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Report

The Future Role of Coal in Europe

Part I -

commissioned by:
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Basel, 31.01.2006

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1 Executive Summary

Focus of the study

Lignite and hard coal cover approximately 1/6 of primary energy consumption in the European union (EU-25). About 2/3 of consumption are covered by domestic production. In the sector of power generation coal is indispensable. Coal delivers an important contribution to a secured and economic power supply within the community.

Due to its high carbon intensity coal gets into a defensive position in European climate protection policies. In particular the trade with greenhouse gases may lead to a dramatic degradation of the economic position of coal use in Europe. Having that in mind, the actual study aims to examine and to evaluate the current situation as well as the future perspectives of coal in Europe.

The focus of the study is on key drivers and determinants of the European market of coal as fuel for power generation, thus providing the basis for the future work on a scenario. Concerning regional terms, the focus is set on the main coal producing countries (Poland, Germany, United Kingdom, Spain, Greece, Czech Republic, Hungary, Bulgaria and Romania) and the major coal consuming markets (the above mentioned and France, Italy, Netherlands).

Coal in Europe

(1) In Europe there is both a large reserve of hard coal as well as subbituminous and lignite available, with reserves regionally dispersed. Including Russia Europe is keeping more than 30% of the proven reserves worldwide, however only 4.4% in the member states of the EU. Reserves in western and southern Europe (EU 15) have significantly decreased due to a high production level during the last 50 years, while EU 10 and candidate countries, especially Poland still keep significant reserves.

(2) Europe (without former soviet union) presently accounts for about 315 Mtce ***coal production***, this is 12% of the world's total annual coal production (2’550 Mtce). Neighbouring countries including Turkey and the states of the former Soviet Union add to approximately the same amount of produced coal (320 Mtce). Germany and Poland are by far the largest coal producers in the EU; together they account for about 2/3 of all coal presently produced in the EU.

(3) After an all-time low of 495 Mtce in 1999 ***coal consumption*** was taking up again, especially in EU 15 (from 292 to 314 Mtce in 2004), while during the same period keeping approximately the same level in EU 10 and selected candidate countries (145 Mtce). Another 60 Mtce are consumed by neighbouring countries of the European Union, not counting the former states of the Soviet Union, which have been as well decreasing to 230 Mtce in 1998 and growing to 250 Mtce in 2004.

(4) Coal consumption is exceeding the European production, with net ***coal imports*** growing from 125 Mtce (1994) to 147 Mtce (2004). The most important countries of origin for European hard coal imports are South Africa, Australia, Colombia, and the Former Soviet Union.

(5) After a twenty year low in 1999/2000 with CIF prices of around $35 a ton for both Japan and Europe, increased domestic demand in major exporting countries (China, Russia) or decreased production (USA) tightened the market for coal, leading to high ***coal prices*** 2004. However, with view on reserves and competitive producer markets as a first conclusion can be drawn, that coal prices are more likely to stay stable than other fossil fuels.

(6) In ***power generation***, coal is still playing a dominant role in the European Union with 25% of installed capacities and almost one third of the power generation. However, investment in building new power plants with roughly one third of today's total ***capacity*** must be made throughout Europe in the next 25 years. This could result in a profound change in the power generation portfolio, with many options under consideration for new plants including nuclear energy, coal, natural gas and renewables.

(7) ***Energy policies*** play a significant role for the development of future power generation markets. The member states of the European Union are increasingly dependent on oil and natural gas imports, as was highlighted in the Commission's Green Paper on Security of Energy Supply (2000). Besides this internal markets for electricity and gas have to be completed, monopolists have to unbundle and provide free access to the power and gas grid. Dependent on the progress of liberalisation, more competition among incumbents and new entrants can be expected.

(8) Electricity generation from ***renewable energy sources*** other than hydroelectricity continues fast-paced growth among the countries of (especially) Western Europe. The governments in the region offer support for non-hydropower renewable power sources, most notably wind, in the form of subsidies, guaranteed feed-in tariffs or required quotas. Germany, Spain, and Denmark are the fastest growing wind producers in the world.

Climate Protection Policies

(9) The Kyoto protocol specifies that the industrialized nations will cut their emissions of the six most important greenhouse gases in 2008-2012 by at least six per cent compared with 1990. The EU installed an ***Emission Trading Scheme***, which covers 54% of the EU-25 CO_2 emissions. According to EEA projections, most EU-15 countries are about to fail, while most EU-10 are going to comply their Kyoto target, which can mainly be attributed to the economic collapse of the East European economies.

(10) The ***national allocation plans*** (NAPs) of the EU member states allocate all GHG emissions to different sectors. The plans define CO_2 emission caps for the ETS participants. NAPs are based on a set of various rules and criteria, which have been applied very heterogeneously in the first stage of the ETS (2005-2007). Inequal

treatment can be still observed for the allocation of new entrants. As further development a harmonization and standardisation can be expected.

(11) Since the start of the European Trading Scheme (ETS), ***carbon prices*** went up to a level of more than 20 €/t. There is a set of explanations, which may give reason to some of the price increase, but not to its whole extent. After all, EUA markets cannot yet be considered as mature.

Country Reports

The study provides 12 detailed country reports with a similar sectional structure. The most relevant European markets have been selected:

- 4 coal producing countries representing the EU 15 (Germany, United Kingdom, Spain, Greece),
- 3 major coal consuming economies of the EU 15 (France, Italy and Netherlands) the main coal consuming countries),
- 3 countries representing the EU 10 (coal producers Poland, Czech Republic and Hungary),
- Bulgaria and Romania as 2 candidate countries for future accession to the EU, both producers of lignite.

Scenarios on future Energy Markets

As a basis for the future work on the role of coal in Europe of 2030 the development of world and European energy markets was examined. Following studies have been analysed:

- 3 scenarios of the European Commissions' [DG TREN, 2003] *EU trends to 2030* and *Scenarios on Key Drivers,* including:
  - *Baseline* Scenario
  - *High Price* Scenario
  - *Energy Efficiency and Renewables* Scenario
- 2 scenarios of the International Energy Agencies (IEA) *World Energy Outlook* [IEA 2004c], including:
  - *Reference* Scenario
  - *Alternative* Scenario
- 3 scenarios of the US Department of Energy, Energy Information Administrations (EIA) *International Energy Outlook* [EIA 2005], including:
  - *Reference* Case
  - *High Economy* Growth Case
  - *Low Economy* Growth Case

2 Target and Structure

2.1 Target

(12) Lignite and hard coal cover approximately 1/6 of primary energy consumption in the European union (EU-25). About 2/3 of consumption are covered by domestic production. In the sector of power generation coal is indispensable. Coal delivers an important contribution to a secured and economic power supply within the community.

(13) Due to its high carbon intensity coal gets in a defensive position in European climate protection policies. In particular the trade with greenhouse gases may lead to a dramatic degradation of the economic position of coal use in Europe. Having that in mind, the actual study aims to examine and to evaluate the actual situation and the future perspectives of coal in Europe.

(14) The focus is set on the main coal producing countries (Poland, Germany, United Kingdom, Spain, Greece, Czech Republic, Hungary, Bulgaria and Romania) and the major coal consuming markets (the above mentioned and France, Italy, Netherlands). Coking coal production and use will be covered occasionally, but is not the main focus.

2.2 Structure

(15) The focus of the study lies on key drivers and determinants of the European market of coal as fuel for power generation, thus providing the basis for the future work on a scenario. As the project overview in figure 2.2-1 shows the study is carried out in two phases:

Phase 1 (preliminary survey) is comprising:

- the actual and future position of coal in Europe,
- climate protection policies and their instruments with a major focus on the European Commissions Emissions Trading Scheme (ETS),
- status of renewable energies,
- a survey of the relevant energy scenarios of EU, IEA and EIA on the development in Europe.

Phase 2 (main study) is comprising:

- a basic scenario on the role of coal in Europe until 2030
- a low energy price scenario
- a scenario with a high CO_2 allowance price (35 €/tCO_2)
- a scenario with a low CO_2 allowance price (15 €/tCO_2)
- a technology scenario in which the best available technology is used for the replacement of old power plants

- evaluation of coal with respect to economic, ecologic and social criteria
- analysis of the potential of coal in European power markets

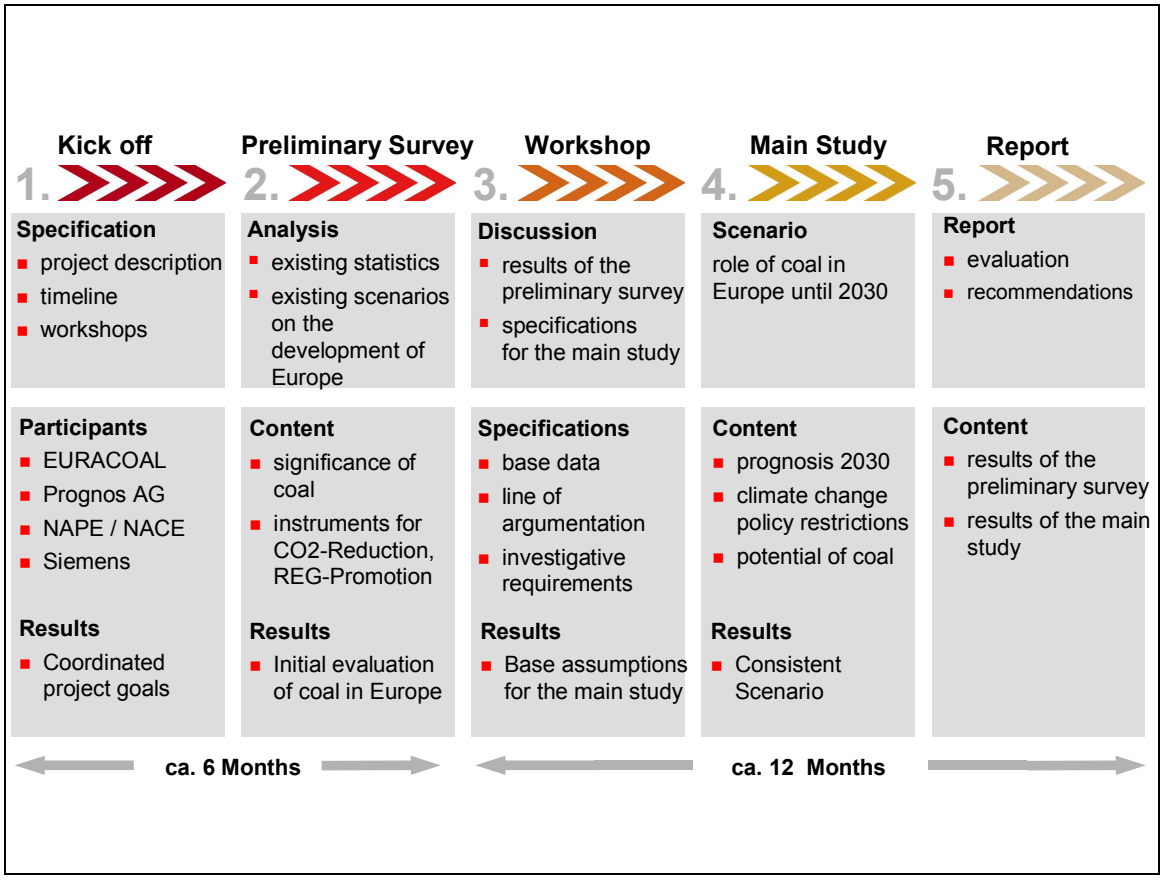

figure 2.2-1 *Project Overview*

2.3 Focus

(16) The focus of this study lies on key drivers and determinants of the European market of coal as fuel for power generation, thus providing the basis for the future scenario work. Consequently the major concerns are:

- Coal as primary energy, concentrating on
  - resources, reserves and production
  - import, trade and prices
- Electricity as final energy focusing
  - development of final energy consumption
  - coal as fuel in power generation
- Policy as a key stakeholder for the development of future energy markets, both on European and national level, especially in the fields of:
  - policy strategies in energy markets,
  - climate protection policies, with a main focus on the emissions trading system,

- renewable energy policies.

(17) A significant section of this report is covering the current situation in 12 selected and most relevant markets of Europe,

- with 7 countries representing the EU 15 (Germany, United Kingdom, Spain, Greece as important coal producers as well as France, Italy and Netherlands (next to the above mentioned) as the main coal consuming countries)
- with 3 countries representing the EU 10 (coal producers Poland, Czech Republic and Hungary)
- and 2 countries representing candidate countries for future accession to the EU, both producers of lignite (Bulgaria and Romania)

3 Coal in Europe - Overview

3.1 Coal Markets

3.1.1 Coal Consumption

Conclusion	After an all-time low of 495 Mtce in 1999 ***coal consumption*** was taking up again, especially in EU 15 (from 292 to 314 Mtce in 2004), while during the same period staying almost constant at 145 Mtce in EU 10 and selected candidate countries. Another 60 Mtce are consumed by neighbouring countries of the European Union, not counting the former states of the Soviet Union, where consumption has been as well decreasing to 230 Mtce in 1998 and growing to 250 Mtce in 2004. Thus, coal remains one of the most important energy sources in Europe.

3.1.1.1 Primary Energy Consumption: The Role of Coal

(18) Coal consumption has been decreasing in Europe over the past decade, both in the old EU 15, the EU 10, candidate (BU, RO, TK) and neighbouring countries (NO, CH, IS). Overall coal consumption showed a 12% decrease from 560 Mtce to an all-time low of 495 Mtce in 1999. This decrease can mainly be attributed to the economic collapse of the East European economies.

(19) In the new millenium coal consumption was taking up again, especially in EU 15 (from 292 to 314 Mtce), keeping the level in EU 10 and selected candidate countries (145 Mtce). Another 60 Mtce are consumed by neighbouring countries of the European Union, not counting the former states of the Soviet Union, which have been as well decreasing to 230 Mtce in 1998 and growing to 250 Mtce in 2004 (cp. figure 3.1-1).

(20) Germany is presently by far the greatest coal consumer in the EU, with Poland far the second-greatest. Overall, the EU accounts for about 15% of the world's total coal consumption *[CSLF 2005]*.

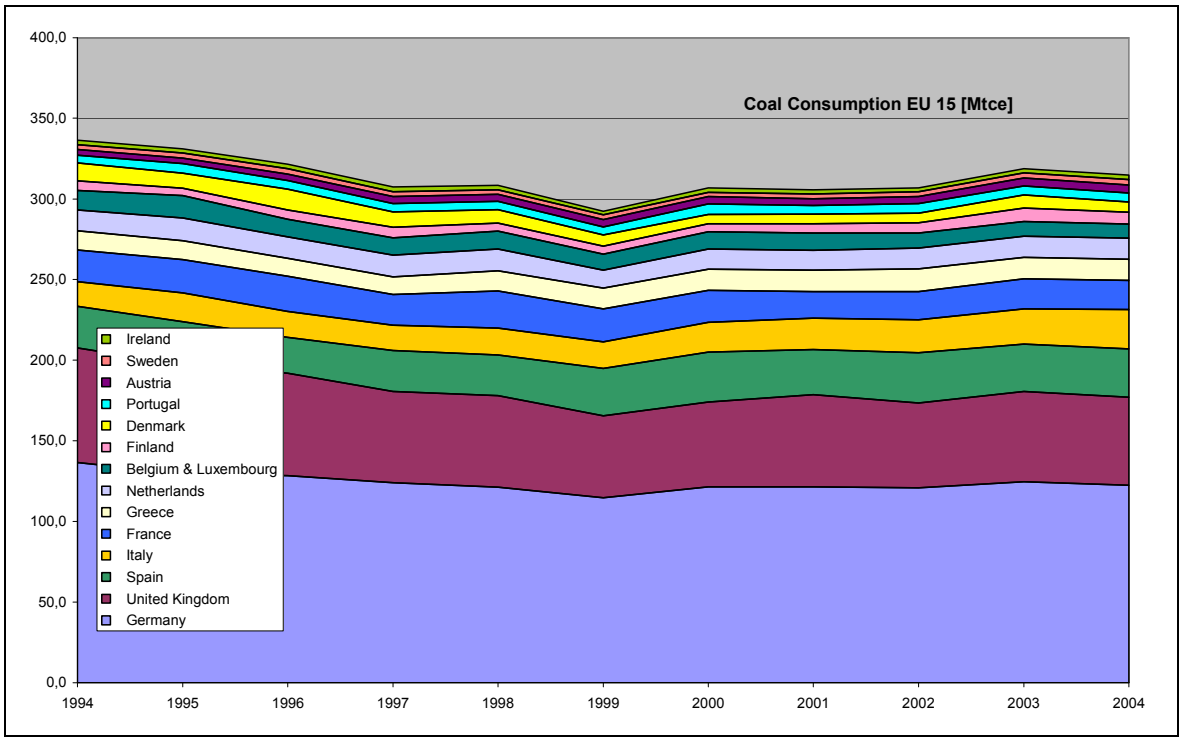

figure 3.1-1 *Coal Consumption in EU 15 [source: BP 2005]*

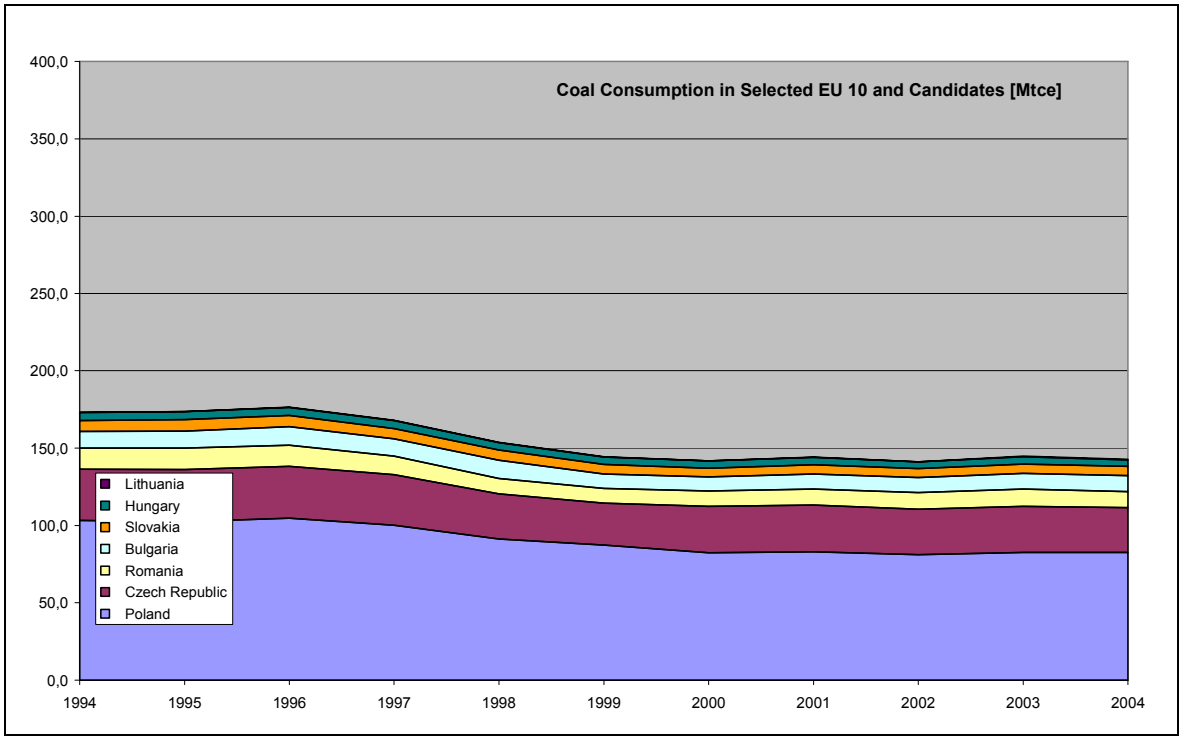

figure 3.1-2 *Coal Consumption in selected EU 10*

table 3.1-1 *Coal and Lignite production, import and consumption (all coals) [BP review 2005]*

	Production		Import		Consumption		
Region	**1994**	**2004**	**1994**	**2004**	**1994**	**2004**	**[% p.a.]**
Europe	**733,2**	**621,2**	**125,5**	**146,8**	**858,7**	**767,9**	**-1.11**
EU 15	***185,5***	***123,9***	***150,9***	***190,8***	***336,4***	***314,7***	***-0.67***
Germany	111,2	78,2	25,4	44,3	136,6	122,5	-1.09
United Kingdom	40,4	21,9	30,6	32,6	71,0	54,4	-2.62
Greece	10,6	13,6	1,4	-0,3	12,0	13,3	1.02
Spain	15,1	9,6	15,3	24,4	25,7	30,2	1.60
France	8,1	0,7	10,6	20,6	19,6	17,9	-0.91
Italy	-	-	11,4	17,1	15,3	24,4	4.80
Netherlands	-	-	12,9	13,0	12,9	13,0	0.11
Belgium & Luxembourg	-	-	12,1	8,7	12,1	8,7	-3.26
Finland	-	-	5,9	7,4	5,9	7,4	2.41
Denmark	-	-	11,1	6,3	11,1	6,3	-5.56
Portugal	-	-	4,9	5,6	4,9	5,6	1.38
Austria	-	-	3,6	5,0	3,6	5,0	3.42
Sweden	-	-	3,0	3,4	3,0	3,4	1.34
Ireland	-	-	2,7	2,6	2,7	2,6	-0.54
EU 10 + Candidates	***191,8***	***153,6***	***-18,6***	***-11,0***	***173,2***	***142,6***	***-1.92***
Poland	127,6	99,7	-24,3	-17,3	103,3	82,5	-2.23
Czech Republic	40,2	33,6	-7,0	-4,4	33,2	29,2	-1.28
Romania	13,0	9,9	7,1	6,0	13,4	10,3	-2.63
Bulgaria	6,9	6,3	4,0	4,0	10,9	10,3	-.54
Slovakia	-	-	0,4	0,4	7,1	6,0	-1.73
Hungary	4,1	4,1	1,0	0,1	5,1	4,3	-1.81
Lithuania	-	-	0,1	0,1	0,1	0,1	0.00

(21) As can be seen from the overview in table 3.1-1 coal consumption has been declining all over Europe with an average annual growth rate of –1.1% p.a. This development can be mainly attributed to the decline of the economy in accession states after 1990 and the fuel switch in United Kingdom. With a decrease in Denmark, Belgium and Luxemburg at one side, there was a significant increase in Italy on the other side.

(22) It has to be taken into account, that in EU 15 coal consumption was increasing with an annual growth rate of 1.5% and was almost stable in EU 10 during the last five years.

3.1.2 Production

Conclusion	Europe (without former soviet union) presently accounts for about 315 Mtce ***coal production***, this is 12% of the world's total annual coal production (2'550 Mtce). Neighbouring countries including Turkey and the states of the former Soviet Union add to approximately the same amount of produced coal (320 Mtce). Germany and Poland are by far the largest coal producers in the EU; together they account for about 2/3 of all coal presently produced in the EU. Coal production has a long tradition and importance in many European economies.

(23) Europe (without former Soviet Union) presently accounts for about 315 Mtce coal production, this is 12% of the world's total annual coal production (2'550 Mtce). Neighbouring countries including Turkey and the states of the former Soviet Union add to approxi-

mately the same amount of produced coal (320 Mtce). Germany and Poland are by far the largest coal producers in the EU; together they account for about two-thirds of all coal presently produced in the EU. Of the other member countries, Greece and the Czech Republic are both relatively large coal producers, with the only other significant coal production coming from Spain and the United Kingdom *[CSLF 2005]*, after closure of the last French coal mine in 2004. (cp. figure 3.1-3)

(24) Overall, annual coal production in the EU in 2004 (277 Mtce) was about 73% of what it was in 1994 (377 Mtce), with Greece being the only country that had a larger annual production rate in 2004 than it did in 1994.

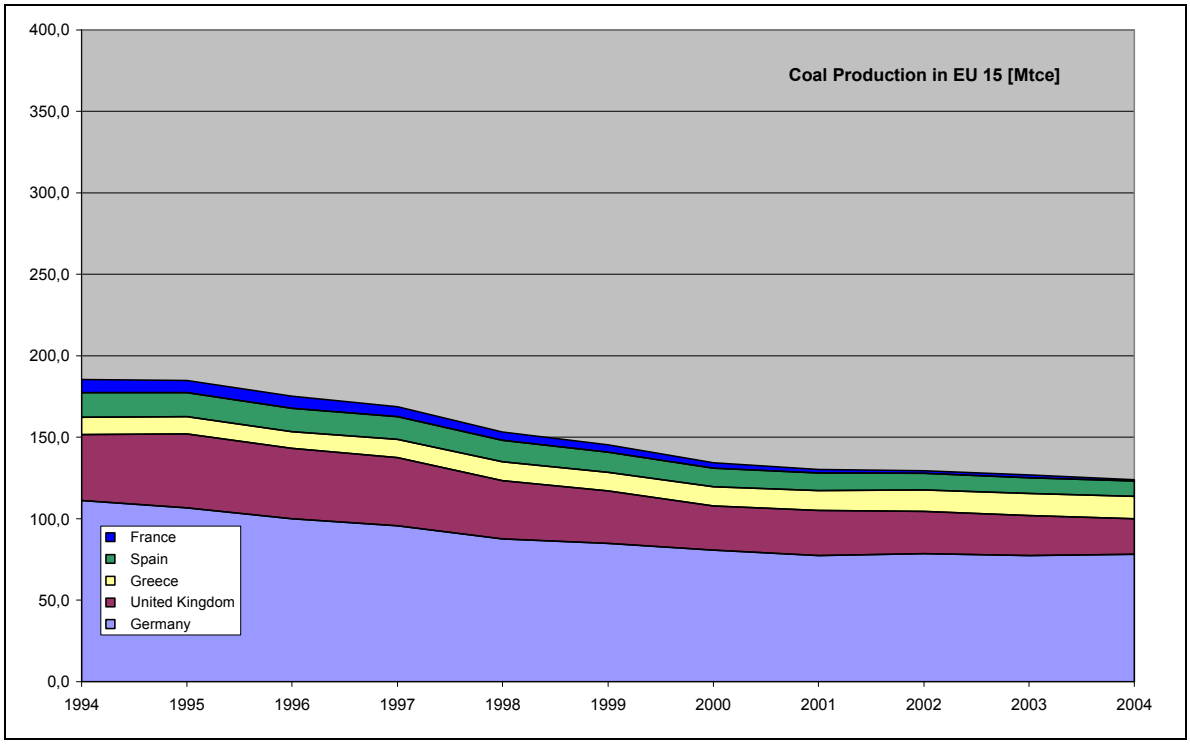

figure 3.1-3 *Coal Production in EU 15*

(25) Coal production went down as well in Eastern Europe, yet after a sharp decrease in the late 90s (from 192 to 157 Mtce in 2000), production was stabilising at the level of the year 2000 (cp. figure 3.1-4). The same decrease was experienced in the neighbour states of the former Soviet Union, but since 1999 production was growing again (after an all-time-low of production in 1998 from about 257 Mtce to 305 Mtce in 2004)

(26) The production of Bulgaria, Greece, Hungary and Romania is dominated by lignite, while Germany, Czech Republic and (at a very low level) Spain are producing both lignite and hard coal. Poland and United Kingdom are mainly hard coal producers.

3.1.3 Resources and Reserves

Conclusion	In Europe there is both a large ***reserve*** of hard coal as well as subbituminous and lignite available, with reserves regionally dispersed. Including Russia Europe is keeping more than 30% of the proven reserves worldwide, however only 4.4% in the member states of the EU. Reserves in western and southern Europe (EU 15) have significantly decreased due to a high production level during the last 50 years, while EU 10 and candidate countries, especially Poland still keep significant reserves.

(27) World coal resources and reserves are abundant. Total resources are estimated to an equivalent of 4'773 billion tce [Euracoal 2005]. Proven reserves add to 670 billion tce, according to the last survey of World Energy Council an amount of 907 billion tons in total (cp. table 3.1-2)

table 3.1-2 *Proven Reserves of Coal by regions and types [source: IEA 2004b)*

Proven Reserves [Mt]	**Bituminous**	**Sub-Bit.**	**Stat. Res.**	**Brown/Lignite**	**Stat. Res.**	**Total**
(end of 2003)	**[Mt]**	**[Mt]**	**[a]**	**[Mt]**	**[a]**	***39'461***
World	***476'971***	***272'326***	***186***	***157'967***	***178***	***907'264***
OECD	*170'563*	*110'352*	201	*90'688*	148	***371'603***
OECD Europe	17'702	4'718	120	17'041	39	***39'461***
OECD North America	115'669	103'149	235	35'614	313	***254'432***
OECD Pacific	37'192	2'485	141	38'033	586	***77'710***
Transition Economies	94'554	114'208	645	38'872	179	***247'634***
Russia	49'088	97'472	780	10'450	133	***157'010***
Asia	*153'572*	*35'527*	94	*28'280*	502	***217'379***
China	62'200	33'700	64	18'600	-	***114'500***
East Asia	1'287	1'766	19	4'330	140	***7'383***
South Asia	90'085	61	262	5'350	211	***95'496***
India	90'085	0	265	2'360	93	***92'445***
Latin America	7'701	12'068	324	124	-	***19'893***
Brazil	0	10'113	1'744	0	-	***10'113***
Africa	50'162	171	206	3	-	***50'336***
Middle East	419	0	419	0	-	***419***

Definitions:	***Resources*** refer to the amount of coal that may be present in a deposit or coalfield, independent of the economic feasibility. ***Reserves*** constitute those resources that are recoverable. ***Probable*** (or indicated) ***reserves*** are estimated with a lower degree of confidence. ***Proved*** (or measured) ***reserves*** are not only confidently considered to be recoverable, but can also be recovered economically, under current market conditions [IEA 2004[1]].

table 3.1-3 *Resources, Reserves and Production in Selected EU-25 and Candidate Countries (2004) [source: EURACOAL member, estimates]*

Region	Hard Coal			Lignite		
	Resources [Mt]	Reserves [Mt]	Production [kt]	Resources [Mt]	Reserves [Mt]	Production [kt]
EU 15						
Germany	186'000	23'000	29'200	77'600	41'300	181'900
Greece	-	-	-	6'700	3'200	71'900
Spain	4'200	600	12'300	80	50	8'200
United Kingdom	1'000	220	25'100	-	-	-
France *)	99	-	-	2	-	-
EU 10 + Candidates						
Poland	113'300	12'113	99'200	31'000	2'423	61'100
Czech Republic *)	4'123	295	13'300	3'873	812	48'800
Hungary	450	198	300	9'000	3'400	11'800
Bulgaria	440	270	3'200	4'031	2'045	23'700
Romania	8'307	810	3'700	2'500	1'456	31'600

*) Resources and reserves for France and the Czech Republic in [Mtce]

(28) As outlined in our definition above, the amount of proven reserves is not constant, but dependent on the economic and technologic framework[2]. For the instant a static reserve (reserve divided by actual production) of 186 years for hard coal and 178 years for brown coal or lignite is available. Not counting the Brazilian subbituminous reserves there is a longest available hard coal reserve in Russia (780 years).

(29) In Europe there is both a large reserve of hard coal as well as subbituminous and lignite available, but reserves are regionally dispersed. Including Russia Europe is keeping more than 30% of the proven reserves worldwide, however only 4.4% in the member states of the EU. Reserves in western and southern Europe (EU 15) have significantly decreased due to a high production level during the last 50 years, while EU 10 and candidate countries, especially Poland still keep significant reserves (cp. table 3.1-3).

1 IEA Coal Information (2004 Edition) Part I

2 An WEC estimate in 1978 set proved coal reserves at 636 billion tons. The 2003 figure is 43% larger than 25 years before.

(30) The BGR numeralises reserves and resources on a lower level than EURACOAL. The definitions and estimates for resources and reserves differ. In table 3.1-4 these differences are illustrated. The different figures can in part be explained by the fact that the BGR only indicates legally approved reserves in those countries in which coal is subsidized. The underlying assumption in these figures is that there will be no further production of coal after the period of assured governmental promotion runs out.

table 3.1-4 resources & reserves of coal by regions and types [source: BGR 2005)

Region	Hard Coal			Lignite		
	Resources [Mt]	Reserves [Mt]	Production [kt]	Resources [Mt]	Reserves [Mt]	Production [kt]
Europe	***64'150***	***11'507***	***191'015***	***116'020***	***21'632***	***431'850***
EU 15	***10'995***	***918***	***67'905***	***82'730***	***10'486***	***258'076***
Germany	4'695	183*)	25'691	76'396	6'556*)	181'926
Greece	-	-	-	5'800	3'900*)	68'000
Spain	1'300	500	14'000	200	30	8'000
United Kingdom	5'000	220*)	28'214	220	-	-
France	-	15	-	114	-	150
EU 10 + Candidates	***53'155***	***10'589***	***123'110***	***33'290***	***11'146***	***173'774***
Poland	46'000	8'400	99'170	13'984	1'877	61'000
Czech Republic	7'155	2'094	18'000	2'566	3'458	49'000
Hungary	-	-	300	9'032	3'159	12'000
Bulgaria	-	95	3'000	3'655	2'183	24'000
Romania	-	-	2'640	4'053	469	27'774

Reserves and resources developped in existing legally approved mines.

3.1.4 Coal Imports

(31) Coal consumptions is exceeding the European production, with net imports growing from 125 Mtce (1994) to 147 Mtce (2004). Greece is the only coal producing country of EU 15 with a balanced import saldo. Major importers are Germany (44.3 Mtce) and United Kingdom (32.6), followed by Italy (24.4), Spain (20.6), France (17.1) and Netherlands (13.0).

(32) Not all imported hard coal is used as thermal coal. France (6.1 Mtce), Italy (5.2), the Netherlands (4.4), Belgium (3.4) and Austria (1.9) are using a significant amount (between 15 and 50%) imported coking coal for steel production. Germany (23.0) and United Kingdom (6.8) use both imported and domestic coking coal.

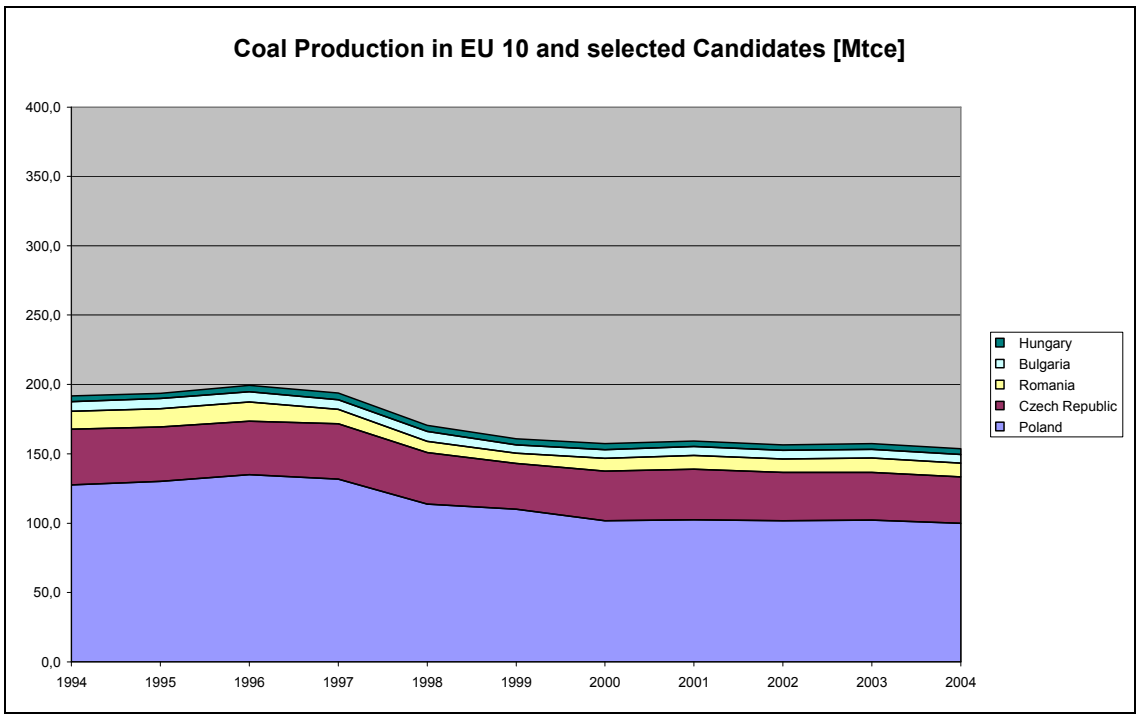

figure 3.1-4 *Coal Production in Selected EU 10 and Candidate Countries*

(33) The demand of EU 10 and of the acceeding states surpasses the domestic production as well, but not in such a significant manner as within EU 15. Poland and Czech Republic are net exporting countries, with 17.3 Mtce (Poland) and 4.4 Mtce (Czech Republic) of exported hard coal in 2004 (cp. figure 3.1-6)

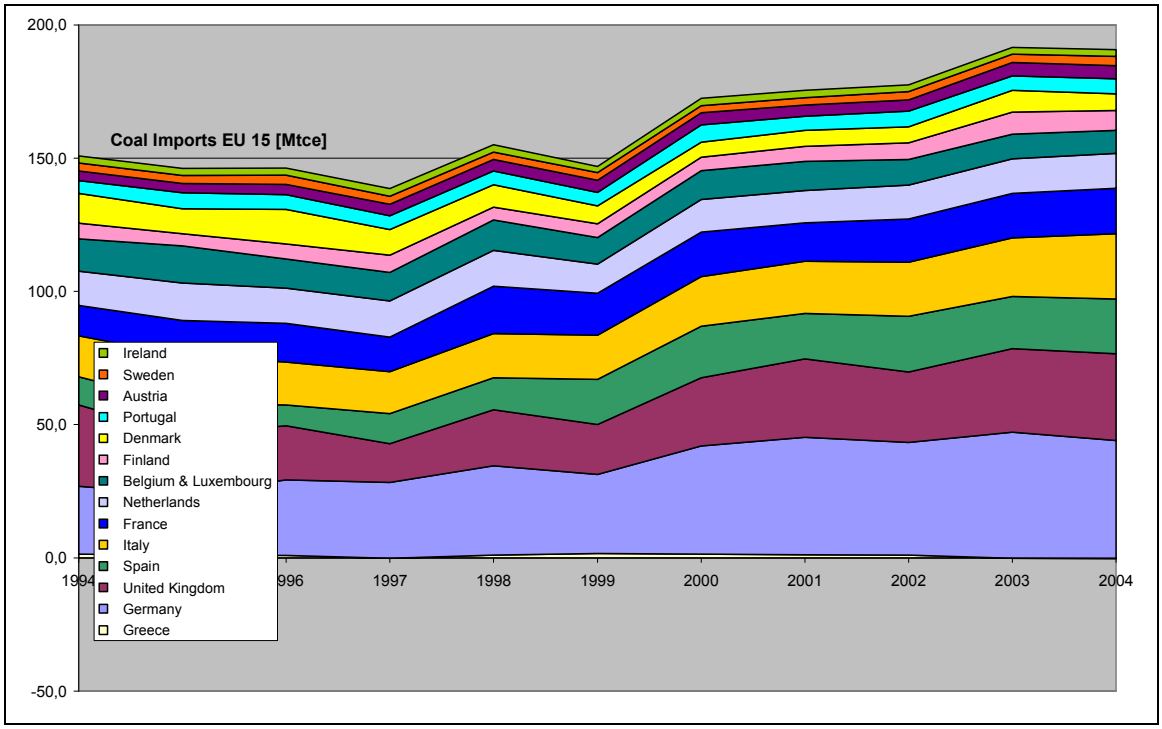

figure 3.1-5 *Coal Imports in EU 15*

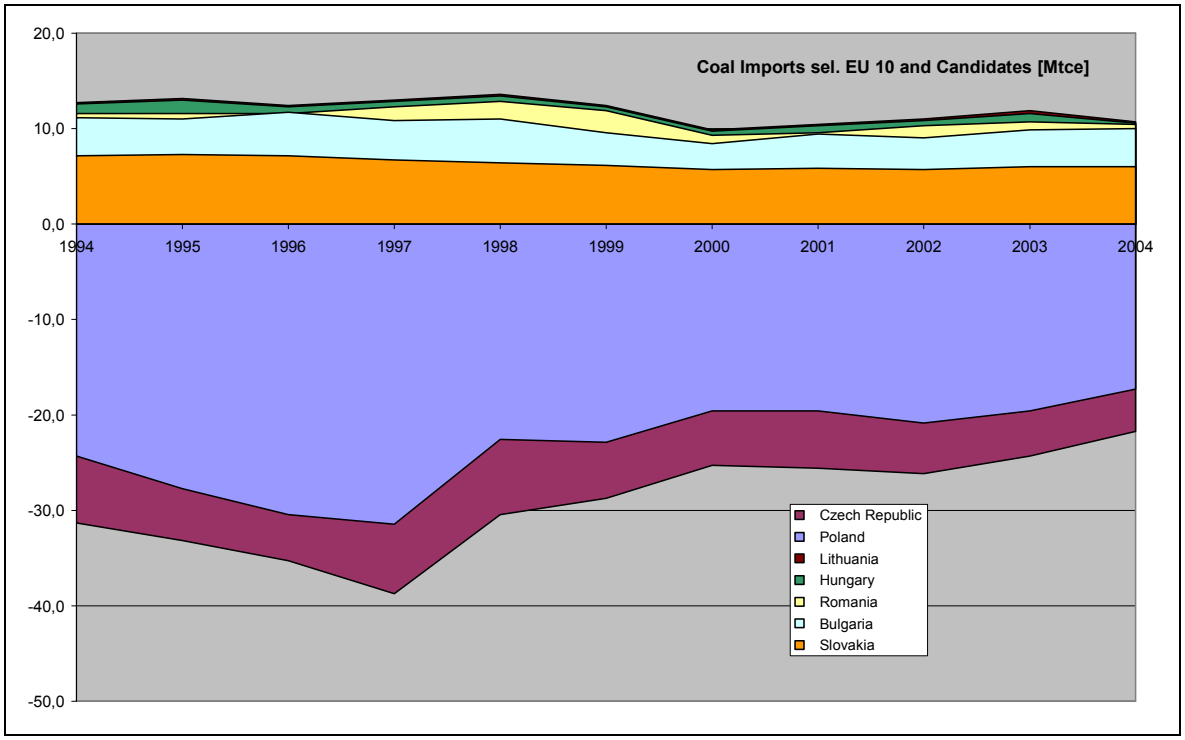

figure 3.1-6 *Net Coal Imports of selected EU-10 and Candidate Countries (own calculation)*

(34) Coking coal is playing a significant role in Slovakia, where most imports are used for steel production, while domestic lignite is used in power plants.

(35) The most important countries of origin for European hard coal imports are - with growing importance:

- South Africa 56 Mt
- Australia 30 Mt
- Colombia 21 Mt
- Former Soviet Union 21 Mt

with decreasing importance:

- U.S. 12 Mt

and – also with decreasing importance – as an important intra-European trade partner:

- Poland 16 Mt

3.1.5 Coal Prices

Conclusion	Price predictions cannot be seriously made, because prices are dependent as well on factors as expectation and speculation. However, with view on reserves and competitive producer markets as a first conclusion can be drawn, that coal prices are more likely to stay stable than other fossil fuels.

(36) Coal prices are an important key for coal as fuel in power generation. They are comparatively stable and do not suffer from high volatility as prices for natural gas, which is – among others - depend-

ent of the oil price development. Especially the low fuel costs for lignite imply the use of coal capacities as base load capacities.

(37) After nearly 20 years of consistent declines, export coal prices nearly doubled from 2003 to 2004. Increased domestic demand in major exporting countries (China, Russia) or decreased production (USA) tightened the market [McKinsey 2005]. China's economic development absorbed coal and steel, among other commodities, turning the nation from an exporter, which pushed Asia-Pacific prices down at the beginning of the century, into a net coal importer.

(38) Furthermore temporary supply/demand imbalances occurred. On the demand side, unusually warm weather in Europe drove the need for electricity and at the same time reduced the availability of alternative energy sources (hydro and nuclear) in favor of coal. Several nuclear power plants in Japan were closed for maintenance.

(39) High oil and gas prices contributed as well through a shift in demand and higher transportation costs for coal. On the supply side, logistical bottlenecks in ports and railway systems in South Africa and Australia led to capesize vessel rates, which were higher than any experienced on the market over the last 25 years (26 US$/t).

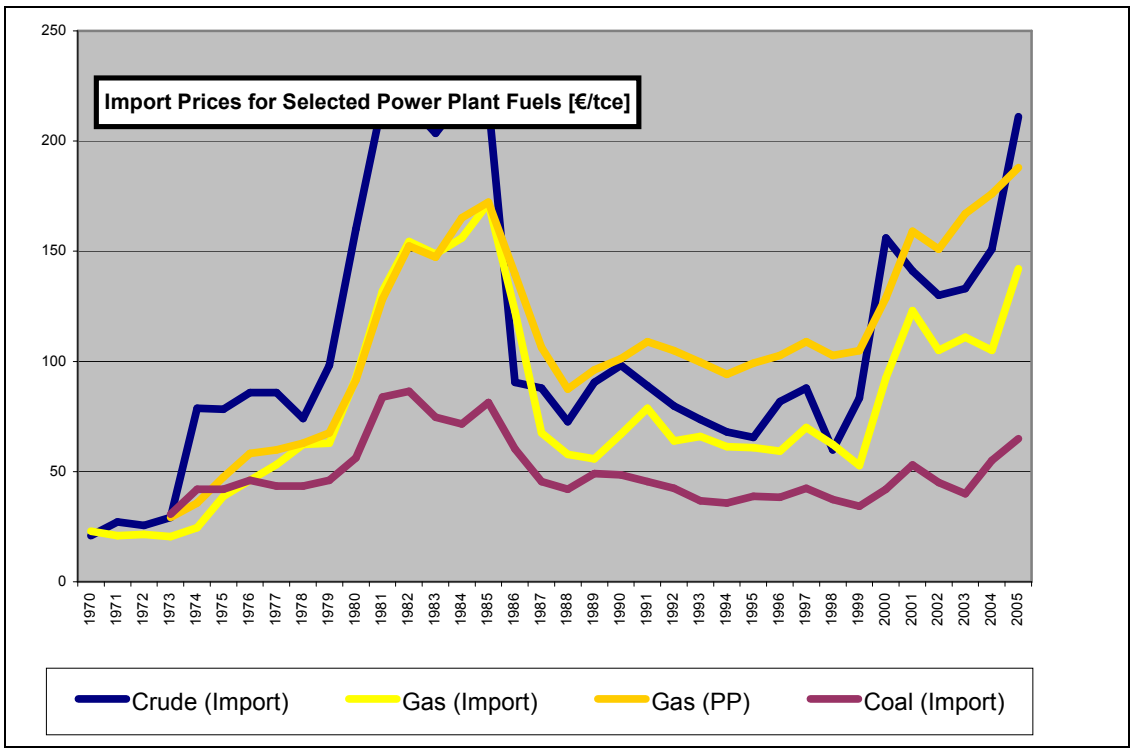

figure 3.1-7 *Prices for Imported Energy Sources in Germany [€/tce]*
[source: Statistik der Kohlenwirtschaft e.V.]

(40) Steam coal prices fell to a twenty year low in 1999/2000 with CIF prices of around $35 a ton for both Japan and Europe. However, since then prices have been rising to levels of $60-80 per tone in early 2005, with the McCloskey Marker Price North West Europe at $78.70 in December 2004 [World Coal Report 2005].

(41) In the same time oil and gas prices were rising due to

- growth of demand
- limited spare capacity
- limited refining capacities
- extreme climate conditions (hurricane Ivan)
- increasing interest in commodity markets for investments and speculative transactions

(42) The price development for imported oil and gas was volatile in the past 30 years. As can be seen in figure 3.1-7 nominal gas and oil prices fluctuated heavily in the past decades. Import steam coal prices followed the prices for imported oil and gas but were not as volatile. Furthermore, the spread between coal prices and prices for other fossil fuels has increased dramatically since 2000. A large spread makes coal more attractive as an energy source for power generation.

(43) As can be seen from recent figures (cp. figure 3.1-8), import coal prices have been declining during the last 15 months, reaching a price level of 55 €/tce in September 2005

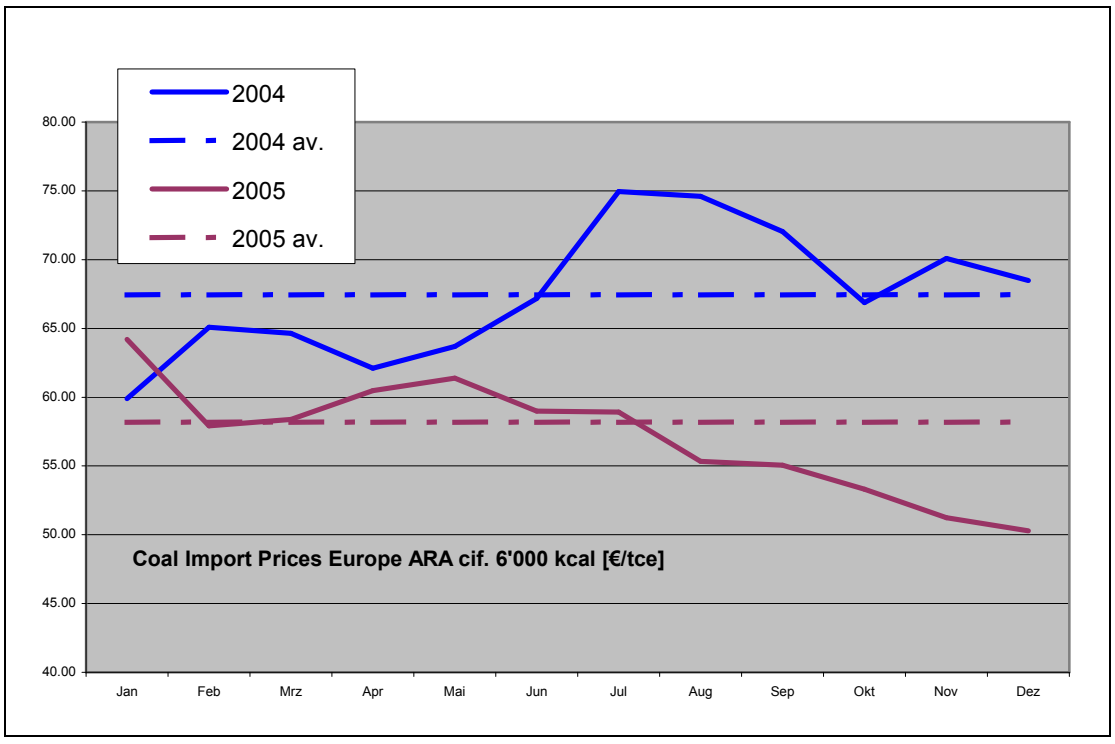

figure 3.1-8 *Coal import prices in Europe [€/tce]* [source: VdKI 2005]

(44) As a preliminary conclusion, all fossil fuels were short because there was inadequate investment in fuel production in response to depressed fossil prices over the last decade of the last century. In the new decade expanding economies develop increasing demand for *all* fossil fuels, not only in Asia, but also in other economic relevant regions (Soviet Union, North America *and* Europe) at the same time. Now, with worldwide fossil energy supplies as costly as they have been in a decade, coal was still more efficient for electricity

generation than gas and oil. Variable cost economics implied burning of coal in existing power plants.

