ENVIRONMENT AGENCY AUSTRIA umweltbundesamt

GHG Projections and Assessment of Policies and Measures in Austria

Reporting under Regulation (EU) 525/2013, 15 March 2019

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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 1 January 2018. The status and current implementation of the measures have been defined at expert level in consultation with the Federal Ministry of Sustainability and Tourism.

Currently – at the beginning of the year 2019 – the national climate and energy strategy is still in preparation. A clear picture of planned measures cannot be anticipated before the negotiations between stakeholders have been completed. For this reason, a scenario 'with additional measures' has not been prepared for the submission in March 2019.

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

PREAMBLE ... 3

SUMMARY ... 9

1 **GENERAL APPROACH** ... 12
1.1 **Guidelines and Provisions** ... 12
1.2 **Quality Assurance & Control** ... 12
1.3 **Description of General Methodology** ... 13
1.3.1 Database and Historical Emission Data ... 13
1.3.2 Emission projections ... 13
1.3.3 Underlying Models and Measures ... 14
1.3.4 Key Underlying Assumptions ... 15
1.4 **Sensitivity Analysis** ... 15
1.5 **Uncertainty in Projections** ... 18

2 **SECTORAL SCENARIO RESULTS** ... 22
2.1 **Energy (CRF Category 1)** ... 22
2.1.1 Energy industries (1.A.1) ... 22
2.1.2 Manufacturing industries and construction (1.A.2) ... 23
2.1.3 Transport (1.A.3) ... 24
2.1.4 Other Sectors & Other (1.A.4 & 1.A.5) ... 25
2.1.5 Fugitive emissions (1.B) ... 26
2.2 **Industrial Processes & Product Use (CRF Category 2)** ... 27
2.3 **Agriculture (CRF Category 3)** ... 29
2.4 **LULUCF (CRF Category 4)** ... 30
2.5 **Waste (CRF Category 5)** ... 31

3 **SECTORAL METHODOLOGY** ... 32
3.1 **Energy (CRF Source Category 1)** ... 32
3.1.1 Energy Industries (1.A.1) ... 33
3.1.2 Manufacturing Industries and Construction (1.A.2) ... 35
3.1.3 Transport (CRF Source Category 1.A.3) ... 36
3.1.4 Other Sectors (CRF Source Category 1.A.4) ... 45
3.1.5 Other (1.A.5) ... 49
3.1.6 Fugitive Emissions from Fuels (1.B) ... 50
3.2 **Industrial Processes & Product Use (CRF Category 2)** ... 51
3.2.1 Mineral, Chemical and Metal Industry (2.A, 2.B, 2.C) ... 52
3.2.2 Fluorinated Gases (2.E, 2.F, 2.G) ... 54
3.2.3 Solvent and Other Product Use (2.D & 2.G) ... 56
3.3 **Agriculture (CRF Source Category 3)** ... 59
3.3.1 Sector Overview ... 59
3.3.2 Methodology used for the sectoral scenarios ... 60

3.4 Land Use, Land-Use Change and Forestry (CRF Source Category 4) 63
3.4.1 Forest (4.A) and HWP (4.G) 63
3.4.2 Non-forest categories (4.B-4.F) 64
3.5 Waste (CRF Source Category 5) 66
3.5.1 Solid Waste Disposal (5.A) 66
3.5.2 Biological Treatment of Solid Waste (5.B) 68
3.5.3 Incineration and Open Burning of Waste (5.C) 69
3.5.4 Waste Water Treatment and Discharge (5.D) 70

4 POLICIES & MEASURES 72
4.1 The framework for Austria's climate policy 72
4.2 Sectoral methodologies 74
4.3 Cross-cutting measures 75
4.3.1 PaM N°1: EU Emission Trading Scheme (ETS) 75
4.3.2 PaM N°2: Domestic Environmental Support Scheme (Umweltförderungsgesetz) 77
4.3.3 PaM N°3: Austrian Climate and Energy Fund (KLI.EN) 77
4.4 Energy Industries (CRF 1.A.1) and Manufacturing Industries and Construction (1.A.2) 78
4.4.1 WEM measures for Energy/Industry 78
4.5 Transport (CRF Source Category 1.A.3) 82
4.5.1 WEM measures for Transport 82
4.6 Other sectors (1.A.4) – Buildings 89
4.6.1 WEM measures for other sectors (1.A.4) 89
4.7 Fugitive Emissions from Fuels (CRF Source Category 1.B) 99
4.8 Industrial Processes and Product Use (CRF Source Category 2) 99
4.8.1 WEM measures for industrial processes and Product Use 99
4.9 Agriculture (CRF Source Category 3) 102
4.9.1 WEM measures for agriculture 102
4.10 Land use, Land-Use Change and Forestry (CRF Source Category 4) 103
4.10.1 WEM measures for LULUCF 103
4.11 Waste (CRF Source Category 5) 105
4.11.1 WEM measures for waste 106

5 CHANGES WITH RESPECT TO SUBMISSION 2017 108
5.1 Energy Industries (1.A.1) 108
5.2 Manufacturing Industries and Construction (1.A.2) & Industrial Processes & Product Use (2) 109
5.3 Transport (CRF Source Category 1.A.3) 110
5.4 Other Sectors (CRF Source Category 1.A.4 & 1.A.5) 111
5.5 Fugitive Emissions from Fuels (1.B) 112
5.6 Agriculture (3) 112

5.7 LULUCF (CRF Source Category 4) ... 113
5.8 Waste (CRF Source Category 5) ... 114
6 ABBREVIATIONS ... 115
7 REFERENCES ... 117
ANNEX 1: INFORMATION EXTRACTED FROM THE REPORTING TEMPLATE ... 126
Emission Projections ... 126
Parameters for Projections ... 130
Policies and Measures ... 133
ANNEX 2: ADDITIONAL KEY PARAMETERS FOR SECTORAL SCENARIOS ... 138
Energy Industries ... 138
Manufacturing Industries and Construction ... 138
Transport ... 139
Residential, Commercial & Other Sectors ... 139
Fugitive Emissions from Fuels ... 141
Agriculture ... 141
ANNEX 3: USE OF NOTATION KEY "IE" ... 142

SUMMARY

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

Total GHG emissions

The trend of GHG without LULUCF shows an increase of 4.6% from 1990 to 2017 and a decrease of 8.1% from 1990 to 2035 in the 'with existing measures' (WEM) scenario, i.e. from 78.7 Mt of CO_2 equivalent in 1990 to 82.3 in 2017 and to 72.3 Mt of 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**	**2017**	**2020**	**2025**	**2030**	**2035**
Total (without LULUCF)	78 670	92 567	84 753	78 897	82 261	79 669	76 637	73 961	72 298
1 Energy	52 946	67 138	59 563	53 409	56 272	54 930	52 886	50 757	49 224
2 Industrial Processes	13 662	15 600	15 930	16 602	17 197	15 978	15 136	14 657	14 526
3 Agriculture	8 137	7 038	7 103	7 249	7 308	7 467	7 546	7 626	7 722
5 Waste	3 925	2 791	2 158	1 638	1 484	1 294	1 069	921	827

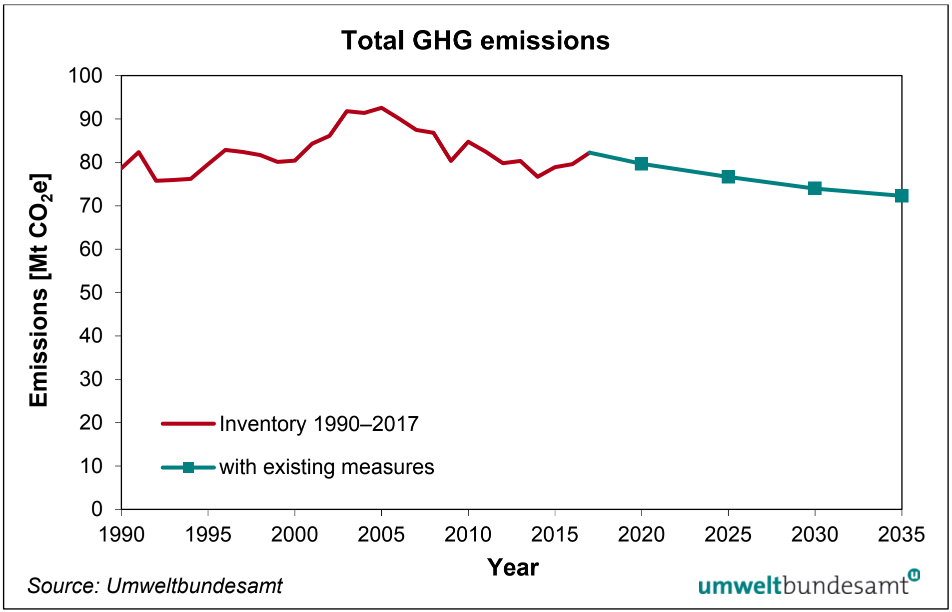


Figure 1: Past trend and scenario (2020–2035): total GHG emissions (without LULUCF).

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**	**2017**	**2020**	**2025**	**2030**	**2035**
CO_2	62 323	79 395	72 228	66 733	69 979	67 773	65 504	63 421	61 928
CH_4	10 363	7 748	7 256	6 678	6 597	6 428	6 210	6 087	6 022
N_2O	4 329	3 590	3 366	3 498	3 505	3 598	3 595	3 598	3 613
F-Gases	1 656	1 833	1 904	1 988	2 180	1 871	1 327	856	735
Total	**78 670**	**92 567**	**84 753**	**78 897**	**82 261**	**79 669**	**76 637**	**73 961**	**72 298**

The WEM scenario predicts a decrease in total GHG emissions by 12% or 10.0 Mt of CO_2 equivalent between 2017 and 2035.

This change is mainly driven by a decrease in the Energy (minus 13% or 7.0 Mt of CO_2 equivalent) and Industrial Processes sector (minus 16% or 2.7 Mt of CO_2 equivalent). Emissions from the Agricultural sector are forecast to increase by 5.7% or 0.4 Mt of CO_2 equivalent. Emissions in the Waste sector are forecast to decrease by 44% or 0.7 Mt of CO_2 equivalent.

In the Energy sector emissions from the sub-sector 1.A.1 Energy Industries are forecast to decrease by 9% or 4.4 Mt of CO_2 equivalent and in 1.A.2 Manufacturing Industries and Construction emissions are forecast to increase by 13% or 1.5 Mt of CO_2 equivalent.

Emissions from the sub-sector 1.A.3 Transport are forecast to decrease by 5.8% or 1.4 Mt of CO_2 equivalent between 2017 and 2035, and emissions from the sub-sector 1.A.4 and 1.A.5 'Other sectors' are forecast to decrease by 27% or 2.5 Mt of CO_2 equivalent.

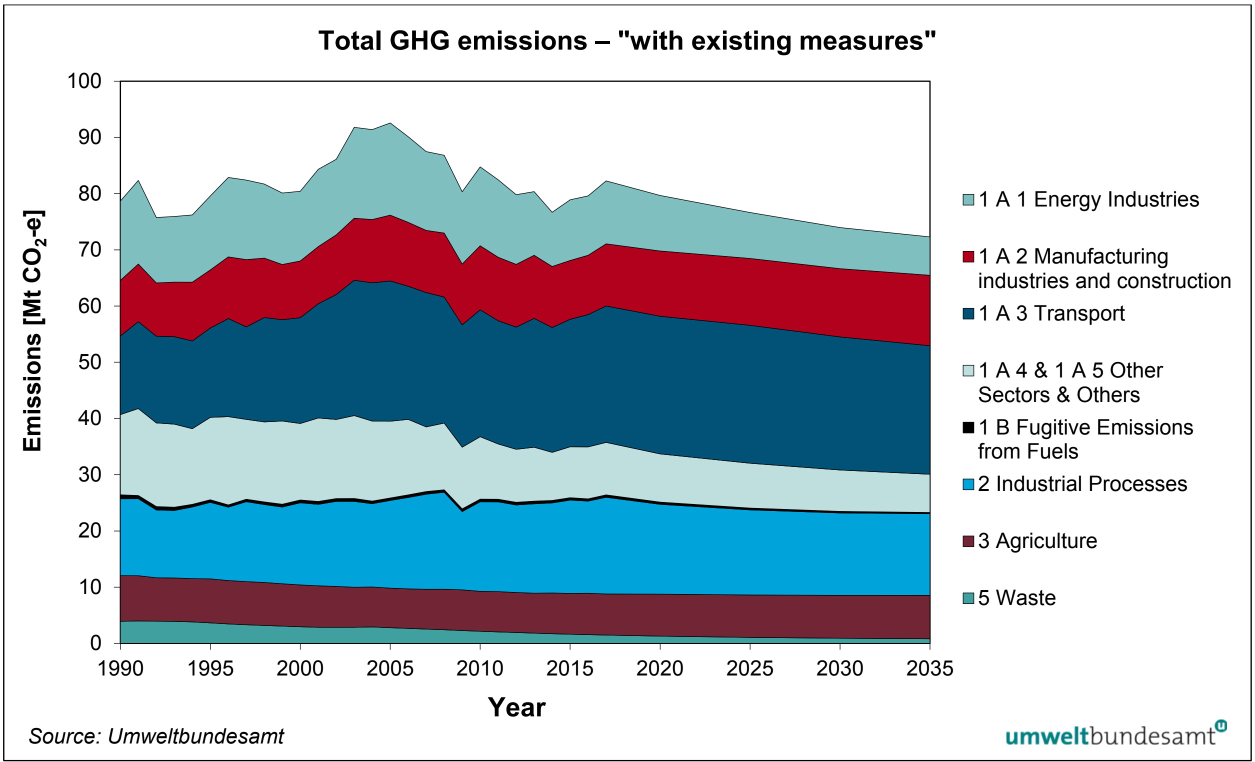


Figure 2: Past trend and scenario (2020–2035): total GHG emissions by sector.

According to the WEM scenario, the most important GHG in Austria will still be CO_2 with a minor increase between 2017 (85.1%) and 2035 (85.7%). Between 2017 and 2035, total CH_4 emissions and N_2O emissions (in CO_2 equivalent) are forecast to increase from 12.3% to 13.3%, whereas the percentage of emissions of fluorinated gases (HFC, PFC, SF_6 and NF_3) is expected to decrease from 2.6% in 2017 to 1.0% 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 22% from 2017 to 2035. A decrease is also projected for the Industrial Processes sector (– 9%).

Total EU Effort Sharing Decision (ESD) GHG emissions are expected to decrease by 10% 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**	**2017**	**2020**	**2025**	**2030**	**2035**
Total (without LULUCF)	29 492	30 555	28 710	26 823	26 051	25 739
1. Energy	15 354	15 967	15 054	13 472	12 712	12 412
2. Industrial Processes	14 138	14 588	13 656	13 350	13 339	13 327
EU ESD GHG emissions	**2015**	**2017**	**2020**	**2025**	**2030**	**2035**
Total (without LULUCF)	49 342	51 652	50 903	49 758	47 851	46 498
1. Energy	38 006	40 263	39 829	39 367	37 996	36 760
2. Industrial Processes	2 450	2 597	2 313	1 776	1 308	1 189
3. Agriculture	7 249	7 308	7 467	7 545	7 626	7 721
5. Waste	1 638	1 484	1 294	1 069	921	827

1 GENERAL APPROACH

1.1 Guidelines and Provisions

The following regulations and guidelines have been 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 for 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
- Commission guidance and recommendations for reporting on GHG projections in 2017 (European Commission, 15 June 2018)
- Recommended parameters for reporting on GHG projections in 2015 (European Commission, Final, 15 June 2018)

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, Michaela Titz
- Agriculture .... Michael Anderl, Simone Haider
- Waste .... Christoph Lampert, Elisabeth Kampel,
  Stephan Poupa
- LULUCF.. Peter Weiss, Carmen Schmid

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 from the Austrian Emission Inventory (submission March 2018) up to the data year 2017.

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 2019 (UMWELTBUNDESAMT 2019a).

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

1.3.3 Underlying Models and Measures

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 2018), supported by calculations based on bottom-up models:
  - TIMES (Austrian Energy Agency – AEA 2018): public electrical power and district heating supply.
  - INVERT/EE-Lab (Energy Economics Group of the Technical University of Vienna and the Zentrum für Energiewirtschaft und Umwelt (e-think), TU WIEN & ZEU 2017): domestic heating and hot water supply.
  - NEMO & GEORG (Technical University of Graz – TU GRAZ 2018): energy demand and emissions of transport (incl. off-road).
- Forecasts of emissions from industrial processes and solvent emissions are based on Umweltbundesamt expert judgements and on projections for the respective gross value added (NACE code).
- Emission estimates for fluorinated gases are based on a study published in 2010 (GSCHREY 2010). Assumptions from the EU F-Gas Regulation have been 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 2018).
- The waste scenario is mostly based on Umweltbundesamt expert judgements on waste amounts that are expected to be pre-treated in mechanical-biological treatment plants (before being landfilled). Furthermore, population scenarios of STATISTIK AUSTRIA 2018b have been considered.

The scenario 'with existing measures' includes all policies and measures implemented by 1 January 2018. The current status of the implementation of measures has been defined at expert level in consultation with the Federal Ministry of Sustainability and Tourism. 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

Year	2015	2020	2025	2030	2035
GDP [billion € 2016]	351	386	414	444	480
GDP real growth rate [%]	1.1%	~ 1.5%	~ 1.5%	~ 1.5%	~ 1.5%
Population [1 000]	8 630	8 942	9 158	9 331	9 447
Stock of dwellings [1 000]	3 831	3 992	4 126	4 230	4 318
Heating degree days	3 238	3 204	3 171	3 118	3 065
Exchange rate [US$/€]	1.2	1.2	1.2	1.2	1.20
International coal price [€ 2016/GJ]	2.0	2.6	3.2	3.8	4.0
International oil price [€ 2016/GJ]	8.0	13.9	15.7	17.3	18.1
International natural gas price [€ 2016/GJ]	7.0	8.9	9.6	10.5	11.2
CO_2 certificate price [€ 2016/t CO_2]	7.8	15.5	23.3	34.7	43.5

Other underlying assumptions are included in the sectoral methodology (Chapter 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 increases and decreases in key factors (or a combination of key factors). The sensitivity assessment in the Energy sector is 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 sensitivity 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) have been calculated:

- WEM sensitivity 1 and
- WEM sensitivity 2.

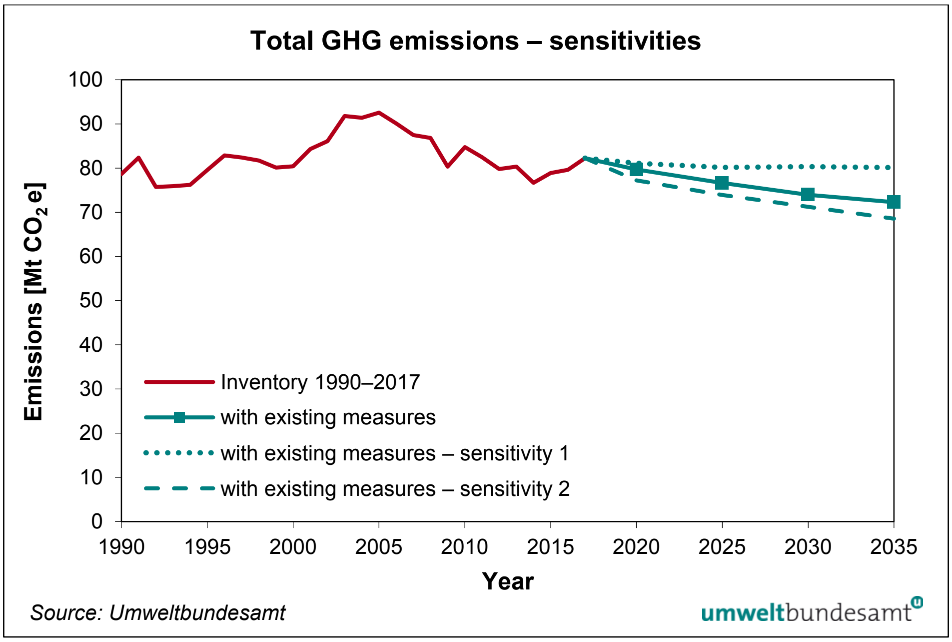
The main input variables are summarised in Table 8. The average economic growth was assumed to be 2.5% per year in WEM sensitivity 1 and 0.8% per year in WEM sensitivity 2 (compared to 1.5% per year in WEM).

Table 5: Basic parameters for sensitivity analysis modelling

Parameter WEM sensitivity 1	**2015**	**2020**	**2025**	**2030**	**2035**
GDP [billion € 2016]	351	390	441	499	564
GDP real growth rate [%]	1.1%	~ 2.5%	~ 2.5%	~ 2.5%	~ 2.5%
International coal price [€ 2016/GJ]	2.0	2.7	3.4	4.3	4.2
International oil price [€ 2016/GJ]	8.0	14.6	18.1	22.1	26.7
International natural gas price [€ 2016/GJ]	7.0	9.5	11.2	13.7	16.6
CO_2 certificate price [€ 2016/t CO_2]	7.8	20.5	28.8	40.8	51.2
Parameter WEM sensitivity 2	**2015**	**2020**	**2025**	**2030**	**2035**
GDP [billion € 2010]	351	377	392	408	425
GDP real growth rate [%]	1.1%	~ 0.8%	~ 0.8%	~ 0.8%	~ 0.8%
International coal price [€ 2016/GJ]	2.0	2.6	3.1	3.6	3.3
International oil price [€ 2016/GJ]	8.0	13.4	14.8	15.9	17.1
International natural gas price [€ 2016/GJ]	7.0	8.8	8.9	9.3	9.7
CO_2 certificate price [€ 2016/t CO_2]	7.8	13.4	18.3	26.7	33.5

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

Figure 3: Trend and projections (2018–2035): total GHG emissions for different sensitivities.



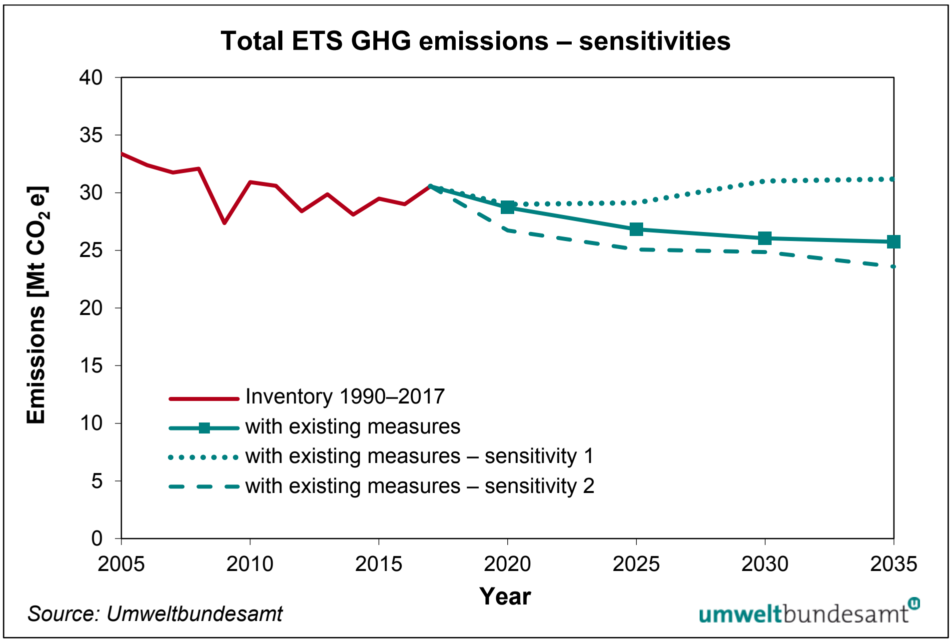


Figure 4: Trend and projections (2018–2035): total ETS GHG emissions for the different sensitivities.

