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European Sustainable Electricity; Comprehensive Analysis of Future European Demand and Generation of European Electricity and its Security of Supply

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WP1: Country-wise analysis for EU-25

CZECH REPUBLIC

1 Energy-Related and Socio-Economic Analysis : Past, Present and Future

1.1 Geographical Description

The Czech Republic is situated in Central Europe, bordering with Austria, Germany, Poland, and Slovakia. With the latter, it formed the Czech and Slovak Federal Republic until 1993. The Czech Republic constitutes an area of 78,866 km^2. The Bohemian west consists of rolling plains, hills, and plateaus surrounded by low mountains whereas the Moravian east is very hilly country. The Vlatva River is the most noteworthy river, providing hydropower potential for most of the Czech hydropower generation. The republic's terrain ranges in altitude from 115 m at the Elbe River up to 1,602 m at Snezka. The climate is influenced by the mutual penetration and mingling of ocean and continental effects. It is temperate with cool summers and cold humid winters, and characterized by prevailing western winds.

Figure 1: Map of The Czech Republic

Source: Ministry of Foreign Affairs (2002).

1.2 Demographics

In 2004, the Czech Republic's population was estimated as 10.202 million. Population growth is somewhat negative, namely –0.05 % (2004). The average size of a Czech household has been declining. In 2000, average household size was 2.61. The number of households was 3,184. The net migration rate indicating the contribution of migration to overall level of population change was 0.6 in 2000. In the next 25 years, demographic indicators are expected to contract further, specifically population down to 9.5 million and household size to 2.3.[1]

1.3 Economics

Due to the transformation from a centrally-planned to a market economy, the Czech economy has undergone fundamental restructuring during the last decade. The transition process has led to a less agricultural and more service based economy. In 2002, 56 % of GDP was generated in the service sector, 40 % in industry, and 4 % in agriculture.[2] The following table shows GDP development in recent years.

[1] See European Commission (2003).
[2] See World Bank (2004).

Table 1: GDP

	1995	2000	2001	2002	2003
GDP in bn € 2000	55.72	60.4	61.8	62.8	65.12
GDP in bn PPP current prices	110.2	137.5	144.1	152.1	150.0
GDP in PPP/capita current prices	10,664	12,811	13,531	14,319	14,690

Source: Eurostat (2005), Czech Statistical Office (2005), own calculations.

Real GDP expressed in $€_{2000}$ has increased continuously. Average annual growth from 1993 to 2003 has been 2.3 %/a, which is slightly below EU25 average.[3] GDP per capita, expressed in PPP (current prices) has risen. Still, in 2003 GDP per capita expressed in PPP was only about 70 % of the EU25 average.[4] GDP (in $€_{2000}$) is projected to nearly double within the next twenty-five years.[5]

With the beginning of the transformation process, inflation was a pressing problem. Recently, relatively low retail prices induced by an increasingly competitive market, as well as a successfully implemented inflation targeting network have led to a moderate inflation rate of around 1.5 to 2.5 percent.

Unemployment has risen continuously throughout transition. In recent years the unemployment rate ranged from close to 9 % in 2000 to slightly over 10 % in 2004.[6] Rates of unemployment are stubbornly high in the coal and steel producing regions of Northern Moravia and Northern Bohemia, and among less-skilled and older workers.

Foreign direct investment (FDI) inflow was 3.6 billion $€_{2004}$ in 2004 compared to 5.4 billion $€_{2000}$ in 2000.[7] FDI towards the sector Electricity, Gas and Water has been quite stable.

1.4 Energy

Supply

The Czech Republic has some substantial but limited domestic energy resources, mainly hard coal and lignite. Coal resources are mainly located in Northern Bohemia. In 2001, proved amount in place was quantified as 9.8 Gt, proved recoverable reserves as 5.7 Gt. They are comprised of about 42 % hard coal and 58 % lignite. At current production rates, mineable hard coal reserves will last more than 50 years; lignite slightly more than 30 years. Resources of oil and natural gas are negligible. Reasonably assured Uranium resources (at up to US$ 80/kgU) stood at just over 4,100 tonnes at the end of 1999. There are 24 uranium deposits of which 20 have been mined-out or closed.[8]

Solid fuels make up more than half of total primary energy supply (TPES). The Republic is strongly dependent on oil and gas imports (40 % of TPES). Since the start of the transition in 1990, Czech total energy production has decreased by 27 %, TPES has fallen by 19 %. With imports increasing by 27 %, the import dependency has risen throughout the transformation process, reaching 23 % in 2000. None withstanding, the Czech Republic is a net exporter of solid fuels. Renewable fuels other than hydropower have only slightly entered the picture.

[3] See World Bank (2004).
[4] See Eurostat (2005). Average annual real growth of GDP per capita has been below EU average, too, namely 1.8 % from 1995-2002. See OECD (2005a).
[5] See European Commission (2003).
[6] See Czech Statistical Office (2005).
[7] See Czech National Bank (2005).
[8] See Austrian Energy Agency (2005) and World Energy Council (2001).