3.2 The Role of Coal in Power Generation

3.2.1 Final Energy Demand of Electricity

(45) The consumption of electrical energy is expected to increase at an annual rate of 2.5% worldwide, nearly doubling from 16'100 TWh to 31'700 TWh in 2030. Strong growth is expected in countries of the developing world at an annual rate of 3.5% *[IEA coal 2005]*

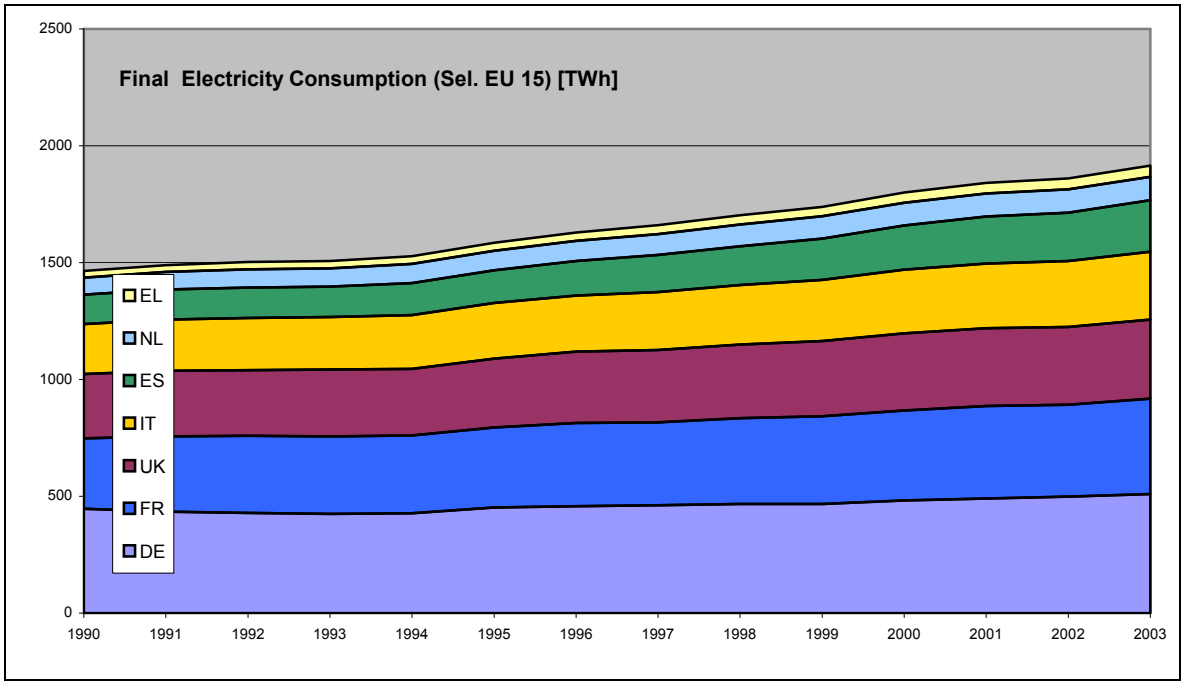

figure 3.2-1 *Electricity Consumption in selected EU 15 [source Eurostat 2005]*

(46) With a total of 2'612 TWh the European Union presently accounts for about 16% of both the world's annual electricity generation and consumption, while EU 15 accounting for 90% of the European Unions' electricity (2'371 TWh). Germany and France are the two greatest electricity producers and consumers in the EU, followed by the United Kingdom, Italy, and Spain (cp.).

(47) The annual growth rate of the EU 15 is at an average of 1.8% p.a. (between 1990 and 2003) and significantly higher than that of the new accession states, where electricity consumption nearly kept the level of 1990. Especially the candidate countries Bulgaria (-2.6%) and Romania (-2.2%) show a negative growth rate over that time period.

(48) However, from figure 3.2-2 it can be seen that in central and eastern Europe the demand of electricity was increasing again during the last ten years after the breakdown of the Comecon system at the beginning of the 90s. In general during the last years (1999-2003) al-

most the same growth rates have been reached in EU 10 (1.9%) as in the EU 15 (2.4%).

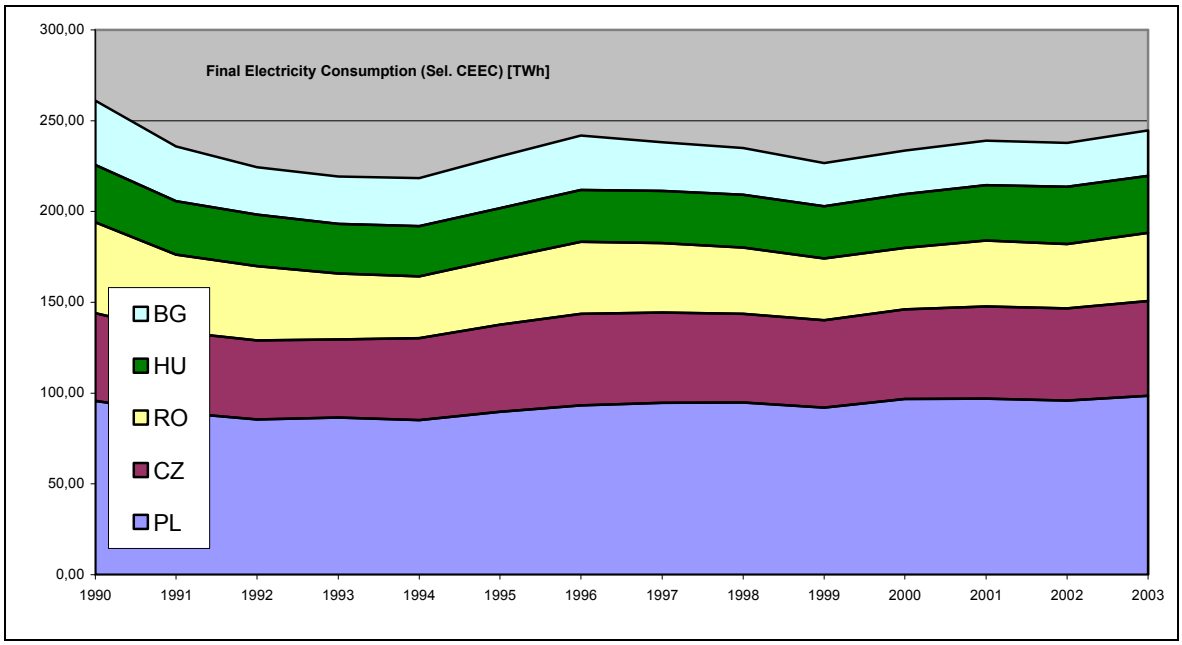

figure 3.2-2 *Electricity consumption in selected Central and East European Countries [source: Eurostat 2004]*

(49) During the last five years (1999-2003) the highest growth rate of electricity consumption can be found in southern Europe with Spain (5.5%); Greece (4.4%), Italy (2.8%), Romania (2.6%) and France (2.2%). That might be strong hint, that summer electricity consumption for cooling is getting a more and more important driver for electricity consumption - next to economic growth.

3.2.2 European Power Markets

3.2.2.1 Stability of Power Generation

(50) The summer of 2003 was marked by several widespread power failures in some of the largest economies of the Western European region. An unusually severe heat wave occurred during the summer months, testing many nations' electricity infrastructures. Nuclear power plants were forced to curb operations in Germany and in France when water temperatures exceeded legal limits and the nuclear power plants could not dispose of the water used to cool nuclear core elements. In addition, a lack of wind resulted in weaker performance of installed wind generation in Germany [EIA 2004].

(51) In August 2003, London experienced an electric power outage that affected 400,000 customers during rush hour. However, the U.K. natural gas and power market regulator, Ofgem, determined that the failure—and another one that followed a week later—were not caused by insufficient grid investment. Instead, the outage was caused by the wrong type of fuse installed on backup protection equipment. Denmark and Sweden, with integrated electricity systems, suffered their worst blackout in 20 years when the 1,135-megawatt nuclear power

plant at Oskarshamn in Sweden was shut down, triggering an automatic closure at Sweden's 1,800 megawatt Ringhals nuclear power plant. The shutdown at Oskarshamn was attributed to a fault on the transmission line. Lack of investment in the Scandinavian power grid has been cited as a key reason for the massive failure [EIA 2004].

(52) The number and severity of the power failures that hit Western Europe in 2003 have raised concerns about the liberalization of electricity markets in the region. In the case of the United Kingdom, Sweden, and Denmark, governments are questioning whether the power failures resulted from a lack of investment in the national grids, which is less profitable to companies than is investment in new capacity. In Italy, on the other hand, the government has moved to speed up the process of liberalization in the wake of the widespread power outages, by expediting legislation on an energy reform bill that would make it easier for companies to construct new generation capacity. In the short term, the government passed an emergency decree at the end of August 2003 that allowed the Industry Ministry to let power producers ignore temperature limits on the waters they discharge [EIA 2004].

3.2.2.2 Liberalization of the Power Market

(53) European power network is organised by the Union for the Coordination of Transmission of Electricity" (UCTE), which is responsible for the operation and development of the electricity transmission grid from Portugal to Poland and from the Netherlands to Romania and Greece (not comprising Great Britain and Scandinavia).

(54) The European power exchange pattern is complex and cannot be read easily because it is highly dependent on the type of demand (base, semi-base, peak) and the actual economic and meteorological framework conditions. If related to the total final electricity consumption the net exchanged electricity is – as a general rule - still below 10% (cp. figure 3.2-3).

(55) There are however exemptions to that rule with France with 60 TWh (15% of its domestic electricity consumption) being the major net exporter of the European Union and at the other side, Italy with a net import of 42 TWh (15%) being the major importer, followed by The Netherlands (16.5 TWh, 16%).

(56) Western Europe's drive to reduce cross-border barriers throughout the regional economy is expected to increase competition in its electricity and natural gas markets. In Eastern Europe, efforts to restructure and liberalize national electricity sectors have been driven by the accession of several countries to the EU. EU membership has compelled many nations of the region to reform electricity markets in order to meet EU standards.

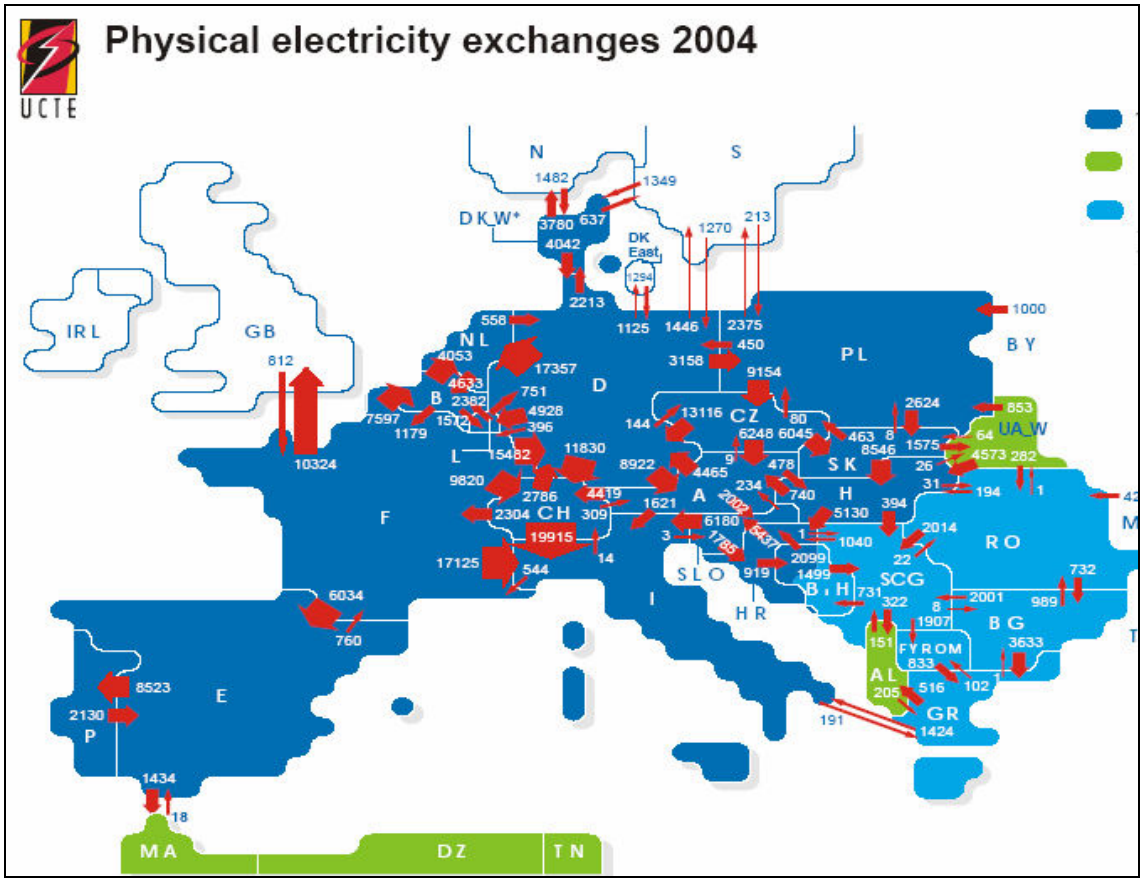

figure 3.2-3 *Physical electricty ex change 2004 [source: UTCE 2005]*

3.2.2.3 Capacities

(57) Installed power generation capacity in the European Union has been steadily increasing over the past several decades, and now accounts for about 18% of the world total when the ten new member countries are included. Germany and France have the largest amount of the EU's installed generating capacity, together accounting for about 35% of the current EU total.

(58) Most of Germany's installed capacity is fossil fuel-based, while France presently accounts for nearly half of the EU's nuclear power generation capacity and more than 20% of the EU's hydroelectric capacity.

(59) As can be seen from the following pictures power capacities in Europe are highly diverse and were dependent on political decisions over the last 30 years. As a reaction to the oil crises in the 1970s and 1980s, national governments decided to promote investments in coal and in nuclear power capacities. Today's power generation mix in Europe reflects the energy policy of these years. The national capacity mix is influenced by aspects as security of supply, domestic availability, diversity, environmental and climate protection, traditional economic structures and technological innovations and state funding.

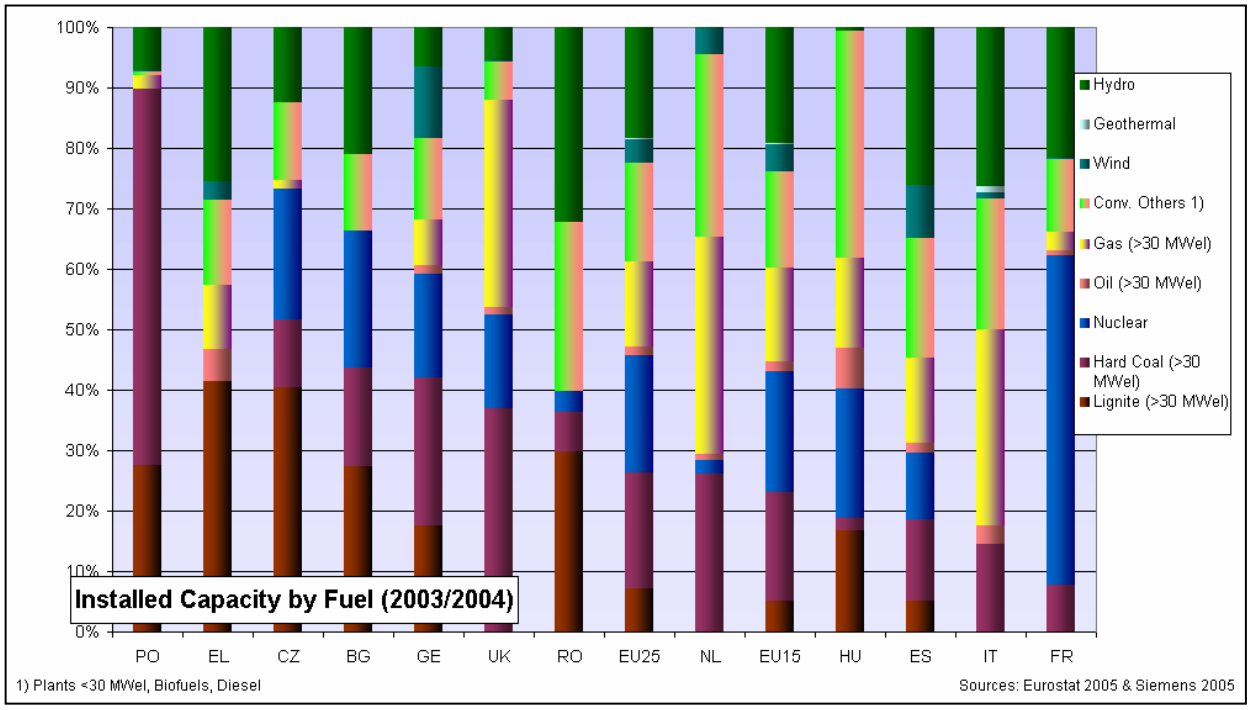

figure 3.2-4 *Installed Capacity by Fuel [source: Eurostat/Siemens/prognos]*

(60) Non-hydroelectric renewable energy sources of electricity have now started to become a significant contributor to the overall mix of electricity generation in the EU; Germany by far has the largest such installed capacity, with nearly as much as the rest of the EU combined. Spain and Denmark have also greatly increased their renewable energy generating capacity. Most of the renewable energy in the EU is wind energy *[CSLF 2005]*

(61) The contribution of renewable energy sources has increased, with almost unchanged capacities in installed hydroelectric, but with a significant increase in installed wind capacities, summing up to 30 GW in 2004, with half of the capacities being installed in Germany and about 6 GW in Spain. The only other significant non-conventional thermal power generating source are geothermal plants in Italy, with 666 MW of installed capacity.

Slightly more than half of the EU's total electricity generation is from fossil fuels, with the amount of generation from fossil fuels about 24% greater in 2001 than it was in 1993 *[CSLF 2005]*. As can be seen from figure 3.2-4 and

(62) figure 3.2-5 coal is playing a dominant role in the European Union with 25% of installed capacities and almost one third of the power generation. Only nuclear capacities have a similar contribution in European power generation.

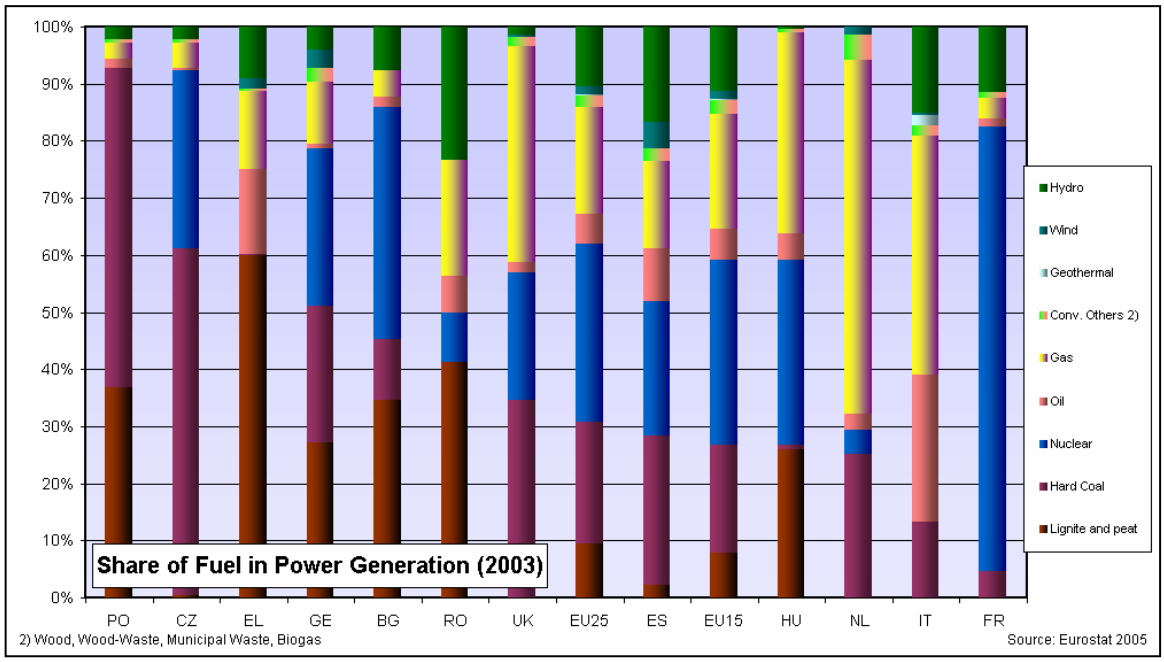

figure 3.2-5 *Share of Fuels in Power Generation [Eurostat]*

3.2.2.4 Outlook on Future Capacities

(63) Investment in building new power plants with roughly one third of today's total capacity must be made throughout Europe in the next 25 years. This could result in a profound change in the power generation portfolio, with options under consideration for new plant including nuclear energy, coal, natural gas and renewables.

(64) As can be seen from figure 3.2-6 there is a demand for replacement of more than 400 GW old capacities larger than 30 MW during the next 30 years in the EU 25, with a large emphasis on coal capacities during the next 10 years, followed by a large amount of the nuclear capacities to be replaced between 2015 and 2025. This structure of power plant capacities is in part a result of the energy policies pursued in the 1970s and 1980s. Additional capacities needed to meet future power demand that will occur during the next 3 decades (cp. chapter 6) are not considered in this calculation.

(65) There are regional differences: in eastern Europe the situation is determined by a lack of investments with a lot of coal capacities already older than 40 years (cp. figure 3.2-7)

(66) Some regions, such as Iberia, will have significant excess capacity by 2010, especially through new gas-fired power plants, so that there is temporarily no need for new coal or gas capacities. For other areas, such as the Central countries, a shortage in generation capacity may occur (compare country reports as well as chapter 6).

(67) The full cost vs. variable cost economics suggest that last 10 years were dominated by a "burn coal, build gas" trend. The impact of the CO_2 costs was expected to strengthen this trend. Consequently, planned expansions in generation capacity were mainly natural gas based. With view to the rising gas prices since 2000, there is a trend back to investments in coal capacities.

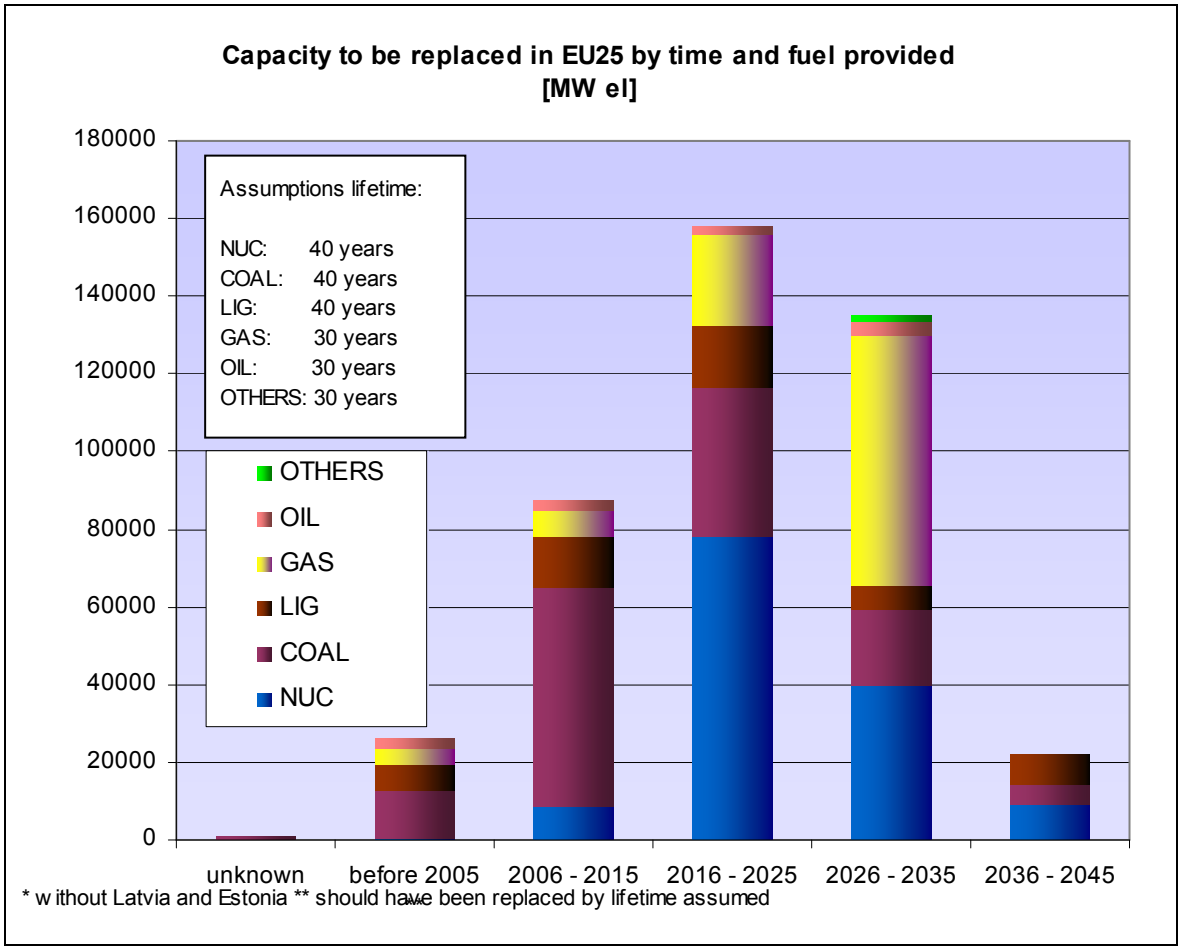

figure 3.2-6 *Power Capacity Renewal* [3] *(Siemens data base / own evaluation)*

(68) The mix of the new generating capacities will depend on a number of factors including:

- investment rentability
  - fuel prices (rsp. costs)
  - electricity retail prices
  - taxes and carbon prices
  - capacity costs
- investment security
  - development of final energy demand
  - indigenous and international fuel availability
  - fuel diversity

3 IEA/OECD 2005

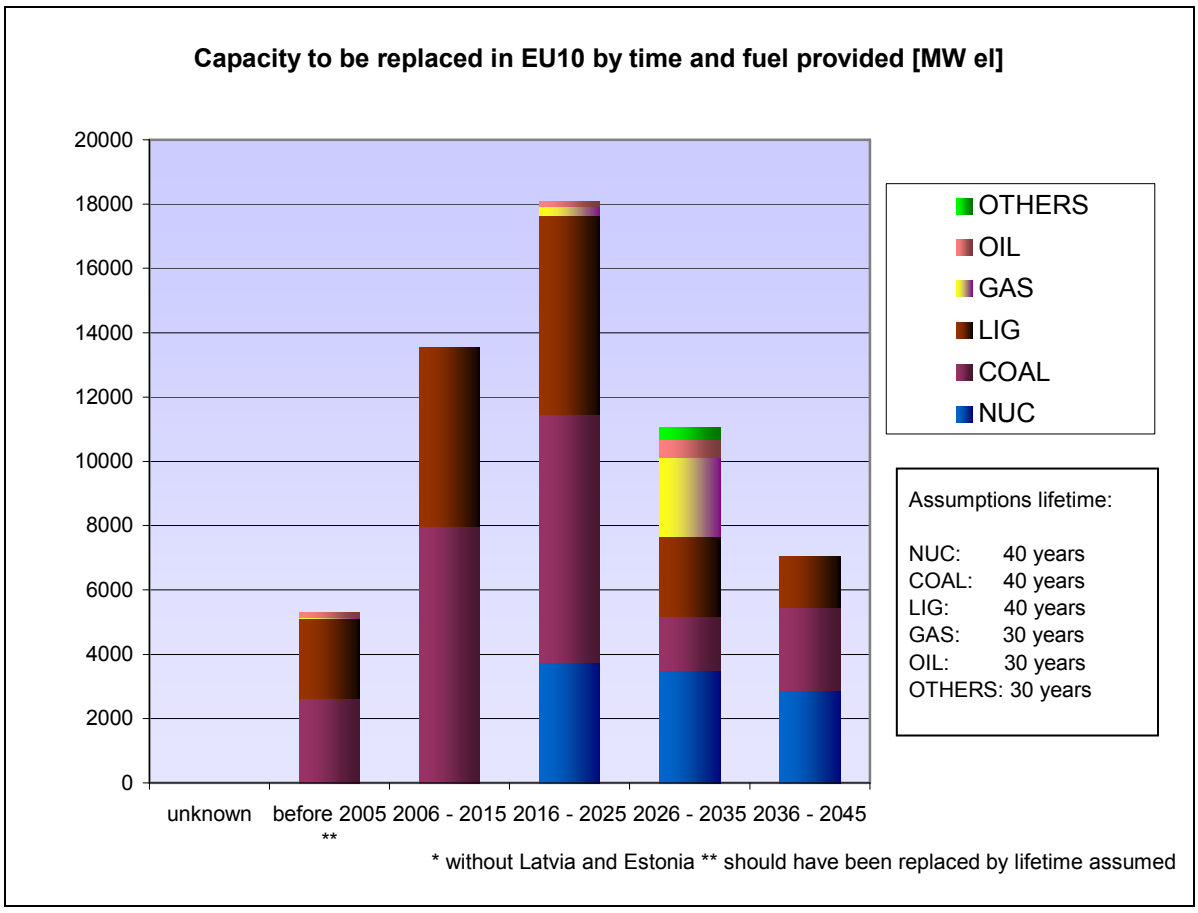

figure 3.2-7 *Capacities to be replaced by time and fuel provided (EU 10) (Siemens data base / own evaluation)*

- infrastructural framework
  - regional infrastructural exposition to (different) fuel markets (fuel terminals and hubs, coast, harbour, river ships, railway terminals)
  - local infrastructural exposition (local fuel terminal, storage capacities, waste management)
  - availability and accesibility to grids
- political framework
  - legal framework: regulations, approval procedures
  - climate protection policies
  - longterm reliability of political systems and political support
- technology framework
  - political support for technologies
  - availability of know-how and skilled staff (especially in case of application of advanced technologies)
- stakeholder acceptability
  - environmental acceptability
  - social acceptability

3.2.2.5 *Regional Economic Relevance of Coal Mining and Power Generation*

(69) In many European countries, there is a tradition of hard coal and lignite mining. There are regions in which the coal industry is one of the main economic factors and employers. The closure of mines in European hard coal mining areas such as the Ruhr in Germany, the Castilla León Autonomous Region in Spain or Selesia in Poland has caused higher unemployment rates in these regions.

(70) National coal policies also have a regional economic and a social dimension, respectively. There is an interaction between coal subsidies and regional economic regeneration. For example, in Spain, the restructuring of the hard coal industry caused production to decline by 33%. The Spanish government pays subsidies to the hard coal industry as long as the regional economic structure is geared to hard coal production. On the other hand it funds projects for regional economic restructuring [IEA 2005b].

(71) The importance of coal as a regional economic factor can also be illustrated when analyzing the East German lignite industry. A study conducted by the Prognos AG shows that the East German lignite industry contributes significantly to the regional value added in East Germany and to regional employment [Prognos 2005, not yet published].

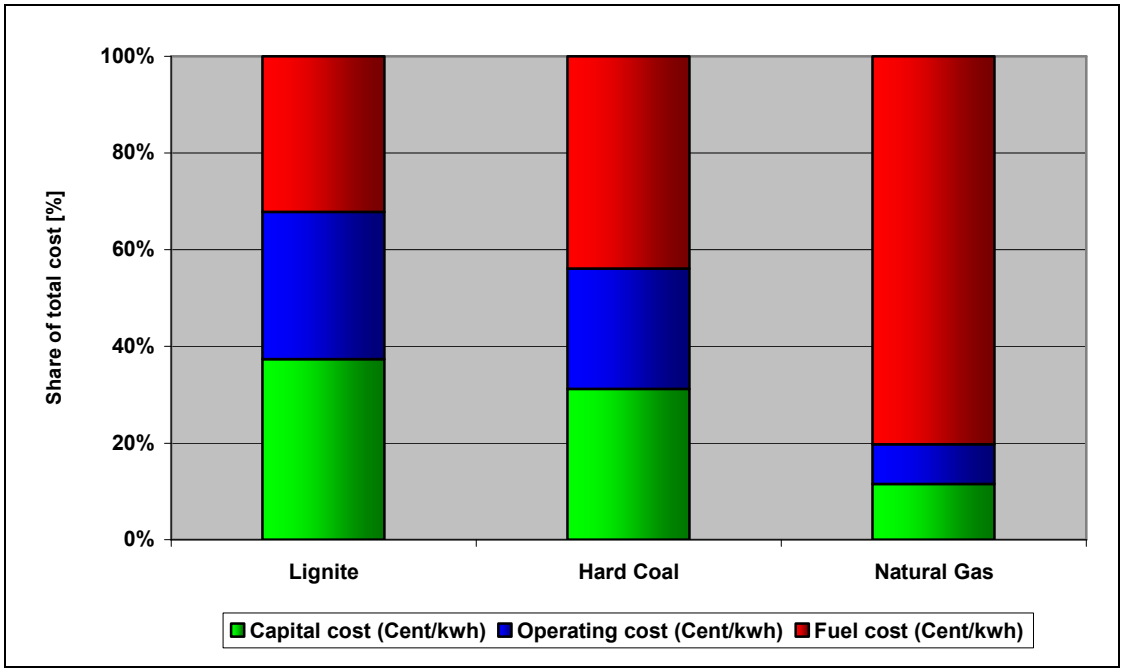

figure 3.2-8 *Cost Shares in Power Generation by Fuel [%]* [source: Prognos (2000)]

(72) As can be seen figure 3.2-8, the share of fuel cost in gas-fired power generation is much higher than in lignite and hard coal-fired power generation. The displayed cost assume an annual amount of 7'000 full load hours in 2000. The higher share of capital cost creates a higher capital intensity and therefore a higher regional or national value added, as far as the equipment is produced in the region or

country.. Also, the total fuel costs are lower for coal and the share of fuel costs is lower as well *[Prognos 2002]*.

3.3 Policies

(73) The member states of the European Union are increasingly dependent on fuel and natural gas imports, as was highlighted in the Commission's Green Paper on Security of Energy Supply (2000). The European Union now imports 50% of its energy needs. Around 2030, this figure is forecast to rise to 70% with an increasing share for fossil fuels. This situation was regarded as making the Union *"particularly vulnerable economically, politically and with regard to the environment"* [EC 2001].

(74) Because of this situation the Final *Report on the Green Paper on Energy [EC 2005]* stresses the priority of supply security in European energy policies. As a result, European energy policies focus on curbing energy demand, controlling external supplies, diversifying energy sources and the establishment of liberalized and competitive energy markets. The EU renewables policy is part of the diversification target. However, coal also plays a major role in the considerations of the EU Commission. The report stresses the significance of coal in electricity generation and of coal mining as an option for European supply security.

(75) The various EU States have widely different starting positions in terms of resource availability and energy policy stipulations. France and Finland, for example, are heavy backers of nuclear energy. The UK and the Netherlands have gas deposits, although output reductions are foreseeable. In Germany, lignite offers a competitive foundation for baseload power generation although hard coal from German deposits is not internationally competitive. In Austria, hydropower is the dominating energy source for generating power, though potentials for expansion are limited. The use of other renewable energy sources is often only feasible if subsidised.

3.3.1 The Integration of the European Union Energy Markets

(76) The EU passed directives in 2003 that establish deadlines for opening electricity and natural gas markets. The directives require that markets for nonresidential consumers be opened to competition by July 2004 and for all consumers throughout the EU by July 2007. The directives also require the separation of distribution nets from generation and retail services.

(77) The 2003 EU directives on electricity and natural gas follow from the original 1996 agreement that began forcing EU member countries to open their electricity markets for competition. The market opening imposed rules upon member countries according to a timetable that allowed each country to define its own pace of market liberalization, somewhere between the European Commission minimum requirements and full immediate opening. Introducing competition into

the EU markets was expected to result in increased energy efficiency and lower prices for consumers.

3.3.2 Renewable Energy Policies

3.3.2.1 Renewable Energy Policies on European Level

(78) On European level the commission (DG TREN) launched a directive to establish a framework to increase the share of renewables in electricity generation from 14% to 22% by 2010. The directive obliges member states to set indicative national targets for the contribution of renewable energies, which should be met by 2010. It is probable that the overall target will be missed (the projection indicates 18% by 2010), thus leaving the member states have to introduce additional measures.

(79) The European Commission (DG TREN) regards renewable energy sources as one attractive option towards energy diversification. Following initiatives have been forwarded:

- the Directive on the promotion of electricity produced from renewable energy sources 2001/77/EC - 27.10.2001
- the Directive on the promotion of biofuels 2003/30/EC - 17.5.2003

3.3.2.2 The Role of Renewable Energies

(80) Electricity generation from ***renewable energy sources*** other than hydroelectricity continues fast-paced growth among the countries of (especially) Western Europe. The governments in the region offer support for non-hydropower renewable power sources, most notably wind, in the form of subsidies or requirements that utilities purchase a certain amount of power from “green” energy sources. Germany, Spain, and Denmark remain the fastest growing wind producers in the world, and the United Kingdom, Ireland, and Portugal all are experiencing a surge in installed wind capacity.

(81) Germany has made a significant increase with the introduction of its renewable energy feed-in tariffs, which provide guaranteed tariffs for renewables. The share of renewables has been rising continuously, shortly being expected to break the 10% share in electricity generation (50 TWh).

(82) In United Kingdom, there is a renewable obligation for electricity supply, which was revised in April 2004 and setting the renewable obligation from 10% to 15%, including the possibility of biomass-co-firing. There is a renewable levy, which electricity end consumers are charged with each kWh. However the share of renewables is below the EU 25 average.

(83) Spain is well promoting electricity generation by renewable energy sources by fixed tariffs. Wind power is on the rise. The government launched a national plan, in order to increase the share of renewables in electricity generation to almost 30% (from an actual level at 25% coming from wind and hydro).

(84) The French government promotes renewable energies by feed-in-tariffs and sets a major focus on the development of wind energy, thus France making (together with Spain) one of the most attractive market for wind power installations.

(85) Italy has established a quota system, which will be completed by a more market orientated system of *green certificates.*

(86) The Netherlands are pursuing a diversified policy in order to promote renewable energies: several measures haven been applied, such as eco-taxes and fixed feed-in-tariffs.

(87) Renewable Energies in Greece are promoted by a feed-in tariff and promotion programs. The share of renewables in electricity is comparable low.

(88) An increasing importance of ***off-shore windpower*** can be expected: In 2003, Ireland's Airtricity began installation of the first phase of the 25.2-megawatt Arklow wind farm. The $59 million project, located 6.3 miles off Ireland's east coast. consists of seven 3.6-megawatt turbines. Airtricity has proposed to eventually expand the site to up to 200 turbines, making it the largest offshore wind project in the world [4].

3.3.3 Energy Efficiency

(89) Another key focus of the European Commission is the demand side efficiency measures including energy efficiency of buildings and appliances:

- the Directive on energy performance of buildings 2002/91/EC - 4.1.2003
- the Directive on energy efficiency requirements for ballasts for fluorescent lighting 2000/55/EC – 01.11.2000
- the Directives on labelling of electric ovens, of airconditioners and of refrigerators
  2002/40/EC - 15.5.2002
  2002/31/EC - 3.4.2003
  2003/66/EC - 9.7.2003
- the Regulation on Energy Star labelling for office equipment 2001/2422/EC–15.12.2001
- the Directive on Eco design requirements for energy using products Proposal COM (2003) 453
- the Directive on energy efficiency and energy services Proposal COM (2003) 739

3.3.4 Energy Intelligent Europe

(90) In June 2003, the Commission launched a new Community support programme in the field of energy, "Intelligent Energy –

4 Construction was commenced in summer 2003 and finished in autumn. Production started at the beginning of 2004. Located around 10km off the coast of Arklow, Ireland, the project's seven GE 3.6 MW wind turbines are the world's first commercial application of offshore wind turbines over three megawatts in size.

Europe", to last until 2006. This programme allowed the various existing programmes[5] to be reoriented and grouped together in a single coherent and efficient programme

(91) The overall budget is € 250 million over 3 years in comparison to the € 220 million for the Save and Altener programmes from 1993 to 2000. "Intelligent Energy – Europe" is intended to promote renewable energy and energy demand management by catalysing national, regional and local efforts across the EU. The programme focuses on the removal of administrative and market barriers which hamper innovative projects to be implemented on a large scale.

(92) Two major campaigns in EIE included addresse the field of renewables and energy efficiency:

- Campaign for take-off (launched in1999), including the promotion of renewable energy sources
- ManagEnergy, adressing the network of 200 energy agencies throughout Europe.

3.3.5 The 7th EU-Research-Framework Program

(93) The new published 7th research framework program has a draft budget of € 70 bill. for 7 years (2007-2013), the largest block "cooperation" keeping approx. € 45 bill.. The Energy programs draft budget is € 3 bill., with following aspects

- energy efficiency
- renewable energy sources
- modern power stations, including
  - efficiency of conventional power plants,
  - development of new power plants (*"zero emission power plant"*) including CO_2 separation, transportation and storage,
  - improvement of fuel flexibility,
- fuel cells
- electricity distribution and storage and hydrogen

3.3.6 Clean Coal Technologies

(94) Recently, the EU Commission launched the *Zero Emissions Technology Platform* which serves as a base for the development of all CO_2 capture and storage as well as clean conversion technologies. The platform is an open body which promotes the cooperation of all stakeholders in order to identify and remove obstacles in the development process of zero emission fossil fuel power plants. In the short or medium term the platform is a means of coordinating the necessary activities that contribute to the development of CO_2 reduction technologies.The European coal industry has introduced the "Clean Coal" concept that promotes the reduction of CO_2 emissions from coal-fired power plants. The programme aims at the reduction of

5 (JOULE, THERMIE, SAVE; ALTENER; STEER, SYNERGY)

emissions by continuously modernizing the power plants. In this framework CO_2 storage and capture technologies are envisioned to be developed until 2020. The gradual increase of power plant efficiencies is a means of coping with the requirements of European energy policy as environmental concerns are considered as well as a contribution to supply security and economic efficiency. In its Sixth Framework Programme, the EU is funding five additional projects in the field of carbon capture and storage. These research projects are listed below [EC 2004b]:The *Enhanced Capture of CO_2 (ENCAP)* wants to provide pre-combustion decarbonisation technologies in power cycles operated by natural gas, residue oil, hard coal and lignite. The main objectives are a capture rate of at least 90% for CO_2 and a 50% capture cost reduction compared to a current level of 50-60 €/tCO_2.

- *CO_2 from Capture to Storage (CASTOR)* focuses on the capture and geological storage of CO_2 emissions. The aim of *CASTOR* is to allow for the storage of 10% of total European CO_2 emissions. Also, the costs of capture and separation are to be reduced. CO_2 is to be separated and captured in a post-combustion process. There will be case studies on four potential storage facilities.
- The *In-Situ R&D Laboratory for Geological Storage of CO_2 (CO_2SINK)* tests the possibility of storing CO_2 in an underground storage in a saline aquifer near Berlin.
- The *Network of Excellence on Geological Sequestration of CO_2 (CO_2GeoNet)* is a partnership of several European research institutes that combine their knowledge in the field of carbon storage.
- The *Innovative In situ CO_2 Capture Technology for Solid Fuel Gasification (ISCC)* is a project that develops a new process for upgrading high-moisture low-rank brown coals in order to create valuable products. As a result a highly enriched H_2 product gas is procduced using in-situ capture.

(97) In addition, to the projects listed above, the European Commission is providing support to two large international projects. The first of these is the Weyburn CO_2 monitoring project, which is an international project established to monitor CO_2 injection into the Weyburn oil field in Southern Saskatchewan, Canada. A team of European scientists are providing expert support to this project in the form of geochemical analysis and modelling [IEA/BGS 2003]

(98) The second is the CO_2 Capture Project, which is a major joint industry project that is principally aiming to significantly reduce the cost of the capture component. Taken together the package of projects should assist in answering many of the outstanding issues relating to geological storage of CO_2 that need to be resolved. In so doing, the projects should help to develop confidence in the technology so that geological storage of CO_2 can be accepted publicly as a safe and effective greenhouse gas mitigation option. [IEA/BGS 2003]

4 Climate Protection Policies: The Emission Trading Scheme

4.1 Climate Protection at International Level

Conclusion	The Kyoto protocol specifies that the industrialised nations will cut their emissions of the six most important greenhouse gases in 2008-12 by at least six per cent compared with 1990. It came into force in February 2005 with Russia signing the protocol. The EU installed an Emission Trading Scheme, which covers 50% of the EU-15 and 54% of the EU-25 CO_2 emissions. According to EEA projections, most EU-15 countries are about to fail, while most EU-10 are going to comply their Kyoto target.

4.1.1 Kyoto Protocol

(99) In December 1997 an agreement was reached on making specified cuts in emissions of greenhouses gases by the world's industrial countries. Adopted in the Japanese city of Kyoto, this deal forms a protocol to the UN framework convention on climate change from 1992. The protocol specifies that the industrialised nations will cut their emissions of the six most important greenhouse gases in 2008-12 by at least six per cent compared with 1990.

(100) The protocol came into force on 16 February 2005, with the ratification of the protocol by the Russian government. The protocol has been ratified by all the members of the Organisation for Economic Cooperation and Development (OECD) except the USA and Australia.

(101) The emission reduction to be achieved in the time period 2008-2012 is specified in % with respect to the levels of a base year or period. Most of the Annex B Parties, including the U.S., have targets for CO_2, CH_4 and N_2O based on 1990 level emissions, and may select either a 1990 or 1995 base year when setting targets for HFCs, PFCs and SF_6. Annex B Parties that are developing market economies, such as the Russian Federation, may select a different base year for all six gases

4.1.2 Climate Protection Policy at European Level

(102) The ***European Union*** presently accounts for about 16% of the world's annual fossil fuel-based carbon emissions. Except for natural gas-based carbon emissions, the overall trend has not been greatly increasing over the past decade. At the 1997 Kyoto conference, the

EU as a whole agreed to limit its increase in greenhouse gas emissions to 8% below 1990 levels by the 2008-2012 time frame [CSFL 2005]

(103) At European level, recent years have seen a number of environment-related initiatives. In 1991, the EC Commission issued the first Community strategy to limit carbon dioxide emissions and improve energy efficiency. In 2001, an amendment to the European Large Combustion Directive was adopted. The most important climate protection initiatives affecting energy generation are in particular:

- Directive of 27 September 2001 on the promotion of electricity from renewable energy sources in the internal electricity market.
- Directive of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity.
- Directive of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community.
- Directive of 27 October 2004 amending Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community, in respect of the Kyoto Protocol's project mechanisms (so called Linking Directive).

(104) Furthermore there are other EU directives towards energy efficiency improvement that have an impact on electricity generation. Besides the transposition of these directives into national law, the EU member States have taken additional measures to limit greenhouse gas emissions at national level.

(105) In its actual released work programme [EC 2005[6]] the commission sees 2006 as a "critical year" for global climate policy. It stresses that the EU needs to maintain its own momentum by putting in place new measures to curb greenhouse gas emissions and reviewing existing ones. Its proposals add up to a substantial package that will keep climate issues at the forefront of the business agenda. These are the future comitments

- legislation to bring ***aviation*** into the EU Carbon Emission Trading Scheme,
- an action plan on ***energy efficiency*** to follow up a green paper published this summer,
- a communication taking stock of the *EU voluntary agreement on* ***new car CO_2 emissions*** and proposing further steps,
- a communication on ***Clean Coal Technologies***, aimed at stimulating technology development and opening the door to carbon capture and storage,
- a communication on future prospects of ***biofuels***, proposing policies beyond 2010,
- a green paper on ***secure, competitive*** and ***sustainable*** EU ***energy policy***,

6 EC 2005: Communication of the European Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions (25 October 05)

- a green paper on ***adaption to climate change***, exploring how to respond to "the increasing adverse effects" of global warming [EC 2005]

4.1.3 Emissions Trading

(106) The European Union's system for emission trading with carbon dioxide started on 1 January 2005.The system currently confines emission trading to carbon dioxide. The EU will consider including the other five greenhouse gases covered by the Kyoto protocol in 2006. So far, the EU-25 is the only region worldwide that has established an emission trading system for CO_2.

(107) Emission trading aims to limit the total amount of greenhouse gas released by participants in a cost-efficient manner. Emission allowances can be bought and sold in the same way as other securities, on terms specified by government authorities. This is achieved because emitters able to make cuts at a reasonable cost can reduce the amount of greenhouse gas they release below the cap imposed on them by the authorities.

(108) Any difference between this cap and their actual emissions can then be sold to other companies who find it cheaper to buy allowances than to invest in reducing emissions. The overall ceiling for emissions set by the government for participants in the trading system determines the overall size of the reduction achieved.

(109) All major power and heat generators are covered by the scheme. In addition, the EU ETS covers all oil refineries, coke ovens and installations that meet a certain output threshold level in specific industries (cement clinkers, ferrous metals, pulp and paper, glass and ce-ramics) [ECN 2005].

4.1.4 Flexible Mechanisms

(110) The interaction of the EU ETS with the Kyoto Mechanisms, JI and CDM, is laid down in the so-called *Linking Directive* [European Commission 2004]. According to this Directive, installations covered by the EU ETS may convert credits from JI and CDM projects into EU Allowances (EUAs) in order to fulfil their obligations under the EU ETS. Credits from CDM projects, called Certified Emission Reductions (CERs), can already be converted into EUAs during the first trading period of the EU ETS (2005-2007), while credits from JI projects, called Emission Reduction Units (ERUs), can only be transferred into the EU ETS starting from its second trading period (2008-2012). The Linking Directive leaves it up to Member States to set a maximum for this transfer of credits [ECN 2005].

(111) The use of CDM and JI is restricted by a **supplementary requirement** in the Marrakesh Accords. Without putting it precisely numerically, the requirement asks the participating countries to achieve a minimum (at least 50%) of carbon emissions reductions by domestic action and a maximum (at most 50%) by flexible mechanisms [ecologic 2004].

