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ENERGY SCENARIOS FOR EASTERN EUROPE (1980-2030)

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1. INTRODUCTION

During the period December 1989 through June 1990 a joint study was carried out by the International Institute for Applied Systems Analysis (IIASA), and the Netherlands Energy Research Foundation (ECN/ESC). This study aimed at the development of scenarios for primary energy requirements for Eastern Europe up to the year 2030, and was complementary to the CRIEPI project of IIASA. The objectives of this joint study were twofold, namely:

1. To determine final and primary energy requirements for the energy scenarios developed within the CRIEPI project.
2. To analyse the performance of the LEAP model when applied for industrialized countries.

Eastern Europe comprises the following countries: Bulgaria, Czechoslovakia, German Democratic Rebublic, Hungary, Poland, Romania and the Soviet Union. In this report only scenarios for total Eastern Europe are given. Scenarios for individual countries can be found in Sinyak, Y. (1990).

This study presents two scenarios, for the period 1980-2030, which have as the starting point the political and economic reforms that can be experienced now in Eastern Europe. Because it is not clear how far these reforms will go, two more or less extreme scenarios were developed:

1. A moderate scenario, assuming a moderate economic restructuring.

2. An enhanced scenario, based on a much higher rate of economic restructuring.

Chapter 2 of this report describes the method used to develop projections for energy production and consumption; chapter 3 gives an overview of the key assumptions and in chapter 4 the scenario results are presented. In chapter 5 the carbon dioxide (CO_2) emissions for each scenario are given. Conclusions are stated in chapter 6.

2. PROJECTION METHOD

The scenarios for Eastern Europe are constructed using two models, and on the basis of exogenous variables. First, the MEDEE-2 model has been used to determine final energy demand. Second, energy conversion and production has been calculated with the LEAP model.

2.1 The MEDEE-2 model

The MEDEE-2 model uses the 'accounting end-use approach' for calculating energy consumption of various end-use fuels. This approach consists of combining information on the activity level of a sector with information on efficiencies and energy intensities for each end-use. MEDEE-2 is an accounting framework for evaluating, over a given period of time, the energy demand implications of a scenario that describes the hypothetical evaluation of economic activities and the lifestyle of a population. Total energy demand is disaggregated into a multitude of end-use categories arising in the following sectors of energy use in an economy:

a. Goods production in agriculture, construction, mining and manufacturing.

b. Transportation.

c. Household and service-sector.

The starting point for the demand projections is a scenario that defines population growth, economic development and energy prices.

Sectoral energy consumption patterns are mainly described by energy intensities and penetration rates plus the efficiencies of respective energy technologies. Calculation of basic energy use of an activity is based on its activity level (value added at constant prices) and energy intensity. A distinction is made between final energy for specific or non-substitutable uses and useful energy for substitutable uses. The prime model output is final energy demand by sector and energy forms.

The first computerised version of MEDEE-2 was developed in the mid1970's by B. Chateau and B. Lapillonne at the Institue of Energy Economics and Law, University of Grenoble (Chateau and Lapillone, 1982; Lapillone, 1978) and implemented at the International Institute for Applied Systems Analysis in late 1970s - early 1980s in its energy related studies (Häfele, 1981). Later a more advanced version of the model was developed, incorporating investments in energy savings and substitutions on the basis of relationships reflecting consumer behaviour, taking into account energy prices, cost of energy savings or fuel substitutions, as well as other factors (subsidies, interest rates, financing constraints, etc.).

2.2 The LEAP model

LEAP stands for Long-range Energy Alternatives Planning system and is designed by the Beijer Institute of the Swedish Academy of Science and the TELLUS Institute (formerly Energy System Research Group), situated in Boston. LEAP is a computerised system which consists of a number of modules, each module covering part of the energy system. So LEAP comprises modules for computing energy demand, for simulating energy conversion processes (e.g. electricity generation), for assessment of biomass resources, for computing investment costs and for determining the impacts on the environment (Raskin, 1986).

The LEAP system runs on a PC (IBM compatible) and is fully 'menu-driven'. The input files are preformatted in a very user friendly way. This enables the LEAP system to be used quickly and easily, also for those users having no detailed knowledge about computers.

