduct case studies in the South, (ii) establish collaborations with research institutions in the South and (iii) build capacity both in Belgium and in its partner countries. The four research streams included: sustainable management of natural resources, sustainable energy and infrastructure, good governance for environment and sustainability, sustainable monitoring and evaluation.

The Flemish Water for Development Partnership – involving over 90 members, ranging from NGOs, public water companies, private firms, 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 facilitate the transfer of expertise to southern partners. To date, these projects have benefited over one million citizens in the South in terms of access to water.

6.5. Methodological Approach for tracking the provision of financial, technological and capacity-building support to non-Annex I Parties

6.5.1 The use of Rio markers to quantify the climate-relevance of projects / programmes

Belgium uses the Rio markers to report to the Development Assistance Committee of the Organization for Economic Cooperation and Development (OECD-DAC) regarding 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 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 will be considered climate finance. For projects that have one or more marker 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 recognizes 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 a 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 state, of Flanders and Wallonia towards international climate finance are made publicly available on the following websites, respectively:

- The Department of Foreign Affairs of Flanders,
- The Walloon Agency for Air and Climate (AWAC),
- Federal state.

6.5.2 Key concepts of the methodological approach

1. Core/general

Core/general contributions are non-earmarked contributions to multilateral organisations. The Belgian development cooperation has had a strict core policy since 2009. This means that contributions to Belgian multilateral partners are primarily non-earmarked. This choice for unrestricted aid has been made to allow for more efficiency, quality, predictability and flexibility.

2. Climate-specific

Climate-specific support through bilateral channels relates to support with a score of 2 for the Rio Marker for mitigation or adaptation, for which the full amount is shown in CTF table 7(b), and to support with a score of 1 for these Rio Markers, of which only part of the budget is allocated as climate finance and shown in CTF table

7(b). With regards to multilateral support (CTF table 7(a)), climate-specific finance is targeted at funds or organizations with a specific mandate and goals related to the fight against climate change.

3. Status (committed/disbursed)

Belgium only makes commitments on the basis of a firm obligation such as a decree, and an agreement, made in writing and backed by the necessary funds, to provide specific assistance to a recipient country or a multilateral organization.

Belgium aims to report only funds that are disbursed (amounts spent). This means that the payments that have been made on the basis of an invoice, or a payment request by a multilateral partner organization or a non-governmental partner, are reported. Reporting of disbursements related to projects and programmes of the Belgian Technical Cooperation is based on actual expenses in the field.

4. Funding source

Official Development Assistance: see definition of the OECD-DAC:

The DAC defines ODA as "*those flows to countries and territories on the DAC List of ODA Recipients and to multilateral institutions which are:*

i. ***provided by official agencies****, including state and local governments, or by their executive agencies; and*

ii. each transaction of which:

a) is administered with the promotion of the ***economic development and welfare of developing countries*** *as its main objective; and*

b) is ***concessional in character*** *and conveys a grant element of at least 25 per cent (calculated at a rate of discount of 10 per cent).*"

Other official flows: Transactions by the official sector with countries on the List of Aid Recipients which do not meet the conditions for eligibility as Official Development Assistance or Official Aid, either because they are not primarily aimed at development, or because they have a Grant Element of less than 25 per cent.

5. Financial instrument

Grant: Transfers made in cash, goods or services for which no repayment is required.

Concessional loan: A loan with a measure of "softness", which is a benefit to the borrower compared to a loan at market rates.

Loan: Transfers for which repayment is required.

6. Type of support

Adaptation: The support intends to reduce the vulnerability of human or natural systems to the impacts of climate change and climate-related risks, by maintaining or increasing adaptive capacity and resilience. This encompasses a range of activities from information and knowledge generation, to capacity development, planning and the implementation of climate change adaptation actions.

Mitigation: The support contributes to the objective of stabilising greenhouse gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system, by promoting efforts to reduce or limit GHG emissions or to enhance GHG sequestration.

Cross-cutting: both types of support (adaptation & mitigation)

7. Sector

Belgium uses the OECD DAC sector classification in its reporting and reports on the level of "main" sectors, such as agriculture, health, education, etc., and not on the subsector level. The OECD DAC's sector classification which is specifically developed to track aid flows and to allow measuring of the share of each sector (e.g. health, energy, agriculture) or other purpose category "non-sector allocable aid" (e.g. general budget support, humanitarian aid) in total aid. The sector of destination is assigned by answering the question "which specific area of the recipient's economic and social structure is the transfer intended to foster?".

8. 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 2018 to comply with this recommendation in the most transparent way.

