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ENERGY SCENARIOS UP TO 2020

On the basis of its model of energy demand and conversion in Austria (DAEDALUS III), WIFO simulated three scenarios to establish a long-term forecast of the development of energy consumption and CO_2 emissions. The baseline scenario assumes the continuation of current developments, while the Kyoto scenario reflects the effects of the Austrian strategy to prevent climate change. The sustainability scenario is based on the adoption of international approaches to implement socially compatible measures aimed at minimising energy consumption and accelerating technological progress.

Summary of a study carried out by WIFO on behalf of the Federal Ministry of Agriculture and Forestry, Environment and Water Management and the Federal Ministry of Economic Affairs and Labour: Kurt Kratena, Stefan Schleicher, Energy Scenarios up to 2020 (2001, 150 pages, ATS 900.00 or EUR 65.41) • Available as of mid November 2001 • Please address your orders to WIFO, Ms. Christine Kautz, A-1103 Vienna, P.O. Box 91, Tel. (+43 1) 798 26 01/282, Fax (+43 1) 798 93 86, e-mail Christine.Kautz@wifo.ac.at

The development of energy consumption and CO_2 emissions until 2020 is calculated for three scenarios. In the "baseline scenario", the consumption of fuels, electricity and gas continues to increase. This development, combined with a rising volume of electricity generation by thermal power plants, results in an increase of CO_2 emissions by about 3.2 million tons per year until 2010. The "Kyoto scenario" reflects the Austrian strategy of preventing climate change, which provides for an increase in energy efficiency and greater reliance on renewable sources of energy, the target being to diminish the level of CO_2 emissions by about 13 million tons against the baseline scenario by 2010. The "sustainability scenario" models the effects of a socially compatible reduction of energy services and an accelerated pace of innovation and technology diffusion. Until 2010, energy consumption and CO_2 emissions decrease by more or less the same amounts as in the Kyoto scenario, but by 2020 CO_2 emissions drop to 63 percent of the year-2000 level. Both the Kyoto scenario and the sustainability scenario are associated with substantial costs, as they require a reallocation of resources, but GDP and employment are higher than in the baseline scenario.

The baseline scenario

The main factors of influence in the "baseline scenario" are the crude oil price, the general development of the economy, and the special impact of energy market liberalisation in Austria. The process of deregulation affects both end-user prices of gas and electricity and the volume of power generated to meet the Austrian electricity demand. Given the objectives laid down in the Austrian Electricity Act, the development of renewable energy sources is also concerned in this context. However, major changes regarding other uses of renewable sources of energy are expected to take place by 2020 also outside the area of electricity generation; relevant information for the baseline scenario has been taken from a new analysis of the Austrian situation (*Haas – Berger – Kranzl*, 2001).

The assumptions regarding the development of crude oil prices are based on the current "World Energy Outlook" of the IEA. According to this organisation, the price of crude oil will drop to EUR 16.5 in real terms by 2003 (on 1990 price basis; this corresponds to a nominal price of USD 21.2) and subsequently rise continuously to EUR 22.5 in real terms (1990 price basis; USD 36 in nominal terms) until 2020.

The most important economic driving forces for energy demand are derived from a medium-term WIFO forecast based on the MULTIMAC III model (*Biffl – Kratena*, 2001), which comprises 32 economic sectors. According to this forecast, the medium-term rate of real GDP growth is about 2 percent per year, accompanied by a process of profound structural change continuing in the Austrian economy.

The liberalisation of the energy market has been assumed to result in price drops of 9.0 percent for electricity (2001) and 2.5 percent for gas (2002) for domestic consumers; the industrial price of gas is expected to decrease by 5.0 percent (2002). According to the literature available on this subject, the initial short-term effects of liberalisation are expected to be followed by a concentration of market power of individual suppliers. Resulting from this prices will rise again such that half the reduction of household prices originally observed in the wake of market liberalisation will be eliminated.

On side of the electricity generation, liberalisation leads to an increase of the net import ratio from currently –2.6 percent of total domestic consumption (export surplus) to up to 3 percent (deficit in foreign electricity trade); at the same time, a small proportion of the existing thermal generation capacity will be closed down on a short-term basis. Thus, Austria is a net importer of electric energy throughout the period considered in the baseline scenario, which constitutes a drastic departure from past developments. A 2 to 3 percent import surplus, combined with a slight increase of electricity generation from hydro and wind power, implies that – given the increase in consumption – a growing share of demand will have to be met from thermal generation.