There were two reasons for using LEAP instead of energy supply models like MARKAL or EFOM. First, there was only limited time available for the modelling part of the study, so a model had to be used that could be made operational quickly. LEAP is such a model. Second, another objective of this study was to test the performance of LEAP for industrialized countries. LEAP was originally designed for developing countries, and has been applied succesfully a number of times for those countries. If LEAP is also applicable for industrialized countries, this means that LEAP can be used as an accounting framework for global energy and CO_2-emission studies. Both at IIASA and at ECN/ESC these studies are a focus of the research activities.

3. SCENARIO ASSUMPTIONS

3.1 Introduction

The political and economic reforms resulting from perestroika are still starting in Eastern Europe, and it is still under discussion how far these reforms will go (especially in the USSR). Particularly it is not clear how far and how fast economic reforms will transform a planned economic system to a more market oriented economic system. Nevertheless, one thing is clear now, the future economic system in Eastern Europe should and will be less energy intensive than it was in the past or than it is at present. This conclusion means that practically all past energy projections are outdated (even the most recent ones). The reason for this is that they were developed on the basis of old economic concepts which, to a large degree, now are considered completely unreasonable, publicly unacceptable, and overestimate the importance of heavy industries with their rigid structure and low economic efficiency and high energy consumption. Of course, the uncertainty of such important factors as economic and social goals of national development (even for the near- and middle-term) makes it difficult to outline energy projections and it will take some time to understand more precisely the new structure of East European economies. Having this in mind, it was decided to develop two energy scenarios which represent more or less two extreme views with respect to the future economic restructuring for this region:

1. Moderate scenario, with moderate rates of economic restructuring and energy efficiency improvements and low but steady growth rates over the long term and without remarkable changes in livestyle.
2. Enhanced scenario, with high rate of economic restructuring, with enhanced energy conservation and remarkable changes in livestyle.

3.2 Key assumptions

The key assumptions of the two scenarios are given in table 1. More detailed information on the scenario assumptions is given in the appendix.

Table 1. Key assumptions for the moderate and enhanced scenario

	Moderate scenario	Enhanced scenario
Average pop. growth	0.7%/yr	0.7%/year
Average econ. growth	2.7%/yr	1990-2000 2%/yr 2000-2010 3%/yr 2010-2030 4%/yr
Average efficiency imp.	0.8%/yr	1.8%/yr
Changes lifestyle	not remarkable	remarkable

The population in Eastern Europe was 378 million in 1980, 408 million in 1990 and is projected to be 437 million in 2000 and 480 million in 2030. The share of urban population is steadily growing and will reach 75% around 2020-2030.

For the moderate scenario an annual economic growth rate is assumed of 2.7%, about the same which prevailed during the 1980s. For the enhanced scenario economic growth will

be much less in the first period due to high investment cost required for restructuring the economy. This restructuring will result in a higher growth rate after 2000, and the full impact will only be felt after 2010.

Efficiency improvements for the moderate scenario are assumed to be .8% per year. This rate is an average over all sectors. Efficiency improvements for transportation sector and residential sector are less, and for manufacturing sector are higher. More pronounced efficiency improvements are expected in the enhanced scenario with an annual rate of 1.8%. This higher factor does not seem unreasonable because, for example, the energy/GNP ratio in the USSR decreased by about 2% over 1960-1985.

Changes of livestyle are related primary to the residential/commercial sector and the transportation sector. Examples are an increase in living space, a more frequent use of private cars, changes in the settlement planning, etc.

4. SCENARIO RESULTS

4.1 Introduction

The scenario results were obtained by using the MEDEE-2 model and the LEAP model as described in chapter 2. When applying LEAP to Eastern Europe, we encountered a number of problems, mainly due to the fact that LEAP has been designed for developing countries. For example, it is not possible to simulate co-generation of heat and power with the current version of LEAP (version 90.01). Another problem was that for some modules within LEAP (e.g. costing module) the simulation period is limited to only 26 years. Most of the problems that were encountered could be fixed by some 'manipulation' of input data or by 'tricks' with the model, although this negatively influences the userfriendliness of LEAP. The SEI-Boston/TELLUS Institute is presently working on these problems, and it is expected that for the next version of LEAP these shortcomings will be overcome.

4.2 General indicators

Table 2 shows a number of general indicators for the two scenarios.