(112) Although there is no quantifiable limit on the amount of credits from the CDM or JI it can be expected that, once the number of CERs/ERUs converted has reached 6% of the total quantity of allowances allocated by the Member States, a review process will automatically be initiated. In this case, the Commission may consider a maximum level of 8% of the total quantity of allowances. The level of 6% of the total quantity of allowances allocated corresponds to 2% of the EU base year emissions. This would represent more than a quarter of the total reductions the EU has to achieve in order to meet its target under Kyoto.

(113) Among the member states of the European Union, Austria and The Netherlands have started programmes that directly purchase significant amounts of EUA, ERUs (from JI action) and CERs (from CDM action). Italy and France intend to purchase ERUs and CERs.

(114) Beside national initiatives there are a number of private companies (especially from the financal sector) who have started purchasing emission certificates for a variety of purposes.

4.2 Development of national emission inventories

(115) The various EU States have widely different starting positions in terms of resource availability and energy policy stipulations. France and Finland, for example rely on nuclear energy. In Poland, Germany, Greece, and Hungary hard coal and lignite offer a competitive foundation for baseload power generation although hard coal from German deposits is not internationally competitive. In Austria, hydropower is the dominating energy source for generating power, though potentials for expansion are limited. The use of other renewable energy sources is often only feasible if subsidised.

table 4.2-1 *Development of Greenhouse Gas Emissions for EU 15 [source EEA 2004]* [7]

Member State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Austria	78	82	75	75	76	79	83	82	82	80	81	84	85
Belgium	146	149	148	147	152	155	159	150	155	148	150	149	150
Denmark	69	79	73	76	80	77	90	81	76	73	68	69	68
Finland	77	75	72	72	79	76	82	81	78	77	75	81	82
France	565	589	579	556	552	560	576	568	583	564	558	562	554
Germany	1 249	1 196	1 146	1 131	1 108	1 101	1 119	1 082	1 056	1 020	1 016	1 027	1 016
Greece	105	105	106	107	109	110	114	120	124	124	130	135	135
Ireland	53	54	55	55	57	58	59	62	64	66	68	70	69
Italy	509	511	506	500	493	525	517	523	535	540	544	554	554
Luxembourg	13	13	13	13	13	10	10	9	8	9	10	10	11
Netherlands	211	218	218	221	222	225	234	218	224	213	213	216	214
Portugal	58	60	64	62	63	67	65	68	72	80	78	78	82
Spain	285	291	300	289	304	316	310	331	341	370	385	383	400
Sweden	72	72	72	72	75	74	77	73	73	70	68	68	70
United Kingdom	743	744	721	701	696	686	708	684	679	648	648	656	635
EU-15	**4 231**	**4 239**	**4 147**	**4 076**	**4 079**	**4 119**	**4 204**	**4 132**	**4 151**	**4 083**	**4 090**	**4 144**	**4 123**

7 As EU 15 were acting as a single party during negotu

(116) While Germany (probably), Finland, France (probably), the UK, Luxembourg and Sweden are well on track to achieve their goals – the same is true for almost all accession countries –Belgium, Denmark, Italy, the Netherlands (if not by flexible mechanisms), Austria, Ireland, Greece, Portugal and Spain will miss the burden sharing targets. By 2002, the EU-15 as a whole had only achieved a reduction of 2.9%.

(117) As a distance to target indicator 12 countries are "short", still needing a total reduction of 232 Mt CO_2, while 13 countries seem to be long, with a distance to target surplus of 325 Mt CO_2. However, this *"hot air"* can basically not be found in the NAP schemes.

4.3 National Allocation Plans

Conclusion	The national allocation plans of the EU member states allocate all GHG emissions to different sectors. The plans define CO_2 emission caps for the ETS participants. In 2003, the EU ETS covered 50% of the EU-15 and 54% of the EU-25 CO_2 emissions. The design of a NAP has significant implications on the role of coal in power generation. NAPs are based on a set of various rules and criteria, which have been applied very heterogenously in the first stage of the ETS (2005-2007). Inequal treatment can be still observed for the allocation of new entrants. As further development a harmonisation and standardisation can be expected.

4.3.1 Purpose And General Framework

(118) The EU has chosen to fulfill its Kyoto commitment by forming a "bubble" which is an obligation for the EU-15 states to reduce their overall GHG emission by 8% compared to 1990 levels until the 2008-2012 reduction period. Within this "bubble" individual states may have stronger reduction obligations while others may even increase their overall amount of GHG emissions. The target levels for each individual state were constituted in the EU Burden Sharing Agreement.

(119) Every EU member country has to establish a national allocation plan to be approved by the European Commission. The first plan is valid for the 2005-2007 period. The next plan will be for the 2008-2012 period. The national allocation plan of each EU member country determines the national emission inventory of all climate gases of that country and allocates the corresponding amount of GHG emissions to different sectors such as transport, industry, or the residential sector.

(120) Each plan defines the total amount of CO_2 emissions (a cap) to be allocated to the energy and industrial sector and arranges the way in which allowances for CO_2 emissions are handed out to the

operators of individual installations. These allowances can be traded in the EU ETS.

(121) The amount of allowances that is allocated to the ETS participants of each EU country depends either on historic emissions, or on future emission projections. Countries with a reduction obligation generally allocate their allowances on the basis of historic emissions whereas countries whose obligation comprises a limited increase execute an allocation based on future projections. The latter countries' challenge is to keep their CO_2 emissions below the business-as-usual assumptions of a reference scenario.

4.3.2 Implementation of the CO_2 Emission Trading System (ETS)

(122) The facilities included in the ETS account for the CO_2 emissions of the industry and the electricity sector. The electricity sector accounted for about 64% of the CO_2 emissions of the participating sectors in the EU-15. In most of the EU-25 countries electricity generation causes most of the CO_2 emissions. Exceptions are Austria, Luxemburg, and Sweden where the industry sector prevails.[8]

(123) The reduction obligation differs from country to country. However, the cap compared to base year levels has been set at a comparatively low level in the first reduction period of 2005-2007 in each country, i.e. reduction efforts are to be kept low as the first reduction period is considered to be a test period for the ETS.

(124) Emission projections for 2010 indicate that most countries will fail their Kyoto target regarding their total GHG emissions. Exceptions are the UK, Sweden, and maybe Germany according to the European Environmental Agency. A continuation of current policies in the EU-15 will result in a reduction of one per cent. However, flexibility mechanisms such as CDM and JI are not taken account of in this projection. [EEA 2004]

(125) The CO_2 emission projections for 2005-2007 for the emission trading sector exceed the amount of allowances issued in almost every EU member country.

(126) Most of the EU-25 member countries do not oblige their ETS participants to reduce their emissions compared to base year levels but to limit the increase of emissions to a certain level instead.

[8] In these countries the steel industry is responsible for the high share of industrial emissions. Moreover, in Austria and Sweden large amounts of electricity are generated by hydropower and nuclear power, respectively.

table 4.3-1 *ETS Share of Total CO_2 Emissions in Selected Countries (2003)*

Country	Total 2003 national CO_2 emissions	Average annual allowances for ETS Sectors (Cap)	Share of ETS allocated emissions in 2003 total national emissions of CO_2
	[$MtCO_2$]	[$MtCO_2$]	[%]
EU-25	**4064.1**	**2190.9**	**53.9**
EU-15	**3447.5**	**1739.3**	**50.5**
Germany	865.4	499.0	57.7
UK	557.5	245.3	44.0
Poland	321.3	239.1	74.4
Italy	487.3	232.5	47.7
Spain	331.8	174.6	52.6
France	408.2	156.5	38.3
Czech Republic	127.1	97.6	76.8
Netherlands	176.9	95.3	53.9
Greece	110.0	74.4	67.6
Hungary	60.5	31.3	51.7

(127) The above table shows the total CO_2 emissions and the share and the absolute amount of CO_2 emissions covered by allowances in selected EU member countries as well as in the EU-25 and the EU-15, respectively. In most countries more than half of the CO_2 emissions are covered by the ETS. In countries that have a large share of coal-fired power plants in their power generation mix, the share of emissions attributed to the ETS participants is even higher.

table 4.3-2 *Emission Trading Sector Emissions and Reduction Obligation in 2005-2007*

Country	Average yearly emissions ET sector in base period	Average yearly emission trading budget in 2005-07	Projected average yearly emissions in 2005-07 for the ET sector	Reduction obligation in 2005-07 compared to base year levels
	[$MtCO_2$]	[$MtCO_2$]	[$MtCO_2$]	[%]
Germany	501.0	499.0	no data	-0.4
UK	245.4	245.4	267.3	0.0
Italy	224.0	232.5	244.5	+3.8
Poland	219.8	239.1	263.0	+8.8
Spain	164.1	174.4	181.6	+6.3
France	141.1	156.5	163.8	+10.9
Netherlands	89.5	95.3	98.6	+6.5
Czech Republic	88.8	97.6	103.7	+9.6
Greece	70.1	74.4	76.0	+6.1
Hungary	32.0	31.3	31.3	-2.2

(128) In the above table the reduction target of selected member countries is displayed. The average annual emission trading budget represents the CO_2 emission cap of each member state. The targets illustrate that most states allow an increase of CO_2 emissions compared to base year levels.

table 4.3-3 *CO_2 Emissions of Selected EU-15 Countries (2003)*

Country	Total ETS emissions	Electricity emissions	Industry emissions	Share of electricity in ETS
	[$MtCO_2$]	[$MtCO_2$]	[$MtCO_2$]	[%]
EU-15	**1586.9**	**1010.5**	**576.4**	**63.7**
Germany	451.7	322.6	129.1	71.4
UK	262.2	174.5	87.7	66.6
Italy	213.1	128.1	85.0	60.1
Spain	158.3	91.1	67.2	57.5
France	123.0	45.4	77.6	36.9
Netherlands	81.7	54.6	27.1	66.8
Greece	62.7	52.7	10.0	84.1

(129) The table shows that the electricity sector has the largest share of CO_2 emissions covered by the ETS in most member states. It is striking that the relative share of the electricity industry is higher in countries whose electricity generation is predominantly based on coal.

(130) The data indicate that the participants in most countries have problems complying to their emission trading cap. This even applies to East European countries that have reduced the amount of allowances in the ETS to an amount that resembles scarcity.

(131) About half of the CO_2 emissions of the EU member states is not included in the ETS. Thus, compliance with Kyoto targets does not fully depend on the ETS.

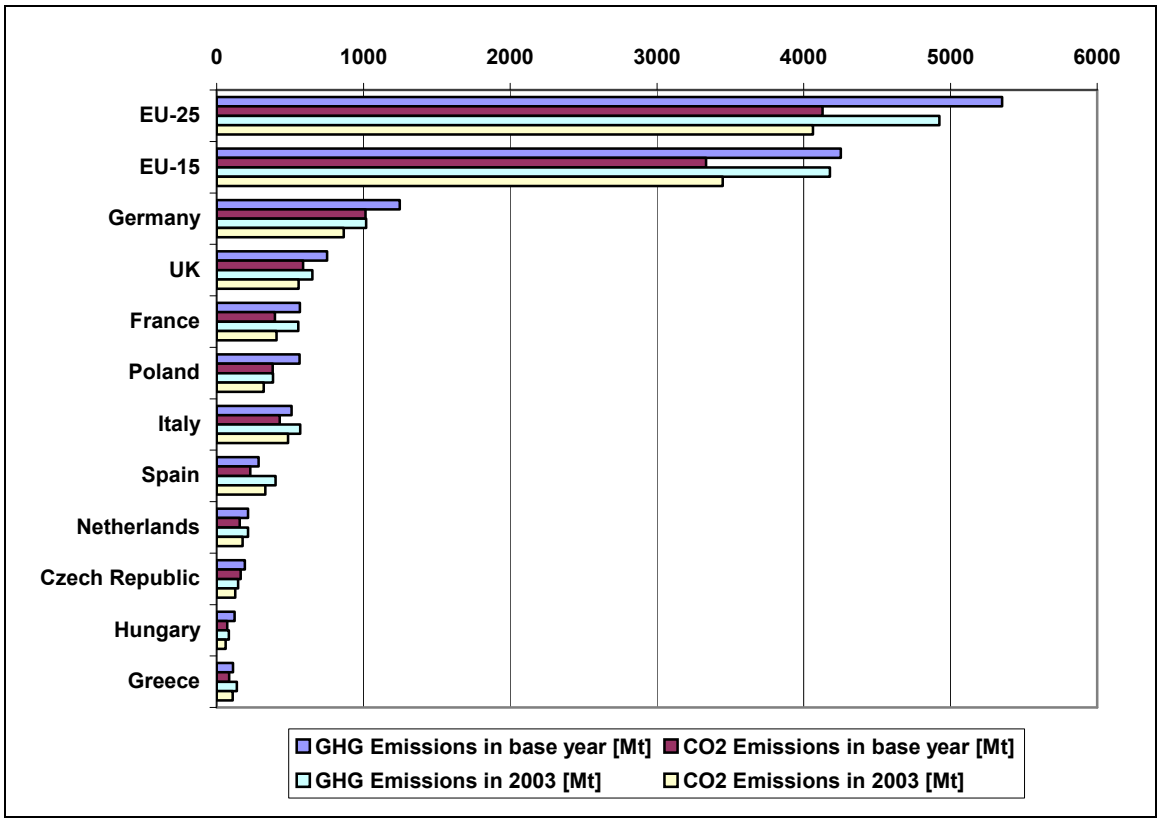

figure 4.3-1 *Absolute GHG and CO_2 Emissions in Selected EU-25 Countries [source: EEA (2005)]*

(132) In figure 4.3-1 the absolute amounts of GHG and CO_2 emissions in selected participating countries are displayed. The countries responsible for the largest emissions within the EU-25 are shown in the order of their total GHG base year emissions. Additionally, the emissions in 2003 are indicated, which illustrates the change of emissions compared to base year levels. The displayed EU-15 member states are the ones with the largest emission inventories. These states are also responsible for the largest part of the absolute reduction obligation agreed upon in the Burden Sharing Agreement.

4.3.2.1 Policy Options for National Allocation Plans

(133) The policy applied in the national allocation plan of a member state depends on the historic development of its emission inventory and its reduction obligation. As the reduction obligation of countries with a high growth potential corresponds to a limited increase of CO_2 emissions, these countries can use a ***business-as-usual scenario*** to define their policy measures and targets. Most member states allow an increase of emissions measured against the baseline period, but imply a reduction against business-as-usual scenario. Only four states keep the amount of allowances within the emissions of the baseline period: Slovenia –3.0%, Hungary –2.2%, Germany –0.4% and the UK 0.0%.

(134) The East European member states dispose of a large inventory which facilitates the compliance of their reduction target (***hot air***).

Nevertheless the amounts of allowances handed out to the ETS participants *force them to reduce their emissions*, not having the *hot air* penetrated the ET scheme.

(135) The member states allocate their allowances to existing facilities more ore less exclusively for free according to the historic emission (***grandfathering***) refering to a ***base period***, which can be variously definded. Four member states use ***auctions*** for a small amount of their allowances (DK, HU, LT, IR).

(136) All national allocation plans set up a reserve of allowances to be allocated to ***new entrants*** (NER: New Entrant Reserve). Newcomers usually receive their allowances free of charge. Most countries allocate allowances for newcomers based on a best available technology benchmark. This reserve amounts to 102 Mt, representing 4.7% of the total annual allowances of 2'200 Mt CO2). Following rules can be observed:

- *first come, first serves:* if the NER is exhausted, operators will have to acquire allowances on the market (AT, BE, DK, EE, EL, IR; LV , MT, NL, PT, SK, SL, ES, UK).
- if the NER is exhausted the member states purchase allowances on own costs and distribute them for free to new operators (DE, FR, IT, LU, PL).
- the needed allowances will be cut proportionally among all new entrants if not sufficient.

(137) If the NER is larger than needed, some member states intend to auction or sell surplus allowances (AT, CZ, EE, FI, EL, HU, IR, LU, PL, UK). The remaining member states will cancel allowances at the end of the period, if not allocated.

(138) An investment in a less CO_2 intensive technology before the start of the first reduction period is refered to as ***early action***. This kind of measure may be rewarded by the plan. The operators are either rewarded by a compliance factor = 1 (DE) or a special early action bonus (EE, LV, PO; CZ, HU, BE). Other states reward early action by a benchmarking system which is also applied to incumbents (AT, NL, DK, BE, LT, SL) or by an early base period (CY).

4.4 Prices of Emissions Certificates

Conclusion	Since the start of the European Trading Scheme (ETS), carbon prices went up to a level of more than 20 €/t. There is a set of explanations, which may give reason to some of the price increase, but not to its whole extent. After all, EUA markets cannot yet be considered as mature.

4.4.1 Actual Price Development

(139) After falling from an all-time high of €29.10 to €19.60 in eleven days during July 11-22 the 2005 EUA market seems to have settled into a narrower €20-22 range [Platts 2005], yielding a half year aver-

age of 15 € (January until July 05) (cp. figure 4.4-1). This price is still high as most experts would have expected a price range between 1 to 5 € per allowance *[MIT 2005]*.

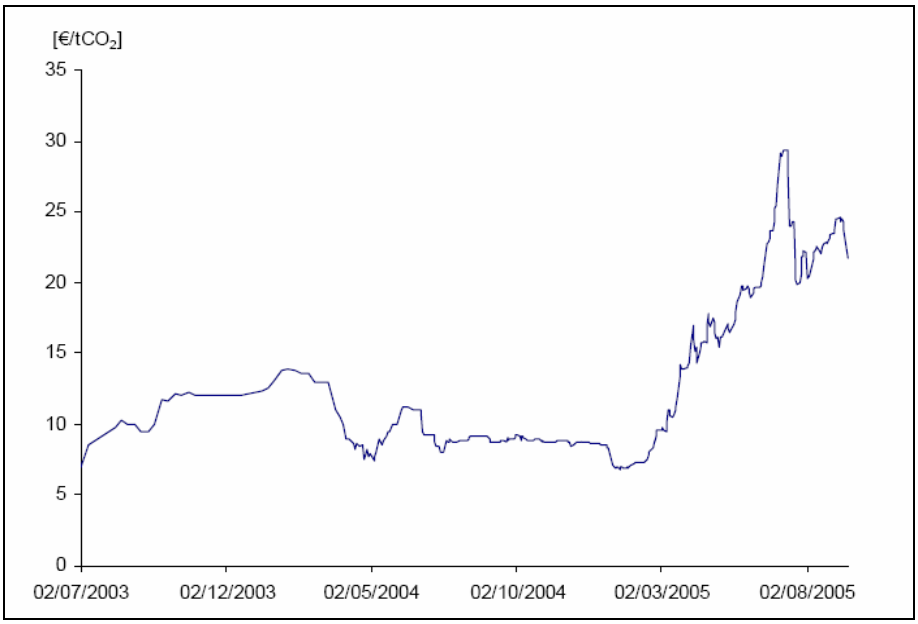

figure 4.4-1 Carbon Prices [ECN 2005]

(140) The most important reason for the high prices was the gas-coal differential: gas prices have been rising, while coal prices remained under pressure. The gas-coal break-even price of CO_2 based on short run marginal costs of power generation can be expressed in a resulting carbon price. It can be shown, that an increasing differential leads to a significant increase of the break-even point: ECN shows that a 40% change in gas price leads to a 84% increase in break-even (from 18 to 34 €/t CO_2).

(141) Another reason was the higher demand in the market, especially from Iberia, where the severe drought conditions have reduced hydro output significantly and forced utilities to burn more fossil fuels [DB Research 2005].

(142) It might be another reason for shortage, that EUAs are kept because participant expect future allowances to be emitted on the basis on actual allowances[9]. At least the options for emissions abatement are either not seen or postponed to the second comittment period.

(143) Expectations about the carbon price of the next allocation period may also play an important role, though this might not be rational, because the ETS does not allow banking between two comittment periods.

(144) But as MIT was concluding, all of these reasons are not enough to explain the carbon price in a range of 20 €/t. As a conclu-

9 This follows the simple arithmetics that the 2008-2012 period is longer and it pays better to abate emissions at the beginning of the second (longer) period than at the end of the first (shorter) period.

sion it can be drawn that the market is still small and not yet liquid and mature, making it possible to be influenced by few transactions of big movers *[MIT 2005]*.

4.4.2 Future Price Development

(145) It is currently not very transparent which factors influence the emission certificate prices the most. The trading volume for emission credits on the Leipzig energy exchange is rather small. Larger volumes are probably traded bilaterally. It is therefore not evident whether the going price reflects the existing shortage [DBResearch 2005].

(146) The market yet has to show a new direction. The most common complaint is that the price is not following the obvious fundamentals such as the gas-coal differential [Platts 2005].

table 4.4-1 *Projections of CO_2 prices [source: ECN2005]*

[€/tCO_2]	Phase 1: 2005-07			Phase 2: 2008-12		
Study	Low	Central	High	Low	Central	High
ICF (03/2003)	2	5	10	4	10	20
PointCarbon (04/2003)[a]	15	5	40	2	7	45
DKW (10/2003)		15			25	
JP Morgan (11/2003)		6			28	
ILEX (12/2003)	5-7		15-18	5-7		19-25
Oxera (06/2004)	5	10	15	5	10	25
Enviros (2004)		6-20			10-25	
ECON (2004b)	1	5	8	5	8	15

a) Based on a sounding among market specialists (PointCarbon, 25 April 2003).

(147) One may conclude that emissions price are influenced by several factors:

- gas-coal differential
- electricity prices, especially supply situation of power markets:
  - capacity shortage, pushing the market to longterm average costs (favouring investments).
  - capacity overflow, pushing the markets to short-term marginal costs (favouring low-price-fuels)
- substitute prices, such as
  - renewable energy sources: hydro, wind, biomass,
  - energy efficiency measures, carbon abatements,
  - flexible mechanisms such as JI/CDM
- climate-conditions, such as
  - temperature, driving demand in winter and summer
  - drought conditions, leading to reduction of nuclear and hydro capacities
- climate protection policy, especially the further allocation of certificates

(148) The majority of studies expect a price for a EUA between 5-10 €/tCO_2 for the period 2005-2007 and between 10-25 €/tCO_2 for the period 2008-2012. (compare table 4.4-1)

4.5 First Observations of Emission Trading

(149) The ETS has created a market value for CO_2 in the EU. The cap for CO_2 allowances has turned CO_2 into a short resource. Thus, ETS participants have to deal with an additional cost component which might influence their competitiveness on world markets.

(150) As the energy industry is part of the ETS, effects on European electricity prices are likely. The heterogenous design of the NAPs of the individual member states complicates the assessment of the European climate protection policy.

(151) The price for CO_2 allowances depends on a variety of factors which are hard to predict (cp. (147)).

(152) Electricity production from renewables determines to some extent the merit order of use fossil fuel-fired power plants. As gas competes with coal in power generation and its CO_2 content is lower than that of coal, the price of CO_2 allowances is also determined by the price differential between coal and gas. (cp. (140)).

5 Country Reports

5.1 Germany (DE)

(153) Germany is a federal country comprised of 16 federal states with the capital Berlin. The reunification of West and East Germany took place in1990. Germany is located in Central Europe and covers about 357'031 km², making it Europe's sixth largest nation measured by area.

(154) In the northwest Germany is bordered by the North Sea and to the northeast by the Baltic Sea and Denmark. Poland and the Czech Republic surround the eastern border, with Austria and Switzerland to the south and France, Luxemburg, Belgium and the Netherlands to the west.

(155) The major natural resources of Germany are: the hard coal deposits of the Rhenish-Westphalian industrial area and the Aachen and Saar fields; the large lignite fields in the Rhenish and Leipzig Basins and in Lower Lusatia; the iron ore deposits in the Rhenish Slate Mountains, in the east of the Franconian Alp and the northern periphery of the Harz; the rock salt deposits in Lower Saxony and Bavaria and the potash fields in Lower Saxony, Hesse, Thuringia and South Baden.

(156) Germany is member of the European Union (EU 25) and the OECD.

5.1.1 Socioeconomic Framework

(157) Germany's actual population is about 82 million inhabitants. Due to a low fertility rate its native population is declining. However the total population remains almost stable due to migration.

(158) The nominal German GDP is expected to rise moderately by an annual growth rate of 2% in average.

table 5.1-1 *Assumptions for Future Economic Development*

		1990	**2000**	**2010**	**2020**	**2030**
Population	[million]	79.43	82.19	83.20	83.06	81.75
GDP	[€ billion]	1733.7	2062.5	2494.5	3069.2	3723.1
			1990/2000	**2000/2010**	**2010/2020**	**2020/2030**
Population Growth	[%]		0.34	0.12	-0.02	-0.16
GDP Growth	[%]		1.6	2.1	2.1	1.9

5.1.2 Primary Energy Consumption

Conclusion	Germany is a net energy importer, with its total energy consumption exceeding its production by a large margin. The difference between its energy production and consumption has been mostly due to its oil and gas imports.

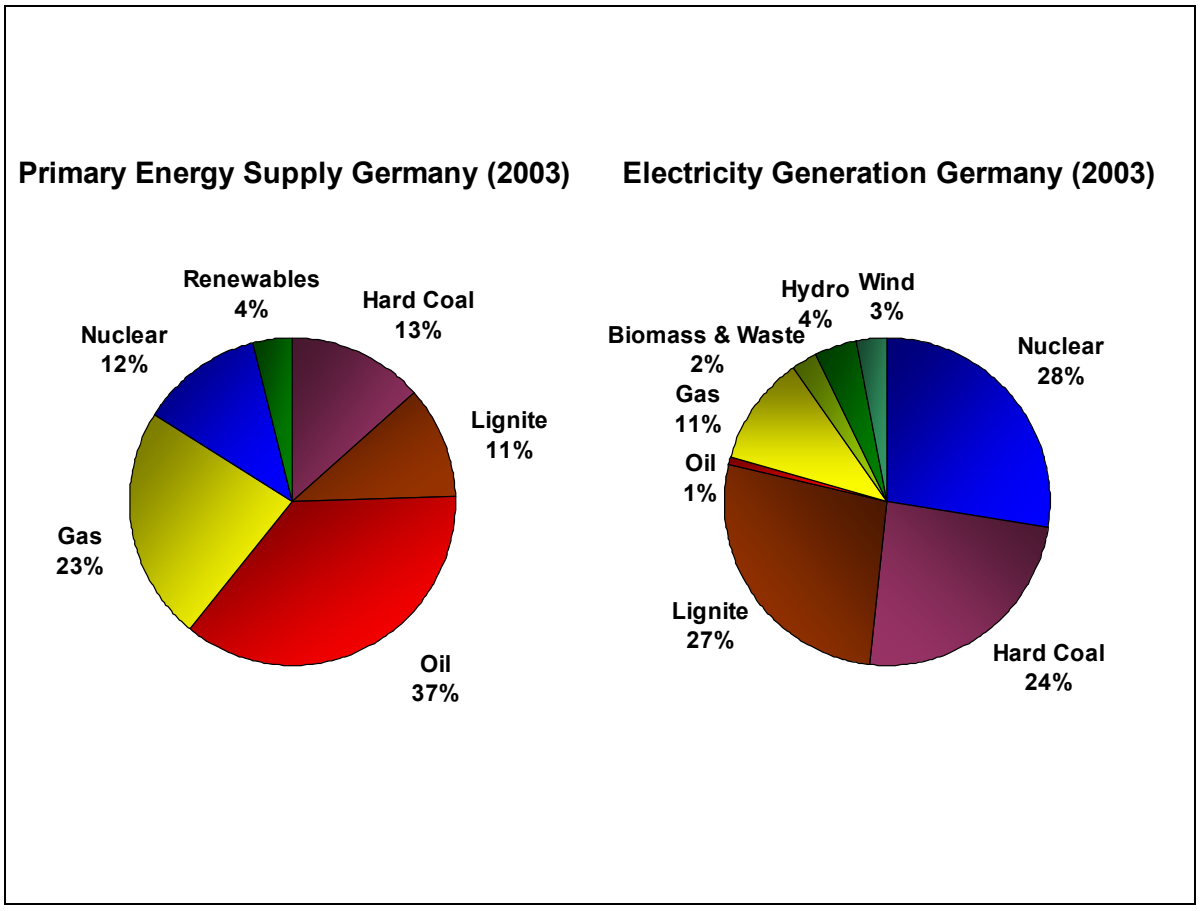

figure 5.1-1 *Primary Energy Supply and Electricity Generation (Germany) [Eurostat]*

table 5.1-2 *Primary Energy Supply (Germany)*

Energy Source		1990	2000	2002	2003	Share PES in 2003 [%]
Total	**[mtce]**	**508.89**	**490.87**	**494.28**	**495.88**	**100.0**
Solid fuels	[mtce]	183.61	121.17	121.21	121.61	24.5
Oil	[mtce]	180.67	188.18	184.04	180.73	36.4
Gas	[mtce]	78.56	102.62	107.93	113.12	22.8
Nuclear	[mtce]	56.91	63.14	61.37	61.45	12.4
Renewables	[mtce]	9.02	15.39	18.51	19.03	3.8

table 5.1-3 *Primary Energy Supply and Domestic Production Germany (2003) [source: IEA 2005a]*

Primary Energy Consumption	Primary Energy	Domestic Production	Domestic Production Share
	[Mtce]	[Mtce]	[%]
Total	**495.88**	**191.26**	**38.6**
Coal	121.61	82.64	68.0
Hard Coal		26.50	
Steam Coal		*9.41*	
Coking Coal		*17.09*	
Lignite and Peat		56.14	
Oil	180.73	5.41	3.0
Natural Gas	113.12	22.74	20.1
Nuclear Energy	61.45	61.45	100.0
Renewables	19.03	19.03	100.0

5.1.3 The Role of Coal

Conclusion	Coal is one of the most important primary energy sources. Germany has the largest reserves of lignite within the EU-15 and is the world's largest producer of lignite. Both hard coal and lignite are the most important reserves.

(159) Coal is one of the most important primary energy sources in Germany. In 2003 coal accounted for 24.5% of total primary energy supply.

(160) Coal plays a major role in indigenous primary energy production. However, most of the hard coal used in Germany is imported.

(161) The importance of coal has been declining over the past years. In 1991 about 30% of total primary energy supply came from coal. In the long term a further decline of coal demand is expected.

5.1.3.1 Hard Coal

(162) Hard coal market volume was 66.5 Mtce in 2004. 49.3 Mtce were used for power and heat generation (steam coal) and 17.2 Mtce were coking coal.

(163) Most of the hard coal used in Germany was imported (54.3% in 2003). The main importers were the Republic of South Africa (25%), Poland (22%), and Russia (16%).

(164) Indigenous hard coal production has been declining. Hard coal is produced in three areas:

- the Ruhr area
- the Saar area
- the Ibbenbuehren area

(165) Germany produced 29.16 Mt (26.72 Mtce) of hard coal in 2004. 12.52 Mt (10.26 Mtce) were steam coal, and 16.64 Mt (16.64 Mtce) were coking coal.

5.1.3.2 Lignite

(166) Germany has the largest reserves of lignite within the EU-15 and is the world's largest producer of lignite (22% of global output in 2002).

(167) Germany produced 56.1 Mtce of lignite in 2003. Lignite production has been constant over the past years. There are four areas of lignite production:

- the Rhineland
- the Lusatian mining area
- the Central German mining area
- the Helmstedt mining area

In these areas lignite is produced in opencast mines. Lignite is expected to play an important role in Germany's long term electricity supply.

(168) Lignite is mainly used for electricity generation and heating (93% in 2003).

5.1.3.3 Reserves & Production

(169) Hard coal and lignite are the most important domestic fuels. According to EURACOAL, Germany's coal reserves are abundant:

- Reserves of hard coal: 23'000 Mt
- Reserves of lignite: 41'300 Mt

(170) The *Bundesanstalt für Geowissenschaften und Rohstoffe (BGR)* uses a different definition of reserves for Germany which can be seen in table 5.1-4. Especially reserves for hard coal are significantly lower because they reflect the amount that would be produced until 2012 under the assumption that public funding would cease by that time and hard coal mining would be discontinued.

(171) Natural gas and oil only play minor roles in domestic production as reserves are negligible.

(172) Germany produced 56.6 Mtce of lignite in 2004 and 26.7 Mtce of hard coal making coal the most significant fuel of domestic primary energy production.

table 5.1-4 *Resources, Reserves and Production of Coal Germany (2004)*

Reserves and Resources	Resources	Reserves	Production	Static Res
	[Mt]	[Mt]	[Mt]	[a]
Hard Coal*)	4'695	183	25.7	7
Lignite	76'396	6'556	181.9	36

[source: BGR 2005] *) Reserves are the minable amount with the guaranteed governmental funding for hard coal until 2012. The minable amount is higher.

5.1.4 Power Generation

Conclusion	Germany is both the greatest electricity generator and consumer in Europe, ranking fifth worldwide (accounting for about 3.6% of the world total). Germany's annual electricity consumption has been

slowly trending upward over the past decade and is now about 12% higher than it was at the beginning of the 1990s. More than 60% of Germany's electricity is generated from fossil fuels (more than 50% from coal). Germany intends to phase out nuclear energy gradually. Germany is now the world's leading generator of electricity from wind.

5.1.4.1 The Role of Electricity

(173) Final energy demand decreased by 0.05% annually since 1990. Oil accounts for almost half of total final energy consumption in Germany (47.9% in 2003).

(174) Electricity consumption increased by 11.9% from 1990 to 2003 [IEA 2005]. Electricity's share in final energy consumption increased form 14.6% in 1990 to 17.8% in 2003 [IEA 2005].Final energy demand decreased by 7.3% (between 1990 and 2002).

(175) Germany generates slightly more electricity than it consumes. Annual growth in electricity consumption has been forecast at about 1.3% for the next decade. *[CSLF 2005]*

5.1.4.2 Power Generation: Overview

(176) Coal is the most important energy source for electricity production. 51.1% (2003) of electricity produced was generated by coal.

(177) Lignite had a share of 27.1%, hard coal had a share of 24% of national gross electricity production.

(178) 27.5% of electricity generated came from nuclear power plants. According to the agreement between the government and the electricity producers on phasing out nuclear energy, generation from nuclear power plants will decline from 160 TWh in 2000 to 152 TWh in 2005 and 133 TWh in 2010. In 2020 nuclear power generation will be at 46 TWh and will eventually cease by 2025, at the latest.

(179) The share of renewables will be increasing in the long term according to the government's targets.

5.1.4.3 Power Generation: Capacities

Conclusion	Even though net electricity generation in Germany has been trending upward over the past decade, installed electricity generating capacity has not as overcapacity was scrapped. A huge challenge is on the horizon, as Germany has agreed to phase out nuclear power generation over the next two decades. Replacement will most likely be a mix of gas-fueled and coal-fueled power plants, as well as increases in renewable energy.

(180) Gross plant capacities amounted to 125.1 GW in 2003. Hard coal capacities made up 30.5 GW while lignite capacities were 22.2 GW.

(181) Gas and steam power plants play a major role in the installation of new capacities. Within the past ten years 3.3 GW of new capacities were built, mainly highly efficient combined heat and power generators.

(182) About 9.5 GW of German lignite power plant capacity comes from power plants which were upgraded or newly built in the past ten years.

table 5.1-5 Installed Power Plant Capacities (Germany)

Installed Power Plant Capacities			
	[Mwel]	[GWh]	[h full cap.] (4)
Total	**124'669**	**599'470**	**4'808**
Nuclear	***21'439***	***165'060***	***7'699***
Conv' Thermal (1)	***80'365***	***391'111***	***4'867***
Coal (>30 Mwel)	52'291	306'510	5'862
Hard Coal (>30 Mwel)	*30'366*	*144'052*	*4'744*
Lignite (>30 Mwel)	*21'924*	*162'458*	*7'410*
Oil (>30 Mwel)	1'756	4'677	-
Gas (>30 Mwel)	9'431	65'773	-
Conv' Others (2)	***16'887***	***14'151***	
Biomass (wood, wood-waste, biogas)	-	8'792	-
Waste	-	5'359	-
Renewables (3)	***22'865***	***43'299***	
Hydro	8'256	24'440	-
Pumped Storage	-	-	-
Wind	14'609	18'859	1'291
Geothermal	-	-	-

Please note: Table is presenting a synthesis from different statistics.
Data may not be consistent, for following reasons:
(1) Conventional Thermal: conv. thermal capacites above 30 MW, power generation from all conventional thermal
(2) Conventional Others: conv. thermal capacites below 30 MW incl. biofuel and waste capacities, power generation from biofuel and waste only
(3) Renewable capacities without biofuel capacities; renewable power generation without biofuels
[source: Eurostat]2003 and 2004; Siemens Database 2005

5.1.4.4 New Capacities

(183) About 40 GW of generation capacity will have to be installed within the next 20 years due to increasing demand and the expected phase-out of nuclear energy. In fact, there have been slight decreases in both thermal-electric and hydroelectric generation capacities. *[CSLF 2005]*

(184) New hard coal power generation capacity amounted only to roughly 0.8 GW within the past ten years, but due to volatile and currently high gas prices this trend seems to change.

(185) Variable cost economics imply burning of coal in existing power plants (the same is true for nuclear power plants), but full cost ecomomics imply a necessity of new gas capacities. CO_2 cost may strengthen this strategic paradigma *[McKinsey 2005]*. On the other hand a larger spread between coal and gas prices may result in additional coal capacities (cp. chapter 3.2.2.5).

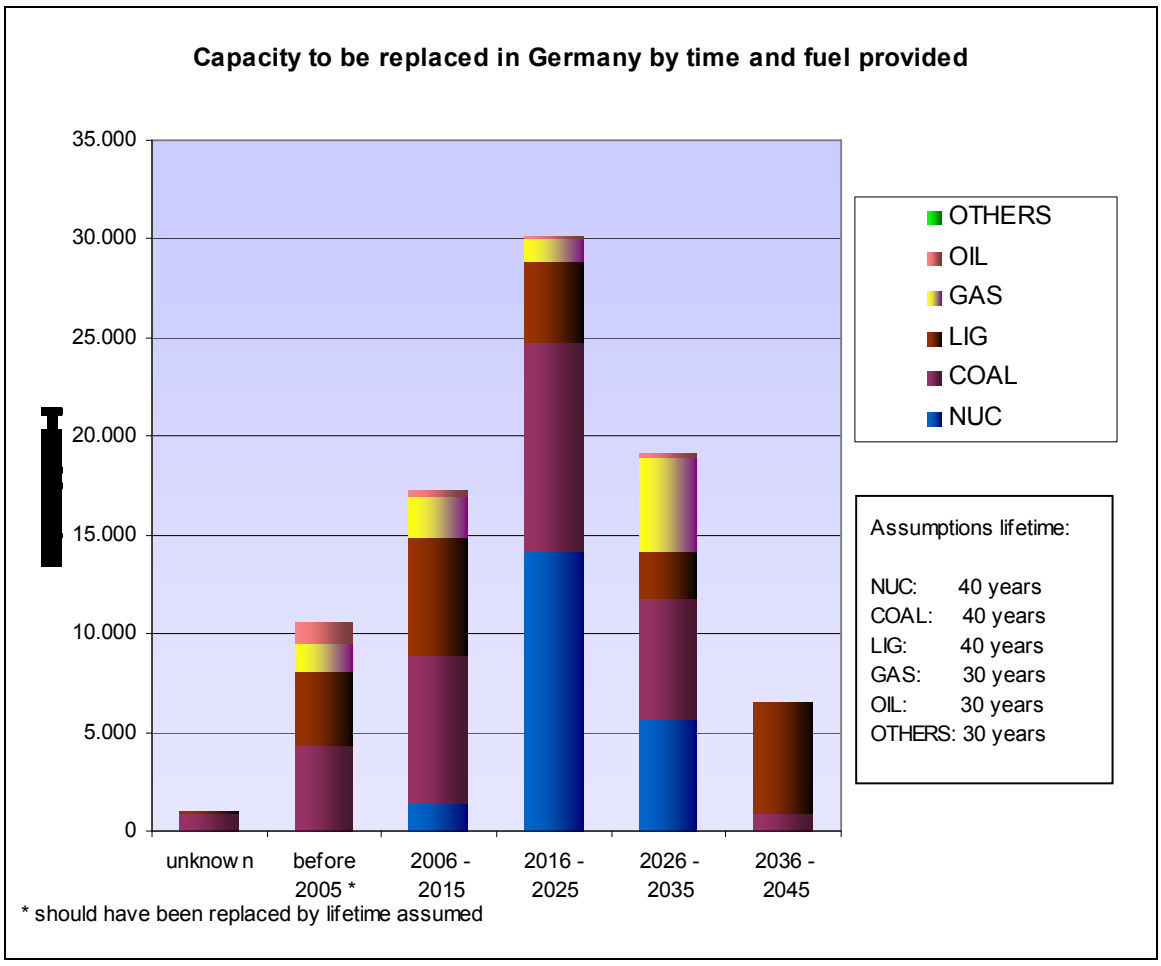

figure 5.1-2 *Capacity Replacements (Germany)*

(186) However, there is no significant trend: 17 GW of newly planned capacities consist of both 50% of natural gas and 50% of coal.

(187) RWE has planned a new lignite plant (BoA Neurath), two blocks with a total of 2'100 MW, expecting that the rules for the allo-

cation of the emission allowances will not be significantly changed for the second comittment period of 2008-2012.

(188) Vattenfall is planning a 30 MW clean coal pilot plant on oxy-fuel basis. The pilot start is scheduled for 2008. Further phases are targeting on a demonstration (large) scale plant for 2015.

5.1.5 Energy Policy

Conclusion	In line with the EU-policy the German government actively promotes the development of renewable energy sources. At the same time Germany supports domestic hard coal production by subsidies. Due to a high import dependency, security and diversification of energy supply play important roles in the country's political strategy.

5.1.5.1 General Strategy

(189) Germany pursues three major aims:

- Economic efficiency – Deregulation of the energy sector,
- Security of Supply – Germany is highly dependent on imports of fuels. Therefore the country aims at the diversification of energy sources and the promotion of energy efficiency,
- Environmental compatibility – Environmental resources are to be treated with care according to the principles of sustainability.

(190) Germany intends to phase out nuclear energy gradually. According to the plans of the new German government this situation remains basically unchanged.

5.1.5.2 Coal Policy

(191) A substantial element of security of supply is the use of own domestic energy reserves. Due to geological conditions domestic hard coal is not competitive with imported coal since world market prices are far below production costs. compared to world market prices. Domestic lignite is basically exploited without state subsidies.

(192) Since the beginning of the coal crisis 1957/58, policy developed instruments to support coal mining and coal power generation.

(193) The current agreement on coal subsidies foresees the further decline of coal mining to 16 Mt/a. This is to ensure the accesibility of coal mines beyond 2012.

5.1.5.3 The 5th Energy Research Programme of the Federal Government

(194) The Federal Government provides approximately 1.8 bill. € for the promotion of research and development of modern energy technologies (5th research framework program) between 2005 and 2007. Objective is the adjustment and modernization of the German power supply.

(195) The main focus of the program lies on "energy efficiency" and "renewable energies". In detail the project-oriented promotion is directed in particular towards the following fields:

- modern power plant technologies based on coal and gas (including CO_2-separation, transport and storage (COORETEC),
- photovoltaics and off-shore wind power,
- fuel cells and hydrogen as secondary fuel and medium for energy storage
- technologies and schemes for energieefficient buildings,
- energetic use of biomasses,
- nuclear safety and final disposal of nuclear waste.

(196) For the modernization and innovation in modern power plants the Federal Ministry of Economic Affairs (BMWi) provides a budget of 71 mill. € p. a. (284 mill. € 2005-2008). Approximately the same amount of subsidies was provided from 2003 to 2005.

(197) 40 mill. € per year are provided for basic research in the field of rational use of energies (which can also comprise power plant technologies). Research in the field of renewable energies is funded with a total budget of 120 mill. €, nuclear power receives 30 mill. € p. a. and fusion technologies are supported by 115 mill. € per year.

(198) The Federal Government aims to increase the efficiency of the usual types of power stations by 20 % until 2020. That means an efficiency level for the steam power plant of approx. 55 % and for the CC power station of approx. 65 % mean. In order to achieve this goal, it is necessary to increase the process parameters pressure and temperature and to decrease the losses over the entire transformation chain.

5.1.6 Renewable Energy

Conclusion	Germany promotes renewables with feed-in tariffs and special programmes. The share of renewables in electricity generation has been rising continuously. The government pursues ambitious aims of promoting renewables.

5.1.6.1 Actual Status

(199) In 2004 electricity generation from renewables amounted to 56 TWh (9.3% of total electricity generation).

(200) Due to governmental promotion the installed capacity of renewables, particularily wind and photovoltaics, increased □educe□ttially. The amount of electricity generated from renewables tripled since 1990 while total electricity generation increased by about 25%

(201) Installed capacity of hydro power plants remained rather constant. There is no significant potential for new hydro power plants.

5.1.6.2 Renewable Policies

(202) The government intends to increase the share of renewables to 4.2% of primary energy supply and to 12.5% of gross electricity supply by 2010, 20% by 2020.

(203) The most powerful instrument for the achievement of these targets is the Erneuerbare Energiengesetz (EEG), put into force in 2000. It provides guaranteed feed-in tariffs. Some adjustments have been made in the novels of the EEG, in 2003 and 2004. In general the EEG can be expected to remain stable, with some changes concerning

- the adjustment of selected feed-in tariffs and
- the allocation of financial loads to the sector of the end consumers, especially taking loads from energy intensive industries.

(204) Renewables will be generally promoted by incentive programmes like the Marktanreizprogramm, by further emphasis of renewable heat supply and the export initiative coordinated by Dena (The German Energy Agency). The foundation of an International Renewable Energy Agency will be supported.

5.1.6.3 Outlook

(205) The installed capacity of wind energy power plants can be boosted up to 25'000 MW (2004: 16600 MW) within the next 25 years if the potential for offshore wind parks is fully exploited.

(206) A more selective promotion of renewable power generation can be expected.

5.1.7 Climate Protection Policy

Conclusion	Germany has a reduction target of 21% within the EU Burden Sharing Agreement. This target is a result of the high emission inventory of East Germany which is included in the 1990 reference year. The German national allocation plan forces the obliged sectors to reduce their emissions until the 2008-12 period. There is no business-as-usual reference scenario.

(207) Germany is the greatest carbon emitter in Europe (ranking sixth worldwide) and is currently responsible for about 3.4% of the world's total fossil fuel-based carbon emissions. There has been about a 9% decrease in annual fossil fuel-based carbon emissions since the beginning of the 1990s, due to industrial breakdown, energy production and usage improvements in the former East Germany since its incorporation into the country.

(208) Germany is both a signer of the 1992 Framework Convention on Climate Change (which it ratified in 1993) and the Kyoto Protocol (which it ratified in 2002). Under the Kyoto agreement, Germany has a goal of reducing emissions of six greenhouse gases by 21% between 2008 and 2012 compared to 1990 levels, as its part of the European Union's Burden Sharing Agreement. According to latest forecasts, this target will be met.

(209) The national target to reduce CO_2-emissions by 25% between 1990 and 2005 was missed. Germany will probably reach 19% of CO_2-emissions-reduction by 2006.

(210) To that end, Germany instituted an "eco-tax" in 1999 on fossil fuels. A part of the revenues is used to fund renewable energy and energy efficiency projects.

5.1.7.1 Policy and Kyoto Targets

(211) Greenhouse gas (GHG) emissions are to be reduced within the EU burden sharing agreement by 21% in the first commitment period of 2008-2012 compared to 1990 levels.

(212) The high reduction target can be ascribed to the decline of economic activity and the restructuring of the energy sector in East Germany which had fairly high emissions in 1990. Additionally, an increase of energy efficiency measures within the framework of a voluntary agreement between the German government and the industry has contributed significantly to emission reduction. A large part of the German industry and energy sector has agreed to reduce the GHG emission levels on a voluntary basis by 35% until 2012 compared to 1990 levels.

5.1.7.2 Development of National Emission Inventory

(213) Germany is basically on track concerning its linear Kyoto target path.

(214) Most of the emission reductions were achieved in the 1990s after the restructuring of the East German energy and industry sector.

(215) Germany does not make use of a business-as-usual scenario as a reference to reduce the country's emissions.

5.1.7.3 National Allocation Plan

(216) The German National Allocation Plan is valid for 1849 installations of the energy and the industry sector.

(217) The allowances are issued free of charge in equal parts every year. German ETS participants receive 499 $MtCO_2$ p. a. in the 2005-2007 period and 495 $MtCO_2$ in the 2008-2012 period. This covers more than 58% of all relevant CO_2 emissions.

(218) The energy sector receives 79% of all allowances which are distributed to 67% of all installations.

(219) The allocation of allowances to existing installations is based on historical emissions.

(220) The reserve for new entrants amounts to 3 $MtCO_2$ p. a. (0.6% of all allowances) in the 2005-2007 period. If this reserve should prove to be not sufficient, the government will provide the missing allowances. All allowances for new entrants are handed out free of charge.

(221) New entrants receive their allowances according to announced emissions. The allocation is carried out according to the need of the installation for the next 14 years. The electricity generation facilities receive a maximum amount of 750 gCO_2/kWh, i.e. lignite-fired power plants do not receive enough allowances to cover their emissions. Industrial installations get their allowances based on a best available technology standard for predefined product groups.

(222) For new installations replacing existing ones, the allowances are transferred. After four years the amount of allowances is adapted according to the installations' actual needs. The compliance factor for a new installation remains one for 14 years.

(223) Early action measures are rewarded with a compliance factor of one for 12 years.

(224) There are efficiency benchmarks for installations that are older than 15 years. This is of special concern for lignite and coal-fired power plants. This so-called malus rule may result in a reduction of annual allowances of 15%.

5.1.7.4 Implications And Outlook

(225) Germany might achieve its Kyoto target but needs to conduct some more measures of emission reduction if the country does not want to fail its target.

(226) The main part of the German reductions is a result of the decline of the East German industry and energy efficiency measures taken in the context of the restructuring of the East German industry.

The additional measures to be taken to comply with the Kyoto target are more costly than previous reduction efforts.

(227) In the 2005-2007 period the German industry and energy sector will presumably dispose of a sufficient amount of allowances. In 2008-2012 Germany might be short of allowances and become a net buyer within the ETS.

(228) JI/CDM credits are not taken into consideration.

(229) The comparatively moderate pressure on the ETS participants will most likely result in more tightened measures to be taken in other sectors.

5.2 United Kingdom (UK)

(230) The United Kingdom of Great Britain and Northern Ireland (UK) is a constitutional monarchy and consists of England, Scotland, Wales, and Northern Ireland. The UK covers an area of 242'900 km^2.

(231) England, Wales, and Scotland have no borders with other countries as these territories are surrounded by the Atlantic Ocean, the Irish Sea, and the North Sea. Northern Ireland is located in the northern part of the Irish Isle and has a border with the Republic of Ireland in the South.

(232) The UK was a net primary energy importer until 2004 when it became an exporter of energy.

