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GHG Projections and Assessment of Policies and Measures in Austria

Reporting under Regulation (EU) 2018/1999

15 March 2021

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REPORT
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PREAMBLE

This report presents Austria's greenhouse gas emission projections for 2020, 2025, 2030, 2035 and 2040.

The projections for the greenhouse gases and their development include a scenario 'with existing measures' (WEM) and a scenario 'with additional measures' (WAM). The former takes into account mitigation measures implemented by 1 January 2018. The latter is based on policies and measures specified in the Integrated National Energy and Climate Plan for Austria (December 2019).

Additional measures to meet the current 2030 target as well as the enhanced ambition for 2030 are currently under discussion and have therefore not be included in the modelling exercise.

Furthermore, the effect of the current health crisis (Covid-19 pandemic) on energy demand and emissions has not been considered in the scenario analysis, as final data for 2020 was not available at the time of preparation and further short-term impacts of the crisis itself are still unclear.

Therefore, a full update will be submitted in 2023, together with additional policies and measures to comply with the national targets for 2030.

The emission projections provided in this report are based on economic scenarios for the period up to 2040. 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 the generation of electricity, energy and heat were carried out by the University of Technology in Vienna and the Austrian Energy Agency (AEA). For transport, agricultural and waste 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 is in compliance with the requirements for reporting according to Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action, and with the UNFCCC Guidelines FCCC/CP/1999/7 (Guidelines for the preparation of National Communications by Parties included in Annex I to the Convention) for national reports on climate change.

CONTENTS

SUMMARY

This summary provides an overview of the projections for the scenario "with existing measures" (WEM) and the scenario "with additional measures" (WAM).

The main results of the five CRF sectors (without LULUCF) and of all greenhouse gases are presented in CO_2 equivalent units. Trend graphs include GHG totals by category and by gas.

Total GHG emissions

Emissions (without LULUCF) increased by 1.8% from 1990 to 2019, i.e. from 78.4 Mt of CO_2 equivalent in 1990 to 79.8 Mt in 2019. The "with existing measures" (WEM) scenario shows a decrease of 11.6% from 1990 to 2040, i.e. from 78.4 Mt of CO_2 equivalent in 1990 to 69.3 Mt of CO_2 equivalent in 2040. The WAM scenario shows a decrease of 22.1% between 1990 and 2040 to 61.1 Mt CO_2 equivalent in 2040.

Figure 1: Past trend and scenarios (2020–2040): total GHG emissions (without LULUCF).

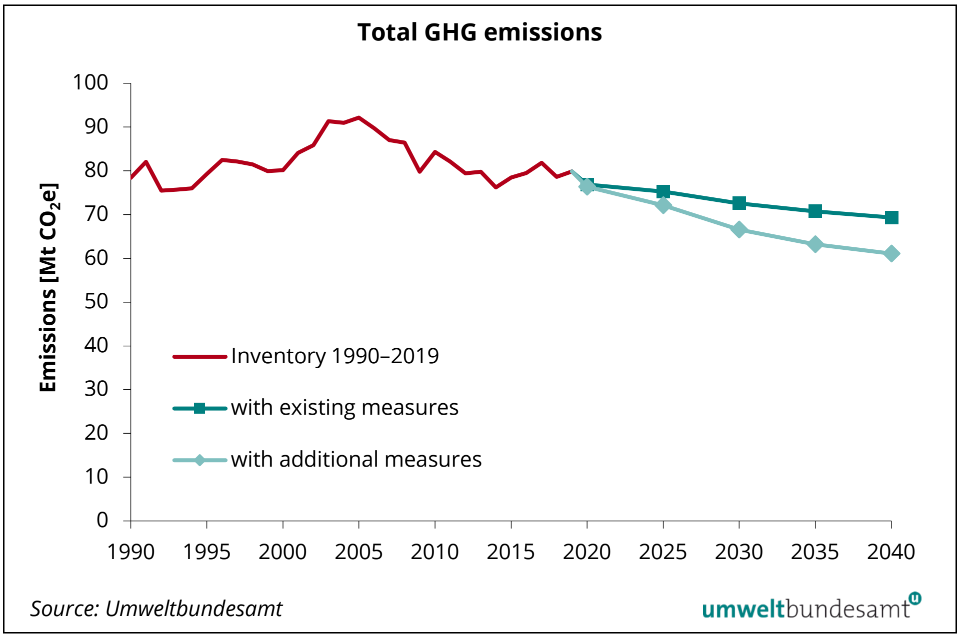


Table 1: Historical trends and projections (2020–2040): greenhouse gas emissions (without LULUCF) – scenario "with existing measures" (WEM). (Umweltbundesamt)

	Inventory trend [kt CO_2 eq]				Emissions 'with existing measures' [kt CO_2 eq]				
	1990	**2005**	**2015**	**2019**	**2020**	**2025**	**2030**	**2035**	**2040**
Total (without LULUCF)	78 420	92 147	78 462	79 842	76 885	75 232	72 540	70 719	69 329
1 Energy	52 804	66 869	53 085	55 048	53 715	52 207	50 077	48 485	47 142
2 Industrial Processes	13 570	15 467	16 552	16 383	14 854	14 828	14 316	14 076	13 986
3 Agriculture	8 120	7 017	7 274	7 152	7 110	7 192	7 272	7 364	7 458
5 Waste	3 926	2 794	1 551	1 260	1 206	1 005	874	794	742

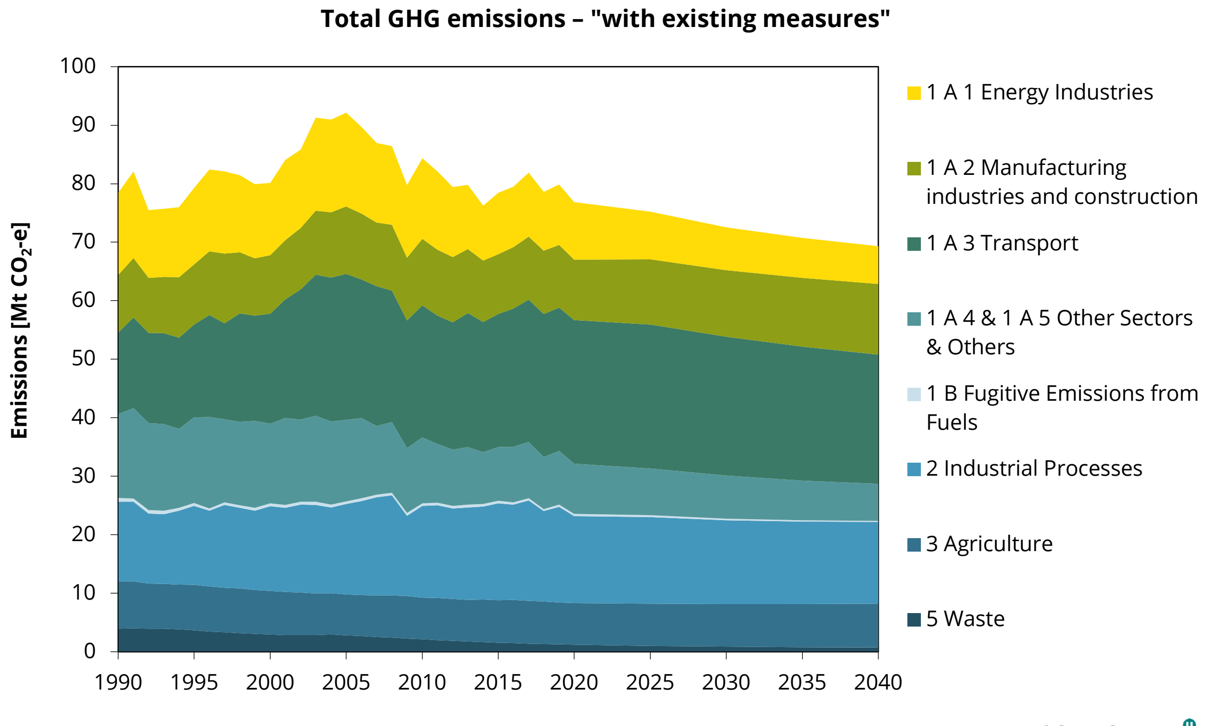
Table 2: Historical trends and projections (2020–2040): greenhouse gas emissions (without LULUCF) – scenario "with additional measures" (WAM). (Umweltbundesamt)

	Inventory trend [kt CO_2 eq]				Emissions 'with additional measures' [kt CO_2 eq]				
	1990	**2005**	**2015**	**2019**	**2020**	**2025**	**2030**	**2035**	**2040**
Total (without LULUCF)	78 420	92 147	78 462	79 842	76 384	72 108	66 536	63 163	61 078
1 Energy	52 804	66 869	53 085	55 048	53 213	49 422	44 852	41 892	40 042
2 Industrial Processes	13 570	15 467	16 552	16 383	14 854	14 811	14 245	13 948	13 803
3 Agriculture	8 120	7 017	7 274	7 152	7 110	6 870	6 566	6 528	6 490
5 Waste	3 926	2 794	1 551	1 260	1 206	1 005	874	794	742

The WEM scenario predicts a decrease in total GHG emissions of 13% or 10.5 Mt of CO_2 equivalent between 2019 and 2040.

This change is mainly driven by a decrease in the energy (minus 14% or 7.9 Mt of CO_2 equivalent) and industrial processes sector (minus 15% or 2.4 Mt of CO_2 equivalent). Emissions from the agricultural sector are predicted to increase by 4.3% or 0.3 Mt of CO_2 equivalent. Emissions in the waste sector are projected to decrease by 41% or 0.5 Mt of CO_2 equivalent. In the energy sector, emissions from the sub-sector 1.A.1 Energy industries are projected to decrease by 37% or 3.8 Mt of CO_2 equivalent and emissions from 1.A.2 Manufacturing industries and construction are projected to increase by 12% or 1.3 Mt of CO_2 equivalent. Emissions from the sub-sector 1.A.3 Transport are predicted to decrease by 9.8% or 2.4 Mt of CO_2 equivalent between 2019 and 2040, and emissions from the sub-sector 1.A.4 and 1.A.5 'Other sectors' are predicted to decrease by 31% or 2.8 Mt of CO_2 equivalent.

Figure 2: Past trend and scenario (2020–2040): total GHG emissions by sector) – scenario "with existing measures".

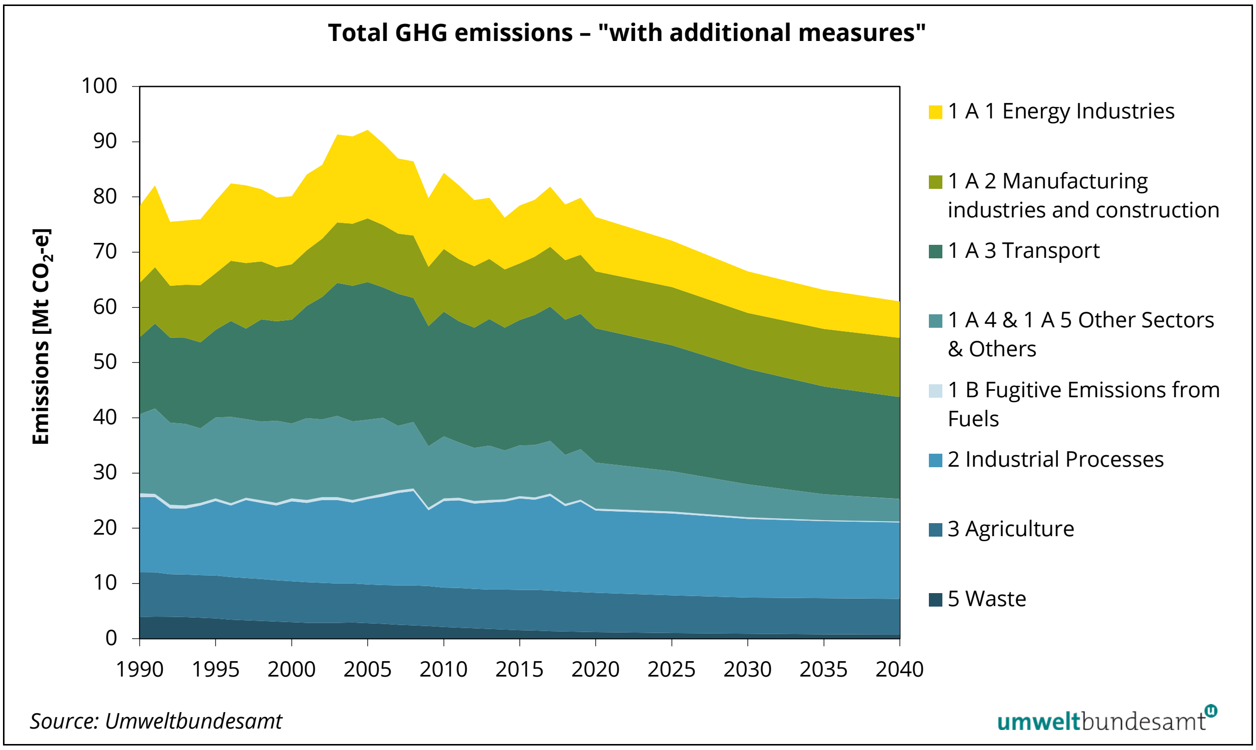


Source: Umweltbundesamt

In the scenario "with additional measures" total GHG emissions are predicted to decrease by 24 % or 18.8 Mt CO_2 equivalent between 2019 and 2040. This decrease is mainly driven by an expected decrease in emissions from the energy sector (minus 27% or 15 Mt CO_2 equivalent) and the industrial processes sector (minus 16% or 2.6 Mt CO_2 equivalent). Emissions are projected to decrease in the waste sector by 41.0% or 0.5 Mt CO_2 equivalent and in the agriculture sector by 9.2% or 0.7 Mt CO_2 equivalent.

In the energy sector, emissions from the sub-sector 1.A.4 and 1.A.5 'Other sectors' are predicted to decrease by 56% or 5.1 Mt CO_2 equivalent. Emissions are also predicted to decrease in the sub-sector 1.A.1 Energy industries (by 36% 3.7 Mt CO_2 equivalent) and in the sub-sector 1.A.3 Transport by 25 % or 6.0 Mt CO_2 equivalent. Emissions from the sub-sector 1.A.2 Manufacturing industries and construction are projected to remain more or less constant.

Figure 3: Past trend and scenario (2020–2040): total GHG emissions by sector) – scenario "with additional measures" (WAM).



According to the WEM scenario, the dominant GHG emitted in Austria will still be CO_2 with a minor increase between 2019 (85.1 %) and 2040 (85.6 %). Between 2019 and 2040, Austria's total CH_4 emissions and N_2O emissions (in CO_2 equivalent) are projected to increase from 12.1 % to 13.2 %, whereas the percentage of emissions of fluorinated gases (HFC, PFC, SF_6 and NF_3) is expected to decrease from 2.8 % in 2019 to 1.2 % in 2040.

Table 3: Past trend and scenario (2020–2040): GHG emissions by gas (without LULUCF) – scenario "with existing measures" (WEM). (Umweltbundesamt)

	Emission trend [kt CO_2 eq]				Emissions 'with existing measures' [kt CO_2 eq]				
	1990	**2005**	**2015**	**2019**	**2020**	**2025**	**2030**	**2035**	**2040**
CO_2	62 140	79 068	66 352	67 962	65 211	64 536	62 484	60 748	59 358
CH_4	10 394	7 801	6 607	6 194	6 103	5 909	5 801	5 745	5 748
N_2O	4 231	3 515	3 450	3 447	3 344	3 347	3 347	3 361	3 377
F gases	1 656	1 764	2 053	2 239	2 227	1 441	908	864	847
Total	**78 420**	**92 147**	**78 462**	**79 842**	**76 885**	**75 232**	**72 540**	**70 719**	**69 329**

In the WAM scenario, the most important GHG emitted in Austria in 2040 will also be CO_2, with an increasing share in national total emissions (from 85.1 % in 2019 to 85.3 % in 2040). Between 2019 and 2040, CH_4 and N_2O emissions are predicted to increase from 12.1 % to 13.4 %. Emissions of fluorinated gases (HFC, PFC, SF_6 and NF_3) are predicted to decrease from 2.8 % in 2019 to 1.4 % in 2040.

Table 4: Past trend and scenario (2020–2040): GHG emissions by gas (without LULUCF)) – scenario "with additional measures" (WAM). (Umweltbundesamt)

	Emission trend [kt CO_2 eq]				**Emissions 'with existing measures' [kt CO_2 eq]**				
	1990	**2005**	**2015**	**2019**	**2020**	**2025**	**2030**	**2035**	**2040**
CO_2	62 140	79 068	66 352	67 962	64 724	61 754	57 200	54 030	52 076
CH_4	10 394	7 801	6 607	6 194	6 087	5 720	5 394	5 224	5 104
N_2O	4 231	3 515	3 450	3 447	3 346	3 194	3 033	3 044	3 051
F gases	1 656	1 764	2 053	2 239	2 227	1 441	908	864	847
Total	**78 420**	**92 147**	**78 462**	**79 842**	**76 384**	**72 108**	**66 536**	**63 163**	**61 078**

An analysis of past trends and scenarios 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 given in the sub-chapters 3.1 to 3.5.

EU ETS/EU ESR emissions

GHG emissions covered by the EU's Emissions Trading Scheme (ETS) show a downward trend in the "with existing measures" scenario until 2040. The driving force is the energy sector with a projected decrease of about 24% from 2019 to 2040. A decrease is also projected for the industrial processes sector (– 8%).

The EU's total GHG emissions under the Effort Sharing Regulation (ESR) are expected to decrease by 11% over the same period.

Table 5: EU ETS and EU ESR GHG emissions – scenario "with existing measures" (WEM). (Umweltbundesamt)

	with existing measures [kt CO_2 eq]						
EU ETS GHG emissions	**2015**	**2019**	**2020**	**2025**	**2030**	**2035**	**2040**
Total (without LULUCF)	***29 492***	***29 564***	***26 953***	***26 244***	***25 514***	***24 992***	***24 713***
1. Energy	15 354	15 809	14 751	13 292	12 546	12 225	12 022
2. Industrial Processes	14 138	13 754	12 201	12 952	12 968	12 767	12 691
EU ESR GHG emissions	**2015**	**2019**	**2020**	**2025**	**2030**	**2035**	**2040**
Total (without LULUCF)	***48 920***	***50 232***	***49 887***	***48 941***	***46 977***	***45 675***	***44 561***
1. Energy	37 682	39 192	38 917	38 869	37 482	36 208	35 065
2. Industrial Processes	2 414	2 629	2 653	1 876	1 349	1 309	1 295
3. Agriculture	7 274	7 152	7 110	7 192	7 272	7 364	7 458
5. Waste	1 551	1 260	1 206	1 005	874	794	742

Due to additional measures, the decrease in EU ETS emissions from 2019 to 2040 is expected to be more substantial in the WAM scenario (about 18 %) than in the WEM scenario (16 %). More specifically, the projected decrease in EU ETS GHG emissions in the energy sector is assumed to be about 25 % and the increase in the industrial processes sector 9%. The total ESR GHG emissions in the WAM scenario are expected to decrease by 27 % over the same period.

Table 6: EU ETS and EU ESR GHG emissions – scenario "with additional measures" (WAM). (Umweltbundesamt)

	with additional measures [kt CO_2 eq]						
EU ETS GHG emissions	**2015**	**2019**	**2020**	**2025**	**2030**	**2035**	**2040**
Total (without LULUCF)	***29 492***	***29 564***	***26 932***	***26 333***	***25 384***	***24 809***	***24 385***
1. Energy	15 354	15 809	14 731	13 398	12 503	12 184	11 891
2. Industrial Processes	14 138	13 754	12 201	12 935	12 881	12 625	12 494
EU ESR GHG emissions	**2015**	**2019**	**2020**	**2025**	**2030**	**2035**	**2040**
Total (without LULUCF)	***48 920***	***50 232***	***49 406***	***45 729***	***41 103***	***38 302***	***36 638***
1. Energy	37 682	39 192	38 436	35 978	32 300	29 656	28 097
2. Industrial Processes	2 414	2 629	2 653	1 876	1 363	1 323	1 309
3. Agriculture	7 274	7 152	7 110	6 870	6 566	6 528	6 490
5. Waste	1 551	1 260	1 206	1 005	874	794	742

1 GENERAL APPROACH

1.1 Guidelines and Provisions

The following regulations and guidelines are taken into account:

- **Regulation (EU) 2018/1999** of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action
  - Article 18 – Integrated reporting on greenhouse gas policies and measures and on projections
- **Commission Implementing Regulation (EU) 2020/1208** of 7 August 2020 on structure, format, submission processes and review of information reported by Member States pursuant to Regulation (EU) 2018/1999 of the European Parliament and of the Council
  - Article 36 – Reporting on national systems for policies and measures and projections
  - Article 37 – Reporting on national policies and measures
  - Article 38 – Reporting on national projections

The structure for reporting information on projected GHG data and policies and measures follows the structure of the templates provided in the Annex of the Regulation.

- 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).
- Commission guidance for reporting on GHG projections in 2021 under Art. 18 of the Regulation on the Governance of the Energy Union and Climate Action (European Commission, 30 June 2020)
- Recommended parameters for reporting on GHG projections in 2021 (European Commission, 30 June 2020)

1.2 Quality Assurance & Control

A questionnaire has been used for checking input data for compliance with the most important data quality requirements. The QA/AC strategy include 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 ....Barbara Schodl, 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, Katja Pazdernik, 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 provided in this report are consistent with the historical GHG emission data from the Austrian Emission Inventory (submission March 2021) up to the year 2019.

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*). GHG 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 2021 (UMWELTBUNDESAMT 2021).

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).
- 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).

Two scenarios were modelled: "with existing measures" includes all measures implemented by 1 January 2018; "with additional measures" includes planned policies and measures as reported in the Integrated National Energy and Climate Plan for Austria (BMNT 2019).

Additional measures to meet the current 2030 target as well as the enhanced ambition for 2030 are currently under discussion and could therefore not be included in the scenarios. Furthermore, the effect of the current health crisis (Covid-19 pandemic) has not been considered in the scenario analysis, as final data for 2020 was not available at the time of preparation and further short-term impacts of the crisis are still unclear. Both issues will be addressed in the forthcoming submission in 2023.

The status of the implementation of measures has been defined at expert level in consultation with the Federal Ministry of Climate Action, Environment, Energy, Mobility, Innovation and Technology. Information on national policies and measures included in the scenarios can be found in Chapter 4.

1.3.4 Key Underlying Assumptions

The key factors used for the scenarios "with existing measures" and "with additional measures" are as follows:

Table 7: Key input parameters for emission projections

Year	Scenario	2017	2020	2025	2030	2035	2040
GDP [billion € 2016]	WEM	361	386	414	444	480	518
GDP real growth rate [%]	WEM	3.1	1.8	1.4	1.4	1.6	1.6
GDP [billion € 2016]	WAM	361	375	404	434	466	501
GDP real growth rate [%]	WAM	3.1	1.7	1.5	1.4	1.4	1.5
Population [1 000]	both	8 797	8 942	9 158	9 331	9 447	9 562
Stock of dwellings [1 000]	both	3 831	3 992	4 126	4 230	4 318	4 402
Heating degree days	both	3 224	3 204	3 171	3 118	3 065	3 013
Exchange rate [US$/€]	both	1.2	1.2	1.2	1.2	1.20	1.2
International coal price [€ 2016/GJ]	both	3.0	2.6	3.2	3.8	4.0	4.2
International oil price [€ 2016/GJ]	both	8.2	13.9	15.7	17.3	18.1	19.1
International natural gas price [€ 2016/GJ]	both	5.8	8.9	9.6	10.5	11.2	11.6
CO_2 certificate price [€ 2016/t CO_2]	both	7.0	15.5	23.3	34.7	43.5	51.7

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 parameters (or a combination of key parameters). 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 about economic growth and energy prices) have been calculated:

- WEM sensitivity 1 and
- WEM sensitivity 2.

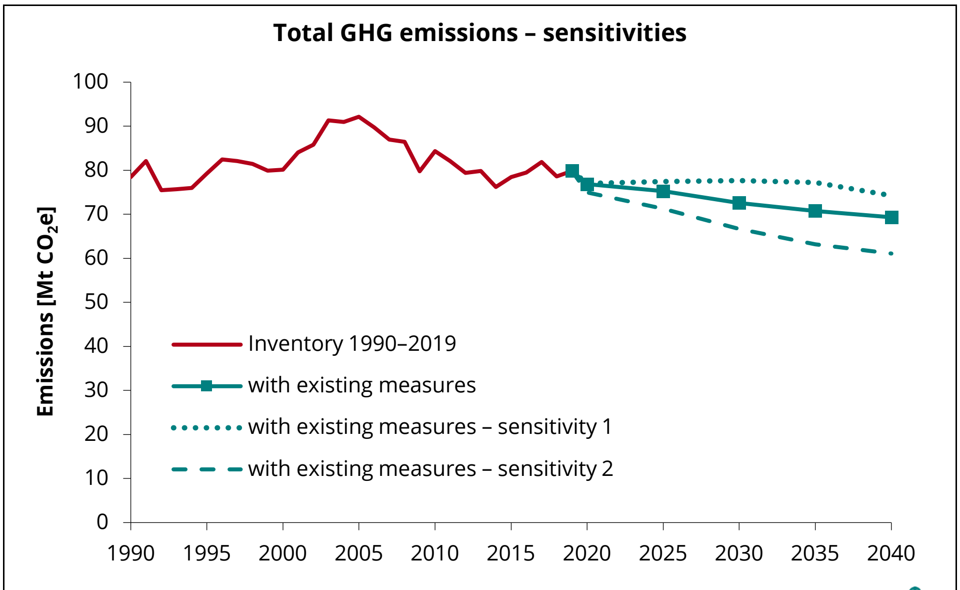
The main input variables are summarised in Table 11. The average economic growth was assumed to be 2.5% per year in WEM sensitivity 1 and 0.8% per year in WEM sensitivity 2 (compared to 1.5% per year in WEM).

Table 8: Basic parameters for sensitivity analysis modelling (Umweltbundesamt)

Parameter WEM sensitivity 1	**2017**	**2020**	**2025**	**2030**	**2035**	**2040**
GDP real growth rate [%]	3.1%	~ 2.5%	~ 2.5%	~ 2.5%	~ 2.5%	~ 2.5%
GDP [billion € 2016]	361	390	441	499	564	638
International coal price [€ 2016/GJ]	3.0	2.6	3.2	4.1	4.5	4.4
International oil price [€ 2016/GJ]	8.2	14.5	17.3	20.9	24.1	29.6
International natural gas price [€ 2016/GJ]	5.8	9.2	10.7	12.6	15.2	17.7
CO_2 certificate price [€ 2016/t CO_2]	7.0	17.6	35.0	48.6	58.0	68.9
Parameter WEM sensitivity 2	**2017**	**2020**	**2025**	**2030**	**2035**	**2040**
GDP real growth rate [%]	3.1%	~ 0.8%	~ 0.8%	~ 0.8%	~ 0.8%	~ 0.8%
GDP [billion € 2016]	361	377	392	408	425	442
International coal price [€ 2016/GJ]	3.0	2.6	3.1	3.7	3.8	3.4
International oil price [€ 2016/GJ]	8.2	13.1	14.4	15.4	15.7	17.0
International natural gas price [€ 2016/GJ]	5.8	8.6	9.2	9.4	9.6	9.7
CO_2 certificate price [€ 2016/t CO_2]	7.0	13.4	17.5	23.6	29.0	34.5

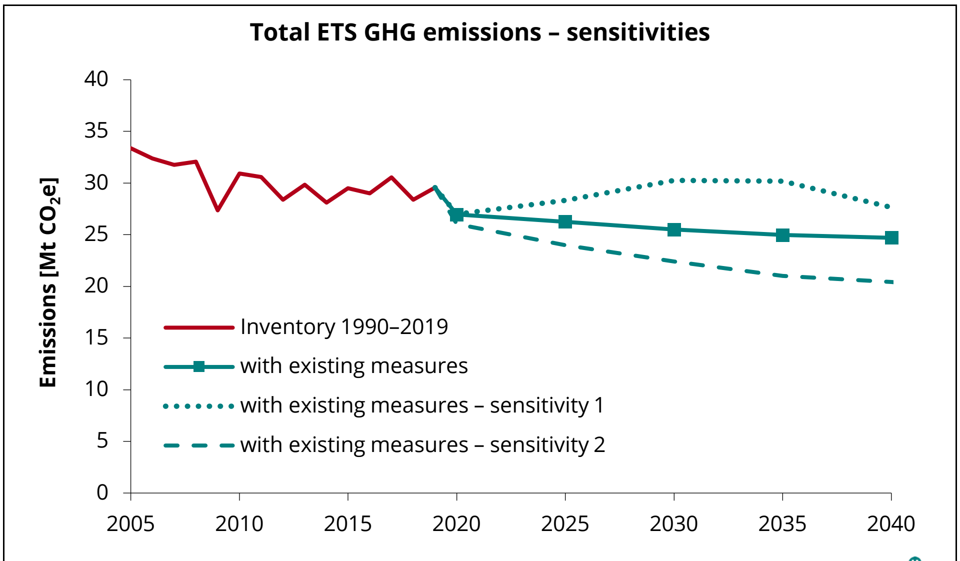
The following charts show an analysis of the trends in Austria's total GHG emissions and the two sensitivity analyses. In addition, the results are presented separately for ETS (Directive 2003/87/EC) and ESR (Regulation (EU) 2018/842).

