ENVIRONMENT AGENCY AUSTRIA umweltbundesamt

GHG Projections and Assessment of Policies and Measures in Austria

Reporting under Regulation (EU) 525/2013, 15 March 2017

ENVIRONMENT AGENCY AUSTRIA umweltbundesamt

GHG PROJECTIONS AND ASSESSMENT OF POLICIES AND MEASURES IN AUSTRIA

Reporting under Regulation (EU) 525/2013,
15 March 2017

REPORT
REP-0610

Vienna 2017

Project management

Andreas Zechmeister

Authors

Michael Anderl
Michael Gössl
Simone Haider
Elisabeth Kampel
Thomas Krutzler
Christoph Lampert
Katja Pazdernik
Maria Purzner
Stephan Poupa
Wolfgang Schieder
Carmen Schmid
Gudrun Stranner
Alexander Storch
Herbert Wiesenberger
Peter Weiss
Andreas Zechmeister
Gerhard Zethner

Editor

Brigitte Read

Layout and typesetting

Elisabeth Riss

Title photograph

© Ute Kutschera

For further information about the publications of the Umweltbundesamt please go to: http://www.umweltbundesamt.at/

Imprint

Owner and Editor: Umweltbundesamt GmbH
Spittelauer Lände 5, 1090 Vienna/Austria

Printed on CO_2-neutral 100% recycled paper.

ISBN 978-3-99004-424-7

PREAMBLE

This report presents Austria's greenhouse gas emission projections for 2020, 2025, 2030 and 2035.

The projections for greenhouse gas developments contained in this report are based on a scenario 'with existing measures' (WEM). The scenario includes all policies and measures implemented by 30 May 2016. The status and current implementation of the measures have been defined at expert level in consultation with the Federal Ministry of Agriculture, Forestry, Environment and Water Management.

Currently – at the beginning of the year 2017 – the national climate and energy strategy is in preparation. A clear picture of planned measures cannot be anticipated before the negotiations between stakeholders have been finished. For this reason, a scenario 'with additional measures' has not been prepared for the submission in March 2017.

Emission projections in this report are based on economic scenarios for the period up to 2035. To calculate the scenarios, several models have been applied. The energy scenario is based on analyses of total energy demand and production conducted by the Austrian Institute for Economic Research (WIFO). The calculations of the demand for and generation of electricity, energy and heat were carried out by the University of Technology in Vienna and the Austrian Energy Agency (AEA). For the transport, agricultural and waste sectors additional models were used.

The sectoral structure of the emission scenario is based on the format for emission reporting under the UN Framework Convention on Climate Change (UNFCCC).

The report itself is in compliance with the requirements for reporting according to EU Regulation No 525/2013 of 21 May 2013 concerning a mechanism for monitoring and reporting greenhouse gas emissions, and with the UNFCCC Guidelines FCCC/CP/1999/7 (guidelines for the preparation of National Communications by Parties included in Annex I to the Convention) for national reports on climate change.

CONTENTS

SUMMARY

This chapter presents a summary of the projections for the scenario 'with existing measures' (WEM). The main results for the five CRF sectors (without LULUCF) and all greenhouse gases are presented in CO_2 equivalent. Trend graphs include GHG totals by category and by gas.

Total GHG emissions

The 'with existing measures' (WEM) scenario without LULUCF shows a decrease of 4.3% from 1990 to 2020 and a decrease of 14.6% from 1990 to 2035, i.e. from 78.8 in 1990 to 75.4 Mt CO_2 equivalent in 2020 and 67.3 Mt CO_2 equivalent in 2035.

Table 1: Historical trends and projections (2020–2035): greenhouse gas emissions (without LULUCF). (Umweltbundesamt)

	Inventory Trend [kt CO_2 eq]				Emissions 'with existing measures' [kt CO_2 eq]			
	1990	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**
Total (without LULUCF)	78 805	92 642	85 059	78 851	75 393	72 724	69 767	67 274
1 Energy	53 028	67 134	59 881	53 351	51 227	49 347	47 171	44 636
2 Industrial Processes	13 663	15 612	15 926	16 676	15 512	14 947	14 308	14 267
3 Agriculture	8 189	7 104	7 094	7 168	7 342	7 347	7 357	7 538
5 Waste	3 925	2 791	2 158	1 656	1 312	1 083	930	833

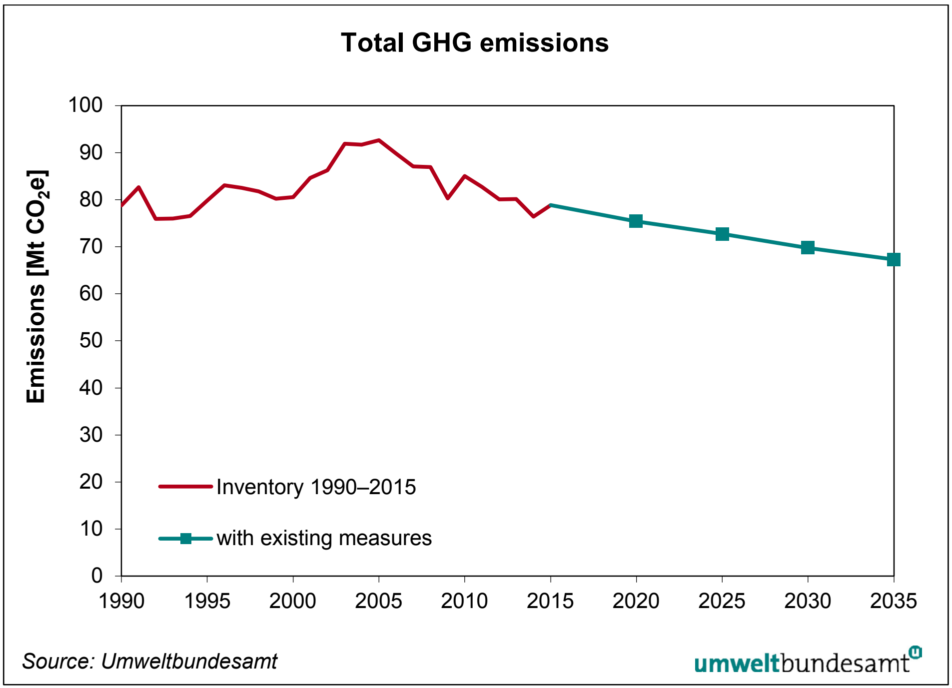


Figure 1: Past trend and scenario (2020–2035): total GHG emissions (without LULUCF).

Table 2: Past trend and scenario (2020–2035): GHG emissions by gas (without LULUCF). (Umweltbundesamt)

	Emission Trend [kt CO_2 eq]				Emissions 'with existing measures' [kt CO_2 eq]			
	1990	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**
CO_2	62 293	79 369	72 547	66 724	63 562	61 702	59 525	57 136
CH_4	10 514	7 808	7 211	6 575	6 312	6 064	5 920	5 942
N_2O	4 342	3 633	3 399	3 517	3 544	3 490	3 440	3 445
F-Gases	1 656	1 831	1 901	2 034	1 975	1 468	881	751
Total	**78 805**	**92 642**	**85 059**	**78 851**	**75 393**	**72 724**	**69 767**	**67 274**

The WEM scenario predicts a decrease in total GHG emissions by 14.7% or 11.6 Mt CO_2 equivalent between 2015 and 2035.

This change is mainly driven by a decrease in the Energy sector of 16.3% or 8.7 Mt CO_2 equivalent and the Industrial Processes (reduction by 14.4% or 2.4 Mt CO_2 equivalent). Emissions from the Agricultural sector are forecast to increase by 5.2% or 0.4 Mt CO_2 equivalent. Emissions in the Waste sector are forecast to decrease by 49.7% or 0.8 Mt CO_2 equivalent.

In the Energy sector emissions from the sub-sector 1.A.1 Energy Industries are forecast to decrease by 30.5% or 3.3 Mt CO_2 equivalent and in 1.A.2 Manufacturing Industries and Construction emissions are forecast to increase by 5.8% or 0.6 Mt CO_2 equivalent.

Emissions from the sub-sector 1.A.3 Transport are forecast to decrease by 10.4% or 2.4 Mt CO_2 equivalent between 2015 and 2035, and emissions from the sub-sector 1.A.4 and 1.A.5 'Other sectors' are forecast to decrease by 37,9% or 3.4 Mt CO_2 equivalent.

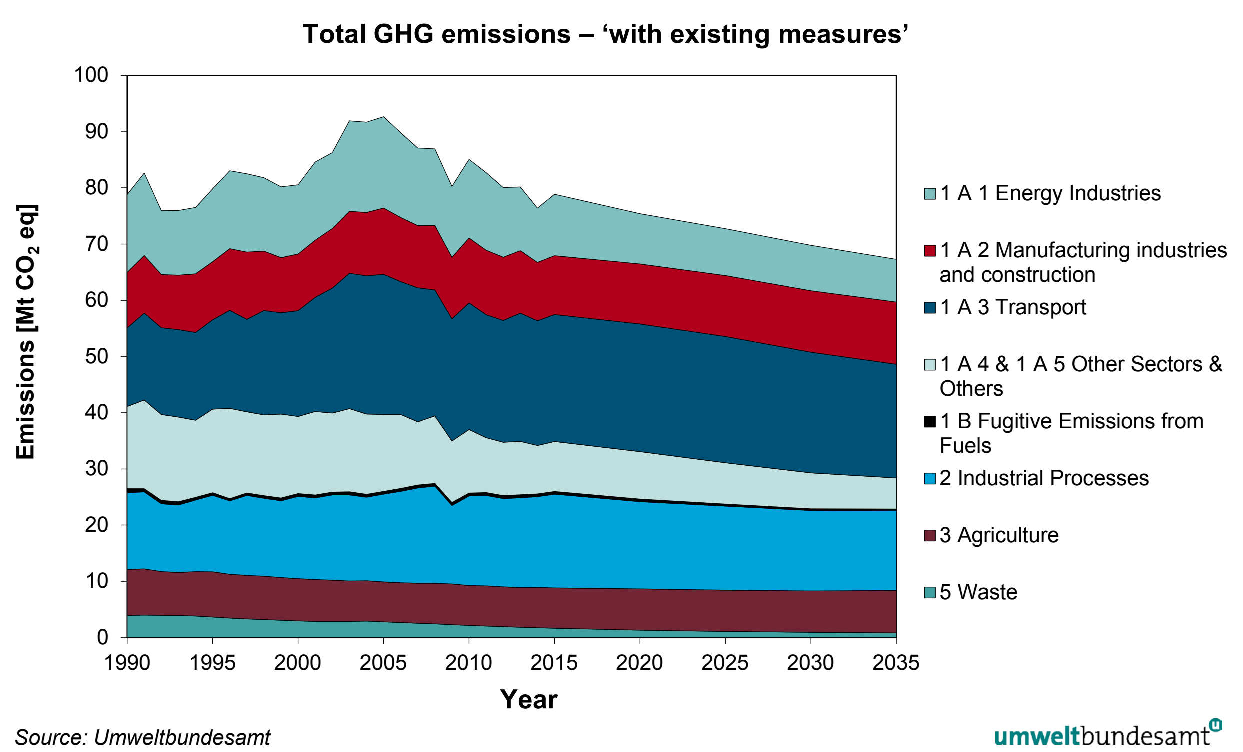


Figure 2: Past trend and scenario (2020–2035): total GHG emissions by sector.

According to the WEM scenario, the most important GHG in Austria will still be CO_2 with an almost constant share in the national total emissions from 2015 (84.6%) to 2020 (84.3%) and an increase to 84.9% in 2035. Between 2015 and 2035, total CH_4 emissions and N_2O emissions (in CO_2 equivalents) are forecast to increase from 12.8% to 14.0%, whereas the percentage of emissions of fluorinated gases (HFC, PFC, SF_6 and NF_3) is expected to decrease from 2.6% in 2015 to 1.1% in 2035.

An analysis of the past trend and the scenario by sector is presented in chapter 2 'Sectoral Scenario Results'. Tables with detailed emissions by sub-sector and gas are included in the Annex. Specific sectoral assumptions and activities are described in the sub-chapters 3.1 to 3.5.

EU ETS/EU ESD emissions

GHG emissions covered by the EU Emissions Trading Scheme (ETS) show a downward trend until 2035. The driving force is the Energy sector with a projected decrease by about 24% from 2015 to 2035. A decrease is also projected for the Industrial Processes sector (– 8%).

Total EU Effort Sharing Decision (ESD) GHG emissions are expected to decrease by 14% over the same period.

Table 3: EU ETS and EU ESD GHG emissions (Umweltbundesamt)

	with existing measures [kt CO_2 eq]				
EU ETS GHG emissions	**2015**	**2020**	**2025**	**2030**	**2035**
Total (without LULUCF)	29.492	26.179	25.476	25.036	24.587
1. Energy	15.354	13.152	12.515	12.134	11.602
2. Industrial Processes	14.138	13.027	12.961	12.903	12.985
EU ESD GHG emissions	**2015**	**2020**	**2025**	**2030**	**2035**
Total (without LULUCF)	49.295	49.142	47.167	44.637	42.580
1. Energy	37.947	38.027	36.783	34.985	32.980
2. Industrial Processes	2.525	2.462	1.953	1.364	1.230
3. Agriculture	7.168	7.342	7.347	7.357	7.538
5. Waste	1.656	1.312	1.083	930	833

1 GENERAL APPROACH

1.1 Guidelines and Provisions

The following regulations and guidelines were taken into account:

- **EU Monitoring Mechanism Regulation (EU) No 525/2013** on the mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and EU level relevant to climate change and repealing Decision No 2080/2004/EC of the European Parliament and the Council of 21 May 2013.
  - Article 12 – National and Union systems for policies and measures and projections
  - Article 13 – Reporting on polices and measures
  - Article 14 – Reporting on projections
- **Commission Implementing Regulation (EU) No 749/2014** of 30 June 2014 on structure, format, submission processes and review of information reported by Member States pursuant to Regulation (EU) No 525/2013 of the European Parliament and of the Council.
  - Article 22 – Reporting on polices and measures
  - Article 23 – Reporting on projections
- The **Guidelines for the preparation of National Communications** by parties included in Annex I to the Convention (FCCC/CP/1999/7 and draft version FCCC/SBI/2016/L.22).
- The structure of reporting information on projected GHG data and policies and measures follows the recommendation as included in the MM Article 23 'Reporting on projections' Templates provided by the European Commission in March 2016.
- Commission guidance and recommendations for reporting on GHG projections in 2017 (European Commission, Final, 14 June 2016)
- Recommended parameters for reporting on GHG projections in 2015 (European Commission, Final, 14 June 2016)

1.2 Quality Assurance & Control

A questionnaire has been used for checking input data for compliance with the most important data quality requirements. The project's strategy includes several data consistency checks, e.g. through documentation of data inputs and changes to the calculation files. A standard data input form has been used for each sector.

In general, data quality checks similar to those applied to the Austrian Air Emission Inventory have been performed for each sector. Often the person who is responsible for the sectoral emissions is identical with the person who is also responsible for the relevant sectors in the inventory and most sectors use emission methods based on the verified inventory methods.

An output data check has been carried out involving a detailed comparison of sector results and checking the plausibility of emission trends.

The specific responsibilities for this report have been as follows:

- Coordination & general chapters.... Andreas Zechmeister
- Energy Industries & .... Michael Gössl, Thomas Krutzler,
  Manufacturing Industries Herbert Wiesenberger
- Transport .... Gudrun Stranner
- Other Energy Sectors .... Wolfgang Schieder, Alexander Storch
- Fugitive Emissions .... Stephan Poupa
- Industrial Processes &.................... Herbert Wiesenberger
  Product Use.................................... Maria Purzner
- Agriculture .... Michael Anderl, Simone Haider
- Waste .... Katja Pazdernik, Christoph Lampert,
  Stephan Poupa
- LULUCF.. Peter Weiss, Carmen Schmid
- Policies and Measures .... Elisabeth Kampel

1.3 Description of General Methodology

1.3.1 Database and Historical Emission Data

The projections for Greenhouse Gases are fully consistent with the historical GHG emission data of the Austrian Emission Inventory (submission March 2017) up to the data year 2015.

1.3.2 Emission projections

The activity scenarios are based on the structure of the national inventory of greenhouse gases. The data structure for activities, input data, emission factors and emission calculations is based on SNAP categories (*Selected Nomenclature for sources of Air Pollution*). The output data are reported and aggregated in the Common Reporting Format (CRF) of the UNFCCC.

Emission projections are generally calculated by applying the same methodologies as those used for the national GHG inventory. These are described in Austria's National Inventory Report 2017 (UMWELTBUNDESAMT 2017a).

The emission factors used and for the projection as well as the underlying parameters are detailed in the methodological approach described in the subchapters 3 of this report.

1.3.3 Underlying Models and Measures

The emission projections are based on the following sectoral forecasts:

- Energy Forecast, based on the National Energy Balance of Statistik Austria and an econometric input-output model DYNK of the Austrian Institute of Economic Research (WIFO 2017), supported by calculations based on bottom-up models:
  - TIMES (Austrian Energy Agency – AEA 2017): public electrical power and district heating supply.
  - INVERT/EE-Lab (Energy Economics Group of the Technical University of Vienna, TU WIEN 2017): domestic heating and hot water supply.
  - NEMO & GEORG (Technical University of Graz – TU GRAZ 2017): energy demand and emissions of transport (incl. off-road).
- Forecasts of emissions from industrial processes and solvent emissions are based on Umweltbundesamt expert judgements.
- Emission estimates for fluorinated gases are based on a study published in 2010 (GSCHREY 2010. Assumptions from the EU F-Gas Regulation were included, as well as changes in technology (changes in emission factors etc.), based on SCHWARZ et al. 2011.
- The agricultural scenario is based on the PASMA model of the Austrian Institute of Economic Research (WIFO & BOKU 2015).
- The waste scenario is generally based on Umweltbundesamt expert judgements on waste amounts that are expected to be pre-treated in mechanical-biological treatment plants (before being landfilled). Furthermore, the population scenarios of STATISTIK AUSTRIA 2016a and a national study on the N_2O reduction potential of wastewater treatment plants (BMLFUW 2015a) have been considered.

The scenario 'with existing measures' includes all policies and measures implemented by 30 May 2016. The current status of the implementation of measures has been defined at expert level in consultation with the Federal Ministry of Agriculture, Forestry, Environment and Water Management. Information on national policies and measures included in the scenario can be found in chapter 4.

1.3.4 Key Underlying Assumptions

The key factors used for the scenario with existing measures are as follows:

Table 4: Key input parameters for emission projections (UMWELTBUNDESAMT 2017b).

Year	2015	2020	2025	2030	2035
GDP [billion € 2015]	335	360	388	419	454
GDP Real growth rate [%]	1.0%	~ 1.5%	~ 1.5%	~ 1.5%	~ 1.5%
Population [1 000]	8 621	8 939	9 156	9 314	9 432
Number of households [1 000]	4 197	4 438	4 624	4 776	4 908
Heating degree days	3 238	3 204	3 171	3 118	3 065
Exchange rate [US$/€]	1.12	1.16	1.20	1.20	1.20
International coal price [US$15/t]	57	74	92	110	117
International oil price [US$15/bbl.]	55	89	105	115	120
International natural gas price [US$15/GJ]	6.2	7.7	8.3	9.0	9.6
CO_2 certificate price [€/t CO_2]	7.5	15.0	20.0	26.5	36.5

Other underlying assumptions are included in the sectoral methodology chapters 3 and in the Annex.

1.4 Sensitivity Analysis

Scenarios are usually based on specific assumptions which provide the direction for future developments. These sensitive key drivers (e.g. GDP) can be varied in order to verify the robustness or sensitivity of the models and projections.

This chapter presents sensitivity assessments for specific sectors, analysing the increase and decrease in key factors or a combination of key factors. The assessment in the Energy sector was based on the influence of economic growth on GHG emissions from Transport, Energy Industries and Manufacturing Industries and Construction, as well as on the influence of changes in fuel prices and subsidies on GHG emissions in the Residential and Commercial sector.

All these assessments are based on model results obtained by calculating the effects on the Energy sector. It is important to note that, in general, emission results and changes in an input factor are not linearly dependent. This is the reason why the presented sensitivity data cannot be seen as a functional dependency with varied parameters. The emission effect can only be seen in the specific values of the given parameters.

For the Energy sector two complete scenarios (with different assumptions on economic growth and energy prices) were calculated:

- WEM sensitivity 1 and
- WEM sensitivity 2.

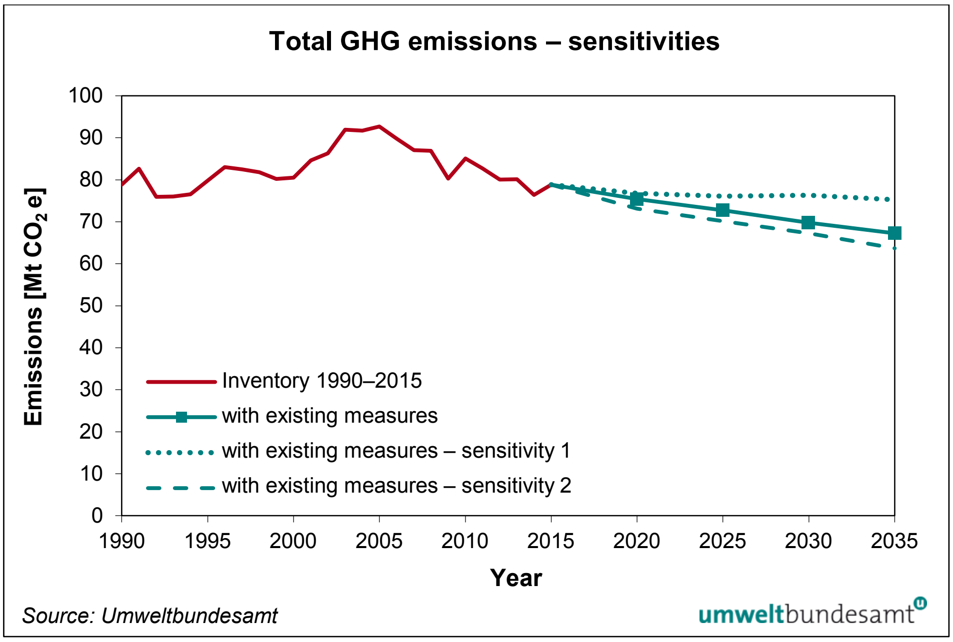
The main input variables are summarised in Table 8. Average economic growth was assumed to be 2.5% per year in WEMsens 1 and 0.8% per year in WEM-sens2 compared to 1.5% per year in WEM.

Table 5: Basic parameters for sensitivity analysis modelling (UMWELTBUNDESAMT 2017b).

Parameter WEM sensitivity 1	**2015**	**2020**	**2025**	**2030**	**2035**
GDP [billion € 2015]	335	379	429	485	549
GDP Real growth rate [%]	1.0%	~ 2.5%	~ 2.5%	~ 2.5%	~ 2.5%
International coal prices [US$15/t]	57	76	98	124	122
International oil price [US$15/bbl]	55	94	121	147	178
International natural gas price [US$15/GJ]	6	8	10	12	14
CO_2 certificate price [€/t CO_2]	8	20	25	31	43
Parameter WEM sensitivity 2	**2015**	**2020**	**2025**	**2030**	**2035**
GDP [billion € 2015]	335	349	363	378	393
GDP Real growth rate [%]	1.0%	~ 0.8%	~ 0.8%	~ 0.8%	~ 0.8%
International coal prices [US$15/t]	57	74	89	105	97
International oil price [US$15/bbl]	55	87	99	106	114
International natural gas price [US$15/GJ]	6	8	8	8	8
CO_2 certificate price [€/t CO_2]	8	13	16	20	28

The following charts show an analysis of trends in national total GHG emissions and the two sensitivity analyses. The results are also presented separately for ETS (Directive 2003/87/EC) and ESD (Decision 406/2009/EC).

Figure 3: Trend and projections (2016–2035): total GHG emissions for different sensitivities.



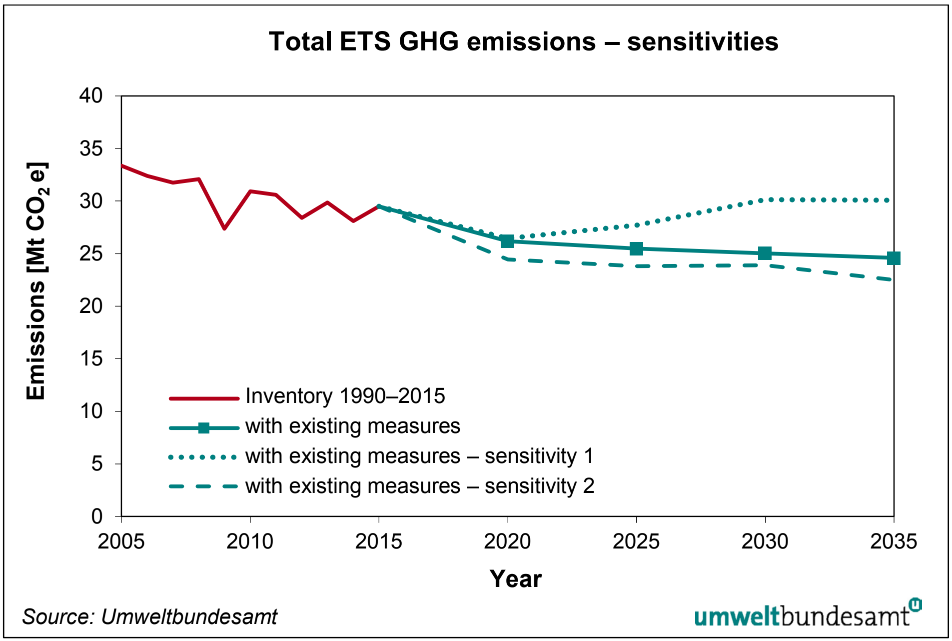


Figure 4: Trend and projections (2016–2035): total ETS GHG emissions for the different sensitivities.

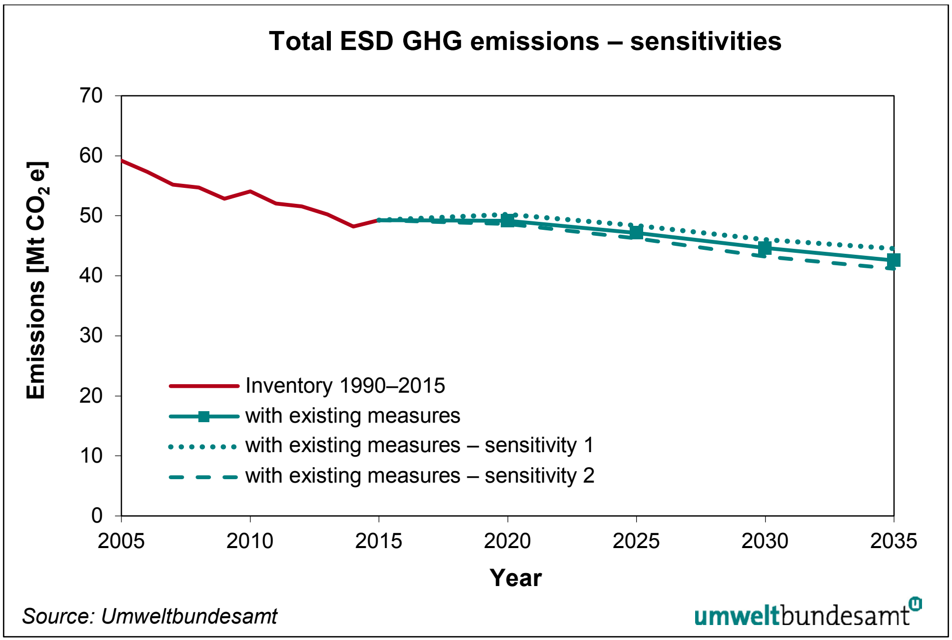


Figure 5: Trend and projections (2016–2035): total ESD GHG emissions for the different sensitivities

The sectoral conclusions and the outcome of the sensitivity analysis are summarised below:

The sensitivity analysis shows that **Heat and Power Generation (1.A.1)** has a relatively strong dependence on GDP growth, especially the amount of transformation inputs. In the first sensitivity scenario, an increase in production in existing power plants as a result of an increased electricity demand is expected to be economically viable. In the second sensitivity scenario, transformation input is expected to rise at a sligthly lower rate than in the WEM scenario due to a lower growth rate (0.8% p.a).
For public electricity and heat production a significant decrease in emissions is expected as a lower GDP growth rate (10% in 2020) is assumed. For 2030, with

lower imports in the sensitivity scenario, the decrease is expected to be less pronounced. If the GDP growth rate is higher, emissions are expected to increase significantly (50% in 2030), together with a substantial increase in the electricty price.
For the only Austrian refinery no GDP growth-related changes are expected. Therefore, trends in 1.A.1 total sensitivity are dependent on the sensitivity as calculated for sub-sector 1.A.1.a.

For **Manufacturing Industries and Construction (1.A.2)** final energy use varies depending on GDP growth. In the sensitivity scenario 2, emissions are expected to be 7% lower in 2030 while in the sensitivity scenario 1 emissions are expected to increase by 5% compared to the WEM scenario.

The sensitivity analysis for **Industrial Processes & Product Use (2)** also shows that a higher/lower annual GDP growth rate results in an increase/decrease in total GHG emissions, which is however less distinctive than in the sector 1A2.

For the **Transport sector (1.A.3)** a higher annual GDP growth rate results in an increase of total GHG emissions (+6% in 2030). This is mainly caused by intensified economic activities between Austria and its neighbouring countries and increased export quotas, leading to an increase in freight transport by road with heavy duty diesel vehicles. GHG emissions are expected to rise accordingly. The results for the sensitivity 2 scenario show that a lower annual GDP growth rate results in a decrease in the total GHG emissions (–6% in 2030) from this sector.

GDP variations do not have a huge effect on emissions in Other Sectors **(1.A.4)**, as the variation in GHG emissions is below ±2% for 2030. Increased economic growth leads to an increase in fossil energy demand compared to the WEM scenario (especially natural gas). In WEM sensitivity 2 total fuel demand for heating is substantially higher than in the WEM scenario due to lower investment in renovation measures. The reduction in the use of fuel oil is less pronounced than in the WEM sensitivity 1 scenario.

1.5 Uncertainty in Projections

For the last inventory submission a complete uncertainty assessment was performed (see UMWELTBUNDESAMT 2017a). The uncertainty for the total GHGs in Austria's GHG Inventory is estimated to be between 3–5 percent for the last inventory year. As fuel combustion is the major source of emissions, this sector (with a relatively small uncertainty) also determines the overall uncertainty. Uncertainties tend to be higher for individual sources and can vary significantly between sources.

The development of GHG scenarios adds another layer of uncertainty. In general, the uncertainty associated with projected activity data is a good deal higher, while the uncertainty in the emission factors might be of a similar range to uncertainty levels of the inventory.

On the whole, different types of uncertainty can be identified in emission projections:

- Inaccuracy of the database (uncertainty in the GHG inventory, energy balance and key statistic/surveys)
- Assumptions on economic activities and key drivers (GDP, energy prices, population…)
- Impacts of policies and measures
- Weather conditions (especially for particular years)

The main factors which are uncertain are described for each sector in the following.

Energy Industries (1.A.1), Manufacturing Industries and Construction (1.A.2) and Industrial Processes & Product Use (CRF Source Categories 2)

Economic development (gross value added) directly influences energy demand and has been identified as the most important parameter. As can be seen in the sensitivity analysis, a decrease in GDP growth reduces the energy demand more than any additional measures.

Another very important parameter is the global oil price along with the development of energy prices. How much power the Austrian plants will produce for the international market also depends on the international price for electricity.

The third important parameter is the number of existing and prospective heat and power plants in Austria. Any long-term decisions on whether or not to build new gas-fired power plants in Austria strongly depend on the gas and electricity prices and on national and international policies.

For the wood and the pulp and paper industries, the availability of biomass and the costs involved are also a key parameter.

Less uncertainty is associated with population growth in Austria.

For halocarbons and SF_6

Several assumptions have been made on how the policies and measures considered in this report will influence the annual use of fluorinated gases and leakage rates. As past experiences are not available, assumptions about changes in leakage rates have a particular influence on the overall uncertainty of forecast emissions.

While EU Regulation 517/2014 specifies rules for the quotas of F-gases which may be placed on the market, the percentage applicable for Austria is unclear. This has a certain influence on the overall uncertainty in the projected emissions.

For 2.D solvent use

A simple method has been used for projecting CO_2 emissions in the subsector 2.D 'Non-Energy Products from Fuels and Solvent Use'. Therefore the level of uncertainty can be considerably high.

Transport (CRF Source Category 1.A.3)

Numerous exogenous factors have an influence on projections such as population growth, fuel price trend, fuel export trend (fuel purchased in Austria and consumed abroad because of lower fuel prices in Austria compared to neighbouring countries), fuel efficiency trends in newly registered vehicles and the effectiveness of the implementation of the Energy Efficiency Directive (2012/27/EC).

Other Sectors (CRF Source Category 1.A.4)

The sensitivity analysis shows that variations in the assumptions for GDP slightly influence emission projections (see previous chapter).

Some uncertainty is associated with the implementation and acceptance of measures which influence overall heating demand, e.g. the renovation rate and the boiler exchange rate.

Economic development (gross value added), especially in the commercial sector, directly influences energy demand. Furthermore, a specific economic situation inhibits or postpones the implementation of renovation measures, which may result in smaller reductions of greenhouse gas emissions.

Less uncertainty is associated with population growth in Austria, with permanently occupied dwellings and the number of buildings.

Fugitive Emissions from Fuels (1.B)

The uncertainty in the projections for fugitive emissions is closely linked to the uncertainty in the Energy Industries sector. A higher level of uncertainty has to be expected when predicting CO_2 emissions from natural gas refineries since they depend on the composition of explored natural gas.

Agriculture (CRF Source Category 3)

Projections into the future are fraught with a range of uncertainties which have to be kept in mind when considering the results of this analysis:

- **Model uncertainty:** The first uncertainty factor is related to the type of model. The model is static by design and adjustments to future situations are calculated in discrete steps which are based on exogenous assumptions (prices, costs, technical coefficients) and model-endogenous coefficients (marginal costs) which are based on observations in the reference period. Investment costs are not considered in the model as it is based on gross margin calculations. The model assumes a swift adaptation of land uses and management and an efficient use of resources. In practice such adaptations may be over-optimistic because farmers are not able or willing to adjust as the model suggests.
- **Market uncertainty:** A comparison of past OECD-FAO projections and the observed outcomes suggests that there is a considerable difference between them. The range of such uncertainties is discussed in more detail. in the OECD-FAO report (2014).

- **Policy uncertainty:** Policies affect decisions of farmers and other market participants in various ways. The range of policies is not limited to agricultural policies alone: energy policies affect energy prices and thus input costs; urban planning regimes affect decisions about developments of residential and commercial areas which have an impact on the availability of agricultural land.

Land Use, Land-Use Change and Forestry (CRF Source Category 4)

The forest sub-category (including harvested wood products) has the highest impact on the LULUCF projection results. Consequently, the uncertainties for this sub-category are expected to account for most of the uncertainty in the total LULUCF trends. There is a particularly high level of uncertainty in the simulated changes in forest soil C stock.

Waste (CRF Source Category 5)

Several assumptions have been made regarding future waste amounts treated in treatment facilities, with a moderate level uncertainty as current expectations are largely based on historical activity data, population trends, GDP trends as well as some expert judgement on future legal requirements.

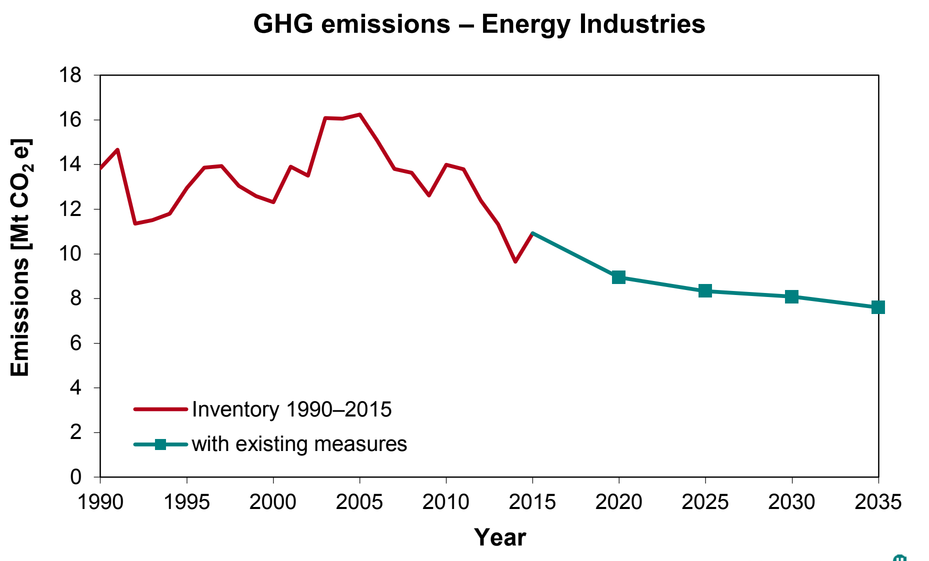
Regarding waste disposal it is important to note that for upcoming trends, historical deposits are of relevance as well (according to the First-Order-Decay method), with relatively low levels of uncertainty thanks to good quality country-specific data which are available on an annual basis (Electronic Data Management).

2 SECTORAL SCENARIO RESULTS

2.1 Energy (CRF Category 1)

2.1.1 Energy industries (1.A.1)

Figure 6: Past trend and scenario (2016–2035): GHG emissions from 1.A.1 – Energy Industries.



Source: Umweltbundesamt

In 2015 emissions from Energy Industries were 21% below the level in 1990. Emissions from power plants have been decreasing steadily since 2005, mainly because of the growing contribution of renewable energy sources, the replacement of solid and liquid fuels by natural gas and biomass as well as improvements in efficiency. The share of biomass used as a fuel in this sector increased from 0.9% (1990) to 27% (2015), the contribution of hydro and wind power plants to total public electricity production increased from 69% (1990) to 79% (2015). Electricity consumption has increased by 47% since 1990 but since 2002 the increase has mainly been covered by electricity imports.

In the Energy Industries sector GHG emissions will continue to decrease due to a shift away from oil and coal to renewables. The installed capacity of hydro power, solar and wind plants is expected to increase significantly. After 2015 the first biomass CHP plants will be decommissioned – unless more subsidies than foreseen in the WEM scenario are granted.

The major driving force behind the emissions in this sector is expected to be electricity demand, especially after 2020. Whereas demand in the year 2020 is expected to be lower than in 2015, it is expected to rise almost by an average of 1% per year thereafter. The demand for district heat is expected to decrease slightly in the period until 2035.

Emissions from petroleum refining are projected to remain more or less constant as the total production capacity is not expected to change significantly as no major changes in production capacity or technology are expected. Emissions from oil and gas exploration and storage are expected to decline considerably due to a reduction in gas exploration activities in the next decade.

2.1.2 Manufacturing industries and construction (1.A.2)

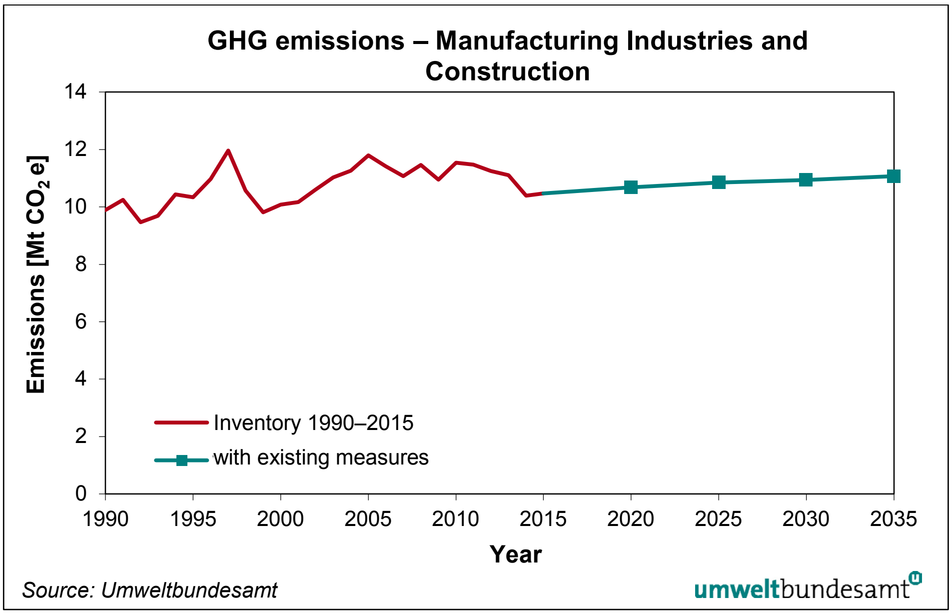


Figure 7: Past trend and scenario (2016–2035) GHG emissions from 1.A.2 – Manufacturing Industries and Construction.

Energy related GHG emissions from the Manufacturing Industries and Construction sector increased by 5.8% from 1990 to 2015, mainly in the chemical and other industries. Fuel consumption increased by 36% in that period, mainly due to an increased use of natural gas and biomass. As natural gas has a lower carbon content and CO_2 emissions from biomass combustion are not accounted for under the UNFCCC reporting framework, the increase in GHG emissions is significantly smaller (only +6%) compared to the increase in fuel combustion.

The Industry sector is one of the main sources of greenhouse gases in Austria, mainly due to the CO_2 emissions in this sector. Major sub-groups contributing to these emissions are: iron and steel production, the production of non-metallic minerals, the pulp and paper industry and the chemicals industry.

