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GHG Projections and Assessment of Policies and Measures in Austria

Reporting under Decision 280/2004/EC

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Reporting under Decision 280/2004/EC, March 2009

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VORWORT

Der vorliegende Endbericht präsentiert die österreichischen Treibhausgasprojektionen für die Jahre 2010, 2015 und 2020.

Die vorliegenden Projektionen der Treibhausgasemissionsentwicklung beinhalten die Szenarien „with measures“ (wm) und „with additional measures“ (wam), welche die Klimaschutzmaßnahmen der österreichischen Klimastrategie 2002 und 2007 folgendermaßen berücksichtigen: Für das wm-Szenario sind die bis zum Stichtag 8.8.2008 bereits implementierten Maßnahmen inkludiert. Das wam-Szenario beinhaltet zusätzlich jene Maßnahmen im Planungsstadium, die nach Expertenmeinung und nach Abstimmung mit dem Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft (BMLFUW) voraussichtlich umgesetzt und bis 2020 wirksam werden.

Die Emissionsszenarien in diesem Bericht basieren auf Annahmen für die wirtschaftliche Entwicklung bis 2020, die vor der aktuellen Finanz- und Wirtschaftskrise getroffen wurden. Es war folglich nicht möglich die momentanen Entwicklungen in die Szenarienentwicklung einfließen zu lassen.

Zur Berechnung der Szenarien wurden mehrere Modelle verwendet. Die Energieszenarien basieren auf Berechnungen von Gesamtenergiebedarf und Produktion des Österreichischen Instituts für Wirtschaftsforschung (WIFO). Diese wurden mit Berechnungen von Energiebedarf Elektrizität, Energie- und Wärmeaufbringung der Österreichischen Energieagentur (AEA) und Technischen Universität Wien ergänzt. Weitere Modelle wurden für den Verkehrsbereich, die Landwirtschaft und den Abfall eingesetzt.

Die Sektor-Einteilung der Emissionsszenarien orientiert sich am Format der Emissionsberichterstattung für das UN Rahmenübereinkommen über Klimaänderungen (UNFCCC).

Dieser Bericht folgt den Anforderungen zur Berichterstattung gemäß der Entscheidung 280/2004/EG *über ein System zur Überwachung der Treibhausgasemissionen in der Gemeinschaft und zur Umsetzung des Kyoto-Protokolls* und den UNFCCC Leitlinien für nationale Klimaberichte.

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1 PREAMBLE

This report presents Austria's greenhouse gas emission projections for 2010, 2015 und 2020. It complies with reporting requirements under Article 3(2)(a) and 3(2)(b) of the EU Monitoring Mechanism (280/2004/EC).

The results include projections for a "with measures" (wm) and a "with additional measures" (wam) scenario. The former takes into account climate change mitigation measures that were implemented under the Austrian Climate Strategies 2002 and 2007 before 8th August 2008. The latter takes into account planned policies and measures with a realistic chance of being adopted and implemented in time to influence the emissions. Furthermore, information on policies and measures which limit and/or reduce greenhouse gas emissions by sources is included.

Emission projections in this report are based on economic scenarios that were developed before the current financial and economic crisis. Therefore, recent economic developments are not taken into account in the emission projections presented here.

The report complies with the following guidelines and provisions:

- UNFCCC Guidelines FCCC/CP/1999/7: guidelines for the preparation of National Communications by Parties included in Annex I to the Convention,
- EU Council Decision 280/2004/EC of 11 February 2004, concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol,
- Implementing Provisions by the Commission Decision 2005/166/EC of 10 February 2005.

The structure of reporting information on projected GHG data and policies and measures follows the recommendation as included in the MM Article 2 Reporting Template v4.2 provided by the European Commission in 2009.

2 EMISSIONS PROJECTIONS SUMMARY

This chapter presents a summary of the projections for the “with measures” (wm) and the “with additional measures” (wam) scenario. The main results of the five CRF sectors (without LULUCF) and of the single gases are presented in CO_2 equivalents. Trend graphs of the GHG totals, GHG totals by category and by gas are included.

Total GHG emissions

Table 1: Total emissions, with measures.

	Inventory Trend [Gg CO_2e]			Emissions with measures [Gg CO_2e]		
	1990	**2003**	**2005**	**2010**	**2015**	**2020**
Total (without LULUCF)	79 037	93 112	92 832	93 873	95 473	98 112
1. Energy	55 595	71 412	71 906	72 743	74 289	76 692
2. Industrial Processes	10 111	10 662	10 306	11 006	11 458	11 864
3. Solvents	512	423	394	412	419	426
4. Agriculture	9 171	8 020	7 848	7 797	7 811	7 893
6. Waste	3 649	2 594	2 378	1 915	1 495	1 237

Table 2: Total emissions, with additional measures.

	Inventory Trend [Gg CO_2e]			Emissions with additional measures [Gg CO_2e]		
	1990	**2003**	**2005**	**2010**	**2015**	**2020**
Total (without LULUCF)	79 037	93 112	92 832	92 871	91 582	89 605
1. Energy	55 595	71 412	71 906	71 808	70 434	68 223
2. Industrial Processes	10 111	10 662	10 306	11 006	11 458	11 864
3. Solvents	512	423	394	412	419	426
4. Agriculture	9 171	8 020	7 848	7 729	7 775	7 855
6. Waste	3 649	2 594	2 378	1 915	1 495	1 237

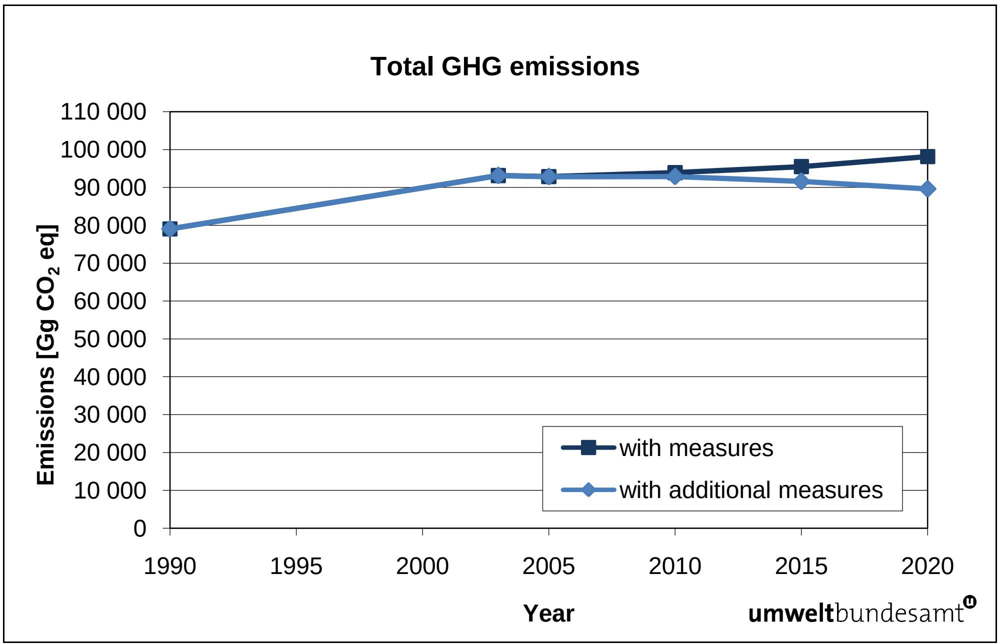

Figure 1: Trend and forecast of total GHG emissions (without LULUCF).

The wm scenario shows an increase of 23 per cent from 1990 to 2020, i.e. from 79.0 to 98.1 Mt CO_2 equivalents. The wam scenario shows an increase of 12 per cent, i.e. from 79.0 in 1990 to 89.6 Mt CO_2 equivalents in 2020. Total greenhouse gas emissions in this report exclude Land Use Change and Forestry for methodological reasons.

Table 3: Trend and forecast of GHG emissions by gas (without LULUCF).

	Emission Trend [Gg CO_2e]			Emissions with measures [Gg CO_2e]			Emissions with additional measures [Gg CO_2e]		
	1990	**2003**	**2005**	**2010**	**2015**	**2020**	**2010**	**2015**	**2020**
CO_2	62 082	78 055	79 009	80 554	82 602	85 210	79 632	78 756	76 750
CH_4	9 183	7 460	7 178	6 847	6 496	6 378	6 784	6 478	6 367
N_2O	6 167	6 038	5 326	5 041	4 961	4 918	5 024	4 934	4 881
HFC	23	863	908	835	819	871	835	819	871
PFC	1 079	102	125	160	155	155	160	155	155
SF_6	503	594	286	436	440	582	436	440	582
Total	**79 037**	**93 112**	**92 832**	**93 873**	**95 473**	**98 112**	**92 871**	**91 582**	**89 605**

In the "with measures" scenario total GHG emissions are forecast to increase between 2005 and 2020 by 6% or 5.3 Tg CO_2 equivalents. This increase is mainly driven by the forecast increase of emissions from the Energy sector by 7% or 4.8 Tg CO_2 equivalents, followed by the forecast increase of emissions from the Industrial Processes sector by 15% or 1.6 Tg CO_2 equivalents. Emissions from the sectors Solvents and Agriculture are also forecast to increase by 8% and 1% respectively. The Waste sector is the only sector in the "with measures" scenario in which emissions are forecast to decrease by 48% or 1.1 Tg CO_2 equivalents. In the Energy sector emissions from the sub-sectors 1.A.1 Energy industries and 1.A.2 Manufacturing industries and construction are forecast to increase by 15% or

2.4 Tg CO_2 equivalents and 14% or 2.2 Tg CO_2 equivalents. Emissions from the sub-sector 1.A.3 Transport are forecast to increase by 4% or 1 Tg between 2005 and 2020, and emissions from the sub-sector 1.A.4 Other sectors are forecast to decrease by 7% or 0.9 Tg CO_2 equivalents.

According to the forecast the most important GHG in 2020 in Austria will still be CO_2, increasing its share of total emissions from 85% in 2005 to 87% in 2020. Between 2005 and 2020 CH_4 emissions and N_2O emissions are both forecast to decrease by 11% and 8%, whereas emissions of fluorinated gases (HFC, PFC and SF_6) are forecast to increase by 22%.

In the "with additional measures" scenario total GHG emissions are forecast to decrease between 2005 and 2020 by 3% or 3.2 Tg CO_2 equivalents. This decrease is mainly driven by the forecast decrease of emissions from the Energy sector by 5% or 3.7 Tg CO_2 equivalents, followed by the forecast decrease of emissions in the Waste sector by 48% or 1.1 Tg CO_2 equivalents. By contrast, emissions from the sectors Industrial Processes and Solvents are forecast to increase by 15% or 1.6 Tg CO_2 equivalents and 8% or 0.03 Tg CO_2 equivalents. In the Energy sector emissions from the sub-sector 1.A.4 Other sectors are forecast to decrease by 20% or 2.7 Tg CO_2 equivalents. Emissions are also forecast to decrease in the subsector 1.A.1 Energy industries by 13% or 2.2 Tg CO_2 equivalents and in the subsector 1.A.3 Transport by 4% or 1.1 Tg CO_2 equivalents. By contrast, emissions from the sub-sector 1.A.2 Manufacturing industries and construction and from the sub-sector 1.B Fugitive are forecast to increase by 14% or 2.2 Tg CO_2 equivalents and 11% or 0.1 Tg CO_2 equivalents.

According to the forecast, the most important GHG in 2020 in Austria will still be CO_2, increasing its share of total emissions from 85% in 2005 to 86% in 2020. Between 2005 and 2020 CH_4 emissions and N_2O emissions are both forecast to decrease by 11% and 8%, and emissions of fluorinated gases (HFC, PFC and SF_6) are forecast to increase by 22% like in the "with measures" scenario.

An analysis of the trend forecast by sector is presented in chapter 4 Sectoral Scenario Results. Tables with detailed emissions by sub-sectors and gas are included in Annex 1. The specific sectoral assumptions and activities are described in the methodical sub-chapters 5.1 to 5.5.

The following figures show sectoral developments and total emissions by gas.

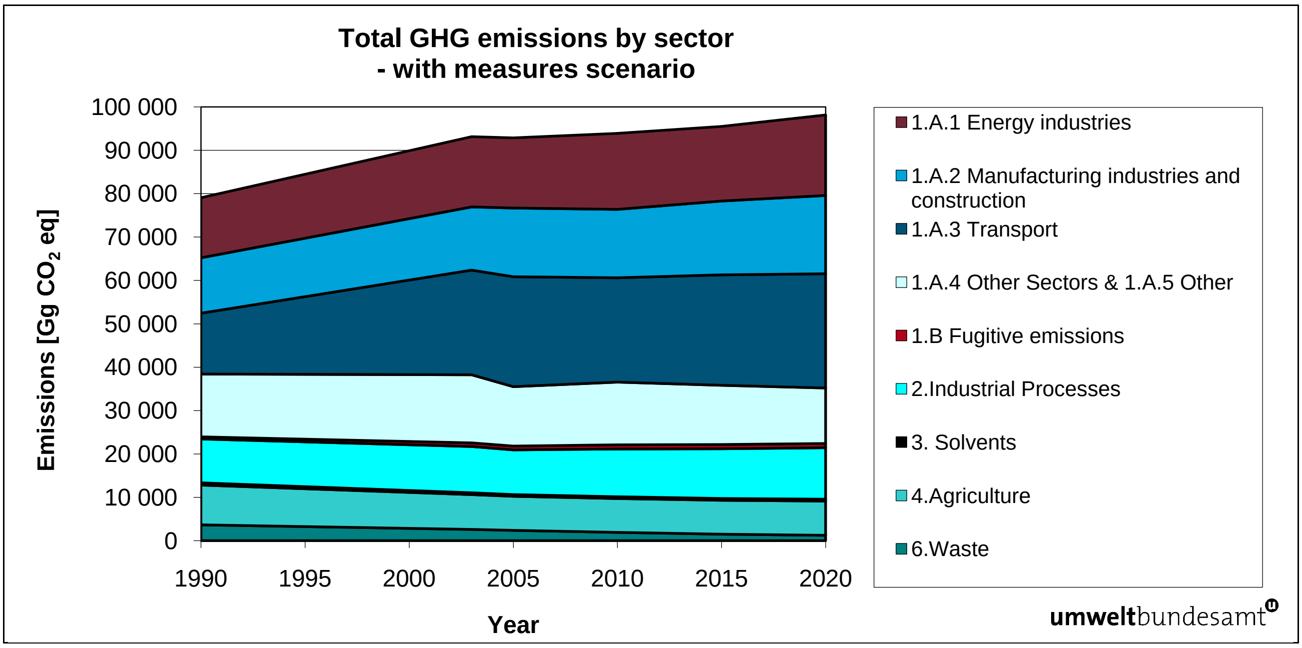

Figure 2: Historical and forecast total GHG emissions of the with measures scenario by sector.

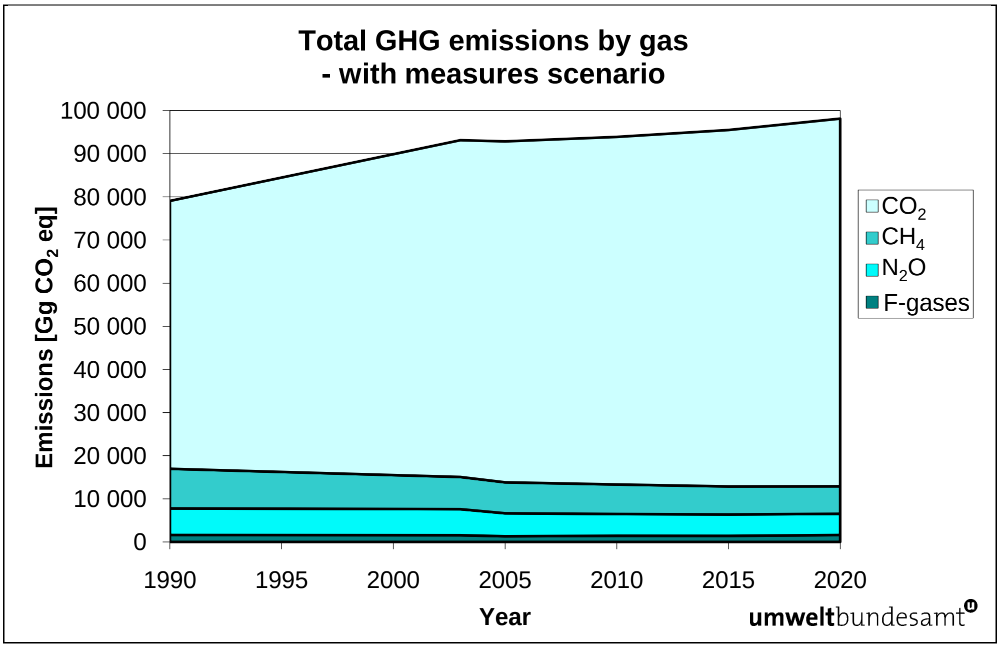

Figure 3: Historical and forecast total GHG emissions of the with measures scenario by gas.

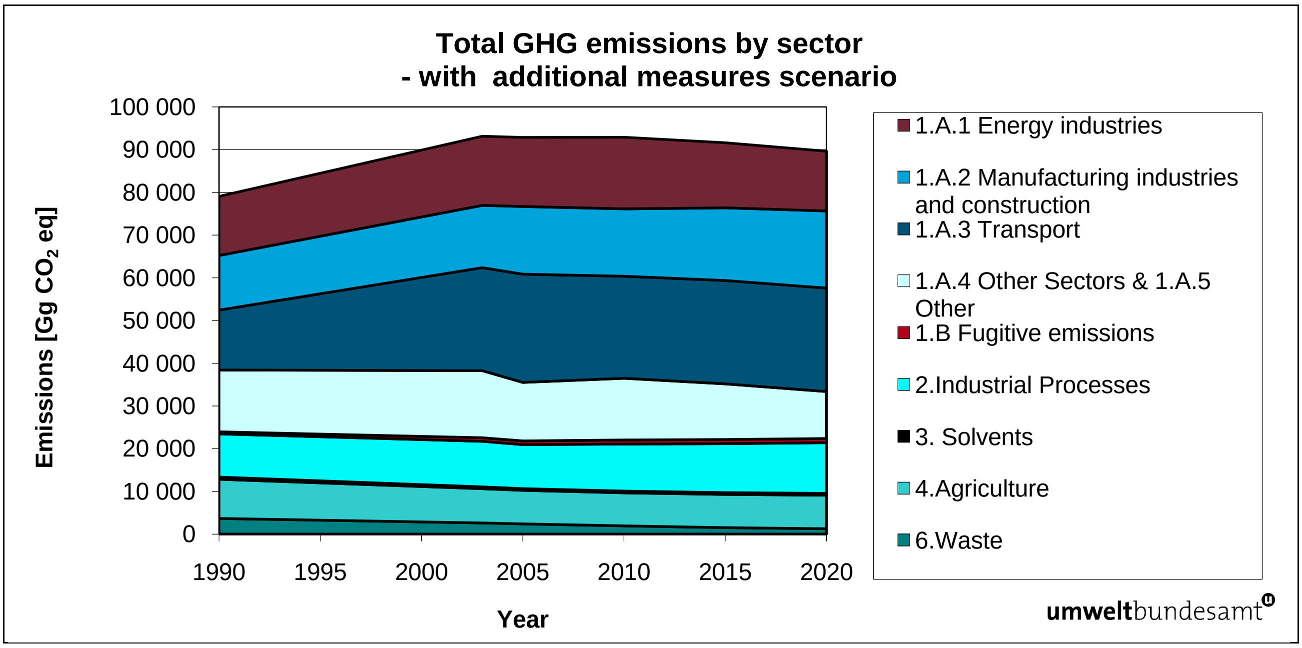

Figure 4: Historical and forecast total GHG emissions of the with additional measures scenario by sector.

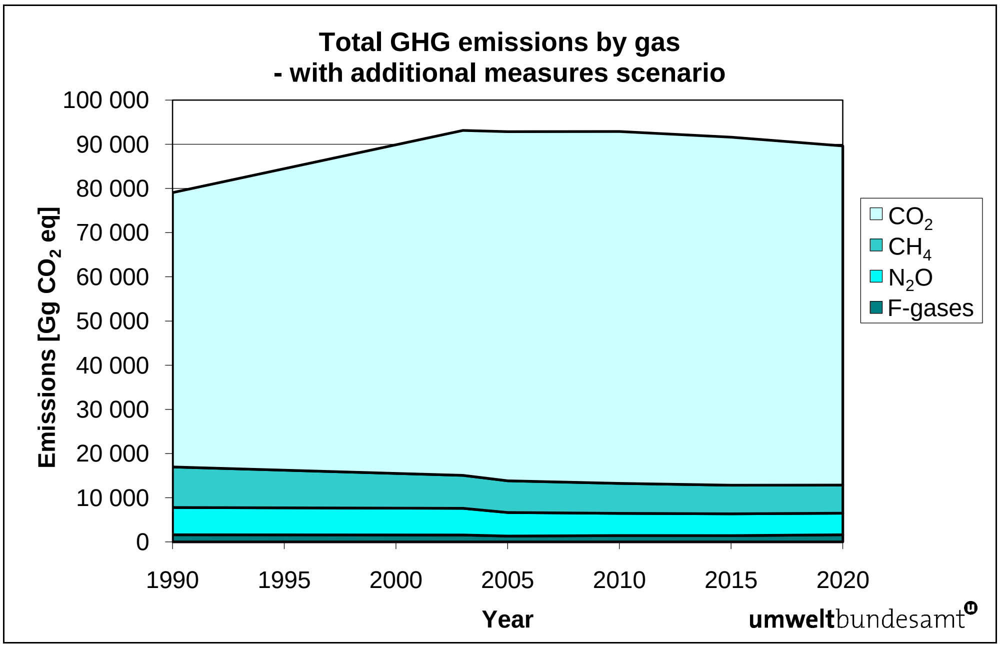

Figure 5: Historical and forecast total GHG emissions of the with additional measures scenario by gas.

3 GENERAL APPROACH

3.1 Considered Guidelines and Provisions

The following regulations and guidelines were taken into account:

- The Guidelines for the preparation of National Communications by parties included in Annex I to the Convention (FCCC/CP/1999/7),
- EU Monitoring Mechanism for anthropogenic CO_2 and other greenhouse gases according to Council Decisions 93/389/EEC revised by the Council Decision 99/296/EC and later revised by the Decision No 280/2004/EC of the European Parlament and of the Council of 11 February 2004
- Implementing Provisions of the EU Monitoring Mechanism: Commission Decision 2005/166/EC of 10 February 2005. In particular, Chapter II Section 2, Article 9 and Article 10 referring to Article 3(2)(a) and (b) of Decision No 280/2004/EC.
- The structure of reporting information on projected GHG data and policies and measures follows the recommendation as included in the MM Article 2 Reporting Template v4.2 provided by the European Commission in 2009.

3.2 Description of General Methodology

3.2.1 Database and Historical Emission Data

Projections are consistent with the historical emission data of the Austrian Emission Inventory (Inventory Submission January 2008) up to the data year 2006. For consistency with previous reporting and following the reporting obligation, latest updated emissions from the years 1990, 2003 and 2005 of the inventory submitted in January 2009 are included as a reference.

3.2.2 Emission projections

Emission projections are generally calculated applying the same methodologies as for the national GHG inventory. These are reported in Austria's National Inventory Report 2009 (UMWELTBUNDESAMT 2009).

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

Emission factors and underlying parameters are described in the methodological subchapters 5.1 – 5.5 of this report.

3.2.3 Underlying Models and Measures

The emission projections are based on the following sectoral forecasts:

- Energy Forecast, based on the National Energy Balance of Statistics Austria and on a macro-economic model of the Austrian Institute of Economic Research (WIFO 2007a), supported by calculations with the bottom-up models BALMOREL, LEAP (AEA) and ERNSTL (EEG).
- Transport Forecast, based on a bottom-up, national transport model GLOBEMI (Technical University of Graz).
- Forecast of emissions from industrial processes, of solvent emissions and emissions of fluorinated gases are based on expert judgements of the Umweltbundesamt.
- Agricultural Forecast, based on the PASMA model of the Austrian Institute of Economical Research (SINABELL & SCHMID 2005) and expert consultations with the Agricultural Research and Education Centre, Gumpenstein (PÖLLINGER 2005, 2008).
- Waste Forecast, based on the Umweltbundesamt forecast of the quantity of waste deposited and wastewater handled.

Two scenarios were modelled: "with measures" includes all measures implemented until 8th August 2008; "with additional measures" includes planned policies and measures with a realistic chance of being adopted and implemented in time to influence the emissions. All additional measures have been defined at expert level in consultation with the Federal Ministry of Agriculture, Forestry, Environment and Water Management. Information on national policies and measures included in the scenarios can be found in chapter 7.

3.3 General Key Underlying Assumptions

With measures and with additional measures

The same general key factors are used for both scenarios.

Table 4: Key input parameter of emission projections.

Year	2010	2015	2020
GDP [bio€ 2 000]	256.52	287.83	321.70
Population [1 000]	8 427	8 561	8 672
Stock of dwellings [1 000]	3 602	3 725	3 827
International coal prices [€/GJ]	6.59	7.36	7.44
International oil prices [€/GJ]	14.93	14.93	14.93
International gas prices [€/GJ]	9.62	9.62	9.62

Other underlying assumptions are included in the sectoral methodology chapters 5.1 – 5.5 and in the Annexes 1 and 2.

3.4 Sensitivity of Underlying Assumptions

This report presents sensitivity assessments for specific sectors, analysing the increase and decrease of key factors or of a combination of key factors. The assessment in the Energy sector was made on the influence of the natural gas price, electricity demand and electricity imports on CO_2 emissions of Energy Industries, the influence of the oil price on CO_2 emissions from Manufacturing Industries and Construction, the influence of fuel price changes, changes of renovation rate and changes of boiler exchange rates on CO_2 emissions from the Residential and Commercial sector, and the influence of fuel price differences between Austria and neighbouring countries on CO_2 emissions from Transport. There is an additional sensitivity analysis for the agricultural sector based on a change of product prices.

All these assessments are based on model results, obtained by calculating effects on energy or live stock. It is necessary to mention that the emission results have in general no linear dependence on changes of an input factor. This is the reason why all presented sensitivity data cannot be seen as a functional dependency with varied parameters. The emission effect can be seen only for the specific value of the parameters given.

3.5 Quality Assurance & Control

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

In general, data quality checks similar to the management system of the Austrian Air Emission Inventory have been performed in each sector. Often the person who is responsible for the sectoral emission is identical with the person who is responsible within the Inventory and some sectors use emission methods based on the verified inventory methods.

An output data check has been carried out by comparing the results of the sectors in detail and checking the plausibility of the emission trends.

Specific responsibilities for this report have been as follows:

- Coordination & General chapters ....Barbara Muik, Melanie Sporer
- Energy Industries & Manufacturing Industries ....Siegmund Böhmer, Michael Gössl, Thomas Krutzler, Herbert Wiesenberger
- Transport ....Barbara Schodl
- Other Energy Sectors ....Alexander Storch, Andreas Zechmeister
- Fugitive Emisisons..........................Stephan Poupa
- Industrial Processes ....Barbara Muik, Herbert Wiesenberger
- Solvents ....Traute Köther
- Agriculture ....Michael Anderl, Gerhard Zethner
- Waste ....Katharina Lenz, Katja Pazdernik, Elisabeth Schachermayer, Stephan Poupa

3.6 Uncertainty of emission projections

The variation of the chosen input parameters in the Sensitivity Analysis can be seen as an indicator of the overall uncertainty caused by changed input data. The methodological subchapters 5.1 – 5.5 additionally include qualitative discussions of uncertainty in the specific sectors.

4 SECTORAL SCENARIO RESULTS

4.1 Energy (CRF Category 1)

4.1.1 Energy industries (1.A.1)

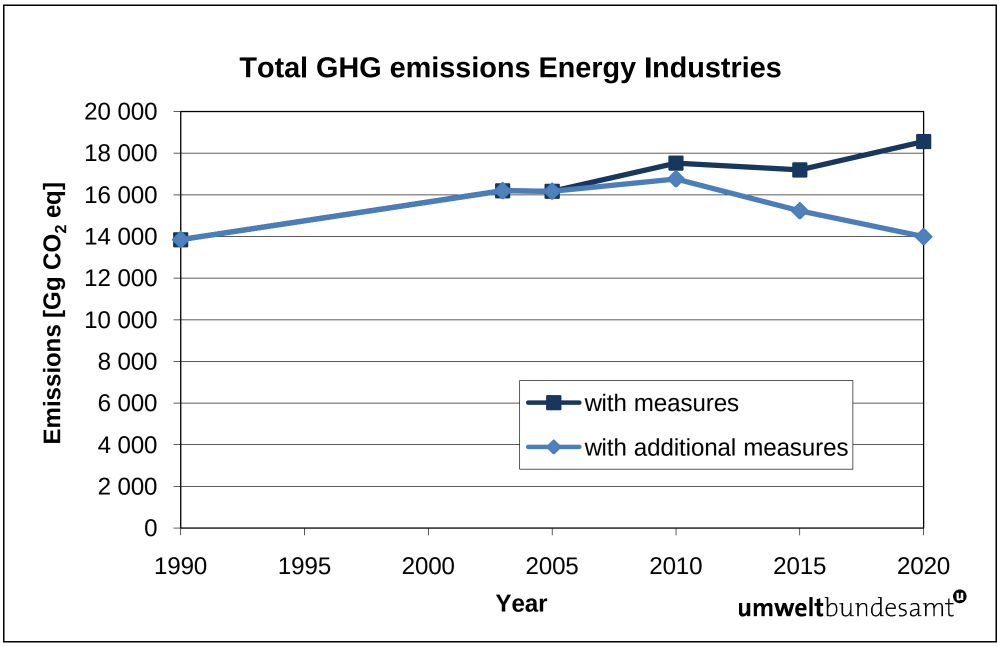

Figure 6: Historical and forecast GHG emissions from 1.A.1 Energy Industries.

In the energy industries sector GHG emissions will rise almost by 10% by 2010 compared to 2006, according to the wm scenario. However, the period from 2010 to 2015 will see a slight decline in emissions, followed by another increase by a margin of about 20% above current levels (2006). The wam scenario predicts a slight increase in emissions by 2010, but in the following years CO_2 emissions of the energy industries are projected to fall constantly to approximately the 1990 level in 2020.

The major driving force for the continuing rise in emissions in the wm scenario will be the growing electricity demand. However, it is assumed that the increase of emissions will be significantly slower than electricity production, mainly due to a shift of production technologies to new gas-fired combined cycle gas turbines with high electrical efficiencies. The growth rates of wind power production and electricity and heat production from biomass and waste of biogenic origin will be significantly higher than the average growth rates of electricity and heat production. However, the boost of these renewables will be compensated by a comparatively modest increase in hydropower, as hydropower is already well developed in Austria.

Even in the wam scenario electricity and heat consumption will rise by more than 20% by 2020 compared to 2006. However, the driving forces for the decline in emissions in the wam scenario are a significant shift in electricity and heat production to renewables (wind +142% by 2020 compared to 2006, biomass +>1 00%, waste of biogenic origin +52%) and new, more efficient gas-fuelled power plants.

Emissions from petroleum refining are projected to remain constant as, from a current point of view, the total production capacity will not change significantly. Higher emissions caused by the operation of new production units or expansions of existing ones are likely to be balanced by a general increase in energy efficiency. Emissions from oil and gas exploration and from storage[1] will continue to rise. For these areas there is no difference between the scenarios wm and wam.

[1] Emissions of compressors for the transport of natural gas are dealt with in the sector transport (1.A.3), fugitive emissions of the pipelines are dealt with in the sector fugitive emissions from fuels (1.B).

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

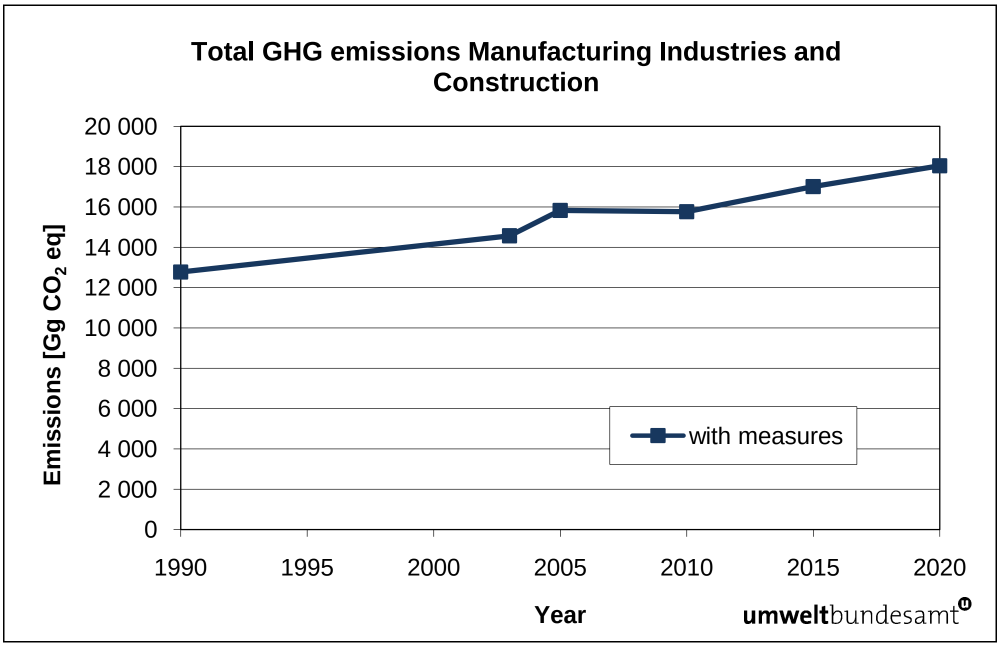

Figure 7: Historical and forecast GHG emissions from 1.A.2 Manufacturing Industries and Construction.

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

For the period 1990 and 2003 the industry sector was characterised by an emission increase of about 10%. For the years 2005 and 2006 CO_2 emissions increased due to the enlargement of an integrated steelwork plant.

For the sector of other industries (CRF category 1 A 2 f) a decrease in emissions can be observed from 2005 to 2010 which applies to the whole category. For the period 2010–2020 a stable increase of CO_2 emissions, based on increased sectoral GDP projections, is assumed.

4.1.3 Transport (1.A.3)

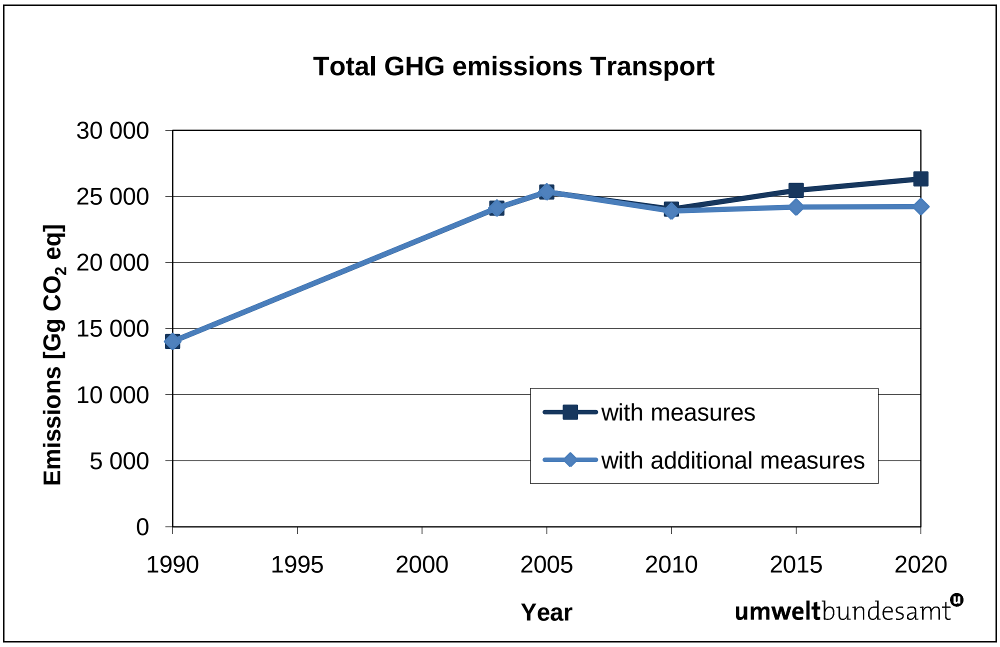

Figure 8: Historical and forecast GHG emissions from 1.A.3 Transport.

The transport sector is one of the main sources of greenhouse gases in Austria. While emissions from gasoline vehicles are declining steadily, emissions from diesel are increasing constantly. About a third of the GHG emissions are caused by fuel export due to persistent lower fuel prices in Austria compared to the neighbouring countries.

The steep increase of recent years reached its peak in 2005. The implementation of the EU biofuels directive and the declining fuel export changed the trend. Despite a higher fuel efficiency of the fleet, GHG emissions is beginning to increase once again. For the future it is assumed that the peak of the emissions of 2005 will be reached again. The implemented measures cannot reverse the trend of increasing road performance.

In the wam scenario after 2010 the increase can be halted due to the implementation of further fuel efficiency measures for cars and the control of speed limits combined with traffic control systems.

Another source in this sector are emissions from pipeline compressors. These amounted to 2% of the emissions in the transport sector in 2005 and are forecast to double until 2020, due to new compressor projects. Emissions of pipeline transport are forecast to rise sharply in the coming years; in the next decade emissions will continue to increase albeit at a reduced rate.

The outlook shows oscillating GHG emissions at a high level.