Figure 4: Trend and projections (2020–2040): total GHG emissions for different sensitivities.



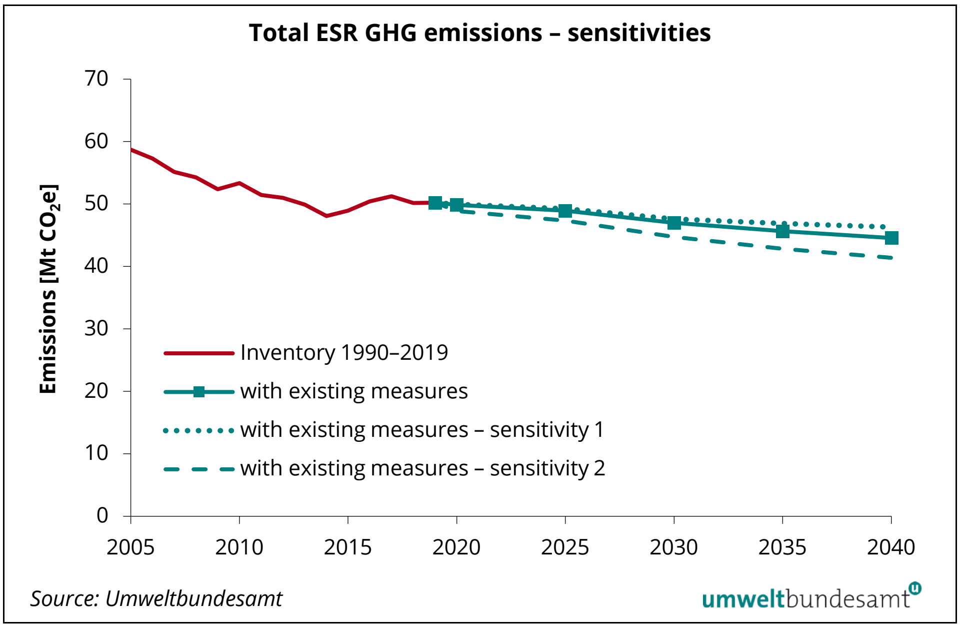
Source: Umweltbundesamt

Figure 5: Trend and projections (2020–2040): total ETS GHG emissions for the different sensitivities.



Source: Umweltbundesamt

Figure 6: Trend and projections (2020–2040): total ESR 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)** – especially the amount of transformation input – has a relatively strong dependence on GDP growth. 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 (28 % in 2030 compared to WEM) is assumed. If the GDP growth rate is higher, emissions are expected to increase significantly (around 50 % in 2030), together with a substantial increase in the electricity 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 9 % lower in 2030 while in the sensitivity scenario 1 emissions are expected to increase by 3 % 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 in total GHG emissions (+ 3 % 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 road freight transport by 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 (–8% 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 investments in renovation measures. The reduction in the use of fuel oil is less noticeable than in the WEM sensitivity 1 scenario.

1.5 Uncertainty in Projections

For most recent inventory submissions, a complete uncertainty assessment was performed (see UMWELTBUNDESAMT 2021). The uncertainty of the GHG totals in Austria's GHG Inventory is estimated to be about 5 percent for the last inventory year. As fuel combustion is a major source of emissions, it is a sector (with a relatively small uncertainty) that also determines the overall uncertainty. Uncertainties tend to be higher for some sources and can vary significantly between individual 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.

Overall, 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 some 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 developments in 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 SF6

Projections are mainly based on the pre-set quotas for the EU FC phase down. However, while EU Regulation 517/2014 specifies rules for the quotas of F gases which may be placed on the European market, the percentage applicable for Austria is unclear, which introduces an intrinsic uncertainty in estimated emissions. Furthermore, the expected decrease in leakage rates due to technical developments as well as the side effects of implemented measures have not yet been accounted for in the model.

For 2.D solvent use

Projections of CO_2 emissions in the sub-sector 2.D 'Non-Energy Products from Fuels and Solvent Use' are mainly based on economic growth data for sectors in which solvents are used. However, a possible decoupling of solvent use from economic growth through continuous technical improvement has not been fully considered.

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 yearly trends in new registrations of electric vehicles and the share of BEVs (battery electric vehicles) and PHEVs (plug-in electric vehicles).

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

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, specific economic conditions 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, and 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 the explored natural gas.

Agriculture (CRF Source Category 3)

Future projections are fraught with a range of uncertainties which need 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 PASMA model (WIFO & BOKU 2018) 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) 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 in the way the model suggests.
- **Market uncertainty:** A comparison of different OECD-FAO projections suggests that there is a considerable difference between them. The range of such uncertainties is discussed in more detail in the relevant 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 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, in some cases, expert judgement on future legal requirements.

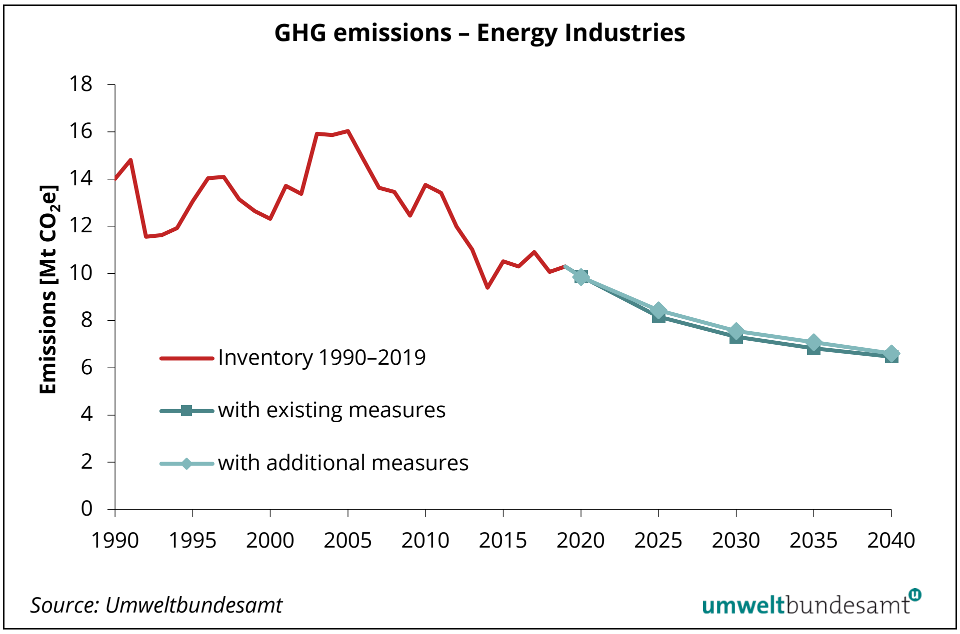
Regarding waste disposal, it is important to note that for upcoming trends historical deposits are relevant as well (according to the First Order Decay method), with relatively low levels of uncertainty thanks to good quality country-specific data which are available on an annual basis (Electronic Data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

2 SECTORAL SCENARIO RESULTS

2.1 Energy (CRF Category 1)

2.1.1 Energy industries (1.A.1)

Figure 7: Past trend and scenarios (2020–2040): GHG emissions from 1.A.1 – Energy Industries.



In the In 2019, emissions from energy industries were 27% below 1990 levels. Emissions from power plants have been decreasing steadily since 2005, mainly because of growing contributions of renewable energy sources, use of natural gas and biomass as substitutes for solid and liquid fuels as well as improved efficiency.

The share of biomass used as fuel in this sector increased from 0.9% in 1990 to 25% in 2019. The contribution of hydro and wind power plants to total public electricity production increased from 69% in 1990 to 78% in 2019. Electricity consumption has increased by 51.5% since 1990, and 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 hydropower and especially solar and wind plants is expected to increase significantly. The capacity of biomass CHP plants is expected to increase only up to 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 the growing 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, and to decrease thereafter.

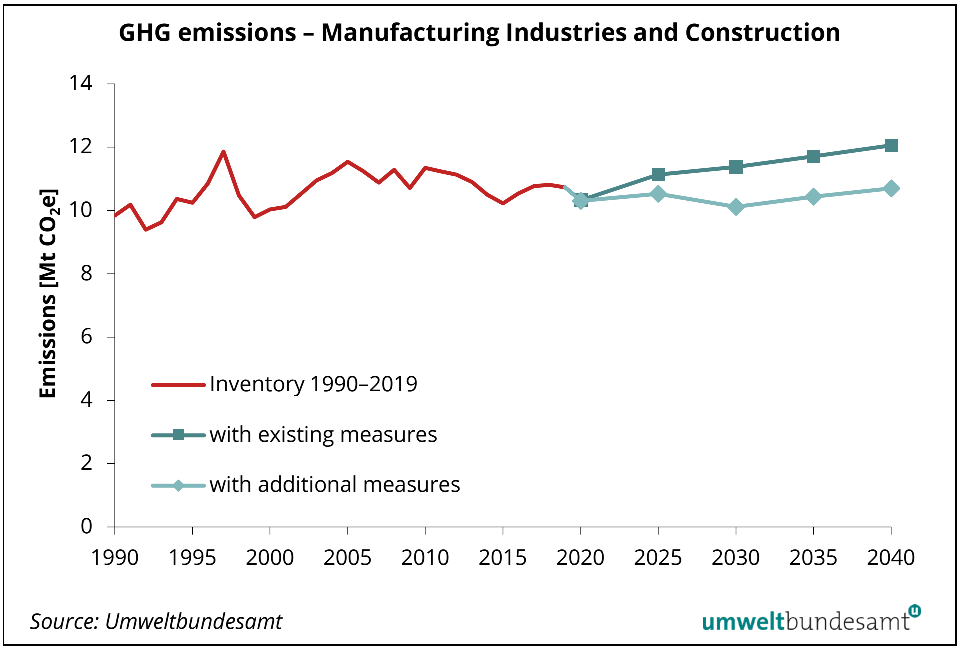
WAM scenario, electricity demand is expected to rise even more due to electric vehicles, heat pumps and electric appliances in industry. This additional demand will be met by creating additional capacities of renewable energy (mostly wind and photovoltaics). District heating demand will increase by another 10% (compared to WEM) until 2030. This demand will be met by installing additional natural gas boilers. Emissions in WAM are thus expected to be slightly higher than in WEM.

Emissions from petroleum refining are projected to remain more or less constant as the total production capacities are not expected to change significantly. There is no difference between the WEM and WAM scenarios.

Emissions from oil and gas exploration and storage are expected to decline considerably due to a decline of gas exploration activities expected over the next decade.

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

Figure 8: Past trend and scenarios (2020–2040) GHG emissions from 1.A.2 – Manufacturing Industries and Construction.



The Industry sector is one of the main sources of greenhouse gas emissions in Austria, mainly due to its CO_2 emissions. Major sub-groups contributing to these emissions are: energy related emissions from iron and steel production, the production of non-metallic minerals, the pulp and paper industry and the chemicals industry. Emissions from iron and steel production are to a major extent also included under process emissions (sector 2C).

Energy related GHG emissions from manufacturing industries and the construction sector increased by 9% from 1990 to 2019, mainly in the chemicals industry and from off road vehicles, while emissions from iron & steel, pulp & paper and other manufacturing industries have decreased since 1990. Fuel consumption has increased by 36% over that period, mainly due to an increased use of natural gas and biomass. As natural gas has a lower carbon content, and CO_2 emissions from biomass combustion are not accounted for under the UNFCCC reporting framework, the increase in GHG emissions is significantly smaller (only +9%) compared to the increase in fuel combustion.

For the period 2019–2040, 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.

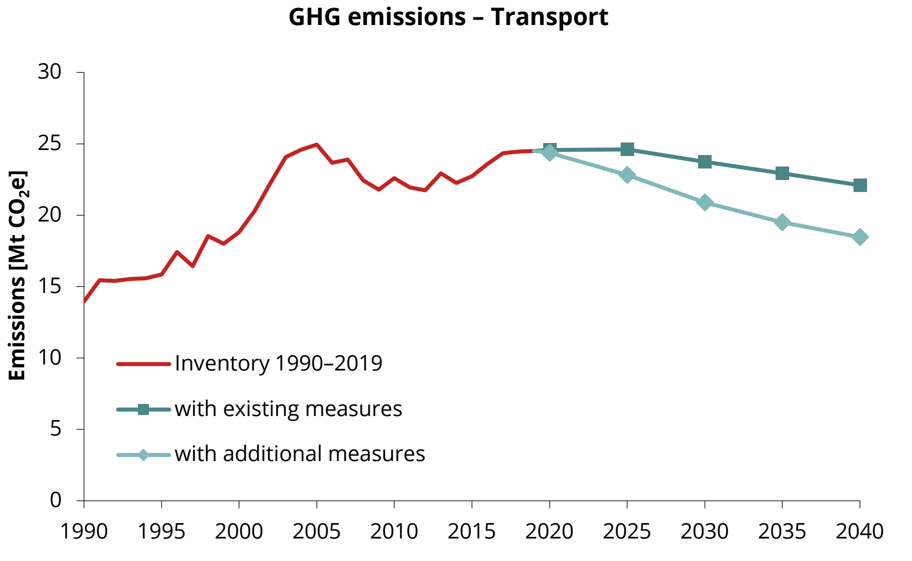
Emission increases are expected in several industrial sectors: non-ferrous metal industry (1A2b, + 22 %), chemical industry (1A2c; +3 2 %), pulp and paper industry (1A2d, + 10 %), food processing (1A2e, + 48 %) and other stationary manufacturing industry (1A2g8; + 41 %).

A decrease is expected in the iron and steel industry (1A2a; – 20 %) and in the non-metallic minerals industry (1A2f; – 10 %). The mobile sources in this sector (CRF 1A2g7) accounted for 1.2 Mt of CO_2 equivalent in 2019 and are expected to rise by 17% by 2040.

In the scenario WAM, the Energy Efficiency Act generally results in a higher increase in efficiency for all industrial sectors. Additional subsidies for efficiency measures yield an increase of energy efficiency resulting in a lower final energy consumption in the non-ETS branches. Furthermore, it is assumed that the new Renewable Energy Expansion Act (Erneuerbaren-Ausbau-Gesetz) will provide larger amounts of biomethane and hydrogen. Biomethane is assumed to be distributed in the ESR sectors proportionally to the use of natural gas in the sectors, whereas hydrogen is assumed to be integrated in the natural gas network and thus to be used in the ETS. In the iron and steel production sector, these measures affect not only sector 1A2a, but also sector 2C1.

2.1.3 Transport (1.A.3)

Figure 9: Past trend and scenarios (2020–2040) GHG emissions from 1.A.3 – Transport.



Source: Umweltbundesamt

The transport sector has shown a strong increase in GHG emissions since 1990 (+76%) 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 2012, 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. GHG emissions from sector transport have gradually increased since the year 2015.

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).

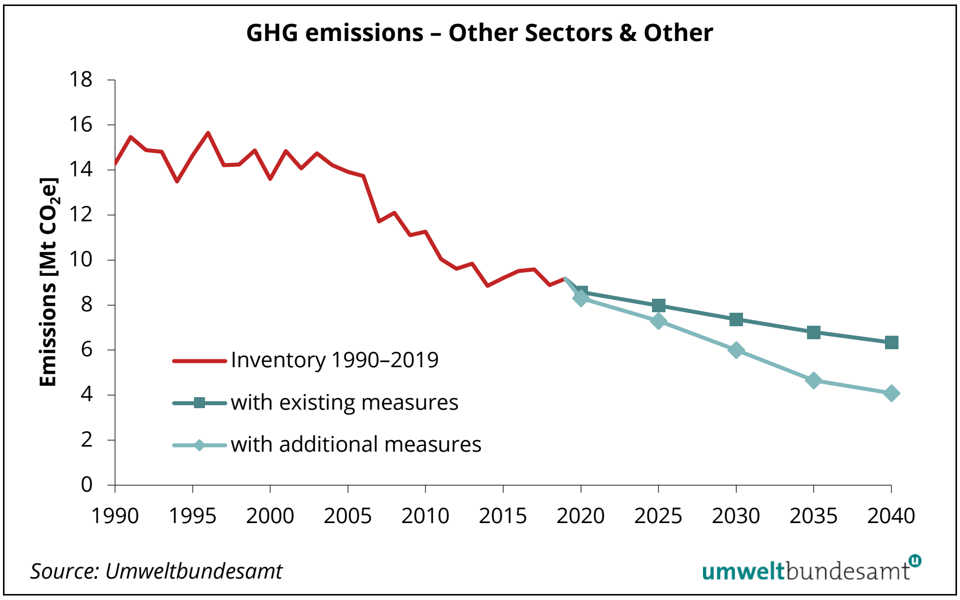
In 2030, diesel PC and gasoline PC will each account for 44% of the total car fleet. BEV will account for 13%. In 2040, gasoline cars will account for the majority with a share of 41% (compared to 33% accounted for by diesel cars and 26% by BEV).

In the WAM scenario, additional measures are taken that in particular accelerate the market ramp-up of alternative-powered vehicles and this results in a further reduction of transport-related GHG emissions. The proportion of petrol-powered cars increases to 54% in 2030, as this category also reflects the increasing proportion of plug-in hybrid electric vehicles. The proportion of diesel-powered cars will be reduced to 31% and the share of BEVs will be 12% in 2030. In 2040, the share of diesel-powered cars in the WAM scenario is 51%, and that of gasoline-powered cars is 21%. The share of battery electric cars (BEVs) will then already be 29%.

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. After 2005, the implementation of the EU Biofuels Directive (2003/30/EC) and declining fuel exports led to a change in this trend. In addition, the economic slowdown resulted in further emission reductions, especially in 2008 and 2009, but emissions have been going up again after an increase in economic and transport activities from 2010 onwards. It is now estimated that the use of biofuels, along with higher fuel efficiency standards and especially the promotion of electric mobility, will help stabilise GHG emissions, and reduce them from 2024 onwards.

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

Figure 10: Past trend and scenarios (2020–2040) 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 change in the fuel mix are the most important drivers for emissions from 'Other sectors'. Emissions in 2019 were 36% lower than in 1990. This reduction is mainly attributable to a declining consumption of heating oil and coal and an increase in the consumption of biomass and natural gas, as well as the growing importance of district heating and modernised heating systems. Total fuel consumption in this sector (including mobile sources) has decreased by 10% since 1990 to 2019.

The '1.A.4 Other sectors' category accounts for a considerable amount of Austria's total greenhouse gas emissions. Despite growing numbers of households, occupied living space and commercial useful floor area the total GHG emissions in this sector are expected to see substantial reductions by 2040 in the WEM scenario.

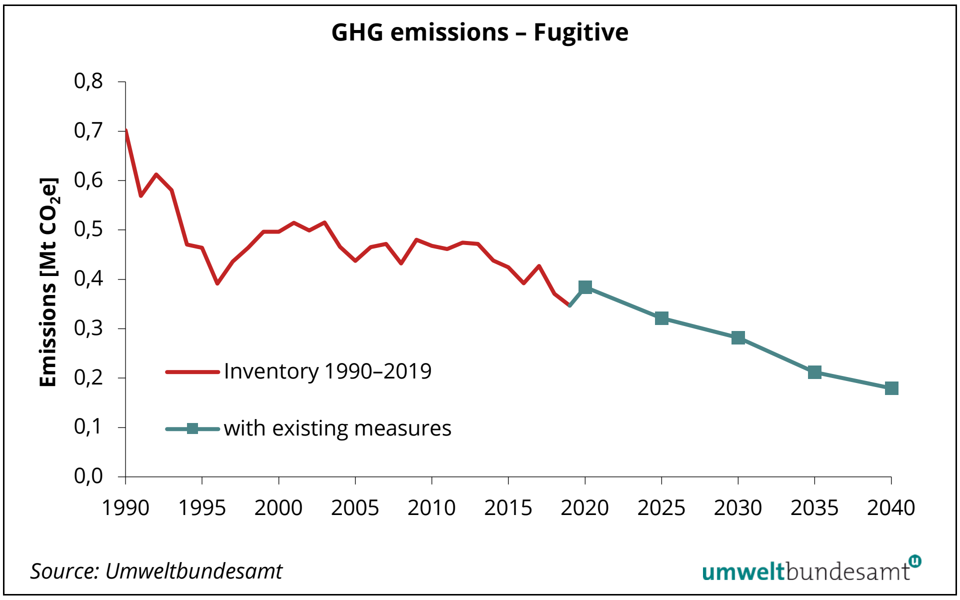
The driving force behind these reductions is the expected shift away from fossil fuels to renewables like biomass, solar heat and ambient heat, combined with a stable share of district heat and an increasing share of electricity for heat pumps, which means that more emissions will occur in Sector 1.A.1 Energy Industries. Furthermore, a reduction in total energy consumption (incl. electricity) of about 11% together with improved insulation for new buildings (or better insulation through renovation measures) and an improved efficiency of primary heating systems in buildings are expected to lead to a considerable reduction in GHG emissions between now and 2040.

In the WAM scenario the reduction in GHG emissions is more significant. A couple of measures restricting the use of fossil fuels and concerted replacement of fossil fuel oil heating systems accelerates the fuel shift towards renewables and district heating. Further mandatory enhancement of the energy efficiency of buildings leads to a reduction in total energy consumption (incl. electricity) of about 13%. The combined additional measures are expected to lead to a considerably higher reduction in GHG emissions between now and 2040 compared to the WEM scenario.

Mobile sources in this sector (mainly CRF 1A4c2 Agriculture/Forestry) accounted for 1.0 Mt of CO_2 equivalent in 2019 and are expected to rise by 1.1% until 2040 in the WEM scenario, whereas it is estimated that they will decline by 11.4% until 2040 in the WAM scenario.

2.1.5 Fugitive emissions (1.B)

Figure 11: Past trend and scenarios (2020–2040) GHG emissions from 1.B – Fugitive emissions.

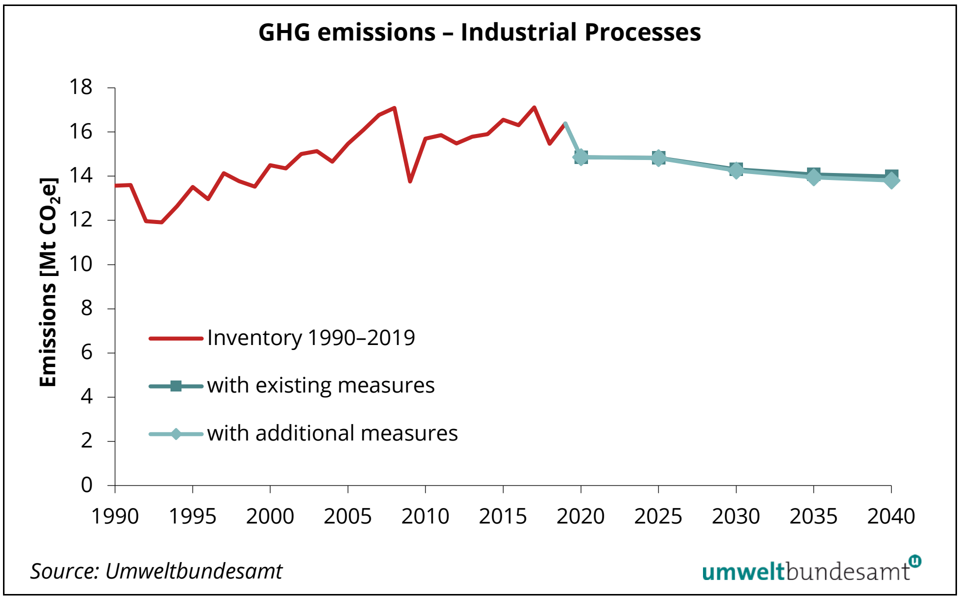


Between 1990 and 2019, fugitive emissions from coal mining, fossil fuel exploration, refining, transport, production and distribution decreased by 51%. The main driving force behind this decrease was the closure of coal mines. There have been no coal-mining activities in Austria since 2007. The increase 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 2040, 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 12: Past trend and scenarios (2020–2040) GHG emissions from 2 – Industrial Processes & Product Use.



In 2019, greenhouse gas emissions from Industrial Processes and Other Product Use amounted to 16 383 kt CO_2 equivalent, which corresponds to 21% of total national emissions.

The most important sub-categories of this sector are the metal industry and the mineral industry, generating 63% and 17% of the total emissions of this sector respectively. The most important greenhouse gas in this sector is CO_2 with a contribution of 85% to total sectoral emissions, followed by HFCs (11%), SF_6 (2.7%), N_2O (0.7%), CH_4 (0.3%) and PFCs (0.2%). NF_3 contributed 0.1% of the total emissions from this sector in 2019.

The overall trend in GHG emissions from Industrial Processes and Other Product Use is an increase of 21% from 1990 to 2019. Emissions fluctuated within this period, with a minimum level in 1993 and a maximum in 2017. The main drivers behind the emission trend in this sector were (i) the end 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 26% increase in GHG emissions in 2019 from 1990 levels with a temporary decline in production in 2009 and (iv) a strong increase in HFC emissions in the period 1992 to 2019 (from 5.6 to 1 750 kt CO_2 equivalent).

The largest increase in GHG emissions between 1990 and 2019 can be observed in the metal industry due to an increase in GHG emissions from iron and steel production (+55%). In sub-categories mineral industry and chemical industry, GHG emissions declined by 9.2% and 45% respectively during that period.

Emissions of fluorinated gases have increased by 35% since 1990, driven by increasing emissions of HFCs (+402% since 1995) used as cooling agents to replace Ozone Depleting Substances (ODSs).

Emissions from industrial processes are expected to see a slight decrease in the years until 2040. 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 a significant production decline in 2020 and an increasing use of imported direct reduced iron in the blast furnace . Emissions from 'chemical products' are expected to remain stable.

Differences to WEM in process emissions are due to different assumptions in the iron and steel production sector (2C1): here the measures described in sector 1A2 also result in emission reductions in sector 2C1.

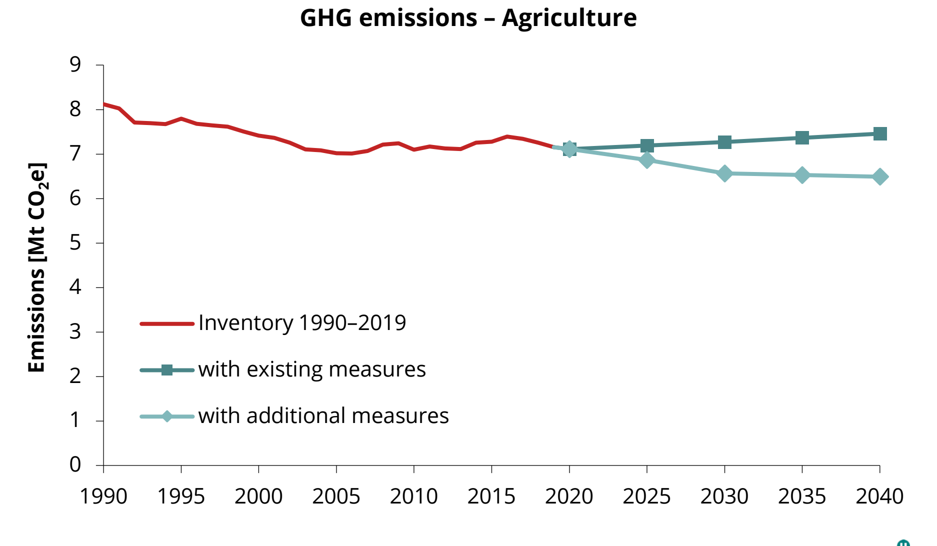
Another source included in this sector is 'fluorinated gases' (HFC, PFC and SF_6). These gases contributed 14% of industrial processes emissions in 2019, with a projected decrease to 6.2% by 2040 in the scenario with existing measures, a decrease which will be brought about mainly by several legislative measures. HFC emissions are expected to have reduced due to the effects of the EU F gas Regulation (Regulation (EU) No. 517/2014) as well as the Kigali Amendment to the Montreal Protocol, and the increased availability of low GWP alternatives.

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 in switchgears (sector 2 G) will continue to increase, due to the growing demand in energy.

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 –40 % between 1990 and 2019 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. Emissions in this sector are expected to increase slightly in the period until 2040.

2.3 Agriculture (CRF Category 3)

Figure 13: Past trend and scenarios (2020–2040) GHG emissions from 3 – Agriculture.



Source: Umweltbundesamt

In 2019, greenhouse gas emissions from *Agriculture* amounted to 7 152 kt CO_2 equivalent, which corresponds to 9.0% of Austria's total emissions.

The most important sub-categories of this sector are enteric fermentation (57%) and agricultural soils (28%). Agriculture is the largest source of national N_2O and CH_4 emissions: in 2019, 70% (8.1 kt N_2O) of the total N_2O emissions and 74% (184 kt CH_4) of the total CH_4 emissions in Austria originated from this sector. Total GHG emissions from the sector agriculture are dominated by CH_4 with a share of 64% and N_2O with a share of 34%. CO_2 emissions account for 2.0% of the emissions from this sector.