The baseline scenario assumes an increase in the end use of energy, above all of motor fuels, gas and electric energy. As a result, CO_2 emissions caused by energy end use will go up by about 2.7 million tons until 2010. Overall, industrial emissions will remain constant, household emissions will decline, and emissions of the service and transport sectors will increase.

Table 1: Total energy end use

	2000	2005	2010 In tJ	2015	2020
Coal	64,787	54,762	47,207	39,667	32,389
Mineral oil, fuel	113,033	117,981	112,435	106,798	100,127
Mineral oil, motor fuel	256,654	272,430	290,574	305,689	320,205
Gas	174,148	196,504	208,636	216,773	220,724
Electricity	181,875	201,175	213,531	227,016	242,867
Fossil energy	608,621	641,677	658,852	668,926	673,444
Biomass	105,015	108,473	111,561	115,254	118,501
District heating	42,075	49,020	52,801	57,606	66,171
Renewable heat	6,773	8,832	11,515	15,009	19,567
Hydro power	46	46	46	46	46
Total	944,405	1,009,222	1,048,306	1,083,857	1,120,596

The development of electricity generation is of crucial importance for the forecast. The main factors impacting on non-thermal generation are the reactivation of small hydro power plants and the utilisation of wind power and photovoltaic systems. According to the assumptions of the baseline scenario, the targets set out in the Austrian Electricity Act with regard to green electricity will be reached. Nevertheless, electricity generation by thermal power plants will rise to more than 70,000 tJ per year by 2020, which implies a slight increase in the generation capacities of "independent power producers".

Table 2: Total energy consumption and CO_2 emissions

	Total consumption In tJ	CO_2 emissions 1,000 t
2000	1,165,401	60,292
2001	1,190,485	61,898
2002	1,210,347	62,627
2003	1,228,352	63,269
2004	1,246,754	63,928
2005	1,264,924	64,634
2006	1,279,604	65,111
2007	1,292,072	65,440
2008	1,302,705	65,599
2009	1,315,722	66,055
2010	1,327,352	66,215
2011	1,339,185	66,530
2012	1,351,219	66,842
2013	1,360,398	66,960
2014	1,371,398	67,172
2015	1,383,478	67,506
2016	1,394,437	67,781
2017	1,405,239	68,037
2018	1,416,932	68,341
2019	1,429,255	68,665
2020	1,443,251	69,263

Thus, CO_2 emissions from conversion processes will increase by about 3.2 million tons until 2010. This is due exclusively to higher emissions from electric utilities (+1.5 million tons) and industrial heat and power generation (+1.7 million tons). As a result, total energy consumption and CO_2 emissions will go up.

The DEADALUS III model provides for two interfaces between the *energy system and the economic system:* the development of GDP, household incomes and real sector output (gross output) determine the demand for energy. Inversely, the costs of energy and the level of domestic generation have an effect on output and employment levels of the remaining economic sectors.

The baseline scenario assumes a slight increase of energy costs for the Austrian economy until 2020; the costs of energy for commercial transportation are expected to rise steeply.

With the exception of coal, the baseline scenario assumes a rise of domestic energy production in all energy supply sectors, above all in the gas supply sector. However, given further productivity increases, the level of employment of the sector will continue to go down in all areas.

The Kyoto scenario

The Kyoto scenario was drawn from the climate control strategy of the Austrian federal government, as adopted on 13 March 2001. This strategy is also based on a scenario of trends and aims at reducing all greenhouse gas emissions by 13 percent from the 1990 level by the Kyoto commitment period of 2008 to 2012. This goal is to be reached through numerous specific measures in the following areas: building construction, small-scale electricity consumption, transportation, electricity and heat, industry, agriculture, waste management, and other gases. The measures to be taken are all geared to the Kyoto commitment period and will subsequently expire; hence, the effects achieved will remain constant. The measures can be classified according to their effect on the energy system:

1. Reduction of (redundant) energy services (e.g., transportation services, room temperature control),
2. use of more efficient end-use technologies (e.g., vehicle engines, thermal insulation of buildings),
3. use of more efficient technologies of energy transformation (e.g., through co-generation, improvement of energy efficiency of plant and equipment),
4. Shift in the mix of energy sources (e.g., greater reliance on low-carbon and carbon-free energy).