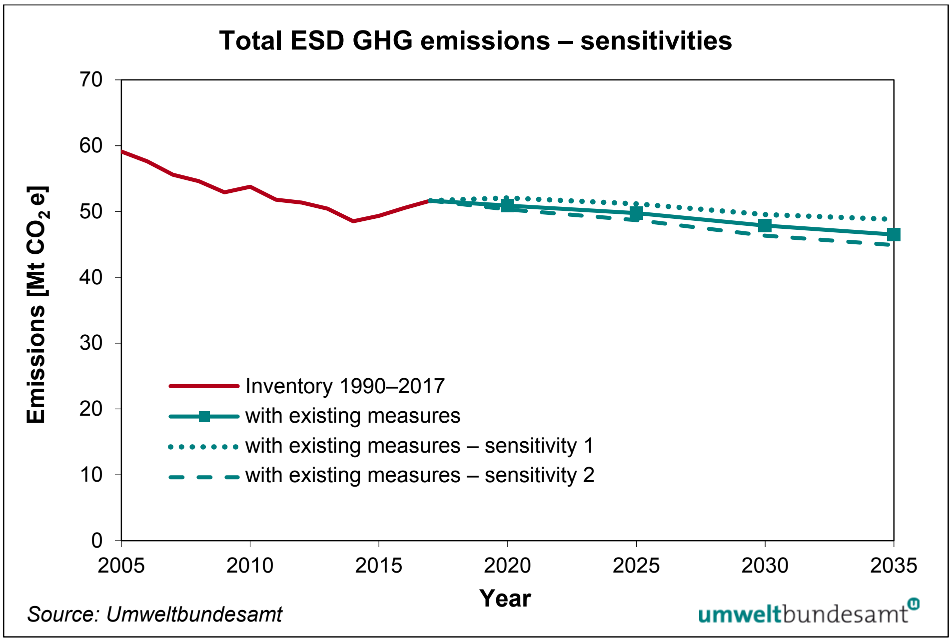


Figure 5: Trend and projections (2018–2035): total ESD GHG emissions for the different sensitivities

The sectoral conclusions and the results of the sensitivity analysis can be summarised as follows:

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 input. In sensitivity scenario 1, an increase in production in existing power plants as a result of an increased electricity demand is expected to be economically viable. In sensitivity scenario 2, 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 level of 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 (around 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 pronounced 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 scenario 2 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 smaller 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 2019a). 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 a 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 considerably higher, while the uncertainty in the emission factors might be in a range similar to that of the uncertainty levels in the inventory.

On the whole, there are different types of uncertainty that 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 in particular years)

The main uncertainty factors 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 sub-sector 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 as well as the trend in new registrations of electric vehicles per year and the share of BEVs (battery electric vehicles) and PHEVs (plug-in electric vehicles).

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

The sensitivity analysis shows that variations in 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 may inhibit or postpone 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 (2018).

- **Policy uncertainty:** Policies affect the 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 in 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. A particularly high level of uncertainty is associated with 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 of 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.

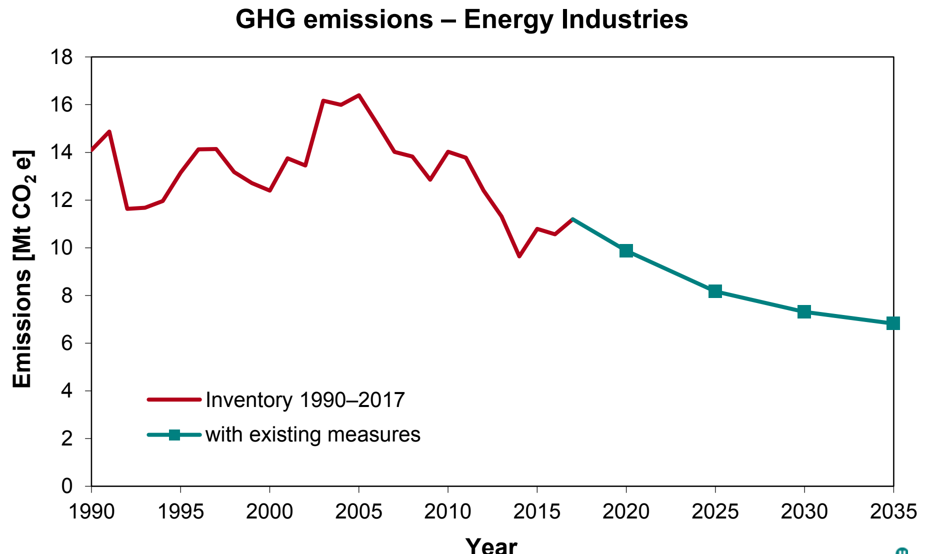
Regarding waste disposal, it is important to note that for upcoming trends historical deposits are of relevance as well (according to the First Order Decay method), with relatively low levels of uncertainty thanks to good quality country-specific data which are available on an annual basis (Electronic 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 (2018–2035): GHG emissions from 1.A.1 – Energy Industries.



Source: Umweltbundesamt

In 2017, emissions from Energy Industries were 21% below the level of 1990. Emissions from power plants have been decreasing steadily since 2005, mainly because of growing contributions of renewable energy sources, substitution of solid and liquid fuels by natural gas and biomass as well as improvements in efficiency. The share of biomass used as fuel in this sector increased from 0.9% (1990) to 25% (2017), the contribution of hydro and wind power plants to total public electricity production increased from 69% (1990) to 77% (2017). Electricity consumption has increased by 51.5% since 1990; since 2002, this increase has largely been covered by electricity imports.

In the Energy Industries sector, GHG emissions are expected to continue to decrease due to a shift away from gas, coal and oil to renewables. The installed capacity of hydro power, solar and wind plants is expected to increase significantly. The capacity of biomass CHP plants will only increase until 2020 – unless more subsidies than planned in the WEM scenario are granted.

The major driving force behind the emissions in this sector is expected to be electricity demand, especially after 2030. Demand is expected to rise by more than 1% per year. The demand for district heat is expected to remain stable until 2030, but expected to decrease thereafter.

Emissions from petroleum refining are projected to remain more or less constant as total production capacities are not expected to change significantly given that 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)

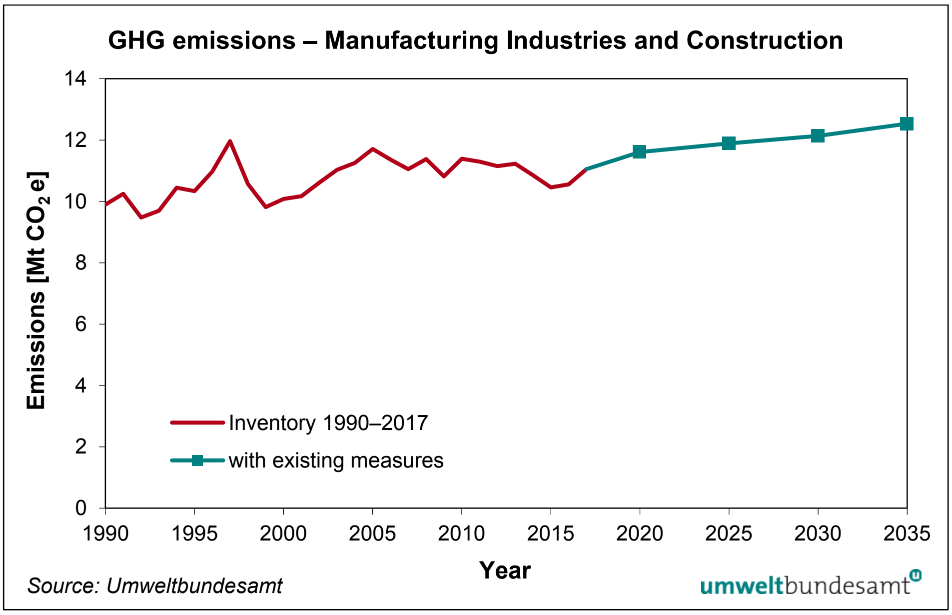


Figure 7: Past trend and scenario (2018–2035) GHG emissions from 1.A.2 – Manufacturing Industries and Construction.

The Industry sector is one of the main sources of greenhouse gases in Austria, mainly due to the CO_2 emissions caused by 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.

Energy related GHG emissions from the Manufacturing Industries and Construction sector increased by 12% from 1990 to 2017, mainly in the chemical and other manufacturing industries, while emissions from iron & steel and pulp & paper industries decreased after 1990. Fuel consumption increased by 41% 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 lower (only +12%) than the increase in fuel combustion.

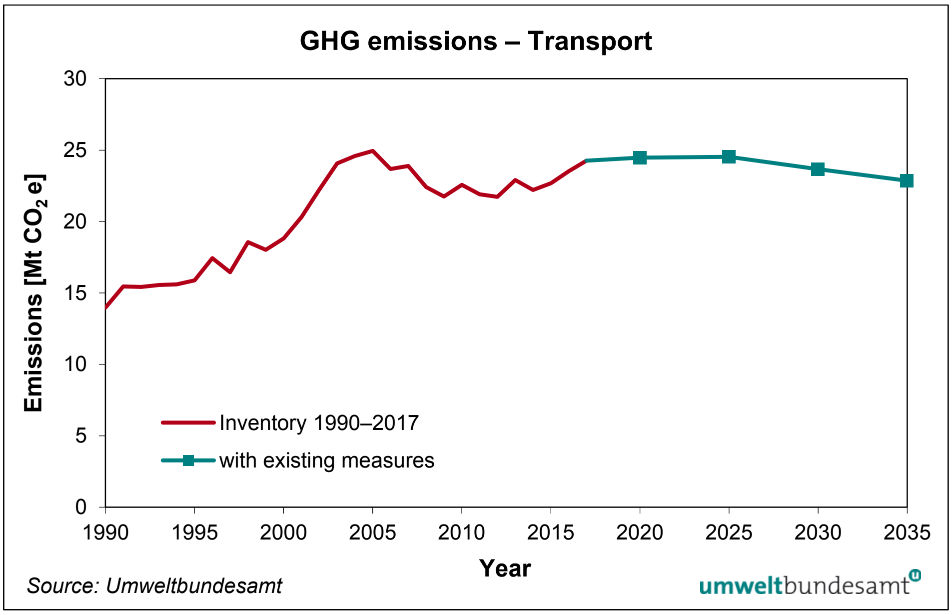
For the period 2016–2035 an increase in GHG emissions is expected as a result of higher sectoral GDP projections. Sectoral emission trends are mainly the result of different sectoral economic growth rates, which are in turn outcomes of the macroeconomic model.

Emission increases are expected in nearly every industrial sector: iron and steel industry (1A2a; +6%), non-ferrous metal industry (1A2b, +38%), chemical industry (1A2c; +23%), pulp and paper industry (1A2d, +21%), food processing (1A2e, + 24%) and other stationary manufacturing industry (1A2g8; + 37 %).

In the non-metallic minerals industry (1A2f) a slight decrease is expected. The mobile sources in this sector (CRF 1A2g7) accounted for 1.1 Mt of CO_2 equivalent in 2016 and are expected to rise by 30% by 2035.

2.1.3 Transport (1.A.3)

Figure 8: Past trend and scenario (2018–2035) GHG emissions from 1.A.3 – Transport.



The Transport sector has shown a strong increase in GHG emissions since 1990 (+74%) mainly due to an increase in passenger and freight transport (kilometres driven). In addition to the increase in kilometres driven on Austrian roads, the amount of fuel sold in Austria and used in neighbouring countries (fuel export) as a result of lower fuel prices in Austria has increased considerably since 1990. Between 2005 and 2014, GHG emissions decreased as less fuel was sold and the use of biofuels increased, and because of a gradual replacement of the fleet with newer vehicles with lower specific fuel consumption. The year 2017 is now the third year showing an increase in GHG emissions from 1.A.3 transport and the second year with decreasing amounts of biofuels. Moreover, 2017 is the second year in which total fuel sales were higher compared to the peak year 2005.

The Transport sector is and will remain one of the main sources of greenhouse gases in Austria. GHG emissions are assumed to increase up to 2024 mainly as a result of the increase in vehicle kilometres driven by vehicle category 1.A.3.b.3 Heavy Duty Trucks and Buses. The main driving force is the positive GDP development, as well as low fuel prices in general and especially the assumption that diesel prices will continue to be lower in Austria compared to our neighbouring countries (an important source of income for the national budget).

In 2030, diesel PC and gasoline PC will each account for 44% of the total car fleet. BEV will account for 13%. In 2035, gasoline cars will account for the majority with a share of 43% compared to 38% accounted for by diesel cars and 19% by BEV.

Around 23% of the GHG emissions in this sector are currently caused by fuel exports as Austria's fuel prices continue to be lower (especially the diesel price) than in the neighbouring countries (BMNT 2018a); this amount is expected to remain relatively constant in the future. After a steep increase in recent decades, GHG emissions reached a peak in 2005. Then the implementation of the EU Biofuels Directive (2003/30/EC) and declining fuel exports resulted in a change to this trend. In addition, the economic slowdown resulted in further emission reductions, especially in 2008 and 2009, but emissions went up again after an increase in economic and transport activities from 2010 onwards. From now on, the use of biofuels, along with higher fuel efficiency standards and especially the promotion of electric mobility are expected to help stabilise GHG emissions, and to reduce them from 2024 onwards.

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

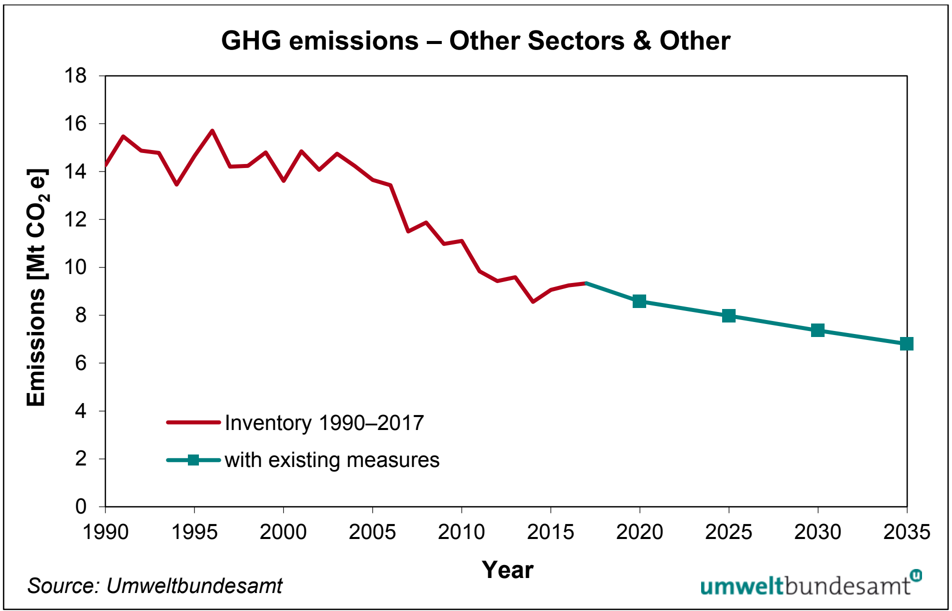


Figure 9: Past trend and scenario (2018–2035) GHG emissions from 1.A.4 – Other sectors (including Residential, Commercial/Institutional and Agriculture/ Forestry/Fishing) and 1.A.5 – Other (military).

The variation in the 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 the sub-category Other sectors. Emissions in 2017 were 35% 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 a growing importance of district heating and modernised of heating systems. Total fuel consumption in this sub-category has decreased by 15% since 1990.

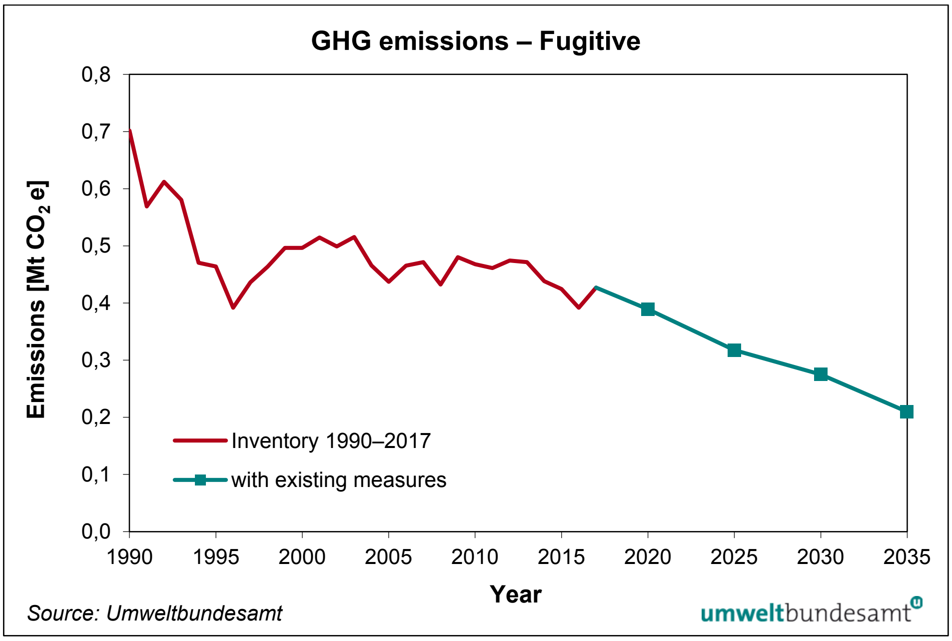
The '1.A.4 other sectors' category accounts for a considerable amount of Austria's total greenhouse gas emissions. Despite growing numbers of households and occupied living space, the total GHG emissions in this sector are expected to see substantial reductions by 2035 in the WEM scenario.

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

Mobile sources in this sector (mainly CRF 1A4c2 Agriculture/Forestry) accounted for 0.9 Mt of CO_2 equivalent in 2017 and are expected to rise by 2% until 2035.

2.1.5 Fugitive emissions (1.B)

Figure 10: Past trend and scenario (2018–2035) GHG emissions from 1.B – Fugitive emissions.



Between 1990 and 2017, fugitive emissions from coal mining, fossil fuel exploration, refining, transport, production and distribution decreased by 39%. The main driving force behind this decrease was the closure of coal mines. There have been no coal-mining activities in Austria since 2007. The increase in and after 1996 was due to an extension of the natural gas distribution network and increasing emissions from natural gas and oil extraction.

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

2.2 Industrial Processes & Product Use (CRF Category 2)

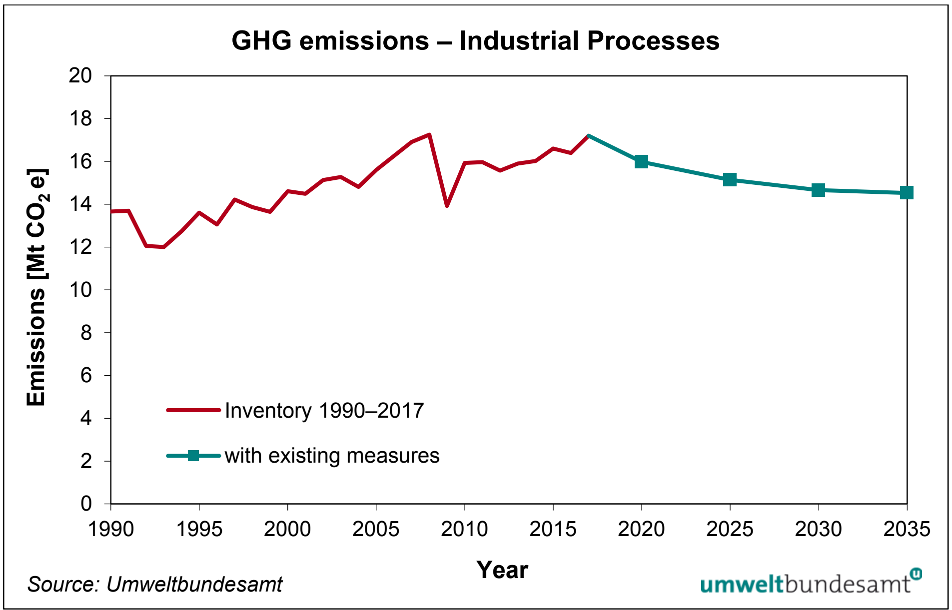


Figure 11: Past trend and scenario (2018–2035) GHG emissions from 2 – Industrial Processes & Product Use.

In 2017, greenhouse gas emissions from Industrial Processes and Other Product Use amounted to 17 197 kt of CO_2 equivalent, corresponding to 21% of Austria's 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 respectively. The most important greenhouse gas in this sector is CO_2 with a share of 86% in the total sectoral emissions, followed by HFCs with 10%, SF_6 with 2.3%, N_2O with 1.0%, PFCs and CH_4 with 0.3% each. NF_3 contributes 0.01% of the total emissions from this sector.

The overall trend in GHG emissions from Industrial Processes and Other Product Use is an increase in emissions of 26% for the period 1990–2017. Emissions fluctuated within this period, with a minimum level in 1993 and a maximum in 2008. The main drivers behind the emission trend in this sector were (i) the termination of primary aluminium production in 1993, (ii) the introduction of N_2O abatement technologies in the chemical industry in 2004 and 2009 (becoming fully operational in 2010), (iii) an increase in metal production resulting in a 37% increase in GHG emissions in 2017 from 1990 levels and (iv) a strong increase in HFC emissions in the period 1992–2017 (from 5.6 to 1 725 kt of CO_2 equivalent).

The largest increase in GHG emissions between 1990 and 2017 can be observed in the *metal industry* due to an increase in emissions from iron and steel production (+69%). In the sub-categories *mineral industry* and *chemical industry*, emissions declined by 9.5% and by 52% respectively during that period.

Emissions of *fluorinated gases* have increased by 32% since 1990, driven by increasing emissions of HFCs (+388% since 1995) used as cooling agents to replace Ozone Depleting Substances (ODSs). Emissions from *solvent use* have dropped by 68%, due to legal measures regulating the solvent content of products and their use.

Emissions from industrial processes are expected to see a slight decrease in the years until 2035. The main sources are the categories 'metal production' and 'mineral products'. Emissions from the categories 'mineral products' are expected to decline due to slightly negative economic growth rates, 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 onwards. Emissions from 'chemical products' are expected to remain stable.