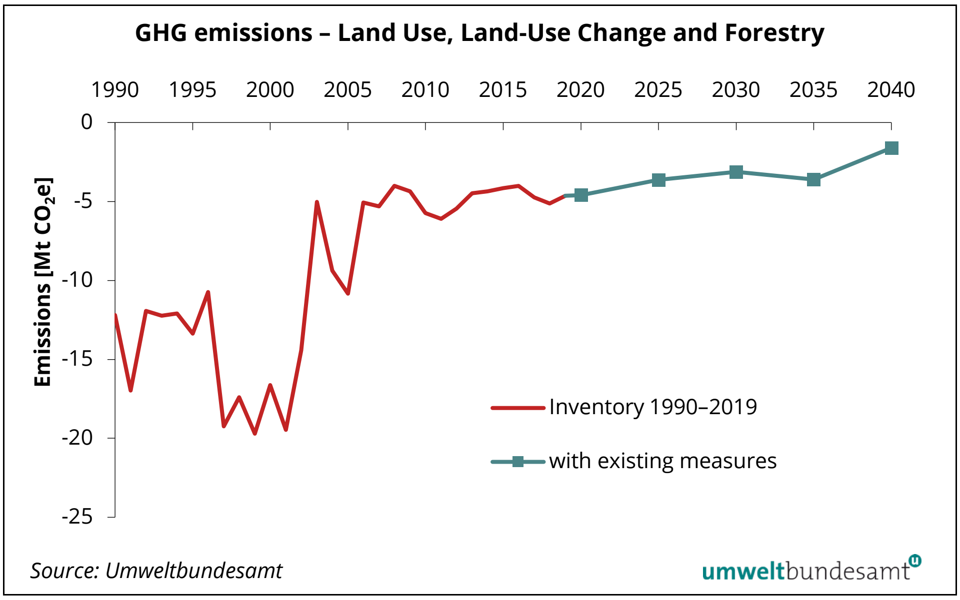
The overall trend in GHG emissions from agriculture shows a decrease of 12% from 1990 to 2019. The main drivers for this trend are decreasing livestock numbers and lower amounts of N fertilisers applied on agricultural soils.

In the WEM scenario, a 4.3% increase in emissions can be expected between 2019 and 2040. 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, pig meat production 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.

In the WAM scenario the implementation of policy measures (as outlined in 4) results in a decreasing emission trend (–9.2% from 2019 to 2040). This trend is affected by measures including animal feeding (climate friendly and N-reduced feeding of cattle, pigs and chicken, increased grazing for cows), improved N management along the entire manure chain resulting in decreased emissions from housings, storage and application of manure on soils. Further, we have assumed a significantly increased use of manure in biogas plants and a decreased use of mineral fertilisers.

2.4 LULUCF (CRF Category 4)

Figure 14: Past trend and scenario (2020–2040) GHG emissions from 4 – Land Use, Land-Use Change and Forestry[1].



In 2019, net removals from the sector LULUCF amounted to −4 636 kt CO_2 equivalent, which corresponds to 5.8% of the total national GHG emissions (without LULUCF) in 2019 compared to 15% in the base year.

With regard to the overall trend of net removals from LULUCF, the removals decreased by 62% over the observed period. The main driver for this trend is the biomass carbon stock change 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 windthrow 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 2040. Between 2019 and 2040, net removals are expected to decrease by approximately 3 Mt of CO_2 equivalent. This will be strongly influenced by the decrease in removals from 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

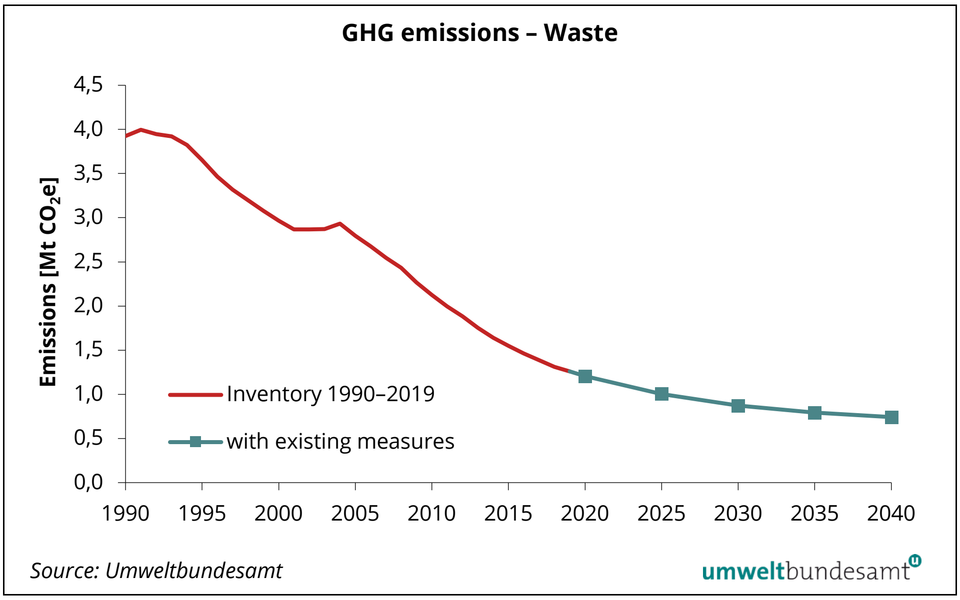
[1] The historical values of category 4.A.1 (having the main impact on the LULUCF totals) for the years 2009 and 2010 are based on averages of the NFI observation periods 2002 and 2008 and will be revised on the basis of the results of the next NFI.

change and the net sink is expected to increase, which can also be explained by a lower level of forest biomass use and by a slightly increasing biomass growth. However, after 2035 the net removals are projected to further decrease because biomass use slightly increases and biomass growth slightly decreases. The second largest category, harvested wood products (HWP), is projected to remain a net sink on a stable level (about −1.9 Mt CO_2 on average) during the period 2019−2040.

On the other hand, the non-forest sectors (cropland, grassland, wetlands, settlements)) are sources of emissions for the projected time series, amounting to approximately 0.9 Mt of CO_2 equivalent per year. Other land is a very small sink between 2020 and 2028 as a result of land conversion dynamics (from grassland to other land in the historical years) (GHG inventory).

2.5 Waste (CRF Category 5)

Figure 15: Past trend and scenario (2020–2040) GHG emissions from 6 – Waste.



In 2019, greenhouse gas emissions from the sector *Waste* amounted to 1 260 kt CO_2 equivalent, which corresponds to 1.6% of the total national emissions.

The most important sub-category of *Waste* is *solid waste disposal*, which caused 70% of the emissions from this sector in 2019, followed by *waste water treatment and discharge* (15%) and *biological treatment of solid waste* (15%). The most important greenhouse gas is CH_4 with a share of 78%, mainly arising from *solid waste disposal*, followed by N_2O with 21% and CO_2 with 0.2%.

Overall, GHG emissions from waste show a decreasing trend, with a decrease of 68% from 1990 to 2019. 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 waste disposed of to landfill sites has decreased correspondingly especially since 2004 when pre-treatment of waste became obligatory (although some exceptions were granted in some Austrian provinces). The legal basis for the reduced disposal of waste and for landfill gas recovery is the Landfill Ordinance. Since 2009, all wastes with a high organic content have to be pre-treated before being landfilled (without exception). Methane recovery from landfills was introduced in the 1990s.

The scenario shows a further downward trend in waste treatment and disposal rates up to 2020/2035. This is in line with the decreasing carbon content of historically landfilled waste, as well as the decrease in the amount of waste disposed of in landfills (due to legislation). Emissions from 'waste water handling and discharge' are increasing slightly under the current policies ('WEM'), in line with the rate of population growth.

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 Centre of Economic Scenario Analysis and Research (CESAR), 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 using 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 important input parameters (AEA 2018).

For modelling energy consumption for domestic heating and domestic hot water supply, the software package INVERT/EE-Lab (TU WIEN & ZEU 2018) has been 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 2021).

As regards the only refinery in Austria, no major changes in 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 2018–2019.

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 (total inputs to power and heat plants, split into the different fuel types) can be seen in the Annex., Energy demand is shown by sector, split by fuel type (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. Municipal waste is burned exclusively 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.

Scenario "with existing measures"

Price of CO2 tonne under the Emission Trading Scheme

It has been assumed that the European ETS will continue beyond 2030 and that the price will not be influenced by decisions of Austrian plant operators. Prices from recommendations of the European Commission have been used as follows:

- 15.5 €/t in 2020, 34.7 €/t in 2030.

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 hydropower plants, it has been assumed that the projected losses that will arise as a result of the implementation of the Water Framework Directive will be offset by higher production levels as a result of repowering.

Green Electricity Act

Kn 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 met for hydropower, exceeded for photovoltaics and wind power and that the goals for biomass will not be met. 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.

Scenario "with additional measures"

A draft for a new law for the expansion of renewable energies (Renewable Energy Expansion Act) sets a target of an additional 27 TWh generated from renewable energies in 2030 (11 TWh from photovoltaics, 10 TWh from wind energy, 5 TWh from hydropower and 1 TWh from biomass).

3.1.1.3 Activities

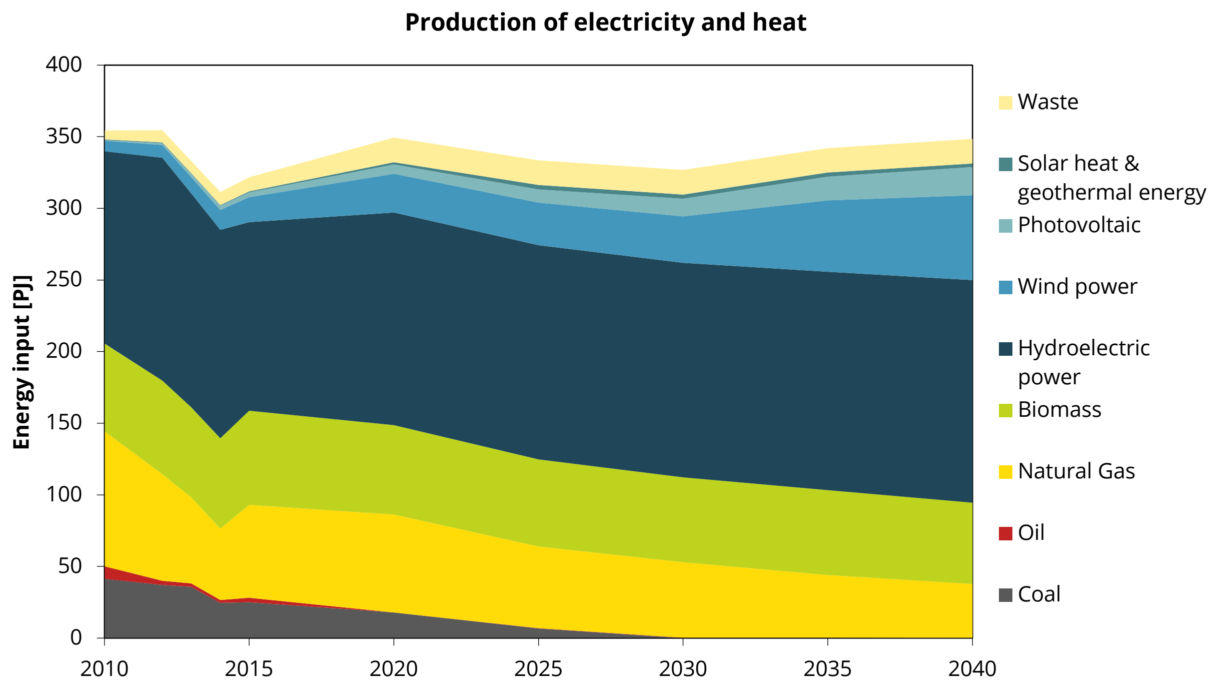
Scenario "with existing measures"

The energy input to Austrian heat and power plants is shown in Figure 16. 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 input to gas plants is expected to decline only slightly. The decline in fossil fuel power plants will be driven by a significant increase in the production of hydro-electric, wind and photovoltaic energy with lower marginal costs. Input to biogas plants is expected to decline as subsidy schemes will expire, while biomass heat and power 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 2040 as indicated in Chapter 3.1.1.1.

As regards oil and gas exploration and storage, natural gas is the only fuel source. Input is expected to shrink steadily due to limited reserves.

Figure 16: Energy input for electricity and heat production (1.A.1.a) – with existing measures

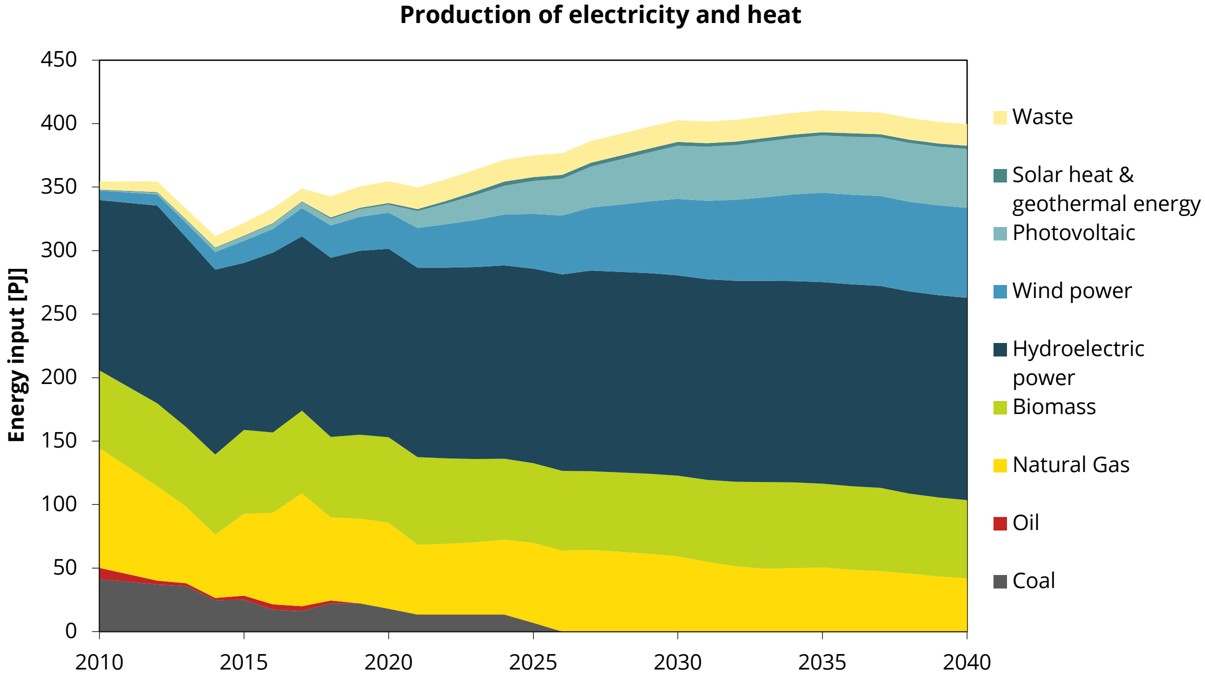


Source: Umweltbundesamt

Scenario "with additional measures"

The production of photovoltaics, wind and hydropower increases according to the targets of the draft bill for renewable energies (Renewable Energy Expansion Act). The production of oil and coal plants will be phased out by 2025.

Figure 17: Energy input for electricity and heat production (1.A.1.a) – with additional measures



Source: Umweltbundesamt

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 2021).

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 2019 onwards, a steady increase in the oil price is expected. GDP growth is expected to average 1.5% per year until 2040 (see Chapter 1.3.4).

EU ETS/non-ETS

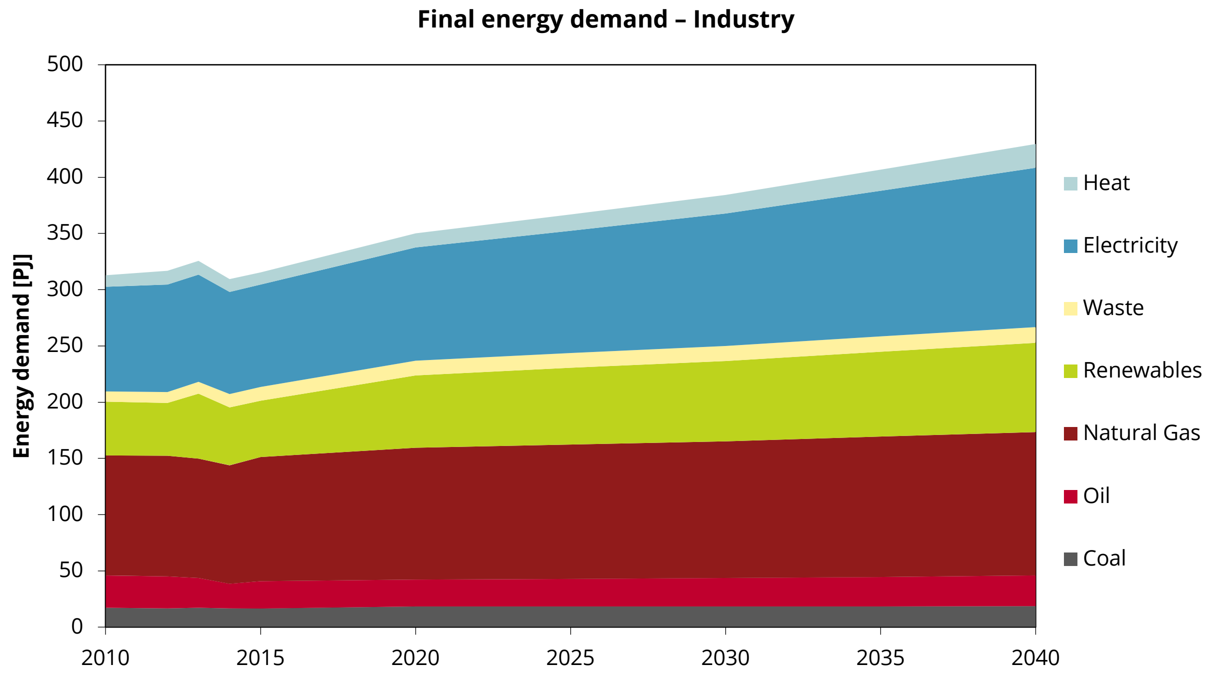
Emissions for EU ETS/non-ETS have been split on the basis of sectoral fuel input. Here the ETS share of each fuel (averaged over the most recent years) has been used for determining the fuel input for EU ETS/non-ETS until 2040. For sectors with a low non-ETS share, the split into EU ETS/non-ETS emissions has been based on the corresponding split in emissions in the most recent years.

3.1.2.3 Activities

Scenario "with existing measures"

Based on the sectoral gross value added, the energy demand in the industrial sector is expected to increase steadily from 2015 to 2040 (see Figure 18). Detailed figures are given in Annex 2.

Figure 18: Energy demand in the industrial sector (incl. off-road) – with existing measures

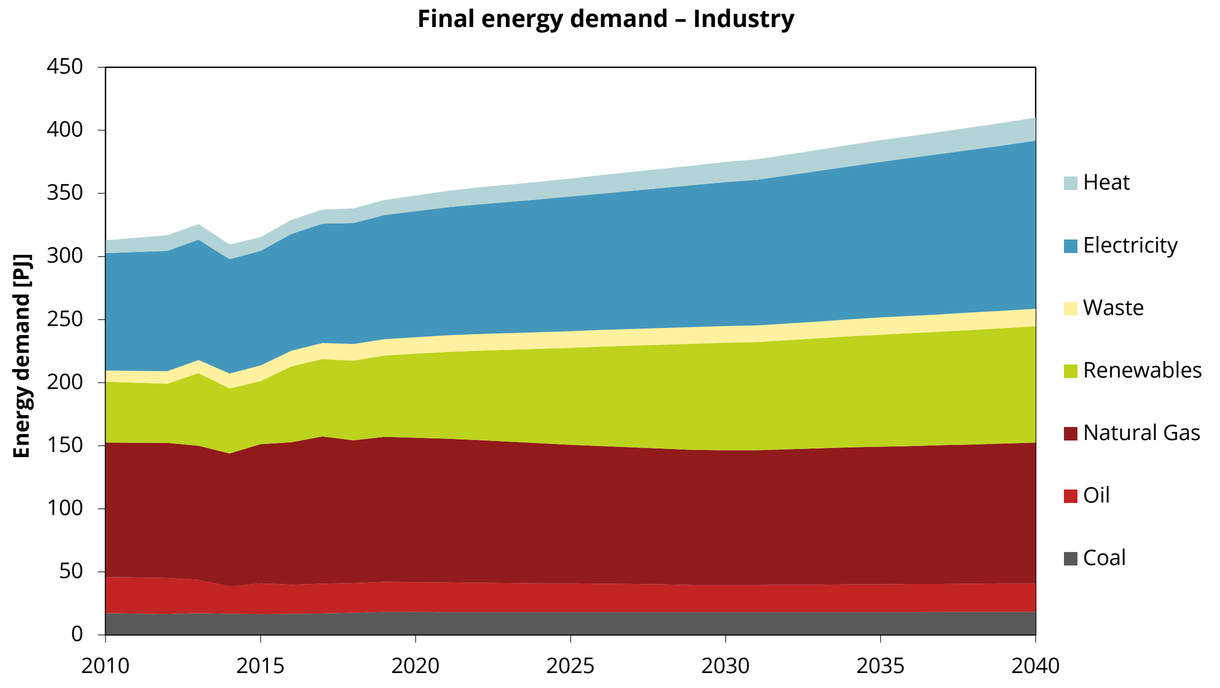


Source: Umweltbundesamt

Scenario "with additional measures"

Due to energy efficiency measures, the final demand in WAM is 10 PJ lower than in WEM in 2030. There is still an increase in final demand due to an increase in GDP.

Figure 19: Energy demand in the industrial sector (incl. off-road) – with additional measures



Source: Umweltbundesamt

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 2040 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 so that it is 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 'ur-

ban', '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 2021 (UMWELTBUNDESAMT 2021).

- **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 2021).
- **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 2021 (UMWELTBUNDESAMT 2021).

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 the aviation fuels gasoline and kerosene has been estimated. The monetary demand for flight services is indirectly dependent on the population (via total consumption, number of 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 2040 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

Projections for energy consumption in the aviation sector up to 2040 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% (11% in 2040). After 2017, energy consumption is projected to stagnate up to 2024 as oil prices are expected to rise faster over the period to 2024 (thus resulting in a lower demand) than thereafter.

The assumptions made for the WAM scenario are the same as those described above.

1 A 3 b – Road Transport

Development of a 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. Given 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 between 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 when the WEM scenario was set up, 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.

Whenthe WAM scenario was developed, the CO_2 limit values for the years 2025 and 2030, set and decided at European level, were already known and included accordingly in the modelling of this scenario. These limits are as follows: reduction of the average fleet's CO_2 emissions by 15% for PC, LDV and HDV by 2025, and by 37.5% (PC), 31% (LDV) and 30% (HDV) by 2030. The reference years are 2021 for PC and LDV and 2019 for HDV.

Development of passenger kilometres (pkm)

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

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). One of the reasons for this discrepancy is the 'fuel export in vehicle tanks' as a result of relatively low fuel prices in Austria, in comparison to its 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 use it abroad. Most of the fuel export, however, is accounted for by freight transport on the road in heavy duty vehicles. This has been confirmed by two national studies (MOLITOR et al. 2004, MOLITOR et al. 2009).

Table 9: 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 when it comes to 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 will stay constant over time, resulting in a relatively constant share of GHG emissions from fuel exports until 2040. No adaptions have been made here in the WAM scenario.

Alternative fuels: development

Biofuels

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 – these amounts are incorporated in the calculated 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 on biofuel composition of the fuel standard) or sold alternatively as pure fuel.

According to current blending standards, the limits of E5[3] and B7[4] have been taken as a 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 track for the RED II goal. Since we cannot estimate exactly which of the advanced biofuel types will be available, the following has been assumed: as long as the quantities can be fulfilled by raising E5 to E10[5], ethanol will be used. For anything beyond that it will be HVO (as a renewable "drop-in biofuel" 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 vehicle registration data indicate no immediate breakthrough for these energy sources, especially without the necessary incentives and with an insufficient availability of vehicle models on the market.

Development of electric mobility

WEM and WAM 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

[2] Hydrotreated Vegetable Oil

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

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

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

temporal development of the effects of six potential barriers to the registration of electric vehicles (as opposed combustion engine vehicles):

- the number of vehicle models announced and expected on the market
- the number of vehicles that are actually available (with an acceptable delivery period)
- the availability of charging infrastructure
- vehicle costs
- 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 a factor of 2.5 for 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 the RED II. Electricity used by other means of transport will be calculated without factors.

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

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

For road freight transport, electric trucks of all size categories have been available for sale for some time. However, consumer acceptance is not sufficient yet and many freight operators are experimenting with electric vehicles only in a few single pilot projects. Therefore, only a very small numbersof electric heavy duty trucks has been considered in the current projections. Furthermore, rail transport 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 2040 has been assumed for the operating hours of mobile off-road machinery in industry.

Projections for NRMM in agriculture are based on grain harvesting. The hours tractors are in use are expected to increase by around 0.3% on average per year between 2017 and 2040.

Projections for NRMM in forestry are based on woodcutting. The hours tractors and chainsaws are in use in forestry are expected to increase by around 0.7% on average per year between 2017 and 2040, which reflects the historical average growth per year between 1990 and 2017.

Projections for NRMM in households are based on estimates of how many hours gardening tools are expected to be in use, showing an average yearly increase of 0.3% between 2017 and 2040. For other NRMM in households a constant trend has been assumed for 1990–2040 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 Austria's total GHG emissions from *1.A.3 Transport* is very small at 0.1%. The economic slowdown resulted in a decrease in national energy demand for domestic aviation from the peak year 2007 onwards.

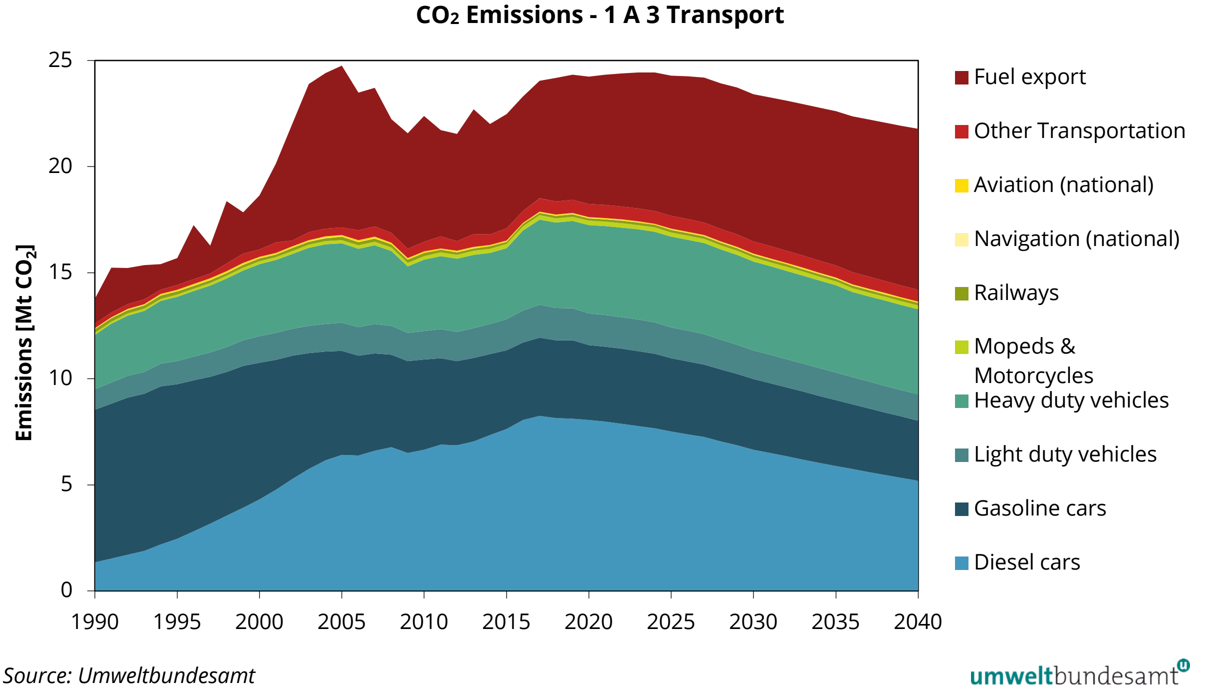
For the WEM projections, it has been assumed that the domestic aviation sector will not reach the GHG emissions level of the peak year 2007 until 2035. For GHG emissions from domestic aviation, a 15% increase over 2017 levels has been projected for 2030 (22% between 2017 and 2035) (WIFO 2018). No adaptations were made to the WAM scenario, as no additional activities have been included.

1 A 3 b – Road Transport

Since 2005, energy demand has decreased in road transport, reaching 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.

For the WEM projections it has been assumed that up to 2040 GHG emissions will not reach the level of the peak year 2005. For GHG emissions from road transport, a 4% decrease over 2019 levels is projected until 2030 (and an 11% decrease until 2040).