These measures were implemented in the DAEDALUS III model, which was then run until 2020 on the same assumptions as the baseline scenario.

Since the effect of these measures, if quantified individually, is likely to be greater than the effect derived from their simultaneous implementation ("overlaps"), these sets of measures were simulated individually; the Kyoto scenario as a whole was computed separately within DAEDALUS III. The compensation effect obtained on the basis of these simulations amounts to 4.2 million tons, i.e., 25 percent of the gross reduction effect is lost through the simultaneous implementation of the measures.

In the Kyoto scenario, CO_2 emissions in 2010 will amount to approximately 53.3 million tons per year, which is some 5.2 million tons above the target value of 48.3 million tons resulting from a 13 percent reduction of the 1990 level. The reduction of CO_2 emissions by 12.75 million tons against the baseline scenario is accounted for by end use (–9.55 million tons, i.e., 75 percent of the total reduction) and conversion (–3.2 million tons, i.e., 25 percent of total reduction).

Table 3: Simulations of reductions in CO_2 emissions

	DAEDALUS III	"Climate control strategy"
	Million t	
Kyoto strategy: individual measures	16.94	17.88
Kyoto strategy overall	12.75	14.74
"Overlaps"	4.19	2.84

Table 4: Energy end use in the "Kyoto scenario"

	2000	2005	2010 In tJ	2015	2020
Coal	64,787	52,621	43,414	36,251	30,047
Mineral oil, fuels	113,888	103,087	79,720	71,034	61,240
Mineral oil, motor fuels	256,654	252,933	234,839	226,256	211,214
Gas	174,148	180,113	167,458	166,796	161,688
Electricity	181,875	196,514	203,736	220,006	236,647
Fossil energy	609,476	588,753	525,430	500,336	464,189
Biomass	105,015	107,298	113,859	118,297	122,342
District heating	42,075	51,696	62,578	66,367	74,298
Renewable heat	6,773	11,081	19,855	26,012	34,086
Hydro power	46	46	46	46	46
Total	945,260	955,388	925,504	931,064	931,608
"Baseline scenario"	945,260	1,010,077	1,049,161	1,084,712	1,121,451

Table 5: CO_2 emissions in the "Kyoto scenario"

	2000	2005	2010 1,000 t	2015	2020
Coke oven	365	349	347	340	335
Blast furnace	78	88	98	102	106
Refinery	658	619	585	592	580
Heat generation	1,548	1,375	1,003	1,039	1,133
Electricity	7,243	7,810	6,577	7,400	9,045
Industry	4,676	5,271	5,985	6,332	6,742
Conversion processes	14,568	15,512	14,594	15,805	17,942
Total	60,292	59,224	53,467	52,582	51,895
"Baseline scenario"	60,292	64,634	66,215	67,506	69,263

Owing to the measures provided for by the climate control strategy and their effects, the economic development in the Kyoto scenario differs from that of the baseline scenario. Changes in the energy system have an impact on the economic system through the costs of energy for economic operators and households, the output of the energy sectors concerned, and the changes in energy-relevant capital spending (investments). The successful implementation of the measures triggers behavioural changes and/or changes in the use of technologies and the corresponding capital expenditure (substitution of energy volumes by capital), which in turn bring energy costs down (induced energy-saving technological progress; *Newell – Jaffe – Stavins*, 1999).

To quantify the effects of technological progress, studies on the investment costs of specific technologies were referred to. The additional investments have an effect on demand and cannot be equated with the macro-economic costs of implementing the scenarios. As a matter of fact, the macro-economic costs arise from the reallocation of resources: investments in energy-saving technologies would not be made without additional incentives; hence, the resources to be released for these purposes are not available elsewhere. Costs are incurred through the provision of incentive finance for investments, promotion programmes, information and training campaigns intended to overcome existing barriers, and the refund of network connection charges for electricity generated from renewable sources of energy.

Given the agreed public sector deficit goal, either higher tax revenues or a restructuring of spendings must be achieved in order to cover additional expenses, the macroeconomic effect being a reduction of disposable income. The investment and expenditure effects were also implemented into a macro-model of the Austrian economy, which replicates the income cycle and the public sector. This exercise illustrates the effect of investments at a given level of capital expenditure on macro-economic demand. Additional tax revenues result from the public-sector model block.