Another source in this sector is 'fluorinated gases' (HFC, PFC and SF_6). These gases contributed 13% of industrial processes emissions in 2017, with a projected decrease to 5.1% by 2035 in the scenario with existing measures, a decrease which will be brought about mainly by several legislative measures. HFC emissions are expected to be reduced due to the effects of the EU F-Gas Regulation (Regulation (EU) No. 517/2014), and the increased availability of low GWP alternatives. The effects of the regulation will be attenuated between 2021-2023 due to increased emissions from disposal of commercial refrigeration.

SF_6 emissions are projected to increase until 2020 due to SF_6 emissions from the disposal of noise insulating glazing for windows at the end of the use phase of the glazing. SF_6 was last used for windows in 2003, and the lifetime of windows is assumed to be 25 years. SF_6 filling peaked in 1995, and SF_6 emissions, which began from the year 2000 onwards, will increase from year to year, peaking in 2020 and decreasing thereafter, and they will cease by 2028.

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 –58% between 1990 and 2017 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 increase slightly 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 decrease slightly when using the same assumptions as for the Energy sectors. Emissions from Paraffin Wax Use depend on population growth, and are thus expected to increase slightly.

2.3 Agriculture (CRF Category 3)

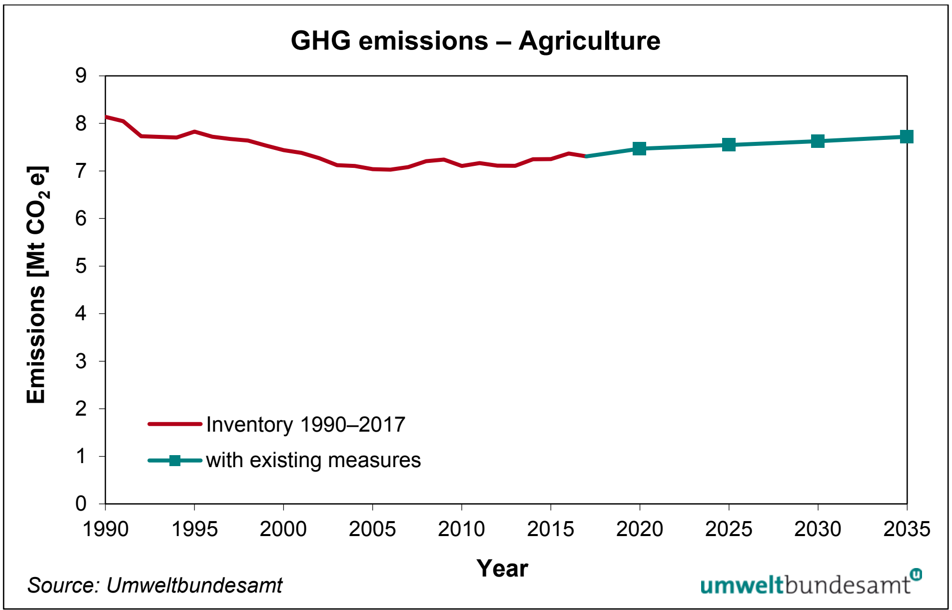


Figure 12: Past trend and scenario (2018–2035) GHG emissions from 3 – Agriculture.

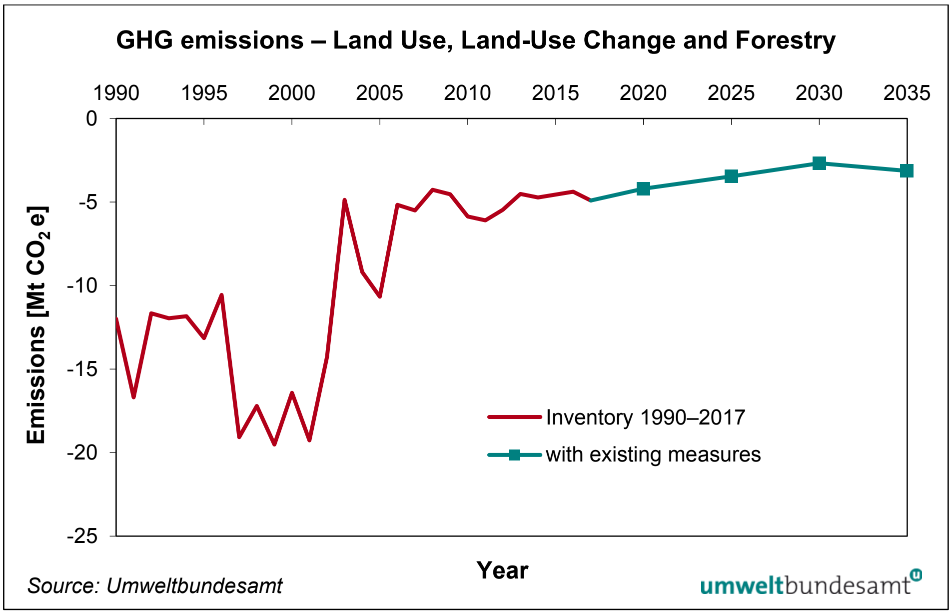
In 2017, greenhouse gas emissions from Agriculture amounted to 7 308 kt of CO_2 equivalent, corresponding to 8.9% of Austria's total emissions. The most important sub-categories of this sector are enteric fermentation (57%) and agricultural soils (28%). The sector agriculture is the largest source for both N_2O and CH_4 emissions: in 2017 71% (8.3 kt N_2O) of Austria's total N_2O emissions and 71% (188 kt CH_4) of its total CH_4 emissions originated from this sector. Total GHG emissions from the sector Agriculture are dominated by CH_4 with 64% and N_2O with 34%. CO_2 emissions account for 1.6% of the emissions from this sector.

The overall trend in GHG emissions from Agriculture shows a decrease of 10% from 1990 to 2017. The main drivers for this trend are decreasing livestock numbers and lower amounts of N fertilisers applied on agricultural soils.

Between 2017 and 2035 an increase in emissions by 5.7% can be expected. Underlying livestock projections indicate that the declining trends for cattle will come to an end. Cattle numbers will increase because milk production is likely to increase after the abolition of the milk quota in 2015, as well as due to attractive payment schemes for beef and milk production in Austria. However, production of swine and pork is expected to decline. Decreasing prices for pork will lead to falling numbers of pigs. Implemented policy measures (see Chapter 3.4.1) may weaken but will not change the increasing trend.

2.4 LULUCF (CRF Category 4)

Figure 13: Past trend and scenario (2018–2035) GHG emissions from 4 – Land Use, Land-Use Change and Forestry[1].



In 2017, net removals from the category LULUCF amounted to −4 906 kt of CO_2 equivalent, corresponding to 6.0% of the national total GHG emissions (without LULUCF) in 2017 compared to 15% in the base year.

With regard to the overall trend in net removals from LULUCF, removals decreased by 59% from 1990 to 2017. The main driver for this trend is a change in biomass carbon stock in forest land. Fluctuations are due to weather conditions which affect the growth rates on the one hand (e.g. very low increment in 2003) and windthrows on the other, as well as timber demand and prices (e.g. very high harvest rates in 2007 and 2008).

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 2017 and 2030 net removals are expected to decrease by approximately 2.2 Mt of CO_2 equivalent. This will be strongly influenced by the decrease in removals on forest land caused by a decreasing trend in biomass growth. Biomass use also shows a decreasing trend but at a lower rate. From 2030-2035 onwards, this trend is expected to change and the net sink expected to increase, which can also be explained by a lower level of forest biomass use and by a slightly increasing biomass growth. The second largest category, harvested wood products (HWP), is projected to remain a net sink on a stable level (about −2.1 Mt CO_2 on average) during the period 2017−2035.

On the other hand, the non-forest sectors (Cropland, Grassland, Wetlands, Settlements and Other land) are sources of emissions for the projected time series, amounting to approximately 1.2 Mt of CO_2 equivalent per year.

[1] The historical values of category 4.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 on the basis of the results of the next NFI.

2.5 Waste (CRF Category 5)

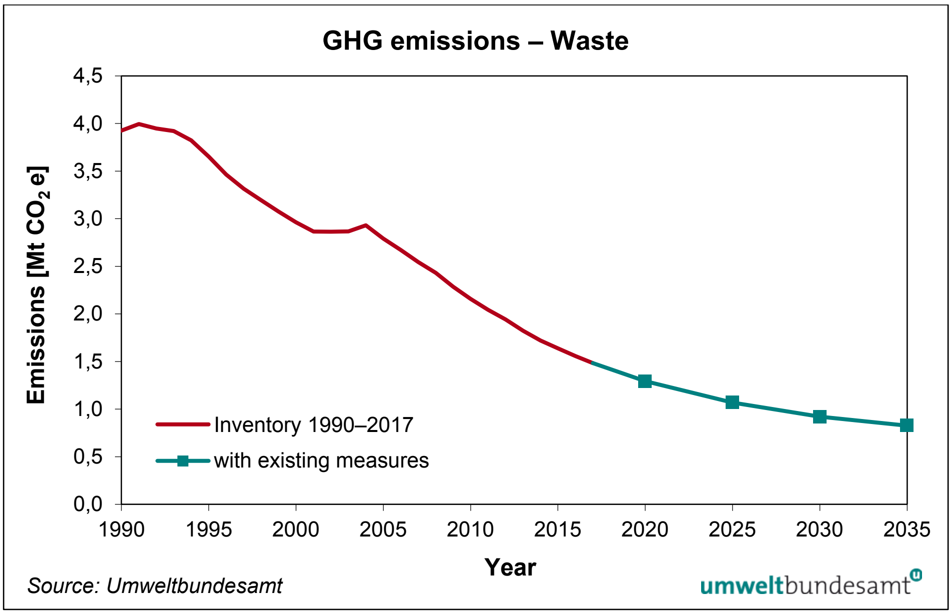


Figure 14: Past trend and scenario (2018–2035) GHG emissions from 6 – Waste.

In 2017, greenhouse gas emissions from Waste amounted to 1 484 kt of CO_2 equivalent, corresponding to 1.8% of Austria's total national emissions.

The most important sub-category of the waste sector is solid waste disposal, which caused 75% of the emissions from this sector in 2017, followed by waste water treatment and discharge (13%) and biological treatment of solid waste (12%). The most important greenhouse gas is CH_4 with an 82% share of of the emissions (mainly from waste disposal), followed by N_2O with 18% and CO_2 with 0.1%.

Overall, GHG emissions from waste show a decreasing trend, with a decrease of 62% from 1990 to 2017. 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 disposed waste has decreased correspondingly, especially since 2004 when the pre-treatment of waste became obligatory (although some exceptions were granted to some Austrian provinces). The legal basis for reduced disposal of waste as well as landfill gas recovery is the Landfill Ordinance. Since 2009 all waste with a high organic content has been subject to pre-treatment before deposition (without exception). Furthermore, methane has been recovered from landfills since the 1990s.

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. Emissions from 'waste water handling and discharge' are increasing slightly under the current policy ('WEM') in line with a 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 Center of Economic Scenario Analysis (CESAR) and Research, the Austrian Energy Agency, the Energy Economics Group of the Vienna University of Technology, e-think and the Institute for Internal Combustion Engines and Thermodynamics at the Graz University of Technology. 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 determined 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 2018).

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 (according to the INVERT/EE-Lab model). Subsidies (e.g. granted under the Green Electricity Act) and fees (like emission allowances) are also important input parameters (AEA 2018).

For modelling the energy consumption for domestic heating and domestic hot water supply, the software package INVERT/EE-Lab (TU WIEN & ZEU 2018) 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 for 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 in 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 in 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 described in the Austrian Inventory Report (UMWELTBUNDESAMT 2019a).

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 new production units have been introduced 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 has been calculated using the average emissions of the years 2015–2016.

The exploration of oil and gas is expected to decline considerably over 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. '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.

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. Prices from PRIMES have been used as follows:

- 15.5 €/t in 2020, 34.7 €/t in 2030.

The effects of the changes of ETS Phase 3 have been considered.

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

As regards the implementation of the Water Framework Directive and potential optimisation of existing hydro power plants, it has been assumed that projected losses due to the implementation of the Water Framework Directive and higher production levels as a result of 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, as well as installing 2 000 MW of wind power and 1 200 MW of photovoltaic capacity, and biomass plants of 200 MW_{el} by 2020. The Green Electricity Act stipulates no specific goals beyond the year 2020.

Petroleum refining

See Chapter 3.1.1.1 for assumptions regarding this sector.

Manufacture of solid fuels and other energy industries

See Chapter 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) for economic reasons and because of the age of the plants, whereas the input to gas plants is expected to rebound in 2017 and decline thereafter. The decline in fossil fuel power plants will be driven by a significant increase in the production of hydro-electrical, wind and photovoltaic energy with lower marginal costs. Input to biogas plants is expected to decline as subsidies will expire, while biomass power and heat plants are assumed to remain stable.

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 due to limited reserves.

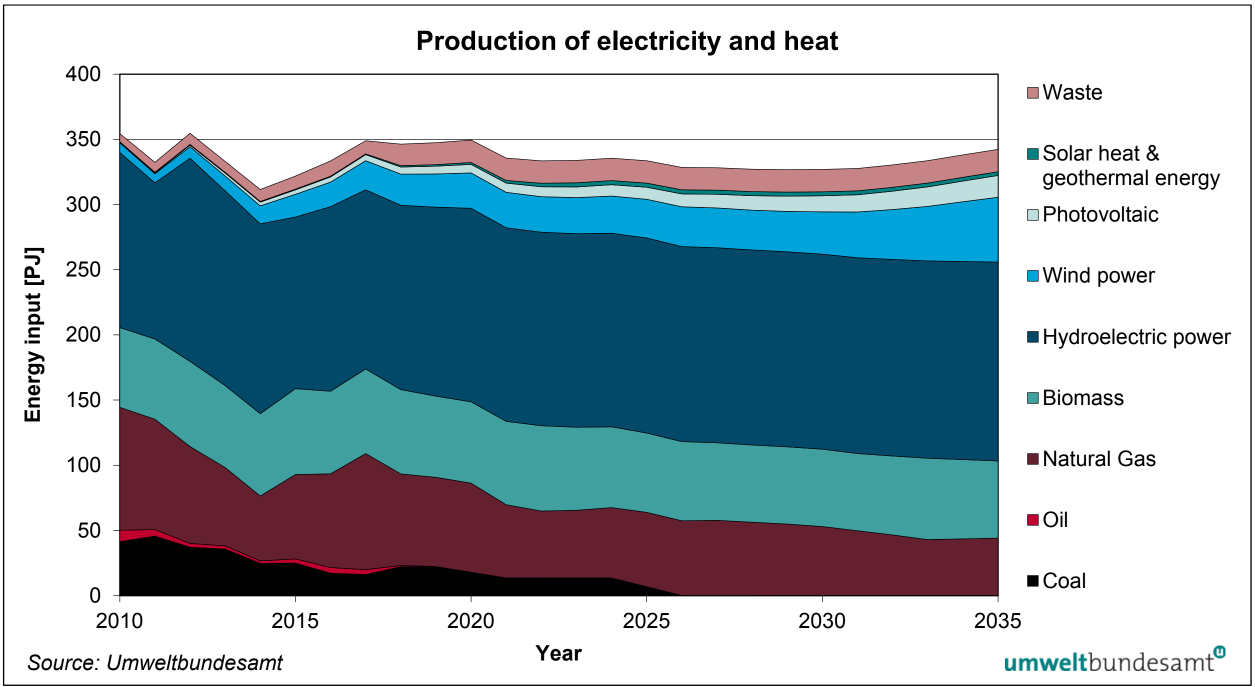


Figure 15: Energy input for electricity and heat production (1.A.1.a)

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 2019a).

The models are described in the Energy Chapter 3.1.

3.1.2.2 Assumptions

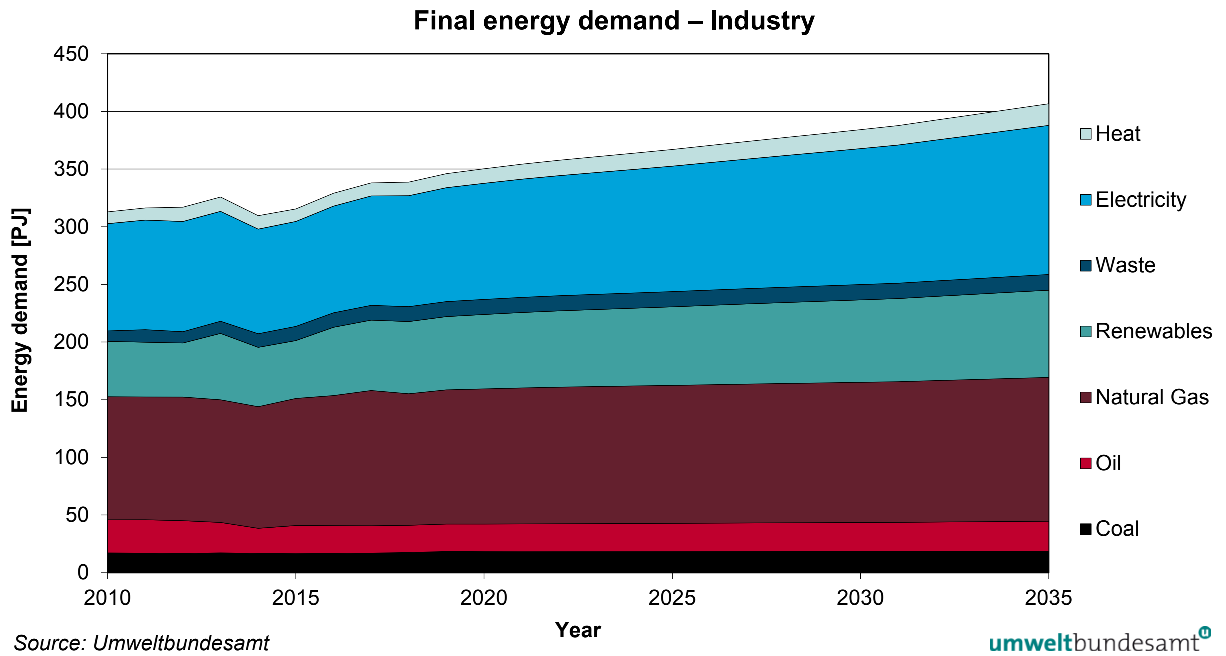
Assumptions for the global oil price are given in US$. From 2015 a continuous increase in the oil price is expected. GDP growth is expected to average 1.5% per year until 2035 (see Chapter 1.3.4).

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 splits of emissions 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 2.



Source: Umweltbundesamt

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 (Network Emission Model, DIPPOLD et al. 2012, HAUSBERGER et al. 2015, 2018). NEMO has been 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.

For more details see the chapter on methodology in 3.2.12.2. Road Transport of Austria's National Inventory Report 2019 (UMWELTBUNDESAMT 2019a).

- **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 has been 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.

  For more details see the chapter on methodology in 3.2.12.2. Road Transport of Austria's National Inventory Report 2019 (UMWELTBUNDESAMT 2019a).

- **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). Using 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).

  For more details see the chapter on methodology in 3.2.13.2 Other sectors – mobile combustion of Austria's National Inventory Report 2019 (UMWELTBUNDESAMT 2019a).

1 A 3 a – Aviation

Projections for energy consumption in the aviation sector were carried out using the econometric input-output model DYNK of the Austrian Institute of Economic Research (WIFO 2018). 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. The monetary demand for flight services is indirectly dependent on the population (via total consumption, employed persons), on relative prices (not the ticket *per se*, but the price of "flight services") and on their trend (in the consumption mix).

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 prices, economic developments 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, amounting to 32 PJ in 2017. The increase in energy demand for air traffic from 2017 to 2030 is assumed to be 6% (2035: 9%). After 2017, energy consumption is projected to stagnate up to 2024 as oil prices are expected to rise faster over the period to 2024 (and thus resulting in a lower demand) than thereafter. In addition, the average annual economic growth rate is expected be below 1.5% between 2017 and 2020.

1 A 3 b – Road Transport

Development of conventional PC fleet

New passenger car registrations show a decline in diesel car registrations, accelerating the declining trend of the previous year. In the fourth quarter of 2017, there were more newly registered conventional petrol passenger cars than diesel engine cars. In 2018, the share of new diesel car registrations fell even below 40% within a few months. Due to this trend and the problems with diesel cars and their emission behaviour, it is assumed that from 2020 onwards we will see a 50/50 split in diesel and gasoline in new car registrations each year.

As the new CO_2 limit values for PC, LDV and HDV had not been agreed at the time of setting up the WEM scenario, the fleet still shows a development based on the old limit value of 95g CO_2/km for a manufacturer's PC fleet (to be achieved by 2021). The fuel efficiency per kilometre of conventional diesel and gasoline PC is estimated to be 0.1% and 0.6% pa from 2022 onwards.

Development of passenger kilometres (pkm)

The distances travelled by people have seen a steady increase since 1990. In the WEM scenario it is assumed that pkm travelled will increase further based on assumptions for the development of parameters such as the degree of motorisation and population (STATISTIK AUSTRIA 2018b). The increase will not affect all transport modes in the same way. Individual passenger transport with PC, mopeds and motorcycles is expected to increase rapidly and includes assumptions about the future fleet of electric vehicles (details below). Bus and rail travel and electric local public transport are also expected to increase slightly (for more details see chapter Activities below).

Fuel exports: developments

Since the end of the 1990s the gap between fuel sales in Austria and domestic fuel consumption has become wider (roughly 23% of total fuel sales in road transport in 2017). A reason for this discrepancy is the 'fuel export in vehicle tanks' as a result of relatively low fuel prices in Austria – in comparison to the neighbouring countries. The table below 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 that fuel is consumed abroad. Most of the fuel export, however, is accounted for by 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 6: Differences in gross diesel prices in €/l – average values for 2018 (10/9/2018) (BMNT 2018a).

Gross diesel prices	€/l	Difference to Austria
Austria	**1.195**	
Czech Republic	1.206	0.01
Hungary	1.222	0.03
Slovakia	1.229	0.03
Germany	1.239	0.04
Slovenia	1.263	0.07
Italy	1.474	0.28

The 'fuel export' phenomenon is relevant for climate policies, 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.

It has been assumed that the price difference between Austria and its neighbouring countries stays constant over time resulting in a relatively constant share of GHG emissions from fuel exports until 2035.

Alternative fuels: development

Biofuels

WEM projections for alternative fuel consumption in transport are primarily based on the requirement to meet the European objective, i.e. to achieve a 10% share of renewable energy in the transport sector in 2020 (Renewable Directive RED I 2009/28/EC) as well as a 14% share in 2030 (Renewable Directive RED II 2018/2001/EC). The 2030 goal includes a sub-target for advanced biofuels (biofuels produced from a specific raw material listed in the Renewable Energy Directive – those amounts are incorporated in the accounted volumes).

Besides the biofuels blended into the standard fuels (5% bioethanol and ETBE in gasoline and 7% biodiesel in diesel), our national projections also include HVO[2]. This fuel can be used as an additional blend for diesel (given the high limits for biofuels in the fuel standard) or sold alternatively as pure fuel.