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

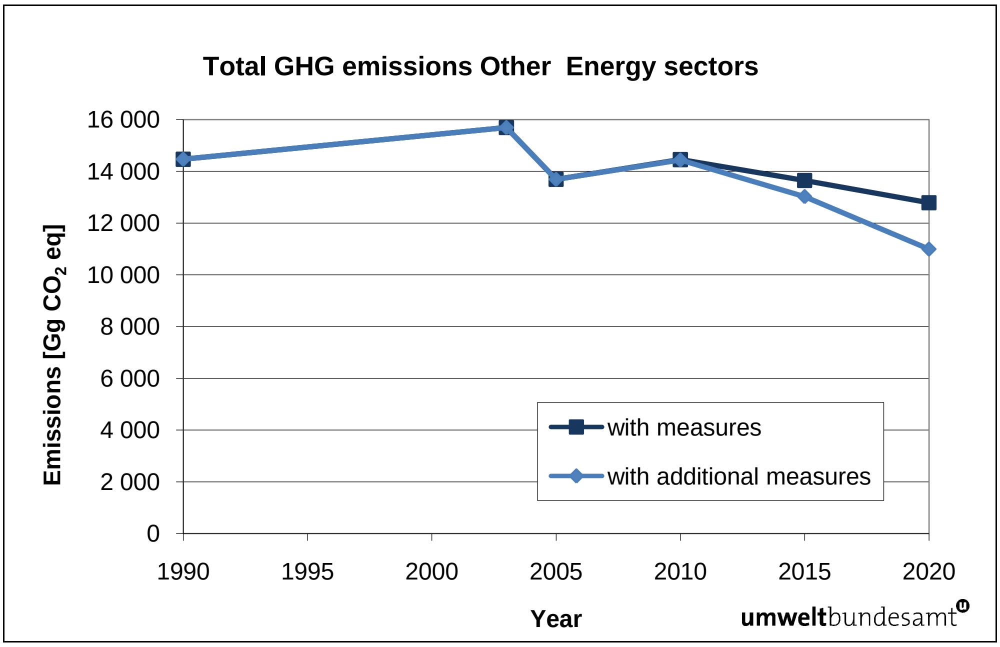

Figure 9: Historical and forecast GHG emissions from 1.A.4 Other sectors (includes Residential, Commercial/Institutional and Agriculture/Forestry/Fishing) and 1.A.5 Other (military transport).

The "1.A.4 Other sectors" account for a considerable amount of the total greenhouse gas emissions in Austria. Despite growing numbers of households and occupied living space, the total GHG emissions in this sector are slightly reduced by 2020 for the scenario with measures and significantly reduced for the scenario with additional measures.

The driving force is the shift of fossil fuels to renewables like biomass, solar heat und heating pumps as well as a slight transfer to other sectors (district heat). The only moderate increase of total energy consumption corresponds to the increased insulation of new buildings and during renovation measures, as well as to the improved efficiency of primary heating systems in buildings.

4.1.5 Fugitive emissions (1.B)

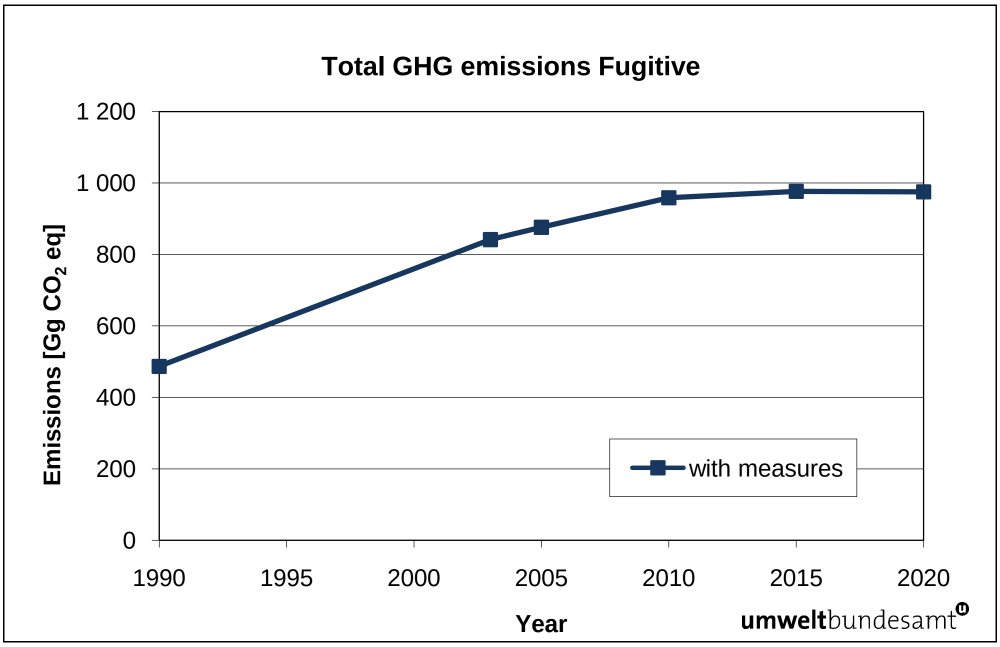

Figure 10: Historical and forecast GHG emissions from 1.B Fugitive emissions.

Fugitive emissions from the exploration, refining, transport, production and distribution of fossil fuels increased strongly between 1990 and 2007 (by nearly 100%). The main driving force behind this increase is the extension of the natural gas distribution network and the increasing natural gas and oil extraction. A further increase is projected for 2010 and a stabilization of emissions by 2020. Although the gas distribution network and storage capacities are assumed to be further extended after 2010, this is assumed to be compensated by the substitution of valves (hydraulically controlled systems by electrical devices) and by a decrease in natural gas production.

4.2 Industrial Processes (CRF Category 2)

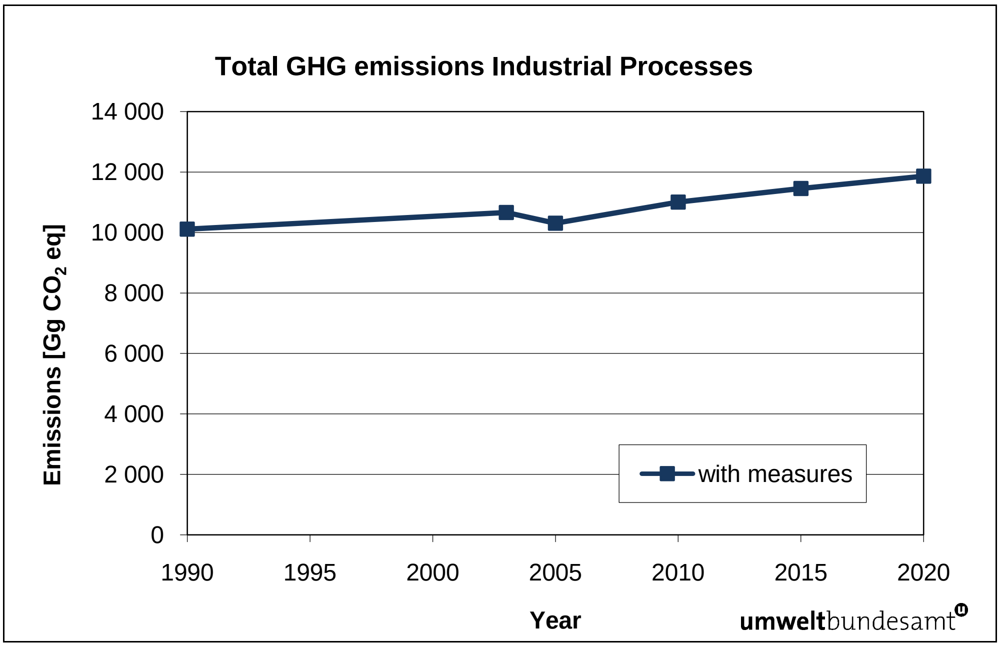

Figure 11: Historical and forecast GHG emissions from 2 Industrial Processes.

For the projection of N_2O emissions a major reduction measure implemented at a nitric acid plant at the end of 2003 has been taken into account.

For the years 2005 to 2020 emissions from industrial processes are assumed to rise due to a projected increase of production. The main contributors are the categories "metal production" and "mineral products".

Another source in this sector are fluorinated gas (HFC, PFC and SF_6) emissions. These amounted to 13% of the emissions in the industrial processes sector in 2005 and are forecast to increase their share to 14% in 2020. The main driving force behind this increase is the forecast increase of SF_6 emissions from the disposal of sound-proof windows.

4.3 Solvents (CRF Category 3)

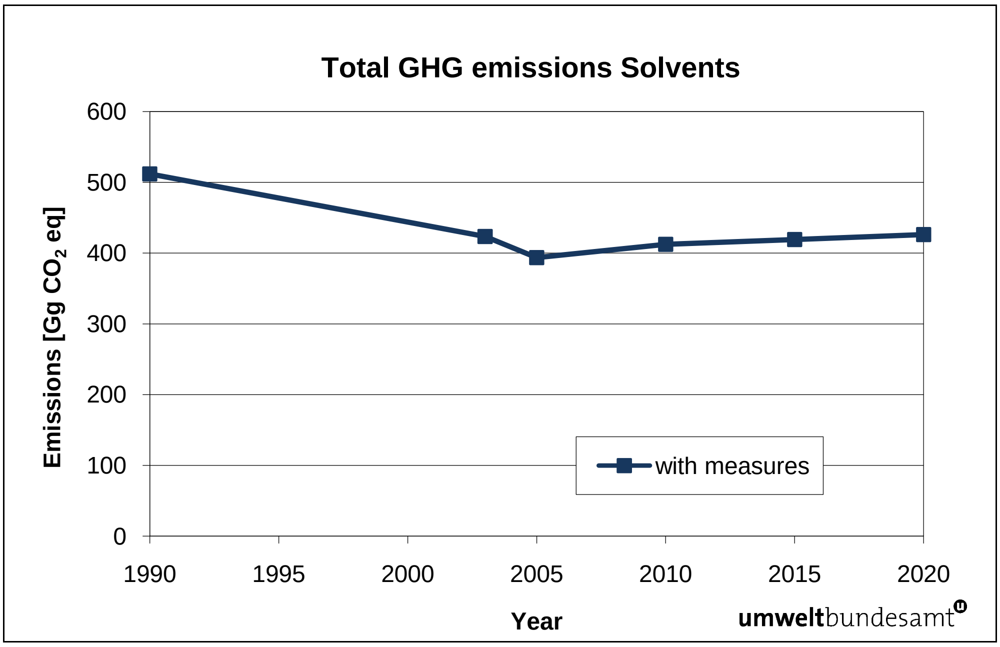

Figure 12: Historical and forecast GHG emissions from 3 Solvents.

The CRF Source Category 3 "Solvents and Other Product Use" is one of the minor sources with less than 1% of total greenhouse gases in Austria.

Greenhouse gas emissions in this sector decreased by 23% between 1990 and 2005 due to decreasing solvent and N_2O use and due to the positive impact of the enforced laws and regulations in Austria. Since 2006 a slight increase of GHG emissions has been observed due to increasing solvent use as a result of the growing population. This trend is forecast to continue up to 2020. In the "with measures" (wm) scenario, which is equal to the "with additional measures" scenario (wam), emissions are forecast to increase by 8% until 2020 (compared to 2005).

4.4 Agriculture (CRF Category 4)

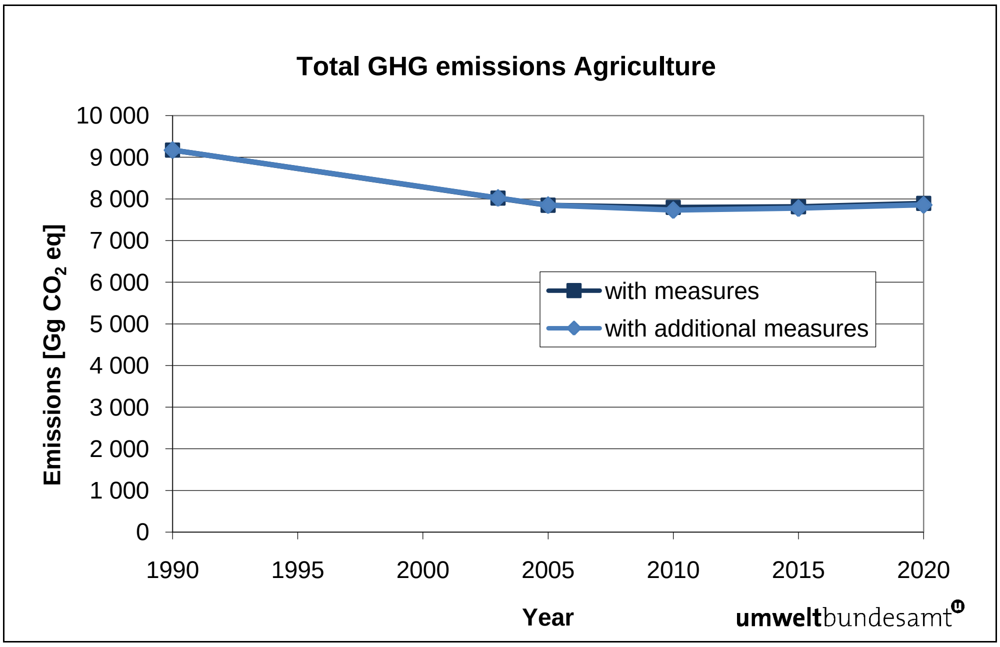

Figure 13: Historical and forecast GHG emissions from 4 Agriculture.

From 1990 to 2005, emissions showed a stable decrease, mainly due to the decreasing livestock numbers. From 2010 onwards a stabilisation of animal numbers is expected. Additionally, consumption of the mineral fertilizer N is expected to increase slightly because an expected growing demand of food, feed and biomass for energy purposes would otherwise cause a nutrient deficit and diminish the crop harvest. The trend to liquid animal waste management systems causes increasing CH_4 emissions from manure management. Anaerobic digestion in biogas plants could slightly lower CH_4 emissions from manure management.

4.5 LULUCF (CRF Category 5)

This report does not give the results for modelled emissions for the LULUCF sector. For a first estimate the general assumption for the forecast is a constant value of net removals up to 2020 of -17 398 Gg CO_2 equivalents (this value corresponds to the 2007 removals in the 2009 submission).

4.6 Waste (CRF Category 6)

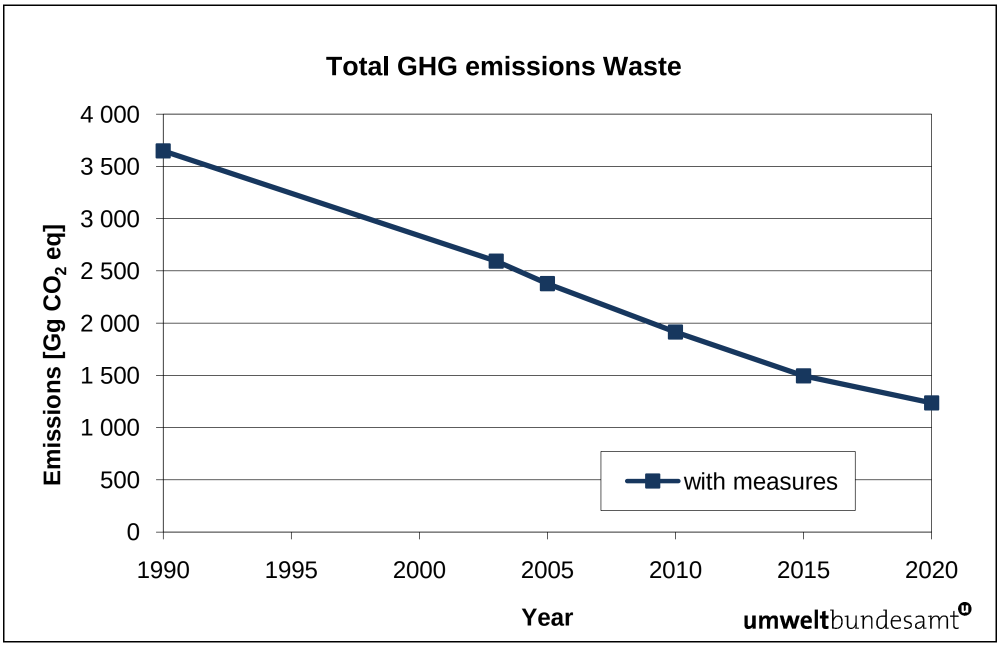

Figure 14: Historical and forecast GHG emissions from 6 Waste.

The “with measures” scenario shows a further downward trend for waste treatment and disposal up to 2020. This development follows the decline of the amount of untreated solid waste as a result of legislative regulations. As the sub-sector CH_4 emissions from solid waste disposal on land is responsible for the major part of greenhouse gas emissions from the sector waste treatment (80% in the year 2007) the projected increase in N_2O emissions from the sub-sector wastewater handling will not change the declining trend. Emissions from the sub-sectors compost production and waste incineration are minor. Thus, they were projected to stay stable until the year 2020.

5 SECTORAL METHODOLOGY – PROJECTIONS

5.1 Energy (CRF Source Category 1)

The total energy demand and production was evaluated on the basis of the model of the Austrian Institute of Economic Research ("Wirtschaftsforschungsinstitut", WIFO) (WIFO 2005) and supported by calculations based on additional models determining the

- electrical power demand (LEAP),
- domestic heating and domestic hot water supply (ERNSTL) and
- public electrical power and district heating supply (BALMOREL).

The general approach of the WIFO energy model is to handle most variables as endogenously as possible and therefore reduce the amount of exogenous assumptions. Considering the costs of energy sources only the price of oil has to be provided as input. Other exogenous values that have to be considered are taxes, deregulations and environmental promotion. The original energy projection by the WIFO (WIFO 2005) was modified by assuming an average oil price of USD 120.00 (WIFO 2007a).

For evaluating the electrical power demand the software package *Long range Energy Alternatives Planning System* (LEAP[2]; COMMEND 2009) was applied. It was developed by the Stockholm Environment Institute (SEI-US) and is a modelling tool for energy and economy projections based on scenarios. It is a simulation package with the aim to describe the development in an accurate way but does not perform any form of optimization (e.g. minimizing costs or emissions). Since LEAP uses a demand driven approach it can be used for the simulation of the electrical power demand. The main inputs for private households, public and private services, real assets production and other sectors are (top down approach):

- assumption for development of energy intensity
- development of gross value added (data from WIFO) (WIFO 2007a)

To describe the energy consumption for domestic heating and domestic hot water supply the software package *Energetisches Raumwärme-Simulations-Tool* (ERNSTL[3]) (EEG 2009) was applied. This model is based on a stochastic, non-recursive, myopic and economic algorithm with the objective function to minimize costs. The base algorithm was developed by Schriefl (EEG 2007). It is based on the principle of the model INVERT. It allows the calculation of the energy demand for heating (space heating and hot water) of apartment buildings and buildings of the public or private service sector 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

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[2] http://www.energycommunity.org

[3] http://eeg.tuwien.ac.at

The determination of the total public electrical power and district heating supply was realized by the optimization package BALMOREL[4] which is a bottom-up energy system model developed and used for energy policy analysis. It is a linear programming tool, which is based on the General Algebraic Modelling System (GAMS[5]), that allows the representation of electrical and district heating generation plants. Due to the linear structure of the model only generic technologies can be represented. Specific plants with corresponding capacities cannot be described within this approach. The objective function of BALMOREL is the minimization of the system costs for the generation of electrical power and district heat. The main inputs are:

- demand for electric power
- demand for district heating
- net imports of electrical power
- fuel prices
- emission factors
- emission fees (e.g. cost for CO_2 emission certificates)

The simulation starts with the year 2006 and is calibrated by data of existing power generation plants. The basic time unit is a year, which is additionally split into 12 periods to describe the seasonal change in power demand properly. Austria is handled as a single region. The output obtained by BALMOREL is:

- amount of electric power and heat generated within a time period (subdivided by generation technology)
- amount of emission caused by power generation
- marginal costs for power generation

The results of the different models are balanced within a few cycles. Umweltbundesamt experts combined the data of the different models and includes additional calculations on

- energy input for the iron and steel industry
- production of electric power and district heating within industry
- use of waste as fuel in power plants and industry
- energy input of compressor stations
- demand of the energy producing sector
- total energy demand.

The output of the model ERNSTL was used in LEAP (electricity demand for heating and cooling) and in BALMOREL (demand of district heating). The electricity demand of LEAP was used in BALMOREL.

The base year for the WIFO model was 2003 while it was 2006 for the other models. The WIFO calculations (WIFO 2007a) were not a full run of the macroeconomic model but only a scenario run based on the previous results.

[4] http://www.balmorel.com

[5] http://www.gams.com

5.1.1 Energy Industries (1.A.1)

5.1.1.1 Methodology of the sectoral emission forecast

The output of the model BALMOREL (see chapter 5.1) provides fuel-specific activity data for Energy Industries (i.e. Electricity and Heat Production including Waste Incineration). These were multiplied by established and fuel specific emission factors used by the Austrian Inventory. Emission factors for fuels not specified (e.g. for refinery fuel gas, refinery coke) or for wastes (e.g. municipal solid waste, hazardous waste) were derived from plant-specific data. The methodology for the emission factors is discussed in the Austrian Inventory Report (UMWELTBUNDESAMT 2009).

As regards the only refinery operated in Austria no major changes of production capacities or used technologies are expected from a current point of view. Relevant restructuring programmes and commencement of new production units have been undertaken in previous years, the last one finished in 2008. Thus, the emission average of the years 2005 to 2007 has been used for the projection. For oil and gas exploration and storage the trend of the past has been prolonged.

5.1.1.2 Assumptions

The assumptions for both scenarios for the total gross inland consumption and for the total input to and output from power plants, all split by fuel type, can be seen in Annex 1 and Annex 3. Moreover, the energy demand by sectors is shown, split by delivered fuel (final energy consumption).

The assumption for the basic weather parameter – the heating degree days – is explained in chapter 3.3.

With measures

Price of CO_2 ton in Emission Trading

It has been assumed that the European ETS will continue beyond 2020 and that there will be a significant shortfall in emission certificates ensuring a substantial price for certificates. Furthermore, it has been assumed that the price is not influenced by decisions of Austrian plant operators. The following prices have been assumed:

- 20 €/t until 2010, 21 €/t until 2015; 22 €/t until 2020

The effects of recent changes to the ETS have not been considered.

Losses in electricity production due to implementation of the Water Framework Directive

With measures:

For the implementation of the Water Framework Directive, assumptions have been made as summarised in Table 5. For the year 2015 losses are projected in the range of 400 GWh, for 2020 losses of 750 GWh. Total losses are given until 2027.

Table 5: Projected losses due to implementation of the Water Framework Directive.

	losses (GWh)	starting after the year
small plants (< 10 MW)	832	2010
large plants (> 10 MW)	377	2010
storage plants (> 10 MW)	280	2020

Optimisation of existing hydro power plants

According to a study (PÖYRY 2008) the potential for optimisation amounts to a total of 1 400 GWh, with 50% to be contributed by small plants (< 10 MW) and 50% by large plants (> 10 MW).

Green Electricity Act 2008

For the scenario with measures it is assumed that the goals of the Green Electricity Act 2008 (Federal Legal Gazette I No 44/2008) will be fulfilled. The act aims at a construction of hydro plants with a capacity of 700 MW, wind plants with 700 MW and biomass plants with 100 MW_{th} until the year 2015 (with full operation of all constructed plants expected in the year 2017). The Green Electricity Act has no specific goals beyond the year 2015. However, the projections are based on the assumption that the growth rates for individual renewable energy sources remain at the same level until 2020.

kli.en

In the working programme of the climate and energy fund (kli.en) 8 million euros per year are dedicated to the subsidisation of photovoltaic plants with a peak performance of less than < 5 kW_p. The programme will last until 2010.

Electricity import

It has been assumed that the proportion of electricity imports will remain stable at the current level.

Petroleum refining

See chapter 5.1.1.1 for assumptions regarding this sector.

Manufacture of solid fuels and other energy industries

See section 5.1.1.1 for assumptions regarding this sector.

With additional measures

The following changes have been made compared to the wm scenario: The price of the CO_2 ton in Emission Trading was assumed to be 40 €.

The additional production of hydropower increases by 10% due to a more efficient application of the Green Electricity Act 2008.

Energy efficiency measures (see chapter 7.3) are fully implemented and cause a decrease of the electricity demand.

The electricity production of new power plant projects very likely to be realized has been taken into account in the projections. The remaining electricity demand is assumed to be covered by imports.

5.1.1.3 Activities

With measures

The transformation input in Austrian power and heat plants for the wm scenario is depicted in Figure 15. As can be seen overall, there is a continuous increase. While the input of coal and residual fuel oil decreases, the increase of the input of gas, biomass and waste is more pronounced (not depicted in Figure 15). Additionally, the amount of wind power increases significantly.

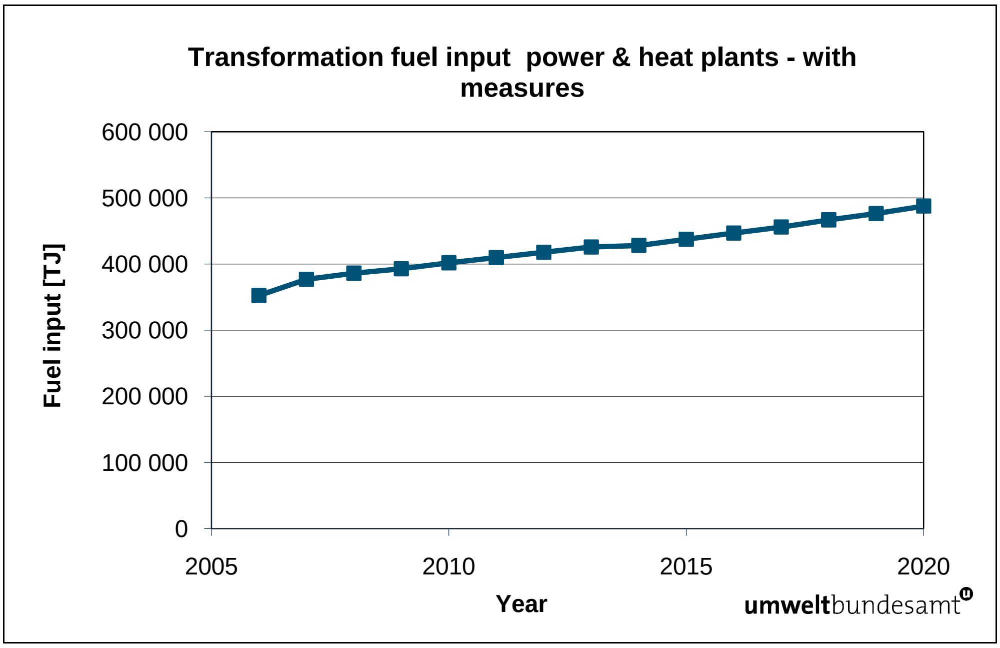

Figure 15: Transformation fuel input in Austrian power and heat plants (1.A.1.a) for the wm scenario given in TJ.

Emissions of the only refinery (and therefore its energy input) are expected to remain stable until 2020 as indicated in chapter 5.1.1.1, both in the wm and wam scenario.

For oil and gas exploration and storage the trend of the past has been prolonged, both in the wm and wam scenario. As natural gas is the only fuel used, emissions and energy input increase concurrently (see Figure 16).

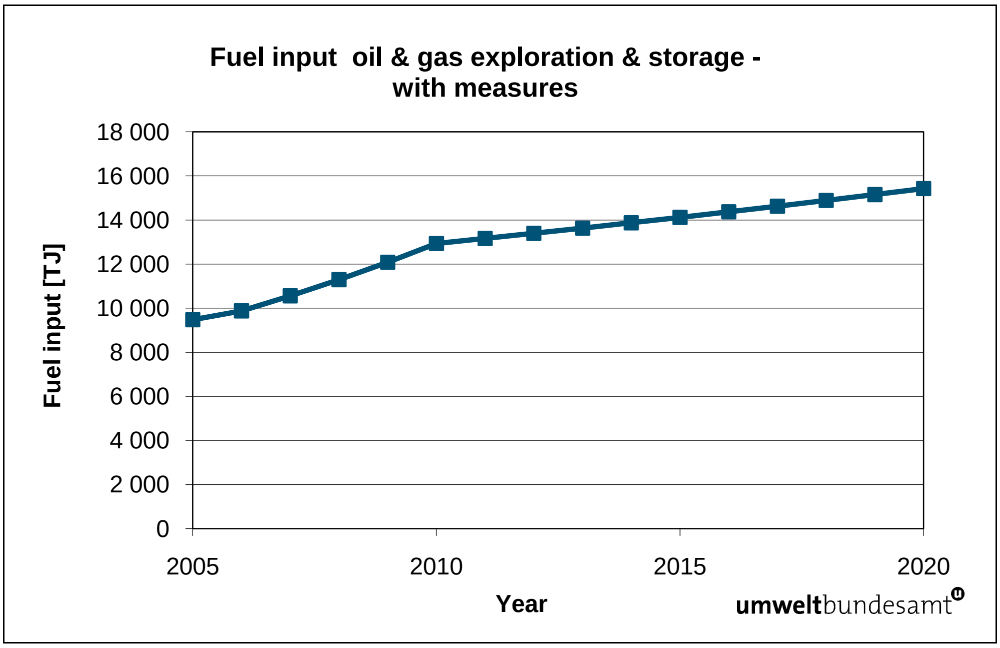

Figure 16: Fuel input in oil and gas exploration and storage (1.A.1.c) for the scenario wm given in TJ.

With additional measures

The transformation input in Austrian power and heat plants for the wam scenario is depicted in Figure 17. There is only a small increase until the year 2012. Afterwards the emissions remain constant. The higher electricity and heat demand is compensated by an enlarged share of renewable energy sources.

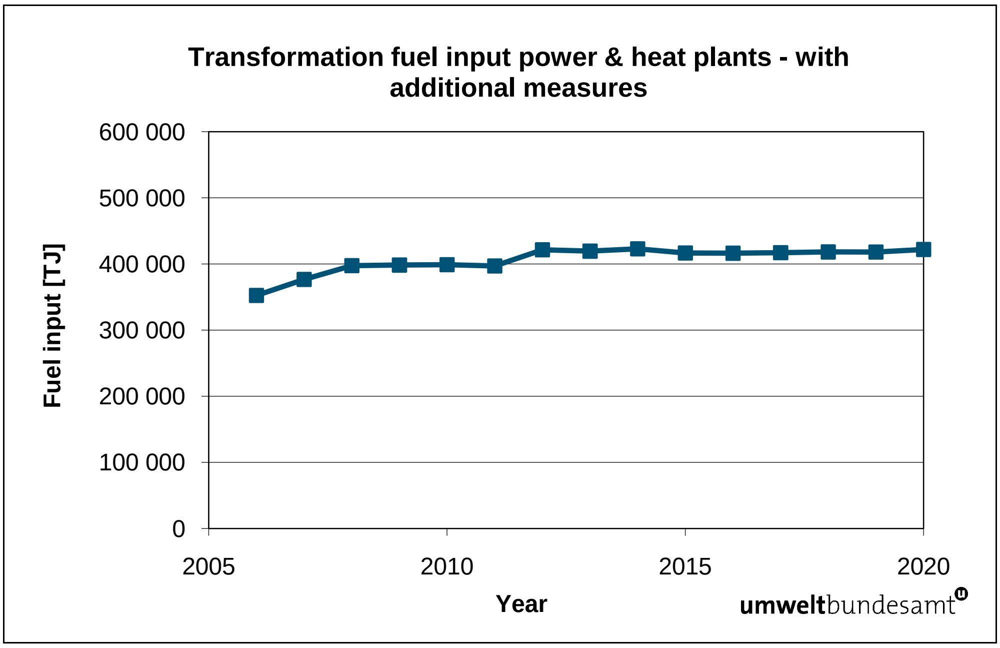

Figure 17: Transformation fuel input in Austrian power and heat plants (1.A.1.a) for the wam scenario given in TJ.

5.1.1.4 Sensitivity Analysis

For the sensitivity analysis of the public power generation three parameters have been varied: price of natural gas (+10%, -10%), electricity demand (+0.1% p.a., -0.1% p.a.) and electricity imports (+10%, -10%). Each variation has been studied separately.

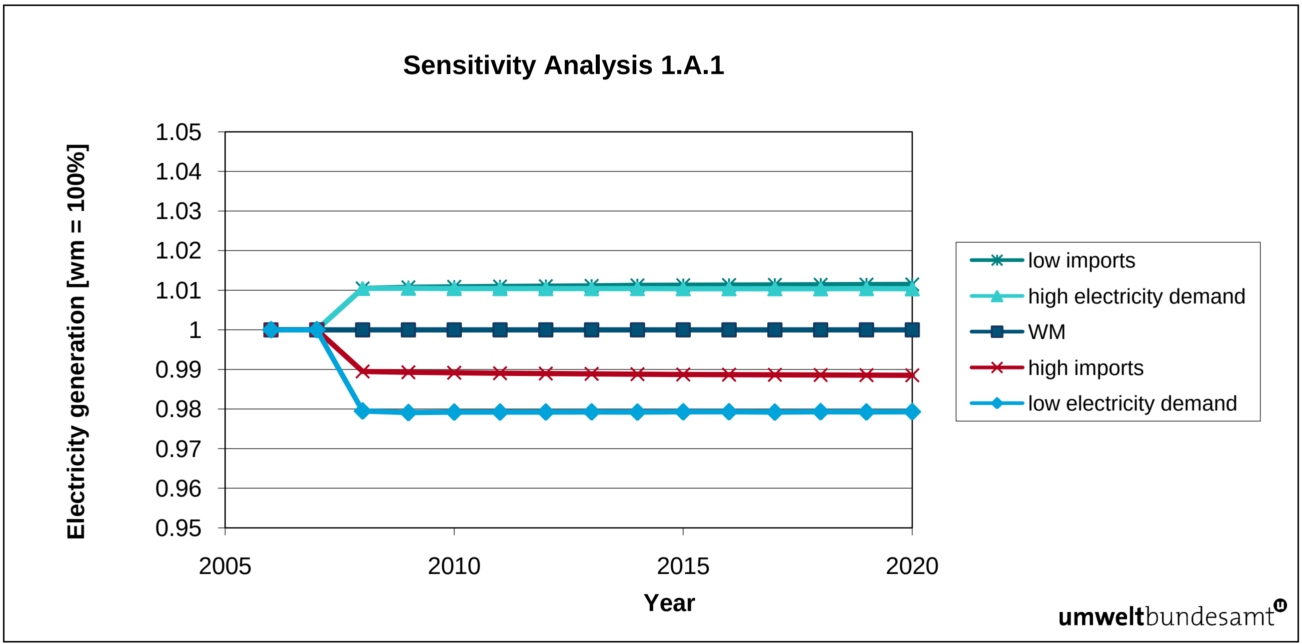

Figure 18: Changes in electricity generation according to different parameters of sensitivity analysis.

Figure 18 depicts the changes in electricity generation resulting from variations of electricity imports and the electricity demand, respectively. Overall the impact is rather low with a maximum deviation of 2% for low electricity demand. Otherwise the variations yield the expected results – electricity production increases with low imports and high demand and decreases at high imports and low demand.
A change of the gas price does not affect the overall production but the amount of electricity produced by gas or coal plants (see Table 6).

Table 6: Effects of gas price on electricity generation for the year 2020 given in GWh.

	total generation [GWh]	by new gas CHP [GWh]	by new coal CHP [GWh]
wm	87 195	14 511	0
gas price +10%	87 195	14 243	735
gas price -10%	87 195	15 131	0

In Table 7 the differences of the sensitivity scenarios in relation to the scenario with measures are summarised. The differences have been calculated in Gg CO_2 emissions based on the differences in fuel input under the various assumptions. Overall the differences are rather low, with the greatest difference coming from the low electricity demand scenario.

Table 7: Differences to the scenario wm of the sensitivity scenarios for the year 2020 given Gg CO_2.

Parameters varied	Difference to wm [Gg CO_2] in 2020
gas price +10%	101.6
gas price -10%	-80.5
high demand	180.7
low demand	-359.2
high imports	-199.3
low imports	199.6

In Table 8 the effects of the variations on the public generation of district heat are summarised. Overall production and the production from renewables and waste do not change. Thus there is a trade-off between coal CHP and gas CHP. While a low gas price, high demand and low imports boost the generation, a high gas price, low demand and high imports have negative effects.

Table 8: Sensitivity analysis – public generation of district heat for the year 2020.

	by new gas CHP [GWh]	by old gas CHP [GWh]	by coal CHP [GWh]
wm	2 069	1 977	1 513
gas price +10%	1 625	1 297	2 637
gas price -10%	1 726	2 523	1 309
low demand	1 587	2 459	1 513
high demand	1 503	2 543	1 513
high imports	1 587	2 459	1 513
low imports	1 726	2 320	1 513

5.1.1.5 Uncertainty

For uncertainties regarding emission factors see the Austrian National Inventory Report 2009 (UMWELTBUNDESAMT 2009).

The sensitivity analysis shows that a variation of assumptions for the price of natural gas, electricity demand and electricity imports influences emission projections only by about 2%. This influence is considered to be low compared to the influence of economic developments on the uncertainty of emission projections in this sector.

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

5.1.2.1 Methodology of the sectoral emission forecast

The models have been described in chapter 5.1.

5.1.2.2 Assumptions

With measures

The oil price is assumed to be 120 US$ from the year 2008 onwards. GDP growth averages 2.43% until 2012 and is then stable at 2.25% per year. The ratio US$/€ is 1.37 from the year 2009 onwards.

With additional measures

The scenario differs from the scenario with measures in terms of electrical energy. Due to increased efficiencies induced by the measures described in chapter 7.3 the electricity demand strongly diminishes. The difference is depicted in Figure 19.

In the year 2020 the difference is approximately 17 400 TJ.

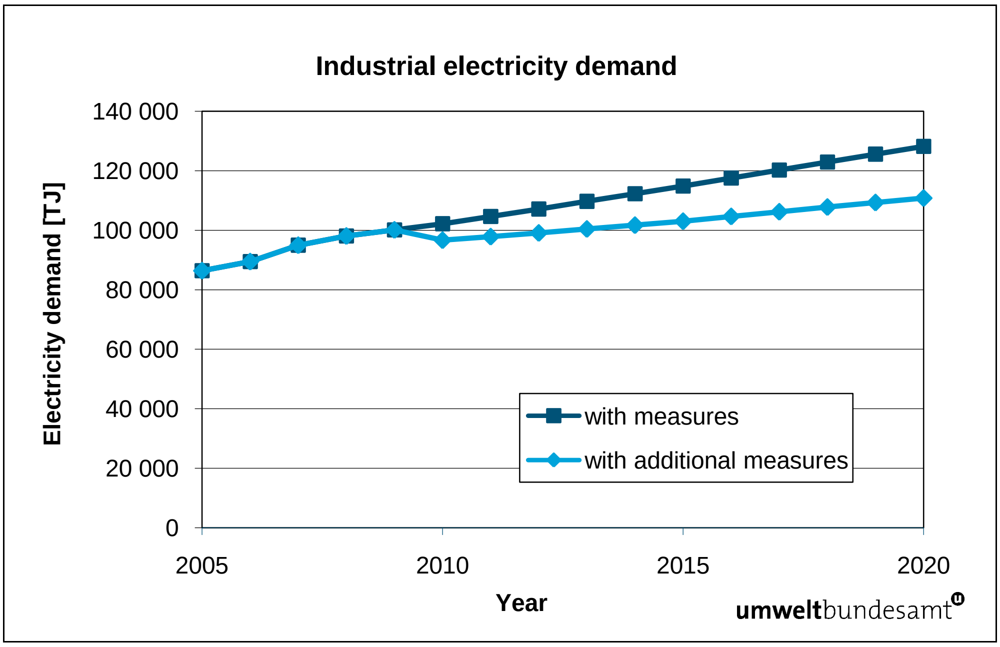

Figure 19: Industrial electricity demand in the wm and wam scenarios given in TJ.