(233) The UK is member of the European Union (EU 25) and the OECD.

5.2.1 Socioeconomic Framework

(234) The UK has a population of 59.3 million inhabitants, most of which live in England (more than 80%).

(235) The UK's GDP growth is expected to perform slightly above the EU-25 average until 2030 with annual growth rates of about 2.5% on the average.

table 5.2-1 *Assumptions for Future Economic Development (United Kingdom)*

		1990	**2000**	**2010**	**2020**	**2030**
Population	[million]	57.56	59.76	61.21	62.50	63.51
GDP	[€ billion]	1239.2	1559.4	1997.2	2550.3	3232.9
			1990/2000	**2000/2010**	**2010/2020**	**2020/2030**
Population Growth	[%]		0.37	0.24	0.21	0.16
GDP Growth	[%]		2.3	2.5	2.5	2.4

5.2.2 Primary Energy Consumption

Conclusion	As a result of the large deposits of resources of oil and gas, the UK managed to be a net exporter of primary energy between 1996 and 2004. Although some new sources have been found, their exploitation could not prevent the decline in domestic production in recent years.

(236) Oil and natural gas are the main pillars of British primary energy consumption. In 2003 gas had a share of 37% while oil accounted for 35.1% of total primary energy supply. Coal covered 16.5% and nuclear energy made up for 10% of primary energy supply. The share of renewables was at 1.4%.

(237) Domestic oil and gas production had been on the rise since the early 1970s. British oil production peaked in 1999, natural gas production in 2000. In 2004, the United Kingdom changed from a net energy importer to a net energy exporter due to increased oil and gas exports from its North Sea production; it is now, by far, the greatest petroleum producer and exporter in the EU and second overall in western Europe (behind Norway) *[CSFL 2005]*. Its oil and gas production amounted to 168.23 mtce and 133.27 mtce, respectively.

table 5.2-2 *Primary Energy Supply (United Kingdom) [Eurostat]]*

Energy Source		1990	2000	2002	2003	Share PES in 2003 [%]
Total	**[mtce]**	**303.11**	**332.80**	**326.41**	**331.36**	**100.0**
Solid fuels	[mtce]	90.16	51.44	50.95	54.61	16.5
Oil	[mtce]	118.04	119.52	115.01	116.30	35.1
Gas	[mtce]	67.41	124.82	122.62	122.67	37.0
Nuclear	[mtce]	24.48	31.67	32.71	33.02	10.0
Renewables	[mtce]	1.56	3.61	4.10	4.50	1.4

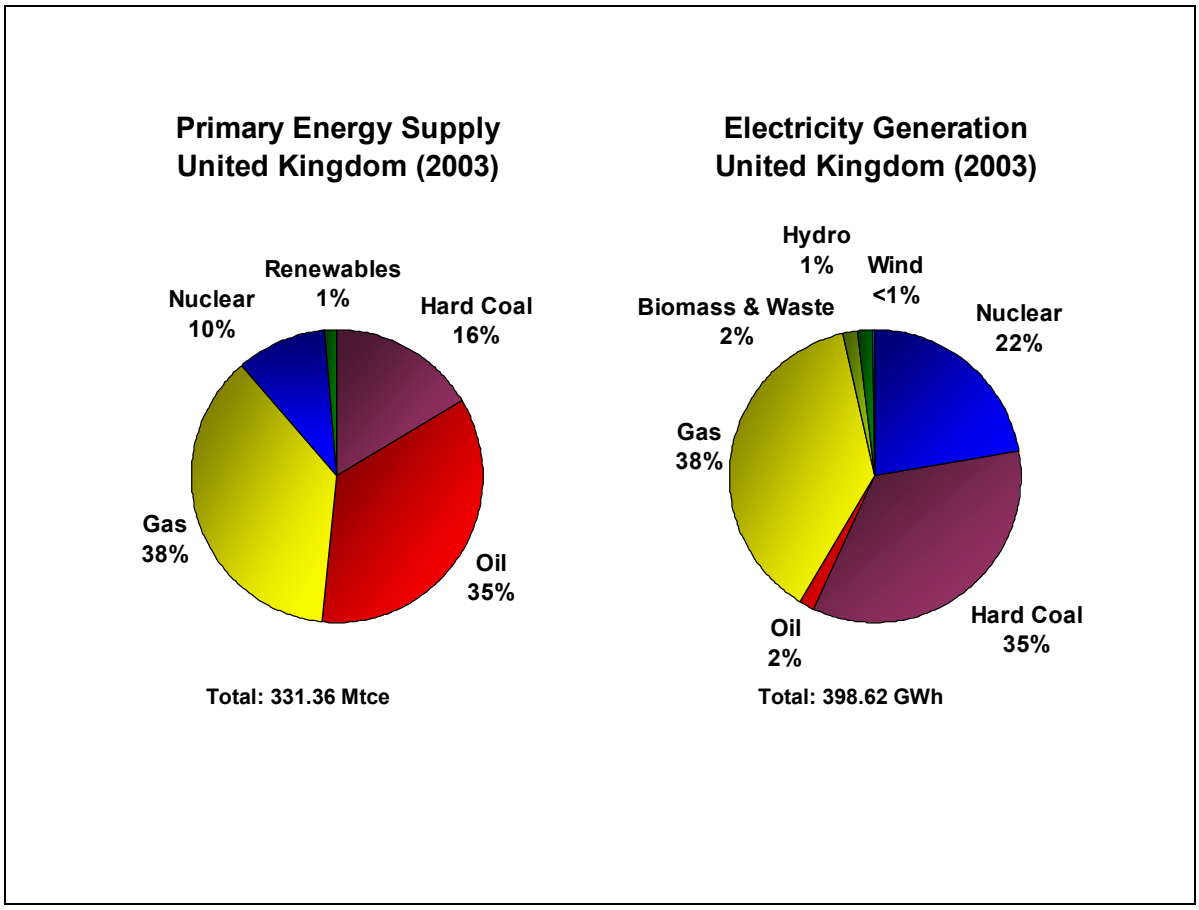

figure 5.2-1 *Primary Energy Supply and Electricity Generation (Spain) [Eurostat 2004]*

table 5.2-3 Primary Energy Consumption and Production (United Kingdom) [IEA 2005a]

Primary Energy Consumption	Primary Energy	Domestic Production	Domestic Production Share
	[Mtce]	[Mtce]	[%]
Total	**331.36**	**351.26**	**106.0**
Coal	54.61	23.98	43.9
Hard Coal		23.98	
Steam Coal		*23.59*	
Coking Coal		*0.39*	
Lignite and Peat		0.00	
Oil	116.30	157.61	135.5
Natural Gas	122.67	132.14	107.7
Nuclear Energy	33.02	33.02	28.4
Renewables	4.50	4.50	3.7

(238) Renewables play a minor role in primary energy consumption. Among the renewable energy sources, biofuels or so-called combustible renewables accounted for the most part of primary renewable energy production.

5.2.3 The Role of Coal

(239) The share of coal in primary energy supply has declined significantly since the early 1970s. As domestic gas production surged, electricity producers switched from coal to gas-fired power plants.

(240) The production of hard coal has declined dramatically over the last decades. The amount produced fell from 130.1 Mt in 1980 to 25.1 Mt in 2004.

(241) Imports of hard coal are on the rise. The main importers to the UK are: Australia, Colombia, Poland, South Africa, and the United States and Russia, the latter recently taking the top of the importers list. Imports of hard coal increased from 7.3 Mt in 1980 to 36.2 Mt in 2004.

(242) There are resources of lignite but there are no lignite mines in the UK.

(243) While coal consumption declined since the 1970s, the proportion of coal used for power generation increased continuously and amounted to 83% of total coal consumption in 2004.

5.2.3.1 Hard Coal

(244) The hard coal mines operated in the UK are located

- in central and northern England,
- in South Wales, and
- in central and southern Scotland.

(245) British hard coal reserves amount to about 220 Mt. Hard coal resources are estimated at about 5’000 Mt.

(246) As a result of the privatization of the domestic coal industry, production has been declining, especially in deep mines, where about half of the domestic production comes from. However, the government still promotes domestic coal mines with the so-called Coal Investment Aid which grants financial aids for projects which maintain access to coal reserves and protect or create jobs.

(247) Along with the decline of domestic hard coal mining, imports of hard coal have been increasing dramatically. Hard coal imports make up for more than half of the overall UK market volume.

5.2.3.2 Lignite

(248) There are lignite resources of some 220 Mt.

(249) Although there are resources, lignite is not mined in the UK. Therefore there is no relevant lignite market in the UK at present.

5.2.3.3 Reserves & Production

(250) Most of the United Kingdom's coal fields are located in north-central England and southern Wales. Coal production has declined dramatically along with the decreasing consumption over the past two decades. Most of the coal consumed is used for the production of electricity. Until the beginning of the 1990s (when privatization of the electricity markets occurred), domestic coal was purchased at a cost much higher than the international market price. The costs of the subsidy were passed on to electricity consumers *[CSLF 2005]*.

(251) The United Kingdom's coal industry was privatized in 1994 and many loss-running mines were closed. Presently, about 37% of electricity generation is coal-fueled, but this share is expected to decline as some aging coal-fired power plants will be replaced by natural gas-fueled units. Continued use of coal is important to the United Kingdom's energy future, though, and use of clean coal technologies is expected to increase *[CSLF 2005]*.

table 5.2-4 Resources, Reserves and Production of Coal United Kingdom (2004)´ BGR 2005]

Reserves and Resources	Resources	Reserves	Production	Static Res
	[Mt]	[Mt]	[Mt]	[a]
Hard Coal	5'000	220	28.214	8
Lignite	220	-	-	-

(252) The United Kingdom has proven natural gas reserves of about 736.2 billion cubic meter [corresponding 7'500 TWh], mostly located in the North Sea off the southeastern English coast. Increases in gas production during the second half of the 1990s made the United Kingdom a net exporter of natural gas. Gas production is now in decline, however, and with its large annual gas consumption (second in Europe, behind Germany) the United Kingdom could relatively soon again become a net natural gas importer *[CSLF 2005]*.

(253) Natural gas reserves amounted to 1'241 bcm in 2003.

(254) The estimates for the remaining reserves of oil were at a level of 1'267 Mt in 2003.

5.2.4 Power Generation

Conclusion	Demand for electricity has been steadily increasing in the United Kingdom, with consumption being about 20% higher than it was in 1990. However, the growth rate of electricity consumption (1.2%) has been below the average of IEA European countries. Coal and oil-fired power plants have been replaced by gas-fired ones or nuclear power plants on a wide scale. The importance of coal as an energy source has been declining up to the mid of 90s, since then coal use has been stabilised.

5.2.4.1 Final Energy Consumption: The Role of Electricity

(255) Demand for electricity has been steadily increasing in the United Kingdom, with consumption being about 20% higher than it was in 1990. Today, the United Kingdom is the third-greatest electricity market in Europe (behind Germany and France).

(256) In final energy consumption in 2003 oil had the largest share of 46.6%, followed by natural gas (32.3%), and electricity (18.1%).

(257) Electricity shows an increasing share of total final consumption. However, the growth rate of electricity consumption (1.2%) has been below the average of the IEA European countries (2.6%) from 1973 to 2001.

(258) Total final energy consumption grew slowly at an average annual rate of 0.8% from 1973 to 2002.

(259) In August 2003, London experienced an electric power outage that affected 400'000 customers during rush hour. However, the U.K. natural gas and power market regulator, Ofgem, determined that the failure—and another one that followed a week later—were not caused by insufficient grid investment. Instead, the outage was caused by the wrong type of fuse installed on backup protection equipment *[EIA 2005]*.

(260) There is still excess generating capacity in the United Kingdom, but some of this is outdated and/or uneconomical to operate and may soon be closed down in the wake of ongoing power sector privatizations and mergers. In spite of this overcapacity, the United Kingdom is importing significant amounts of electricity, mostly from France. *[CSLF 2005]*

5.2.4.2 Power Generation: Overview

(261) There were dramatic shifts in the mix of fuels used for power generation in the early 1990s when the use of gas increased rapidly, replacing coal and oil-fired plants. Since then, the mix of fuels has stabilised

(262) The nuclear power industry has been privatized. The government's nuclear policy focuses on the decommissioning of nuclear sites belonging to the public sector.

table 5.2-5 *Installed Power Plant Capacities (United Kingdom)*

Installed Power Plant Capacities			
	[Mwel]	[GWh]	[h full cap'] (4)
Total	**78'538**	**398'620**	**5'076**
Nuclear	***12'098***	***88'686***	***7'331***
Conv' Thermal (1)	***61'872***	***302'687***	***4'892***
Coal (>30 Mwel)	29'050	138'242	4'759
Hard Coal (>30 Mwel)	*29'050*	*138'242*	*4'759*
Lignite (>30 Mwel)	-	-	-
Oil (>30 Mwel)	1'041	7'017	-
Gas (>30 Mwel)	26'897	150'707	-
Conv' Others (2)	***4'884***	***6'721***	
Biomass (wood, wood-waste, biogas)	-	6'718	-
Waste (municipal and industrial waste)	-	3	-
Renewables (3)	***4'568***	***7'247***	
Hydro	4'256	5'962	-
Pumped Storage	-	-	-
Win	312	1'285	4'119
Geothermal	-	-	-

Please note: Table is presenting a synthesis from different statistics.
Data may not be consistent, for following reasons:
(1) Conventional Thermal: conv. thermal capacites above 30 MW, power generation from all conventional thermal
(2) Conventional Others: conv. thermal capacites below 30 MW incl. biofuel and waste capacities, power generation from biofuel and waste only
(3) Renewable capacities without biofuel capacities; renewable power generation without biofuels
[source: Eurostat]2003 and 2004; Siemens Database 2005

(263) Despite the comparatively large share of coal-fired power plants in the importance of coal as an energy source has been declining rapidly.

(264) The dominant sources of power generation are natural gas (37.8%), coal (34.7%), and nuclear power (22.2%). Total electricity generation amounted to 398.62 TWh in 2003.

(265) The share of renewables (3.5%) and oil (1.8%) in power generation is low *[Eurostat 2003]*.

(266) Most of the coal consumed in the UK is steam coal for power plants. Coal-fired power plants were responsible for more than 80% of coal demand. This corresponds to a volume of 50.5 Mt in 2004.

5.2.4.3 Power Generation: Capacities

(267) The overall power generation capacity installed in the UK amounted to about 77 GW in 2002.

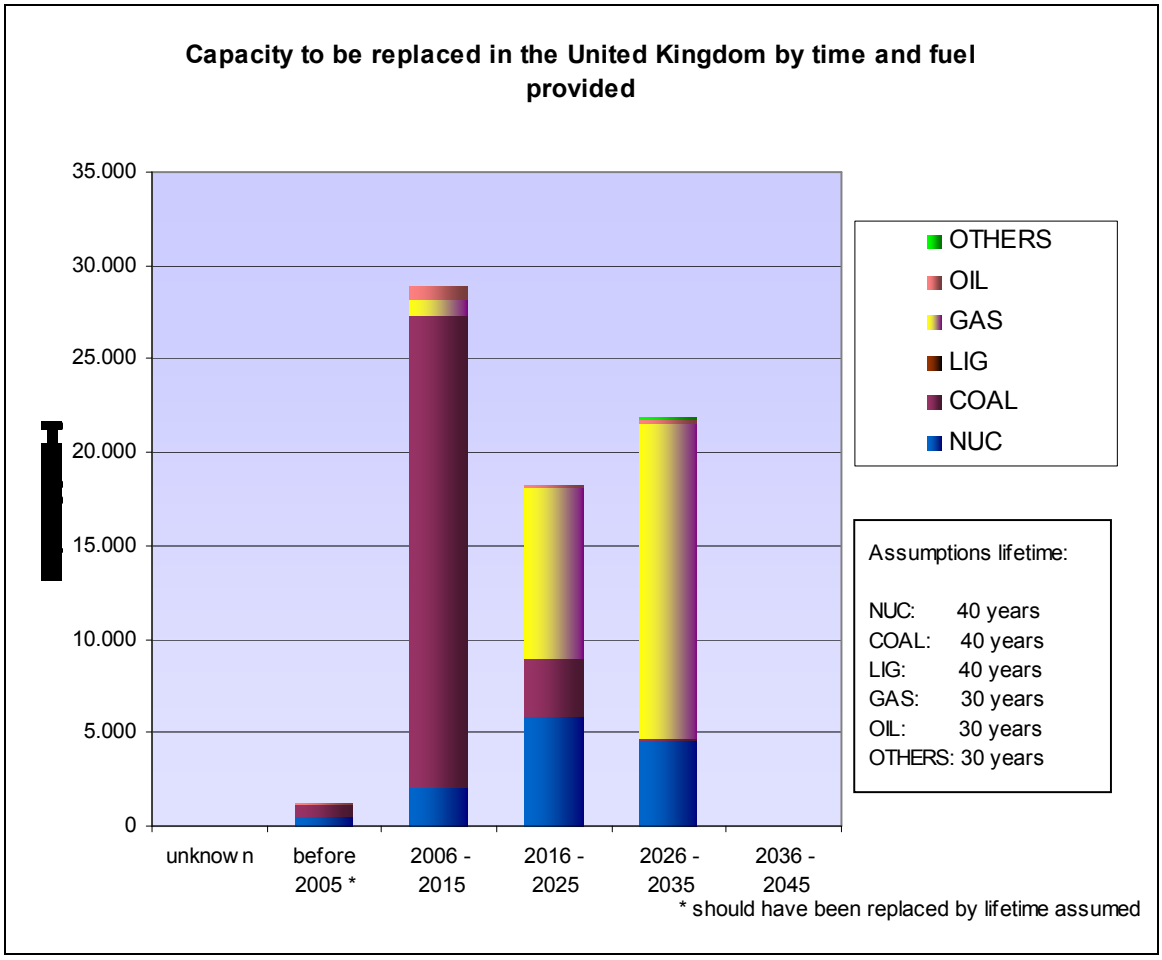

figure 5.2-2 *Capacity Replacements (United Kingdom)*

(268) About 85% of power generation capacity can be allocated to conventional thermal combustion power plants (59.7 GW). Installed nuclear capacity was at 12.5 GW. Renewables made up for about 7.7 GW. Hydropower had the largest share of renewable energy capacity.

(269) Installed renewable capacity is therefore at roughly 10% of total installed capacity.

5.2.5 Energy Policy in General

Conclusion	The UK's energy policy is focused on the perpetuation of a reliable energy supply and environmental targets in order to control the growing dependency on energy imports. The UK also pursues environmental targets.

(270) The UK government pursues four main objectives:

- CO_2 emissions are to be reduced by 60% around 2050 with real progress in 2020 – emission trading and other policy measures have to be used to achieve this goal.
- Reliability of energy supplies – as the UK becomes more and more dependent on energy imports, reliability of supply is of

crucial importance to the country. The government aims to secure energy supplies by promoting measures of energy efficiency and by diversifying energy supply.
- Promotion of competitive energy markets in the UK and elsewhere – energy customers shall benefit from lower prices.
- Homes must be heated adequately and affordably – electricity and gas suppliers are obliged to help their customers to improve their energy efficiency in order to save energy and to reduce their energy bill.

5.2.6 Clean Coal Technology Programme: Aims and Objectives

Conclusion	The UK government actively supports the development of clean coal technologies.

(271) The DTI (Department of Trade and Industry) has established a six-year collaborative programme of activities linking R&D with technology transfer and export promotion activities, focussing on clean coal technologies

(272) The DTI plans to spend £17 million on cleaner coal technology over the life of the programme. This represents some £8m on R&D and a further £9m on technology transfer and exports promotion. *[DTI 2005]*

(273) There are four programme objectives designed to meet this programme aim:

- To assist industry meet the technology targets determined by the task force for advanced power generation.
- To encourage fundamental coal science research in universities in support of recommendations in collaboration with the British Coal Utilisation Research Association (BCURA)
- To encourage the development of an internationally competitive cleaner coal component industry and promote UK expertise and know-how in the main export markets.
- To examine the potential for developing the UK coal bed methane resource and underground coal gasification technology

(274) Current partnership activities are:

- A Memorandum of Understanding with China for collaborative R&D and the promotion of cleaner coal technology.
- Under the auspices of the IEA, of a range of publications and seminars to promote cleaner coal technology and help reduce the non-technical market barriers to their development.
- Help with initiating and establishing a major R&D collaboration on advanced supercritical technology under the auspices of the European Commission's Framework Programme.
- Liaison with the US Department of Energy to determine areas for future collaboration under the US/UK Memorandum of Understanding on Energy R&D.

- Participation, with US and Canadian Government research organisations and industry, in a major international project, based in Canada, to investigate the potential for using carbon dioxide sequestration technology.

5.2.7 Renewable Energy

Conclusion	The British government promotes renewables by means of a levy and an percentual obligation for electricity producers. However, the share of renewables in electricity generation is below the EU-25 average.

5.2.7.1 Actual Status

(275) Renewables contribute a relatively low amount to the total primary energy supply in the UK (1.3% in 2002). Among the renewable energy sources, biomass provides the largest share of energy (1.0% of total primary energy supply). Hydropower (0.2%), wind (0.05%), and solar thermal power (0.01%) only play minor roles.

(276) Renewable energy sources produced 13.97 TWh of power in 2003, which represented a share of 3.5% of total electricity generation.

5.2.7.2 Renewable Policies

(277) The Renewables Obligation requires all electricity suppliers to offer a specific percentage of electricity produced by renewable sources which is increasing every year.

(278) In 2002 the UK established an emissions trading scheme on a voluntary basis. This scheme runs out in 2007 and overlaps with the EU emissions trading system established in 2005.

(279) The government intends to increase the share of renewables in electricity generation to 10.4% in 2010 and plans to double this share by 2020. This target will be implemented with the Renewables Obligation. The share of renewables shall increase each year by one percentage point, reaching 15.4% in 2015.

(280) Renewables are actively supported by the government with special funding.

(281) The climate change levy defines fixed rates to be paid for the consumption of fuels producing GHG emissions. The domestic sector is excluded from paying the tax. The levy has to be payed for the use of electricity, gas, coal, and LPG.

5.2.7.3 Outlook

(282) The UK is on track with its targets. Nonetheless the government is convinced that it should excel in the application of emission reducing technologies and should aim at exceeding its targets.

5.2.8 Climate Protection Policy

Conclusion	The UK may overachieve its Kyoto reduction target. The emission cap for the energy sector is tighter than for the industry sector. Investments in gas-fired power plants are promoted by the national allocation plan.

(283) The United Kingdom causes about 2.3% of the world's total fossil fuel-based carbon emissions (ranking it eigth in the world). Decreased use of coal for power generation, in large part, has already contributed to a reduction in the United Kingdom's total fossil fuel-related carbon emissions of about 6% from 1990 levels, though these emissions have been back on the rise since 1999 *[CSLF 2005]*.

5.2.8.1 Policy and Kyoto Targets

(284) Greenhouse gas (GHG) emissions are to be reduced within the EU burden sharing agreement by 12.5% in the first commitment period of 2008-2012 compared to 1990 levels.

(285) Moreover, the British government has formulated the objective to overachieve its Kyoto target and has an ambitious national reduction target of 20%.

5.2.8.2 Development of National Emission Inventory

(286) The UK is on track concerning its linear Kyoto target path.

(287) The business-as-usual assumptions indicate a reduction of GHG emissions of 20% compared to 1990 levels by 2010.

5.2.8.3 National Allocation Plan

(288) The National Allocation Plan of the UK applies for 1078 installations. These installations are responsible for 46% of the country's GHG emissions.

(289) The sectoral allowances are allocated according to the projected emissions of the business-as-usual scenario in 2005-2007. The allowances for the energy sector do not comply with the projected emissions as they are reduced by an amount of 5.5 $MtCO_2$ in the 2005-2007 period.

(290) The overall amount of emissions allocated to the ETS participants is 714.5 $MtCO_2$ p. a. which is handed out in three equal tranches. The energy sector receives an annual share of 67% not including the reserve for newcomers.

(291) The reserve for newcomers is 7.7% of all allowances. This is a total of 56.8 $MtCO_2$ in the 2005-2007 period. Excess allowances are auctioned at the end of each year.

(292) Allowances for new entrants are benchmarked against the "best available technology". For coal-fired power stations the benchmarks are gas-fired power plants which results in an allocation below the emission level.

(293) If an installation is replaced by a new one, the same rules apply as for other new entrants.

(294) There are no specific early action measures.

(295) JI/CDM credits are not taken into consideration.

5.2.8.4 Implications and Outlook

(296) The UK is about to comply with its Kyoto target. Most likely, the country will outperform its aims.

(297) Due to its ambitious national target, the UK requires significant emission reduction efforts from the ETS participants. Especially the energy sector has to reduce its emissions dramatically.

(298) The small amount of allowances and the benchmarking for new entrants against the “best available technology” leads to a preference for investments into gas-fired installations against coal-fired facilities.

(299) The UK has several programmes in action which promote energy efficiency in all sectors of the economy.

(300) It is likely that the UK will be a net buyer of allowances, at least in the 2008-2012 period if the government plans to continue to pursue its national target of a 20% reduction of emissions. In the 2005-2007 period, however, the UK might be a net seller.

5.3 Spain (ES)

(301) Spain is a constitutional monarchy, consisting of 17 autonomous regions and 50 provinces, with the capital Madrid. Spain's territory comprises an area of about 505'000 km2.

(302) Spain covers most of the territory of the Iberain Peninsula which is surrounded by the Atlantic Ocean in the West and the North and by the Mediteranian in the South and in the East. Spain has borders with Portugal in the West and with France and Andorra in the North.

(303) Hard coal and lignite are the only important energy resources. Aside from coal Spain also possesses deposits of some minerals such as iron ore, copper, and zinc.

(304) Spain is member of the European Union (EU 25) and the OECD.

5.3.1 Socioeconomic Framework

(305) Spain has a population of about 40 million inhabitants. The population is expected to grow slowly in the mid term and to decrease slightly in the long run (until 2030). Thus the population level will remain rather stable in the next decades.

(306) Spain's economy grows remarkably faster than the EU-25 average.

table 5.3-1 *Assumptions for Future Economic Development (Spain)*

		1990	**2000**	**2010**	**2020**	**2030**
Population	[million]	38.85	39.93	41.12	40.78	39.83
GDP	[€ billion]	468.8	608.8	816.9	1084.5	1406.0
			1990/2000	**2000/2010**	**2010/2020**	**2020/2030**
Population Growth	[%]		0.27	0.29	-0.08	-0.24
GDP Growth	[%]		2.6	3.0	2.9	2.6

5.3.2 Primary Energy Consumption

Conclusion	Spain's primary energy consumption depends on imports to a large extent. The high import dependency is mainly due to the predominance of imported oil in the Spanish primary energy mix. The most important domestic primary energy sources are hard coal and lignite.

(307) Total primary energy supply amounted to 194.43 mtce in 2003. As in most other European countries, oil had the largest share accounting for more than 50% of primary energy consumption. Coal (14.8%), natural gas (15.7%), and nuclear power (11.9%) showed

almost equal shares. Renewables made up for 6.9% of inland consumption.

(308) Hard coal and lignite are the most important indigenous energy resources.

(309) Spain has to cover most parts of its energy supply with imports. The country's import dependency in 2003 amounted to 76.4%.

table 5.3-2 *Primary Energy Supply (Spain) [source: Eurostat]*

Energy Source		1990	2000	2002	2003	Share PES in 2003 [%]
Total	**[mtce]**	**130.10**	**178.11**	**188.01**	**194.43**	**100.0**
Solid fuels	[mtce]	27.56	29.88	30.84	28.73	14.8
Oil	[mtce]	66.36	92.64	96.10	98.63	50.7
Gas	[mtce]	7.10	21.74	26.78	30.50	15.7
Nuclear	[mtce]	20.20	23.16	23.46	23.04	11.9
Renewables	[mtce]	8.93	10.14	10.18	13.38	6.9

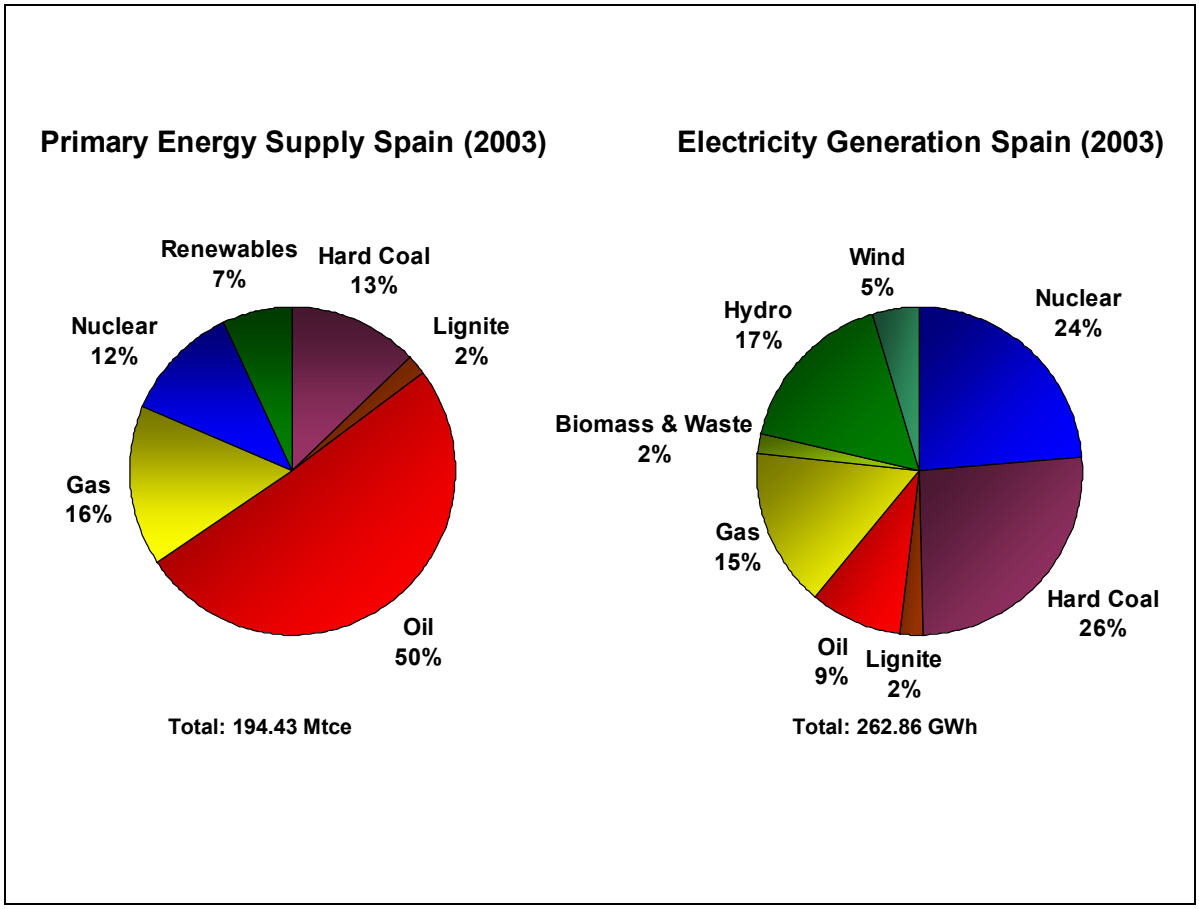

figure 5.3-1 *Primary Energy Supply and Electricity Generation (Spain)*

(310) Nuclear power plays a major role in Spain's primary energy supply. Spain possesses nine nuclear power units. The Spanish nuclear power stations were built in the mid 1960s and the mid-1970s,

respectively. One unit was built 1980. Nuclear power plants generate more than half of domestic primary energy output.

(311) Overall primary energy demand has increased along with economic growth while primary energy supply from renewables has increased only slightly leading to a declining proportion of renewable energy sources in total primary energy supply.

table 5.3-3 *Primary Energy Consumption and Domestic Production Spain (2003)*

Primary Energy Consumption	Primary Energy	Domestic Production	Domestic Production Share
	[Mtce]	[Mtce]	[%]
Total	**194.43**	**47.13**	**24.2**
Coal	28.73	9.96	34.7
Hard Coal		6.30	
Steam Coal		*6.30*	
Coking Coal		*0.00*	
Lignite and Peat		3.66	
Oil	98.63	0.47	0.5
Natural Gas	30.50	0.28	0.9
Nuclear Energy	23.04	23.04	23.4
Renewables	13.38	13.38	43.9

Source: IEA 2005a

5.3.3 The Role of Coal

(312) Hard coal and lignite are the only indigenous fossil fuels of crucial importance to Spain's primary energy supply. In 2003 coal accounted for an energy output of 28.73 mtce, of which 9.96 mtce were produced in Spain. Thus, 34.7% of primary coal output came from domestic coal production.

(313) Lignite is mined and almost exclusively used for power generation in lignite-fired power plants located near the lignite mines. 3.66 mtce of lignite were produced in Spanish lignite mines in 2003.

5.3.3.1 Hard Coal

(313) Hard coal production in 2004 amounted to 12.3 Mt.

(314) Spain produces only steam coal as domestic hard coal does not suffice the quality requirements for coking coal.

(315) Hard coal is mined in deep mines and opencast mines. There are mining areas in the northern and in the southern part of the country. The mining areas are located in

- Asturias
- Castilla-León
- Aragón León and Palencia
- Aragón and Ciudad Real.

(316) Spanish coal has problems competing with coal from other parts of the world due to comparatively high production costs and an inferior quality.

(317) The government subsidises hard coal mining but intends to decrease its support in order to adapt Spanish coal to world market conditions. Coal mining is essential for certain regions in terms of employment.

5.3.3.2 Lignite

(318) Lignite production in 2004 amounted to 8.2 Mt.

(319) Lignite mines are situated in the provinces of

- Galicia
- Orense
- Granada.

(320) Lignite production is not subsidized.

(321) Spanish lignite reserves are comparatively small.

5.3.3.3 Reserves & Production

Conclusion	Spain produces hard coal and lignite exclusively for power generation. Hard coal reserves are sufficient while lignite reserves are comparatively small.

(322) Spain disposes of hard coal and lignite reserves. Hard coal resources are estimated to be about 1'300 Mt whereas lignite resources are 200 Mt. Hard coal reserves amount to 500 Mt. Lignite reserves are about 30 Mt. *[BGR 2005]*

table 5.3-4 Resources, Reserves and Production of Coal Spain (2004) [BGR 2005]

Reserves and Resources	Resources	Reserves	Production	Static Res
	[Mt]	[Mt]	[Mt]	[a]
Hard Coal	1'300	500	14.0	36
Lignite	200	30	8.0	4

5.3.4 Power Generation

Conclusion	Final energy demand has been increasing contiuously with above EU-25 average growth rates. Especially final energy consumption of natural gas has increased dramatically. Electricity demand is growing rapidly. Lignite and coal-fired power plants account for the largest share of Spanish power generation, which is about one-third of total generation. Generation from gas-fired power plants is on the rise. The Spanish government expects replacements of coal-fired power plants by gas. Significant growth rates are expected for wind power and co-generation.

5.3.4.1 *Final Energy Consumption: The Role of Electricity*

(323) Conclusion Total final energy consumption amounted to 143.15 mtce in 2003. Oil had the largest share (60.1%) followed by electricity (18.7%) and natural gas (15.8%). Renewables accounted for 3.8% of total final energy demand in 2003.

(324) Driven by strong economic growth, electricity consumption increased with annual average growth rates of 5.3% in the last decade. This made Spain one of the fastest growing markets for electricity consumption in the EU. [IEA 2005]

(325) Renewables and solid fuels contributed a nearly constant amount to final energy consumption since 1990 whereas the amount of gas increased steadily.

5.3.4.2 *Power Generation: Overview*

(326) In 2003 Spain's electricity production amounted to 262.86 TWh.

(327) Energy markets in Spain began opening to competition in 1999. Since then, the markets have opened faster than required by the EU directive on electricity. Consumers profited from lower prices, especially in the electricity sector.

(328) The power generation mix is diversified. Coal has the largest share of 28.4%. 23.5% of the Spanish electricity supply were generated by nuclear power. The same contribution came from renewables, natural gas (15.4%), and oil (9.1%) also contributed significant amounts.

(329) Domestic hard coal and lignite production is almost exclusively used for power generation.

(330) Coal plays an important role in Spanish electricity generation. Roughly one-third of energy generated in Spain can be attributed to coal-fired power plants.

table 5.3-5 *Installed Power Plant Capacities (Spain)*

Installed Power Plant Capacities			
	[Mwel]	[GWh]	[h full cap'] (4)
Total	**68'879**	**262'860**	**3'816**
Nuclear	***7'581***	***61'875***	***8'162***
Conv' Thermal (1)	***37'310***	***145'013***	***3'887***
Coal (>30 Mwel)	12'751	74'722	5'860
Hard Coal (>30 Mwel)	*9'178*	*68'817*	*7'498*
Lignite (>30 Mwel)	*3'573*	*5'905*	*?*
Oil (>30 Mwel)	1'227	24'002	-
Gas (>30 Mwel)	9'611	40'601	-
Conv' Others (2)	***13'721***	***5'688***	
Biomass (wood, wood-waste, biogas)	-	5'648	-
Waste (municipal and industrial waste)	-	40	-
Renewables (3)	***23'988***	***55'972***	
Hydro	18'043	43'897	-
Pumped Storage	-	-	-
Wind	5'945	12'075	2'031
Geothermal	-	-	-

Please note: Table is presenting a synthesis from different statistics.
Data may not be consistent, for following reasons:
(1) Conventional Thermal: conv. thermal capacites above 30 MW, power generation from all conventional thermal
(2) Conventional Others: conv. thermal capacites below 30 MW incl. biofuel and waste capacities, power generation from biofuel and waste only
(3) Renewable capacities without biofuel capacities; renewable power generation without biofuels
[source: Eurostat]2003 and 2004; Siemens Database 2005

(331) The share of electricity generation from coal-fired power plants has decreased compared to the 1990s when coal accounted for nearly 40% of aggregate power generation.

(332) According to government projections the proportions within the generation mix will continue to shift. Gas-fired power plants are emerging and will replace coal-fired plants on a large scale in the near future. The share of nuclear power is expected to remain constant at about one quarter. Natural gas will cover about one quarter as well. Hydropower, renewables, waste and coal will generate between 14% and 15% of electricity. Oil will be of less importance accounting for approximately 7% of generated power.

5.3.4.3 Power Generation: Capacities

(333) Iberia will have significant excess capacity by 2010, especially through new gas-fired power plants, so that the coal vs. gas question seems settled. [McKinsey 2005]

(334) Power generation capacities in Spain summed up to 60.2 GW in 2002. Nuclear power capacity was 7.6 GW. Power generation capacity of conventional thermal power plants amounted to 29.9 GW. Installed capacities of hydropower were 17.9 GW while those of wind were 4.9 GW.

(335) New investments in power capacities mainly focus on cogeneration and wind.

(336) Spain is one of largest producers of wind energy. In 2004 installed capacity amounted to 8 GW. Applications for new generation added up to another 50 GW.

(337) The Spanish government expects that an additional 26 GW of capacity will be installed until 2011.

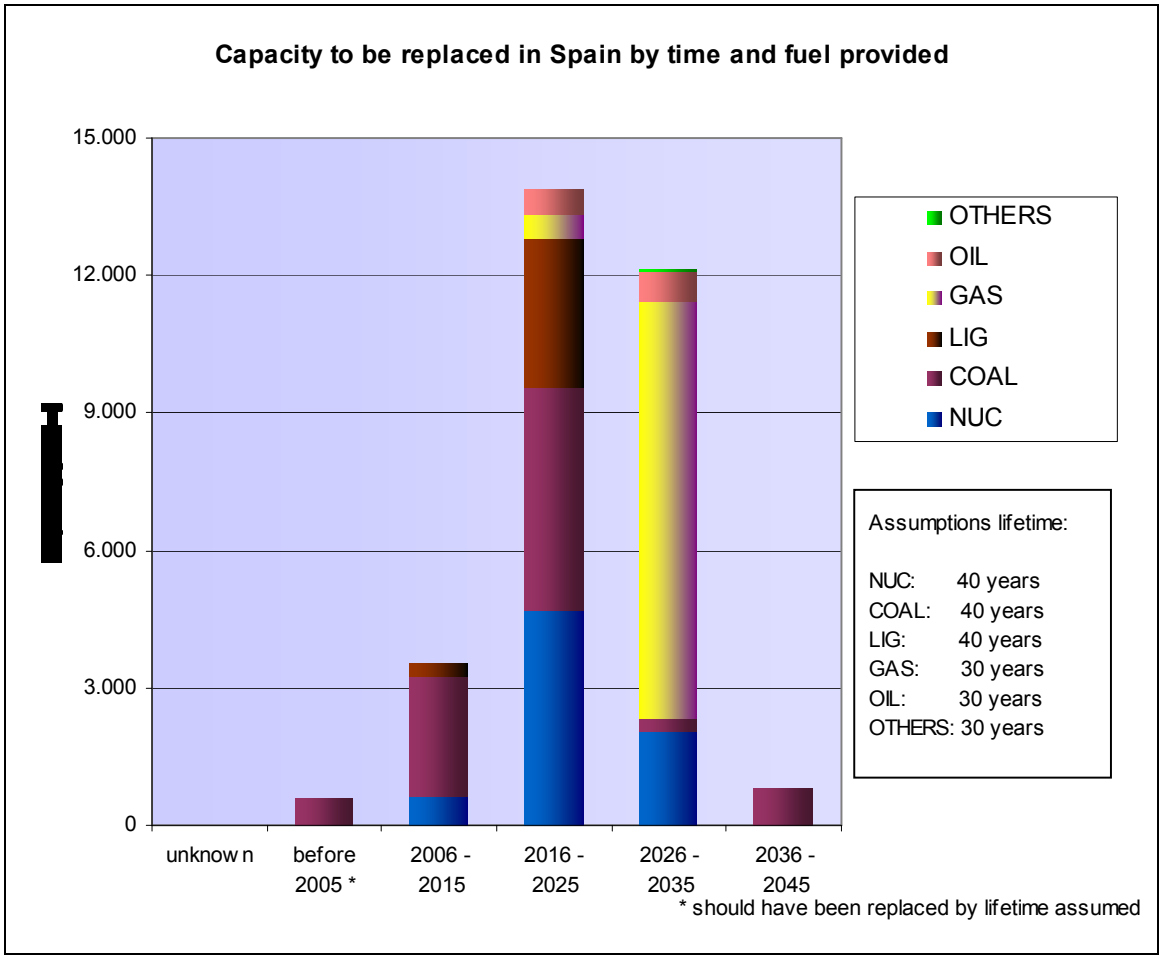

figure 5.3-2 *Capacity Replacements (Spain)*

5.3.5 Energy Policy in General

Conclusion	The cornerstones of Spanish energy policy focus on diminishing the country's import dependency by promoting diverstity and security of supply. The use of domestic sources especially of renewables contributes to this means.

(338) The Spanish government pursues the following objectives:

- Security and diversity of supply – Spain is highly dependant on energy imports. More than 70% of the country's primary energy

supply is imported. Moreover, about two-thirds of Spain's primary energy supply comes from hydrocarbons.

- Competitiveness of energy markets – the Spanish government wants to promote competition in energy markets to reduce energy prices.
- Environmental protection and energy efficiency – the promotion of renewables and a higher energy efficiency in proportion to the GDP.
- The current Spanish government has uttered the intention to phase out nuclear power. There is no specific plan for the phase-out.

5.3.6 Renewable Energy

Conclusion	The Spanish government promotes renewables in power generation with fixed tarrifs. Electricity production by wind power is on the rise. The government issued a national plan in which it pursues ambitious targets concerning the electricity supply from renewable sources.

5.3.6.1 Actual Status

(339) In 2003 renewables accounted for a 6.9% share of primary energy supply.

(340) The share of renewables in power generation was 23.5%.

(341) Installed renewable capacities have been increasing steadily. Especially wind and hydropower capacities have risen dramatically. Spain is the second-largest producer of wind energy in the world.

(342) Other renewables such as waste, solar thermal, and solar PV are part of the energy mix but do not contribute as significant amounts of capacity as wind or hydropower.

5.3.6.2 Renewable Policies

(343) Spain has established a system of fixed feed-in tariffs to promote renewable energy sources. The level of the tariffs depends on the kind of technology. The tariffs are the main reason for the strong investments in wind energy.

(344) Operators of renewable energy generators may choose to sell their energy at market prices and also receive a premium. They have to stick with the price system of choice for one year.

(345) Furthermore, renewables are promoted by public funds and tax incentives. Public funds divided into funds for renewables and for energy efficiency. These subsidies have helped to increase investment in the renewables sector significantly.

(346) The Spanish government issued a promotion plan for renewables. The plan sets targets for installed capacities differentiated by energy source for the years 1999 to 2010.

(347) The overall target is to increase the share of renewable energy to 12% of total primary energy supply and to 29.4% of electricity generation until 2010.

(348) Biomass plays a crucial role in the government plan. The national plan sets an objective of 8.57 Mtce for biomass installations, of which 7.29 Mtce are to be used for electricity generation by 2010. About half of this target is to be achieved by 2006. However, the plan lags behind its targets. By 2004, less than 8% of the target for the electricity sector had been achieved and only about 17.5% of the objective for thermal uses was fulfilled.

5.3.6.3 Outlook

(349) The government will have to develop a strategy to cut GHG emissions.

(350) Due to the high level of GHG emissions a nuclear phase-out is unlikely provided that the government wants to comply with the Burden Sharing Agreement.

(351) Installed capacity of wind farms will increase.

(352) The national target levels for some renewables will not be achieved unless the government takes additional measures to promote these kinds of energy sources.

5.3.7 Climate Protection Policy

Conclusion	Spain is obliged to limit the increase of its emissions to 15%. The ETS participants receive allowances according to projected emissions. The energy sector has to meet stronger reduction targets.

5.3.7.1 Policy and Kyoto Targets

(353) According to the Burden Sharing Agreement, Spain is obliged to limit its GHG emissions in the 2008-2012 period to a level of 15% above 1990 levels.

5.3.7.2 Development of National Emission Inventory

(354) Spain is not on track concerning the linear Kyoto target path. In 2001, Spain's GHG emissions were almost 24% above 1990 levels.

(355) Business-as-usual assumptions project a GHG emission increase of 54% between 1990 and 2010. Estimates foresee further increasing GHG emissions in 2005-2007.

5.3.7.3 National Allocation Plan

(356) The National Allocation plan is valid for 819 installations which take part in the ETS.

(357) The industry sector and the energy sector get their allowances according to their projected emissions in 2005-2007. There is a basic distinction between power generation, industry and cogeneration activities.

(358) In the 2005-2007 compliance period, power generation facilities receive an annual amount of 88 MtCO2 (54.9%). The remaining 72.28 $MtCO_2$ p.a. (45.1%) are allocated to the industry sector and to other cogeneration activities. The other cogeneration activities get annual amount of 12.03 $MtCO_2$ (7.5%).

(359) The total reserve for newcomers amounts to 5.42 $MtCO_2$ p.a.. It is divided into two parts: a reserve for the energy sector which comprises allowances for 1.84 $MtCO_2$ and a reserve for industrial sectors which includes the remaining 3.58 $MtCO_2$. A best available technology benchmark is applied.

(360) Allowances from the reserve are handed out on a first come first serve basis. The remaining allowances are auctioned at the end of each year.

(361) Allowances from old installations are not transferable to the replacing facilities. A replacement is treated the same way as a new entrant. Allowances from installtions whose permit has expired are immediately transferred to the new entrant reserve.

(362) The allocation of allowances to the specific sectors indicates different reduction targets for the energy and the industrial sector. Both sectors receive their allowances according to projected emissions. However, installations of the energy sector get 6.4% less allowances than they would need according to business-as-usual assumptions. Facilities of the industry sector receive their allowances in accordance with the business-as-usual scenario.

(363) Early action is not considered in the Spanish National Allocation Plan.

5.3.7.4 Implications And Outlook

(364) Spain has to take more political measures if it wants to comply with its Kyoto target.

(365) Provided that the business-as-usual assumptions apply, Spain especially exerts pressure on the energy sector which has strong reduction obligations and a rather small reserve. The Spanish government promotes cogeneration.

(366) Spain is planning to make use of flexible project mechanisms (CDM/JI) on a large scale in 2008-2012. 100 $MtCO_2$ are to be bought which complies to a share of about 7% of the 1990 level emissions.

(367) The Spanish government will take additional policy measures aside from the allocation of allowances in order bring the country back on track with its Kyoto target.

(368) The obligations for the energy sector including the size of the reserve imply that Spain is actively pursuing a policy of reducing the share of coal-fired power plants. The general framework supports investments into technologies with low CO_2 emissions.

5.4 Greece (EL)

(369) Greece is a parliamentary republic located in southeastern Europe. It covers an area of about 132'000 km^2 and consists of 13 regions and one autonomous region of the Mountain of Athos. Greece is made up of a peninsula and of about 2'000 islands. The country's capital is Athens.

(370) Most of Greece is surrounded by the Mediteranian, namely the Aegean and the Ionic Sea. In its North, Greece has borders with Albania, Bulgaria, Macedonia, and Turkey.

(371) The most important natural resources are bauxite, lignite, magnesite, oil, and marble.

(372) Greece is member of the European Union (EU 25) and the OECD.

5.4.1 Socioeconomic Framework

(373) Greece has a population of about 10.9 million inhabitants which is expected to grow somewhat in the coming years but will stagnate at a level of slightly above 11 million inhabitants in the mid-term. The low population growth rates can be attributed to a relatively low fertility rate.

(374) Greece's GDP is expected to increase with a growth rate above the EU-25 average. The average annual growth rate until 2030 is estimated to be more than 3%.

table 5.4-1 *Assumptions for Future Economic Development (Greece) [DG TREN 2003]*

		1990	2000	2010	2020	2030
Population	[million]	10.16	10.56	11.15	11.18	11.09
GDP	[€ billion]	97.7	122.9	181.4	249.5	336.1
			1990/2000	2000/2010	2010/2020	2020/2030
Population Growth	[%]		0.38	0.54	0.03	-0.09
GDP Growth	[%]		2.3	4.0	3.2	3.0

5.4.2 Primary Energy Consumption

Conclusion	Greece imports a large part of its primary energy sources, which can be attributed to the dominant role of oil. Lignite is the most important domestic energy source accounting for almost one-third of total domestic primary energy supply and which are used for electricity generation. Oil and gas reserves are of no crucial importance.

(375) Total primary energy supply in Greece was 42.70 mtce in 2003. Oil had the largest share of all fuels (57.5%) followed by lignite

(29.8%). Renewables, natural gas and other energy sources contributed much smaller shares to primary energy supply. Greece refrains from nuclear power.

(376) The most important indigenous energy source is lignite.