[2] Hydrotreated Vegetable Oil

For current blending, the limits of E5[3] and B7[4] are taken as the baseline to which the "advanced biofuels" come as an addition – from 0.5% in 2020 to 3.5% in 2030 (to be continued thereafter). This means that Austria is on the path to the RED II goal. Since we cannot estimate exactly which of the advanced biofuel types will be available, the following is assumed: as long as the quantities can be fulfilled via a raise of E5 to E10[5], ethanol will be used. For anything beyond that it will be HVO (as a renewable"drop-in fuel" for diesel or in a pure form).

Other existing biofuels like pure vegetable oil or biogas are assumed to decrease to zero by 2020 in this scenario. Necessary additional contributions of renewables to meet the EU target in transport will be realised by renewable electricity deployed for the transport sector (passenger cars, rail, etc.).

Other fuels

The WEM projections presented here for CNG (natural gas), LPG and hydrogen as alternative fuels up to 2020 and beyond are projected with a conservative view, since the vehicle registration data indicate no immediate breakthrough for these energy sources, especially without the necessary incentives and an insufficient availability of vehicle models on the market.

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 (BEV) and PHEV (UMWELTBUNDESAMT 2016, 2018). A comprehensive demand analysis was performed for the period up to 2050. The evaluation deals with the temporal development of the effects of six potential barriers to the registration of electric vehicles (as opposed to vehicles with combustion engines):

- the number of vehicle models announced and expected on the market
- the number of actually (and with acceptable delivery period) available vehicles
- the availability of charging infrastructure
- the vehicle costs
- the vehicle ranges
- the public's subjective attitudes

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 the factor 2.5 in the case of rail transport, and a factor of 5 for road vehicles. From 2021 onwards, these factors will change to 1.5 for rail and to 4 for road due to changes to RED II. Electricity used by other means of transport will be calculated without using factors.

For all modes, the renewable share of domestic electricity generation as measured two years before the reporting year has to be used.

Current projections include all electrified transport modes on the road. For the projections it is assumed that the vehicle kilometres of conventional diesel and

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[3] blended gasoline with 5% ethanol (volumetric)

[4] blended diesel with 7% biodiesel (volumetric)

[5] blended gasoline with 10% ethanol (volumetric)

gasoline cars as well as of buses will be 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 sold. However, market acceptance is not sufficient as yet and many freight operators are experimenting with electric vehicles only in a few single pilot projects. Therefore, electric heavy duty trucks are only considered in a very small number in the current projections. Furthermore, rail transport already provides an alternative to long distance road transport. A shift away from road to rail should be aimed for in freight transport. 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 3 c, 1 A 3 d, 1 A 2 g 7, 1 A 4 b 2, 1 A 4 c 2 – Off-road

Projections for GHG emissions from rail (diesel and coal based) and shipping show slight yearly increases of 0.1% and 0.8% (on average).

Projections for NRMM (Non-Road-Mobile-Machinery) in industry and construction are based on the development of value added according to the NACE sectors of the DYNK model (WIFO 2018). An average yearly increase of 1.3% up to 2035 is assumed for the operating hours of mobile off-road machinery in industry.

Projections for NRMM in agriculture are based on grain harvesting. Operating hours of tractors are expected to increase by around 0.3% on average per year between 2017 and 2035.

Projections for NRMM in forestry are based on woodcutting. Operating hours of tractors and chainsaws used in forestry are expected to increase by around 0.7% on average per year between 2017 and 2035, which reflects the historical average growth per year between 1990 and 2017.

Projections for NRMM in households are based on estimates of gardening tools in households showing an average yearly increase of 0.3% in operating hours between 2017 and 2035. For other NRMM in households a constant trend is assumed for 1990–2035 due to a lack of historical data.

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 from *1.A.3 Transport* is very small in Austria with 0.1%. The economic slowdown 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 15% increase over 2017 levels is projected for 2030 (22% between 2017 and 2035) (WIFO 2018).

1 A 3 b – Road Transport

Since 2005 energy demand has decreased in road transport with a low in 2009 (as a result of the economic slowdown) and a further low in 2011 and 2014. From 2015 onwards fuel consumption has increased.

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 2% decrease over 2017 levels is projected until 2030 (6% decrease until 2035).

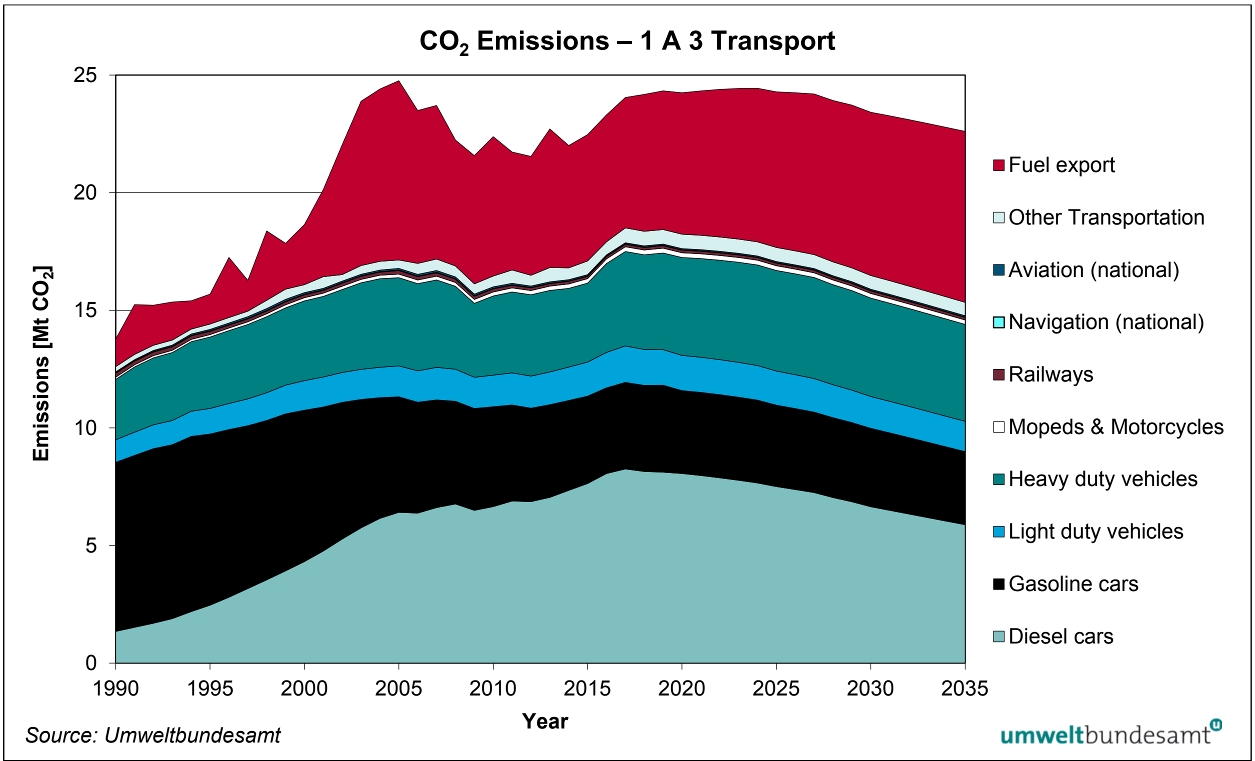

Figure 17: Past trend and scenario (2018–2035) CO_2 emissions from transport.

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 2017 shows the current data). As blended biofuels have the main share on the biofuels market, every reduction in energy consumption caused by other transport policy measures results in a similar reduction of the biofuel amounts.

The following graph shows the estimated amounts of biofuels and alternative fuels (CNG, LPG). The explanation for this development can be found under Alternative fuels: *developments (see chapter above)*.

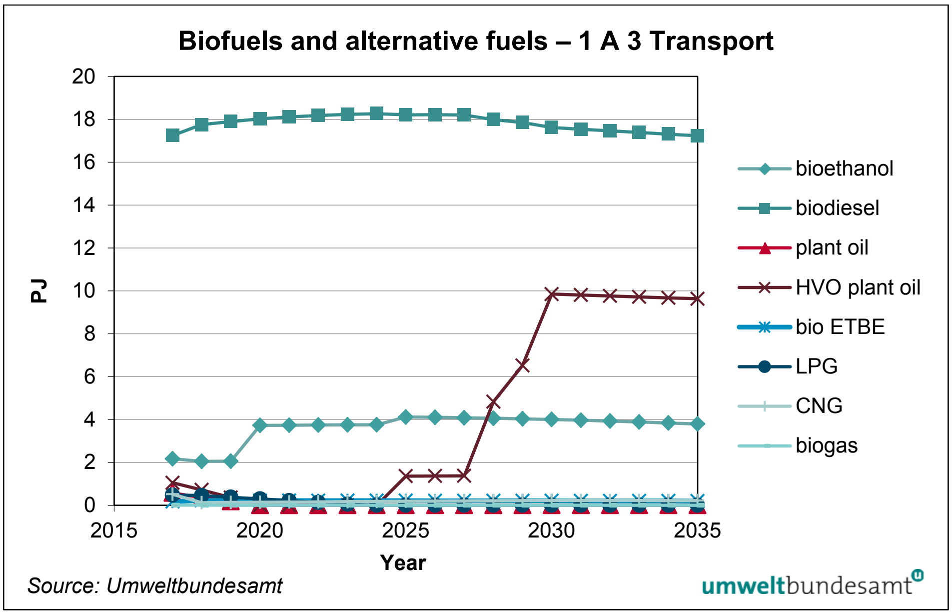

Figure 18: Scenario for biofuel deployment in Austria.

The following graph shows the estimated passenger car fleet development for BEV, HEV and PHEV in Austria up to 2035 (the base year 2017 shows the current data). The explanation for this development can be found in Chapter 3.1.3.2.

The electric vehicle stock is estimated to be roughly 1.3 million passenger cars in 2030 and around two million passenger cars in 2035, which means that one third of the total car fleet will be electrically powered.

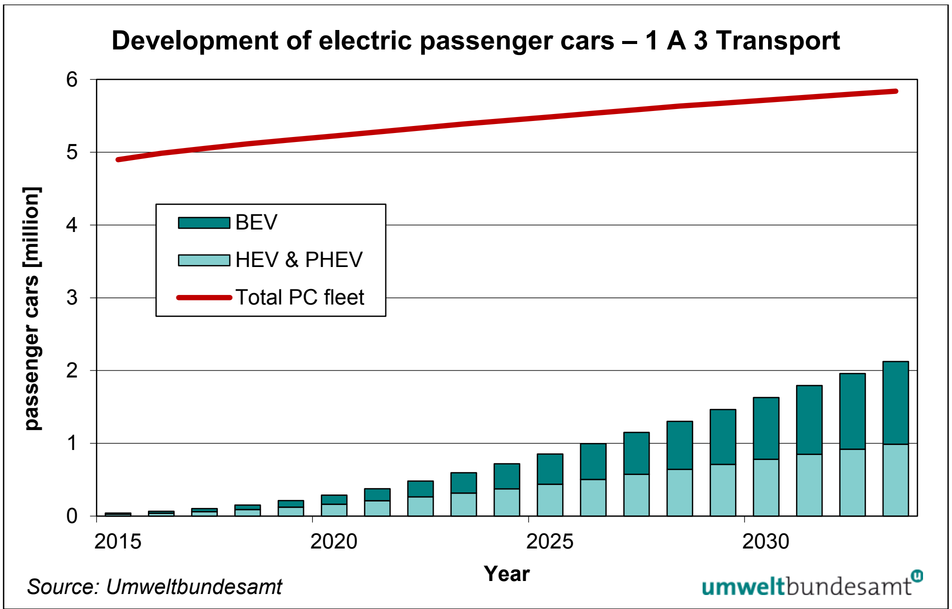

Figure 19: Scenario for electric mobility in Austria.

The following table shows the modal split development in inland passenger transport (excl. fuel export, international aviation and international navigation). The measures included in the WEM scenario will not result in a substantial change in the modal split of passenger transport, as shown in the following chart.

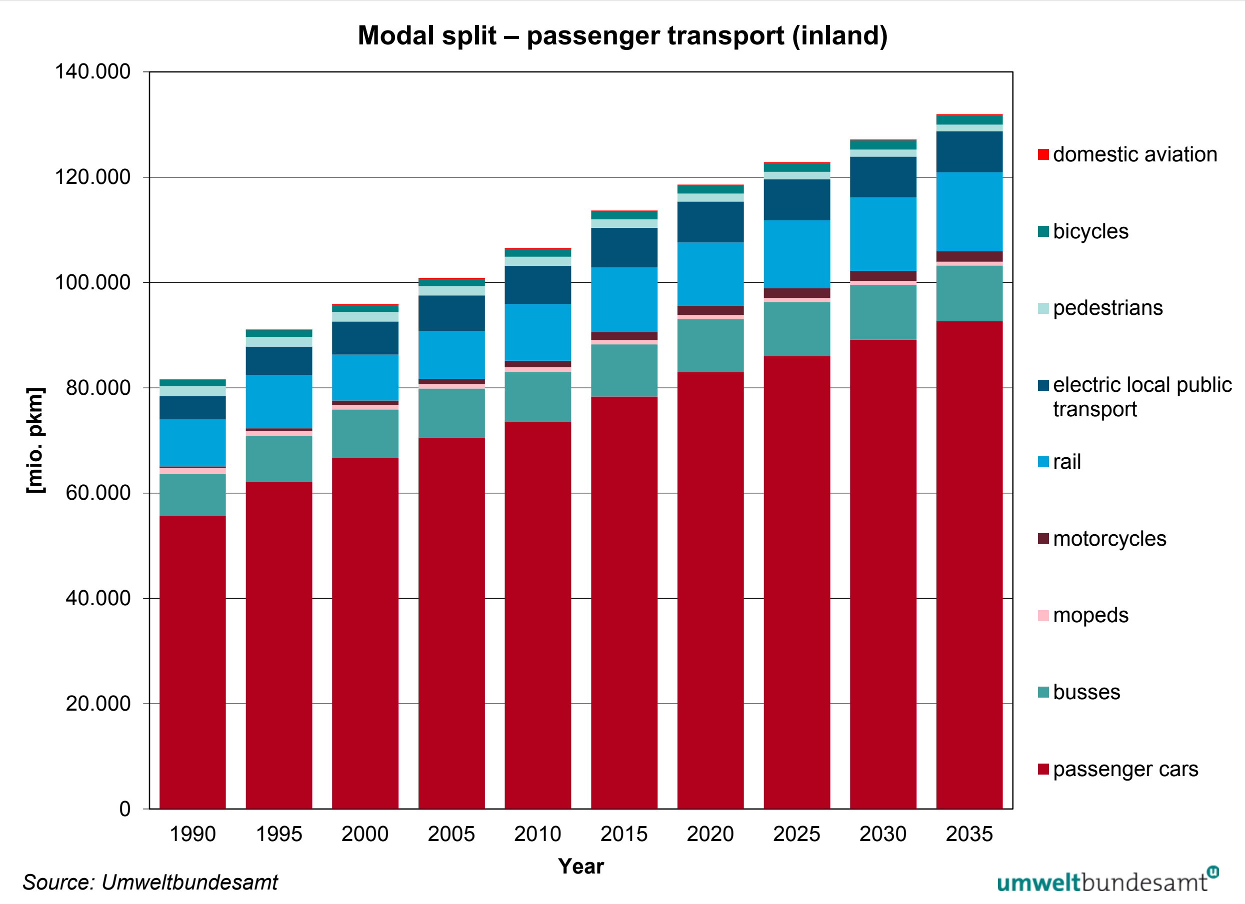

Figure 20: Past trend and scenario (2018–2035) of pkm (excl. fuel export).

This phenomenon of fuel export plays a minor role for passenger transport in the WEM scenario, with an average share of 9% in the total GHG emissions from road transport between 2018 and 2035.

The following table shows the modal split development in inland freight transport (excl. fuel export, international aviation and international navigation). Transport volumes (given in tkm) have increased since 1990 and are expected to increase unimpededly in the WEM scenario following GDP development. Freight rail transport is expected to increase slightly. However, the share of rail transport will stay at around 27% (on average) between 2017 and 2035, because road freight transport – holding the major share – is assumed to grow by 1.3% on average per year. Freight volumes of domestic navigation and aviation are expected to remain constant on a very low level.

The measures included in the scenario will not result in a change in the modal split of freight transport as shown in Figure 21.

Fuel export in heavy duty vehicles continues to play a major role in Austria in the WEM scenario, with an average share of 29% in the total GHG emissions from road transport between 2018 and 2035.

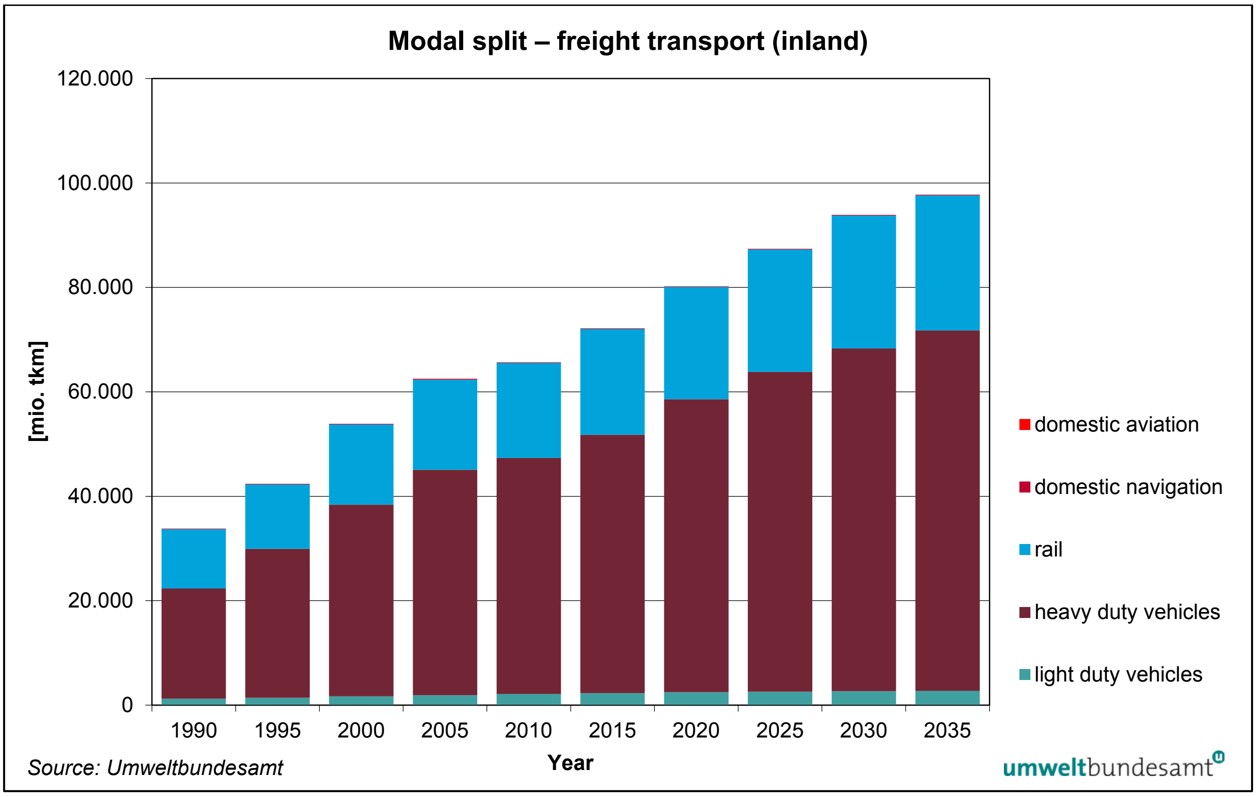

Figure 21: Past trend and scenario (2018–2035) of tkm (excl. fuel export).

1 A 3 e – Other transportation – pipeline compressors

Energy demand has shown some fluctuations in recent years with a peak in 2017. In the future the energy demand is expected to decrease slightly by 0.5%/a.

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, 1.A.4.a Commercial/Institutional (incl. services and institutions), as well as emissions from stationary facilities and mobile sources in Agriculture/Forestry/Fishing 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 2018) 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 2019a). 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 and the Zentrum für Energiewirtschaft (e-think), is referred to as INVERT/EE-Lab. It is a comprehensive dynamic bottom-up simulation tool (TU WIEN & ZEU 2018).

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 (BMWFW 2014, 2017). 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 (2018).

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 the insulation material 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 and 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 residences) is expected to increase by about 11% from 2017 to 2035 (see Annex). This is due to the fact that the trend towards single households is stronger than overall population growth.

As regards the number of residential buildings, an overall increase of 10% is expected from 2017 to 2035, whereas the number of commercial (non-residential) buildings is expected to rise by about 15% during this period.

The total gross floor area of residential buildings is assumed to increase by 12% until 2035, whereas for commercial buildings the total gross floor area is expected to increase by about 16% from 2017 to 2035.

Price assumptions are especially important in this sector because they may influence decisions on which fuels to prefer 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 26–45%) from 2017 to 2035. For biofuels, wood logs, wood chips and wood pellets an increase of around 25% is expected by 2035 over the same time frame. The electricity price is assumed to rise by about 59%, whereas district heat is expected to increase by about 28% 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 the total installation cost), 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 decrease from 1.1% in 2017 to 0.8% in 2035. For residential buildings with one or two apartments (about 87% of the total residential building stock) there is a slightly stronger decrease of renovation rates from 1.1% in 2017 to 0.7% in 2035 and for commercial buildings the rate remains the same at 0.7% in 2017 and in 2035 (see Annex 2).

Model-based results predict a rise in the boiler exchange rate (expressed as a proportion of the gross floor space in the year in which the boiler exchange is performed) in residential buildings with one or two apartments from 2.0% in 2017 to 3.6% in 2035 and in residential buildings with more than two apartments from 1.5% in 2017 to 2.7% within the same time frame. The boiler exchange rate in commercial buildings also rises from 1.1% in 2017 to 2.5% in 2035.

Moreover, the average final energy demand for heating in residential buildings is expected to decrease from 127 kWh/m² gross floor space in 2017 to 95 kWh/m² gross floor space in 2035, while the average heating demand for commercial buildings is expected to decrease from 140 kWh/m² to 107 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/Institutional and 1.A.4.b Residential, which were modelled with INVERT/EE-Lab. For the sector 1.A.4.c Agriculture/Forestry/Fishing 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 2018).

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 57% in the period from 2017 to 2035. Alternative energies like solar heat and ambient energy are expected to increase by 85% and 72% until 2035. As regards log wood, energy consumption is expected to decline by around 30%, 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 32% reduction in the use of heating gasoil is expected for the period until 2035, as well as a 17% decline in natural gas consumption and a 77% decrease in coal use. Total energy consumption without electricity is expected to decline by 14% in the overall sector (w/o mobile sources).