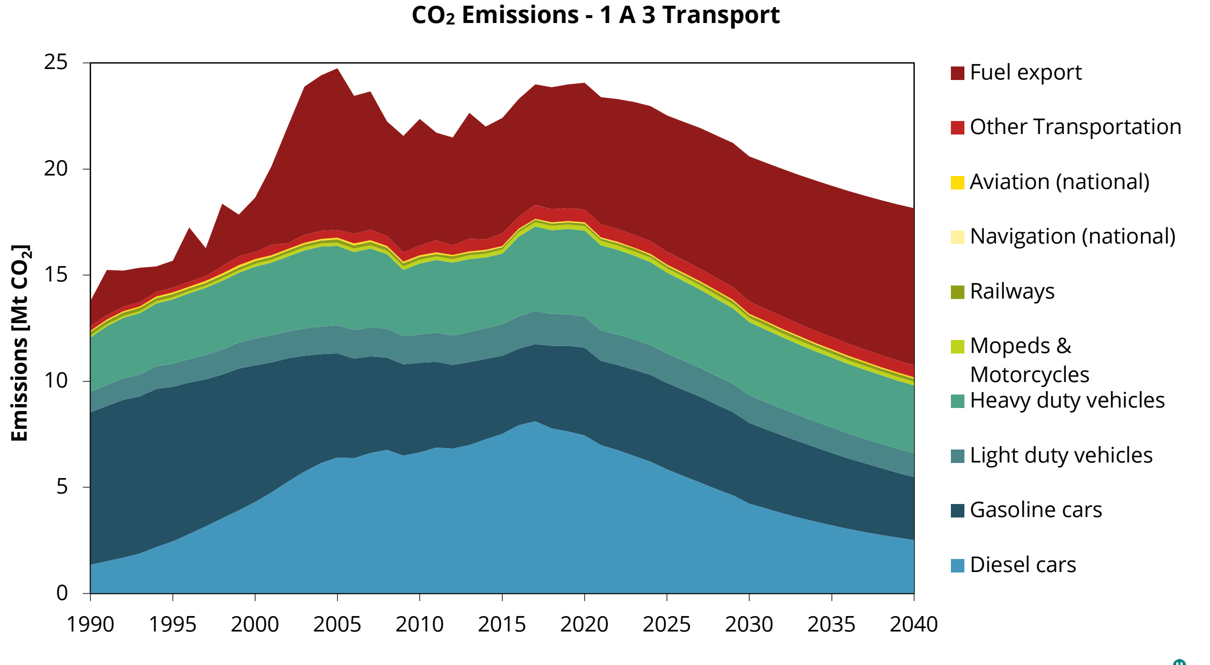
Figure 20: Past trend and scenario (2020–2040) CO_2 emissions from transport – scenario with existing measures.



Source: Umweltbundesamt

The WAM scenario shows a further reduction in GHG emissions compared to the WEM scenario. For GHG emissions from road transport, a 15% decrease over 2017 levels is projected until 2030 (and a 25% decrease until 2040).

Figure 21: Past trend and scenario (2020–2040) CO_2 emissions from transport – scenario with additional measures.

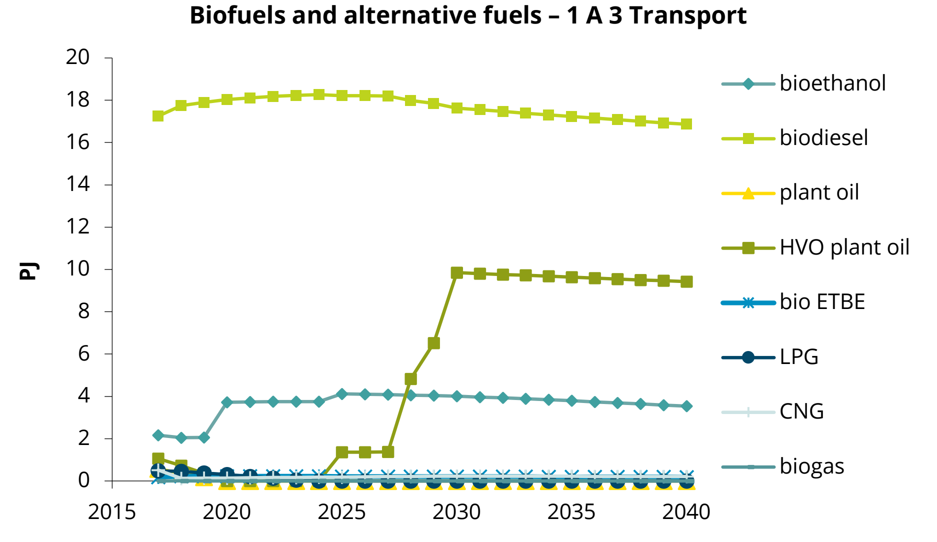


Source: Umweltbundesamt

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 2040 (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) in the scenario WEM. An explanation for this development can be found under 'Alternative fuels: *developments'* (see chapter above).

Figure 22: Scenario for biofuel deployment in Austria – scenario with existing measures.



Source: Umweltbundesamt

The following graph shows increased estimated amounts of biofuels and alternative fuels (CNG, LPG) in the scenario WAM, mainly due to blending fossil fuels with higher volumes of biofuels. An explanation for this development can be found under Alternative fuels: *developments* (see chapter above).

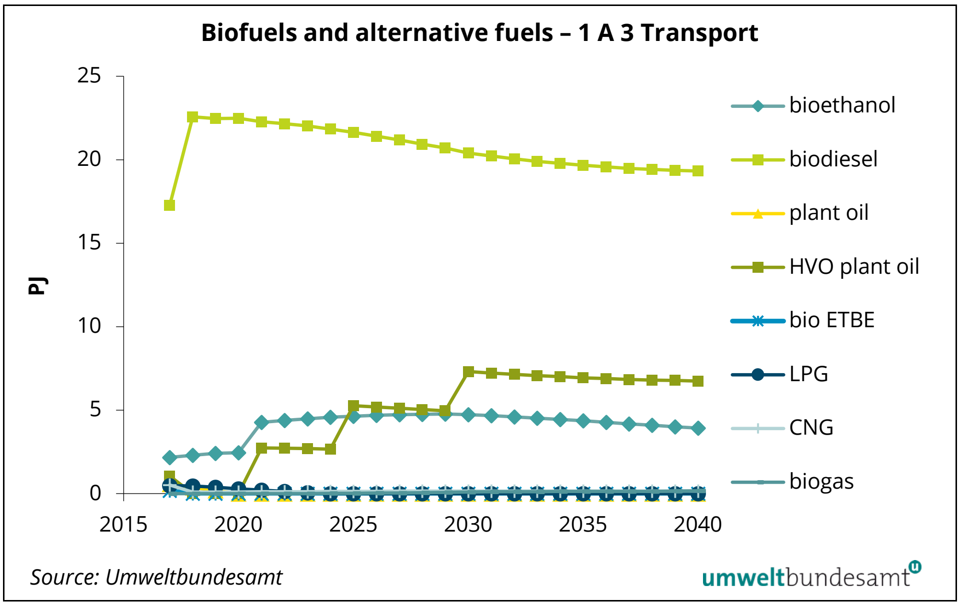


Figure 23: Scenario for biofuel deployment in Austria – scenario with additional measures.

The following graph shows the estimated passenger car fleet development for BEV, HEV and PHEV in Austria up to 2040 (the base year 2017 shows current data) in the WEM scenario. An explanation for this development can be found in Chapter 4.

The electric vehicle stock is estimated to be roughly 1.3 million passenger cars in 2030 and around 2.9 million passenger cars in 2040, which means that almost half of the total car fleet will be (partially) electrically powered.

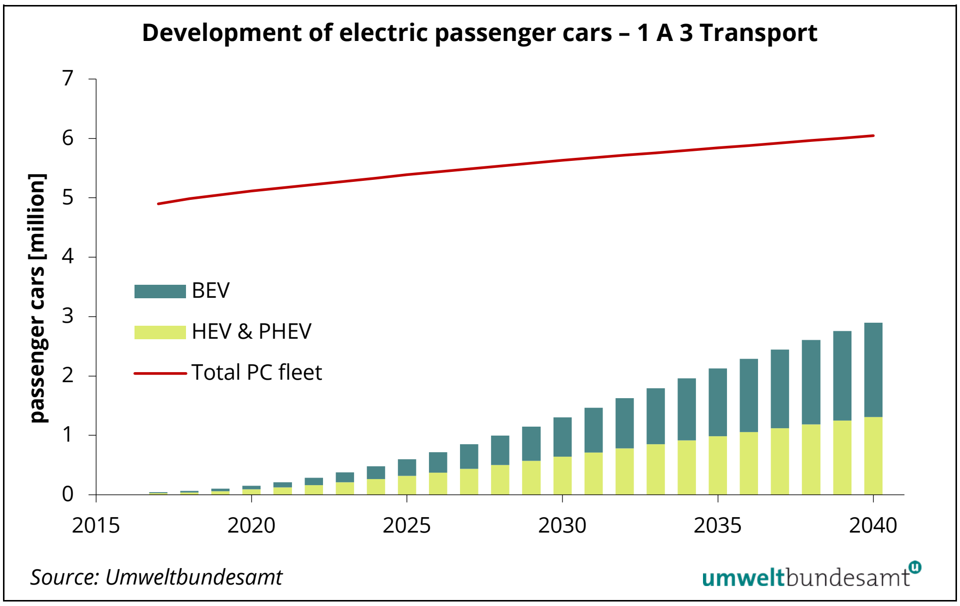
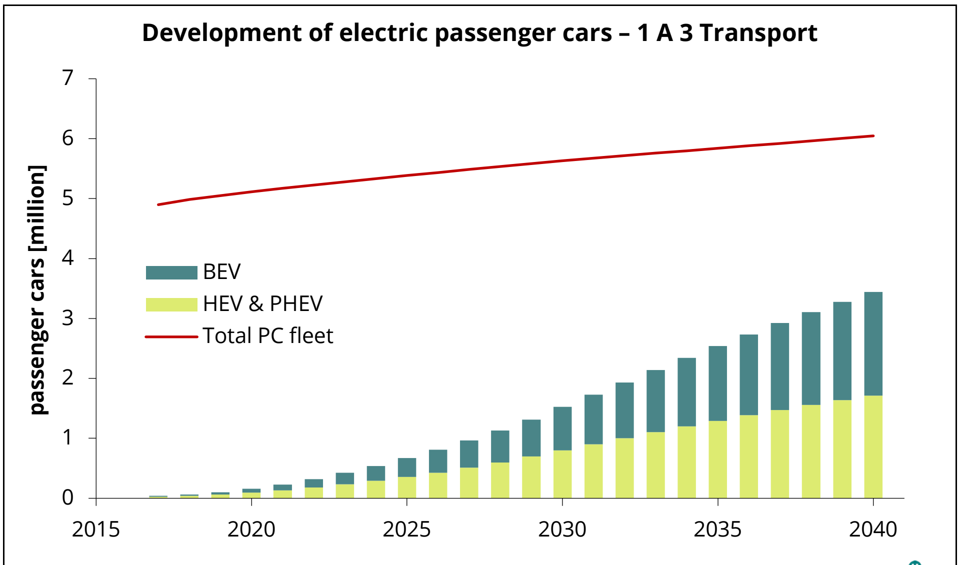


Figure 24: Scenario for electric mobility in Austria – scenario with existing measures.

In the WAM scenario, fleet penetration with electrified PCs is higher, which is a result of higher market shares of new registrations, already from 2021 onwards. The electric vehicle stock is estimated to be roughly 1.5 million passenger cars in 2030 and around 3.5 million passenger cars in 2040, which means that 57% of the total car fleet will be (partially) electrically powered.

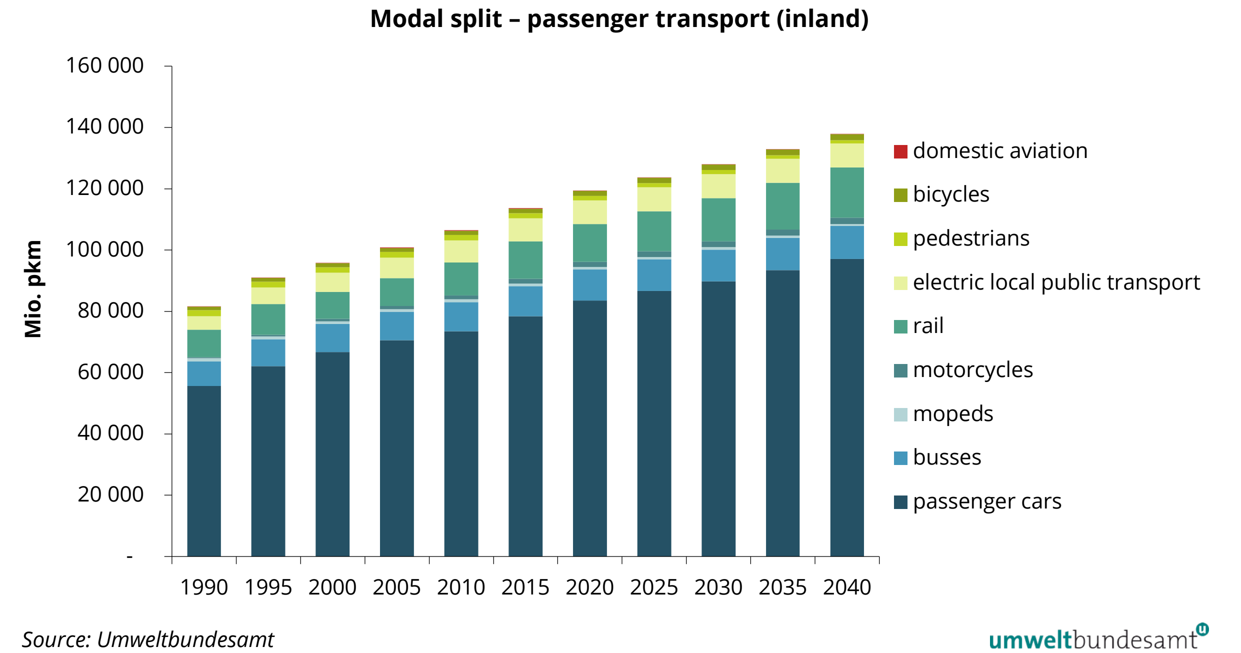
Figure 25: Scenario for electric mobility in Austria – scenario with additional measures.



Source: Umweltbundesamt

The following graphs shows the modal split 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. In the WAM scenario passenger kilometres are expected to shift from passenger cars to rail transport, especially from 2030 onwards.

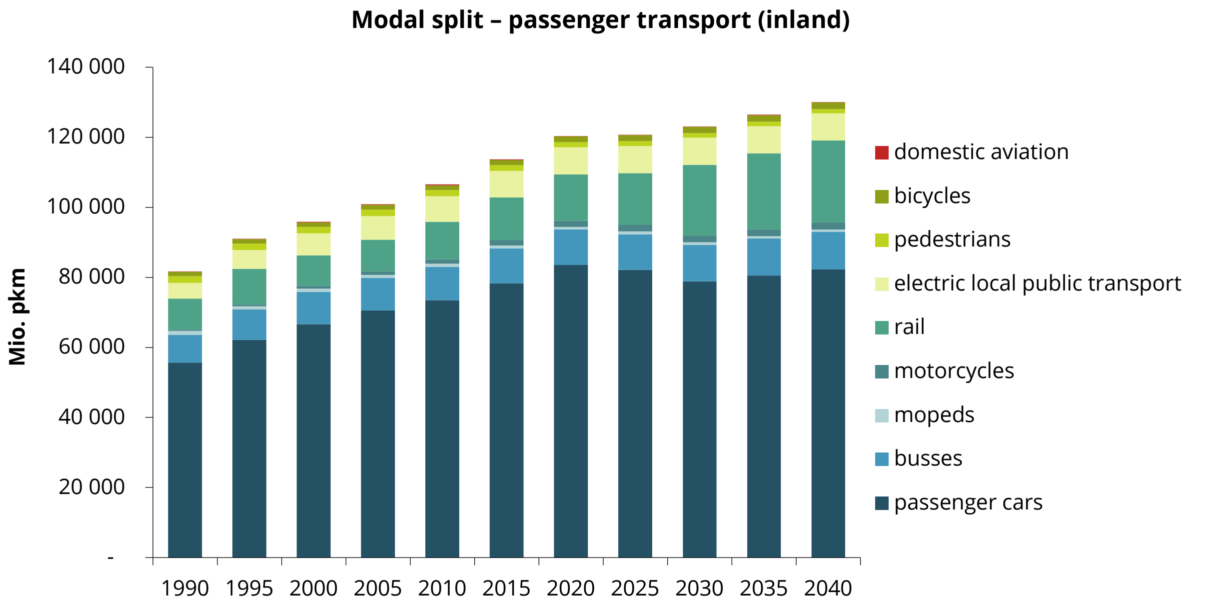
Figure 26: Past trend and scenario (2020–2040) of pkm (excl. fuel export) – scenario with existing measures.



Source: Umweltbundesamt

This phenomenon of fuel export plays a minor role in passenger transport with an average share of 9% in the total GHG emissions from road transport between 2018 and 2040 in the WEM scenario (and 8% in the WAM scenario).

Figure 27: Past trend and scenario (2020–2040) pkm (excl. fuel export) – scenario with additional measures.



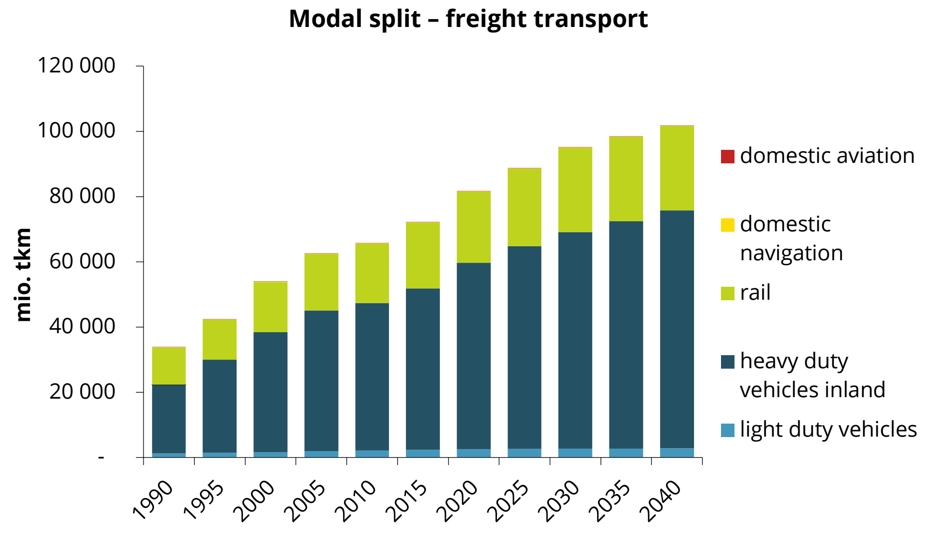
Source: Umweltbundesamt

The following graphs show the modal split and its 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 growth. Freight rail transport is expected to increase slightly. However, the share of rail transport will stay at around 27% (on average) between 2017 and 2040, 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 28.

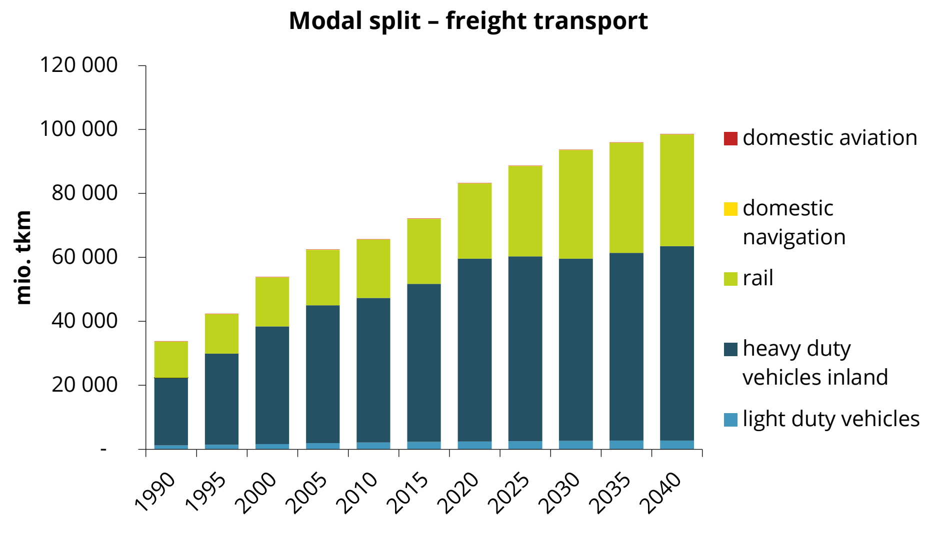
Figure 28: Past trend and scenario (2020–2040) for tkm (excl. fuel export) – scenario with existing measures.



Source: Umweltbundesamt

In the WAM scenario, a significant shift in freight transport from road to rail is expected by 2020. This results in an almost constant freight transport volume on the road of around 60 billion tonne kilometers between 2020 and 2040.

Figure 29: Past trend and scenario (2020–2040) for tkm (excl. fuel export) – scenario with additional measures.



Source: Umweltbundesamt

Fuel exports in heavy duty vehicles continue 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 2040. In the WAM scenario, this share increases to 33%.

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, 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.

Assumptions formobile sources in 1.A.4.b and 1.A.4.c are described in Chapter 3.1.3 and 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) has been used. For the stationary sources in 1.A.4.c (e.g. greenhouses, drying facilities) the econometric input-output model DYNK (WIFO 2018) has been used.

Emission factors have been taken from the national emission inventory. The methodology and references are discussed in Austria's National Inventory Report (UMWELTBUNDESAMT 2021). 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 (2018b).

The basic decision algorithm

The basic decision-making/selection process is performed 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 13% from 2017 to 2040 (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 11% is expected from 2017 to 2040, whereas the number of commercial (non-residential) buildings is expected to rise by about 20% during this period.

The total gross floor area of residential buildings is assumed to increase by 15% until 2040, whereas for commercial buildings the total gross floor area is expected to increase by about 21% from 2017 to 2040.

Price assumptions are especially important in this sector because they may influence decisions about the fuel that will be used 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 (all values at real prices) are expected to rise considerably for all fossil fuels (about 29–51%) from 2017 to 2040. For biofuels, wood logs, wood chips and wood pellets an increase of around 25% to 29% is expected by 2040 within the same time frame. The electricity price is assumed to rise by about 59%, whereas district heat is expected to increase by about 31% by 2040.

The basic assumptions on population, permanently occupied dwellings, residential and commercial buildings and the total gross floor area are the same in both scenarios. Detailed assumptions can be found in Annex 2.

For some of the assumptions, there are differences between the WEM and WAM scenarios.

Scenario "with existing measures"

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 building renovation rate (expressed as full renovation equivalent) 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 0.7% in 2040. For residential buildings with one or two apartments (about 87% of the total residential building stock, expressed as the number of buildings) there is a slightly stronger decrease in renovation rates from 1.1% in 2017 to 0.6% in 2040 and for commercial buildings the rate remains the same at 0.7% in 2017 and in 2040 (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 2.8% in 2040 and in residential buildings with more than two apartments from 1.5% in 2017 to 2.4% within the same time frame. The boiler exchange rate in commercial buildings also rises from 1.1% in 2017 to 2.1% in 2040.

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 89 kWh/ m² gross floor space in 2040, while the average heating demand for commercial buildings is expected to decrease from 140 kWh/m² to 99 kWh/m².

In Chapter 4 more information on measures included in the WEM scenario can be found.

Scenario "with additional measures"

In the WAM scenario, funding for the renovation of existing buildings, energy efficient new buildings and heating systems – including all relevant funding programmes of the federal government and the federal provinces – and the subsidy rates are the same as those in the WEM scenario. It is assumed that the funding allocated for subsidies for early replacement of fossil fuel oil heating systems will be higher.

The energy prices remain the same as in the WEM scenario; however, costs for the installation of new gas heating systems using fossil gas are expected to rise because compensation measures have to be taken (mandatory share of onsite renewables such as solar thermal or photovoltaics, fees as a financial incentive). Price relations influence the choice of heating systems.

The building renovation rates are about the same as in the WEM scenario. However, the average energy savings achieved by thermal renovation are about 17% higher (specific energy needs for heating, taking into account user behaviour).

The boiler exchange rates are noticeably higher in the years 2030 to 2035 in the WAM scenario reflecting the tightened measures for early and mandatory replacement of fossil fuel heating systems. In residential buildings with one or two apartments, the exchange rates rise from 2.0% in 2017 to 2.4% in 2040 with a higher peak in 2035 of 3.9%, and in residential buildings with more than two apartments from 1.5% in 2017 to 2.1% within the same time frame, peaking in 2035 with 2.8%. The boiler exchange rate in commercial buildings also rises from 1.1% in 2017 to 2.1% in 2040.

In the WAM scenario the final energy demand for heating is reduced by about the same amount as in the WAM scenario and expected to be 89 kWh/m² of gross floor space for residential buildings in 2040, while the average heating demand for commercial buildings is expected to decrease from 140 kWh/m² to 94 kWh/m².

Although the average thermal renovation is more effective in the WAM scenario, the concerted switch towards renewables to some extent mitigates these efforts (referring to final energy demand for heating) because of the lower fuel efficiency especially of fuel wood boilers compared to a more common use of condensed oil and gas boilers in the WEM scenario.

In Chapter 4, more information on measures included in the WAM scenario can be found.

3.1.4.3 Activities

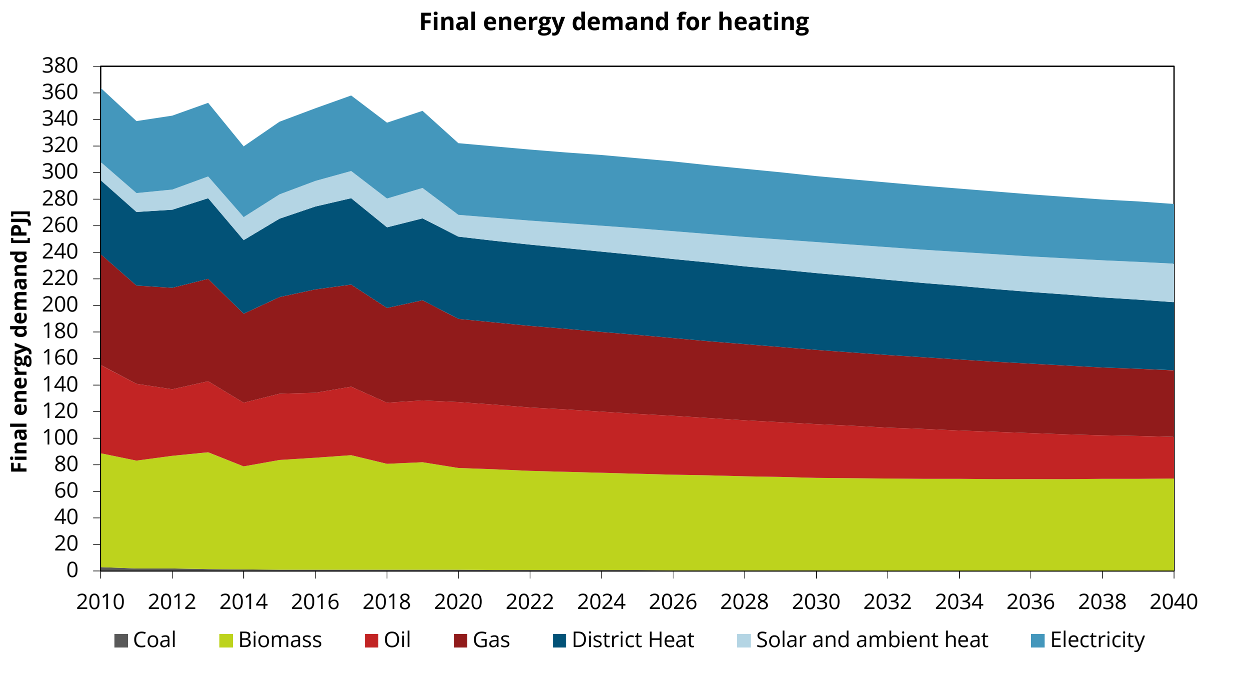
Emissions were calculated on the basis of the consumption of coal, wood log and wood briquettes, wood chips, wood pellets, natural gas, liquefied petroleum gas (LPG) and heating oil, and separately for the sectors 1.A.4.a Commercial/ Institutional and 1.A.4.b Residential, which were modelled with INVERT/EE-Lab. 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).

Scenario "with existing measures"

There is a discernible trend towards renewable and alternative energies, which is partly reflected in an increase in wood pellets use, solar heat and heat pumps. More specifically, the use of pellets is expected to rise by 7% in the period from 2019 to 2040. Alternative energies like solar heat and ambient energy are expected to increase by 27% until 2040. As regards log wood, energy consumption is expected to decline by around 36%, 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 33% reduction in the use of heating gasoil is expected for the period until 2040, as well as a 33% decline in natural gas consumption and a 78% decrease in coal use. Total energy consumption (w/o electricity for uses other than heat application) is expected to decline by 20% in the overall sector (w/o mobile sources).