For the Kyoto scenario, the estimate (based on current prices) arrives at annual costs of ATS 16.7 billion (cumulative costs until 2020: ATS 261 billion) and annual investments of ATS 26 billion (cumulative investments: ATS 363 billion), the resulting difference of ATS 9.3 billion remaining as a macro-economic stimulus. Compared with the baseline scenario, the costs of energy consumption are substantially reduced, above all for commercial transportation and household consumers (approximately ATS 19 billion overall by 2020).

To some extent, the positive impact on demand of investments in energy-saving technologies is only felt until 2010, whereas the effects of lower energy consumption and, consequently, lower costs due to higher energy efficiencies continue to increase until 2020. The fossil energy supply sectors will experience a steep decline (by as much as 30 percent against the baseline scenario) in terms of output and employment. The higher level of capital expenditure will have a favourable impact on the metal goods, office machinery and electrical equipment sectors until 2010; the construction industry will benefit from capital spending on improved thermal insulation throughout the period under consideration. The impact on sectors with a low degree of income elasticity (textiles and clothing, food) is slightly negative.

Overall, *gross output* is lower than in the baseline scenario, the difference being 2.3 percent in 2020. The level of employment increases against the baseline scenario in almost all non-energy sectors; the total number of persons in employment will exceed the corresponding figure of the baseline scenario by 20,000 to 25,000, i.e., 0.6 percent.

The basic pattern resulting from the reallocation of resources from the energy sector to other sectors of the economy (motivated by the goal of reducing CO_2 emissions) can be described as a decline of energy demand for input-intensive goods production (less "throughput") and an increase of demand for capital for labour-intensive goods production (use of new technologies in the energy sector). In the Kyoto scenario, GDP (the *net output* of the sectors) is approximately 1 percent higher than in the baseline scenario until 2010 and approximately 0.6 percent higher for the remaining period under consideration.

The decline in energy demand is largely accounted for by imported intermediate goods, which are contained in gross output, but not in the GDP; hence, they are GDP-neutral. Owing to the positive effects on GDP, the model calculations also result in higher public-sector revenues, which would have to be offset against the potentially higher public-sector expenses in the Kyoto scenario. Given the requirements of the EU Stability Pact, a net increase in government spending on account of the Kyoto measures is excluded, which means that the public budget will get the full benefit of the additional tax revenues. Overall, a reduction of the net deficit by as much as ATS 19 billion is to be expected in the Kyoto scenario.

The sustainability scenario

The design of the "sustainability scenario" is based on three current developments at the international level:

- the sustainability strategy of the European Union,
- the global energy scenarios of the United Nations Development Programme and the World Energy Council (WEC), and
- the "Third Assessment Report" of the Intergovernmental Panel on Climate Change (IPCC).

The analyses leading to the notion of *sustainable development* were all based on a review of economic operations with a view to possible negative consequences for the vital opportunities of subsequent generations. The resulting recommendations can be summarised as follows:

- The prosperity of a society ought to be achievable with a substantially reduced degree of energy intensity.
- A controlled withdrawal from the use of fossil energy is to be aimed at.

Energy scenarios based on the principle of sustainability first look at the technological options available to change both the volume and the type of energy flows. Technologies are to be identified which meet a greatly reduced energy demand with non-fossil sources of energy. For the most important energy services in the fields of housing and transport, the availability of such technologies is a realistic possibility.

The "sustainability scenario" of this study is modelled largely on the energy scenarios developed by IIASA and the WEC (*Nakicenovic – Nadejda – Tsuneyuki*, 1998), which use the example of energy to discuss the issue of a global sustainability strategy from the "economic", "ecological" and "social" points of view. The problems of the existing energy systems in developing countries in respect of economic and social development as well as human health are factors of considerable weight in these scenarios. The model of "sustainable development" is developed by *Nakicenovic – Nadejda – Tsuneyuki* (1998) in scenario C, which also serves as a starting point for our study. To operationalise the concept of sustainability, the scenario designed for Austria first reduces the volume of energy services in a socially compatible manner. This applies, in particular, to transportation, domestic demand for electricity, and process energy used in industry.