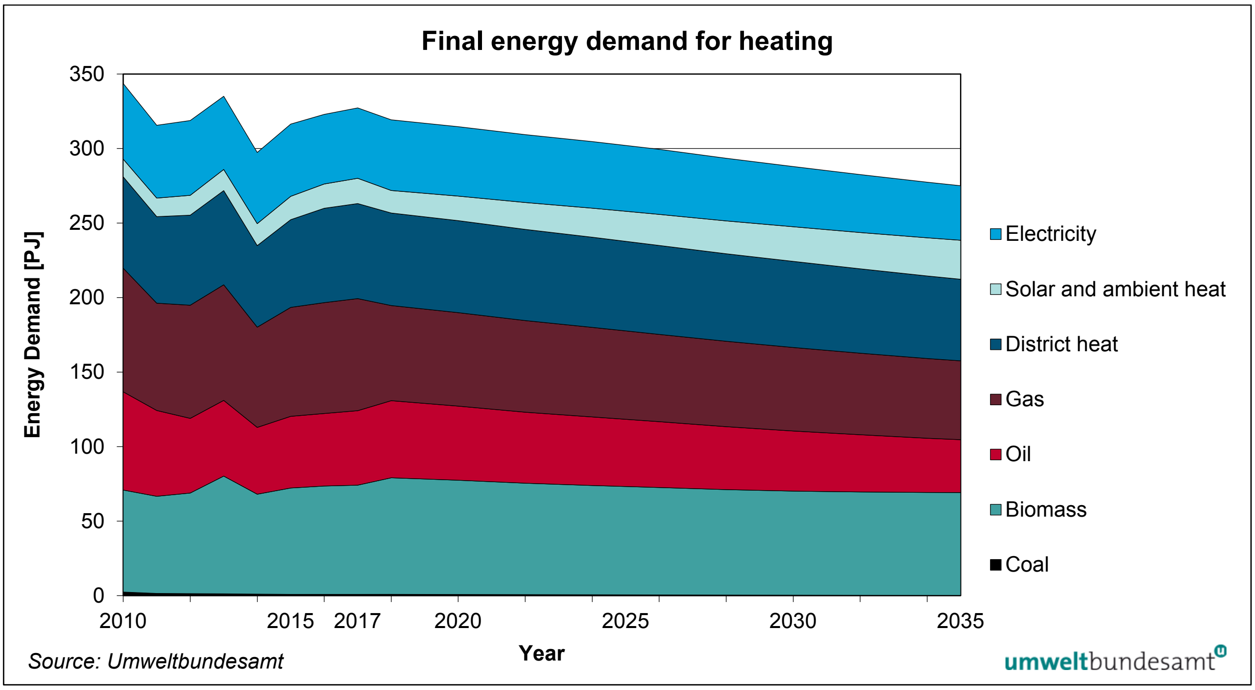

Figure 22: Past trend and scenarios (2020–2035) final energy demand for heating (w/o other electricity use).

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 planned 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 2019a).

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 2017. Projected emissions are calculated by multiplying 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 growth rate for 2013–2017 (250 km/year) so that the result is an increase of 15% from 2017 to 2035, assuming the number of end consumers is constantly growing. CH_4 emissions have been calculated by means of the averaged implied emission factors for 2013-2017.

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 2013–2017 (main and medium range pipeline length = 24% of the length of the distribution network). This results in an estimated growth of about 16% between 2017 and 2035. CO_2 and CH_4 emissions have been calculated by means of the implied emission factors of 2017. 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 m^3 in 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 2017 to 2035, using the implied emission factor of 2017.

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 2018) which is assumed to remain at the same level until 2050.

CH_4 emissions from natural gas processing are calculated by means of the average implied emission factors for the period 2013 to 2017 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 2040. 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

For natural gas consumption, refinery intake and natural gas production, data from the energy projections included in this project are used.

Past trends and scenarios: pipeline and distribution lengths and natural gas storage are presented in Table 7.

Table 7: 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	7 523	31 256	5 700
2025	7 823	32 503	5 700
2030	8 123	33 751	5 700
2035	8 424	34 999	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 Metal Industry and Mineral Industry are expected to see a slight decrease until 2035. Emissions from the Chemical industry show a marginal increase, whereas emissions from other processes (mainly F-gases) are expected to follow a decreasing trend until 2035.

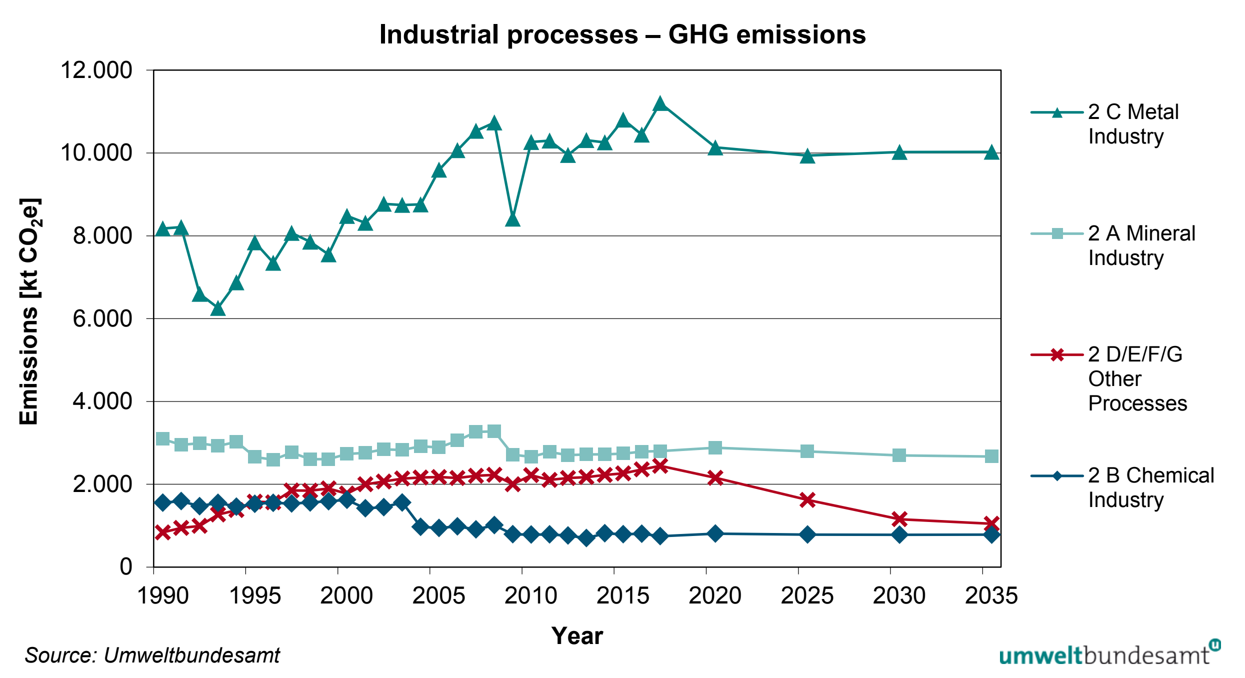

Figure 23: GHG emissions and projections (2020–2035) from Industrial Processes and Product Use.

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

3.2.1.1 Methodology for sectoral emission scenarios

The methodology used here is the same as the one used in the Austrian Inventory, and the emission factors including the methodology are discussed in detail in the Austrian Inventory Report (UMWELTBUNDESAMT 2019a).

3.2.1.2 Assumptions

Mineral Industry

Activities in 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 different sources, according to their historical share in total energy input. 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 increase in ammonia is assumed for the years after 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 2018).

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.

Whereas production of steel continuously increases between 2015 and 2035, the production of ammonia stabilises after 2020 mainly due to a decline in fertiliser demand, for which part of the ammonia is used. Production of cement clinker declines after 2020 due to declining growth rates expected in the non-metallic mineral industry.

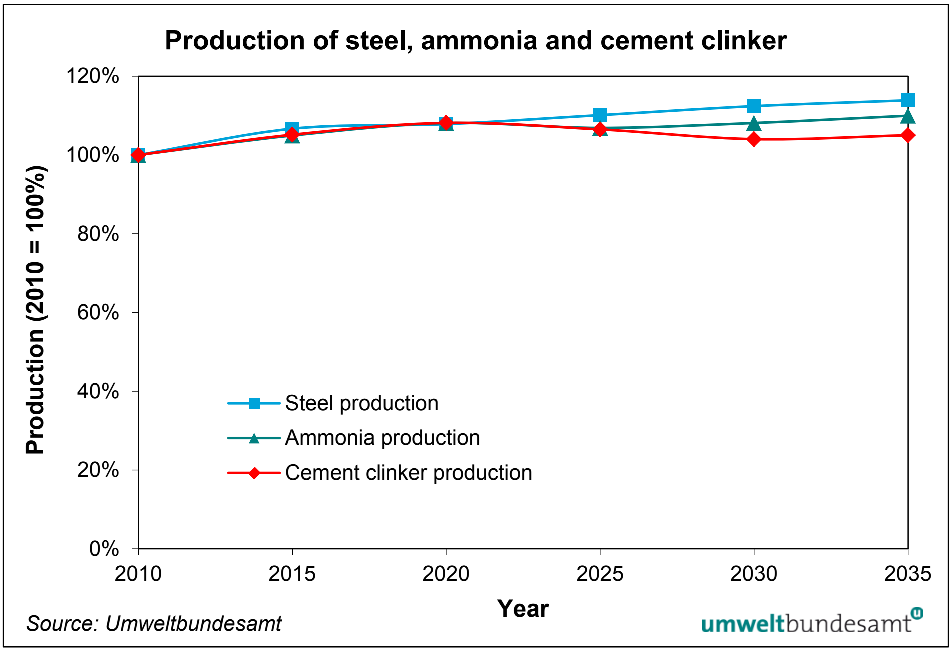

Figure 24: Assumption for the production of steel, ammonia and cement clinker.

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 2.8% 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 a phase down on 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 European 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, in favour of the use of refrigerants with a very low GWP. Certain uses of F-gases, for instance in semiconductor manufacturing, or use as areosols and (in the case of SF_6) in 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 used of F-gases is strictly regulated by the F-Gas Regulation, no further measures are envisaged at the moment.

3.2.2.2 Assumptions

(a) The provisions of the Austrian Ordinance on the bans and restrictions on 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 charged with < 150 g (unless exported) is in force. Consequently, there is a ban on HFCs in domestic refrigerators and freezers as the charge of refrigerant is normally approximately 100 g. Use of HFCs is allowed in refrigeration and air conditioning systems charged with 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 emissions occur only from disposal
- production of commercial refrigeration (including some exported domestic refrigeration equipment) remains constant
- all other sub-categories remain unchanged, assuming growth rates of 1–1.5% for refrigeration and air conditioning and 3% for heat pumps.
- HFCs phase down according to Annex V to the F-Gas Regulation – even though the exact quota is not known as yet, the amount of F-gases used (expressed in CO_2 equivalent) is set to go down to 21% of the average level of 2009–2012. This step-by-step decrease has been 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.

Foam Blowing: The Austrian Ordinance bans the use of fluorinated gases in this sub-category (including the use of XPS foams with a layer thickness of more than 8 cm containing HFCs with a GWP < 300 which had initially been allowed and was banned in 2008). In 2017, there was no foam production in Austria involving the use of F-gases, only the use of some open cell foams continued. Emissions from waste disposal are still occurring (long lifetime of XPS/PU plates) in the years until 2030.

Fire Extinguishers: A constant emission factor of 1.5% is assumed as well as constant annual HFC consumption in the years 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 2010–2017. For HFCs it is assumed that emissions will remain constant after 2020 (as the trend for the past three years is unusually high). Emissions from PFCs, NF_3 and SF_6 are expected to increase according to the trend observed during the past few years.

Electrical equipment: Constant emissions have been assumed for the period after 2017. 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 has been assumed for this sub-category. 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 to 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 has been taken from the national energy balance (total final non-energy use consumption). Lubricants used for 2-stroke engines have not been 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 has been 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
  (according to 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 used either as candles or when incinerated with or without heat recovery, or in wastewater treatment. In case of incineration and wastewater treatment, emissions should be reported in the Energy or Waste sector. It is 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 on candles. Production statistics on candles are only available for the past 8 years. For the years before, the average of the available data has been used for the remaining reporting period. As no statistical data is available on imports and exports before 1995, the years before 1995 have been correlated with population growth.

The quantity 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 trends in others, or a constant development in sectors where technological advances offset an increased use (see Chapter 3.2.3.2 for more details on assumptions.

Basic data for the Austrian Air Emission Inventory come from 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 from data reported under the VOC Directive.

In order to determine the quantity of solvents used for the various applications in Austria, a combination of a bottom-up and a top-down approach has been used. 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 number of employees in that sector, in order to include installations not exceeding 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.

With the 2018 update of the solvent model, recent data from the solvent balances of the majority of solvent-using plants have been used. Respective sub-sectors have been linked to NACE data, so that in most cases projections are based on economic projections. Domestic uses of products containing solvents are based on expected population growth. Emission factors are based on a study conducted in 2000 and updated in 2015 (with recent data obtained from plants) and are considered to remain mostly stable until 2035.

N_2O Emissions from Solvent and Other Product Use

Basic data for the Austrian Air Emission Inventory (OLI) 2018 (data 2017) have been provided by companies selling N_2O or are based on estimates provided by the Austrian Industrial Gases Association ('Österreichischer Industriegasever-band', ÖGIV) and on default emission factors according to IPCC Guidelines. The methodology recommended in the IPCC Guidelines has been applied.

For projections of N_2O emissions from 2 G 'Other Product Use', emissions from 2017 onwards are linked to population growth.

3.2.3.2 Assumptions

CO_2 emissions from lubricant use have been correlated with assumptions based on the national energy balance. About 50% of the emissions arise from transportation and 50% in the metal industry. WEM scenarios for both sectors show constant emissions. Emissions are thus based on the mean of the past five years and assumed to remain constant 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 up to 2035 it is assumed that emissions from domestic use, i.e. use of paints, domestic solvent use and domestic use of pharmaceutical products, are linked to population growth. The other SNAPs that form the basis for the calculation of emissions from this sector are linked to their NACE code, and to the projections for this particular sector. In some cases, expert judgement has been applied, in cases where solvents are re-used or where it can be assumed that solvent use will not increase to the same extent as economic growth (because solvents are only responsible for part of the emissions from this sector).

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 CAP reform in 2013 introduced 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 to the distribution of farm payments in Austria. Regions where cattle and milk production prevails will benefit from these changes.

In June 2018 the European Commission published legislative proposals for a reformed Common Agricultural Policy (CAP), consistent with the proposals of the Multi-Annual Financial Framework for the period 2021-2027, and pursuing nine policy goals. Environmental care and climate change action are specific priorities of the CAP. The European Commission proposes a more flexible system and the policy will shift the emphasis from rules and compliance towards results and performance.

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. Throughout the current period 2015–2020 climate goals have been ranking high on the agenda because climate change mitigation (and adaptation) is a horizontal issue that has to be addressed in all programmes.

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 progress (e.g. adoption of GMO crops in major producing countries, organic food production) will be the main 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 2018).

National energy policies

Austrian energy policy is committed to substitute non-renewable energy sources by 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). A directive aimed at reducing indirect land use change for biofuels and bioliquids entered into force in 2015 (EU 2015/1513). Both measures are channelled to the agricultural sector via the price system: the regulations to boost bioenergy crop production work like a subsidy for farm commodities. Because Austrian sources of feedstock are not favoured over imported ones, relevant production incentives in Austria are dominated by the price signals coming from regional and global markets.

In late 2016, the Commission published a proposal for a revised Renewable Energy Directive to make the EU a global leader in renewable energy and to ensure that the 2030 target is met. The Commission, the Parliament and the Council reached a political agreement in mid-2018. It includes a binding renewable energy target for the EU for 2030 of 32%, with a clause for an upward revision by 2023. The implications for the Austrian energy policy have not yet been determined.

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 2019 (UMWELTBUNDESAMT 2019a).

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 2018).

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. Apart from milk price projections all estimates are derived from OECD-FAO outlooks on agricultural markets (OECD-FAO 2018). Based on previously observed price wedges between the EU and Austria, estimates for the coming periods were made. In a previous analysis (WIFO & BOKU 2015), lower milk prices were assumed for Austria than those forecast by OECD-FAO (2014) for the EU. The reasoning behind this 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. Market reports do not confirm this assumption. Milk prices in Austria have been slightly higher than in most other EU countries (e.g. AMA 2018). Other exogenous economic assumptions for Austria (e.g. GDP or population size) are not necessary but they are embedded in exogenous price assumptions. Other driving forces are prices, technology and constraints.

Other assumptions

- Increase in milk yield per cow from +3% (2020) to +13% (2035) relative to 2017
- Loss of agricultural land following a long-term trend

Main results

Cattle numbers are expected to increase slightly. This result is not consistent with the observed declining trend over the last decades but consistent with previous scenarios (WIFO & BOKU 2015). However, in the current projections (WIFO & BOKU 2018) cattle numbers are significantly lower than expected in 2015. This is mainly due to different price assumptions. Lower levels of projected milk yields per cow are another explanation. The Programme of Rural Development and the coupled alpine farming premium provide favourable conditions for extensive cattle producers even when the premiums are lower than previously assumed. The availability of grassland and relatively high beef prices make production attractive.

Decreasing prices for pork lead to a falling number of pigs. This result is in line with expectations of pig production experts, who predict a decline in production mainly due to limitations in production facilities. This is in contrast to the results in 2015, which indicated a sharp increase. The reason for the difference between 2018 and 2015 lies in the price projections. According to the most recent OECD/FAO projections, prices for pork will be significantly lower.

According to the model results, poultry production will decrease. This result is not consistent with the observed trend (increases in the numbers of poultry). Following international projections (EC 2017), one would expect growing numbers of poultry as well. The model result is the consequence of relative prices. Relatively high feed costs (mainly soya meal) make the production of poultry meat unprofitable. Furthermore, 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 very slightly. This result is consistent with a long-term trend but not consistent with observations of more recent sales data. According to the results of 2015 projections, the amount of nutrient sales was expected to decline significantly, which can be explained by prices and livestock numbers. Relative prices of inputs and outputs are such that it is now more profitable to use purchased inputs than in the projections of 2015. In the projection of 2015, the livestock number is higher than in the current submission. The model assumes that manure is a well-suited substitute for mineral fertiliser with cheap trade options within NUTS-3 regions and therefore a smaller amount of mineral fertiliser is needed.

Scenario 'with existing measures' (WEM)

WEM uses price projections of OECD/FAO from 2018 for the EU, the existing legal framework of regulations in agriculture, farm policies after the reform following the proposals of the European Commission from mid-2018 onwards and climate change measures as implemented in the Austrian agri-environmental programme 2014-2020, as well as assumptions about the programme thereafter. Information on implemented measures can be found 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 2019 (UMWELTBUNDESAMT 2019a).

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 2019a). Gross energy (GE) intake of dairy cows was calculated on the basis of projected milk yields.

Projected livestock data are taken from (WIFO & BOKU 2018).

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.

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 on rice cultivation activities 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.

Projected mineral fertiliser application data are taken from (WIFO & BOKU 2018).

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: data on harvested crops have been taken from (WIFO & BOKU 2018); the fraction burnt in 2017 has been used as activity data for all projected years.

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

After the submission in 2017, LULUCF projections have been recalculated based on new data and methodologies available, in line with the GHG inventory.

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

3.4.1.1 Methodology used for the sectoral scenarios

Emission projections for sector 4.A are based on a study on the GHG balance of the Austrian Forests and their value chain ('CareForParis: Adaptation for carbon efficient forests and the entire wood value chain – pathways supporting the Paris Agreement'[6]) which is currently underway, conducted by the Austrian Research Centre for Forests (BFW), the University of Natural Resources and Applied Life Sciences, Vienna (BOKU), Kompetenzzentrum Holz (Wood K Plus) and Umweltbundesamt. The study includes several scenarios, with a Reference Scenario (R) which corresponds to the existing measures scenario (WEM).

The reference scenario was established based on historical 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. Temperature and precipitation data was fed into the model to simulate climatic conditions (on the basis of a regionalised RCP 4.5 climate scenario). Models for salvage cutting and incidental felling were integrated as well. An in-growth 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 harvested timber volumes and increment were estimated and calibrated iteratively based on the CALDIS model (conducted by the Austrian Research Centre for Forests) and the Forest Sector Model FOHOW2 (conducted by the University of Natural Resources and Applied Life Sciences, Vienna), which has been used for projections of HWP and fuelwood production as well as for wood demand. FOHOW2 (NORTHWAY et al. 2013) is a partial equilibrium dynamic forest sector model simulating Austria's wood product supply chain.

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[6] Project funded by the Climate and Energy Funds (KLIEN) – 9th ACRP call

3.4.1.2 Assumptions

The reference scenario assumes that there will be no policy changes and that wood demand in terms of quantity and composition will correspond to the trend observed over the past few years. Likewise, it is assumed that market participants will not change their behaviour.

GDP growth projections to 2018 were derived from the National Statistics/WIFO; afterwards the OECD long-term forecasts were applied. Oil prices have been taken from the EIA Annual Energy Outlook 2017.

Wood imports are determined in accordance with the future developments of wood export markets. However, a maximum amount has been defined for wood imports in the model to limit wood imports, assuming that the amount of wood available for imports cannot increase forever as demand is likely to rise in other countries as well. The maximum amount has been defined in line with the historical maxima for the period 2000-2016. External supply of recycled paper is limited to 1 million tonnes which corresponds to the level of recent years. .

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 not be continued after 2020. After 2020, 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 as reported for the WEM scenario for energy projections described in Chapter 3.1.

3.4.1.3 Activities

It has been assumed that the area of forest land remains constant. No further split into forest land sub-categories (land conversion to forest land) has been made.

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

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

Methodolgy

Emission projections for the Cropland and Grassland sector are based on projections derived from

- calculations using the PASMA model (Positive Agricultural Sector Model Austria) carried out by the Austrian Institute of Economic Research (WIFO) and 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 2018) and has also been used for the activity data projections for the Agriculture sector (CRF Source Category 3).
- and expert judgements provided by several experts from agricultural institutions in Austria.

Estimates of the area of land use change from cropland to grassland and vice versa are based on the arithmetic means of estimations obtained from expert judgements. Land use changes from cropland/grassland to forest land as well as remaining areas of cropland and grassland are based on the results of the PASMA model with some adjustments for the remaining areas in order to ensure consistency with other land use categories like settlements. In order to take into account the impacts of the ÖPUL programme, the areas managed through the four most important ÖPUL measures have been estimated using the PASMA model as well.

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 2019a).

Assumptions

For a more detailed description of the methodology and assumptions see Chapter 3.3.2.

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: 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 have been calculated to derive the relevant areas for the years 2013–2035. LUC areas from other land use categories which were converted to settlement areas were estimated on the basis of historical trends, overall area consistency for 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, based on the estimated decline in the area of these land use classes.

Other land: Estimates of 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 historical 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 wetland will continue.

Settlements: Expert judgements are based on the assumption of a continuously growing population which will settle mainly in urban and suburban regions, with a corresponding demand for infrastructure. Assumptions for settlement developments are described in detail in the study ÖROK (2015).

Other land: It has been assumed that the annual LUC from forest land to other land remains constant (as in the last years of the historical 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 are 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 historical data on deposited waste. This method assumes that the degradable organic component (DOC) of waste decays slowly over a few decades (IPCC 2006). The Tier 2 method is recommended for the calculation of landfill emissions on a 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 oxidised methane.