Table 2: TPES by Energy Carrier

Energy Carrier	1990			2002			2003			Change [%/a]***
	PJ/a	[mtoe/a]	[%]	[PJ/a]	[mtoe/a]	[%]	[PJ/a]	[mtoe/a]	[%]	
Coal	1,253	29.84	62.3	861	20.51	49.2	873	20.79	47.6	-2.7
Oil	375	8.94	18.9	357	8.52	20.4	368	8.77	20.1	-0.1
Gas	221	5.26	11.1	326	7.76	18.6	330	7.86	18.0	3.1
Others*	-	-	-	34	0.82	2.0	34	0.81	1.9	-
Nuclear	138	3.28	6.92	205	4.88	11.7	283	6.74	15.4	5.7
Hydro	5.04	0.12	0.25	8.82	0.21	0.5	5.04	0.12	0.3	-0.3
Import**	-2.52	-0.06	-0.13	-41.2	-0.98	-2.3	-58	-1.39	-3.2	27.5
Total	**1,990**	**47.38**	**100**	**1,752**	**42.72**	**100**	**1,835**	**43.7**	**100**	**-0.6**

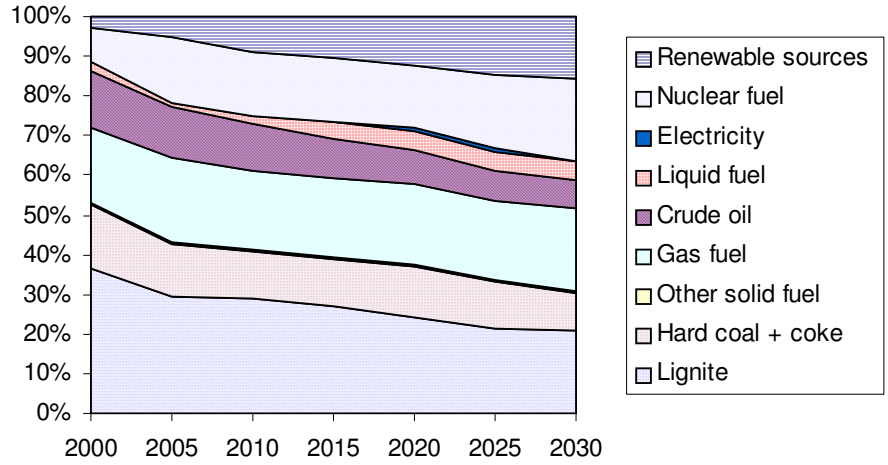
* Others include Combustible Renewables & Waste.
** Import stands for Net Electricity Imports.
*** Average annual percent change 1990-2003.
Source: IEA (2004a).

Demand

With economic transition, final consumption has plumped. Total final energy consumption was 1,045 PJ (25 mtoe) in 2002, a decrease of 438 PJ (10 mtoe) or 30 % compared to 1990. Coal, which constituted 50 % of final energy consumption in 1990, reduced its share to 14 % in 2002. The share of gas increased substantially.[9]

Regarding future trends, the IEA expects natural gas demand to increase and constitute 21 % of total demand in 2010 and 31 % in 2020. Demand for coal is forecasted to reduce to 30 % in 2020. Alternatively to the IEA prognosis, the Czech Ministry of Industry and Trade has formulated a desired future scenario, which is said to be in compliance with national energy policies. Figure 2 indicates the associated development of demand by energy sources. It clearly indicates the decreasing share of coal as well as the expected gains in gas, nuclear and renewable fuels. Although coal will lose further significance (in absolute and relative terms) it will remain the most important energy carrier in volume terms.

Figure 2: Scenario Primary Energy Consumption



Source: Revised Green Scenario, Ministry of Industry and Trade (2004).

[9] See IEA (2004a).

Sectoral Energy Demand

The composition of energy consumption by sector has changed. In 2000, industry demand was only half of what it was in 1990. Still, industry accounts for 44 % of final energy consumption compared to 56 % in 1990. This share is considerably higher than the average for OECD Europe (30 %). Demand of the residential and commercial sector has decreased just slightly, to 34 %, because of continuing poor energy efficiency in the housing sector. Only the transportation sector has increased its energy demand, namely by 46 %. For the future, the Czech government expects a rising share of the transport sector, albeit on a relatively low level compared to Germany for instance. The strongest demand increase will be experienced by the commercial and by the service sector. Industry and construction share of energy consumption is expected to stay constant, whereas households' share is expected to decrease.[10]

Intensity and Efficiency

The economic slowdown and restructuring during the transformation process was accompanied by a decrease in energy intensity, albeit on a high level. Measured as TPES per GDP, intensity contracted by approx. 17 %. Intensity is below that of Bulgaria and Ukraine, for instance. Still, despite achieved improvements, relative primary energy demand and energy intensity in the Czech Republic are well above the average of the EU (by approx. 60 %) and of other accession countries, e.g. Hungary (by approx. 25 %). It is mainly transport, industry and the building industry that exhibit high energy intensity. Intensity in the transport sector has even increased due to a shift from rail traffic to more energy-intensive road traffic.[11] Relatively scant intensity reduction suggests that efficiency is still to be improved. Table 3 reflects the decreasing trend of energy intensity in the Czech economy.