Table 2. General indicators for the moderate and enhanced scenarios

			Moderate scenario		Enhanced scenario	
	1980	1990	2000	2030	2000	2030
Population (million)	378	408	437	480	437	480
GNP (billion $1980)	1675	2255	3030	6200	2750	8000
Final energy demand (mln tce)	1810	2070	2430	3125	2155	2385
Electricity consumption	1495	2200	3000	6300	2760	6000
Electricity share in final demand (%)	10.9	13.4	16	26.3	16.7	31

Due to the high rate of restructuring, which requires high investment costs and an adjustment period with lower productivity, GNP in 2000 for the enhanced scenario is expected to be lower compared to the moderate scenario. After 2000, the restructuring will cause a faster economic growth resulting in a higher GNP in 2030.

For the enhanced scenario final energy demand only slightly increases during the period 2000-2030, in spite of a large increase of GNP. This is due to a high rate of efficiency improvements (1.8% annually). Electricity share in final demand is growing for both scenarios. From 11% in 1980 to 16% in 2000 and 27% in 2030 for the moderate scenario and 17% in 2000 and 31% in 2030 for the enhanced scenario.

4.3 Moderate scenario

Table 3 gives the energy production, primary energy consumption and net energy trade for the moderate scenario.

Table 3. Production, consumption and net trade by fuel for Eastern Europe (1980, 1990, 2000, 2030)

	Moderate scenario, mln tce					
	Solid	Liquid	Gaseous	Nuclear	Other	Total
Production						
1980	669	790	504	41	98	2102
1990	698	843	745	99	121	2506
2000	745	840	1115	125	160	2985
2030	935	820	1580	365	245	3945
Consumption						
1980	655	721	468	41	98	1983
1990	678	783	675	99	121	2356
2000	720	810	1010	125	160	2825
2030	890	800	1375	365	245	3675
Net trade						
1980	–14	–69	–36	-	-	–119
1990	–20	–60	–70	-	-	–150
2000	–25	–30	–105	-	-	–160
2030	–45	–20	–205	-	-	–270

For the moderate scenario total energy production in Eastern Europe almost doubles during the period 1980-2030 (average annual growth rate of 1.3%). For a small part this increase in production is caused by an increase of exports, particularly natural gas, but the major part is due to a large increase of own consumption.

The production of coal is expected to increase slightly till 2000. This moderate increase of coal production is due to environmental constraints which limit the wide use of coal. After 2000, the use of coal will increase rapidly.

The moderate scenario shows practical stabilization of crude oil production till 2000, and a slight decline after 2000. Although, according to some estimates (Eskin et al., 1988), a production increase after 2000 is technically feasible, it is aimed at reaching an absolute reduction in oil production level beyond 1995-2000, to avoid the high investment costs required for new oil production technologies for the development of new fields. For this reason priority is given to stabilize or even decrease the use of oil products[1]. In 1980, diesel/gasoline yields in oil refining was about the same as residual/fueloil yields. In the future this ratio will change radically. In 2030 the diesel/gasoline yields will amount to approximately 66% of total oil refining.

The propects for natural gas are very bright. They are based on large resources which exceed 50 trillion cubic meters for reserves. Because of a more moderate increase of

1 Of course, with high market prices for oil it will be profitable to maintain high domestic crude oil production levels

nuclear production, and a stabilization of crude oil production, the production of natural gas is expected to increase to about 950-1000 billion cubic meters annually in 2000. At the beginning of the next century, production of natural gas will reach its maximum level which is estimated to be around 1300-1350 billion cubic meters annually.

The category 'others' in table 1 comprises hydropower, solar energy and non-commercial energy. Electricity produced by hydropower is expected to increase from 64 mln tce in 1980 to 150 mln tce in 2030. Also electricity produced by solar systems will increase.

Due to the Chernobyl accident, the nuclear energy programme has been revised and the introduction of new nuclear power plants during 1986-1995 is postponed or slowed down. This drop in nuclear (compared to earlier expectations) is compensated by an accelerated growth of the use of natural gas for electricity production. It is expected that, after a period of consideration and research, nuclear energy production will rise again. Table 4 gives the generated electricity for the moderate scenario.

Table 4. Electricity generation for the moderate scenario (TWh)

	1980	2000	2030
Fossil fuels			
Solids	560	990	1840
Liquids	495	275	120
Gaseous	330	1240	3310
Nuclear	130	445	1035
Hydro + other	190	410	585
Total	1705	3360	6890

4.4 Enhanced scenario

Table 5 shows primary energy consumption, energy production and net energy trade for the enhanced scenario.