As the difference is only restricted to electricity demand, there is no change in GHG emissions from scenario wm to wam.

5.1.2.3 Activities

With measures

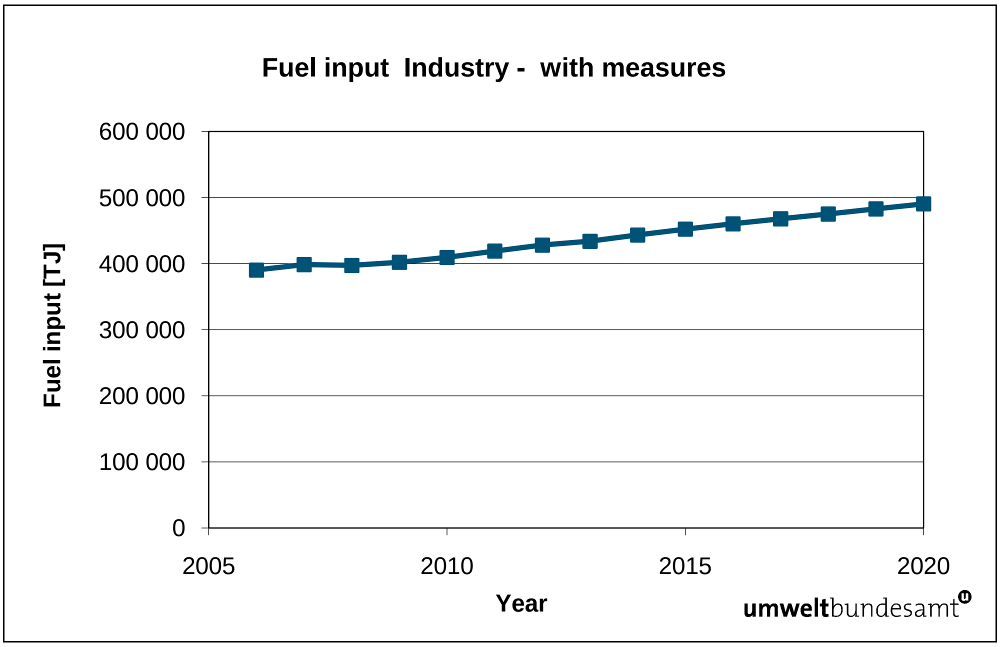

Figure 20: Industrial fuel input in the wm scenario given in TJ.

The total energy input (autoproducer and final energy demand) in industry is nearly constant until the year 2010 and increases continuously afterwards.

Detailed figures are given in the Annexes.

With additional measures

The difference to the scenario with measures is described in chapter 5.1.2.2.

5.1.2.4 Sensitivity Analysis

The impact of the oil price on CO_2 emissions has been assessed by calculation of a scenario featuring an oil price of US$ 80 (instead of 120 as in wm) (WIFO 2007b).

As can be seen in Figure 21 the CO_2 emissions increase only by 2% if the oil price decreases by 33%.

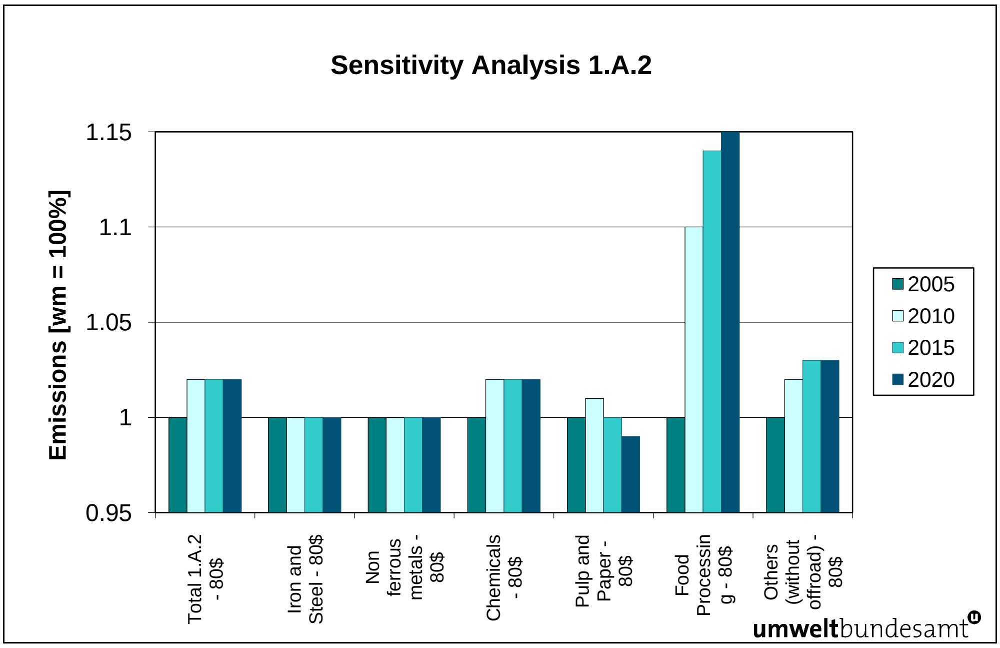

Figure 21: CO_2 emissions of industrial branches in the sensitivity scenario (oil price US $ 80 in comparison to the wm scenario (100%).

5.1.2.5 Uncertainty

For uncertainties regarding emission factors see the Austrian National Inventory Report 2009 (UMWELTBUNDESAMT 2009).

The sensitivity analysis shows that a variation of assumptions on the price of crude oil influences emission projections only by about 2%. This influence is considered to be low compared to the influence of economic developments on the uncertainty of emission projections in this sector.

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

5.1.3.1 Persistent fuel export

Since the end of the 1990s an increasing discrepancy between total Austrian fuel sales and the computed domestic fuel consumption has become apparent. From 2003 onwards this gap has accounted for roughly 30 percent of the total fuel sales. A possible explanation for this discrepancy is the “fuel export in the vehicle tank” – due to the relatively low fuel prices in Austria (in comparison to the neighbouring countries), which means that to a greater extent fuel is filled up in Austria and consumed abroad. This assumption is underpinned by a national study (MOLITOR et al. 2009).

In 2007 about 7 million tons CO_2 result from fuel exports in vehicle tanks. CO_2 emissions are expected to remain steady until 2020 (in relative terms).

Therefore the “fuel export” problem is relevant for climate policy, e.g. the Kyoto commitment, because emissions are allocated according to national fuel sales. For this reason GHG emissions from “fuel exports” are assigned to Austria in total.

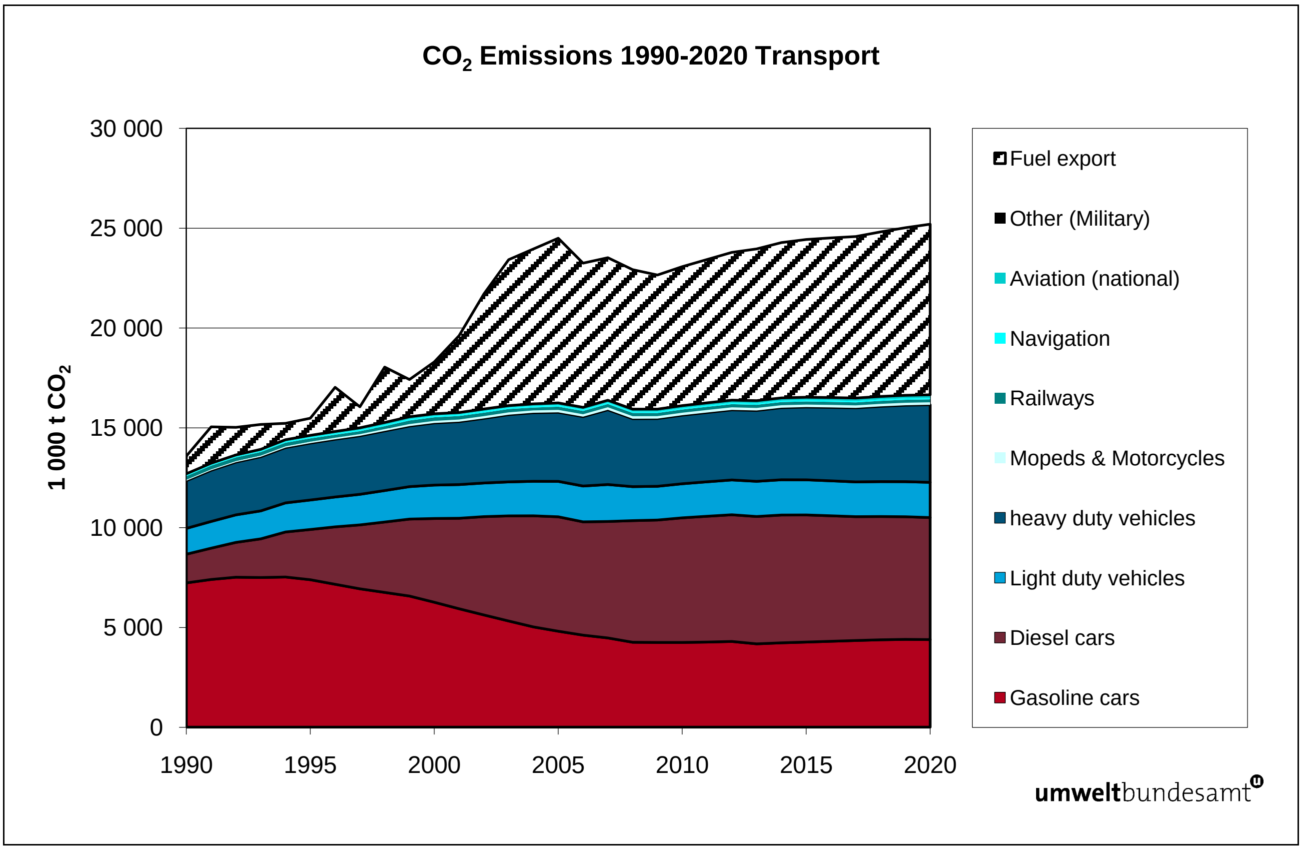

Figure 22: Historical and forecast development of CO_2 emissions in Transport 1990–2020.

5.1.3.2 Methodology of the sectoral emission forecast

The forecast comprises different models:

1 A 3 Transport (without aviation)

The calculation of transport emissions is based on different models:

- Transport demand model

  The transport demand data which is the basis for emission modelling results from calculations and forecasts made by a team of authors who compiled the Austrian "Environmental Balance of Transport" 2006/2008. The Environmental Balance of Transport is a multidisciplinary inter-modal analysis of transport demand in Austria since 1950 and its impact on environment, human health and climate.

  Transport volumes for road and rail are based on an amalgamation as well as an analytical synthesis of official background statistics relevant for travel and freight transport demand. Available information such as population data, of motorisation rates, vehicle fleet sizes, economic and income development statistics were used. Transport volumes for all other modes (i.e. inland waterways, local buses and trams) were derived from data collected by official Austrian bodies such as "Statistics Austria" (STATISTIK AUSTRIA 2006a).

- Emission model road

  For the calculation of road emissions the GLOBEMI model is used (HAUSBERGER, 1998). GLOBEMI was developed for the calculation of emission inventories in larger areas. Input parameters are, amongst others, the vehicle stock of each category (cars, light duty vehicles, …) split into layers according to the propulsion system (SI, CI, …), engine volume or vehicle mass, the emission factors of the vehicles according to the year of first registration and the passengers per vehicle and tons payload per vehicle. Furthermore, the model delivers an assumption for the fuel export effect.

- Emission model off road (1 A 2 f, 1 A 3 c, 1 A 3 d, 1 A 4 b, 1 A 4 c, 1 A 5)

  The energy consumption and off-road emissions in Austria are calculated with the model GEORG (Grazer Emissionsmodel für Off Road Geräte) (PISCHINGER 2000). The model GEORG has a fleet model part, which simulates the actual age and size distribution of the vehicle stock via age- and size-dependent dropout rates (probability that a vehicle is scrapped by the next year). With this approach the stock of each category of mobile sources is calculated according to the year of first registration and the propulsion system (gasoline 4-stroke, gasoline 2-stroke, diesel > 80 kW, diesel < 80 kW).

1 A 3 a – aviation

The projection of energy consumption and emissions is an extrapolation of the trend of the latest years. Between 2010 and 2020 the annual growth rate (of energy) is assumed to be 2.1%.

1 A 3 e – other transportation – pipeline compressors

For pipeline transport no major changes are expected until 2010, and therefore the trend of the past years has been prolonged. From 2010 onwards a sharp increase in emissions is expected due to new compressor projects. Thereafter emissions are expected to increase at the same rate as in the past years.

5.1.3.3 Assumptions

(a) Elasticities[6] of Transport

In Table 9 the elasticities of transport measured in vehicle kilometres are described. One can see that in the period 1990 to 2003 the elasticity of transport (measured in vehicle kilometres) was 1.97%, which means that in this period a 1% increase in GDP would lead to a 1.97% increase in vehicle kilometres. The same increase in GDP would lead to a 1.23% increase in the period 2003–2005. In the period 1990–2003 the higher elasticity is due to a strong increase in vehicle-km caused by fuel export.

Table 9: Elasticities of Transport: 1990–2020, wm/wam.

	GDP [bio. Euro]	transport growth [mio. vehicle-km]	[gr* vehicle-km/gr GDP]	Period Elasticities
1990	161	49 866	–	
2003	214	86 284	1.97%	1990–2003
2005	225	92 107	1.23%	2003–2005
2010	257	92 238	0.01%	2005–2010
2015	288	99 592	0.66%	2010–2015
2020	322	104 852	0.46%	2015–2020

* *growth rate*

(b) Elasticities of transport– split by passenger and freight

In Table 10 one can see the elasticities of transport (measured in freight kilometres and in passenger kilometres). In the period 1990–2003 the elasticity of freight transport is 4.16%, which means that a 1% increase in GDP leads to a 4.16% increase in transport kilometres in that period. The elasticities of freight transport are all positive but there is no visible clear trend, especially in the forecasts. In the period 2005–2010 it is expected that the elasticities of passenger kilometres will decline by 0.10% if the GDP increases by 1%.

Table 10: Growth of transport relative to GDP – split by passenger and freight wm/wam.

	GDP [bio. Euro]	[mio. t-km]	[mio. p-km]	[gr* t-km/gr GDP]	[gr p-km/gr GDP]	Period Elasticities
1990	161	41 610	84 199	–	–	
2003	214	129 278	114 204	4.16%	1.08%	1990–2003
2005	225	140 555	119 492	1.58%	0.84%	2003–2005
2010	257	157 162	117 887	0.86%	-0.10%	2005–2010
2015	288	177 651	124 476	1.06%	0.47%	2010–2015
2020	322	193 507	128 792	0.77%	0.30%	2015–2020

* *growth rate*

[6] A measure of responsiveness. The responsiveness of behaviour measured by variable Z to a change in variable Y is the change in Z observed in response to a change in Y. Specifically this approximation is commonly used: elasticity = (percentage change in Z) / (percentage change in Y).

(c) The growth of passenger kilometres, rate of change of modal split

The transport performance of passenger transport has increased since 1990. It is assumed that passenger kilometres will increase further until 2020. This increase will not affect all means of transport in the same way. Passenger car transport will increase rapidly. Also, passenger rail and electric local public transport will increase slightly. Transport by bus, moped, motorcycle, bicycle and pedestrians will neither increase nor decrease but remain constant on a low level.

Table 11: The growth of passenger kilometers.

	[mio. p-km]							
	passenger cars	**bus**	**moped**	**Motor-cycle**	**rail**	**electr. local public transport**	**bicyle**	**pedestrian**
1990	55 995	8 624	443	308	8 912	2 796	4 499	2 621
2003	81 041	12 530	332	941	8 673	3 604	4 213	2 871
2005	85 877	12 367	332	1 005	9 061	3 770	4 176	2 906
2010	83 071	12 485	319	1 112	9 768	4 059	4 082	2 992
2015	88 322	12 718	319	1 179	10 605	4 266	3 987	3 079
2020	91 878	12 813	319	1 202	11 141	4 380	3 893	3 166

Modal split for passenger transport describing the percentage of travelers using different means of transport. The change of passenger transport performance until 2020 is given as percentage.

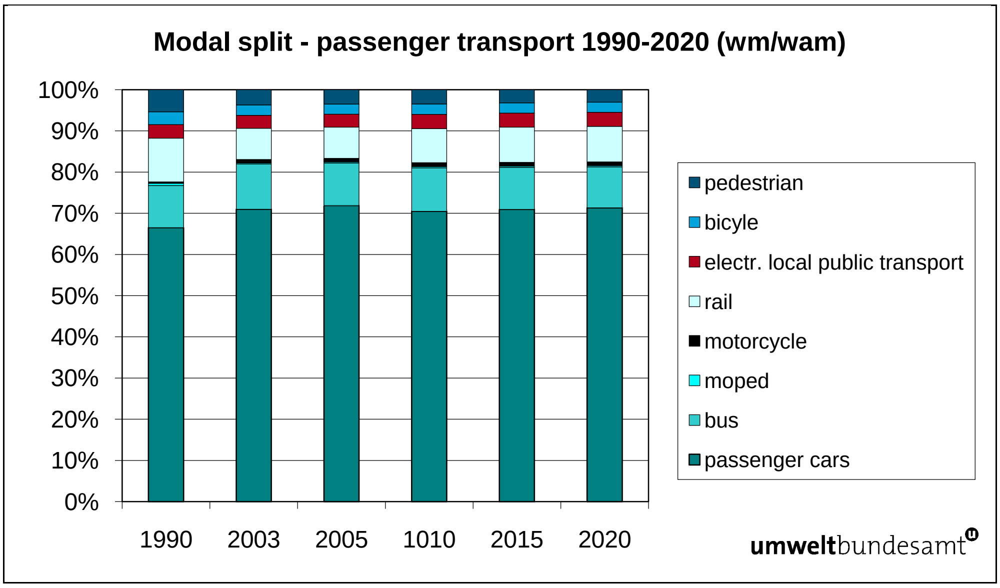

Figure 23: Historical and forecast modal split – passenger transport 1990–2020.

In this illustration the development of passenger transport is displayed, including fuel export. Domestic transport performance of passenger cars is 20% less, making room for the other transport modes.

(d) The growth of freight ton kilometres¸ rate of change of modal split

The situation with freight transport is similar. The transport performance of heavy duty vehicles has increased since 1990 and it is assumed that it will increase unimpededly until 2020. Freight rail transport will increase slightly. Light duty vehicles and navigation will remain constant on a low level.

Table 12: The growth of freight ton kilometers.

	[mio. t-km]			
	light duty vehicles	**heavy duty vehicles**	**rail**	**navigation**
1990	426	28 171	11 349	1 663
2003	586	111 019	15 397	2 276
2005	630	121 040	16 124	2 760
2010	668	135 785	18 112	2 598
2015	716	154 254	19 814	2 868
2020	760	168 000	21 580	3 167

Modal split for freight transport describing the percentage of freight being shipped by different means of transport. The change of freight transport performance until 2020 is given as percentage.

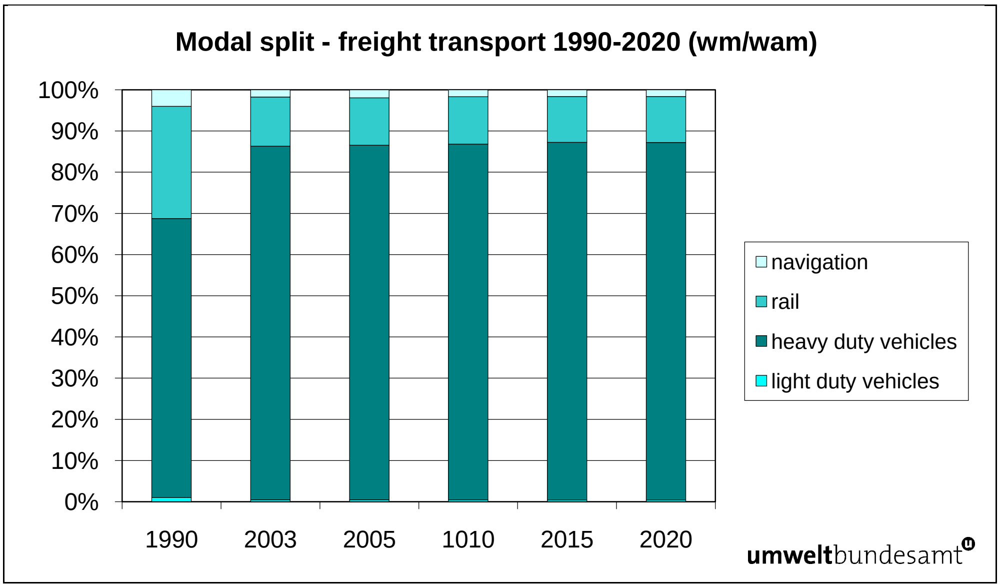

Figure 24: Historical and forecast modal split – freight transport 1990–2020.

In this illustration the development of freight transport is displayed, including fuel export. Domestic transport performance of heavy duty vehicles is 20% less, making room for the other transport modes.

(e) Further assumptions

Fuel price:

The transport model is based on the following assumptions for the fuel price.

Table 13: Fuel price [Euro] in wm/wam.

	Austria		neighbouring countries	
	gasoline	**diesel**	**gasoline**	**diesel**
2003	1.014	0.739	0.920	0.644
2005	0.933	0.642	1.069	0.769
2010	1.048	0.801	1.158	0.907
2015	1.092	0.841	1.154	0.928
2020	1.092	0.841	1.154	0.928

It is assumed that the Austrian fuel price stays higher than the price in neighbouring countries. Therefore fuel export will not cease to exist.

Vehicle stock (passenger cars), motorisation rate:

The vehicle stock is counted annually and is an input for the motorisation rate. Another yearly statistical input is the population number. The transport model is based on the following assumptions for the motorisation rate.

Table 14: Vehicle stock, motorisation wm/wam.

	Vehicle stock	**Motorisation rate**
2003	2 785 962	363
2005	4 054 308	499
2010	4 156 743	505
2015	4 656 930	555
2020	5 030 070	588

5.1.3.4 Activities

Development renewable energy carrier 1990–2020

In 2007 the share of renewable energy used within the transport sector attained a level of 4.23% (measured by the energy content). Biodiesel, bioethanol and straight vegetable oil (SVO) represent the set of renewable energy carrier, which were mainly distributed by blending them with fossil fuels to an extent of 5% (measured by volume).

In 2007, about 370 000 tons of biodiesel, 20 000 tons of bioethanol, 20 000 tons of bioethanol and 18 000 tons of SVO were distributed within the Austrian territory, thus promoting the substitution of fossil fuels in transport.

The outlook for 2020 is based on present circumstances (initiatives, promotion, current infrastructure etc.) as well as foreseeable developments on national and international level. This means that about 820 000 tons of biodiesel, 216 000 tons of bioethanol and 31 000 tons of SVO would be distributed within the Austrian territory.

After 2010, the fuels/energy carrier CNG, biogas, hydrogen & electricity (for passenger cars) are also included in the energy scenarios.

The assumptions for the development of renewable energy carriers are valid for both scenarios.

Details on developments and assumptions for renewable energy carriers can be found in Annex 2. Details on energy consumption by fuel type can be found in Annex 3.

Development of energy consumption (wm/wam)

Table 15 provides information on the predicted energy consumption of the transport and off-road sector until 2020 in TJ. In the wm scenario energy consumption will increase by about 105% between 1990 and 2020. The reason for this strong increase is largely the strong increase in freight transport (+300%). Another important reason for the strong increase is the continual growth of vehicle kilometres travelled by passenger cars (average car 50%, diesel cars – 420%). Another essential element is the previously mentioned fuel export. If this is excluded, the increase of energy consumption will be by about 50%.

In the wam scenario energy consumption will increase by about 89%. The measures "additional fuel efficiency of cars" and "control of speed limits, traffic control systems and supporting measures" will lead to this reduction effect. Both measures in this scenario have an influence of the fuel efficiency of cars (see chapter 6.2.3). The energy consumption in all other vehicle categories is assumed to be equal to the wm scenario.

Details on energy consumption by IPPC category can be found in Annex 3.

Table 15: Energy consumption wm/wam (1 A 2 f, 1 A 3, 1 A 4 b, 1 A 4 c, 1 A 5).

TJ	1990	2003	2005	2010	2015	2020
wm	203 944	345 571	364 901	367 088	395 029	417 746
wam	203 944	345 571	364 901	364 882	376 519	386 164

5.1.3.5 Sensitivity Analysis

The emission calculation for the transport sector is characterised by significant uncertainties. As mentioned in chapter 5.1.3.1 the price-induced fuel export is a great challenge concerning the projection of CO_2 emissions. For this reason, two sensitivity scenarios are constructed. The main variable describing the fact of price- induced fuel export is the price difference between Austria and the neighbouring countries[7].

Therefore the scenarios are as follows:

- *Scenario "wm"*: Is the present scenario with fuel price differences held constant from 2007 onwards.
- *Scenario "0"*: Here the fuel price differences decline in stages until 2010 where they are assumed to be zero.
- *Scenario "X2"*: The fuel price differences are gradually increased so that they are twice as high in 2010 compared to the year 2007.

[7] For a detailed discussion of this topic see Hausberger et al. 2009, 2nd fuel export study not published yet.

In Figure 25 the results of the three scenarios are illustrated. One can see that the CO_2 emissions develop at a lower rate in the scenario where they converge to zero in the year 2010 (scenario "0").

The results of the other two scenarios can be summed up as follows:

- Equalization of fuel price with neighbouring countries: lower emissions
- Doubling of fuel price level in comparison to neighbouring countries: higher emissions

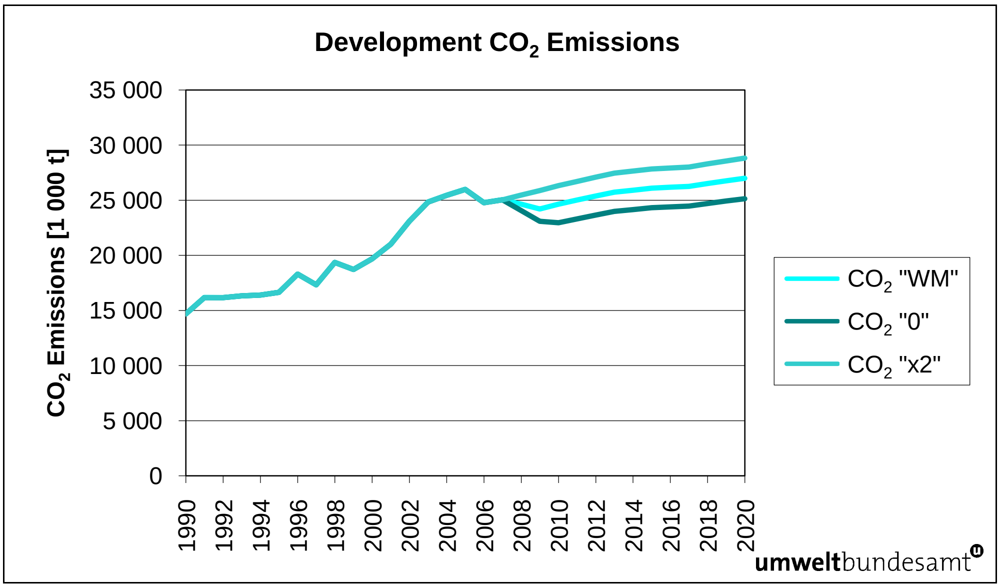

Figure 25: Historical (1990–2005) and forecast CO_2 emissions in different scenarios 2010–2020 (Transport & Off Road, without aviation).

5.1.3.6 Uncertainty

Numerous exogenous factors influence the projections:

- Road pricing for Heavy Duty Vehicles
- Development of fuel prices
- Fuel export due to lower fuel prices
- Development of the fuel efficiency of newly registered vehicles

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

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

5.1.4.1 Methodology of the sectoral emission forecast

To calculate energy consumption separately for stationary sources in the subsector residential and commercial, a comprehensive building model is used.

Emissions for the mobile sources in 1A4b and 1A4c are described in chapter 5.1.3, and are added to the total sum of 1A4.

Due to its minor contribution to the total 1A4 energy consumption and its relatively constant trend, the subsector 1A4c agriculture was calculated in a different way. Therefore, the mean values for the period 2003–2007 were extrapolated for each fossil fuel over the forecast period. Consequently, the emissions in sector 1A4c are assumed to be constant over the whole period.

The used emission factors are taken from the national emission inventory system. The methodology and references are discussed in Austria's National Inventory Report (UMWELTBUNDESAMT 2009).

Below there is a short introduction to the model used.

The energy demand model for heating of buildings: Methodology

This model, operated by the Energy Economics Group (EEG) of the Vienna University of Technology, is called ERNSTL and is a comprehensive dynamic bottom-up simulation tool (TU WIEN 2009).

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 aside premium) on the energy carrier mix, CO_2 reductions and costs involved for society when promoting certain strategies. Furthermore, the ERNSTL Model is designed to simulate different scenarios (price scenarios, insulation scenarios, different consumer behavior 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 myopical, stochastic optimization algorithm which optimizes the objectives of "agents" that represent the decision-makers in building related decisions. ERNSTL models the stock of buildings in a highly disaggregated manner. Therefore the simulation tool reflects characteristics of an agent-based simulation.

The forecast model starts with the year 2002, which is based on a complete survey of all Austrian buildings for the year 2001. For model calibration the sampling period from 2003 to 2006 was applied. Based on the development of energy demand (primary fuels) in this sector, a model calibration of non-monetary parameters was accomplished.

The basic decision algorithm

The basic decision/selection process works on an annual basis and decides for each building segment if the system (regarding building shell and heating/dom. hot water system) remains as it is or if a new heating technology or a measure to improve the building shell has to be chosen.

The overall costs (in the sense of monetary costs, societal costs or greenhouse gas emissions) of each new technology/measure are compared with respective running costs caused by the existing structure, and the technology / measure which is the most cost-saving one is chosen.

The applied objective implemented in the model for all scenarios is to minimize monetary costs.

Modelling the energy demand

Energy demand is modelled depending on service demand and efficiency. The two energy services under investigation are space heating and water heating. Behavioural aspects in the case of space heating (such as the level of indoor temperature, ventilation habits) are considered through a service factor. This parameter describes the relation 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 water heating is modelled as dependent on the number of people living in the dwelling under consideration, on service demand for domestic hot water (volume of hot water with 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; this means that in the model their annual efficiency decreases from year to year.

Overview of technology options

The technology options to choose from are divided into “single measures” and “combined measures”. Single measures include: change of heating system or domestic hot water system only, installation of new windows, insulation of facade only/ ceiling only/floor only. Combined measures include: change of heating system and domestic hot water system, insulation of facade and new windows, thermal improvement of the whole building shell, insulation of facade and ceiling, complete renovation.

Within each technology segment, a broad range of new systems can be selected for implementation, namely 20 different options for space heating systems (with the possibility of hot water integration) and 5 different options for stand-alone hot water systems. Solar hot water generation and solar combi systems (solar space and water heating) are integrated into the model. Concerning modifications of the building shell, up to 10 different insulation materials for insulation of building parts and 6 different window types are implemented. The thickness of insulations is calculated by an optimization algorithm (with upper and lower boundaries).

Currently implemented Austrian stock of buildings and heating systems

The currently implemented buildings represent a detailed, disaggregated image of the Austrian buildings stock. They include:

- Residential buildings: 4 types of buildings, 8 construction periods and renovated and un-renovated buildings
- Non residential buildings: 7 types of buildings, up to 4 construction periods und up to 3 different buildings sizes per building type

5.1.4.2 Assumptions

Despite the decrease of population growth rates in Austria, the number of permanently occupied dwellings (principal residence) is assumed to increase by about 13 per cent from 2005 to 2020 (see Annex 1 and 2). This reflects the fact that the trend to single households is stronger than the overall population growth.

In terms of the number of buildings, an overall increase of 16% is expected from 2005 to 2020, whereas the number of buildings with more than two apartments is expected to rise by about 13% in this period. Residential buildings with one or two apartments, which make up the majority (with about 78% of total buildings) in Austria, are expected to increase by 14% from 2005 to 2020. The strongest increase (with about 25% until 2020) is expected for commercial (non-residential) buildings.

The total gross floor area in residential building is assumed to increase by 15.5% until 2020, whereas the total gross floor space, which is a better indicator for huge buildings, is expected to increase by about 25% for commercial buildings from 2005 to 2020.

Price assumptions are especially important in this sector because they may influence decision as to which fuels are going to be preferably used over time, and decisions regarding the quality and quantity of thermal renovation activity. Over a period of about thirteen years this can have a noticeable effect on the specific energy demands. The energy prices are assumed to rise considerably for all fossil fuels (about 30%) from 2006 to 2020. Until 2020 a more moderate increase is expected for bio fuels, wood logs (10%) and wood chips (7%). The price of wood pellets is expected to increase very slightly until 2020, after the high level reached in 2006.

The subsidy rate for renovation measures is constant at 30% for both the wm and wam scenario. The detailed assumptions can be found in Annex 1 and 2.

Furthermore, there are assumptions that differ between the wm and wam scenario.

With measures

In Austria, the subsidy policy for heating systems aims to achieve the installation of efficient und low emission (CO_2) boilers. Therefore the regional authorities grant financial support for biomass, district heat and solar heat. The individual rates differ between each local authority. On average 10% (district heat), log wood and wood chips (20%) and pellets (23%) as well as solar heat (20–25%) are used. It is further assumed that the percentages are constant over the forecast period in the wm scenario.

The renovation rate indicates the proportion of buildings (or households), which accomplish sanitation measures on the thermal building envelopes (like house front, windows, top and bottom floor ceiling). It is therefore an indicator for the renewal of buildings, which usually reduces their heating demands. The total renovation rate for all buildings (residential and commercial) is assumed to increase from 0.43% in 2005 to 1.28% in 2020. The individual rates for each type of building differ (see Annex 1 and 2).

Model-based results predict a rise of the boiler exchange rate from 1.1% in 2005 to 2.3% in 2020.

Moreover, the average heating demand for residential buildings is expected to decrease from 153 kWh/m² in 2005 to 117 kWh/m² in 2020, while the average heating demand for commercial buildings is expected to decrease from 55 kWh/m³ to 48 kWh/m³.

With additional measures

The wam scenario uses the same basic values for subsidies, but with a proportion doubling for district heat and an approximately 50% increase for biomass proportion by 2020 (for specific details see Annex 2).

The total renovation rate for the wam scenario is noticeably higher than for wm and expected to increase from 0.43% to 1.82% in 2020. Moreover, the boiler exchange rate for residential buildings is expected to increase up to about 3% until 2020.

In the wam scenario the average heating demand is further improved to 111 kWh/m² for residential buildings in 2020. The average heating demand for commercial buildings is expected to decrease to 45 kWh/m³ in 2020.

In chapter 6.2.4 more information on measures included in the wam scenario can be found.

5.1.4.3 Activities

Emissions were calculated on the basis of the energy consumption of coal, wood log and wood briquettes, wood chips, wood pellets, natural gas, liquefied petroleum gas (LPG) and heating oil, separated for the sector 1A4a commercial and 1A4b residential, which were modelled with ERNSTL.

A short description of the trend is presented separately for wm and wam.

With measures

There is a remarkable trend towards renewables, which is partly noticeable in an increase of wood chips and wood pellets consumption. In detail, the usage of wood chips in residential plants is expected to rise by 15%, whereas pellets are expected to see a nearly sixfold increase in the period from 2005 to 2020. Other alternative energies like solar heat and ambient energy are expected to increase by 400% and 85% until 2020 in residential buildings. The energy consumption for log wood is declining by around 20%, due to operating stress and more difficult handling in comparison to other fuels.

On the other hand, there is a shift away from fossil fuels. In the residential sector, a reduction of 34% is expected in the usage of heating oil, an 8% decline in natural gas consumption and a 55% decrease in coal use until 2020.

Whereas the overall energy consumption without electricity is expected to decline by 6% in the residential sector, the total energy demand without electricity will increase by 13% in the commercial sector (until 2020). This entails a lower decrease for fossil fuels like heating oil (- 20%) and coal (- 37%) and even an increase in natural gas by 9% in commercial buildings until 2020. Wood chips are expected to rise by 82%. Owing to the low usage of pellets in 2005, an approximately 17 times higher consumption is assumed for 2020. Similar to the trend in the sector residential, log wood is expected to decline by about 15% until 2020. A considerable gain in energy demand is expected for solar heat (215%) and ambient energy (510%). Detailed data can be seen in Annex 1 and 3.

With additional measures

Due to additional measures, which prompt a rise in the boiler exchange rate and a rise of the renovation rate, the overall demand of energy in the subsectors residential and commercial is expected to be further reduced. Therefore, the specific changes of energy consumption until 2020 are partly weaker than in the wm scenario.

For detailed information see Annex 1 and 3.