Table 3: Energy Intensity Indicators – Past, Present, and Future

	1990	2000	2002	2020
TFC per GDP (GJ/thousand€2000) [1990=100]	24.5 [100]	17.5 [72]	16.6 [68]	9.7 [40]
TFC per capita (GJ/capita) [1990=100]	143 [100]	103 [72]	102 [71]	114 [79]
Energy Intensity by Sector (1990=100)				
Industry *(energy on value added)*	100	55.3	42.9*	27.0
Residential *(energy on household income)*	100	59.8	50.1*	35.9
Tertiary *(energy on value added)*	100	50.6	45.3*	31.3
Transport *(energy on GDP)*	100	167.8	157.5*	126.8

* Projections for 2005.

Source: IEA (2004a), European Commission (2003), own calculations.

Energy Transport

The Czech Republic is a major transit country that plays a strategic role in European gas supply. There are three major gas border hubs: Two of them are located at the border to Germany for the import of Norwegian gas as well as for the transit deliveries of Russian gas targeted at Western European markets. The Russian gas enters at a third hub at the Czech-Slovak border. Crude oil imports are mainly delivered from Russia via a pipeline entering from Slovakia, denominated Slovakia-Kralupy pipeline. It is operated by *CEPRO a.s.*. *CEPRO* originated from the privatization of the former state company *Benzina*. Sole shareholder of *CEPRO* is the National Property Fund, i.e. the Czech state. To a somewhat smaller but nonetheless important extent, oil is imported from Italian ports piped through

[10] See Riesner / Reichel (2003).

[11] See Ministry of Industry and Trade (2004), and Deutsche Bank Research (2002).

Germany via the Ingolstadt-Kralupy-Litvinov pipeline. This pipeline is under operation by the German company *MERO Pipeline GmbH*, which is a subsidiary of the Czech company *MERO CR a.s.*, the latter being fully owned by the National Property Fund. The German subsidiary owns the German part of the pipeline, whereas the trajectories situated on Czech territory are owned by *MERO CR a.s.*.[12]

The Czech *electricity grid network* is part of the regional electricity system CENTREL, which links the Czech Republic, Slovakia, Hungary and Poland. In 1995, CENTREL was connected to Western Europe's grid, so that nowadays the Czech Republic is a member of the UCTE transmission system.

1.5 Electricity

Despite the overall reduction in TPES, Czech electricity *production* has increased throughout the years. The Czech Republic is independent in its electricity production. In fact, it is a net exporter. In 2000, it exported 36,120,000 GJ (10 TWh) of electricity. Major target markets are Germany, Austria, and the Slovak Republic.[13]

Electricity *consumption* per capita has increased slightly since 1990. In 2002, it was 4,982 kWh/capita.[14] Overall domestic consumption has been rather stable, although with significant sectoral changes. Table 4 displays final electricity consumption by sector. It reflects the efficiency gains realized through economic transformation as well as the general trend towards a service based economy (as indicated by the above stated sectoral economic activity).

Table 4: Final Electricity Consumption by Sector

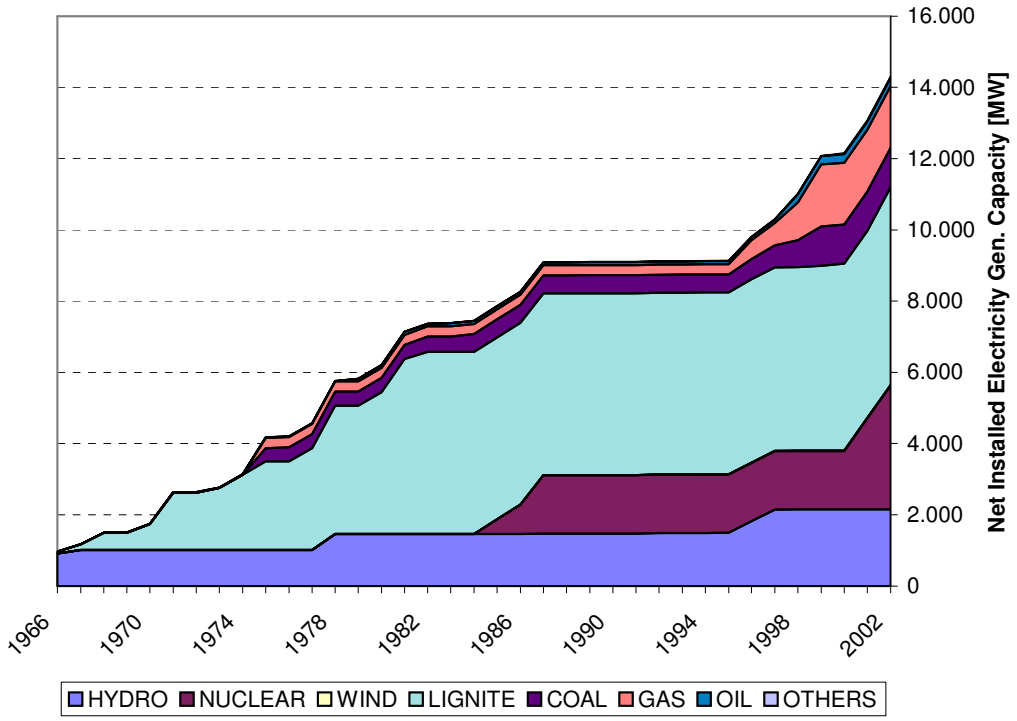
Consumer Groups	1990			2002			Change 1990-2002
	[TWh]	[PJ]	[%]	[TWh]	[PJ]	[%]	[%]
Industry	26.92	96.9	50.7	20.56	74.02	38.3	-23.3
Transport	3.17	11.4	6.0	2.15	7.74	4.0	-32.2
Agriculture	2.91	10.5	5.5	1.14	4.10	2.1	-60.8
Service	3.64	13.1	6.9	11.38	41.0	21.2	+313
Residential	9.62	34.6	18.1	14.12	51.0	26.3	+46.8
Energy	4.86	17.5	9.2	2.85	10.3	5.3	-41.4
Others	1.91	6.9	3.6	1.47	5.3	2.7	-23.0
Total	**53.04**	**191**	**100**	**53.67**	**193.2**	**100**	**+1.2**