For the enhanced scenario the average annual increase of energy production is 0.9%, with practically stabilizing final energy demand after 2005-2010. Primary energy requirements in 2030 are almost 20% less compared to the moderate scenario. The production of natural gas is expected to be only slightly less than for the moderate scenario, and nuclear and renewable energies are approximately the same. So that means less coal and crude oil is necessary in this scenario.

Table 5. Production, consumption and net trade by fuel for Eastern Europe (1980, 1990, 2000,2030), enhanced scenario, mln tce

	Solid	Liquid	Gaseous	Nuclear	Other	Total
Production						
1980	669	790	504	41	98	2102
1990	593	833	768	98	99	2391
2000	525	795	1130	125	145	2720
2030	525	570	1575	360	230	3260
Consumption						
1980	655	721	468	41	98	1983
1990	573	716	698	98	99	2184
2000	500	695	1025	125	145	2490
2030	480	525	1370	360	230	2965
Net trade						
1980	–14	–69	–36	-	-	–119
1990	–20	–117	–70	-	-	–207
2000	–25	–100	–105	-	-	–230
2030	–45	–45	–205	-	-	–295

For the enhanced scenario a higher penetration rate of electricity is expected. For 2030 electricity production is only slightly less than in the moderate scenario. Table 6 gives electricity generation per fuel.

Table 6. Electricity generation for the enhanced scenario (TWh)

	1980	2000	2030
Fossil fuels			
Solids	560	660	1530
Liquids	495	275	120
Gaseous	330	1350	3415
Nuclear	130	445	1035
Hydro + other	190	415	520
Total	1705	3145	6620

The scenarios presented in tables 3 and 5 are designed to take into account the recent political and economic developments in Eastern Europe. These developments will result in considerable efficiency improvements. Energy demand for this region will therefore be (much) less than was expected until recently. To what extent the energy demand might be affected can be illustrated by a comparison with the scenarios developed for the 14th Congress of the World Energy Conference (WEC scenarios). Primary energy demand in the WEC scenarios is about 20% higher.

Table 7. Comparison energy scenarios for Eastern Europe (2000, 2020/2030)

	Primary energy demand (mln tce)			
	WEC		IIASA/ESC	
	2000	2020	2000	2030
Medium scenario	3460	4407	2825	3675
Low scenario	3284	3850	2490	2965

5. CO_2-EMISSIONS

5.1 Introduction

Tables 5.2 and 5.3 set out the projections of carbon dioxide (CO_2) emissions associated with the previously discussed energy scenarios.

For the calculation of the CO_2-emissions the environmental module of LEAP has been used. This module links the energy demand and transformation devices, processes, and facilities that consume, transform, or produce energy, to the environmental data base. This data base contains detailed information on environmental emissions and impacts.

CO_2-emissions have been calculated using the following emission coefficients: solids 2.929 ton CO_2/tce/year, liquids 2.167 ton CO_2/tce/year and gaseous 1.465 ton CO_2/tce/year.

5.2 CO_2-emissions moderate scenario

Table 8. CO_2-emissions for the moderate scenario, mln ton CO_2/year

	Moderate scenario		
	1990	2000	2030
Total emission by sector	4710	5395	6595
Electricity	1095	1585	3060
Transportation	465	600	785
Residential/service	835	930	750
Industry	2315	2280	2000

For the moderate scenario total CO_2-emissions in 1990 amount to 4710 mln ton. This is about 23% of total world CO_2-emissions. Average annual growth of CO_2-emissions for this period is 0.9% (table 8). This growth rate is less after 2000, due to a switch to electricity and natural gas. This switch to electricity results in a decrease of emissions after 2000 for the residential/services sector and industry. After 2000 the electricity sector becomes the major source for the CO_2 emission reaching to more than 45% of total CO_2 emissions in the region as compared to less than 25% today.

5.3 CO_2-emissions enhanced scenario

For the enhanced scenarios the average annual growth of CO_2-emissions is 0.4% (table 9) for the period 1990-2030. In 2030 more than half of total emissions are produced by the electricity sector.

With respect to CO_2-abatement both scenarios can be described as 'business as usual' in the sense that no specific CO_2-abatement measures have been considered. A reduction of

20% compared to the 1990 level (this means a reduction in 2030 of about 900 mln ton CO_2/year), can only be achieved with a large expansion of renewable and nuclear energy (Sinyak, 1990, to be published).