(377) Greece is highly dependant on imports for most of its supply. In 2003 about two thirds of the energy consumed was imported.

table 5.4-2 *Primary Energy Supply (Greece) [source: Eurostat]*

Energy Source		1990	2000	2002	2003	Share PES in 2003 [%]
Total	**[mtce]**	**31.69**	**39.74**	**41.46**	**42.70**	**100.0**
Solid fuels	[mtce]	11.53	12.91	12.82	12.72	29.8
Oil	[mtce]	18.30	22.31	23.67	24.56	57.5
Gas	[mtce]	0.20	2.43	2.57	2.89	6.8
Nuclear	[mtce]	0.00	0.00	0.00	0.00	0.0
Renewables	[mtce]	1.58	2.09	2.05	2.27	5.3

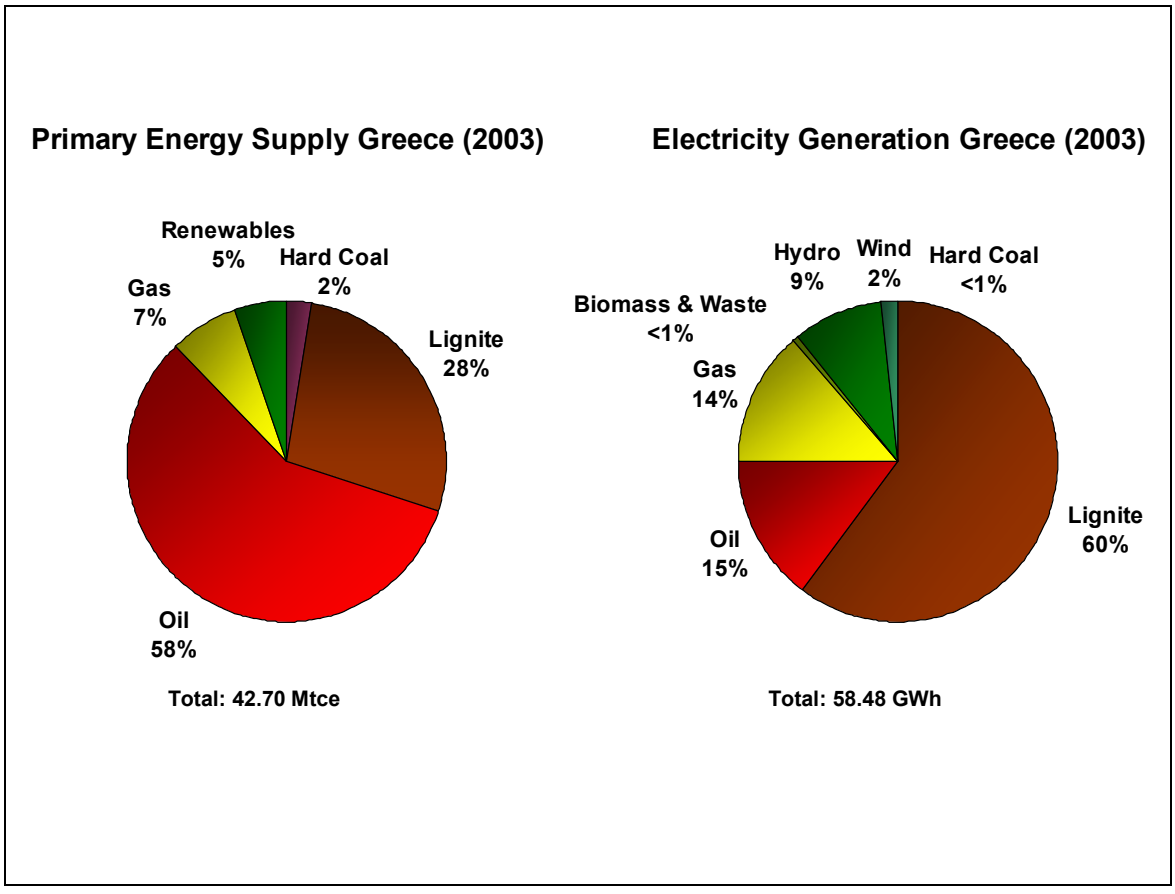

figure 5.4-1 *Primary Energy Supply and Electricity Generation (Greece)*

(378) Greece produces some oil. Domestic production has been declining over the past decade. Greek reserves are at about 7 million bbl. Indigenous production covers only small parts of domestic demand. In 2003 domestic oil production accounted for 0.8% of primary oil supply.

(379) The share of renewables in total primary energy supply has remained almost constant since 1990. In 2003 renewables had a share of nearly 5.3% of total primary energy supply. The main renewable energy sources were combustible renewables and waste, which made up about two thirds of the renewables' share.

table 5.4-3 *Primary Energy Consumption and Domestic Production Greece (2003) [IEA 2005a]*

Primary Energy Consumption	Primary Energy	Domestic Production	Domestic Production Share
	[Mtce]	[Mtce]	[%]
Total	**42.70**	**14.42**	**33.8**
Coal	12.72	11.91	93.6
Hard Coal		0.23	
Steam Coal		0.23	
Coking Coal		0.00	
Lignite and Peat		11.68	
Oil	24.56	0.19	
Natural Gas	2.89	0.04	1.5
Nuclear Energy	0.00	0.00	0.0
Renewables	2.27	2.27	100.0

5.4.2.1 Primary Energy Consumption: The Role of Coal

(380) Lignite is the main domestic energy source. In 2003 Greece produced 11.68 mtce of lignite. This corresponds to a share of 82.3% of total domestic primary energy production.

(381) Greece has no hard coal reserves. Hard coal is imported from South Africa, Russia, Venezuela, and Colombia. The amount of hard coal consumed in Greece was 0.7 mtce in 2004, all of which was steam coal.

(382) The amount of lignite produced has been rising steadily since the 1970s. The share of lignite in total primary energy supply has declined some but remained rather stable at above 30%.

(383) Lignite is almost exclusively used for power generation.

5.4.2.2 Hard Coal

(384) There are no hard coal reserves and no hard coal mining.in Greece.

5.4.2.3 Lignite

(385) The major lignite deposits are located in the northern part of Greece. The major lignite mining sites are situated at

- Ptolemais-Amynteon and Florina
- Drama
- Elassona
- and Megalopolis in the South.

(386) Lignite production has been partly privatized. Most of the lignite is mined by the Public Power Corporation that has the right to exploit over 60% of the known reserves.

(387) Most of the lignite production (92%) is used for electricity generation.

5.4.2.4 *Reserves & Production*

(388) Lignite resources were about 5'800 Mt, whereas reserves were 3'900 Mt in 2004 *[BGR 2005].* According to estimates 3,200 Mt can be economically mined.

(389) Lignite production has increased over time and amounted to 68.0 Mt in 2004 *[BGR 2005].*

(390) Greek oil production peaked in the mid 1980s. Reserves amounted to about 7 million bbl. Oil production was 6'411 bbl per day in 2004.

(391) Greece's natural gas reserves are negligible.

table 5.4-4 *Resources, Reserves and Production of Coal Greece (2004) [source: BGR 2005]*

Reserves and Resources	Resources	Reserves	Production	Static Res
	[Mt]	[Mt]	[Mt]	[a]
Hard Coal	-	-	-	-
Lignite	5'800	3'900	68.0	57

5.4.3 Power Generation

Conclusion	Final energy consumption is dominated by oil. Electricity production is mainly based on lignite-fired power plants which account for roughly two-thirds of electricity production. Renewables play a minor role. Even though power generation is dominated by lignite-fired power plants, the share of lignite in the power generation mix has been declining particularly at the expense of gas. Due to a fast growing economy new capacities will be installed in the near future. The new capacities will primarily be based on gas-fired power plants and renewables.

5.4.3.1 *Final Energy Consumption: The Role of Electricity*

(392) Total final energy consumption amounted to 30.85 mtce in 2003. Oil as the dominant fuel had a share of 70.6%. Electricity contributed an amount of 5.97 mtce (19.4%).

(393) Eletricity consumption has been increasing steadily. The average annual growth rate in the 1990s was well above the EU average. Electricity consumption grew at an average annual rate of 4.2% and is expected to increase further at an average rate of 4.7% according to government projections.

(394) Lignite-fired power stations were responsible for about 64% of gross electricity production in 2002. Oil (16%), natural gas (13%), and hydropower (5.2%) chiefly amounted for the rest of electricity production. There are no nuclear power plants in operation.

(395) Lignite-fired power plants produce most of the electricity in the mainland. On islands, however, heavy fuel oil, diesel, and renewables are predominant.

(396) Greece can obtain electricity imports from Italy, Bulgaria, Macedonia, and Albania. The reserve margin is estimated to be low or even negaive (-0.3%) in summertime if imports are not included according to the EU benchmarking report.

table 5.4-5 *Installed Power Plant Capacities (Greece)*

Installed Power Plant Capacities			
	[MWel]	[GWh]	[h full cap'] (4)
Total	**12'057**	**58'478**	**4'850**
Nuclear	***-***	***-***	***-***
Conv. Thermal (1)	***8'607***	***52'125***	***6'056***
Coal (>30 Mwel)	5'003	35'169	7'030
Hard Coal (>30 Mwel)	-	*78*	-
Lignite (>30 Mwel)	*5'003*	*35'091*	*7'014*
Oil (>30 Mwel)	636	8'722	-
Gas (>30 Mwel)	1'265	7'988	-
Conv. Others (2)	***1'704***	***246***	
Biomass (wood, wood-waste, biogas)	-	-	-
Waste (municipal and industrial waste)	-	246	-
Renewables (3)	***3'450***	***6'353***	
Hydro	3'079	5'332	-
Pumped Storage	-	-	-
Wind	371	1'021	2'752
Geothermal	-	-	-

Please note: Table is presenting a synthesis from different statistics.
Data may not be consistent, for following reasons:
(1) Conventional Thermal: conv. thermal capacites above 30 MW, power generation from all conventional thermal
(2) Conventional Others: conv. thermal capacites below 30 MW incl. biofuel and waste capacities, power generation from biofuel and waste only
(3) Renewable capacities without biofuel capacities; renewable power generation without biofuels
[source: Eurostat]2003 and 2004; Siemens Database 2005

5.4.3.2 Power Generation

(397) Domestic power generation amounted to 58.48 TWh in 2003.

(398) Electricity generation is dominated by lignite-fired power plants which account for 60% of total power generation.

(399) Oil (14.9%), gas (13.7%), and renewables (11.3%) are also part of the fuel mix used for power generation.

(400) Lignite is almost exclusively used for power generation.

(401) In spite of the increasing production of lignite, the proportion of lignite in the power generation mix has been declining from over 70% in the early 1990s to about 60%.

(402) The decreasing importance of coal-fired generation can be attributed to the emergence of gas-fired power plants.

5.4.3.3 *Power Generation: Capacities*

(403) Total power generation capcities amounted to 11.55 GW in 2002. Installed capacity of lignite-fired plants was about 5 GW.

(404) The largest part of the capacity is installed in combustion power plants which are fired by lignite, gas, or oil.

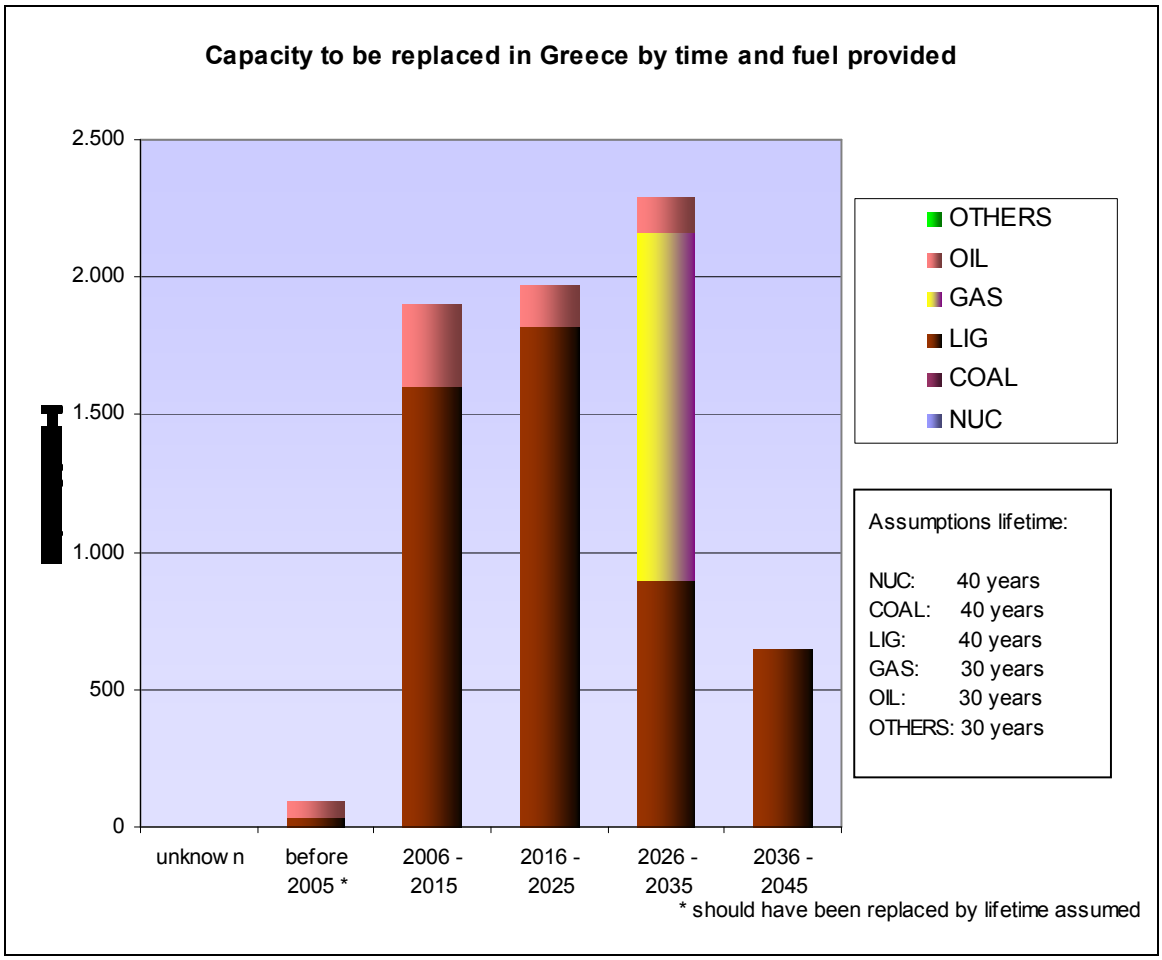

figure 5.4-2 *Capacity Replacements (Greece)*

(405) There are hydropower capacities amounting to about 3 GW.

(406) Other renewable energy sources such as wind, geothermal, and solar power play only minor roles in capacity installation.

(407) The rising electricity consumption requires new power plant capacities in the near future. Licenses for more than 4 GW of new capacity have been granted, most of which will be generated by gas and renewables.

5.4.4 Energy Policy in General

Conclusion	The Greek energy policy aims at means of reducing the country's import dependency and of complying with environmental targets.

(408) Greece's major energy policy objectives are:

- Energy security – due to a high import dependency the Greek government aims at a more diversified energy mix and promotes natural gas and the increasing use of indigenous energy sources, mainly renewables.
- Energy efficiency – the promotion of energy savings aims at the reduction of total final consumption in relation to the GDP.
- Reduction of CO_2 emissions – cutting GHG emissions in order to comply with the Kyoto targets.
- Promoting research and development of new technologies as well as investments in the domestic energy sector.

5.4.5 Renewable Energies

Conclusion	Renewables are actively promoted by the Greek government by means of feed-in tariffs and promotion programmes. The share of renewables in electricity production is comparatively low.

5.4.5.1 Actual Status

(409) The share of renewables in total primary energy supply was 5.3% in 2003. Combustible renewables and waste had the largest share of Greece's renewable energy supply.

(410) Electricity production from renewables accounted for 11.3% of total gross electricity generation (6.60 TWh).

(411) Aside from hydropower, waste, and combustible renewables, energy produced by wind and solar power is increasing, but on a low level. For example, there were 278 MW of capacity installed for wind power stations in 2002. By 2003 397 MW had been installed. However, licenses have been granted to install a total of 3'790 MW.

(412) Solar power is used on a large scale to supply households with warm water.

5.4.5.2 Renewable Policies

(413) Renewables are promoted by feed-in tariffs. The tariffs are paid by the Hellenic Transmission System Operator and amount to 70% of the low-voltage end-use tariff and 90% for co-generators using renewable energy, respectively.

(414) According to the EU Renewables Directive, Greece complies to generating 20.1% of its electricity including hydropower by 2010.

(415) The government promotes and subsidises investments into the improvement of energy efficiency measures, renewables, and co-generation.

5.4.5.3 Outlook

(416) Greece has trouble fulfilling the goals of the Burden Sharing Agreement and the national target concerning the proportion of renewable energy sources until 2010 according to the EU Renewables Directive.

(417) The government will have to implement more drastic measures if it wants to comply with its national targets.

5.4.6 Climate Protection Policy

Conclusion	Greece is to limit the increase of its GHG emissions to 25% compared to 1990 levels. The national allocation plan allocates allowances according to historic emissions. Compliance factors refer to a business-as-usual scenario. As Greece is off the linear Kyoto target path, the country will have to take additional policy measures to comply with its Kyoto aim.

5.4.6.1 Policy and Kyoto Targets

(418) Within the Burden Sharing Agreement Greece has the obligation to limit the increase of its GHG emissions to 25% in the 2008-2012 period compared to 1990 levels.

(419) The Greek climate policy is based on strong economic growth assumptions.

5.4.6.2 Development of National Emission Inventory

(420) Greece is not complying with its linear target path towards the Kyoto target. In 2002, CO_2 emissions were already 28% above 1990 levels.

(421) The business-as-usual scenario used in the Greek National Allocation Plan predicts a 39.2% increase of GHG emissions until 2010 compared to 1990 levels.

5.4.6.3 National Allocation Plan

(422) 141 installations take part in the emission trading system (ETS).

(423) The Greek National Allocation Plan distinguishes between a trading and a non-trading sector. Allowances are allocated according to projections on basis of average annual historic emissions in 2000-2003.

(424) In 2005-2007 an amount of 74.42 $MtCO_2$ p.a. is handed out to the ETS participants. The electricity sector receives 73% of the allowances issued, which resembles the significant share of lignite in Greek power generation.

(425) The reserve for newcomers is an annual amount of 3.16 $MtCO_2$. Allowances out of the reserve are allocated for free. The remaining allowances will be auctioned by the end of 2007.

(426) Allowances from existing installations that are replaced by new installations are transferred to the extent they are needed. Remaining allowances fill up the reserve for newcomers.

(427) The Greek ETS participants have to oblige to compliance factors which are related to the official business-as-usual scenario. There are different compliance factors depending on the the type of installation. Electricity generation installations have to abide by a compliance factor of 0.975, i.e. a reduction effort of 2.25% in com-

parison to business-as-usual assumptions. Other industries such as steel production have to comply to lower reduction obligations. The aim is to reduce the CO_2 emissions by 2.1% within the 2005-2007 period.

(428) The toal quantity of emission allowances is based on projected emissions in 2005-2007.

(429) There is no special provision for early action.

(430) Greece is not yet considering the purchase of CDM/JI credits.

5.4.6.4 Implications and Outlook

(431) Greece has difficulties complying with its Burden Sharing Agreement target. Additional measures will have to be taken to return to the Kyoto target path.

(432) The National Allocation Plan imposes reduction obligations on the ETS participants which refer to a business-as-usual scenario. If these assumptions apply, the reduction obligation especially for electricity generation is comparatively tight.

(433) Using future projections for the allocation of allowances is a plausible way of establishing the ETS in Greece as the economy is expected to grow fast in the future. The Burden Sharing Agreement target does not call for a reduction but only a limited increase of GHG emissions.

(434) However, additional measures will be necessary to achieve the Kyoto aim. These measures may be taken outside of the ETS. Nevertheless, the climate policy situation indicates that there is not much room for a more generous National Allocation Plan in the 2008-2012 period.

5.5 France (FR)

(435) France is a republic consisting of 22 regions which include 96 departments and four departments overseas. The capital is Paris. France covers an area of 543'965 km^2.

(436) France is bordered by Belgium and Luxemburg to the North-east. Germany, Switzerland, and Italy form the Western border. To the South France borders the Mediteranian, Spain, and Andorra. The Western border is the Atlantic Ocean.

(437) There are no significant amounts of energy resources. The production of coal, oil, and natural gas has been declining for some time. French oil production peaked in the late 1980s, natural gas production only plays a minor role, and coal production phased out in 2004.

(438) France is member of the European Union (EU 25) and the OECD.

5.5.1 Socioeconomic Framework

(439) France has a population of about 59.5 Million inhabitants which is expected to rise moderately in the mid term.

(440) The real French GDP is expected to rise by an annual growth rate of more than 2% in average

table 5.5-1 *Assumptions for Future Economic Development (France)*

		1990	**2000**	**2010**	**2020**	**2030**
Population	[million]	58.2	60.6	63.1	64.6	65.4
GDP	[€ billion]	1'177.7	1'416.9	1'791.9	2'235.2	2'748.8
			1990/2000	**2000/2010**	**2010/2020**	**2020/2030**
Population Growth	[%]		0.41	0.40	0.24	0.13
GDP Growth	[%]		1.9	2.4	2.2	2.1

5.5.2 Primary Energy Consumption

Conclusion	Nuclear energy prevails in France's primary energy supply. It has a larger share than oil. Although France strives for a high degree of independence, the country is a net energy importer. Coal production has ceased. Although there are some resources of hard coal and lignite left, none of these are mined. Coal-fired power plants are of inferior importance in the French energy sector.

(441) France's primary energy supply is dominated by nuclear energy. Oil and gas are also of major importance to primary energy supply. Coal and renewables only play minor roles.

(442) Even though France pursues the aim of an independent energy supply, France is a net energy importer, with its total energy consumption exceeding its production by a large margin (import dependency of 50.5% in 2003). The difference between its energy production and consumption has been mostly due to its oil imports. France's energy production and consumption have both been gradually increasing over the past decade, and are now about 20% greater than in the beginning of the 1990s. *[CSLF 2005]*

table 5.5-2 *Primary Energy Consumption (France) [source: Eurostat 2004]*

Energy Source		1990	2000	2002	2003	Share PES in 2003 [%]
Total	**[mtce]**	**324.69**	**367.81**	**379.98**	**387.55**	**100.0**
Solid fuels	[mtce]	28.87	21.49	19.38	20.50	5.3
Oil	[mtce]	124.69	124.63	130.37	130.05	33.6
Gas	[mtce]	37.18	51.08	53.53	56.24	14.5
Nuclear	[mtce]	116.93	154.56	162.60	164.21	42.4
Renewables	[mtce]	22.60	24.59	23.55	24.66	6.4

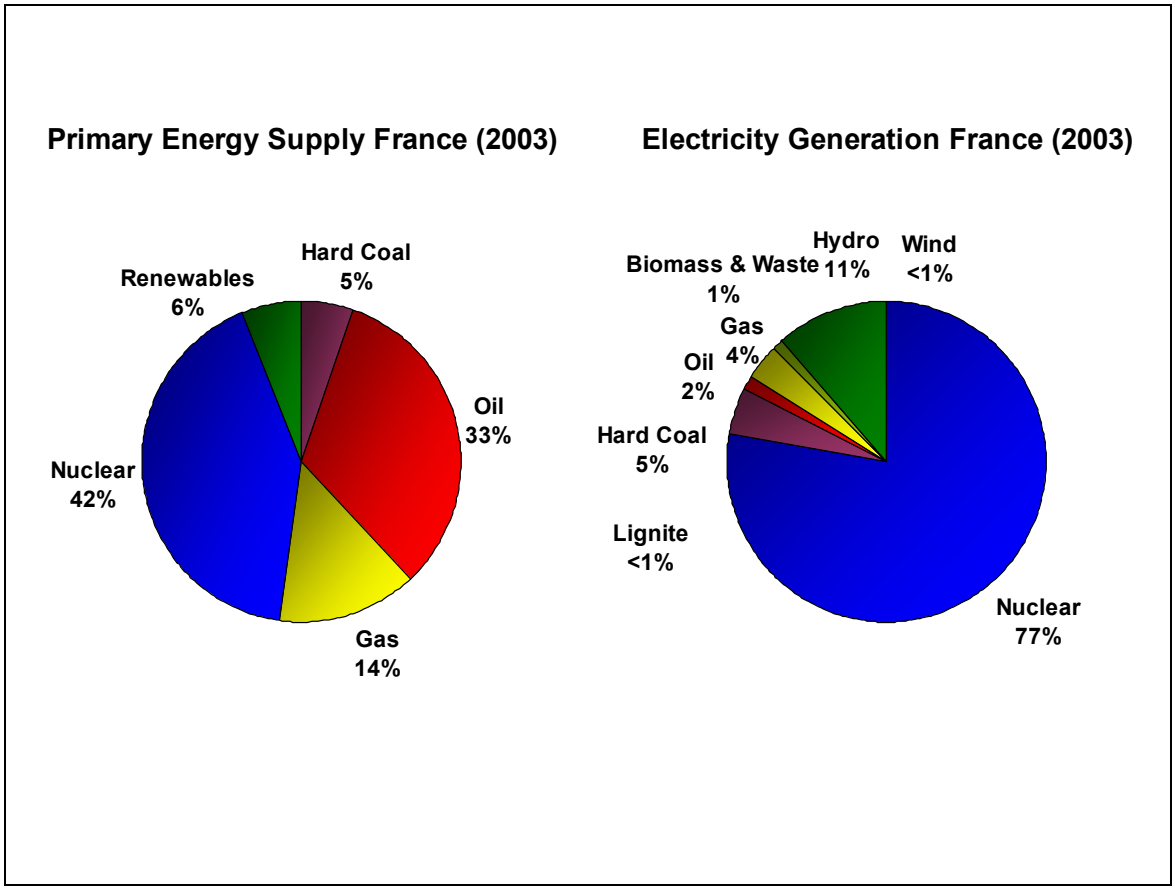

figure 5.5-1 *Primary Energy Supply and Electricity Generation (France)*

table 5.5-3 *Primary Energy Consumption and Domestic Production France (2003) [IEA 2005a]*

Primary Energy Consumption	Primary Energy	Domestic Production	Domestic Production Share
	[Mtce]	[Mtce]	[%]
Total	**387.55**	**194.69**	**50.2**
Coal	20.5	1.99	9.7
Hard Coal		1.98	
Steam Coal		1.98	
Coking Coal		0.00	
Lignite and Peat		0.01	
Oil	130.05	2.00	1.5
Natural Gas	56.24	1.83	3.3
Nuclear Energy	164.21	164.21	126.3
Renewables	24.66	24.66	43.8

5.5.3 The Role of Coal

(443) Coal is of little importance in France's primary energy supply. The share of coal as a primary energy source has declined from 15.5% in 1973 to 4.7% in 2004.

(444) France phased out domestic production of coal in 2004.

(445) Coal is mainly used for power generation and for steel production. Along with the decreasing domestic coal production France has replaced most of its coal-fired power plants by nuclear power plants

(446) France is a hard coal importing country and has ceased to produce coal on its own. Lignite is used in negligible amounts. Coal reserves are estimated at about 40 million tons. Coal mining in France has been on the decline for decades, and was phased-out in 2004 in favour of cheaper imported coal.

(447) Even though coal still represents about 5% of France's primary energy consumption mix, coal consumption has also been on the decline, with coal having been largely supplanted by nuclear power for electricity generation over the past four decades. France presently imports coal from Australia, the United States, and South Africa *[CSLF 2005]*

5.5.3.1 Hard Coal

(448) Hard coal market volume was 20.0 mtce in 2004. Most of the hard coal used in France was steam coal.

(449) In 2004, nearly all of the coal used in France was imported. From 2005 on there will be no domestic production of coal. The main coal exporters to France were Australia (29.9%), South Africa (18.2%), the United States of America (10.7%), and Poland (5.9%).

5.5.3.2 Lignite

(450) There are virtually no lignite resources in France. Due to the specific features of lignite, there is no lignite market worth mentioning in France.

5.5.3.3 Reserves & Production

(451) France ceased to produce coal in 2004.

(452) There are only some resources of hard coal left. The country's coal deposits are nearly exploited.

(453) The indigenous production of natural gas peaked in 1985, that of oil in 1990. Consumption of gas has increased significantly especially in the residential and the industrial sector.

table 5.5-4 Resources, Reserves and Production of Coal France (2004) [source: BGR 2005]

Reserves and Resources	Resources	Reserves	Production	Static Res
	[Mt]	[Mt]	[Mt]	[a]
Hard Coal	-	15	-	-
Lignite	114	-	0.0015	-

table 5.5-5 Installed Power Plant Capacities (France)

Installed Power Plant Capacities			
	[MWel]	[GWh]	[h full cap'] (4)
Total	**116'199**	**566'900**	**4'879**
Nuclear	***63'363***	***441'070***	***6'961***
Conv' Thermal (1)	***27'387***	***60'612***	***2'213***
Coal (>30 Mwel)	8'940	26'259	2'937
Hard Coal (>30 Mwel)	*8'940*	*26'240*	*2'935*
Lignite (>30 Mwel)	*-*	*19*	*-*
Oil (>30 Mwel)	1'028	8'673	-
Gas (>30 Mwel)	3'453	20'627	-
Conv' Others (2)	***13'967***	***5'053***	
Biomass (wood, wood-waste, biogas)	-	5'046	-
Waste (municipal and industrial waste)	-	7	-
Renewables (3)	***25'449***	***65'218***	
Hydro	25'235	64'877	-
Pumped Storage	-	-	-
Wind	214	341	1'593
Geothermal	-	-	-

Please note: Table is presenting a synthesis from different statistics.
Data may not be consistent, for following reasons:
(1) Conventional Thermal: conv. thermal capacites above 30 MW, power generation from all conventional thermal
(2) Conventional Others: conv. thermal capacites below 30 MW incl. biofuel and waste capacities, power generation from biofuel and waste only
(3) Renewable capacities without biofuel capacities; renewable power generation without biofuels
[source: Eurostat]2003 and 2004; Siemens Database 2005

5.5.4 Power Generation

Conclusion	The increase of electricity production since the 1970s was accompanied by a dramatic increase of nuclear power generation which is now responsible for the largest share of electricity generation, making France one of the largest producers of electricity in Europe. France's electricity production exceeds its demand. The surplus amount is exported to neighbouring countries.

5.5.4.1 Final Energy Consumption: The Role of Electricity

(454) In final energy consumption oil constitutes the largest share of all energy sources (51.2% in 2003).

(455) Electricity and natural gas have shares in final energy consumption of 20.3% each.

(456) Electricity consumption and production has increased since 1973 from 19.9 mtce to 55.2 mtce in 2002 (an increase of about 178%).

5.5.4.2 Power Generation: Overview

(457) Especially power generation from nuclear energy has increased dramatically. In 1973, 14.8 TWh were generated by nuclear power plants whereas in 2004, 448.2 TWh came from nuclear energy.

(458) France is the second-greatest electricity generator and consumer in the EU (behind Germany), ranking seventh in electricity generation (accounting for about 3.5% of the world total) and eighth in electricity consumption (2.9% of the world total) worldwide.

(459) France generates significantly more electricity than it consumes and exports the surplus to neighbouring countries, mainly to Switzerland, the U.K., Italy, and Germany.

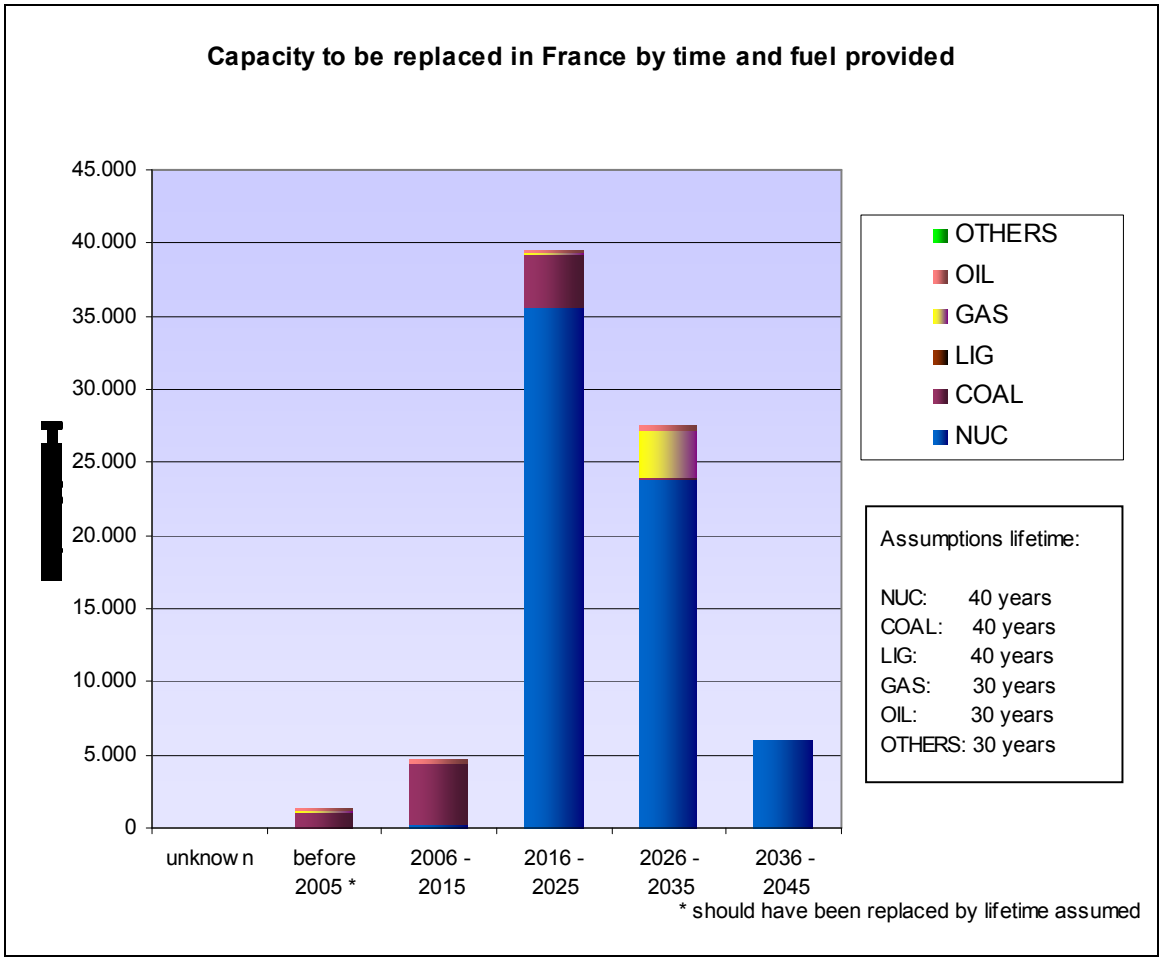

figure 5.5-2 *Capacity Replacements (France)*

(460) Renewables had a 12.4% share in electricity generation in 2003.

(461) Power generation from coal-fired plants is decreasing. In 2003, coal had a share of 4.6% in French power generation.

(462) France has been the slowest in liberalizing its electricity sector. It has opened 30 percent of its electricity market to compeion, but only 5 percent of the country's power companies have third-party access agreements. Further, state-owned Electricité de France (EdF) covers 87 percent of total French electricity demand today and owns the entire national grid, making competition difficult. In January 2004, however, the French Commission de Regulation de l'Energie announced that French electricity (and natural gas) distributors must start testing their computer systems by April 2004 in preparation for open retail markets. Commercial and industrial customers are able to pick their electricity suppliers since July 2005 and residential customers will do so by 2007.

5.5.4.3 Power Generation: Capacities

(463) Total power plant capacities amounted to 106.0 GW in 2004. Hard coal-fired power plants had an installed capacity of 2.4 GW.

(464) France possesses 59 nuclear power plants, which form the second largest integrated system of nuclear power plants in the world. Nuclear energy accounted for 78.3% of total electricity production in 2004. France's annual nuclear power generation has increased by about 40% since the beginning of the 1990s, while annual generation from other sources has not greatly changed during that period [CSFL 2005].

(465) Although the government pursues the aim of promoting renewables, nuclear energy is the crucial energy source for power generation for the future as especially oil and coal will be losing importance in the years to come.

(466) Nuclear power plants have an installed capacity of 63 GW.

5.5.5 Energy Policy in General

Conclusion	The predominant aim of the French energy policy is independence of energy supply. Other policy aims can be linked to this target.

(467) France's major aims are:

- Independence – developing a cost-effective national network. Strong government involvement with a centralised, nation-based approach.
- Security and continuity of supply – procurement of energy sources is to be secured in the long term.
- Diversity of supply – the diversification of energy sources focuses especially on renewables and the extension of nuclear energy.
- Offering energy services at competitive prices to secure compatibility.

5.5.6 Renewable Energy

Conclusion	The French government promotes renewables with feed-in tariffs and plans to promote wind power.

5.5.6.1 Actual Status

(468) France has the highest renewable energy production of all EU countries (expressed in absolute figures).

(469) 98% of renewable energy comes from hydropower and biomass. These technologies have such a dominant market share because they can be operated at competitive prices.

(470) Energy from renewable energy sources added up to an amount of 70.27 TWh in 2003.

(471) Electricity generation by wind power plants is only of inferior significance. Energy from hydro power plants contributes the largest share of renewable energy.

5.5.6.2 *Renewable Policies*

(472) The government intends to keep final energy consumption at the level of 2003 by 2015.

(473) Up to 10.000 MW of wind power are to be installed by 2010.

(474) The government promotes non-hydro renewable installations below 12 MW with feed-in tariffs above market prices. Installations above 12 MW can bid for long term sales contracts.

5.5.6.3 *Outlook*

(475) France is confronted with an expected increase of GHG emissions due to an expected rise in consumption in the transport and the residential sector.

(476) Due to the structure of electricity production there is little room for CO_2 emissions reduction in power generation.

5.5.7 Climate Protection Policy

Conclusion	France's Kyoto target is to keep its GHG emissions at 1990 levels. Because of the large share of nuclear power plants, the energy sector in France contributes only a comparatively small share to the overall GHG emissions. Reduction obligations in the obliged sectors refer to a business-as-usual scenario. Most reductions must be achieved in the sectors outside of the ETS. In the mid-term nuclear power plants are expected to be replaced by gas and coal-fired power plants.

(477) France is the fifth-greatest carbon emitting country in Europe (ranking twelfth worldwide) and is currently responsible for about 1.7% of the world's total fossil fuel-based carbon emissions.

(478) The annual increase of fossil fuel-based carbon emissions since the beginning of the 1990s was comparatively low. France is classified as an Annex I country under the UN Framework Convention on Climate Change and has pledged to limit its carbon emissions to the 1990 level (102 million metric tons) under the EU Burden Sharing Agreement.

5.5.7.1 *Policy and Kyoto Targets*

(479) France is obliged to maintain its GHG emissions at 1990 levels in the 2008-2012 period according to the EU Burden Sharing Agreement.

(480) According to the French national policy, the French industry sector has a reduction target of -28%.

(481) CO_2 emissions are to be reduced by 75% until 2050.

(482) France wants to create incentives for more energy efficiency for its industry.

5.5.7.2 Development of National Emission Inventory

(483) The industry and the energy sector account only for a comparatively small share of the total emission inventory. The share of these sectors amounts to about 28%,

(484) After a period of GHG emission reduction in the 1990s, GHG emissions have been on the rise since the beginning of the decade.

(485) Business-as-usual projections predict an increase of 3.5% in GHG emissions until 2010.

(486) For the 2005-2007 period a 3.5% increase in GHG emissions compared to 1990 levels is expected.

5.5.7.3 National Allocation Plan

(487) France distinguishes between three sectors which are obliged to take part in the emission trading system (ETS): the industry sector, the energy sector and the other energy industries sector.

(488) The obliged sectors have an overall share of 28% of the total national emission inventory. 1'172 installations have to take part in the ETS.

(489) The National Allocation Plan for the 2005-2007 period allocates a total annual amount of 156.51 $MtCO_2$ to all the sectors. The industry sector receives 58.26 $MtCO_2$, (38.6%) the energy sector 64.98 $MtCO_2$ (43.1%), and the other energy industries sector 27.57 $MtCO_2$ (18.3%).

(490) A reserve of 5.69 $MtCO_2$ p.a. is held back for new entrants that receive their emission rights for free. The allocation is based on a best available technology benchmark.

(491) The amount of emission allowances issued complies to a reduction target of -2.43% compared to the business as usual reference scenario.

(492) Each sector receives its allowances based on its historic emissions in the 1998-2001 average. Every single installation within a predefined sector then receives allowances according to a distribution key which includes the highest emissions over three years between 1996 and 2002, a progress factor of -5%, a sector specific growth factor and a compliance factor of -2.43%, as mentioned above.

(493) Early action is only rewarded as the participants can choose a reference period which dates back to 1996.

(494) The French government is planning to purchase credits for additional measures (CDM/JI) as well as to establish a carbon fund of 50 million € for this purpose.

5.5.7.4 Implications And Outlook

(495) France will have difficulties complying with its Kyoto target. However, France might achieve its target by implementing additional efforts.

(496) Most difficulties with the target compliance can be attributed to the sectors that are not taking part in the ETS. Particularly the transport sector contributes significantly to the total national emissions.

Additional policy measures are expected concerning the sectors which are not participating in the ETS.

(497) The intention to buy CDM and JI credits indicates the necessity of additional measures if the French government wants to comply with its Kyoto targets and the Burden Sharing Agreement, respectively.

(498) The reduction obligation for the ETS participants will put France in a position in which the country will be short of allowances if business-as-usual projections will apply.

(499) In the long term, the French government assumes that decommissioned nuclear power plants will be replaced by coal and especially gas-fired power plants, causing increasing emissions from the energy sector. This applies to a period from about 2015 or 2020 to 2030.

(500) In the short term, particularly in the first reduction period, the number of coal-fired installations will be reduced as nuclear power plants will not be decommissioned on a large scale. Moreover, the ETS incentivizes investors to refrain from coal-fired facilities.

5.6 Italy (IT)

(501) Italy is a republic that is made up of 20 regions, 103 provinces and 8101 municipalities. Italy's surface area is 301'300 km2. The country is located in southwestern Europe. Italy's capital is Rome.

(502) In the North, Italy has borders with Switzerland and Austria. In the Northwest it is bordered by France, and in the Northeast it has a common border with Slovenia. Most of the country is surrounded by the Mediteranian.

(503) Italy is highly dependant on imports in order to meet its energy demand. There are deposits of oil and gas which are being exploited.

(504) Italy is member of the European Union (EU 25) and the OECD.

5.6.1 Socioeconomic Framework

(505) In Italy live about 58 Million people. The number of inhabitants is expected to decrease until 2030. The fertility rate is rather low.

(506) The Italian GDP is expected to rise moderately by an annual growth rate of about 2% in average.

table 5.6-1 *Assumptions for Future Economic Development (Italy) [DG TREN 2003]*

		1990	**2000**	**2010**	**2020**	**2030**
Population	[million]	56.72	57.76	57.92	56.61	54.65
GDP	[€ billion]	996.6	1'164.8	1'470.8	1'836.4	2'262.8
			1990/2000	**2000/2010**	**2010/2020**	**2020/2030**
Population Growth	[%]		-1.07	-0.92	-0.92	-0.72
GDP Growth	[%]		1.6	2.4	2.2	2.1

5.6.2 Primary Energy Consumption

Conclusion	Italy has to import most of its primary energy sources. The country also has to import electricity on a large scale. Coal is one of the important pillars of Italian primary energy supply. Coal is also imported and is expected to gain significance. The use of natural gas will increase dramatically in connection with the replacement of oil-fired power plants.

(507) Most of the Italian primary energy supply comes from the combustion of fossil fuels. Nearly half of the primary energy supply is assigned to oil (48.3%). Natural gas accounts for more than one-third (35.0%) and coal for 8.2% of primary energy consumption (2003 figures).

(508) Italy is a net energy importer, and presently consumes almost six times the amount of energy it produces. Italy is dependent on outside sources for almost all of its crude oil, natural gas, and coal. The country even imports a significant part of its electricity supply *[CSLF 2005]*. In 2004 the gap was about 45 TWh. Electricity is mainly imported from France and Switzerland.

(509) The option to use nuclear power was excluded in a 1987 referendum.

table 5.6-2 *Primary Energy Supply (Italy) [source: Eurostat 2004]*

Energy Source		1990	2000	2002	2003	Share PES in 2003 [%]
Total	**[mtce]**	**211.47**	**246.85**	**247.95**	**258.61**	**100.0**
Solid fuels	[mtce]	20.90	17.94	19.61	21.25	8.2
Oil	[mtce]	121.13	125.80	124.93	124.87	48.3
Gas	[mtce]	55.70	82.75	82.41	90.48	35.0
Nuclear	[mtce]	0.00	0.00	0.00	0.00	0.0
Renwables	[mtce]	9.48	14.91	14.77	15.75	6.1

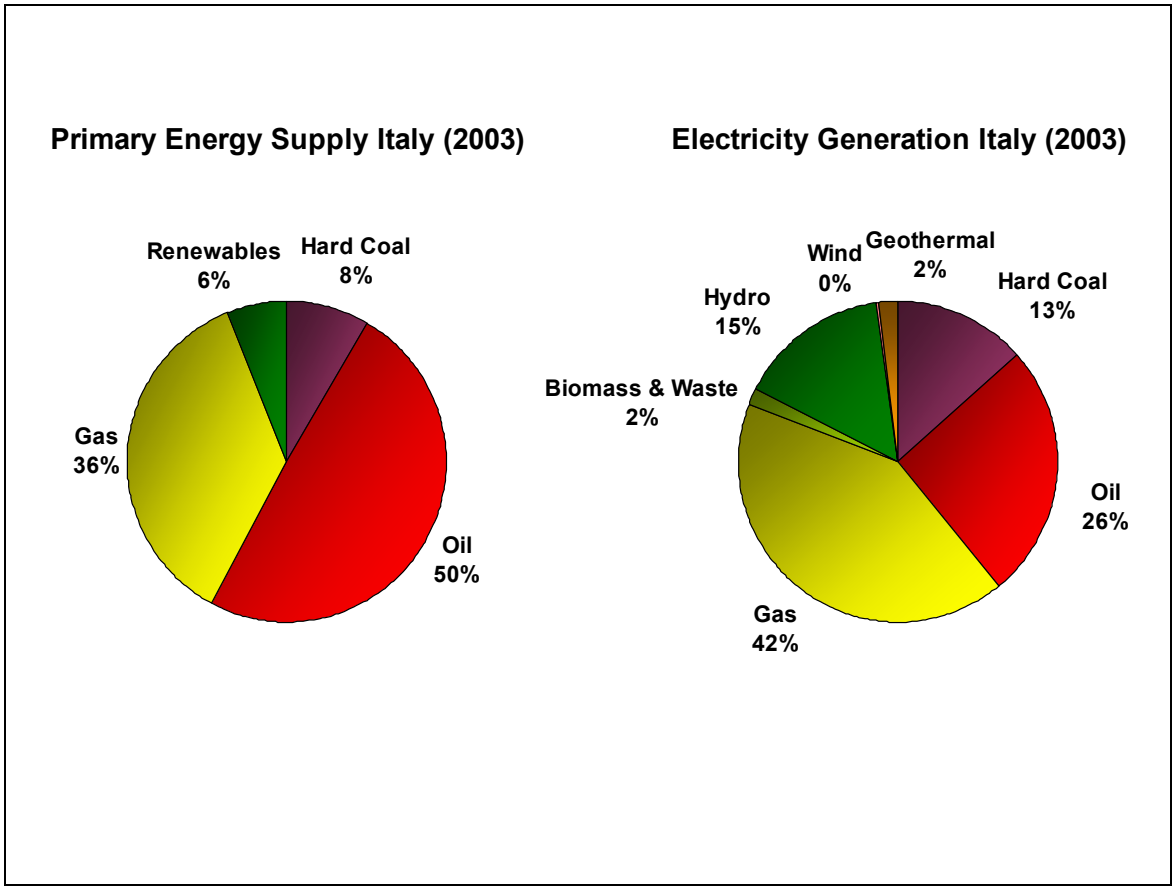

figure 5.6-1 *Primary Energy Supply and Electricity Generation (Italy)*

table 5.6-3 Primary Energy Consumption and Domestic Production (Italy)[source: IEA 2005a]

Primary Energy Consumption	Primary Energy	Domestic Production	Domestic Production Share
	[Mtce]	[Mtce]	[%]
Total	**258.61**	**40.14**	**15.5**
Coal	21.25	0.23	1.1
Hard Coal		0.23	
Steam Coal		0.23	
Coking Coal		0.00	
Lignite and Peat		0.00	
Oil	124.87	7.92	6.3
Natural Gas	90.48	16.24	18.0
Nuclear Energy	0.00	0.00	0.0
Renewables	15.75	15.75	17.4

(510) The indigeneous production of oil can cover only small amounts of domestic demand. Although domestic production declined at the beginning of the decade, there are still considerable proven recoverable reserves left (580 million barrels in 2000).

(511) The share of natural gas in primary energy supply is increasing continuously especially due to its growing importance in power generation. There are plans for building new LNG terminals in the years to come. Italy's natural gas production is declining, and proven reserves are rather small. In 2002, domestic production accounted for roughly 20% of domestic gas demand.

(512) The share of renewables in primary energy consumption was at 6.3% in 2003.

5.6.3 The Role of Coal

(513) Italy's primary energy supply mainly depends on fossil fuels. Coal is an important energy source along with oil and natural gas.

(514) Italy neither produces hard coal nor lignite and is therefore fully dependent on coal imports. The country ceased its domestic coal production in 2000.

(515) Hard coal is exclusively imported. In 2004, Italy imported about 24 Mt of hard coal which was primarily used for power generation. The imports mainly came from South Africa (7 Mt), Indonesia (2.8 Mt), Colombia (3.1 Mt), and Russia (1.9 Mt).

(516) The importance of coal in primary energy supply is expected to grow as Italy strives to curtail the use of oil power production in order to diversify its energy mix. By 2010 the share of coal in total primary energy supply is expected to rise to 22% (government prognosis).

5.6.3.1 Hard Coal

(517) Italy produces no hard coal, though coal contributes about 8% to Italy's primary energy demand. Italy imports steam coal from a va-

riety of places including South Africa, Indonesia, Colombia, the United States, China, and Australia. Demand is increasing, mostly from additions to coal-fueled power generation capacity *[CSLF 2005]*.

(518) All of the hard coal used in Italy is imported. (24 Mt in 2004), most of which was steam coal to be used for power generation purposes.