Figure 30: Past trend energy balances (2010–2019) and scenarios (2020–2040): final energy demand for heating (w/o other electricity use) – scenario "with existing measures".



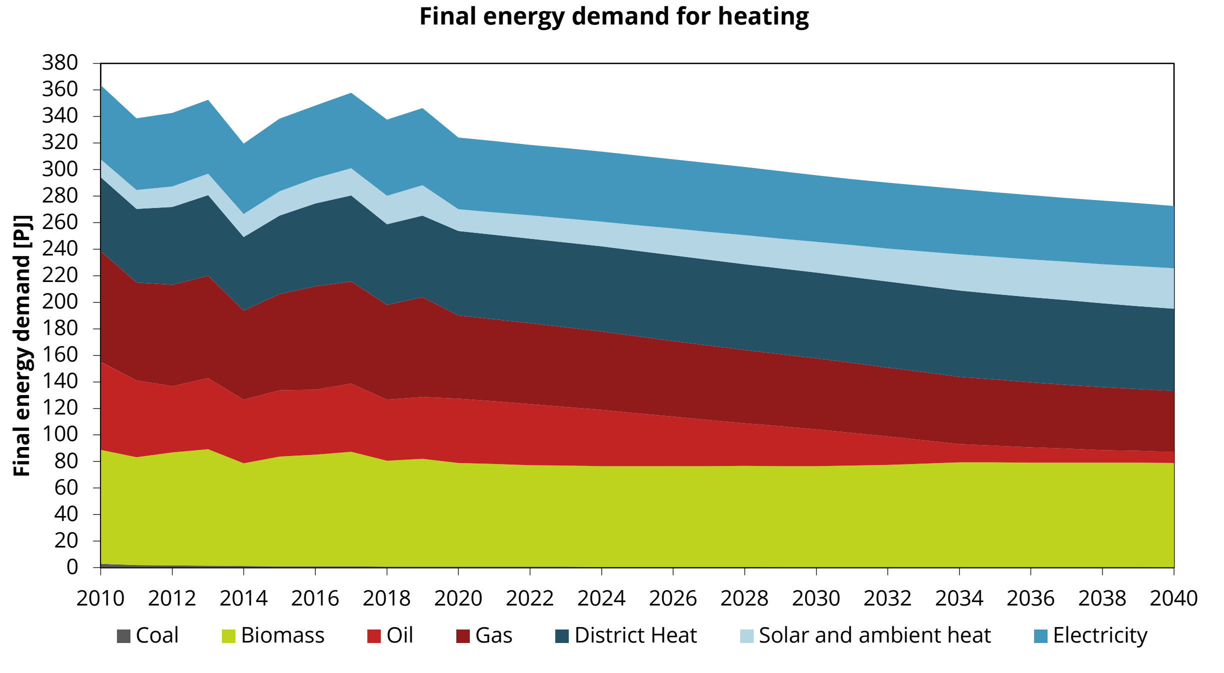
Source: Statistik Austria (2020), Umweltbundesamt

Scenario "with additional measures"

Due to additional measures the overall demand for energy in the sub-sectors 'residential' and 'commercial' is expected to be further reduced. Particularly the replacement of fossil fuels with renewable energy sources until 2040 is far more pronounced than in the WEM scenario.

The use of wood pellets is expected to rise by 26% in the period from 2019 to 2040. Alternative energies like solar heat and ambient energy are expected to increase by 33% until 2040. The decline in the use of log wood (–28%) is less evident than in the WEM scenario. On the other hand, the use of fossil fuels is significantly reduced. In the overall sector, an 82% reduction in the use of heating gasoil is expected for the period until 2040, as well as a 39% decline in natural gas consumption and a 78% decrease in coal use. Total energy consumption (w/o electricity for uses other than heat application) is expected to decline by 21% in the overall sector (w/o mobile sources). Detailed information can be found in Annex 2.

Figure 31: Past trend energy balances (2010–2019) and scenarios (2020–2040): final energy demand for heating (w/o other electricity use) – scenario "with additional measures".



Source: STATISTIK AUSTRIA (2020), Umweltbundesamt

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 2021).

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 2019. 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 2040.

The length of the distribution network has been extrapolated by means of the average yearly growth rates for 2015–2019 (218 km/year) so that the result is an increase of 15% from 2019 to 2040, assuming the number of end consumers is constantly growing. CH_4 emissions have been calculated by means of the averaged implied emission factors for 2015-2019.

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 2015–2019 (main and medium range pipeline length = 24% of the length of the distribution network). This results in an estimated growth of about 15% between 2019 and 2040. CO_2 and CH_4 emissions are calculated by means of 2019 implied emission factors.

Forecasts for natural gas storage are based on plans for storage site extensions from the Austrian Oil Exploration Company (RAG, Rohöl-Aufsuchungs AG). According to the inventory, this natural gas storage capacity (5700 M^3m) has reached by 2017. CH_4 emissions 2020 are calculated by the mean storage volumes and implied emission factors 2015-2019 and predicted to remain constant until the year 2040.

The CH_4 emissions from 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 using the average implied emission factors for the period 2015 to 2019 and domestic natural gas production as assumed in the energy scenarios. It is assumed that 2040 is the last year of domestic natural gas production. 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 downward 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 report are used.

Past trends and scenarios: pipeline and distribution lengths and natural gas storage are presented in Table 10.

Table 10: Past trend and scenarios (2020–2040) activity data: natural gas distribution, transmission and storage (Umweltbundesamt).

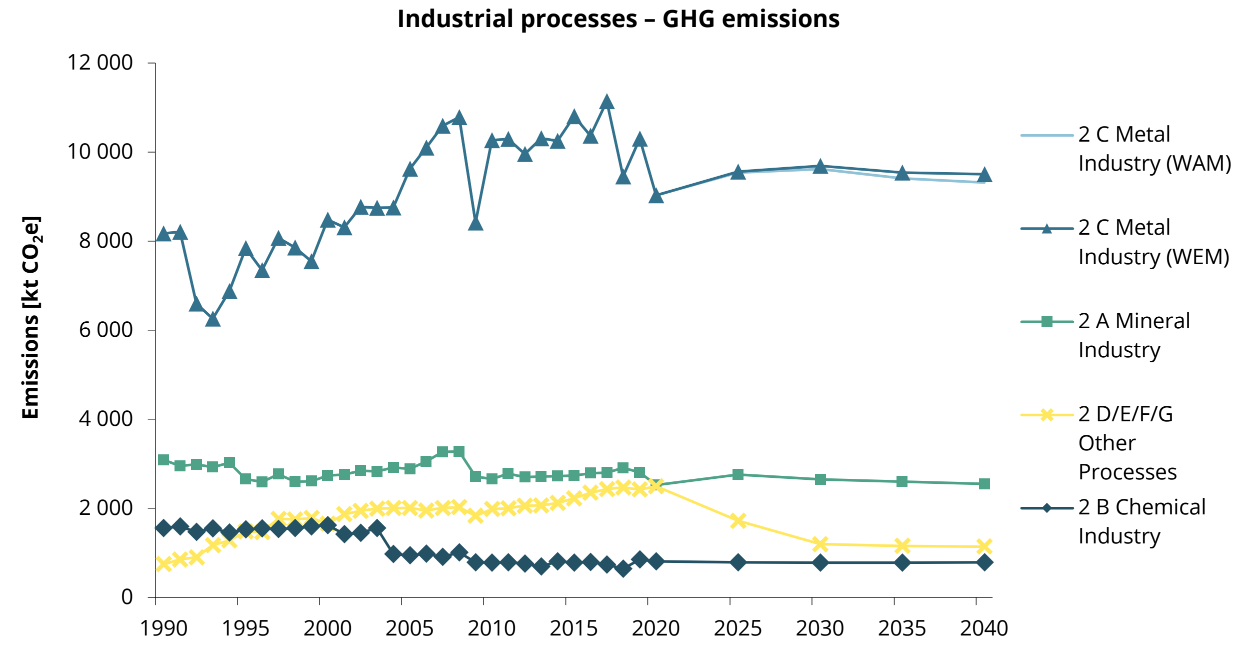
	Pipeline length [km]	**Gas network length [km]**	**Natural gas stored [Mm³]**
1990	3 628	11 672	1 500
2000	5 966	24 099	1 665
2010	6 798	28 733	3 070
2015	7 242	30 067	5 317
2020	7 304	30 497	5 861
2025	7 565	31 587	5 861
2030	7 826	32 676	5 861
2035	8 087	33 765	5 861
2040	8 348	34 855	5 861

3.2 Industrial Processes & Product Use (CRF Category 2)

The main emissions in this sector come from the metal industry (in particular iron and steel production), the chemical industry (in particular ammonia and nitric acid), 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.

The following chart shows greenhouse gas emissions aggregated into four categories of industrial processes. All sectors (Mineral Industry, Chemical Industry, Metal Industry and Other Processes) are expected to see a slight decrease until 2040. Emissions are approximately the same in the WEM and the WAM scenario, except for sector 2 C Metal Industry (Figure 32).

Figure 32: GHG emissions and projections (2020–2040) from Industrial Processes and Product Use.



Source: Umweltbundesamt

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 2021).

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 historical shares in the 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

Ammonia production has been linked to fertiliser demand and the chemical industry (urea/melamine), whereas the production of nitric acid has been coupled to fertiliser production (see Figure 33).

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).

SF_6 is used as an 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. The assumption for the emission projections, it thus 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

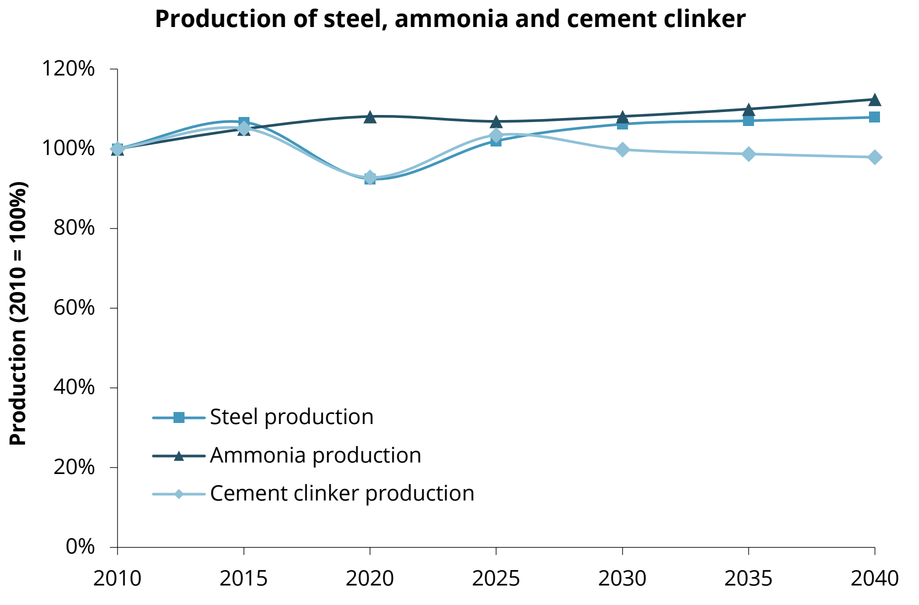
Emissions have been split into EU ETS/non-ETS according to the share of ETS emissions in the corresponding sectors for the most recent years.

3.2.1.3 Activities

Figure 33 presents the assumptions used for the production of cement clinker, ammonia and crude steel.

Whereas production of steel shows a significant decline in 2020 and thereafter a slight growth, the production of ammonia stabilises after 2020 mainly due to a decline in fertiliser demand, for which some of the ammonia is used. Cement clinker production reaches a low in 2020 and declines after 2025. Activity rates are the same for the WEM and WAM scenario.

Figure 33: Assumptions for the production of steel, ammonia and cement clinker.



Source: Umweltbundesamt

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

Fluorinated gases have been in use in Austria in a wide range of applications, most importantly 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 2040.

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 expected 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 and selective placing on the market prohibitions for 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 from 2030 onwards 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.

In 2016, the Kigali Amendment to the Montreal Protocol was established, which foresees a global phase down of HFCs, which will lead to an additional phase-down after 2030 in the EU.

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. Projections until 2040 are based on the assumptions from Annex V to the F gas Regulation, the Kigali Amendment and the MAC Directive, and changes in emission factors are based on assumptions made in SCHWARZ et al. (2011).

As the use of F gases is strictly regulated by the F gas Regulation/Kigali Amendment, 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) has been fully implemented and the Directive relating to emissions from air-conditioning systems in motor vehicles (EU 2006/40/EC) has been partially implemented. The additional phase down after 2030 as foreseen in the Kigali Amendment has also been implemented.
c. Growth rates as well as changes in EFs as described by SCHWARZ et al. 2011 have also been 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 containing < 150 g of refrigerant (unless exported) is in force. Consequently, there is a ban on HFCs in domestic refrigerators and freezers as the amount of refrigerant they contain is normally approximately 100 g. Use of HFCs is allowed in refrigeration and air conditioning systems containing 150 g–20 kg of refrigerant, and 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; however, use of HFCs is slowly phased out (based on the trend of the last years) due to the global provisions under the Kigali Amendment to the Montreal Protocol.
- HFC phase down according to Annex V to the F gas Regulation – even though the exact quota is not known yet, the amount of F gases used (expressed as CO_2 equivalent) is set to decrease to 21% of the average level of 2009–2012 from 2030 onwards. This step-by-step decrease has been assumed for the sub-sectors covered by the F gas Regulation. An additional phase down under the Kigali Amendment has been assumed, which leads to -83% of all HFCs placed on the market compared to 2019/2020.

Mobile Air Conditioning: The MAC Directive (EU 2006/40/EC) requires the introduction of refrigerants with a GWP < 150 in new passenger cars placed 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 but were 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. Emissions from stocks are still occurring (long lifetime of XPS/PU plates) even after 2040.

Fire Extinguishers: Constant stocks and constant emission factors based on 2019 data are assumed.

Aerosols: The F gas Regulation bans the use of fluorinated gases in this sub-category except for medical uses. It has thus been 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 2011–2019, the mean emission values of these years are applied for all years after that.

Electrical Equipment: A constant trend of emissions has been assumed for the period after 2019, as an increased demand for energy will mean an increase in equipment. Alternatives to medium voltage switchgear are currently being developed, but it is unclear when and how they will be implemented.

Other Uses of SF_6: The Austrian Ordinance bans the use of SF_6 in other applications such as footwear and car tyres as well as sound proof windows. Sound proof windows have an average life span of 25 years. Their production and installation ended in 2003. Thus, emissions are expected to occur until 2028, until the last sound proof windows filled with SF_6 has been disposed of.

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

Solvents are chemical compounds used to dissolve substances such as paint, glue, ink, rubber, plastic, pesticides, or they are used for cleaning purposes (degreasing). After their use (or other procedures involving solvent use), most of the solvents are released to air. The use of N_2O (as an anaesthetic and in 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.

Lubricant Use has been estimated according to the IPCC Tier 1 method described in the 2006 IPCC Guidelines:

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.

Data on paraffin wax use is based on the import and export statistics of candles and wax products, and on the production statistics on candles.

CO_2 Emissions from Solvent and Other Product Use

Emission projections for 2020–2040 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).

The Austrian solvents model is based on import-export statistics (foreign trade balance) and production statistics provided by Statistik Austria on the one hand and data reported under the VOC Directive on the other, combined with data and information from Austrian surveys (WINDSPERGER et al. 2002a, 2002b, 2004; WINDSPERGER & SCHMID-STEJSKAL 2008)

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 2020 update of the solvent model, recent data from the solvent balances for 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 EFs for 2015 and 2019 are based on data obtained from operators using solvents and are considered to remain mostly stable until 2040.

N_2O Emissions from Solvent and Other Product Use

Basic data for the compilation of the Austrian Air Emission Inventory (OLI) 2020 (data 2019) has been provided by companies selling N_2O as an anaesthetic and a producer of whipped cream chargers, and by supermarkets and other producers selling whipped cream chargers or spray cans. Emission factors are based on the IPCC Guidelines.

For projections of N_2O emissions from 2 G 'Other Product Use', it has been assumed that emissions from 2019 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% from the metal industry. WEM scenarios for both sectors show constant emissions. Emissions are thus based on the mean value of the past five years and assumed to remain constant until 2040.

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

Most of the demand for solvents arises 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 2040 it has been 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 farming policy, provides information on basic economic and technological assumptions and describes the methodologies used for the sectoral scenarios by 2040.

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, implemented in 2015. The CAP reform in 2013 introduced a new architecture of direct payments. The objective was to make payments better targeted, more equitable and greener. Direct payments brought considerable changes to the distribution of farm payments in Austria. Regions where cattle and milk production prevails benefit from these changes.

In the new CAP period, environmental care and climate change action are specific priorities. The European Commission proposes a more flexible system and the policy shifts the emphasis from rules and compliance towards results and performance. Currently, member states are preparing their national strategy plans for the new CAP period.

Additionally, the EU programme for rural development is of major importance for the Austrian agriculture sector, because transfers of payment entitlements from this source outweigh transfers from the 'first pillar of the CAP', e.g. commodity-related instruments. Climate goals are 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

The Austrian energy policy is committed to substitute non-renewable energy sources with renewable ones. Raw materials produced by agriculture are a major alternative source. Two major legal sources are of interest in this context: the Austrian law for the provision of green electricity (Ökostromgesetz) and the European Biofuels Directive (EU, 2003) repealed by the EU Directive on Renewable Energy (Directive 2009/28/EC). A directive aimed at reducing indirect land use change for biofuels and bioliquids entered into force in 2015 (EU 2015/1513). Both measures are associated with the agricultural sector via the price system: the regulations to boost bioenergy crop production act as a subsidy for farm commodities. In December 2018, the Renewable Energy Directive 2018/2001/EU entered into force including a binding renewable energy target for the EU for 2030 of at least 32%, with a clause for a possible upward revision by 2023.

3.3.2 Methodology used for the sectoral scenarios

Emissions are calculated based on the methodology used for the Austrian Greenhouse Gas Inventory. A comprehensive description can be found in the Austrian National Inventory Report 2021 (UMWELTBUNDESAMT 2021).

The PASMA Model

The Positive Agricultural Sector Model Austria (PASMA), developed by the Austrian Institute of Economic Research (WIFO), maximises sectoral farm welfare and is calibrated on the basis of historical crops, forestry, livestock, and farm tourism activities. The method of Positive Mathematical Programming (PMP) 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 (WIFO & BOKU 2018).

Economic assumptions

Apart from the milk price projections, all estimates are derived from OECD-FAO outlooks on agricultural markets (OECD-FAO 2018). Estimates for the coming period were made on the basis of previously observed wedges between EU and Austrian price levels.

Milk prices in Austria are 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; they are embedded in exogenous price assumptions. Other driving forces are prices, technologiesy and constraints.

Other assumptions

- Increase in milk yield per cow (+14% from 2020 to 2040)
- Loss of agricultural land follows the long-term trend

Main results

Cattle numbers are expected to increase slightly.The Programme of Rural Development and the coupled alpine farming premium provide favourable conditions for extensive cattle producers. The availability of grassland, relatively high beef prices and moderate levels of projected milk yields per cow make production attractive.

Decreasing prices for pork lead to falling numbers of pigs. This result is in line with expert expectations, predicting a decline in production mainly due to the limitations of production facilities. OECD/FAO projections indicate low prices for pork as well.

According to the model results, poultry production will decrease. Relatively high feed costs (mainly soya meal) makes production of poultry meat in Austria less profitable. Furthermore, poultry and egg producers in Austria have to cope with considerably higher costs compared to producers in other countries.

The sale of mineral nutrients is likely to decline slightly. This result is consistent with a long-term trend but not consistent with observations of more recent sales data. 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)

The scenario is based on price projections of OECD/FAO (OECD-FAO 2018) for the EU, existing farm policies and the existing legal framework of regulations. It considers the climate change measures as implemented in the current Austrian agri-environmental programme 2014-2020, as well as assumptions about the programme thereafter. Information on implemented measures are provided in Chapter 4.9.

Scenario "with additional measures" (WAM)

The WAM scenario takes into account the additional policy measures for the agriculature sector as provided in the Integrated National Energy and Climate Plan (BMNT 1019a) and the National Air Pollution Control Programme (BMNT 1019b). For a detailed description of considered measures see Chapter 4.9.2.

Activity data

Scenario WEM

PASMA (WIFO & BOKU 2018) provides the basic activity data for the WEM scenario.

Scenario WAM

Projected activity data is the same as the data used in the WEM scenario (WIFO & BOKU 2018), except for cattle. For cattle, additional measures have been assumed, with the result that animal numbers will no longer increase from 2025 onwards (see chapter 4.9.2.1).

Emission calculation

Emission calculations are based on the methodology used for the Austrian Greenhouse Gas Inventory. A comprehensive description can be found in the Austrian National Inventory Report 202021 (UMWELTBUNDESAMT 2021).

3.3.2.1 Enteric Fermentation (3.A)

This source category includes CH_4 emissions from the fermentation of feed within the animal's digestive system.

Scenario WEM

Feed intake parameters and methane conversion rates are the same as the ones used in the national greenhouse gas inventory (UMWELTBUNDESAMT 2021). Gross energy (GE) intake in dairy cows was calculated on the basis of projected milk yields.

Scenario WAM

WAM includes additional measures to support climate friendly breeding and feeding (e.g. improved feed quality according to the animals' needs and adapted to local conditions, use of methane-reducing feed additives.

Additional measures result in lower CH_4 emission rates from enteric fermentation in cattle in 2030 compared to the WEM scenario. For more detailssee Chapter 4.9.2.

3.3.2.2 Manure Management (3.B)

This source category includes CH_4 and N_2O emissions occurring during the housing and the storage of livestock manure.

Scenario WEM

Emission factors and parameters correspond to those of the national inventory. In the distribution of manure management systems a slight trend towards loose housing and liquid manure systems has been assumed for all scenarios until 2030.

Austria-specific volatile solid (VS) excretion and N excretion values for dairy cows were calculated on the basis of projected milk yields (+14% from 2020 to 2040).

Scenario WAM

The WAM scenario includes the following additional measures:

Slightly decreased nitrogen excretion from cattle (with the exception of dairy cows), pigs and chicken by 2030 compared to the WEM scenario;

- Increased grazing for milk & suckling cows by 2030.
- Measures listed in the National Air Pollution Control Programme effecting lower NH_3-N losses and therefore lower indirect N_2O emissions;
- Increased share of Austria's total amount of manure treated in biogas plants by 2030.

For more details see Chapter 4.9.2.

3.3.2.3 Rice Cultivation (3.C)

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

3.3.2.4 Agricultural Soils (3.D)

This source category includes N_2O emissions from anthropogenic N inputs to agricultural soils.

Scenario WEM

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

Scenario WAM

Sustainable N management reduces nitrogen losses and finally results in a lower demand for mineral N fertilisers in 2030. Additional measures listed in the National Air Pollution Control Programme result in lower NH_3-N losses during manure application on soils and therefore in lower amounts of indirect N_2O emissions from agricultural soils. For more details see Chapter 4.9.2.

3.3.2.5 Prescribed Burning of Savannas (3.E)

No prescribed burning of savannas is projected for Austria (notation key 'NO').

3.3.2.6 Field Burning of Agricultural Residues (3.F)

In Austria, a federal law restricts the burning of agricultural residues on open fields. Residue burning is only permitted occasionally and on a very small scale. Thus, we have applied a simple approach using the 2020 fraction of burnt agricultural residues for both scenarios.

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

Since the last submission, LULUCF projections have been recalculated based on new historical data. Projected values are based on the same modelling exercise and have only been updated according to the changes made in the GHG inventory. For the LULUCF sector, currently only a WEM scenario is available. For consistent reporting with regard to the other sector, the WEM data was also inserted for WAM for the LULUCF sector.

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 diameter growth and height growth 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 the 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 de-

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

mand. FOHOW2 (NORTHWAY et al. 2013) is a partial equilibrium dynamic forest sector model simulating Austria's wood product supply chain.

The modelling exercise only provides projections for total forest land (4.A) and no split into forest land sub-categories is available. In addition, it has been assumed that the forest area remains constant in the scenarios. Therefore, it has been assumed that the emissions/removals calculated for 4.A are equal to 4.A.1. Forest land remaining forest land and land use changes to forest land were calculated separately based on forest area trends and emission factors from the GHG inventory.

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 follow the same trend as 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; for the projections after 2018, 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 indefinitely as demand is likely to rise in other countries as well. The maximum amount has been defined in line with the historical maximum amounts 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 policy assumptions, it has been 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 and the model does not provide for a split into forest Land sub-categories. Therefore, the land use change areas were calculated based on an extrapolation of historical trends. The remaining land area was calculated by subtracting the land use change areas from the total forest land area.

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 the University of Natural Resources and Applied Life Sciences, Vienna (BOKU). The PASMA model was developed by the Austrian Institute of Economic research (WIFO) (WIFO & BOKU 2018) and has also been used for activity data projections in 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 such as 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 from 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 2021).

Assumptions

For a more detailed description of the methodology and assumptions related to the PASMA model see Chapter3.3.2.

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 the one used in the National Greenhouse Gas Inventory (UMWELTBUNDESAMT 2021).

Settlements: Projected areas for sector 4.E Settlements are based on expert judgements as well as the 14^{th} Austrian Spatial Planning Report (ÖROK 2015).The arithmetic means of these sources have been calculated to derive the relevant areas for the years 2013–2040. 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 in 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 2021). 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 settling 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 has been 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, DOC_F, 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 pre-treatment of waste (accounting for 95% of the total 'non residual waste' since the introduction of the ban on the disposal of untreated waste).

Activity data come from a country-specific source. Since 2008 data have been taken from the Electronic Data Management, an electronic database administered by the BMK (Federal Ministry of Climate Action, Environment, Energy, Mobility, Innovation and Technology) which delivers data as input to the national Federal Waste Management Plan. The parameters used in the emissions calculation are described in UMWELTBUNDESAMT 2021.

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 (below 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 mean values are applied on the basis of the amounts deposited in most recent years (partly back to 2005).

Regarding methane recovery, a constant decrease in recovery rates has been assumed due to the decreasing gas generation potential of deposited waste. The assumption is based on historical values 2008–2017 as reported by the federal provinces (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 2021).

3.5.1.3 Activities

Disposal of waste on landfills without pre-treatment has not been allowed since 2009 (see Landfill Ordinance). The main fraction relevant for current and future waste disposal (92% share in 2019) 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 7.4% in the total amount deposited in 2019. The basis for the projections for this activity is the mean value of the waste amounts reported for the years 2005 – 2019. 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), accounting for most of the current and future emissions.

Table 11: Past trend (1990–2015) and scenarios (2020–2040) 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	160	160
2025	0.0	160	160
2030	0.0	160	160
2035	0.0	160	160
2040	0.0	160	160

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 12).

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

[kg/t humid waste]	CH_4	N_2O
Biogenic waste composted	0.75	0.1
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 (Statistik Austria 2020a). Amounts of waste treated in composting plants are partly (50%) expected to remain constant at 2019 levels (loosely piled bulk and wood used as structural material in the composting process), and partly (50%) 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, there was a decrease in activities from 2007 to 2012. Since then the waste amount treated in MBT has stabilised.

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 (e.g. the BREF document for waste treatments issued in 2018). Projections for input amounts have been made until 2040 and are based on the amounts treated mechanical-biologically in 2019 (see Table 13).

The emission factors used for the projections are in accordance with the Austrian National Inventory Report 2021 (UMWELTBUNDESAMT 2021; see also Table 13).

Anaerobic digestion

Waste amounts treated in anaerobic digestion plants are assumed to remain constant at the level of a 2018-2019 mean value as there is no reliable information on the future developments of anaerobic digestion and any 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) – has been assumed.

3.5.2.3 Activities

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

Table 13: Past trend (1990–2015) and scenarios (2020–2040) – activity data for biological waste treatment (Umweltbundesamt).

[kt waste treated]	1990	2000	2005	2010	2015	2020	2025	2030	2035	2040
Composted organic waste	418	1 467	2 375	2 523	2 718	2 916	2 954	2 986	3 012	3 038
Mechanically-biologically treated waste	345	254	623	551	439	430	430	430	430	430
Anaerobically treated waste	0	0	152	378	438	509	509	509	509	509

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 the 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 the CRF sector 1.A – Fuel Combustion. In Austria, there was only one waste incineration plant without energy recovery in operation until 1991, with a capacity of 22 000 tonnes of municipal waste per year. This plant was rebuilt as a district heating plant which went into operation in 1996. Consequently, since the re-opening of this plant (i.e. from 1996 onwards), emissions have been reported under the CRF sector 1 A – Fuel Combustion.

3.5.3.1 Methodology used for the sectoral emission scenarios

For this calculation, the simple CORINAIR methodology has been applied: the quantity of waste oil is multiplied by an emission factor for CO_2, CH_4 and N_2O. Emission factors are consistent with the emission factors used in the Austrian Inventory (UMWELTBUNDESAMT 2021).