Table 6: Gross output in the "Kyoto scenario"
In real terms in 1983 prices

	2005	2010	2015	2020
	Difference against "baseline scenario" in percent			
Agriculture and forestry	± 0.0	± 0.0	± 0.0	± 0.0
Coal mining	– 1.2	– 2.2	– 1.8	– 1.7
Oil and gas extraction	– 8.0	– 19.3	– 23.5	– 28.9
Gas supply	– 8.3	– 18.6	– 19.1	– 20.2
Oil processing	– 8.2	– 19.5	– 23.8	– 29.1
Electricity and heat supply	– 2.4	– 5.0	– 3.5	– 2.9
Water supply	± 0.0	± 0.0	± 0.0	± 0.0
Iron and non-ferrous metals	+ 0.2	+ 0.2	+ 0.1	+ 0.1
Stone and glass ware, mining	+ 0.5	+ 0.5	+ 0.4	+ 0.4
Chemicals	+ 0.8	+ 0.8	+ 0.5	+ 0.5
Metal products	+ 5.3	+ 4.7	+ 0.8	+ 0.7
Mechanical engineering	+ 0.6	+ 0.6	+ 0.3	+ 0.4
Office machinery	+ 40.0	+ 27.2	+ 3.3	+ 2.7
Electrical equipment	+ 2.4	+ 2.1	+ 0.7	+ 0.7
Vehicle engineering	+ 0.5	+ 0.5	+ 0.3	+ 0.3
Food and beverages, tobacco	– 0.1	– 0.2	– 0.2	– 0.3
Textiles, clothing, shoes	+ 0.1	± 0.0	– 0.1	– 0.1
Paper and board, printing	+ 1.1	+ 1.0	+ 0.8	+ 0.7
Rubber and plastic goods	+ 0.3	+ 0.2	± 0.0	± 0.0
Recycling	+ 0.4	+ 0.4	+ 0.3	+ 0.3
Other goods producing industries	+ 0.8	+ 0.7	+ 0.5	+ 0.5
Construction	+ 3.3	+ 3.4	+ 2.7	+ 2.4
Distribution and storage	+ 0.5	+ 0.5	+ 0.3	+ 0.4
Hotel and catering industry	+ 0.5	+ 0.5	+ 0.3	+ 0.4
Road, rail and bus transportation	+ 0.3	+ 0.4	+ 0.2	+ 0.3
Navigation, aviation	+ 1.0	+ 1.0	+ 0.6	+ 0.6
Other transportation services	+ 0.5	+ 0.5	+ 0.3	+ 0.4
Telecommunication	+ 0.4	+ 0.3	+ 0.1	+ 0.1
Banking and insurance	+ 0.5	+ 0.6	+ 0.4	+ 0.4
Other marketable services	+ 0.7	+ 0.8	+ 0.5	+ 0.5
Non-marketable services	± 0.0	± 0.0	± 0.0	± 0.0
Total	– 0.1	– 1.5	– 2.1	– 2.3

Stepping up the pace of technology diffusion is another priority of the sustainability scenario. The underlying paradigm is the interpretation of sustainability as the principle of an innovative economic development pattern in which technologies that have almost reached the stage of market maturity are to be disseminated over large areas as quickly as possible. In this context, zero-emission vehicles and electricity and heat generation technologies (generation of green electricity from wind power and photovoltaic systems) are of special importance. Moreover, given the wide-spread use of co-generation technologies based on fuel cells, strong "fuel shift" effects occur.

Table 7: Energy end use in the "sustainability scenario"

	2000	2005	2010	2015	2020
			In tJ		
Coal	64,787	52,497	42,957	33,735	26,360
Mineral oil, fuels	113,888	100,825	78,282	70,883	61,058
Mineral oil, motor fuels	256,654	253,089	229,915	194,722	146,080
Gas	174,148	180,973	173,610	172,647	164,343
Electricity	181,875	192,911	192,218	191,701	189,209
Fossil energy	609,476	587,384	524,764	471,987	397,841
Biomass	105,015	97,182	88,211	81,982	73,534
District heating	42,075	50,220	57,720	57,132	58,160
Renewable heat	6,773	11,434	21,515	28,202	36,975
Hydro power	46	46	46	46	46
Total	945,260	939,178	884,474	831,051	755,764
"Baseline scenario"	945,260	1,010,077	1,049,161	1,084,712	1,121,451