Table 9. CO_2-emissions for the enhanced scenario, mln ton CO_2/year

	Moderate scenario		
	1990	2000	2030
Total emission by sector	4260	4565	5080
Electricity	990	1190	2525
Transportation	420	575	580
Residential/service	755	930	475
Industry	2095	1870	1500

6. CONCLUSIONS

At this moment perestroika is just starting, and it is not clear to what extent the economies of the Eastern Europe countries will turn into market economies. One thing that can be said is that the future shape of the economies will be less energy intensive. This is due to the large potential for improvements of the energy efficiencies and the changes of live style.

On the assumptions presented here, on the average, primary energy demand in Eastern Europe till 2030 grows by between 0.9 and 1.3% annually, depending on the scenario considered. It should be stressed that the scenarios presented here only defines the margins of the future energy situation in Eastern Europe and could be considered as 'conservative' in the sense of CO_2 abatement requirements.

Striking in both scenarios is the large increase of natural gas production. Due to a stabilization or even decline of oil, nuclear and coal, production of natural gas is increasing rapidly to fill the gap between energy demand and supply. Export of natural gas is expected to reach a level of around 160 billion m^3 in 2030.

The CO_2-emissions associated with these scenarios grow, on the average, by between 0.4 and 0.9% annually. In particular after 2000 these growth rates will be less than the average due to the large penetration of natural gas. But even in the case of enhanced energy savings, the scenario assumptions are still not enough to decline the absolute value of the CO_2-emissions.

The current version of LEAP (version 90.01) has a number of shortcomings when the model is applied to industrialized countries. Most serious shortcoming is the impossibility to specify co-generation of heat and power. However, it is expected that these shortcomings will be fixed with the next version of LEAP. Meanwhile, it was proved that the MEDEE model could work excellent in the combination with the LEAP model.

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APPENDIX: MEDEE-2 INPUT DATA FOR THE MODERATE AND ENHANCED SCENARIO

		Moderate scenario		Enhanced scenario	
	1980	2000	2030	2000	2030
Population (mln people)	378.0	437.0	480.0	437.0	480.0
GDP (10^9 $)					
Total	1675.0	3030.0	6200.0	2750.0	8000.0
Agriculture	164.1	251.4	415.4	233.7	480.0
Construction	130.6	236.3	477.4	200.7	240.0
Mining	40.2	84.8	210.8	66.0	120.0
Manufacturing					
Basic materials	139.4	197.5	269.7	185.9	403.2
Machinery and equipm.	295.2	529.4	1069.8	492.6	1276.8
Food & textiles	172.2	260.7	454.8	250.9	560.0
Energy sector	70.3	136.3	297.6	121.0	280.0
Services (incl. transp.)	663.3	1333.2	3000.8	1199.0	4640.0
Energy intensity					
Agriculture					
Motor fuel (kWh/$VA)	1.512	1.360	1.134	1.285	0.680
Electr. (kWh/$VA)	0.800	0.960	0.960	0.944	0.920
Construction					
Motor fuel (kWh/$VA)	2.977	2.679	2.233	2.530	1.340
Electr. (kWh/$VA)	0.900	1.125	1.125	1.080	1.035
Mining					
Motor fuel (kWh/$VA)	0.000	0.000	0.000	0.000	0.000
Electr. (kWh/$VA)	0.000	0.000	0.000	0.000	0.000
Manuf. basic materials					
Thermal (useful, kWh/$VA)	9.831	9.314	7.762	8.797	4.657
Electr. (kWh/$VA)	3.447	4.025	4.725	4.025	3.850
Manuf. mach. & equipm.					
Thermal (useful, kWh/$VA)	4.419	4.186	3.488	3.953	2.093
Electr. (kWh/$VA)	1.084	1.265	1.485	1.265	1.210
Manuf. food & textiles					
Thermal (useful, kWh/$VA)	5.523	5.233	4.360	4.942	2.616
Electr. (kWh/$VA)	0.571	0.667	0.783	0.667	0.638
Steel prod. (10^6 tons)	200.0	200.0	200.0	190.0	150.0
Feedstock req. (10^6 toe)	80.0	155.0	255.0	110.0	255.0