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

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

3.5.3.2 Assumptions

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

3.5.3.3 Activities

The 2005 Austrian Waste Incineration Ordinance 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 2040 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 the 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, 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)

$F_{IND-COM}$ = 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.

Moreover CH_4 and N_2O emissions from the sub-category *5.D.2* Industrial wastewater handling are estimated on the basis of a study conducted in 2019 (UMWELTBUNDESAMT 2019c), investigating the practice of wastewater handling in industrial plants in Austria.

Regarding CH_4, data on generated gas and methane concentration (measured by the plants) was collected via a survey among industrial wastewater plant operators. An EF of 1% of the methane generated was then applied for all plants with anaerobic pre-treatment. Indirect N_2O emissions were calculated using measured N loads from direct industrial discharges reported annually within the EMREG database and the emission factor for wastewater discharge, which is 0.005 kg N_2O-N/kg N. (IPCC 2006).

A detailed description of the methodologies is included in the National Inventory Report 2021 (UMWELTBUNDESAMT 2021).

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[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)

3.5.4.2 Assumptions

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

- The N load in the influent flow generated by the population and entering treatment plants will increase with population growth, the load generated through industrial activities (30% of the population load) will remain constant at the same level as in 2019.
- The N removal rate will remain constant at 80.7% (2012-2019 mean value)
- Population growth will take place only in areas that are connected to sewer systems. The level of connection will therefore increase slightly, the number of people not connected will remain constant.
- Data on future population growth has been taken from (STATISTIK AUSTRIA 2020).

Table 15: Past Trend (1990–2015) and scenarios (2020–2040) – indicators of waste water treatment/management (STATISTIK AUSTRIA 2020a, Umweltbundesamt).

	1990	2000	2005	2010	2015	2020	2025	2030	2035	2040
Inhabitants [1 000]	7 678	8 012	8 225	8 361	8 630	8 922	9 088	9 225	9 336	9 447
Connection rate to wastewater treatment plants [%]	59.0	84.3	88.9	93.9	95.1	96.0	96.1	96.1	96.2	96.2
Nitrogen influent wwtp [t]	28 994	43 227	46 379	47 157	47 414	50 420	51 037	51 788	52 287	52 786
Nitrogen effluent incl. pop. not connected to wwtp [t]	41 031	23 475	17 136	11 998	10 972	11 449	11 593	11 713	11 809	11 905

4 POLICIES & MEASURES

This chapter describes the policies and measures included in the 'with existing measures' (WEM) and the 'with additional measures' (WAM) scenario.

The 'with existing measures' scenario includes all measures implemented by 1 January 2018; The 'with additional measures' scenario includes planned policies and measures which were reported with the Integrated National Energy and Climate Plan for Austria (BMNT 2019).

The content of the chapter on policies and measures (PaMs) is in compliance with Article 18 (1) (a), Annex VI of the Governance of the Energy Union and Climate Action Regulation (EU 2018/1999) and Article 37, Annex XXIV of the related Implementing Regulation (EU 2020/1208).

It also meets the requirements of the UNFCCC 'Decision 18/CMA.1 Modalities, procedures and guidelines for the transparency framework for action and support referred to in Article 13 of the Paris Agreement'.

The measures listed in this chapter provide a basis for future efforts to limit GHG emissions beyond the commitments under Regulation (EU) 2018/842 and Regulation (EU) 2018/84, but none of the measures on its own is expected to deliver an emission reduction beyond the existing commitments.

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 for achieving the so-called Toronto target.

[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

- 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).

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 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 emissions 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
- Mobility management
- Waste prevention/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, and are 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).

- Integrated National Energy and Climate Plan 2021-2030 (NECP, BMNT 2019a): The National Energy and Climate Plan includes a number of detailed measures that will make a significant contribution to achieving the 2030 targets in the areas of greenhouse gas emissions, energy efficiency and renewable energy. Austria's objectives until 2030 are:
  - Reduction of greenhouse gas emissions by 36% compared with 2005 levels in sectors that are not covered by the EU emissions trading system;
  - Increasing the share of renewable energy in gross final energy consumption to 46– 50%;
  - Coverage of 100% of domestic electricity consumption from renewable sources (national, net balance, with exceptions for controlling and balancing energy supply for grid stabilisation and internal electricity generation from fossil fuels in tangible goods production);

- Improving primary energy intensity, defined as primary energy use per GDP unit, by 25–30% compared with 2015.

The policies and measures defined in the National Energy and Climate Plan are considered in the scenario 'with additional measures'.

Additional measures to meet the current 2030 target as well as the enhanced ambition for 2030 are currently under discussion and have therefore not been implemented in the modelling exercise.

- Austria's long-term strategy through to 2050: Within its long-term climate strategy, Austria has committed itself to become climate neutral by no later than 2050, without using nuclear power. This means that the unavoidable greenhouse gas emissions (for example from agriculture and production processes) will be compensated by carbon storage in natural or technical sinks.

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 noted 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 the measures.

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

- 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 the projections, ensuring consistency between the projection reporting and the policies and measures.

Three measures apply to more than one sector. In previous submissions, they were allocated to the sector 'cross-cutting policies and measures'. As 'cross-cutting' is no longer a default value, all affected sectors are shown in the present submission. This is the case for the EU Emission Trading Scheme, which targets the energy supply and the industry sectors. Two other measures that have been allocated to more than one sector are national funding mechanisms providing support to climate friendly projects in various sectors.

Compared to the 2019 submission, there has been no change in the reporting of policies and measures for the WEM scenario. The policies and measures in the WAM scenario have been added and are in line with Austria´s Integrated National Energy and Climate Plan (BMNT 2019).

The reporting of 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 Measures affecting more than one sector

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. It is aimed at reducing CO_2 emissions from 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 (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, 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 covered only CO_2 emissions. From 2010 onwards, N_2O emissions in Austria have been considered as well. The system covers large emitters from the industry and energy supply sectorse

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 have now been 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 an 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 administrative costs and – if allowances have to be purchased – the costs to be paid for allowances that have to be purchased to cover emissions. Thus, the costs vary depending on the circumstances of a particular installation. The price of allowances has increased to about 20 euros, which is still lower than predicted at the beginning of the ETS's 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 environmental performance in the energy, manufacturing and 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 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 in 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 thus 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 hydropower 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 will only be effective until 2021. Though a new law replacing the Green Electricity Act from 2012 is very likely (see PaM Further enhancement of renewable energy in energy supply), providing for some form of support after 2020 (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 (compared to 2016, adjusted for weather conditions) will be produced in green electricity plants in 2020, 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 in 2020 (final figures not published yet) 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 (Energy Efficiency Directive (2012/27/EU)), Austria adopted an Energy Efficiency Act in 2014 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 is granted for heat and power cogeneration in order to support an efficient use of primary energy for electricity production.

GHG affected: CO_2

Type of policy: planning, economic, regulatory

Implementing entity: federal government, federal provinces

Mitigation impact: not available

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

Energy Efficiency Act
('Energieeffizienzgesetz')

Type: EU policy

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

The Energy Efficiency Act is aimed at 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 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, whose CHP provisions 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.

Under the law, subsidies are provided to new and refurbished installations which are put into operation by the end of 2020.

Subsidies for new CHP plants are 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 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.

4.4.2 WAM measures for Energy Industries

4.4.2.1 PaM N°6: Further enhancement of renewable energy in power supply and district heating

A further increase in the share of renewable energy in the supply of power and district heating by 2030 is the main purpose of this policy designed to reduce climate impacts of the energy system. Beyond the traditional use of large-scale hydropower for electricity generation, quantitative targets will be set in the Renewable Energy Expansion Act to increase, in the next decade, the share of wind power, photovoltaics, small hydropower plants and biomass/biogas in electricity generation.

Investment support for biomass-based district heating systems will continue to be granted via the Domestic Environmental Support Scheme. Funding for this scheme has been considerably increased recently. Additional support for innovative district heating systems will be granted (see PaM Domestic Environmental Support Scheme).

GHG affected: CO_2

Type of policy: regulatory, economic

Implementing entity: federal government (Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology)

Key PaM (yes/no): yes

Mitigation impact: 8 500 kt CO_2 eq in 2030 (Renewable Energy Expansion Act)

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

Renewable Energy Expansion Act
('Erneuerbaren-Ausbau-Gesetz')

Type: EU policy

EU legislation	National Implementation	Start
RES Directive 2018/2001/EC	Renewable Energy Expansion Act (in preparation)	2021

Directive 2018/2001/EU will be implemented by adopting the Renewable Energy Expansion Act, which is aimed at a cost-efficient expansion of renewable energy supply. It is a revision of the Green Electricity Act and is expected to be adopted in 2021.

Among other things, the new Act is expected to establish a harmonised framework for promoting electricity production from various forms of renewable sources, e.g. biomass, wind power, small hydropower, geothermal energy and photovoltaics. Support will be provided to renewable energy sources by a combination of fixed feed-in tariffs or market premiums and investment support. Market premiums will (except for small installations) become the standard form of support for photovoltaics, biomass and, at a later stage, for wind power.

For later technologies, subsidies will be allocated through a tendering process. The time period of the guaranteed feed-in subsidy will be extended to 20 years for all power plants supported by a market premium or a feed-in tariff.

The forthcoming revision of the Green Electricity Act will be aimed at raising national electricity production from renewable energy sources by 27 TWh by 2030, thus bringing national production of green electricity to 100 % of the national demand (on a yearly basis). Quantitative sub-targets will be set for further increasing the share of wind power, photovoltaics, small and medium hydropower plants and biomass/biogas in electricity generation. The expansion target will include the following sub-targets for 2030 (vs. 2020):

- Hydropower +5 000 GWh
- Wind power +10 000 GWh
- Photovoltaics +11 000 GWh
- Biomass and biogas +1 000 GWh
- Quantification/Projected GHG emissions/removals:

In accordance with the Renewable Energy Expansion Act, an additional 27 TWh (approximately) of electricity (compared to 2020, adjusted for weather conditions) will be produced in green electricity plants in 2030. This increase in green electricity production will result in emission reductions of about 4 300 kt CO_2 eq. in 2025 and about 8 500 kt CO_2 eq in 2030 (using an emission factor of 0.4 kt CO_2 eq./GWh). The installed capacity of renewable energy sources is expected to increase by 10 GW by 2030.

4.4.2.2 PaM N°7: Further enhancement of energy efficiency in energy industries

A further increase in energy efficiency in the energy and manufacturing industries is essential for the achievement of climate and energy goals. Based on EU legislation, Austria adopted an Energy Efficiency Act and prepared a National Energy Efficiency Action Plan in 2014 and 2017, respectively, with quantitative targets for final and primary energy consumption in 2020. The Energy Efficiency Action Plans have since been integrated into the National Energy and Climate Plans. The Austrian plan was published at the end of 2019.

Furthermore, support by the Domestic Environmental Support Scheme in the sector non-ETS industry is expected to increase (see PaM Domestic Environmental Support Scheme).

Financial support for heat and power cogeneration based on fossil fuels will no longer be granted from 2021.

GHG affected: CO_2

Type of policy: regulatory, economic, planning

Implementing entity: federal government (Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology), federal provinces

Key PaM (yes/no): no

Mitigation impact: 918 kt CO_2 eq in 2025; 1 726 kt CO_2 eq in 2030

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

Austria implemented the Energy Efficiency Directive (2012/27/EU) by adopting the Energy Efficiency Act in 2014, which is aimed at 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 (see PaM Increase energy efficiency in energy and manufacturing industries). The Energy Efficiency Act is currently under review.

The following Energy Efficiency Goals for the period 2020-2030 have been set in the National Energy and Climate Plan:

- a reduction of primary energy intensity of 25-30 % by 2030 (via 2015)
- a primary energy demand target of 1 200 PJ in 2030 (should this target not be achieved, the exceeding demand has to be supplied by renewable energy sources)
- a final energy demand of 1000-1070 PJ (based on an economic growth of 1.5 %/a)
- cumulated energy savings of 500 PJ over the period 2021-2030
- The targets shall be achieved through a combination of strategic measures and energy saving obligations for energy suppliers.

Quantification/Projected GHG emissions/removals:

The Energy Efficiency Act is expected to deliver savings of a combined total for all sectors of approximately 90 PJ in 2030 through an energy efficiency obligation scheme and strategic measures (BMNT 2019a). Final energy demand is expected to be 1 134 PJ in 2030 in the scenario WAM. However, reductions have been calculated based on a comparison of emissions in the sector energy and manufacturing industries between the scenarios WAM and WEM. The results may thus be influenced by other factors. The bulk of the calculated savings of 1 726 kt CO_2 eq. will materialise in the ESR sector.

4.4.2.3 PaM N°8: Further enhancement of renewables in gas supply

Austria intends to increase the share of renewables in its final energy demand. As in the sector energy industries, natural gas is the predominant fuel. It is therefore essential to raise the share of renewable gas in the gas grid.

GHG affected: CO_2

Type of policy: regulatory, economic

Implementing entity: federal government (Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology)

Key PaM (yes/no): no

Mitigation impact: 126 kt CO_2 eq in 2025; 568 kt CO_2 eq in 2030;

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

Integration of renewable gases

Type: EU policy

EU legislation	National Implementation	Start
RES Directive 2018/2001/EC	Renewable Energy Expansion Act (in preparation)	2021

Austria will increase the share of biomethane and hydrogen in the gas grid. This will be achieved by a combination of instruments, including the setting of obligations for suppliers and a hydrogen strategy. These renewable gases fed to the grid will then be used by all gas consuming sectors (e.g. the energy industries).

The forthcoming Renewable Energy Expansion Act will provide the basis for future renewable quotas for gas suppliers. The hydrogen strategy is expected to be finalised soon. Its expected target is a hydrolysis capacity of 1-2 GW by 2030. This would be well above the assumptions for the WAM scenario on which the calculation below is based.

Quantification/Projected GHG emissions/removals:

In the WAM scenario existing biogas installations will be converted so that they will feed 100 million m^3 of biomethane into the gas grid. Additionally, a further

250 million m^3 of biomethane will come from new installations. Together they will account for approx. 3.5 TWh of biomethane in 2030. Furthermore, the measures mentioned above are expected to result in approx. 1 TWh of hydrogen fed into the grid.

However, these gases will not result in emission savings on the energy supply side but on the consumption side in various sectors (industry, buildings, transport). The following calculation only takes into account the reductions achieved due to renewable gases in the sector energy industries, but not in other sectors. Approx. three quarters of the gas will be used in the energy industry sector. Thus, savings of 568 kt CO_2 eq. will be achieved in this sector in 2030.

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

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

4.5.1 WEM measures for transport

4.5.1.1 PaM N°9: 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 amended 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) and 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 electrically powered cableways or ski lifts. 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 fuel sold in the transport sector. 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 BEVs (battery electric vehicles) and PHEVs (Plugin Hybrid Electric Vehicles) in different vehicle categories as well as for the installation of charging infrastructure for BEVs and PHEVs 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).

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

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 available (with an acceptable delivery period)
- 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 the transport sector by 2020. Consumption of renewable electrical energy is calculated using a factor of 2.5 for rail transport and a factor of 5 for road vehicles. From 2021 onwards, a factors of 1.5 will be used 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 domestic electricity generation has to be achieved two years before the reporting year.

Current projections include all electrified transport modes on the road. For the projections it has been 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 available for sale. However, consumer acceptance is not sufficient yet and many freight operators are experimenting with electric vehicles only in a few single pilot projects. Therefore, only very a small number of electric heavy duty trucks has been considered in the current projections. Furthermore, rail transport 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 to promote the adoption of 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 only)

2035: 3 190 kt CO_2 eq (domestic only)

4.5.1.2 PaM N°10: 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 was 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 on 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 class, day-time and night-time driving and zero emission vehicle. 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 toll rate changes, and on expert estimates by TU Graz, which have all been included in the NEMO model. The reduction 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 that older vehicles are removed on a regular basis.

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°11: 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 a funding programme for businesses, communities and associations, target group-oriented counselling programmes, awareness-raising initiatives, partnerships, and training and certification initiatives. For 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. The aim is 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 a 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, several 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 only)

2035: 370 kt CO_2 eq (domestic 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 only)

4.5.2 WAM measures for Transport

4.5.2.1 PaM N°12: Further enhancement of fuel efficiency in road transport

With this measure, PaM N°10 is to be expanded and intensified beyond the ambition level of the WEM scenario. The greatest technology-related contribution to increasing the fuel efficiency of road transport can be achieved through the use of electric vehicles, especially in combination with electricity from renewable energy sources, which contribute to increasing the comparatively high energy efficiency of the technology itself. The measure therefore focuses on using instruments that intend to directly or indirectly promote the market ramp-up of battery-electric vehicles or vehicles that are powered by hydrogen fuel cells.

GHG affected: CO_2

Type of policy: fiscal, education, planning and regulatory

Implementing entity: federal government (Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology), regional entities, companies / businesses / industrial associations;

Key PaM (yes/no): yes

Mitigation impact in addition to WEM: 2030: 720 kt CO_2 eq; 2035: 1 400 kt CO_2 eq; 2040: 1 700 kt CO_2 eq

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

Electrification initiative – vehicles

This instrument includes a continuation of the purchase bonus for private vehicle conversions to emission-free cars, two-wheelers and cargo bikes as a public-private partnership with the vehicle industry. In addition, the purchase bonus for vehicle conversions by companies, municipalities and regional authorities, in particular for cars, two-wheelers, e-bikes, buses and commercial vehicles, will also be implemented as a public-private partnership with the vehicle industry. The focus on promoting e-mobility management, e-logistics and e-fleets (e.g. driving school fleets, etc.) in the operational and municipal area (e.g. accompanying conversion funding for zero-emission taxis) will also be maintained. Driving schools will switch to zero-emission vehicles. The Clean Vehicles Directive (EU 2019/1161) will be fully implemented.

Electrification initiative – infrastructure

This instrument includes, among other things, a needs-based expansion of the publicly accessible charging infrastructure at rest areas on motorways and expressways, with the aim of achieving 100% network coverage by 2030. In addition, the needs-based expansion of P&R systems with infrastructures for e-charging stations will continue. A continuation of the interoperable rollout of the concept of “multimodal nodes” to other cities and municipalities in Austria is also planned. So-called "E-Mobility Checks" are used to analyse the building stock in apartment buildings. Support for setting up private e-charging stations in apartment buildings, e-charging stations for employees, customers and guest parking spaces, and e-charging stations for company vehicles (craftsmen, etc.) will be continued. Minimum standards are in place, in particular for the e-vehicle infrastructure and the infrastructure for new forms of e-mobility (car sharing) in the vicinity of public train stations, public transport stops and P&R facilities.

Electrification initiative – legal framework

This instrument includes the amendment to the Occasional Traffic Act and sees newly registered vehicles in the taxi and rental car industry drive only with zero emissions from January 1, 2025. The Federal Road Toll Act provides for temporary discounts for zero-emission vehicles. Tax advantages for zero-emission vehicles will be retained until 2025 or until the percentage of zero-emission vehicles reaches 10% of the total number of vehicles.

Electrification initiative – hydrogen

This instrument includes a continuation of the support for the conversion of diesel fleets to zero-emission vehicles (e.g. battery-electric, hydrogen), including infrastructure funding and the production of fuel/hydrogen produced on the basis of renewable energy. A systemic approach (vehicles, infrastructure, production of the renewable fuel) is pursued on a project basis and based on work carried out for an Austrian hydrogen strategy until 2030.

4.5.2.2 PaM N°13: Further modal shift to environmentally friendly transport modes

With this measure, PaM N°11 is to be expanded and intensified beyond the ambition level of the WEM scenario. In view of the ambitious national and international climate targets, a further shift to environmentally friendly transport modes with a lower energy demand is essential. This applies to both passenger transport and freight traffic. In the field of motorised transportation – for mobility management and spatial planning see PaM N°15 - public transport and rail-bound freight transport are of particular importance. This PaM therefore includes instruments that focus on expanding the range of public transport services and offer additional capacities for rail-bound freight transport.

GHG affected: CO_2

Type of policy: fiscal, planning;

Implementing entity: national government (Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology), regional entities (federal provinces), local governments, Companies / businesses / industrial associations;

Key PaM (yes/no): yes

Mitigation impact in addition to WEM: 2030: 650 kt CO_2 eq; 2035: 590 kt CO_2 eq; 2040: 490 kt CO_2 eq

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

Promoting public transport

This instrument includes an accelerated implementation of the Austrian Federal Railways (ÖBB) 'target network' in the form of a more ambitious framework plan 2018-2023. The 'target network 2025+' will be implemented including some additional, particularly climate-effective measures, especially in the metropolitan areas. The expansion of the so-called transport service contracts will ensure that an expansion of the stipulated capacity on the rail network of 37% (period 2015-2029) can be reached. These transport service contracts will be extended to include private railways. Possible financing must be clarified for additional local transport services , from a climate perspective, e.g. to optimally exploit the potential of new and improved infrastructures. Another goal is to expand rail-bound public long-distance and international transport and night train services. With attractive offers, passengers can be persuaded to use the train rather than air transport, in support of climate change action. For the first time, a federal grant is planned for the construction of trams or tram-train projects such as those in Linz, Graz and Innsbruck. The instrument also includes an Austria-wide uniform tariff system for public transport and an analysis of the introduction of an Austria ticket (for general subscription, based on the Swiss model).

Improving freight transport

The above mentioned accelerated implementation of the ÖBB 'target network' also benefits rail freight transport. In addition, a new plan for state aid for connecting railways is drawn up. A possible adjustment of the rail freight transport subsidy to the maximum permissible under EU aid law is considered. In addition, an innovation programme for combined transport is started for intermodal transport.

4.5.2.3 PaM N°14: Further enhancement of clean energy sources for transport

With this measure, PaM N°11 is to be expanded and intensified beyond the ambition level of the WEM scenario. In PaM N°14, the target of a 14% share of renewable energy in the transport sector is implemented in accordance with the Directive on the promotion of renewable energy (RES II). The proportion of renewable energy in the transport sector will increase, primarily due to the increasing market penetration of electric mobility paired with a high proportion of renewable energy in the electricity mix and a slight increase in the use of sustainably produced biofuels. In 2017, Austria had a share of renewables in the transport sector of around 9.5%. The additional 4.5% to achieve the minimum target of 14% in 2030 can be reached by increasing the share of e-mobility and an increased share of biofuels in gasoline and diesel fuels.

GHG affected: CO_2, CH_4, N_2O

Type of policy: fiscal and regulatory

Implementing entity: national government (Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology), companies / businesses / industrial associations;

Key PaM (yes/no): yes

Mitigation impact in addition to WEM: 2030: 1 080 kt CO_2 eq; 2035: 1 040 kt CO_2 eq; 2040: 1 010 kt CO_2 eq

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

More intensive use of biofuels

This instrument describes the increased use of biofuels, both in their pure form and in the form of admixtures. In particular, the addition of biodiesel to diesel fuel is to be increased from currently 7% to 10%, and that of bioethanol to gasoline from currently 5% to at least 7%.

4.5.2.4 PaM N°15: Enhanced consideration of climate mitigation in spatial planning & mobility management

The current transport system is the result of decades of car-centred traffic and spatial planning. This way of planning and the increasing urban sprawl have complemented each other. Spatial structures react only slowly to external impulses. At the same time, the creation of short distances and the mix of different uses are of central importance in order to enable sustainable, environmentally friendly mobility. In PaM N°15, ecological spatial planning is promoted and combined with multimodal mobility management. The aim is to sustainably reduce the need for using a private car, to support multimodal mobility behaviour and thus optimise energy efficiency in the transport sector.

GHG affected: CO_2

Type of policy: regulatory, planning, information, education

Implementing entity: national government (Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology), regional entities (federal provinces), local governments, companies / businesses / industrial associations;

Key PaM (yes/no): yes

Mitigation impact in addition to WEM: 2030: 400 kt CO_2 eq; 2035: 440 kt CO_2 eq; 2040: 460 kt CO_2 eq

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

Improvement of spatial structures

This instrument focuses on the incorporation of climate and energy goals in the regional planning of the federal states and in building codes, land use planning and development planning of the federal states, cities and municipalities, as well as the implementation of energy spatial planning to reduce energy consumption and emissions. Parking space regulations of the federal states are amended with a view to climate policies and mobility-relevant framework conditions such as housing subsidies are improved. Relevant areas and routes are to be secured for the future further development of climate-friendly mobility and energy infrastructures, and the system of public transport quality classes is to be widely used in the area of spatial and transport planning. The aim is to achieve optimal accessibility of settlements – so that they can be reached by public transport, bicycle and on foot, to promote dense compact settlements along the axes of public transport to reduce urban sprawl and to make town and city centres more attractive.

Mobility management

This instrument aims to expand the 'klimaaktiv mobil' advisory and funding programmes for mobility management to support Austria's companies, property developers and fleet operators, cities, municipalities and regions, tourism, schools and youth initiatives in the development and implementation of climate-friendly, clean mobility projects. Improved framework conditions for mobility management at federal, state and municipal level are created with incentives for climate-friendly mobility for employees on the way to work and during business trips, for customers and guests as well as for zero-emission vehicle fleets and CO2-neutral logistics. Another aim of this instrument is the expansion and sustainable provision of sufficient budget funds so that the Austrian master plans for the development of cycling and walking can be consistently implemented and the goals set therein can be achieved.

4.6 Other sectors (1.A.4) – Buildings

The measures included in this sector are aimed at energy consumption in buildings. They 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'), 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 - Buildings

Where applicable (i.e. where a single measure has been ineffective), 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°16: 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 for 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 of property and landlords in the course of real estate transactions or renting. There are interdependencies with PaM N°17: 'Increased share of renewable energy for space heating' since energy efficiency measures entail for example an 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: 629 (94 new building, 535 renovation) kt CO2 eq in 2025
698 (112 new building, 586 renovation) kt CO_2 eq in 2030
638 (97 new building, 541 renovation) kt CO2 eq in 2035
589 (84 new building, 505 renovation) kt CO_2 eq in 2040

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, edition 2015 (OIB-330.6-009/15)	2015–2017 (depending on legislation in the federal provinces)
	National plan according to Art. 9(3) of 2010/31/EU, edition 2014 (OIB-330.6-014/14-012)	2014

The 2015 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 predecessor of OIB Guideline 6, released in October 2011). The periodical adjustments of the 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.

Mitigation impact: The reduction potential of this single instrument is expected to amount to an annual maximum of 53 kt of CO_2 equivalent in 2025. The effects are estimated at 53 kt of CO_2 equivalent in 2030, 45 kt of CO_2 equivalent in 2035 and 42 kt of CO_2 equivalent in 2040, assuming a reference scenario with no changes beyond the second stage of the National Plan until 2040 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)
- Austrian Climate and Energy Fund (Klimafonds)
- Housing Support Scheme (WBF)
- Renovation of federal buildings (federal real-estate property) and construction of new federal buildings
- 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 nominal climate-effective funds provided under the Domestic Environmental Support Scheme (building related funding only) will drop by 65% until 2025 and by 94% until 2030 (compared to 2017). After 2030, funding is set to be discontinued in the WEM scenario.

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). Thereafter 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. 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.

Nominal climate-effective funding for thermal renovation from the Housing Support Scheme is assumed to drop by about 38% by 2025, 60% by 2030, 63% by 2035 and 66% by 2040. New building subsidy nominal climate-effective budgets from the Housing Support Scheme are set to drop about by 17% by 2025, 28% by 2030, 30% by 2035 and 33% by 2040.

All other subsidy funds taken into account (w/o federal building renovation initiatives, details see below) are assumed to drop by about 21% by 2025, 26% by 2030, 63% by 2035 and 64% by 2040.

The total funding volume for new buildings (nominal value) is expected to decrease from € 379 million per year in 2017 to € 142 million per year in 2025, € 92 million in 2030, € 77 million in 2035 and € 63 million in 2040. The climate-effective shares are estimated at 30% in 2017, declining to 14% in 2025, 10% in 2030, 9% in 2035 and 8% in 2040.

The total budget for thermal insulation subsidies (at nominal value) is expected to decrease from € 227 million per year in 2017 to € 137 million per year in 2025, € 83 million in 2030, € 64 million in 2035 and € 55 million in 2040. The climate-effective shares are estimated at 84% in 2017 and projected to remain at 84% until 2030; after that, they are expected to decline to 78% in 2035 and to 72% in 2040.

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 nominal funds (€ 44 million per year in 2017, an estimated € 37 million climate-effective) will decline and be discontinued after 2030. For further details, see the relevant chapters on these two instruments below.

Mitigation impact: 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 2021 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 nominal climate-effective budget is assumed to drop from € 27 million per year in 2017 to € 14 million per year in 2025 and € 5 million in 2030. After 2030, funding is set to be discontinued in the WEM scenario.

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

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 2020.

Funding is available for the thermal renovation of buildings that are more than 20 years old (heat recovery, efficient energy use in industrial processes, optimisation or exchange of the heating system). The initiative is aimed at companies and commercial organisations, including registered associations and professional organisations.

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

Mitigation impact: The reduction potential of this single instrument 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 Act on the Presentation of an Energy Performance Certificate ('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.