Source: IEA (2004a).

The commissioning curve shown in figure 3 gives an approximate overview on the development of the electricity generation composition. The dominant role of coal fired generation and the recent growth in gas fired generation are obvious.

[12] See Mero (2005), Cepro (2004).
[13] See IEA (2004a).
[14] See eurelectric (2005).

Figure 3: Approximate Commissioning Curve of Installed Capacity



Source: Own calculations.

Installed *capacity* has increased substantially since the mid 1990s. Given a rather stable overall consumption, a capacity of nowadays at about 15.2 GW implies a reserve margin of over 50 %, well above domestic demand. The capacity reserve margin is expected to increase even more substantially in the near future, with the second national nuclear plant Temelin (1.8 GW) coming fully on line.[15] Table 5 displays net maximum electricity generating capacity of major energy carriers for recent years. It underlines the decreasing but still clearly dominating role of hydrocarbon, i.e. coal, in electricity production.

Table 5: Electricity Generating Capacity

Energy Carrier	1995		2000		2002		Change
	$[GW]_{net}$	[%]	$[GW]_{net}$	[%]	$[GW]_{net}$	[%]	[%]*
Combustible	9.14	74.5	9.19	70.9	9.27	66.0	1.01
Nuclear	1.76	14.3	1.76	13.6	2.76	19.7	56.8
Hydro	1.37	11.2	2.00	15.4	2.01	14.3	1.5
Total	**12.27**	**100**	**12.95**	**100**	**14.04**	**100**	**8.8**

* Change of GW_{net} 2002 compared to 1995.
Source: IEA (2004a).

Nuclear power, produced in the two plants Temelin (2 x 1,000 MW) and Dukovany (4 x 440 MW) with relatively low variable costs is used for baseload power generation and accounts for 21 % of total production. As domestic lignite is relatively cheap, it supplies the

[15] The reserve margin represents the extra supply capacity available to respond to unexpected events. The margin should be adequate to cover a reasonable amount of extreme weather and/or unplanned shutdowns.

largest share of power generation, namely 72 % of baseload and middleload. Peak load is mainly supplied by hydropower.
On the one hand, the full commissioning of the Temelin plant is expected to double the share of nuclear power at the expense of coal-fired generation, whose output would then drop by 20 %. On the other hand, part of the future shut down of obsolete 110 MW and 200 MW lignite fired units after 2010 is expected to be compensated by new plants burning domestic coal. Next to coal and nuclear energy, gas will become the third pillar of the mix. The potential of hydropower plants is, in practice, used to full capacity. Other renewable energy capacity is projected to play an increasing role. Total generation capacity is projected to double until 2030 (28.47GW_e). Hence, the Czech Republic will remain a net exporter.[16] Future trends are summarized in table 6.

Table 6: Future Electricity Production in the Czech Republic

Electricity Generation in TWh_{el} [PJ]	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Nuclear	28.76	28.67	28.63	28.51	28.41	14.91
	[103.54]	[103.21]	[103.07]	[102.64]	[102.28]	[53.68]
Hydro & Wind	2.28	2.80	3.68	4.45	5.05	6.24
	[8.21]	[10.08]	[13.25]	[16.02]	[18.18]	[22.46]
Thermal (incl. Biomass)	45.69	51.95	58.83	65.84	72.48	91.78
	[164.48]	[187.02]	[211.79]	[237.02]	[260.93]	[330.41]
Total	**76.73**	**83.42**	**91.15**	**98.80**	**105.94**	**112.93**
	[276.23]	[300.31]	[328.14]	[355.68]	[381.38]	[406.55]
Electricity Generation [%]	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Nuclear	37.5	34.4	31.4	28.9	26.8	13.2
Hydro & Wind	3.0	3.4	4.0	4.5	4.8	5.5
Thermal (incl. Biomass)	59.5	62.3	64.5	66.6	68.4	81.3
Total	100.0	100.0	100.0	100.0	100.0	100.0

Source: European Commission (2003).