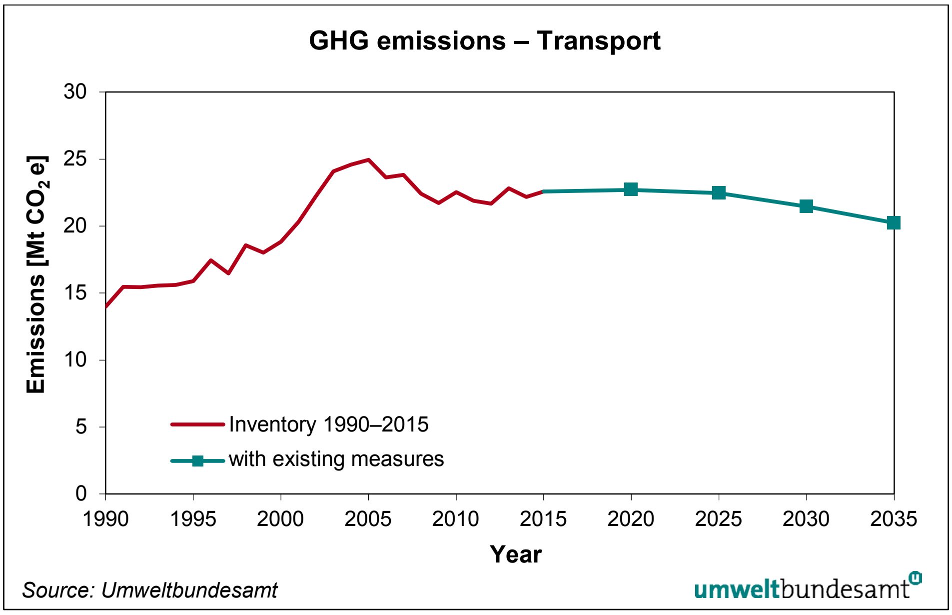
During the period between 1990 and 2005 the Industry sector was responsible for an emissions increase by more than 20%. Since 2005 emissions have slightly decreased. For the period from 2015 to 2035 a slight increase in CO_2 emissions (as a result of higher sectoral GDP projections) is expected.

Sectoral emission trends are mainly the result of different sectoral economic growth rates, which are in turn outcomes of the macroeconomic model. The highest emission increase is expected for the chemical industry (1A2c; + 17 %), whereas moderate rises are expected for the iron and steel industry (1A2a; + 7 %) and the other stationary manufacturing industry (1A2g8; + 9 %). In other sectors emissions are expected to remain more or less stable (1A2b Non-ferrous Metals and 1A2d Pulp, Paper and Print) or to decrease slightly (1A2e Food Processing and 1A2f Non-Metallic Minerals).

The mobile sources in this sector (1A2g7) accounted for 1.1 Mt CO_2 equivalent in 2015 and they are expected to rise by 28% until 2035.

2.1.3 Transport (1.A.3)

Figure 8: Past trend and scenario (2016–2035) GHG emissions from 1.A.3 – Transport.



The Transport sector shows a strong increase in GHG emissions from 1990 to 2015 (+62%) mainly due to an increase in passenger and freight transport (kilometres travelled). In addition to this increase in road use within Austria, the amount of fuel sold in Austria but used elsewhere – driven by lower fuel prices in Austria compared to the neighbouring countries – has increased considerably since 1990. However, from 2005 onwards GHG emissions have been decreasing due to a decreasing trend in total fuel sold together with an increased use of biofuels and the gradual replacement of vehicles by newer cars (with less specific fuel consumption). In 2015, however, total fuel sales nearly reached the level of 2005 again.

The Transport sector is and will remain one of the main sources of greenhouse gases in Austria. While emissions from gasoline vehicles are expected to decline steadily, emissions from diesel will increase. In 2030 diesel driven passenger cars will still account for the majority of the vehicle stock in this category (51%) despite an increased share of electric cars. Around 25% of the GHG emissions in this sector are currently caused by fuel exports due to Austria's fuel prices which are persistently lower (especially for diesel) compared to the neighbouring countries (BMWFW 2017); this share is expected to remain relatively constant also in the future. GHG emissions saw a steep increase in recent years and reached their peak in 2005. Then the implementation of the EU Biofuels Directive (2003/30/EC) and declining fuel exports brought about a change in this trend. In addition, the economic downturn resulted in further emission reductions, especially in 2008 and 2009, but emissions went up again because of an increase in economic and transport activities from 2010 onwards. In 2015 total fuel sales nearly reached the level of 2005 again. From 2015 onwards, the use of biofuels, plus higher fuel efficiency standards and especially the promotion of electric mobility are expected to help stabilise GHG emissions in the first place and then reduce them from 2022 onwards.

2.1.4 Other Sectors & Other (1.A.4 & 1.A.5)

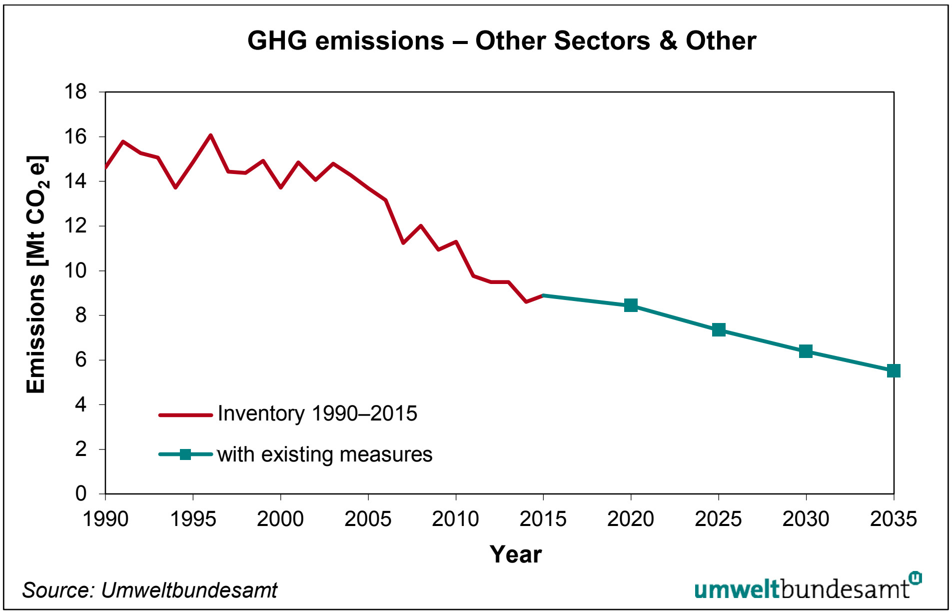


Figure 9: Past trend and scenario (2016–2035) GHG emissions from 1.A.4 – Other sectors (includes Residential, Commercial/Institutional and Agriculture/Forestry/ Fishing) and 1.A.5 – Other (military).

The variation in demand for heating and hot water generation (due to climatic circumstances) and the shift in the fuel mix are the most important drivers for emissions from Other Sectors. Emissions in 2015 were 39% lower than in 1990. This reduction is mainly attributable to a declining consumption of heating oil and coal and an increase in the consumption of biomass and natural gas as well as the growing importance of district heating and the modernisation of heating systems. Total fuel consumption in this sub-category decreased by 17% from 1990 to 2015.

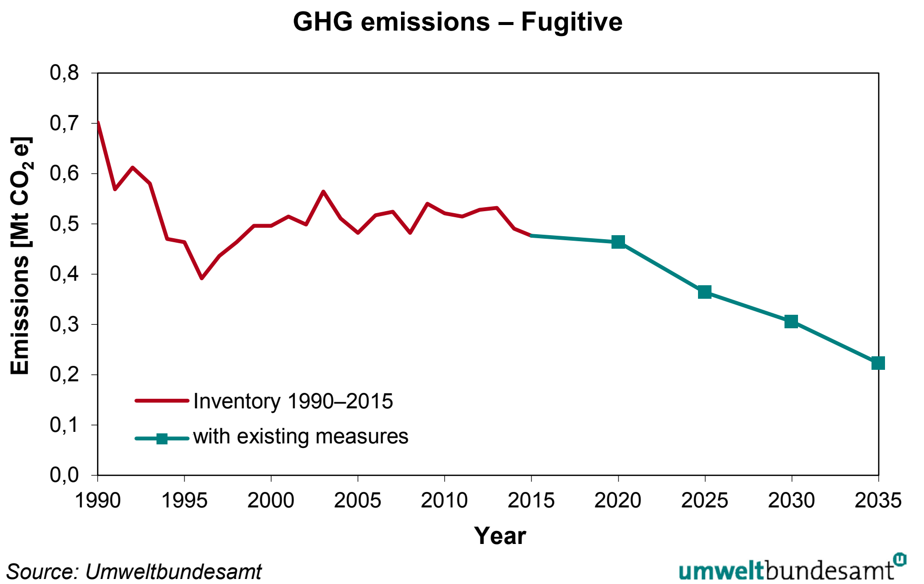
The '1.A.4 other sectors' account for a considerable amount of the total greenhouse gas emissions in Austria. Despite growing numbers of households and occupied living space, the total GHG emissions in this sector are expected to see substantial reductions by 2035 in the WEM scenario.

The driving force behind these reductions is the shift away from fossil fuels to renewables like biomass, solar heat and ambient heat, as well as a the stable share of district heat and the increasing share of electricity for heat pumps, which means in both cases transferring emissions to Sector 1.A.1 Energy Industries. Furthermore, a slight reduction in total energy consumption (incl. electricity) together with increased insulation in new buildings (or better insulation through renovation measures), as well as an improved efficiency of primary heating systems in buildings are all expected to lead to a considerable reduction in GHG emissions between now and 2035.

The mobile sources in this sector (mainly 1A4c2 Agriculture/Forestry) accounted for 0.9 Mt CO_2 equivalent in 2015 and they are expected to rise by 8% until 2035.

2.1.5 Fugitive emissions (1.B)

Figure 10: Past trend and scenario (2016–2035) GHG emissions from 1.B – Fugitive emissions.



Source: Umweltbundesamt

Between 1990 and 2015 fugitive emissions from coal mining, fossil fuel exploration, refining, transport, production and distribution decreased by 32%.The main driving force behind this decrease was the closure of coal mines. So there have been no coal-mining activities in Austria since 2007. The increase since 1996 was due to the extension of the natural gas distribution network and increasing emissions from natural gas and oil extraction.

It is expected that the total fugitive emissions will strongly decrease due to a continuous reduction in natural gas exploration. In the year 2035, emissions are expected to consist mostly of fugitive CH_4 emissions as a result of gas distribution and pipeline network extensions.

2.2 Industrial Processes & Product Use (CRF Category 2)

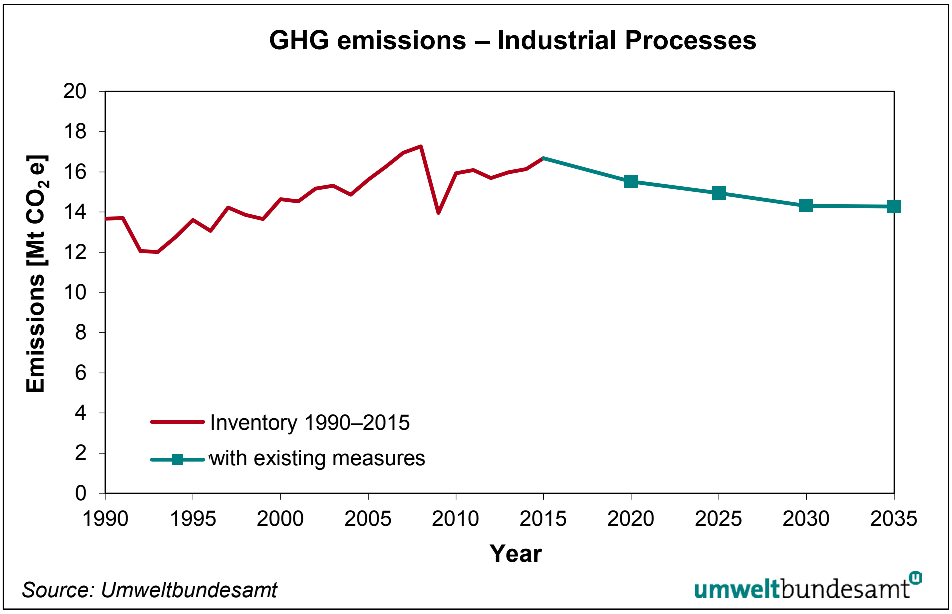


Figure 11: Past trend and scenario (2016–2035) GHG emissions from 2 – Industrial Processes & Product Use.

In 2015, greenhouse gas emissions from *Industrial Processes and Other Product Use* amounted to 16 676 kt CO_2 equivalent, corresponding to 21% of the total national emissions.

The most important sub-categories of this sector are the *metal industry* and the *mineral industry*, generating 65% and 16% of the total sectoral emissions (2015). The most important greenhouse gas of this sector is CO_2 with a contribution of 86% to the total sectoral emissions (2015), followed by HFCs with 10%, SF_6 with 1.9%, N_2O with 1.1%, and PFCs and CH_4 with 0.3% each. NF_3 contributes 0.1% of the total emissions from this sector.

The overall trend in GHG emissions from *Industrial Processes and Product Use* shows an increase in emissions by 22% from 1990 to 2015. Within this period, emissions fluctuated, reaching their lowest level in 1993. The main drivers for the trend in the emissions from this sector were (i) the closing down of primary aluminium production in 1993, (ii) the introduction of N_2O abatement technologies in the chemical industry in 2004 and in 2009 (which became fully operational in 2010), (iii) increasing metal production resulting in GHG emissions which were 31.7% higher in 2015 compared to 1990 and (iv) a strong increase in HFC emissions in the period 1992 to 2015 from 5.6 to 1 662 kt CO_2 equivalent.

The largest increase in GHG emissions between 1990 and 2015 can be observed in the *metal industry* due to an increase in emissions from iron and steel production (+62.5%). In the sub-categories *mineral industry* and *chemical industry*, emissions declined by 11.4% and 49% respectively during that period.

The increase in emissions of *fluorinated gases* over 1990 levels was 21%, brought on by higher emissions of HFCs (+559% since 1995) which were used as cooling agents, replacing Ozone Depleting Substances. Emissions from *solvent use* dropped by 48%, due to legal measures controlling the solvent content of products and their use.

Emissions from industrial processes are expected to see a slight decrease in particular until 2030. The main sources are the categories 'metal production' and 'mineral products'. Whereas emissions from the categories 'mineral products' are expected to remain stable in the period 2015 to 2035, emissions from 'metal products' are projected to decrease slightly in particular due to the use of imported direct reduced iron in the blast furnace from 2016. Emissions from 'chemical products' are also projected to decrease slightly from 2020 onwards, mainly due to a decreasing demand for fertilisers and their intermediate products such as ammonia.

Another source in this sector is the source 'fluorinated gases' (HFC, PFC and SF_6). These gases contributed 12.2% of the emissions in the industrial processes sector in 2015 with a projected decrease to 5.3% by 2035 in the scenario with existing measures, a decrease which will mainly be brought about by several legislative measures (see chapter on methodology for more information).

Solvent and Other Product Use (CRF source category 2D and G) is one of the minor sources, contributing less than 1% of the total greenhouse gases in Austria. Greenhouse gas emissions in this sector decreased by –38% between 1990 and 2015 due to a decrease in solvent and N_2O use and as a result of the positive impact of the laws and regulations enforced in Austria. These emissions are expected to stabilise in the period until 2035. CRF sector 2D comprises two other sub sectors, 2D1 Lubricant Use (0.03% of the national total) and 2D2 Paraffin Wax Use (0.02% of the national total). Combined, 2D is a key category. There are no measures in place for either 2D1 or 2D2.

Emissions from Lubricant Use are expected to rise when using the same assumptions as for the Energy sectors. Emissions from Paraffin Wax Use depend on population growth.

2.3 Agriculture (CRF Category 3)

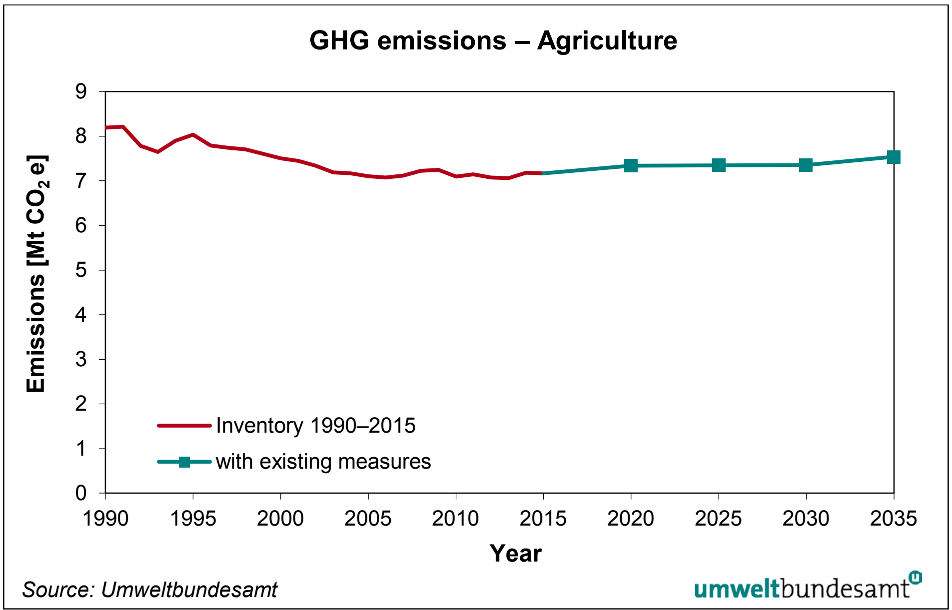


Figure 12: Past trend and scenario (2016–2035) GHG emissions from 3 – Agriculture.

In 2015, greenhouse gas emissions from *Agriculture* amounted to 7 168 kt CO_2 equivalent, corresponding to 9.1% of the total national emissions.

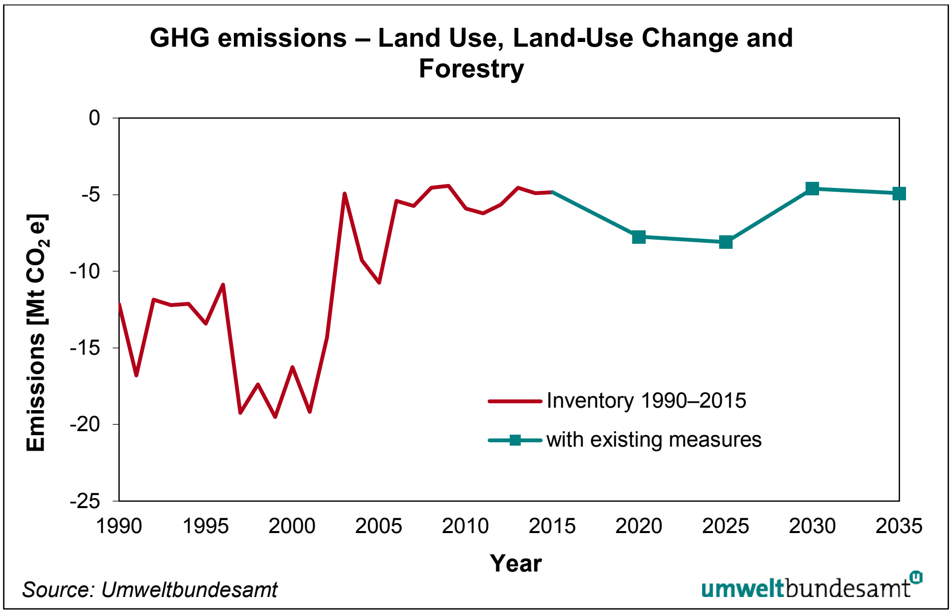
The most important sub-categories of this sector are *enteric fermentation* (58%) and *agricultural soils* (29%). The Agriculture sector is the largest source for both N_2O and CH_4 emissions: in 2015 71% (8.3 kt) of the total N_2O emissions and 69% (183 kt) of the total CH_4 emissions in Austria originated from this sector. 64% of the GHG emissions from the sector are CH_4, 34% N_2O and 1.6% CO_2 emissions.

The overall trend in GHG emissions from *Agriculture* is decreasing, with a decrease by 12% from 1990 to 2015. The main drivers for this trend are decreasing livestock numbers and lower amounts of N fertilisers applied on agricultural soils. Fluctuations, which can be seen in particular in the first half of the 1990s, result from variations in the sale of mineral fertiliser due to price volatilities.

Between 2015 and 2035 an increase in emissions by 5.2% can be expected. Underlying livestock projections indicate that the declining trends will come to an end. Dairy cattle numbers will increase because milk production is likely to increase after the abolition of the milk quota in 2015. Slightly increasing prices for pork will lead to increases in the numbers of pigs. Implemented policy measures (see chapter 3.5) may weaken but will not change the increasing trend.

2.4 LULUCF (CRF Category 4)

Figure 13: Past trend and scenario (2016–2035) GHG emissions from 4 – Land Use, Land-Use Change and Forestry[1].



The LULUCF sector has been a net sink in the past and is projected to remain a net sink in the period until 2035. Between 2015 and 2020 net removals increase by approximately 2.9 Mt CO_2 equivalent due to an increase of the HWP sink over the same period. From 2025-2030 onwards the net sink decreases, which can also be explained by a similar trend in the dominating HWP pool and by an increased use of forest biomass. After 2030 the aggregated net sink of the two largest LULUCF sectors, 4.A Forest land and 4.G HWPs, is projected to remain stable, resulting in a stabilisation of the total net sink in the LULUCF-sector.

On the other hand, the non-forest sectors (Cropland, Grassland, Wetlands, Settlements and Other land) are sources of emissions in the projected time series, amounting to approximately 1 Mt CO_2 equivalent per year.

[1] The historical values of category 5.A.1 (having the main impact on the LULUCF totals) for the years 2009 and 2010 are based on averages of the NFI observation period 2002 and 2008 and will be revised in line with the results of the next NFI

2.5 Waste (CRF Category 5)

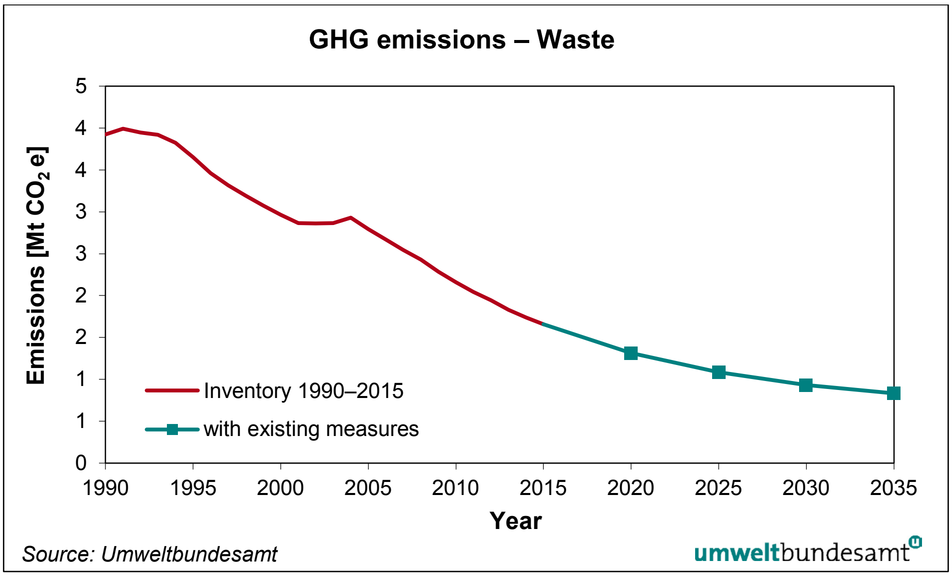


Figure 14: Past trend and scenario (2016–2035) GHG emissions from 5 – Waste.

In 2015, greenhouse gas emissions from *Waste* amounted to 1 656 kt CO_2 equivalent, corresponding to 2.1% of the total national emissions.

The most important sub-category of the Waste sector is *solid waste disposal*, which was responsible for 78% of the emissions from this sector in 2015, followed by *waste water treatment and discharge* (11%) and *biological treatment of solid waste* (11%). Emissions from 'waste incineration without energy recovery' have been of minor importance since 1993. Emissions from 'waste incineration with energy recovery' are considered under category 1.A (Fuel Combustion). The most important greenhouse gas is CH_4 with a share of 85% in the emissions from *waste* (2015), followed by N_2O with 15% and CO_2 with 0.1%.

The overall trend in GHG emissions from *waste* is decreasing, with a decrease of 58% from 1990 to 2015. The main driver for this trend is the implementation of waste management policies: Waste separation, reuse and recycling activities have increased since 1990 and the amount of deposited waste has decreased correspondingly, especially since 2004 when the pre-treatment of waste became compulsory (although some Austrian provinces were granted some exceptions). Furthermore, methane recovery has improved. The legal basis for the reductions in waste disposal and for landfill gas recovery is the Landfill Ordinance. Since 2009 all wastes with a high organic content have been pre-treated before deposition (legal requirement without exception).

The scenario shows a further downward trend in waste treatment and disposal rates up to 2020/2035. This is in line with a decreasing carbon content of historically landfilled waste as well as a decrease in the amount of waste deposited in landfills (due to legislative regulations). Increasing amounts of waste being incinerated (with energy recovery) and a reduction of the amount of wastes treated in MBT plants are further factors contributing to the decline in emissions from solid waste disposal and biological treatment of solid waste. Emissions from 'waste water handling and discharge' are increasing slightly under the current policy ('WEM') in line with the rising population.

3 SECTORAL METHODOLOGY

3.1 Energy (CRF Source Category 1)

Total energy demand and production was evaluated on the basis of an energy scenario developed by a consortium of the Environment Agency Austria (Umweltbundesamt), the Austrian Institute of Economic Research ('Wirtschaftsforschungsinstitut', WIFO), the Austrian Energy Agency, the Energy Economics Group of the Vienna University of Technology and the Institute for Internal Combustion Engines and Thermodynamics at the Graz University of Technology (UMWELTBUNDESAMT 2017b). The scenario was developed with the help of several models:

- econometric input-output data (DYNK),
- domestic heating and domestic hot water supply (INVERT/EE-Lab),
- public electrical power and district heating supply (TIMES Austria) and
- energy demand and emissions of transport (NEMO & GEORG).

In addition, several parameters were calculated endogenously, e.g. pipeline compressors and industrial autoproducers.

The econometric input-output model DYNK combines a private consumption module with an energy and environment module. Important input parameters are energy prices, population and household income (WIFO 2017).

For projecting the production of electricity and district heating a model based on TIMES has been used. The model has been adapted especially for Austria. It is based on available capacities for all types of power plants in combination with energy prices and the demand for electricity and district heating (taken from the model INVERT/EE-Lab). Subsidies (e.g. granted under the Green Electricity Act) and fees (like emission allowances) are also important input parameters (AEA 2017).

For modelling the energy consumption for domestic heating and domestic hot water supply, the software package INVERT/EE-Lab (TU WIEN 2017) was applied. This model is based on a stochastic, non-recursive, myopic and economic algorithm with the objective function to minimise costs. The basic algorithm is based on the principle of the model INVERT. It allows the calculation of the energy demand for heating (space heating and hot water) in apartment buildings and buildings of the public or private service sector by including the effects of various funding instruments. The main inputs for the calculation are:

- availability of resources,
- market penetration of different technologies,
- maximum replacement and refurbishment periods,
- minimum and maximum lifetime of technical installations.

The results obtained with the different models were exchanged and adjusted within a few cycles. Umweltbundesamt experts combined the data obtained with the different models and included additional calculations for

- energy inputs for the iron and steel industry,
- production of electric power and district heating in industry,
- use of waste as fuel in power plants and industry,
- energy input of compressor stations,

- total energy demand,
- electricity demand in the Transport sector.

3.1.1 Energy Industries (1.A.1)

3.1.1.1 Methodology of the sectoral emission scenarios

The output of the model based on TIMES (see chapter 3.1) provides fuel-specific activity data for the Energy Industries (i.e. Electricity and Heat Production including Waste Incineration). These were multiplied by established and fuel-specific emission factors used in the Austrian Inventory. Emission factors for wastes (e.g. municipal solid waste, hazardous waste) were derived from plant-specific data. The methodology used to create the emission factors is discussed in the Austrian Inventory Report (UMWELTBUNDESAMT 2017a).

As regards the only refinery in operation in Austria, no major changes in the production capacities or in the technologies used are expected from the current point of view. Restructuring programmes and start-ups of new production units were undertaken in the past. The last one was completed in 2008. The projections are based on the output of the DYNK model using a refinery-specific emission factor which was calculated using the average emissions of the years 2010–2015.

The exploration of oil and gas is expected to decline considerably in the next decade. Emissions from oil and gas exploration and storage have been calculated by multiplying the energy input by a fuel-specific emission factor.

3.1.1.2 Assumptions

The assumptions on which the scenario is based (for total inputs to power and heat plants, split into the different fuel types) can be seen in the Annex. Moreover, the energy demand is shown by sectors, split into the fuel types delivered (final energy consumption). The assumption on which the basic weather parameter is based (heating degree days) is explained in chapter 1.3.4.

Energy efficiency measures (see chapter 4) are expected to have been fully implemented, leading to a decrease in electricity demand.

EU ETS/non-ETS

In ‘Public Electricity and Heat Production’ (1A1a) none of the non-ETS installations uses coal whereas waste is burned completely in non-ETS installations. For natural gas and liquid fuels it is assumed that the current ETS/non-ETS share will remain stable throughout the reporting period for each of the production technologies (i.e. CHP and heat only plants, respectively). ‘Petroleum Refining’ (1A1b) is completely covered by the ETS except for non-CO_2 greenhouse gas emissions. In the sector ‘Manufacture of Solid Fuels and Other Energy Industries’ (1A1c) it is assumed that the current ETS/non-ETS share will remain stable throughout the reporting period. In 2013 additional installations were included in the ETS.

Price of CO_2 tonne under the Emission Trading scheme

It has been assumed that the European ETS will continue beyond 2020 and that the price will not be influenced by decisions of Austrian plant operators. The prices have been taken from PRIMES as follows:

- 15 €/t in 2020, 36.5 €/t in 2030.

The effects of the changes for phase 3 in the ETS have been considered.

Losses in electricity production due to implementation of the Water Framework Directive/Optimisation of existing hydro power plants

As regards the implementation of the Water Framework Directive and the potential for optimisation of existing hydro power plants it has been assumed that projected losses due to the implementation of the Water Framework Directive and additional production levels due to repowering offset each other.

Green Electricity Act

For the scenario 'with existing measures' it is assumed that the goals of the Green Electricity Act 2012 (Federal Law Gazette I No. 75/2011) will be fulfilled for hydro power, exceeded for photovoltaics and wind power but not fulfilled for biomass. The Act aims at a construction of hydroelectric power plants with a capacity of 1 000 MW, wind farms with 2 000 MW, photovoltaic systems with 1 200 MW and biomass plants with 200 MW_{el} by 2020. The Green Electricity Act stipulates no specific goals beyond the year 2020. It should be noted that the goals for photovoltaic installations are expected to be surpassed on account of their profitability, whereas the goals for wind power will be surpassed with the help of subsidies.

Petroleum refining

See chapter 3.1.1.1 for assumptions regarding this sector.

Manufacture of solid fuels and other energy industries

See section 3.1.1.1 for assumptions regarding this sector.

3.1.1.3 Activities

The energy input to Austrian heat and power plants is depicted in Figure 15. The input to coal and oil plants is expected to decline (input to coal plants is expected to end in 2025, to oil plants in 2018), whereas the input to gas plants is expected to rebound in 2016 and decline thereafter. The decline in fossil fuel plants will, however, be compensated for by increased input to hydro-electrical, wind and photovoltaic plants.

Whereas input to biomass power and heat plants is expected to decline, wind and hydro power and photovoltaics are assumed to increase significantly.

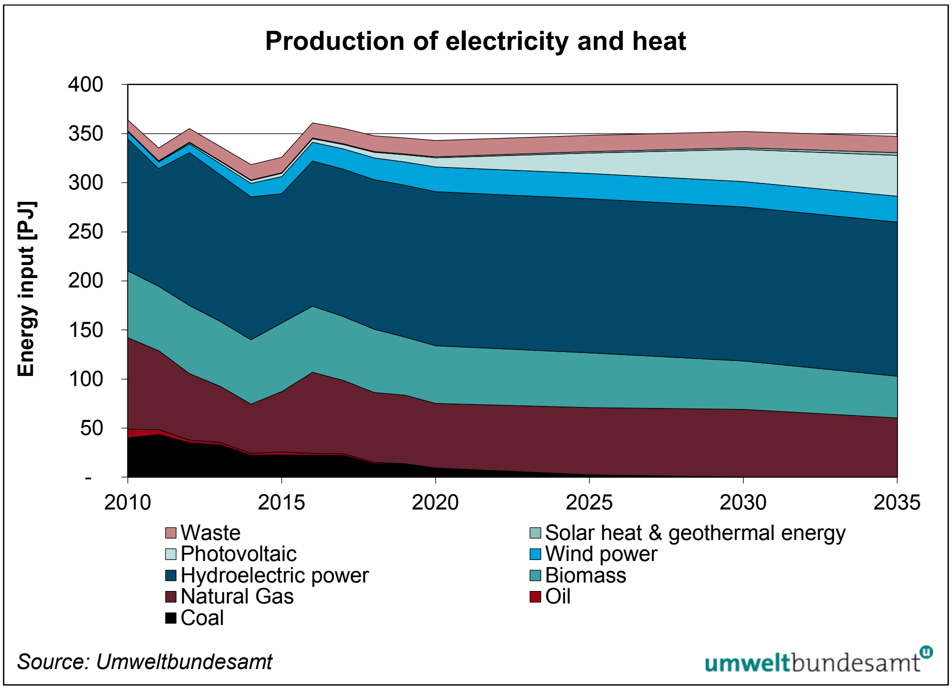


Figure 15: Energy input for electricity and heat production (1.A.1.a)

GHG emissions (and thus energy inputs) from the only refinery in Austria are expected to remain more or less stable until 2035 as indicated in chapter 3.1.1.1.

For oil and gas exploration and storage, natural gas is the only fuel source. Input is expected to shrink steadily.

3.1.2 Manufacturing Industries and Construction (1.A.2)

3.1.2.1 Methodology used for the sectoral emission scenarios

The methodology used here is the same as the methodology used in the Austrian Inventory and the emission factors and methodology are discussed in detail in the Austrian Inventory Report (UMWELTBUNDESAMT 2017a).

The models are described in the energy chapter 3.1.

3.1.2.2 Assumptions

Assumptions for the global oil price are given in US$. From 2015 a continuous increase in the oil price is expected. GDP growth is expected to average 1.5% per year until 2035 (see chapter 1.3.4).

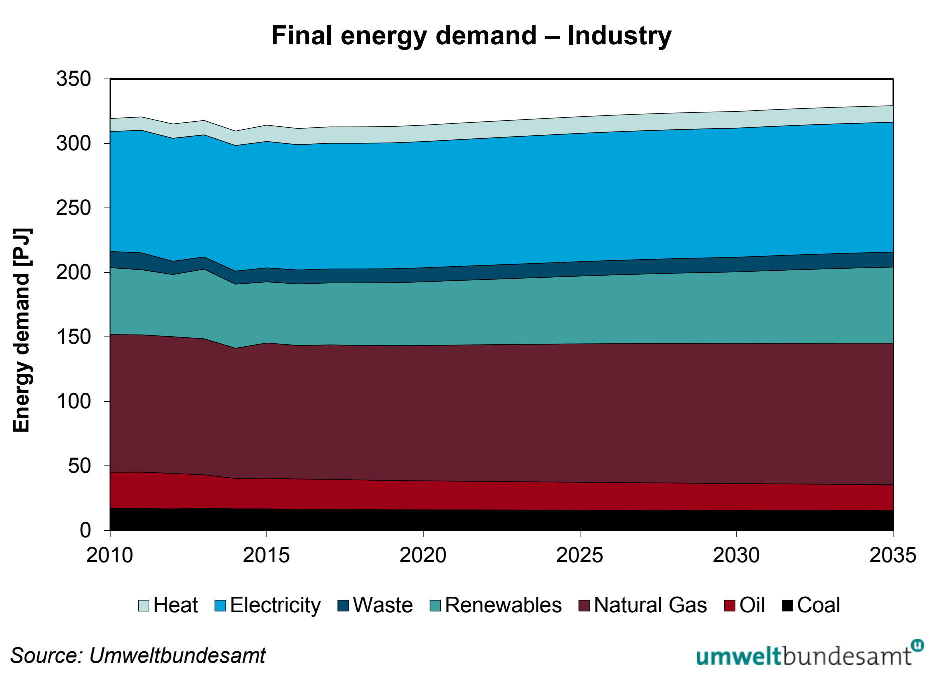
EU ETS/non-ETS

Emissions for EU ETS/non-ETS have been split on the basis of sectoral fuel input. Here the ETS share of each fuel (averaged over the most recent years) has been used for determining the fuel input for EU ETS/non-ETS until 2035. For sectors with a low non-ETS share the split into EU ETS/non-ETS emissions has been based on the corresponding emission shares in the most recent years.

3.1.2.3 Activities

Based on the sectoral gross value added, the energy demand in the industrial sector is expected to increase continuously from 2015 to 2035 (see Figure 16). Detailed figures are given in Annex II.

Figure 16: Energy demand in the industrial sector (incl. off-road).



3.1.3 Transport (CRF Source Category 1.A.3)

3.1.3.1 Methodology used for the sectoral emission scenarios

The scenario comprises different models:

1 A 3 Transport (without aviation)

The calculation of transport emissions is based on different models:

- **NEMO – Emission model road (CRF Source Category *1 A 3 b*)**

From the 2015 submission onwards, projections for the time series up to 2035 have been based on NEMO – the Network Emission Model (DIPPOLD et al. 2012, HAUSBERGER et al. 2015). NEMO is set up according to the same methodology as the former model GLOBEMI and combines a detailed calculation of the fleet composition with a simulation of energy consumption and emission output on a vehicle level. It is fully capable of depicting the upcoming variety of possible combinations of propulsion systems (internal combustion engine, hybrid, plug-in hybrid, electric propulsion, fuel cell …) and alternative fuels (CNG, biogas, FAME, ethanol, GTL, BTL, H2 …).

In addition, NEMO has been designed in such a way as to be suitable for all the main application fields in the simulation of energy consumption and emission output using a road-section based model approach. As there is as yet no complete road network for Austria on a high resolution spatial level, the old methodology based on a categorisation of traffic activities into ‘urban’, ‘rural’ and ‘motorway’ has been applied with the NEMO model.

- **KEX Tool (CRF Source Category *1 A 3 b*)**

The KEX tool is used in projections to map the future development of domestic fuel demand in road transport as a function of GDP, population and fuel prices, and to calculate the quantities of fuel exported in motor vehicles abroad in the future. The KEX tool was developed for estimating the change in domestic fuel demand and the export of fuels in motor vehicles [MOLITOR et al. 2004; MOLITOR et al. 2009)]. As independent variables, the KEX tool uses GDP, population, export quotas and domestic and foreign gasoline and diesel prices. Whereas the NEMO model calculates domestic fuel consumption, the KEX tool estimates the amount of fuel purchased in Austria and used abroad. The KEX tool includes a very simplified statistical tool, while NEMO includes predefined technologies for new vehicle registrations, their market penetration and the effects on consumption and emissions.

- **GEORG – Emission model off-road (CRF Source Category 1 A 2 f, 1 A 3 c, 1 A 3 d, 1 A 4 b, 1 A 4 c, 1 A 5)**

Energy consumption and off-road emissions in Austria are calculated using the GEORG model (**G**razer **E**missionsmodel für **O**ff **R**oad **G**eräte) (HAUSBERGER 2000). GEORG has a fleet model part which simulates the actual age and size distribution of non-road mobile machinery (NRMM) stock via age- and size-dependent drop-out rates (i.e. the probability that a vehicle will have been scrapped by the following year). With this approach the number of vehicles in each mobile source category is calculated according to the year of the vehicles' first registration and their propulsion systems (gasoline 4-stroke, gasoline 2-stroke, diesel > 80 kW, diesel < 80 kW).

1 A 3 a – Aviation

Projections for energy consumption in the aviation sector were carried out with the econometric input-output model DYNK of the Austrian Institute of Economic Research (WIFO 2017). Within the framework of an energy demand scenario for the different NACE sectors in Austria, the energy demand for aviation gasoline and kerosene has been estimated.

1 A 3 e – Other transportation – pipeline compressors

Projections for energy demand in pipeline transport up to 2035 are based on expert judgements of European gas demand, gas and electricity price, economic development and on a regression analysis of observed historical trends.

3.1.3.2 Assumptions

1 A 3 a – Aviation

WEM projections for energy consumption in the aviation sector up to 2035 are based on a scenario developed by the Austrian Institute of Economic Research (WIFO) as mentioned above. The scenario is based on jointly agreed parameters for e.g. annual GDP growth or domestic income.

After a slackening of economic growth, total consumption of kerosene and aviation gasoline has risen again in recent years and amounted to 31 PJ in 2015. The increase in energy demand for air traffic from 2015 to 2035 is assumed to be 10%. After 2015 energy consumption is projected to stagnate up to 2020 as oil prices are expected to grow faster in the first 10 years (between 2015–2025) than thereafter. In addition, the average annual economic growth rate is expected be below 1.5% between 2015 and 2020.

1 A 3 b – Road Transport/1 A 3 c Rail Transport/1 A 3 d Navigation

Modal split development in inland passenger transport
(excl. fuel export, international aviation and international navigation)

The distances travelled by people have been increasing steadily since 1990. In the WEM scenario it is assumed that the passenger kilometres (pkm) travelled will increase further until 2035. Therefore, elasticities have been calculated for passenger transport (based on GDP growth as assumed up to 2035) (UMWELTBUNDESAMT 2017b). The increase will not affect all transport modes in the same way. Individual passenger transport with cars, mopeds and motorcycles is expected to increase rapidly and includes assumptions about the future fleet of electric and plug-in hybrid cars (assumptions about trends in electric mobility are given below). Bus, rail and electric local public transport are also expected to increase slightly.

The following table shows the passenger kilometers travelled in Austria per transport mode.

Table 6: Past trend and scenario (2020–2035) increase in passenger kilometers in absolute numbers (in million pkm excl. fuel export), (Umweltbundesamt).

	passenger cars	buses	mopeds	motor cycles	rail	electric local public transport	pedestrians	bicycles	domestic aviation
1990	55 677	7 970	443	308	8 912	4 468	1 914	1 213	84
1995	62 156	8 701	369	510	10 124	5 397	1 857	1 264	126
2000	66 668	9 224	348	812	8 740	6 274	1 817	1 304	172
2005	70 557	9 319	332	1 005	9 061	6 776	1 793	1 345	211
2010	73 458	9 587	353	1 253	10 737	7 283	1 698	1 430	219
2015	78 347	9 917	326	1 551	12 208	7 560	1 603	1 515	155
2020	80 804	9 889	333	1 686	12 230	7 760	1 508	1 600	150
2025	83 451	10 081	324	1 786	13 112	7 778	1 413	1 685	153
2030	86 048	10 270	315	1 851	14 134	7 797	1 318	1 770	162
2035	89 271	10 457	307	1 901	15 226	7 806	1 223	1 855	171

The measures included in the scenario will not result in a substantial change in the modal split of passenger transport, as shown in the following chart.