Table 8: CO_2 emissions in the "sustainability scenario"

	2000	2005	2010	2015	2020
			1,000 t		
Coke oven	365	346	335	311	285
Blast furnace	78	87	94	91	87
Refinery	658	609	560	516	442
Heat generation	1,548	1,528	1,462	1,318	1,209
Electricity	7,243	6,479	4,767	3,609	2,454
Industry	4,676	5,184	5,643	5,456	5,247
Conversion processes	14,568	14,233	12,859	11,302	9,724
Total	60,292	57,807	51,491	45,607	38,242
"Baseline scenario"	60,292	64,634	66,215	67,506	69,263

Energy end use declines at about the same rate until 2010 in both the sustainability scenario and the Kyoto scenario. Therefore, CO_2 emissions from energy end use, amounting to 38.6 million tons in 2010, are also approximately the same as in the Kyoto scenario (38.9 million tons). However, through the persistent effect of sustainability strategies, emissions from the end use of energy are further reduced to 28.5 million tons by 2020.

Total CO_2 emissions reach a level comparable to that of the Kyoto scenario (51.5 million tons, Kyoto scenario: 53.3 million tons) in 2010 and continue to decline drastically to 38.2 million tons by 2020. This corresponds to a drop to 63 percent of the emission level of 2000. On the energy supply side, generation by thermal power plants is clearly on the decrease, while wind power and photovoltaic systems are gaining in importance. The impact on thermal generation is felt even more strongly, as the total volume of electricity generated is declining.

Thus, the Kyoto scenario and the sustainability scenario differ more strongly in the end use of electric energy rather than of fossil-based energy. Given an energy efficiency (relation between primary energy input and final energy output) of less than 100 percent, a "multiplier" is applied to CO_2 reductions upstream of thermal electricity generation in the sustainability scenario. Subsequently, the development of total energy consumption (gross) from 2010 onwards differs even more strongly between the Kyoto scenario and the sustainability scenario than that of energy end use.

In the sustainability scenario, total annual costs for enterprises and consumers of ATS 25.4 billion (cumulative costs of ATS 450 billion) compare with annual capital expenditure of approximately ATS 37.9 billion (cumulative capital expenditure of ATS 638 billion). The difference of ATS 12.5 billion per year – ATS 3 billion more than in the Kyoto scenario – acts as a comparatively stronger macro-economic stimulus. Again, the costs of energy are considerably lower than in the baseline scenario, above all for commercial transport and households. However, unlike in the Kyoto scenario, primary industries achieve a substantial reduction of their energy costs through the shift to alternative raw materials. For the purposes of this simulation, the reduction of costs is assumed to translate fully into an increase of disposable income. Alternatively, the cost reductions could also be interpreted as an increase in price competitiveness; in that case, the corresponding demand effects would have to be represented in the primary sectors.

Energy costs for passenger cars are higher than in the baseline scenario on account of the low price elasticity of fuel demand with respect to tax increases. Given the crude oil price increase (after 2015), the annual cost reductions are less significant.

As regards the macro-economic variables, the results of the sustainability scenario are similar to those of the Kyoto scenario. Production in the fossil energy supply sectors is declining fast (by as much as 47 percent against the baseline scenario by 2010). Like in the Kyoto scenario, the higher volume of capital spending stimulates investments in plant and equipment (metal goods, office machinery, electrical equipment) until 2010; the stimulating effect on the construction industry persists throughout the period under consideration. Overall, *gross output* in 2020 is 4.6 percent lower than in the baseline scenario. As in the Kyoto scenario, the negative effects on output in the energy sectors translate into a proportional decline in employment. Most other sectors experience a growth in employment; overall, the level of employment is 1 percent, i.e., 30,000 to 40,000 jobs, higher than in the baseline scenario. In the sustainability scenario level of GDP (*net output* of the sectors) is about 1.4 percent above the level of the baseline scenario until 2010 and 1 percent above that level for the remaining period.

Model calculations result in a corresponding increase of state revenues by ATS 20 to 30 billion per year. Given the requirements of the EU Stability Pact, investment incentives and other public expenses have to be financed through expenditure shifts, as is the case in the Kyoto scenario, which means that the public budget gets the full benefit of additional tax revenues.