		Moderate scenario		Enhanced scenario	
	1980	2000	2030	2000	2030
Transportation activity levels Freight transp. (10^9 tkm)					
Total	9606.0	13106.0	20725.0	12440.0	23130.0
Truck	576.3	917.4	2072.4	870.8	2312.9
Train					
Total	7109.0	9568.0	13471.0	9082.0	15034.0
Steam	319.8	95.6	0.0	0.0	0.0
Diesel	4052.0	4209.7	3367.7	4086.7	3006.8
Electric	2736.9	5262.1	10103.2	4994.8	12027.4
Barge	480.3	655.3	828.9	622.0	925.1
Pipe	1440.9	1965.9	4352.1	1866.0	4857.2
Passenger transp. Intercity (10^9 pkm)					
Total	1153.0	1748.0	1920.0	1748.0	1680.0
Car	135.4	314.6	1008.0	314.6	864.0
Bus	406.9	573.3	364.0	573.3	285.6
Train					
Total	458.0	588.0	319.0	588.0	367.0
Steam	6.8	0.0	0.0	0.0	0.0
Diesel	203.7	205.6	79.8	205.6	55.0
Electric	247.2	381.9	239.4	381.9	312.1
Plane	152.6	272.3	228.0	272.3	163.2
Passenger transp. Urban (10^9 pkm)					
Total	905.0	1452.0	2107.0	1452.0	1314.0
Car					
Motor fuel	90.4	290.2	756.8	290.2	394.2
Electric	0.0	0.0	84.0	0.0	59.1
Mass transit					
Motor fuel	651.4	870.8	756.8	870.8	505.8
Electric	162.8	290.2	504.5	290.2	413.9
Transport. energy intens. Freight transp. (kWh/tkm)					
Truck	0.849	0.767	0.640	0.756	0.407
Steam	0.340	0.307	0.262	0.297	0.157
Diesel	0.113	0.102	0.087	0.099	0.052
Electric	0.037	0.031	0.024	0.030	0.013

		Moderate scenario		Enhanced scenario	
	1980	2000	2030	2000	2030
Barge	0.113	0.099	0.076	0.099	0.052
Pipe	0.0	0.0	0.0	0.0	0.0
Passenger transp. Intercity (kWh/pkm)					
Car	0.379	0.313	0.214	0.313	0.165
Bus	0.085	0.090	0.069	0.090	0.060
Train					
Steam	0.186	0.215	0.227	0.215	0.227
Diesel	0.062	0.072	0.072	0.072	0.055
Electric	0.020	0.022	0.020	0.022	0.014
Plane	1.030	1.017	0.914	1.017	0.797
Passenger transp. Urban (kWh/pkm)					
Car					
Motor fuel	0.534	0.473	0.455	0.473	0.282
Electric	0.100	0.104	0.100	0.104	0.095
Mass transit					
Motor fuel	0.110	0.124	0.105	0.124	0.08
Electric	0.072	0.082	0.083	0.082	0.074
Dwellings (million)					
Pre-80-dwellings					
Single family	5.72	5.34	5.66	5.34	5.66
Appartment	39.93	37.42	37.75	37.42	37.75
Room heating	64.35	46.33	3.77	46.33	3.77
Post-80-dwellings					
Single family	0.0	11.31	24.36	11.31	24.36
Appartment	0.0	33.93	73.55	33.93	73.55
Room heating	0.0	11.31	23.92	11.3	23.92
Service sector buildings (million sqm)					
Pre-80	1800.0	1405.8	594.3	1405.8	712.5
Post-80	0.0	1248.1	2313.6	1213.5	1566.7
Energy int. household (1000 kWh/dw/yr)					
Pre-80-dwellings					
Single family	18.177	16.576	15.069	16.576	14.127
Appartment	15.709	14.325	13.023	14.325	12.209
Room heating	11.511	11.046	10.465	11.046	9.883

		Moderate scenario		Enhanced scenario	
	1980	2000	2030	2000	2030
Post-80-dwellings					
Single family	14.904	16.878	16.074	16.074	9.946
Appartment	9.949	12.457	12.859	12.457	8.288
Room heating	5.153	5.721	5.550	5.452	2.637
Water heating	2.991	2.695	2.668	2.965	2.668
Cooking	1.162	0.930	0.872	0.930	0.755
Air conditioning	2.325	2.325	2.325	2.325	2.325
Sec. elec. appl.	1.100	1.800	2.800	1.700	2.500
Energy int. service sector (kWh/sqm/yr)					
Space and water heating					
Pre-80	246.8	225.1	204.6	225.1	191.8
Post-80	223.8	209.3	168.6	197.6	127.9
Air conditioning	81.3	81.3	81.3	81.3	63.9
Specific use elec.					
Pre-80	42.5	40.0	33.0	40.0	29.0
Post-80	62.5	70.0	70.0	65.0	50.0