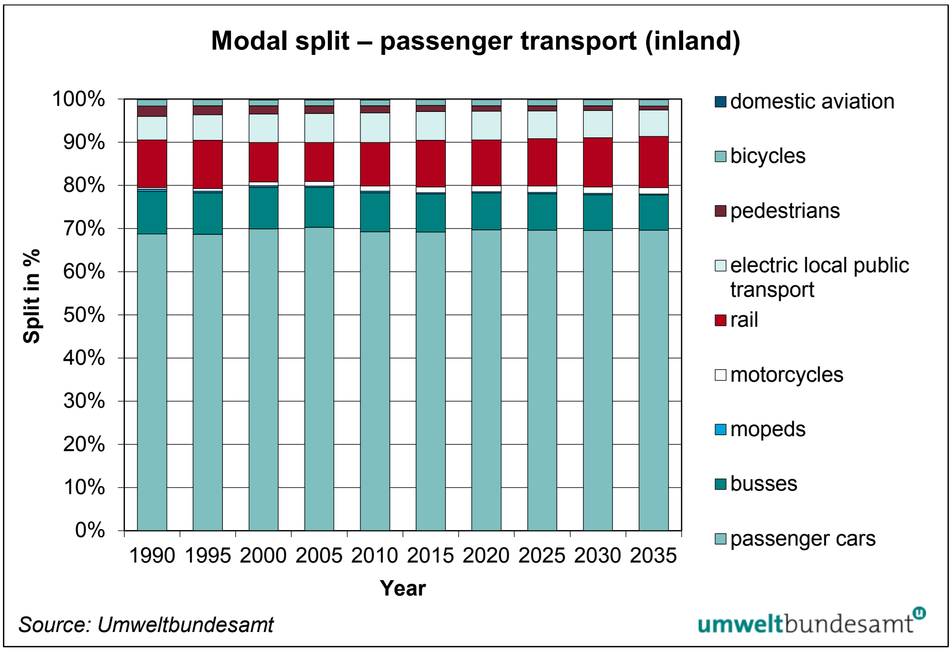


Figure 17: Past trend and scenario (2020–2035) passenger transport: modal split (excl. fuel export).

Fuel export in passenger transport on the road

It is true that private persons living close to the Austrian border or passing through Austria in their private car in transit take advantage of the lower fuel prices in Austria with the result that a certain amount of fuel is purchased in Austria and used abroad. This phenomenon of fuel export plays a minor role for passenger transport in the WEM scenario, with an average share of 2% in the total GHG emissions from road transport between 2015 and 2035.

Modal split development in inland freight transport
(excl. fuel export, international aviation and international navigation)

Transport volumes (given in tonne kilometres (tkm)) have increased since 1990 and are expected to increase unimpededly in the WEM scenario, assuming that GDP dependent freight transport elasticities continue to be valid up to 2035 (UMWELTBUNDESAMT 2017b). Freight rail transport is expected to increase slightly. Freight volumes transported by light duty vehicles, navigation and aviation are expected to remain constant on a very low level.

The following table shows the tonne kilometres travelled in Austria per transport mode. The share of rail transport will be around 30% (on average) between 2015 and 2035 while road freight transport will continue to have the major share.

Table 7: Past trend and scenario (2020–2035) increase in freight tonne kilometres (in million tkm excl. fuel export), (Umweltbundesamt).

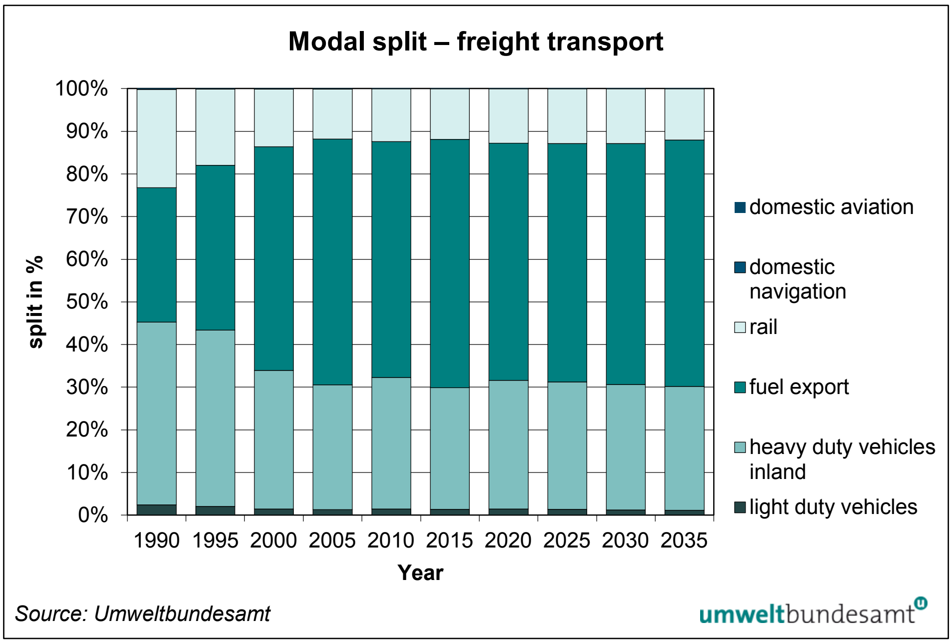
	light duty vehicles	heavy duty vehicles	rail	domestic navigation	domestic aviation
1990	1 187	21 125	11 349	101	1
1995	1 391	28 518	12 321	83	2
2000	1 649	36 731	15 331	117	2
2005	1 895	43 165	17 253	157	3
2010	2 127	45 215	18 209	73	1
2015	2 306	48 703	20 266	67	2
2020	2 422	51 838	21 895	96	2
2025	2 505	55 529	23 835	101	3
2030	2 518	59 269	25 881	107	3
2035	2 508	62 841	25 881	112	3

The measures included in the scenario will not result in a change in the modal split of freight transport as shown in the following chart.

Fuel export in freight transport by road

Fuel export in heavy duty vehicles continues to play a major role in Austria in the WEM scenario, with an average share of 24% in the total GHG emissions from road transport between 2015 and 2035. Figure 18 shows the modal split in freight transport including fuel export with heavy duty vehicles. More information about future developments is given below (sub-chapter 3.1.3.3 Activities).

Figure 18: Past trend and scenario (2020–2035) freight transport: modal split (incl. fuel export).



Development of alternative fuels

Biofuels

WEM projections for alternative fuel consumption in transport are primarily based on the requirement to meet the European objective, i.e. a 10% share of renewable energy in the Transport sector in 2020. This is to be achieved primarily through the blending of biofuels with fossil fuels and an increased use of electric vehicles. Assumptions used in the Austrian Fuels Strategy 2014 (BMLFUW 2014) have also been used for the development of the scenario.

In addition to biodiesel and bioethanol blends, the usage of pure biofuels or fuel blends with a higher amount of biofuel than required by existing standards (FAME and HVO mostly in fleets) has also been considered. Although these fuels had a good market share in the past, it is assumed that they will play a minor role in the future. The level achieved with biofuel-fossil fuel blends largely depends on the amount of fossil fuels sold on the market. By 2020, at least 10% of the total energy used in transport in each Member State will have to come from renewable sources such as biofuels, or from electricity produced from renewable energy sources. About 2% of the sub-target will be covered by electricity used in rail transport and other forms of transport (pipelines, cableways and ski lifts)

The EU recently published a draft for a new RED Directive under which the development of biofuels will be significantly limited. This is due to a restriction of conventional biofuels to less than 3.4% while other biofuels, partially not yet available, are expected to contribute 6%. It is not clear at the present moment what the impact of this proposal will be on the development of the biofuel market and if these targets will be included in the published Directive.

Other fuels

The WEM projections presented here for CNG (natural gas), LPG and hydrogen as alternative fuels up to 2020 and beyond are more conservative than those assumed in the Energy Strategy Austria (BMWFJ & BMLFUW 2010) since the vehicle registration data indicate no immediate breakthrough for these energy sources.

Development of electric mobility

WEM projections for the development of electric mobility are based on a fleet model for the development of registration numbers for electric vehicles (Battery Electric Vehicles (BEV) and Plug-In Hybrid Electric Vehicles (PHEV)) (UMWELTBUNDESAMT 2016a). A comprehensive demand analysis was performed for the period up to 2035. The evaluation deals with the temporal development of the effects of five potential barriers to the registration of electric vehicles (as opposed to vehicles with combustion engines):

- the number of available vehicle models
- the availability of charging infrastructure
- the vehicle costs
- the vehicle ranges
- the subjective attitudes in the public

The share of renewable electricity in the electric mobility sector is particularly high in Austria and a powerful lever in the achievement of the mandatory goal of a 10% share of renewable energy in transport by 2020, as the amount of renewable electrical energy used is calculated using a factor of 2.5. Therefore, the amount of electricity generated from renewable sources will be a critical aspect for the trend in electric mobility (BMWFJ & BMLFUW 2010).[2]

Current projections include all electrified transport modes on the road. For the projections it is assumed that the vehicle kilometres of conventional diesel and gasoline cars have been substituted with electric vehicles. The increased power consumption by electric vehicles is included in the energy-producing sectors.

In road freight transport, electric trucks of all size categories are now commercially distributed. However, market acceptance is not sufficient as yet. Therefore, electric heavy duty trucks are not considered in the current projections. Furthermore, rail transport already provides an alternative to long distance road transport. Therefore, a shift away from road to rail freight transport should be aimed for. For urban collection and delivery services, electric light duty vehicles are already in use and included in the current projections.

1 A 3 e – Other transportation – pipeline compressors

EU ETS/non-ETS

Emissions from ‘Other Transportation’ (1A3e), accounted for as non-ETS emissions up to 2012, have been covered by the ETS scheme from 2013 onwards, except for emissions of greenhouse gases other than CO_2.

1 A 2 g 7, 1 A 4 b 2, 1 A 4 c 2 – Off-road

Projections for NRMM (Non-Road-Mobile-Machinery) in industry and construction are based on the development of the value added according to NACE sectors of the DYNK model (WIFO 2017).

Projections for NRMM in agriculture are based on grain harvesting, which is expected to grow by around 0.5% per year. This reflects approximately the growth rate of the past 15 years, although it is somewhat lower as historical production increases in agriculture must be accounted for and soil sealing also has to be considered.

Projections for NRMM in forestry are based on woodcutting and follow the historical trend with an average growth of 1.8% per year.

Projections for NRMM in households are based on estimates of gardening tools in households showing a slight overall growth.

For other NRMM in households a constant trend is assumed for 1990–2035 due to a lack of historical data.

[2] With the future implementation of the ILUC Directive a factor 2.5 is expected to be applicable for rail transport and a factor 5 for EVs (electric vehicles).

3.1.3.3 Activities

1 A 3 a – Aviation

According to international reporting guidelines only GHG emissions from domestic aviation (domestic LTO and cruise traffic) need to be included in the national total. Therefore, the share of aviation in total GHG emissions is very small in Austria with 0.06%. The economic downturn resulted in a decrease in the national energy demand for domestic aviation from the peak year 2007 onwards.

Under the WEM projections it is assumed that the domestic aviation sector will not reach the GHG emissions level of the peak year 2007 until 2035. For GHG emissions from domestic aviation a 10% increase over 2015 levels is projected for 2035 (WIFO 2017).

1 A 3 b – Road Transport

Since the end of the 1990s the gap between Austrian fuel sales and domestic fuel consumption has become wider, amounting to roughly 25% of total fuel sales in road transport in 2015. A reason for this discrepancy is 'fuel export in vehicle tanks', which is a result of the relatively low fuel prices in Austria in comparison to the neighbouring countries. Table 8 shows that all neighbouring countries have higher diesel prices than Austria. A large number of motorists tend to fill up their cars with fuel in Austria and the fuel is consumed abroad. The majority of fuel export, however, is due to freight transport by road with heavy duty vehicles. This has been confirmed by two national studies (MOLITOR et al. 2004, MOLITOR et al. 2009).

Table 8: Differences in gross diesel prices in €/l (8/2/2017) (BMWFW 2017).

Gross diesel prices	€/l	Difference to Austria
Austria	**1.121**	
Czech Republic	1.130	0.01
Italy	1.395	0.27
Germany	1.192	0.07
Hungary	1.203	0.08
Slovakia	1.164	0.04
Slovenia	1.188	0.07

The 'fuel export' phenomenon is relevant for climate policy, e.g. for Austria's UNCCC commitment (Kyoto protocol), because emissions are allocated according to national fuel sales. GHG emissions from fuel export are thus assigned to Austria and included in the national total.

Since 2005 energy demand has decreased in road transport with a low in 2009 (as a result of the economic downturn) and a further low in 2011.

Under the WEM projections it is assumed that up to 2035 GHG emissions will not reach the level of the peak year 2005. For GHG emissions from road transport, a 10% decrease over 2015 levels is projected until 2035. The share of GHG emissions from fuel export is expected to show a relatively constant trend until 2035. Based on the historical trend which shows a slight reduction in the difference in diesel price between Austria and its neighbouring countries over the past few years, it has been assumed that this difference becomes smaller in the future. This results in a reduction in fuel export activities in absolute numbers. The share in GHG emissions will remain constant however, as fuel consumption in Austria will also decline from 2022 onwards.

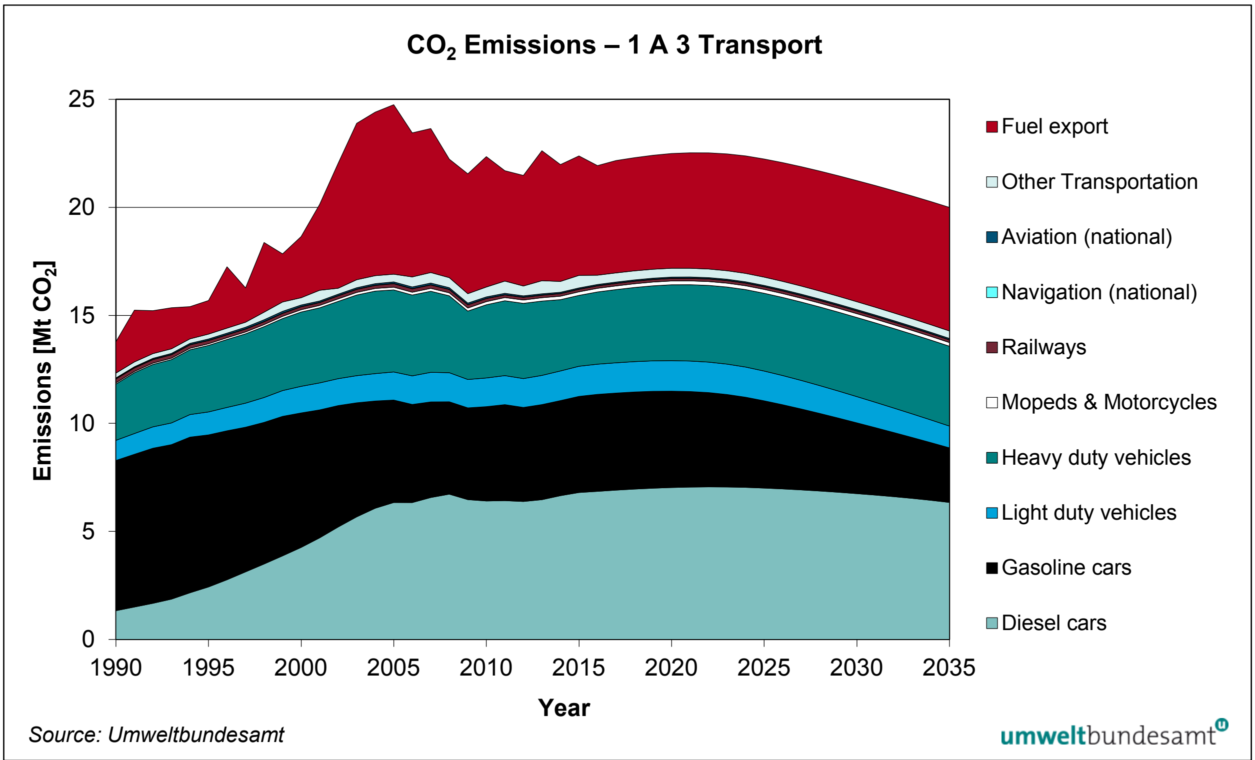


Figure 19: Past trend and scenario (2020–2035) CO_2 emissions from transport.

Since 2005 biogenic fuels (biodiesel, bioethanol, and vegetable/plant oil) have been used in the Austrian road transport sector. Biodiesel and bioethanol are mainly used for blending fossil fuels, whereas vegetable/plant oil is distributed in its pure form. The following graph shows the developments and trends in biodiesel, bioethanol, vegetable/plant oil and biogas up to 2035 (the base year 2015 shows current data). As blended biofuels have the main share on the biofuels market, every reduction in energy consumption brought about by other measures results in a similar reduction of the biofuel amounts.

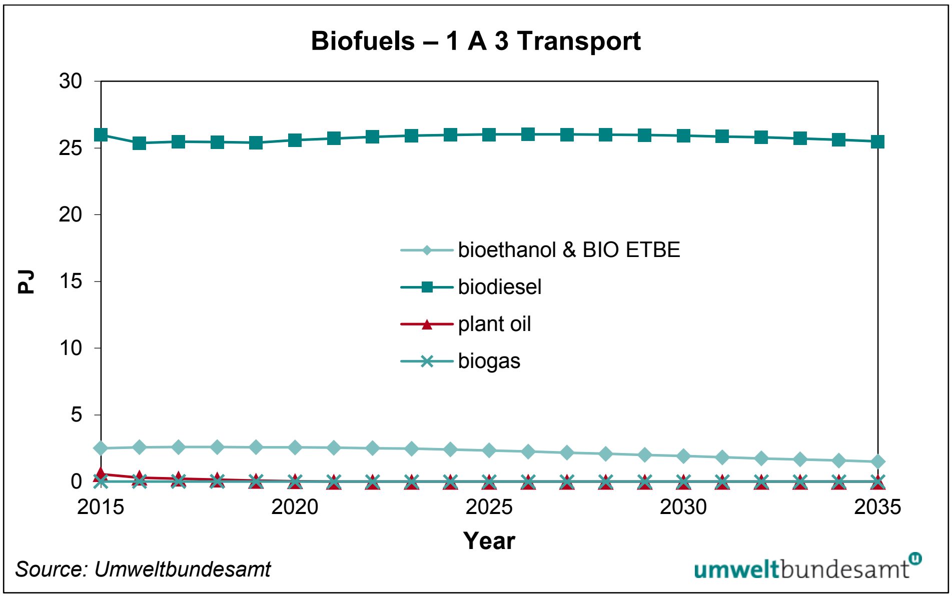


Figure 20: Scenario for biofuel deployment in Austria.

The following graph shows the estimated energy demand for electric vehicles (EVs, passenger cars) and plug-in hybrid electric vehicles (PHEVs) in road transport in Austria up to 2035 (the base year 2015 shows current data). The vehicle stock in 2035 is estimated to be roughly two million passenger cars, which means that one third of the total car fleet is electrically driven.

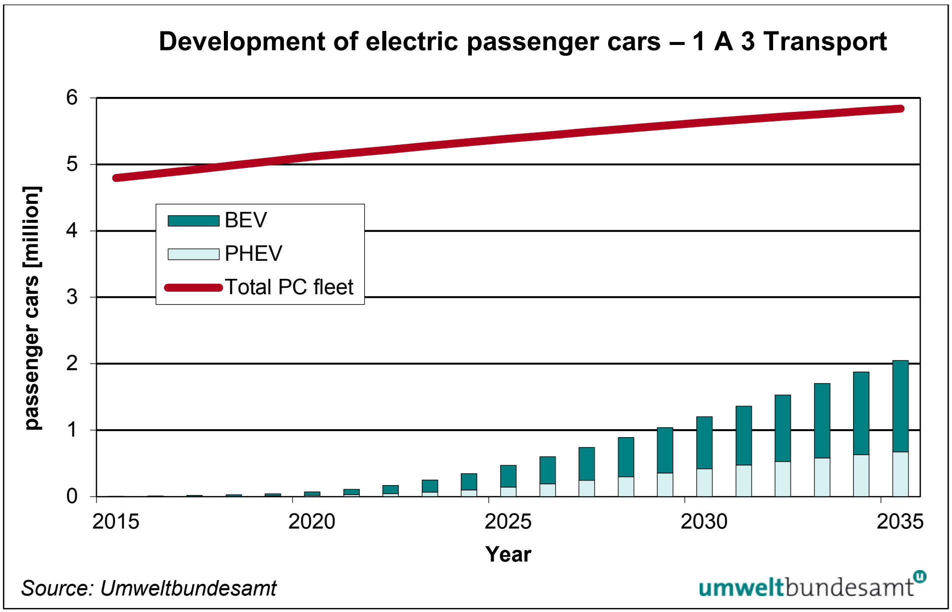


Figure 21: Scenario for electromobility in Austria.

1 A 3 e – Other transportation – pipeline compressors

Energy demand has shown high fluctuations in recent years with a significant rise in 2015. In the future the energy demand is expected to decrease continually by a total of 40% to 2035 (base year 2015).

3.1.4 Other Sectors (CRF Source Category 1.A.4)

The sector '1.A.4 Other Sectors' includes all greenhouse gas emissions from 1.A.4.b residential/households, 1.A.4.a commercial (incl. services and institutions), as well as emissions from stationary facilities and mobile sources in agriculture and forestry (1.A.4.c) and other off-road vehicles.

Assumption from the mobile sources in 1.A.4.b and 1.A.4.c are described in chapter 3.1.3 and are added to the total sum of 1.A.4.

3.1.4.1 Methodology used for sectoral emission scenarios

To calculate energy consumption separately for stationary sources in the subsector 'residential and commercial', a comprehensive building model (INVERT/EE-Lab) is used. For the stationary sources in 1.A.4.c (e.g. greenhouses, drying facilities) the econometric input-output model DYNK (WIFO 2017) is used.

Emission factors have been taken from the national emission inventory. The methodology and references are discussed in Austria's National Inventory Report (UMWELTBUNDESAMT 2017a). Furthermore, adjustments have been made for CH_4 emission factors to consider recent ecodesign product policy measures.

A short introduction to the building model can be found below.

The energy demand model for heating systems in buildings

This model, operated by the Energy Economics Group (EEG) of the Vienna University of Technology, is referred to as INVERT/EE-Lab. It is a comprehensive dynamic bottom-up simulation tool (TU WIEN 2017).

The model evaluates the effects of different promotion schemes (investment subsidies, feed-in tariffs, tax exemptions, fuel input subsidy, CO_2 taxes, soft loans, and additional set-aside premium) on the energy carrier mix, as well as CO_2 reductions and the costs of certain strategies to society when they are promoted. Furthermore, the INVERT/EE-Lab model is designed to simulate different scenarios (price scenarios, insulation scenarios, different consumer behaviour patterns etc.) and their respective impact on future trends of renewable as well as conventional energy sources on a national and regional level.

The core of the tool is a myopic, stochastic optimisation algorithm which optimises the objectives of 'agents' that represent decision-makers in building related decisions. INVERT/EE-Lab models the stock of buildings in a highly disaggregated manner. Therefore the simulation tool reflects the characteristics of an agent-based simulation.

The scenario model starts with the year 2012, based on a complete survey of all Austrian buildings for the years 2001 and 2011, supplemented with latest available sample census data and the Austrian building renovation strategy appended to the first NEEAP under Directive 2012/27/EU. Based on the average energy demand (primary fuels) in this sector, a model calibration of non-monetary parameters has been performed using current national energy balance data of Statistik Austria.

The basic decision algorithm

The basic decision-making/selection process is done on an annual basis. For each building segment it is decided if the system (building shell and heating/ domestic hot water system) remains as it is or if a new heating technology or a measure to improve the building shell is required.

The overall costs (monetary costs, societal costs or greenhouse gas emissions) of each new technology/measure are compared with the respective running costs for the existing structure, and the most cost-effective technology/measure is chosen.

The objective implemented in the model is to minimise monetary costs.

Modelling energy demand

Energy demand is modelled by taking into account the demand for energy services, as well as energy efficiency. The two energy services considered are space heating and hot water supply. Behavioural aspects with respect to space heating (such as the level of indoor temperature, ventilation habits) are considered by using a service factor. This parameter describes the relationship between the actual and the theoretical (calculated) energy consumption for space heating.

The model calculates the service factor as a function of the thermal quality (specific heat load) of the building and the degree of automation of the heating system (central heating system vs. single stove heating system).

The final energy demand for hot water supply is modelled on the basis of the number of people living in a dwelling, the service demand for domestic hot water (volume of hot water at 50 °C) per person and day and on the annual efficiency of the water heating system. The model incorporates the ageing of heating systems and domestic hot water systems, which means that in the model, annual efficiency decreases from one year to another.

Overview of technology options

The technology options available are divided into 'single options' and 'combined options'. Single options include: change of heating system or domestic hot water system only, installation of new windows, insulation of outside walls only/ceiling only/floor only. Combined options include: change of heating system and domestic hot water system, insulation of outside walls and new windows, thermal improvement of the whole building shell, insulation of outside walls and ceiling, complete renovation.

Within each technology segment, a broad range of new systems can be selected for implementation, namely 20 different space heating options (with the possibility of hot water integration), 9 space hearting options (without hot water integration) and 5 different stand-alone hot water systems. Solar hot water generation and solar combined systems (solar space heating and hot water system) are integrated into the model. For building shell alterations, up to 10 different insulation materials for different parts of buildings and 6 different window types are implemented in the model. The thickness of insulation is calculated by using an optimisation algorithm (with upper and lower boundaries).

Austrian stock of buildings and heating systems

The buildings currently implemented in the model represent a detailed, disaggregated picture of the Austrian building stock. They include:

- *Residential buildings:* 4 types of buildings, 8 construction periods, and renovated and not renovated buildings;
- *Non-residential buildings:* 7 types of buildings, up to 4 construction periods und up to 3 different building sizes per building type.

3.1.4.2 Assumptions

Despite decreasing population growth rates in Austria, the number of permanently occupied dwellings (principal residence) is expected to increase by about 14% from 2015 to 2035 (see Annex). This is due to the fact that the trend towards single households is stronger than the overall population growth.

As regards the number of residential buildings, an overall increase of 12% is expected from 2015 to 2035, whereas the number of commercial (non-residential) buildings is expected to rise by about 14% in this period.

The total gross floor area in residential buildings is assumed to increase by 16% until 2035, whereas for commercial buildings the total gross floor area is expected to increase by about 14% from 2015 to 2035.

Price assumptions are especially important in this sector because they may influence decisions on which fuels are to be preferred for heating systems in the long term, as well as decisions regarding the quality and quantity of thermal renovation activities. Over a period of about twenty years this can have a noticeable effect on specific energy demands. Energy prices are expected to rise considerably for all fossil fuels (about 36–52%) from 2015 to 2035. For bio fuels, wood logs, wood chips and wood pellets an increase around 38% is expected by 2035 over the same time span. The electricity price is assumed to rise about 16%, whereas district heat is expected to increase by about 31% by 2035.

Detailed assumptions can be found in Annex 2.

In Austria, the policy on subsidising heating systems is aimed at the installation of efficient and low emission (CO_2) boilers. Therefore, regional authorities grant financial support for biomass, district heat and solar heat. The subsidies vary between the different local authorities. On average, subsidies are granted for district heating (15% of total installation costs), log wood and wood chips (20%), heat pumps (5–15%), local heat and pellets (23%) as well as solar heat (20–25%). It is assumed that these percentages will remain constant over the forecast period in the WEM scenario.

The renovation rate (expressed in full renovation equivalents) indicates the proportion of gross floor space in a given year where improvement measures on the thermal building envelope (house front, windows, top and bottom floor ceiling) are performed. It is therefore an indicator of the renewal of buildings, which usually reduces their heating demand. The renovation rate for residential buildings with more than two apartments is assumed to remain at the same level (0.9% in 2015 and in 2035). For residential buildings with one or two apartments (about 90% of the total residential building stock) there is a slight increase of renovation rates from 1.0% in 2015 to 1.1% in 2035 and for commercial buildings from 0.9% in 2015 to 1.1% in 2035 (see Annex 2).

Model-based results predict a rise in the boiler exchange rate (expressed in proportion of gross floor space of the actual year when the boiler exchange is performed) in residential buildings with one or two apartments from 2.3% in 2015 to 3.1% in 2035 and in residential buildings with more than two apartments from 1.6% in 2015 to 2.7% within the same time span. The boiler exchange rate in commercial buildings also rises from 1.4% in 2015 to 2.5% in 2035.

Moreover, the average final energy demand for heating in residential buildings is expected to decrease from 133 kWh/m² gross floor space in 2015 to 92 kWh/m² gross floor space in 2035, while the average heating demand for commercial buildings is expected to decrease from 148 kWh/m² to 97 kWh/m².

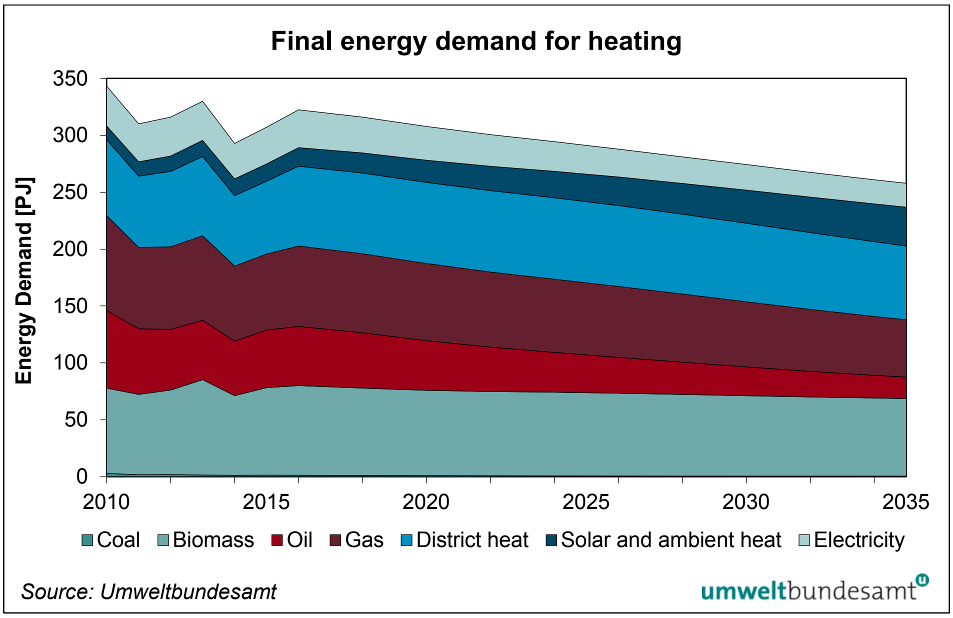
3.1.4.3 Activities

Emissions were calculated on the basis of the consumption of coal, wood log and wood briquettes, wood chips, wood pellets, natural gas, liquefied petroleum gas (LPG) and heating oil, and separately for the sectors 1.A.4.a commercial and 1.A.4.b residential, which were modelled with INVERT/EE-Lab. For the sector 1.A.4.c agriculture and forestry emissions were calculated on the basis of the consumption of coal, wood log and wood briquettes, other biomass, natural gas, liquefied petroleum gas (LPG) and heating oil, which were modelled with DYNK (WIFO 2017).

There is a discernible trend towards renewable and alternative energies, which can partly be seen from an increase in the use of wood pellets, solar heat and heat pumps. More specifically, the use of pellets is expected to rise by 166% in the period from 2015 to 2035. Alternative energies like solar heat and ambient energy are expected to increase by 158% and 94% until 2035. As regards log wood, energy consumption is expected to decline by around 48%, due to operating stress and because log wood is more difficult to handle in comparison to other fuels.

On the other hand, there are driving forces for moving away from fossil fuels. In the overall sector, a 64% reduction in the use of heating gasoil is expected for the period until 2035, as well as a 29% decline in natural gas consumption and a 62% decrease in coal use. Total energy consumption without electricity is expected to decline by 18% in the overall sector.

Figure 22: Past trend and scenarios (2020–2035) final energy demand for heating (without other electricity use).



3.1.5 Other (1.A.5)

This category contains emissions from mobile military sources. These emissions have been included in the calculations for the Transport sector (3.1.3); methodological issues and emissions can be found in this chapter. In this source category all emissions from mobile military sources are summarised, including emissions from military jet fuel.

3.1.6 Fugitive Emissions from Fuels (1.B)

This sector covers fugitive CH_4 emissions from brown coal open cast mining (1.B.1), fugitive CO_2 and CH_4 emissions from combined oil and natural gas production, fugitive CH_4 emissions from oil refineries, fugitive emissions from natural gas distribution, transmission and storage (1.B.2). No specific measures are foreseen in the Austrian Climate Strategy to reduce emissions from this sector.

3.1.6.1 Methodology used for sectoral emission scenarios

The methodology applied for calculating projected emissions is the same as the one used in the Austrian GHG inventory (UMWELTBUNDESAMT 2017a).

CH_4 emissions from storage are calculated by multiplying the amount of stored natural gas by a national emission factor. CH_4 emissions from natural gas distribution networks are calculated by multiplying the distribution network length by an implied emission factor.

CH_4 emissions from natural gas pipelines are calculated by multiplying the pipeline length by a national emission factor.

CO_2 and CH_4 emissions from oil and natural gas production are reported by the *Association of the Austrian Petroleum* Industry for 2003 to 2015. Projected emissions are calculated by multiplying the oil or natural gas production by implied emission factors which are derived from previous years.

3.1.6.2 Assumptions

No specific policies and measures are considered in the emission scenarios.

In 2006 the last brown coal open surface mine closed in Austria and it has been assumed that there will be no coal mining in the period up to 2035.

The length of the distribution network has been extrapolated by means of the average yearly grow rate 2011–2015 (267 km/year) so that the result is in an increase of 18% from 2015 to 2035, assuming that the number of end consumers grows continuously. CH_4 emissions have been calculated by means of the implied emission factor of 2015.

The total main and medium range pipeline length is assumed to have the same proportion of the natural gas distribution network length as the average percentage during the period 2011–2015 (main and medium range pipeline length = 24% of the length of the distribution network). This results in an estimated growth of about 18% between 2015 and 2035. CO_2 and CH_4 emissions have been calculated by means of the implied emission factors of 2015. Forecasts for natural gas storage are based on plans for storage site extensions from the Austrian Oil Exploration Company (RAG, Rohöl-Aufsuchungs AG). Capacities are set to be extended to 5.7 billion m³ until 2017. However, according to the inventory, this storage capacity was already reached in 2013. Therefore, CH_4 emissions from storage have been estimated on the basis of a constant yearly storage capacity of 5.7 billion m^3 from the year 2015 to 2035, using the implied emission factor of 2015.

The CH_4 emissions of the refinery are calculated by means of the emission factor from the GHG inventory and on the basis of the refinery intake from the energy scenarios (WIFO 2017) which is assumed to continuously decrease between 2015 and 2035, reaching a level that is about 9% lower in 2035 than in the year 2015.

CH_4 emissions from natural gas processing are calculated by means of the average implied emission factors for the period 2011 to 2015 and domestic natural gas production as assumed in the energy scenarios. CO_2 emissions from raw gas processing are expected to increase by 50% per Nm^3 of processed gas until 2014. However, due to the strong decrease in natural gas exploration this does not affect the strong declining trend in GHG emissions.

3.1.6.3 Activities

Data on natural gas consumption, refinery intake and natural gas production are taken from the energy projections included in this project.

Past trends and scenarios: pipeline and distribution lengths and natural gas storage are presented in Table 9.

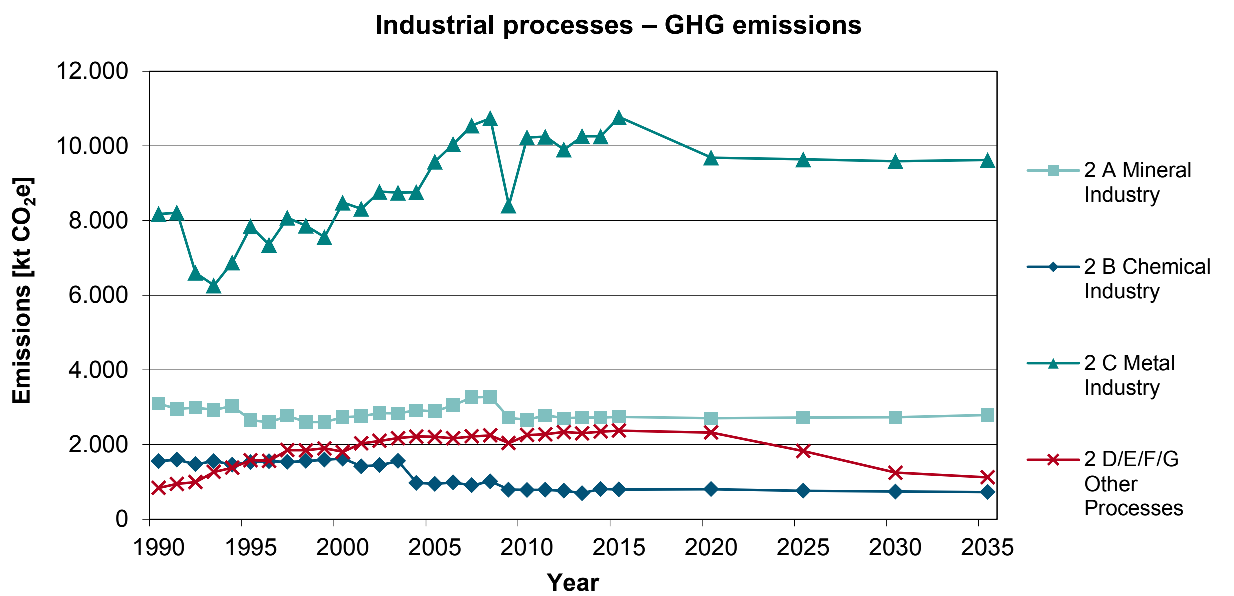
Table 9: Past trend and scenarios (2020–2035) activity data: natural gas distribution, transmission and storage (Umweltbundesamt).

	Pipeline length [km]	Gas network length [km]	Natural gas stored [Mm³]
1990	3 628	11 672	1 500
2000	5 966	24 099	1 665
2010	6 798	28 733	3 070
2015	7 242	30 067	5 317
2020	7 599	31 402	5 700
2025	7 922	32 736	5 700
2030	8 245	34 070	5 700
2035	9 537	39 408	5 700

3.2 Industrial Processes & Product Use (CRF Category 2)

The main emissions in this sector come from the cement industry, the lime industry, lime stone use in iron and steel production and from the use of halocarbons and SF_6. Detailed assumptions have been made for these sources.

Figure 23 shows greenhouse gas emissions aggregated into four categories of industrial processes. The sectors ‘chemical industry and ‘metal industry’ are expected to show a slight decrease until 2035. Emissions from the ‘mineral industry’ are expected to remain static, whereas emissions from other processes (mainly F-gases) are expected to follow an increasing trend until 2020, and a decreasing trend up to 2035.



Source: Umweltbundesamt

Figure 23: GHG emissions and projections (2020–2035) from Industrial Processes and Product Use.

3.2.1 Mineral, Chemical and Metal Industry (2.A, 2.B, 2.C)

3.2.1.1 Methodology used for sectoral emission scenarios

The methodology used here is the same as the one used in the Austrian Inventory and the emission factors and methodology are discussed in detail in the Austrian Inventory Report (UMWELTBUNDESAMT 2017a).

3.2.1.2 Assumptions

Mineral Industry

Activities for the cement industry and for other sources (i.e. lime stone use, ceramic industry and soda ash use) have been derived from the total energy input, which has been allocated to the different sources according to their historical share in the total energy inputs. Consistent with the IPCC 2006 Guidelines for inventory compilation, the demand for lime stone in the iron and steel industry has been accounted for under 'iron and steel industry'.

Chemical industry

For the production of ammonia, a slight decrease in ammonia is assumed from 2020 (see Figure 24). Other production activities (nitric acid) have been combined with these activities.

Metal industry

This source category covers CO_2 emissions from iron and steel production (2.C.1) and from ferro-alloy production (2.C.2) as well as PFC emissions in aluminium production (2.C.3) and SF_6 used in aluminium and magnesium foundries (2.C.4).

During the process of primary aluminium smelting, PFCs are formed through a phenomenon known as the anode effect. Additionally, CO_2 emissions arise from the consumption of anode material in primary aluminium production. SF_6 is used as inert gas in cases of fire in light metal foundries.

Further assumptions:

(a) Primary aluminium production plants in Austria closed down in 1992 and will not be reopened (only secondary Al production without SF_6).

(b) The Austrian Ordinance on fluorinated gases (Federal Law Gazette II No. 447/2002) bans the use of SF_6 as a protective gas in magnesium production. Thus, for the emission projections, it has been assumed that SF_6 is not used.

(c) Production of pig iron and production of crude steel from basic oxygen furnaces have both been calculated on the basis of a macroeconomic model from WIFO (WIFO 2017).