1.6 Prices

At the beginning of the transformation process, the Czech Republic made sluggish progress in establishing market prices for energy. Prices were not cost covering but cross-subsidized. To mirror actual costs, especially electricity prices had to be adjusted. Electricity prices to industry increased from 0.53 CZK/kWh in 1990 to 1.61 CZK/kWh in 1995. In that same period , household prices increased from 0.48 CZK/KWh to 0.99 CZK/kWh.[17] More recently, from January 2001 to end of 2002 household electricity prices rose by 25 %.[18] So, the situation has changed, as the electricity market has been opened for the wholesale fully and for the final consumption gradually since 2002. For years, Czech electricity prices do cover costs and generate profits.[19]
Following Eurostat price data as given in table 7, electricity retail prices before taxes expressed in current prices have increased substantially only for households (43 % from January 2000 to July 20004). Industrial consumer prices have fluctuated. Over the years, i.e

[16] See Eurelectric (2005), European Commission (2003), and Deutsche Bank Research (2002).
[17] See IEA 2004a.
[18] See Riesner / Reichel (2003).
[19] See Eurelectric (2005).

from January 2000 to July 2004 they decreased somewhat for large consumers (-1 %) respectively substantially for small commercial consumers (-17 %). Gas retail prices have increased for large industrial consumers by 33 % between January 2000 and July 2004. Small industrial consumes (37 %) and domestic consumers (55 %) have experienced an even greater increase. However, from July 2003 to July 2004 a slight decrease in all three costumer categories is to be observed.

Table 7: Eurostat Electricity and Gas Retail Prices (Current Prices, Before Taxes)

	Jan 2000	July 2000	Jan 2001	July 2001	Jan 2002	July 2002	Jan 2003	July 2003	Jan 2004	July 2004
Electricity Retail Prices [€/MWh]										
Large Industrial Consumers (>24GWh/year)	41	34	39	33	43	38	42	38	40	41
Small Industrial Consumers (50MWh/year)	72	55	74	58	81	65	78	57	77	60
Household (3.5MWh/year)	48	48	54	55	64	69	65	65	66	68
Gas Retail Prices [€/MWh]										
Large Industrial Consumers (>24GWh/year)	11	12	14	15	16	16	14	15	14	14
Small Industrial Consumers (50MWh/year)	12	14	17	18	19	19	17	18	17	17
Household (3.5MWh/year)	13	13	16	19	21	21	19	20	19	19

Source: Eurostat Retail Prices as indicated in Commission of the European Communities (2005).

In an international context, it is stated that in 2000 household power prices were still 50 % lower than the average for OECD-Europe.[20] For July 2004, household electricity prices in the Czech Republic are reported as approx. 60 % of the EU15 average. Electricity prices to large industrial consumers and small commercial users are well below EU15 average, too. Gas prices for households have been about half of EU15 average, and about two third for small industrial consumers respectively. To large industrial consumers, Czech prices have been almost exactly on EU15 average since mid of 2001.[21] None withstanding, energy costs already account for a considerable chunk of household budget expenditures.[22] As prices affect consumption it is reasonable to assume that the recent development will enhance energy efficiency.[23]

1.7 Environment

Energy transformation and consumption under the centrally-planned system exerted substantial stress on the environment. Air and water pollution in areas of northwest Bohemia and in northern Moravia as well as in the city of Prague persist. Domestic forest is damaged by acid rain. To improve this situation, total environmental investment was increased more than twenty fold from 1986 to 1997. Thanks to this investment and to dedicated policies, performance has improved in terms of greenhouse gas emissions and pollutants. For instance,

[20] See Deutsche Bank Research (2002). This statement is affirmed by price comparisons published in Commission of the European Communities (2005).
[21] See Commission of the European Communities (2005).
[22] See Deutsche Bank Research (2002).
[23] See Riesner / Reichel (2003).

from 1990 to 1998 total emissions of pollutants have been reduced by 55 %. However, since 1997 environmental investment was basically halved.[24] This is concerning because emissions remain considerably higher than in countries with similar population and industrial development. This is mainly due to the economy's high energy intensity combined with an intensive use of solid fuels.

Table 8 and table 9 compare sector emissions of relevant greenhouse gases and other sources originating from fuel combustion for the years 1990 (1992) and 2002. They detect the drastic decrease in emissions of several major pollutant that accompanied the economic transition. Table 8 and table 9 also highlight the different sectoral trends, especially the increase of CO_2 and several other gases in the transport sector. It is shown that CO_2 emissions in the energy industry have increased contrary to the general trend. This reflects the hydrocarbon intensity of the Czech energy production.

Table 8: Sectoral Anthropogenic Emissions of Green House Gases from Combustion

GHG in thousand tonnes of CO_2 equivalent		CO_2	CH_4	N_2O	Sum of major GHG*
Energy Industries	1990	59,171	149.1	645.7	59,965.6
	2002	57,729	13.8	662.2	58,404.6
Manufacturing Industries and Construction	1990	59,457	25.9	394.9	59,877.3
	2002	30,969	16.6	206.4	31,191.0
Transport	1990	7,275	64.4	80.4	7,419.8
	2002	12,428	46.3	595.4	13,070.2
Residential, Commercial, Others	1990	34,177	1,006.2	296.1	35,479.7
	2002	15,108	225.1	66.4	15,399.6
Total Fuel Combustion	1990	160,080	1,245.5	1417.1	162,742.4
	2002	117,426	307.1	1545.0	119,278.4
National Total	1990	163,990	16,763.4	11265.5	192,019.0
	2002	123,048	10,373.5	8151.2	141,572.6

* Lacking HFC_s PFC_s and SF_6, due to incomplete documentation. National total emissions of HFC_s PFC_s and SF_6 were 1,322 t of CO_2 equivalent in 2002.
Source: UNFCC (2004).