CH_4 generation is calculated separately for the different waste types, 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 collected by municipal waste collecting systems. 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’ covers especially residues from the sorting and pretreatment of waste (accounting for 95% of the total ‘non residual waste’ since the the ban on the disposal of untreated waste was introduced).

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 BMNT (Federal Ministry of sustainability and tourism) and delivering data as input to the national Federal Waste Management Plan. The parameters used in the emissions calculation are described in UMWELTBUNDESAMT 2019a.

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 the 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 the 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 a low TOC content (above 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, and a mean value is applied for the years since 2005 and 2009 (lower waste amounts deposited due to the Landfill Ordinance).

Regarding methane recovery, a constantly decrease in recovery rates is assumed due to the decreasing gas generation potential of deposited waste. The assumption is based on historical values 2008–2017 (taken from UMWELTBUNDESAMT 2014 and UMWELTBUNDESAMT 2019b).

The parameters used for emission projections are the same as those used in the (historical) Austrian greenhouse gas inventory (see UMWELTBUNDESAMT 2019a).

3.5.1.3 Activities

Since 2009 disposal of waste on landfills without pre-treatment has no longer been allowed (see 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 the residues from this activity, will 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 treatment, with a share of 5.1% in the total amount deposited in 2017. The basis for the projections for this activity is the mean value of the waste amounts reported for the years 2005 – 2017. 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 8: Past trend (1990–2015) and scenarios (2020–2035) 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	141	141
2025	0.0	141	141
2030	0.0	141	141
2035	0.0	141	141

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 in 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 9).

Table 9: Emission factors for composting and mechanical-biological treatment (Umweltbundesamt).

[kg/t humid waste]	CH_4	N_2O
Biogenic waste composted	0.75	0.1
Mechanically-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% of CH_4 of the 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 2017 levels (loosely piled bulk and wood used 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, a decrease in activities was observed from 2007 to 2012. Since 2012 the amounts have remained on a similar level.

Activity data projections are based on an analysis of the waste amounts treated in MBT plants in recent years and consider current developments in waste legislation. Projections for input amounts have been made for the years 2020, 2025, 2030 and 2035 (see Table 10).

The emission factors used for the projections are in accordance with the Austrian National Inventory Report (UMWELTBUNDESAMT 2019a; see also Table 10).

Anaerobic digestion

Waste amounts treated in anaerobic digestion plants are assumed to remain constant at the level of 2017 as there is no reliable information on the future developments of anaerobic digestion and their effects on activity data. In 2017 a new Ordinance (Abfallbehandlungspflichtenverordnung, Federal Law Gazette II No. 120/2017) was issued requiring a gas-tight cover for storage facilities. Emissions are expected to decrease. For this reason a decreasing emission factor (% of the CH_4 generated) – from 5% (2015) to a minimum of 1% (2030) – is assumed.

3.5.2.3 Activities

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

Table 10: 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	2 883	2 933	2 974	3 002
Mechanically-biologically treated waste	345	254	623	551	439	414	414	414	414
Anaerobically treated waste	0	0	152	378	438	443	443	443	443

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 purposes in district heating plants or on industrial sites. Emissions are therefore reported under CRF sector 1.A – Fuel Combustion. In Austria, only one waste incineration plant without energy recovery was 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 re-opening of this plant (i.e. from 1996 onwards), emissions have been reported under 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 2019a).

Table 11: 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 under CRF sector 1.A – Fuel Combustion.

3.5.3.3 Activities

The 2005 Austrian Waste Incineration Ordinance has sets strict air pollution limits 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 the years until 2035 for incineration activities without energy recovery.

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 as indirect emissions from wastewater after the discharge 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 that proportion of the population that is 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:

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

N_2O_{PLANTS} = total N_2O emissions from plants for the 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-discharge (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:

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

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

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

Data on $N_{effluent\ plants}$ are retrieved from EMREG ('Emissionsregister – Oberflächenwasserkörper', abbreviated 'EMREG-OW'[7]), 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 carried out by ZESSNER & LINDTNER 2005. For the projections, N flows are expected to increase in line with Austrian population growth rates.

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

A detailed description of the methodologies is included in the National Inventory Report 2019 (UMWELTBUNDESAMT 2019a).

3.5.4.2 Assumptions

The following assumptions have been made with regard to N_2O emissions:

- In determining future indirect N_2O emissions, nitrogen effluent increases with population growth and assumptions on the connection rate to waste water treatment plants.
- N_2O emissions from wastewater treatment plants (direct emissions) are expected to increase in line with a rising population. There are no further improvements anticipated regarding the connection rate to wastewater treatment plants (expected to remain at the level of 2017: 95.2%) and the denitrification rate (expected to remain at the level of the mean value for the years 2013 -2017: 80.9%)
- CH_4 from wastewater handling will slightly increase in line with population growth. The connection rate to septic tank systems, however, is expected to remain stable at the level of 2015 (3.1%).
- Data on future population growth has been taken from (STATISTIK AUSTRIA 2018b).

Table 12: Past Trend (1990–2015) and scenarios (2020–2035) – indicators of waste water treatment/management (STATISTIK AUSTRIA 2018b, Umweltbundesamt).

	1990	2000	2005	2010	2015	2020	2025	2030	2035
Inhabitants [1 000]	7 678	8 012	8 225	8 361	8 630	8 942	9 158	9 331	9 447
Connection rate to wastewater treatment plants [%]	59.0	84.3	88.9	93.9	95.0	95.2	95.2	95.2	95.2
Nitrogen effluent [t]	41 031	23 475	17 136	11 998	10 912	11 812	12 044	12 230	12 354

[7] 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)

4 POLICIES & MEASURES

This chapter describes the policies and measures included in the 'with existing measures' (WEM) scenario. In 2019, Austria is not reporting a 'with additional measures' (WAM) scenario as the National Climate and Energy Plan (NCEP) is currently in the process of being developed.

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 Austria's climate policy[8].

- At first, two committees were set up by the Federal Minister of the 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.
- Klimaschutzgesetz-KSG (Federal Law Gazette I No. 106/2011) (Climate Change Act, CCA).

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[8] 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

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. The Climate Change Act stipulates maximum emission quantities for each sector for the period 2008–2012 (according to the targets of the Climate Strategy 2007, BMLFUW 2007). It 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. Due to an amendment in 2017 both entities were merged and placed under the chairmanship of the Ministry of Sustainability and Tourism.

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, to be reported in the National GHG inventory. The Federal Minister of Sustainability and Tourism 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, several climate change programmes are in place at regional level in addition to the national climate strategy. These programmes are complemented by initiatives and actions at the 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, it has not been possible to quantify all the policies and measures included in the scenarios of this report.

In June 2016 a Green Paper was published which launched a broad public consultation process (online and through working groups) that closed in December 2016 (BMWFW & BMLFUW). The results of this consultation were considered in the Austrian Climate and Energy Strategy (#mission 2030), which was finalised in May 2018 (BMNT & BMVIT 2018) and which served as a basis for the preparation of a draft Integrated Energy and Climate Plan according to the Energy Governance Regulation (EU/2018/1999).

Austria has now reached the final stage of development for the Integrated National Energy and Climate Plan (NECP) for the years 2021-2030.

The targets for the forthcoming Integrated National Energy and Climate Plan (such as greenhouse gas emissions reductions, renewable energy, energy efficiency and others) have yet to be decided. A low-carbon development strategy is in preparation.

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, although 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.

General descriptions of the measures can also be found in the following: reports on the sectoral scenarios for energy (AEA 2018, WIFO 2018), transport (TU GRAZ 2018), other sectors – buildings (TU WIEN & ZEU 2018), and agriculture (WIFO & BOKU 2018). 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 the so-called Austrian 'social partners' and other stakeholders, have been considered as well.

It should be considered 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 individual effects of measures are simply added up. Interactions between measures have to be taken into account; 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 measures.

The allocation of the 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 reporting on projections, ensuring consistency between reporting 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 sectors. Two other measures allocated to this sector are national funding mechanisms which provide support to climate friendly projects in various sectors.

Compared to the 2017 submission, reporting on policies and measures has improved, although the number of reported policies has stayed the same. All policies and measures have been reviewed and updated.

Reporting on policies and measures is consistent with the corresponding reporting requirements of the EU and the UNFCCC.

In the following chapters each policy and measure is described, including details on underlying actions, ambitions and assumptions. Summary data can be found in the Annex.

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 for reducing CO_2 emissions from the energy industries, manufacturing industries and industrial processes, as well as N_2O emissions from the chemical industry and CO_2 emissions from aircraft operators. The 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 also considered N_2O emissions in Austria. 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 envisaged 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 previous periods).

Emissions covered by the ETS have fluctuated in the current trading period. As industrial emissions are influenced by several factors, an accurate quantification of the effect produced by the ETS is not possible without in-depth investigation. However, ETS evaluations have shown that the ETS has a positive effect on the scale of ‘cleantech’ innovations (MUULS et al. 2016).

ETS costs comprise the administrative costs and – if allowances have to be purchased – the costs to be paid for the allowances that have to be purchased to cover emissions. Thus the costs vary depending on the circumstances of a particular installation. The price of the allowances has increased to about 20 euros, which is still 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 companies know that the overall number of allowances (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 (considered in WEM): Federal Law Gazette I No. 58/2017

The objective of the domestic environmental support scheme is environmental protection, to be achieved through the prevention and reduction of air pollution, greenhouse gases, noise and waste. The Domestic Environmental Support Scheme provides financial support to projects which improve the environmental performance of the energy, manufacturing and the service industry beyond mandatory standards. The Ministry of Sustainability and Tourism 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 emissions from the use of fossil fuels.

In 2017, more than 99% of the projects funded by the Ministry were climate related. Most of the projects were targeted at mobility (53%), efficient energy use (35%) and renewable energy (12%), with funding being provided for electric cars, the distribution of heat and the switch to LED lighting and biomass heating (BMNT 2018c).

Estimated Impact

According to the latest evaluation (BMNT 2018c), the projects funded in 2017 are expected to achieve an annual CO_2 reduction of approx. 328 ktonnes. The CO_2 savings achieved through these projects funded in 2017 will amount to 1.0 million tonnes by 2020, and to 6.4 million tonnes over the whole lifetime of the projects. About 73% of the total lifetime reductions are expected to be achieved through renewable energy projects and about 25% through projects focusing on energy efficiency. In 2017, final energy savings of about 614 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,
last amended by Federal Law Gazette I No. 58/2017

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 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:

It is estimated that the projects supported so far will 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 potential for GHG emission reductions 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)

The GHG emission reduction effect of individual policies and measures has been estimated where possible. 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.

To quantify the effects of the relevant policies and measures in this sector, it has been assumed that additional/less green electricity production results in less/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 the supply of power and district heating is the main purpose of this policy designed to reduce climate impacts of the energy system. Beyond the traditional use of large-scale hydro-power for electricity generation, quantitative targets have been set for increasing the share of wind power, photovoltaics, small hydropower plants and biomass/biogas in electricity generation in the Green Electricity Act, and are to be achieved by fixed feed-in tariffs. Investment support for biomass-based district heating systems has been 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
Directive 2009/72/EC Internal electricity market (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. 408/ 2017 (Feed-in Tariff Ordinance)	2017

Directive 2009/28/EC on the promotion of the use of energy from renewable sources was implemented through the Green Electricity Act. The Green Electricity Act provides for a harmonised system for promoting electricity production from renewable energy sources by granting fixed feed-in tariffs and investment support, respectively, 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 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.

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

Existing legal provisions for the support of green electricity are effective only until 2020. Though a new law replacing the Green Electricity Act from 2012 is very likely, providing for some form of support after 2012 (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 the Green Electricity Act, an additional 19 PJ (approximately) of electricity will be produced in 2020 in green electricity plants compared to 2016 (adjusted to take account of weather conditions), resulting in emission reductions of about 2 100 kt CO_2 eq. in 2020 and about 3 500 kt CO_2 eq. in 2030 (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 the energy and manufacturing industries is essential if the growing demand for fuel is to be reduced, along with environmental impacts. Based on EU legislation, Austria implemented an Energy Efficiency Directive (2012/27/EU) and prepared a National Energy Efficiency Action Plan in 2017 with quantitative targets for final and primary energy consumption in 2020. In addition, financial support for heat and power cogeneration is granted in order to support 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

Directive 2012/27/EU 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.

The Energy Efficiency Act specifies:

- an energy efficiency target of 1 050 PJ in 2020
- Large businesses 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 expected 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 providing for monitoring and the achievement of legally binding goals and the implementation of measures have to be compiled every three years.

The latest energy efficiency action plan was submitted to the European Commission in April 2017.

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 an energy efficiency obligation scheme and strategic measures (BMWFW 2017). According to the latest energy efficiency action plan 26 PJ of these savings have already been achieved. Most of them have been realised through strategic measures while only about 9 PJ come from energy efficiency obligation schemes for energy suppliers. It has not been possible to quantify the total effect on the projected GHG emissions for the energy and manufacturing industries alone as the reductions in the electricity and district heat demand in other sectors have to be considered as well.

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 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 have been 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 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).

In the future subsidies for new CHP plants will be limited to 12 million euros per year, of which 7 million euros are to be reserved for industrial CHP (Federal Law Gazette I No. 72/2014). However, any additional effects are estimated to be low, because of the low profitability of natural gas-based CHP plants under the current market conditions. Therefore only a few plants producing electricity and heat for industrial processes have been subsidised since 2011, and no support has been provided to new public CHP plants.

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

This chapter lists the WEM measures relevant for the Transport sector. The main objective of these measures is to reduce CO_2 emissions from fossil fuels.

The measures and the 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 Directives on the promotion of renewable energy sources require Member States to replace at least 10% of the fuels used in transport by renewables (biofuels and electricity from renewable energy sources) by 2020, and to replace 14% by 2030. 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 electric mobility initiative envisaged under the national climate and energy strategy (#mission 2030, 'E-Mobilitätsoffensive') stipulates different ways of promoting electric mobility, in order to increase the share of electric vehicles in the Austrian passenger car and truck fleet. An action plan is in place to promote electric mobility and renewable energy in Austria (package for 2017 and 2018) and to provide financial incentives to purchase electric vehicles. It has been extended to the years 2019 and 2020.

GHG affected: CO_2

Type of policy: regulatory, economic

Implementing entity: federal government

Mitigation impact: (see details below)

2030: 4 490 kt CO_2 eq; 2035: 5 751 kt CO_2 eq

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')* and RED II (2018/2001/EC)

Type: EU policy

EU legislation	National Implementation	Start
RED II Directive 2018/2001/EC		
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 – RED I 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. Regarding the renewable energy share within the transport sector, the sub-target of 10% in 2020 will be reached thanks to additional activities. Besides rail and underground, the transport sector also includes cableways or ski lifts which are electrically powered. The amount of renewable electrical energy used is calculated using a factor of 2.5 for rail transport and a factor of 5 for road vehicles.

In November 2016, the European Commission published its 'Clean Energy for all Europeans' initiative. As part of this package, the Commission adopted a legislative proposal for a recast of the Renewable Energy Directive. The RED II Directive (Directive 2018/2001/EC) raises the overall EU target for renewable energy sources consumption by 2030 to 32%. Moreover, Member States must require fuel suppliers to supply a minimum of 14% of the energy consumed in road and rail transport by 2030 as renewable energy. In the current WEM scenario Austria is on track to meet the RED II goal. Electricity will be relevant in road and rail transport from 2021 onwards, due to changes in RED II: factors will change to 1.5 for rail and 4 for road. Electricity consumption for other means of transport will be calculated without using factors.

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 (gasoline). There are standards in place for gasoline fuel (E10) and diesel fuel (B7). This means that at the moment it is possible to blend 10% of ethanol with gasoline fuels and 7% of FAME with diesel fuels. The transport fleets in municipalities and companies have been converted to run on pure biofuels or on fuel with a share of biofuels of more than 40%. This has been promoted especially by 'klimaaktiv mobil', an initiative of the Federal Ministry of Sustainability and Tourism (BMNT – 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 fuel sold. Except for blending, the use of biofuels, e.g. pure FAME for fleets, is expected to decline to zero over the period up to 2020 due to market uncertainties.

Further details can be found in Austria's annual report on biofuels in the Transport sector (BMNT 2018a).

Quantification/Projected GHG emissions/removals:

2030: 2 670 kt CO_2 eq

2035: 2 570 kt CO_2 eq

Action plan for electric mobility and electric mobility initiative (*#mission2030*)

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:

- Provide funding for the purchase of BEV (battery electric vehicle) and PHEV (Plugin Hybrid Electric Vehicle) of different vehicle categories as well as for the installation of charging infrastructure for BEV and PHEV within the framework of the action plan to promote electric mobility and renewable energy in Austria[9]
- Promotion of electric mobility as laid down in *#mission2030*
- 'klimaaktiv mobil' (initiative launched by the Austrian Federal Ministry of Sustainability and Tourism)
- Climate Fund (funding for research and application-oriented promotion e.g. model regions).

The new national climate and energy strategy *#mission2030* (BMNT 2018) puts a focus on "lighthouse projects for electric mobility" as well as on enforced registration of new BEVs for new passenger car registrations ("Schwerpunktverschiebung").

WEM projections for the development of electric mobility are based on a fleet model of the development of electric vehicles (BEV) and PHEV registrations (UMWELTBUNDESAMT 2016, 2018). A comprehensive demand analysis was performed for the period up to 2050. The analysis deals with the temporal development of the effects of six potential barriers to electric vehicle registration (as opposed to vehicles with combustion engines):

- the number of vehicle models announced and expected on the market
- the number of vehicles that are actually (or with an acceptable delivery period) available
- the availability of charging infrastructure
- the vehicle costs
- the vehicle ranges
- the public's subjective attitudes

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. Consumption of renewable electrical energy is calculated using the factor 2.5, for rail transport and the factor 5 for road vehicles. From 2021 onwards, the factors will change to 1.5 for rail and 4 for road, due to changes in the upcoming RED II. For other means of transport electricity consumption will be calculated without using factors. For all modes the renewable share of the domestic electricity generation has to be achieved two years before the reporting year.

[9] For more information see: https://www.bmvit.gv.at/verkehr/elektromobilitaet/foerderungen/emoboffensive.html

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 as well as of buses will be 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 and many freight operators are experimenting with electric vehicles only in a few single pilot projects. Therefore, electric heavy duty trucks are only considered in a very small number in the current projections. Furthermore, rail transport already provides an alternative to long distance road transport. A shift away from road to rail should be aimed for in freight transport. 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), costs and medium-term infrastructure (preparation of standards and providing suitable conditions, construction of charging infrastructure, offering concessions) could be adapted in such a way as to promote electric vehicles.

WEM projections assume that the electric vehicle stock in 2030 will amount to roughly 1.3 million passenger cars and to around two million passenger cars in 2035, which means that one third of the total car fleet will be electrically powered.

Quantification/Projected GHG emission removals:

2030: 1 830 kt CO_2 eq (domestic effects only)

2035: 3 190 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. Although technical progress has, in theory, led to improvements in the efficiency of motors and vehicles, real-world emissions (especially of passenger cars) are slowly decreasing. Moreover, consumer behaviour (i.e. the desire for larger cars and bigger engines with more power) does not usually develop in a way that is favourable to the environment. 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, 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: (see details below)

2030: 2 020 kt CO_2 eq; 2035: 1 090 kt CO_2 eq

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:

2030: 1 080 kt CO_2 eq

2035: 1 050 kt CO_2 eq

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 amended 2014)	2002

Under the Federal Toll Law and the Ordinance of Toll Tariffs, the mileage-based lorry toll has been split into 3 categories (according to the number of axles) since 1 January 2010, differentiated by EURO classes, day- and night-time driving and zero emission vehicles. 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 observations of historical fleet renewal rates after changing toll rates, and on expert estimates by TU Graz, which have all been included in the NEMO model. The potential of an early fleet renewal decreases over time and runs out in 2024. The given future fleet renewal cycle of heavy duty vehicles is determined in the fleet module of the NEMO model, which assumes continuous removal of older vehicles.

Quantification/Projected GHG emissions/removals:

2030: 0 kt CO_2 eq

2035: 0 kt CO_2 eq

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 amended 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 speed on the respective motorway sections were used to calculate the emissions.

Quantification/Projected GHG emissions/removals:

2030/2035: 40 kt CO_2 eq

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 a reduction of 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 (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 achieving a shift in transport activities from road to rail.

GHG affected: CO_2

Type of policy: information, economic

Implementing entity: federal government

Mitigation impact: (see details below)

2030: 480 kt CO_2 eq

2035: 460 kt CO_2 eq

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 Sustainability and Tourism (BMNT) 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, some thousand climate-friendly mobility projects have been initiated – implemented by establishments, cities, municipalities and regions, tourist facilities and schools.

‘klimaaktiv mobil’ also includes the ‘klimaaktiv mobil’ fuel saving initiative (‘klimaaktive Spritsparinitiative’). Training sessions for fuel-efficient driving are offered 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 Sustainability and Tourism 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 over 20 000 people have participated in these programmes.

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

Quantification/Projected GHG emissions/removals:

2030: 390 kt CO_2 eq (domestic effects only)

2035: 370 kt CO_2 eq (domestic effects only)

The CO_2 mitigation potential is kept constant up to 2020.

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 at 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, and 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:

2030/2035: 90 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 Chapter 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. There are interdependencies with PaM N°10 since energy efficiency measures entail for example the exchange of heating systems to switch to renewables and low carbon technologies.

GHG affected: CO_2

Type of policy: regulatory, economic, information

Implementing entity: federal government, federal provinces

Mitigation impact:

476 (67 new building, 409 renovation) kt CO_2 eq in 2020

629 (94 new building, 535 renovation) kt CO_2 eq in 2025

698 (112 new building, 586 renovation) kt CO_2 eq in 2030

638 (97 new building, 541 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 legislation in 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 successive 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 to 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 – all of which impact on 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 41–55 kt of CO_2 equivalent in 2020, depending on when the amendments are carried out in the federal provinces. The upper limit is estimated at 53 kt of CO_2 equivalent in 2025, 53 kt of CO_2 equivalent in 2030 and 45 kt of CO_2 equivalent in 2035, assuming a reference scenario with no changes beyond the second stage of the National Plan until 2035 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-optimal 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 is provided under 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 (building related funding only) will drop by about 31% until 2020, by 65% until 2025, by 88% until 2030 and by 94% 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, last amendment: Federal Law Gazette II No. 213/2017) 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.

Most of the federal provinces in Austria provide financial support to 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 of existing and new (often biomass-fired) district heating systems. Thermal minimum standards for new buildings are defined in the Technical Construction Regulations of the federal provinces, which are based on 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). The final stage of the 'nearly zero energy building' has to be achieved for renovated buildings to be eligible for funding under the Housing Support Scheme by 2050. New residential buildings must overachieve on those requirements (NZEB) by 18% (in terms of the energy needed for heating) in order 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% by 2020, 38% by 2025, 60% by 2030 and 66% by 2035. New building subsidy budgets from the Housing Support Scheme are set to drop about by 8% by 2020, 17% by 2025, 28% by 2030 and 30% by 2035.