5.1.4.4 Sensitivity Analysis

The ERNSTL model provides the energy demand for stationary sources in residential and commercial buildings. For verification of the stability of the modelled wm outcome, a sensitivity analysis examines the changes of following parameters:

- WM-Sens_foss+30%: price chance of fossil fuels (+ 30%)
- WM-Sens_gas+30%: price change of gas (+ 30%)
- WM-Sens_bio+20%: price change of biomass (+ 20%)
- WM-Sens_renrate+0.3%: change of renovation rate (+ 0.3%)
- WM-Sens_renrate-0.3%: change of renovation rate (- 0.3%)
- WM-Sens_boilexrate+1%: change of boiler exchange rate (+ 1%)
- WM-Sens_boilexrate-1%: change of boiler exchange rate (- 1%)

Furthermore, for a deeper analysis minor changes of parameters were studied. On the assumption that very small alternations of input parameter do not influence the output significantly we tested the robustness of the model for these parameters:

- WM-Rob_renrate+0.02: renovation rate (+ 0.02 percentage points)
- WM-Rob_renrate-0.02: renovation rate (- 0.02 percentage points)
- WM-Rob_boilerexrate+0.02: boiler exchange rate (+ 0.02 percentage points)
- WM-Rob_boilerexrate-0.02: boiler exchange rate (- 0.02 percentage points)
- WM-Rob_gas+0.02: price change of gas (+ 0.02 percentage points)
- WM-Rob_gas-0.02: price change of gas (- 0.02 percentage points)
- WM-Rob_foss+0.02: price change of fossil fuels (+ 0.02 percentage points)
- WM-Rob_foss-0.02: price change of fossil fuels (- 0.02 percentage points)
- WM-Rob_bio+0.02: price change of biomass (+ 0.02 percentage points)
- WM-Rob_bio-0.02: price change of biomass (- 0.02 percentage points)

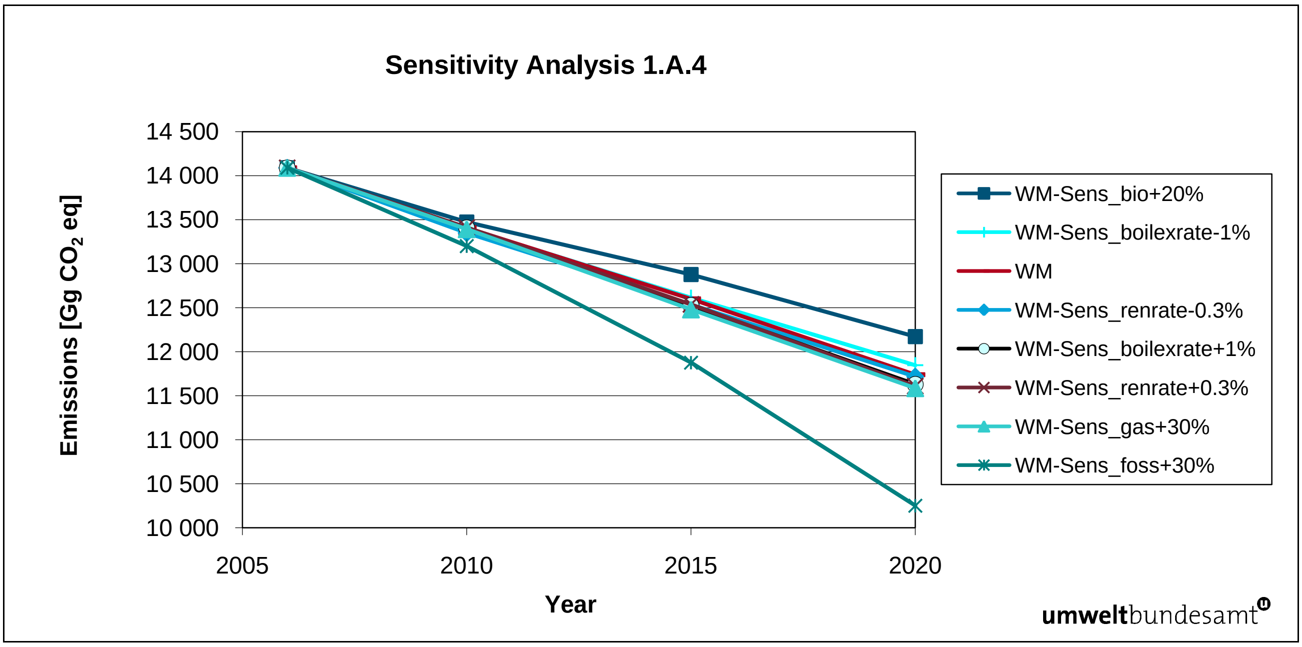

Figure 26: 1.A.4 Other Sectors (stationary sources), wm Scenario and results of sensitivity analysis.

The variation of the renovation rate and boiler exchange rate at the stated rates shows that there is a low influence of these parameters alone. The greenhouse gas emissions vary at most by 1%. A more significant impact is produced by the alternation of prices. An increase of 30% in the price of fossil fuels will reduce GHGs by about 13% in 2020, whereas an increase in the biomass price will lead to a gain of around 4% in greenhouse gas emissions.

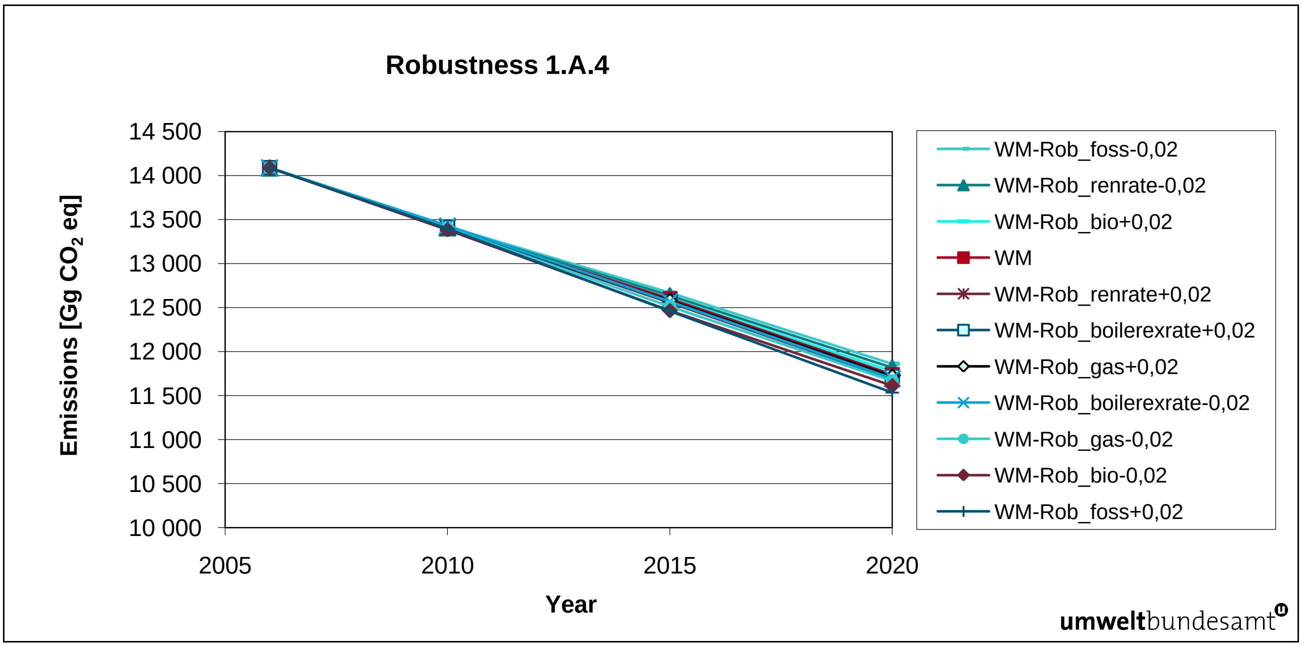

Figure 27: 1.A.4 Other Sectors (stationary sources), wm scenario and results of robustness analysis.

Predominantly minor changes of the parameters have a minor influence on the total greenhouse gas emissions in this sector. Due to the carbon intensity of fossil fuels, a price change of these fuels has a larger effect on the total emissions.

The relatively high overall change in emissions triggered by a small change of the input parameters shows that the model has an intensifying effect on the output over time.

5.1.4.5 Uncertainty

The sensitivity analysis shows that a variation of assumptions for the price of fossil energy influences the emission projections significantly (see previous chapter), whereas the development of the oil price, with multiple effects on other fuels, is the main uncertainty parameter.

Another uncertainty lies in the implementation and acceptance of measures which influence the overall heating demand e.g. by renovation rate and boiler exchange rate.

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

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

5.1.5 Other (1.A.5)

This category contains emissions of mobile military sources. These emissions have been included in the calculations of the transport sector (5.1.3); methodological issues and emissions can be found in this chapter. The summation of this source category includes all emissions from mobile military sources, e.g. emissions from military jet fuel.

5.1.6 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). There are no specific measures in the Austrian Climate strategy to reduce emissions from this sector.

5.1.6.1 Methodology of the sectoral emission forecast

The same methodology as in the Austrian inventory (UMWELTBUNDESAMT 2009) is applied for calculating projected emissions.

CH_4 emissions from storage are calculated by multiplying natural gas stored by the IPCC emission factor. CH_4 emissions from natural gas distribution networks are calculated by multiplying the distribution pipeline length by the IPCC default emission factor.

CH_4 emissions from natural gas pipelines are calculated by multiplying the distribution pipeline length by an emission factor. The assumed emission factors are based on the IPCC default, but until 2020 a decrease is assumed because of the substitution of hydraulically controlled valve systems by electrical devices.

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 2007. Projected emissions are calculated by multiplying oil or natural gas production by the averaged implied emission factors 2003–2007.

5.1.6.2 Assumptions

No policies and measures are considered for the emission forecast.

In 2006 the last brown coal open surface mine closed in Austria and it has been assumed that no coal mines will be operated until 2020.

Pipeline length is assumed to be extended by 400 km until 2020.

The distribution network is assumed to increase proportionally to the total gross inland consumption of natural gas.

Natural gas stored is forecast according to extension plans of storage sites from the Austrian Oil Exploration Company (RAG, Rohöl-Aufsuchungs AG). Until 2017 it is planned to extend capacities to 5.7 billion m^3.

5.1.6.3 Activities

Natural gas consumption, refinery intake and natural gas production are taken from the energy projection (WIFO 2007a).

Historical and forecast pipeline and distribution lengths and natural gas stored are presented in Table 16.

Table 16: Historical (1990, 2003, 2005) and forecast (2010, 2015, 2020) activity data for natural gas distribution, transmission and storage.

	Pipeline length [km]	Gas network length [km]	Natural gas stored [Mm³]
1990	1 032	15 200	1 500
2003	1 430	32 000	1 651
2005	1 430	34 750	2 207
2010	1 640	37 198	3 730
2015	1 794	39 660	5 137
2020	1 948	42 123	5 700

5.1.6.4 Sensitivity Analysis

No sensitivity analysis was performed in this sector.

5.1.6.5 Uncertainty

The uncertainty of the projections of fugitive emissions is closely linked to the uncertainty in Energy Industries (see chapter 5.1.1.4)

5.2 Industrial Processes & Solvents (CRF Source Categories 2 & 3)

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

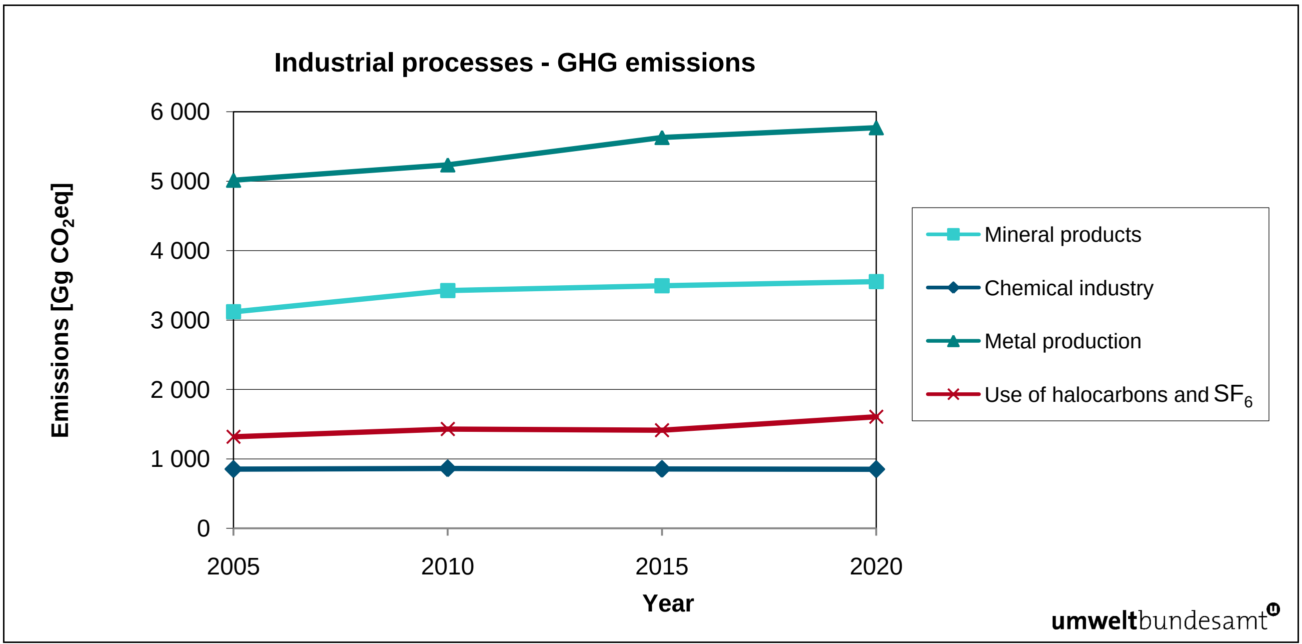

Figure 28: GHG emissions from industrial processes given in Gg CO_2 equivalents.

Figure 28 shows the greenhouse gas emissions of three categories of industrial processes. For mineral products there is a slight increase until the year 2007. After that the increase is hardly noticeable.

For emissions from chemical processes a slow decrease until the year 2013 is projected to be followed by a minor increase of the emissions.

Concerning the emissions from metal processes, the two (planned) expansion steps of the biggest steel work in Austria are clearly noticeable and responsible for the projected increase in emissions.

5.2.1 Mineral Products (2.A)

5.2.1.1 Methodology of the sectoral emission forecast

The same methodology as in the Austrian Inventory has been used and the emission factors and methodology are discussed in detail in the Austrian Inventory Report (UMWELTBUNDESAMT 2009).

5.2.1.2 Assumptions

Activities for the cement industry have been derived from total energy input. Activities for the lime industry have been estimated from the additional need of lime stone in the iron and steel industry. For other sources, i.e. lime stone use, ceramic industry and soda ash use, activities have been extrapolated from historical data.

There are no differences between the assumptions for the scenarios with measures and with additional measures.

5.2.1.3 Activities

Figure 29 presents the assumptions for the production of cement clinker.

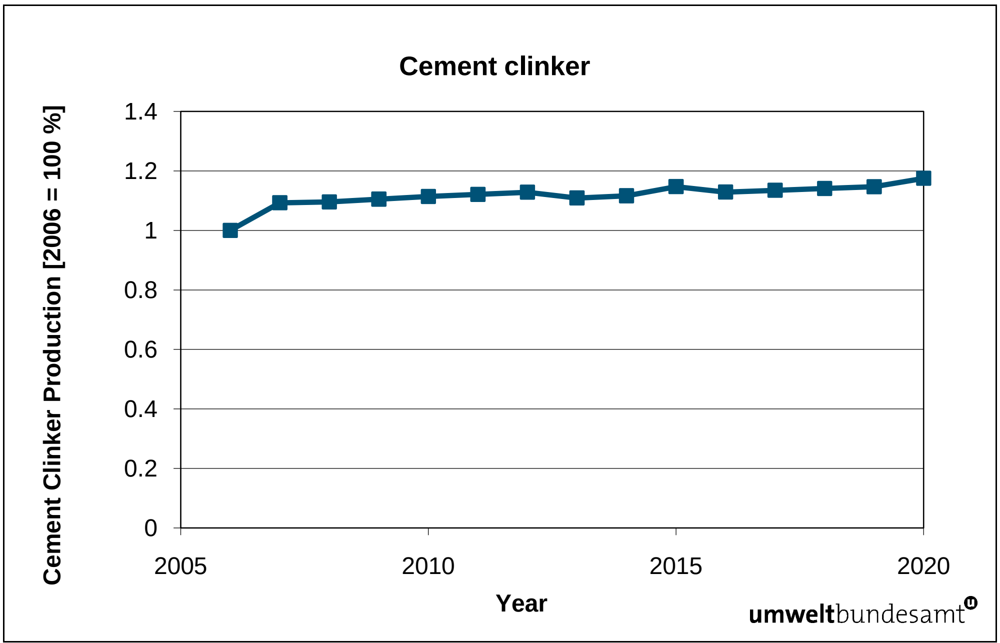

Figure 29: Assumption for the production of cement clinker.

Assumptions for the "with additional measures" scenario are the same as for the "with measures" scenario.

5.2.1.4 Sensitivity Analysis

The variation of the oil price (80$ instead of 120$) had no impact on the emissions from industrial processes.

5.2.1.5 Uncertainty

Uncertainties regarding emission factors can be found in the Austrian National Inventory Report 2009 (UMWELTBUNDESAMT 2009).

5.2.2 Chemical Industry (2.B)

5.2.2.1 Methodology of the sectoral emission forecast

The same methodology as in the Austrian Inventory has been used and the emission factors and methodology are discussed in detail in the Austrian Inventory Report (UMWELTBUNDESAMT 2009).

5.2.2.2 Assumptions

Activities for the production of urea and fertilisers have been extrapolated from historical data. Other productions (ammonia and nitric acid) have been coupled to these activities.

The scenario includes a planned Opt-In of N_2O from nitric acid plants into the EU-ETS at the beginning of 2010.

Assumptions for the “with additional measures” scenario are the same as for the “with measures” scenario.

5.2.2.3 Activities

Figure 30 presents the assumptions for the production of urea and fertiliser.

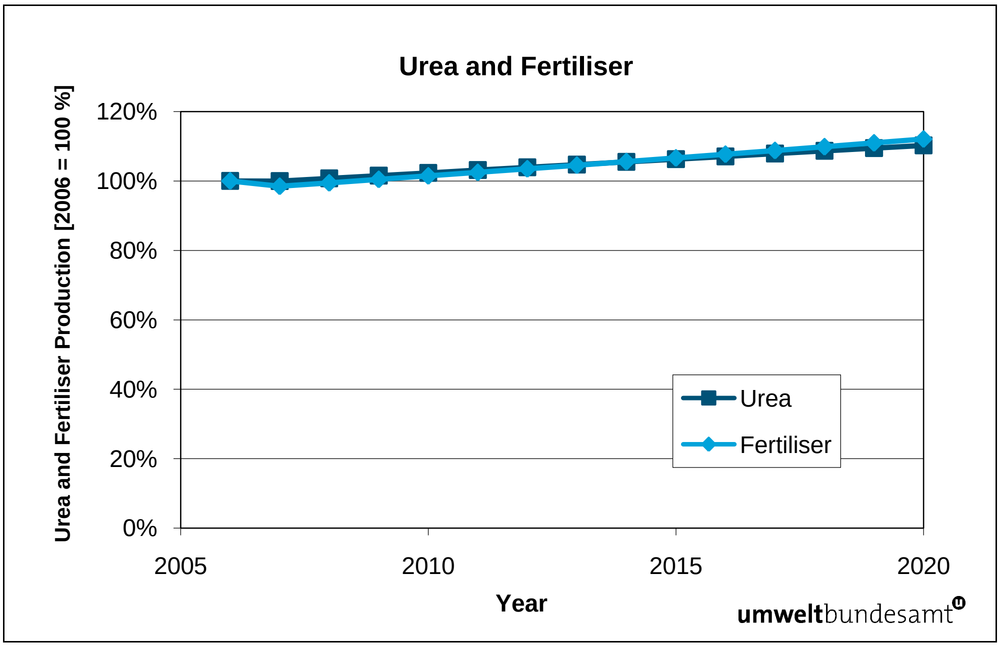

Figure 30: Assumption for the production of urea and fertiliser.

Assumptions for the “with additional measures” scenario are the same as for the “with measures” scenario.

5.2.2.4 Sensitivity Analysis

The variation of the oil price (80$ instead of 120$) had no impact on the emissions from industrial processes.

5.2.2.5 Uncertainty

Uncertainties are described in chapter 5.2.1.5

5.2.3 Metal Production (2.C)

5.2.3.1 Methodology of the sectoral emission forecast

The methodology for the emissions factors is discussed in the Austrian Inventory Report (UMWELTBUNDESAMT 2009). 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 inert gas in light metal foundries. PFCs are formed during a phenomenon known as the anode effect in the process of primary aluminium smelting. Additionally, CO_2 emissions arise from the consumption of the anode in primary aluminium production.

5.2.3.2 Assumptions

(a) Primary aluminium production plants in Austria closed down in 1992 and will not be reopened until 2020 (only secondary Al production without SF_6)

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

(c) Production of pig iron and production of crude steel from basic oxygen furnaces have been calculated from the total energy input of the macroeconomic model from WIFO (WIFO 2005), taking into account recent data of the Austrian producer (VOESTALPINE 2008 and 2009).

Assumptions for the “with additional measures” scenario are the same as for the “with measures” scenario.

5.2.3.3 Activities

Figure 31 presents the assumptions for the production of crude steel and pig iron.

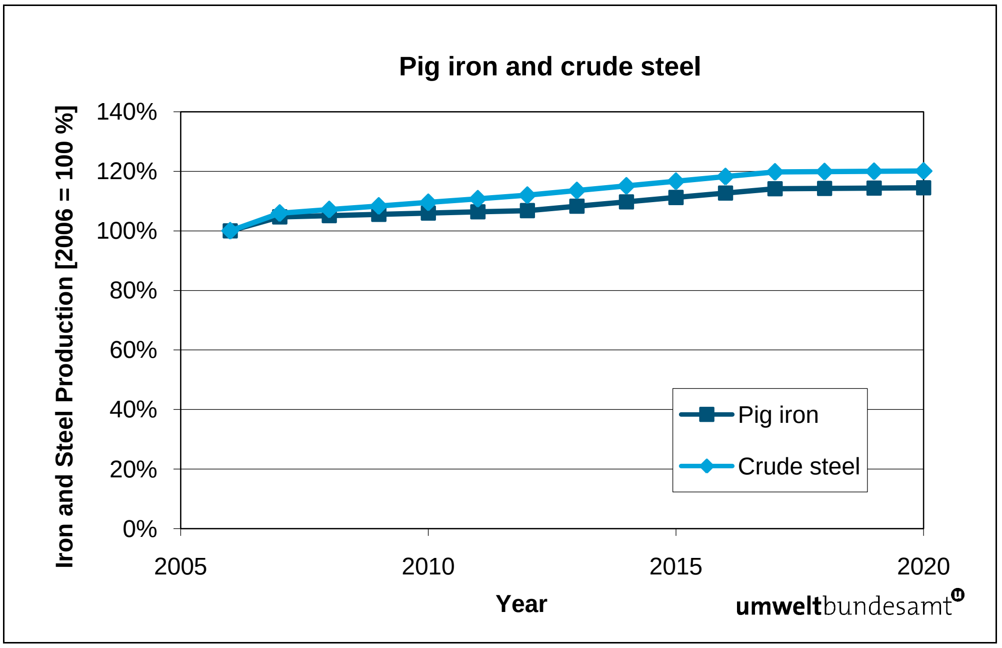

Figure 31: Assumption for the production of pig iron and crude steel (only from basic oxygen furnace plants).

5.2.3.4 Sensitivity Analysis

The variation of the oil price (80$ instead of 120$) had no impact on the emissions from industrial processes.

5.2.3.5 Uncertainty

Uncertainties are described in chapter 5.2.1.5.

5.2.4 Halocarbons and SF_6 (2.E & 2.F)

There is no production of halocarbons and SF_6 (2.E) in Austria and the scenario assumes that none will take place until 2020.

Halocarbons and SF_6 (fluorinated gases) have been used in Austria for a wide range of applications. Among them is the use of HFC and PFC as refrigerants in refrigeration and air conditioning systems (2.F.1), the use of HFC as blowing agents in the production of foams (2.F.2), the use of HFC and PFC as fire extinguishing agents (2.F.3), the use of HFC as propellants in aerosols (2.F.4), the use of HFC as solvents (2.F.5), the use of HFC, PFC and SF_6 as etching gases in semi-conductor manufacturing (2.F.7), the use of SF_6 as insulating gas in electrical equipment (2.F.8), and other uses of SF_6 (2.F.9) in soundproof windows, tyres and research.

Although fluorinated gases are not used in big amounts (1–1.8 kt per year) they contribute approximately 1.5% 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 even 5% by 2020 in the business-as-usual scenario. This forecast was based on the fact that HFCs are used in many applications as substitutes for ozone layer depleting 'Montreal gases' and thus, without reduction measures, their use would strongly increase. Because of this expected scenario, the Federal Environment Ministry started a consultation procedure in spring 2001 to the aim of a draft ordinance on reducing and phasing-out the use of 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 Legal Gazette II No 447/2002) and amended in 2007 (Federal Legal 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).

5.2.4.1 Methodology of the sectoral emission forecast

The emission calculation is based on the same methodology as the one used in the Austrian GHG inventory, and performed at the same level of detail; for more information see Austria's National Inventory Report 2009 (UMWELTBUNDESAMT 2009).

Emissions were calculated from projected annual stocks and emission factors. Annual stocks correspond to the amounts of halocarbons and SF_6 stored in applications the year before, minus emissions of the year before, plus consumption of the year considered. Additional emissions occur from the disposal of products containing fluorinated gases.

5.2.4.2 Assumptions

With measures

(a) The Austrian Ordinance on reducing and phasing-out of HFCs, PFCs and SF_6 is and will be – with regard to prohibitions and restrictions that come into effect later than 2007 – fully implemented.

(b) The European Regulation on certain fluorinated greenhouse gases and the Directive relating to emissions from air-conditioning systems in motor vehicles will be fully implemented.

Projections for annual stocks and emission factors were, as far as provided, taken from national studies (BICHLER et al. 2001) (OBERNOSTERER et al. 2004). These are based on expert judgments and industry inquiries. If not yet considered, prohibitions, restrictions, and regulations on the prevention of leakage and on the recovery and destruction of fluorinated gases under the Austrian and EU legislation were used to forecast stocks and emission factors.

The same emission factors as those used for the inventory were applied for projecting emissions, except:

<u>Stationary Refrigeration and Air Conditioning:</u> The European Regulation on certain fluorinated greenhouse gases includes measures for the detection and prevention of leakages. When considering this measure for emission projections in the subcategories cooling devices in food trade (industrial refrigeration) and stationary air conditioning, a decrease of the leakage rate from 8% to 7% and 6%, respectively, until 2013 is assumed. The same lower leakage rates are assumed up to 2020.

Mobile Air-conditioning: The European Directive relating to emissions from air-conditioning systems in motor vehicles regulates maximum leakage rates for air-conditioning systems in new vehicles designed to contain a fluorinated GHG with a global warming potential higher than 150. When considering this measure for emission projections in the subcategory passenger cars a leakage rate of 7.15% for new vehicles is assumed from 2008 onwards (15% for the years before).

Solvents: according to the Austrian Ordinance, the continued use of HFC remains permissible in closed systems only. Thus a leakage rate of 10% is assumed from 2010 to 2020.

Assumptions used to project the annual consumption of fluorinated gases are as follows:

Stationary Refrigeration and Air Conditioning: The same annual consumption of fluorinated gases as in 2007 was assumed until 2020, except for fridges and freezers in shops and homes (domestic and commercial refrigeration): zero consumption was assumed from 2008 onwards, because fluorinated gases are banned in these applications under the Austrian regulation.

Mobile Air Conditioning: The same annual consumption of fluorinated gases as in 2007 was assumed until 2020, except for passenger cars: The economic crisis affects the number of new cars and thus the number of fluorinated gases consumed in air conditioning systems. From 2011 onwards the European Directive relating to emissions from air-conditioning systems in motor vehicles (2006/40/EC) bans the use of fluorinated gases with a GWP higher than 150. For the forecast it has been assumed that CO_2 will be used as refrigerant and thus zero consumption of fluorinated gases is assumed from 2011 onwards.

Foam Blowing: The Austrian Ordinance bans the use of fluorinated gases in this subcategory. For the forecast zero consumption of fluorinated gases is assumed, except for XPS foams with a layer thickness of more than 8 cm, where continuously decreasing consumption is assumed until 2020.

Fire Extinguishers, Solvents: The same annual consumption of fluorinated gases as in 2007 has been assumed until 2020.

Aerosols: The Austrian Ordinance bans the use of fluorinated gases in this subcategory except for medical uses. For the forecast the mean value (2004–2007) of annual consumption for medical uses has been assumed until 2020.

Semiconductors: For the forecast the mean value of the annual consumption of the last 3 years was assumed until 2020.

Electrical equipment: Annual consumption is assumed to equal the mean value of the last 5 years until 2020.

Other use of SF_6: The Austrian regulation bans the use of SF_6 in other applications. Thus for the forecast no further consumption in this sub-category is assumed.

With additional measures

No additional measures are planned in this category.

5.2.4.3 Activities

With measures

Activities in the sector Halocarbons and SF_6 can be expressed as potential emissions and as annual stocks. Annual stocks are defined in the methodology subchapter. Potential emissions correspond to the amounts consumed in the considered year. As potential emissions are usually reported together with actual emissions in the National Inventory Report, potential emissions are reported as activity data in Annex 3.

5.2.4.4 Sensitivity Analysis

There are no main parameters influencing the projected trend of emissions from halocarbons and SF_6. Thus, no sensitivity analysis was performed in this sector.

5.2.4.5 Uncertainty

Several assumptions have been made on how the considered policies and measures will influence annual consumptions and leakage rates of fluorinated gases. Because of the lack of experiences from the past, especially assumptions for changes in leakage rates influence the total uncertainty of the forecasted emissions.

5.2.5 Solvent and Other Product Use (CRF Source Category 3)

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

5.2.5.1 Methodology of the sectoral emission forecast

CO_2 emissions from Solvent and Other Product Use

Emission projections are calculated by multiplying emissions in the latest inventory year (2007; submission 2009) by the rate of population growth until 2020.

The basis for the data of the Austrian air emission inventory (OLI) 2008 (data basis 2007) are surveys (WINDSPERGER et al. 2002, 2002b, 2004a; WINDSPERGER & SCHMID-STEJSKAL 2008) as well as import-export statistics (foreign trade balance) and production statistics provided by STATISTIK AUSTRIA.

To determine the quantity of solvents used in Austria for the various applications, a bottom-up and a top-down approach were combined. The top down approach provided the total quantities of solvents used in Austria. The share of the solvents used for the different applications and the solvent emission factors have been calculated on the basis of the bottom-up approach. By linking the results of bottom-up and top-down approach, the quantities of solvents annually used and solvent emissions for the different applications were obtained.

N_2O Emissions from Solvent and Other Product Use

The basis for the data of the Austrian air emission inventory (OLI) 2008 (data basis 2007) is the Austrian Industrial Gases Association (Österreichischer Industriegaseverband, ÖIGV) and default emission factors according to IPCC Guidelines. The recommended methodology of the IPCC Guidelines was applied.

For the projections of N_2O emissions from 'Other Product Use' the rate of population growth is used.

5.2.5.2 Assumptions

With measures

The largest demand for solvents comes from the paint and coatings industry but also from household cleaners, disinfectants, personal care products and the printing industry. Besides the paint which is used in the sub-sector 'Construction and buildings', most of the consumer products are coated with paint. Furthermore solvents are used in many industrial-cleaning applications including cleaning for maintenance and cleaning in the manufacturing process. Solvents are also important for the cleaning of high-precision mechanical parts such as ball bearings

For the emission forecast it is assumed that the growth rate of CO_2 emissions for the period 2007–2020 correlates/corresponds with the population growth rate because of the wide range of solvent applications as mentioned above.

With additional measures

No additional measures are planned in this category.

5.2.5.3 Activities

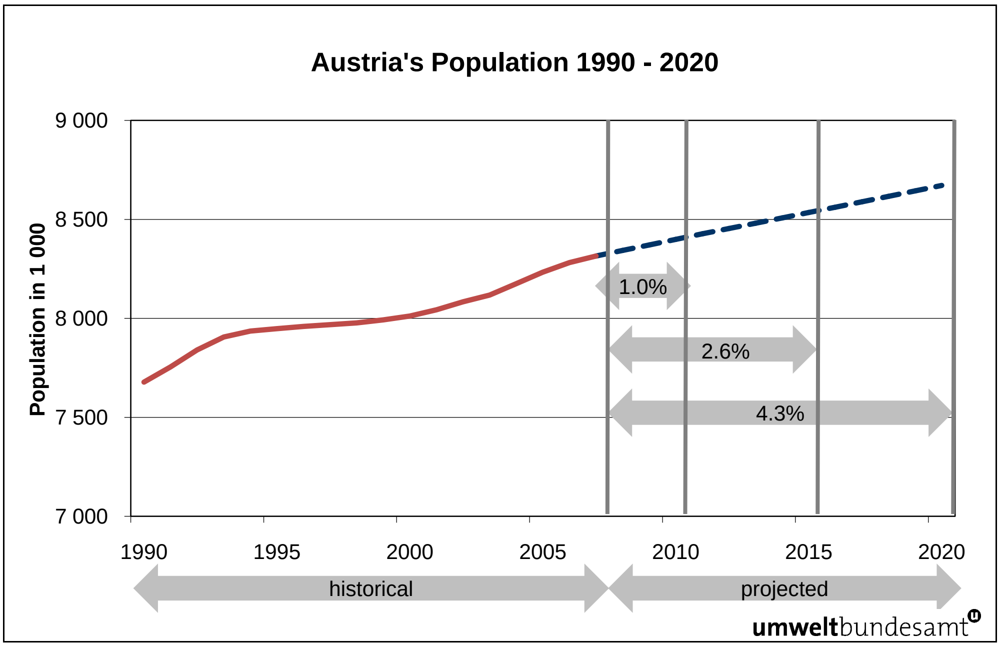

Figure 32: Historical and forecast Population in Austria (Source: STATISTIK AUSTRIA 2006b).

From a demographic perspective, Austria's population growth has a positive net migration (balance of immigration and emigration), with the natural increase (balance of births and deaths) making only a comparatively small contribution to population growth. The population increased by 8.3% in the period 1990–2007.

The basis for the Austrian population projection is a study prepared by Statistics Austria (2006) and commissioned by the Austrian Conference on Spatial Planning (ÖROK)[8]**.** According to this study (but with the reference year 2007), the rate of population growth is about 1%for the period 2007–2010, for the period 2007–2015 about 2.6% and for the period 4.3%.

5.2.5.4 Sensitivity Analysis

For the projections of CO_2 and N_2O emissions from the sector 'Solvent and Other Product Use' no sensitivity analysis has been performed.

5.2.5.5 Uncertainty

A simple method is used for projecting CO_2 emissions from the sector 'Solvent and Other Product Use'. Therefore the uncertainty can be considered high.

5.3 Agriculture (CRF Source Category 4)

5.3.1 Sector Overview

5.3.1.1 Farm policy and market

The 2003 CAP Reform

As a result of the decoupling of payment premiums from production, farmers do not need to plant certain crops or raise bulls in order to obtain financial support. Thus, future production decisions are expected to be more strongly based on market signals (i.e., crop and input prices). All farmers receiving direct payments must set aside part of their land (small farms and organic farms are exempted) and are subject to compulsory cross-compliance. From 2007 onwards the percentage of these set aside area is zero. Additional support schemes have to be considered as a building block in the decoupling process (e.g., rural development programme 07-13, subsidies for agri-environmental programmes and payments for farms on less favoured areas). EU member states co-finance farm subsidies in addition to EU funds.

The programme for rural development

The programme for rural development is of prime importance for the Austrian agricultural sector, because transfers from this source outweigh to some extent lower transfers from the market regime (the 'first pillar of the CAP'), i.e. commodity-related instruments.

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[8] Österreichische Raumordnungskonferenz (ÖROK)

International food markets

European farm commodity markets are interlinked with international food markets in many ways. Given the discrepancies between supply and demand in many markets, the EU is a major exporter, in particular of cereals, milk and white meat. Efforts are made to bring domestic market prices closer to world market prices. Domestic supply is therefore increasingly determined by the fluctuation of world market prices – except the more regulated milk market. Global demand for food, feed and technological progresses will be major driving forces of agricultural production during the next decade.

National energy policies

In its energy policy, Austria has committed itself to the substitution of non-renewable energy sources by renewable ones. Raw materials produced by agriculture are a major alternative source. Two major legal sources are of interest in this context: the Austrian Federal Act on the provision of green electricity 'Ökostromgesetz' and the European Bio-fuel Directive which was implemented in Austria in 2004.

5.3.1.2 Activities

Activity data were generated within the PASMA model (SINABELL & SCHMID 2005). PASMA depicts the political, natural, and structural complexity of Austrian farming in a very detailed manner. The model maximises sectoral farm welfare and is calibrated to historical data of crops, forestry, livestock, and farm tourism activities by using the method of Positive Mathematical Programming (PMP). This method assumes a profit-maximizing 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.

The model considers conventional and organic production systems (crop and livestock), all other relevant management measures from the Austrian agri-environmental programme ÖPUL, and the support programme for farms in less-favoured areas (LFA). Thus the two most important components of the programme for rural development are covered on a measure by measure basis.

Activity data is described in the respective subcategories of the chapter Agriculture, the tables are presented in Annex 3.

5.3.1.3 Sensitivity

The sensitivity analysis shows the consequences of higher and lower prices for a given scenario. Comparing the results of the "expected price" scenario with the "high" and "low" price scenario shows that results are sensitive to prices (SINABELL & SCHMID 2005).

The variation of prices is a range of plus and minus 5% of the "expected prices". The consequences of price changes are relatively limited. We have observed that the levels of different activities are changing in a way we would expect, but that the results are not fundamentally altered.

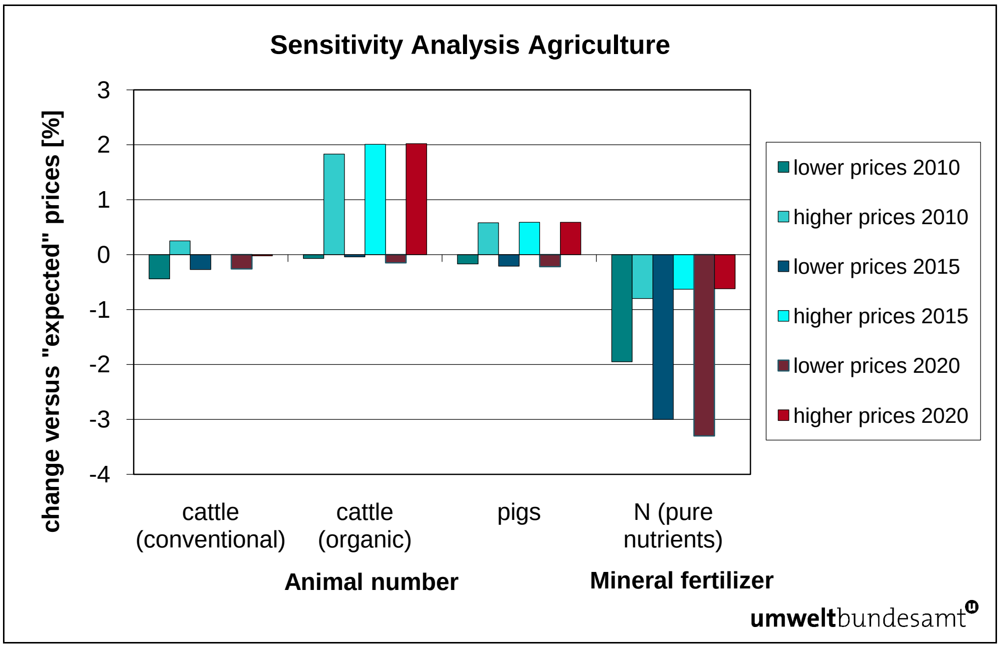

Figure 33: Sensitivity analysis Agriculture, including "high price" and "low price" scenarios in comparison to the wm scenario.