Table 9: Sectoral Anthropogenic Pollutants from Combustion

Pollutant in thousand tonnes of CO_2 equivalent		CO	NO_x	NMVOC	SO_2
Energy Industries	1992	130.8	355.7	1.8	814.5
	2002	11.3	100.8	6.9	141.7
Manufacturing Industries and Construction	1992	22.5	76.9	3.5	532.9
	2002	87.4	35.6	4.3	41.2
Transport	1992	210.0	210.1	53.3	3.2
	2002	239.2	112.7	48.4	4.7
Residential, Commercial, Others	1992	472	39	32	187,8
	2002	151.4	62.3	36.4	43.0
Total Fuel Combustion	1992	835	682	91	1,538
	2002	489.3	311.3	96	230.6

[24] See CZSO (2005).

National Total	1992	1141	707	257	1,559
	2002	569	318	203	237

Source: UNFCC (2004).

Despite the obvious success in emission reduction, overall CO_2 emissions in 2002 were 123 million tonnes. This translates to 12 t CO_2 per capita, which is one of the highest in Europe. Table 10 shows the actual and expected development of CO_2 emissions and intensities of the Czech economy. It also demonstrates that in recent and in future years further reductions seem to be less simple.

Table 10: CO_2 Intensity Indicators- Past, Present, and Future

	1990	1995	2000	2005	2010	2020	2030
CO_2 emission index *(1990=100)*	100	80.0	74.9	65.0	64.9	63.3	68.5
Carbon intensity *(t of CO_2/MJ of GIC)*	79.76	72.62	70.00	60.00	58.33	55.33	59.52
CO_2 in final energy demand *(t of CO_2/MJ)*	72.14	56.00	52.38	51.66	49.29	44.52	39.76
CO_2 per capita *(t of CO_2/inhabitant)*	15.33	12.30	11.59	10.10	10.18	10.18	11.45
CO_2 per GDP *(t of CO_2/thousand€2000)*	2.62	2.20	1.94	1.41	1.18	0.87	0.77

GIC: Gross inland consumption.
Source: European Commission (2003).

2 Politics

2.1 Present Politics

Harmonizing with IEA and EU Standards

After standard oil stocks and emergency preparedness had been brought in line with IEA and EU requirements by the implementation of a legislative act of 1999, in 2001, the Czech Republic became the twenty-fifth member of the IEA and the second IEA country in Central Europe. The Czech emergency oil reserves are the most far reaching of the new EU members. Although in 2003 it was still below EU-requirements (80 days instead of 90 days), the Ministry of Trade and Industry states that nowadays needs are covered for up to 90 days.[25] The overall aim of energy policy is the harmonization of the Czech energy sector standards with those in the EU, e.g. full compatibility with 96/92/EC Directive. This includes the following issues.

Privatization Politics

Energy policy has been dominated by measures to privatize and restructure the industry. Despite some considerable success, the leading companies remain predominantly state owned, especially the corporation *CEZ a.s.* which is the main electricity production company and is two-third state-owned. *CEZ* produces about 70 % of the country's electricity. It operates the two nuclear plants, as well as 15 coal-fired plants and 13 hydroelectric plants. *CEZ* is beginning to operate internationally (e.g. Bulgaria), however experiencing some difficulties (e.g. Slovakia). In 2002, privatization of *CEZ* failed because of bidding offers being too low.

[25] See Ministry of Industry and Trade (2004) as well as Riesner / Reichel (2003).

Production and distribution has been unbundled. Since 1999, *CEPS a.s.* (Czech Transmission System Operator) is responsible for development, management, operation and maintenance of the transport network. *CEPS* controls the operation of interconnections, provides real time load dispatching services and is responsible for ancillary services. It was statutorily unbundled from *CEZ* but up to March 2003 remained its subsidiary. In April 2003, 51 % of *CEPS*'s shares were transferred into the ownership of *OSINEK*, a company controlled by the National Property Fund, and 15 % to the Ministry of Labour and Social Affairs leaving *CEZ* with the remaining 34 %.[26] Nowadays, *CEPS* is fully held by a 100 % state owned company.[27]

Ownership of distributing companies has been consolidated. In 2004, eight regional joint stock companies carried out lower voltage electricity distribution to final consumers.[28] Two of the distribution companies are almost 100 % owned by the German *E.ON*. In four of them, *CEZ* owns approx. 99 % recently, preparing to buy the rest as well as a fifth company.