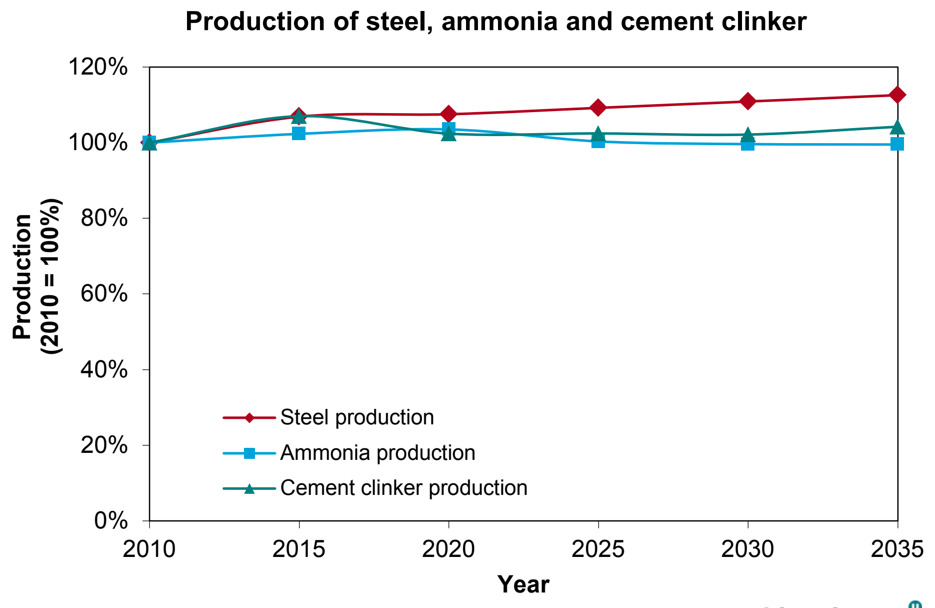
EU ETS/non-ETS

Emissions for EU ETS/non-ETS have been split on the basis of the share of ETS emissions in the corresponding sectors for the most recent years.

3.2.1.3 Activities

Figure 24 presents the assumptions used for the production of cement clinker, ammonia and crude steel (basic oxygen furnace – BOF).

Figure 24: Assumption for the production of steel, ammonia and cement clinker.



Source: Umweltbundesamt

3.2.2 Fluorinated Gases (2.E, 2.F, 2.G)

Fluorinated gases have been used in Austria in a wide range of applications, the most important one being the use of HFCs as refrigerants in refrigeration and air conditioning systems (2.F.1); other important sources include the use of HFCs as blowing agents in the production of foams (2.F.2), HFC, PFC and SF_6 as etching or insulation gases or in semi-conductor manufacturing (2.E.1) and the use of SF_6 (2.F.9) in soundproof windows. Minor sources include the use of HFCs as fire extinguishing agents (2.F.3), HFCs as propellants in aerosols (2.F.4), HFCs as solvent (2.F.5) and SF_6 as an insulating gas in electrical equipment, research, shoes and tyres (2.G.2).

There is no production of fluorochemicals (2.B.9) in Austria and the scenario is based on the assumption that there will be no production up to 2035.

Although fluorinated gases are not used in large amounts (around 1 kt per year), they contribute approximately 2.6% of the total GHG emissions due to their high GWPs. In Austria's Third National Communication to the UNFCCC (2001) fluorinated gases were expected to reach 3% of the total GHG emissions by 2010 and as much as 5% by 2020 in the business-as-usual scenario. This forecast was based on the fact that HFCs were going to be used in many applications as substitutes for ozone layer depleting 'Montreal gases' and that, without reduction measures, their use would strongly increase. Because of this expected scenario, the Federal Environment Ministry started a consultation procedure in spring 2001 with the aim to produce a draft ordinance on reducing and phasing out HFCs, PFCs and SF_6 in all relevant applications on the basis of the Federal Chemicals Act. The Austrian Ordinance on fluorinated gases was adopted in

2002 (Federal Law Gazette II No. 447/2002) and amended in 2007 (Federal Law Gazette II No. 139/ 2007). On European level the European Parliament and the Council of the European Union adopted the Regulation on certain fluorinated greenhouse gases (842/2006/EC) and the Directive relating to emissions from air-conditioning systems in motor vehicles (2006/40/EC). In 2014, the European Regulation was revised and changed into Regulation 517/2014, repealing the 2006 Regulation. In addition to the measures set forth in the 2006 Regulation, the 2014 Regulation aims at controlling the placing on the market of F-gases within the EU. Certain F-gases (those with a GWP above 2 500) will be banned as a first step, and only a certain amount of F-gases will be allowed to be placed on the community market each year, reducing the amount of F-gases on the market to 21% of the average total from 2009–2012. This calculation is based on the total in CO_2 eq, favouring the use of refrigerants with a very low GWP. Certain uses of F-gases, like for instance in semiconductor manufacturing, or the use as areosols and (in the case of SF_6) for electronic equipment, are exempted from this ban.

3.2.2.1 Methodology used for the sectoral emission scenarios

The emission calculation is based on the results of the Austrian GHG inventory, and performed with the same level of detail. The projections until 2035 are generally based on the assumptions from Annex V to the F-gas Regulation and the MAC Directive, and changes in emission factors are based on assumptions made in SCHWARZ et al. (2011).

As the MAC Directive has as yet not been fully applied (with German car manufacturers not using R 1234yf), the assumption was based on a decrease in availability of R-134 (based on the logic of the F-gas Regulation), with amounts decreasing half as quickly as in the rest of sector 2.F.1. This assumption is thus quite conservative, as the provisions of the MAC Directive ca as yet not be fully applied.

As the F-gas Regulation is very strictly applied, no further measures will be implemented for the moment.

3.2.2.2 Assumptions

(a) The provisions of the Austrian Ordinance on bans and restrictions for HFCs, PFCs and SF_6 remain fully applicable.

(b) The European Regulation on certain fluorinated greenhouse gases (Regulation EC 517/2014) is fully implemented and the Directive relating to emissions from air-conditioning systems in motor vehicles (EU 2006/40/EC) is partially implemented.

(c) Growth rates as well as changes in EFs as described by SCHWARZ et al. 2011 are also taken into account.

The assumptions used for fluorinated gas emission projections are as follows:

Stationary Refrigeration and Air Conditioning: A ban on the use of HFCs in stationary equipment with charges < 150 g (unless exported) is in force. Consequently, there is a ban on HFCs in domestic refrigerators and freezers as the refrigerant charge is normally approximately 100 g. The use of HFCs is allowed in refrigeration and air conditioning systems containing a refrigerant charge of 150 g–20 kg, as well as in commercial refrigeration equipment and industrial refrigeration equipment.

One can thus assume that the use (and thus emissions) of HFCs in

- domestic refrigeration has been phased out and that only emissions from disposal occur
- production of commercial refrigeration (including some exported domestic refrigeration equipment) will remain constant
- all other sub-categories will remain unchanged, assuming that the growth rates will be 1–1.5% for refrigeration and air conditioning and 3% for heat pumps.
- HFCs will be phased down according to Annex V to the F-gas Regulation – even though the exact quota is not known yet, the amount of F-gases used (in CO_2 equivalent) will go down to 21% of the average level of 2009–2012. This step-by-step decrease was assumed for the sub-sectors covered by the F-gas Regulation.

Mobile Air Conditioning: The MAC Directive (EU 2006/40/EC) requires the introduction of refrigerants with a GWP < 150 in new passenger cars placed newly on the market during the period 2011–2017, and in all passenger cars after 2017. Currently, German car manufacturers are not selling cars filled with R1234yf. As it is unclear how this situation will be resolved, a decrease in R134a was assumed as indicated by the F-gas Regulation. It was assumed that this decrease would take place half as quickly as in other sub-sectors.

Foam Blowing: The Austrian Ordinance bans the use of fluorinated gases in this sub-category (the use of XPS foams with a layer thickness of more than 8 cm containing HFCs with a GWP < 300 was still allowed at first until they were finally banned in 2008). In 2015, there was no foam production in Austria involving the use of F-gases, and only the use of some open cell foams continued. Emissions from waste disposal are still occurring (long lifetime of XPS/PU plates) until 2030.

Fire Extinguishers: A constant emission factor of 1.5% is assumed as well as constant annual HFC consumption until 2035.

Aerosols: The F-gas regulation bans the use of fluorinated gases in this sub-category except for medical uses. It is thus assumed that HFC emissions from metered dose inhalers will continue to increase, following the trend of the past few years, and will be constant from 2025 onwards (according to information from Ökorecherche GmbH).

Semiconductors: Projections are based on emissions of the years 2010–2015. For HFCs it is assumed that emissions will remain constant after 2020 (as the trend over the past three years is unusually high). Emissions from PFCs, NF_3 and SF_6 will increase based on the trend during the past few years.

Electrical equipment: Constant emissions have been assumed for the period after 2015. This sector will continue to grow, but emission abatement techniques will also improve and therefore offset increased emissions, but it is unclear when this will take place.

Other uses of SF_6: The Austrian Ordinance bans the use of SF_6 in other applications (e.g. footwear and car tyres). Thus no further consumption in this subcategory has been assumed. Only emissions from sound-proof glazing are taken into account, but as the use of SF_6 for the production of sound-proof glazing has been prohibited, the only emissions expected to arise are those from SF_6 banks and disposal.

3.2.3 Solvent and Other Product Use (2.D & 2.G)

Solvents are chemical compounds which are used to dissolve substances such as paint, glue, ink, rubber, plastic, pesticides, or they are used for cleaning purposes (degreasing). After their application (or other procedures involving solvent use) most of the solvents are released into air. The use of N_2O from other product use (anaesthesia and aerosol cans) is also considered in this sector.

3.2.3.1 Methodology used for the sectoral emission scenarios

CO_2 Emissions from Lubricant Use

Emission calculations follow the rules set out in the IPCC 2006 Guidelines. The amount of lubricants used in Austria was taken from the national energy balance (total final non-energy use consumption). Lubricants used for 2-stroke engines were not estimated, as there are hardly any 2-stroke engines in use in Austria, and as the amount of lubricants used in the 310 million km driven by 2 stroke engines per year is estimated at 0.2 kt CO_2, which is below the uncertainty threshold.

Lubricant Use was estimated according to the IPCC Tier 1 method described in the Guidelines:

CO_2 emissions=$LC*CC_{Lubricant}*ODU_{Lubricant}*44/12$

Where:

LC=total lubricant consumption in TJ (taken from the Austrian Energy Balance)

$CC_{Lubricant}$=default value of carbon content of lubricants (20 t C/TJ)

$ODU_{Lubricant}$=ODU factor (0.2), based on default composition of oil and grease)

44/12 = mass ratio of CO_2/C

CO_2 Emissions from Paraffin Wax Use

Paraffin waxes are used in applications such as: candles, corrugated boxes, paper coating, board sizing, food production, wax polishes, surfactants and many others. Emissions from the use of waxes arise primarily when the waxes or derivates of paraffin are combusted when being used (e.g. candles) or when incinerated with or without heat recovery or in wastewater treatment. In the cases of incineration and wastewater treatment, emissions should be reported in the Energy or Waste sectors respectively. It is also assumed that boxes and papers, as well as food production, are accounted for in the respective sectors.

Data on paraffin wax use is based on the import and export statistics of candles and wax products, as well as the production statistics of candles. Production statistics on candles are only available for the past 8 years. For the years before, the average of the available data was used for the remaining reporting period. As statistical data on imports and exports is only available until 1995, the years before have been correlated with population growth.

The amount of candles used in Austria has been converted to TJ, using a Net Calorific Value of 40.2 TJ/kt, and then calculated according to the IPCC Guidelines Tier 1 method:

CO_2 Emissions=$PW*CC_{wax}*ODU_{wax}*44/12$

PW= total wax consumption in TJ

CC_{wax}=carbon content of paraffin wax (default, 20 t C/TJ)

ODU_{wax}=ODU factor for paraffin wax, fraction (0.2)

44/12=mass ratio of CO_2/C

CO_2 emissions from Solvent and Other Product Use

Emission projections for 2015–2035 are calculated using the emissions of the latest inventory year and by assuming either a correlation with population growth or economic growth in some sub-sectors or a continuation of the trend in others, or in some other sectors, a constant development where technological achievements offset increased use (see chapter 3.2.5.3 on assumptions for more detail).

The basic data for the Austrian Air Emission Inventory were provided by surveys (WINDSPERGER et al. 2002a, 2002b, 2004; WINDSPERGER & SCHMID-STEJSKAL 2008) as well as the import-export statistics (foreign trade balance) and production statistics provided by Statistik Austria, and data reported under the VOC Directive.

In order to determine the quantity of solvents used for the various applications in Austria, a bottom-up and a top-down approach were combined. The top-down approach provided the total quantities of solvents used in Austria, whereas the amount of solvents used in different applications and the solvent emission factors were calculated on the basis of the bottom-up approach. Where possible, emissions reported under the VOC Directive were assumed for the relevant sectors (emissions were extrapolated taking into account the amount of employees in that sector, in order to include those installations that would not pass the threshold for reporting). By combining the results from the bottom-up and the top-down approach, the quantities of solvents used per year and the solvent emissions from the different applications were determined.

The trend in solvent (substance) quantities and solvent-containing products, i.e. the relationship between imports and exports, is assumed to be constant after 2015. The production of solvents is assumed to be constant (value of 2015). It is further assumed that the prospective error/deviation caused by extrapolation and using constant values is comparatively small compared to the total level of uncertainty. Data from reports under the VOC installation ordinance were taken into consideration for 2012. The model is currently being evaluated, as we presume that the amount of substances assumed to be used as solvents is currently too high (i.e. some uses as yet not taken into account).

The emission factors used for the scenarios are the same as in 2010, as the positive impact of the laws and regulations enforced in Austria is expected to be only minimal in subsequent years. Emission factors are calculated from data on solvent use per substance category at NACE-level 4 for all industrial sectors, and are based on information from surveys in households and industry as well as structural business statistics.

N_2O Emissions from Solvent and Other Product Use

The basic data for the Austrian Air Emission Inventory (OLI) 2014 (data 2013) were provided by the companies selling N_2O or are based on estimates provided by the Austrian Industrial Gases Association ('Österreichischer Industriegaseverband', ÖGIV) and default emission factors according to IPCC Guidelines. The methodology recommended in the IPCC Guidelines was applied.

For projections of N_2O emissions from 2 G 'Other Product Use' constant emissions from 2015 onwards are assumed.

3.2.3.2 Assumptions

The CO_2 emissions from lubricant use were correlated with assumptions based on the national energy balance. Emissions have been declining since 1990, the trend of the past few years is assumed to continue until 2035.

Emissions from paraffin wax use were correlated with assumptions on population growth.

Most of the demand for solvents comes from the paint and coatings industry but also from households (cleaners, disinfectants, personal care products) and from the printing industry. Besides paint used in the sub-sector 'Construction and buildings', most consumer products are coated with paint. Furthermore, solvents are used in many industrial cleaning applications such as cleaning for maintenance purposes and cleaning which has to be done in the manufacturing process. Solvents are also used for the cleaning of high-precision mechanical parts such as ball bearings.

For the emission scenarios until 2035 it is assumed that emissions from car manufacturing, domestic use, coil coating, other industrial cleaning, rubber processing, pharmaceuticals, paint manufacturing, inks manufacturing, glues manufacturing, asphalt blowing, adhesive, films and photographs and printing industry, will remain constant, as increase of use due to economic factors will be balanced by products containing less solvents or technological advances.

For car repairing, construction and buildings, wood coating and fat, edible and non-edible oil were correlated with the expected economic growth and for dry cleaning, electronic components, application of glues and adhesives, treatment of vehicles and other, the trend of the last years was continued until 2035. Domestic solvent use, as well as domestic use of pharmaceuticals were correlated with population growth. Only for textile finishing as well as preservation of wood, a downward trend can be expected due to technological achievements.

3.3 Agriculture (CRF Source Category 3)

3.3.1 Sector Overview

In this sector, the focus is on sources of methane (CH_4) and nitrous oxide (N_2O) emissions. This chapter gives an overview of the European and Austrian farm policy, provides information on basic economic and technological assumptions and describes the methodologies used for the sectoral scenarios by 2035.

Common Agricultural Policy

In 2008 the EU agriculture ministers reached a political agreement on a 'Health Check' of the Common Agricultural Policy (EC 2011). Among a considerable range of measures, the most important change was the abolition of the EU milk quota system, which was implemented in 2015.

The new CAP introduces a new architecture of direct payments. The objective is to make payments better targeted, more equitable and greener. The role of direct payments as a safety net that strengthens rural development has become more important. The internal convergence of direct payments brings considerable changes of the distribution of farm payments in Austria. The consequence will be that regions in which cattle and milk production prevails will reap the benefits.

Additionally, the EU programme for rural development is of major importance for the Austrian Agriculture sector, because transfers from this source outweigh transfers from the 'first pillar of the CAP', e.g. commodity-related instruments. In the new period 2015–2020 climate policy goals are ranking high on the agenda because climate change mitigation (and adaptation) is a horizontal issue that has to be addressed in every programme.

International food markets

European farm commodity markets are interlinked with international food markets in many ways. Given the imbalances between supply and demand, the EU is a major exporter, in particular of cereals, milk and white meat. Policy efforts to bring domestic market prices closer to equilibrium prices lead to a narrower gap between EU domestic prices and world market prices. Global demand for food and technological progresses (e.g. the adoption of GMO crops in major producing countries, organic food production) will be the major driving forces in agricultural production in the next decade. In the medium term, the world's agricultural markets are supported essentially by a rising food demand driven by an improved macro-economic environment, a growing population, urbanisation and changes in dietary patterns (OECD-FAO 2014).

National energy policies

Austrian energy policy is committed to substituting non-renewable energy sources with renewable ones. Raw materials produced by agriculture are a major alternative source. Two major legal sources are of interest in this context: the Austrian law for the provision of green electricity ('Ökostromgesetz') and the European Biofuels Directive (EU 2003), repealed by the EU Directive on Renewable Energy (Directive 2009/28/EC). Both measures are introduced into the Agriculture sector via the price system: regulations to boost bioenergy crop production work like a subsidy for farm commodities.

3.3.2 Methodology used for the sectoral scenarios

Emissions are calculated on the basis of the methodology used for the Austrian Greenhouse Gas Inventory. A comprehensive description can be found in the Austrian National Inventory Report 2017 (UMWELTBUNDESAMT 2017a).

Activity data

The results obtained from the Positive Agricultural Sector Model Austria (PASMA), developed by the Austrian Institute of Economic Research (WIFO), provide the basic activity data (WIFO & BOKU 2015). For the current submission the projected activity data were adjusted to the values of 2015.

The PASMA model maximises sectoral farm welfare and is calibrated on the basis of historical crops, forestry, livestock, and farm tourism activities, using the method of Positive Mathematical Programming (PMP). This method assumes a profit-maximising equilibrium (e.g. marginal revenue equals marginal cost) in the base run and derives coefficients of a non-linear objective function on the basis of observed levels of production activities.

Economic assumptions

Price estimates are specific to the Austrian market situation, derived from OECD-FAO outlooks on agricultural markets (OECD-FAO 2014). For Austria lower milk prices are assumed than in the OECD-FAO scenarios for the EU. The reasoning behind this deviation is that for countries which are likely to expand their milk production, lower prices may prevail over a long period until a new equilibrium is established (see SINABELL et al. 2011 for more elaboration on this assumption). Other exogenous economic assumptions for Austria (like the GDP or population size) are not necessarily essential for the model used in this analysis because the partial equilibrium model of the Agriculture sector mainly depends on prices of outputs and inputs. Since the Austrian agriculture is an integral part of the common market, carry-over effects from European demand patterns are noticeable and determine the results.

Other assumptions

- Increase in milk yield per cow from +7% (2020) to +22% (2035) relative to 2015
- loss of agricultural land following the long-term trend

Main results

The number of dairy cows is expected to increase. The reason for this increase is that milk production is likely to expand after the abolition of the milk quota in 2015. Additionally, the Rural Development programme promotes farming in mountain regions where milk production is the most profitable activity if sufficient workers are available.

Slightly increasing prices for pork lead to an increasing number of pigs. The expansion of pork production is consistent with the overall outlook at European level (EC 2014). But it is not consistent with the currently observed trend of declining numbers of pigs. An expansion of pork production is not unrealistic if the sector makes the same adjustments as the milk sector (which gained significant market shares outside the domestic market).

According to the model results, poultry production will decrease. This result is not consistent with the observed trend of increasing numbers of heads. Following international projections (EC 2014) one would expect more poultry as well. The model result is the consequence of relative prices. Poultry and egg producers in Austria have to cope with considerably higher costs than producers in other countries.

The sale of mineral nutrients is likely to decline. This result is consistent with the long term trend but not consistent with observations of more recent sales data. However, the result seems to be plausible given the relative increase in energy costs which determines the fertiliser costs, along with the fact that agricultural land will decline and the production of manure increase (due to increasing livestock numbers).

Scenario 'with existing measures' (WEM)

The scenario includes regulations related to the implementation of the CAP Reform 2013 and existing measures already implemented in the context of the Austrian Agri-Environmental Programme 2014–2020. This programme includes specific measures agreed under Austria's Climate Change Act (CCA), e.g. financial compensation for environmental measures such as phase feeding of pigs, promotion of grazing, covering of slurry tanks, improved fertilisation (e.g. band spreading of slurry). The measures are targeted at a more effective handling, storage and use of manure and mineral fertilisers in order to decrease GHG emissions. Information on these measures is presented in detail in chapter 4.9.

Emission calculation

Emissions are calculated on the basis of the methodology used for the Austrian Greenhouse Gas Inventory. A comprehensive description can be found in the Austrian National Inventory Report 2017 (UMWELTBUNDESAMT 2017a).

3.3.2.1 Enteric Fermentation (3.A)

Feed intake parameters and the methane conversion rate are the same as the ones used in the national greenhouse gas inventory (UMWELTBUNDESAMT 2017a). Gross energy (GE) intake of dairy cows was calculated on the basis of projected milk yields.

Projected livestock data are based on calculations carried out with the PASMA model (WIFO & BOKU 2015) and adjusted to the inventory data of 2015.

3.3.2.2 Manure Management (3.B)

In this source category CH_4 and N_2O emissions occurring during the housing and storage of livestock manure are considered.

Special attention is given to increased feeding efficiency, the covering of slurry tanks and improved use of fertilisers (see chapter 3.5). Austria-specific volatile solid (VS) excretion and N excretion values for dairy cows have been calculated on the basis of projected milk yields.

3.3.2.3 Rice Cultivation (3.C)

No activities on rice cultivation are projected for Austria (notation key 'NO').

3.3.2.4 Agricultural Soils (3.D)

In this source category emissions of N_2O resulting from anthropogenic N inputs to soils are included.

Mineral fertiliser application data have been taken from (WIFO & BOKU 2015) and adjusted according to the inventory data of 2015. An increased efficiency of mineral fertiliser use is assumed (see chapter 3.5).

3.3.2.5 Prescribed Burning of Savannas (3.E)

There is no prescribed burning of savannas in Austria and the scenario assumes that there will be none until 2035.

3.3.2.6 Field Burning of Agricultural Residues (3.F)

A federal law restricts the burning of agricultural residues on open fields in Austria. It is only permitted occasionally and on a very small scale.

The contribution of emissions from the category *Field Burning of Agricultural Waste* to the total emissions is very low. Thus a simplified approach has been applied: 2015 values have been used as activity data for all projected years.

3.4 Land Use, Land-Use Change and Forestry (CRF Source Category 4)

In 2016, the projections for the sector Land Use, Land-Use Change and Forestry (LULUCF) were completely revised (see UMWELTBUNDESAMT 2016b). The forest sector (4.A) was revised and projections for HWP (4.G) were included, and projections were calculated for the first time for the non-forest sectors: Cropland (4.B), Grassland (4.C), Wetlands (4.D), Settlements (4.E) and Other land (4.F).

3.4.1 Forest (4.A) and HWP (4.G)

3.4.1.1 Methodology used for the sectoral scenarios

The emission projections for sector 4.A are based on a study on the GHG balance of the Wood Chain from the Austrian Forests 'Treibhausgasbilanz der österreichischen Holzkette', conducted by the Austrian Research Centre for Forests (BFW), the University of Natural Resources and Applied Life Sciences, Vienna (BOKU) and Umweltbundesamt (WEISS et al. 2015). The study included several scenarios, with a Reference Scenario (R) which corresponds to the existing measures scenario (WEM).

The reference scenario was established based on historic field data from the Austrian national forest inventory (NFI) 2007/09 which served as input to the CALDIS model. CALDIS is a climate-sensitive single individual-tree based forest growth model (KINDERMANN 2010; GSCHWANTNER et al. 2010; LEDERMANN, 2002) that simulates forest development on the basis of the increment of single trees. It is based on a derivative of the PROGANUS model. The model applies a set of tree species-specific, mathematical-statistical equations which describe the growth of diameter and the height of single individual trees. In addition, temperature and precipitation data was fed into the model to simulate climatic conditions. Models for salvage cutting and incidental fellings were integrated as well. An ingrowth model estimated the renewal of forest stands. On this basis, above and below ground biomass was calculated on a single tree level. For estimating soil organic carbon the YASSO 07 model (LISKI et al. 2009, 2005) was applied (BFW 2015).

To ensure consistency between category 4.A Forest land and 4.G HWPs, the timber volume and increment have been calibrated iteratively based on the CALDIS model and the Forest Sector Model FOHOW2 which has been used for projections of HWPs.

3.4.1.2 Assumptions

The reference scenario assumes no changes in policies and that the wood demand in terms of quantity and composition corresponds to the trend in the past years. Likewise market participants do not change their behaviour.

Wood imports are determined in accordance with future developments of wood export markets. The amount of Austria’s wood imports is expected to decrease, resulting from an increase in installed wood processing capacities and the use of wood for energy in exporting countries. Amounts of saw log, Apulpwood and fuel wood available for exports are expected to decline by 50% until 2025 (compared to the levels of 2010). External supply of recycled paper will be limited to 1 million tonnes from 2015 onwards.

From 2025 to 2035 the supply curves which are applied to the model remain on the same level, but this does not imply that modelled imports to Austria remain constant (see Table 10). The demand for wood will to a very large extent be covered by the supply from the Austrian forest (from about 75% in 2010 to >90% until 2050).

Table 10: Amount of net imported saw log in the WEM scenario (BRAUN et al. 2015)

[million m³]	2010	2015	2020	2025	2030	2035
net imported sawlogs	4.30	3.32	2.39	2.06	2.00	1.97

As regards to policy assumptions, it is assumed that the national targets as defined in the National Renewable Energy Action Plan 2010 (BMWFJ 2011) for the year 2020 will be achieved and that current subsidies for fuel wood will be continued until 2020. The renewable energy share will increase to 34% of the total gross final energy consumption by 2020, with 45% stemming from woody biomass. After 2020 the development of the domestic wood demand will be driven by market mechanisms only and will correspond to the demand for forest biomass resulting from the domestic energy scenarios from 2013 (UMWELTBUNDESAMT 2013). It should be noted that the WEM scenario includes the same assumptions for gross domestic consumption of woody biomass by UMWELTBUNDESAMT 2013 as reported by Austria for the WEM scenario in the 2013 submission under the EU Monitoring Mechanism Decision.

3.4.1.3 Activities

It has been assumed that the area of forest land remains constant over time. A further split into forest land sub-categories (land conversions from and to forest land) has not been applied.

3.4.2 Non-forest categories (4.B-4.F)

3.4.2.1 Cropland (4.B) and Grassland (4.C)

Methodolgy

The emission projections for the sector Cropland and Grassland are based on projected areas derived from

- expert judgements made by several experts from agricultural institutions in Austria and
- calculations using the PASMA model (Positive Agricultural Sector Model Austria), carried out by the University of Natural Resources and Applied Life Sciences, Vienna (BOKU). The PASMA model was developed by the Austrian Institute of Economic research (WIFO) (WIFO & BOKU 2015) and has also been used for the projections of activity data for the Agriculture sector (CRF Source Category 3).

For all areas of the sub-categories of the Cropland and Grassland sector the arithmetic means of the estimations obtained from expert judgements and the calculations carried out with the PASMA model have been used to derive the areas for the years 2020 to 2035. In order to take the impacts of the ÖPUL programme into account, the areas managed through the four most important ÖPUL measures were estimated by applying the same methodology.

All emissions of both sectors are calculated on the basis of the methodology used for Austrian Greenhouse Gas Inventory. A comprehensive description can be found in the Austrian National Inventory Report (UMWELTBUNDESAMT 2017a).

Assumptions

For the model PASMA the abolition of the milk quota and the suckler cow premium in 2015 is implemented in the WEM scenario, as well as the continuation of ‘cross compliance’ and ‘greening’ requirements. Market price developments are derived from OECD-FAO 2014 forecasts. The policies and measures in the WEM scenario of the PASMA model are the same as for the WEM projections of the Agriculture sector.

Concerning the expert judgements, it has been assumed that no changes in current policies (2013) occur. Some examples of underlying assumptions for cropland development from the expert judgements are provided here for clarification purposes:

- Further structural changes in agriculture, marginalisation (areas of farmland cease to be viable under an existing land use and socio-economic structure);
- Increasing yields due to technical progress;
- Increasing mechanisation;
- The land use trend revealed by past farm structure surveys is continuing;
- Further increasing settlement due to population development;
- Climate change/rising mean temperature;
- EU Common Agricultural Policy and world market prices are the main driving forces.

For a more detailed description of the methodology and assumptions see submission 2016 under Art 14 of the MMR.

3.4.2.2 Wetlands (4.D), Settlements (4.E) and Other land (4.G)

Methodology

Wetlands: The emission projections for sector 4.D follow the same methodology as in the National Greenhouse Gas Inventory (UMWELTBUNDESAMT 2017a).

Settlements: The projected areas for sector 4.E Settlements are based on expert judgements as well as the 14th Austrian Spatial Planning Report (ÖROK 2015).The arithmetic means of these sources were calculated to derive the areas for the years 2013–2035. The LUC areas from other land use categories which were converted to settlement areas were estimated on the basis of the historic trends, overall area consistency in all sectors (year-to-year area changes are equal to net LUC areas to/from the category) and the 'availability' of cropland and grassland for settlement due to the estimated decline of the areas of these land use classes.

Other land: The land use change areas of forest land converted to other land are based on expert judgements, assuming that the annual LUC from forest land to other land remains constant (as in the last years of the historic time series).

Assumptions

Wetlands: The results of the Real Estate Database show an average annual increase in wetland area of 1% since 1990 (UMWELTBUNDESAMT 2017a). It has been assumed that this long-term increase in wetland area and LUC from forest land and grassland to wetlands will continue.

Settlements: The expert judgements are based on the assumption that the population is expected to grow continuously, with concentrations in urban and suburban regions and with a corresponding demand for infrastructure. Assumptions for settlement development are described in detail in the study ÖROK (2015).

Other land: It was assumed that the annual LUC from forest land to other land remains constant (as in the last years of the historic time series).

3.5 Waste (CRF Source Category 5)

This chapter includes information on the methods used for greenhouse gas projections, as well as assumptions on activity data projections in view of anticipated waste management and waste treatment activities. The projections described in this chapter include projections on Solid Waste Disposal, Biological Treatment of Solid Waste, Waste Incineration and Waste Water Treatment and Discharge.

Waste management and treatment activities constitute sources of methane (CH_4), carbon dioxide (CO_2) and nitrous oxide (N_2O) emissions.

3.5.1 Solid Waste Disposal (5.A)

3.5.1.1 Methodology used for the sectoral emission scenarios

For the calculation of methane (CH_4) arising from solid waste disposal on land the IPCC (Intergovernmental Panel on Climate Change) Tier 2 (First Order Decay) method is applied, taking into account also historical data on deposited waste. This method assumes that the degradable organic component (DOC) of waste decays slowly throughout a few decades (IPCC 2006). The Tier 2 method is recommended for the calculation of landfill emissions on the national level; it consists of two equations: one for the calculation of the amount of methane generated based on the amount of accumulated degradable organic carbon at landfills in a particular year, and one for the calculation of the methane actually emitted after subtracting the recovered and the oxidised methane.

The calculation of CH_4 generated is done for the different waste types separately, taking into account waste type specific characteristics (DOC, DOCf, half life times). The Austrian Inventory distinguishes between two main categories 'residual waste' and 'non residual waste'. 'Residual waste' corresponds to mixed waste from households and similar establishments covered by the municipal waste collecting system. It is directly deposited in landfills. 'Non residual waste' is all other deposited waste containing biodegradable compounds, including waste from industrial sources; it is divided into different waste types (wood, paper, textiles, residues etc.). 'Non residual waste' especially covers residues from the sorting and pre-treatment of waste (accounting for 99% of the total 'non residual waste' amount).

Activity data are based on a country-specific source. Since 2008 data have been taken from the Electronic Data Management, an electronic database administered by the BMLFUW and delivering data as input to the national Federal Waste Management Plan. The parameters used in the emissions calculation are described in UMWELTBUNDESAMT 2017a.

3.5.1.2 Assumptions

In the scenarios of future waste generation and disposal amounts, predictable future trends in waste management (resulting from the implementation of legal provisions, especially the Landfill Ordinance) are considered. Residues from pre-treatment of municipal solid waste have become the main category of deposited solid waste. Assumptions are thus in line with the assumptions made for developments of mechanical-biologically treated waste reported as a fraction under CRF Sector 5.B.1 Composting. Some minor amounts of sludge, construction waste and paper with little TOC content (beyond the threshold for TOC disposal) are expected to be landfilled as well. Assumptions on the projected amounts of these waste types are based on historical depositions by applying a mean value for the years since 2005 and 2009 (lower waste amounts deposited due to the Landfill Ordinance).

Regarding methane recovery, a constantly decreasing share is assumed due to the decreasing gas generation potential of deposited waste. The assumption is based on historical values 2008–2012 (taken from UMWELTBUNDESAMT 2014).

The parameters used for emission projections are the same as those used in the (historical) Austrian greenhouse gas inventory (see UMWELTBUNDESAMT 2017a).

3.5.1.3 Activities

Since 2009 the disposal of waste on landfills without pre-treatment has no longer been allowed (in accordance with the Landfill Ordinance). The main fraction relevant for current and future waste disposal is thus made up by residues from the pre-treatment of waste (covered by the main category 'non residual waste'), especially residues/stabilised waste from mechanical-biological treatment plants. It is expected that amounts undergoing mechanical biological treatment, and thus also residues from this activity, will decrease steadily until 2025 and then remain constant for the rest of the projected period, in conformity with the assumption made for this waste category under sector 5.B (Biological Treatment of Solid Waste). Another waste fraction deposited on landfills is sludge from wastewater handling and waste from sewage cleaning, with a share of 1.8% in the total amount deposited 2015. The basis for the projections for this activity is the mean value of the waste amounts reported for the years 2005–2015. As the First Order Decay method is applied for emissions projections, data on historical waste disposal are also taken into account in the calculation (covering both 'residual' and 'non residual' waste). These account for most of the current and future emissions.

Table 11: Past trend (1990–2015) and scenarios (2016–2035) activity data for landfilled 'Residual waste' and 'Non-residual Waste' (Umweltbundesamt).

Year	Residual Waste [kt/a]	Non-residual Waste [kt/a]	Total Waste [kt/a]
1990	1 996	649	2 644
2000	1 052	827	1 879
2005	242	390	631
2010	0.0	245	245
2015	0.0	132	132
2020	0.0	135	135
2025	0.0	119	119
2030	0.0	119	119
2035	0.0	119	119

3.5.2 Biological Treatment of Solid Waste (5.B)

3.5.2.1 Methodology used for the sectoral emission scenarios

Sector 5.B covers category 5.B.1 – emissions from the composting of biogenic waste and mechanical-biological treatment (MBT) plants as well as category 5.B.2 – emissions from anaerobic digestion at biogas plants (unintentional leakages, storage of fermentation residues).

Composted biogenic waste comprises biogenic waste collected from households by separate collection systems and other organic waste (e.g. municipal garden and park waste) treated in composting plants (centralised composting), as well as bio-waste composted ‘at source’ (home composting/decentralised composting).

CH_4 and N_2O emissions from composting (5.B.1) are calculated by multiplying the quantity of waste by the corresponding emission factor (see Table 12).

Table 12: Emission factors for composting and mechanical-biological treatment (Umweltbundesamt).

[kg/t humid waste]	CH_4	N_2O
Biogenic waste composted	0.75	0.1
Mechanical-biologically treated waste	0.6	0.1

CH_4 emissions from anaerobic digestion (5.B.2) are calculated using the IPCC 2006 default EF of 5% CH_4 of biogas produced. The CH_4 generation potential was set to 110 m^3/t based on an assumption made for mixed organic waste (UMWELTBUNDESAMT 2011).

3.5.2.2 Assumptions

Composting plants, home composting

Home-composted waste amounts are assumed to increase in accordance with population growth. Amounts of waste treated in composting plants are partly expected to remain constant at 2015 levels (loopings and wood as structural material in the composting process), partly to increase with population growth (organic waste collected from households).

Mechanical-biological treatment plants

As regards the amount of waste undergoing mechanical-biological treatment (MBT) in Austria, it is assumed that activities will decline due to the expected closures and reconstructions of MBT plants triggered among others by future requirements stipulated in the BREF Document for the waste treatment industries which is currently under revision.

Activity data projections are based on a detailed analysis of existing MBT plants and expected plant-specific developments and trends in input amounts, assuming that the planned BREF update will be completed by the end of 2017 and contain transition and adjustment periods until the end of 2021. Projections for input amounts have been made for the years 2020, 2025, 2030 and 2035 (see Table 13); the values in-between have been interpolated.

It is assumed that some plants will close down in response to stricter regulations on waste air purification. At the same, other treatment options such as thermal treatment and dry stabilisation are expected to grow in importance.

The emission factors used for the projections are in accordance with the Austrian National Inventory Report (UMWELTBUNDESAMT 2017a; see also Table 13).

Anaerobic digestion

Waste amounts treated in anaerobic digestion plants are assumed to stay constant at the level of 2015 as there is no reliable evidence on the future developments of anaerobic digestion and any effects on activity data. In 2017 a new ordinance will be issued requiring a gas-tight cover of storage facilities. Emissions are expected to decrease. For this reason a decreasing emission factor (% of CH_4 generated) from 5% (2015) to 1% (2030) is assumed.

3.5.2.3 Activities

On the basis of the assumptions made, the projected activity data are as follows:

Table 13: Past trend (1990–2015) and scenarios (2020–2035) – activity data for biological waste treatment (Umweltbundesamt).

[kt waste treated]	1990	2000	2005	2010	2015	2020	2025	2030	2035
Composted organic waste	418	1 467	2 375	2 523	2 718	2 783	2 832	2 868	2 896
Mechanical-biologically treated waste	345	254	623	551	439	439	385	385	385
Anaerobically treated waste	0	0	152	378	438	438	438	438	438

3.5.3 Incineration and Open Burning of Waste (5.C)

In this category, CO_2 emissions from the incineration of waste oil and clinical waste are included, as well as CO_2, CH_4 and N_2O emissions from municipal waste incineration without energy recovery. All CO_2 emissions from Category 5 'Waste' are caused by waste incineration.

In Austria, waste oil is incinerated in specially designed so-called 'USK facilities'. Emissions from waste oil combustion for energy recovery (e.g. in the cement industry) are reported under the CRF sector 1.A – Fuel Combustion. In general, municipal, industrial and hazardous wastes are combusted for energy recovery in district heating plants or on industrial sites. Emissions are therefore reported in the CRF sector 1.A – Fuel Combustion. In Austria, there was only one waste incineration plant without energy recovery in operation until 1991, with a capacity of 22 000 tonnes of municipal waste per year. This plant was rebuilt as a district heating plant which went into operation in 1996. Consequently, since the reopening of this plant (i.e. from 1996 onwards), emissions have been reported in the CRF sector 1 A – Fuel Combustion.

3.5.3.1 Methodology used for the sectoral emission scenarios

For this calculation the simple CORINAIR methodology has been applied: the quantity of waste oil is multiplied by an emission factor for CO_2, CH_4 and N_2O. Emission factors are consistent with the emission factors used in the Austrian Inventory (UMWELTBUNDESAMT 2017a).

Table 14: Emission factors of IPCC Category 5 C – Waste Incineration (Umweltbundesamt).

Waste Type	CO_2 [kg/Mg]	CH_4 [g/Mg]	N_2O [g/Mg]
Clinical Waste	880	100	12
Waste Oil	3 224	2	24

3.5.3.2 Assumptions

It is assumed that the incineration of waste oil and clinical waste without energy recovery has been constant from 2015 onwards. All existing and planned waste incineration plants include energy recovery and emissions are therefore reported in the CRF sector 1.A – Fuel Combustion.

3.5.3.3 Activities

Since 2005, the Austrian Waste Incineration Ordinance has been setting strict limits for air pollution for all types of waste incineration, without setting quantity limits. All operators with a permit for the incineration of a specific type of waste need to be registered in a national database. The numbers of waste incineration plants which are not considered in sector 1.A are as follows:

- Waste oil: 8 plants
- Clinical waste: 1 plant

Constant values (500 Mg of clinical waste and 500 Mg of waste oil) are predicted for incineration activities without energy recovery until 2035.

3.5.4 Waste Water Treatment and Discharge (5.D)

3.5.4.1 Methodology used for the sectoral emission scenarios

N_2O emissions occur as direct emissions from wastewater treatment plants and indirect emissions from wastewater after disposal of effluent into waterways or lakes (IPCC 2006 GL). In the Austrian inventory, N_2O emissions from wastewater handling are calculated separately for:

1. Direct N_2O emissions from advanced centralised waste water treatment plants
2. Indirect N_2O emissions from effluent originating from wastewater treatment plants
3. Indirect N_2O emissions from direct effluent from the population not connected to wastewater treatment plants

N_2O emissions from wastewater treatment plants are calculated using Equation 6.9 from the IPCC 2006 GL, and CS activity data and EF:

$$\mathbf{N_2O_{PLANTS} = P * T_{CND\text{-}PLANTS} * F_{IND\text{-}COM} * EF_{PLANT}}$$

N_2O_{PLANTS}= total N_2O emissions from plants in inventory year, kg N_2O/yr

P = human population

$T_{CND\text{-}PLANTS}$ = degree of utilisation of modern, centralised wastewater treatment plants [%] (CS)

$F_{IND\text{-}COM}$ = fraction of industrial and commercial co-discharged protein (CS)

EF_{PLANT} = emission factor [BMLFUW 2015a] (CS)

For the calculation of indirect N_2O emissions Equation 6.7 from the IPCC 2006 GL is used, with CS activity data on nitrogen effluent:

$$\mathbf{N_2O\ Emissions = N_{EFFLUENT} * EF_{EFFLUENT} * 44/28}$$

$$N_{effluent} = N_{effluent\ plants} + N_{effluent\ population\ not\ connected}$$

$$EF_{PLANT} = [0.005\ kg\ N_2O\text{-}N/kg\ N]\ (IPCC\ 2006\ GL)$$

Data on $N_{effluent\ plants}$ are retrieved from EMREG ('Emissionsregister – Oberflächenwasserkörper', abbreviated 'EMREG-OW'[3]), an electronic register of material emissions to surface water bodies from point sources, especially municipal sewage treatment plants. The $N_{effluent\ population\ not\ connected}$ is based on investigations made by ZESSNER & LINDTNER 2005. For projections N flows are expected to increase in line with Austrian population growth rates.