5.6.3.2 Reserves & Production

(519) Italy possesses no reserves of hard coal or lignite since its production ceased. The Italian coal resources are negligible.

(520) Italy has proven natural gas reserves of about 8 trillion cubic feet (tcf), which is less than a twenty-year supply at current production rates. Italy's gas consumption is presently third-highest in Europe, behind Germany and the United Kingdom *[CSLF 2005]*.

(521) Domestic gas production is declining. Proven gas reserves are estimated to be over 200 bcm. The major fields are located in the Po region and in the Adriatic Sea.

(522) Gas consumption is growing at a steady rate, and gas consumption in 2001 was fully 50% greater than it was in 1990. Most of Italy's gas imports presently come from Algeria and Russia, but there is a project underway to bring in gas from Libya via a new pipeline running under the Mediterranean from Libya to Sicily. *[CSLF 2005]*

(523) Italy is also increasing its ability to import liquefied natural gas (LNG) by constructing additional regasification terminals at some of its port facilities. LNG now accounts for about 10% of Italy's natural gas imports *[CSLF 2005]*.

(524) Proven oil reserves were 79 Mt (580 million barrels) in 2000. The reserves yet to be found are estimated to be from 850 million bbl to 3'750 million bbl.

5.6.4 Power Generation

Conclusion	Electricity demand has been increasing faster than total final energy demand since 1990. The proportion of the energy sources remained nearly unchanged. Electricity is partly imported from neighbouring countries. Existing power generation facilities are mainly coal or gas-fired. Renewables have a high share. The Italian power plants are fairly old. Replacements and new capacities to reduce the import dependency will chiefly be installed as coal and gas-fired power plants.

5.6.4.1 Final Energy Consumption: The Role of Electricity

(525) As in primary energy consumption, oil plays a dominant role in final energy consumption (nearly 49% in 2003).

(526) Between 1990 and 2002 demand for electricity increased by more than 30% while total final energy demand increased by 16%. Electricity's share in final energy demand rose from 17.2% to 19.5% within the same period.

(527) The structure of final energy consumption remained nearly unchanged within the past decade.

5.6.4.2 Power Generation: Overview

(528) Most of Italy's domestic produced electricity comes from fossil fuels, though a shift is occurring away from oil toward natural gas. Italy presently imports more than 15% of the electricity it consumes, mostly from France and Switzerland

(529) taly phased out nuclear power abruptly in 1987 subsequently to the Czernobyl catastrophy. The four functioning nuclear power plants at that time have been dismantled.

(530) Most of Italy's power generation facilities are combustion power plants. In 2003, natural gas (41.7%) and oil (25.9%) fired power plants had the largest share of total domestic electricity generation.

table 5.6-4 Installed Power Plant Capacities (Italy)

Installed Power Plant Capacities			
	[Mwel]	[GWh]	[h full cap'] (4)
Total	**78'255**	**293'865**	**3'755**
Nuclear	**-**	**-**	**-**
Conv' Thermal (1)	***56'053***	***242'789***	***4'331***
Coal (>30 Mwel)	11'352	38'813	3'419
Hard Coal (>30 Mwel)	*11'277*	*38'813*	*3'442*
Lignite (>30 Mwel)	*75*	-	-
Oil (>30 Mwel)	2'462	75'986	-
Gas (>30 Mwel)	25'364	122'604	-
Conv' Others (2)	***16'875***	***5'386***	
Biomass (wood, wood-waste, biogas)	-	3'456	-
Waste (municipal and industrial waste)	-	1'930	-
Renewables (3)	***22'202***	***51'076***	
Hydro	20'666	44'277	-
Pumped Storage	-	-	-
Wind	870	1'458	1'676
Geothermal	666	5'341	8'020

Please note: Table is presenting a synthesis from different statistics.
Data may not be consistent, for following reasons:
(1) Conventional Thermal: conv. thermal capacites above 30 MW, power generation from all conventional thermal
(2) Conventional Others: conv. thermal capacites below 30 MW incl. biofuel and waste capacities, power generation from biofuel and waste only
(3) Renewable capacities without biofuel capacities; renewable power generation without biofuels
[source: Eurostat]2003 and 2004; Siemens Database 2005

(531) New power-generating facilities, at least in the near future, will be fueled by natural gas and coal. Clean coal technologies such as fluidized-bed combustion and integrated gasification combined cycle are expected to be used for any new coal-fueled power plants *[CSLF 2005]*

(532) Renewables had a 19.2% share in electricity generation in 2003.

(533) In September 2003, a power failure caused by falling tree limbs cut off power to 55 million people in Italy for 18 hours, attributed, at least in part, to the slow reaction of ETRANS (the Swiss firm that coordinates participation in Europe's grid) to inform Italian grid operator Gestore della Rete di Trasmissione [EIA 2005].

(534) Total power plant capacities amounted to 60.1 GW in 2004. Hard coal-fired power plants had an installed capacity of 5.7 GW.

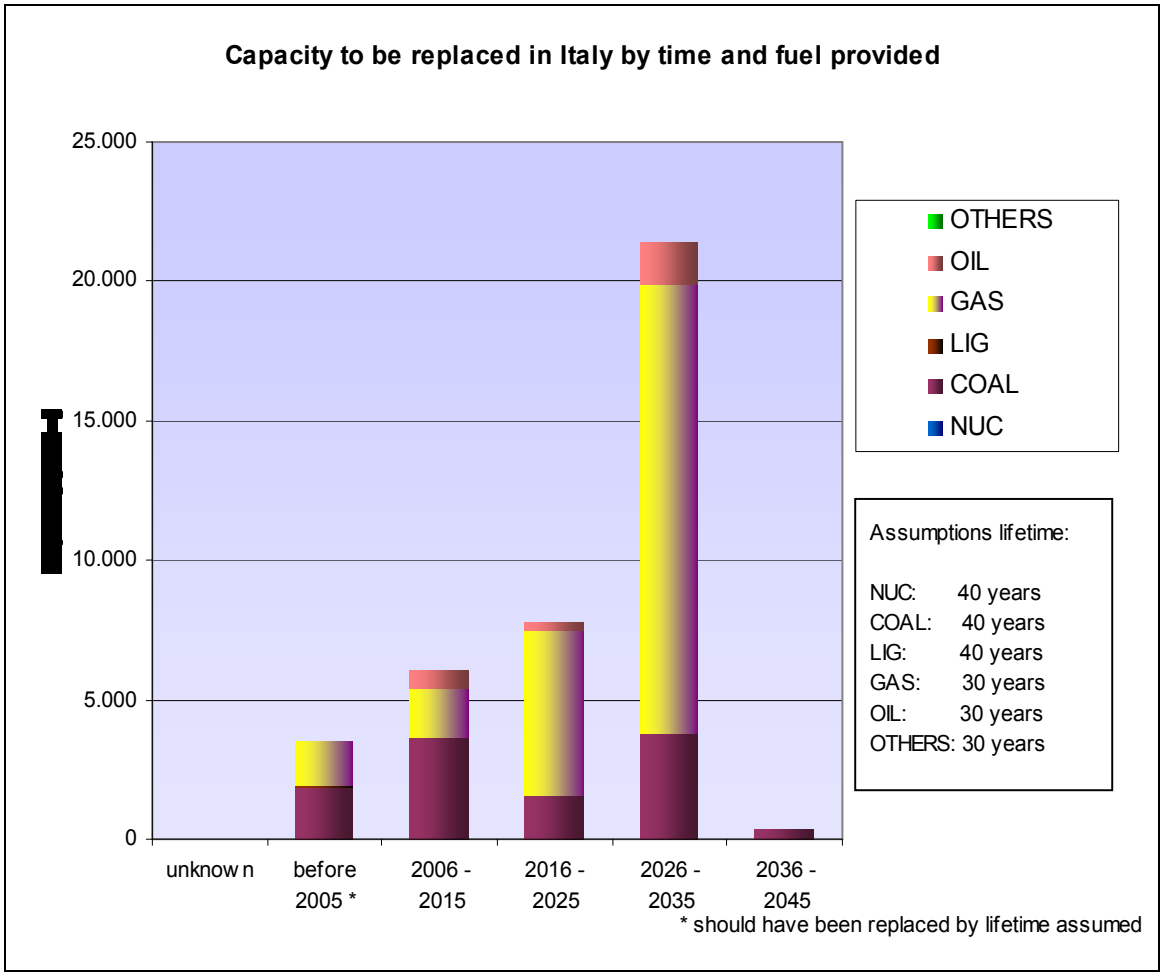

figure 5.6-2 *Capacity Replacements (Italy)*

(535) The share of installed capacity of renewables including hydropower is relatively high. While conventional thermal power stations covered about 68%, hydropower accounted for nearly 30% of installed capacity. Other renewables (wind, geothermal) only accounted for about 2% of installed capacity (Eurostat figures).

(536) The average Italian generating capacity is of old age (24 years at the end of 2001), and the reserve margin is decreasing. Increasing electricity demand and the need to replace outdated power plants require new capacities in the near future.

5.6.5 Energy Policy in General

Conclusion	Italy's energy policy primarily aims at reducing the country's import dependency.

(537) Italy's major energy policy objectives are:

- Diversification of supply sources – Italy is highly dependent on imports concerning primary and final energy consumption. A diversification will secure future energy supply. The government promotes renewables and wants to increase the share of coal which is below EU-average in order to be less dependent on oil and gas imports.
- Energy security – diversified supply sources serve the objective of energy security. Energy security received special attention due to black outs in 2003
- Energy efficiency – curbing final energy consumption in order to reduce the increase of energy demand.
- Environmental protection – obeying to Kyoto targets, i.e. reducing GHG emissions by 6.5% and refraining from the producing nuclear energy.
- Market liberalization – Liberalising especially the gas and electricity markets.

(538) New power-generating facilities, at least in the near future, will be fueled either by natural gas or coal. Clean coal technologies such as fluidized-bed combustion and integrated gasification combined cycle are expected to be used for any new coal-fueled power plants *[CSLF 2005]*

5.6.6 Renewable Energy

Conclusion	Renewables in electricity generation are promoted by legal quotas to be fulfilled by big electricity providers. A system of green certificates was established for this purpose. This is in line with Italy's intention to use a more market oriented approach in dealing with renewable energies.

(539) Most of the energy produced by renewables in Italy comes from hydropower (approximately 80%). With about 5.3 GWh in 2002 Italy is one of the few significant producers of geothermal energy. Wind (3%) and biomass (5%) were of minor importance.

(540) The overall contribution of renewables to domestic electricity production amounted to 56.46 TWh in 2003.

(541) Since 2002, electricity providers generating or importing more than 100 GWh are obliged to supply at least 2% of electricity produced by renewables. This quota will be lifted up to 2.35% in 2005, 2.7% in 2006 and 3.05% in 2007. For this purpose a trade system with green certificates was established.

(542) The government has the objective to raise the output of renewables to 76 TWh (9.93 mtce) in 2010.

(543) Additionally the government issued objectives for the amounts to be delivered by different renewable energy sources in 2010 to achieve a level of 5% of total primary energy supply.

(544) The objectives concerning energy supply from renewables can presumably not be achieved with the legal quotas.

(545) Italy is moving towards a more market-oriented approach to deal with renewables. Financial promotion of specific technologies has been reduced.

(546) It is possible that the legal quotas for the supply of energy generated by renewables will be lifted in order to comply with the GHG reduction targets.

5.6.7 Climate Protection Policy

Conclusion	Italy is not on track concerning its Kyoto reduction target of 6.5%. The national allocation plan supports new investments in coal and gas-fired power plants due to a large reserve for new entrants. Reduction efforts have to be made in sectors which are not obliged by the ETS. Furthermore, flexible mechanisms will have to be used on a large scale.

(547) Italy currently is responsible for about 1.8% of the world's total fossil fueled-based carbon emissions (ranking it 10th in the world), but has taken some steps to reduce its carbon emissions, including encouraging the use of natural gas for power generation and implementing a carbon tax (in 1999). Increased use of renewable energy is also a national priority; Italy now funds more than 25% of all photovoltaic research in the EU, and Italy already ranks 5th in the world in geothermal electricity generation *[CSLF 2005]*.

5.6.7.1 Policy and Kyoto Targets

(548) Italy's is obliged to reduce its GHG emissions by 6.5% in the 2008-2012 period compared to 1990 levels according to the Burden Sharing Agreement.

(549) The considerations to promote the diversification of Italy's energy mix and to reduce the use of oil play an important role in the country's climate policy.

5.6.7.2 Development of National Emission Inventory

(550) The participants of the emission trading system (ETS) account for more than 40% of the total emissions.

(551) Italy is not on track concerning its linear target path to the Kyoto aim. Emissions have increased significantly since 1990. In 2001, the gap between the country's actual total emissions and the target path amounted to 10.7%.

(552) Business-as-usual projections predict an increase of 12% of all GHG emissions until 2010.

5.6.7.3 National Allocation Plan

(553) The obliged sectors comprise 1'240 installations that are part of the ETS.

(554) Allowances are issued to the energy and the industry sector.

(555) The Italian National Allocation Plan for 2005-2007 allocates three different amounts of allowances for each year. 239.96 $MtCO_2$ (42.9% of total emissions) will be allocated to the participants in 2005. This amount will rise to 240.57 $MtCO_2$ in 2006 and to 241.61 $MtCO_2$ in 2007.

(556) There is a large reserve intended for newcomers in the energy sector. Its size is 112.74 $MtCO_2$ for the 2005-2007 period. New entrants receive their allowances free of charge. A possible rest of the reserve can be sold at the market. New installations and extensions receive their allowances according to best available technology standards while installations re-commencing operation after at least one year receive their allowances on the basis of existing installations.

(557) According to the allowances issued in Italy, the country has no reduction target within the ETS. The emission cap for CO_2 emissions for the participants resembles an increase of 7.4% compared to the emissions in the base period.

(558) The business-as-usual scenario which is referred to in the National Allocation Plan incorporates an increase of GHG emissions of 12% compared to 1990 levels.

(559) The sectoral allocation is generally based on the historic emissions in the base period. An exception is made in the electricity generating industry where future projections and a possible ex-post adjustment are additional criteria to be considered.

(560) Early action is rewarded since the allocation of allowances is based on historical emissions.

5.6.7.4 Implications And Outlook

(561) Italy is not on track concerning its Kyoto target. GHG emissions are above the linear target path and have increased constantly since 1990.

(562) The National Allocation Plan promotes the national energy policy aims of diversifying the national energy mix and reducing the country's dependency on energy imports, especially oil.

(563) Therefore the Italian National Allocation Plan can be seen as a means of promoting investments in the domestic energy sector. The Italian government favours more investments in electricity generation based on hard coal and gas.

(564) The industry sector does not experience the same privileges as the energy sector concerning the size of the reserve for new entrants.

(565) As Italy is about to fail its Kyoto target, the purchase of JI/CDM credits is a realistic option to reduce the gap between the actual emission path and the linear target path. The government has ut-

tered its will to promote such measures as a means to reduce its emissions.

(566) Due to the comparatively generous allocation of allowances, Italy might be a net seller of certificates depending on the further development of its industry. Investments in the energy sector are likely. Especially coal and gas-fired power plants are possible.

(567) However, the long term perspective for the Italian ETS participants may change if the government wants to comply with its Kyoto target in the 2008-2012 period.

5.7 The Netherlands (NL)

(568) The Netherlands is a constitutional monarchy consisting of 12 provinces. It covers an area of 41'528 km2. The capital is Amsterdam and the seat of the government is located in The Hague.

(569) The Netherlands is located in northwestern Europe. The northern and western borders are formed by the North Sea Coast. In the South, the country has a border with Belgium. To the East the Dutch territory is bordered by Germany.

(570) There are significant deposits of oil and particularly natural gas which are the country's most important natural resources. Moreover, the Netherlands produces moderate amounts of metallic and non-metallic minerals.

(571) The Netherlands is member of the European Union (EU 25) and the OECD.

5.7.1 Socioeconomic Framework

(572) The Netherlands' population is about 16 million. It is expected to remain almost stable, with a modest growth rate in the forthcoming decades reaching nearly 18 million in 2030.[10]

(573) The expected annual economic growth ranges near the average growth of the EU-25 countries of above 2%.

table 5.7-1 *Assumptions for Future Economic Development (The Netherlands)*

		1990	**2000**	**2010**	**2020**	**2030**
Population	[million]	14.95	15.92	16.82	17.40	17.86
GDP	[€ billion]	301.4	401.1	503.1	630.3	780.1
			1990/2000	**2000/2010**	**2010/2020**	**2020/2030**
Population Growth	[%]		0.63	0.55	0.34	0.26
GDP Growth	[%]		2.9	2.3	2.3	2.2

5.7.2 Primary Energy Consumption

Conclusion	Primary energy supply resembles the importance of the domestic energy sources as gas and oil are prevailing. Coal is imported to the Netherlands and used for power generation.

(574) Total primary energy supply amounted to 115.47 mtce in 2003. Natural gas (44.5%) and oil (39.0%) are the fuels that dominate

10 Population and growth projections by EU DG TREN. Other sources expect no significant growth of population and a more modest economic growth rate (information by EURACOAL experts)

the Dutch primary energy mix. Coal contributed 10.8% while nuclear power and renewables were of minor significance accounting for 1.5% and 2.9%, respectively.

(575) Primary energy consumption in the Netherlands reflects the importance of the country's main resources. Especially gas production exceeds domestic demand.

(576) Because of its large deposits of natural gas, the country's import dependency of 37.6% is far below the EU-25 average.

table 5.7-2 *Primary Energy Supply (The Netherlands)*

Energy Source		1990	2000	2002	2003	Share PES in 2003 [%]
Total	**[mtce]**	**95.18**	**108.25**	**112.23**	**115.47**	**100.0**
Solid fuels	[mtce]	12.72	11.42	11.97	12.49	10.8
Oil	[mtce]	34.78	40.86	42.64	45.04	39.0
Gas	[mtce]	44.00	49.57	51.19	51.41	44.5
Nuclear	[mtce]	1.30	1.46	1.46	1.50	1.3
Renewables	[mtce]	1.24	2.61	2.96	2.95	2.6

[source: Eurostat]

table 5.7-3 *Primary Energy Consumption and Domestic Production (2003)*

Primary Energy Consumption	Primary Energy	Domestic Production	Domestic Production
	[Mtce]	[Mtce]	[%]
Total	**115.47**	**83.50**	**72.3**
Coal	12.49	0.00	0.0
Hard Coal		0.00	
Steam Coal		*0.00*	
Coking Coal		*0.00*	
Lignite and Peat		0.00	
Oil	45.04	4.48	
Natural Gas	51.41	74.57	145.0
Nuclear Energy	1.50	1.50	100.0
Renewables	2.95	2.95	100.0

[Source: IEA 2005a]

(577) The Netherlands operated two nuclear power plants at Borssele and Dodewaard which were chiefly used for research purposes. The unit in Dodewaard has been closed. Borssele was to be shut down in 2003 but the government decided to keep it operating in order to comply with its targets to reduce GHG emissions. Operating time hase been extended to 2033.

(578) Primary energy demand has increased moderately since 1990. The proportions within the primary energy mix remained almost unchanged with gas and oil playing the most important roles. A nuclear phase out would not have a significant impact on Dutch energy supply as the share of nuclear energy is comparatively small.

5.7.3 The Role of Coal

Conclusion	There are no reserves or resources of coal or lignite. Natural gas and oil reserves exist and are being exploited.

(579) Imports of hard coal contributed 10.7% to primary energy supply. Hard coal is predominantly used for power generation, i.e. mainly steam coal is imported to the Netherlands.

(580) Lignite is not part of the primary energy mix.

(581) Overall primary energy supply from coal amounted to nearly 12.5 mtce in 2003.

(582) Hard coal was mined in the south Limburg area until the mid-1970s. The hard coal field was exploited by means of deep mining operations. The Netherlands still disposes of considerable hard coal resources and reserves. However, these reserves are not mined.

(583) Lignite was produced in opencast mines until 1968. The country's lignite reserves are now depleted.

(584) Natural gas is the most important energy resource. Proven reserves were 1'670 bcm at the end of 2003.

(585) The Dutch oil reserves amounted to 30 Mt in 2004. Resources were estimated at 60 Mt. Production of oil in the Netherlands amounted to 3.0 Mt. *[BGR 2005]*

table 5.7-4 *Resources, Reserves and Production of Hard Coal and Lignite The Netherlands (2004)*

Reserves and Resources	Resources	Reserves	Production	Static Res
	[Mt]	[Mt]	[Mt]	[a]
Hard Coal	1'406.0	497.0	-	-
Lignite	-	-	-	-

[Source: BGR 2005]

5.7.4 Power Generation

Conclusion	Gas and coal-fired power plants dominate Dutch power generation. The power generation capacities are considered to be sufficient in the mid-term. Final energy consumption in the Netherlands totalled 88.75 mtce in 2003. As in other EU-25 countries, final energy demand has increased constantly. The share of gas declined from almost 50% in 1990 to less than 38% in 2003. The share of oil is at 43.1%.

5.7.4.1 Final Energy Consumption: The Role of Electricity

(586) Electricity consumption increased along with final energy demand. The share of electricity has increased moderately since 1990 and amounted to almost 14% (12.35 mtce) in 2003. Yet within this period electricity demand increased by 36% in absolute terms.

(587) The share of renewables in final energy demand was below 1% in 2003.

5.7.4.2 Power Generation

(588) Total domestic power generation amounted to 96.78 TWh in 2003.

(589) Dutch power is predominantly generated by gas-fired (62.5%) and coal-fired (25.0%) power plants.

(590) Renewables accounted for 5.7% of total electricity generation.

(591) The absolute amount of electricity generated by coal-fired power plants has decreased slightly since 1990 even though total electricity production increased from a level of 71.97 TWh in 1990 to 96.78 TWh in 2002, which complies to a relative increase of about one-third.

table 5.7-5 Installed Power Plant Capacities (The Netherlands)

Installed Power Plant Capacities			
	[MWel]	**[GWh]**	**[h full cap] (4)**
Total	**20'791**	**96'775**	**4'655**
Nuclear	***449***	***4'018***	***8'949***
Conv' Thermal (1)	***19'421***	***91'355***	***4'704***
Coal (>30 MWel)	5'442	24'339	4'472
Hard Coal (>30 Mwel)	*5'442*	*24'339*	*4'472*
Lignite (>30 MWel)	-	-	-
Oil (>30 MWel)	220	2'858	-
Gas (>30 MWel)	7'471	60'008	-
Conv' Others (2)	***6'288***	***4'150***	
Biomass (wood, wood-waste, biogas)	-	3'898	-
Waste (muncipal and industrial waste)	-	252	-
Renewables (3)	***921***	***1'402***	
Hydro	37	72	-
Pumped Storage	-	-	-
Wind	884	1'330	1'505
Geothermal	-	-	-

Please note: Table is presenting a synthesis from different statistics.
Data may not be consistent, for following reasons:
(1) Conventional Thermal: conv. thermal capacites above 30 MW, power generation from all conventional thermal
(2) Conventional Others: conv. thermal capacites below 30 MW incl. biofuel and waste capacities, power generation from biofuel and waste only
(3) Renewable capacities without biofuel capacities; renewable power generation without biofuels
[source: Eurostat]2003 and 2004; Siemens Database 2005

5.7.4.3 Power Plant Capacities

(592) Power generation capacities amounted to 20.8 GW in 2002, 19.6 GW or 94% of this were conventional thermal power plants, mainly gas and coal-fired.

(593) Installed capacity of renewable energy sources was slightly above 0.7 GW which complies to a proportion of 3.4%.

(594) The Netherlands has not depleted its potential for wind energy capacities, yet. Especially offshore wind farms are a realistic option for The Netherlands. The Dutch government aims at installing some 6 GW of wind power capacity by 2020.

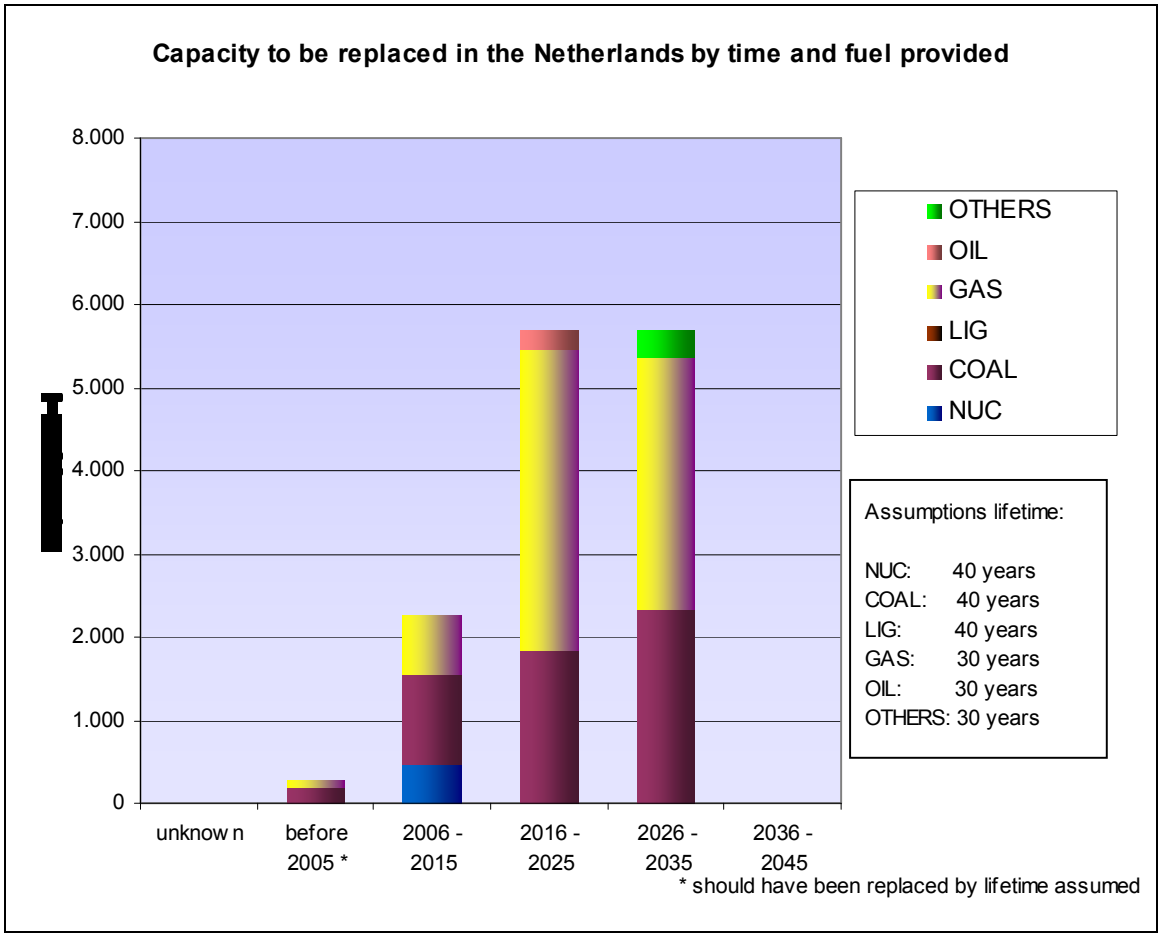

figure 5.7-1 *Capacity Replacements (The Netherlands)*

(595) The average age of Dutch power generating units is around 15 years. There is no need to replace large amounts of generating capacity in the near future. The lifetime of older power plants will presumably be prolonged. Furthermore, some power plants have been mothballed and can be reactivated if necessary. In the short term there will be no need for significant investments into power generation capacities according to the Dutch transmission net operator TenneT.

(596) Even though The Netherlands disposes of a sufficient amount of generating capacity it might well be affected by the generation capacities of its neighbouring countries. As Belgium and Germany plan to phase out nuclear energy, the amount of imported electricity might decrease in the future.

5.7.5 Energy Policy in General

Conclusion	Dutch energy policy supports competitiveness on energy markets and the efficient handling of fossil fuels especially gas in order to achieve a high degree of independence from energy imports.

(597) The guidelines of Dutch energy policy are:

- Sustainability – The Netherlands advocates the efficient use of fossil fuels. This also includes the promotion of renewables and the Dutch National Allocation plan.
- Liberalisation of energy markets – Establishment of free market principles in order to strengthen the customers' position and to integrate the Dutch energy markets into the European and international energy markets. The government aims at the creation of a European level playing field for energy markets.
- Security of supply – Supply of natural gas, oil, and electricity is to be secured in the short term and in the long term. Stimulating investments into new generation capacities and promoting the exploitation of new natural gas deposits are considered to be appropriate measures to increase the Dutch security of supply.

5.7.6 Renewable Energy

Conclusion	The Netherlands pursues a diversified policy in order to promote renewables. Several measures have been taken in order to promote renewables, such as an ecotax, fixed feed-in tariffs, and the promotion of energy efficiency in voluntary covenants.

5.7.6.1 Actual Status

(598) The share of renewables in primary energy supply (2.2%) is rather low.

(599) Electricity generation from renewable energy sources has a 4.2% share.

(600) Biomass and waste are the most important renewable energy sources accounting for nearly the complete energy production from renewable sources. Wind, hydropower, and photovoltaics contributed negligible amounts to Dutch electricity production.

5.7.6.2 Renewable Policies

(601) The government targets are to reach a level of 10% of total primary energy consumption from renewable energy sources by 2020 and 17% of electricity production, respectively. By 2010, The Netherlands wants to achieve a level of 5% for primary energy production and 8.5% for electricity consumption.

(602) There was an ecotax (REB) in place which was implied on electricity generated by fossil fuels. Renewables were exempted from the tax in order to stimulate the demand for electricity from renewable energy sources.

(603) However, the ecotax exemption was reduced substantially and a system with fixed feed-in tariffs was established (MEP) in order to promote the supply of renewable energy. The highest tariffs are paid for offshore wind, photovoltaics, hydro, as well as wave and tide energy.

(604) Further measures include special rules of deduction for investments in renewable energy and in energy efficiency as well as the promotion of research and development programmes in the renewable energy sector.

(605) The Netherlands pursues an energy efficiency policy which is targeted at improving the country's overall efficiency by 1% annually. This target will be lifted up to 1.3% from 2008 and to 1.5% from 2012, respectively. To implement this objective the government concluded a benchmarking covenant in which large parts of the Dutch industry pledged to achieve the best international energy efficiency standard by 2012. The participation is on a voluntary basis.

5.7.6.3 Outlook

(606) The implementation of feed-in tariffs will help to boost the share of renewables.

(607) The government will support investments into wind parks and plans to install 1.5 GW onshore by 2010 and about 6 GW offshore by 2020. Recent budget discussions however may give reason to doubt this.

(608) As the Netherlands has managed to stabilize its GHG emissions in recent years, the reduction target can only be achieved by additional measures promoting renewables. The government considers biomass an appropriate fuel to reduce its domestic GHG emission. Biomass is to be used as an extra fuel in coal-fired power plants that is to replace up to 30% of coal (0.475 GW).

5.7.7 Climate Protection Policy

Conclusion	The reduction target of the Kyoto Agreement of 6% compared to 1990 levels will only be achieved if the Dutch government complies to its target of purchasing CDM an JI credits on a large scale. The national emission inventory is to remain constant while the reduction effort for the obliged sectors is made through the purchase of the credits.

5.7.7.1 Policy and Kyoto Targets

(609) According to the Burden Sharing Agreement The Netherlands has to reduce its GHG emissions by 6% in 2008-2012 compared to 1990 levels.

(610) The Dutch strategy to achieve this target is based on the intention to keep domestic emissions of the ETS participants at a constant level and to buy CDM/JI credits simultaneously.

5.7.7.1 Development of National Emission Inventory

(611) The Netherlands is on track concerning its linear Kyoto target path. Recent estimates show that there are no significant deviations from the target path if CDM/JI credits are bought in the intended amount.

(612) The Dutch reference scenario for business-as-usual assumptions indicates a moderate increase of GHG emissions from 219 $MtCO_2$ in 2000 to 239 $MtCO_2$ in the 2008-2012 period.

5.7.7.2 National Allocation Plan

(613) The Dutch National Allocation Plan applies for 333 installations. However, the Dutch government has created a collective opt-out for installations emitting less than an annual amount of 25'000 tCO_2. Therefore the plan applies to 259 facilities.

(614) The allowances are allocated free of charge. The allocation per installation is based on historic emissions in 2001-2002, expected sector growth, the degree of energy efficiency and a correction factor of 3%. For electricity producing installations fixed efficiency requirements are applied. Energy efficiency requirements result from covenants. If no covenant has been signed, an energy efficiency improvement of 15% applies.

(615) In the 2005-2007 period 115 $MtCO_2$ are available for emission trading. 98.3 $MtCO_2$ are handed out to the Dutch ETS participants. In the 2008-2012 reduction period the overall amount of available emissions will be 112 $MtCO_2$ p.a. of which 95.5 $MtCO_2$ will be allocated. The share of emissions incorporated in the ETS is 56%.

(616) The industry sector and the energy sector are summarised in the ETS, i.e. the overall amount of allowances is proportionally allocated to every single installation.

(617) The Dutch Allocation Plan formulates emission targets for specific sectors until 2010. The energy and industry sector have a target of 112 $MtCO_2$ for 2010. The CO_2 emissions of these sectors amounted to 101.2 $MtCO_2$ in 2000.

(618) The annual reserve for newcomers is 4 $MtCO_2$. Allowances for newcomers are allocated according to sector growth assumptions and a best available technology benchmark. If there are allowances left by the end of 2006, the remaining allowances are distributed proportionally to the participants according to the initial allocation.

(619) Early action is incorporated by considering energy efficiency measures. The (historic) energy efficiency measures are part of the allocation formula.

5.7.7.3 Implications And Outlook

(620) The Netherlands is nearly on track concerning its Kyoto target under the assumption that the country will purchase an annual amount of 20 $MtCO_2$ of CDM/JI credits. If CDM/JI credits cannot be acquired in the aspired amount, the country will definitely fail its target.

(621) By choosing to fulfill the Kyoto reduction obligation with flexible mechanisms, the Dutch government has alleviated the pressure imposed on the ETS participants.

(622) Nevertheless, particularly the investment in energy efficiency measures is rewarded in the allocation formula.

(623) The Netherlands is expected to be a net seller of allowances in the first reduction period and might also be a net seller in 2008-2012.

(624) Coal-fired power plants may experience unsufficient allocation during the 2008-2012 reduction period, dependent on the design of NAP 2.

5.8 Poland (PL)

Conclusion	The privatization and opening of the energy and coal markets is very advanced. Both hard coal and lignite play an important role in the energy balance of the country.

(625) Poland is a republic comprised of 16 voivoidships with the capital Warsaw. Poland is located in Central Europe and covers about 312 685 km^2, making Europe's ninth largest nation measured by area.

(626) In the North Poland is bordered by the Baltic Sea and Russia. Lithuania, Belarus and Ukraine surround the Eastern border, with Slovakia and Czech Republic to the South and Germany to the West.

(627) The major natural resources of Poland are: hard coal in Upper, Lower Silesia basins and in Lublin area; lignite deposits in Torow area, Belchatow area and Adamow/Konin area; copper deposits are located in Lower Silesia (in the northern-Sudetic syncline) and in the pre-Sudetic monocline; natural gas fields occur in the Fore-Carpathian Depression as well as in the Polish Lowland: pre-Sudetic and Wielkopolska regions and in the Western Pomerania; rock salt deposits occur in northern Poland and in the pre-Sudetic Monocline as well as in central Poland and in the marginal zone of the Carpathian thrust belt.

(628) Poland is member of the European Union (EU 25) and OECD

5.8.1 Socioeconomic Framework

(629) Poland's actual population is about 38 Million inhabitants. Due to the low fertility rate its native population is declining.

(630) The nominal Polish GDP is expected to rise moderately by an annual growth rate of 3,9% in average.

table 5.8-1 *Assumptions for Future Economic Development (Poland) [DG TREN 2003]*

		1990	**2000**	**2010**	**2020**	**2030**
Population	[million]	38.12	38.65	38.26	37.67	36.62
GDP	[€ billion]	138.1	194.6	282.4	429.6	613.9
			1990/2000	**2000/2010**	**2010/2020**	**2020/2030**
Population Growth	[%]		0.01	-0.01	-0.02	-0.03
GDP Growth	[%]		3.7	3.8	4.3	3.6

5.8.2 Primary Energy Consumption

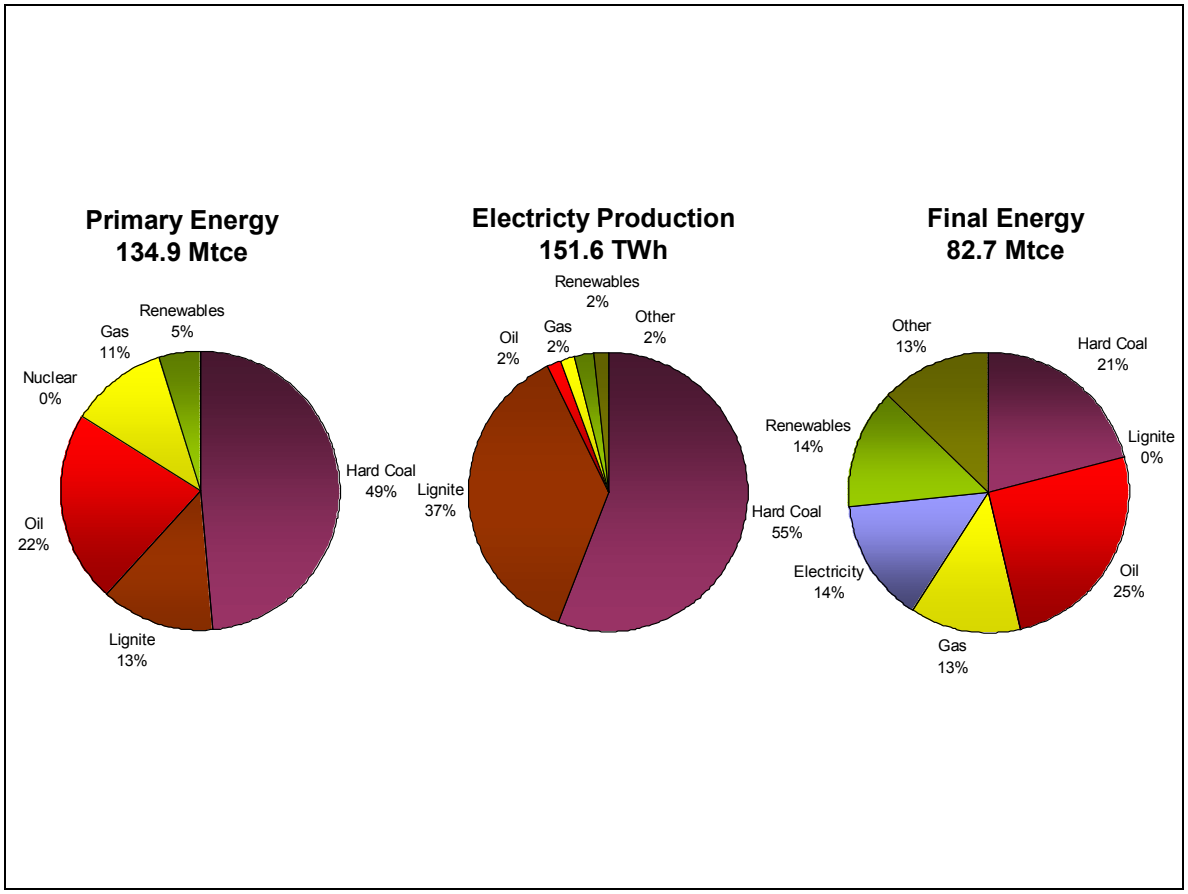

figure 5.8-1 Energy Consumption and Electricity Production (Poland)
[source: Eurostat 2004, DG TREN 2003, own calculations]

table 5.8-2 Primary Energy Consumption and Domestic Production 2003 (Poland)
[source: Eurostat 2004, IEA 2004, own calculations]

Primary Energy Consumption	Primary Energy	Domestic Production	Share of Production
	[Mtce]	[Mtce]	[%]
Total	**134.93**	**113.71**	
Hard Coal	64.83	82.58	127.4%
Steam Coal	54.67	66.56	121.7%
Coking Coal	10.16	16.02	157.7%
Lignite	17.55	17.65	100.6%
Oil	29.21	1.10	3.8%
Natural Gas	16.09	5.16	32.1%
Nuclear Energy	0.00	0.00	-
Hydro and Renewables	7.25	7.23	100%

(631) Primary energy mix is coal dependant. Coal, oil and gas are the most important primary energy sources.

(632) Poland's primary energy supply is dependant on imports (import dependency of 11.3 % in 2002)

5.8.3 The Role of Coal

(633) Coal is one of the most important primary energy sources. In 2003 coal accounted for 61.1% of total primary energy supply.

(634) Poland produced 1.1 Mtce of oil and 5.16 Mtce of natural gas in 2003.

(635) The most important renewable energy source in Poland is biomass. Total biomass primary energy production in Poladn reached 7.02 Mtce in 2003.

(636) Coal plays a major role in indigenous primary energy production. Most of the hard coal used in Poland is from domestic production.

(637) The importance of coal has been declining over the past years. In 1991 76,5% of total primary energy supply came from coal. Due to restructuring of coal mining in Poland further decline of coal demand is expected until 2020. According to long term program in 2020 coal sales will drop to 80 Mt (110 Mt in 2002)

table 5.8-3 *Coal Market Volume and Domestic Production Poland (2002)*

Coal Market Volume and Domestic Production	Total	Domestic Production
	[Mtce]	[Mtce]
Hard Coal	64.83	82.58
Steam Coal	54.67	66.56
Coking Coal	10.16	16.02
Lignite	17.55	17.65

5.8.3.1 Hard Coal

(638) Hard coal market volume was 64.83 Mtce in 2003. 54.67 Mtce was used for power and heat generation (steam coal) and 10.16 Mtce were coking coal.

(639) Almost all of the hard coal used in Poland is from domestic production.

(640) Indigenous hard coal production has been declining. Hard coal is produced in three areas:

- the Upper Silesian Basin (almost 97%)
- the Lower Silesian Basin
- Lublin Basin

(641) Poland produced 82.58 Mtce of hard coal in 2003. 66.56 Mtce was steam coal, and 16.02 Mtce were coking coal.

5.8.3.2 Lignite

(642) Poland produced 17.7 Mtce lignite in 2003. Lignite production has been declining until 2002, but it is increasing now. All of the lignite mines in Poland are opencast mines. There are four main lignite mines in Poland:

- Adamow lignite mine
- Belchatow lignite mine

- Konin lignite mine
- Turow lignite mine

(643) Lignite is mainly used for electricity generation (99.2% in 2002).

5.8.3.3 *Reserves & Production*

(644) Hard coal and lignite are the most important domestic fuels

- Reserves of hard coal: 14.9 Gtce (20,300 Mt), 2003
- Reserves of lignite: 0.54 Gtce (1,860 Mt) , 2003

(645) Natural gas and oil plays minor role in domestic production

(646) Poland produced 17.7 Mtce of lignite in 2003 and 82.6 Mtce of hard coal making coal the most significant fuel of domestic primary energy production

table 5.8-4 *Resources, Reserves and Production of Hard Coal and Lignite (Poland) [source: BP 2005, WEC 2001, own calculations]*

Reserves and Resources	Resources	Reserves	Production	Static Res
	[Mt]	[Mt]	[Mt]	[a]
Coal	**64'500**	**22'160**	**161.3**	
Hard Coal	50'900	20'300	100.4	202
Lignite	13'600	1'860	60.9	31

5.8.4 Power Generation

5.8.4.1 *Final Energy Consumption: The Role of Electricity*

(647) Final energy demand decreased by 8.6% from 1990 to 2002. Coal accounts for most of total final energy consumption in Poland (61.7 % in 2002)

(648) Electricity consumption was almost at the same level in 2002 as it was in 1990. The share of electricity in final energy consumption increased from 13.8% in 1990 to 15.1% in 2002.

5.8.4.2 *Power Generation*

(649) In 2003 coal was the most important source for electricity generation. 92.8% of electricity generated was produced by coal.

(650) Lignite had a share of roughly 37%, hard coal had a share of about 56% of national gross electricity production.

(651) There is no nuclear power generation in Poland.

(652) The share of renewables will be increasing in the long term according to the government plan.

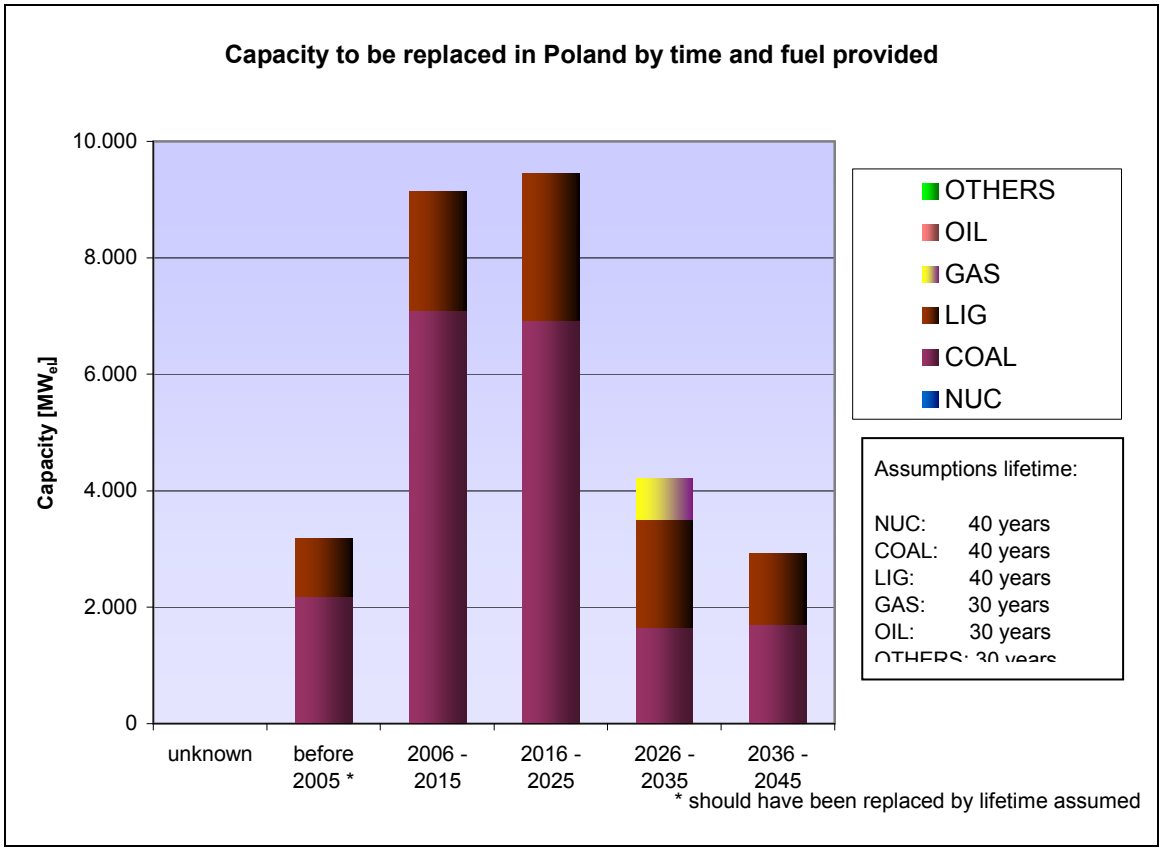

figure 5.8-2 Capacity Replacements (Poland) *[source:* Eurostat *2004, Siemens, own calculations]*

table 5.8-5 Installed Power Plant Capacities (Poland)
[source: Eurostat *2004, IEA 2005, own calculations]*

Installed Power Plant Capacities			
	[MWel]	**[GWh]**	**[h full cap] (4)**
Total	**31'407**	**151'631**	**4'828**
Conv' Thermal (1)	***29'099***	***148'213***	***5'093***
Coal (>30 MWel)	28'233	140'658	4'982
Hard Coal (>30 Mwel)	*19'558*	*84'720*	*4'332*
Lignite (>30 MWel)	*8'675*	*55'938*	*6'448*
Oil (>30 MWel)	0	2'456	-
Gas (>30 MWel)	700	4'359	-
Conv' Others (2)	***166***	***740***	
Biomass (wood, wood-waste, biogas)	-	*454*	-
Waste (muncipal and industrial waste)	-	*286*	-
Renewables (3)	***2'308***	***3'418***	
Hydro	2'273	3'294	-
Pumped Storage	-	-	-
Wind	35	124	3'543
Geothermal	-	-	-

Please note: Table is presenting a synthesis from different statistics.
Data may not be consistent, for following reasons:
(1) Conventional Thermal: conv. thermal capacites above 30 MW, power generation from all conventional thermal
(2) Conventional Others: conv. thermal capacites below 30 MW incl. biofuel and waste capacities, power generation from biofuel and waste only
(3) Renewable capacities without biofuel capacities; renewable power generation without biofuels
[source: Eurostat]2003 and 2004; Siemens Database 2005

5.8.5 Energy Policy in General

(653) Poland pursues three major aims:

- Security of supply: Poland is dependant on import of liquid fuels. Therefore the country aims at the diversification of energy sources. There are investigations undertaken for closer connection with EU natural gas supply system. Starting 2020, the nuclear energy will be introduced in power generation.
- Raising competitiveness of Polish and products offered for international and domestic markets.
- Protection of environment against negative impact of energy generation.

5.8.6 Renewable Energy

5.8.6.1 Actual Status

(654) In 2003 the share of renewable energy in energy balance accounted to 5,4%.

(655) In 2003 electricity generation from renewables amounted to 3,7 TWh (2.4% of total electricity generation)

(656) Installed capacity of renewables, particularly hydropower, increased. The amount of electricity generated from renewables increased by 170% since 1990 while total electricity generation increased by about 15%

(657) Installed capacity of wind and photovoltaic power plants remained on a very low level. There were only 0,82 GW of new wind and photovoltaic power installed since 1990.

5.8.6.2 Renewable Policies

(658) According to the *Strategy of RES development* from 2002 there is target to increase the share of renewables to 5.5% of primary energy supply by 2010 and 6.1% by 2020. The share of green electricity in total electricity consumption should reach 7,5% by 2010 and 14% in the year 2020.

(659) The most powerful instrument for the achievement of these targets was the *Decree of the Minister for Economic Affairs & Labor concerning the scope of obligatory purchase of electric energy and heat produced based on renewable energy sources*, put into force in 2004. It provides methods of calculation of tariffs and yearly minimum limit of purchase green electricity by energy companies. It also allows to co-fire the biomass with the hard coal in power generation facilities

(660) The certificates of origin for green electricity have been introduced 2005 in order to control the flows of this. Starting 2006 they are tradable.