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

4.6.1.2 PaM N°17: 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: 1 076 kt CO_2 eq in 2025
1.437 kt CO_2 eq in 2030
1.473 kt CO_2 eq in 2035
1.529 kt CO_2 eq in 2040

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 (as defined in the Austrian integrated national energy and climate plan, BMNT 2019a) will be achieved through financial support and by making people aware of the fact that old, inefficient heating systems should be replaced.

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

District Heating and Cooling Act
('Wärme- und Kälteleitungssausbaugesetz')

Type: National legislation: Federal Law Gazette I No. 72/2014 (last 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 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 have been considerably lower in the past.

This law (Federal Law Gazette I No. 113/2008) aims at a permanent reduction of up to 3 000 kt of CO_2.

Mitigation impact: 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. 39/2018; Federal Law Gazette I No. 40/2007 as amended by Federal Law Gazette I No. 37/2018.

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 Austrian Energy and Climate Fund (Klimafonds).

Financial support can be requested in cases where old oil-fired boilers, old wood boilers or electric heating are replaced with 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 2020. It is assumed that this instrument will be continued up to 2035.

Mitigation impact: This initiative is expected to save 69–79 kt CO_2 by 2020.[10]

4.6.1.3 PaM N°18: 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 the 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 are included here. Furthermore, national implementation of the Energy Efficiency Directive (2012/27/EU) is included.

GHG affected: CO_2

Type of policy: regulatory, information

Implementing entity: federal government, federal provinces

Mitigation impact: The reduction potential of this single measure has not been estimated.

Information about policy costs is currently not available.

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

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

Type: EU policy

EU legislation	National Implementation	Start
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 con-

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

sidered, as well as the whole product life cycle, from the choice of raw materials 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.

Mitigation impact: 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 energy efficiency 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.

Mitigation impact: 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.

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

4.6.2 WAM measures for other sectors - Buildings

In the WAM scenario, measures have been integrated which are not yet implemented, but for which it has already been decided that they will be implemented or whose implementation can be regarded as likely. It should be noted that the WAM scenario is far from containing all possible measures. Therefore, the WAM scenario cannot be interpreted as an upper limit for the renovation potential or for the use of renewable energy.

Selected additional measures have been divided into three groups for a quantification of the mitigation impact:

- Group A: Further tightening of mandatory construction standards
- Group B: Restriction and replacement of fossil fuel oil heating systems
- Group C: Restricted natural gas networks access for heating purposes

The mitigation effects of group A, of group A plus B and of group A plus B plus C from three supplementary scenarios were calculated against the WEM scenario for reference. Using differentiation, the single group effects of B and C were roughly estimated, However, possible interdependencies or additionality from single measures have not been considered.

4.6.2.1 PaM N°19: Further enhancement of energy efficiency of buildings

This measure consists of one instrument: adaptation of construction guidelines according to the Energy Efficiency Directive (2012/27/EU) amended by Directive (EU) 2018/844 and the revision of the corresponding National Plan.

GHG affected: CO_2

Type of policy: regulatory, economic, information

Implementing entity: federal government, federal provinces

Key PaM (yes/no): no

Mitigation impact: 80 kt CO_2 eq in 2025
135 kt CO_2 eq in 2030
144 kt CO_2 eq in 2035
153 kt CO_2 eq in 2040

The instrument listed below has 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 (amended by Directive (EU) 2018/844)	OIB Guideline 6, draft edition 2018 (OIB-330.6-038/18)	2020–2021 (depending on legislation in the federal provinces)
	National plan according to Art. 9(3) of 2010/31/EU, edition 2018 (OIB-330.6-005/18)	2018

The 2018 draft edition of the OIB Guideline No. 6 of the Austrian Institute for Constructional Engineering (released in June 2018) transposes (like its predecessor) the EU Directive on the energy performance of buildings (Directive 2010/31/ EC (amended by Directive (EU) 2018/844) into national law for both residential and non-residential buildings.

The mandatory target values for useful heating energy per gross floor space have been tightened. Consequently, the average specific amount of energy needed for heating, taking into account user behaviour in new buildings, declines by about 16%. Energy use after thermal renovation is about 17% more effective.

Mitigation impact: The reduction potential of this single instrument equals the total effect of the measure PaM N°19: Further enhancement of energy efficiency of buildings.

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 correspondingly revised OIB document released in February 2018 ('OIB-Dokument zum Nachweis der Kostenoptimalität der Anforderungen der OIB-RL6 bzw. des Nationalen Plans gemäß Artikel 5 zu 2010/31/EU. Erste Revision nach 5 Jahren.', OIB-330.6-005/18-001).

4.6.2.2 PaM N°20: Replacement of fossil fuels with renewable energy sources

This measure consists of four instruments: restrictions on fossil fuel heating systems in new buildings, restrictions on fossil fuel oil heating systems in existing buildings, concerted replacement of old fossil fuel oil heating systems and restricted natural gas networks access for heating purposes.

GHG affected: CO_2

Type of policy: regulatory, economic, information

Implementing entity: federal government, federal provinces

Key PaM (yes/no): yes

Mitigation impact: 391 kt CO_2 eq in 2025
940 kt CO_2 eq in 2030
1 721 kt CO_2 eq in 2035
1 794 kt CO_2 eq in 2040

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

Restrictions on fossil fuel heating systems in new buildings
('Ölkesseleinbauverbotsgesetz – ÖKEVG 2019')

Type: National legislation: Federal Law Gazette I No. 6/2020.

The installation of liquid or solid fossil fuel boilers in newly constructed buildings will not be permitted as of 2020.

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

Restrictions on fossil fuel oil heating systems in existing buildings
('Erneuerbaren-Gebot')

Type: National policy

In the WAM scenario it is assumed that the national policy leads to no further installations of liquid fossil fuel-based heating systems as of 2024.

This will be achieved through various measures (as defined in the Austrian integrated national energy and climate plan, BMNT 2019a), e.g. by making people aware of the fact that old, inefficient heating systems should be replaced and replacing old fossil fuel oil boilers by switching to renewables or district heating renewable energy rule in accordance with Directive (EU) 2018/844).

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

There is no information about policy costs.

Concerted replacement of fossil fuel oil heating systems
('Forcierte Außerbetriebnahme')

Type: National policy

In the WAM scenario it is assumed that the national policy leads to the replacement of liquid fossil fuel heating systems that are older than 25 years with systems using renewables or district heating. The effectiveness of the replacements is set at 75% in urban areas, 55% in suburban areas and 35% in rural areas.

This will be achieved through various measures (as defined in the Austrian integrated national energy and climate plan, BMNT 2019a), initially by increasing the subsidies for early replacement and by raising awareness about the mandatory replacement of fossil fuel oil boilers that are older than 25 years.

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

There is no information about policy costs.

Restricted natural gas networks access for heating purposes
('Vermeidung des Ausbaus des Erdgasnetzes für Heizzwecke')

Type: National policy

In the WAM scenario it is assumed that the national policy leads to no further expansions of the natural gas network (at consumer network level) for heating purposes. The expansion of network connections is capped at +45% in urban areas, +35% in suburban areas and +25% in rural areas. If district heating is available, maximum expansion is lowered to +13% in urban areas, +10% in suburban areas and +5% in rural areas.

There are no installations of natural gas heating systems in new buildings as of 2030, except where certified renewable gas is used. The connection of existing buildings to the natural gas network – thus the installation of new natural gas heating systems – is still possible, but unless renewable gas is used, compensation measures have to be taken (mandatory share of onsite renewables such as solar, thermal or photovoltaics, fees as a financial incentive).

Mitigation impact: The mitigation impact is roughly estimated against the WEM scenario.
44 kt CO_2 eq in 2025
326 kt CO_2 eq in 2030
853 kt CO_2 eq in 2035
714 kt CO_2 eq in 2040

There is no information about policy costs.

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 are only aimed at 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°21: Decrease emissions from F gases and other product use

A considerable 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 in force since 2002: the use of SF_6 is prohibited for 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 has not been 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 from 2030 onwards 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. In 2016 the Kigali Amendment to the Montreal Protocol was adopted, and signed by Austria and the EU in 2018. This Amendment foresees a global phase-down of HFCs, which will mean that developed countries will have to phase-down HFCs placed on the market by -83% compared to the total used in 2019/2020 after 2035. The EU F gas Regulation is currently under review, and it can be expected that these provisions will be added. However, until then, we are referring to the Kigali Amendment as it has been available up to now.

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 restrictions on 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 consistent 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 required. The use of SF_6 as a filling gas for the sound insulation of windows, shoes, and tyres is now prohibited. In addition, the 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 controlling the production and imports of other F gases in the European Union. Aspects of Regulation No 842/2006 regarding the reduction of leakage rates and the training of staff have been implemented. 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 the 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 (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 applied 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.

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°22: Implementation of EU agricultural policies

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 have been 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.

4.9.2 WAM measures for agriculture

4.9.2.1 PaM N°23: Livestock and feeding management

Activity data:

Projected activity data are the same as the data used in the WEM scenario (WIFO & BOKU 2018), except for cattle. For cattle, in accordance to Austria's NECP, the following additional measures have the effect that animal numbers no longer increase from 2025 onwards:

- Site-adapted, area-based livestock farming while maintaining animal welfare (and thus maximum moderate livestock densities)
- Trend towards a healthier diet for the human population with high quality foods
- Reduction of food waste (strategy "Food is precious")
- Breeding progress resulting in lower animal numbers

Climate friendly breeding and feeding (CH_4):

Additional instruments for climate friendly breeding and feeding of cattle listed in Austria's NECP (BMNT 2019a) (e.g. improved feed quality according to the animals' needs and adapted to local conditions, use of methane-reducing feed additives) will result in decreased CH_4 emission rates from enteric fermentation from cattle by 5% by 2030 compared to the WEM scenario.

Reduction of nitrogen excretion (N_2O):

By optimising feed rations and feed quality, fewer surplus N quantities are fed, resulting in lower N species emissions (especially N_2O and NH_3) along the entire farmyard manure chain.

According to Austria's NECP (BMNT 2019a) and NAPCP (BMNT 2019b), the following instruments related to feeding are intended to reduce the nitrogen excretion rates of cattle (with the exception of dairy cows), pigs and chicken by 5% by 2030 compared to the WEM scenario.

- Further improvements of cattle feed quality
- Feeding adapted to the animals' needs (e.g. multiphase feeding);
- Awareness raising (education and advisory services);
- Promoting marketing opportunities for older cattle - the longer use of an animal leads to emission reductions, but requires that meat from older cattle can also be sold on the market (e.g. old cow fattening).
- Breeding progress (digestibility, lifetime performance);

Promotion of grazing (CH_4, N_2O):

Grazing animals excrete faeces and urine separately. Faster infiltration of urea into the soil results in lower GHG and ammonia emissions. Grazing also means that less nitrogenous feed is used. In addition, grazing is particularly beneficial from an animal welfare perspective.

The following instruments listed in Austria's NECP (BMNT 2019a) and NAPCP (BMNT 2019c) are intended to increase grazing for dairy & suckling cows by 30% by 2030:

- Further development and expansion of animal grazing within the framework of the agri-environmental programme ÖPUL, e.g. through a gradual extension of the grazing period.
- Awareness raising (education and advisory services).

GHG affected: CH_4, N_2O

Type of policy: Regulatory, Economic, Education

Implementing entity: National government, Regional entities

Key PaM (yes/no): no

Mitigation impact: The reduction potential of this measure has not been estimated.

4.9.2.2 PaM N°24: Sustainable N management

Reduction of mineral fertiliser use on agricultural soils (N_2O):

This measure will help to further reduce the use of mineral fertiliers by improving overall farm nitrogen management or by paying a premium for reduced use. The Austrian agri-environmental programme ÖPUL already includes some effective instruments for this purpose, which will be further developed or expanded accordingly.

- Improvement of demand-oriented dosage through fertiliser planning, soil testing and increased awareness raising (building on existing training and advisory services). Reduction of losses in mineral and organic fertiliser management and increased nitrogen efficiency;
- Legal regulations within the framework of the Nitrate Action Programme;
- Further development and expansion of the ÖPUL measures, which contribute to a reduced use of nitrogen mineral fertilisers, e.g. complete renunciation of mineral fertilisers, organic farming;
- Nitrogen fixation through the cultivation of leguminous plants, reducing the need of mineral fertilisers;
- Reduction of soil erosion and nitrogen losses (e.g. catch crops, environmentally sound crop rotations, mulch and direct sowing);
- Reduction in the use of fertilisers, e.g. through specific measures in areas with increased pollution or risk situations.

Measures of the National Air Pollution Control Programme (NH_3, N_2O):

Adopting a comprehensive approach to estimating the nitrogen budget, Austria has established a link between the ammonia and the nitrous oxide emissions inventory (and projections). Thus, the WAM scenario also includes the following measures listed in the NAPCP:

- Increase in the coverage rate of manure storages for cattle slurry by +5%, for pig slurry by +10% by 2030
- Low-emission design
  - of cattle barns (floors with rubber sealing lips +50% by 2030)
  - of pig houses (partially slatted floor +30% by 2030)
  - of chicken houses (manure removal +50% by 2030)
- Significant increase in the use of emission reducing application techniques for cattle and pig slurries (to 40% of cattle slurry, to 40-60% of pig slurry)

According to Austria's NECP (BMNT 2019a) and NAPCP (BMNT 2019b), the additional instruments for improved N management will reduce the use of mineral fertilisers by 20% by 2030 compared to the scenario "with existing measures".

GHG affected: CH_4, N_2O

Type of policy: regulatory, economic, education

Implementing entity: National government, regional entities

Key PaM (yes/no): no

Mitigation impact: The reduction potential of this measure has not been estimated.

4.9.2.3 PaM N°25: Anaerobic digestion of manure

The share of slurry treated in biogas plants is to be significantly increased and expected to amount to 30% of Austria's total manure production by 2030 in accordance with Austria's NECP. The programme includes the following instruments:

- Identification of sites for the construction of biogas plants with suitable framework conditions (suitable livestock or raw material supply, short distances, possibility of feeding into the gas grid);
- Appropriate incentives (e.g. energy prices or a bonus for the use of animal manure for anaerobic digestion, incentives for the raw material management of agricultural residues);
- Strengthening cooperation between farmers;
- Awareness raising (education and advisory services);
- Research in the field of substrate use and plant technology.

GHG affected: CO_2, CH_4, N_2O

Type of policy: Regulatory, Economic, Research

Implementing entity: National government, Regional entities

Key PaM (yes/no): yes

Mitigation impact: The reduction potential of this measure has not been estimated.

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) is 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 has indirect impacts on LULUCF.

4.10.1.1 PaM N°26: 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 together in 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

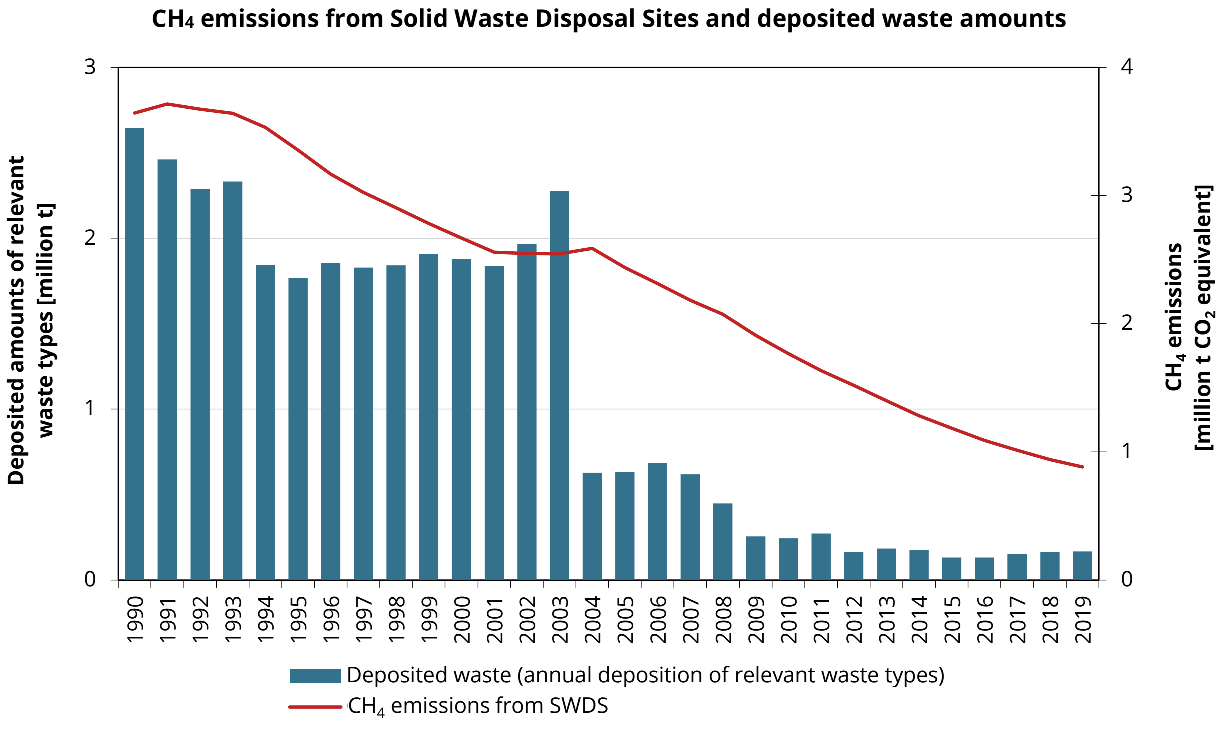
These measures are explained in more detail in the Austrian LULUCF Action Plan (see BMLFUW 2015b).

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 34 below).

Figure 34: Methane emissions from landfills and annually deposited waste with relevant organic carbon content.



Source: Umweltbundesamt

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°27: 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*' i.e. 'Food is precious' and "United against waste') have been established to minimise 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 (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 882 kt CO_2 equivalent in 2019 to 421 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 been necessary to receive a permit for biogas plants from the respective authorities even before a legal requirement was established with the issuance of a new ordinance in 2017.

Quantification/Projected GHG emissions/removals:

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

Emission from biogas plants will decrease from 22 430 t of CO_2 equivalent in 2019 to 5 457 t of CO_2 equivalent in 2035.

5 SCENARIO DEFINITION

Two scenarios were modelled: "with existing measures" includes all measures implemented by 1 January 2018; "with additional measures" includes planned policies and measures reported with the Integrated National Energy and Climate Plan for Austria (BMNT 2019) in addition to the measures of the scenario "with existing measures".

The following tables summarise the policies and measures and their instruments for both scenarios. Details can be found in Chapter 4 and are provided in the reporting table according to Implementing Regulation (EU) No 1208/2020, which has been submitted together with this report.

5.1 Scenario "with existing measures"

Table 16: PAMs included in the scenario "with existing measures"

CRF	Policies & Measures
Measures affecting more than one sector	No. 1. EU Emission Trading Scheme (ETS) No. 2. Domestic Environmental Support Scheme No. 3 Austrian Climate and Energy Fund
1.A.1 Energy industries and 1.A.2 Manufacturing Industries and Construction	No. 4. Increase the share of renewable energy in power supply and district heating • Green Electricity Act 2012 and Feed-In tariff ordinance No. 5. Increase energy efficiency in energy and manufacturing industries • Energy Efficiency Act • Promotion of combined heat and power
1.A.3 Transport	No. 9. Increase the share of clean energy sources in road transport • Implementation of Directive 2009/28/EC on the promotion of the use of energy from renewable sources and RED II (2018/2001/EC) • Action plan for electric mobility and electric mobility initiative (#mission2030) No. 10 Increase fuel efficiency in road transport • Fuel tax increase in 2011 • Greening the truck toll • Air quality induced speed limits No. 11 Modal shift to environmentally friendly transport modes • Mobility management and awareness – 'klimaaktiv mobil' initiative • Promotion of corporate rail connections for freight transport

CRF	Policies & Measures
1.A.4 & 1.A.5 Other Sectors (Residential, Commercial, Agriculture and Other)	No. 16 Increased energy efficiency of buildings • OIB guideline 6 – Energy savings and thermal insulation • National and funding programmes • Building renovation initiative for private buildings to improve energy performance (renovation cheques) • Building renovation initiative for commercial and industrial buildings to improve energy performance • Recast of the Energy Performance of Buildings Directive No. 17 Increased share of renewable energy for space heating • Stepping up the replacement of heating systems • District Heating and Cooling Act • Funding for wood heating systems and solar heating systems No. 18 Increased energy efficiency in residential electricity demand • Eco-design requirements for energy using products • Effect of the Energy Efficiency Directive (2012/27/EU) • Energy labelling of household appliances
1.B Fugitive Emissions from fuels	No policies and measures.
2 Industrial Processes and solvent use	No. 21 Decrease emissions from F gases and other product use • Prohibition and restrictions on the use of (partly) fluorinated hydrocarbons and SF6 • Quota system for the production and import of F gases • Reducing HFC emissions from air conditioning in motor vehicles • Limitation on VOC emissions from the use of organic solvents in industrial installations
3 Agriculture	No. 22 Implementation of EU agricultural policies • Common Agricultural Policy (CAP)
4 LULUCF	No. 26 Sustainable Forest Management
5 Waste	No. 27 Reduce emissions from waste treatment • Landfill Ordinance • Reduction of emissions from anaerobic treatment of biogenic waste

5.2 Scenario "with additional measures"

Table 17: PAMs included in the scenario "with additional measures" (in addition to the measures listed in the previous table)

CRF	Measures
1.A.1 Energy Industries and 1.A.2 Manufacturing Industries and Construction	No. 6 Further enhancement of renewable energy in power supply and district heating • Renewable Energy Expansion Act No. 7 Further enhancement of energy efficiency in energy industries • Energy Efficiency Act No. 8 Further enhancement of renewables in gas supply • Integration of renewable gases
1.A.3 Transport	No. 12 Further enhancement of fuel efficiency of road transport • electrification offensive – vehicles , infrastructure, legal framework and hydrogen No. 13 Further modal shift to environmentally friendly transport modes • Fostering public transport • Improving freight transport No. 14 Further enhancement of clean energy sources for transport • More intensive use of biofuels No. 15 Enhanced consideration of climate mitigation in spatial planning & Mobility Management • Improvement of spatial structures • Mobility management
1.A.4 & 1.A.5 Other Sectors (Residential, Commercial, Agriculture and Other)	No. 19 Further enhancement of energy efficiency of buildings • OIB guideline 6 – Energy savings and thermal insulation No. 20 Replacement of fossil fuels with renewable energy sources • Restrictions on fossil fuel heating systems in new buildings • Restrictions on fossil fuel oil heating systems in existing buildings • Concerted replacement of fossil fuel oil heating systems • Restricted natural gas networks access for heating purposes
1.B Fugitive Emissions	There are no additional sector-specific measures
2 Industrial Processes and product use	There are no additional sector-specific measures.

CRF	Measures
3 Agriculture	No. 23 Emission reduction through livestock and feeding management • Climate friendly breeding and feeding • Reduction of nitrogen excretion • Promotion of grazing No. 24 Sustainable N management • Reduction of mineral fertiliser use on agricultural soils • Measures of the National Air Pollution Control Programme No. 25 Anaerobic digestion of manure • Increased share of slurry treated in biogas plants
4 LULUCF	There are no additional sector-specific measures
5 Waste	There are no additional sector-specific measures

6 CHANGES WITH RESPECT TO SUBMISSION 2019

According to Article 18 (3) of Regulation 2018/1999/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 2019 (UMWELTBUNDESAMT 2019a) 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 tables show a comparison of past trends and scenarios for national emission totals and by sector.

Table 18: Comparison of projections 2011, 2013, 2015, 2017, 2019 and 2021 – 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
Projections 2021	78 420	92 147	84 337	78 462	76 885	75 232	72 540	70 719
Difference 2021/19	– 250	– 419	– 417	– 435	– 2 784	– 1 406	– 1 422	– 1 581

6.1 Energy Industries (1.A.1)

Table 19: Comparison of projections 2011, 2013, 2015, 2017, 2019 and 2021 – 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
Projections 2021	14 011	16 032	13 756	10 511	9 873	8 169	7 311	6 824
Difference 2021/19	– 89	– 365	– 272	– 281	0	0	0	0

The changes to the report of 2019 are due to minor adjustments in the energy balance (1990–2019), where no significant impacts on the scenarios could be identified. Therefore, the scenarios were not updated in this sector.

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

Table 20: Comparison of projections 2011, 2013, 2015, 2017, 2019 and 2021 – 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
Projections 2021	23 416	27 008	27 044	26 780	25 177	25 962	25 693	25 792
Difference 2021/19	– 146	– 300	– 278	– 279	– 2 412	– 1 067	– 1 103	– 1 267

1A2 & 2 Processes

Changes to the report of 2019 are mainly due to changes in the energy balance (1990–2019). The scenario has been adjusted to match these changes. Since activities in the mineral industry are derived from the total energy input, changes in the energy balance also result in changes to activity rates in the mineral industry. For the iron and steel sector, current production figures of 2020 have been taken into account for calculating the emissions for 2020.

2 F gases

Table 21: Comparison of projections 2011, 2013, 2015, 2017, 2019 and 2021 – CRF 2 F-gases (in kt CO2e), (Umweltbundesamt).

2 F gases – WEM	**1990**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**
Projections 2011	1 600	1 628	1 713	1 734	1 738	1 785	1 804	
Projections 2013	1 600	1 628	1 575	1 501	1 494	1 514	1 533	
Projections 2015	1 656	1 825	1 900	2 135	2 302	1 938	1 606	1 568
Projections 2017	1 656	1 831	1 901	2 034	1 975	1 468	881	751
Projections 2019	1 656	1 833	1 904	1 988	1 871	1 327	856	735
Projections 2021	1 656	1 764	1 761	2 053	2 227	1 441	908	864
Difference 2021/19	0	– 70	– 142	+ 65	+ 357	+ 113	+ 52	+ 129

The calculation model for F gases is improved regularly, whenever new information becomes available. The changes made between the 2015 projections and later projections are mostly due to the fact that the calculation model for stationary air conditioning has undergone major improvements, leading to an increase in emissions. Furthermore, 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 2019 and 2021 projections is due to several improvements of the FC inventory, particularly a more accurate allocation of refrigerant consumption to the different sub sectors (now amounts for large stationary air conditioning units are estimated using a bottom-up approach based on information obtained from industry representatives).

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

Table 22: Comparison of projections 2011, 2013, 2015, 2017, 2019 and 2021 – 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
Projections 2021	13.957	24.944	22.585	22.726	24.555	24.605	23.743	22.933
Difference 2021/19	– 18	+ 0	+ 17	+ 50	+ 77	+ 76	+ 75	+ 75

The small difference between the 2019 and 2021 projections is due to a slight revision of transport performance and fuel consumption in inland navigation.

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

Table 23: Comparison of projections 2011, 2013, 2015, 2017, 2019 and 2021 – 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
Projections 2021	14 289	13 915	11 263	9 196	8 579	7 978	7 364	6 800
Difference 2021/19	+ 19	+ 264	+ 157	+ 135	0	0	0	0

The changes to the submission in 2019 are due to minor adjustments in the energy balance (1990–2019), in particular fossil fuel use for heating. As these changes are only minor changes to historical values, the projections (using the INVERT/EE-Lab model) have not been updated this time.

6.5 Fugitive Emissions from Fuels (1.B)

Table 24: Comparison of projections 2011, 2013, 2015, 2017, 2019 and 2021 – 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
Projections 2021	702	437	468	424	384	321	282	212
Difference 2021/19	0	0	0	0	– 5	+ 4	+ 7	+ 2

The difference between the 2021 and 2019 projections is mainly due to the assumption that the yearly increase in the gas distribution network is lower (+218 km/year compared to +250 km/year), based on the historical 5-year average growth rate. Other changes result from different historical years (e.g. 2015 – 2019 instead of 2013-2017) considered to calculate averaged emission factors.

Compared to 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.

6.6 Agriculture (3)

Table 25: Comparison of projections 2011, 2013, 2015, 2017, 2019 and 2021 – 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
Projections 2021	8 120	7 017	7 095	7 274	7 110	7 192	7 272	7 364
Difference 2021/19	– 17	– 21	– 8	25	– 356	– 354	– 354	– 358

Projections of animal livestock, average milk yields of dairy cows and mineral N fertiliser amounts are based on the study WIFO & BOKU (2018). In order to increase consistency between inventory data and projections, projected activity data were adjusted to the last available inventory time series. Inventory revisions of the 2020 and 2021 submissions resulted in only minor changes to the emission figures.

6.7 LULUCF (CRF Source Category 4)

Table 26: Comparison of projections 2011, 2013, 2015, 2017, 2019 and 2021 – 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
Projections 2021	– 12 196	– 10 833	– 5 724	– 4 163	– 4 594	– 3 633	– 3 129	– 3 605
Difference 2021/19	– 208	– 174	139	388	– 392	– 169	– 458	– 474

The revisions with respect to the projections 2019 are due to:

- Updates of historical time series for all categories based on changes in the GHG inventory which were mainly due to a review recommendation suggesting the use of a consistent land use matrix. Therefore, historical areas of forest land, cropland, grassland, settlements and other land were updated, with minor impacts on the projected time series.
- Update of projections activity data for cropland, grassland and settlements to provide a consistent land use matrix.
- Update of area for organic soils (in grassland remaining grassland). The projected trend from the PASMA model seemed rather unrealistic. Therefore, it has been assumed that the projected area trend follows the historical trend.