Foreign companies have especially entered the gas sector as well as the oil and refining sector. *E.ON* owns the majority in one Czech gas distributor. The German company *RWE* is an important player in the gas sector, as it holds a majority in six out of eight Czech gas distributors and owns the transport company *Transgas*. *Transgas* itself receives supplies from *Gasexport*, which is a subsidiary of the Russian *Gazprom*. In the upstream market, 99 % of available gas are controlled by the largest company.[29] The only remaining "independent" electricity and gas distributor is controlled by the City of Prague.[30]

In the oil sector, privatization is somewhat regressive. The important corporation *Unipetrol*, after having been owned by a national fertilizer producer, is now again owned by the state.[31]

As for the coal sector, the government is further reducing its shares in the hard coal mining company *OKD* to the benefit of the majority owner and key market player *Karbon Invest*.[32] Only in one of four major Czech coal mining companies, the state possesses a 54 % stake, the rest is fully private.[33]

Diversification, Efficiency and Energy Act

Diversification in supply is aimed at by fully implementing the nuclear sector and by new hydrocarbon imports, as well as by renewables in the long term.

The *Energy Efficiency Action Plan* focuses on promotion of energy efficiency in end-use. It features a list of concrete policy actions to develop energy efficiency. The Czech government has endorsed this document and recommended adopting its policies and measures when suitable.[34] More recently, an amendment of the *Law on Energy Management* is under preparation. The amendment aims at incorporating the EU legal provisions on promotion of cogeneration and on energy efficiency.

In 2000, a new *Energy Policy Paper* was issued by the ministry of industry, addressing the development goals of the sector for 2030. The crucial objective is to establish reliable, safe and environmentally acceptable energy supplies to support economic competitiveness. Based on that policy paper, a new *Energy Act* came into force in 2002. The act aims at increasing competition in the sector, enhancing transparency, designing regulation and -in general- translating EU directives into national energy law.

[26] See CEPS (2004).
[27] See Eurelectric (2005).
[28] See Eurelectric (2004).
[29] See Commission of the European Communities (2005).
[30] See Eurelectric (2005).
[31] See Austrian Energy Agency (2005).
[32] See IEA (2004b).
[33] See Eurelectric (2005).
[34] See IEA (2001).

The *Energy Act* brought into effect an independent regulatory body for the grid based energy industries, the Energy Regulatory Office. It organizes the regulated third party access and sets prices for non-eligible customers. Consequently, its main tasks are to grant licenses, to set tariffs, to regulate prices, and to resolve disputes related to access to transmission or distribution networks. In addition, the Office for Protection of Economic Competition is responsible for enforcing the *Competition Act* in the energy sector.

Promoting Renewable Energy

Renewable energy technologies still hold a small share of electricity production. To increase this share, renewable electricity production is promoted by guaranteeing prices as well as take-up and feeding-in into the grid system. The Energy Regulatory Office sets feed-in tariffs well above market electricity price. Distribution companies are obliged to buy the production from renewables' operators. The principle target of this policy is to reach a renewable share of 8 % of national production by 2010.[35] In March 2005, this support policy was newly designed by the *Act on Promotion of Use of Renewable Sources*. Within this law, two support instruments may be chosen, namely either fixed feed-in tariffs or green bonuses. Fixed feed-in tariffs are the purchase price paid by the grid operator to the producer of electricity from renewable sources. A green bonus is the financial amount increasing the market price of electricity that is paid by the operator to the producer of electricity from renewable sources. It takes into account reduced damage to the environment resulting from use of a renewable source compared to combustion of fossil fuels, the type and size of the production plant and the quality of electricity supplied. In particular, producers have the right to get paid green bonuses in the case of self-consumption, meaning if the renewably produced electricity is not fed into the grid system. The law is quite controversial. It is said to be intransparent and could open doors of misuse in the form of discrimination against new independent producers. For instance, distribution companies may refuse access to the grid in case of a risk for grid stability. Of course, grid stability itself is desirable; but companies of the renewable energy industry as well as independent producers fear to be denied their right to market access. Furthermore, tariffs are not fixed but are adjusted by the regulatory body on a yearly basis. Consequently, investors confidence is hampered despite a 15 year feed-in guarantee for new projects. Also, the law does not clarify the mechanism on how to prorate associated additional costs to electricity consumers.[36]

Environmental Politics

By achieving the national target on renewable energy share, considerable emissions reduction would be attained, namely CO_2 by 2 million tonnes, SO_2 by 1,800 tonnes, and NO_x by 1,240 tonnes per year. The Czech Republic has ratified the Kyoto Protocol in 2001. The corresponding national commitment for greenhouse gas emission reduction is 8 %. Today, emissions are 20 % below the 1990 reference value so that even in the case of high economic growth, the Czech Republic will quite easily fulfill its Kyoto engagement.[37] Next to Kyoto, the republic is participating in the emission permit trading system of the EU and submitted its corresponding National Allocation Plan. For the period 2005-2007, a volume of 107.5 million tonnes per year will be available for emission trading allowances. On a national level, the *Clean Air Act* has introduced emission standards for facilities with a unit capacity above 0.2 MW and emission taxes on SO_2, NO_x, CO, hydrocarbons and particulates. In this context, the new environmental legislation has set strong emission limits especially for coal fired power plants. Consequently, the producer *CEZ* by now has modernized all its coal-fired capacity in operation. Reduction of environmental damage through the energy sector has largely been decreased by voluntary measures, too. Regarding the energy sector, especially

[35] See OECD (2005b).
[36] See Ministry of Industry and Trade (2005) as well as Winkelmann (2005).
[37] See World Energy Council (2003).

phasing out of obsolete plants and building of new facilities has improved environmental conditions. For instance, the oldest soft coal power stations, whose modernization and desulphurization had not been found effective, were gradually phased out. Nonetheless, as environmental problems persists, ambitious policies on energy efficiency and the environment are still required.