5.8.6.3 Outlook

(661) The achievement of 7,5% share of green electricity in total electricity consumption will be possible by both co-firing of biomass

with hard coal In large power plants and by construction of new power generation facilities mostly in off-shore wind power plants.

(662) The goal to obtain at least 14% renewables share in the fuel and energy balance by 2020 is confirmed by Long-term Strategy for Sustainable Development for Poland Until 2025 (2002).

5.8.7 Climate Protection Policy

5.8.7.1 Policy and Kyoto Targets

(663) The policy is driven by obligations set by Kyoto targets, EU requirements concerning development of renewable energy sources and introduction of emission trading scheme. Polish National Allocation Plan for CO_2 Emission Allowance became to be most important instrument called for reduction of GHG emissions.

(664) The existing legal framework favorises renewable energy sources, by setting obligation of purchase the green electricity by power distribution companies, however the price of it is subject of regulation (as justified price is the average price of green electricity generated in all kinds of installations in previous year)

(665) The public aid for development of RES is provided in form of soft loans and grants by Polish ecological funds and EU Structural Funds.

(666) The national target is to reduce CO_2-emissions by 6% in the period between 1990 and 2012. Greenhouse gas (GHG) emissions are to be reduced within the EU burden sharing agreement by 21% in the first commitment period of 2008-2012

(667) In 1999 GHG emissions were 31.1% below the base year (1990) levels.

(668) Is still under construction based on statistical data and operator's information to be verified. According to the *Ordinance of the Ministry of Environment on kinds of installations covered be ETS during period 2005-2007* from 30 September 2005 all fuel combusting installations with capacity over 20 MW are covered by ETS.

5.8.7.2 National Allocation Plan

(669) Distance-to-target all GHG 2008-2012 amounts to 26,3% and 148,6 Mt CO_2.

(670) Share of CO_2 emissions in total GHG amounts to 68% (where 51% comes from power plants and 17% from CHP's).

(671) Foresees reduction of unit GHG emission in 1166 installations (221 temporary excluded).

(672) The Polish national allocation plan for 2005-2007 allocates 229.7 $MtCO_2$ for the first trading period in 2005. This amount will rise to 238.0 $MtCO_2$ in 2006 and to 246.4 $MtCO_2$ in 2007 for a total number of 714,1 $MtCO_2$ in the 2005-2007 period.

(673) The energy sector receives 67% of all allowances.

(674) The polish national allocation plan permits creation of groupings of operators (pooling).

(675) The number of allowances for new installations will be calculated as a percentage of the total number of allowances for trading period. Any unused allowances from this reserve will be auctioned in case of lack of allowances for new installations the administrator may purchase additional allowances or move some allowances from different sectors.

(676) Under certain circumstances it is possible to bank allowances from the first trading period for the second trading period. This is a support mechanism for emission reduction investments.

(677) It is possible to move allowances granted to an installation that is being deactivated to a new installation that replaces the deactivated installation's production.

(678) There is special bonus for CHP's foreseen (with 65% cogeneration factor). The bonus for Early Action and CHP installations is 1,8 $MtCO_2$.

(679) No auctioning for emission trading is foreseen.

5.9 Czech Republic (CZ)

Conclusion	The privatization and opening of the energy markets is very advanced. The role of hard coal and lignite will slightly decrease due to the extension of renewable and nuclear energy. However, rising crude oil and gas prices will increase the importance of coal reserves.

(680) The Czech Republic is a republic comprised of 14 regions with the capital Prague. The Czech Republic is located in Central Europe and covers about 78'866 km^2, making Europe's 18th largest country nation measured by area.

(681) In the North the Czech Republic is bordered by Poland. Germany surrounds the Western border, with Slovakia and Austria to the South.

(682) The major natural resources of the Czech Republic are lignite in the West around the towns Chomutov, Most, Teplice and Sokolov and hard coal deposits in the Ostrava-Karvina coalfield in the North-East part of the country.

(683) The Czech Republic is a member of the European Union (EU 25) and the OECD.

5.9.1 Socioeconomic Framework

(684) The Czech Republic's actual population is about 10.22 Million inhabitants (31 March 2005). Due to the low fertility rate its native population is declining.

(685) Macroeconomic data between 2000 and 2004 are mentioned in following table. The Economist intelligence Unit (EIU) projects that Czech Republic´s growth will reach an annual average rate of 3% in 2005-30. Following substantial rises in GDP in the 2005-09 period—when growth is forecast to average 4.3% annually owing to major foreign investments and improved labour productivity—annual real GDP growth is set to slow slightly to 2.7% in 2010-30.
SOURCE: Country Forecast by the Economist Intelligence Unit Published on EIU ViewsWire 09 Aug 2005 .

table 5.9-1 *Assumptions for Future Economic Development (Czech Republic)*

		1990	2000	2010	2020	2030
Population	[million]	10.36	10.27	10.12	9.88	9.51
GDP	[€ billion]	60.6	61.3	87.7	115.9	142.1
			1990/2000	2000/2010	2010/2020	2020/2030
Population Growth	[%]		-0.01	-0.01	-0.02	-0.04
GDP Growth	[%]		0.1	3.6	2.8	2.1

5.9.2 Primary Energy Consumption

(686) Primary energy mix is diversified. Lignite, oil, gas, hard coal and nuclear energy are the most important primary energy sources.

(687) The Czech Republic's primary energy supply is dependent on imports (import dependency of 26.6 % in 2002).

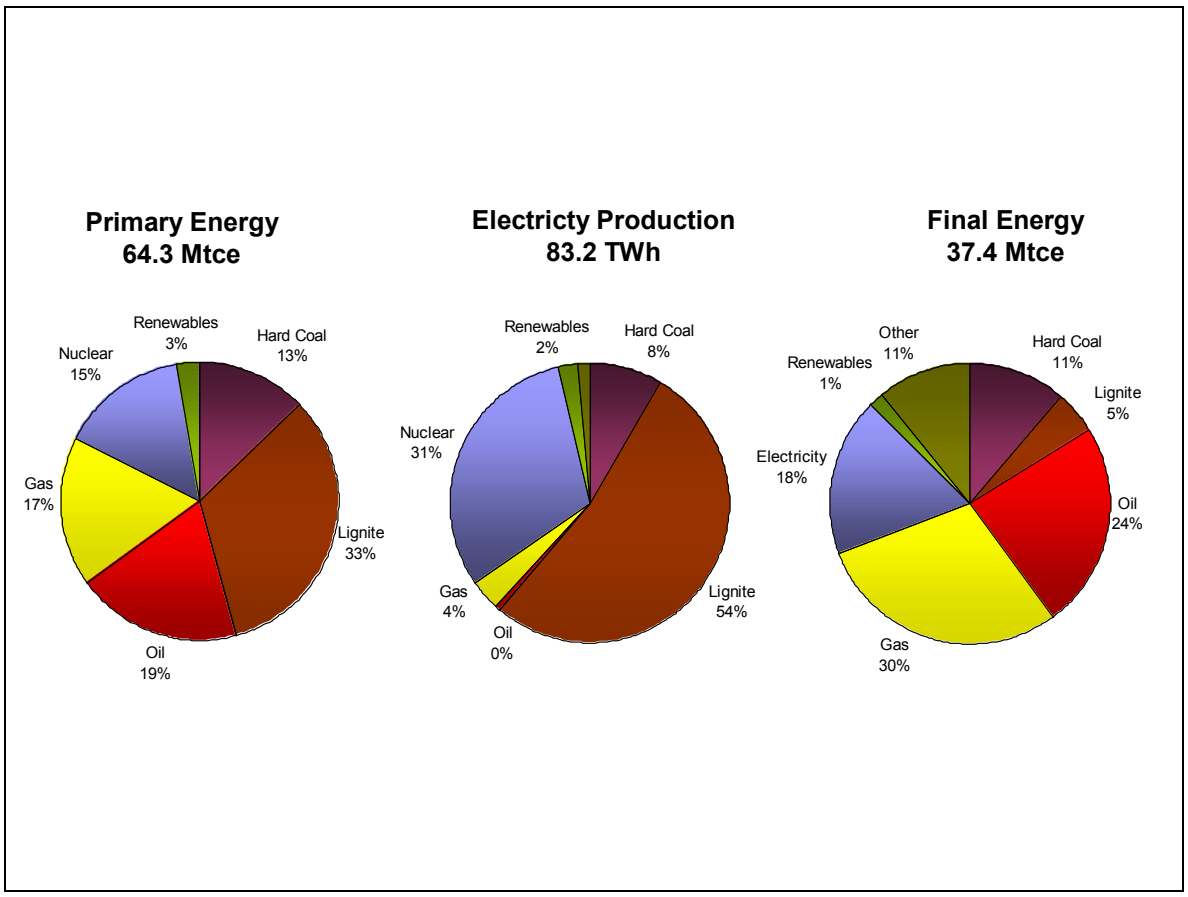

figure 5.9-1 *Energy Consumption and Electricity Production (Czech Republic)*
[source: Eurostat 2004, DG TREN 2003, own calculations]

5.9.3 The Role of Coal

(688) Hard coal and lignite are the most important domestic fuels

- Reserves of hard coal: 1,95 Gtce (2,114 Mt), 1999
- Reserves of lignite: 1,70 Gtce (3,564 Mt) , 1999

(689) Natural gas and oil only play minor roles in domestic production

(690) Czech Republic produced 21.5 Mtce of lignite in 2003 (2002: 21.3) and 13.2 Mtce (2002: 12.9) of hard coal making coal the most significant fuel of domestic primary energy production

table 5.9-2 Primary Energy Consumption and Domesti Production Czech Republic (2002)
[source: Eurostat 2004, IEA 2005, own calculations]

Primary Energy Consumption	Primary Energy	Domestic Production	Share of Production
	[Mtce]	[Mtce]	[%]
Total	**64.27**	**46.37**	
Hard Coal	8.24	12.93	156.9%
Steam Coal	4.08	5.52	135.3%
Coking Coal	4.16	7.41	178.1%
Lignite	21.30	21.50	100.9%
Oil	12.26	0.44	3.6%
Natural Gas	11.20	0.19	1.7%
Nuclear Energy	9.53	9.53	100%
Hydro and Renewables	1.73	1.78	103%

(691) Coal (lignite and hard coal) is the most important primary energy sources. In 2002 coal accounted for half of total primary energy supply.

(692) Coal plays a major role in indigenous primary energy production. All lignite and most of the hard coal used in the Czech Republic are from domestic production.

(693) The importance of coal has been declining over the past years. In 1991 64.1% of total primary energy supply came from coal. Further decline of coal demand is expected until 2010.

table 5.9-3 Coal Market Volume and Domestic Production Czech Republic (2003)
[source: DG TREN 2003, IEA 2004, own calculations]

Coal Market Volume and Domestic Production	Total	Domestic Production
	[Mtce]	[Mtce]
Hard Coal	8.24	12.93
Steam Coal	4.08	5.52
Coking Coal	4.16	7.41
Lignite	21.30	21.50

5.9.3.1 Reserves & Production

(694) Hard coal and lignite are the most important domestic fuels

- Reserves of hard coal: 1,95 Gtce (2,114 Mt), 1999
- Reserves of lignite: 1,70 Gtce (3,564 Mt) , 1999

(695) Natural gas and oil only play minor roles in domestic production

(696) Czech Republic produced 21.57 Mtce of lignite in 2003 and 12.18 Mtce of hard coal making coal the most significant fuel of domestic primary energy production

table 5.9-4 *Resources, Reserves and Production of Hard Coal and Lignite (Czech Republic) [source: BP 2005, WEC 2001, own calculations]*

Reserves and Resources	Resources	Reserves	Production	Static Res
	[Mt]	[Mt]	[Mt]	[a]
Coal	**14'318**	**5'678**	**59.2**	
Hard Coal	7'231	2'114	14.4	**147**
Lignite	7'087	3'564	44.8	**80**

5.9.3.2 Hard Coal

(697) Hard coal consumption volume was 7,95 Mtce in 2004.

(698) All of the hard coal used in Czech Republic was from domestic production.

(699) Indigenous hard coal production almost has not changed. Hard coal is produced in several mines in one region of Eastern Silesia

5.9.3.3 Lignite

(700) Czech Republic produced 20,57 Mtce of lignite in 2004. Lignite production has been declining over the past years. Lignite production is located in:

- Ore Mountains Foothills Basins

(701) Lignite is mainly used for electricity generation (86.7% in 2002).

5.9.4 Power Generation

5.9.4.1 Final Energy Consumption: The Role of Electricity

(702) Final energy demand decreased by 28.5% from 1990 to 2003. Coal accounts for 16% of total final energy consumption in Czech Republic in 2003.

(703) Electricity consumption increased by 1.1% from 1990 to 2003 . Electricity gained significance.

5.9.4.2 Power Generation: Overview

(704) In 2003 coal was the most important source for electricity generation. 61.2% of electricity generated was produced by coal.

(705) Lignite had a share of roughly 53%, hard coal had a share of about 8% of national gross electricity production.

(706) Nuclear power had about 31% share.

(707) The share of renewables will be increasing in the long term according to the government plan.

table 5.9-5 Installed Power Plant Capacities (Czech Republic)

Installed Power Plant Capacities			
	[MWel]	**[GWh]**	**[h full cap] (4)**
Total	**17'332**	**83'223**	**4'802**
Nuclear	***3'760***	***25'872***	***6'881***
Conv' Thermal (1)	***11'423***	***55'557***	***4'864***
Coal (>30 MWel)	8'950	50'966	5'695
Hard Coal (>30 MWel)	*1'948*	*50'668*	?
Lignite (>30 MWel)	*7'002*	*298*	?
Oil (>30 MWel)	0	368	-
Gas (>30 MWel)	233	3'726	-
Conv' Others (2)	***2'240***	***497***	
Biomass (wood, wood-waste, biogas)	-	*497*	-
Waste (muncipal and industrial waste)	-	*0*	-
Renewables (3)	***2'149***	***1'794***	
Hydro	2'149	1'794	-
Pumped Storage	-	-	-
Wind	-	-	-
Geothermal	-	-	-

Please note: Table is presenting a synthesis from different statistics.
Data may not be consistent, for following reasons:
(1) Conventional Thermal: conv. thermal capacites above 30 MW, power generation from all conventional thermal
(2) Conventional Others: conv. thermal capacites below 30 MW incl. biofuel and waste capacities, power generation from biofuel and waste only
(3) Renewable capacities without biofuel capacities; renewable power generation without biofuels
[source: Eurostat]2003 and 2004; Siemens Database 2005

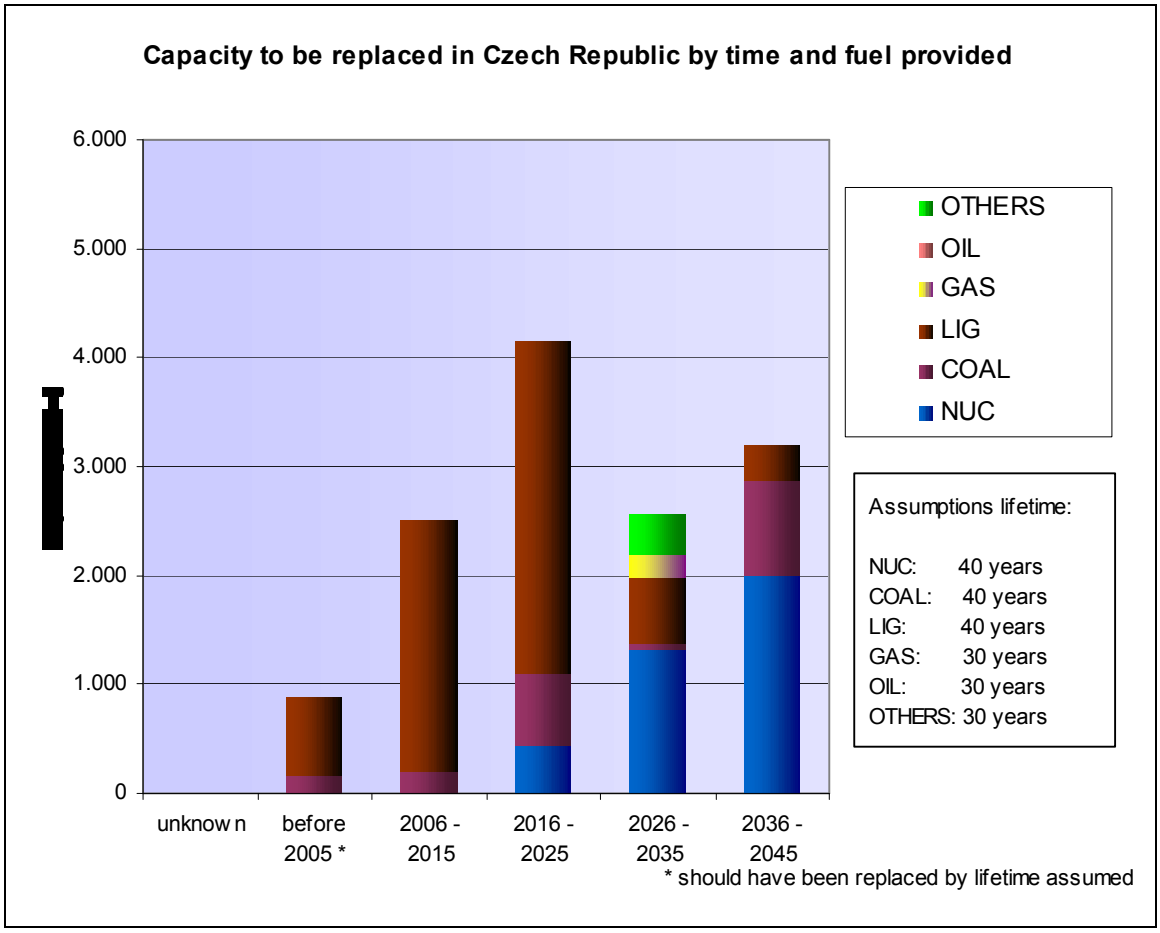

figure 5.9-2 *Capacity Replacements (Czech Republic)*

5.9.5 Energy Policy in General

(708) Czech Republic pursues three major aims, defined in *State energy policy of the Czech Republic from 2004*:

- Independence: Independence from foreign energy sources. Independence from energy sources from risky regions. Independence from reliability of supplies from foreign sources;
- Safety: Safety of energy sources including nuclear safety, Reliability of supplies of all kinds of energy, Reasonable decentralisation of all energy systems;
- Sustainable Development: Environmental protection, Economic and social development

5.9.6 Renewable Energy

5.9.6.1 Actual Status

(709) In 2004 electricity generation from renewables amounted to 2.34 TWh..

(710) The installed capacity of renewables increased, particularly, photovoltaic and wind. The amount of electricity generated from re-

newables increased by 47% since 1990 while total electricity generation increased by about 23%.

(711) Installed capacity of hydro power plants remained rather constant. There were 0.23 GW of wind and solar power capacity installed.

5.9.6.2 Renewable Policies

(712) In 2003 electricity generation from renewables amounted to 2,9 TWh (3.5% of total electricity generation)

(713) The installed capacity of renewables increased, particularly, photovoltaic and wind. The amount of electricity generated from renewables increased by 47% since 1990 while total electricity generation increased by about 33%.

(714) Installed capacity of hydro power plants remained rather constant. There were 0,23 GW of wind and solar power capacity installed.

(715) The government intends to increase the share of renewables to 10.5% of primary energy supply by 2010 and to 15.7% by 2030.

(716) The most powerful instrument for the achievement of these targets was the *Act on Promotion for Electricity and Heat Energy Produced from Renewable Energy Sources* , put into force in 2005. It provides system of guaranteed feed-in tariffs and sets quota of purchases of green certificates for selected electricity suppliers. Green electricity is divided into 'clear' green energy – only generated by renewable energy sources and 'mixed' green energy, generated in sources in co-firing of biomass and fossil solid fuel. The clear green electricity more favorised in tariffs than the mixed one.

(717) Through implementation of incentive programs, the share of electricity generated by renewables is intended to be increased up to 10% after 2010 (5% in 2005).

(718) The actually share of renewables in primary energy supply will slightly increase thanks the state support policy.

5.9.7 Climate Protection Policy

1.1.1.1 Policy and Kyoto Targets

(719) The national target is to reduce CO_2-emissions by 8% in the period between 1990 and 2012. Greenhouse gas (GHG) emissions are to be reduced within the EU burden sharing agreement by 21% in the first commitment period of 2008-2012

(720) In 1999 GHG emissions were 26.6% below the base year (1990) levels

(721) The policy is driven by obligations set by Kyoto targets, EU requirements concerning development of renewable energy sources and introduction of emission trading scheme. It will be also performed through reduction of coal based power generation and development of nuclear power generation. There are no instruments which are directly called for implementation of above mentioned aims.

(722) The share of renewable energy sources will increase as result of the state funding programs and setting favorable price and purchase conditions.

(723) The inventory was constructed based on questionnaires verified by authorities.

5.9.7.1 National Allocation Plan

(724) Distance-to-target all GHG 2008-2012 amounts to 17.7% and 34 Mt CO_2.

(725) Share of CO_2 emissions in total GHG amounts to 70% (where 67% comes from both power plants and CHP's)

(726) The maximum total allocated quantity of allowances for the 2005-2007 period is 292. 8 $MtCO_2$. One third of this amount will be allocated in each of these years (97.6 $MtCO_2$). It is not permitted to transfer allowances to a second trading period (no allowances banking).

(727) All allowances will be distributed free of charge. Any unused allowances from reserves for new entrants will be sold in an auction.

(728) One million of allowances have been reserved for the purpose of correcting allocation for the reason of standardization of temperatures.

(729) The reserve for new entrants equals 3 million allowances; unused allowances from this reserve will be sold in auction.

(730) It is permitted to create groupings of operators (pooling).

(731) With respect to early action and CHP, 3% and 1.5%, respectively, of the total projection of the total projection of emission from all facilities, except for new entrants, will be allocated.

(732) The basic allocation is based on historical emissions in 1999-2001 period (average for the two years with the highest emissions) and the projected growth to 2007 and individual negotiations.

(733) Foresees reduction of unit GHG emission in 426 installations (minus JI projects)

(734) There is special bonus for CHP's foreseen.

(735) No auctioning for emission trading is foreseen.

5.10 Hungary (HU)

Conclusion	The privatization and opening of energy and coal markets is very advanced. The role of hard cole and lignite in the country's energy balance is low and will remain rather constant at that low level.

(736) Hungary is a republic comprised of 19 counties with the capital Budapest. Hungary is located in Central Europe and covers about 93 030 km^2, making Europe's 18th largest nation measured by area.

(737) In the north Hungary is bordered by Slovakia and Ukraine. Romania surrounds the Eastern border, with Serbia and Montenegro and Croatia to the South and Slovenia and Austria to the West.

(738) The major natural resources of Hungary are: oil and natural gas reserves at Aglyo and Nagylengyel; lignite deposits can be found in the foothills of the Mátra and Bükk Mountains; Copper, molybdenum, gold and silver deposits can be found at the Recks deep deposit.

(739) Hungary is a member of the European Union (EU 25) and OECD

5.10.1 Socioeconomic Framework

(740) Hungary's actual population is about 10 Million inhabitants. Due to the low fertility rate its native population is declining.

(741) The nominal Hungarian GDP is expected to rise moderately by an annual growth rate of 2,4% in average.

table 5.10-1 *Assumptions for Future Economic Developments (Hungary)*

		1990	**2000**	**2010**	**2020**	**2030**
Population	[million]	13.37	10.02	9.54	9.07	8.58
GDP	[€ billion]	51.6	55.7	81.2	106.9	130
			1990/2000	**2000/2010**	**2010/2020**	**2020/2030**
Population Growth	[%]		-0.25	-0.05	-0.05	-0.05
GDP Growth	[%]		0.8	3.8	2.8	2,0

5.10.2 Primary Energy Consumption

(742) Primary energy mix is diversified. Gas, oil and coal are the most important primary energy sources.

(743) Hungary's primary energy supply is heavily dependant on imports (import dependency of 58.2 % in 2002)

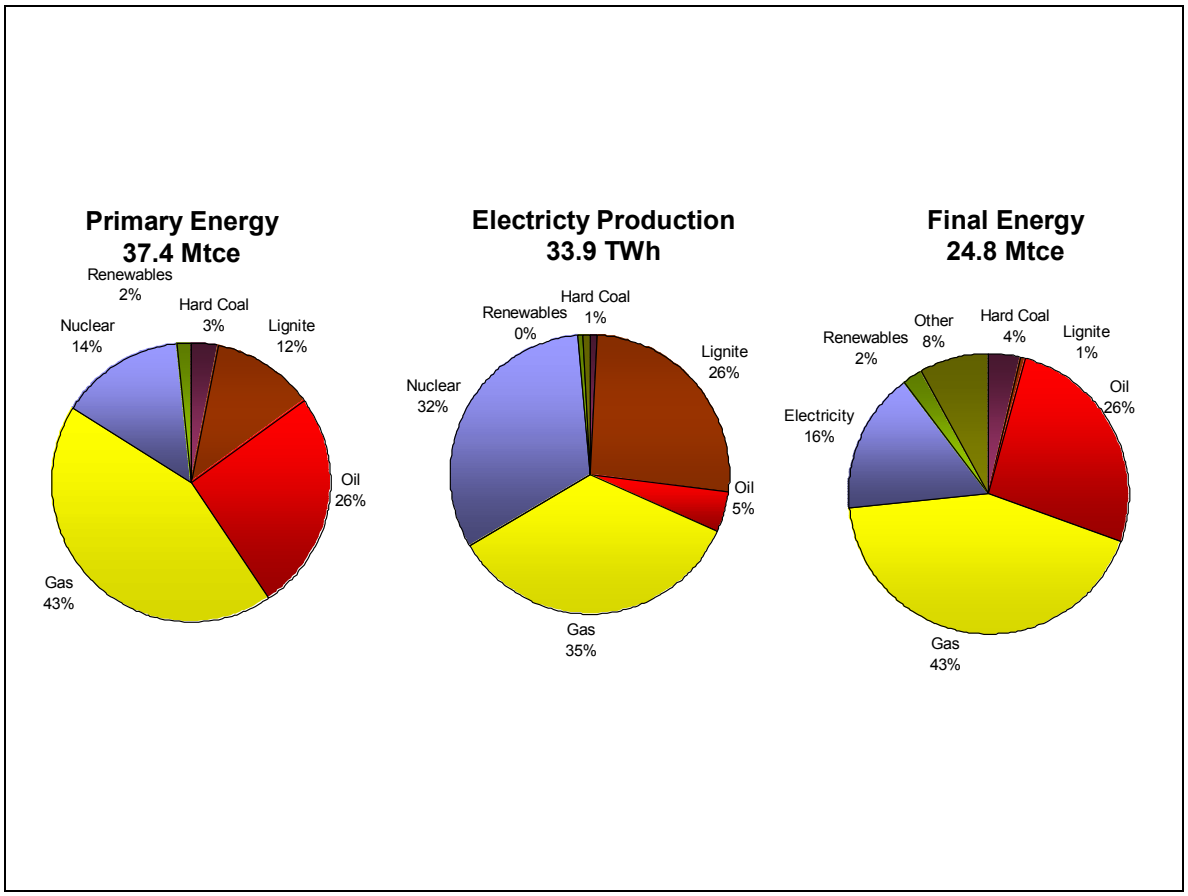

figure 5.10-1 Energy Consumption and Electricity Production (Hungary)
[source: Eurostat 2004, DG TREN 2003, own calculations]

table 5.10-2 Primary Energy Consumption and Domestic Production Hungary (2002)
[source: Eurostat 2004, IEA 2004, own calculations]

Primary Energy Consumption	Primary Energy	Domestic Production	Share of Production
	[Mtce]	[Mtce]	[%]
Total	**37.35**	**14.68**	
Hard Coal	1.12	0.00	0.0%
Steam Coal	0.29	0.00	0.0%
Coking Coal	0.83	0.00	0.0%
Lignite	4.23	3.87	91.6%
Oil	9.65	2.30	23.9%
Natural Gas	16.98	3.27	19.2%
Nuclear Energy	4.06	4.06	100%
Hydro and Renewables	1.31	1.19	90%

5.10.3 The Role of Coal

(744) Coal is one of the less important primary energy sources. In 2002 coal accounted for 14.4% of total primary energy supply.

(745) Coal plays a major role in indigenous primary energy production. Most of the hard coal used in Hungary is from domestic production.

(746) The importance of coal has been declining over the past years. In 1991 28.0% of total primary energy supply came from coal. Further decline of coal demand is expected until 2010.

table 5.10-3 *Coal Market Volume and Domestic Production Hungary (2002)*

Coal Market Volume and Domestic Production	Total	Domestic Production
	[Mtce]	[Mtce]
Hard Coal	1.12	
Steam Coal	0.29	
Coking Coal	0.83	
Lignite	4.23	3.4

5.10.3.1 Hard Coal

(747) Hard coal market volume was 1.1 Mtce in 2002. 0.3 Mtce were used for power and heat generation (steam coal) and 0.8 Mtce were coking coal.

(748) Hungary produced 0.4 Mtce of hard coal in 2002.

(749) Indigenous hard coal production has been declining. Hard coal is produced in two open pit mines located in the southern part of Hungary. Most of the hard coal used in Hungary was imported (63.6%).

5.10.3.2 Lignite

(750) Hungary produced 3.4 Mtce and imported 0.8 Mtce of lignite in 2002. Lignite production has been declining over the past years.

(751) Lignite is mainly used for electricity generation (96.2% in 2002).

5.10.3.3 Reserves & Production

(752) Hard coal and lignite are one of the most important domestic fuels

- Reserves of hard coal: 1,45 Gtce (1,978 Mt), 1999
- Reserves of lignite: 0,3 Gtce (1,097 Mt) , 1999

(753) Natural gas and oil production was 5,6 Mtce.

(754) Hungary produced 4,2 Mtce of lignite in 2003 and 0,0 Mtce of hard coal making lignite one of the most significant fuel of domestic primary energy production

table 5.10-4 Resources, Reserves and Production of Hard Coal and Lignite (Hungary)
[source: BP 2005, WEC 2001, own calculations]

Reserves and Resources	Resources	Reserves	Production	Static Res
	[Mt]	[Mt]	[Mt]	[a]
Coal	5'178	3'357	14.9	
Hard Coal	1'978	1'978	0.7	
Lignite	3'200	1'097	14.2	77

Definitions and estimates for resources and reserves may differ according to the definition. Hungarian Geological Survey 2004 gives figures as follows:

table 5.10-5 Resources, Reserves and Production of Hard Coal and Lignite (Hungary)
[source: HUN04, own calculations]

Reserves and Resources	Resources	Reserves	Production	Static Res
	[Mt]	[Mt]	[Mt]	[a]
Coal	**9618,7**	**3227,3**	**14,9**	
Hard Coal	1596,7	199,0	0,7	**284**
Lignite	8022,0	3028,3	14,2	**248**

5.10.4 Power Generation

table 5.10-6 *Installed Power Plant Capacities (Hungary)*

Installed Power Plant Capacities			
	[MWel]	**[GWh]**	**[h full cap] (4)**
Total	**8'708**	**34'141**	**3'921**
Nuclear	***1'866***	***11'013***	***5'902***
Conv' Thermal (1)	***6'788***	***22'957***	***3'382***
Coal (>30 MWel)	1'634	9'170	5'612
Hard Coal (>30 MWel)	*170*	*307*	*1'806*
Lignite (>30 MWel	*1'464*	*8'863*	*6'054*
Oil (>30 MWel)	587	1'626	-
Gas (>30 MWel)	1'294	11'967	-
Conv' Others (2)	***3'273***	***194***	
Biomass (wood, wood-waste, biogas)	-	*194*	-
Waste (muncipal and industrial waste)	-	-	-
Renewables (3)	***54***	***171***	
Hydro	54	171	-
Pumped Storage	-	-	-
Wind	-	-	-
Geothermal	-	-	-

Please note: Table is presenting a synthesis from different statistics.
Data may not be consistent, for following reasons:
(1) Conventional Thermal: conv. thermal capacites above 30 MW, power generation from all conventional thermal
(2) Conventional Others: conv. thermal capacites below 30 MW incl. biofuel and waste capacities, power generation from biofuel and waste only
(3) Renewable capacities without biofuel capacities; renewable power generation without biofuels
[source: Eurostat]2003 and 2004; Siemens Database 2005

5.10.4.1 *Final Energy Consumption: The Role of Electricity*

(755) Final energy demand decreased by 11,9% from 1990 to 2003. Gas accounts for most of total final energy consumption in Hungary (45,5 % in 2003)

(756) Electricity consumption in 2003 is similar to 1990. The share of electricity in final energy consumption increased from 14,5% in 1990 to 16,4% in 2003.

5.10.4.2 *Power Generation*

(757) In 2003 coal was one of the most important source for electricity generation. 26.5% of electricity generated was produced by coal.

(758) Lignite had a share of roughly 26%, hard coal had a share of about 0.5% of national gross electricity production.

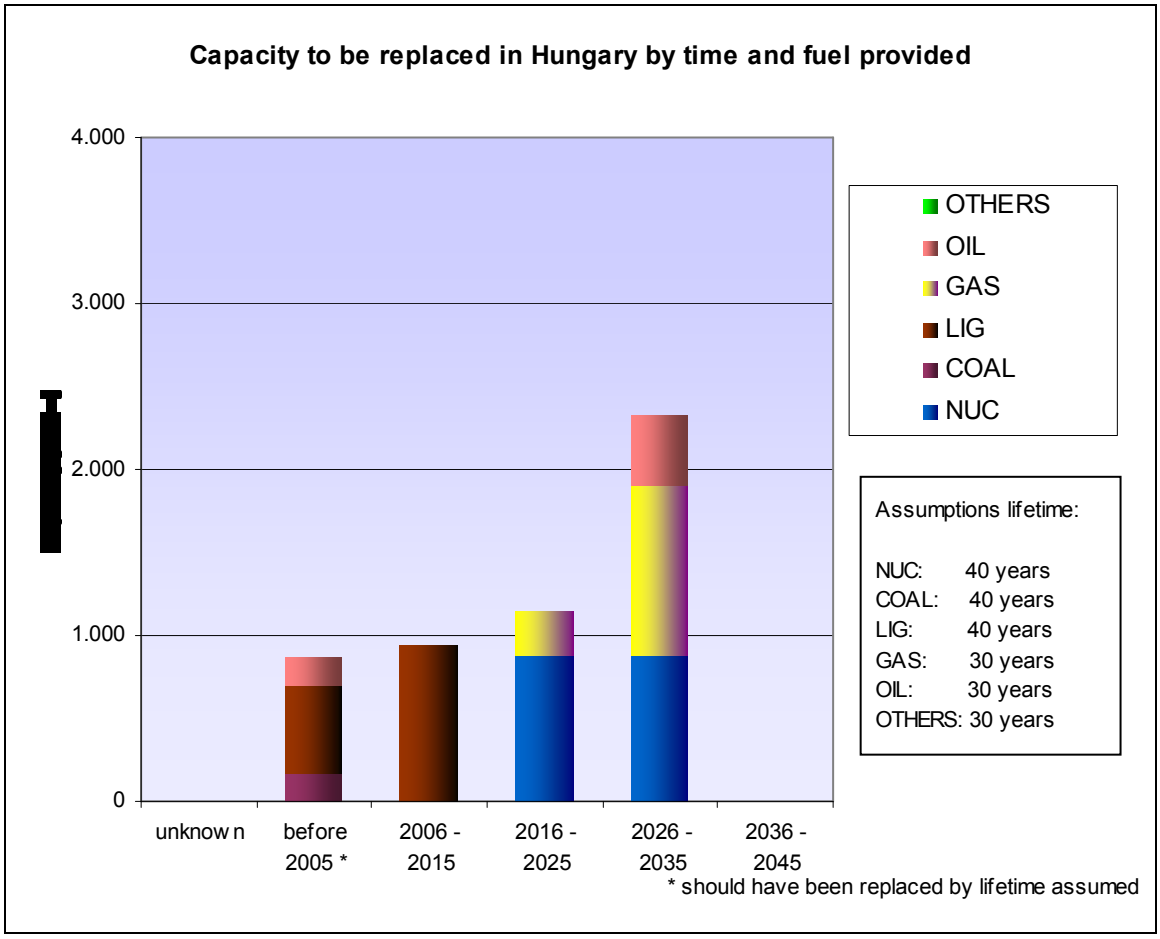

figure 5.10-2 *Capacity Replacements (Hungary)*

(759) In 2003 gas and nuclear energy were the most important sources for electricity generation. 35.0% of electricity generated was produced by gas and 32.4% by nuclear power.

(760) The share of renewables will be increasing in the long term according to the government plan.

(761) Hungary will withdraw from the nuclear energy by 2003

5.10.5 Energy Policy in General

(762) Hungary pursues seven major aims defined in *Energy Savings Plan and Strategy* from 1999:

- Security of energy supply through diversification of energy sources;
- Contribution to environmental protection;
- Modernisation of the supply-side energy systems;
- Increased demand-side energy efficiency;
- Improvement in public information on energy consumption;
- Attracting foreign capital for the necessary investments;
- Approaches to the EU and other international organizations.

5.10.6 Renewable Energy

(763) In 2003 electricity generation from renewables amounted to 0,36 TWh (1.1% of total electricity generation)

(764) The installed capacity of renewables increased, particularly, biomass fired plants, photovoltaic and wind. The amount of electricity generated from renewables increased by 105% since 1990 while total electricity generation increased by about 19%.

(765) Installed capacity of hydro power plants remained constant. There were 0,09 GW of wind and solar power capacity installed.

(766) There is number of heat as well as power installations, which use biomass as fuel. The total capacity of power generation facilities, which use biomass only has reached 100 MW (700 GWh/y)

(767) Current installed capacity in wind power generation reached 3,6 MW.

(768) Development of renewable energy sources was granted by the *Szechenyi Plan* with support of up to 30% investment outlays in renewable energy.

(769) The energy component of *Szechenyi Plan* was replaced 2002 by the *National Energy Saving Programm* aimed to replace conventional energy by renewable in private sector and *Environmental Protection and Infrastructure Operative Program*, launched 2004 for both development of RES and increase of energy efficiency.

(770) New *National Renewable Strategy* from 2005 indicates doubling the renewable sources in fuel mix up to 6% and increase of green electricity share in electricity production from 0,5% to 3,6% in the year 2010.

(771) There is feed-in-tariff system introduced by the Decree of Ministry of Economy from 2002 *Guaranteed feed in tariff for all energy generated from renewable energy sources*. The prices are fixed by Ministry of Economy. Currant prices are approximately 70% higher than the prices of energy produced from conventional solid fuels.

(772) It is assumed that the targets will be achieved thanks to market forces supported by the state support policy e.g. granting regular energy audits in industry, development of municipal and regional energy management facilities, awareness campaigns for energy saving

(773) Further 20-50 MW of wind power capacities are expected till 2010

5.10.7 Climate Protection Policy

1.1.1.2 Policy and Kyoto Targets

(774) The policy is driven by obligations set by Kyoto targets, EU requirements concerning development of renewable energy sources and introduction of emission trading scheme. There are no instruments which are directly called for implementation of above mentioned aims with except of auctioning of 2.5% of emission allowance. There is legal framework favorising renewable energy sources. The public aid is provided by sectoral governmental programs and EU Structural Funds.

(775) The national target is to reduce CO_2-emissions by 6% in the period between 1985-1987 and 2012. Greenhouse gas (GHG) emissions are to be reduced within the EU burden sharing agreement by 21% in the first commitment period of 2008-2012

5.10.7.1 National Allocation Plan

(776) In 1999 GHG emissions were 29.5% below the base year (1990) levels. Distance-to-target all GHG 2008-2012 amounts to 24.8% and 28.0 Mt CO_2.

(777) Share of CO_2 emissions in total GHG amounts to 40% (where 53% comes from power plants and 5% from CHP's).

(778) The Hungarian national allocation plan for 2005-2007 allocates 31.3 $MtCO_2$ in average each year for a total number of 93.9 $MtCO_2$ in the 2005-2007 period.

(779) 97,5% of allowances will be distributed cost-free. There is auctioning of 2,5% of allowances foreseen in order to finance climate protection measures.

(780) Allocations will be distributed proportionally in accordance with historic emissions of installations in the 1998-2003 base period with the year with the lowest emissions being excluded.

(781) There is reserve for new installations of 1.79 $MtCO_2$ for 2005-2007 period. New installations will receive cost-free allocations from this reserve, if the need is greater than reserve then allocations will be reduced proportionally. Unused allowances will be carried over to the following year. At the and of 2007 unused allowances will be auctioned.

(782) There is special reserve of 0.5 $MtCO_2$ of allowances for the 2005-2007 period reserved for Early Action. In case amounts applied for turn out higher, then the bonus will be reduced proportionately.

(783) Following closure of an installation (value of 10% or less of previous year's emissions) no further allowances will be issued. Temporarily closed installation that re-commences will be treated like a new installation.

(784) Operators or their legal successors may transfer allocations of a closed installation to a replacement installation for four years.

(785) There is no special bonus for CHP’s foreseen

5.11 Bulgaria (BG)

Conclusion	Free market principles have not been fully established in the Bulgarian energy sector, yet. Especially lignite will remain an important energy source.

(786) Bulgaria is a republic comprised of 28 regions with the capital Sofia. Bulgaria is located in Southern Europe and covers about 110 910 km^2, making Europe's 16th largest nation measured by area.

(787) In the North Bulgaria is bordered by the Romania. The Black Sea surrounds the Eastern Border, with Turkey and Greece to the South and F.Y.R.O.M to the West.

(788) The major natural resources of Bulgaria are: lignite deposits of Perkin basin; other coal producing basins are the Maritsa basin South of Stara Zagora, the Maritsa basin at Dimitrovgrad in the South, and Lom on the Danubethe Maritsa basin; iron deposits are located at Kremikovtsi near Sofia, smaller quantities of iron are located in Northwest (Montana), central region (Troyan) and in the Southeast (Yambol); There are significant deposits of nonferrous ores (copper, lead, and zinc) in the Rhodope Mountains, the Balkan Mountains, and the Sredna Mountains.

(789) Bulgaria is a candidate country to the European Union and is not a member of OECD

5.11.1 Socioeconomic Framework

table 5.11-1 Important Framework Data Bulgaria *[source: DG TREN 2003]*

		1990	2000	2010	2020	2030
Population	[Million]	8.72	8.17	7.39	6.65	5.95
Population Density	[Persons/km^2]	79	74	67	60	54
GDP	[€ billion]	17.4	14.6	22.6	30.4	38.1

table 5.11-2 *Assumptions for Future Socioeconomic Development [source: DG TREN 2003]*

Growth Rates					
		1990/2000	2000/2010	2010/2020	2020/2030
Population Growth	[%]	-0.06	-0.10	-0.10	-0.11
GDP Growth	[%]	-1.7	4.4	3.0	2.3

(790) Bulgaria's actual population is about 7.5 Million inhabitants. Due to the low fertility rate its native population is declining.

(791) The nominal Bulgarian GDP is expected to rise moderately by an annual growth rate of 2,0% in average.

5.11.2 Primary Energy Consumption

(792) Primary energy mix is diversified. Coal, nuclear and oil are the most important primary energy sources.

(793) Bulgarian primary energy supply is heavily dependant on imports (import dependency of more than 70 % in 2002)

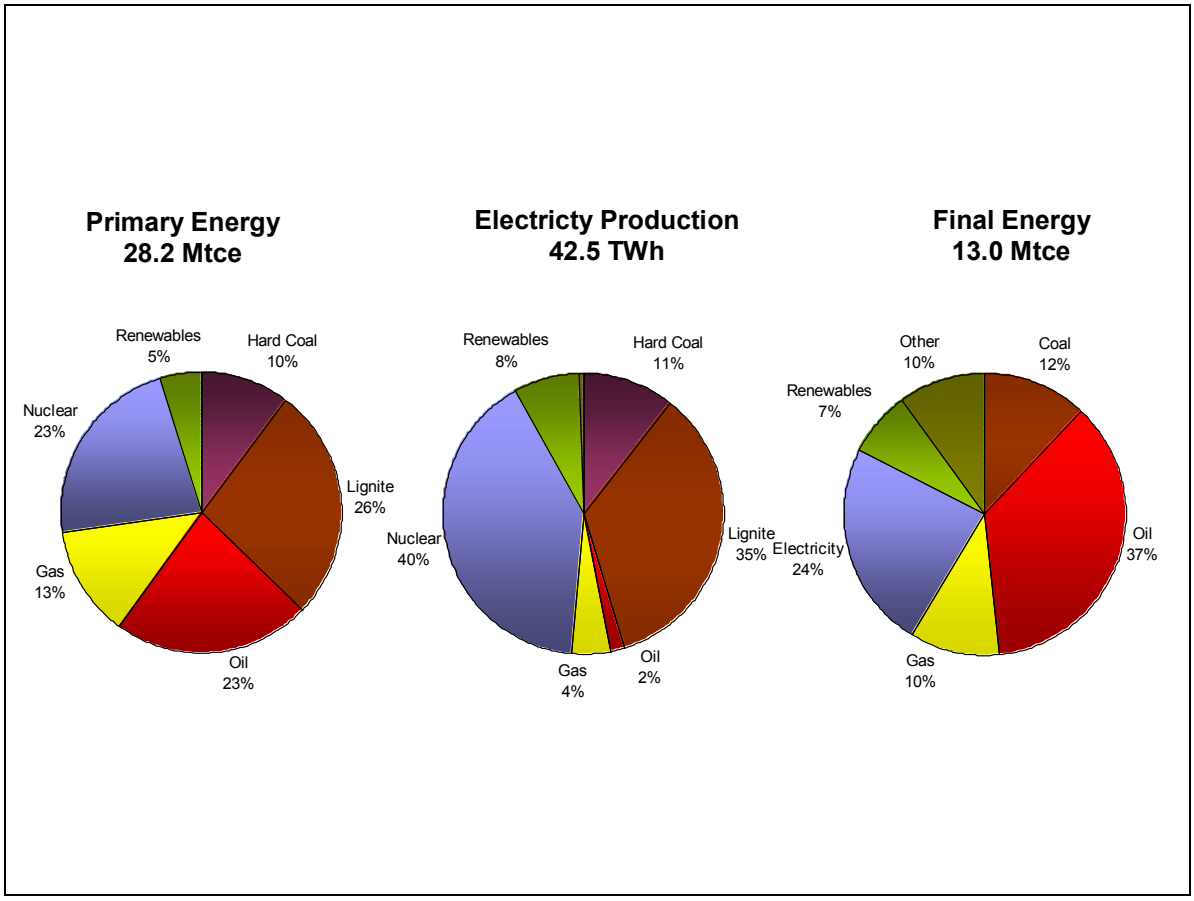

figure 5.11-1 *Primary Energy Consumption Bulgaria 2003 (Status and Outlook)* (source: Eurostat 2004, DG TREN 2003, own calculations)

table5.11-3 *Primary Energy Consumption and Domestic Production 2003 (Bulgaria)* (source: Eurostat 2004, IEA 2004, own calculations)

Primary Energy Consumption	Primary Energy	Domestic Production	Share of Production
	[Mtce]	[Mtce]	[%]
Total	**28.17**	**14.42**	
Hard Coal	2.92	0.03	1.0%
Steam Coal	2.02	-	-
Coking Coal	0.90	-	-
Lignite	7.55	6.61	87.6%
Oil	6.43	0.04	0.6%
Natural Gas	3.57	0.02	0.5%
Nuclear Energy	6.37	6.37	100%
Hydro and Renewables	1.34	1.35	101%

5.11.3 The Role of Coal

(794) Coal is one of the most important primary energy sources. In 2003 coal accounted for 37.2% of total primary energy supply.

(795) Coal plays a major role in indigenous primary energy production. Most of the lignite used in Bulgaria is from domestic production.

(796) The importance of coal slightly increased over the past years. In 1991 35.7% of total primary energy supply came from coal.

Table 1.1-3 *Coal Market Volume and Domestic Production 2003 (Bulgaria) (source: Eurostat 2004, IEA 2004, own calculations)*

Coal Market Volume and Domestic Production	Total	Domestic Production
	[Mtce]	[Mtce]
Hard Coal	**2.92**	0.03
Steam Coal	**2.02**	-
Coking Coal	**0.90**	-
Lignite	**7.55**	6.61

5.11.3.1 Hard Coal

(797) Hard coal market volume was 2.92 Mtce in 2003. 2.02 Mtce were used for power and heat generation (steam coal) and 0.90 Mtce were coking coal.

(798) Most of the hard coal used in Bulgaria was imported (99%). Main importers are Russia (36%) and other former USRR countries (47%).

(799) Indigenous hard coal production has been declining.

(800) Bulgaria produced 0.03 Mtce of hard coal in 2003.

5.11.3.2 Lignite

(801) Bulgaria produced 6.61 Mtce and imported 0.94 Mtce of lignite in 2003. Lignite production slightly has been declining over the past years. There are four areas of lignite production:

- the Maritsa East Mines;
- the Bobov Dol Mines;
- the Stanyantsi, Beli Breg, Chukorovo Mines;
- the Pernik Mines

In these areas lignite is produced in opencast mines.

(802) Lignite is mainly used for electricity generation (95% in 2002)

5.11.3.3 Reserves & Production

(803) Hard coal and lignite are one of the most important domestic fuels

- Reserves of hard coal: 0.00954 Gtce (13 Mt), 2000
- Reserves of lignite: 0.672 Gtce (2.698 Mt) , 2000

(804) Nuclear energy is the most important energy source while gas and oil only play minor roles in domestic energy production

(805) Bulgaria produced 6.61 Mtce of lignite in 2003 and 0.03 Mtce of hard coal making coal one of the most significant fuel of domestic primary energy production

Reserves and Resources	Resources	Reserves	Production	Static Res
	[Mt]	[Mt]	[Mt]	[a]
Coal	**3'200**	**2'187**	**26.0**	
Hard Coal	200	13	0.1	**144**
Lignite	3'000	2'698	25.9	**104**

table5.11-4 Reserves and Production of Coal (Bulgaria) (source: BP 2005, WEC 2001, own calculations)

5.11.4 Power Generation

table 5.11-5 Installed Power Plant Capacities (Bulgaria)

Installed Power Plant Capacities			
	[MWel]	**[GWh]**	**[h full cap] (4)**
Total	**11.997**	**42.533**	**3.545**
Nuclear	***2.723***	***17.280***	***6.346***
Conv' Thermal (1)	***6.759***	***22.019***	***3.258***
Coal (>30 MWel)	5.230	19.237	3.678
Hard Coal (>30 MWel)	*1.940*	*4.525*	*2.332*
Lignite (>30 MWel)	*3.290*	*14.712*	*4.472*
Oil (>30 MWel)	0	789	-
Gas (>30 MWel)	0	1.987	-
Conv' Others (2)	***1.529***	***1.762***	**-**
Biomass (wood, wood-waste, biogas)		225	-
Waste (muncipal and industrial waste)		***6***	
Renewables (3)	***2.515***	***3.234***	-
Hydro	2.515	3.234	-
Pumped Storage	**-**	-	**-**
Wind	-	-	-
Geothermal	-	-	-

Please note: Table is presenting a synthesis from different statistics.
Data may not be consistent, for following reasons:
(1) Conventional Thermal: conv. thermal capacites above 30 MW, power generation from all conventional thermal
(2) Conventional Others: conv. thermal capacites below 30 MW incl. biofuel and waste capacities, power generation from biofuel and waste only
(3) Renewable capacities without biofuel capacities; renewable power generation without biofuels
[source: Eurostat]2003 and 2004; Siemens Database 2005

5.11.4.1 The Role of Electricity

(806) Final energy demand decreased by 43.3% from 1990 to 2003. Oil accounts for most of total final energy consumption in Bulgaria (36.5 % in 2003)

(807) Electricity consumption declined by 27.7% in 2003 in comparison to 1990. Share of electricity in final energy consumption grew from18.9% in 1990 to 24% in 2003.