6.5.3 New and additional financial resources

Belgium provided €23.6 million to the Global Environment Facility during the reporting period. The GEF, as operating entity of the UNFCCC Financial Mechanism, provides resources for drafting biennial update reports and national communications, and has recently 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). As such, financial support to climate action in developing countries does not only flow through the operating entities of the Financial Mechanism.

Over the years, there have also been significant changes regarding the involvement of Belgium in international climate finance. While the federal government, through its Directorate for Development Cooperation, remains the main donor, the Regional governments now also play 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, all the more so due to the lack of an internationally-agreed definition of this concept. For these reasons, Belgium puts strong emphasis on transparency regarding its use of reporting methodologies.

Moreover, Belgium would describe its financial support, since these new developments, as new and additional, since it comprises:

- Provisions in line with Article 4, paragraph 3, of the Convention (€23.6 million to GEF;)
- Contributions which would not have existed without the financial commitments stemming from the Copenhagen Accord (€55.7 million in the reporting period);
- Budget lines on top of the annual budget for bilateral development cooperation (€23 million in the reporting period);
- Only the climate-specific or climate-relevant part of projects and programmes. Based on our methodology (see below/above), Belgium does not report the full amount of the projects/programmes if these are only partly relevant to climate action (€145 million in the reporting period);
- Only climate-related projects in developing countries additional to the previous reporting period (€185.6 million in the reporting period);
- Contributions from the revenue obtained from auctioning greenhouse gas emission allowances.

Belgium does not agree with a clear separation of climate finance from development finance, as climate and development assistance are strongly interdependent and due to the fact that climate is mainstreamed in development finance. Any climate-related support that meets agreed ODA definition is reported as such. ■

7. Other reporting matters

7.1. Domestic arrangements related to compliance

Belgium's domestic arrangements related to self-assessment of compliance with emissions reduction commitments at European and international levels, as well as the establishment of national rules for taking local action against domestic non-compliance with emissions reduction targets include:

- **National burden sharing agreement:** National objectives for GHG emissions and renewable energy sources have been shared between the 4 authorities (Federal state and Regions), in the context of the National burden sharing agreement. This agreement covers: (1) Greenhouse gas emissions reduction objectives, for sectors that are not covered by the EU ETS ("non-ETS" sectors); (2) Renewable energy objectives; (3) Share of the auctioning revenues of ETS emissions allowances; (4) Contribution to international climate financing. The agreement was enforced by a legally binding cooperation agreement between the regions and the federal state which contains not only the commitments of the political agreement, but alos identifies implementation modalities and responsibilities.
- **The mechanism for increasing awareness of climate responsibility among the Regions for the building sector:** Under the Law of 6 January 2014, this mechanism consists of establishing a multiannual trajectory for the reduction of greenhouse gas emissions in the residential and tertiary building

sectors (excluding industrial buildings), for each Region. A financial bonus is awarded to a region when it exceeds its imposed objective.

The bonus is calculated on the basis of the reference trajectory, and must be invested in emissions reduction policies. If a region fails to meet its imposed objective, a financial penalty is envisaged.

The penalty will be calculated on the basis of the difference between the reference trajectory and the actual emissions, to be invested in emissions reduction policies by the Federal State.

This mechanism will be funded by the revenues from the auctioning of emissions quotas assigned to Belgium that are yet to be distributed between the Regions and the Federal State through the domestic burden-sharing arrangement. The amounts are calculated by multiplying the distance to target in tonnes of CO_2-eq. with the emissions quotas average price auctioned during the same year.

In order to ensure that a sufficient proportion of the auctioning revenues is preserved, a bonus ceiling is set at a level equal to the Federal State's share of auctioning revenues, while the penalties ceiling is set at 50% of the regional share of the auctioning revenues.

– **A substitution right for international obligations under the UNFCCC and its Protocols**[1]**:** 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 Law of Treaty (this is also the interpretation given in European Union Court of Justice case-law).

  As a consequence, the Federal State vouches for international law violations on the part of federal entities. The substitution right was introduced in order to remedy the contradiction between Belgian 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 aimed at implementing the UNFCCC and its Protocols. ■

[1] Article 16(4) of the Special Institutional Reform Law of 8 August 1980 (*Loi spéciale de réforme institutionnelle du 8 août 1980/Bijzondere wet van 8 augustus 1980 tot hervorming der instellingen*).