As emissions are directly proportional to activity data, the GHG emissions from the Sector Agriculture show the following sensitivity range (see Figure 33):

- 2010..... -1.95% to 1.83%
- 2015..... -3.00% to 2.01%
- 2020..... -3.30% to 2.02%

5.3.2 Enteric Fermentation (4.A)

5.3.2.1 Methodology of the sectoral emission forecast

Emissions are calculated on the basis of the methodology used for the Austrian Greenhouse Gas Inventory. A comprehensive description can be found in the Austrian National Inventory Report 2009 (UMWELTBUNDESAMT 2009).

Input parameters for the projection of the activity data have been estimated by the Federal Research Institute for Alpine Regions Gumpenstein (PÖLLINGER 2008) and the Positive Agricultural Sector Model Austria (PASMA), developed by the Austrian Institute of Economic Research (WIFO) (SINABELL & SCHMID 2005).

5.3.2.2 Assumptions

A) PASMA Model, developed by WIFO (SINABELL & SCHMID 2005)

The development of the agricultural sector is mainly analysed in terms of impacts of the demand for farm commodities and public services, and technological progress. The framework of the analysis relies on three major assumptions

- The development of farm commodity prices is mainly driven by the demand for farm commodities and technological progress.

- In future, society will be willing to pay for non-commodity outputs (e.g. landscape for leisure activity, protection of biodiversity features, water protection) of the agricultural sector. However, the large increase observed in recent years will come to a halt.
- Technical progress will slightly increase the agricultural output at the same input level.

Several assumptions were made to run the model. These were basically input prices, which are derived from other sources (FAPRI 2003, OECD 2004). Price projections were based on assumptions about the development of key indicators like population and GDP growth, and exchange rates (see Annex 2).

In the model, prices were derived from OECD outlooks on agricultural markets (OECD 2004). Due to the type of model, exogenous economic assumptions for Austria (GDP growth, population dynamics, etc.) are not necessary. The production is driven by resource availability, prices and technological development. Since Austrian agriculture is an integrated part of the common market, European demand patterns carry over and determine the results. Other driving forces (prices, technology, constraints) are referenced in the following sections.

For the period beyond 2013 the assumption is made that prices remain nominally constant. However, technological progress was assumed to go on. Linear approximation techniques were used to obtain these specific results. Special attention was given to the requirement of additional benefits.

Assumptions, in particular technical progress in plant and animal production, are based on (SINABELL & SCHMID 2005). For the estimates of future milk yields of dairy cows the estimates made by (PÖLLINGER 2005) have been considered.

The assumption of domestic consumption (e.g. milk/beef consumption) is that in affluent societies with low population growth, the overall food consumption will be relatively constant. Therefore, changes in demand trends will affect mainly the composition of food components (e.g. substitution of red meat by white meat).

B) Expert judgement

Assumptions and projections of the Austrian Animal Waste Management System (AWMS) distribution 2010 to 2020 are based on the expert judgement from Alfred Pöllinger, Agricultural Research and Education Centre (AREC) Raumberg-Gumpenstein (PÖLLINGER 2008).

The major driving forces of the sector development are the prices of farm commodity markets, technological progress and policy variables. The differences among the two scenarios can be summarized as follows:

With measures

In the scenario ‘with measures’ more arable land is used for the production of maize silage, sunflowers and rape seed (which is likely to be used for the production of biofuels) and the number of livestock heads is smaller because of the policy instrument shift. However, the overall effects of this scenario are minor with respect to the volume of livestock and crop production.

With additional measures

In the scenario "with additional measures" organic farming is expanded significantly (the number of organic livestock is higher and the acreage of organic crops increased) mainly due to the attractive premiums assumed in this scenario. In addition, the volume of renewable energy production on set-aside land is higher (based on exogenously given expert judgement).

5.3.2.3 Activities

Input data based on the PASMA Model

As a result of the PASMA model (SINABELL & SCHMID 2005) animal numbers for 2010, 2015 and 2020 for conventional and organic farms are given (see Annex 3).

As the PASMA model gives very similar results in animal numbers for both scenarios, no separate figures have been generated.

Figure 34 provides trends and projections for the Austrian cattle population and shows a stabilization of the domestic cattle population.

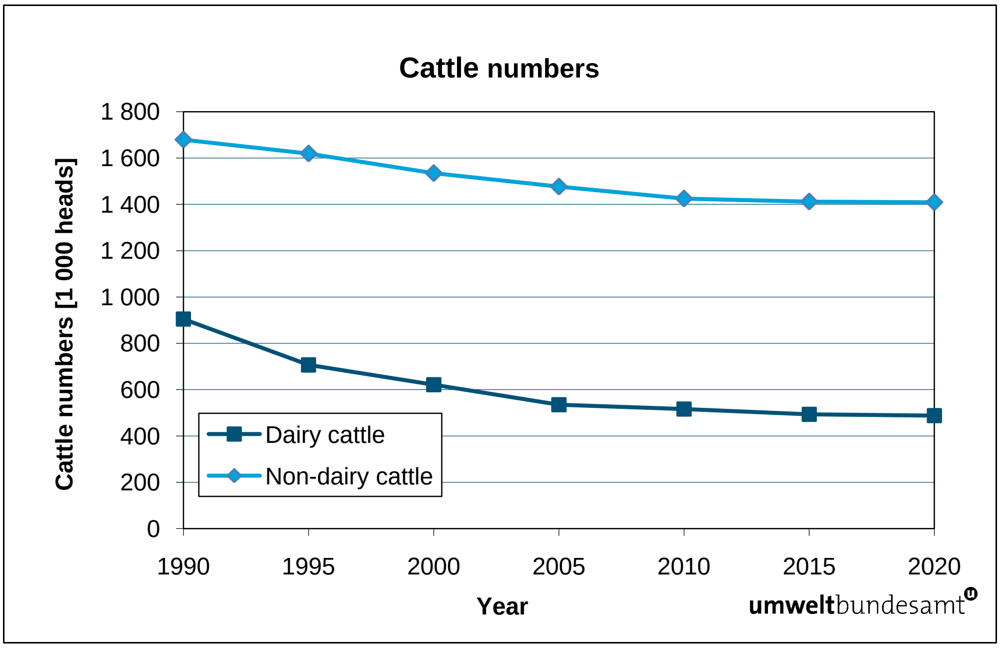

Figure 34: Historical and forecast (2010, 2015, 2020) cattle numbers.

5.3.2.4 Sensitivity Analysis

The validity of the model and the forecast results were proved by repeated sensitivity tests (see chapter 5.3.1.3).

5.3.2.5 Uncertainty

The main uncertainty arises from the prospective drop in the EU milk quota scheme from 2013 onwards and changes in the demand of red and white meat on the world market. It has to be taken into account that changing oil prices and floating exchange rates of EUR and USD may also increase the uncertainty.

5.3.3 Manure Management (4.B)

In this source category the CH_4 and N_2O emissions occurring during the storage of livestock manure are taken into account.

5.3.3.1 Methodology of the sectoral emission forecast

Emissions are calculated on the basis of the methodology used for the Austrian Greenhouse Gas Inventory. A comprehensive description can be found in the Austrian National Inventory Report 2009 (UMWELTBUNDESAMT 2009).

Input parameters for the projection of the activity data have been estimated by Alfred Pöllinger, Agricultural Research and Education Centre (AREC) Raumberg-Gumpenstein (PÖLLINGER 2005) and the Positive Agricultural Sector Model Austria (PASMA), developed by the Austrian Institute of Economic Research (WIFO) (SINABELL & SCHMID 2005).

5.3.3.2 Assumptions

The projected animal waste management system (AWMS) distributions presented in the tables in Annex 2 is based on the expert judgement of Alfred Pöllinger (PÖLLINGER 2008). The 2005 value reflects the AWMS distribution data currently used in the national inventory (KONRAD 1995).

From 2005 to 2007 a comprehensive investigation of Austria's agricultural practice was carried out (AMON et al 2007). This study is not yet implemented in the national inventory. Nevertheless, in the forecast the basic results of this study were taken into account.

In general, the projections show a trend to liquid systems. For CH_4 emissions from manure management, this shift results in an increase in emissions as the methane conversion factor is 39% for liquid systems in contrast to only 1% for solid systems (IPCC 1997). The lower N_2O emission factor for liquid systems slightly counteracts (but does not compensate) higher overall emissions.

No distinction between the 'with measures' and the 'with additional measures' has been made in this section. The same AWMS distribution has been used for both scenarios.

Anaerobic digestion of slurry and manure from livestock in Austria

With measures

As the Austrian *Ökostromgesetz* (Green Electricity Act) stimulates the installation of biogas plants, this technology has to be taken into account.

In March 2003 a survey based on questionnaires was carried out (RESCH et al. 2004). The results of this survey show that slurry of about 7 300 Livestock Units (LU) was digested in a sample of 84 biogas plants. The future trend of LUs was forecast based on these results (see Table 17).

Following the *Ökostromgesetz*, the operators of 198 biogas plants made reports to E-Control (E-CONTROL 2008) in 2007 to obtain their premiums for the digested agricultural products. Reported data show that slurry contributes only a small part of the overall input material in these plants. The predominant fermentation substrate is covered by agricultural products such as corn and grass silage and leftover. Hence, only about 6% of the electricity produced in these biogas plants results from the digestion of animal manure. This development is driven by incentives to use agricultural products for biogas production as stipulated in the *Ökostromgesetz* 2006.

On the other hand it has to be considered that only 198 plants of potentially 340 plants reported their data to E-Control to receive compensation for the higher market price of agricultural products for digestion. It is likely that these plants act in a different manner regarding the digestion of slurry. Due to this unclear situation, the LU value for 2010 was estimated as follows: the LU amount of the biogas plants reported in (E-CONTROL 2008) was calculated with a percentage of slurry of 6.15. The remaining 142 plants were estimated using same conditions as reported in (RESCH et al. 2004). Estimations for 2007 resulted in a slurry digestion of 18 423 LU. This value was taken for the 'with measures' scenario 2010.

Table 17 presents the calculated trend of digested manure (expressed in livestock units (LU)) in dependency of the power generation in biogas plants. For 2015 and 2020 the LU value already applied in Austria's previous GHG projections, submission 2005 based on (RESCH et al 2004) has been used. As the technical design of biogas plants is flexible, increased usage of slurry could be achieved rapidly by introducing the appropriate incentives.

Table 17: Energy figures of Austrian biogas plants and projected LU development – scenario 'With Measures'.

Date	Power generation	Livestock Units (LU)
01.01.2003	84 GWh	7 300
wm Scenario 2010	440 GWh	18 423
wm Scenario 2015, 2020	490 GWh	42 583

With additional measures

In the 'with additional measures' scenario from 2010 onwards a usage of 800.000 m³ slurry for biogas production has been assumed (SINABELL & SCHMIDT 2005). This value corresponds to 53 333 LUs.

Table 18 and Table 19 present for both scenarios the calculated reduction of CH_4 emissions due to anaerobic digestion in biogas plants.

Table 18: Projected abatement of CH_4 emissions by reason of anaerobic digestion ('with measures' scenario).

	2010	2015	2020
CH_4 [Gg]	1.5	3.5	3.5

Table 18 shows a reduction of 1.5 Gg CH_4 in 2010 and of 3.5 Gg CH_4 from 2015 to 2020 due to fermentation of slurry in biogas plants in the 4.B manure management category.

Table 19: Projected abatement of CH_4 emissions by reason of anaerobic digestion ('with additional measures' scenario).

	2010	2015	2020
CH_4 [Gg]	4.4	4.4	4.4

Table 19 shows a reduction of 4.4 Gg CH_4 from 2010 to 2020 due to fermentation of slurry in biogas plants in the 4.B manure management category.

5.3.3.3 Activities

Animal number

The applied data on Austrian livestock are a result of the calculations within the PASMA model. Animal numbers for 2010, 2015 and 2020 are presented in Annex 2. The scenario 'with additional measures' shows a significant higher number of organic livestock.

VS- and N excretion values

The same feed intake parameters as in the national greenhouse gas inventory have been applied (UMWELTBUNDESAMT 2009). Austrian specific VS and N excretion values of dairy cows were calculated in dependency of projected milk yields (see Annex 3). VS excretion values for non-dairy cattle were calculated from typical Austrian diets under organic and conventional management (GRUBER & STEINWIDDER 1996).

Slurry digested in biogas plants

In both scenarios, the underlying animal numbers were calculated on the basis of the questionnaire mentioned in the chapter before (RESCH et al. 2004). Following this questionnaire the digested slurry originated by 47% from cattle, by 42% from pigs, by 9% from hens and by 2% from others. This split was used for the conversion from livestock units (LU) to livestock numbers (head) in dependency of the projected power generation 2010–2020.

5.3.3.4 Sensitivity Analysis

Validity of model and the forecast results were proved by repeated sensitivity tests (see chapter 5.3.1.3).

5.3.3.5 Uncertainty

There is a high uncertainty of the projection because so far GHG reduction techniques are not considered enough in the investment incentives to renew the slurry/manure storage systems (e.g. cover of slurry storage tanks). Additionally, a parameter not considered is the reflux of nitrogen to soil from the application of fermented agricultural products from biogas plants.

5.3.4 Rice Cultivation (4.C)

There is no rice cultivation in Austria and the scenario assumes that none will take place until 2020.

5.3.5 Agricultural Soils (4.D)

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

Prices on farm commodity markets, technological progress, and policy variables determine the sector development. Whereas in the 'with measures scenario' the agricultural land has to be maintained in good ecological condition, the stimulation of the production of organic crops in the 'with additional measures' scenario has some additional beneficial environmental consequences (e.g. the reduction of mineral fertilizers).

5.3.5.1 Methodology of the sectoral emission forecast

Emissions are calculated on the basis of the methodology used for the Austrian Greenhouse Gas Inventory. A comprehensive description can be found in the Austrian National Inventory Report 2009 (UMWELTBUNDESAMT 2009).

Underlying activity data are estimated by the Positive Agricultural Sector Model Austria (PASMA) (SINABELL & SCHMID 2005), taking into account the assumptions of (PÖLLINGER 2005).

5.3.5.2 Assumptions

With measures

It is assumed that the acreage of utilised agricultural area will not change significantly, because the single farm payment is only paid if land is 'maintained in good agricultural and ecological condition', and grassland should be left untouched (no change to arable land). The cross-compliance conditions are strong enough to prevent forestation. The price situation on crop commodity markets – even after implementation of the Bio-fuel Directive – does not lead to an expansion of arable land at the cost of grassland.

It is assumed that more land is used for the production of silage maize, sunflowers and rape seed, which are all likely to be used for the production of biofuels. However, at a national scale the acreage used for such activities is still unknown as common crops are used for biofuels and energy production. In order to meet the quantity goals it is likely that the relevant crops will be imported.

With additional measures

In the scenario 'with additional measures' organic farming is expanded significantly compared to the other scenarios mainly due to the attractive premiums assumed in this scenario. The increase of organic crop production is likely to be complemented by more environmentally friendly crop rotations and management practices. In the calculations reduced mineral fertilizer application data is the most important input parameter.

5.3.5.3 Activities

The following mineral fertilizer application data resulted from the scenarios calculated within the PASMA model:

Table 20: Forecast mineral fertilizer application 2010, 2015, 2020.

	With measures			With additional measures		
Pure Nutrients	**2010**	**2015**	**2020**	**2010**	**2015**	**2020**
N (total)	95.7	100.5	102.0	95.2	99.2	100.5
of which Urea	6.2	7.0	7.7	6.1	6.9	7.6

Both scenarios show that the decrease in mineral fertilizer application (-27% from 1990–2005) will not continue. This is in line with the recent sales data: from 2005 to 2007 the consumption of mineral fertilizers increased by 3.6% (BMLFUW 2008).

The EFMA long-term forecast 2007–2017 supports this assumption: EFMA projects an increase in N consumption in Austria due to a strong development of energy crops (EFMA 2007).

5.3.5.4 Sensitivity Analysis

The validity of the model and the forecast results were proved by repeated sensitivity tests (see chapter 5.3.1.3).

5.3.5.5 Uncertainty

The main part of the uncertainty is located in the influence of the planned bio fuel production. If the demand for biomass for energy purpose determines the common EU market for crops then the domestic production will grow with increased mineral fertiliser use. Growing demand for organic products would lower the demand for mineral fertiliser as well as other measures in the agri-environment programme. It is unclear yet which development will be stronger.

5.3.6 Prescribed Burning of Savannas (4.E)

There is no prescribed burning of savannas in Austria and the scenario assumes that none will take place until 2020.

5.3.7 Field Burning of Agricultural Residues (4.F)

Burning agricultural residues on open fields in Austria is legally restricted by federal law, and is only occasionally permitted on a very small scale.

The contribution of emissions from the category *Field Burning of Agricultural Waste* to the total emissions is very low. Thus, a simple approach has been applied: the arithmetic mean of the area burnt from1990–2007 has been used as activity data.

5.4 Land use, Land-Use Change and Forestry (CRF Source Category 5)

No forecast is available for Austria's land-use, land use change and forestry at the moment. The general assumption for both scenarios for the emission projection is a continuous value of the CO_2 sink up to 2020. This means that for this projection the total effect of land use change and forestry in Austria by changes in specific surface sink factors and the size of the corresponding areas is assumed to be the same value from 2007 up to 2020 with emissions of -17 398 Gg CO_2 equivalents.

5.5 Waste (CRF Source Category 6)

This chapter includes information on and descriptions of the methods of greenhouse gas projections as well as references of activity data projections concerning waste management and waste treatment activities. The projections addressed in this chapter include projections from the CRF Classification Solid Waste Disposal on Land, Wastewater Handling, Waste Incineration and Other Waste (Compost Production). No additional measures are planned, thus the "with additional measures" scenario is the same as the "with measures" scenario.

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

5.5.1 Solid Waste Disposal on Land (6.A)

5.5.1.1 Methodology of the sectoral emission forecast

For the calculation of methane (CH_4) arising from the solid waste disposal on land the IPCC (Intergovernmental Panel on Climate Change) Tier 2 method is applied in line with the GHG inventory.

The Tier 2 method is recommended for the calculation of landfill emissions on national level; it consists of two equations: one of them calculates the amount of methane accumulated until the year of the inventory. The second equation calculates the emitted methane after subtraction of the recovered and oxidised methane amounts.

Equation (1): CH_4 generated in year t [Gg/yr] = $\sum_x$ [(A • k • MSW_T(x) • L_0 (x)) • $e^{-k(t-x)}$]

x = starting year of data record until t

t	*year of inventory*
X	*years for which input data should be added*
A	*$(1 – e^{-k})/k$; (0<A<1) normalisation factor which corrects the summation*
K	*methane generation rate constant [a^{-1}]; k = ln2 / t•1/2*
t•1/2	*half-life*
$MSW_T(x)$	*total municipal solid waste (MSW) generated in year x [Gg/a]*
L_0 (x)	*methane generation potential*
	= [MCF(x) • DOC(x) • DOC_F • F • 16/12 [Gg CH_4/Gg MSW_{feucht}]
MCF(x)	*methane correction factor in year x (fraction)*
DOC(x)	*degradable organic carbon (DOC) in year x (fraction) [Gg C/Gg MSW]*
DOC_F	*fraction of DOC dissimilated*
F	*fraction by volume of CH_4 in landfill gas*
16/12	*conversion from C to CH_4*

Equation (2): CH_4 emitted in year t [Gg/yr] = (CH_4 generated in year t – R(t)) • (1 – OX)

R(t)	*recovered CH_4 in inventory year t [Gg/yr]*
OX	*oxidation factor (fraction)*

Where available, country-specific parameters are used and checked if they are in the proposed range of the IPCC guidelines. If country-specific parameters are not available IPCC default values are taken. The parameters used can be found in Austria's National Inventory Report (UMWELTBUNDESAMT 2009).

For calculating the emission projections for solid waste disposal on land the directly deposited waste is separated into the categories: "residual waste" and "non residual waste".

"Residual waste" corresponds to waste from households and similar establishments (after sorting out of bio-waste, paper, glass, metals etc. at the source), which is directly deposited at landfills without any treatment.

It originates from private households, administrative facilities of commerce, industry and public administration, kindergartens, schools, hospitals, small enterprises, agriculture, market places and other generation points covered by the municipal waste collecting system.

Once disposed of, waste emits landfill gas for many years. The amount of gas emitted per year is not constant. It declines exponentially over time. For the calculation the amount of landfill gas produced in the year of disposal and in the 30 years after disposal is taken into account. To determine the total amount of landfill gas emissions for one year, the amounts generated by waste disposed of in the last 31 years are summed up. After subtracting the recovered gas and multiplying it by the CH_4 content of landfill gas (approximately 55%) the emitted quantity of CH_4 from residual waste is obtained.

"Non Residual Waste" is directly deposited waste other than residual waste but with biodegradable compounds. Non Residual Waste comprises for example:

- bulky waste
- construction waste
- mixed industrial waste
- road sweepings
- sewage sludge
- rakings
- residual matter from waste treatment

5.5.1.2 Assumptions

In order to make forecasts for the generation, recycling and disposal of waste materials with biodegradable compounds and waste streams, a large number of influencing factors were taken into account. An overview of these factors is provided below.

Estimations of waste management trends were made

- based on waste management trends in the past (observation period going back to 1989, the first year for which a comprehensive description of waste management in Austria was produced), or based on a predictable future trend in waste management for a significant period of time
  - for the production of goods,
  - for the use and consumption of goods,
  - for the replacement, re-use and further use of goods,
  - for the use of the energy content of goods and wastes,
  - for waste collections (improvement or discontinuation),
  - for waste treatment (e.g. by material conversion),
  - when considering plans for waste prevention,
  - when implementing or amending legal provisions at federal province and federal government level, as well as at EU level (Landfill Ordinance, Packaging Ordinance)
- with regard to expected municipal contributions to climate protection ("climate alliance" municipalities)
- considering stricter overall conditions for compliance with limit values, as well as with regard to potential health hazards from production processes and health and safety at work
- in line with the production statistics of Statistics Austria
- based on the consignment notes entered into the hazardous waste register
- according to information provided by relevant experts, technical offices, civil engineering offices
- according to information provided by the relevant departments of the provincial and federal governments (surveys and reviews, measures planned, …)
- from operators of waste management plants
- according to information provided by the relevant organisations (chambers, recycling companies for different sectors, interest groups, …)

- according to data from specialist literature (studies, sector-specific concepts, …)
- for materials derived from the clean-up of contaminated land: plans for transferring wastes from contaminated sites or landfills
- considering impacts resulting from a higher level of connection with the public sewage system
- considering impacts resulting from improved plant-internal prevention and recovery measures

A recent study on landfill gas collection in Austria (UMWELTBUNDESAMT 2008) showed that the amount of gas collected has decreased constantly since the year 2002. This is due to the fact that in many cases landfilled waste has been subjected to preceding pre-treatment processes (like mechanical biological treatment) that reduce the gas formation potential

From 2002 to 2007 the average decrease of collected landfill gas volumes was 7% per year. For the projection it has been assumed that this trend continues.

The carbon content of "residual waste" was assumed to stay constant because the separate collection of biodegradable compounds of "residual waste" has reached a high level in Austria and an increase of the collection rate is not likely.

5.5.1.3 Activities

No "residual waste" will be landfilled after the year 2008 following the measures described in chapter 6.2.11. The only "non residual wastes" with biodegradable compounds landfilled after 2008 are (1) the landfill fraction from the mechanical biological treatment of residual wastes, (2) the landfill fraction from the mechanical treatment of waste and (3) contents of grit chambers from waste water treatment.

Table 21: Historical (1990, 2003, 2005) and forecast (2010, 2015, 2020) activity data for landfilled "Residual waste" and "Non Residual Waste".

Year	Residual Waste	Non Residual Waste	Total Waste	IEF CH_4
	[Gg/a]	[Gg/a]	[Gg/a]	[kg /Mg]
1990	1 995.7	664.5	2 660.3	60.4
2003	1 385.9	899.6	2 285.5	46.5
2005	241.7	340.7	582.4	160.0
2010	0	242.8	242.8	278.2
2015	0	247.6	247.6	192.1
2020	0	252.7	252.7	139.5

5.5.1.4 Sensitivity Analysis

The intended scenarios "High Emissions" and "Low Emissions" were not incorporated into the study of (DOMENIG & PERZ 2005). Parameters for a sensitivity analysis, which have been agreed for the energy scenarios and the overall project respectively (oil price), are not relevant for this sector; and separate assumptions for this sector were not considered useful.

5.5.1.5 Uncertainty

According to the Austrian National Inventory Report 2009 (UMWELTBUNDESAMT 2009), the uncertainty for emission factors for 6 A Solid Waste Disposal is 25% and 12% for activity data, respectively.

Though the emission calculation for the projections is based on the same methodology as in the Inventory Report, the uncertainty of the projected activity data must be a good deal higher, while the uncertainty for emission factors might be in the same range.

5.5.2 Wastewater Handling (6.B)

5.5.2.1 Methodology of the sectoral emission forecast

The same method as described in the National Inventory Report 2009 (UMWELTBUNDESAMT 2009) is used for estimating future emissions from wastewater treatment.

N_2O emissions arising in waste water treatment plants, i.e. waste water originating from households connected to a sewage system are calculated by using a country-specific method based on IPCC. N_2O emissions resulting from households not connected to the public sewage system – taken into account in submission 2006 for the first time – are calculated as described in the Revised 1996 IPCC Guidelines. For the calculation of N_2O emissions from industrial waste water a simple assumption is made.

CH_4 emissions from urban waste water treatment covering emissions from cesspools and septic tanks are calculated pursuant to the IPCC method, using mainly IPCC default values.

5.5.2.2 Assumptions

N_2O emissions from urban waste water are calculated on the basis of the overall nitrogen freight in wastewater from the Austrian population. For waste water that is treated in sewage plants, the amount of nitrogen that is denitrified is additionally taken into account. For the calculation of N_2O emissions from industrial waste water it is assumed that they account for 30% of N_2O emissions from urban waste water treatment plants.

To estimate future N_2O emissions the following assumptions were made:

- The annual protein intake remains constant at the current level (118 g/Capita/Day);
- The denitrification rate will remain stable at the level of 2006 (77%) as no further improvements in the cleaning capacity are expected; the legal basis anticipates a denitrification rate of 70% (Federal Legal Gazette 186/1996);
- The level of connection to sewage treatment plants will continue to increase. It is assumed that in the year 2015 about 94.2% (in 2020 about 95%) of the waste water will be treated in sewage plants. Due to the settlement structure in Austria 100% cannot be achieved.

CH_4 emissions are calculated by taking into account the number of inhabitants using septic tanks and cesspools (where anaerobic conditions do exist) to handle their waste water.

Table 22: Historical (1990, 2003, 2005) and forecast (2010, 2015, 2020) indicators for waste water management in Austria.

	1990	2003	2005	2010	2015	2020
Inhabitants [1 000]	7 678	8 118	8 233	8 408	8 566	8 704
Annual protein intake per capita [g/day/capita]	102	111	118	118	118	118
Wastewater treatment [%]	59	89	89	93	94	95
Denitrification [%]	10	68	73	77	77	77

5.5.2.3 Activities

Data on the future development of the population are taken from recent statistics of (STATISTIK AUSTRIA 2009) in contrast to the population forecast used in other sectors and reported in Annex 1.

5.5.2.4 Sensitivity Analysis

No sensitivity analysis was performed in this sector.

5.5.3 Waste Incineration (6.C)

In this category CO_2 emissions from the incineration of waste oil and clinical waste are included as well as CO_2, CH_4 and N_2O emissions from municipal waste incineration without energy recovery. All CO_2 emissions from Category *6 Waste* are caused by waste incineration.

In Austria waste oil is incinerated in specially designed so-called "USK facilities". The emissions of waste oil combustion for energy recovery (e.g. in the cement industry) are reported under *CRF sector 1.A Fuel Combustion*. In general, municipal, industrial and hazardous wastes are combusted for energy recovery in district heating plants or in industrial sites and therefore the emissions are reported in *CRF sector 1.A Fuel Combustion*. There was only one waste incineration plant without energy recovery which was operated until 1991 with a capacity of 22 000 tons of municipal waste per year. This plant was rebuilt as a district heating plant starting operation in 1996. Therefore the emissions since the re-opening of this plant have been reported under *CRF sector 1 A Fuel Combustion* from 1996 onwards.

5.5.3.1 Methodology of the sectoral emission forecast

For the calculation the simple CORINAIR methodology is 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 emission factors used in the Austrian Inventory (UMWELTBUNDESAMT 2009).

Table 23: Emission factors of IPCC Category 6 C Waste Incineration.

Waste Type	CO_2 [kg/ Mg]	CH_4 [g / Mg]	N_2O [g / Mg]
Clinical Waste	836	100	12
Waste Oil	3 224	2	24

5.5.3.2 Assumptions

It is assumed that the incineration of waste oil and clinical waste without energy recovery has been constant from 2007 onwards. All existing and planned waste incineration plants include energy recovery and therefore emissions are reported under *CRF sector 1.A Fuel Combustion.*

5.5.3.3 Activities

The constant values of 3 100 Mg of clinical waste and 3 000 Mg of waste oil are forecast to be incinerated without energy recovery until 2020.

5.5.3.4 Sensitivity Analysis

No sensitivity analysis was performed in this sector.

5.5.4 Other Waste Treatment (6.D)

5.5.4.1 Methodology of the sectoral emission forecast

To forecast the emissions from compost production, bio-waste and green waste (mainly loppings, garden and park waste, graveyard waste, waste from roadside vegetation and private green waste) were taken into account as well as the emissions from mechanical biological treatment. All in all they make up over 95% of GHG emissions in compost production, leaving aside sewage sludge treatment, where forecasts were not possible.

The increase of GHG emissions in this sector between the years 2005 and 2010 can be traced back to the improvement of activity data collection for green waste in the last years (see Table 24).

Projected CH_4 and N_2O emissions were calculated by multiplying an emission factor by the quantity of waste.

In accordance with the Austrian National Inventory Report (UMWELTBUNDESAMT 2009) the following emission factors (Table 24) are used.

Table 24: Emission Factors for Compost Production.

	CH_4 [kg/t humid waste]	N_2O [kg/t humid waste]
Biowaste and green waste	0.75	0.1
Mechanical biological treatment	0.6	0.1

For quality assurance the standards of the Austrian Inventory System have been applied.

5.5.4.2 Assumptions

According to expert judgement the amount of composted waste will stay nearly unchanged over the period predicted. The street network in Austria is complete, home composting is not really predictable and biogenic waste has been assumed to stay constant, too.

The same is true for the amount of mechanically biologically treated waste in Austria. According to expert judgement no further facilities for mechanical biological treatment are planned until the year 2020. On the contrary, one facility closed down in the year 2008. Nevertheless, this decrease of treated waste amounts will be compensated by the possibility of the other facilities to expand their capacities.

5.5.4.3 Activities

Taking into account the assumptions made, the following activity data for compost production were forecast:

Table 25: Historical (1990, 2003, 2005) and forecast (2010, 2015, 2020) activity data for Compost Production.

	1990	2003	2005	2010	2015	2020
Biowaste and green waste [Gg]	417.8	1 542.6	1 664.5	3 082.3	3 082.3	3 082.3
Mechanical biological treatment [Gg]	345	217.6	623.4	684.3	684.3	684.3

5.5.4.4 Sensitivity Analysis

No sensitivity analysis was performed in this sector.

6 POLICIES & MEASURES

The content of the chapter policies and measures and the appending Monitoring Mechanism Reporting Template follows not only the implementing provisions adopted under 280/2004/EC (Commission Decision 2005/166/EC) but also the UNFCCC reporting guidelines (FCCC/CP/1999/7).

6.1 The framework for Austria's climate policy

In order to provide information on the legal and institutional steps to prepare the implementation of international commitments, significant milestones in the Austrian climate policy are given in the following[9].

- Two committees were set up by the Federal Minister of Environment, Youth and Family Affairs i.e. the National CO_2 Commission in 1990 and the Inter-ministerial Committee to Coordinate Measures to Protect Global Climate (IMC Climate) in 1991. The National CO_2 Commission was later reorganised as the Austrian Council on Climate Change (ACCC) (*Österreichischer Klimabeirat*). The ACCC is a scientific platform whereas the IMC Climate pursues administrative activities.
- Energy Reports were published in 1990, 1993 and 1996 outlining the national strategy in order to achieve the so-called Toronto target.
- After the negotiation of the Kyoto-Protocol under the UNFCCC the Kyoto Forum was established at the Federal Ministry of Agriculture, Forestry, Environment and Water Management in 1999.
- In 2002 the Austrian Climate Strategy 2010 was released as national climate change programme in order to reach the Kyoto target (BMLFUW 2002).
- The Austrian Climate Strategy 2010 was adapted and the revised Climate Strategy II was published in 2007 (BMLFUW 2007).

Jurisdiction in Austria is distributed among the federal government, the federal provinces (*Bundesländer*) and the municipalities. Hence, there are many climate change programmes at regional level in addition to the national climate strategy. Accordingly, coherent monitoring and evaluating of policies and measures has caused difficulties in the past. Due to a lack of comparable information on policies and measures it was not possible to quantify all policies and measures included in the scenarios of this report.

Efforts have been made with respect to comparability by means of using the Monitoring Mechanism Reporting Template as recommended (see Annex 1).

An important contribution to an effective implementation and evaluation of additional measures will be the planned Climate Change Act (*Bundesklimaschutzgesetz* 204/ME (XXIII.GP)).

[9] More detailed information can be found in the Fourth National Communication of the Austrian Federal Government.

6.2 Sectoral methodologies

In general the sectoral definitions requested by the UNFCCC guidelines have been used. Each section describes the methodologies applied for quantifying the most important policies and measures. Furthermore a rationale is provided if quantification was not possible.

The paragraphs need to be read in conjunction with the Monitoring Mechanism Reporting Template in Annex 1. The reporting template presents the information required by Decision 280/2004/EC for all policies and measures which are included either in the WM scenario or in the WAM scenario in tabular form. In general, the measures included in the scenarios are based on the policies and measures for climate protection detailed in the Austrian Climate Strategy 2010 (2002) and the revised Climate Strategy II (2007).

It has to be emphasised that the quantification of the GHG emission reduction effect of a policy or measure per year presented in the reporting template is not meant to be added up. Interactions between measures cannot be avoided; therefore adding up these figures to express the total effect of measures tends to result in an overestimation of the total effect of measures.

Cross-sectoral policies are presented repeatedly e.g. the Green Electricity Act is discussed in the chapter Energy Industries and in the chapter Manufacturing Industries and Construction. Usually such measures have been quantified and discussed in detail in the section for which the policy is more relevant. In other cases the effect has been subdivided and quantification has been undertaken separately for the sectors affected. In any case the procedure is documented in the respective chapters.

6.2.1 Energy Industries (1.A.1)

The policies & measures relevant for the sector energy industries are given in Annex 1 (P&M No.: 1-8_EN).

Where possible the GHG emission reduction effect of individual policies and measures has been estimated. However, for various measures (e.g. emission trading, promotion of CHP) the reduction effect could not be estimated; for others it was only possible to estimate the reduction effect by 2010.

No grouping of policies and measures has been undertaken.

It has been assumed that the additional/reduced green electricity production results in a reduced/additional domestic production of electricity in fossil fuel power plants. Emission reductions have been calculated on the basis of an emission factor of 0.4 t/MWh.

In detail the following assumptions were made for the respective policies and measures:

01_EN Domestic environmental support scheme (UFI) (Federal Legal Gazette N o 185/1993 amended by 34/2004) (WM):

The reduction effect for installation not affected by the ETS has been estimated on a combination of historical data and projections for the amount of future subsidies. It has not been possible to provide estimates for 2015 and 2020 due to the fact that future amounts of subsidies are unknown. The quantification is given in CO_2 eq. and includes the CO_2, CH_4 and N_2O emission reduction effect; providing a split per gas is not possible.

02_EN Green Electricity Act (Federal Legal Gazette I 149/2002 amended by 105/2006) (WM+WAM):

The assumption is that its objective for the year 2015 will be reached and that the promotion of green electricity will continue thereafter. The figures given are the total reduction effect of the measure per year. It is estimated that a vast part of the reductions will concern installations that take part in the emission trading scheme, mainly in the energy supply sector.

05_EN Austrian Climate and Energy Fund (Federal Legal Gazette I No 40/2007) (WM):

The reduction effects were calculated on the basis of the total yearly amount of subsidies, a production of 880 kWh/kW_p and a duration of the programme of three years.

04_EN Water Framework Directive (Directive 2000/60/EC) (WM):

The effects have been calculated according to section 5.1.1.2.

07_EN Directive 2006/32/EC on energy end-use efficiency and energy services and the corresponding first Austrian energy efficiency action plan (WAM):

In the WAM scenario it is assumed that Austria will attain the objectives set out in the Directive.

It has not been not possible to quantify the following policies and measures:

03_EN Emission Trading System (ETS) Emission Trading Directive (2003/87/EC) (WM):

Due to interactions with other measures the specific reduction effect of emission trading in the energy sector could not be estimated.

06_EN Promotion for combined heat and power (CHP) (Federal Legal Gazette I No 45/2008) (WM):

The amounts of subsidies in the future cannot be estimated.

08_EN Eco Design Directive and amendments (2005/32/EC) (WAM):

The reduction effect of this measure could not be estimated.

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

The policies & measures relevant for the sector manufacturing industries and construction are given in Annex 1 (P&M No.: 01-03_IND).

No grouping of policies and measures has been undertaken.

In detail, the following assumptions were made for the respective policies and measures:

02_IND Green Electricity Act (Federal Legal Gazette I 149/2002 amended by 105/2006):

The total reduction effect of all sectors concerned has been reported in the energy supply sector (sector energy industries). Therefore no specific reduction effects have been given for the sector manufacturing industries and construction. It is assumed that the major reductions take effect in the energy supply sector.

01_IND Environmental support scheme for installations (Federal Legal Gazette No 185/1993 amended by 34/2004) (UFI):

An ex-post estimate of the total GHG reduction effect of this measure has been given, but an ex-ante estimate for the industry sector could not be given. The reduction effect includes both the installations affected and those not affected by the ETS.

03_IND Emission Trading Scheme (Directive 2003/87/EC) (ETS):

Due to interactions with other measures the specific reduction effect of emission trading in the industry sector could not be estimated.

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

In this chapter, the quantified measures relevant for the sector transport will be specified (P&M No.: 01-09_TRA).