Table 9: Gross output in the "sustainability scenario"
In real terms, 1983 prices

	2005	2010	2015	2020
	Difference against "baseline scenario" in percent			
Agriculture and forestry	± 0.0	± 0.0	± 0.0	± 0.0
Coal mining	– 2.2	– 6.2	– 11.6	– 18.8
Oil and gas extraction	– 9.7	– 23.0	– 34.0	– 46.9
Gas supply	+ 0.8	– 12.0	– 24.3	– 37.8
Oil processing	– 9.8	– 23.1	– 34.0	– 46.9
Electricity and heat supply	– 4.1	– 10.0	– 15.6	– 22.1
Water supply	± 0.0	± 0.0	± 0.0	± 0.0
Iron and non-ferrous metals	+ 0.2	+ 0.2	+ 0.2	+ 0.2
Stone and glass ware, mining	+ 1.1	+ 1.0	+ 0.9	+ 1.0
Chemicals	+ 1.3	+ 1.3	+ 1.0	+ 1.2
Metal goods	+ 6.5	+ 5.8	+ 2.4	+ 2.4
Mechanical engineering	+ 0.8	+ 0.8	+ 0.5	+ 0.9
Office machinery	+ 49.4	+ 33.7	+ 10.9	+ 8.9
Electrical equipment	+ 2.8	+ 2.5	+ 1.2	+ 1.4
Vehicle engineering	+ 0.6	+ 0.6	+ 0.4	+ 0.6
Food and beverages, tobacco	– 0.2	– 0.3	– 0.3	– 0.6
Textiles, clothing, shoes	+ 0.1	+ 0.1	– 0.1	– 0.1
Paper and board, printing	+ 2.0	+ 1.9	+ 1.5	+ 1.6
Rubber and plastic goods	+ 0.3	+ 0.2	± 0.0	+ 0.1
Recycling	+ 0.5	+ 0.5	+ 0.4	+ 0.6
Other goods-producing industries	+ 1.3	+ 1.2	+ 1.0	+ 1.2
Construction	+ 5.5	+ 5.7	+ 4.7	+ 4.5
Distribution and storage	+ 0.6	+ 0.7	+ 0.5	+ 0.8
Hotel and catering industry	+ 0.6	+ 0.7	+ 0.5	+ 0.8
Road, rail and bus transportation	+ 0.4	+ 0.5	+ 0.3	+ 0.5
Navigation, aviation	+ 1.2	+ 1.3	+ 0.9	+ 1.3
Other transportation services	+ 0.6	+ 0.7	+ 0.5	+ 0.8
Telecommunication	+ 0.4	+ 0.4	+ 0.2	+ 0.4
Banking and insurance	+ 0.7	+ 0.7	+ 0.5	+ 0.8
Other marketable services	+ 0.8	+ 0.9	+ 0.7	+ 0.9
Non-marketable services	± 0.0	± 0.0	± 0.0	± 0.0
Total	+ 0.2	– 1.6	– 3.4	– 4.6

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Energy Scenarios up to 2020 – Summary

On the basis of its model of energy demand and energy conversion in Austria (DAEDALUS III), WIFO simulated three scenarios to establish a long-term forecast of the development of energy consumption and CO_2 emissions. The baseline scenario assumes a continuation of current developments, while the Kyoto scenario reflects the effects of the Austrian strategy to counteract climate change. The sustainability scenario is based on the adoption of international approaches to implement socially compatible measures aimed at minimising energy consumption and accelerating technological progress.

Under the "baseline scenario", the consumption of fuels, electricity and gas continues to increase. This development, combined with a rising volume of electricity generation by thermal power plants, results in an increase of CO_2 emissions by about 3.2 million tons per year until 2010. The "Kyoto scenario" reflects the Austrian strategy of preventing climate change, which provides for an increase in energy efficiency and greater reliance on renewable sources of energy, the goal being to diminish the level of CO_2 emissions by about 13 million tons against baseline by 2010. The "sustainability scenario" simulates the effects of a socially compatible reduction of energy services and an accelerated pace of innovation and technology diffusion. Until 2010, energy consumption and CO_2 emissions decrease by more or less the same amounts as under the Kyoto scenario, but by 2020 CO_2 emissions drop to 63 percent of the year-2000 level. Both the Kyoto scenario and the sustainability scenario are associated with substantial costs, as they require a diversion of resources, but GDP and employment are slightly higher than in the baseline scenario.