2.2 Future Politics

From 2006 on, the electricity market is planned to be completely open. According to the Energy Act, by 2006 all consumers are supposed to be able to choose their electricity supplier. In the case of natural gas, however, only major consumers will become eligible. It is planned to further extend third party access to include 33 % of natural gas transmission until August 2008.[38]

Next to liberalization, major trends and issues are the (associated) reorganization of the energy sector, the improvement of energy policy, and the diversification of the energy carrier mix. Hereto, topics will be to some extent the decline of coal and its replacement by natural gas, the development of renewable energy from currently 1.7 % to 8 % in 2010, and the future of the nuclear energy. Regarding the latter, the Czech energy concept does not include any new nuclear sources to be put into operation at least until 2010.

Price changes will affect future development. Concerning the increasing use of gas as energy carrier, price increases might delay or partly offset fuel switching. It is possible that for instance an increase in gas prices by 13 %, as it was brought into effect by the *Energy Regulatory Office* at the end of 2004, evokes some shift from gas back to coal or to alternative fuels such as biomass. Similarly, a substantial increase in electricity prices (around 11 %) is expected.[39] A general price increase brought into effect by the regulatory body could also enhance privatization of the sector.[40]

It has been debated whether a carbon/energy tax should be levied and used to further support investment in renewable energy. Finally, repowering and revitalizing old generation plants will be a major issue in the medium-term future.

2.3 Critical Review

In 2003, the Czech Republic was classified the most well prepared EU accession country with respect to its energy profile.[41] The Czech Republic has made substantial progress in the fields of privatization, market access, regulation, fuel switch replacing coal and in the field of environmental improvement. Comparing the number of significant market participants in electricity sectors of the EU25 and accession candidates shows that the Czech Republic exhibits a relatively de-concentrated market structure.[42] Nonetheless, privatization still is too inert. Several privatizations have led to joint stock companies that fully or largely belong to the National Property Fund. Hence, the state retains a key position in the market. As in most new member countries, upstream gas markets have high entry barriers, so that liberalization of the gas market is yet to be improved. Accordingly, balancing in the gas sector remains unfavorable or unclear. High network charges and inflexible services are observed.[43] Much remains to be done before third party access and competition in the energy market are truly effective. To offset any possible cohesive development evolving from such a constellation of effective cooperation between the regulatory body and the Office of Competition is necessary.

[38] See World Energy Council (2003).
[39] See IEA(2004b).
[40] See Deutsche Bank Research (2002).
[41] See Riesner / Reichel (2003).
[42] See Commission of the European Communities (2005).
[43] See Commission of the European Communities (2005).

Furthermore, liberalization should be enhanced by solving the trade-off between conductive privatization and maximizing the profits from selling the (mainly) state-owned enterprises. Regarding the energy mix, the law for promoting renewables specifies the future role of renewable energy but leaves unsolved the trade-off between the associated grid stability and grid access. The full commissioning of the nuclear power plant Temelin will further increase electricity export potential and opens up possibilities of reducing CO_2-emissions by phasing out lignite electricity production. Strategies for maximizing the benefits from the Kyoto-Protocol, for example through JI should be keenly designed. Further future topics will be to handle or to further reduce the dependence on Russian natural gas and oil imports and diversifying the supply. In addition, the Czech republic may implement strategies to gain from its location as a transit country for Russian energy transports towards the western EU.

3 Peculiarities

3.1 Visegrad

The Czech Republic is a founding member of the Visegrad Group, which also includes Hungary, Poland, and the Slovak Republic. The group was created in February 1991 with the intention to organize an economic and also energy-related cohesion and integration of the region. The Visegrad countries are neither large producers nor large consumers of energy. Coal is the single abundant fossil fuel in the region, with only Poland and the Czech Republic having significant quantities. In 2002, coal accounted for 45.6 % of the Visegrad countries' total primary energy consumption. Just as the Czech Republic, all other Visegrad countries import most of their crude oil and natural gas requirements, mainly from Russia. Dependence on Russian deliveries as well as acquisition activities of Russian companies in the course of the Visegrad's privatization processes are sometimes stated to be a point of discontent. The strategic importance of the region, however, lies largely in the crude oil and natural gas pipelines which traverse the Visegrad countries on their way to Western Europe.[44]

3.2 Important Characteristics

Coal has been and still is the Czech Republic's main energy carrier. None withstanding, substantial changes of the energy mix have been carried out in consequence of the economic transformation. The Czech Republic is not only self sufficient in its electricity production but is a net electricity exporter. Disputes over safety measures in the course of commissioning the nuclear power plant of Temelin have arisen with its main electricity buyers Austria and Germany. Despite privatization politics, energy sectors are characterized by dominant players, in particular *CEZ*, *RWE*, and *E.ON*.

[44] See EIA (2004). Eurelectric (2005) states that Russian ownerships do **not** create an issue.

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