Quantifiable measures in the WM Scenario:

04_TRA EU- Biofuels Directive & Development renewable energy carrier 1990 – 2020 (Directive 2003/30/EC):

In 2007 the share of renewable Energy used within the transport sector attained a level of 4.23% (measured by the energy content). Biodiesel, bioethanol and straight vegetable oil (SVO) represent the set of renewable energy carriers which were mainly distributed by blending them with fossil fuels to an extent of 5% (measured by volume).

The outlook for 2020 is based on present circumstances (initiatives, promotion, current infrastructure etc.) as well as foreseeable developments on national and international level.

The assumptions for the development of renewable energy carriers are valid for both scenarios.

Details on the effects of these measures can be seen in the reporting template in Annex 1.

07_TRA Klima:aktiv→mobile programme

For this measure a fixed reduction effect of 250 000 tons per year has been assumed. This value is based on the expert judgement of the Umweltbundesamt and the Austrian Energy Agency. The quantification is given in CO_2 eq. and includes the CO_2, CH_4 and N_2O emission reduction effect; providing a split per gas is not possible.

Quantified measures in the WAM Scenario:

08_TRA Enhanced fuel efficiency of cars:

The Community's strategy to reduce CO_2 emissions from passenger cars and improve fuel economy is based on three pillars, namely the Commitments of the automobile industry on fuel economy improvements, the fuel-economy labelling of cars and the promotion of car fuel efficiency by fiscal measures.

As the first and foremost pillar of the strategy, the Commitments of the European (ACEA), Japanese (JAMA) and Korean (KAMA) automobile manufacturers' associations are designed to achieve a total of EU15 new passenger car fleet average CO_2 emissions of 140 g CO_2/km by 2008 (ACEA) and 2009 (JAMA and KAMA). The targets of the Commitments must mainly be achieved by technological developments affecting different car characteristics and market changes linked to these developments.

Since the period under review is still ongoing for the Japanese and Korean automobile manufacturers' associations, the CO_2 reduction potential of the industry's commitment is still taken into account in the given projection.

This scenario assumes that Austria reaches the objective of this voluntary agreement for newly registered cars in Austria. To reach the target of 140 g/km, CO_2 emissions per kilometer driven would need clearly higher rates of efficiency improvements compared to the past 10 years. In the periods from 2000 to 2003 and 2003 to 2006, the specific fuel consumption of the newly registered car fleet dropped by 2.2% and +/-0% respectively. Based on the figures of 2006 a reduction of more than 15% would be necessary to meet the desired target.

The effect of this measure can be seen in the reporting template in Annex 1. The quantification is given in CO_2 eq. and includes CO_2 and N_2O emission reduction effects. Providing a split per gas is not possible.

09_TRA Control of speed limits, traffic control systems and fuel saving driving style

One can see that this is a bundle of measures. These single measures are quantified together.

1) On Austrian highways an increasing share of the road network shall be equipped with section control systems. These systems measure the average speed over a longer section of the road. Number plates of the vehicles are registered automatically and vehicles exceeding the speed limits on average over the section have to pay a fine.

2) On Austrian highways critical sections shall be equipped with traffic control systems. In this measure "traffic control systems" with relevance for energy consumption and emissions are defined as systems with flexible speed limits according to air quality and/or noise and traffic volume aspects. It is planned to define activation values below the air quality limits to prevent exceeding of the NOx and/or PM 10 air quality targets. Thus the number of days with reduced speed limits has to be assessed. For the calculation it was assumed that the traffic control systems will be relevant on 20% of the highway kilometres driven and that, on 50 days per year, the traffic control systems will lower the speed limits from the existing 130 km/h to 100 km/h. Thus, the measure influences 2.74% of the total mileage driven by cars on Austrian highways. Correspondingly, the overall emission reduction is rather low. This measure aims rather at cutting seasonal and regional emission peaks.
3) Increase of public awareness on a fuel saving driving style (ecodrive): Running the cars at lower engine speeds improves fuel efficiency; such a driving style is known as "ecodrive". The overall effects (in terms of pollutant emissions) of such a driving style can be assessed only roughly at the moment.

   To assess the overall effect of the public awareness campaign it is assumed that 10% of all drivers will change their behaviour and switch to "ecodriving" (constant level until 2020).

   The effects of better speed limit control, a speed limit of 100 km/h instead of 130 km/h over periods with critical air quality and ecodriving are combined and implemented into the emission factors for passenger cars in the model GLOBEMI. It is assumed that all measures will be introduced until 2012, with 100% of their efficiency reached from 1.1.2012 onwards.

The effect of these measures can be seen in the Monitoring Mechanism Reporting template in Annex 1. The quantification is given in CO_2 eq. and includes CO_2 and N_2O emission reduction effects. Providing a split per gas was not possible.

The following policies and measures were not quantifiable at that time:

01_TRA ACEA – voluntary agreement (CO2 emissions of newly registered vehicles) (Basis: Strategie [KOM (95) 689.]) (WM)

02_TRA CO2 labelling and other measures to reduce emissions from passenger cars (WM)

03_TRA Mileage based toll for lorries (WM)

05_TRA Euro classification (EURO 5&6 PC, EURO 5 HDV – assumption EURO 6 HDV, assumption Off Road stage 3b&4) (WM)

06_TRA Measures concerning infrastructure, public transport and mobility management (WM)

These measures are not quantifiable simply because there is no data available to assess an emission reduction effect.

A new study concerning transport related policy assessment will be carried out in 2009.

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

The policies and measures included in the “with measures” scenario of the sector “Other Sectors” are listed in Annex 1 (P&M No.: 1-7_RES).

Due to the huge number of defined measures, policies and measures have been grouped. The estimated effects on greenhouse gas emissions were calculated separately for each group of measures.

Quantifiable groups of measures:

01_RES increased use of renewable energy in the sector residential and commercial (Erneuerbare)

The increased use of biomass (log wood, wood chips, wood pellets and wood briquettes), solar heat and ambient energy through specific subsidies for renewables leads to a reduction of approximately 17 PJ of fossil fuels by 2020. This represents an abatement of 1 128 Gg CO_2 eq in the sector 1A4.

02_RES forced building renovation (Sanierung)

This group of measures comprises the effects of increased thermal renovation of buildings. The measures included target an increase of building renovation and improvements of building quality, which entails a reduction of energy consumption of 16.5 PJ (9.2 PJ fossil fuels) by the year 2020. In the sector residential and commercial, a reduction of GHGs in the extent of approximately 600 Gg CO_2 eq has been calculated.

03_RES forced replacement of heating systems (Heizkesseltausch)

An increase in the boiler exchange rate via various measures (defined in the Austrian climate strategy) will result in savings of 11.2 PJ fossil fuels by 2020, but with an increase in non-climate-effective biomass demand by 4.3 PJ. With this group of measures a reduction of 780 Gg CO_2 eq can be reached by 2020.

04_RES public support for new buildings (Neubau)

This group of measures represents the effects of subsidized heating systems (renewable) and compulsory building regulations for thermal building quality in new buildings. With this input a reduction of 7.9 PJ of fossil fuels was estimated, inducing a decrease of approximately 500 Gg CO_2 eq by the year 2020.

05_RES additional measures to reduce energy consumption in the sectors residential and commercial (WAM)

The following measures are included in this bundle of measures:

- exchange of boilers older than 30 years
- support condensing boiler technology in new installations of fossil heating systems
- increase building renovation rate to max. 2%

- ban on electric resistance heating systems as primary heating system (see Directive 6 for energy saving and insulation at buildings, *Österreichisches Institut für Bautechnik*, http://www.oib.or.at/RL6_250407.pdf)
- central heating systems in new buildings with more than three apartments
- Buildings with a floor space of more than 1 000 m² have to use an alternative heating system, if its technical, ecological and economical application is purposeful

Based on these assumptions, a further reduction of approximately 26 PJ of fossil fuels can be reached until 2020, including 16 PJ savings of heating oil. The overall reduction of GHGs will amount to 1 798 Gg CO_2 eq by the year 2020.

06_RES National energy efficiency action plan (Energieeffizienzaktionsplan, EEAP) in the residential and commercial sector without fuel energy for heating and hot water

According to Directive 2006/32/EC (energy end-use efficiency and energy services) each EU member state has to set measures for improving the energy efficiency by 9% until 2016. For the sector residential and commercial mainly soft measures like information campaigns, labelling obligations and consulting have been taken.

Thus, a reduction in electric energy consumption of 4 605 TJ in the sector residential and 4 239 TJ in the sector commercial can be achieved by the year 2016.

GHG emissions were not estimated in this sector, but were included in measure 07_EN in the sector energy industries.

07_RES additional measures to reduce electric power consumption in the sector residential and commercial without energy use for heating and hot water

Based on current EU regulation drafts, a reduction of electric energy consumption in the sector residential (households) can be achieved due to the use of efficient lighting technologies and a decrease of stand-by and quasi-off demands, as well as compulsory usage of efficient home appliances (incl. “office and entertainment”). The calculated total electric energy reduction in households by 2020 is approximately 4 400 TJ.

In the subsector commercial the reduction potential was estimated with the “ESP” database of the European Commission. Therefore, the energy demand for office equipment (computer, monitor, copy and print machines) and other engine-driven appliances (assembly line, lift/elevator, …) can be reduced by 8 500 TJ up to the year 2020.

GHG emissions were not estimated in this sector, but were included in measure 07_EN in the sector energy industries.

6.2.5 Other (CRF Source Category 1.A.5)

There are no measures assumed in this sector.

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

There are no measures assumed in this sector.

6.2.7 Industrial Processes (CRF Source Category 2)

The policies & measures relevant for the sector industrial processes are given in Annex 1 (P&M No.: 07_IP, 08_IP, 09_IP).

For a quantification of policies and measures affecting the sub-category halocarbons and SF_6 a "without measures (wom)" scenario was calculated. This scenario was based on the same assumptions as the wm scenario but excluded assumptions on the effects of Austrian and EC policies. The average annual emission reduction was calculated by subtracting the wm scenario emissions from the wom scenario. Some measures are included in both the Austrian Ordinance on fluorinated gases (Federal Legal Gazette II No 447/2002 amended by Federal Legal Gazette II No 139/2007) and the European Regulation on certain fluorinated greenhouse gases (842/2006/EC). The Austrian Ordinance was adopted in 2002 and thus cannot be considered the implementation of the European Regulation. This is also the reason why most effects have been attributed to the Austrian Ordinance.

07_IP Austrian F-gas Ordinance

08_IP EU F-gas Regulation (Reg. No 842/2006)

09_IP HFC emissions from air conditioning in motor vehicles (Dir 2006/40/EC)

6.2.8 Solvents and other product use (CRF Source Category 3)

The policies and measures included in the "with measures" scenario of the sector solvent and other product use are listed in Annex 1 (P&M No.: 01 – 06_IP).

The following policies and measures are considered in the "with measures" scenario:

01_IP Solvent Ordinance *(*Federal Legal Gazette II No 398/2005):

Limitation of emissions of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products in order to combat acidification and ground-level ozone.

02_IP Ordinance for paint finishing systems (surface technology systems) (Federal Legal Gazette No 873/1995)

Limitation of emissio

ns of volatile organic compounds due to the use of organic solvents by activities such as surface coating, painting or varnishing of different materials and products along the entire chain in the painting process in order to combat acidification and ground-level ozone.

03_IP Federal Ozone Law (Federal Legal Gazette No 309/1994):

Establishing, by various measures, a reduction in emissions of the ozone precursors NO_x and NMVOC.

04_IP Ordinance for industrial facilities and installations applying chlorinated hydrocarbons (Federal Legal Gazette No 865/1994):

For the limitation of emissions of chlorinated organic solvents from industrial facilities and installations applying chlorinated hydrocarbons.

05_IP Ordinance for emissions of volatile organic compounds (VOC) due to the use of organic solvents in certain activities and installations (Federal Legal Gazette II No 301/2002)

06_IP Ordinance on the limitation of emissions during the use of solvents containing lightly volatile halogenated hydrocarbons in industrial facilities and installations (Federal Legal Gazette II No 411/2005)

In the sector 'Solvent and Other Product Use' the effects of several PAMs are not estimated.

6.2.9 Agriculture (CRF Source Category 4)

The following policies and measures are considered implemented and listed in Annex 1 (P&M No.: 01 – 14_AGR). It was not possible to quantify the individual policies and measures in this sector. PAMs included in the wm scenario are given in the following:

01_AGR Common Agricultural Policy (CAP) 2003 reform (Council Regulation No. 1782/2003)

Implementation of the Common Agricultural Policy (CAP) 2003 reform.

02_AGR Austrian implementation of the CAP

Special attention is given to the Austrian way of implementation (keeping the premiums for suckling cows – including heifers – and part of the slaughter premiums; allocation of premium rights on farms).

An important part of the Austrian CAP implementation is to continue with the premium for suckling cows. Beef production is the other side of milk cattle market. As the average milk yields per cow nearly doubled in the last twenty years cattle holders invested in milk specialisation or got out of business and started keeping suckling cows instead. No single quantification of GHG emissions is possible as this influences the whole cattle market.

03_AGR Funds transfer from 'modulation'

Due to uncertainties concerning the flow of funds from "modulation" the scenario makes the assumption that Austrian farms that might be beneficiaries get the same amount as other farms that lose through this measure.

The modulation would shift the transfer of direct payment to the second pillar – rural development programme with agri-environment measures -, but anyhow the overall revenue would be very small. No separate analyses have been done on the possible effects.

04_AGR Land is maintained in good agricultural and ecological condition ("cross compliance")

That land has to be maintained in good agricultural condition is one of the requirements of 'cross compliance'. Direct payments, decoupled from the production, lead to extensively managed agricultural land, but with the potential to return to production. No separate analyses have been done.

05_AGR The programme for rural development is maintained in an unmodified way

The Austrian rural development programme is one of the biggest in Europe. Assuming that it is not possible to increase the amount of premium, a constant time line is the realistic scenario. Some effort was expected to increase the organic farming section in the programme expansions without changing the financial seal.

06_AGR Implementation of the Biofuels Directive in Austria

Austria follows an ambitious plan to implement the Biofuels Directive. Most of the needed agricultural products will be imported. There is some evidence that a shortage of agricultural products could lead to high price periods and that an increased domestic production could be introduced. But this is done with restrictions in the scenario because of plausible phyto sanitarian restrictions (e.g. for rapeseed). The growing demand should leave the domestic crop production mostly unchanged. Some common crops would increase their productivity via technical development. This is part of the development in the crop section and included in the model.

07_AGR Grassland maintenance

Leaving grassland unchanged (i.e. not returning it to arable land) is one of the conditions of cross compliance and the decoupling of production from direct payments for farmers. As grassland is already on disadvantage sites, the change of grassland into arable land would lead to environmental damage and rising GHG emissions. As it is part of the CAP development this is marked as a bundle of measures. No separate analyses have been done yet.

08_AGR Prices increase for the following crops: rape-seeds (+10%), sunflowers (+5%) and maize (+2,5%) starting in 2008

The demand for crops for bio fuel production could introduce higher prices for the individual crops. Austria follows an ambitious plan to implement the Biofuels Directive. Most of the agricultural products needed will be imported. There is evidence that shortages on the EU agricultural market would lead to higher prices and domestic production could be influenced. The growing demand should increase the domestic crop production only slightly. These developments are reflected in the price fluctuations of the model.

In the WAM scenario “With Measures" the following modifications are implemented:

09_AGR 25% more organic farming

The percentage of organic farming within the given budget of the programme for rural development (additional premiums are offset by an equivalent reduction of premiums for basic subsidies) is increased by 25%.

Organic farming considerably reduces the use of mineral fertiliser. As the amount of money within the rural development programme is high already, it is necessary to reduce other less targeted measures in favour of the organic farmers. Larger organic farm areas were implemented in the model as a price signal for organic products, while considering the effects from reducing mineral fertilisers.

10_AGR Payments for investments in emission reducing animal production technologies

Payments for investments in emission reducing animal production technologies (funded by the programme for rural development), e. g. slurry and manure store facilities, slurry hose techniques.

It is assumed that requests for investment in manure/slurry tanks and application techniques introduce the best available technology to reduce GHG emissions in general. In our view it is necessary to streamline the existing conditions for the incentives in this direction. As it is possible to improve these conditions, calculation follows the effects in the manure storage section.

11_AGR Set aside additional land for short rotation forests

Setting aside of additional land for short rotation forests (+ 5 000 ha in 2008 and + 20 000 ha from 2010 onwards)

An effective CO_2 sequestration strategy is the short rotation of forest trees on arable land. It is necessary to check the influence of such short rotation production on existing biodiversity. As the resulting reduction effect is seen in CO_2 emissions that are accounted for in the energy sector, the effect in the agriculture sector is in decreased land area only.

12_AGR Usage of 800 000 m^3 slurry for biogas production

The anaerobic digestion of slurry and manure in biogas plants is a very effective measure to reduce methane emissions from manure management. Additionally, the reduction potential in the energy sector should be taken into account.

13_AGR Usage of 13 500 hectares of set aside land for biogas production from silage-maize (from 2008 onwards)

In the scenario, part of the set aside area is used to produce crops for digestion in biogas plants. The flow back of nutrition and emissions of GHG in soil is not calculated yet. It is part of the development of the biogas scheme and has not been separately evaluated.

14_AGR Usage of 10 000 ha silage of grassland and alfalfa (from 2008 onwards)

Part of the grassland and arable land is used for digestion in biogas plants. The flow back of nutrition and emissions of GHG in soil is not calculated yet. The changes of the demanded amount of products have been introduced in the model.

6.2.10 Land use, Land-Use Change and Forestry (CRF Source Category 5)

Effects of policies and measures in this sector have not been evaluated.

6.2.11 Waste (CRF Source Category 6)

The policies and measures included in the "with measures" scenario of the sector waste are given in Annex 1 (P&M No.: 1-4_WASTE).

The single measures implemented could not be quantified. Nevertheless the progress can be made visible by the indicator 'annually deposited waste/CH_4 emissions' (see the following figure).

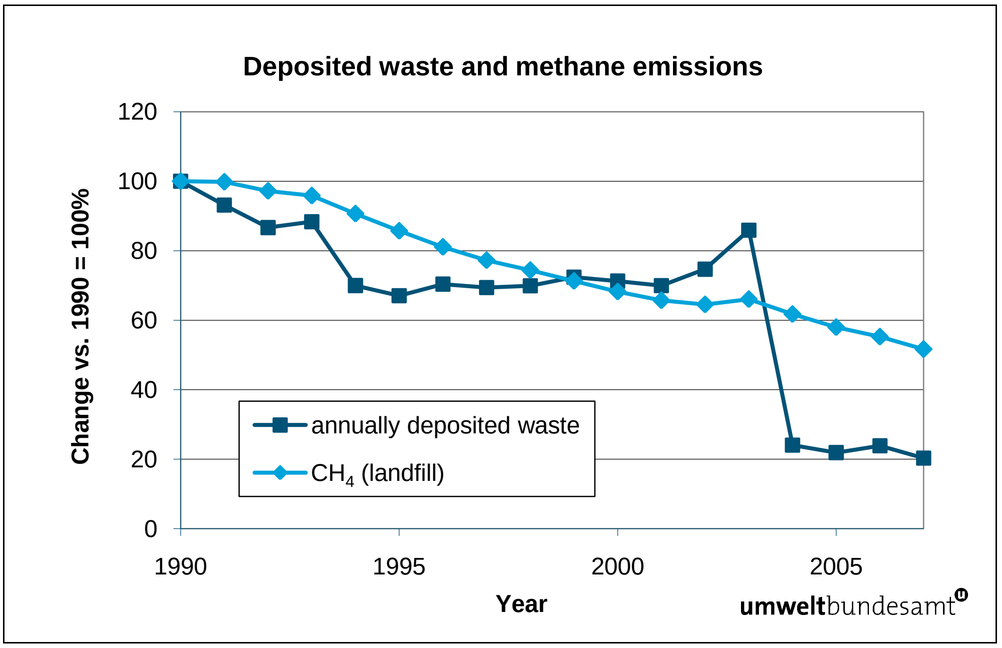

Figure 35: Methane emissions from landfills and annually deposited waste.

01_WASTE Landfill Ordinance (deposition of untreated biodegradable waste) (WM)

The most important measure is the implementation of the Austrian Landfill Ordinance Federal Legal Gazette No 164/1996 of the year 1996 according to the Austrian Waste Management Act.

According to this Ordinance the deposition of untreated biodegradable waste has been forbidden since 2004. Therefore the methane emissions from landfills will decrease constantly. However, there is the possibility to apply for an exemption until the year 2008, and several provinces have made use of this. But from then on only the landfill of pre-treated wastes will be allowed.

As a consequence, waste incineration and mechanical biological pre-treatment of waste will be increasingly applied.

02_WASTE Waste Landfill Ordinance (Federal Legal Gazette No 164/1996) (collection and drainage of landfill gas (WM)

A second important measure with respect to reductions of greenhouse gas emissions from landfills is the mandatory collection and drainage of landfill gas originating from mass-waste landfills according to § 22 of the Austrian Landfill Ordinance. This measure has been mandatory for new landfills since 01.01.1997 and for existing landfills with a transition period until 01.01.2004. The landfill gas has to be used or subjected to treatment.

03_WASTE Remediation of Contaminated Sites Act (Federal Legal Gazette No 299/1989) (WM)

Indirectly, the Remediation of Contaminated Sites Act (Federal Legal Gazette No 299/1989, as amended in 2004) contributes to a reduction of greenhouse gas emissions from landfills because it stipulates higher costs for the deposition of wastes on landfills without gas collection.

The amendment 2000 of the Contaminated Sites Act provides for a significantly higher contribution from the deposition of untreated biodegradable waste from 2004 onwards.

04_WASTE Guideline for the Mechanical Biological Treatment of Waste (BMLFUW 2002) (WM)

The reduction of the gas formation potential by mechanical biological treatment of biodegradable wastes prior to landfilling. The Guideline for the Mechanical Biological Treatment of Wastes was elaborated after expert consultations together with the Federal Environment Agency (BMLFUW 2002). With this guideline a consistent state of the art process for mechanical biological treatment is provided.

7 SCENARIO DEFINITION

7.1 Definition of the Scenarios as a Sum of Policies & Measures

Both scenarios, the "with measures" (wm) and the "with additional measures" (wam) scenario contain all measures combined in total. Effects of single measures or groups of measures are presented in Annex 1 (reporting template).

The scenario "with measures" includes measures before 8th August 2008. The scenario definition table lists the most important measures.

The scenario "with additional measures" additionally takes into account planned policies and measures with a realistic chance of being adopted and implemented in time to influence the emissions.

The selection process for measures to be considered for both scenarios has been carried out by sectoral experts in consultation with the Federal Ministry of Agriculture, Forestry, Environment and Water Management and in cooperation with the respective modelling teams. Occasionally, it will not be possible to run the model with any other set of measures, especially if the measures are implicit with regard to any modelling parameters. Thus the definition of policies and measures is not always completely on par with definitions used in the Austrian Climate Strategy (BMLFUW 2002) and Climate Strategy II (BMLFUW 2007). Generally it has to be noted that the process differs from sector to sector.

7.2 "With Measures"

Table 26: PAMs included in "With Measures" Scenario.

CRF	Policies & Measures
1.A.1 Energy industries	Energy related measures are defined in the energy projection. The following measures and regulations which are relevant for the sector energy industries have been considered: 03_EN: Emission Trading Directive (2003/87/EC) and amendments thereto (including National Allocation Plans) 02_EN: Amendment to the green electricity act 2008 (Federal Legal Gazette I No 114/2008) which promotes the use of renewable energy sources (RES) in power production 06_EN: Combined Heat and Power (CHP) Act (Federal Legal Gazette I No 45/2008) 05_EN: Austrian climate and energy fund (KLI.EN) 04_EN: EU Water Framework Directive (2000/60/EC) 01_EN: Domestic Environmental Support Scheme (UFI) Status 2006 –Status 2009 Measures such as the "liberalisation of markets for electricity and gas" and "Energy levies" are no longer included.
1.A.2 Manufacturing Industries and Construction	There are no sector specific measures. Energy related measures are defined in 1.A.1 and 1.A.3.

CRF	Policies & Measures
1.A.3 Transport, 1.A.4 & 1.A.5 Other Mobile Sources and Machinery	a) 01_TRA: ACEA – voluntary agreement (CO_2 emissions of newly registered vehicles) 1998: (Vereinbarung mit den Herstellern) (ACEA, KAMA, JAMA1) [COM(98) 495 final.];(Basis: Strategy [COM(95) 689.]) b) 02_TRA: CO_2 Labelling and guidelines: Dir. 1999/94/EC (Basis: Strategy [COM(95) 689]) c) 03_TRA: Toll for heavy duty vehicle „Bundesgesetz über die Mauteinhebung auf Bundesstraßen“ (Federal Highways Toll Act, Federal Legal Gazette I No 109/2002); the toll was introduced on 1.1.2004 d) 04_TRA: EU-Biofuels directive: Dir 2003/30/EG. Implemented with the legislative act of “Kraftstoffverordnung” (Fuel Ordinance), 4.11.2004 (Federal Legal Gazette II No 417/2004). Substitution of fuel by bio fuels (measured by the energy content of fuels put in circulation): e) 05_TRA: EURO classification (EURO 4, 5 & 6 for passenger cars, light duty vehicles and heavy duty vehicles), EURO 3 for Motorcycles, stage 3b for off road machinery f) 06_TRA: Numerous measures concerning infrastructure, public transport and mobility management. g) 07_TRA Klima:aktiv →mobile programme
1.A.4 & 1.A.5 Other Sectors (Residential, Commercial, Agriculture and Other)	According to measure definition in CRF 1A1 all energy related measures are fixed in detail in the energy projection itself. The following measures and regulations for this category have been implemented: a) 01_RES increased use of renewable energy in the sector residential and commercial (Erneuerbare) b) 02_RES increased building renovation (Sanierung) c) 03_RES RES increased replacement of heating systems (Heizkesseltausch) d) 04_RES public support for new buildings (Neubau) e) 06_RES National energy efficiency action plan (Energieeffizienzaktionsplan, EEAP) in the residential and commercial sector without fuel energy for heating and hot water **Status 2006 – Status 2009** The 2006 measures are included in the 2009 scenario. The allocation of measures to groups is slightly different, due to the new model applied in this sector.
1.B Fugitive Emissions from fuels	No existing policies and measures.
2 Industrial Processes	a) 07_IP, 08_IP, 09_IP Halocarbons and SF_6: The scenario includes the Austrian Regulation on fluorinated gases (Federal Legal Gazette II No 447/2002) and its amendment 2007 (Federal Legal Gazette II No 139/2007), the EC Regulation on certain fluorinated greenhouse gases (842/2006/EC) and the EC Directive relating to emissions from air-conditioning systems in motor vehicles (2006/40/EC). **Status 2006 – Status 2009** The voluntary reduction measure is no longer included.

CRF	Policies & Measures
3 Solvent and Other Product Use	a) 01_IP Solvent Ordinance b) 02_IP Ordinance for paint finishing system c) 03_IP Federal Ozone Law d) 04_IP_ Ordinance for industrial facilities and installations applying chlorinated hydrocarbon e) 05_IP Ordinance for emissions of volatile organic compounds (VOC) due to the use of organic solvents in certain activities and installations f) 06_IP Ordinance on the limitation of emissions during the use of solvents containing lightly volatile halogenated hydrocarbons in industrial facilities and installations
4 Agriculture	The following policies and measures are considered implemented: 01_AGR Common Agricultural Policy (CAP) 2003 reform 02_AGR Austrian variant of implementation 03_AGR Funds transfer from "modulation" 04_AGR Land is maintained in good agricultural and ecological condition ("cross compliance") 05_AGR The programme for rural development is maintained in an unmodified way 06_AGR Implementation of the biofuels directive in Austria 07_AGR Grassland maintenance 08_AGR Prices increase for the crops
6 Waste	a) Austrian landfill ordinance (deposition of untreated biodegradable waste) Federal Legal Gazette No 164/1996 of the year 1996 according to the Austrian Waste Management Act. b) Austrian landfill ordinance (collection and drainage of landfill gas) c) Remediation of Contaminated Sites Act Federal Legal Gazette No 299/1989 d) The Guideline for the Mechanical Biological Treatment of Wastes

7.3 "With Additional Measures"

Table 27: PAMs included in the "With Additional Measures" Scenario.

CRF	Measures
1.A.1 Energy industries	Measures are defined in the energy projection. For the scenario WAM the following additional measures have been considered, which are relevant for the whole sector energy industry: a) 07_EN: Directive 2006/32/EC on energy end-use efficiency and energy services and the corresponding first Austrian energy efficiency action plan b) 02_EN: Amendment to the green electricity act 2008 (Federal Legal Gazette I No 114/2008): more stringent exploitation of hydropower c) 08_EN: Eco Design Directive and amendments (2005/32/EC) thereto

CRF	Measures
1.A.2 Manufacturing Industries and Construction	There are no sector-specific additional measures. Energy-related measures are defined in 1.A.1. and 1.A.3.
1.A.3 Transport, 1.A.4 & 1.A.5 Other Mobile Sources and Machinery	In this scenario further measurements are considered which are estimated to have an additional effect. a) 08_TRA: Enhanced fuel efficiency of passenger cars b) 09_TRA: Control of speed limits, traffic control systems and fuel saving driving style **Status 2006 – Status 2009** The measure 'bringing fuel prices in line with neighbouring countries' is covered in the sensitivity analysis but not included in the wam scenario in 2009. Measures aimed at transport demand are not quantifiable in the course of this study and therefore not included in the scenario in 2009.
1.A.4 & 1.A.5 Other Sectors (Residential, Commercial, Agriculture and Other)	In this scenario further measures are considered which have an effect on emissions from households. a) 05_RES additional measures to reduce energy consumption in the sectors residential and commercial b) 07_RES additional measures to reduce electric power consumption in the sector residential and commercial without energy use for heating and hot water **Status 2006 – Status 2009** The "measures in the area of energy efficiency" are included in 2009, but due to the new model used, "increase of fuel levies" is no longer considered in the scenario.
1.B Fugitive Emissions from fuels	There are no sector-specific additional measures
2 Industrial Processes	No additional measures are assumed for Halocarbons and SF_6.
3 Solvent and Other Product Use	There are no sector-specific additional measures
4 Agriculture	The scenario "With Measures" plus the following modifications are implemented: a) 09_AGR 25% more organic farming payments for investments in emission reducing animal production technologies (funded by the programme for rural development) e. g. slurry and manure store facilities, slurry hose techniques b) 10_AGR payments for investments in emission reducing animal production technologies c) 11_AGR Set aside additional land for short rotation forests (+ 5 000 ha in 2008 and + 20 000 ha from 2010 onwards) d) 12_AGR Usage of 800 000 m^3 slurry for biogas production e) 13_AGR Usage of 13 500 hectares of set aside land for biogas production from silage-maize (from 2008 on) f) 14_AGR Usage of 10 000 ha silage of grassland and alfalfa (from 2008 on)
6 Waste	A discussion with experts about additional measures in the sector waste came to the conclusion that no additional measures in the field of waste management were foreseen until 2020. The state of the art of the technical facilities of landfills and mechanical biological plants is fully developed and the separate collection and recycling of biodegradable waste has reached a high level. From today's perspective there will be no further innovative development in the next years regarding greenhouse gas emission minimisation.

8 CHANGES WITH RESPECT TO SUBMISSION 2006

Changes compared to the last GHG emission projections 2006 are presented in this chapter. Generally there are three main factors influencing these changes:

1) Recalculations in the GHG inventory that are triggered by methodological changes. This led, consequently, also to recalculations of the emission projections, as the methods are applied consistently for the calculation of historical and forecast emissions.
2) Assumptions for activity forecasts have changed. These changes might be triggered by revised economic or technical scenarios, additional policies and measures considered, and revisions of policies or measures e.g. due to amendments to legal texts.
3) A change of the model used for activity or emission scenarios.

The following table shows a comparison of historical and forecast total national emissions.

Table 28: Comparison of projections 2006 with projections 2009 – National Total.

Total – wm	**1990**	**2003**	**2005**	**2010**	**2015**	**2020**
Projections 2006	78 357	91 069	89 028	89 933	92 109	96 263
Projections 2009	79 037	93 112	92 832	93 873	95 473	98 112
Difference	680	2 043	3 804	3 940	3 364	1 849
Total – wam						
Projections 2006	78 357	91 069	88 214	80 968	84 137	87 299
Projections 2009	79 037	93 112	92 832	92 871	91 582	89 605
Difference	680	2 043	4 618	11 903	7 445	2 306

The following tables present changes of historical and forecast emissions by sector.

8.1.1 Energy Industries (1.A.1)

Table 29: Comparison of projections 2006 with projections 2009 – Energy Industries.

1.A.1 – wm	**1990**	**2003**	**2005**	**2010**	**2015**	**2020**
Projections 2006	13 672	16 105	15 086	16 687	18 089	21 200
Projections 2009	13 844	16 192	16 167	17 518	17 193	18 554
Difference	171	87	1 081	831	-896	-2 647
1.A.1 – wam						
Projections 2006	13 672	16 105	14 781	14 042	17 336	20 264
Projections 2009	13 844	16 192	16 167	16 763	15 230	13 988
Difference	171	87	1 386	2 721	-2 106	-6 277

The changes have been caused by a switch to a new model for the energy projection. While a macroeconomic model was used for the previous calculations, an optimisation model (BALMOREL) has now been used for this projection. This has led to a completely new set of input data.

Assumptions have been changed under the impact of the Water Framework Directive and the Austrian legislation (e.g. Green Electricity Act).

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

Table 30: Comparison of projections 2006 with projections 2009 – Manufacturing Industries and Construction.

1.A.2 – wm	1990	2003	2005	2010	2015	2020
Projections 2006	13 138	14 338	14 961	15 582	16 514	17 543
Projections 2009	12 773	14 571	15 832	15 767	17 011	18 045
Difference	-365	232	871	185	497	502
1.A.2 – wam						
Projections 2006	13 138	14 338	14 592	15 123	16 130	17 139
Projections 2009	12 773	14 571	15 832	15 767	17 011	18 045
Difference	-365	232	1 240	644	881	906

The changes have resulted from the use of new activity data derived from a scenario run of the macroeconomic model.

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

Table 31: Comparison of projections 2006 with projections 2009 – Transport.

1.A.3 – wm	1990	2003	2005	2010	2015	2020
Projections 2006	12 637	22 996	22 028	21 584	22 139	22 870
Projections 2009	14 023	24 114	25 340	24 043	25 460	26 329
Difference	1 387	1 118	3 312	2 459	3 321	3 459
1.A.3 – wam						
Projections 2006	12 637	22 996	22 020	16 062	15 684	15 443
Projections 2009	14 023	24 114	25 340	23 883	24 194	24 224
Difference	1 387	1 118	3 320	7 822	8 510	8 781

The projection 2009 shows, for both scenarios (wm/wam), higher emissions than in the projection of 2006. This difference is basically due to a new transport demand model. This model predicts different transport performances for all relevant vehicle categories, see Table 32. Another reason for the divergence in the wm scenario is an adapted plan for biofuels.

The wam scenario 2009 is not as optimistic as the wam scenario in 2006. The reason is that instead of five assumed wam measures in the projection 2006, only two measures have now been quantified in the current year 2009. Measures aimed at transport demand are not quantifiable within the scope of this study.

(a) The new transport demand model, see chapter 5.1.3.
The transport demand model used for the projection 2009 leads to different transport volume data; this can be seen in the following table:

Table 32: Scenario comparison (veh.-km).

Million Veh.-km	Projection 2006	Projection 2009	Change rel.
1990	48 359	49 866	3%
2003	84 050	86 284	3%
2005	83 263	92 107	11%
2010	87 418	92 238	6%
2015	91 251	99 592	9%
2020	94 992	104 852	10%

The effect in CO_2 emissions can be seen in next table.

Table 33: Scenario comparison (CO_2 emissions 1.A.3.b).

1 A 3 b	Projection 2006	Projection 2009	Change rel.
1990	11 924	13 286	11%
2003	21 883	23 080	5%
2005	20 928	24 145	15%
2010	20 555	22 714	11%
2015	21 112	24 025	14%
2020	21 812	24 832	14%

(b) For new assumptions concerning fuels and fuel types see chapter 5.1.3.

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

Table 34: Comparison of projections 2006 with projections 2009 – Other Energy Sectors.

1.A.4 & 1.A.5 – wm	**1990**	**2003**	**2005**	**2010**	**2015**	**2020**
Projections 2006	15 119	15 337	14 998	14 399	13 747	12 713
Projections 2009	14 468	15 694	13 690	14 455	13 649	12 789
Difference	-651	356	-1 308	56	-98	75
1.A.4 & 1.A.5 – wam						
Projections 2006	15 119	15 337	14 943	14 164	13 666	12 646
Projections 2009	14 468	15 694	13 690	14 436	13 022	10 991
Difference	-651	356	-1 252	272	-644	-1 655

Even though a new top-down approach (model ERNSTL) has been applied for the forecast of stationary sources in the “Other Sectors”, the reductions in the wm scenario are almost the same as in the last projection (2006). The difference of the old projection (2006) to the results of the inventory in the year 2005 shows the weakness of the old model in calculating the outputs for first years.

The larger difference in the wam scenario between the forecasts simply arises from a larger number of additional measures considered in the new projection.

8.1.5 Fugitive Emissions from Fuels (1.B)

Table 35: Comparison of projections 2006 with projections 2009 – Fugitive emissions.

1.B – wm	**1990**	**2003**	**2005**	**2010**	**2015**	**2020**
Projections 2006	380	554	479	509	500	485
Projections 2009	487	842	876	959	977	975
Difference	107	287	397	450	477	490
1.B – wam						
Projections 2006	380	554	479	509	500	485
Projections 2009	487	842	876	959	977	975
Difference	107	287	397	450	477	490

The differences can be seen in historical and forecast data; they are linked to methodological improvements in the inventory, especially the use of IPCC methodology for calculating emissions from the natural gas distribution system.

8.1.6 Industrial Processes (2)

Table 36: Comparison of projections 2006 with projections 2009 – Industrial Processes.

2 – wm	**1990**	**2003**	**2005**	**2010**	**2015**	**2020**
Projections 2006	9 937	10 548	10 474	10 717	10 991	11 499
- of which F-gases	1 585	1 507	1 466	1 473	1 370	1 469
Projections 2009	10 111	10 662	10 306	10 954	11 393	11 784
- of which F-gases	1 605	1 559	1 320	1 431	1 414	1 608
Difference	174	114	-167	236	402	285
- of which F-gases	20	52	-146	-42	44	139
2 – wam						
Projections 2006	9 937	10 548	10 397	10 639	10 725	11 405
Projections 2009	10 111	10 662	10 306	10 954	11 393	11 784
Difference	174	114	-90	315	668	379

Changes in emissions from Industrial Processes without F-gases have resulted from the use of new activity data derived from a scenario run of the macroeconomic model.