All other subsidy funds that are taken into account are assumed to drop by about 19% by 2020, 48% by 2025, 74% by 2030 and 91% by 2035.

The total funding volume for new buildings (nominal value) is expected to decrease from € 379 million per year in 2017 to € 348 million per year in 2020, € 142 million in 2025, € 92 million in 2030 and € 77 million in 2035.

The total budget for thermal insulation subsidies (at nominal value) is expected to decrease from € 227 million per year in 2017 to € 191 million per year in 2020, € 137 million in 2025, € 83 million in 2030 and € 64 million 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 (€ 37 million per year in 2017) will decline and be discontinued after 2030. For further details, see the relevant 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. 58/2017 (last amendment considered in WEM)	2017
	Federal Law Gazette I No. 185/1993	1993

The 'renovation cheque' is an incentive of the federal government that was launched in 2011 to promote the renovation of private buildings. It is planned to remain in place for private households in 2018 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 aimed at owners and tenants of rented apartments in multi-storey buildings and detached/semi-detached family houses. Special emphasis is put on the replacement of fossil fuel oil-fired heating systems ('Raus aus Öl' bonus).

The budget is assumed to drop from € 27 million per year in 2017 to € 23 million per year in 2020, € 14 million in 2025 and € 5 million in 2030. After 2030 funding is set to be discontinued in the WEM scenario.

Quantification/Projected GHG emissions/removals:

The reduction potential is expected to amount to 190–220 kt CO_2 by 2020[10].

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. 58/2017 (last amendment considered in WEM)	2017
	Federal Law Gazette I No. 185/1993	1993

The domestic environmental support scheme fund (UFI), an incentive of the federal government to promote the renovation of commercial and industrial buildings, provides about € 9 million per year for renovation purposes. It is assumed that this instrument will remain in place after 2018.

Funding is available for the thermal renovation of buildings that are more than 20 years old (heat recovery, efficient energy use in industrial processes, optimi-

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

sation or exchange of the heating system). The initiative is aimed at companies and commercial organisations, including registered associations and professional organisations.

The budget is assumed to drop from € 9 million per year in 2017 to € 8 million per year in 2020, € 4 million in 2025 and € 1 million in 2030. After 2030 funding is set to be discontinued in the WEM scenario.

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
Recast of the Energy performance of buildings (Directive 2010/31/EU) amending 2002/91/EC	Federal Law Gazette I No. 27/2012	2012

The aim of the recast of the Directive on the energy performance of buildings (2010/31/EU) is 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 notification 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 a particular building. When selling a building or an apartment the owner is obliged to present an 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. It will therefore be an incentive for sellers to take measures in order to achieve a positive energy performance. A quantification of the emission reductions achieved through this measure 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 other important measure used to achieve a reduction of 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 at 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:

655 kt CO_2 eq in 2020

1 076 kt CO_2 eq in 2025

1.437 kt CO_2 eq in 2030

1.473 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 to 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 up to € 60 million per year. However, allocated funds were considerably lower in the past.

This law (Federal Law Gazette I No. 58/2009) aims at a permanent reduction of up to 3 000 kt of 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. 58/2017; 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, old wood boilers or electric heating are replaced by efficient heating systems based on woodchips or pellets. In addition, solar heating systems are subsidised as well.

This funding initiative, launched in 2012, has been extended until 2019. 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.[11]

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

An increase in energy efficiency in residential electricity demand is a further policy target which is to be achieved by far-reaching 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 to inform people of 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
Information about policy costs is currently not available.

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

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

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

Type: EU policy

EU legislation	National Implementation	Start
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.

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

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
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 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
Regulation (EU) 2017/1369 (repealing Directive 2010/30/EU)		
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 with the amended 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 have been 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, a 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, or 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 a national level in 2002 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 coherent with those of 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, detailed reporting and documentation is strictly required. The use of SF_6 as a filling gas for the sound insulation of windows, shoes, and tyres is now 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 financial support provided by the federal government for housing construction) have been implemented by Agreement 15a B-VG (Austrian Federal Constitutional Law; between the federal government and the federal provinces). An amendment adopted in 2007 includes mainly 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 control of their 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 for 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 to phase out refrigerants with a high GWP in motor vehicles.

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
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.

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, covering of manure storages, low-loss application of manure and biogas slurry,promotion of organic farming, promotion of grazing, reduced usage of mineral fertilisers.

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 the sugar quota and the suckling cow premiums)
- Internal convergence of direct payments ('regional premium' scheme instead of historical 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;
- Programme for rural development 2014–2020 (see above). Assumed to be maintained over the entire projection period.

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

The projections for LULUCF were completely revised in 2016 and 2019. 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 sectors influence emissions/removals in the LULUCF sector as well. 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 current Austrian Rural Development Programme (see PAM N°13) 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 assigns 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 such as 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, all of which are 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
- Ban on 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 decreasing trend in the amounts of deposited waste (and the respective carbon content) is expected to continue, 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. The indicator 'annually deposited waste/CH_4 emissions' also shows this trend (see the Figure 25 below).

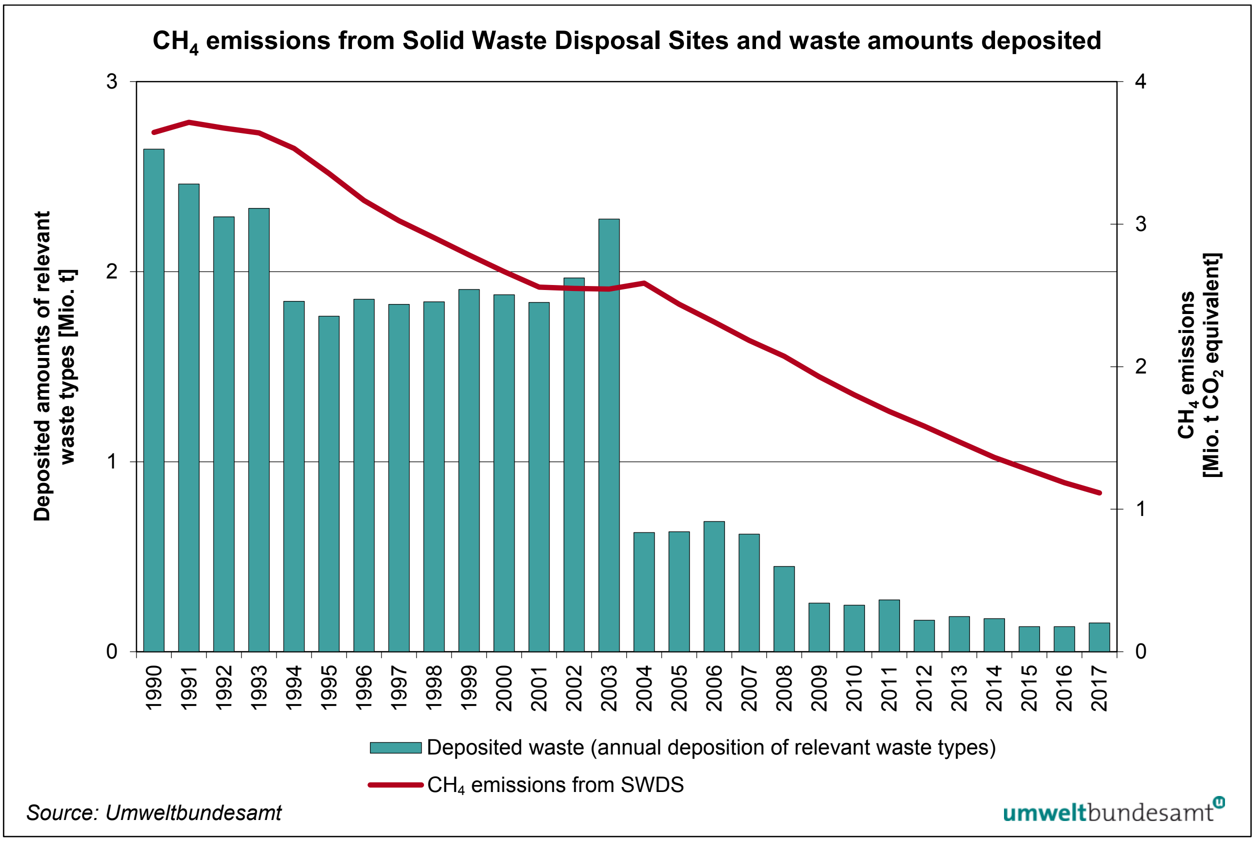

Figure 25: Methane emissions from landfills and annually deposited waste with relevant organic carbon content.

4.11.1 WEM measures for waste

For the Waste sector the following (category-specific) measures, summed up as PAM N°15, 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).

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

In order to reduce the potential for emissions, the generation of waste has to be prevented. To achieve this, 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

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 underway. In the coming years, the focus will be 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 1 114 kt CO_2 equivalent in 2017 to 452 kt of CO_2 equivalent in 2035.

Further provisions as stipulated in the Landfill Ordinance 2008 (water balance management, in-situ stabilisation) and improvements in practical implementation 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. Surveys of gas collection systems conducted in 2014 (UMWELTBUNDESAMT 2014) and 2019 (UMWELTBUNDESAMT 2019b) 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 these studies.

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 unintentional leakages during process disturbances or other unexpected events. Gas-tight covers for storage facilities had become relevant for permits to be granted for biogas plants by the respective authorities even before a legal requirement was established in 2017, when a new ordinance was issued which includes a requirement for gas-tight covers of storage facilities.

Quantification/Projected GHG emissions/removals:

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

Emission from biogas plants will decrease from 21 200 t of CO_2 equivalent in 2017 to 4 700 t of CO_2 equivalent in 2035.

5 CHANGES WITH RESPECT TO SUBMISSION 2017

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 2017 (UMWELTBUNDESAMT 2017) are influenced by four main factors:

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

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

Table 13: Comparison of projections 2011, 2013, 2015, 2017 and 2019 – 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
Projections 2019	78.670	92.567	84.753	78.897	79.669	76.637	73.961	72.298
Difference 2019/17	– 134	– 75	– 306	+ 46	+ 4.276	+ 3.913	+ 4.194	+ 5.024

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

5.1 Energy Industries (1.A.1)

Table 14: Comparison of projections 2011, 2013, 2015, 2017 and 2019 – 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
Projections 2019	14.100	16.397	14.028	10.792	9.873	8.169	7.311	6.824
Difference 2019/17	+ 262	+ 158	+ 40	– 136	+ 930	– 166	– 770	– 774

The major revision of the energy balance shows lower natural gas consumption for category 1.A.1.c in the year 2015 (about –100 kt CO_2). The changes of the years 1990 to 2000 are due to a revised allocation of some waste incineration plants (formerly included in category 1.A.4.a).

The revisions with respect to the latest scenario are due to a slower phase-out of coal fired power plants than expected in previous projections, a revised growth in electricity consumption and recent developments on European electricity markets, leading to an updated projection of electricity prices and updated operation data on fossil fuel plants.

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

Table 15: Comparison of projections 2011, 2013, 2015, 2017 and 2019 – 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
Projections 2019	23.562	27.308	27.322	27.058	27.588	27.029	26.796	27.058
Difference 2019/17	+ 10	– 99	– 147	– 85	+ 1.400	+ 1.238	+ 1.554	+ 1.721

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 2018) has been used. The most recent ecological projections have also been incorporated in the energy projections.

Economic growth (approximately 3 % in 2017 and 2018) leads to a higher energy demand in the industrial branches. For the 2017 projections it had been assumed that the 2020 targets of the Austrian Energy Efficiency Acts would be met. For the 2019 projections these assumptions have been modified. Thus the yearly increase in energy efficiency is back to the historical average.

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

2 F-gases

The calculation model for F-gases is changed regularly, whenever new information is available. The changes made between the 2013 projections and later projections are mostly due to the fact that the calculation model for stationary air conditioning has undergone major changes, leading to an increase in emissions. Also, projection scenarios before 2015 were not based on the EU F-gas regulation or on information on new technologies, which became available at a later date. The difference between the 2017 and 2019 projections is due to new information regarding stationary equipment and real data on the phase-down of cooling agents: double counting of emissions in several sectors (due to the allocation of top-down data) was eliminated on the one hand, andon the other, the reaction of the industries in Austria to the first cut in available cooling agents was slower than expected. Also, new information on low GWP agents and their use in stationary air conditioning has become available. Another issue was the implementation of the MAC Directive: in 2017 it seemed that the phase-out of R134a in cars and small trucks was not going to work as well as expected; two years later, reality showed that theDirective was finally implemented.

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

Table 16: Comparison of projections 2011, 2013, 2015, 2017 and 2019 – 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
Projections 2019	13.975	24.944	22.568	22.676	24.478	24.529	23.669	22.859
Difference 2019/17	– 1	+ 10	+ 38	+ 88	+ 1.770	+ 2.069	+ 2.202	+ 2.631

In the 2019 submission GHG emissions are higher compared to 2017, for several reasons:

- The majority of the lower GHG potential in 2030 and 2035 can be explained by updated assumptions regarding the shares of different propulsion systems in new PC registrations and their respective efficiency rates. As described earlier, the WEM scenario does not include the new legislation on CO_2 emissions for PC, vans and heavy duty vehicles, as the new CO_2 limit value legislation had not come into force before the due date for WEM19 (1 January 2018). Therefore it was not considered as an existing measure.
- Both of the above have a major impact on the updated estimations of the electric-mobility trend. The 2017 submission reflected a very optimistic outlook, whereas the current WEM19 is much more conservative.The share of EV in total new PC registrations in 2030 is thus only 25% (2035: 32%) compared to 35% in the former submission. The main reason for this more conservative outlook for the development of the EV fleet in Austria compared to the 2017 submission is the delayed and insufficient availability (or even unavailability) of a number of EV models that had been announced in earlier years and were expected to be suitable for the mass market.

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

Table 17: Comparison of projections 2011, 2013, 2015, 2017 and 2019 – 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
Projections 2019	14 269	13 651	11 106	9 061	8 579	7 978	7 364	6 800
Difference 2019/17	– 353	– 32	– 191	+ 169	+ 144	+ 634	+ 980	+ 1 282

In the 2019 submission GHG emissions are higher compared to 2017, 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 recent inventory data years, in particular fossil fuel use for heating (+3.2% against 2017 projections in the year 2015) which form the basis for the projections (and the model calibration).
- In the 2019 projections, energy prices for district heat (+17%), electricity (+13%), and fuel wood (+9%) in the year 2035 have been assumed to be significantly higher. All energy prices around the year 2015 have been adjusted based on recent statistical data (increase up to +27% for all prices except electricity –19%). Changes in price assumptions influence decisions on which fuels to prefer for heating systems in the long term, as well as decisions regarding the quality and quantity of thermal renovation activities.
- Assumptions about the development of subsidies for thermal renovation and exchange of heating systems for the period from 2020 onwards until 2035 result in an increase in fossil fuel consumption for heating (+27%) and a higher overall final energy demand for heating (+14%).
- Final energy demand for heating in commercial buildings in the year 2035 is about 30% higher against 2017 projections partly because of an increase in gross floor space (+18%).

5.5 Fugitive Emissions from Fuels (1.B)

Table 18: Comparison of projections 2011, 2013, 2015, 2017 and 2019 – 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
Projections 2019	702	437	468	424	389	318	275	210
Difference 2019/17	0	– 45	– 54	– 53	– 75	– 47	– 31	– 13

The difference between the 2019 and 2017 projections is mainly due to a lower assumption for the yearly increase in the gas distribution network (+250 km/year compared to +267 km/year), derived from the historical 5-year average growth rate.

Since the 2017 projections, a strong decrease has been assumed for future natural gas production, comparable with the assumptions made for the 2011 projections, while in the 2013 and 2015 projections a more constant level (or slight decrease) of natural gas exploration had been assumed.

5.6 Agriculture (3)

Table 19: Comparison of projections 2011, 2013, 2015, 2017 and 2019 – 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
Projections 2019	8 137	7 038	7 103	7 249	7 467	7 545	7 626	7 721
Difference 2019/17	– 52	– 66	+ 9	+ 81	+ 125	+ 199	+ 268	+ 184

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

- New comprehensive survey of agricultural practices in Austria (TIHALO II, PÖLLINGER et al. 2018). The results of this study (data on livestock feeding, management systems and practices, application techniques) were used as the basis for the calculation of Austria's emission inventory submitted in 2019 resulting in revisions of CH_4 and N_2O emissions for all animal related emission sources.
- Methodological improvements of the agriculture inventory model. The main revisions affect methane calculations of 3.B Manure Management for sheep, goats, horses, poultry and deer, which have been improved by applying the IPCC Tier 2 methodology. Furthermore, Austria's N flow has been improved according to the EMEP/EEA GB 2016.

- Revised activity data scenarios as a result of the implementation of new PASMA model results (WIFO & BOKU 2018). In contrast to the data used in the previous projections (WIFO & BOKU 2015), the results obtained from the new model indicate that the number of cattle is expected to be significantly lower than projected in previous projections. This result is driven by different price assumptions and lower levels of expected milk yields per cow. Furthermore, swine and pork production is set to decrease. The reason for the difference compared to previous projections is the expected price for pork, which is set to be significantly lower than projected in 2015. The amount of mineral nutrient sales, likely to decline significantly according to previous projections, is now expected to decline only slightly in the very long run. The reason for these differences is that it is more profitable to use purchased inputs than in the projections of 2015. Furthermore, due to the smaller numbers of livestock according to 2018 data, a higher amount of mineral fertiliser is needed.

The new data on on agricultural practices in Austria had the strongest impact on the revisions.

5.7 LULUCF (CRF Source Category 4)

Table 20: Comparison of projections 2011, 2013, 2015, 2017 and 2019 – 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
Projections 2019	– 11 988	– 10 659	– 5 864	– 4 551	– 4 202	– 3 464	– 2 671	– 3 131
Difference 2019/17	165	96	47	296	3 546	4 637	1 937	1 774

The revisions with respect to the projections 2017 are due to:

- A complete revision of the sector 'forest land' based on a new model
- Update of activity data for cropland and grassland based on the results of a new agriculture model
- Update of emission factors for perennial cropland
- Update of the methodology for soil carbon stock changes in annual cropland remaining annual cropland
- Update of biomass emission factors for settlements

5.8 Waste (CRF Source Category 5)

Table 21: Comparison of projections 2011, 2013, 2015, 2017 and 2019 – 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
Projections 2019	3 925	2 791	2 158	1 638	1 294	1 069	921	827
Difference 2019/17	0	0	0	– 18	– 17	– 14	– 9	– 6

The differences in the revised emissions (as compared to 2017 projections) are mainly due to revisions of activity data included in the national GHG inventory, in particular sub-category 5.A Solid Waste Disposal on Land and 5.D Waste Water Treatment and Discharge.

The majority of the differences in the projection results are triggered by the results of a new study on landfill gas collection in Austria for the years 2013- 2017 (UMWELTBUNDESAMT 2019b). The results show that more methane is collected and treated than previously expected.

Minor differences are due to changes in other sub-categories, e.g. new data on N loads in the effluents of waste water treatment plants for 2016 (showing higher loads than expected).

6 ABBREVIATIONS

AEA ....Austrian Energy Agency

B7 ....Blended diesel with 7% biodiesel (volumetric)

BEV ....Battery Electric Vehicle

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)

BMLFUW............Bundesministerium für Nachhaltigkeit und Tourismus
Federal Ministry of Sustainability and Tourism

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 (UNFCCC)

E5 ....Blended gasoline with 5% ethanol (volumetric)

E10 ....Blended gasoline with 10% ethanol (volumetric)

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

HEV....................Hybrid Electric Vehicle

HVO....................Hydrotreated Vegetable Oil

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
PHEV .... Plug-in Hybrid Vehicle
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

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ANNEX 1: INFORMATION EXTRACTED FROM THE REPORTING TEMPLATE

Emission Projections

Table 22: CO_2 emissions in 2015/2017 and projections 2020–2035 (Umweltbundesamt).

CO_2 [kt]	2015	2017	2020	2025	2030	2035
Total excluding LULUCF	**66 733**	**69 979**	**67 773**	**65 504**	**63 421**	**61 928**
Total including LULUCF	**62 022**	**64 910**	**63 411**	**61 888**	**60 614**	**58 674**
1. Energy	**52 233**	**55 061**	**53 765**	**51 791**	**49 715**	**48 232**
A. Fuel Combustion	52 071	54 923	53 629	51 696	49 645	48 203
1. Energy Industries	10 658	11 066	9 750	8 054	7 201	6 714
a. Public Electricity and Heat production	7 580	8 046	6 944	5 279	4 421	3 929
b. Petroleum Refining	2 804	2 739	2 629	2 633	2 638	2 643
c. Manufacture of Solid Fuels and Other Energy Industries	274	281	177	141	142	142
2. Manufacturing Industries and Construction	10 302	10 900	11 444	11 723	11 962	12 348
3. Transport	22 468	24 046	24 246	24 285	23 417	22 605
a. Domestic Aviation	50	42	46	47	49	52
b. Road Transportation	21 718	23 243	23 457	23 508	22 653	21 854
c. Railways	106	116	118	120	121	118
d. Domestic Navigation	11	10	11	11	11	11
e. Other Transportation	582	634	614	599	584	570
4. Other Sectors	8 594	8 861	8 140	7 586	7 013	6 482
a. Commercial/Institutional	1 263	1 176	1 292	1 200	1 103	1 016
b. Residential	6 507	6 849	6 022	5 553	5 090	4 627
c. Agriculture/Forestry/Fisheries	824	836	827	832	821	839
5. Other	49	50	48	49	51	54
B. Fugitive Emissions from Fuels	162	138	136	95	70	29
1. Solid Fuels	NA	NA	NA	NA	NA	NA
2. Oil and Natural Gas	162	138	136	95	70	29
2. Industrial Processes & Product Use	**14 386**	**14 801**	**13 892**	**13 599**	**13 595**	**13 587**
A. Mineral Products	2 740	2 800	2 881	2 794	2 697	2 668
B. Chemical Industry	699	661	725	708	708	712
C. Metal Production	10 804	11 192	10 126	9 928	10 015	10 028
D. Non-energy products from fuels and solvent use	144	148	159	169	174	178
E. Electronics industry	NO	NO	NO	NO	NO	NO
F. Product uses as substitutes for ODS	NO	NO	NO	NO	NO	NO
G. Other product manufacture and use	NA	NA	NA	NA	NA	NA
3. Agriculture	**112**	**114**	**114**	**112**	**109**	**108**
4. Land Use, Land-Use Change and Forestry	**-4 711**	**-5 069**	**-3 681**	**-2 966**	**-2 188**	**-2 664**
5. Waste	**2**	**2**	**2**	**2**	**2**	**2**
C. Incineration and open burning of waste	2	2	2	2	2	2

Table 23: CH_4 emissions in 2015/2017 and projections 2020–2035 (Umweltbundesamt).