CH_4 emissions from domestic wastewater disposal in septic systems are calculated pursuant to the IPCC 2006 GL, using mainly IPCC default values.

A detailed description of the methodologies will be included in the National Inventory Report 2016 (UMWELTBUNDESAMT 2017a).

3.5.4.2 Assumptions

The following assumptions were made with regard to N_2O emissions:

- In determining future indirect N_2O emissions, the nitrogen effluent increases with population growth.
- N_2O emissions from wastewater treatment plants (direct emissions) are expected to increase in line with the rising population. There are no further improvements anticipated regarding the connection rate to wastewater treatment plants (expected to remain at the level of 2015: 95%) and the denitrification rate (expected to remain at the level of 2015: 82%)
- CH_4 from wastewater handling will slightly increase in line with population growth. The connection rate to septic systems, however, is expected to remain stable at the level of 2015 (3.1%).
- Data on the future population growth has been taken from (STATISTIK AUSTRIA 2016a) and is also reported in the Annex.

[3] BGBl. II No.29/2009: Verordnung des Bundesministers für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft über ein elektronisches Register zur Erfassung aller wesentlichen Belastungen von Oberflächenwasserkörpern durch Emissionen von Stoffen aus Punktquellen (EmRegV-OW)

Table 15: Past Trend (1990–2015) and scenarios (2020–2035) – indicators of waste water treatment/management (Umweltbundesamt).

	1990	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**
Inhabitants [1 000]	7 678	8 012	8 225	8 361	8 630	8 939	9 156	9 314	9 432
Connection rate wastewater treatment plants [%]	59.0	84.3	88.9	93.9	95.0	95.0	95.0	95.0	95.0
Nitrogen effluent [t]	41 031	23 475	17 136	11 998	10 739	11 053	11 273	11 433	11 553

4 POLICIES & MEASURES

This chapter describes the policies and measures included in the 'with existing measures' (WEM) scenario. In 2017, Austria is not reporting a 'with additional measures' (WAM) scenario as the Integrated Climate and Energy Strategy is currently in the process of being developed. Several policies which were reported under the WAM scenario in 2015 are now included in the WEM scenario as they have been implemented.

The content of the chapter on policies and measures (PaMs) is in compliance with Article 13 of EU Monitoring Mechanism Regulation (EU) No 525/2013 und Article 22 of the Implementing Regulation (EU) 749/2014. It also meets the requirements of the UNFCCC 'Guidelines for the preparation of national communications by Parties' (FCCC/CP/1999/7). In the Annex to this report a list of policies and measures, plus some additional information per PAM is provided.

4.1 The framework for Austria's climate policy

In order to provide information on the legal and institutional steps to prepare for the implementation of international commitments, the following paragraphs list significant milestones in Austrian climate policy[4].

- At first, two committees were set up by the Federal Minister of Environment to combat climate change, i.e. 'The National CO_2 Commission' in 1990 and 'The Interministerial Committee (IMC) to Coordinate Measures to Protect the Global Climate (IMC)' in 1991. The National CO_2 Commission was later reorganised and became the Austrian Council on Climate Change (ACCC) ('Österreichischer Klimabeirat'). The ACCC is a scientific platform whereas the IMC pursues administrative activities.
- Energy Reports were published in 1990, 1993, 1996 and 2003, outlining the national strategy to achieve the so-called Toronto target.
- After the negotiation of the Kyoto-Protocol under the UNFCCC the 'Kyoto Forum' was established within the Federal Ministry of Agriculture, Forestry, Environment and Water Management in 1999.
- In 2002 the 'Austrian Climate Strategy 2010' was launched as a national climate change programme in order to reach the Kyoto target (BMLFUW 2002).
- The Austrian Climate Strategy 2010 was reviewed and the revised Climate Strategy II was published in 2007 (BMLFUW 2007).
- The Minister for the Environment and the Minister for Economic Affairs initiated a stakeholder process to establish a new Energy Strategy for Austria in response to the legally binding European commitments on renewable energy and climate change by 2020. The Energy Strategy was adopted in 2010.

---

[4] More detailed information can be found in the Sixth National Communication of the Austrian Federal Government: http://unfccc.int/files/national_reports/annex_i_natcom/submitted_natcom/application/pdf/aut_nc6.pdf

- Klimaschutzgesetz-KSG (Federal Law Gazette I No. 106/2011) (Climate Change Act, CCA).

  In November 2011 the Austrian Climate Change Act was implemented to ensure compliance with the GHG emissions targets and the promotion of effective measures for climate change mitigation. It stipulates maximum emission quantities for each sector for the period 2008–2012 (according to the targets of the Climate Strategy 2007, BMLFUW 2007). The Climate Change Act was amended in 2013 and now specifies maximum quantities per sector also for 2013–2020, based on the Annual Emissions Allocation (AEA) for Austria under the Effort Sharing Decision.

  According to this legislation, Austria is obliged to reach a -16% emission reduction target by 2020 (compared to 2005) in all sectors not covered by the European emission trading scheme. In addition to domestic measures, flexible instruments may be used to a limited extent in order to achieve the target.

  Two new bodies have been established under the amended Climate Change Act, namely the Climate Change Committee (CCC) – consisting of ministries, provinces, social partners – and the Climate Change Advisory Board (CCAB) – consisting of NGOs, political parties, scientists. Both are chaired by the Ministry of Agriculture, Forestry, Environment and Water Management.

  The Austrian Climate Change Act defines clear sectoral targets, responsibilities and rules and allows for a coordinated implementation of specified measures.

  The CCA determines procedures under which sectoral negotiation groups develop measures which cover *inter alia* the following topics:

  - Increase in energy efficiency
  - Increase the share of renewable energy sources in final energy consumption
  - Increase the total energy efficiency of buildings
  - Inclusion of climate change mitigation measures in spatial planning
  - Management of mobility
  - Waste avoidance
  - Protection and extension of natural carbon sinks
  - Economic incentives for climate change mitigation

  The first programme, which covered the years 2013-2014, was adopted by the federal government and the provinces in 2013 (BMLFUW 2013). The second programme (containing measures for all sectors) covers the period 2015-2018 (BMLFUW 2015c). The measures included in both programme have been considered in the projections and are reported as policies and measures.

  The measures are designed to lead to a measurable, reportable and verifiable reduction of GHG emissions or to an enhancement of carbon sinks, which is reported in the National GHG inventory. The Federal Minister of Agriculture, Forestry, Environment and Water Management has to submit an annual report on the progress achieved in complying with the emission targets to the Austrian Parliament and the National Climate Change Committee. Should the emission limits be exceeded, additional measures must be planned and implemented.

In Austria, legislative power is distributed between the federal government and the federal provinces/regional entities *(*'Bundesländer'). Hence, there are many climate change programmes at regional level in addition to the national climate strategy. These programmes are complemented by initiatives and actions at local level which are not reflected in this report. Accordingly, coherent monitoring and the evaluation of policies and measures is a complex and challenging process. Due to a lack of comparable information on the different policies and measures in place it has not been possible to quantify all the policies and measures included in the scenarios of this report.

4.2 Sectoral methodologies

In general, sectoral definitions as requested by the UNFCCC reporting guidelines have been used. In each section the methodologies applied for quantifying the most important policies and measures are described, but as yet not all measures have been quantified, either due to a lack of data or because of the complexity of the measures, linkages with other policies, or uncertainty.

In general, the measures are also described in the reports on the sectoral scenarios for energy (UMWELTBUNDESAMT 2017b, AEA 2017, WIFO 2017), transport (TU GRAZ 2017), and other sectors – buildings (TU WIEN 2017), and agriculture (WIFO & BOKU 2015). Therefore, the measures of the second programme under the Austrian Climate Change Act covering the years 2015–2018, which are the results of the negotiations between civil servants and other stakeholders, have been considered as well,.

It should be emphasised that the quantification of the GHG emission reduction effect of a policy or measure for each year (as presented in the reporting template) is not an exercise where the individual effects of measures are simply added up. Interactions between measures cannot be avoided; and measuring the total effect of measures by simply adding up figures derived from individual instruments tends to result in an overestimation of the total effect of the measures.

The allocation of measures is undertaken on the basis of the following categories:

- Cross-cutting: includes measures which are relevant for more than one sector
- Energy Industries (CRF 1.A.1) & Manufacturing Industries and Construction (1.A.2)
- Transport (CRF 1.A.3)
- Other sectors: representing energy consumption in commercial, institutional and residential buildings (CRF 1.A.4)
- Industrial Processes and Product Use (CRF sector 2)
- Agriculture (CRF sector 3)
- LULUCF (CRF sector 4
- Waste (CRF sector 5)

The same categories have been used for the reporting of projections, therefore ensuring consistency between the reporting of projections and policies and measures.

Where measures apply to more than one sector, they have been allocated to the sector 'cross-cutting policies and measures'. This is the case for the EU Emission Trading Scheme, which targets the Energy Supply and the Industry sector. Two other measures allocated to this sector are national funding mechanisms which provide support to climate friendly projects in various sectors.

Compared to the 2015 submission, reporting of policies and measures has improved, although the number of reported policies and measures has decreased as only WEM measures are reported. This is due to the fact that the climate and energy strategy, which will be the basis for the WAM scenario, is still being developed. One additional measure in the LULUCF sector has been added.

The objective of the changes was to achieve a consistent approach across all sectors and to allow for consistency in the reporting of policies and measures under various reporting requirements of the EU and the UNFCCC.

The policies and measures which were reported in 2015 have been reviewed and updated (see Table 16). In the following sections each policy and measure is described, including details on the underlying actions, ambitions and assumptions. Summary data can be found in the Annex.

Table 16: Overview of Austrian Policies and Measures (Umweltbundesamt).

N°	PAM Name	Instrument(s)	Scenario
Cross-cutting Policies and Measures			
PAM N°1	EU Emission Trading Scheme	N/A	WEM
PAM N°2	Domestic Environmental Support Scheme	N/A	WEM
PAM N°3	Austrian Climate and Energy Fund (KLI.EN)	N/A	WEM
Policies and Measures for the Sectors: Energy Industries (CRF 1.A.1) and Manufacturing Industries and Construction (1.A.2)			
PAM N°4	Increase the share of renewable energy in power supply and district heating	Green Electricity Act 2012 and Feed-In tariff ordinance	WEM
PAM N°5	Increase energy efficiency in energy and manufacturing industries	Energy Efficiency Act Implementation of the National Energy Efficiency Action Plan 2011 Promotion of combined heat and power	WEM
Policies and Measures for the Sector: Transport (CRF 1.A.3)			
PAM N°6	Increase the share of clean energy sources in road transport	Implementation of Directive 2009/28/EC on the promotion of the use of energy from renewable sources Implementation Plan for electric mobility	WEM

N°	PAM Name	Instrument(s)	Scenario
PAM N°7	Increase fuel efficiency in road transport	Fuel tax increase in 2011 Greening the truck toll Mobility management and awareness raising – 'klimaaktiv mobil' fuel saving initiative Air quality induced speed limits	WEM
PAM N°8	Modal shift to environmentally friendly transport modes	Mobility management and awareness – 'klimaaktiv mobil' initiative Promotion of corporate rail connections for freight transport	WEM
Policies and Measures for the Sector: Other sectors (CRF 1.A.4)			
PAM N°9	Increased energy efficiency of buildings	OIB guideline 6 – Energy savings and thermal insulation (*'OIB Richtlinie 6')* National and funding programmes Building renovation initiative for private buildings to improve energy performance (renovation cheques) Building renovation initiative for commercial and industrial buildings to improve energy performance Recast of the Energy Performance of Buildings Directive	WEM
PAM N°10	Increased share of renewable energy for space heating	Stepping up the replacement of heating systems District Heating and District Cooling Act Funding for wood heating systems and solar heating systems	WEM
PAM N°11	Increased energy efficiency in residential electricity demand	Ecodesign requirements for energy using products Effect of Energy Efficiency Directive (2012/27/EU) Energy labelling of household appliances	WEM
Policies and Measures for the Sector: Industrial Processes and Product Use (CRF Sector 2)			
PAM N°12	Decrease emissions from F-gases and other product use	Prohibition and restriction of the use of (partly) fluorinated hydrocarbons and SF_6 Quota system for the production and import of F-gases Reducing HFC emissions from air conditioning in motor vehicles Limitation of VOC emissions from the use of organic solvents in industrial installations	WEM
Policies and Measures for the Sector: Agriculture (CRF Sector 3)			
PAM N°13	Implementation of EU agricultural policies	Programme for rural development 2014–2020 Common agricultural policy (CAP)	WEM
Policies and Measures for the LULUCF Sector			
PAM N°14	Sustainable Forest Management	Austrian Forest Act LULUCF Action Plan	

N°	PAM Name	Instrument(s)	Scenario
Policies and Measures for the Sector: Waste (CRF Sector 5)			
PAM N°15	Reduce Emissions from Waste Treatment	Landfill Ordinance Reducing emissions from anaerobic treatment of biogenic waste Reducing emissions from mechanical biological treatment plants	WEM

4.3 Cross-cutting measures

4.3.1 PaM N°1: EU Emission Trading Scheme (ETS)

GHG affected: CO_2, N_2O

Type of policy: regulatory, economic

Implementing entity: federal government

Mitigation impact: not available

EU legislation	National Implementation	Start
Directive 2009/29/EC amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community	Federal Law Gazette I No. 118/2011 (Emissions Allowance Trading Act)	2005
Commission Regulation 601/2012/EU on the monitoring and reporting of greenhouse gas emissions		

The EU Emission Trading Scheme is the most important policy instrument for installations with a high energy demand to reduce CO_2 emissions in the energy industries, manufacturing industries and industrial processes, as well as N_2O emissions from chemical industry and CO_2 emissions from aircraft operators. Its objective is to limit emissions by means of trading allowances, which were initially allocated for free or auctioned. Around 200 Austrian installations and roughly 15 aircraft operators assigned to Austria are covered by the EU ETS.

Legal basis

The basis for the EU Emissions Trading System (EU ETS) is the Emissions Trading Directive 2003/87/EC, which was last amended in 2015. This Directive was transposed into Austrian law through the Emissions Allowance Trading Act 2011 (‘Emissionszertifikategesetz’ EZG 2011, Federal Law Gazette I No. 118/ 2011).

First and second trading period

The first trading period of the EU ETS was a trial period and covered the years 2005–2007. The second period covered the years 2008–2012. In the first two trading periods the EU ETS included CO_2 emissions. From 2010 onwards it has covered N_2O emissions in Austria as well. The system covers large emitters from the industry and energy supply sectors.

Current trading period

The current trading period runs from 2013–2020. Subsequent periods are foreseen in the Emissions Trading Directive. Directive 2009/29/EC (the revised Directive 2003/87/EC) introduced substantial improvements to the EU ETS. The revised Directive was transposed into Austrian law through the Emissions Allowance Trading Act 2011 (Federal Law Gazette I No. 118/2011).

Electricity generation installations no longer receive free allowances (apart from a few exceptions) but have to purchase allowances on the market or acquire them through auctioning. For the industry sectors and for heat generation the allocation is still free, on an interim basis. Industry sectors with a significant risk of carbon leakages receive up to 100% free allocations, whereas the allocation for other sectors decreases every year (from 80% in 2013 to 30% in 2020) based on a benchmarking system.

As a result of the extension of the scope of the EU ETS from 2013 onwards more than 20 additional installations are now included in the EU ETS (compared to the previous periods).

According to the overall trend, emissions covered by the ETS are declining, especially in the power generation sector where installations do not receive free allocations. Since industrial emissions are influenced by several factors, an accurate quantification of the effect produced by the ETS is not possible without deeper investigation. However, ETS evaluators have found evidence that the ETS has a positive effect on the scale of ‘cleantech’ innovations (MUULS et al. 2016).

Costs of the ETS comprise administrative costs and - if allowances have to be purchased – the costs of the allowances to cover emissions. Thus the costs vary depending on the circumstances of the installation. The price of the allowances is still well under 10 euros, which is lower than predicted at the beginning of ETS implementation. However, the ETS can have an effect that is not directly related to the current price for allowances since the companies know that the allowance cap will decline in the future and are therefore planning their investments accordingly.

4.3.2 PaM N°2: Domestic Environmental Support Scheme (Umweltförderungsgesetz)

GHG affected: CO_2, CH_4, N_2O

Type of policy: economic

Implementing entity: federal government

National policy: Federal Law Gazette No. 185/1993, last amendment: Federal Law Gazette I No. 21/2017

The objective of the domestic environmental support scheme is environmental protection through the prevention and reduction of pressures such as air pollution, greenhouse gases, noise and waste. The Domestic Environmental Support Scheme provides financial support to projects which improve environmental performance beyond the mandatory standards in the energy, manufacturing and the service industry. The Ministry of Agriculture, Forestry, Environment and Water Management puts the focus of its funding policy on climate change. Projects may be related to all greenhouse gases but are mainly targeted at CO_2 from the use of fossil fuels. In the climate change context the focus is on projects to improve energy efficiency and to promote the use of renewable energy sources.

In 2015, more than 98% of the projects funded by the Ministry were climate relevant. Most projects were targeted at efficient energy use (60%) and renewable energy (39%). Biomass heating, the distribution of heat and the switch to LED lighting were the most frequently addressed funding areas (BMLFUW 2016b).

Estimated Impact:

According to the latest evaluation (BMLFUW 2016b), the projects funded in 2015 will achieve an annual CO_2 reduction of approx. 300 ktonnes. The CO_2 savings accumulated through projects funded in 2015 will amount to 1.5 million tonnes by 2020, and CO_2 reductions of 5.6 million tonnes are expected over the whole lifetime of the projects. About 78% of the total reduction is expected to be achieved through renewable energy projects and about 22% through projects focusing on energy efficiency. In 2015, final energy savings of about 436 GWh per year were achieved.

4.3.3 PaM N°3: Austrian Climate and Energy Fund (KLI.EN)

GHG affected: CO_2

Type of policy: economic, research

Implementing entity: federal government

Mitigation impact: not available

National policy: Federal Law Gazette I No. 40/2007

In 2007, the Federal Government established a specific fund (Climate and Energy Fund – KLI.EN) to support the reduction of GHGs in Austria in the short, medium and long term (Federal Law Gazette I No. 40/2007). The focus is on the research and development of renewable energy systems, the development and testing of new transport and mobility systems and the market penetration of sustainable energy technologies – ranging from basic and applied research to the granting of subsidies for the implementation of climate friendly technology (KLIEN 2017). Support is provided to companies, research institutions and municipalities as well as to individuals, depending on the respective programme.

The KLI.EN fund supports measures in the field of mobility, buildings, industrial production and energy supply – sectors which are the main emitters of GHGs.

Quantification/Projected GHG emissions/removals:

According to project evaluations, the projects supported so far are expected to trigger cumulated emission reductions of 71 million tonnes of CO_2 (KLIEN 2016). However, this quantification is associated with considerable uncertainty, even though (according to the estimates) a high GHG emission reduction potential can be assumed for the long term. The emission saving potential depends very much on how far research, pilot projects or model regions can penetrate the market in the future and contribute to substantial emission savings.

4.4 Energy Industries (CRF 1.A.1) and Manufacturing Industries and Construction (1.A.2)

Where possible the GHG emission reduction effect of individual policies and measures has been estimated. However, for some measures the reduction effect could not be estimated; whereas for others, it was only possible to estimate the reduction effect achieved by 2020.

For a quantification of the effects of the relevant policies and measures in this sector it has been assumed that additional/reduced green electricity production results in a reduced/additional domestic electricity production in fossil fuel power plants. Emission reductions have been calculated on the basis of an emission factor of 0.4 t CO_2/MWh.

In the following, the assumptions behind the respective policies and measures are described in greater detail.

4.4.1 WEM measures for Energy/Industry

4.4.1.1 PaM N°4: Increase the share of renewable energy in power supply and district heating

An increase in the share of renewable energy in power supply and district heating is the main purpose of the policy to reduce climate impacts on the energy system. Beyond the traditional use of large-scale hydro power for electricity generation, quantitative targets for increasing the share of wind power, photovoltaics, small hydro plants and biomass/biogas in electricity generation have been set in the Green Electricity Act and shall be achieved by fixed feed-in tariffs. Investment support for biomass-based district heating systems is granted (see PAM_ Domestic Environmental Support Scheme).

GHG affected: CO_2

Type of policy: regulatory, economic

Implementing entity: federal government

Mitigation impact: 4 200 kt CO_2 eq in 2020 (Green Electricity Act)

The instrument listed below has been taken into account in the current scenario.

Green Electricity Act 2012 and Feed-In tariff ordinance (‚Ökostromgesetz 2012 und Ökostrom-Einspeisetarifverordnung 2012‘)

Type: EU and National policy

EU legislation	National Implementation	Start
RES Directive 2009/28/EC (repealing RES-E Directive 2001/77/EC and Biofuel Directive 2003/30/EC),	Federal Law Gazette I No. 75/2011 (Green Electricity Act 2012, Amendment)	2012
Internal electricity market 2009/72/EC (repealing 2003/54/EC)	Federal Law Gazette I No. 149/2002 (Green Electricity Act 2002)	2002
Directive 2006/32/EU on Energy End-Use Efficiency and Energy Services (meanwhile repealed by Directive 2012/27/EU)	Federal Law Gazette II No. 397/2016 (Feed-in tariff ordinance)	2016

Directive 2001/77/EC on the promotion of electricity produced from renewable energy sources was implemented through the Green Electricity Act. The Green Electricity Act not only addresses the main issues specified in the Directive, but also provides for a harmonised system for promoting electricity production from renewable energy sources by granting fixed feed-in tariffs for various forms of electricity generated from renewable sources, e.g. biomass, wind power, small hydropower, geothermal energy and photovoltaics.

The 2012 amendment of the Green Electricity Act, implementing the RES Directive, was designed to increase funding for the expansion of renewables. It includes new expansion targets for renewables for 2020 (vs. 2010):

- Hydropower +1 000 MW
- Wind power +2 000 MW
- Photovoltaics +1 200 MW
- Biomass and biogas + 200 MW.

Furthermore, the guaranteed feed-in time period was extended in 2009 to 13 years in general, and to 15 years for power plants based on biomass and biogas fuels.

The existing legal provisions for the support of green electricity are effective only until 2020. Though it is very likely that there will be some form of support thereafter (currently a more market based amendment to the Green Electricity Act is under discussion) this has not been taken into account in the WEM scenario.

Quantification/Projected GHG emissions/removals:

In accordance with this Act, more electricity (i.e. an additional 16 PJ approximately) was produced in green electricity plants in 2015 compared to 2010 (corrected for weather conditions, STATISTIK AUSTRIA 2016b), and an additional 38 PJ (approximately) will be produced in 2020 compared to 2010 (Federal Law Gazette I No. 75/2011), resulting in emission reductions of about 1 800 kt CO_2 eq. in 2015 and about 4 200 kt CO_2 eq. in 2020, respectively (using an emission factor of 0.4 kt CO_2-eq./GWh). The above mentioned target for photovoltaic installations and wind power plants is expected to be surpassed whereas the target for biomass installations will not be achieved.

4.4.1.2 PaM N°5: Increase energy efficiency in energy and manufacturing industries

An increase in energy efficiency in energy and manufacturing industries is essential if the growing demand for fuels is to be limited, along with their environmental impacts. Based on EU legislation, Austria implemented the Energy efficiency Directive (2012/27/EU) and prepared its National Energy Efficiency Action Plan in 2014 with quantitative targets for final and primary energy consumption in 2020. In addition, financial support for cogeneration of power and heat is granted in order to improve the efficient use of primary energy for electricity production.

GHG affected: CO_2

Type of policy: planning, economic, regulatory

Implementing entity: federal government, federal provinces

Mitigation impact: not available

The instruments listed below have been taken into account in the current scenario.

Energy Efficiency Act (‚Energieeffizienzgesetz‘)

Type: EU policy

EU legislation	National Implementation	Start
Energy efficiency Directive 2012/27/EU, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC	Federal Law Gazette I No. 72/2014 (Energy Efficiency Act)	2014

The Directive 2012/27/EU on energy efficiency was implemented by adopting the Energy Efficiency Act, which targets a cost efficient energy efficiency increase to be achieved in businesses and households by 2020. It includes different provisions for energy suppliers, companies and the federal government, respectively.

The Energy Efficiency Act specifies:

- an energy efficiency target of 1 050 PJ in 2020
- Big companies have to conduct mandatory external energy audits every four years or introduce mandatory energy or environmental management systems including regular energy audits.
- Energy suppliers are supposed to deliver annual energy savings (either themselves or through measures taken by their end users) amounting to a total of 0.6% of their annual energy supply.
- Austria has to meet an annual renovation goal of 3% through refurbishments or other energy savings.
- Energy efficiency action plans including the monitoring of binding goals and measures have to be compiled every three years.

The latest energy efficiency action plan was submitted to the European Commission in April 2014.

Quantification/Projected GHG emissions/removals:

The Energy Efficiency Act is expected to deliver savings of a combined total for all sectors of approximately 60 PJ in 2020 through the energy efficiency obligation scheme and strategic measures, respectively (BMWFW 2014). However, it was not possible to quantify the total effect on the projected GHG emissions for the energy and manufacturing industries sector alone as the reductions in electricity and district heat demand in other sectors are also relevant.

Implementation of the National Energy Efficiency Action Plan 2011 (‘Nationaler Energieeffizienzaktionsplan 2011’)

Type: *EU policy*

EU legislation	National Implementation	Start
Energy efficiency Directive 2012/27/EU, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC	National Energy Efficiency Action Plan 2014	2014

Since the implementation of the EU Directive on energy end-use efficiency and energy services (2006/32/EC) each Member State has been obliged to regularly report about its efforts on energy efficiency.

In the third national energy efficiency action plan, the first under Directive 2012/27/EU, the NEEAP 2014, Austria defines its targets regarding the reduction of energy consumption as follows: It aims at stabilising final energy consumption in 2020 at the level of 2005, i.e. at a maximum of 1 100 PJ. This target has since been lowered to 1 050 PJ and communicated to the Commission in a progress report in 2015 – in line with the Energy Efficiency Act. By 2016 Austria intends to save 80.4 PJ. The highest reductions in final energy consumption have already been achieved in the building and heating sector (80% up to 2012; BMWFW 2014). Most of these reductions were achieved through measures undertaken by the federal provinces.

Quantification/Projected GHG emissions/removals:

It was not possible to estimate the reduction potential of this measure as there are strong linkages with the Energy Efficiency Act (see above) and with measures targeting energy efficiency in the building sector.

Promotion of combined heat and power (‘Kraftwärmekopplungs-Gesetz’)

Type: EU policy

EU legislation	National Implementation	Start
Combined Heat and Power (CHP) Directive 2004/8/EC (meanwhile repealed by Directive 2012/27/EU)	Federal Law Gazette I No. 111/2008 (CHP Act)	2008
Internal electricity market 2009/72/EC (repealing 2003/54/EC)	Federal Law Gazette I No. 72/2014 (Amendment of the CHP Act)	

With regard to combined heat and power production, Directive 2004/8/EC of 11 February 2004 on the promotion of cogeneration based on a useful heat demand in the internal energy market was transposed into national law by Federal Law Gazette I No. 111/2008. The Directive was repealed by the Energy Efficiency Directive, the CHP provisions of which were implemented in Austria through Federal Law Gazette I No. 72/2014. The main purpose of this law and the Directive is to increase energy efficiency and improve the security of supply by creating a framework for the promotion and development of high efficiency cogeneration of heat and power, based on useful heat demand and primary energy savings on the internal energy market.

The law provides for support to be granted to new and refurbished installations which are put into operation by the end of 2020 (at the latest).

The amounts of future subsidies for new CHP plants are limited to 12 million euros per year, of which 7 million euros are reserved for industrial CHP (Federal Law Gazette I No. 72/2014, part 2, section 7). However, any additional effects are estimated to be low, because of the low profitability of natural gas-based CHP plants under current market conditions.

4.5 Transport (CRF Source Category 1.A.3)

In this chapter the WEM measures relevant for the Transport sector will be specified. Their main objective is to reduce CO_2 emissions from fossil fuels.

The measures and GHG mitigation potentials used in the WEM scenario are described below.

4.5.1 WEM measures for Transport

4.5.1.1 PaM N°6: Increase the share of clean energy sources in road transport

One important and well established policy target for the Transport sector is to increase the share of clean energy sources in road transport. The EU Directive on the promotion of renewable energy sources requires Member States to replace at least 10% of the fuels used in transport by renewables (biofuels and electricity from renewable energy sources) by 2020. The Austrian Fuel Ordinance stipulates minimum targets for the share of biofuels (fatty-acid methyl ester and ethanol) in diesel and gasoline sold in Austria. The national Implementation Plan for electric mobility, a joint initiative of three federal ministries, aims at a (moderate) electrification of road transport; funding instruments are used to increase the share of electric vehicles and plug-in hybrid vehicles in the fleet from less than 0.1% in 2013 to about 1% in 2020.

GHG affected: CO_2

Type of policy: regulatory, economic

Implementing entity: federal government

Mitigation impact: 6,800 kt CO_2 eq in 2035 (see details below)

The instruments listed below have been taken into account in the current scenario.

Implementation of Directive 2009/28/EC on the promotion of the use of energy from renewable sources (‘Umsetzung der Richtlinie Erneuerbare Energieträger (2009/28/EG) gemäß Kraftstoffverordnung 2012’)

Type: EU policy

EU legislation	National Implementation	Start
RES Directive 2009/28/EC (Amendment)	KVO Federal Law Gazette II No. 398/2012 (last amendment 2014)	2012
RES-E Directive 2001/77/EC	KVO Federal Law Gazette II No. 168/2009	2009
Biofuels Directive 2003/30/EC	Federal Law Gazette II No. 417/2004	2004
Fuel Quality directive 2009/30/EC	Federal Law Gazette No. 267/1967	

Both the Directive on the promotion of renewable energy sources (2009/28/EC) as well as the Fuel Quality Directive (2009/30/EC) can be regarded as successors to the Biofuels Directive (2003/30/EC). They both lay down – directly and indirectly – goals for the use of biofuels. Apart from an overall goal, i.e. a certain percentage of the total energy demand to be covered by renewables by 2020; the Renewable Energy Directive also defines a goal for the use of renewables in the Transport sector. By 2020, each Member State must replace at least 10% of the fuels used in transport by renewables such as biofuels, or use electricity from renewable energy sources.

In Austria, the Directive was implemented in 2004 by amending the Austrian Fuel Ordinance (‘Kraftstoffverordnung’ – KVO 2012). According to this ordinance, there is an obligation for 2.5% of the amount of diesel and petrol (measured by energy content) put on the market after 1 October 2005 to be made up by renewable fuels. This minimum share was increased to 4.3% on 1 October 2007 and to 5.75% on 1 January 2009.

Biofuels have been on the Austrian market since 2005 mainly in the form of a mix of biodiesel with conventional diesel. Since October 2007 ethanol has been added to petrol. Currently there are standards for gasoline fuel E10 and diesel fuel B7. This means that at the moment it is possible to blend 10% ethanol with gasoline fuels and 7% FAME (fatty-acid methyl ester) with diesel fuels. In addition, the transport fleets of the municipalities and companies were converted to run on pure biofuels or on a share of biofuels of more than 40%. This was especially promoted by ‘klimaaktiv mobil’, an initiative of the Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW – see also ‘klimaaktiv’ instruments).

Assumptions about the development of the volume of biofuels blended with fossil fuels depend largely on the amount of fossil transport fuels sold. Except for blending, biofuels usage, e.g. pure FAME used in fleets, is expected to decline to zero in the period up to 2020 due to market uncertainties.

According to the amendment to the Austrian Fuel Ordinance (KVO 2012 in force since 1.1.2013) the substitution target will be 8.45% (relative to the energy content) from 1 October 2020 onwards, measured by total gasoline and diesel fuel used or when first put into circulation on Austrian territory.

Regarding the renewable energy share within the Transport sector, the sub-target of 10% will be reached thanks to additional activities. Besides rail and underground transport, the Transport sector also includes cableways or ski lifts which are electrically powered.

Further details can be found in Austria's annual report on biofuels in the Transport sector (BMLFUW 2016a).

Quantification/Projected GHG emissions/removals:

2035: 2 300 kt CO_2 eq (incl. fuel export)/1 200 kt CO_2 eq (excl. fuel export)

Implementation Plan for electric mobility ('Umsetzungsplan Elektromobilität')

Type: National policy

The estimated scenario is based on the current political, economic, technical and ecological conditions for the introduction of electric vehicles as well as on the current attitude towards (and acceptance of) electric mobility among the Austrian public. Many measures and initiatives with the aim to encourage the development of electric vehicles are already in place. These are in particular:

- Implementation plan for electric mobility as a joint initiative undertaken by three ministries (BMLFUW & WIKO 2010),
- 'klimaaktiv mobil' (initiative launched by the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management)
- Climate Fund (funding for research and application-oriented promotion e.g. model regions).

WEM projections for developments in electric mobility are based on a fleet model for the development of registration numbers for electric vehicles (Battery Electric Vehicles (BEV) and Plug-In Hybrid Electric Vehicles (PHEV)) (UMWELTBUNDESAMT 2016a). A comprehensive demand analysis was performed for the period up to 2035. This evaluation deals with the temporal development of the effects of five potential barriers to the registration of electric vehicles (as opposed to vehicles with combustion engines):

- the number of available vehicle models
- the availability of charging infrastructure
- the vehicle costs
- the vehicle ranges
- the subjective attitudes in the public

The share of renewable electricity in electric mobility is particularly high in Austria and a powerful lever in the achievement of the mandated goal of a 10% share of renewable energy in transport by 2020, as the renewable electrical energy used is calculated using a factor of 2.5. Therefore, the amount of electricity generated from renewable sources will be a critical aspect for electric mobility (BMWFJ & BMLFUW 2010).[5]

[5] With the future implementation of the ILUC Directive a factor of 2.5 is expected for rail transport and a factor of 5 for EVs (electric vehicles).

Current projections include all electrified transport modes on the road. For the projections it is assumed that the vehicle kilometres of conventional diesel and gasoline cars have been substituted with electric vehicles. The increased power consumption by electric vehicles is included in the energy-producing sectors.

In road freight transport, electric trucks of all size categories are now commercially distributed. However, market acceptance is not sufficient as yet. Therefore, electric heavy duty trucks are not considered in the current projections. Furthermore, rail transport provides an alternative to long distance road transport. Therefore, a shift away from road to rail freight transport should be aimed for. For urban collection and delivery services, electric light duty vehicles are already in use and included in the current projections.

With appropriate policies (e.g. taxation) especially the costs and medium-term infrastructure (preparation of standards and providing suitable conditions as well as the construction of and concessions for charging infrastructure) could be adapted to promote electric vehicles.

WEM projections assume that the fleet of electric vehicles (EVs) and plug-in hybrid electric vehicles (PHEVs) (passenger cars) will comprise approx. 2 million vehicles in 2035. This would imply that 35% of the Austrian passenger car fleet will be electrified (UMWELTBUNDESAMT 2016a).

Quantification/Projected GHG emission removals:

2035: 4 500 kt CO_2 eq (domestic effects only)

4.5.1.2 PaM N°7: Increase fuel efficiency in road transport

The increase in fuel efficiency in road transport is an essential measure for limiting energy demand in transport which has more than doubled in the course of the last three decades, also driven by fuel exports in vehicle tanks. Although technical progress has, in principle, led to improvements in the efficiency of motors and vehicles, consumer behaviour (i.e. the desire for larger cars and bigger engines with more power) has counteracted that trend. Fuel efficiency is affected by vehicle type and use. Several instruments, including taxes and tolls along with awareness raising and training, have been implemented to improve the fuel efficiency of the fleet. The mineral oil tax and the fuel consumption-based car registration tax are expected to promote the sale of cars with lower fuel consumption. Awareness raising and training programmes for fuel-efficient driving aim at improving driving performance. Other instruments like speed limits, been established in response to other environmental concerns, contribute to reduced fuel consumption.

GHG affected: CO_2

Type of policy: fiscal, information, regulatory, economic

Implementing entity: federal government, federal provinces

Mitigation impact: 1 330 kt CO_2 eq in 2035 (see details below)

The instruments listed below have been taken into account in the current scenario.

Fuel tax increase in 2011 (‘*MöSt-Erhöhung 2011* Klimabeitrag’)

Type: national policy

EU legislation	National Implementation	Start
Framework for the taxation of energy products and electricity (2003/96/EC)	‘Mineralölsteuergesetz’ Federal Law Gazette I No. 630/1994 (last amended 2014)	2011

The mineral oil tax is a tax directly related to fuel consumption, which means that a fixed amount has to be paid per litre of fuel consumed. In 2011 the mineral oil tax was raised (i.e. a CO_2 supplement of 20 €/t CO_2 introduced). Consequently, the petrol price increased by € 0.04 (€ 0.048 including VAT) and the diesel price by € 0.05 (€ 0.06 incl. VAT) per litre.

The purpose of increasing the fuel tax is to reduce individual motorised transport and encourage people to switch to public transport. Moreover, the aim is to reduce GHG emissions from fuel export.

Quantification/Projected GHG emissions/removals:

2035: 1 000 kt CO_2 eq (incl. fuel export)/100 kt CO_2 eq (excl. fuel export)

Greening the truck toll (‘Ökologisierung der LKW-Maut’)

Type: National policy

EU legislation	National Implementation	Start
Taxation of heavy goods vehicles 2006/38/EC	Federal Law Gazette I No. 109/2002) (last amendment 2014)	2002

Under the Federal Toll Law and the Ordinance of Toll Tariffs the mileage based lorry toll has been split into 3 different groups since 1 January 2010, in line with the EURO classes. Since 1 January 2012 there have been 4 tariff groups and new tariffs because emission class EURO 6 was included. This measure is based on EU Directive 2006/38/EC on the charging of heavy goods vehicles for the use of certain infrastructures (amendment to Directive 1999/62/EC).

The reduction potential of this measure is based on an expert estimate and has been included into the NEMO model. It is decreasing over time, given the future fleet renewal cycle of heavy duty vehicles as determined in the fleet module of the NEMO model, which assumes a continuous removal of older vehicles.

Quantification/Projected GHG emissions/removals:

2035: 200 kt CO_2 eq (domestic effects only)

Mobility management and awareness raising – 'klimaaktiv mobil' fuel saving initiative ('klimaaktive *Spritsparinitiative'*)

Type: National policy

Training sessions for fuel-efficient driving are expected to reduce fuel consumption. Compared against conventional driving, GHG emissions can be reduced by 5–15%. The initiative 'klimaaktiv mobil' launched by the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management aims at promoting fuel-efficient driving.

Nationwide competitions and pilot campaigns for companies owning large fleets have been organised and have already led to energy savings.

In addition, training programmes for all types of vehicle drivers have been launched and more than 22 000 people have participated in these programmes.

Since 2008 fuel-efficient driving has been a compulsory part of the training in driving schools. There are more than 1 200 qualified trainers for fuel-efficient driving. Under the Austrian training programme in driving schools 80 000 learner drivers are participating in one fuel-efficiency training session per year. Besides, the programme also informs people about alternative fuels and motors, e.g. in terms of guidelines for fleets. 26 driving schools have been rewarded for their outstanding commitment to learner driver tuition and the running of their schools.

Quantification/Projected GHG emissions/removals:

2035: 100 kt CO_2 eq (domestic effects only)

The CO_2 mitigation potential is kept on a constant level up to 2035.

Air quality induced speed limits ('Bestehende Tempolimits gemäß Immissionsschutzgesetz-Luft')

Type: national policy

EU legislation	National Implementation	Start
Air quality Directive 2008/50/EC	Federal Law Gazette I No 115/1997 (last amendment 2010)	1997/NA

The Ambient Air Quality Act lays down ambient air quality limit values for several pollutants.

In order to reduce and avoid exceedances of the limit value for NO_2, the speed limits have been lowered on certain parts of the Austrian motorways, either permanently or in sections controlled by traffic management systems. Based on an analysis of mileage-based speed, a difference in driving speeds of 6.2 km/h was used as input for the NEMO model (DIPPOLD et al. 2012). The calculated reduction potentials for energy use and emissions were simulated in the NEMO model. Traffic volumes and traffic speed on the respective motorway sections were used to calculate the emissions.

Quantification/Projected GHG emissions/removals:

2035: 30 kt CO_2 eq (domestic effects only)

4.5.1.3 PaM N°8: Modal shift to environmentally friendly transport modes

One of the most important policy measures is the promotion of a modal shift towards environmentally friendly transport modes. Although Austria belongs to the EU Member States with the highest share of rail transport (both passenger and freight transport) in the modal split, a further shift to environmentally friendly transport modes with a lower energy demand is essential for decreasing GHG emissions. Besides considerable investments in railway and other public transport infrastructure over the last decade, the programme 'klimaaktiv mobil' for mobility management and awareness raising is an essential tool for the promotion of environmentally friendly transport modes like public transport, cycling and walking. The cornerstones of 'klimaaktiv mobil' are the funding programme for businesses, communities and associations, target group-oriented counselling programmes, awareness-raising initiatives, partnerships, and training and certification initiatives. With respect to freight transport, investment support for corporate feeder lines aims at shifting transport activities from road to rail.

GHG affected: CO_2

Type of policy: information, economic

Implementing entity: federal government

Mitigation impact: 600 kt CO_2 eq in 2035 (see details below)

The instruments listed below have been taken into account in the current scenario.

Mobility management and awareness – klimaaktiv mobil initiative (‚Mobilitätsmanagement und Bewusstseinsbildung – klimaaktiv mobil Programm')

Type: National policy

The 'klimaaktiv mobil' initiative of the Austrian Federal Ministry of Agriculture and Forestry, Environment and Water Management offers extensive measures for promoting climate-friendly mobility management as well as cycling initiatives. It is intended to motivate relevant stakeholders and decision makers and to support them in the development and implementation of projects for the promotion of climate-friendly, efficient and sustainable mobility. The cornerstones of 'klimaaktiv mobil' are the funding programme for businesses, communities and associations, target group-oriented counselling programmes, awareness-raising initiatives, partnerships, and training and certification initiatives. Numerous projects have already been successfully implemented:

- Mobility management for commercial building promoters and fleet owners
- Mobility management for leisure, tourism and youth
- Mobility management for cities, municipalities and regions

Furthermore, over 5 000 climate-friendly mobility projects have been initiated – implemented by establishments, cities, municipalities and regions, tourist facilities and schools.