The differences of F-gas emissions are due to:

- 1990–2003: inclusion of the sources solvents and aerosols in the inventory
- 2005–2010: a decrease of emissions in the inventory and, consequently, in the projections in semi-conductor production
- 2015–2020: the projections 2006 did not include the amendment to the Austrian F-gas Ordinance.

8.1.7 Solvents and other product use (3)

Table 37: Comparison of projections 2006 with projections 2009 – Solvents and other product use.

3 – wm	1990	2003	2005	2010	2015	2020
Projections 2006	515	426	421	411	411	411
Projections 2009	512	423	394	412	419	426
Difference	-3	-3	-28	1	8	15
3 – wam						
Projections 2006	515	426	421	411	411	411
Projections 2009	512	423	394	412	419	426
Difference	-3	-3	-28	1	8	15

To improve and update the solvent model a study (WINDSPERGER & SCHMIDT-STEJSKAL, 2008) was finalized; the main results will be presented in the NIR 2009. The revision of the model included an update of activity data by using the structural business statistics from 2000 onwards and updating the activity data on non-solvent use and the solvent content of products. Furthermore emission factors were updated with information from surveys of companies and associations which were extrapolated using structural business statistics provided by Statistics Austria.

8.1.8 Agriculture (4)

Table 38: Comparison of projections 2006 with projections 2009 – Agriculture.

4 – wm	1990	2003	2005	2010	2015	2020
Projections 2006	8 456	7 349	7 286	7 261	7 333	7 384
Projections 2009	9 171	8 020	7 848	7 797	7 811	7 893
Difference	714	671	563	536	478	509
4 – wam						
Projections 2006	8 456	7 349	7 286	7 236	7 299	7 349
Projections 2009	9 171	8 020	7 848	7 729	7 775	7 855
Difference	714	671	563	493	476	506

The differences can be seen in historical and forecast data; they are linked to methodological improvements in the inventory, especially the revision of the N-excretion values.

8.1.9 Waste (CRF Source Category 6)

Table 39: Comparison of projections 2006 with projections 2009 – Waste.

6 – wm	**1990**	**2003**	**2005**	**2010**	**2015**	**2020**
Projections 2006	4 503	3 415	3 296	2 782	2 385	2 157
Projections 2009	3 649	2 594	2 378	1 915	1 495	1 237
Difference	-855	-820	-918	-867	-890	-920
6 – wam						
Projections 2006	4 503	3 415	3 296	2 782	2 385	2 157
Projections 2009	3 649	2 594	2 378	1 915	1 495	1 237
Difference	-855	-820	-918	-867	-890	-920

Until 2006 a country-specific methodology was used for inventory calculations and thus also for previous emission projections. In 2007, according to the results of a national study (SCHACHERMAYER 2005), the methodology was changed to Tier 2. This method is now also used for emission projections and explains the majority of the changed projection figures. In the 2006 inventory the methodology for calculating CH_4 emissions from wastewater treatment was also changed from country-specific to IPCC, resulting in lower emissions and emission forecasts.

9 ABBREVIATIONS

AEA.................... Austrian Energy Agency

BMLFUW............ Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft (Federal Ministry for Agriculture, Forestry, Environment and Water Management)

CHP .... Combined heat and power

CRF.................... Common Reporting Format

EEG .... Energy Economics Group

GDP .... gross domestic product

Gg .... Gigagram

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

LEAP.................. Long range Energy Alternatives Planning System

PAM .... Policies and Measures

SVO .... Straight Vegetable Oil

Tg....................... Terragram

UFI .... Domestic environmental support scheme (Umweltförderung im Inland)

UNFCCC............ United Framework Convention on Climate Change

wam .... with additional measures

WIFO.................. Österreichisches Wirtschaftsforschungsinstitut

wm .... with measures

Greenhouse gases

CH_4..................... Methane

CO_2 .... Carbon Dioxide

N_2O .... Nitrous Oxide

HFC.................... Hydroflurocarbons

PFC.................... Perfluorocarbons

SF_6 .... Sulphur hexafluoride

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ANNEX 1: INFORMATION EXTRACTED FROM REPORTING TEMPLATE

Emission Projections – with measures

Table 40: CO_2 Emissions in 2005 and Projections 2010, 2015 and 2020 in Gg – with measures.

CO_2 [Gg]	2005	2010	2015	2020
Total (without LULUCF)	**79 009**	**80 554**	**82 602**	**85 210**
1. Energy	**70 080**	**71 006**	**72 557**	**74 961**
A. Fuel Combustion Activities	69 875	70 777	72 346	74 777
1. Energy Industries	16 095	17 382	17 034	18 369
a. Public Electricity and Heat production	12 743	13 824	13 409	14 673
b. Petroleum Refining	2 827	2 842	2 842	2 842
c. Manufacture of Solid Fuels and Other Energy Industries	525	717	782	855
2. Manufacturing Industries and Construction	**15 684**	**15 619**	**16 863**	**17 893**
a. Iron and Steel	6 450	6 626	7 099	7 267
b. Non-Ferrous Metals	220	194	185	192
c. Chemicals	1 583	1 564	1 804	2 087
d. Pulp, Paper and Print	2 286	2 079	2 313	2 521
e. Food Processing, Beverages and Tobacco	904	1 007	1 107	1 190
f. Other	4 242	4 149	4 355	4 636
3. Transport	**24 995**	**23 821**	**25 301**	**26 214**
a. Civil Aviation	67	82	91	100
b. Road Transportation	24 145	22 714	24 025	24 832
c. Railways	162	159	155	148
d. Navigation	76	67	72	76
e. Other Transportation	545	798	957	1 057
4. Other Sectors	**13 056**	**13 908**	**13 100**	**12 249**
a. Commercial/Institutional	2 250	4 347	4 368	4 329
b. Residential	9 804	8 564	7 716	6 895
c. Agriculture/Forestry/Fisheries	1 003	997	1 016	1 024
5. Other	**44**	**46**	**49**	**52**
a. Stationary	NO	NO	NO	NO
b. Mobile	44	46	49	52
B. Fugitive Emissions from Fuels	205	229	211	184
1. Solid Fuels	0	0	0	0
2. Oil and Natural Gas	205	229	211	184
2. Industrial Processes	8 697	9 285	9 778	9 978
A. Mineral Products	3 120	3 448	3 517	3 579
B. Chemical Industry	563	602	630	628
C. Metal Production	5 014	5 235	5 631	5 771
3. Solvent and Other Product Use	220	250	255	259
6. Waste	**12**	**12**	**12**	**12**
C. Waste Incineration	12	12	12	12

Table 41: CH_4 Emissions in 2005 and Projections 2010, 2015 and 2020 in Gg – with measures.

CH_4 [Gg]	**2005**	**2010**	**2015**	**2020**
Total (without LULUCF)	**341.8**	**326.1**	**309.3**	**303.7**
1. Energy	**48.8**	**48.8**	**51.0**	**52.3**
A. Fuel Combustion Activities	16.9	14.1	14.5	14.6
1. Energy Industries	0.2	0.4	0.5	0.5
2. Manufacturing Industries and Construction	0.6	0.7	0.7	0.8
3. Transport	1.3	0.7	0.5	0.4
4. Other Sectors	14.8	12.3	12.8	12.9
B. Fugitive Emissions from Fuels	32.0	34.7	36.5	37.7
1. Solid Fuels	0.0	0.0	0.0	0.0
2. Oil and Natural Gas	32.0	34.7	36.5	37.7
2. Industrial Processes	**0.8**	**0.9**	**0.9**	**0.9**
B. Chemical Industry	0.7	0.9	0.9	0.9
4. Agriculture	**195.4**	**204.6**	**205.8**	**211.5**
A. Enteric Fermentation	153.1	148.3	146.6	147.0
1. Cattle	143.3	138.5	136.6	137.1
2. Buffalo	NO	0.0	0.0	0.0
3. Sheep	2.6	2.7	2.7	2.7
4. Goats	0.3	0.3	0.3	0.3
5. Camels and Llamas	NO	0.0	0.0	0.0
6. Horses	1.6	1.6	1.6	1.6
7. Mules and Asses	IE	0.0	0.0	0.0
8. Swine	4.8	4.8	4.8	4.8
9. Poultry	0.3	0.3	0.3	0.3
10. Other	0.3	0.3	0.3	0.3
B. Manure Management	41.9	55.8	58.8	64.0
1. Cattle	21.8	34.5	37.9	42.5
2. Buffalo	NO	0.0	0.0	0.0
3. Sheep	0.1	0.1	0.1	0.1
4. Goats	0.0	0.0	0.0	0.0
5. Camels and Llamas	NO	0.0	0.0	0.0
6. Horses	0.1	0.1	0.1	0.1
7. Mules and Asses	IE	0.0	0.0	0.0
8. Swine	18.9	20.1	19.8	20.4
9. Poultry	1.0	1.0	0.9	0.9
D. Agricultural Soils	0.4	0.4	0.4	0.4
F. Field Burning of Agricultural Residues	0.1	0.1	0.1	0.1
6. Waste	**96.8**	**71.7**	**51.6**	**39.0**
A. Solid Waste Disposal on Land	93.2	67.6	47.6	35.2
B. Waste Water Handling	2.0	1.4	1.3	1.1
C. Waste Incineration	0.0	0.0	0.0	0.0
D. Other	1.6	2.7	2.7	2.7

Table 42: N_2O Emissions in 2005 and Projections 2010, 2015 and 2020 in Gg – with measures.

N_2O [Gg]	2005	2010	2015	2020
Total (without LULUCF)	17.18	16.26	16.00	15.86
1. Energy	**2.58**	**2.30**	**2.13**	**2.04**
A. Fuel Combustion Activities	2.58	2.30	2.13	2.04
1. Energy Industries	0.22	0.41	0.48	0.56
2. Manufacturing Industries and Construction	0.44	0.43	0.43	0.44
3. Transport	1.03	0.67	0.48	0.34
4. Other Sectors	0.90	0.78	0.74	0.70
B. Fugitive Emissions from Fuels	0.00	0.00	0.00	0.00
2. Industrial Processes	**0.88**	**0.87**	**0.80**	**0.84**
B. Chemical Industry	0.88	0.87	0.80	0.84
3. Solvent and Other Product Use	**0.56**	**0.52**	**0.53**	**0.54**
4. Agriculture	**12.08**	**11.29**	**11.26**	**11.14**
A. Enteric Fermentation	0.00	0.00	0.00	0.00
B. Manure Management	2.83	2.41	2.22	2.06
D. Agricultural Soils	9.25	8.88	9.03	9.07
1. Direct Soil Emissions	5.04	4.87	4.97	5.00
2. Pasture, Range and Paddock Manure (3)	0.71	0.55	0.54	0.53
3. Indirect Emissions	3.51	3.47	3.52	3.54
6. Waste	**1.07**	**1.28**	**1.29**	**1.31**
A. Solid Waste Disposal on Land	0.00	0.00	0.00	0.00
B. Waste Water Handling	0.85	0.90	0.91	0.93
C. Waste Incineration	0.00	0.00	0.00	0.00
D. Other	0.23	0.38	0.38	0.38

Table 43: HFC, PFC and SF_6 Emissions in 2005 and Projections 2010, 2015 and 2020 in Gg CO_2 equivalents – with measures & with additional measures.

	2005	2010	2015	2020
HFC [Gg CO_2 eq]				
Total (without LULUCF)	**908**	**835**	**819**	**871**
2. Industrial Processes	**908**	**835**	**819**	**871**
F. Consumption of Halocarbons and SF_6	908	835	819	871
PFC [Gg CO_2 eq]				
Total (without LULUCF)	**125**	**160**	**155**	**155**
2. Industrial Processes	**125**	**160**	**155**	**155**
F. Consumption of Halocarbons and SF_6	125	160	155	155
SF_6 [Gg CO_2 eq]				
Total (without LULUCF)	**286**	**436**	**440**	**582**
2. Industrial Processes	**286**	**436**	**440**	**582**
F. Consumption of Halocarbons and SF_6	286	436	440	582

Emission Projections – with additional measures

Table 44: CO_2 Emissions in 2005 and Projections 2010, 2015 and 2020 in Gg – with additional measures.

CO_2 [Gg]	2005	2010	2015	2020
Total (without LULUCF)	**79 009**	**79 632**	**78 756**	**76 750**
1. Energy	**70 080**	**70 084**	**68 711**	**66 501**
A. Fuel Combustion Activities	69 875	69 855	68 500	66 317
1. Energy Industries	16 095	16 628	15 075	13 816
a. Public Electricity and Heat production	12 743	13 069	11 451	10 120
b. Petroleum Refining	2 827	2 842	2 842	2 842
c. Manufacture of Solid Fuels and Other Energy Industries	525	717	782	855
2. Manufacturing Industries and Construction	15 684	15 619	16 863	17 893
a. Iron and Steel	6 450	6 626	7 099	7 267
b. Non-Ferrous Metals	220	194	185	192
c. Chemicals	1 583	1 564	1 804	2 087
d. Pulp, Paper and Print	2 286	2 079	2 313	2 521
e. Food Processing, Beverages and Tobacco	904	1 007	1 107	1 190
f. Other	4 242	4 149	4 355	4 636
3. Transport	24 995	23 667	24 042	24 113
a. Civil Aviation	67	82	91	100
b. Road Transportation	24 145	22 561	22 766	22 732
c. Railways	162	159	155	148
d. Navigation	76	67	72	76
e. Other Transportation	545	798	957	1 057
4. Other Sectors	13 056	13 895	12 470	10 442
a. Commercial/Institutional	2 250	4 271	3 791	3 008
b. Residential	9 804	8 626	7 664	6 410
c. Agriculture/Forestry/Fisheries	1 003	997	1 016	1 024
5. Other	44	46	49	52
a. Stationary	NO	0	0	0
b. Mobile	44	46	49	52
B. Fugitive Emissions from Fuels	205	229	211	184
1. Solid Fuels	0	0	0	0
2. Oil and Natural Gas	205	229	211	184
2. Industrial Processes	**8 697**	**9 285**	**9 778**	**9 978**
A. Mineral Products	3 120	3 448	3 517	3 579
B. Chemical Industry	563	602	630	628
C. Metal Production	5 014	5 235	5 631	5 771
3. Solvent and Other Product Use	**220**	**250**	**255**	**259**
6. Waste	**12**	**12**	**12**	**12**
C. Waste Incineration	12	12	12	12

Table 45: CH_4 Emissions in 2005 and Projections 2010, 2015 and 2020 in Gg – with additional measures.

CH_4 [Gg]	**2005**	**2010**	**2015**	**2020**
Total (without LULUCF)	**341.8**	**323.0**	**308.5**	**303.2**
1. Energy	**48.8**	**48.7**	**51.2**	**52.8**
A. Fuel Combustion Activities	16.9	14.0	14.7	15.1
1. Energy Industries	0.2	0.4	0.5	0.5
2. Manufacturing Industries and Construction	0.6	0.7	0.7	0.8
3. Transport	1.3	0.7	0.5	0.4
4. Other Sectors	14.8	12.2	13.0	13.4
B. Fugitive Emissions from Fuels	32.0	34.7	36.5	37.7
1. Solid Fuels	0.0	0.0	0.0	0.0
2. Oil and Natural Gas	32.0	34.7	36.5	37.7
2. Industrial Processes	**0.8**	**0.9**	**0.9**	**0.9**
B. Chemical Industry	0.7	0.9	0.9	0.9
4. Agriculture	**195.4**	**201.7**	**204.8**	**210.5**
A. Enteric Fermentation	153.1	148.3	146.4	146.9
1. Cattle	143.3	138.4	136.5	137.0
2. Buffalo	NO	0.0	0.0	0.0
3. Sheep	2.6	2.7	2.7	2.7
4. Goats	0.3	0.3	0.3	0.3
5. Camels and Llamas	NO	0.0	0.0	0.0
6. Horses	1.6	1.6	1.6	1.6
7. Mules and Asses	IE	0.0	0.0	0.0
8. Swine	4.8	4.8	4.8	4.8
9. Poultry	0.3	0.3	0.3	0.3
10. Other	0.3	0.3	0.3	0.3
B. Manure Management	41.9	52.9	57.9	63.1
1. Cattle	21.8	33.2	37.5	42.1
2. Buffalo	NO	0.0	0.0	0.0
3. Sheep	0.1	0.1	0.1	0.1
4. Goats	0.0	0.0	0.0	0.0
5. Camels and Llamas	NO	0.0	0.0	0.0
6. Horses	0.1	0.1	0.1	0.1
7. Mules and Asses	IE	0.0	0.0	0.0
8. Swine	18.9	18.7	19.3	19.9
9. Poultry	1.0	0.9	0.9	0.9
D. Agricultural Soils	0.4	0.4	0.4	0.4
F. Field Burning of Agricultural Residues	0.1	0.1	0.1	0.1
6. Waste	**96.8**	**71.7**	**51.6**	**39.0**
A. Solid Waste Disposal on Land	93.2	67.6	47.6	35.2
B. Waste Water Handling	2.0	1.4	1.3	1.1
C. Waste Incineration	0.0	0.0	0.0	0.0
D. Other	1.6	2.7	2.7	2.7

Table 46: N_2O Emissions in 2005 and Projections 2010, 2015 and 2020 in Gg – with additional measures.

N_2O [Gg]	**2005**	**2010**	**2015**	**2020**
Total (without LULUCF)	**17.18**	**16.21**	**15.92**	**15.74**
1. Energy	**2.58**	**2.26**	**2.09**	**1.98**
A. Fuel Combustion Activities	2.58	2.26	2.09	1.98
1. Energy Industries	0.22	0.41	0.47	0.52
2. Manufacturing Industries and Construction	0.44	0.43	0.43	0.44
3. Transport	1.03	0.65	0.46	0.33
4. Other Sectors	0.90	0.77	0.74	0.69
B. Fugitive Emissions from Fuels	0.00	0.00	0.00	0.00
2. Industrial Processes	**0.88**	**0.87**	**0.80**	**0.84**
B. Chemical Industry	0.88	0.87	0.80	0.84
3. Solvent and Other Product Use	**0.56**	**0.52**	**0.53**	**0.54**
4. Agriculture	**12.08**	**11.27**	**11.21**	**11.08**
A. Enteric Fermentation	0.00	0.00	0.00	0.00
B. Manure Management	2.83	2.41	2.22	2.06
D. Agricultural Soils	9.25	8.86	8.99	9.02
1. Direct Soil Emissions	5.04	4.86	4.94	4.97
2. Pasture, Range and Paddock Manure (3)	0.71	0.55	0.53	0.53
3. Indirect Emissions	3.51	3.46	3.51	3.52
6. Waste	**1.07**	**1.28**	**1.29**	**1.31**
A. Solid Waste Disposal on Land	NA	NA	NA	NA
B. Waste Water Handling	0.85	0.90	0.91	0.93
C. Waste Incineration	0.00	0.00	0.00	0.00
D. Other	0.23	0.38	0.38	0.38

Indicators for projection to monitor and evaluate progress

According to Annex III of Commission Decision 2005/166/EC

Table 47: Indicators for projection to monitor and evaluate progress.

Indicator/Numerator/denominator	2010	2015	2020
MACRO **Total CO_2 intensity of GDP, t/Mio Euro**	**314.0**	**287.0**	**264.9**
Total CO_2 emissions, kt	80 554	82 602	85 210
GDP, Bio Euro (EC2000)	256.5	287.8	321.7
TRANSPORT C0 **Passenger Car CO_2 Gg/Mvkm)**	**0.159**	**0.150**	**0.143**
CO_2 emissions from passenger cars, kt	11 329	11 504	11 499
Number of kilometres by passenger cars, Mkm	71 061	76 602	80 524
TRANSPORT D0 **Freight Transport CO_2 (Gg/Mtkm)**	**0.070**	**0.068**	**0.067**
CO_2 emissions from freight transport (All modes), kt	10 967	12 102	12 915
Freight transport (All modes), Mtkm	157 162	177 651	193 507
INDUSTRY A1 **Energy related CO_2 intensity of industry, t/Mio Euro**	**220.4**	**206.1**	**189.6**
CO_2 emissions from fossil fuel combustion in industry, kt	15 619	16 863	17 893
Gross value-added total industry, Bio Euro (EC2000)	70.9	81.8	94.4
HOUSEHOLDS A.1 **Specific CO_2 emissions of households, t/dwelling**	**2.38**	**2.07**	**1.80**
CO_2 emissions from fossil fuel consumption households, kt	8 564	7 716	6 895
Stock of permanently occupied dwellings, 1000	3 602	3 725	3 827
SERVICES A0 **CO_2 intensity of the Service Sector, t/Mio Euro**	**30.3**	**27.3**	**24.1**
CO_2 emissions from fossil fuel consumption in services, kt	4 347	4 368	4 329
Gross value-added services, Bio Euro (EC2000)	143.7	160.0	179.9
TRANSFORMATION B0 **Specific CO_2 emissions of public and autoproducer power plants, t/TJ**	**102.3**	**90.9**	**86.1**
CO_2 emissions from public and autoproducer thermal power stations, kt	14 748	14 805	16 289
All products –output by public and autoproducer thermal power stations, PJ	144.2	162.9	189.1
AGRICULTURE **Specific N_2O emissions of fertiliser and manure use, kg/kg**	**0.02**	**0.02**	**0.02**
N_2O emissions from synthetic fertiliser and manure use, kt	3.8	3.9	3.9
Use of synthetic fertiliser and manure, kt nitrogen	193.2	197.4	198.7
AGRICULTURE **Specific CH_4 emissions of cattle production, kg/head**	**71.3**	**71.7**	**72.3**
CH_4 emissions from cattle, kt	138.5	136.6	137.1
Cattle population, 1 000 head	1 941	1 905	1 896
WASTE **Specific CH_4 emissions from landfills, kt/kt**	**NA**	**NA**	**NA**
CH_4 emissions from landfills, kt	67.6	47.6	35.2
Municipal solid waste going to landfills, kt*	0.0	0.0	0.0

** no MSW landfilled in Austria anymore, only sorting residues*

List of parameters for projections

According to Annex IV of Commission Decision 2005/166/EC

Table 48: Parameters for projections – general economic parameters.

		2010	2015	2020
1a. Gross Domestic Product	Value (millon €)	256 517	287 825	321 696
1b. Gross Domestic Product growth Rate	Annual growth rate (%)	2.5%	2.3%	2.3%
2a. Population	Thousand people	8 427	8 561	8 672
3. International coal prices	€ per GJ	6.59	7.36	7.44
4. International oil prices	€ per GJ	14.93	14.93	14.93
5. International gas prices	€ per GJ	9.62	9.62	9.62

Table 49: Parameters for projections – Energy sector: inland consumption, electricity generation.

		2010	2015	2020
6. Total gross inland consumption	PJ	1 488	1 577	1 676
6a. – Oil (fossil)	PJ	540	549	558
6b. – Gas (fossil)	PJ	339	388	448
6c. – solid fuels	PJ	193	180	173
6d. – Renewables	PJ	228	259	285
6e. – Nuclear (IEA definition for energy calc.)	PJ	0	0	0
6f. Net Electricity import (-+)	PJ	29	31	36
6g. – Other[1)]	PJ	159	171	177
Total gross electricity generation by fuel type	GWhe	65 484	72 715	80 686
7. – Oil (fossil)	GWhe	1 681	1 216	941
8. – Gas (fossil)	GWhe	9 676	15 833	23 416
9. – soild fuels	GWhe	7 355	5 108	3 953
10. – Renewable	GWhe	40 554	43 420	44 545
11. Nuclear (IEA definition for energy calc.)	GWhe	0	0	0
12. – Other [2)]	GWhe	6 217	7 138	7 831

[1)] electricity, heat, waste, H_2, coal (transport)

[2)] unallocable autoproducers and non-renewable waste

Table 50: Parameters for projections – Energy demand by sector.

		2010	2015	2020
Total Energy Demand	PJ	1 603.41	1 734.39	1 858.66
13. Energy Industries	PJ	422.58	477.78	534.48
13a. Oil (fossil)	PJ	47.03	42.58	41.25
13b. Gas (fossil)	PJ	111.57	147.34	195.11
13c. Solid fuels	PJ	155.65	157.54	149.74
13d. Renewables	PJ	75.96	93.92	109.60
13e. Nuclear (IEA definition for energy calc.)	PJ	0.00	0.00	0.00
13e. – Other[1)]	PJ	32.37	36.40	38.78
14. Industry	PJ	373.15	411.52	445.78
14a. Oil (fossil)	PJ	21.11	21.19	22.04
14b. Gas (fossil)	PJ	125.02	137.57	149.30
14c. Solid fuels	PJ	53.12	56.82	59.67
14d. Renewables	PJ	52.21	56.96	61.76
14e. Electricity	PJ	102.15	114.82	128.16
14f. Heat (from CHP)	PJ	10.17	11.04	11.80
14g. – Other	PJ	9.37	13.12	13.05
15. Commercial (Tertiary)	PJ	157.24	172.48	189.33
15a. Oil (fossil)	PJ	31.52	31.13	30.24
15b. Gas (fossil)	PJ	32.58	33.72	34.52
15c. Solid fuels	PJ	0.69	0.59	0.46
15d. Renewables	PJ	14.02	17.30	20.79
15e. Electricity	PJ	58.17	68.86	81.96
15f. Heat	PJ	20.27	20.88	21.35
16. Residential	PJ	283.35	277.58	271.33
16a. Oil (fossil)	PJ	62.30	53.69	45.83
16b. Gas (fossil)	PJ	58.78	57.16	55.06
16c. Solid fuels	PJ	5.13	4.03	2.83
16d. Renewables	PJ	77.83	83.01	85.29
16e. Electricity	PJ	53.75	53.10	55.01
16f. Heat	PJ	25.55	26.59	27.31
17. Transport		367.09	395.03	417.75
17a. Gasoline	PJ	69.56	70.41	72.50
of which biofuels	PJ	2.64	5.16	5.77
17b. Diesel	PJ	286.46	311.23	328.07
of which biofuels	PJ	19.49	23.75	31.06
17c. Jet Kerosine	PJ	1.63	1.79	1.95
17d. Other liquid fuels	PJ	0.11	0.11	0.11
17e. Gas (fossil)	PJ	0.32	1.42	3.39
17f. Renewables	PJ	0.76	0.96	1.16
17g. – Other[2)]	PJ	8.26	9.11	10.55

[1)] non-renewable waste; includes also electricity demand of sector energy and transportation losses

[2)] Sum of: H_2, Electricity, Coal

Table 51: Parameters for projections – Other.

		2010	2015	2020
Assumptions on weather parameters				
18a. Heating Degree Days	Annual HDD	3 245	3 187	3 133
Assumptions for the Industry Sector				
19. Gross value-added total industry, Bio Euro (EC2000)	Value (€)	70.86	81.82	94.39
21. The growth of the industrial sector in GDP	Annual growth rate (%)	2.48%	2.56%	2.73%
Metals	%	2.36	2.14	1.56
Mineral industries	%	0.90	0.38	-0.21
Paper and print	%	4.58	5.11	3.92
Chemistry	%	2.50	2.35	2.50
Others	%	3.11	2.88	3.00
Assumptions for the transport sector				
24b. Number of kilometres by passenger car, Mkm	Mkm	71 061	76 602	80 524
25b. Freight transport (all modes), Mtkm	Mtkm	157 162	177 651	193 507
Assumptions for buildings (in residential and commercial or tertiary sector)				
26. Gross value-added — services, Bio Euro (EC2000)	Value (€)	143.69	160.04	179.88
31a. The number of dwellings	1 000	3 602	3 725	3 827
Assumptions in the agriculture sector				
33. Total Cattle	1 000 heads	1 941	1 905	1 896
33a. Dairy cattle	1 000 heads	516	493	488
33b. Non-dairy cattle	1 000 heads	1 425	1 412	1 409
34. sheep	1 000 heads	335	338	338
35. swine	1 000 heads	3 216	3 226	3 228
36. poultry	1 000 heads	13 007	13 007	13 007
37. Other, please specify	1 000 heads	39	40	40
39. Fertilizer Used (Synthetic & Manure)	kt Nitrogen	193.2	197.4	198.7

Policies and Measures

Table 52: Policies & Measures I.

P&M-No	Status of policy, measure or group	Scenario	Name of policy or measure (or group)	Common and coordinated policy and measure (CCPM)
01_IP	implemented	WM	**Solvent Ordinance** (Lösungsmittelverordnung, LMV 2005): Federal Law Gazette (BGBl.) II No. 398/2005, amendment of Federal Law Gazette (BGBl.) 872/1995 ; amendment of Federal Law Gazette (BGBl.) 492/1991	Council Directive 2004/42/CE of the European Parliament and of the Council of 21 April 2004 on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products and amending Directive 1999/13/EC
02_IP	implemented	WM	**Ordinance for paint finishing system** (surface technology systems) (Lackieranlagen-Verordnung): Federal Law Gazette (BGBl.) No. 873/1995; amendment of Federal Law Gazette 27/1990	
03_IP	implemented	WM	**Federal Ozone Law**: Federal Law Gazette 309/1994; amendment of Federal Law Gazette 210/1992	
04_IP	implemented	WM	**Ordinance for industrial facilities and installations applying chlorinated hydrocarbon**: Federal Law Gazette (BGBl) No. 865/1994	
05_IP	implemented	WM	**Ordinance for volatile organic compounds (VOC) due to the use of organic solvents in certain activities and installations**; Federal Law Gazette II No. 301/2002 , amended by Federal Law Gazette	Council Directive 1999/13/EC of March 1999 on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain activities and installations
06_IP	implemented	WM	**Ordinance on the limitation of emission during the use of solvents containing lightly volatile halogenated hydrocarbons in industrial facilities and installations**: Federal Law Gazette II No. 411/2005	
01_EN	implemented	WM	**Domestic environmental support schemes (UFI)**	
02_EN	implemented	WM+ WAM	Promotion for electricity from renewable energy sources (RES): Green Elictricity Act (Federal Law Gazette I No. 149/2002 amended by Federal Law Gazette. I No. 114/2008)	En. supply: Electricity production from renewable energy sources (Dir 2001/77/EC)
03_EN	implemented	WM	**Emission Trading System (ETS)**: Emission Trading Directive (3003/87/EC)	Cross-cut: Emissions trading scheme (Dir 2003/87/EC) Cross-cut: Kyoto Protocol project mechanisms (Dir 2004/101/EC)
04_EN	implemented	WM	**EU Water Framework Directive**: (2000/60/EC)	Cross-cut: Emissions trading scheme (Dir 2003/87/EC)
05_EN	implemented	WM	**Austrian Climate and energy fund** (KLI.EN)	En. supply: Electricity production from renewable energy sources (Dir 2001/77/EC)

P&M-No	Status of policy, measure or group	Scenario	Name of policy or measure (or group)	Common and coordinated policy and measure (CCPM)
06_EN	implemented	WM	**Promotion for combined heat and power** (CHP): (Federal Law Gazette I No 45/2008)	En. supply: Promotion of cogeneration (Dir 2004/8/EC)
07_EN	planned	WAM	Directive 2006/32/EC on energy end-use efficiency and energy services and the corresponding first **Austrian energy efficiency action plan**	En. consumption: End-use efficiency and energy services (Dir 2006/32/EC)
08_EN	planned	WAM	**Eco Design Directive** and amendments (2005/32/EC) thereto	En. consumption: Ecodesign requirements for energy-using products (Dir 2005/32/EC)
01_WASTE	implemented	WM+ WAM	**landfill ordinance (deposition of untreated biodegradable waste)** (Federal Legal Gazette (BGBl.) No 164/1996)	Waste: Landfill Directive (Dir 1999/31/EC)
02_WASTE	implemented	WM+ WAM	**landfill ordinance (collection and drainage of landfill gas)** (Federal Legal Gazette (BGBl.) No 164/1996)	Waste: Landfill Directive (Dir 1999/31/EC)
03_WASTE	implemented	WM+ WAM	**Remediation of Contaminated Sites Act Federal Legal** Gazette No 299/1989	
04_WASTE	implemented	WM+ WAM	**Guideline for the Mechanical Biological Treatment of Waste** (BMLFUW 2002)	Waste: Landfill Directive (Dir 1999/31/EC)
01_IND	implemented	WM	**Environmental support schemes for installations** (UFI)	
02_IND	implemented	WM+ WAM	Promotion for electricity from renewable energy sources (RES): (Ökostromgesetz) **Green Elictricity Act** (Ökostromgesetz) (Federal Law Gazette I No. 149/2002 amended by Federal Law Gazette I No. 114/2008)	
03_IND	implemented	WM	**Emission Trading System** (ETS): Emission Trading Directive (3003/87/EC)	Cross-cut: Kyoto Protocol project mechanisms (Dir 2004/101/EC)
07_IP	implemented	WM	**Austrian F-gas Ordinance** (Federal Legal Gazette (BGBl) II No 447/2002) and its amendment 2007 (Federal Legal Gazette (BGBl.) II No 139/2007)	Ind. Process: F-gas regulation (Reg No 842/2006)
08_IP	adopted	WM	**EU F-gas Ordinance** (Federal Legal Gazette (BGBl.) II No 447/2002) and its amendment 2007 (Federal Legal Gazette (BGBl.) II No 139/2007) (842/2006/EC)	Ind. Process: F-gas regulation (Reg No 842/2006)
09_IP	adopted	WM	**HFC emissions from air conditioning in motor vehicles (Dir 2006/40/EC)**	HFC emissions from air conditioning in motor vehicles (Dir 2006/40/EC)
01_TRA	adopted	WM	**ACEA – voluntary agreement** (CO_2 emissions of newly registrated vehicles) 1998: (Vereinbarung mit den Herstellern) (ACEA, KAMA, JAMA1) [COM(98) 495 final.); (Basis: Strategy [COM (95) 689.])	Trans: Voluntary agreement with car manufacturers to reduce specific CO_2 emissions (ACEA, KAMA, JAMA)
02_TRA	implemented	WM+ WAM	**CO_2 labelling** and other measures to reduce emissions from passenger cars	Trans: Labelling of new passenger cars (Dir 1999/94/EC)
03_TRA	adopted	WM+ WAM	**Mileage based toll for lorries**	

P&M-No	Status of policy, measure or group	Scenario	Name of policy or measure (or group)	Common and coordinated policy and measure (CCPM)
04_TRA	implemented	WM+ WAM	**Promotion of biofuels**, tax excamption resp. Reduction for pure biofuels resp. fuels blended with biofuels	Trans: Biofuels Directive (Dir 2003/30/EC)
05_TRA	adopted	WM+ WAM	**Euro classification** (EURO 5&6 PC, EURO 5 HDV – assumption EURO 6 HDV, assumption Off Road stage 3b&4)	EU Directive: 70/220/EEC; 1999/96/EC; 200$/26/EC
06_TRA	adopted	WM+ WAM	**Measures concerning infrastructure, public transport and mobility management**	
07_TRA	implemented	WM+ WAM	**klima:aktiv-->mobil programme** (mobility management in companies, in public administration, leisure & tourist traffic, in schools, for cities, communities&regions, for developer&investors, individual consulting	
08_TRA	planned	WAM	enhanced **fuel efficiency of cars**	Trans: Voluntary agreement with car manufacturers to reduce specific CO_2 emissions (ACEA, KAMA, JAMA)
09_TRA	planned	WAM	**control of speed limits, traffic control systems and supporting measures**	
01_RES	implemented	WM	measure group: forced use of **renewable energy** in the sector residential and commercial (Erneuerbare)	
02_RES	implemented	WM	measure group: increased **building renovation** (Sanierung)	En. consumption: Energy performance of buildings (Dir 2002/91/EC)
03_RES	implemented	WM	measure group: increased **replacement of heating systems** (Heizkesseltausch)	En. consumption: Energy performance of buildings (Dir 2002/91/EC)
04_RES	implemented	WM	measure group: **public support for new buildings** (Neubau)	En. consumption: Efficiency requirements for new hot-water boilers (Dir 92/42/EEC) Energy performance of buildings (Dir 2002/91/EC)
05_RES	planned	WAM	measure group: additional measures to **reduce energy consumption in the sectors residential and commercial**	
06_RES	implemented	WM	National energy efficiency action plan (Energieeffizienzaktionsplan, EEAP) in the residential and commercial sector without fuel energy for heating and hot water	En. consumption: End-use efficiency and energy services (Dir 2006/32/EC)
07_RES	planned	WAM	measure group: additional measures to **reduce electric power consumption in the sector residential and commercial without energy use for heating and hot water**	En. consumption: End-use efficiency and energy services (Dir 2006/32/EC)
01_AGR	implemented	WM+ WAM	Implementation of the **Common Agricultural Policy (CAP)** 2003 reform	Agri: Common rules for direct support schemes under CAP (Regulation (EC) No 1782/2003)

P&M-No	Status of policy, measure or group	Scenario	Name of policy or measure (or group)	Common and coordinated policy and measure (CCPM)
02_AGR	implemented	WM+ WAM	**Austrian variant of implementation of the CAP** (keeping the premiums for suckler cows – including heifers- and part of the slaughter premiums; allocation of premium rights on farms)	Agri: Common rules for direct support schemes under CAP (Regulation (EC) No 1782/2003)
03_AGR	implemented	WM+ WAM	**Funds from "modulation"**	Agri: Common rules for direct support schemes under CAP (Regulation (EC) No 1782/2003)
04_AGR	implemented	WM+ WAM	Land is maintained in **good agricultural and ecological condition** ("cross compliance")	Agri: Common rules for direct support schemes under CAP (Regulation (EC) No 1782/2003)
05_AGR	implemented	WM+ WAM	The programme for **rural development** is maintained in an unmodified way	Agri: Support for rural development (Reg (EC) No 1783/2003 amending a number of other Regulations)
06_AGR	implemented	WM+ WAM	Implementation of the **Biofuels Directive** in Austria	Agri: Common rules for direct support schemes under CAP (Regulation (EC) No 1782/2003)
07_AGR	implemented	WM+ WAM	**Grassland maintenance**	Agri: Common rules for direct support schemes under CAP (Regulation (EC) No 1782/2003)
08_AGR	planned	WM+ WAM	**Price increase for the following crops**: rape-seeds (+10%), sunflowers (+5%) and maize (+2,5%) starting in 2008	Agri: Agricultural production methods compatible with environment (Reg (EEC) No 2078/92)
09_AGR	planned	wam	**25% more organic farming** within the given budget of the programme for rural development (additional premiums are offset by an equivalent reduction of premiums for basic subsidies)	Agri: Support for rural development (Reg (EC) No 1783/2003 amending a number of other Regulations)
10_AGR	adopted	wam	**Payments for investments in emission reducing animal production technologies** (funded by the programme for rural development) e. g. slurry and manure store facilities, slurry hose techniques	Agri: Support for rural development (Reg (EC) No 1783/2003 amending a number of other Regulations)
11_AGR	expired	WM+ WAM	**Set aside additional land for short rotation forests** (+ 5 000 ha in 2008 and + 20 000 ha from 2010 onwards)	Agri: Support for rural development (Reg (EC) No 1783/2003 amending a number of other Regulations)
12_AGR	implemented	wam	**Usage of 800 000 m^3 slurry for biogas production**	En. supply: Internal electricity market (Dir 2003/54/EC)
13_AGR	implemented	wam	**Usage of 13 500 hectares of set aside land for biogas production from silage-maize (from 2008 on)**	En. supply: Internal electricity market (Dir 2003/54/EC)
14_AGR	implemented	wam	**Usage of 10 000 ha silage of grassland and alfalfa (from 2008 on)**	En. supply: Internal electricity market (Dir 2003/54/EC)

IP = Industrial processes, EN = EnergySupply, IND = Industry, TRA = Transport, RES = Residential, AGR = Agriculture

Table 53: Policies & Measures II.