Annex. Description of used models

I. Flemish energy and greenhouse gas simulation model

A new Flemish simulation model has been developed in 2014 (and is 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).
- Share of the emissions, per sector, that comes from processes (and thus is not related to fuel consumption).
- For the agricultural emissions (dust, greenhouse gasses 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 ecodesign 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 lifetime of installations (since new installations mostly can 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 slices (electricity demand is not equal in winter and in summer, neither during night or 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 realize 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. Modelling tools in the Walloon Region

EPM (Energy/Emissions Projection Model) is used to build the WEM scenario. EPM is a projection model for energy demand and atmospheric emissions that covers all relevant emission sectors (energy sector, industry, residential, commercial, transport). It has been developed progressively by ECONOTEC since 1993 in the framework of a number of studies carried out for public authorities, as well as regional as at national level.

Given the heterogeneity of sectors such as the iron & steel industry, the chemical sector or the residential sector, it is necessary to take into account internal structural effects, i.e. the difference in evolution of sub-sectors when these sub-sectors have different levels of specific consumptions or emissions.

EPM is a simulation model, of the "bottom-up" type, i.e. explaining energy consumptions and GHG emissions from activity variables expressed as far as possible in physical 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.

The model, which includes a techno-economic data based on the energy

consumption and emission reduction measures, is 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;
- evaluating economic emission reduction potentials;
- constructing emission reduction scenarios, based on the reduction measures with a marginal cost below a given ceiling;
- constructing cost curves, providing either the marginal or the total cost as a function of the level of emission or energy consumption reduction;
- assessing the impact of existing or draft legislations on energy consumptions,
- emission levels and costs.

The present model description is focused on energy consumptions and CO_2 emissions, but the situation is similar for other atmospheric pollutants CH_4, N_2O, SO_2, NO_x and VOCs. The case of fluorinated gases, which has been handled for the Federal Department of the Environment, requires a more specific approach.

Sectoral disaggregation

Industry is represented by about a hundred activity variables (pig iron production, oxygen steel production, ethylene production, clinker production, flat glass production…). The large energy consumption branches are modelled in more detailed than the others. For example, iron & steel production is taken into account per workshop (agglomeration, blast furnace, oxygen steel production…); for the chemical industry about twenty basic products are distinguished.

In the residential sector are considered existing and new houses, existing and new apartments (electric and non-electric heated), domestic water heating and 10 specific uses of electricity (cooking, refrigerators, washing machines, dryers…). The heat load is estimated using a separate module, from a typology of the building stock composed of 14 type-dwellings, of which the dimensioning and the thermal characteristics are entirely defined. In this module, the energy consumptions are calculated using the performances of 15 heat production, distribution or emission systems. In the tertiary sector, about 30 sub-sectors are grouped into 8 categories, and 5 energy uses are distinguished (heating, ventilation, cooling, lighting and other electric uses). The activity variable is the floor area of buildings.

In the transportation sector, one distinguishes between road transportation of persons, road transportation of goods, rail transportation and inland water transportation. For road transportation, the standard vehicle emissions calculator COPERT has been used to calculate emission levels as a function of the average specific energy consumptions of vehicles at the time of their first use and taking into account (European) regulations on polluting emissions applicable at that time.

For each sector, the energy consumptions are divided by use of energy (heating, fans, compressors, cooling, lighting…). For each emission source, the reduction measures are identified, as a function of the use of energy, and costs and performances are evaluated, as well as the technical potential of these measures. By measure, by sector, by energy use and by year, the model calculates the cost per tonne of CO_2 as the sum of the annualised investment cost and the operating costs, minus the value of the energy saving achieved. The latter is a function of the energy carrier, the sector, the year and a possible tax.

In a first step, energy consumptions and emissions are calculated for a reference year, recent past year serving as a basis for the projections. These consumptions and emissions are then projected into the future on the basis of assumptions on evolutions of various factors (activity variables, specific consumptions, emission factors).

Two emission categories are considered: emissions linked to energy consumption and “process” emissions.

Emissions of the reference year

The basic data used for the reference year are the energy consumptions of the statistical energy balances (by sector and by energy carrier). Some corrections are applied to these consumptions, e.g. a climatic correction on energy consumptions for space heating, so as to obtain an average climate, and hence to project an average climate.

However, these energy balances are generally quite aggregated. Typically, there are less than ten branches for industry, the residential and commercial sectors might be completely aggregated, and the internal transport is only split between road, rail, water and air transport.

In EPM, the sector disaggregation level is much higher. Therefore, the energy consumption of the main sectors is disaggregated by sub-sector. For each of the main sub-sectors, the consumption is calculated by multiplying an activity variable by a specific consumption. This is done separately for two categories of energy carriers (fuels, electricity). The balance, calculated by difference, corresponds to a "balance" sub-sector.