Quantification/Projected GHG emissions/removals:

2035: 500 kt CO_2 eq (domestic effects only)

The CO_2 mitigation potential is kept on a constant level up to 2035.

Promotion of corporate rail connections for freight transport *('Anschlussbahnförderung')*

Type: National policy

This instrument aims at supporting investment in corporate feeder lines in order to maintain and expand the railway network. The improvement of rail infrastructures at company/industrial sites aims at shifting transport activities from road to rail. By promoting and financing feeder lines on company sites the share of freight transported by rail could be increased.

The railway infrastructure service company (SCHIG) which is responsible for the implementation of this measure, the Federal Ministry for Transport, Innovation and Technology and the Climate and Energy Fund (KLI.EN) have provided estimates of the CO_2 emission reduction potential by 2020.

Quantification/Projected GHG emissions/removals:

2035: 100 kt CO_2 eq (domestic effects only)

4.6 Other sectors (1.A.4) – Buildings

Measures included in this sector concern energy consumption in buildings and are interlinked with the energy supply sector.

Significant national policy instruments that promote the implementation of measures are the Housing Support Scheme ('Wohnbauförderung' – WBF), the Technical Building & Construction Regulations of the regional authorities ('Bundesländer'), the Austrian Climate and Energy Fund ('Klima- und Energiefonds' – KLI.EN), the Domestic Environmental Support Scheme ('Umweltförderung im Inland' – UFI), and the 'klimaaktiv' programme. The last three programmes are funded by the federal government.

Further details on the Domestic Environmental Support Scheme and the Austrian Climate and Energy Fund are provided in section 4.3 (cross-cutting measures).

4.6.1 WEM measures for other sectors (1.A.4)

Where applicable (i.e. where a single measure had no effect), an updated 'without measures' (WOM) scenario has been used as a fictitious reference scenario for a quantification of the mitigation impact.

4.6.1.1 PaM N°9: Increased energy efficiency of buildings

Increasing the energy efficiency of buildings is one of the most effective means of reducing the carbon footprint of the Austrian population. Tighter mandatory construction standards improve the energy performance of new buildings and come close to a 'zero energy' standard in the future. Housing support is granted for the construction of buildings with improved energy efficiency only, and support for the thermal renovation of buildings is provided under several programmes, e.g. the federal 'renovation cheque' initiative for residential buildings and a programme under the environmental support scheme for commercial and industrial buildings. Improvements in the efficiency of new boilers are achieved through mandatory requirements at national level and eco-design standards at EU level. Furthermore, energy performance certificates have to be produced by sellers and landlords in the course of real estate transactions or renting.

GHG affected: CO_2

Type of policy: regulatory, economic, information

Implementing entity: federal government, federal provinces

Mitigation impact:

438 (62 new building, 376 renovation) kt CO_2 eq in 2020

566 (84 new building, 482 renovation) kt CO_2 eq in 2025

607 (95 new building, 513 renovation) kt CO_2 eq in 2030

632 (105 new building, 527 renovation) kt CO_2 eq in 2035

The instruments listed below have been taken into account in the current scenario.

OIB guideline 6 – Energy savings and thermal insulation (‚*OIB Richtlinie 6 – Energieeinsparung und Wärmeschutz*')

Type: EU policy, national policy

EU legislation	National Implementation	Start
Recast of the Energy performance of buildings (Directive 2010/31/EU) amending 2002/91/EC	OIB Guideline 6	2015–2017 (depending on the legislation of the federal provinces)
	National plan according to Art. 9(3) of 2010/31/EU	2014

The latest edition of the OIB guideline No. 6 of the Austrian Institute for Constructional Engineering (released in March 2015) transposes (like its predecessor) the EU Directive on the energy performance of buildings (Directive 2010/31/EC) into national law for both residential and non-residential buildings.

The federal provinces are responsible for translating this guideline into their respective regional laws (amending the second last edition of OIB guideline 6, released in October 2011). The periodical adjustments of OIB Guideline No 6 include the sequential stages of the National Plan.

The National Plan requires an improvement of the building standards for new buildings every two years to achieve a 'nearly zero energy' building standard which will comply with the target of the EU Directive in 2020. Furthermore, evolving targets are set for existing buildings undergoing major renovation. The focus is no longer just on the thermal heat demand of buildings but also on hot water, ventilation, cooling, the demand for electricity and photovoltaics which all impact on the total energy efficiency. Moreover, the new energy certificate for buildings specifies parameters such as the total energy efficiency factor, CO_2 emissions and the demand for primary energy on the cover sheet. Minimum requirements are specified for thermal heat demand and final energy consumption.

Quantification/Projected GHG emissions/removals:

The reduction potential of this single instrument is expected to amount to an annual maximum of 60–93 kt CO_2 equivalent in 2020, depending on when the amendments are carried out in the federal provinces. The upper limit is estimated at 95 kt CO_2 equivalent in 2025, 101 kt CO_2 equivalent in 2030 and 106 kt CO_2 equivalent in 2035, assuming no changes beyond the second stage of the National Plan until 2035 as a reference scenario for this single measure.

There is no information about policy costs. However, the level of ambition of the National Plan is set to meet the cost-optimality level of the EPBD (Directive 2010/31/EU) through a corresponding OIB document released in March 2014 ('OIB-Dokument zum Nachweis der Kostenoptimalität der Anforderungen der OIB-RL6 bzw. des Nationalen Plans gemäß 2010/31/EU').

National and funding programmes (*Bundes- und Förderprogramme*)

Type: national policy

In the WEM scenario it has been assumed that the following funding and national programmes will be continued in order to improve the energy efficiency of buildings:

- 'Klimaaktiv':
  - e5-communities: consultancy for communities to promote climate policies
  - energy saving: education, information and advice for consumers and commercial enterprises to reduce energy consumption
  - renewable energy: provide know-how and support networking for committed companies and associations
- Domestic Environmental Support Scheme (UFI):
  - KLI.EN: This is a fund included in the Environmental Support Scheme which supports energy efficiency measures for buildings (for more details see 4.3.3).
- Housing Support Scheme (WBF)

- Renovation of federal buildings (federal real-estate property) and construction of new federal buildings
- Building renovation initiative for commercial and industrial buildings to improve their energy performance: This measure includes funding for heat recovery, efficient energy use in industrial processes, optimisation or exchange of heating systems.
- Consultancy service and information campaigns

Funding for thermal renovation and new buildings includes all relevant funding programmes of the federal government and the federal provinces.

In the WEM scenario it is assumed that funds provided under the Domestic Environmental Support Scheme will drop by about 27% until 2020, by 30% until 2025, by 33% until 2030 and by 35% until 2035 (compared to 2017).

Instruments to support efficient new residential buildings, the thermal renovation of existing dwellings and the replacement of heating systems within the Housing Support Scheme (WBF) are regulated by the Austrian '15a BV-G Agreement' of the Federal Constitutional Law between the federal government and the federal provinces. This constitutional agreement between the federal provinces and the federal government came into effect in 2006 (Federal Law Gazette II No. 19/2006, succeeded by Federal Law Gazette II No. 251/2009) and provided for further improved standards as a prerequisite for receiving subsidies and for a shift to subsidies supporting the thermal renovation of existing dwellings. With regard to the quality of the renovations, minimum standards shall be adjusted according to the second stage of the National Plan for the amendment planned to entrer into force in 2017.

Most federal provinces in Austria support the replacement of old fossil fuelled heating systems with highly efficient systems based on renewable energy (solar, biomass) or natural gas (with condensing boiler technology). In addition, the federal provinces continue to promote combinations with existing or new (often biomass-fired) district heating. Thermal minimum standards for new buildings are defined in the Technical Construction Regulations of the federal provinces, which based on the OIB Guideline No 6.

In the WEM scenario the funding guidelines of the Housing Support Scheme will be adapted in order to fulfil the requirements of the building codes of the provinces two years earlier (see instrument 'OIB guideline No 6' above). In 2020 new residential buildings must overachieve the building code requirements of 2021 by 18% (regarding the energy needs for heating) to be eligible for funding under the Housing Support Scheme.

Funding for thermal renovation from the Housing Support Scheme is assumed to drop by about 15% until 2020, by 38% until 2025, by 60% until 2030 and by 63% until 2035. New building subsidy budgets from the Housing Support Scheme are set to drop about 8% until 2020, by 17% until 2025, by 28% until 2030 and by 30% until 2035.

All other subsidy funds that are taken into account are assumed to drop by about 15% until 2020, by 40% until 2025, by 64% until 2030 and by 80% until 2035.

The total funding volume for new buildings is expected to decrease from € 1 490 million annually in 2017 to € 1 369 million annually in 2020, to € 1 231 million annually in 2025, to € 1 081 million annually in 2030 and to € 1 039 million annually in 2035.

Total budget for thermal insulation subsidies is supposed to decrease from € 309 million annually in 2017 to € 260 million annually in 2020, to € 189 million annually in 2025, to € 117 million annually in 2030 and to € 101 million annually in 2035. The total funding volume for thermal insulation also includes funding for the federal building renovation initiatives: In the WEM scenario it is assumed that the funds (€ 40 million annually in 2017) will continually decline and be discontinued after 2030. For further details see the chapters on these two instruments below.

Quantification/Projected GHG emissions/removals:

The reduction potential of this single instrument has not been estimated.

Building renovation initiative for private buildings to improve energy performance (renovation cheques) *('Sanierungsscheck zur Verbesserung der Energieeffizienz von Privatgebäuden')*

Type: national policy

EU legislation	National Implementation	Start
Recast of the Energy performance of buildings (Directive 2010/31/EU) amending 2002/91/EC	Federal Law Gazette I No. 116/2016 (last amendment considered in WEM)	2016
	Federal Law Gazette I No. 185/1993	1993

The 'renovation cheque' is an incentive launched by the federal government in 2011 to promote the renovation of private buildings. This already existing building renovation initiative is planned to be continued for private households in 2017 and beyond.

Funding is available for the thermal renovation of buildings that are older than 20 years: insulation of front walls and ceilings, an exchange of windows and front doors as well as the heating system. The initiative is focused on owners of and tenants in rented apartments in multi-storey buildings as well as detached/semi-detached family houses.

The budget is assumed to drop from € 30 million annually in 2017 to € 24 million annually in 2020, to € 13 million annually in 2025 and to € 2 million annually in 2030. After 2030 in the WEM scenario funding is set to be discontinued.

Quantification/Projected GHG emissions/removals:

The reduction potential is expected to amount to 190–220 kt CO_2 by 2020[6].

[6] Source: BMLFUW 2013 (internal paper): 'Maßnahmentabelle Bund, Stand 18.01.2013'

Building renovation initiative for commercial and industrial buildings to improve energy performance (‘*Sanierungsoffensive zur Verbesserung der Energieeffizienz von betrieblichen Gebäuden’*)

Type: national policy

EU legislation	National Implementation	Start
Recast of the Energy performance of buildings (Directive 2010/31/EU) amending 2002/91/EC	Federal Law Gazette I No. 116/2016 (last amendment considered in WEM)	2016
	Federal Law Gazette I No. 185/1993	1993

As an incentive of the federal government to promote the renovation of commercial and industrial buildings, the domestic environmental support scheme fund (UFI) recently provided about € 30 million annually for this purpose. It is assumed that this instrument will be continued beyond 2015.

Funding is available for the thermal renovation of buildings that are older than 20 years: heat recovery, efficient energy use in industrial processes, optimisation or exchange of the heating system. The initiative is focused on companies and commercial organisations, such as registered associations and professional organisations.

Quantification/Projected GHG emissions/removals:

The reduction potential has not been estimated.

Recast of the Energy Performance of Buildings Directive *(‘Energieausweis-Vorlage-Gesetz 2012 – EAVG 2012’)*

Type: EU policy

EU legislation	National Implementation	Start date
Recast of the Energy performance of buildings (Directive 2010/31/EU) amending 2002/91/EC	Federal Law Gazette I No. 27/2012 (Amendment)	2012
	Federal Law Gazette I No. 137/2006	

The recast of the Directive on the energy performance of buildings (2010/31/EU) was released in order to improve the efficiency of previous building regulations and to counteract deficiencies in national implementation. The mechanisms have remained the same:

- Definition of calculation methods for total energy efficiency and minimum requirements
- Specifications for the creation, submission and notice of the energy performance certificate
- Inspections of heating and cooling systems.

The new elements include requirements for building technology systems, requirements for low-energy buildings and the compulsory creation of financial incentives by the Member States.

Austria has implemented the Buildings Directive and introduced several measures such as the 'Energy Certification Providing Act' ('Energieausweis-Vorlage-Gesetz 2012' – EAVG 2012) and the Austrian Institute of Construction (OIB) Engineering Guidelines have been adopted to maximise energy efficiency in new and existing residential buildings in Austria.

The energy certificate has to specify the thermal heating demand and the total energy efficiency factor for the building. When selling a building or an apartment the owner is obliged to present the energy certificate for the building. The energy certificate must not be older than 10 years and must be provided at least 14 days after the sale. It is expected that the energy certificate will influence potential buyers' decisions, and therefore be an incentive for sellers to take measures in order to achieve a positive energy performance. A quantification of emission reductions has not been possible.

Quantification/Projected GHG emissions/removals:

The reduction potential of this single instrument has not been estimated.

4.6.1.2 PaM N°10: Increased share of renewable energy for space heating

Increasing the share of renewable energy for space heating is the second important measure to decrease CO_2 emissions from space heating. Awareness raising measures on federal ('klimaaktiv' programme) and regional (federal provinces) level about the advantages of modern heating systems are expected to increase the boiler exchange rate. Financial support for biomass and solar heating systems is provided for households through funding from the federal provinces and the Austrian Climate and Energy Fund, and support for commercial and industrial applications is provided under the Domestic Environment Support Scheme. The District Heating and Cooling Act aims at the construction of district cooling systems in order to reduce electricity demand, as well as the expansion of district heating networks; subsidies are provided for that purpose.

GHG affected: CO_2

Type of policy: economic, regulatory

Implementing entity: federal government, federal provinces

Mitigation impact:

593 kt CO_2 eq in 2020

945 kt CO_2 eq in 2025

1 319 kt CO_2 eq in 2030

1 222 kt CO_2 eq in 2035

The instruments listed below have been taken into account in the current scenario.

Stepping up the replacement of heating systems (‘*Heizkesseltausch’)*

Type: National policy

An increase in the boiler exchange rate through various measures (defined in the Austrian Climate Strategy) will be achieved through financial support and by making people aware of the fact that old, inefficient heating systems should be replaced.

Quantification/Projected GHG emissions/removals:

The reduction potential of this single instrument has not been estimated.

District heating and district cooling Act *(‚‘Wärme- und Kälteleitungssausbaugesetz‘)*

Type: National legislation Federal Law Gazette I No. 72/2014 (last amendment), Federal Law Gazette I No. 58/2009 (amendment), Federal Law Gazette I No. 113/2008.

The district heating and district cooling Act (DHDC) as amended was implemented in 2009. It aims at achieving cost effective CO_2 emission reductions and at enhancing energy efficiency. The construction of district cooling systems is expected to lower the electricity demand for air conditioning and use existing heat and waste heat potentials, especially from industries. Renewable energy sources shall be included and district heating expanded in rural areas. Further expansions in agglomerations will be triggered. DHDC expansion is subsidised with € 60 million per year.

This law (Federal Law Gazette I No. 58/2009) is expected to lead to a permanent reduction of 3 000 kt CO_2.

Quantification/Projected GHG emissions/removals:

The reduction potential of this single instrument has not been estimated.

Funding for wood heating systems and solar heating systems (‚‘Ausbau der Förderung von Holzheizungen und Solaranlagen‘)

Type: National legislation: Federal Law Gazette I No. 185/1993, as amended by Federal Law Gazette I No. 116/2016; Federal Law Gazette I No. I No. 40/2007 as amended.

This funding initiative intends to enforce the installation of environmentally friendly heating systems in private households. It is financed under the domestic environmental support scheme (UFI) via the KLI.EN funds.

Financial support can be requested in cases where old oil-fired boilers are replaced by heating systems based on woodchips or pellets. In addition, solar heating systems are supported as well.

This funding initiative, launched in 2012, has been extended until 2017. It is assumed that this instrument will be continued up to 2035.

Quantification/Projected GHG emissions/removals:

This initiative is expected to save 69–79 kt CO_2 by 2020.[7]

4.6.1.3 PaM N°11: Increased energy efficiency in residential electricity demand

An increase in energy efficiency with respect to residential electricity demand is a further policy target which will be achieved by important instruments at EU level, especially eco-design requirements (Directive 2006/32/EC) for energy using products and mandatory labelling of household appliances according to their energy consumption, supported by awareness raising measures at national level with respect to energy efficient products and advice provided by regional energy agencies. Furthermore, the national implementation of the Energy Efficiency Directive (2012/27/EU) is considered in the scenario.

GHG affected: CO_2

Type of policy: regulatory, information

Implementing entity: federal government, federal provinces

Mitigation impact: not available

There is no information about policy costs currently available.

The instruments listed below have been taken into account in the current scenario.

Eco-design requirements for energy using products *(‘Ökodesign-Verordnung’)*

Type: EU policy

EU legislation	National Implementation	Start date
Eco-design Directive 2009/125/EC (amending 2005/32/EC)	Federal Law Gazette II No. 187/2011 (Amendment)	2011
	Federal Law Gazette II No. 126/2007	2007

The Eco-design Ordinance transposes the EU Eco-design Directive 2009/125/EC into national law. It consists of minimum eco-design requirements for specific energy-using products. These products have to be marked with the CE label and have to meet the minimum requirements defined in the EU Directive.

For the product design environmental impacts (resource use and energy consumption, emissions and recyclability) and safety-related requirements must be considered and the whole product life cycle, from the choice of raw material until final waste disposal, must be taken into account.

[7] Source: BMLFUW 2013 (internal paper): ‘Maßnahmentabelle Bund, Stand 18.01.2013’

During the first phase of the implementation of the Eco-design Directive primarily consumer products (household appliances) were affected. The amended Directive extends the scope to services and industries, such as heating systems, ventilation and air conditioning, machines, pumps and transformers.

Quantification/Projected GHG emissions/removals:

The reduction potential of this single instrument has not been estimated.

Effect of the Energy Efficiency Directive (2012/27/EU) *('Bundes-Energieeffizienzgesetz')*

Type: EU policy

EU legislation	National Implementation	Start date
Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC	Federal Law Gazette I No. 72/2014	2014
	First National Energy Efficiency Action Plan of the Republic of Austria 2014 in accordance with the Energy Efficiency Directive 2012/27/EC	2014

The Federal Energy Efficiency Act ('Bundes-Energieeffizienzgesetz') transposes the EU Energy Efficiency Directive 2012/27/EC into national law. It consists, inter alia, of final energy demand guidance levels to be attained by 2020 and it specifies measurements to assess energy efficiency gains, while enhancing the security of energy supply, increasing the renewable energy share and reducing greenhouse gas emissions. The most important provisions are:

- Increase in energy efficiency by at least 3% per year in buildings owned by the federal state
- Introduce mandatory energy management systems or external energy audits in enterprises with more than 250 employees
- Energy providers are obliged to provide proof of final energy demand savings and measures within their own organisations, amongst their own customers or with other final energy users.

For the WEM scenario energy savings resulting from the Federal Energy Efficiency Act have been calibrated using recent data on reported energy efficiency measures and implemented through corresponding subsidy types.

Quantification/Projected GHG emissions/removals:

The reduction potential of this single instrument has not been estimated. However, the additional effect on GHG emission savings might be only moderate because of possible overlaps with other WEM measures (see PAM N°5: Increase energy efficiency in energy and manufacturing industries).

Energy labelling of household appliances ('Produkte-Verbrauchsangabenverordnung 2011 – PVV 2011')

Type: EU policy

EU legislation	National Implementation	Start date
Directive 2010/30/EU on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products	Federal Law Gazette II No. 232/2011	2011

Directive 2010/30/EU on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products was implemented in Austria in 2011 (Federal Law Gazette II No. 232/2011). It specifies different energy classes, starting from A+++ (the best class) to D (the poorest performance class). As under the amendment to the Eco-design Directive, the scope of this Directive has been expanded to include a larger group of energy consuming products.

The energy label helps consumers to compare products in terms of their energy consumption.

New specific requirements have been established for the following products: dishwashers, refrigerators, freezers, washing machines, televisions, room air conditioning appliances, laundry dryers, vacuum cleaners, space and combination heaters, water heaters and electric lamps.

Quantification/Projected GHG emissions/removals:

The reduction potential of this single instrument has not been estimated.

4.7 Fugitive Emissions from Fuels (CRF Source Category 1.B)

It is assumed that no measures will be implemented in this sector.

4.8 Industrial Processes and Product Use (CRF Source Category 2)

The measures listed here target only F-gas emissions and emissions from product use, as other measures relevant for the Industry sector are covered in the Energy sector. These measures focus on energy efficiency and the use of renewable energy sources which also affect GHG emissions from industrial processes.

4.8.1 WEM measures for industrial processes and Product Use

4.8.1.1 PaM N°12: Decrease emissions from F-gases and other product use

A decrease in emissions from F-gases and other product use is the target to be achieved in this sector. National bans on certain uses have been enacted since 2002: The use of SF_6 is prohibited in most applications, the use of HFCs and PFCs is banned e.g. in the production of foam materials. National regulations were complemented by EU law at a later stage: Provisions for the maintenance of refrigeration and air conditioning systems aim at a minimisation of emissions; the use of refrigerants with GWPs higher than 150 in the air conditioning systems of new passenger car models has been prohibited since 2013; and from 2017 onwards the use of refrigerants with a GWP higher than 150 will not be permitted (German car manufacturers are currently not in compliance with the MAC directive). In 2014, the revised EU F-Gas Regulation came into effect, aiming at reducing the amount of F-gases to 21% of the average amount of refrigerants used in the European Union between 2009–2012 (in CO_2 eq). This scenario was included in the calculations for the projections; it applies to refrigerants only, and does not affect semiconductor manufacturing, electrical equipment, and medical aerosols.

GHG affected: HFCs (and PFCs used in refrigeration)

Type of policy: regulatory

Implementing entity: federal government

Mitigation impact: not available

The instruments listed below have been taken into account in the current scenario.

Prohibition and restriction of the use of (partly) fluorinated hydrocarbons and SF_6 (‘*Industriegasverordnung’)*

Type: National policy

EU legislation	National Implementation	Start
	Federal Law Gazette II No. 139/2007 (amendment)	2002

In Austria restrictions and bans on F-gases were first enacted on national level by the Industrial Gas Ordinance – ‘Industriegasverordnung’ (Federal Law Gazette II No. 447/2002, amended by Federal Law Gazette II No. 139/2007). The provisions are thematically related to the EU F-gas Regulation.

The use of HFCs, PFCs and SF_6 is banned or restricted in all sectors covered in the National Inventory. Where a use is, exceptionally, envisaged, strict reporting and documentation is required. The use of SF_6 as a filling gas for the sound insulation of windows, shoes, and tyres is prohibited. In addition, restrictions on the use of SF_6 in foam materials have been tightened. Measures in public procurement (removal of products containing F-gases) and public funding (criteria for federal financial support provided for housing construction) were implemented in the agreement 15a B-VG (Austrian Federal Constitutional Law;

between the federal government and the federal provinces). An amendment adopted in 2007 mainly focused on changes regarding the use of F-gases in refrigeration and extinguishing agents.

Quota system for the production and import of F-gases ***(‘Umsetzung der EU-F-Gas-Verordnung 2014‘)***

Type: EU policy (EU Regulation No 517/2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006)

The EU Regulation aims at reducing F-gases by prohibiting certain F-gases with very high GWPs, and at controlling the production and imports of other F-gases into the European Union. Aspects regarding the reduction of leakage rates and the training of staff were adopted from Regulation No 842/2006. The Regulation includes a number of provisions to reduce emissions such as the regular servicing and maintenance of refrigeration and air conditioning equipment, recovery of equipment containing F-gases, training and certification of personnel involved in the installation, servicing and maintenance of equipment and systems; reporting on imports, exports and the production of F-gases, as well as the labelling of products containing F-gases and a ban on the use of SF_6 in magnesium die casting effective from 1 January 2008, except where the quantity used is below 850 kg per year, and a ban on the use of SF_6 for the filling of tyres (effective from July 2007).

The amendment also deals with the placing on the market of F-gases and their control of use: from 1 January 2020 onwards the use of fluorinated gases with a global warming potential of 2 500 or more to service or maintain refrigeration equipment with a charge size of 40 tonnes of CO_2 equivalent or more will be prohibited (for certain categories, this rule will not apply before 2030, recycled uses will be permitted). For the placing on the market, as well as imports and production, a quota system will be applied. The maximum quantity of F-gases imported or produced in the EU will be controlled by applying the following percentages (to the annual average of the total quantity placed on the market in the European Union) from 2009–2012 (expressed in t of CO_2 equivalent): 2015: 100%; 2016–17: 63%; 2018–20: 63%; 2021–23: 45%; 2024–26: 31%; 2027–29: 24%; 2030: 21%. Only certain uses, e.g. for military equipment, etching for semiconductor material, and medical aerosols, will qualify for an exemption.

Quantification/Projected GHG emissions/removals:

A quantification of the GHG reduction potential has not been carried out. The F-gas regulation (WEM) is legally binding, and even though it is unclear how strictly these ambitious measures will be implemented at national level, it is the only scenario for F-gas emissions currently available.

Reducing HFC emissions from air conditioning in motor vehicles (‘Verringerung von HFC Emissionen durch Klimaanlagen von Kraftfahrzeugen‘)

Type: EU policy

EU legislation	National Implementation	Start
HFCs in mobile air conditioning systems – Directive 2006/40/EC	Federal Law Gazette I No. 275/2007 (Amendment)	2007
	Federal Law Gazette No. 267/1967	

According to the EU Directive on HFCs in mobile air conditioning units, car manufacturers are no longer allowed to use refrigerants with a GWP (global warming potential) higher than 150 in new passenger car models placed on the market. This affects the period from 2013 onwards. From 2017 onwards, the use of refrigerants with a GWP higher than 150 will be prohibited. However, most German car manufacturers have so far not used alternative refrigerants.

The objective is that refrigerants in motor vehicles with a high GWP shall be phased out successively.

Quantification/Projected GHG emissions/removals:

A quantification of the reduction potential is not available.

Limitation of VOC emissions from the use of organic solvents in industrial installations (‘Begrenzung der Emissionen bei der Verwendung organischer Lösungsmittel in gewerblichen Betriebsanlagen‘)

Type: EU and national policy

EU legislation	National Implementation	Start date
Industrial Emissions Directive 1999/13/EC	Federal Law Gazette II No. 301/2002	2002
	Federal Law Gazette II No. 42/2005 (Amendment)	2005
	Federal Law Gazette II No. 77/2010 (Amendment)	2010

Emissions of volatile organic compounds from the use of organic solvents in certain industrial installations and commercial enterprises fall within the scope of the Industrial Emissions Directive. The operators are obliged to comply with regulations concerning emission limits. For this reason regular measurement and reporting is necessary. An annual solvent report has to be submitted to the district authorities.

The Austrian Ordinance on VOC emissions further includes guidelines for the reduction of emissions.

4.9 Agriculture (CRF Source Category 3)

4.9.1 WEM measures for agriculture

4.9.1.1 PaM N°13: Implementation of EU agricultural policies

The implementation of EU agricultural policies in Austria puts *inter alia* a focus on environmentally sound farming practices in Austria's mostly small agricultural holdings. The Austrian Agri-Environmental Programme allocated funding for actions like a reduced use of mineral fertilisers, organic farming, low-loss application of manure etc. for the period 2007–2013. The reform of the Common Agricultural Policy at EU level in 2013 brought about some changes regarding direct payments and the requirement to maintain land in good agricultural and ecological condition; the Austrian Agri-Environmental Programme will be continued for the period 2014–2020 with some modifications and additions.

GHG affected: CH_4, N_2O

Type of policy: regulatory, economic

Implementing entity: federal government, federal provinces

Mitigation impact: not available

The instruments listed below have been taken into account in the current scenario.

Programme for rural development 2014–2020 ('Österr. Programm für die Entwicklung des Ländlichen Raums 2014–2020')

Type: EU policy

EU legislation	National Implementation	Start
Council Regulation (EC) No. 1305/2013.	Rural Development Programme 2014-2020.	2015

Measures implemented in the context of the Austrian Agri-Environmental Programme 2014–2020.

The Austrian Agri-Environmental Programme 2014–2020 includes several measures agreed under Austria's Climate Change Act (CCA) and designed to reduce GHG emissions from the Agricultural sector, e.g.:

- **Improved feeding of pigs and poultry**

  Feeding efficiency is increased by 2.5% in 2020.
- **Covering of manure storages**

  75% of cattle slurry and 85% of pig slurry is covered in 2020.
- **Low-loss application of manure and biogas slurry**

  30% of cattle slurry and 40% of pig slurry is applied through band spreading techniques in 2020. 10% of cattle, 40% of pig and 60% of poultry solid manure is applied within 12 hours in 2020.

- **Promotion of organic farming**
  The current share of organic farming is maintained.
- **Promotion of grazing**
  The current share of grazing is maintained.
- **Reduced usage of mineral fertilisers**
  Improved management practices result in a reduced amount of mineral fertilisers being used.

Common Agricultural Policy (CAP) (‘Gemeinsame Europäische Agrarpolitik‘)

Type: EU policy

EU legislation	National Implementation	Start
Common Agricultural Policy related regulations	implemented	2013

The following provisions of the CAP are taken into account:

- Implementation of the CAP 2013 reform (in particular the abolition of sugar quota and suckling cow premiums)
- Internal convergence of direct payments (‘regional premium’ scheme instead of historic payments)
- Land is maintained in good agricultural and ecological condition (‘cross compliance’ and the requirements for ‘greening’ (in particular the crop rotation requirement) are met;
- The programme for rural development 2014–2020 (see above)

4.10 Land use, Land-Use Change and Forestry (CRF Source Category 4)

The projections for LULUCF were completely revised in 2016. The assumptions on policies and measures are in line with the most recent WEM scenario and the information submitted in the Austrian LULUCF Action Plan (BMLFUW 2015b) in accordance with Article 10 of Decision 529/2013/EU.

4.10.1 WEM measures for LULUCF

Several of the measures attributed to other sector influence also the emissions/removals in the LULUCF sector. In the following, measures from the Agriculture and Energy sector are listed which also affect carbon stocks in the LULUCF sector.

Agriculture

The main sector which overlaps with LULUCF is the Agriculture sector. Measures taken in this sector directly and indirectly contribute to carbon stock changes. In this context the most relevant measure is the Austrian Rural Development Programme (see PAM N°13), currently for the period 2014–2020, which includes the Austrian Agri-environmental programme ÖPUL. Amongst others, the ÖPUL programme includes several measures that promote the enhancement of carbon stocks in the agricultural environment (e.g. reduced tillage, organic farming), especially in soils.

Energy

There are several other cross-cutting and mainly energy-related measures listed in the Austrian LULUCF Action Plan which are relevant for the LULUCF sector, such as:

- EU Emission Trading Scheme (ETS) (see PAM N°1)
- Domestic Environmental Support Scheme (see PAM N°2)
- Austrian Climate and Energy Fund (KLI.EN) (see PAM N°3)
- Increase the share of renewable energy and district heating (see PAM N°4)
- Increase the share of clean energy sources in road transport (see PAM N°6)
- Increase the share of renewable energy for space heating (see PAM N°10)

These measures aim at increasing the share of renewable energy sources such as biomass and switching to fuels with a lower (fossil) carbon content, which primarily affects the emissions in the energy industries sector, as well as in the housing and transport sector, but also have indirect impacts on LULUCF.

4.10.1.1 PAM 14: Sustainable Forest Management

Type of policy: regulatory

Implementing entity: federal government, federal provinces

Mitigation impact: not available

The overall principles of forest management in Austria are stipulated in the Forest Act (Federal Law Gazette I No. 1975/440, as amended), section 1: preservation of forest area, preservation of the productivity of forest sites and their functions, and the preservation of yields for future generations; i.e. sustainable management. The Forest Act furthermore attributes four functions to forests: productive (i.e. sustainable timber production), protective (i.e. protection against erosion and natural hazards, welfare (i.e. the protection of environmental goods like drinking water), and recreation (use for recreation).

With the Forest Act providing the regulatory basis for forest management in Austria, a wide range of forest-related measures are regulated or triggered by it, which are all clustered under this PAM and listed in the following:

- Guiding Principles of Forest Management
- General ban on forest clearance/deforestation

- General ban on forest destruction
- Immediate re/afforestation after felling
- Forest litter removal
- Forest protection (from fires and pests)
- Provisions for harvest haulage & forest roads
- Sustainable use of forests
- Austrian Forest Dialogue
- Forest cooperatives
- Task Force Renewable Energy
- Protection of wetlands

These measures are explained in more detail in the Austrian LULUCF Action Plan (see BMLFUW 2015b).

A LULUCF specific quantification cannot be given for the PAMs listed above due to a lack of data and because of overlapping activities.

4.11 Waste (CRF Source Category 5)

In the WEM scenario for waste the amount of deposited waste (and the carbon content respectively) is expected to continue on a decreasing trend, mainly as a result of the requirements of the Landfill Ordinance, but also because waste incineration and other forms of treatment are becoming more important. This trend is also shown by the indicator 'annually deposited waste/CH_4 emissions' (see the Figure 25 below).

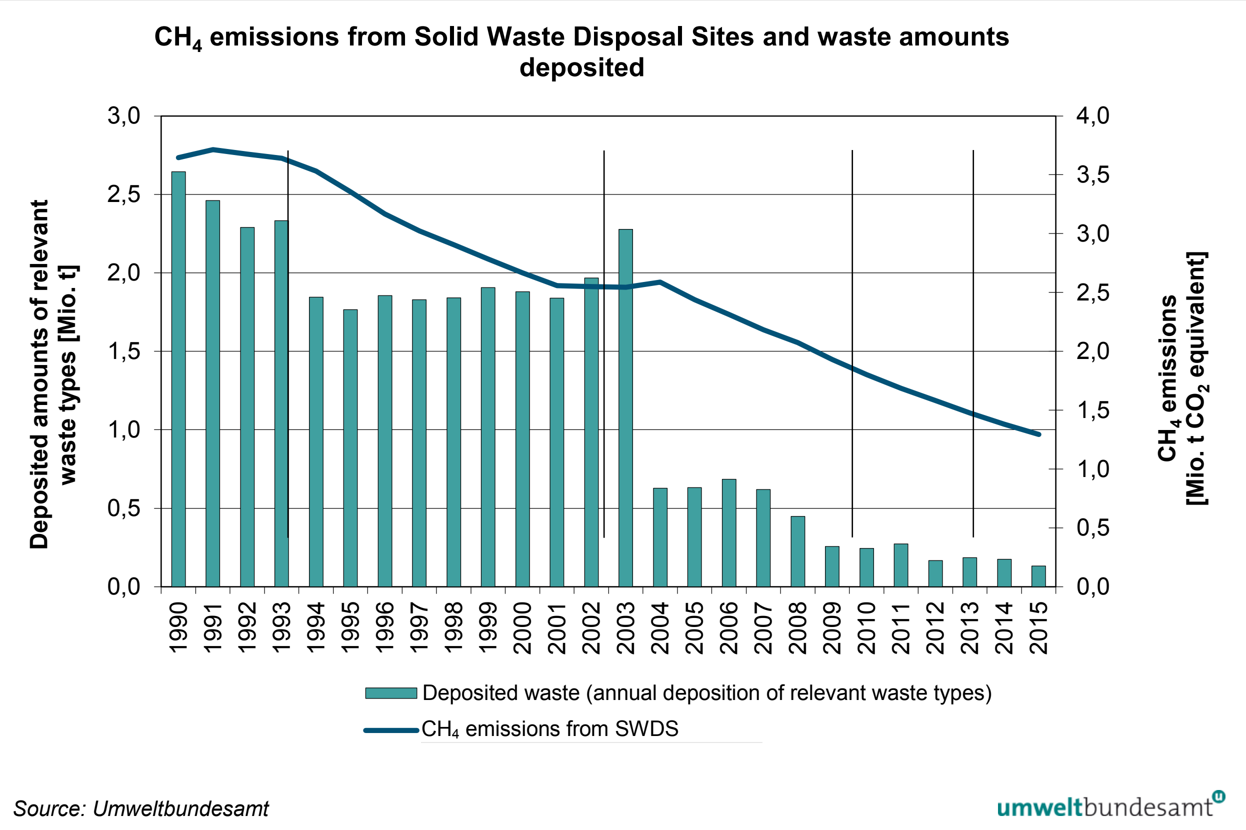


Figure 25: Methane emissions from landfills and annually deposited waste with relevant organic carbon content.

4.11.1 WEM measures for waste

For the Waste sector the following (category-specific) measures, summed up as PAM N°23, are considered in the WEM scenario.

4.11.1.1 PaM N°15: Reduce emissions from waste treatment

To reduce emissions from waste treatment, deposition of untreated biodegradable waste has been banned completely (Austrian Landfill Ordinance). According to this Ordinance, no untreated biodegradable waste has been allowed on landfills since 2004, with no exemptions permitted since 2008. The carbon content of waste is reduced through incineration or mechanical-biological treatment before deposition (pre-treatment options). Due to their size, more than half of the existing mechanical-biological treatment plants fall under the scope of the EU Industrial Emissions Directive, which limits emissions have according to BAT provisions. The Reference Document on Best Available Techniques ('BREF Document') which specifies emission limits and technical requirements is under revision and will be issued in 2018. Within 4 years plant operators will have to comply with the emission limits provided in the revised BREF Document.

Methane emissions from mass landfills are reduced by the mandatory collection and use of landfill gas.

In order to reduce the potential for emissions, generation of waste has to be prevented. Therefore projects, awareness raising campaigns and networks (e.g. 'Lebensmittel sind kostbar' and "United against waste') have been established to minimise especially food waste and to promote the re-use of waste.

GHG affected: CH_4, N_2O

Type of policy: regulatory

Implementing entity: federal government, federal provinces

Mitigation impact: see details below

The instruments listed below have been taken into account in the current scenario.

Landfill Ordinance ('*Deponieverordnung'*)

Type: EU policy, national policy

EU legislation	National Implementation	Start
Landfill Directive 1999/31/EC	Federal Law Gazette No. 164/1996, Federal Law Gazette II No. 39/2008	1997/NA

The implementation of the Landfill Directive is still ongoing and it will focus in the coming years on (1) managing the water balance and the aerobic in-situ stabilisation of closed landfills and on (2) increasing efforts to collect landfill gas (e.g. through detection of leakages, examination of gas collection systems) (Landfill Ordinance 2008).

Quantification/Projected GHG emissions/removals:

The Landfill Ordinance is still the most effective instrument for reducing emissions in the Waste sector, as it affects future amounts of deposited waste in the WEM scenario. Emissions from landfills are expected to decrease from 1 294 kt CO_2 equivalent in 2015 to 467 kt CO_2 equivalent in 2035.

Further provisions as stipulated in the Landfill Ordinance 2008 (water balance management, in-situ stabilisation) and improvements in the practical implementation of the Ordinance could enhance the reduction effect. For a quantification of this instrument, however, several assumptions need to be made, leading to a high level of uncertainty. A survey of gas collection systems conducted in 2014 showed that the measures described can lead to higher amounts of landfill gas collected at least at some landfills. However, no future trend for gas collection rates can be derived from that study.

Reduction of emissions from mechanical-biological treatment plants *('Emissionsreduktion aus MBA')*

Type: EU policy

The mechanical-biological treatment (MBT) of biodegradable wastes prior to landfilling reduces the gas formation potential. The Reference Document on Best Available Techniques (in short: 'BREF document') of the European Commission for the Waste Treatment Industries contains emission limits and technical specifications, which will be revised in an upcoming version in 2018, with a transition and adjustment period of 4 years. The Document is relevant for 9 out of 14 Austrian MBT plants (as of December 2015). The importance of the BREF document will increase in any case as the recommendations on best available technology will be adopted as mandatory requirements for treatment plants and as a central element in the procedure for granting operating licences. The requirements set out in the BREF will impact on the cost effectiveness of the MB treatment plants.

Besides the BREF, MB treatment has become (and is expected to become) even more diverse, especially with respect to the biological treatment step, which is sometimes only used for biological drying as pre-treatment for combustion. Sometimes MB treatment consists of mechanical treatment only.

The BREF and the developments in MB treatment technology (with different aims for the pre-treatment) will lead to a smaller amount of MB-treated waste and, in consequence, to fewer residues from this type of treatment to be disposed of in landfills (thus affecting emissions from Biological Treatment and Solid Waste Disposal as well).

Quantification/Projected GHG emissions/removals:

A quantification of projected GHG emissions is associated with a high level of uncertainty. The future requirements for MB treatment plants, as stipulated in the BREF document, are still pending. The development of MB treatment plants (biological drying, mechanical treatment only etc.) is also uncertain. Nevertheless, an estimation of the expected effect of mechanical-biological treatment plants on the stock of plants and activities (waste input amounts) has been taken into account in the WEM scenario (in the Solid Waste Disposal and Biological Treatment of Solid Waste sectors), as closures and reconstructions can be expected when the technical requirements set out in the BREF document will become mandatory in a few years' time.

Reduction of emissions from anaerobic treatment of biogenic waste

Emissions from the anaerobic treatment of biogenic waste are due to the storage of fermentation residues and due to unintentional leakages during process disturbances or other unexpected events. In recent years gas-tight covers for storage facilities have become relevant for permits to be granted for biogas plants by the respective authorities even though no legal requirement is existent. Probably in 2017 a new ordinance will be issued which will include a requirement for a gas-tight covers of storage facilities.

Quantification/Projected GHG emissions/removals:

Due to the future requirement of gas-tight covers for storage facilities for fermentation residues, emissions from biogas plants will be reduced. However, leakages of unintentional releases will still occur also in the future.

Emission from biogas plants will decrease from 23 500 t CO_2 equivalent in 2015 to 4 700 t CO_2 equivalent in 2030.