P&M-No	Objective of measure(s)	Type of instruments
01_IP	limitation of emission of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products in order to combat acidification and ground-level ozone	Reg
02_IP	limitation of emission of volatile organic compounds due to the use of organic solvents by activities such as surface coating, painting or varnishing of different materials and products along the entire chain in the painting process in order to combat acidification and ground-level ozone	Reg
03_IP	establishes by various measures a reduction in emissions of ozone precursors NOx and NMVOC	Reg
04_IP	for limitation of emission of chlorinated organic solvents from industrial facilities and installations applying chlorinated hydrocarbon	Reg
05_IP	limitation of VOC	Reg
06_IP	limitation of VOC	Reg
01_EN	GHG relevant are funded projects for energy efficiency and renewables	Fi
02_EN	The Green Electricity Act promotes the power production from renewable energy sources. Power plants based on renewable energy sources are awarded a fixed feed-in tariff at least for the first ten years of operation. The objective of the Green Electricity Act currently in force is to raise the share of electricity from RES in electricity consumption in public grids to 10% by 2010, which will likely be missed. However, an amendment to the Green Electricity Act which has been adopted by the Austrian government but not yet approved by the European Comission intends to raise the share of all power plants based on RES that were sponsored by the Green Electricity Act, in electricity consumption in public grids to 15% by 2015. Among other amendments, the feed-in time was raised to in general 13 years and 15 years for power plants based on biomass, respectively.	Ec
03_EN	The objective is to limit the CO_2 emissions from large power plants and industrial plants through a trading mechanism for emission certificates.	Ec Reg
04_EN	The improvement of the water bodies has a negative effect on the production of electricity from hydro power plants.	Reg
05_EN	The objective is to meet the target specified within the Kyoto Protocol for Austria. One energy-related measure involves subsidies for PV plants < 5 kW. (PV= Photovoltaics)	Ec
06_EN	The objective is to expand the Austrian CHP facilities.	Ec
07_EN	energy savings target of 9% by 2016	Ec, Reg, Inf, Res
08_EN	minimum ecodesign requirements for specific energy-using products	Reg
01_WASTE	reduction of the deposition of untreated deposited waste	Reg
02_WASTE	mandatory collection and drainage of landfill gas originating from mass-waste landfills	Reg
03_WASTE	higher costs for the deposition of wastes on landfills without gas collection	Fi
04_WASTE	reduction of the gas formation potential	P
01_IND	GHG-relevant are funded projects for energy efficiency and renewables	Fi
02_IND		
03_IND		Ec, Reg
07_IP	aims at reducing and phasing-out respectively the use of HFCs, PFCs and SF_6 in all relevant applications on the basis of the Federal Chemicals Act.	Reg
08_IP		Reg
09_IP		Reg

P&M-No	Objective of measure(s)	Type of instruments
01_TRA	Raising the market share of advanced engine technologies with low fuel consumption	Vo
02_TRA	Raising the market share of advanced engine technologies with low fuel consumption	Reg, Inf
03_TRA	Internalisation of external costs for road transport	Fi
04_TRA	Minimum shares for transport fuels from renewable energy sources	Fi, Reg
05_TRA	drowtown of the emission limits	Reg
06_TRA	Increase the share of public transport in passenger transport by promoting and optimising transport and tariff associations	Ec, Inf
07_TRA		Ec, Inf, Ed
08_TRA	Raising the market share of advanced engine technologies with low fuel consumption	Vo
09_TRA	indirect fuel efficiency of cars	Reg
01_RES	aims to reduce GHGs with increased use of renewables (biomass, solar heat, heat pumps)	Reg, Inf, Ed
02_RES	to improve thermal building envelopes (house front, windows, top and bottom floor ceiling) and the overall renovation rate	Ec, Reg, Inf, Ed
03_RES	give financial support and raise awareness for changing old, inefficient heating systems	Ec, Reg, Inf
04_RES	grant financial subsidies (credit, cash) for better thermal quality (insulation) of new buildings	Ec, Reg, Inf, Ed
05_RES	further reduction of GHGs by obligated exchange of heating systems older than 30 years, new heating systems with fossil fuels have to support the condensing boiler technology, further increase in renovations rates	Ec, Reg
06_RES	further improvement of energy efficiency (implementation of Dir 2006/32/EC in Austria)	Reg, Inf
07_RES	reduction of electric energy consumption	Reg, Inf
01_AGR	Reduction of environmental pollution from agricultural activity	Ec
02_AGR	incentives to livestock holders in less favoured regions	Ec
03_AGR	big farms losing support for the benefit of environmental programme	Ec, Fi
04_AGR	decoupling of the production and maintenance of unproductive agricultural areas	Ec
05_AGR	support of environmental measures in agricultural	Ec
06_AGR	promoting production of biomass for energy purpose	Ec
07_AGR	grassland saving	Ec
08_AGR	price development followed by bio fuel demand	O
09_AGR	organic farming area increased	Ec
10_AGR	new installations of livestock stables and manure storage	Ec
11_AGR	Short rotation areas increased	Ec
12_AGR	support of fermentation of manure	Ec
13_AGR	support of agricultural crops	Ec
14_AGR	support of agricultural crops	Ec

IP = Industrial processes, EN = EnergySupply, IND = Industry, TRA = Transport, RES = Residential, AGR = Agriculture

Ec = Economic, Fi = Fiscal, Vo = Voluntary, Reg =regulatory, Inf = Information, Ed = Education, Res = Research, P = Planning, O = Other

Table 54: Policies & Measures III.

P&M-No	GHG affected	Ex-ante (Projected) Estimate of GHG emission reduction effect or sequestration effect in Gg CO_2 eq per year for the year(s) indicated			Indicators used to monitor progress of implementation
		2010	2015	2020	
01_IP	CO_2	NE	NE	NE	There is no indicator in use for monitoring the reduction effect or progress in the implementation of this measure.
02_IP	CO_2	NE	NE	NE	There is no indicator in use for monitoring the reduction effect or progress in the implementation of this measure.
03_IP	CO_2	NE	NE	NE	There is no indicator in use for monitoring the reduction effect or progress in the implementation of this measure.
04_IP	CO_2	NE	NE	NE	There is no indicator in use for monitoring the reduction effect or progress in the implementation of this measure.
05_IP	CO_2	NE	NE	NE	There is no indicator in use for monitoring the reduction effect or progress in the implementation of this measure.
06_IP	CO_2	NE	NE	NE	There is no indicator in use for monitoring the reduction effect or progress in the implementation of this measure.
01_EN	CO_2, CH_4, N_2O	-39.00	NE	NE	total for the years 2008–2012 for non-ETS sector: 195 Gg CO_2e
02_EN	CO_2	-2.24	-3.29	-3.97	yearly reduction by subsidised green electricity plants; indicators are the share of electricity from RES in the electricity consumption in public grids and the yearly installed capacity of renewable energy plants
03_EN	CO_2	NE	NE	NE	ETS cannot be estimated
04_EN	CO_2	0.00	-160.00	-300.00	a reduction of electricity produced by fossil fuels of 400 GWh by 2015 and a reduction of 750 by 2020
05_EN	CO_2	-1.46	-3.08	-3.08	programme from 2008–2010, a reduction of electricity produced by fossil fuels of 3.66 GWh by 2010 and a reduction of 7.71 GWh by 2015 and 2020, is expected
06_EN	CO_2	NE	NE	NE	There is no indicator in use for monitoring the reduction effect or progress in the implementation of this measure.
07_EN	CO_2	NE	NE	NE	annual final inland energy consumption of all energy users within the scope of the directive
08_EN	CO_2	NE	NE	NE	There is no indicator in use for monitoring the reduction effect or progress in the implementation of this measure.
01_WASTE	CH_4	NE	NE	NE	amount waste landfilled
02_WASTE	CH_4	NE	NE	NE	amount gas collected
03_WASTE	CH_4	NE	NE	NE	amount gas collected
04_WASTE	CH_4	NE	NE	NE	reduction of gas formation potential
01_IND	CO_2, CH_4, N_2O	NE	NE	NE	There is no indicator in use for monitoring the reduction effect or progress in the implementation of this measure.
02_IND	CO_2	IE	IE	IE	There is no indicator in use for monitoring the reduction effect or progress in the implementation of this measure.
03_IND	CO_2	NE	NE	NE	There is no indicator in use for monitoring the reduction effect or progress in the implementation of this measure.
07_IP	HFC, PFC, SF_6	-30.00	-18.00	-17.00	There is no indicator in use for monitoring the reduction effect or progress in the implementation of this measure.
08_IP	HFC, PFC, SF_6	-14.00	-3.00	-2.00	There is no indicator in use for monitoring the reduction effect or progress in the implementation of this measure.
09_IP	HFC	-10.00	-17.00	-6.00	There is no indicator in use for monitoring the reduction effect or progress in the implementation of this measure.

P&M-No	GHG affected	Ex-ante (Projected) Estimate of GHG emission reduction effect or sequestration effect in Gg CO_2 eq per year for the year(s) indicated			Indicators used to monitor progress of implementation
		2010	2015	2020	
01_TRA	CO_2, N_2O	NE	NE	NE	There is no indicator in use for monitoring the reduction effect or progress in the implementation of this measure.
02_TRA	CO_2	NE	NE	NE	There is no indicator in use for monitoring the reduction effect or progress in the implementation of this measure.
03_TRA	CO_2	NE	NE	NE	There is no indicator in use for monitoring the reduction effect or progress in the implementation of this measure.
04_TRA	CO_2	-1 653	-2 110	-2 766	There is no indicator in use for monitoring the reduction effect or progress in the implementation of this measure.
05_TRA	CO_2, CH_4, N_2O	NE	NE	NE	There is no indicator in use for monitoring the reduction effect or progress in the implementation of this measure.
06_TRA	CO_2, CH_4, N_2O	NE	NE	NE	There is no indicator in use for monitoring the reduction effect or progress in the implementation of this measure.
07_TRA	CO_2, CH_4, N_2O	-250.00	-250.00	-250.00	There is no indicator in use for monitoring the reduction effect or progress in the implementation of this measure.
08_TRA	CO_2, N_2O	-160	-833	-1 715	There is no indicator in use for monitoring the reduction effect or progress in the implementation of this measure.
09_TRA	CO_2, N_2O	0.0	-433	-390	There is no indicator in use for monitoring the reduction effect or progress in the implementation of this measure.
01_RES	CO_2	-183.92	-723.33	-1 128.39	statistics of yearly sold facilities (for log wood, pellets, wood chips, heat pumps, solar heat) number of facilities subsidized by local authorities
02_RES	CO_2	-91.75	-287.37	-599.33	statistics of realized thermal renovations from local authorities, census of renovation measures in housholds (every two years), modelled average heating demand (HWB)
03_RES	CO_2	-90.21	-461.84	-779.16	statistics of realized replacements of heating systems by subsidies, new sale volumes of individual heating systems
04_RES	CO_2	-36.20	-276.97	-501.41	spent subsidies for new (low-energy) buildings in euros
05_RES	CO_2	-15.11	-626.77	-1 797.84	
06_RES	CO_2	NE	NE	NE	electric energy consumption
07_RES	CO_2	NE	NE	NE	electric energy consumption
01_AGR	CO_2, CH_4, N_2O	NE	NE	NE	The agricultural set aside area is an instrument to influence the market supply. In 2005 it was dropped
02_AGR	CH_4, N_2O	NE	NE	NE	Young beef units are a main target of support for farmers under conditions
03_AGR	CO_2	NE	NE	NE	big farms losing support for the benefit of environmental programme
04_AGR	CO_2, N_2O	NE	NE	NE	decoupling of the production and maintenance of unproductive agricultural areas
05_AGR	CO_2, CH_4, N_2O	NE	NE	NE	support of environmental measures in agricultural
06_AGR	CO_2, N_2O	NE	NE	NE	promoting production of biomass for energy purpose
07_AGR	CO_2, N_2O	NE	NE	NE	grassland will be saved as a sustainable resource for the production of biomass on steep hills and mountains

P&M-No	GHG affected	Ex-ante (Projected) Estimate of GHG emission reduction effect or sequestration effect in Gg CO_2 eq per year for the year(s) indicated			Indicators used to monitor progress of implementation
		2010	2015	2020	
08_AGR	CO_2, N_2O	NE	NE	NE	price for energy crops developed by the development of bio fuel demand
09_AGR	CO_2, CH_4, N_2O	NE	NE	NE	the development of organic farming is a main goal for GHG emission reduction – mainly N_2O
10_AGR	CH_4, N_2O	NE	NE	NE	The investments and support for new installations of livestock stables and manure storage cause reductions of CH_4 and N_2O emissions.
11_AGR	CO_2	NE	NE	NE	Short rotation areas with quick growing trees should be increased
12_AGR	CH_4, N_2O	NE	NE	NE	Usage of manure as a basis for fermentation to bio gas is intended
13_AGR	CO_2, CH_4, N_2O	NE	NE	NE	Support of agricultural crops for fermentation is introduced
14_AGR	CH_4, N_2O	NE	NE	NE	Support of agricultural crops for fermentation is introduced

IP = Industrial processes, EN = EnergySupply, IND = Industry, TRA = Transport, RES = Residential, AGR = Agriculture

ANNEX 2: ADDITIONAL KEY INPUT PARAMETERS FOR SECTORAL FORECASTS

Transport

Table 55: Assumptions for the development of renewable energy carrier.

fuel grade/ energy carrier	Assumptions and Development	Energetic contribution 2020 (%)
Bioethanol/ ETBE blended	At present, blending is limited to a maximum level of 5% by volume due to fuel standards. New standards which allow blending at a level of 10% by volume are expected to be introduced within the examined time frame, most likely by 2014. This facilitates doubling the amount of blended fuel distributed blending.	1.28
Bioethanol/ ETBE other distribution (E85)	At present the amount of sold E85 is very limited, primarily due to the lack of area-wide filling stations (At the moment there are 13 filling stations). The development incorporates the vehicle manufacturer pledge to increase production of FFV (vehicles which can be powered with Ethanol E85), as well as the Austrian initiative which aims to increase the number of filling stations distributing E85.	0.14
Biodiesel, blended	Before 2008 blending was limited to a maximum level of 5% by volume due to fuel standards. Since 2009 a new fuel standard has allowed blending up to 7% by volume. Further standards which allow blending at a level of 10% by volume are expected to be introduced within the examined time frame, most likely by 2017. By then, the first quantities of second generation biodiesel are expected, which need to be part of the blended biodiesel in order to guarantee desired fuel properties (cold-start behaviour).	6.63
Biodiesel, other distribution	The development of biodiesel distributed in other ways than blending is based on current figures. Due to the lack of type approvals for vehicles powered with biodiesel with higher levels of blending as well as lacking financial incentives, the development was assumed to be moderate (from 72 kt to 100 kt).	1.00
Straight vegetable oil	SVO is primarily used in machinery utilized in farming. As there are no initiatives to increase sales in this niche, growth in terms of sales figures is likely to be restrained.	0.28
Biomethane	In 2007 biogas is generally used to generate electric power, besides small testing plants distributing regionally, or over the existing natural gas grid, after special treatment of biomethane (purging the biomethane to gain a similar quality to the one CNG provides). Similar to Ethanol, there are initiatives to promote and stimulate production as well as distribution, going along with financial incentives, to increase the usage of biomethane.	0.17
Hydrogen	Hydrogen seems to be the technology which will not be introduced in large quantities within the investigated timeframe. Nevertheless, small amounts will be introduced through expected R&D&D programmes.	0.01
Electricity	Regarding the adverse reputation of biofuels (causing loss of biodiversity etc.), electric propulsion seems to be the most attractive and promising future technology. Comparable initiatives to ethanol and biomethane have already been started by the Austrian government.	0.51

According to the definition of renewable energy, production of hydrogen and electric energy has to occur with energy from renewable power plants.

Residential, Commercial & Other Sectors

Table 56: Assumptions for energy prices (wm & wam) in cent/kWh.

residential sector		**2010**	**2015**	**2020**
coal	cent/kWh	6.00	6.49	7.02
wood log and wood briquettes	cent/kWh	3.81	3.64	3.76
wood chips	cent/kWh	2.52	2.60	2.68
wood pellets	cent/kWh	4.04	4.16	4.29
natural gas	cent/kWh	8.00	8.00	8.00
heating and Other Gas Oil (HEL 2007)	cent/kWh	9.00	9.00	9.00
distr. heat Vienna	cent/kWh	3.58	3.60	3.62
distr. heat Other	cent/kWh	4.22	4.24	4.27
distr. heat biomass	cent/kWh	6.41	6.48	6.54
commercial sector		**2010**	**2015**	**2020**
coal	cent/kWh	5.00	5.41	5.85
wood log and wood briquettes	cent/kWh	3.18	3.04	3.13
wood chips	cent/kWh	2.10	2.17	2.24
wood pellets	cent/kWh	3.37	3.47	3.58
natural gas	cent/kWh	6.67	6.67	6.67
heating and Other Gas Oil (HEL 2007)	cent/kWh	7.50	7.50	7.50
distr. heat Vienna	cent/kWh	2.98	3.00	3.02
distr. heat Other	cent/kWh	3.51	3.54	3.56
distr. heat biomass	cent/kWh	5.34	5.40	5.45

Table 57: Assumptions on subsidy rates in percent – with measures.

subsidy rates	**2010**	**2015**	**2020**
wood log and wood briquettes	20%	20%	20%
wood chips	20%	20%	20%
wood pellets	23%	23%	23%
distr. heat Vienna	10%	10%	10%
distr. heat Other	10%	10%	10%
distr. heat biomass	23%	23%	23%
solarthermie	20–25%	20–25%	20–25%
renovation measures (insulation and window)	30%	30%	30%

Table 58: Assumptions on subsidy rates in percent – with additional measures.

subsidy rates	2010	2015	2020
wood log and wood briquettes	20%	32%	32%
wood chips	20%	32%	32%
wood pellets	23%	35%	35%
distr. heat Vienna	10%	22%	22%
distr. heat Other	10%	22%	22%
distr. heat biomass	20–25%	32%	32%
solarthermie	23%	34%	34%
renovation measures (insulation and window)	30%	30%	30%

Table 59: Assumptions for the number and size of buildings, and the number of permanently occupied dwellings (wm & wam).

Number of buildings		**2010**	**2015**	**2020**
residential buildings with one or two apartments	number	1 501 250	1 569 803	1 633 948
residential buildings with more than two apartments	number	185 951	193 809	201 410
commercial buildings	number	233 991	253128	273 613
Size of buidlings		**2010**	**2015**	**2020**
residential buildings with one or two appartments	million m² gross floor area	259	271	284
residential buildings with more than two apartments	million m² gross floor area	153	160	167
commercial buildings	million m³ gross floor volume	1 218	1 317	1 422
Number of permanently occupied dwellings		**2010**	**2015**	**2020**
residential buildings with one or two apartments	number in 1 000	1 715	1 786	1 852
residential buildings with more than two apartments	number in 1 000	1 791	1 868	1 942

Agriculture

Table 60: Assumptions for macro-economic variables in the European Union, 2010–2013.

		2010	2011	2012	2013
real GDP EU-15	%	1.90	2.10	2.10	2.10
CPI EU	%	1.60	1.60	1.60	1.60
population EU-25	million	459.60	460.00	460.40	460.70
exchange rate EU-15	€/$	1.15	1.15	1.15	1.15

Sources: OECD 2004, EUROSTAT 2005.

Table 61: Forecast animal waste management distribution – dairy cows.

Dairy Cows	**Waste Management System [%]**		
Year	**liquid/slurry**	**solid**	**p/r/p**
2005	19.0	70.4	10.6
2010	40.0	51.0	9.0
2015	50.0	42.0	8.0
2020	60.0	32.5	7.5

Table 62: Forecast animal waste management distribution – suckling cows.

Suckling Cows	**Waste Management System [%]**		
Year	**liquid/slurry**	**solid**	**p/r/p**
2005	19.0	70.4	10.6
2010	22.5	63.5	14.0
2015	22.5	62.5	15.0
2020	22.5	62.5	15.0

Table 63: Forecast animal waste management distribution – cattle 1–2 years.

Cattle 1–2 years	**Waste Management System [%]**		
Year	**liquid/slurry**	**solid**	**p/r/p**
2005	12.0	61.8	26.2
2010	41.0	52.5	6.5
2015	43.5	50.0	6.5
2020	43.5	50.0	6.5

Table 64: Forecast animal waste management distribution – cattle < 1 year.

Cattle < 1 year	**Waste Management System [%]**	
Year	**liquid/slurry**	**solid**
2005	28.8	71.2
2010	20.0	80.0
2015	20.0	80.0
2020	20.0	80.0

Table 65: Forecast animal waste management distribution – n.-d. cattle > 2 years.

Non-dairy cattle > 2 year	**Waste Management System [%]**	
Year	**liquid/slurry**	**solid**
2005	48.6	51.4
2010	45.0	55.0
2015	45.0	55.0
2020	45.0	55.0

Table 66: Forecast animal waste management distribution – breeding sows.

Breeding Sows	**Waste Management System [%]**	
Year	**liquid/slurry**	**solid**
2005	70.0	30.0
2010	60.0	40.0
2015	65.0	35,0
2020	70.0	30.0

Table 67: Forecast animal waste management distribution – fattening pigs.

Fattening Pigs	**Waste Management System [%]**	
Year	**liquid/slurry**	**solid**
2005	71.9	28.1
2010	90.0	10.0
2015	90.0	10.0
2020	90.0	10.0

ANNEX 3: ADDITIONAL KEY OUTPUT PARAMETERS FOR SECTORAL FORECASTS

Energy Industries

with measures

Table 68: Projected fuel input into energy industries, scenario wm, given in TJ.

Energy (TJ)	2010	2015	2020
Bituminous Coal and Anthracite	63 270	43 774	33 871
Lignite/Brown Coal	6 644	4 823	3 732
Residual Fuel Oil	18 482	13 355	10 037
Natural gas	89 780	123 913	169 906
Geothermal	736	945	1 159
Waste	15 035	16 997	17 142
Biomass solid	62 949	79 177	94 036
Biomass liquid	706	780	855
Biomass gaseous	4 281	4 955	5 630
Sewage sludge and landfill gas	506	506	506
Hydropower	132 173	136 834	135 246
Photovoltaics	83	196	330
Wind power	7 268	11 187	15 291

with additional measures

Table 69: Projected fuel input into energy industries, scenario wam, given in TJ.

Energy (TJ)	2010	2015	2020
Bituminous Coal and Anthracite	55 983	29 599	18 048
Lignite/Brown Coal	0	0	0
Residual Fuel Oil	16 160	10 270	7 433
Natural gas	103 024	125 093	124 505
Geothermal	736	945	1 159
Waste	15 035	16 997	17 142
Biomass solid	62 949	79 177	94 036
Biomass liquid	706	780	855
Biomass gaseous	4 281	4 955	5 630
Sewage sludge and landfill gas	506	506	506
Hydropower	132 174	136 832	137 046
Photovoltaics	83	196	330
Wind power	7 268	11 187	15 291

Manufacturing Industries and Construction

with measures

Table 70: Projected fuel input into industry, wm scenario, given in TJ.

Industry (TJ)	2010	2015	2020
Bituminous Coal and Anthracite	5 701	6 893	8 493
Lignite/Brown Coal	1 212	1 285	1 436
Coke Oven Coke	7 104	7 645	7 564
Coke Oven Gas	2 781	2 961	3 048
Blast Furnace Gas	0	0	0
Motor Gasoline	4 288	4 288	4 213
White Spirit SBP	149	149	143
Gas/Diesel Oil	41 469	43 091	47 143
Heating and other Gasoil	239	217	199
Residual Fuel Oil	7 508	6 948	6 757
LPG	1 644	1 414	1 313
Petrol Coke	1 836	1 564	1 426
Natural gas	104 941	118 240	133 624
Industrial Waste	10 984	11 633	11 874
Fuel Wood	1 807	2 033	2 263
Wood Waste	11 056	11 934	12 791
Black Liquor	15 399	17 017	18 027
Other	2 399	2 535	2 625
Biogas	327	301	274
Electricity	102 152	114 819	128 162
Heat	10 322	11 224	12 007

with additional measures

Table 71: Projected fuel input into industry, wam scenario, given in TJ.

Industry (TJ)	2010	2015	2020
Bituminous Coal and Anthracite	5 701	6 893	8 493
Lignite/Brown Coal	1 212	1 285	1 436
Coke Oven Coke	7 104	7 645	7 564
Coke Oven Gas	2 781	2 961	3 048
Blast Furnace Gas	0	0	0
Motor Gasoline	4 288	4 288	4 213
White Spirit SBP	149	149	143
Gas/Diesel Oil	41 469	43 091	47 143
Heating and other Gasoil	239	217	199
Residual Fuel Oil	7 508	6 948	6 757
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Wood Waste	11 056	11 934	12 791
Black Liquor	15 399	17 017	18 027
Other	2 399	2 535	2 625
Biogas	327	301	274
Electricity	96 626	103 014	110 790
Heat	10 322	11 224	12 007

Transport

Table 72: Energy consumption of mobile sources by fuel, wm scenario (TJ).

TJ	Gasolin Fossil	Diesel Fossil	Bioethanol	Biodiesel	Vegetable – oil	Natural – gas	Bio – gas	H2	Electricity – pc
1990	108 556	89 727	–	–	–	–	–	–	–
2003	93 202	243 320	–	–	–	–	–	–	–
2005	88 051	264 078	–	3 488	–	–	–	–	–
2010	66 920	266 968	2 637	19 489	760	253	63	–	2
2015	65 249	287 483	5 163	23 747	957	1 138	284	10	42
2020	66 727	297 015	5 774	31 060	1 159	2 715	679	34	755

Table 72 continuation.

TJ	coal	Electricity – railways	Aviation Kerosene	Aviation Gasoline
1990	69	7 457	790	103
2003	23	7 681	1 303	110
2005	6	7 413	1 368	118
2010	5	8 254	1 625	112
2015	5	9 049	1 789	113
2020	4	9 758	1 953	114

Table 73: Energy consumption of mobile sources by fuel, wam scenario (TJ).

TJ	Gasoline Fossil	Diesel Fossil	Bioetha-nol	Biodiesel	Vegetable – oil	Natural – gas	Bio – gas	H2	Electricity – pc
1990	108 556	89 727	–	–	–	–	–	–	–
2003	93 202	243 320	–	–	–	–	–	–	–
2005	88 051	264 078	–	3 488	–	–	–	–	–
2010	66 507	265 319	2 620	19 369	755	251	63	–	2
2015	62 104	273 628	4 914	22 602	911	1 083	271	9	40
2020	61 535	273 906	5 325	28 643	1 069	2 504	626	31	696

Table 73 continuation.

TJ	coal	Electricity – railways	Aviation Kerosene	Aviation Gasoline
1990	69	7 457	790	103
2003	23	7 681	1 303	110
2005	6	7 413	1 368	118
2010	5	8 254	1 625	112
2015	5	9 049	1 789	113
2020	4	9 758	1 953	114

Table 74: Energy consumption by CRF category – mobile sources plus 1.A.3.e – wm (TJ).

TJ	1990	2005	2010	2015	2020
1 A 3 - mobile	**187 667**	**342 310**	**341 655**	**367 378**	**387 996**
1 A 3 a	438	915	1 125	1 252	1 379
1 A 3 b	176 731	330 704	328 973	353 733	373 496
1 A 3 c	9 787	9 640	10 576	11 338	11 981
1 A 3 d	710	1 051	981	1 055	1 140
1 A 3 e	6 633	9 837	14 400	17 280	19 080
1 A 4 c	10 397	11 575	11 612	12 011	12 382
1 A 2 f	3 475	8 524	11 384	13 173	14 833
1 A 4 b	1 922	1 892	1 797	1 790	1 819
1 A 5	484	599	639	678	716

Table 75: Energy consumption by CRF category – mobile sources plus 1.A.3.e – wam (TJ).

TJ	2003	2005	2010	2015	2020
1 A 3 - mobile	**324 268**	**342 310**	**339 450**	**348 867**	**356 413**
1 A 3 a	857	915	1 125	1 252	1 379
1 A 3 b	312 546	330 704	326 767	335 223	341 914
1 A 3 c	9 968	9 640	10 576	11 338	11 981
1 A 3 d	896	1 051	981	1 055	1 140
1 A 3 e	6 633	9 837	14 400	17 280	19 080
1 A 4 c	10 552	11 575	11 612	12 011	12 382
1 A 2 f	8 261	8 524	11 384	13 173	14 833
1 A 4 b	1 907	1 892	1 797	1 790	1 819
1 A 5	583	599	639	678	716

Residential, Commercial & Other Sectors

Table 76: Heating demand, renovation rates and boiler exchange rates – with measures.

Heating demand (average)		2010	2015	2020
residential buildings with one or two apartments	kWh/m².a	164	149	134
residential buildings with more than two apartments	kWh/m².a	105	96	87
commercial buildings	kWh/m³.a	53	51	48
renovation rate				
residential buildings with one or two apartments	%	0.74%	1.08%	1.25%
residential buildings with more than two apartments	%	0.62%	1.01%	1.45%
commercial buildings	%	1.14%	1.42%	1.34%
boiler exchange rate in residential buildings	%	1.87%	2.14%	2.30%

Table 77: Heating demand, renovation rates and boiler exchange rates – with additional measures.

Heating demand (average)		**2010**	**2015**	**2020**
residential buildings with one or two apartments	kWh/m².a	166	150	126
residential buildings with more than two apartments	kWh/m².a	105	96	86
commercial buildings	kWh/m³.a	53	50	45
renovation rate				
residential buildings with one or two apartments	%	0.67%	1.59%	1.87%
residential buildings with more than two apartments	%	0.75%	1.48%	1.52%
commercial buildings	%	1.19%	1.59%	1.78%
boiler exchange rate in residential buildings	**%**	**1.99%**	**2.63%**	**2.96%**

Fugitive Emissions from Fuels

Table 78: Historical (2005) and forecast activities for calculation of fugitive emissions.

	2005	**2010**	**2015**	**2020**
Gas pipeline and distribution network length [km]	36 180	38 838	41 455	44 071
Natural gas production [1 000 m³]	1 764	1 903	1 750	1 528
Natural gas consumption [PJ]	217	209	223	237
Refinery crude oil input [Mt]	8.32	8.09	8.53	9.56
Natural gas storage capacities [Mm³]	2 207	3 730	5 137	5 700

Industrial Processes

Halocarbons and SF_6

Table 79: Potential emissions (annual consumption) of halocarbons and SF_6 in Gg CO_2 equivalents.

	1990	**2005**	**2010**	**2015**	**2020**
HFC [Gg CO_2 eq]	47.42	1474.95	1294.26	1085.37	1087.37
PFC [Gg CO_2 eq]	32.28	351.35	416.01	408.84	408.56
SF_6 [Gg CO_2 eq]	839.91	485.67	425.43	429.40	429.37

Agriculture

Table 80: Forecast livestock population 2010, 2015, 2020 – conventional farming.

	With measures			With additional measures		
	2010	**2015**	**2020**	**2010**	**2015**	**2020**
Livestock (heads)	**Conventional farming**					
equids	75 605	75 605	75 605	75 605	75 605	75 605
cattle (total)	1 643 220	1 616 222	1 609 608	1 638 693	1 609 337	1 602 515
dairy cows	443 322	426 611	422 278	442 234	424 558	420 133
other cows	179 939	181 239	181 719	178 950	179 827	180 151
other cattle < 1 year	510 989	500 520	497 929	509 525	498 152	495 426
other cattle 1–2 years	360 567	359 867	359 781	359 836	359 048	359 061
other cattle > 2 years	148 404	147 985	147 903	148 148	147 752	147 744
hens (total)	11 725 621	11 725 621	11 725 621	11 725 621	11 725 621	11 725 621
laying hens	6 269 196	6 269 196	6 269 196	6 269 196	6 269 196	6 269 196
broiler	5 456 425	5 456 425	5 456 425	5 456 425	5 456 425	5 456 425
other poultry	616 684	616 684	616 684	616 684	616 684	616 684
pigs (total)	3 172 979	3 179 194	3 180 706	3 173 966	3 180 746	3 182 361
porker > 50 kg	1 207 467	1 211 009	1 211 901	1 208 003	1 211 906	1 212 859
breeding pigs > 50 kg	333 722	333 878	333 878	333 755	333 910	333 910
pigs < 50 kg	1 631 791	1 634 307	1 634 927	1 632 207	1 634 930	1 635 592
sheep (total)	255 348	257 808	258 224	254 815	256 737	257 140
goats (total)	35 763	36 035	36 035	35 830	36 147	36 147
fallow deer	32 780	32 910	32 958	32 720	32 766	32 769

Table 81: Forecast livestock population 2010, 2015, 2020 – organic farming.

	With measures			With additional measures		
	2010	**2015**	**2020**	**2010**	**2015**	**2020**
Livestock (heads)	**Organic farming**					
equids	11 467	11 467	11 467	11 467	11 467	11 467
cattle (total)	297 431	288 729	286 809	300 587	293 891	292 157
dairy cows	72 735	66 601	65 340	74 098	69 117	67 967
other cows	58 427	58 389	58 458	58 871	58 938	59 020
other cattle < 1 year	100 117	96 647	95 923	101 229	98 530	97 881
other cattle 1–2 years	52 202	52 831	52 826	52 417	53 008	52 991
other cattle > 2 years	13 950	14 262	14 261	13 972	14 297	14 297
hens (total)	628 737	628 737	628 737	628 737	628 737	628 737
laying hens	256 427	256 427	256 427	256 427	256 427	256 427
broiler	372 310	372 310	372 310	372 310	372 310	372 310
other poultry	35 640	35 640	35 640	35 640	35 640	35 640
pigs (total)	43 256	46 603	47 272	42 382	45 199	45 805
porker > 50 kg	19 676	21 627	22 019	19 166	20 807	21 161
breeding pigs > 50 kg	90	90	90	91	91	91
pigs < 50 kg	23 490	24 885	25 164	23 126	24 302	24 553
sheep (total)	79 238	79 781	79 781	78 828	79 235	79 235
goats (total)	14 341	14 466	14 466	14 423	14 479	14 479
fallow deer	6 595	6 607	6 607	6 608	6 605	6 605

Table 82: Milk production 2010, 2015, 2020 – conventional and organic farming.

	With measures			With additional measures		
	2010	**2015**	**2020**	**2010**	**2015**	**2020**
Ø milk yield per cow in t/year	6.2	6.6	6.7	6.2	6.6	6.7
milk production (total)	3 194 199	3 259 710	3 259 581	3 194 674	3 260 348	3 260 255

Table 83: Forecast crop yields – conventional and organic farming.

	With measures			With additional measures		
	2010	**2015**	**2020**	**2010**	**2015**	**2020**
Crop yield (t per ha)	**Conventional farming**					
cereals (without maize)	4.9	5.0	5.1	4.9	5.0	5.1
winter wheat	5.5	5.7	5.7	5.5	5.7	5.7
grain maize + CCM	9.4	9.9	10.0	9.4	9.9	10.0
silage maize	46.5	48.9	49.8	46.5	48.9	49.8
sugar beet	63.0	63.4	63.6	63.0	63.4	63.6
rapeseed	2.9	3.0	3.0	2.9	3.0	3.0
sunflowers	2.9	3.0	3.0	2.9	3.0	3.0
fodder beet	46.7	46.7	46.7	46.7	46.7	46.7
Crop yield (t per ha)	**Organic farming**					
cereals (without maize)	3.9	4.1	4.1	3.9	4.1	4.1
winter wheat	4.8	4.9	5.0	4.8	4.9	5.0
grain maize + CCM	7.0	7.3	7.4	7.0	7.3	7.4
silage maize	32.5	33.7	34.0	32.2	33.5	33.9
sugar beet	42.6	44.6	45.3	42.6	44.6	45.3
rapeseed	2.3	2.4	2.4	2.3	2.4	2.4
sunflowers	2.1	2.1	2.1	2.1	2.1	2.1
fodder beet	39.6	39.5	39.5	39.7	40.1	40.3

Source: SINABELL, F. & SCHMID, E. (2005).

Table 84: Forecast land use 2010, 2015, 2020.

Land use – (ha)	**2010**	**2015**	**2020**
Scenario	**With measures**		
permanent grassland (total)	1 680 690	1 669 065	1 667 504
extensive grassland	1 006 937	1 009 684	1 009 699
arable land	1 317 585	1 316 704	1 317 710
Scenario	**With additional measures**		
permanent grassland (total)	1 678 228	1 667 938	1 666 414
extensive grassland	1 006 742	1 009 842	1 009 880
arable land	1 313 876	1 307 485	1 307 218

Source: SINABELL, F. & SCHMID, E. (2005).

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The report "GHG projections and assessment of policies and measures in Austria" presents information on projections, policies and measures according to the reporting obligations as defined in Decision 280/2004/EC. It includes projections of the greenhouse gases (GHGs) CO_2, CH_4, N_2O, HFC, PFC and SF_6 for the years 2010, 2015 and 2020 and describes policies and measures which limit and/or reduce greenhouse gas emissions by sources.

The results include two different scenarios: the scenario "with measures" takes into account climate change mitigation measures that were implemented under the Austrian Climate Strategies 2002 and 2007 before 8th August 2008. The scenario "with additional measures" includes also planned policies and measures. The economic scenarios for the emission projections do not reflect recent economic developments.

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