6.8 Waste (CRF Source Category 5)

Table 27: Comparison of projections 2011, 2013, 2015, 2017, 2019 and 2021 – 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
Projections 2021	3 926	2 794	2 125	1 551	1 206	1 005	874	794
Difference 2021/19	+ 1	+ 3	– 33	– 87	– 88	– 64	– 47	– 32

Compared to the 2019 projections, revisions are mainly due to methodological changes in sub-category 5.A Solid Waste Disposal on Land, where the fraction of CH_4 in the landfill gas formed (factor "F") was adjusted for 2009 and subsequent years in response to an issue raised during the comprehensive ESD Review in 2020. In addition, the method for extrapolating the landfill gas collected was improved based on more detailed data available in the federal provinces.

Further revisions were made for sub-category 5.D Wastewater treatment due to the availability of new data on wastewater volumes 2018 as well as on the percentage of population connected to the wastewater collection and treatment systems (2018).

A new category 5.D.2 Industrial Wastewater was included in the GHG inventory as a source of CH_4 and N_2O emissions (in the submission in 2020 for the first time).

7 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 greenhouse gas emissions by sources and removals by sinks 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 source 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: EMISSIONS

Table 28: CO_2 emissions in 2019 and projections 2020–2040 (Umweltbundesamt).

CO_2 [kt]	2019	2020	2025	2030	2035	2040
Total excluding LULUCF	**67 962**	**65 211**	**64 536**	**62 484**	**60 748**	**59 358**
Total including LULUCF	**63 174**	**60 466**	**60 761**	**59 231**	**57 041**	**57 659**
1.Energy	**53 840**	**52 565**	**51 121**	**49 047**	**47 506**	**46 188**
A. Fuel Combustion	53 722	52 433	51 020	48 967	47 471	46 175
1. Energy Industries	10 167	9 750	8 054	7 201	6 714	6 364
a. Public Electricity and Heat production	7 064	6 944	5 279	4 421	3 929	3 573
b. Petroleum Refining	2 791	2 629	2 633	2 638	2 643	2 648
c. Manufacture of Solid Fuels and Other Energy Industries	312	177	141	142	142	142
2. Manufacturing Industries and Construction	10 592	10 178	10 978	11 215	11 548	11 882
3. Transport	24 208	24 317	24 354	23 486	22 674	21 832
a. Domestic Aviation	46	46	47	49	52	55
b. Road Transportation	23 443	23 457	23 508	22 653	21 854	21 026
c. Railways	93	118	120	121	118	116
d. Domestic Navigation	84	82	80	80	80	80
e. Other Transportation	542	614	599	584	570	556
4. Other Sectors	8 704	8 140	7 586	7 013	6 482	6 041
a. Commercial/Institutional	1 400	1 292	1 200	1 103	1 016	948
b. Residential	6 422	6 022	5 553	5 090	4 627	4 235
c. Agriculture/Forestry/Fisheries	883	827	832	821	839	857
5. Other	51	48	49	51	54	57
B. Fugitive Emissions from Fuels	118	132	101	80	35	13
1. Solid Fuels	NA	NA	NA	NA	NA	NA
2. Oil and Natural Gas	118	132	101	80	35	13
2. Industrial Processes & Product Use	**13 977**	**12 503**	**13 269**	**13 293**	**13 099**	**13 027**
A. Mineral Products	2 809	2 523	2 761	2 649	2 597	2 551
B. Chemical Industry	724	725	708	709	712	719
C. Metal Production	10 299	9 026	9 560	9 689	9 538	9 501
D. Non-energy products from fuels and solvent use	146	228	240	246	251	256
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	**143**	**142**	**143**	**142**	**141**	**141**
4. Land Use, Land-Use Change and Forestry	**-4 788**	**-4 745**	**-3 775**	**-3 253**	**-3 708**	**-1 699**
5. Waste	**2**	**2**	**2**	**2**	**2**	**2**
C. Incineration and open burning of waste	2	2	2	2	2	2

Table 29: CH_4 emissions in 2019 and projections 2020–2040 (Umweltbundesamt).

CH_4 [kt]	**2019**	**2020**	**2025**	**2030**	**2035**	**2040**
Total excluding LULUCF	**247.77**	**244.11**	**236.35**	**232.02**	**229.80**	**229.91**
Total including LULUCF	**248.73**	**245.07**	**237.30**	**232.98**	**230.75**	**230.86**
1. Energy	**22.32**	**22.14**	**19.35**	**17.08**	**14.80**	**13.64**
A. Fuel Combustion Activities	13.18	12.06	10.56	9.00	7.75	6.96
1. Energy Industries	0.99	0.98	0.94	0.92	0.91	0.88
2. Manufacturing Industries and Construction	0.78	0.84	0.92	0.95	0.98	1.01
3. Transport	0.86	0.37	0.32	0.28	0.24	0.21
4. Other Sectors	10.55	9.88	8.37	6.85	5.62	4.85
5. Other	0.00	0.00	0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	9.14	10.08	8.79	8.08	7.05	6.67
2. Industrial Processes & Product Use	**1.86**	**1.87**	**1.86**	**1.86**	**1.87**	**1.87**
B. Chemical Industry	1.86	1.87	1.86	1.86	1.87	1.87
3. Agriculture	**184.04**	**182.71**	**185.98**	**189.29**	**192.64**	**196.11**
A. Enteric Fermentation	162.50	161.27	163.79	166.34	169.05	171.82
1. Cattle	151.65	150.30	152.87	155.47	158.28	161.14
2. Sheep	3.22	3.26	3.27	3.28	3.26	3.23
3. Swine	4.16	4.23	4.19	4.15	4.08	4.02
4. Other	3.47	3.48	3.46	3.44	3.43	3.43
B. Manure Management	21.53	21.42	22.17	22.93	23.57	24.27
1. CH_4 Emissions	21.53	21.42	22.17	22.93	23.57	24.27
1. Cattle	17.40	17.24	18.03	18.84	19.54	20.29
2. Sheep	0.12	0.13	0.13	0.13	0.12	0.12
3. Swine	3.19	3.24	3.21	3.18	3.13	3.08
4. Other	0.82	0.82	0.80	0.78	0.78	0.78
5. Waste	**39.54**	**37.40**	**29.16**	**23.79**	**20.49**	**18.30**
A. Solid Waste Disposal	35.30	33.24	25.27	20.17	16.84	14.63
B. Biological Treatment of Solid Waste	3.34	3.25	2.98	2.72	2.74	2.75
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	0.91	0.91	0.91	0.91	0.91	0.91

Table 30: N_2O emissions in 2019 and projections 2020–2040 (Umweltbundesamt).

N_2O [kt]	2019	2020	2025	2030	2035	2040
Total excluding LULUCF	**11.57**	**11.22**	**11.23**	**11.23**	**11.28**	**11.33**
Total including LULUCF	**12.00**	**11.65**	**11.63**	**11.57**	**11.54**	**11.56**
1. Energy	**2.18**	**2.00**	**2.02**	**2.02**	**2.04**	**2.06**
A. Fuel Combustion Activities	2.18	2.00	2.02	2.02	2.04	2.06
1. Energy Industries	0.33	0.33	0.31	0.29	0.29	0.28
2. Manufacturing Industries and Construction	0.41	0.42	0.45	0.46	0.48	0.50
3. Transport	0.93	0.77	0.81	0.84	0.85	0.86
4. Other Sectors	0.50	0.48	0.45	0.43	0.41	0.40
5. Other	0.00	0.00	0.00	0.00	0.00	0.00
2. Industrial Processes & Product Use	**0.41**	**0.26**	**0.24**	**0.23**	**0.22**	**0.22**
B. Chemical Industry	0.27	0.12	0.10	0.09	0.09	0.08
G. Other Product Manufacture and Use	0.13	0.14	0.14	0.14	0.14	0.14
3. Agriculture	**8.08**	**8.06**	**8.05**	**8.05**	**8.07**	**8.10**
B. Manure Management	1.46	1.46	1.47	1.48	1.49	1.50
2. N_2O Emissions	1.46	1.46	1.47	1.48	1.49	1.50
1. Cattle	0.86	0.86	0.86	0.87	0.88	0.88
2. Sheep	0.03	0.03	0.03	0.03	0.03	0.03
3. Swine	0.13	0.13	0.13	0.13	0.13	0.12
4. Other	0.06	0.06	0.06	0.06	0.06	0.06
5. Indirect N_2O Emissions	0.38	0.38	0.39	0.39	0.40	0.40
D. Agricultural Soils	6.62	6.60	6.59	6.57	6.59	6.61
1. Direct N_2O Emissions from Managed Soils	5.55	5.54	5.52	5.50	5.51	5.52
2. Indirect N_2O emissions from Managed Soils	1.07	1.06	1.07	1.07	1.08	1.09
5. Waste	**0.90**	**0.90**	**0.92**	**0.93**	**0.94**	**0.95**
B. Biological Treatment of Solid Waste	0.33	0.33	0.34	0.34	0.34	0.35
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	0.57	0.57	0.58	0.59	0.60	0.60

Table 31: HFC, PFC SF_6 and NF_3 emissions in 2019 and projections 2020–2040 (Umweltbundesamt).

HFC [kt CO_2e]	**2019**	**2020**	**2025**	**2030**	**2035**	**2040**
Total	**1 750**	**1 712**	**1 138**	**755**	**704**	**680**
2. Industrial Processes & Product Use	**1 750**	**1 712**	**1 138**	**755**	**704**	**680**
E. Electronics Industry	4	3	3	3	3	3
F. Consumption of Halocarbons and SF_6	1 746	1 709	1 135	752	701	677
PFC [kt CO_2e]						
Total	**38**	**49**	**49**	**49**	**49**	**49**
2. Industrial Processes & Product Use	**38**	**49**	**49**	**49**	**49**	**49**
E. Electronics Industry	38	49	49	49	49	49
SF_6 [kt CO_2e]						
Total	**436**	**455**	**244**	**93**	**100**	**107**
2. Industrial Processes & Product Use	**436**	**455**	**244**	**93**	**100**	**107**
E. Electronics Industry	33	34	34	34	34	34
G. Other Product Manufacture and Use	400	421	209	59	66	73
NF_3 [kt CO_2e]						
Total	**14**	**11**	**11**	**11**	**11**	**11**
2. Industrial Processes & Product Use	**14**	**11**	**11**	**11**	**11**	**11**
E. Electronics Industry	14	11	11	11	11	11

ANNEX 2: KEY PARAMETERS FOR SECTORAL SCENARIOS

Energy Industries

Table 32: Projected fuel input into main activity power and heat plants – scenario "with existing measures". (Umweltbundesamt).

Energy [TJ]	2015	2020	2025	2030	2035	2040
Bituminous/Anthracite Coal	24 980	17 872	6 751	0	0	0
Residual Fuel Oil	3 203	69	88	113	144	0
Natural gas	64 718	68 344	57 024	52 899	43 975	37 760
Waste	10 004	17 161	17 161	17 161	17 161	17 161
Biomass	65 845	62 383	60 849	59 319	59 175	56 768
Hydropower	131 675	148 466	149 604	149 604	152 520	155 436
Wind power	17 425	27 109	29 688	32 440	49 745	59 134
Photovoltaics	3 374	6 521	9 241	12 324	16 705	19 665
Geothermal	591	1 504	3 098	2 903	2 707	2 513

Table 33: Projected fuel input into main activity power and heat plants – scenario "with additional measures". (Umweltbundesamt).

Energy [TJ]	2015	2020	2025	2030	2035	2040
Bituminous/Anthracite Coal	24 980	17 872	6 751	0	0	0
Residual Fuel Oil	3 203	0	0	0	0	0
Natural gas	64 718	67 878	63 057	59 169	50 455	41 957
Waste	10 004	17 161	17 161	17 161	17 161	17 161
Biomass	65 845	67 401	62 829	63 527	65 967	61 564
Hydropower	131 675	148 233	153 094	157 954	158 740	159 525
Wind power	17 425	28 471	43 129	60 236	70 431	70 733
Photovoltaics	3 374	6 489	25 951	41 786	45 020	46 372
Geothermal	591	1 178	3 129	3 082	2 723	2 520

Manufacturing Industries and Construction

Table 34: Projected fuel input into autoproducer power and heat plants – scenario "with existing measures" (Umweltbundesamt).

Energy [TJ]	2015	2020	2025	2030	2035	2040
Bituminous/Anthracite Coal	21 034	18 859	19 304	19 441	19 528	19 620
Residual Fuel Oil	7 434	8 053	8 136	8 162	8 168	8 176
Natural gas	11 606	13 447	14 308	15 444	16 620	17 851
Waste	7 615	1 963	1 963	1 963	1 963	1 963
Biomass	22 649	19 550	20 862	22 255	23 765	25 292
Hydropower	1 725	1 946	1 946	1 946	1 946	1 946
Wind power	0	0	0	0	0	0
Photovoltaics	0	0	0	0	0	0
Geothermal	162	172	186	202	221	240

Table 35: Projected fuel input into autoproducer power and heat plants – scenario "with additional measures" (Umweltbundesamt).

Energy [TJ]	2015	2020	2025	2030	2035	2040
Bituminous/Anthracite Coal	21 034	18 708	18 962	18 917	18 951	18 990
Residual Fuel Oil	7 434	8 053	8 136	8 162	8 168	8 176
Natural gas	11 606	13 338	14 042	15 022	16 067	17 170
Waste	7 615	1 963	1 963	1 963	1 963	1 963
Biomass	22 649	19 566	20 875	22 262	23 749	25 271
Hydropower	1 725	1 946	1 946	1 946	1 946	1 946
Wind power	0	0	0	0	0	0
Photovoltaics	0	0	0	0	0	0
Geothermal	162	171	184	198	216	234

Table 36: Final energy demand of industry – scenario "with existing measures" (Umweltbundesamt).

Energy [TJ]	2015	2020	2025	2030	2040
Coal without coke	6 266	5 833	5 804	5 768	5 914
Coke	6 622	6 075	6 056	6 104	6 303
Light Fuel Oil	352	360	370	384	429
Heavy Fuel Oil	6 266	6 570	6 695	6 794	7 034
Other petr. Products	16 910	17 001	17 502	18 047	19 704
Natural gas	110 191	117 203	119 599	121 575	127 540
Derived gas	3 621	6 350	6 402	6 453	6 458
Waste	12 313	13 073	13 216	13 305	13 930
Biomass	50 983	64 513	68 109	71 433	79 371
Electricity	90 984	100 679	108 777	117 873	141 721
Heat	10 838	12 571	14 438	16 423	21 165

Table 37: Final energy demand of industry – scenario "with additional measures" (Umweltbundesamt).

Energy [TJ]	2015	2020	2025	2030	2035	2040
Coal without coke	6 266	5 834	5 793	5 743	5 846	5 957
Coke	6 622	6 076	6 057	6 107	6 130	6 231
Light Fuel Oil	352	356	359	365	375	385
Heavy Fuel Oil	6 266	6 279	5 061	3 764	3 801	3 862
Other petr. Products	16 910	16 930	17 219	17 486	17 896	18 410
Natural gas	110 191	114 521	110 038	106 643	109 029	111 450
Derived gas	3 621	6 303	6 277	6 249	6 176	6 102
Waste	12 313	13 048	13 141	13 220	13 559	13 952
Biomass	50 983	66 663	76 872	85 182	88 850	92 307
Electricity	90 984	99 946	106 679	114 115	123 405	133 253
Heat	10 838	12 501	14 217	16 003	17 168	18 300

Transport

Table 38: Energy consumption of mobile sources by fuel – scenario "with existing measures" (Umweltbundesamt).

Energy [TJ]	2015	2020	2025	2030	2035	2040
Gasoline fossil	65 368	64 431	63 778	61 974	58 704	54 752
Diesel fossil	231 450	286 169	289 055	279 696	273 534	267 723
Bioethanol	2 506	3 725	4 120	4 004	3 792	3 537
Biodiesel	15 330	18 029	18 210	17 621	17 233	16 867
Vegetable oil	4 053	0	1 360	9 851	9 632	9 425
BIO ETBE	344	219	217	211	200	186
LPG	573	295	0	0	0	0
Natural gas	725	142	187	224	218	212
Biogas	35	0	0	0	0	0
H2	0	0	0	0	0	0
Coal	5	4	4	3	3	3
Electricity rail	5 771	7 624	8 147	8 719	8 960	9 217
Electricity road transport	88	729	3 398	8 499	15 488	22 859
Aviation jet fuel	30 463	33 051	33 417	33 922	34 805	35 595

Table 39: Energy consumption of mobile sources by fuel – scenario "with additional measures" (Umweltbundesamt).

Energy [TJ]	2015	2020	2025	2030	2035	2040
Gasoline fossil	66 660	73 286	72 233	68 244	62 823	56 393
Diesel fossil	255 767	273 927	255 183	233 886	221 989	215 767
Bioethanol	2 162	2 449	4 638	4 722	4 357	3 926
Biodiesel	22 513	22 484	21 633	20 397	19 663	19 319
Vegetable oil	4 053	0	5 261	7 311	6 940	6 746
BIO ETBE	344	0	0	0	0	0
LPG	618	293	0	0	0	0
Natural gas	521	103	132	154	150	146
Biogas	13	1	19	87	130	167
H2	0	0	441	881	881	881
Coal	5	5	4	4	4	3
Electricity rail	7 353	7 753	8 820	10 764	11 151	11 574
Electricity road transport	88	753	4 057	10 228	18 509	25 682
Aviation jet fuel	30 580	33 100	33 459	33 959	34 805	35 598

Residential, Commercial & Other Sectors

Table 40: Final energy demand of residential, commercial & other sectors – scenario "with existing measures" (Umweltbundesamt).

Energy [TJ]	2020	2025	2030	2035	2040
Coal	813	570	348	216	180
Biomass	76 653	72 693	69 826	68 994	69 387
Oil	49 732	45 087	40 327	35 466	31 386
Natural gas	62 714	59 326	56 042	52 904	50 157
District heat	61 728	60 083	57 774	54 732	51 292
Solar and ambient heat	16 485	20 179	23 254	26 182	28 951
Electricity	121 902	124 237	124 375	123 738	124 194
Fuels for mobile sources	13 210	13 384	13 567	13 860	14 161

Table 41: Final energy demand of residential, commercial & other sectors – scenario "with additional measures" (Umweltbundesamt).

Energy [TJ]	2020	2025	2030	2035	2040
Coal	848	579	344	185	177
Biomass	77 992	75 930	76 172	79 091	78 791
Oil	48 582	39 847	27 733	12 718	8 264
Natural gas	62 690	58 069	53 597	49 734	45 827
District heat	63 560	64 247	64 471	64 607	62 096
Solar and ambient heat	16 367	19 492	23 279	27 825	30 489
Electricity	121 739	122 966	122 953	122 721	122 859
Fuels for mobile sources	13 197	13 359	13 534	13 825	14 125

Table 42: Assumptions for energy prices for households and commercial – scenario "with existing measures" (Umweltbundesamt).

Price, real [€/MWh]	2017	2020	2025	2030	2035	2040
Natural gas	82	92	97	102	106	108
Heating and other gas oil	68	80	89	95	99	103
Coal	49	54	57	59	62	63
Electricity	149	160	203	230	238	237
Electricity: Heat pump water/water	157	169	213	240	248	248
Electricity: Heat pump air/water	153	164	208	235	243	242
Wood log and wood briquettes	45	48	50	53	55	56
Wood chips	35	39	41	42	44	45
Wood pellets	47	52	54	57	59	60
District heat	70	78	82	86	89	91

Table 43: Assumptions for energy prices for households and commercial – scenario "with additional measures" (Umweltbundesamt).

Price, real [€/MWh]	2017	2020	2025	2030	2035	2040
Natural gas	82	92	97	102	106	108
Heating and other gas oil	68	80	89	95	99	103
Coal	49	54	57	59	62	63
Electricity	149	160	203	230	238	237
Electricity: Heat pump water/water	157	169	213	240	248	248
Electricity: Heat pump air/water	153	164	208	235	243	242
Wood log and wood briquettes	45	48	50	53	55	56
Wood chips	35	39	41	42	44	45
Wood pellets	47	52	54	57	59	60
District heat	70	78	82	86	89	91

Table 44: Assumptions on subsidy rates (Umweltbundesamt) – scenario "with existing measures".

Subsidy rates [%]	2015	2020	2025	2030	2035	2040
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 45: Assumptions on subsidy rates (Umweltbundesamt) – scenario "with additional measures".

Subsidy rates [%]	2015	2020	2025	2030	2035	2040
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 46: Assumptions for the number and size of buildings, and the number of permanently occupied dwellings – scenario "with existing measures" (Umweltbundesamt).

Number of buildings		**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
residential buildings	[number in 1 000]	1 877	1 951	2 008	2 051	2 086	2 118
residential buildings with one or two apartments	[number in 1 000]	1 631	1 694	1 741	1 777	1 804	1 829
residential buildings with more than two apartments	[number in 1 000]	245	257	267	275	282	288
commercial buildings	[number in 1 000]	190	197	206	214	222	231
Size of buildings		**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
residential buildings	[million m² gross floor area]	488	512	530	546	559	571
residential buildings with one or two apartments	[million m² gross floor area]	278	291	300	308	314	320
residential buildings with more than two apartments	[million m² gross floor area]	210	221	230	238	245	252
commercial buildings	[million m² gross floor area]	167	174	181	189	197	205
Number of dwellings		**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Permanently occupied dwellings	[number in 1 000]	3 831	3 992	4 126	4 230	4 318	4 402

Table 47: Assumptions for the number and size of buildings, and the number of permanently occupied dwellings – scenario "with additional measures" (Umweltbundesamt).

Number of buildings		**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
residential buildings	[number in 1 000]	1 877	1 951	2 008	2 051	2 086	2 118
residential buildings with one or two apartments	[number in 1 000]	1 631	1 694	1 741	1 777	1 804	1 829
residential buildings with more than two apartments	[number in 1 000]	245	257	267	275	282	288
commercial buildings	[number in 1 000]	190	197	206	214	222	231
Size of buildings		**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
residential buildings	[million m² gross floor area]	488	512	530	546	559	571
residential buildings with one or two apartments	[million m² gross floor area]	278	291	300	308	314	320
residential buildings with more than two apartments	[million m² gross floor area]	210	221	230	238	245	252
commercial buildings	[million m² gross floor area]	167	174	181	189	197	205
Number of dwellings		**2015**	**2015**	**2020**	**2025**	**2030**	**2035**
Permanently occupied dwellings	[number in 1 000]	3 831	3 992	4 126	4 230	4 318	4 402

Table 48: Final energy demand for heating, renovation rates and boiler exchange rates – scenario "with existing measures" (Umweltbundesamt).

Final energy demand for heating (average)*		**2017**	**2020**	**2025**	**2030**	**2035**	**2040**
residential buildings	[kWh/m².a]	127	121	111	102	95	89
commercial buildings	[kWh/m².a]	140	134	125	115	107	99
renovation rate**	**[%]**						
residential buildings with one or two apartments		1.1	1.0	1.1	1.0	0.7	0.6
residential buildings with more than two apartments		1.1	1.0	1.1	1.1	0.8	0.7
commercial buildings		0.7	0.6	0.7	0.7	0.7	0.7
boiler exchange rate***	**[%]**						
residential buildings with one or two apartments		2.0	2.6	3.1	3.6	3.6	2.8
residential buildings with more than two apartments		1.5	1.9	2.2	2.5	2.7	2.4
commercial buildings		1.1	1.4	2.0	2.3	2.5	2.1

** 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*

Table 49: Final energy demand for heating, renovation rates and boiler exchange rates – scenario "with additional measures" (Umweltbundesamt).

Final energy demand for heating (average)*		**2017**	**2020**	**2025**	**2030**	**2035**	**2040**
residential buildings	[kWh/m².a]	127	122	112	102	95	89
commercial buildings	[kWh/m².a]	140	134	123	112	102	94
renovation rate**	**[%]**						
residential buildings with one or two apartments		1.0	1.0	1.1	1.0	0.7	0.6
residential buildings with more than two apartments		1.0	0.9	1.0	1.1	0.8	0.7
commercial buildings		0.7	0.6	0.8	0.8	0.7	0.6
boiler exchange rate***	**[%]**						
residential buildings with one or two apartments		2.0	2.4	3.3	3.9	3.9	2.4
residential buildings with more than two apartments		1.5	1.8	2.4	2.8	2.8	2.1
commercial buildings		1.1	1.4	2.0	2.4	2.5	2.1

** 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 50: Fugitive activities for calculation of fugitive emissions (Umweltbundesamt).

	2015	2020	2025	2030	2035	2040
Gas pipeline length [km]	6 798	7 177	7 242	7 304	7 565	7 826
Gas distribution network [km]	28 733	29 496	30 067	30 497	31 587	32 676
Natural gas production [million m³]	1 611	1 373	1 197	1 126	745	516
Refinery crude oil input [PJ]	198	198	191	191	190	188
Natural gas storage capacities [Mio m³]	334	368	378	337	338	338

Agriculture

Table 51: Livestock population cattle 2019 and projections 2020–2040– scenario "with existing measures" (Umweltbundesamt).

Year	Population size [heads]	
	Dairy (WEM)	Non-Dairy (WEM)
2019	524 068	1 355 452
2020	522 098	1 328 310
2025	529 714	1 339 369
2030	537 329	1 350 427
2035	540 723	1 356 889
2040	544 117	1 363 350

Table 52: Livestock population cattle 2019 and projections 2020–2040 – scenario "with additional measures" (Umweltbundesamt).

Year	Population size [heads]	
	Dairy (WAM)	Non-Dairy (WAM)
2019	524 068	1 355 452
2020	522 098	1 328 310
2025	529 714	1 339 369
2030	529 714	1 339 369
2035	529 714	1 339 369
2040	529 714	1 339 369

Table 53: Livestock population other animals 2019 and projections 2020–2040 – scenario "with existing measures" (Umweltbundesamt).

	Population size [heads]					
Year	Swine	Sheep	Goats	Poultry	Horses	Other
2019	2 773 225	402 658	92 504	17 460 759	130 000	41 176
2020	2 818 290	407 691	94 969	17 460 759	130 000	41 176
2025	2 792 438	408 991	96 093	16 797 710	129 415	40 808
2030	2 766 586	410 292	97 216	16 134 661	128 830	40 441
2035	2 722 254	406 967	96 425	15 974 118	128 919	40 425
2040	2 677 923	403 642	95 634	15 813 575	129 007	40 410

Table 54: Livestock population other animals 2019 and projections 2020–2040 – scenario "with additional measures" (Umweltbundesamt).

	Population size [heads]					
Year	**Swine**	**Sheep**	**Goats**	**Poultry**	**Horses**	**Other**
2019	2 773 225	402 658	92 504	17 460 759	130 000	41 176
2020	2 818 290	407 691	94 969	17 460 759	130 000	41 176
2025	2 792 438	408 991	96 093	16 797 710	129 415	40 808
2030	2 766 586	410 292	97 216	16 134 661	128 830	40 441
2035	2 722 254	406 967	96 425	15 974 118	128 919	40 425
2040	2 677 923	403 642	95 634	15 813 575	129 007	40 410

Table 55: Milk production and mineral fertiliser use for 2019 and projections (2020–2035) – scenario "with existing measures" (Umweltbundesamt).

	Ø milk yield per dairy cow (kg/yr)					
Year	**2019**	**2020**	**2025**	**2030**	**2035**	**2040**
Ø milk yield per dairy cow (kg/yr)	7179	7271	7440	7609	7947	8285
Mineral fertiliser use (t N/year)	105 685	106 955	104 455	101 955	101 040	100 126

Table 56: Milk production and mineral fertiliser use for 2019 and projections (2020–2035) – scenario "with existing measures" (Umweltbundesamt).

	Ø milk yield per dairy cow (kg/yr)					
Year	**2019**	**2020**	**2025**	**2030**	**2035**	**2040**
Ø milk yield per dairy cow (kg/yr)	7179	7271	7440	7609	7947	8285
Mineral fertiliser use (t N/year)	105 685	106 955	94 260	81 564	80 832	80 101

ANNEX 3: USE OF NOTATION KEY "IE"

In the following section the use of the notation key 'IE' within the submitted 'GovReg_Proj_T1a_T1b_T5a_T5b' template is explained.

1B/1B2 (N_2O): allocated to 1 A 1 c Petroleum Refining

2C/2C1 (CH_4, N_2O): allocated to 1 A 2 a Iron and Steel umweltbundesamt

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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 Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action. It includes greenhouse gas projections for the coming years up to 2040 and describes the policies and measures to reduce emissions from each source.

The results include two different scenarios: the scenario "with existing measures" takes into account climate change mitigation measures implemented by 1 January 2018. It shows a decrease of 11.6 % in greenhouse gases from 1990 to 2040. The scenario "with additional measures" also includes planned policies and measures specified in the Integrated National Energy and Climate Plan for Austria (December 2019). Within this scenario a decrease of 22.1 % is projected for 2040.

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