5 CHANGES WITH RESPECT TO THE SUBMISSION OF 2015

According to Article 14 paragraph 2 of Regulation 525/2013/EU Member States shall communicate any substantial changes to the information reported pursuant to this Article during the first year of the reporting period, by 15 March of the year following the previous report. Changes with respect to the previous GHG emission projections of 2015 (UMWELTBUNDESAMT 2015) are influenced by four main factors:

1. Changes in the base data (e.g. GHG inventory, energy balance)
2. Assumptions for activity scenarios have changed.
   These changes can be triggered by revised economic or technical scenarios, additional policies and measures considered and revisions of policies or measures due to amendments to legal texts.
3. Update of new emission factors
4. Changes in the models used for activity or emission scenario.

The following table shows a comparison of the past trends and scenario for national emission totals.

Table 17: Comparison of projections 2011, 2013, 2015 and 2017 – national totals (in kt CO_2e), (Umweltbundesamt).

Total – WEM	1990	2005	2010	2015	2020	2025	2030	2035
Projections 2011	78 171	92 916	85 237	86 096	87 333	89 098	90 847	
Projections 2013	78 162	92 880	84 594	82 444	81 640	82 764	84 039	
Projections 2015	78 683	92 496	84 788	79 737	79 067	76 779	75 957	75 677
Projections 2017	78 805	92 642	85 059	78 851	75 393	72 724	69 767	67 274
Difference 2017/16	121	146	271	– 886	– 3 674	– 4 055	– 6 190	– 8 403

The following tables present the changes in past trends and scenario emissions by sector.

5.1.1 Energy Industries (1.A.1)

Table 18: Comparison of projections 2011, 2013, 2015 and 2017 – Energy Industries (in kt CO_2e), (Umweltbundesamt).

1.A.1 – WEM	1990	2005	2010	2015	2020	2025	2030	2035
Projections 2011	13 842	16 184	12 605	10 671	10 910	12 005	12 842	
Projections 2013	13 842	16 359	14 293	12 301	11 416	12 155	12 815	
Projections 2015	13 842	16 364	14 150	10 362	9 896	8 635	8 348	9 362
Projections 2017	13 838	16 240	13 988	10 928	8 943	8 335	8 081	7 597
Difference 2017/15	– 4	– 124	– 161	566	– 953	– 300	– 267	– 1 764

Revisions in the base years are mainly due to updates of the national energy balance, as the latest energy balance with data up to 2015 was used. Revisions thereafter are due to a revised growth in electricity consumption, to recent developments on European electricity markets leading to a reduced profitability of gas and coal power plants and to a drastic change in the profitability of photovoltaic installations in the last couple of years.

5.1.2 Manufacturing Industries and Construction (1.A.2) & Industrial Processes & Product Use (2)

Table 19: Comparison of projections 2011, 2013, 2015 and 2017 – Manufacturing Industries and Construction & Industrial Processes & Product Use (in kt CO_2e), (Umweltbundesamt).

1.A.2 & 2 – WEM	1990	2005	2010	2015	2020	2025	2030	2035
Projections 2011	23 395	27 156	27 436	29 910	32 040	34 189	36 536	
Projections 2013	23 394	27 536	26 626	26 214	27 284	28 747	30 426	
Projections 2015	23 475	27 458	27 386	26 966	27 786	28 284	28 949	28 750
Projections 2017	23 553	27 408	27 470	27 144	26 189	25 791	25 242	25 337
Difference 2017/15	78	– 51	83	178	– 1 598	– 2 494	– 3 707	– 3 413

1A2 & 2 Processes

For the current projections (2017), the latest energy balance and a new version of the econometric input-output model DYNK of the Austrian Institute of Economic Research (WIFO 2017) was used.

Here the sectoral economic growth rate for the sector Chemical Industry (1A2c) is significantly lower than in the previous projections. Lower emissions in the sector Non-metal Mineral Industry (1A2f and 2A) are on the one hand due to a higher biomass input in this sector in the 2017 projections. On the other hand the cement industry is expected to remain stable until 2035, whereas in the previous scenario a production increase was expected. Deviations in the Iron and Steel industry (1A2a and 2C) are on the one hand due to lower economic growth rates and on the other hand due to an expected substitution of part of the hot metal production with imports of direct reduced iron.

The differences in the process emissions are mainly due to different energy data and corresponding assumptions for production.

2 F-gases

The differences in F-gas emissions are due to updates of chapter 2.F of the National Inventory on Greenhouse Gases (see UMWELTBUNDESAMT 2017a for further explanations), and an improvement of the calculation model. In the last submission, the F-gas Regulation was not yet fully implemented in the WEM. For this submission, the influence of the Regulation on the different sub-sectors was ameliorated.

2 D Solvents

For the sector 2.D the implementation of the current inventory until 2015 has led to a minor update of the trend until 2035. The difference with respect to the last submission is approximately 30 kt CO_2 equivalent in 2030. This change was based on new information included in the inventory, based on data derived from reports under the VOC Installation Ordinance. A minor recalculation for Paraffin Wax Use in the latest inventory for the years 1990–2007 has also led to minor changes compared to the last estimation.

5.1.3 Transport (CRF Source Category 1.A.3)

Table 20: Comparison of projections 2011, 2013, 2015 and 2017 – Transport (in kt CO_2 eq), (Umweltbundesamt).

1.A.3 – WEM	1990	2005	2010	2015	2020	2025	2030	2035
Projections 2011	14 010	24 981	23 308	24 850	24 872	24 684	24 513	
Projections 2013	14 030	25 040	22 452	23 695	23 800	23 931	23 965	
Projections 2015	13 974	24 939	22 379	23 169	23 267	23 261	23 042	22 594
Projections 2017	13 976	24 934	22 529	22 587	22 708	22 461	21 466	20 228
Difference 2017/15	2	– 5	150	– 582	– 559	– 801	– 1 576	– 2 366

In the 2017 submission GHG emissions are lower compared to 2015, for several reasons:

- Assumptions about the development of fuel prices in Austria and its neighbouring countries have been adapted, resulting in lower fuel consumption for fuel exports. Based on the historical trend which shows a slight reduction of the difference in diesel fuel prices between Austria and its neighbouring countries in the past few years, it is assumed that this difference will become smaller in the future. This results in a reduced consumption of fuel export activities in absolute numbers. The share in GHG emissions will remain constant though, as fuel consumption in Austria will also decline from 2022 onwards.
- Assumptions about the development of electric mobility have been adapted, now giving a much more optimistic outlook. In 2035 one third of all passenger cars are assumed to have been replaced withelectric vehicles.
- The methodology for estimating fuel consumption for aviation has been changed. In the past model of the Austrian Institute of Economic Research fuel consumption was strongly linked to economic growth. Now, fuel consumption of aviation is coupled with the oil price in the econometric input-output model DYNK (WIFO 2017).

5.1.4 Other Sectors (CRF Source Category 1.A.4 & 1.A.5)

Table 21: Comparison of projections 2011, 2013, 2015 and 2017 – Other Energy Sectors (in kt CO_2 eq), Umweltbundesamt.

1.A.4 & 1.A.5 – WEM	1990	2005	2010	2015	2020	2025	2030	2035
Projections 2011	14 468	14 435	12 089	11 173	10 244	9 161	8 067	
Projections 2013	14 441	13 748	11 448	10 648	9 710	8 678	7 705	
Projections 2015	14 507	13 742	11 506	10 292	9 305	7 966	7 095	6 401
Projections 2017	14 622	13 684	11 298	8 892	8 436	7 344	6 384	5 518
Difference 2017/15	116	– 59	– 208	– 1 401	– 869	– 623	– 711	– 882

In the 2017 submission GHG emissions are lower compared to 2015, for several reasons:

- The INVERT/EE-Lab model has been updated with recent statistical data on building stock and thermal building quality. The difference in the years around 2015 is due to emerging trends in activity data (energy consumption) for the recent inventory data years, in particular fossil fuel use (–11% against 2015 projections 2015 in the year 2015) which form the basis for the projections (and the model calibration).

- All energy prices have been assumed to be significantly higher in the 2017 projections with the exception of heating oil (reflecting the recent inventory data years, but only with a small difference by 2035) and electricity. Changes in price assumptions influence decisions as to which fuels will be preferred for heating systems in the long term as well as decisions regarding the quality and quantity of thermal renovation activities.
  - From 2020 onwards assumptions about the development of fuel prices result in lower natural gas consumption for heating.
  - The average final energy demand for heating in residential buildings by 2035 decreases by about 7.4% against the 2015 projections, and by around 14% in commercial buildings by 2035, leading to less overall final energy use in 2035 in spite of increased gross floor space of residential buildings.
- The Federal Energy Efficiency Act (Bundes-Energieeffizienzgesetz), transposing the EU Energy Efficiency Directive 2012/27/EC into national law, has been included under PaM N°11 in the current WEM scenario with an exchange of heating systems, in particular installations of condensing fossil fuel boilers and heat pumps.

5.1.5 Fugitive Emissions from Fuels (1.B)

Table 22: Comparison of projections 2011, 2013, 2015 and 2017 – Fugitive emissions (in kt CO_2e).

1.B – WEM	1990	2005	2010	2015	2020	2025	2030	2035
Projections 2011	312	440	448	444	431	409	388	
Projections 2013	311	441	516	539	570	582	594	
Projections 2015	702	482	521	560	574	589	604	607
Projections 2017	702	482	521	477	464	364	306	223
Difference 2017/15	0	0	0	– 83	– 110	– 224	– 298	– 384

The difference between the 2017 and 2015 projections is mainly due to a change in natural gas exploration data which has been taken from the latest energy projections. For the 2017 projections a strong decrease in future natural gas production has been assumed which is comparable with the assumptions from the 2011 projections while in the projections of 2013 and 2015 a rather constant level (or only a slight decrease) of natural gas exploration had been assumed.

5.1.6 Agriculture (3)

Table 23: Comparison of projections 2011, 2013, 2015 and 2017 – Agriculture (in kt CO_2 eq), (Umweltbundesamt).

3 – WEM	1990	2005	2010	2015	2020	2025	2030	2035
Projections 2011	8 558	7 399	7 534	7 625	7 693	7 687	7 663	
Projections 2013	8 558	7 412	7 453	7 654	7 733	7 711	7 687	
Projections 2015	7 959	6 878	6 852	6 874	7 044	7 052	7 063	7 192
Projections 2017	8 189	7 104	7 094	7 168	7 342	7 347	7 357	7 538
Difference 2017/15	230	226	242	294	298	295	295	345

The differences can be seen in the historical and in the scenario data; they are due to the following changes:

- In the submission of 2015 the national GHG inventory was revised according to the 2006 IPCC GL. Both the new global warming potentials (GWPs) and the new emission factors have led to lower sectoral emissions overall in the entire time series. In the 2017 submission further improvements in the methodologies and in completeness, especially in the source categories manure management and agricultural soils have resulted in increased emissions compared to the 2015 submission (see NIR 2016 and NIR 2017).
- The source of the activity data scenario is the same as the source used for the 2015 projections (PASMA model of WIFO & BOKU 2015). However, due to updates of AD within the national GHG inventories 2015 and 2016 (e.g. mineral fertilisers, horses, poultry and deer) the scenario trends for livestock and fertilisers were adjusted to 2015 inventory values.
- Several measures agreed under Austria's Climate Change Act (CCA) have been implemented in the WEM scenario (see chapter 4.9).

5.1.7 LULUCF (CRF Source Category 4)

Table 24: Comparison of GHG projections 2011, 2013, 2015, 2016 and 2017 – LULUCF (in kt CO_2 eq), (Umweltbundesamt).

4 – WEM	1990	2005	2010	2015	2020	2025	2030	2035
Projections 2011	– 13 139	– 17 332	– 4 773	– 3 493	– 1 823	– 1 823	– 1 823	
Projections 2013	– 10 023	– 7 395	– 3 611	3 533	5 031	5 031	5 031	
Projections 2015	– 9 878	– 7 626	– 3 894	3 508	5 005	5 005	5 005	5 005
Projections 2016	– 12 827	– 11 367	– 6 564	– 8 836	– 8 332	– 8 668	– 5 142	– 5 416
Projections 2017	– 12 153	– 10 756	– 5 911	– 4 848	– 7 747	– 8 101	– 4 608	– 4 905
Difference 2017/15	– 2 275	– 3 130	– 2 017	– 8 355	– 12 753	– 13 107	– 9 613	– 9 910

The revisions with respect to the projections 2015 are due to:

- A complete revision of the sector forest land
- the calculation of projections for the first time for: 4.G HWPs, 4.B Cropland, 4.C Grassland, 4.D Wetlands, 4.E Settlements, 4.F Other land
- Complete time series until 2035

In comparison to the projections of the 2015 submission, the sector 4.A remains a sink and does not become a source of GHG emissions. This can be explained by the impact of the financial crisis in 2008 (reduced production of and demand for wood) which influenced the reference year (2013) and therefore affected the projected time series. The projection of the previous submission was carried out before the economic crisis and assumed a continuation of the trends as before the year 2008.

The revisions of the 2017 submission with respect to the 2016 submission are due to:

- 4.A Forest land: N_2O emissions of LUC areas converted from grassland to forest land that are associated with C stock losses in the mineral soil have been calculated for the historical and projected time series for the first time
- 4.B Cropland: An updated assessment of the historical time series for LUC areas converted from grassland to annual and perennial cropland and vice-versa has been carried out on the basis of the IACS system.
- 4.C Grassland: An updated assessment of the historical time series for LUC areas converted from grassland to annual and perennial cropland and vice-versa has been carried out on the basis of the IACS system. Furthermore, the estimates of emissions from organic soils have been updated on the basis of new default emission factors provided in the IPCC Wetlands Supplement. In addition, CH_4 emissions from the drainage of organic soils have been estimated for the first time.
- 4.E Settlements: The soil C stocks of settlements have been recalculated on the basis of a new assessment and a revision of the share of sealed land in settlements. The LUC areas converted from cropland/grassland to settlements have been revised as a result of the updated historical figures for these two categories. N_2O emissions associated with C stock losses in soil resulting from land use changes to settlements have been estimated for the first time.
- 4.F Other land: N_2O emissions associated with C stock losses in soil resulting from land use changes to Other land have been estimated for the first time.

5.1.8 Waste (CRF Source Category 5)

Table 25: Comparison of projections 2011, 2013, 2015 and 2017 – Waste (in kt CO_2 eq), (Umweltbundesamt).

6 – WEM	1990	2005	2010	2015	2020	2025	2030	2035
Projections 2011	3 586	2 322	1 815	1 423	1 144	964	838	
Projections 2013	3 587	2 345	1 806	1 392	1 128	961	847	
Projections 2015	4 226	2 632	1 993	1 515	1 195	992	856	771
Projections 2017	3 925	2 791	2 158	1 656	1 312	1 083	930	833
Difference 2017/15	– 301	159	164	141	117	91	75	62

The differences in the revised emissions (as compared to the projections of the 2015 submission) are mainly due to methodological adaptations in the national GHG inventory, in particular sub-category 5.A Solid Waste Disposal on Land:

- A slight adaptation of the First Order Decay model (FOD) for the calculation of CH_4 from Solid Waste Disposal (5.A) in accordance with the IPCC 2006 Guidelines for the submission of the NIR 2016, including an extension of the time frame for historical deposition and taking into account a delay time for CH_4 production and average residence time of deposited waste.
- Adaptation of the DOC of residual waste for historical years in response to a recommendation made in the course of the ESD comprehensive review 2016 (Article 19 of the Monitoring Mechanism Regulation).

Moreover, CH_4 emissions from biogas plants resulting from the storage of fermentation residues as well as unintentional leakages have been considered in the projections for the first time, leading to slightly higher emissions from this sub-category from 2000 onwards.Several other small adaptations and improvements have been made to all sub-categories since the previous (2015) projections, with only a minor effect on the overall emission recalculations.

6 ABBREVIATIONS

AEA .... Austrian Energy Agency

BFW .... Bundesamt und Forschungszentrum für Wald
Austrian Federal Office and Research Centre for Forest

BMLFUW .... Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft
Federal Ministry of Agriculture, Forestry, Environment and Water Management

BMUJF .... Bundesministerium für Umwelt, Jugend und Familie
Federal Ministry for Environment, Youth and Family
(before 2000, Environment now included with: BMLFUW)

BMWA .... Bundesministerium für Wirtschaft und Arbeit
Federal Ministry for Economic Affairs and Labour (renamed as BMWFJ)

BMWFJ .... Bundesministerium für Wirtschaft, Familie und Jugend
Federal Ministry of Economy, Family and Youth (formerly called BMWA)

BMWFW .... Bundesministerium für Wissenschaft, Forschung und Wirtschaft (formerly called BMWFJ)

CHP .... Combined Heat and Power

CRF .... Common Reporting Format

EEG .... Energy Economics Group

EU .... European Union

GDP .... Gross Domestic Product

Gg .... Gigagramme

GHG .... Greenhouse Gas

GLOBEMI .... Globale Modellbildung für Emissions- und Verbrauchsszenarien im Verkehrssektor (Global Modelling for Emission and Fuel Consumption Scenarios of the Transport Sector) see (Hausberger 1998)

GWh .... gigawatt hours

GWP .... Global Warming Potential

IPCC .... Intergovernmental Panel on Climate Change

LEAP .... Long-range Energy Alternatives Planning System

LTO .... Landing/Take-Off cycle

LULUCF .... Land Use, Land-Use Change and Forestry – IPCC-CRF Category 5

Mt .... Megatonne

NFI .... National Forest Inventory

NIR .... National Inventory Report

NRMM .... Non-Road-Mobile-Machinery

OLI .... Österreichische Luftschadstoff Inventur
Austrian Air Emission Inventory

PAM .... Policies and Measures

QA/QC .... Quality Assurance/Quality Control

QMS .... Quality Management System
SNAP................. Selected Nomenclature on Air Pollutants
SVO................... Straight Vegetable Oil
Tg .... Teragramme
UFI..................... Umweltförderung im Inland (domestic environmental support scheme)
UNFCCC .... United Nations Framework Convention on Climate Change
WAM.................. scenario 'with additional measures'
WEM.................. scenario 'with existing measures'
UNFCCC .... United Nations Framework Convention on Climate Change
NDC................... National Determined Contribution
WIFO .... Österreichisches Wirtschaftsforschungsinstitut (Austrian Institute of Economic Research)

Greenhouse gases

CH_4 .... methane
CO_2 .... carbon dioxide
N_2O .... nitrous oxide
HFC .... hydrofluorocarbons
PFC .... perfluorocarbons
SF_6 .... sulphur hexafluoride
NF_3 .... nitrogen trifluoride

Notation Keys

According to UNFCCC guidelines on reporting and review (FCCC/CP/2002/8)

'NO' (not occurring)	for activities or processes in a particular source or sink category that do not occur within a country;
'NE' (not estimated)	for existing emissions by sources and removals by sinks of greenhouse gases which have not been estimated. Where 'NE' is used in an inventory for emissions or removals of CO_2, CH_4, N_2O, HFCs, PFCs, or SF_6, the Party should indicate why emissions or removals have not been estimated (see Annex III)
'NA' (not applicable)	for activities in a given source/sink category that do not result in emissions or removals of a specific gas. If categories in the CRF for which 'NA' is applicable are shaded, they do not need to be filled in
'IE' (included elsewhere)	for emissions by sources and removals by sinks of greenhouse gases estimated but included elsewhere in the inventory instead of the expected source/sink category. Where 'IE' is used in an inventory, the Annex I Party should indicate, using the CRF completeness table, where in the inventory the emissions or removals from the displaced source/sink category have been included and the Annex I Party should explain such a deviation from the expected category
'C' (confidential)	for emissions by sources and removals by sinks of greenhouse gases which could lead to the disclosure of confidential information, given the provisions of paragraph 27 as mentioned above

7 REFERENCES

AEA – Austrian Energy Agency (2017): Baumann, M. & Kalt, G: Szenarien für Strom- und Fernwärmeaufbringung und Stromnachfrage im Hinblick auf Klimaziele 2030 und 2050. AEA, Wien. not published yet.

BFW – Bundesforschungsszentrum für Wald und Naturgefahren (2015): Klimaschutz in der Forstwirtschaft: Zukünftige Bewirtschaftungsszenarien für den österreichischen Wald und deren Auswirkungen auf die Treibhausgasbilanz. Austrian Research Centre for Forests, Wien. Available at: http://bfw.ac.at/cms_stamm/050/PDF/holzkette/BFW_Klimaschutz_in_Forstwirtschaft-end.pdf

BMLFUW – Federal Ministry of Agriculture and Forestry, Environment and Water Management (2002): Strategie Österreichs zur Erreichung des Kyoto-Ziels. Klimastrategie 2008/20012. Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, 17.07.2002. Vienna.

BMLFUW – Federal Ministry of Agriculture and Forestry, Environment and Water Management (2007): Klimastrategie 2007. Anpassung der Klimastrategie Österreichs zur Erreichung des Kyoto-Ziels 2008–2012. Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, 21.03.2007. Vienna. http://www.klimastrategie.at.

BMLFUW – Federal Ministry of Agriculture and Forestry, Environment and Water Management (2013): Maßnahmenprogramm 2013/2014 des Bundes und der Länder als Beitrag zur Erreichung des nationalen Klimaziels 2013–2020. Wien. http://www.lebensministerium.at/dms/lmat/umwelt/klimaschutz/klimapolitik_national/ksg/190_23-Ma-nahmenprogramm/190_23%20Ma%C3%9Fnahmenprogramm.pdf.

BMLFUW – Federal Ministry of Agriculture and Forestry, Environment and Water Management (2014): Austrian Fuel Strategy 2014 – Treibstoffpfade 2020, not published yet.

BMLFUW – Federal Ministry of Agriculture and Forestry, Environment and Water Management (2015a): Parravicini, V.; Valkova, T.; Haslinger, J.; Saracevic, E.; Winkelbauer, A.; Tauber, J.; Svardal, K.; Hohenblum, P.; Clara, M.; Windhofer, G.; Pazdernik, K. & Lampert, C.: ReLaKO – Reduktionspotential bei den Lachgasemissionen aus Kläranlagen durch Optimierung des Betriebes. Institut für Wassergüte, Ressourcenmanagement und Abfallwirtschaft der TU Wien & Umweltbundesamt. Wien.

BMLFUW – Federal Ministry of Agriculture and Forestry, Environment and Water Management (2015b): Information on LULUCF Actions Austria. https://www.bmlfuw.gv.at/dam/jcr:6449432b-022a-488e-a388-6d016e2d6abf/LULUCF%20Aktionsplan.pdf

BMLFUW – Federal Ministry of Agriculture and Forestry, Environment and Water Management (2015c): Maßnahmenprogramm des Bundes und der Länder nach Klimaschutzgesetz zur Erreichung des Klimaziels bis 2020. Zweite Umsetzungsstufe für die Jahre 2015 bis 2018. Wien. http://www.bmlfuw.gv.at/dms/lmat/umwelt/klimaschutz/klimapolitik_national/klimaschutzgesetz/ksg/KSG-Ma-nahmenprogramm-Bund-L-nder_2015-2018/KSG-Ma%C3%9Fnahmenprogramm%20Bund-L%C3%A4nder_2015-2018.pdf.

BMLFUW – Federal Ministry of Agriculture and Forestry, Environment and Water Management (2016a): Winter, R.: Biokraftstoffe im Verkehrssektor 2016. Daten zu Biokraftstoffen in Österreich für das Berichtsjahr 2016, BMFLUW, Wien 2016. http://www.bmlfuw.gv.at/umwelt/luft-laerm-verkehr/biokraftstoffbericht.html

BMLFUW – Federal Ministry of Agriculture and Forestry, Environment and Water Management (2016b): Umweltinvestitionen des Bundes 2015, BMLFUW, Wien, 2016. https://www.bmlfuw.gv.at/dam/jcr:2c80245f-3fc2-4efc-997c-2d372655db5e/Bericht_Umweltinvestitionen%20des%20Bundes%202015.pdf

BMLFUW & WIKO (2010): 10 Punkte Aktionsprogramm zur Markteinführung von Elektromobilität mit erneuerbaren Energien, in Österreich. 20.01.2012. http://doku.cac.at/aktionsprogramm_elektromobilitaet.pdf

BMWFJ – Federal Ministry of Environment, Youth and Family (2011): National Renewable Energy Action Plan 2010 for Austria. Available at: http://www.wifo.ac.at/jart/prj3/wifo/resources/person_dokument/person_dokument.jart?publikationsid=40224&mime_type=application/pdf

BMWFJ & BMLFUW – Federal Ministry of Economy, Family and Yout & Federal Ministry of Agriculture and Forestry, Environment and Water Management (2010): Eckpunkte der Energiestrategie Österreich. Wien, 20.03.2010. http://www.energiestrategie.at/.

BMWFW – Federal Ministry of Science, Research and Economics (2014): NEEAP 2014. Erster Nationaler Energieeffizienzaktionsplan der Republik Österreich 2014 gemäß Energieeffizienzrichtlinie 2012/27/EU. Wien, April 2014.

BMWFW – Federal Ministry of Science, Research and Economics (2017): Treibstoffpreismonitor; unter http://www.bmwfw.gv.at/EnergieUndBergbau/Energiepreise/Seiten/MonitorTreibstoff.aspx?Report=3 (7.2.2017).

BRAUN, M.; SCHWARZBAUER, P.& STERN, T. (2015): Kohlenstoffspeicherung durch Holzernteprodukte, Wien. https://bfw.ac.at/cms_stamm/050/PDF/holzkette/BOKU_HolzKohlenstoffpool-end.pdf

DIPPOLD, M.; REXEIS, M.; HAUSBERGER, S. (2012): NEMO – A Universal and Flexible Model for Assessment of Emissions on Road Networks. 19th International Conference 'Transport and Air Pollution', 26. – 27.11.2012, Thessaloniki.

EC – European Commission (2011): Health Check of the Common Agricultural Policy, http://ec.europa.eu/agriculture/healthcheck/index_en.htm (accessed 28 Feb 2011).

EC – EUROPEAN COMMISSION (2014): Prospects for EU agricultural markets and income 2014–2014. December 2014, Brussels.

E-CONTROL (2016): Ökostrombericht 2016. Wien, July 2016.

GSCHREY, B. (2010): Projections of Emissions of Fluorinated Greenhouse Gases in Austria 2008–2020, Study on behalf of the Umweltbundesamt GmbH, Wien, Öko-Recherche GmbH, Frankfurt/Main. Unpublished study.

GSCHWANTNER, T.; KINDERMANN, G. & LEDERMANN, T. (2010): Weiterentwicklung des Wachstumssimulators PrognAus durch Einbindung klimarelevanter Parameter, in: Neumann, M. (Ed.), Auswirkungen des Klimawandels Auf Österreichs Wälder - Entwicklung Und Vergleichende Evaluierung Unterschiedlicher Prognosemodelle. Forschungsbericht A760631. Climate and Energy Fund, Vienna, p. 150.

HAUSBERGER, S.; SCHWINGSHACKL, M. & REXEIS, M. (2015): NEMO Methodenbericht im Rahmen des Projekts NEMO4U. Erstellt im Auftrag des Umweltbundesamtes. Graz 2015.

KINDERMANN, G. (2010): Eine klimasensitive Weiterentwicklung des Kreisflächenzuwachsmodells aus PROGNAUS. Austrian Journal of Forest Science 127, 147–178.

KLIEN – Klima und Energiefonds (2016): Klare Ziele. Richtiger Weg. Wir geben der Zukunft Energie. Klima- und Energiefonds – Jahresbericht 2015. Wien, 2016.

KLIEN – Klima und Energiefonds (2017): Daten und Fakten. https://www.klimafonds.gv.at/ueber-uns/ (last retrieved on February 14th, 2017)

LEDERMANN, T. (2002): Ein Einwuchsmodell aus den Daten der Österreichischen Waldinventur 1981–1996. Austrian Journal of Forest Science 119, 40–77.

LISKI, J.; PALOSUO, T.; PELTONIEMI, M. & SIEVÄNEN, R. (2005): Carbon and decomposition model Yasso for forest soils. Ecol. Modell. 189, 168–182.

LISKI, J.; TUOMI, M. & RASINMÄKI, J. (2009). Yasso07 user-interface manual. Helsinki.

MOLITOR, R.; HAUSBERGER, S. et. al (2004): Abschätzung der Auswirkungen des Tank-tourismus auf den Kraftstoffverbrauch und die Entwicklung der CO_2-Emissionen in Österreich, Bericht im Auftrag von Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Trafico, Wien 2004.

MOLITOR, R.; HAUSBERGER, S. et. al (2009): Abschätzung der Auswirkungen des Export im Kraftstofftank auf den Kraftstoffabsatz und die Entwicklung der CO_2 und Luftschadstoffemissionen in Österreich – Aktualisierung 2007 und Prognose 2030; im Auftrag des Bundesministeriums für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft; Bundesministerium für Verkehr, Innovation und Technologie; Graz-Wien; 2009 (not published).

MUULS, M.; COLMER, J.; MARTIN, R.; WANGER, U. J. (2016): Evaluation the EU Emissions Trading System: Take it or leave it? An assessment of the data after ten years. 02.10.2016 https://www.imperial.ac.uk/media/imperial-college/grantham-institute/public/publications/briefing-papers/Evaluating-the-EU-emissions-trading-system_Grantham-BP-21_web.pdf

OECD-FAO (2014): Agricultural Outlook 2014–2023. OECD & Food and Agriculture Organization of the United Nations. Paris.

ÖROK – ÖSTERREICHISCHE RAUMORDNUNGSKONFERENZ (2015): 14. Raumordnungsbericht. Wien. http://www.oerok.gv.at/raum-region/daten-und-grundlagen/raumordnungsbericht/14-raumordnungsbericht.html

SCHWARZ W.; GSCHREY, B.; LEISEWITZ, A.; HEROLD, A.; GORES, S.; PAPST, I.; USINGER, J.; OPPELT, D.; CROISET, I.; PEDERSEN, P. H.; COLBOURNE, D.; KAUFFELD, M.; KAAR, K. & LINDBORG, A: (2011): Preparatory study for a review of Regulation (EC) No 842/2006 on certain fluorinated greenhouse gases, Final Report, Prepared for the European Commission in the context of Service Contract No 070307/2009/548866/SER/C4.

SINABELL, F.; SCHÖNHART, M. & SCHMID E. (2011): Austrian Agriculture 2005–2030. Consequences of Measures to Mitigate Greenhouse Gas Emission. Österreichisches Institut für Wirtschaftsforschung (WIFO) und BOKU Wien.

STATISTIK AUSTRIA (2016a): Bevölkerungsstruktur für Österreich 2015-2050. Bevölkerungsprognose 2015, Wien. http://www.statistik.at/web_de/services/publikationen/2/index.html?includePage=detailedView&sectionName=Bev%C3%B6lkerung&pubId=539

STATISTIK AUSTRIA (2016b): Energiebilanzen 1970–2015. Wien.

TU GRAZ – TECHNICAL UNIVERSITY OF GRAZ (2017): Hausberger, S.; Schwingshackl, M. & Rexeis, M.: Monitoring Mechanism 2017 und Szenario WAM plus – Verkehr. Institut für Verbrennungskraftmaschinen und Thermodynamik (IVT), Graz. Not published yet.

TU WIEN – TECHNICAL UNIVERSITY OF VIENNA (2017): Kranzl, L.; Müller, A.: Energieszenarien bis 2050: Wärmebedarf der Kleinverbraucher. Endbericht. Energy Economics Group (EEG). Technische Universität Wien, Wien. Not published yet.

UMWELTBUNDESAMT (2011): Lampert, C.; Tesar, M. & Thaler, P.: Klimarelevanz und Energieeffizienz der Verwertung biogener Abfälle. Reports, Bd. REP-0353. Umweltbundesamt, Vienna.

UMWELTBUNDESAMT (2013): Krutzler, T.; Gallauner, T.; Gössl, M.; Heller, C.; Lichtblau, G.; Schindler, I.; Stoiber, H.; Storch, A.; Stranner, G.; Wiesenberger, H. & Zechmeister, A.: Energiewirtschaftliche Inputdaten und Szenarien als Grundlage für den Monitoring Mechanisms 2013 und das Klimaschutzgesetz. Reports, Bd. REP-0415. Umweltbundesamt, Vienna.

UMWELTBUNDESAMT (2014): Lampert, C.: Stand der temporären Abdeckung von Deponien und Deponiegaserfassung. Reports, Bd. REP-0484. Umweltbundesamt, Vienna.

UMWELTBUNDESAMT (2015): Zechmeister, A.; Anderl, M.; Gössl, M.; Haider, S.; Kampel, E.; Krutzler, T.; Lampert, C.; Moosmann, L.; Pazdernik, K.; Purzner; M.; Poupa, S.; Schieder, W., Schmid, C.; Stranner, G.; Storch, A.; Wiesenberger, H.; Weiss, P.; Wieser, M. & Zethner, G.: GHG Projections and Assessment of Policies and Measures in Austria. Reports, Bd. REP-0527. Umweltbundesamt, Vienna.

UMWELTBUNDESAMT (2016a): Fleet model for the development of BEVs and PHEVs based on typical resistance factors reagarding market penetration. Umweltbundesamt. Vienna 2016. Not published yet.

UMWELTBUNDESAMT (2016b): GHG Projections of Land Use, Land Use Change and Forestry and for Non-Forest Land In Austria, Reporting under Art. 14 of Regulation (EU) 535/2013, available: http://cdr.eionet.europa.eu/at/eu/mmr/art04-13-14_lcds_pams_projections/envvqnfkg/MMR_Projections_LULUCF_28-01-2016.pdf/manage_document

UMWELTBUNDESAMT (2016c): Diskussionspapier – Grenzvermeidungskosten im Effort Sharing; Umweltbundesamt. Vienna, 2016. Not published yet.

UMWELTBUNDESAMT (2017a): Anderl, M.; Haider, S.; Kohlbach, M.; Kriech, M.; Lampert, C.; Moosmann, L.; Pazdernik, K.; Pinterits, M.; Purzner, M.: Poupa, S.; Schmid, C.; Schmidt, G.; Seuss, K.; Stranner, G.; Titz, M.; Schwaiger, E.; Schwarzl, B.; Wieser, M.; Weiss, P.; Zechmeister, A.: Austria's National Inventory Report 2017 – Submission under the United Nations Framework Convention of Climate Change and the Kyoto Protocol. Reports, Bd. REP-0608. Umweltbundesamt, Vienna.

UMWELTBUNDESAMT (2017b): Krutzler, T.; Zechmeister, A ; Kellner, M.; Gallauner, T.; Gössl, M.; Heller, C.; Lichtblau, G.; Schindler, I.; Schieder, W.; Storch, A.; Stranner, G. & Wiesenberger, H.: Energie- und Treibhausgas-Szenarien im Hinblick auf 2030 und 2050. Synthesebericht 2017. Umweltbundesamt, Vienna. Not published yet.

WEISS, P.; BRASCHEL, N.; BRAUN, M.; BÜCHSENMEISTER, R.; FREUDENSCHUSS, A.; FRITZ, D.; GSCHWANTNER, T.; JANDL, R.; LEDERMANN, T.; NEUMANN, M.; PÖLZ, W.; SCHAUDAUER, K.; SCHMID, C.; SCHWARZBAUER, P. & STERN, T. (2015): Treibhausgasbilanz der österreichischen Holzkette. BFW Praxisinformation Nr. 38 – 2015, Austrian Research Centre for Forests, Wien. Available at: http://bfw.ac.at/cms_stamm/500/PDF/BFW_praxisinformation38_treibhausgasbilanz.pdf

WIFO & BOKU (2015): Sinabell, F.; Schönhart, M. & Schmid, E.: Austrian Agriculture 2010–2050. Quantitative Effects of Climate Change Mitigation Measures. Wirtschaftsforschungsinstitut (WIFO) und Universität für Bodenkultur (BOKU), Vienna.

WIFO (2017): Sommer, M. & Meyer, I.: Energy Scenarios for Austria 2050. WIFO, Wien. Not published yet.

WINDSPERGER, S. & SCHMIDT-STEJSKAL, H. (2008): Revision der Lösemittelemissionsdaten der Österreichischen Luftschadstoffinventur (OLI). Wien.

WINDSPERGER, S.; STEINLECHNER, H.; SCHMIDT-STEJSKAL, H.; DRAXLER, S.; FISTER, G., SCHÖNSTEIN, R. & SCHÖRNER, G. (2002a): Gegenüberstellung und Abgleich der Daten von Top-down zu Bottom-up für Lösungsmittel im Jahr 2000. Institut für Industrielle Ökologie (IIÖ) und Forschungsinstitut für Energie und Umweltplanung, Wirtschaft- und Marktanalysen GmbH (FIEU). Studie im Auftrag des Lebensministeriums und Bundesministeriums für Wirtschaft und Arbeit. Wien.

WINDSPERGER, S.; STEINLECHNER, H.; SCHMIDT-STEJSKAL, H.; DRAXLER, S.; FISTER, G., SCHÖNSTEIN, R. & SCHÖRNER, G. (2002b): Verbesserung von Emissionsdaten (Inventur und Projektion bis 2010 für den Bereich Lösungsmittel in Österreich. Institut für Industrielle Ökologie (IIÖ) und Forschungsinstitut für Energie und Umweltplanung, Wirtschaft- und Marktanalysen GmbH (FIEU). Studie im Auftrag des Lebensministeriums und Bundesministeriums für Wirtschaft und Arbeit. Wien.

WINDSPERGER, S.; STEINLECHNER, H.; SCHMIDT-STEJSKAL, H.; DRAXLER, S.; FISTER, G., SCHÖNSTEIN, R. & SCHÖRNER, G. (2004): Studie zur Anpassung der Zeitreihe der Lösungsmittelemissionen der österreichischen Luftschadstoffinventur (OLI) 1980–2002. Institut für Industrielle Ökologie (IIÖ) und Forschungsinstitut für Energie und Umweltplanung, Wirtschaft- und Marktanalysen GmbH (FIEU). Studie im Auftrag des Umweltbundesamtes. Wien.

ZESSNER, M. & LINDTNER, S. (2005): Estimations of municipal point source pollution in the context of river basin management. Institute for Water Quality and Waste Management, Vienna University of Technology Published in Water Science & Technology. Vol. 52, No 9 pp 175–182. IWA Publishing 2005.

Legislation

204/ME (XXIII.GP) Bundesklimaschutzgesetz: Bundesverfassungsgesetz, mit dem das Bundesverfassungsgesetz vom 27. November 1984 über den umfassenden Umweltschutz geändert wird, Bundesverfassungsgesetz, mit dem das Bundes-Verfassungsgesetz geändert wird, und Bundesgesetz, mit dem Bund und den Ländern Klimaschutzverpflichtungen zugeordnet werden.

Abwasseremissionsverordnung (BGBl Nr. 186/1996): Verordnung des Bundesministers für Land- und Forstwirtschaft über die allgemeine Begrenzung von Abwasser-emissionen in Fließgewässer und öffentliche Kanalisationen (AAEV).

Council Regulation No. 1782/2003 of 29 September 2003 establishing common rules for direct support schemes under the common agricultural policy and establishing certain support schemes for farmers.

Decision 2005/166 of 10 February 2005 laying down rules implementing Decision No 280/2004/EC of the European Parliament and of the Council concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol (notified under document number C(2005) 247).

Decision 93/389 of 24 June 1993 for a monitoring mechanism of Community CO_2 and other greenhouse gas emissions.

Decision 99/296/EC amending Council Decision 93/389/EEC for a Monitoring Mechanism of Community CO_2 and other Greenhouse Gas Emissions.

Decision No 280/2004/EC of the European Parliament and of the Council of 11 February 2004 concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol.

Directive 1999/62/EC of the European Parliament and of the Council of 17 June 1999 on the charging of heavy goods vehicles for the use of certain infrastructures

Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing framework for Community action in the field of water policy (Water framework directive).

Directive 2003/30/EC of the European Parliament and of the Council of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport.

Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC.

Directive 2005/32/EC of the European Parliament and of the Council of 6 July 2005 establishing a framework for the setting of ecodesign requirements for energy-using products and amending Council Directive 92/42/EEC and Directive 96/57/EC and 2000/55/EC of the European Parliament and of the council (Eco Design Directive).

Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on energy end-use efficiency and energy services.

Directive 2006/38/EC of the European Parliament and of the Council of 17 May 2006 amending Directive 1999/62/EC on the charging of heavy goods vehicles for the use of certain infrastructures

Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe

Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC

Directive 2012/27/EC of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC Text with EEA relevance

Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC (Text with EEA relevance).

Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC Text with EEA relevance

Federal Law Gazette I No. 109/2002 Bundesstraßen-Mautgesetz 2002 – BStMG: Bundesgesetz über die Mauteinhebung auf Bundesstraßen, zuletzt geändert durch BGBl. I Nr. 99/2013.

Federal Law Gazette I No. 115/1997 Bundesgesetz zum Schutz vor Immissionen durch Luftschadstoffe, mit dem die Gewerbeordnung 1994, das Luftreinhaltegesetz für Kesselanlagen, das Berggesetz 1975, das Abfallwirtschaftsgesetz und das Ozongesetz geändert werden (Immissionsschutzgesetz – Luft, IG-L), zuletzt geändert durch BGBl. I Nr. 77/2010.

Federal Law Gazette I No. 149/2002 i.d.F. BGBl. I Nr 105/2006 Ökostromgesetz: Bundesgesetz, mit dem Neuregelungen auf dem Gebiet der Elektrizitätserzeugung aus erneuerbaren Energieträgern und auf dem Gebiet der Kraft-Wärme-Kopplung erlassen werden (Ökostromgesetz) sowie das Elektrizitätswirtschafts- und -organisationsgesetz (ElWOG) und das Energieförderungsgesetz 1979 (EnFG) geändert werden. Zuletzt geändert durch BGBl. I Nr. 114/2008.

Federal Law Gazette I No. 40/2007 Klima- und Energiefondsgesetz KLI:EN-FondsG: Bundesgesetz über die Errichtung des Klima- und Energiefonds.

Federal Law Gazette I No. 44/2008 Ökostromgesetz – ÖSG: Bundesgesetz, mit dem Neuregelungen auf dem Gebiet der Elektrizitätserzeugung aus erneuerbaren Energieträgern und auf dem Gebiet der Kraft-Wärme-Kopplung erlassen werden.