CH_4 [kt]	2015	2017	2020	2025	2030	2035
Total excluding LULUCF	**267.10**	**263.89**	**257.12**	**248.41**	**243.46**	**240.89**
Total including LULUCF	**268.07**	**264.85**	**258.07**	**249.36**	**244.41**	**241.84**
1. Energy	**23.73**	**24.97**	**22.36**	**19.56**	**17.33**	**15.10**
A. Fuel Combustion Activities	13.22	13.41	12.22	10.66	9.11	7.87
1. Energy Industries	1.04	1.04	0.98	0.94	0.92	0.91
2. Manufacturing Industries and Construction	0.88	0.89	1.01	1.04	1.07	1.11
3. Transport	0.46	0.42	0.36	0.31	0.27	0.23
4. Other Sectors	10.84	11.06	9.88	8.37	6.85	5.62
5. Other	0.00	0.00	0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	10.51	11.55	10.14	8.90	8.22	7.23
2. Industrial Processes & Product Use	**1.88**	**1.86**	**1.86**	**1.84**	**1.84**	**1.84**
B. Chemical Industry	1.88	1.86	1.86	1.84	1.84	1.84
3. Agriculture	**186.31**	**188.32**	**191.88**	**195.22**	**198.61**	**202.16**
A. Enteric Fermentation	165.23	166.26	169.59	172.15	174.73	177.55
1. Cattle	154.95	155.38	159.29	161.90	164.53	167.45
2. Sheep	2.83	3.21	2.99	3.00	3.01	2.98
3. Swine	4.27	4.23	4.14	4.10	4.06	4.00
4. Other	3.18	3.43	3.17	3.15	3.13	3.12
B. Manure Management	21.06	22.03	22.27	23.06	23.86	24.59
1. CH_4 Emissions	21.06	22.03	22.27	23.06	23.86	24.59
1. Cattle	16.93	17.91	18.28	19.11	19.96	20.74
2. Sheep	0.11	0.12	0.11	0.12	0.12	0.11
3. Swine	3.27	3.22	3.15	3.12	3.10	3.05
4. Other	0.75	0.78	0.72	0.70	0.69	0.68
5. Waste	**55.19**	**48.75**	**41.01**	**31.79**	**25.68**	**21.80**
A. Solid Waste Disposal	51.01	44.56	36.94	27.91	22.01	18.09
B. Biological Treatment of Solid Waste	3.24	3.24	3.11	2.89	2.67	2.69
C. Incineration and Open Burning of Waste	0.00	0.00	0.00	0.00	0.00	0.00
D. Waste Water Treatment and Discharge	0.93	0.95	0.97	0.99	1.01	1.02

Table 24: N_2O emissions in 2015/2017 and projections 2020–2035 (Umweltbundesamt).

N_2O [kt]	2015	2017	2020	2025	2030	2035
Total excluding LULUCF	**11.74**	**11.76**	**12.07**	**12.07**	**12.07**	**12.12**
Total including LULUCF	**12.20**	**12.23**	**12.53**	**12.49**	**12.45**	**12.46**
1. Energy	**1.96**	**1.97**	**2.03**	**2.03**	**2.04**	**2.06**
A. Fuel Combustion Activities	1.96	1.97	2.03	2.03	2.04	2.06
1. Energy Industries	0.36	0.35	0.33	0.31	0.29	0.29
2. Manufacturing Industries and Construction	0.44	0.44	0.47	0.48	0.50	0.52
3. Transport	0.66	0.70	0.75	0.79	0.82	0.83
4. Other Sectors	0.49	0.48	0.48	0.45	0.43	0.41
5. Other	0.00	0.00	0.00	0.00	0.00	0.00
2. Industrial Processes & Product Use	**0.61**	**0.57**	**0.57**	**0.55**	**0.54**	**0.53**
B. Chemical Industry	0.16	0.13	0.12	0.10	0.09	0.09
G. Other Product Manufacture and Use	0.45	0.44	0.45	0.45	0.45	0.45
3. Agriculture	**8.32**	**8.34**	**8.57**	**8.57**	**8.56**	**8.59**
B. Manure Management	1.49	1.51	1.52	1.53	1.54	1.55
2. N_2O Emissions	1.49	1.51	1.52	1.53	1.54	1.55
1. Cattle	0.88	0.89	0.91	0.92	0.92	0.93
2. Sheep	0.02	0.03	0.03	0.03	0.03	0.02
3. Swine	0.13	0.13	0.12	0.12	0.12	0.12
4. Other	0.06	0.06	0.06	0.05	0.05	0.05
5. Indirect N_2O Emissions	0.40	0.41	0.40	0.41	0.41	0.42
D. Agricultural Soils	6.83	6.83	7.05	7.04	7.02	7.04
1. Direct N_2O Emissions from Managed Soils	5.71	5.70	5.89	5.87	5.85	5.86
2. Indirect N_2O emissions from Managed Soils	1.12	1.13	1.16	1.16	1.17	1.18
5. Waste	**0.86**	**0.88**	**0.90**	**0.91**	**0.93**	**0.94**
B. Biological Treatment of Solid Waste	0.32	0.33	0.33	0.33	0.34	0.34
C. Incineration and Open Burning of Waste	0.00	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	0.60

Table 25: HFC, PFC SF_6 and NF_3 emissions in 2015/2017 and projections 2020–2035 (Umweltbundesamt).

HFC [kt CO_2e]	**2015**	**2017**	**2020**	**2025**	**2030**	**2035**
Total	**1 616**	**1 725**	**1 349**	**1 011**	**679**	**546**
2. Industrial Processes & Product Use	**1 616**	**1 725**	**1 349**	**1 011**	**679**	**546**
E. Electronics Industry	2	4	6	9	12	16
F. Consumption of Halocarbons and SF_6	1 613	1 720	1 343	1 002	666	530
PFC [kt CO_2e]						
Total	**50**	**44**	**40**	**31**	**31**	**31**
2. Industrial Processes & Product Use	**50**	**44**	**40**	**31**	**31**	**31**
E. Electronics Industry	50	44	40	31	31	31
SF_6 [kt CO_2e]						
Total	**310**	**399**	**472**	**276**	**137**	**148**
2. Industrial Processes & Product Use	**310**	**399**	**472**	**276**	**137**	**148**
E. Electronics Industry	42	31	31	30	27	24
G. Other Product Manufacture and Use	266	352	432	237	101	124
NF_3 [kt CO_2e]						
Total	**13**	**12**	**10**	**10**	**10**	**10**
2. Industrial Processes & Product Use	**13**	**12**	**10**	**10**	**10**	**10**
E. Electronics Industry	13	12	10	10	10	10

Parameters for Projections

(according to Annex XII (Table 3) of the Commission Implementing Regulation (EU) No 749/2014)

Table 26: General parameters for projections (Umweltbundesamt).

		2015	2020	2025	2035	2035
Population	1 000	8 630	8 942	9 158	9 331	9 447
Gross domestic product (GDP): Real growth rate	%	1.1%	1.1%	1.4%	1.8%	2.1%
Gross domestic product (GDP): Constant prices	constant EUR million (2016 prices)	351 280	385 810	414 099	443 956	479 502
Gross value added (GVA) total industry	constant EUR million (2016 prices)	60 389	69 708	76 401	82 974	90 208
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	16	23	35	44
International (wholesale) fuel import prices: Electricity Coal	EUR/GJ	2	3	3	4	4
International (wholesale) fuel import prices: Crude Oil	EUR/GJ	8	14	16	17	18
International (wholesale) fuel import prices: Natural gas	EUR/GJ	7	9	10	10	11
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	5	7	8	10	11
Coal, households	EUR/GJ	10	14	16	19	21
Heating oil, industry	EUR/GJ	11	16	17	18	19
Heating oil, households	EUR/GJ	19	27	29	31	32
Transport, gasoline	EUR/GJ	38	48	50	52	53
Transport, diesel	EUR/GJ	31	41	43	46	46
Natural gas, industry	EUR/GJ	11	12	12	13	14
Natural gas, households	EUR/GJ	23	26	27	28	29
National retail electricity prices (with taxes included)						
Industry	EUR/kWh	0.09	0.09	0.10	0.11	0.11
Households	EUR/kWh	0.18	0.19	0.24	0.27	0.28

* *All prices are in EUR 2016 prices*

Table 27: 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]	**1 415**	**1 464**	**1 467**	**1 474**	**1 485**
Coal	136	125	112	106	106
Oil	508	539	539	526	516
Natural gas	288	297	285	280	272
Renewables	416	447	461	478	510
Nuclear	NO	NO	NO	NO	NO
Other	32	34	34	34	35
Gross electricity production [TWh]	**62**	**70**	**70**	**71**	**77**
Coal	5.1	4.2	3.0	2.2	2.2
Oil	0.9	0.3	0.3	0.3	0.3
Natural gas	7.7	8.6	7.5	7.0	6.0
Renewables	47.4	56.0	58.0	59.8	66.8
Nuclear	NO	NO	NO	NO	NO
Other	0.8	1.2	1.2	1.2	1.2
Total net electricity imports	11.3	5.9	10.0	13.6	12.7
Final energy consumption [PJ]	1 140	1 155	1 171	1 180	1 190
Gross final energy consumption	1 179	1 251	1 264	1 272	1 281
Industry	301	337	353	370	391
Transport	403	429	437	439	437
Residential	264	265	257	247	236
Agriculture/Forestry	12	12	13	13	14
Services	111	112	112	112	112
Other	NO	NO	NO	NO	NO

Table 28: 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	113 671	119 416	123 693	127 984	132 941
Freight transport tonnes-kilometres (all modes)	million tkm	72 121	81 656	88 733	95 096	98 417
Final energy demand for road transport	TJ	322 581	341 254	346 364	346 643	341 796
Buildings parameters						
Number of households	1 000	3 831	3 992	4 126	4 230	4 318
Household size	inhabitants/ household	2.25	2.24	2.22	2.21	2.19
Assumptions for the Agriculture sector						
Livestock: Dairy cattle	1 000 heads	534	550	557	565	568
Livestock: Non-dairy cattle	1 000 heads	1 424	1 428	1 439	1 450	1 457
Livestock: Sheep	1 000 heads	354	374	375	376	373
Livestock Pig	1 000 heads	2 845	2 762	2 736	2 710	2 666
Livestock: Poultry	1 000 heads	15 772	14 662	13 999	13 336	13 175
Nitrogen input from application of synthetic fertilizers	kt nitrogen	121	128	126	123	122
Nitrogen input from application of manure	kt nitrogen	124	126	127	128	130
Nitrogen fixed by N-fixing crops	kt nitrogen	IE	IE	IE	IE	IE
Nitrogen in crop residues returned to soils	kt nitrogen	75	79	78	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	140 603	140 603	140 603	140 603
Share of CH_4 recovery in total CH_4 generation from landfills	%	10	9	9	8	7

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 29: 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	Reg	WEM	Ngov, Reg

CC = cross-cutting, EnS = Energy Supply, EnC = Energy Consumption, Tra = Transport, IP = Industrial processes and Product 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 30: 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 the service industry. The Ministry of Sustainability and Tourism puts the focus of its funding policy on climate change. Most projects are targeted at mobility (53%), efficient energy use (35%) and renewable energy (21%).
3	Austrian Climate and Energy Fund (KLI.EN)	• framework policy • multi-sectoral policy	In 2007, the Federal Government established a specific fund (Climate and Energy 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 and development of renewable energy systems, development and testing of new transport and mobility systems and the 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 to increase the share of wind power, photovoltaics, small hydro-power plants and biomass/biogas in electricity generation in the Green Electricity Act and shall be achieved by fixed feed-in tariffs. A new law to extend the scope beyond 2020 is under discussion.
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 latest National Energy Efficiency Action Plan in 2017 with quantitative targets for final and primary energy consumption in 2020. In addition, financial support for heat and power cogeneration has been 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, and 14% by 2030. 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 electric mobility initiative envisaged under the national climate and energy strategy (#mission 2030) stipulates different ways to promote electric mobility in order to increase the share of electric vehicles in the Austrian passenger car and truck fleet.
7	Increase fuel efficiency in road transport	• efficiency improvements of vehicles improved behaviour	Mineral oil taxes and tolls for trucks 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. Other instruments like speed limits, established in response to other environmental concerns, contribute to reducing 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-motorised transport	The programme 'klimaaktiv mobil' for mobility management and awareness raising is an essential tool for the promotion of environmentally friendly transport modes (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	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 provided by sellers and landlords in the course of real estate or rental transactions.
10	Increased share of renewable energy for space heating	• efficiency improvements of buildings • increase in renewable energy	Awareness raising measures on federal (klimaaktiv programme) level and in the federal provinces about the advantages of modern heating systems are expected to increase the boiler exchange rate. Financial support for bio-mass and solar heating systems is provided for households via funding provided by the federal provinces and the Austrian Climate and Energy Fund, along with support for commercial and industrial applications provided by the Domestic Environ-ment 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 dis-trict 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 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 of and restrictions on the use of (partly) fluorinated hydrocarbons and SF_6 by (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 fertiliser/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). It includes measures such as improvement of feeding for 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.

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). Methane emissions from mass landfills are reduced through 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). Biogas plants, treating biogenic waste, gas-tight coverage of storage facilities are obligatory, in order to avoid unintentional leakages. In order to minimise the generation of waste, awareness raising campaigns and networks have been established to minimise especially food waste and to encourage the re-use of waste.

Table 31: 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 ● Fuel Quality Directive 2009/30/EC ● RES directive 2009/28/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
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 ● Waste Management Framework Directive 2008/98/EC

ANNEX 2: ADDITIONAL KEY PARAMETERS FOR SECTORAL SCENARIOS

Energy Industries

Table 32: Projected fuel input into main activity power and heat plants (Umweltbundesamt).

Energy [TJ]	2015	2020	2025	2030	2035
Bituminous Coal and Anthracite	24 980	17 872	6 751	0	0
Residual Fuel Oil	3 203	69	88	113	144
Natural gas	64 718	68 344	57 024	52 899	43 975
Waste	10 004	17 161	17 161	17 161	17 161
Biomass	65 845	62 383	60 849	59 319	59 175
Hydropower	131 675	148 466	149 604	149 604	152 520
Wind power	17 425	27 109	29 688	32 440	49 745
Photovoltaics	3 374	6 521	9 241	12 324	16 705
Geothermal	591	1 506	3 160	3 059	2 862

Manufacturing Industries and Construction

Table 33: Projected fuel input into autoproducer power and heat plants (Umweltbundesamt).

Energy [TJ]	2015	2020	2025	2030	2035
Bituminous Coal and Anthracite	21 034	18 859	19 304	19 441	19 528
Residual Fuel Oil	7 434	8 053	8 136	8 162	8 168
Natural gas	11 606	13 447	14 308	15 444	16 620
Waste	7 615	1 963	1 963	1 963	1 963
Biomass	22 649	19 550	20 862	22 255	23 765
Hydropower	1 725	1 946	1 946	1 946	1 946
Wind power	0	0	0	0	0
Photovoltaics	0	0	0	0	0
Geothermal	162	172	186	202	221

Table 34: Final energy demand of industry (Umweltbundesamt).

Energy [TJ]	2015	2020	2025	2030	2035
Coal without coke	6 266	5 833	5 804	5 768	5 843
Coke	6 622	6 075	6 056	6 104	6 160
Light Fuel Oil	352	360	370	384	405
Heavy Fuel Oil	6 266	6 570	6 695	6 794	6 927
Other petr. Products	16 910	17 001	17 502	18 047	18 858
Natural gas	110 191	117 203	119 599	121 575	124 694
Derived gas	3 621	6 350	6 402	6 453	6 456
Waste	12 313	13 073	13 216	13 305	13 634
Biomass	50 983	64 513	68 109	71 433	75 605
Electricity	90 984	100 679	108 777	117 873	129 297
Heat	10 838	12 571	14 438	16 423	18 741

Transport

Energy [TJ]	2015	2020	2025	2030	2035
Gasoline fossil	65 368	64 431	63 778	61 974	58 704
Diesel fossil	231 450	286 169	289 055	279 696	273 534
Bioethanol	2 506	3 725	4 120	4 004	3 792
Biodiesel	15 330	18 029	18 210	17 621	17 233
Vegetable oil	4 053	0	1 360	9 851	9 632
BIO ETBE	344	219	217	211	200
LPG	573	295	0	0	0
Natural gas	725	142	187	224	218
Biogas	35	0	0	0	0
H2	0	0	0	0	0
Coal	5	4	4	3	3
Electricity rail	5 771	7 624	8 147	8 719	8 960
Electricity road transport	88	729	3 398	8 499	15 488
Aviation jet fuel	30 463	33 051	33 417	33 922	34 805

Table 35: Energy consumption of mobile sources by fuel (Umweltbundesamt).

Residential, Commercial & Other Sectors

Energy [TJ]	2015	2017	2020	2025	2030	2035
Coal	880	881	813	570	348	217
Biomass	71 370	73 283	76 653	72 693	69 826	68 994
Oil	48 088	49 963	49 732	45 087	40 327	35 466
Natural gas	73 107	75 203	62 714	59 326	56 042	52 904
District heat	58 854	63 770	61 728	60 083	57 774	54 732
Solar and ambient heat	15 683	16 974	16 485	20 179	23 254	26 182
Electricity	117 628	118 765	121 902	124 237	124 375	123 738

Table 36: Final energy demand of households and commercial for heating (w/o other electricity use) (Umweltbundesamt).

Price, real [€/MWh]	2015	2017	2020	2025	2030	2035
Natural gas	86	82	92	97	102	106
Heating and other gas oil	73	68	80	89	95	99
Coal	51	49	54	57	59	62
Electricity	151	149	160	203	230	238
Wood log and wood briquettes	45	45	48	50	53	55
Wood chips	37	35	39	41	42	44
Wood pellets	48	47	52	54	57	59
District heat	72	72	81	84	88	92

Table 37: Assumptions for energy prices for households and commercial (Umweltbundesamt).

Table 38: Assumptions on subsidy rates (Umweltbundesamt).

Subsidy rates [%]	2015	2017	2020	2025	2030	2035
Wood log and wood briquettes	20	20	20	20	20	20
Wood chips	20	20	20	20	20	20
Wood pellets	23	23	23	23	23	23
District heat Vienna	15	15	15	15	15	15
District heat Other	15	15	15	15	15	15
District heat biomass	23	23	23	23	23	23
Heat pump	5–15	5–15	5–15	5–15	5–15	5–15
Solar heat	20–25	20–25	20–25	20–25	20–25	20–25

Table 39: Assumptions for the number and size of buildings, and the number of permanently occupied dwellings (Umweltbundesamt).

Number of buildings		**2015**	**2017**	**2020**	**2025**	**2030**	**2035**
residential buildings	[number in 1 000]	1 877	1 904	1 951	2 008	2 051	2 086
residential buildings with one or two apartments	[number in 1 000]	1 631	1 655	1 694	1 741	1 777	1 804
residential buildings with more than two apartments	[number in 1 000]	245	249	257	267	275	282
commercial buildings	[number in 1 000]	190	193	197	206	214	222
Size of buildings		**2015**	**2017**	**2020**	**2025**	**2030**	**2035**
residential buildings	[million m² gross floor area]	488	497	512	530	546	559
residential buildings with one or two apartments	[million m² gross floor area]	278	283	291	300	308	314
residential buildings with more than two apartments	[million m² gross floor area]	210	214	221	230	238	245
commercial buildings	[million m² gross floor area]	167	169	174	181	189	197
Number of dwellings		**2015**	**2017**	**2020**	**2025**	**2030**	**2035**
Permanently occupied dwellings	[number in 1 000]	3 831	3 889	3 992	4 126	4 230	4 318

Table 40: Final energy demand for heating, renovation rates and boiler exchange rates (Umweltbundesamt).

Final energy demand for heating (average)*		**2015**	**2017**	**2020**	**2025**	**2030**	**2035**
residential buildings	[kWh/m².a]	130	127	121	111	102	95
commercial buildings	[kWh/m².a]	143	140	134	125	115	107
renovation rate**	**[%]**						
residential buildings with one or two apartments		1.0	1.1	1.0	1.1	1.0	0.7
residential buildings with more than two apartments		1.1	1.1	1.0	1.1	1.1	0.8
commercial buildings		0.7	0.7	0.6	0.7	0.7	0.7
boiler exchange rate***	**[%]**						
residential buildings with one or two apartments		1.8	2.0	2.6	3.1	3.6	3.6
residential buildings with more than two apartments		1.4	1.5	1.9	2.2	2.5	2.7
commercial buildings		1.9	1.1	1.4	2.0	2.3	2.5

* *m² gross floor space*

** *proportion of gross floor space in the year in which the measures expressed in full renovation equivalents are performed*

*** *proportion of gross floor space in the year in which the boiler exchange is performed*

Fugitive Emissions from Fuels

Table 41: 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	7 523	7 823	8 123	8 424
Gas distribution network [km]	30 067	31 402	31 256	32 503	33 751
Natural gas production [million m³]	1 197	1 126	1 126	745	516
Refinery crude oil input [PJ]	378	349	337	338	338
Natural gas storage capacities [Mio m³]	5 317	5 700	5 700	5 700	5 700

Agriculture

Table 42: Livestock population cattle 2015 and 2017 and projections 2020–2035 (Umweltbundesamt).

Year	Population size [heads]	
	Dairy (WEM)	Non-Dairy (WEM)
2015	534 098	1 423 512
2017	543 421	1 400 055
2020	549 709	1 428 363
2025	557 324	1 439 421
2030	564 939	1 450 480
2035	568 333	1 456 941

Table 43: Livestock population other animals 2015 and 2017 and projections 2020–2035 (Umweltbundesamt).

	Population size [heads]					
Year	Swine	Sheep	Goats	Poultry	Horses	Other
2015	2 845 451	353 710	76 620	15 771 551	120 000	41 812
2017	2 820 082	401 480	91 134	15 771 551	130 000	41 812
2020	2 761 684	373 735	81 848	14 661 665	119 177	41 376
2025	2 735 832	375 035	82 972	13 998 616	118 592	41 008
2030	2 709 980	376 335	84 095	13 335 567	118 008	40 641
2035	2 665 649	373 011	83 304	13 175 024	118 096	40 625

Table 44: Milk production and mineral fertiliser use for 2015 and 2017 and projections (2020–2035) (Umweltbundesamt).

	Ø milk yield per dairy cow (kg/yr)					
year	2015	2017	2020	2025	2030	2035
Ø milk yield per dairy cow (kg/yr)	6 579	6 865	7 097	7 266	7 435	7 773
Mineral fertiliser use (t/year)	120 934	120 163	128 083	125 583	123 083	122 168

ANNEX 3: USE OF NOTATION KEY "IE"

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

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This report presents information on greenhouse gas emission projections for Austria and relevant policies and measures, according to reporting obligations as defined in the EU Monitoring Mechanism Regulation (525/2013/EU). It includes greenhouse gas projections for the coming years up to 2035 and describes the policies and measures currently in place to reduce emissions from each source.
The results are based on the scenario "with existing measures", which takes into account climate change mitigation measures implemented in Austria before 1 January 2018.
The scenario presented in the report shows a 1.3 per cent increase in greenhouse gases from 1990 to 2020 and an 8.1 per cent decrease from 1990 to 2035.
This future trend for the period 2017–2035 is mainly driven by a decrease in the Energy (minus 13% or 7.0 $MtCO_{2e}$) and Industrial Processes sector (minus 16% or 2.7 $MtCO_{2e}$).

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