In this way, the total energy consumption by sector remains consistent with the energy statistics. It should be noted that in the projections, the impact of any inaccuracy on the activity variable or specific consumption of a sub-sector is only of the second order.

For each sub-sector, the consumption by type of fuel is obtained by multiplying the total consumption for fuels by the "market share" of each fuel. The latter is based on the fuel market shares for the sector as a whole and any additional relevant data for the sub-sector.

Emissions linked to fuel consumptions are obtained by multiplying the fuel consumptions with an emission factor expressed by unit of energy consumption. Process emissions are calculated by multiplying the activity variable of the sub-sector by a process emission factor.

Projection

The energy consumption of each sub-sector is first aggregated by category of energy carrier. The evolutions of the activity variables and of the specific energy consumptions which are then applied are exogenous. They are specified as an average annual rate of increase by periods of any number of years. Future fuel market shares are also exogenous. For each sub-sector, the default fuel market shares are those of the reference year.

The evolution of the specific consumptions allows taking into account both the technical progress and the renewal of existing equipment, which lead in a natural way to a decrease of the specific consumptions, even in the absence of any particular policy. It is also used for taking into account the increased electricity consumption linked to the extension of new applications of electricity (atomization, electronic office equipment…). Exogenous evolutions of (fuel or process) emission factors are also allowed, so as to take into account any emission reductions due to any decisions already made. The measures can be classified in the following categories: energy saving, cogeneration, renewable energy and fuel substitution.

III. Energy and Atmospheric Emissions projection model for Brussels Capital Region

Brussels Environment has developed its own projection model for energy demand and atmospheric emissions from stationary sources (residential, tertiary, industry and heat and electricity sector). The horizon of the projections is 2030.

As bottom-up type model, changes in consumption of the several energy carriers used in the Brussels-Capital Region (natural gas, light oil, propane/butane, coal, electricity, wood, solar and heat pump) and their associated emissions (CO_2, CH_4, N_2O, NO_x, CO, NMVOC, SO_x, NH_3, PM) are determined by the evolution of parameters that define the consumption of each sector.

For example, the residential sector is defined by the following main parameters:

- population and average household size (those 2 parameters define the net requirement for new dwellings)
- climate (expressed in degree-days, this parameter is of great importance for the Brussels-Capital Region, as it reflects the need for heating of buildings which represents about 70% of regional GHG direct emissions)
- renovation rate, improvement of energy efficiency expected in case of renovation and new constructions. This improvement depends on the typology of building stock composed of 140 type-dwellings: apartment or house, 5 age range of the building concerned, the 7 energy carriers used for heating, and the installed heating system (central or decentralized.

IV. Transport Emission Projection model for the Brussels-Capital Region

The model has been calibrated for each sector with the regional annual energy balances from 2000 to 2013. The modelled energy consumptions have then been converted into atmospheric emissions through emission factors, the ones used to establish the emission inventories.

The model also takes into account the GHG direct emissions that are not related to energy consumption: i.e. the fugitive methane emissions of natural gas delivery, the use of N_2O for anaesthesia and aerosols, the emissions from the decomposition of organic matter (composting plant, water purification plant).

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…).

The model distinguishes between road, railways and waterways transport. The projections horizon is 2030.

The calculation of atmospheric pollutants emissions and fuels consumption for road transport is based on the European COPERT IV approach. The main input data required for COPERT simulations (vehicles fleet and mobility) comes from a regional transport model, developed on the basis of literature data (TREMOVE projections and INRETS study[1]), 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 a mathematical modelling of passengers behaviour in the BCR during a regular working day. The model is based on surveys and counting that provides a precise view of the mobility situation in the region. MUSTI is calibrated with a variety of observations. The counting shows, 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).

Pollutants emissions calculations with COPERT have been processed using the same software version and hypotheses as for the UNFCCC 2015 GHG inventory preparation. Fuels consumption are 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. Pollutants emissions are calculated by combining fuel consumptions with emission factors from IPCC 2006 Guidelines for national emission inventories. Passengers transport (trains, metro and tramways) is driven by electricity; the transport supply (and the corresponding electricity consumption) increases then by 70% between 2012 and 2025, together with the expected finalization of the express regional network (RER, French acronym).

For inland navigation, the evolution of liquid fuel (gasoil) consumption is derived from a reference scenario of transport demand for Belgium. The 2014 value (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.

[1] 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.

V. 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 inthe 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: as from 2009 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 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. ■

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Under the United Nations Framework Convention on Climate Change

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