Federal Law Gazette I No. 630/1994 Mineralölsteuergesetz 1995, zuletzt geändert durch das BGBl. I Nr. 105/2014.

Federal Law Gazette I No. 72/2014 Bundesgesetz über die Steigerung der Energieeffizienz bei Unternehmen und dem Bund (Bundes-Energieeffizienzgesetz – EEffG)

Federal Law Gazette I No. 72/2014 Energieeffizienzpaket des Bundes: Bundesgesetz, mit dem das Bundes-Energieeffizienzgesetz, das Bundesgesetz, mit dem der Betrieb von bestehenden hocheffizienten KWK-Anlagen über KWK-Punkte gesichert wird, und das Bundesgesetz, mit dem zusätzliche Mittel für Energieeffizienz bereitgestellt werden, erlassen sowie das Wärme- und Kälteleitungsausbaugesetz und das KWK-Gesetz geändert werden (Energieeffizienzpaket des Bundes).

Federal Law Gazette II No. 139/2007. Änderung der Verordnung über Verbote und Beschränkungen teilfluorierter und vollfluorierter Kohlenwasserstoffe sowie von Schwefelhexafluorid (HFKW-FKW-SF6-V), Vienna, 2007.

Federal Law Gazette II No. 301/2002 VOC-Anlagen-Verordnung – VAV: Verordnung des Bundesministers für Wirtschaft und Arbeit zur Umsetzung der Richtlinie 1999/13/EG über die Begrenzung der Emissionen bei der Verwendung organischer Lösungsmittel in gewerblichen Betriebsanlagen, Änderung der VOC-Anlagen-Verordnung – VAV, BGBl. II Nr. 42/2005.

Federal Law Gazette II No. 398/2012 Kraftstoffverordnung 2012: Verordnung des Bundesministers für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft über die Qualität von Kraftstoffen und die nachhaltige Verwendung von Biokraftstoffen (Kraftstoffverordnung 2012). Zuletzt geändert durch BGBl. I Nr. 259/2014.

Federal Law Gazette II No. 411/2005 HKW-Anlagen-Verordnung – HAV: Verordnung des Bundesministers für Wirtschaft und Arbeit über die Begrenzung der Emissionen bei der Verwendung halogenierter organischer Lösungsmittel in gewerblichen Betriebsanlagen.

Federal Law Gazette II No. 447/2002. Verordnung des Bundesministers für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft über Verbote und Beschränkungen teilfluorierter und vollfluorierter Kohlenwasserstoffe sowie von Schwefelhexafluorid (HFKW-FKW-SF6-V); Vienna, 2002.

Federal Law Gazette II No. 492/1991 i.d.F. No.398/2005 Lösemittelverordnung 2005 – LMV (implementation of Council Directive 2004/42/CE): Verordnung des Bundesministers für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft über die Begrenzung der Emissionen flüchtiger organischer Verbindungen durch Beschränkung des Inverkehrsetzens und der Verwendung organischer Lösungsmittel in bestimmten Farben und Lacken.

Federal Law Gazette II No. 39/2008: 39. Verordnung des Bundesministers für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft über Deponien (Deponieverordnung 2008).

Federal Law Gazette No. 164/1996 i.d.F. BGBl. II No.49/2004 Deponieverordnung: Verordnung des Bundesministers für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft über Deponien.

Federal Law Gazette No. 185/1993 i.d.F. 34/2008 Umweltförderungsgesetz UFG: Bundesgesetz über die Förderung von Maßnahmen in den Bereichen der Wasserwirtschaft, der Umwelt, der Altlastensanierung, zum Schutz der Umwelt im Ausland und über das österreichische JI/CDM-Programm für den Klimaschutz.

Federal Law Gazette No. 210/1992 i.d.F. 309/1994 Ozongesetz: Bundesgesetz über Maßnahmen zur Abwehr der Ozonbelastung und die Information der Bevölkerung über hohe Ozonbelastungen, mit dem das Smogalarmgesetz, BGBl. No. 38/1989, geändert wird.

Federal Law Gazette No. 299/1989 i.d.F. No.142/2000 und No.136/2004 Altlasten-sanierungsgesetz: Bundesgesetz vom 7. Juni 1989 zur Finanzierung und Durchführung der Altlastensanierung, mit dem das Umwelt- und Wasserwirtschaftsfonds-gesetz, BGBl. No.79/1987, das Wasserbautenförderungsgesetz, BGBl. No.148/1985, das Umweltfondsgesetz, BGBl. No.567/1983, und das Bundesgesetz vom 20. März 1985 über die Umweltkontrolle, BGBl. No.127/1985, geändert werden.

Federal Law Gazette No.865/1994 CKW-Anlagen-Verordnung 1994: Verordnung des Bundesministers für wirtschaftliche Angelegenheiten über die Begrenzung der Emission von chlorierten organischen Lösemitteln aus CKW-Anlagen in gewerblichen Betriebsanlagen.

IPCC 2006: 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Intergovernmental Panel on Climate change. Japan 2006.

Regulation (EC) No. 842/2006 of the European Parliament and of the Council of 17 May 2006 on certain fluorinated greenhouse gases.

ANNEX 1: INFORMATION EXTRACTED FROM THE REPORTING TEMPLATE

Emission Projections

Table 26: CO_2 emissions in 2015 and projections 2020–2035 (Umweltbundesamt).

CO_2 [kt]	2015	2020	2025	2030	2035
Total excluding LULUCF	**66 724**	**63 562**	**61 702**	**59 525**	**57 136**
Total including LULUCF	**61 744**	**55 697**	**53 493**	**54 825**	**52 151**
1. Energy	**52 198**	**50 145**	**48 339**	**46 215**	**43 735**
A. Fuel Combustion	51 984	49 937	48 200	46 118	43 696
1. Energy Industries	10 796	8 829	8 228	7 983	7 508
a. Public Electricity and Heat production	7 577	5 960	5 462	5 266	4 785
b. Petroleum Refining	2 804	2 695	2 634	2 585	2 590
c. Manufacture of Solid Fuels and Other Energy Industries	416	174	132	133	133
2. Manufacturing Industries and Construction	10 314	10 530	10 695	10 781	10 912
3. Transport	22 378	22 490	22 234	21 236	19 996
a. Domestic Aviation	50	48	49	52	55
b. Road Transportation	21 617	21 903	21 667	20 683	19 460
c. Railways	118	118	121	125	122
d. Domestic Navigation	11	12	11	11	11
e. Other Transportation	582	410	385	364	347
4. Other Sectors	8 446	8 040	6 994	6 066	5 226
a. Commercial/Institutional	1 838	1 840	1 467	1 178	954
b. Residential	5 804	5 371	4 687	4 036	3 399
c. Agriculture/Forestry/Fisheries	805	829	840	852	874
5. Other	49	48	49	51	54
B. Fugitive Emissions from Fuels	**214**	**208**	**139**	**97**	**39**
1. Solid Fuels	NA	NA	NA	NA	NA
2. Oil and Natural Gas	214	208	139	97	39
2. Industrial Processes & Product Use	**14 415**	**13 308**	**13 260**	**13 213**	**13 306**
A. Mineral Products	2 740	2 703	2 721	2 727	2 793
B. Chemical Industry	700	708	675	661	651
C. Metal Production	10 770	9 682	9 637	9 591	9 620
D. Non-energy products from fuels and solvent use	179	181	185	190	194
E. Electronics industry	NO	NO	NO	NO	NO
F. Product uses as substitutes for ODS	NO	NO	NO	NO	NO
G. Other product manufacture and use	27	34	41	45	47
3. Agriculture	**109**	**106**	**101**	**95**	**93**
4. Land Use, Land-Use Change and Forestry	**– 4 980**	**– 7 865**	**– 8 209**	**– 4 701**	**– 4 985**
5. Waste	**2**	**2**	**2**	**2**	**2**
C. Incineration and open burning of waste	2	2	2	2	2

Table 27: CH_4 emissions in 2015 and projections 2020–2035 (Umweltbundesamt).

CH_4 [kt]	**2015**	**2020**	**2025**	**2030**	**2035**
Total excluding LULUCF	**263.00**	**252.48**	**242.56**	**236.80**	**237.68**
Total including LULUCF	**263.96**	**253.43**	**243.52**	**237.76**	**238.63**
1. Energy	**22.41**	**20.55**	**17.71**	**15.84**	**13.91**
A. Fuel Combustion Activities	11.90	10.33	8.72	7.51	6.55
1. Energy Industries	1.02	0.93	0.90	0.84	0.77
2. Manufacturing Industries and Construction	0.88	0.87	0.89	0.91	0.93
3. Transport	0.35	0.29	0.24	0.19	0.15
4. Other Sectors	9.65	8.23	6.68	5.57	4.69
5. Other	0.00	0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	10.51	10.23	9.00	8.33	7.37
2. Industrial Processes & Product Use	**1.88**	**1.88**	**1.85**	**1.85**	**1.84**
B. Chemical Industry	1.88	1.88	1.85	1.85	1.84
3. Agriculture	**182.78**	**188.18**	**190.42**	**192.80**	**199.64**
A. Enteric Fermentation	165.23	167.14	168.56	170.10	175.70
1. Cattle	154.95	156.97	158.49	160.13	165.70
2. Sheep	2.83	2.57	2.27	1.97	1.96
3. Swine	4.27	4.51	4.81	5.10	5.16
4. Other	3.18	3.09	2.99	2.89	2.87
B. Manure Management	17.52	21.01	21.84	22.68	23.92
1. CH_4 Emissions	17.52	21.01	21.84	22.68	23.92
1. Cattle	13.45	16.75	17.38	18.04	19.25
2. Sheep	0.07	0.06	0.05	0.05	0.05
3. Swine	3.39	3.61	3.86	4.11	4.16
4. Other	0.62	0.59	0.54	0.49	0.47
5. Waste	**55.93**	**41.88**	**32.58**	**26.31**	**22.28**
A. Solid Waste Disposal	51.76	37.87	28.80	22.74	18.67
B. Biological Treatment of Solid Waste	3.24	3.04	2.79	2.57	2.59
C. Incineration and Open Burning of Waste	0.00	0.00	0.00	0.00	0.00
D. Waste Water Treatment and Discharge	0.93	0.97	0.99	1.01	1.02

Table 28: N_2O emissions in 2015 and projections 2020–2035 (Umweltbundesamt).

N_2O [kt]	**2015**	**2020**	**2025**	**2030**	**2035**
Total excluding LULUCF	**11.80**	**11.89**	**11.71**	**11.54**	**11.56**
Total including LULUCF	**11.64**	**12.21**	**11.99**	**11.78**	**11.75**
1. Energy	**1.99**	**1.91**	**1.90**	**1.88**	**1.86**
A. Fuel Combustion Activities	1.99	1.91	1.90	1.88	1.86
1. Energy Industries	0.35	0.30	0.28	0.26	0.23
2. Manufacturing Industries and Construction	0.44	0.42	0.42	0.44	0.45
3. Transport	0.67	0.71	0.74	0.76	0.77
4. Other Sectors	0.52	0.47	0.45	0.42	0.40
5. Other	0.00	0.00	0.00	0.00	0.00
2. Industrial Processes & Product Use	**0.61**	**0.61**	**0.58**	**0.56**	**0.55**
B. Chemical Industry	0.16	0.16	0.13	0.12	0.10
G. Other Product Manufacture and Use	0.45	0.45	0.45	0.45	0.45
3. Agriculture	**8.35**	**8.49**	**8.34**	**8.19**	**8.23**
B. Manure Management	1.47	1.53	1.54	1.55	1.59
2. N_2O Emissions	1.47	1.53	1.54	1.55	1.59
1. Cattle	0.89	1.00	1.00	1.01	1.05
2. Sheep	0.02	0.02	0.01	0.01	0.01
3. Swine	0.13	0.06	0.07	0.07	0.07
4. Other	0.05	0.05	0.05	0.05	0.05
5. Indirect N_2O Emissions	0.38	0.40	0.41	0.41	0.41
D. Agricultural Soils	6.88	6.96	6.80	6.64	6.64
1. Direct N_2O Emissions from Managed Soils	5.74	5.79	5.65	5.51	5.50
2. Indirect N_2O emissions from Managed Soils	1.14	1.17	1.15	1.13	1.14
5. Waste	**0.86**	**0.88**	**0.89**	**0.91**	**0.92**
B. Biological Treatment of Solid Waste	0.32	0.32	0.32	0.33	0.33
C. Incineration and Open Burning of Waste	0.00	0.00	0.00	0.00	0.00
D. Waste Water Treatment and Discharge	0.54	0.56	0.57	0.58	0.59

Table 29: HFC, PFC SF_6 and NF_3 emissions in 2015 and projections 2020–2035 (Umweltbundesamt).

HFC [kt CO_2e]	**2015**	**2020**	**2025**	**2030**	**2035**
Total	**1 662**	**1 442**	**1 127**	**659**	**490**
2. Industrial Processes & Product Use	**1 662**	**1 442**	**1 127**	**659**	**490**
E. Electronics Industry	2	3	3	3	4
F. Consumption of Halocarbons and SF_6	1 660	1 440	1 124	656	486
PFC [kt CO_2e]					
Total	**50**	**34**	**21**	**21**	**21**
2. Industrial Processes & Product Use	**50**	**34**	**21**	**21**	**21**
E. Electronics Industry	50	34	21	21	21
SF_6 [kt CO_2e]					
Total	**309**	**476**	**288**	**159**	**188**
2. Industrial Processes & Product Use	**309**	**476**	**288**	**159**	**188**
E. Electronics Industry	42	40	46	51	56
G. Other Product Manufacture and Use	265	434	240	106	130
NF_3 [kt CO_2e]					
Total	**13**	**23**	**32**	**42**	**52**
2. Industrial Processes & Product Use	**13**	**23**	**32**	**42**	**52**
E. Electronics Industry	13	23	32	42	52

Parameters for Projections

(according to Annex XII (Table 3) of the Commission Implementing Regulation (EU) No 749/2014)

Table 30: General parameters for projections (Umweltbundesamt).

		2015	2020	2025	2035	2035
Population	1 000	8 621	8 939	9 156	9 314	9 432
Gross domestic product (GDP): Real growth rate	%	1.0%	1.6%	1.6%	1.5%	1.6%
Gross domestic product (GDP): Constant prices	constant EUR million (2010 = t-10)	302 736	324 857	350 958	378 999	409 847
Gross value added (GVA) total industry	constant EUR million (2010 = t-10)	51 697	57 350	63 380	69 321	75 311
Exchange rates US DOLLAR, if applicable	USD/ currency	1.1	1.2	1.2	1.2	1.2
EU ETS carbon price	EUR/EUA	8	15	20	27	37
International (wholesale) fuel import prices: Electricity Coal	EUR/GJ	2	2	3	3	3
International (wholesale) fuel import prices: Crude Oil	EUR/GJ	8	12	14	15	16
International (wholesale) fuel import prices: Natural gas	EUR/GJ	6	8	8	9	10
Number of heating degree days (HDD)	Count	3 228	3 204	3 161	3 118	3 065
Number of cooling degree days (CDD)	Count	153	153	157	162	170
National retail fuel prices (with taxes included)						
Coal, industry	EUR/GJ	6	7	8	10	11
Coal, households	EUR/GJ	10	12	15	18	21
Heating oil, industry	EUR/GJ	12	15	18	20	23
Heating oil, households	EUR/GJ	19	23	27	31	34
Transport, gasoline	EUR/GJ	37	50	60	68	76
Transport, diesel	EUR/GJ	31	43	51	59	66
Natural gas, industry	EUR/GJ	10	12	14	16	19
Natural gas, households	EUR/GJ	19	23	27	31	36
National retail electricity prices (with taxes included)						
Industry	EUR/kWh	0.10	0.09	0.10	0.11	0.12
Households	EUR/kWh	0.19	0.17	0.19	0.21	0.24

Table 31: Parameters for projections – Energy sector: inland consumption, electricity generation and final energy consumption (Umweltbundesamt).

	2015	2020	2025	2030	2035
Gross inland (primary energy) consumption [PJ]	1 409	1 380	1 371	1 353	1 333
Coal	136	112	104	100	100
Oil	508	494	480	460	438
Natural gas	288	283	282	277	263
Renewables	411	446	462	472	481
Nuclear	NO	NO	NO	NO	NO
Other	67	46	43	43	50
Gross electricity production [TWh]	62	68	70	73	74
Coal	5,1	3,3	2,5	2,2	2,2
Oil	0,9	0,3	0,3	0,3	0,3
Natural gas	7,8	6,4	6,4	6,1	4,8
Renewables	47	57	60	63	66
Nuclear	NO	NO	NO	NO	NO
Other	0,8	0,9	0,9	0,9	0,9
Total net electricity imports	11	4	4	5	7
Final energy consumption [PJ]	1 087	1 090	1 087	1 074	1 059
Gross final energy consumption	1 170	1 181	1 178	1 165	1 150
Industry	300	301	308	312	317
Transport	403	401	403	400	394
Residential	255	267	257	247	235
Agriculture/Forestry	13	12	12	12	13
Services	115	108	106	103	100
Other	NO	NO	NO	NO	NO

Table 32: Parameters for projections – transport, building, agriculture and waste (Umweltbundesamt).

		2015	2020	2025	2030	2035
Assumptions for the Transport sector						
Number of passenger-kilometres (all modes)	million pkm	115 822	119 191	122 905	126 680	131 132
Freight transport tonnes-kilometres (all modes)	million tkm	170 813	171 469	185 693	201 700	216 376
Final energy demand for road transport	TJ	322 362	324 489	321 966	309 427	292 754
Buildings parameters						
Number of households	1 000	4 197	4 438	4 624	4 776	4 908
Household size	inhabitants/household	2.05	2.01	1.98	1.95	1.92
Assumptions for the Agriculture sector						
Livestock: Dairy cattle	1 000 heads	534	538	553	569	593
Livestock: Non-dairy cattle	1 000 heads	1 424	1 387	1 315	1 243	1 271
Livestock: Sheep	1 000 heads	354	321	284	246	245
Livestock Pig	1 000 heads	2 845	3 008	3 204	3 401	3 439
Livestock: Poultry	1 000 heads	15 772	14 563	12 549	10 535	9 853
Nitrogen input from application of synthetic fertilizers	kt nitrogen	121	119	109	99	94
Nitrogen input from application of manure	kt nitrogen	132	132	135	137	141
Nitrogen fixed by N-fixing crops	kt nitrogen	IE	IE	IE	IE	IE
Nitrogen in crop residues returned to soils	kt nitrogen	75	80	79	78	78
Area of cultivated organic soils	ha	12 954	12 954	12 954	12 954	12 954
Waste parameters						
Municipal solid waste (MSW) generation	tonne MSW	NA	NA	NA	NA	NA
Municipal solid waste (MSW) going to landfills	tonne MSW	131 959	134 756	118 702	118 702	118 702
Share of CH_4 recovery in total CH_4 generation from landfills	%	8.3%	6.7%	5.1%	3.5%	1.9%

Policies and Measures

The following three tables are an excerpt from the information required according to Annex XI of the Implementing Regulation 749/2014.

Table 33: Policies & Measures I (Umweltbundesamt).

N°	Name of policy or measure	Sector(s) affected	GHG(s) affected	Type of instrument	Scenario	Reponsible Entity
1	EU Emission Trading Scheme (ETS)	CC	CO_2, N_2O	Reg, Ec	WEM	Ngov
2	Domestic Environmental Support Scheme	CC	CO_2, CH_4, N_2O	Ec	WEM	Ngov
3	Austrian Climate and Energy Fund (KLI.EN)	CC	CO_2	Ec, Res	WEM	Ngov
4	Increase the share of renewable energy in power supply and district heating	EnS	CO_2	Reg, Ec,	WEM	Ngov
5	Increase energy efficiency in energy and manufacturing industries	EnC, EnS	CO_2	Pl, Ec, Reg	WEM	Ngov, Reg
6	Increase the share of clean energy sources in road transport	Tra	CO_2	Reg, Ec,	WEM	Ngov
7	Increase fuel efficiency in road transport	Tra	CO_2	Fi, Inf, Reg, Ec	WEM	Ngov, Reg
8	Modal shift to environmentally friendly transport modes	Tra	CO_2	Inf, Ec	WEM	Ngov
9	Increased energy efficiency of buildings	EnC	CO_2	Reg, Ec, Inf	WEM	Ngov, Reg
10	Increased share of renewable energy for space heating	EnC, EnS	CO_2	Ec, Reg	WEM	Ngov, Reg
11	Increased energy efficiency in residential electricity demand	EnC	CO_2	Reg, Inf	WEM	Ngov, Reg
12	Decrease emissions from F-gases and other product use	IP	HFC, PFC, SF_6, NF_3	Reg	WEM	Ngov
13	Implementation of EU agricultural policies	Ag	CH_4, N_2O	Reg, Ec	WEM	Ngov, Reg
14	Sustainable Forest management	For/LULUCF	CO_2	Reg	WEM	Ngov, Reg
15	Reduce emissions from waste treatment	Wa	CH_4, N_2O	Reg	WEM	Ngov, Reg

CC = cross-cutting, EnS = Energy Supply, EnC = Energy Consumption, Tra = Transport, IP = Industrial processes and Prodcut Use, Ag = Agriculture, Wa = waste management

WEM = with existing measures, WAM = with additional measures

Ec = Economic, Fi = Fiscal, Vo = Voluntary, Reg =regulatory, Inf = Information, Edu = Education, Res = Research, P = Planning, O = Other

Ngov = National/federal government (responsible ministries / departments), Reg = Regional entities/federal provinces, Loc = Local government, Co = Companies / businesses / industrial associations, Res = Research institutions

Table 34: Policies & Measures II (Umweltbundesamt).

N°	Name of policy or measure	Objective	Short Description
1	EU Emission Trading Scheme (ETS)	framework policy multi-sectoral policy	The objective is to limit the CO_2 emission from the energy industries, manufacturing industries and from industrial processes, as well as N_2O emissions from the chemical industry and CO_2 emissions from aircraft operators through the EU-wide trading mechanism for emission allowances.
2	Domestic Environmental Support Scheme	framework policy multi-sectoral policy	The Domestic Environmental Support Scheme provides financial support to projects which improve environmental performance beyond mandatory standards in the energy, manufacturing as well as service industry. The Ministry of Agriculture, Forestry, Environment and Water Management puts the focus of its funding policy on climate change. Most projects are targeted at efficient energy use (about 60%) and renewable energy (about 39%).
3	Austrian Climate and Energy Fund (KLI.EN)	framework policy multi-sectoral policy	In 2007, the Federal Government established a specific fund (Climate and En-ergy Fund – KLI.EN) in order to support the reduction of GHGs in Austria in the short, medium and long term (Federal Law Gazette I No. 40/2007). It focuses on research in and development of renewable energy systems, development and testing of new transport and mobility systems and market penetration of sustainable energy technologies – ranging from basic and applied research to subsidies for the implementation of climate friendly technology (KLIEN 2017). Support is provided to companies, research institutions or municipalities as well as to individuals, depending on the respective programme.
4	Increase the share of renewable energy in power supply and district heating	increase in renewable energy	Beyond the traditional use of large-scale hydro power for electricity generation, quantitative targets have been set for the increase of the share of wind power, photovoltaics, small hydro plants and biomass/biogas in electricity generation in the Green Electricity Act and shall be achieved by fixed feed-in tariffs.
5	Increase energy efficiency in energy and manufacturing industries	efficiency improvements: ● of buildings ● of appliances ● in services/tertiary sector ● in industrial end-use sectors ● in the energy and transformation sector	Based on EU legislation, Austria has implemented the Energy efficiency Directive (2012/27/EU) and prepared its National Energy Efficiency Action Plan in 2014 with quantitative targets for final and primary energy consumption in 2020. In addition, financial support for cogeneration of power and heat is granted in order to improve the efficient use of primary energy for electricity production.
6	Increase share of clean energy sources in road transport	low carbon fuels/electric cars	The EU Directive on the promotion of renewable energy sources requires Member States to replace at least 10% of the fuels used in transport by renewables (biofuels and electricity from renewable energy sources) by 2020. The Austrian Fuel Ordinance stipulates minimum targets for the share of biofuels (fatty-acid methyl ester and ethanol) in diesel and gasoline sold in Austria. The national Implementation Plan for electric mobility, a joint initiative of three federal ministries, aims at a (moderate) electrification of road transport; funding instruments are used to increase the share of electric vehicles and plug-in hybrid vehicles from less than 0.1% in 2013 to about 1% of the fleet in 2020.
7	Increase fuel efficiency in road transport	efficiency improvements of vehicles improved behaviour	Several instruments, including taxes and tolls along with awareness raising and training, have been implemented to improve the fuel efficiency of the fleet. The mineral oil tax and the fuel consumption based car registration tax are expected to promote the sales of cars with lower fuel consumption. Awareness raising and training programmes for fuel-efficient driving improve the performance of drivers. Other instruments like speed limits, established in response to other environmental concerns, contribute to reduced fuel consumption.

N°	Name of policy or measure	Objective	Short Description
8	Modal shift to environmentally friendly transport modes	modal shift to public transport or non-motorized transport	Besides considerable investments in railway infrastructure in the last decade, the programme 'klimaaktiv mobil' for mobility management and awareness raising is an essential tool to promote environmentally friendly transport modes like public transport, cycling and walking. The cornerstones of 'klimaaktiv mobil' are the funding programme for businesses, communities and associations, target group-oriented counselling programmes, awareness-raising initiatives, partnerships, and training and certification initiatives. With respect to freight transport, investment support for corporate feeder lines aims at shifting transport activities from road to rail.
9	Increased energy efficiency of buildings	• efficiency improvements of buildings	Tightening of mandatory construction standards ensures that new buildings show improved energy performance and will come close to a 'zero energy' standard in the future. Housing support funding is granted for the construction of buildings with advanced energy efficiency only, and support for the thermal renovation of buildings is provided within several programmes. Improvements of the efficiency of new boilers result from mandatory requirements at national level and eco-design standards at Union level. Furthermore, energy performance certificates have to be provided by sellers and landlords in the course of real estate transactions or renting.
10	Increased share of renewable energy for space heating	• efficiency improvements of buildings • increase in renewable energy	Awareness raising measures on federal (klimaaktiv programme) and on Länder level on the advantages of modern heating systems are expected to increase the boiler exchange rate. Financial support for biomass and solar heating systems is provided for households via funding of the Länder and of the Austrian Climate and Energy Fund, support for commercial and industrial applications by the Domestic Environment Support Scheme. The District Heating and Cooling Act aims at the construction of district cooling systems in order to reduce electricity demand, as well as at the expansion of district heating networks; subsidies are provided for that purpose.
11	Increased energy efficiency in residential electricity demand	• efficiency improvement of appliances • efficiency improvement in services/tertiary sector	Especially the eco-design requirements (Directive 2006/32/EC) for energy using products and the mandatory labelling of household appliances according to energy consumption, supported by awareness raising measures at national level with respect to energy efficient products and by advice provided by regional energy agencies. Furthermore, the national implementation of the Energy Efficiency Directive (2012/27/EU) is considered.
12	Decrease emissions from F-gases and other product use	• reduction of emissions of fluorinated gases • installation of abatement technologies	This measure includes: • prohibition and restriction of the use of (partly) fluorinated hydrocarbons and SF6 through a national law (Industriegasverordnung) • quota system for production and import of F-gases (Implementation of EU law) • Reducing HFC emissions from air conditioning in motor vehicles (Implementation of EU law) • Reduction of F-gases in stationary applications • Limitation of VOC emissions from the use of organic solvents in industrial installations (Implementation of EU law)
13	Implementation of EU agricultural policies	• reduction of fertilizer/manure use on cropland • other activities improving cropland management • improved livestock management • improved animal waste management systems • activities improving grazing land or grassland management	This measure summarises the implementation of the programme for rural development 2014–2020 and the implementation of the Common agricultural policy (CAP). Herein measures such as improved feeding of pigs and poultry, covering of manure storage, low-loss application of manure and biogas slurry, promotion of organic farming, reduced usage of mineral fertiliser and promotion of grazing are summarised.

N°	Name of policy or measure	Objective	Short Description
14	Sustainable Forest management	enhanced forest management	The overall principles of forest management in Austria are stipulated in the Forest Act and include a wide-range of forest related measures: Guiding Principles of Forest Management, General ban on forest clearance/Deforestation, General ban on Forest Destruction, Immediate Re/Afforestation after felling, Forest Litter removal, Forest Protection (from Fires and Pests), Provisions on Harvest haulage & Forest Roads, Sustainable Use of Forests, Austrian Forest Dialogue, Forest Cooperatives, Task Force Renewable Energy, Protection of Wetlands
15	Reduce emissions from waste treatment	improved treatment technologies reduced landfilling	To reduce emissions from waste treatment, deposition of untreated biodegradable waste has been banned completely (Austrian Landfill Ordinance). Ac-cording to this Ordinance, no untreated biodegradable waste has been allowed on landfills since 2004, with no exemptions permitted since 2008. Methane emissions from mass landfills are reduced by the mandatory collection and use of landfill gas. The carbon content of waste is reduced by incineration or mechanical-biological treatment before deposition (pre-treatment options). Due to their size, more than half of existing mechanical-biological treatment plants fall under the scope of the EU Industrial Emissions Directive, under which emission have to be limited according to BAT provisions. In order to minimise the generation of waste, awareness raising campaigns and networks have been established to minimise especially food waste and to intensify the re-use of waste.

Table 35: Policies & Measures III (Umweltbundesamt).

N°	Name of policy or measure	Implementation status	Relevant EU Policy
1	EU Emission Trading Scheme (ETS)	implemented	• EU ETS directive 2003/87/EC as amended by Directive 2008/101/EC and Directive 2009/29/EC and implementing legislation, in particular 2010/2/EU, 2011/278/EU and 2011/638/EU
2	Domestic Environmental Support Scheme	implemented	national policy
3	Austrian Climate and Energy Fund (KLI.EN)	implemented	national policy
4	Increase the share of renewable energy in power supply and district heating	implemented	• RES Directive 2009/28/EC • Directive 2006/32/EC on end-use energy efficiency and energy services • Completion of the internal energy market (including provisions of the 3d package)
5	Increase energy efficiency in energy and manufacturing industries	implemented	• Energy Efficiency Directive 2012/27/EU • Completion of the internal energy market (including provisions of the 3d package) • Cogeneration Directive 2004/8/EC
6	Increase share of clean energy sources in road transport	implemented	• Biofuels Directive 2003/30/EC
7	Increase fuel efficiency in road transport	implemented	• Energy Taxation Directive 2003/96/EC • Taxation of heavy goods vehicles 2006/38/EC
8	Modal shift to environmentally friendly transport modes	implemented	national policy
9	Increased energy efficiency of buildings	implemented	• Recast of the Energy Performance of Buildings Directive (Directive 2010/31/EU)
10	Increased share of renewable energy for space heating	implemented	national policy

N°	Name of policy or measure	Implementation status	Relevant EU Policy
11	Increased energy efficiency in residential electricity demand	implemented	• Eco-design framework directive 2005/32/EC and its implementing regulations, combined with Labelling Directive 2003/66/EC and 2010/30/EC, including implementing measures • Energy Efficiency Directive 2012/27/EU
12	Decrease emissions from F-gases and other product use	implemented	• F-gas Regulation 2006/842/EC • F-gas Regulation 517/2014 • Motor Vehicles Directive 2006/40/EC • Industrial emissions Directive 2010/75/EU (Recast of IPPC Directive 2008/1/EC and Large Combustion Plant Directive 2001/80/EC)
13	Implementation of EU agricultural policies	implemented	• CAP Reform 2013 regulations: Rural Development (1305/2013), 'Horizontal' issues (1306/2013), Direct payments (1307/2013) and Market measures (1308/2013)
14	Sustainable Forest management	implemented	• LULUCF Decision No 529/2013/EU
15	Reduce emissions from waste treatment	implemented	• Landfill Directive 1999/31/EC • Industrial emissions Directive 2010/75/EU (Recast of IPPC Directive 2008/1/EC and Large Combustion Plant Directive 2001/80/EC)

ANNEX 2: ADDITIONAL KEY PARAMETERS FOR SECTORAL SCENARIOS

Energy Industries

Energy [TJ]	2015	2020	2025	2030	2035
Bituminous Coal and Anthracite	22 630	9 367	2 499	0	0
Residual Fuel Oil	3 174	0	0	0	0
Natural gas	61 458	65 808	68 406	69 078	60 401
Waste	15 762	16 592	16 592	16 592	16 592
Biomass	69 884	58 733	55 764	49 317	42 442
Hydropower	131 677	156 958	156 958	156 958	156 958
Wind power	17 425	25 194	25 805	25 813	26 414
Photovoltaics	3 374	9 339	20 823	32 724	41 652
Geothermal	591	1 028	1 447	1 699	2 775

Table 36: Projected fuel input into main activity power and heat plants (Umweltbundesamt).

Manufacturing Industries and Construction

Energy [TJ]	2015	2020	2025	2030	2035
Bituminous Coal and Anthracite	20 931	20 593	20 361	20 147	20 114
Residual Fuel Oil	7 434	6 666	6 167	5 724	5 424
Natural gas	10 558	12 103	12 418	12 508	12 607
Waste	3 694	3 733	3 733	3 733	3 733
Biomass	21 018	22 006	22 472	22 944	23 463
Hydropower	1 945	1 655	1 547	1 415	1 307
Wind power	0	0	0	0	0
Photovoltaics	0	0	0	0	0
Geothermal	166	154	144	128	109

Table 37: Projected fuel input into autoproducer power and heat plants (Umweltbundesamt).

Energy [TJ]	2015	2020	2025	2030	2035
Coal without coke	6 267	5 898	5 700	5 465	5 280
Coke	6 753	6 163	6 129	6 095	6 069
Light Fuel Oil	2 246	2 091	1 983	1 876	1 781
Heavy Fuel Oil	5 089	4 575	4 270	3 962	3 692
Other petr. Products	16 555	15 807	15 380	14 987	14 673
Natural gas	104 798	105 017	107 320	108 519	109 780
Derived gas	3 621	3 863	3 867	3 871	3 915
Waste	10 858	10 880	11 166	11 351	11 668
Biomass	46 913	49 345	52 588	55 688	59 028
Electricity	98 018	97 877	99 510	100 147	100 681
Heat	12 656	12 718	12 895	12 897	12 804

Table 38: Final energy demand of industry (Umweltbundesamt).

Transport

Table 39: Energy consumption of mobile sources by fuel (Umweltbundesamt).

Energy [TJ]	2015	2020	2025	2030	2035
Gasoline fossil	65 348	67 473	61 408	50 362	39 580
Diesel fossil	231 662	261 010	265 426	264 426	260 097
Bioethanol	2 506	920	820	705	671
Biodiesel	15 344	21 461	21 637	21 118	20 104
Vegetable oil	4 027	3 497	3 478	3 351	3 190
BIO ETBE	344	1 441	1 283	1 104	1 051
LPG	618	279	0	0	0
Natural gas	725	184	239	279	266
Biogas	35	0	0	0	0
H2	0	0	0	0	0
Coal	5	4	4	3	3
Electricity rail	5 771	7 635	8 160	8 734	8 976
Electricity passenger cars	91	716	4 634	12 042	20 506
Aviation jet fuel	30 463	29 637	30 227	31 894	33 789

Residential, Commercial & Other Sectors

Table 40: Final energy demand of households and commercial (Umweltbundesamt).

Energy [TJ]	2015	2020	2025	2030	2035
Coal without coke	667	924	615	480	486
Coke	533	0	0	0	0
Light Fuel Oil	47 274	43 598	33 147	25 250	18 775
Heavy Fuel Oil	1 250	3	3	3	2
Other petr. Products	1 944	100	93	88	86
Natural gas	66 030	67 792	63 341	57 251	50 410
Waste	24	0	0	0	0
Biomass	78 004	74 332	72 586	70 091	67 621
Electricity	109 715	110 041	110 237	110 570	111 638
Heat	79 200	86 438	95 516	98 131	98 950

Table 41: Assumptions for energy prices (Umweltbundesamt).

Price, real [€/MWh]	2015	2020	2025	2030	2035
natural gas	78	90	95	101	106
heating and other gas oil	65	82	89	96	99
coal	37	41	46	51	53
electricity	180	180	192	202	208
wood log and wood briquettes	36	44	46	49	50
wood chips	31	38	40	42	43
wood pellets	46	55	58	61	63
district heat	58	66	70	74	76

Table 42: Assumptions on subsidy rates (Umweltbundesamt).

Subsidy rates [%]	2015	2020	2025	2030	2035
wood log and wood briquettes	20	20	20	20	20
wood chips	20	20	20	20	20
wood pellets	23	23	23	23	23
distr. heat Vienna	15	15	15	15	15
distr. heat Other	15	15	15	15	15
distr. heat biomass	23	23	23	23	23
heat pump	5–15	5–15	5–15	5–15	5–15
solar heat	20–25	20–25	20–25	20–25	20–25

Table 43: Assumptions for the number and size of buildings, and the number of permanently occupied dwellings (Umweltbundesamt).

Number of buildings		**2015**	**2020**	**2025**	**2030**	**2035**
residential buildings	[number in 1 000]	1 886	1 975	2 038	2 086	2 120
residential buildings with one or two apartments	[number in 1 000]	1 640	1 714	1 766	1 806	1 833
residential buildings with more than two apartments	[number in 1 000]	247	260	271	280	287
commercial buildings	[number in 1 000]	145	149	154	159	165
Size of buildings		**2015**	**2020**	**2025**	**2030**	**2035**
residential buildings	[million m² gross floor area]	491	519	539	556	569
residential buildings with one or two apartments	[million m² gross floor area]	280	294	305	313	320
residential buildings with more than two apartments	[million m² gross floor area]	211	224	234	243	250
commercial buildings	[million m² gross floor area]	146	151	156	161	167
Number of dwellings		**2015**	**2020**	**2025**	**2030**	**2035**
Permanently occupied dwellings	[number in 1 000]	3 803	3 995	4 139	4 252	4 341

Table 44: Final energy demand for heating, renovation rates and boiler exchange rates (Umweltbundesamt).

Final energy demand for heating (average)*		**2015**	**2020**	**2025**	**2030**	**2035**
residential buildings	[kWh/m².a]	133	120	110	100	92
commercial buildings	[kWh/m².a]	148	136	122	109	97
renovation rate**	**[%]**					
residential buildings with one or two apartments		1.0	1.3	1.1	1.2	1.1
residential buildings with more than two apartments		0.9	1.1	0.9	1.0	0.9
commercial buildings		0.9	1.2	1.2	1.2	1.1
boiler exchange rate***	**[%]**					
residential buildings with one or two apartments		2.3	4.1	3.6	3.4	3.1
residential buildings with more than two apartments		1.6	2.7	2.5	2.6	2.7
commercial buildings		1.4	3.2	3.2	2.8	2.5

** m² gross floor space*

*** proportion of gross floor space of the actual year in which the measures expressed in full renovation equivalents are performed*

**** proportion of gross floor space of the actual year in which the boiler exchange is performed*

Fugitive Emissions from Fuels

Table 45: Fugitive activities 2015 and scenario (2020–2035) for calculation of fugitive emissions (Umweltbundesamt).

price, real [€/MWh]	2015	2020	2025	2030	2035
Gas pipeline length [km]	7 242	7 599	7 922	8 245	8 568
Gas distribution network [km]	30 067	31 402	32 736	34 070	35 405
Natural gas production [million m³]	1 197	1 126	745	516	203
Refinery crude oil input [PJ]	378	349	341	335	335
Natural gas storage capacities [Mio m³]	5 317	5 700	5 700	5 700	5 700

Agriculture

Table 46: Livestock population cattle 2015 and projections 2020–2035 (Umweltbundesamt).

Year	Population size [heads]	
	Dairy (WEM)	Non-Dairy (WEM)
2015	534 098	1 423 512
2020	537 697	1 387 392
2025	553 208	1 315 418
2030	568 719	1 243 445
2035	592 846	1 270 892

Table 47: Livestock population other animals 2015 and projections 2020–2035 (Umweltbundesamt).

	Population size [heads]					
Year	Swine	Sheep	Goats	Poultry	Horses	Other
2010	3 134 156	358 415	71 768	14 644 413	106 280	47 575
2015	2 845 451	353 710	76 620	15 771 551	120 000	41 812
2020	3 008 005	321 060	68 772	14 563 319	120 000	38 498
2025	3 204 332	283 712	61 103	12 549 183	120 000	35 736
2030	3 400 660	246 365	53 435	10 535 048	120 000	32 973
2035	3 439 307	245 362	51 932	9 853 279	120 000	33 177

Table 48: Milk production and mineral fertiliser use for 2015 and projections (2020–2035) (Umweltbundesamt)..

Ø milk yield per dairy cow (kg/yr)					
year	2015	2020	2025	2030	2035
Ø milk yield per dairy cow (kg/yr)	6.579	7 051	7 511	7 971	8 048
Mineral fertiliser use (t/year)	120 934	119 304	109 355	99 405	94 286

ANNEX 3: NOTATION KEYS

In the following section the use of the notation key 'IE' within the submitted 'MM Article 23 Reporting on projections' template and XML data is explained.

1B/1B2 (N_2O): allocated to 1 A 1 c Petroleum Refining

2C (CH_4, N_2O): allocated to 1 A 2 a Iron and Steel

4C (N_2O): allocated to 3 D Agriculture

ENVIRONMENT AGENCY AUSTRIA umweltbundesamt

Umweltbundesamt GmbH
Spittelauer Lände 5
1090 Wien/Österreich

Tel.: +43-(0)1-313 04
Fax: +43-(0)1-313 04/5400

office@umweltbundesamt.at
www.umweltbundesamt.at

This report covers the results for projections of the air pollutants sulphur dioxide (SO_2), nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOC), ammonia (NH_3) and particulate matter ($PM_{2.5}$) under the scenario "with existing measures" (WEM). It updates the previous projections for air pollutants published in 2015 (REP-0556).

The WEM scenario results in significant reductions in emissions from 2005 to 2030 for all pollutants except NH_3. The most substantial reduction (about 66%) is projected for the pollutant NO_x. Emission reductions for the other pollutants range from 24% to 48 %; NH_3 emissions, however, are projected to increase by 8%.

EMAS
Geprüftes Umweltmanagement
REG.NO. AT- 000484

ISBN 978-3-99004-424-7