5.11.4.2 Power Generation

(808) In 2003 coal was the most important source for electricity generation. 45.2% of electricity generated was produced by coal.

(809) Lignite had a share of roughly 34.6%, hard coal had a share of about 10.6% of national gross electricity production.

(810) In 2003 nuclear energy was the second most important source for electricity generation. The nuclear power plants produced 40.7% of electricity generated.

(811) The share of renewables will be increasing in the long term according to the government plan.

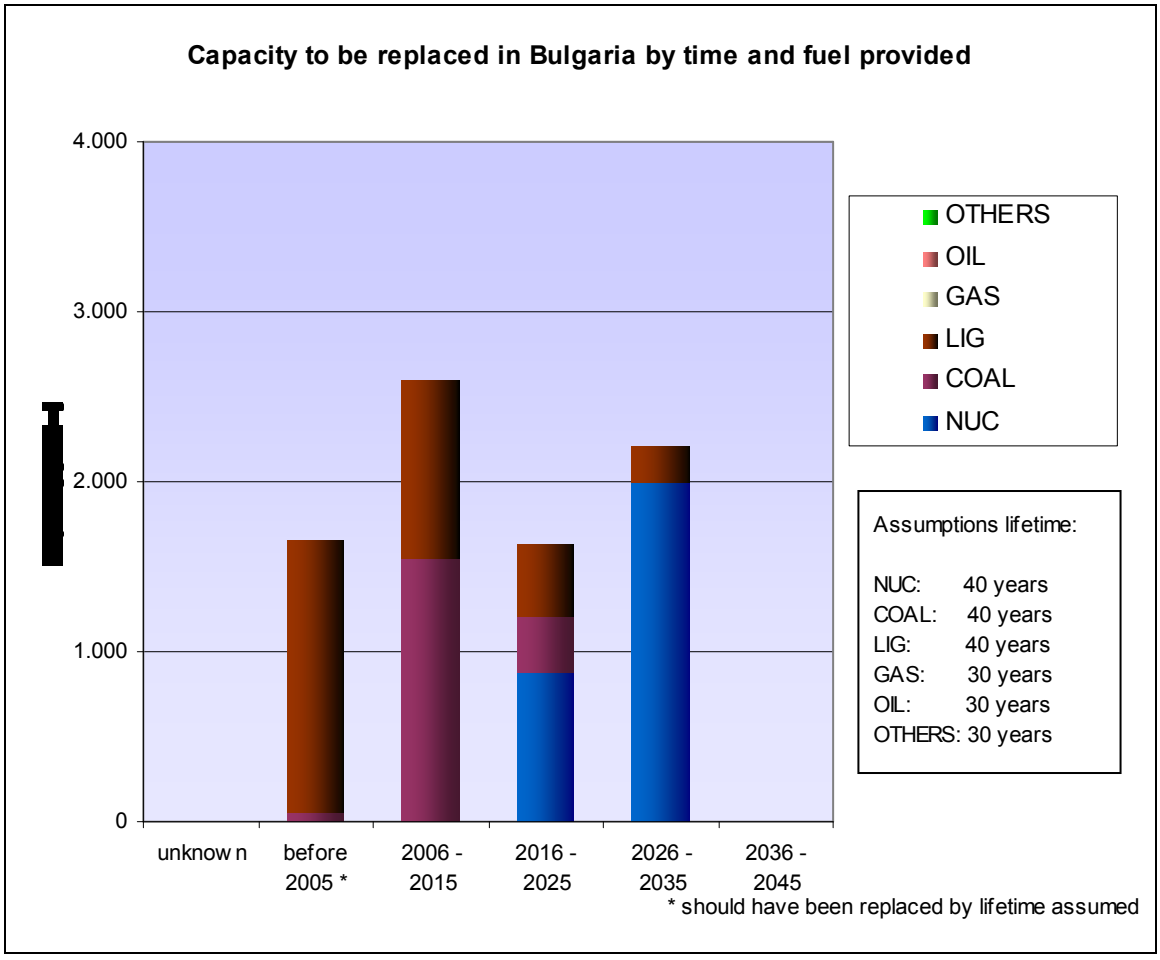

figure 5.11-2 Capacity Replacements (Bulgaria)

5.11.5 Energy Policy in General

(812) Bulgaria pursues six aims defined in: *National Strategy for Development of Energy and Energy Efficiency till 2010*:

- the liberalization of the energy market in view of the integration in the European Union;
- the establishment of a privatization program;
- the reduction of costs;
- the promotion of renewables;
- the energy efficiency;
- nuclear safety.

(813) This goals will be achieved through:

Increase of coal consumption from 30,5 Mt to 46-47 Mt
Construction of new power capacities of 3830 MW in CHP's, pumped storage and nuclear plants.

5.11.6 Renewable Energy

(814) In 2003 electricity generation from renewables amounted to 3,2 TWh (7.5% of total electricity generation) and is placed mostly in hydro power.

(815) The installed capacity of renewables increased. The amount of electricity generated from renewables increased by 70% since 1990 while total electricity generation increased by about 1%.

(816) There was only a slight increase in capacity of hydro power plants and there were 0,04 GW of wind and solar power capacity installed.

(817) The national policy and regulatory framework for RES are formulated in the current *Energy Law and Energy Efficiency Act*. RES are considered as priority and are preferentially treated both towards the purchase electricity prices and towards the obligatory purchase of RES electricity by transmission and/or distribution companies.

(818) According to the *Ordinance on Setting and Applying Prices and Rates of Electric Energy* renewable power enjoys preferential pricing, moreover transmission and distribution enterprises must purchase all quantities of renewable power that independent producers make available.

(819) The development of renewable energy sources will take place especially in hydro power.

5.11.7 Climate Protection Policy

(820) The policy is performed in comply with international conventions European Convention on Cross-Border Air Pollution and its Second Protocol on Sulphur, Rio de Janeiro Convention on preventing the climate changes and on reduction of carbon dioxide emission. There are detailed investment programs for upgrading and modernization of power and heat generation plants in Maritsa East, Varna, Rousse and Bobov. These measures will assure that the sulphur emissions will be 2010 about the target set in second protocol on Sulphur.

(821) The national target is to reduce CO_2-emissions by 8% in the period between 2008 and 2012 Greenhouse gas (GHG) emissions versus the basic 1980 year.

(822) In 1999 GHG emissions were 53.4% below the base year (1988) level.

5.12 Romania (RO)

(823) Romania is a democracy comprised of 41 districts with the capital Bucharest. Romania is located in South-Eastern Europe and covers about 238'391 km^2, making Europe's 12th largest nation measured by area.

(824) In the North Romania is bordered by Hungary and Ukraine. Moldova and the Black Sea surrounds the Eastern border, with Bulgaria to the South and Serbia and Montenegro to the West.

(825) The major natural resources of Romania are: hard coal deposits of Petrosani Depression; lignite deposits are located along the fringe of mountain areas, a large lignite field is located in the Motru Valley; oil deposits are found in the flysh formations that run in a band along the outer rim of the Carpathians, through the Subcarpathians, Bacau and Prahova districts, and in the Romanian sector of the Black Sea; Natural gas is produced in the centre of the Transylvanian Basin.

(826) Romania is a candidate country to the European Union and is not a member of the OECD.

5.12.1 Socioeconomic Framework

(827) Romania's actual population is about 22 Million inhabitants. Due to the low fertility rate its native population is declining.

(828) The nominal Romanian GDP is expected to rise moderately by an annual growth rate of 2.7% in average.

table 5.12-1 Assumptions for Future Economic Development (Romania)

		1990	**2000**	**2010**	**2020**	**2030**
Population	[million]	23.21	22.44	21.79	21.01	20.13
GDP	[€ billion]	50.3	42.2	68.5	104.4	141.1
			1990/2000	**2000/2010**	**2010/2020**	**2020/2030**
Population Growth	[%]		-0.03	-0.03	-0.04	-0.04
GDP Growth	[%]		-1.7	5.0	4.3	3.1

5.12.2 Primary Energy Consumption

(829) Primary energy mix is diversified. Gas, oil and coal are the most important primary energy sources.

(830) Romania's primary energy supply is almost self sufficient. Only 20% of natural gas and 8% of coal are imported.

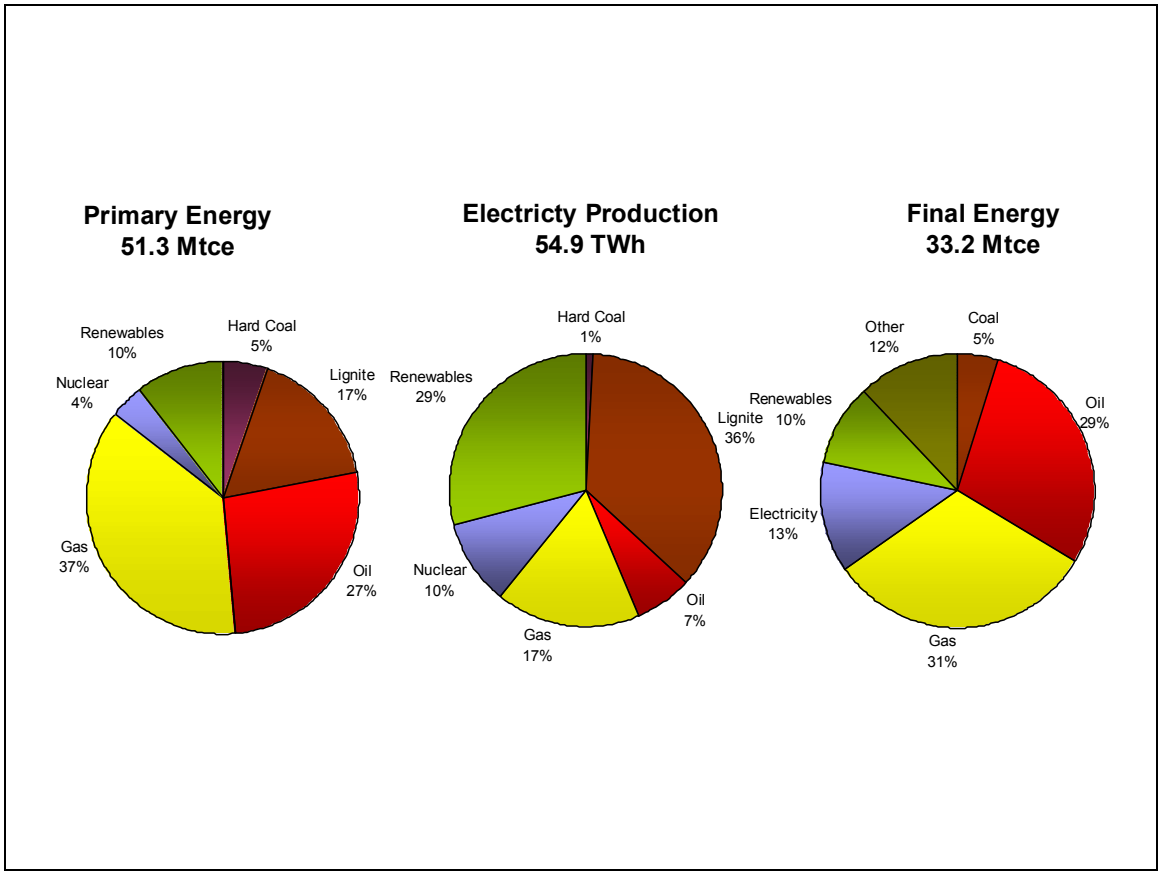

figure 5.12-1 *Energy Consumption and Electricity Production (Romania)*

table 5.12-2 *Primary Energy Consumption and Domestic Production Romania (2002)*

Primary Energy Consumption	Primary Energy	Domestic Production	Share of Production
	[Mtce]	[Mtce]	[%]
Total	**51.25**	**38.18**	
Hard Coal	2.71	0.01	0.5%
Steam Coal	.	.	-
Coking Coal	.	.	-
Lignite	8.50	7.37	86.7%
Oil	13.64	8.73	64.0%
Natural Gas	19.01	14.68	77.2%
Nuclear Energy	2.03	2.03	100%
Hydro and Renewables	5.36	5.36	100%

5.12.3 Primary Energy Consumption: The Role of Coal

(831) Coal is one of the most important primary energy sources. In 2002 coal accounted for 22.0% of total primary energy supply.

(832) Coal plays a major role in indigenous primary energy production. Most of the hard coal used in Romania is from domestic production.

(833) The importance of coal has been increasing over the past years. In 1991 16.5% of total primary energy supply came from coal. Further increase of coal demand is expected until 2010.

table 5.12-3 *Coal Market Volume and Domestic Production Romania (2002)*

Coal Market Volume and Domestic Production	Total	Domestic Production
	[Mtce]	[Mtce]
Hard Coal	2.7	0.0
Steam Coal	.	.
Coking Coal	.	.
Lignite	8.5	7.4

5.12.4 Reserves & Production

(834) Hard coal and lignite are one of the most important domestic fuels

- Reserves of hard coal: 0.73 Mtce (1Mt), 1999
- Reserves of lignite: 0.35 Gtce (1'456 Mt) , 1999

(835) Natural gas and oil production was about 23.41 Mtoe in 2002.

(836) Romania produced 7.37 Mtce of lignite in 2002 and 0.01 Mtce of hard coal making coal one of the most significant fuel of domestic primary energy production.

table 5.12-4 *Resources, Reserves and Production of Hard Coal and Lignite (Romania)*

Reserves and Resources	Resources	Reserves	Production	Static Res
	[Mt]	[Mt]	[Mt]	[a]
Hard Coal	1	1	0.01	77
Lignite	7'141	1'456	22.9	64

5.12.4.1 Hard Coal

(837) Hard coal market volume was 2.7 Mtce in 2002.

(838) Most of the hard coal used in Romania was imported (99.5%). Main importer is Russia (56%).

(839) Indigenous hard coal production has been declining.

(840) Romania produced 0.01 Mtce of hard coal in 2004.

5.12.4.2 Lignite

(841) Romania produced 7.4 Mtce and imported 1.1 Mtce of lignite in 2002. Lignite production has been declining over the past years. There are four areas of lignite production:

- the Southern Carpathian mining area
- the Pre-Carpathian creep
- the Sub-Carpathian creep
- the Panonian Creep

(842) Lignite is mainly used for electricity generation.

5.12.5 Final Energy Consumption: The Role of Electricity

(843) Final energy demand decreased by 41.7% from 1990 to 2002. Coal accounts for one of the most of final energy consumption in Romania (22% in 2002)

(844) Electricity consumption decreased by 29% in 2002 as it was in 1990. The share of electricity in final energy consumption increased to minor extend from 12.9% in 1990 to 13.2 in 2002.

5.12.6 Power Generation

5.12.6.1 Power Generation: Overview

(845) In 2002 coal was the most important source for electricity generation. 37% of electricity generated was produced by coal.

(846) Lignite had a share of roughly 36%, hard coal had a share of about 0.7% of national gross electricity production.

table 5.12-5 *Installed Power Plant Capacities (Romania)*

Installed Power Plant Capacities			
	[MWel]	**[GWh]**	**[h full cap] (4)**
Total	**56'645**	**19'369**	**2'925**
Nuclear	***4'906***	***707***	***6'939***
Conv' Thermal (1)	***38'480***	***12'414***	***3'100***
Coal (>30 MWel)	23'344	7'020	3'325
Hard Coal (>30 MWel)	*0*	*1'260*	0
Lignite (>30 MWel)	*23'344*	*5'760*	4'053
Oil (>30 MWel)	3'633	-	-
Gas (>30 MWel)	11'500	-	-
Conv' Others (2)	***3***	***5'394***	-
Biomass (wood, wood-waste, biogas)	*3*	-	-
Waste (muncipal and industrial waste)	-	-	-
Renewables (3)	***13'259***	***6'248***	***2'122***
Hydro	13'259	6'248	2'122
Pumped Storage	-	-	-
Wind	-	-	-
Geothermal	-	-	-

Please note: Table is presenting a synthesis from different statistics.
Data may not be consistent, for following reasons:
(1) Conventional Thermal: conv. thermal capacites above 30 MW, power generation from all conventional thermal
(2) Conventional Others: conv. thermal capacites below 30 MW incl. biofuel and waste capacities, power generation from biofuel and waste only
(3) Renewable capacities without biofuel capacities; renewable power generation without biofuels
[source: Eurostat]2003 and 2004; Siemens Database 2005

(847) In 2002 nuclear energy was an important source for electricity generation. 10% of electricity generated was produced by nuclear power.

(848) The share of renewables will be increasing in the long term according to the government plan.

5.12.6.2 Power Generation: Capacities

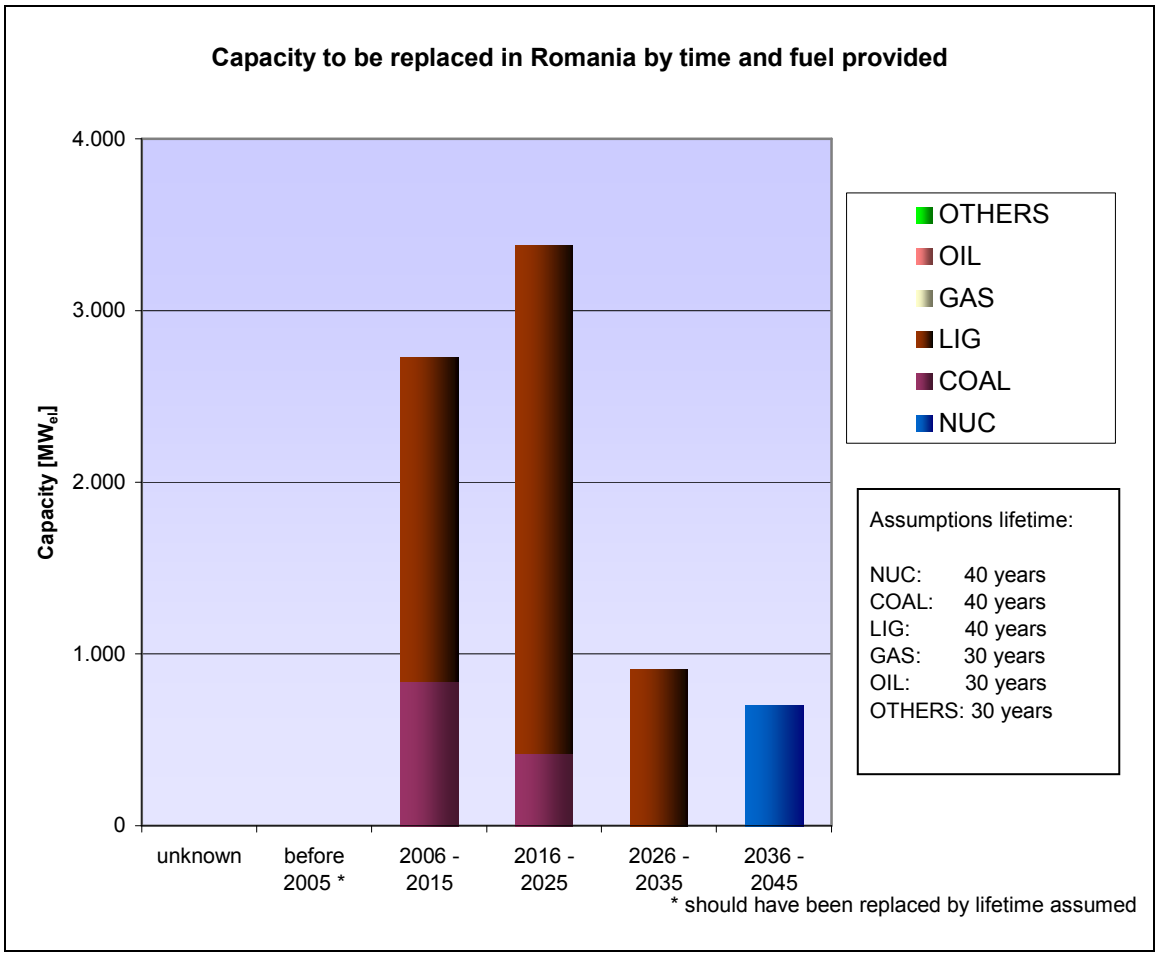

figure 5.12-2 Capacity Replacements (Romania)

5.12.7 Energy Policy in General

(849) Romania pursues three major aims defined in *National Strategy for Energy Development on Medium term* from 2001:

- financial unblocking of the energy sector;
- continuation of the privatization process in the distribution and then in the electricity production sector;
- ensuring a functional and sustainable development on medium term by stimulating new investments for the energy sector.

(850) These aims are to be achieved by decisions concerning liberalization of the energy market: the final transformation of state owned electricity monopoly should happen 2007.

(851) This policy is supported by several restructuring and development plans: World Bank project for the Market of Electricity, World Bank project for Restructuring of Coal Mining.

5.12.8 Renewable Energy

5.12.8.1 Actual Status

(852) In 2002 electricity generation from renewables amounted to 16.05 TWh (29.2% of total electricity generation).

(853) The installed capacity of renewables increased, particularly in hydro power. The amount of electricity generated from renewables increased by 34% since 1990 while total electricity generation decreased by about 15%.

(854) Installed capacity of hydro power plants increased. There is significant potential for new hydro power plants.

5.12.8.2 Renewable Policies

(855) The government actions focus on refurbishment and development of hydro power plants. This will happen through privatization of companies managing them and opening the market for foreign investors.

(856) *The Law on efficient use of energy* from 2000 stipulates obligation of all energy companies to promote renewable energy sources.

(857) Renewables are promoted by law with and with incentive programs. There is a mix of instruments available for investors in taxing and soft loans.

5.12.8.3 Outlook

(858) The highest potential of renewable energy sources is identified in hydro power. This sector will be developed thanks the ownership changes in the energy sector and limited financial support from the state.

5.12.9 Climate Protection Policy

(859) The policy is driven by obligations set by Kyoto targets and integration process with EU. There are no instruments which are directly called for implementation of above mentioned aims. *The Law on Environment Protection* from 1995 introduced the Environmental Fund which collects pollution fees and redistributes them for environment protection projects. Main problems to be solved are toxic air emissions, industrial waste and water pollution. The funding from the state budget is not sufficient for financing necessary measures. International institutions and foreign investors are involved in individual projects.

5.12.9.1 Policy and Kyoto Targets

(860) In 1994 GHG emissions were 34.6% below the base year (1990) levels.

6 The Perspective of Coal in Energy Scenarios

6.1 Review of Energy Scenarios

The projections on energy demand and supply are subject to wide range of uncertainties, including macroeconomic conditions, resource availability, technological developments and investment flows, as well as government energy and environmental policies. The near-term energy outlook depends heavily on the prospects for economic growth and on price trends.

In this chapters the key assumptions and results of three international well regarded institutions are presented:

- The European Commission, represented by its general directorate for transport and energy (DG TREN) The studies have been carried out by a team coordinated by the E3M-Lab at NTUA (National Technical University of Athens)
- The Department of Energy of the US government (DOE)
- The International Energy Agency (IEA)

Usually the studies are carried out by establishing a so called baseline or reference scenarios with all known economy and policy trends at that time. Furthermore some key assumptions are varied to examine the influence of different economic or political developments.

6.1.1 EU Trends to 2030 and Scenarios on Key Drivers

The *EU Trends to 2030* were published in 2003. In 2004 the authors completed the work by different *Scenarios on Key Drivers.* The statistical database is based on Eurostat. It is comprising key data on all member states of the EU 25 including neighbouring countries (Norway, Switzerland, Iceland) and candidate countries (Bulgaria, Romania, Turkey), in this combination refering to *EU 30.* The model is worked out for each different countries thus producing a database, which allows a country specific analysis. We have set our focus on following scenarios:

- EU trends to 2030, *Baseline* Scenario (EU Baseline), published in 2003.
- EU trends to 2030, *High Price* Scenario (EU HighPrice), published in 2004,
- EU trends to 2030, *Efficiency and Renewables* Scenario (EU Efficiency), published in 2004,

6.1.1.1 EU Baseline

Scenario name	EU trends to 2030 (Baseline)
Short Key	EU Baseline
Published	2003
Source	http://europa.eu.int/comm/dgs/energy_transport/figures/trends_2030/
Period	2000-2030 (10 year steps)
Region	Europe (EU 30, EU 25, EU 15, EU 10)
Model	Primes/Poles
Description	Trends to 2030 include a global view that puts European development into the world context. The study addresses international framework to 2030, in which globalisation takes place against the background of increasing population and a moderate expansion of the global economy. For the study an analysis focusing on the examination of world market trends and resulting international fuel price trajectories was performed, using the POLES model of IEPE in Grenoble. The modeling of EU 25 is less detailed as for EU 15, which were modeled by the PRIMES model of the NTUA. The ten acceding countries were modeled with the ACE model, which is less sophisticated and detailed than PRIMES.
Population World	+1.0% (2000-2030)
Population Europe	+0.1% (2000-2030)
Growth World	+2.9% (2000-2030)
Growth Europe	+2.4% (2000-2030) for EU 25 +2.3% (2000-2030) for EU 15 +3.5% (2000-2030) for EU 10
Oil price	US$$_{2000}$/bbl 28 / 20 / 24 / 28 (2000/2010/2020/2030)
Gas price	US$$_{2000}$/bbl 15 / 17 / 21 / 23 (2000/2010/2020/2030)
Coal price	US$$_{2000}$/tce 38 / 37 / 36 / 36 (2000/2010/2020/2030)
Electricity price	Reflecting efficiency gains derived from technological progress fuel switching and completion of the internal energy markets electricity prices fall over time, despite rising fuel prices and heavy investment requirements.
Policy Assumptions	▪ continuing no-nuclear strategies (AT, BE, DE, DK, GR, IR, IT, NL, PT, SW) ▪ continuing nuclear-strategies (FR, FI, ES, UK) ▪ ongoing projects for developing gas infrastructure (in some MS)
Technology Assumptions	▪ dynamic trends in technological process ▪ restructuring power generation through maturation of gas-based power generation
Nuclear	Nuclear contribution grows up to 2010 but stabilises thereafter, a break from rising production trend in recent decades (World). In EU 25 nuclear output declines by 19% between 2000 and 2030, following the assumptions of the nuclear phase-out in certain Member States.
Carbon Emissions	For analytical purposes the Baseline case does not include any new policies to reduce greenhouse emissions.

6.1.1.2 High Price

Scenario name	EU Scenarios on Key Drivers (High Price)
Short Key	EU High Price
Published	2004
Source	http://europa.eu.int/comm/dgs/energy_transport/figures/scenarios/
Period	2000-2030 (10 year steps)
Region	Europe (EU 30, EU 25, EU 15, EU 10)
Model	Primes/Poles/ACE
Description	Compared to the Baseline scenario (REF) which describes a world of abundant oil and gas resources and relatively moderate international fuel price increases in the period to 2030 (as a benchmark the price of oil increases to 23.8 US$$_{2000}$/bbl in 2020 and to 27.9 US$$_{2000}$/bbl in 2030), the high price scenario examines a consistent international energy scenario with high oil and gas prices corresponding to a world with higher economic growth and lower oil and gas resources.
Population World	+1.0% (2000-2030)
Population Europe	+0.1% (2000-2030)
Growth World	+3.1% (2000-2030)
Growth Europe	+2.4% (2000-2030)
Oil price	US$$_{2000}$/bbl 28 / 22 / 27 / 33 (2000/2010/2020/2030)
Gas price	US$$_{2000}$/bbl 15 / 18 / 24 / 31 (2000/2010/2020/2030)
Coal price	US$$_{2000}$/tce 38 / 37 / 36 / 36 (2000/2010/2020/2030)
Key Results	
General	The High Price Scenario leads basically to a slowdown of primary energy demand. The most important change can be observed in the fuel mix: this is particularly pronounced for the natural gas demand, which is 13.6% lower than in the Baseline Scenario. Liquid fuels become almost exclusively a fuel for transportation and the petrochemical industry.
Coal	In the longterm the decrease of natural gas is counterbalanced by a increase in the use of solid fuels (+16.9% from Baseline levels)
Nuclear	The use of nuclear energy in the EU energy system is projected to exhibit limited growth above Baseline levels (24 TWh, +3.1% in 2030)
Capacities	The impact of high oil and gas prices becomes more pronounced in the long run, as solid fuels (and renewables) gain in competitiveness and replace natural gas. Gas turbine cycle plants lose much of their cost effectiveness and are mainly replaced by supercritical coal plants and to a lesser extent by renewable technologies. Total installed capacities are expected to be 26 GW higher, with additional contributions from wind turbines (+16 GW), supercritical polyvalent units (+67 GW) and less GTCC capacities (-75 GW)
Electricity	Electricity exhibits an increase above baseline levels, due to the structural changes in power generation leading to absorption of the additional costs imposed on the energy system. Consequently the price increase of electricity are much less than for oil and gas.
Renewables	The decrease of natural gas is counterbalanced by a strong increase in the use of renewable energy sources (+18.6% from Baseline levels). In

Scenario name	EU Scenarios on Key Drivers (High Price)
	terms of fuel use the most pronounced growth above Baseline levels occurs for biomass and waste. The renewable share in electricity production reaches 18% in 2010 and rises further to 20.4% in 2030 (compared to 18% in the Baseline Scenario).
Carbon Emissions	In the high oil and gas price case the growth of CO_2 emissions is projected to exhibit a slowdown over the projection period. The demand side is the main driver for this reduction, whereas the supply side is characterised by a strong increase of CO_2 emissions, which is driven by the higher exploitation of solid fuels (total emissions are 4'280 Mt instead of 4'320 Mt in Baseline Scenario)

6.1.1.3 EU Efficiency Scenario

Scenario Name	EU Scenarios on Key Drivers (Efficiency)
Short Key	EU Efficiency
Published	2003
Source	http://europa.eu.int/comm/dgs/energy_transport/figures/scenarios/
Period	2000-2030 (10 year steps)
Region	Europe (EU 30, EU 25, EU 15, EU 10)
Model	Primes/Poles
Description	The EU *Efficiency and Renewable* scenario has been guided by the "Action Plan to Improve Energy Efficiency in the European Community" presented by the European Commission in the year 2000, as far as the follow-up activities could be modeled. These alternative cases also include substantial policies on renewables with a view to achieving the 12% renewables target set for 2010. The modeling takes into account adopted and proposed legislation, such as the Directive on the promotion of renewables in the internal electricity market, the Directive on biofuels and the building Directive. It simulates the possible outcome of strengthened policies at both Community and Member State levels to achieve greater energy efficiency and a higher share of renewables. These scenarios do not address policies that might be pursued to achieve more ambitious renewables targets than 12% in the period beyond 2010. Most of the modeling was undertaken in 2002 and early 2003.
Population World	+1.0% (2000-2030)
Population Europe	+0.1% (2000-2030)
Growth World	+2.9% (2000-2030)
Growth Europe	+2.4% (2000-2030)
Oil price	$US\$_{2000}$/bbl 28 / 20 / 24 / 28 (2000/2010/2020/2030)
Gas price	$US\$_{2000}$/bbl 15 / 17 / 21 / 23 (2000/2010/2020/2030)
Coal price	$US\$_{2000}$/tce 38 / 37 / 36 / 36 (2000/2010/2020/2030)
Assumptions	
Nuclear	Strong policies on energy efficiency and renewables also lead to lower nuclear input to power generation mainly due to lower electricity demand.

Scenario Name	EU Scenarios on Key Drivers (Efficiency)
Renewables	The White Paper proposes to double the contribution of renewable energy sources (RES) to the European Union's gross inland energy consumption, establishing an indicative Community objective of 12% of primary energy consumption and 22% of electricity generation by 2010.
Efficiency	In 2000 EC estimated the cost-effective potential for energy efficiency improvement to be more than 18% of EU energy consumption. Exploitation of this potential was constrained by market barriers which prevented the satisfactory diffusion of energy-efficient technology and the efficient use of energy. This potential was equivalent to over 230 Mtce (1900 TWh), roughly the total final energy demand of Austria, Belgium, Denmark, Finland, Greece and the Netherlands combined. Taxation and tariff policies are important instruments for promoting energy efficiency. The recently adopted Directive concerning the broadening of the minimum tax base for energy products is an example. Carefully designed tariff structures for energy supply and distribution can also improve efficient end use and will therefore be promoted. Establishment of energy management agencies at the local and regional levels is supported; third-party financing; training and increased dissemination of information; and increased monitoring and evaluation.
Transport	Policy priorities of a non-technological nature include incentives for optimal occupancy of vehicles, modal shifts and modal integration, completion of the internal market in rail transport, and changing behaviour regarding mobility.
Industry	As energy efficiency is considered as a key factor for the competitiveness of many industrial sectors, it forms an important part of the overall action plan on sustainable development. The development of self-regulation arrangements (e.g. voluntary agreements) will play a key part in this process.
Residential	Buildings are particularly important for improving energy efficiency. The plans on strengthening the legal framework for energy efficiency in the building sector have now led to the adoption of the building Directive. This Directive promotes energy efficiency in the building sector through measures on thermal insulation, energy certification of buildings and regular inspection of boilers and air conditioning systems.
Technology	Horizontal measures reinforce energy efficiency policies. These include: research and technology policy to develop new energy-efficient technologies on the demand side (domestic and tertiary, industry, transport), but also for utilities.
Key Results	
Primary Energy	Primary Energy Consumption in the "Energy efficiency and 12% renewables in 2010" case is projected to be 5.9% below Baseline levels in 2010. This decrease is even more pronounced in the long run (-14.1% in 2030). Total energy consumption remains broadly constant between 2010 and 2030 (only +0.3% total increase over 20 years) leaving more limited space for new energy investments and for a rapid penetration of renewables in particular. Combining policies along the lines of the Action Plan for Energy Efficiency and promotional policies for renewable energy forms leads to a significantly different evolution of the EU-25 en-

Scenario Name	EU Scenarios on Key Drivers (Efficiency)
	ergy system in comparison to the Baseline scenario.
Coal	Lower final energy needs, combined with promotional policies for RES, significantly reduce future energy requirements for fossil fuels as primary energies. The biggest decline occurs for solid fuels (-37.5% from Baseline levels in 2030), while demand for natural gas is also projected to decline at rates above average over the projection period (-17.7% in 2030). In power generation, the consumption of solid fuels in 2030 is just 55% of that in the Baseline scenario. The input of natural gas falls more than 30% below the Baseline level. On the other hand, the use of biomass is about three times higher than in the Baseline scenario (boosted by promotional policies for both renewables and cogeneration).
Electricity	The slowdown in electricity demand growth due to higher energy efficiency and the further penetration of renewable energy forms in the power generation sector lead to a significant fall in the use of nuclear energy, which is projected to be 20% below Baseline levels in 2030.
Power Generation	Declining electricity demand, combined with higher penetration of renewable energy forms in the EU-25 power generation, markedly reduce electricity generation from fossil fuels and nuclear. In the short term the decline, both in absolute and percentage terms, is more pronounced as regards electricity generation from natural gas (-16.3% from Baseline levels in 2010).Solid fuels and nuclear energy lose similar amounts of electricity generation in absolute terms (-12.6% and -9.3% from Baseline levels respectively). From 2020 onwards, electricity generation from solid fuels (which is projected to make a strong comeback in the power sector under Baseline assumptions) experiences the largest decline from Baseline levels (-34.9% in 2020, -43.9% in 2030).
Renewables	Promotional policies for RES in the “Energy efficiency and 12% renewables in 2010” case bring about a large increase in renewables’ deployment in the EU-25 energy system. This increase is well above Baseline levels over the projection period (+53.8% in 2010 compared to Baseline,+43.3 % in 2030) despite the overall decline of primary energy needs. In 2010 the share of renewable energy forms is projected to reach 12.1% of primary energy needs in the EU-25 energy system (+4.7 percentage points above Baseline levels). The renewables share rises to 14.4% in 2030 (compared to 8.6% in the Baseline scenario). Biomass increases by 104% from Baseline levels in 2010 and +70% in 2030. In comparison with Baseline developments, biomass accounts for 84% of all incremental supply of renewable energy use in 2010 and for 70% in 2030. Wind energy is also projected to grow significantly increasing above Baseline by +46.8% in 2010, and by +40.6% in 2030. Wind accounts for 13% of the additional renewable consumption above Baseline in 2010 and for 20% in 2030.
Carbon emissions	The combined effect of slower energy demand growth and changes in the fuel mix away of carbon intensive fuels and towards the use of carbon-free ones is clearly reflected in the projected trend in CO_2 emissions. Such emissions decrease significantly between 2000 and 2010, so that in 2010 CO_2 emissions are 12% below those in 1990. Furthermore, CO_2 emissions are projected to stabilise at that level in the period to 2030, considerably lower than under Baseline developments (-11.9%

Scenario Name	EU Scenarios on Key Drivers (Efficiency)
	from Baseline levels in 2010 and -22.5% in 2030).

6.1.2 IEA World Energy Outlook

The International Energy Agency (IEA) in Paris is an OECD organisation and publishes its *World Energy Outlook* annually. Data are provided in regional clusters, refering OECD or non-OECD countries. As the most recent publication of IEA, the *World Energy Outlook 2005* is focusing the countries of the Middle East and North Africa (MENA), we have used the database of WEO 2004, which is much more detailed for Europe. In some points, we include key results of WEO 2005, especially when it comes to price developments. WEO 2004 is including an *Alternative Scenario* comprising a set of political measures to enhance climate protection policies. Database for coal is completed by the IEA publication *Coal Information 2005* and by some publication of the Coal Industry Advisory Board at IEA CIAB. We have set our focus on following scenarios:

- IEA World Energy Outlook (2030), *Reference* Scenario (IEA Ref04), published in 2004,
- IEA World Energy Outlook (2030), *Alternative* Scenario (IEA Alternative), published in 2004.

6.1.2.1 IEA Reference (IEA Ref04)

Scenario Name	IEA WEO Reference
Short Key	IEA Ref04
Published	2004
Source	http://www.IEA.org/Textbase/weo/
Period	1972-2030 (10 year steps from 2010)
Region	World (OECD regions, non-OECD)
Model	IEA
Description	
Population World	+1.0% (2002-2030)
Population Europe	+0.0% (2002-2030)
Growth World	+3.2% (2002-2030)
Growth Europe	+2.0% (2002-2030)
Oil price	US$$_{2000}$/bbl 27 / 22 / 26 / 29 (2003/2010/2020/2030) in WEO 2004 US$$_{2000}$/bbl 27 / 22 / 26 / 29 (2003/2010/2020/2030) in WEO 2004
Assumptions	
Policy	▪ all policy decisions adopted by mid 2004 are included ▪ markets: electricity and gas markets move ahead ▪ nuclear power: no changes in national policies towards nuclear energy
Renewables	The development of Renewables is a key element of the energy policies of the European Union. The White Paper of 1997 sets a target of 12% in

Scenario Name	IEA WEO Reference
	total energy consumption in 2010, and increasing the share of renewables in electricity consumption from 14% to 22% in 2010. Under current policies IEA does not expect this target to be met, but reaching some 18% share of renewables in electricity consumption.
Emissions Trading	As ratification seemed to be unclear and the scheme was under discussion among member states of the European Union, ETS was not included in the reference scenario.
Key Results	
Coal	Coal will continue to play a key role in the world energy mix and keep its global share in primary consumption. However this is mostly due to the increase in Asian countries, with China and India alone responsible for 68% of the increase in demand. IEA sees for OECD countries coal demand highly dependent on climate change policies. Coal demand in Europe will increase slowly in the first half of the period but then decline to slightly less than current. Demand is to be expected 816 Mt in 2030 compared to 822 Mt in 2002. Coal will continue to lose market share to natural gas in the power supply sector. The relative costs of coal will be influenced by environmental policies.
Electricity	Electricity demand will be doubling from 2002 (9'300) to 2030 (18'400 TWh) with an annual growth rate of 2.5%. In the European Union the increase will lower with an annual growth rate of 1.4%, going from 1'750 TWh up to 2'600 TWh. Input in power generation will be dominated by gas, with 2.5 times primary input (140 Mtce up to 400 Mtce in 2030) and a share of 35% of primary energy supply in power generation. Coal will keep the total amount of primary energy supply in power generation (about 330 Mtce), but loose relative share from 33% to 28%. Nuclear fuels in power generation will decrease from 357 Mtce in 2002 down to 208 Mtce in 2030.
Capacities	Installed Capacities will increase to more than 1'000 GW in 2030. Coal capacities keeping about the same level as in 2002, but generally not participating in the growth of capacities. 250 GW growth of capacities are provided by gas fueled power plants (nearly doubling in three decades), while nuclear capacities are projected to decrease from 140 GW to 70 GW. With hydroelectric capacities staying almost at the same level (+12%), the other major contribution is made by other renewable energy sources (+200 GW) with a seven times higher installed capacity than in 2002 .
Renewables	Wind capacities will be increasing from 20 GW in 2002 to 170 GW in 2030, and wind power generation will be even be 13 times the level of 2002, thus almost doubling the full operation hours from 1'500 to 2'800 GWh, with a more constant contribution from off-shore wind power generation.
Carbon emissions	In IEA Reference the World CO_2 emissions reach a level of almost 38'000 Mt by 2030, an increase of nearly 60% against 2002. In EU 25 the increase of carbon emissions is slowing down in the last decade growing from 4'400 to 4'500 Mt, in total increasing by 20% against 2002. The Kyoto target of the European Union will be missed with an increase of nearly 10% up to 4'100 Mt.

Scenario Name	IEA WEO Reference

6.1.2.2 IEA Alternative (IEA Alternative)

Scenario Name	IEA WEO Alternative
Short Key	IEA Alternative
Published	2004
Source	http://www.IEAorg/Textbase/weo/
Period	1972-2030 (10 year steps from 2010)
Region	World (OECD regions, non-OECD)
Model	IEA
Description	The *IEA Alternative Scenario* depicts a more efficient and more environmentally friendly energy future than the Reference Scenario. It demonstrates the policies that address environmental and security concerns, together with a faster deployment of technology, to substantially reduce energy consumption and carbon emissions.
Population World	+1.0% (2002-2030)
Population Europe	+0.0% (2002-2030)
Growth World	+3.2% (2002-2030)
Growth Europe	+2.0% (2002-2030)
Oil price	US$$_{2000}$/bbl 27 / 22 / 26 / 29 (2003/2010/2020/2030)
Gas price	
Coal price	
Assumptions	
Nuclear	The nuclear option is kept with view to carbon free electricity generation. Instead of reducing capacities by nearly 50%, the share of nuclear energy in electricity generation is reduced from 360 Mtce to 280 Mtce, still keeping a share of 26% in power generation
Renewables	The development of Renewables is a key element of the Energy Policies of the European Union. The White Paper of 1997 sets a target of 12% in total energy consumption in 2010, and increasing the share of renewables in electricity consumption from 14% to 22% in 2010. In the Alternative Scenario IEA expects this target to be met by additional measures and it is assumed that the continued support of renewables would increase their share to 34% in 2030. The much bigger share of renewables will be reached by policies to reduce electricity consumption.
Efficiency	Next to extended operation times of the nuclear power plants an increased share of CHP and distributed energy generation (based on fuel cells) is expected. In addition there will be a faster deployment of renewable energies.
Transport	The Alternative Scenario expects full adoption of the Chinese motor-vehicle-fuel-efficiency standard and an additional improvement of another 10%. The Alternative Scenario expects that this standards will be also applied to buses and trucks. It is also including an adoption of alternative fuel vehicles and a modal shift from road to high-speed and intra-city rail traffic. For Europe the increased use of biofuels is expected and a modal shift from aviation to railway and buses.

Scenario Name	IEA WEO Alternative
Industry	For the industry sector an improved efficiency for motor driven system is implemented. There will be new voluntary programs covering information and assistance in retrofitting. Tax incentives and low-interest loans for investment in new efficient technologies are assumed.
Residential	There are higher efficiency standards for lighting and appliances, as well as programs targeting the reduction of stand-by losses in appliances. Updated labels for washing machines and dishwashers is assumed, as well as the full implementation of the energy performance in buildings directive (EPBD).
Technology	A set of (known) technologies is employed for the Alternative Policy Scenario ranging from hybrid vehicles, fuel cells and solar water heaters to IGCC technology. The impact of breakthrough technologies under actual development is not included and could however modify the trends dramatically. Among these technologies carbon sequestration and advanced nuclear reactors appear most likely to change the long-term outlook. Although not included when modeling the Alternative Scenario, the implications have been reflected: if all new capacities built in OECD after 2015, Clean Coal Technologies would cover 5% of the power generating capacities of the world. The additional investment would be US$ 220 billion. By 2030 the CO_2 reduction would between 1'500 and 2'000 Mt, thus reducing the carbon emissions by 21% (instead of 16%) compared with the Reference Scenario.
Primary Energy	The adoption of the policies and measures now under construction and their application over the projection period would entail a decrease of 8% in energy demand compared to the Reference Scenario worldwide. In Europe primary energy demand reaches 2'670 Mtce, about 9% lower than in Reference Scenario.

6.1.3 EIA International Energy Outlook

The Energy Information Administration (EIA) of the Department of Energy (DOE) is part of the U.S. government, situated in Washington. The *International Energy Outlook (IEO)* is published annually and (usually) consistent with the national *Annual Energy Outlook (AEO)* for the United States. As price developments in late 2004 were surprisingly dynamic the DOE decided to relate its IEO database *not* on the AEO 2005 but to refer to a more actual price basis. This is the reason why prices are higher even than in the EU *High Price* scenario.

The IEO database is – similar to the World Energy Outlook of IEA – clustered in geographic regions (e.g. Western Europe, Eastern Europe), which are *not consistent* with political regions (EU 25, EU 15, EU 10), that are focused in this work. For this reason some data might be different. However, our analysis shows, that the key results are (approximately) the same and relevant for the regions considered in this work.

We have set our focus on following scenarios:

- EIA Reference Case

- EIA High Economic Growth
- EIA Low Economic Growth

6.1.3.1 EIA Reference Case

Scenario name	EIA Reference
Short Key	EIA Ref05
Published	2005
Source	http://www.eia.doe.gov/oiaf/ieo/
Period	1970-2025 (5 year steps from 2010)
Region	World (Emerging Economies, Transitional Economies, Mature Market Economies)
Model	SAGE EIA, System for the Analysis of Global Energy Markets (2005).
Description	The International Energy Outlook 2005 [EIA 2005] presents an assessment by the Energy Information Administration (EIA) of the outlook for international energy markets through 2025. U.S. projections appearing in IEO 2005 are consistent with those published in EIA's Annual Energy Outlook 2005. It is including significant higher reference prices than its predecessor IEO 2004.
Population World	+1.0% (2002-2025)
Population Europe	+0.1% (2002-2025) for Western Europe -0.2% (2002-2025) for Eastern Europe
Growth World	+3.9% (2002-2025)
Growth Europe	+2.0% (2002-2025) for Western Europe +4.1% (2002-2025) for Eastern Europe
Oil price	US$$_{2000}$/bbl 22.50 / 29.15 / 31.67 / 32.93 (2003/2010/2020/2025)
	The EIA has adopted the October oil futures case as the reference scenario for oil price assumptions in the International Energy Outlook 2005. The October oil futures case projects the oil price based on an extrapolation of oil prices that corresponds to the recent mid-term profile of prices at the NYMEX futures market. In this scenario, the oil price is expected to rise to 44 US$$_{2003}$/bbl in 2005 and will then fall to a level of about 31 US$$_{2003}$/bbl in 2010, which is about 6 US$ above the original reference case used in the Annual Energy Outlook.
Assumptions	
Policies	The IEO 2005 projections assume that government laws in place as of October 1, 2004, remain unchanged over the forecast horizon. [EIA 2005]
Carbon emissions	the IEO 2005 reference case forecast does not include the potential impacts of the Kyoto Protocol (which entered into force on February 16, 2005), because the treaty does not indicate the methods by which signatories will implement the Protocol. The Kyoto Protocol also does not address signatory obligations beyond the 2012 time frame, making it impossible in the context of a reference case projection for EIA to assess the impacts of the Protocol through 2025, the end of the IEO 2005 forecast horizon.
Key Results	
Coal	The IEO 2005 forecast for coal use in the emerging economies is nearly 13 percent higher than in IEO 2004. The largest increases in coal use worldwide are projected for China and India, where coal supplies are plentiful. Together, China and India account for 87 percent of the projected rise in coal use in the emerging economies region and 72 percent of the total world increase in coal demand over the forecast period. Coal use worldwide is projected to increase by 2.0 billion short tons between

Scenario name	EIA Reference
	2002 and 2015 and by another 1.0 billion short tons between 2015 and 2025. In this year's outlook for coal, all regions of the world show some increase in coal use, except Western Europe, where natural gas and, to a lesser extent, renewable energy sources are increasingly being substituted for coal to fuel electric power generation. On a regional basis, slightly lower coal use is anticipated relative to last year's outlook in the mature market economies. In the transitional economies of the EE/FSU region, coal use was expected to decline somewhat in the IEO 2004 forecast, but in this year's forecast it is expected to increase by 0.5 percent per year between 2002 and 2025.
Electricity	Electricity generation is expected to nearly double between 2002 and 2025, from 14'275 TWh to 26'018 TWh. The strongest growth in net electricity consumption is projected for the emerging economies of the world, averaging 4.0 percent per year in the IEO 2005 reference case, compared with a projected average increase of 2.6 percent per year worldwide. Robust economic growth in many of the emerging economies is expected to boost demand for electricity to run newly purchased home appliances for air conditioning, cooking, space and water heating, and refrigeration. More modest growth, averaging 1.5 percent per year, is projected for the mature market economies.

6.1.3.2 EIA High Economic Growth

Scenario name	EIA High Economy
Short Key	EIA High05
Published	2005
Source	http://www.eia.doe.gov/oiaf/ieo/
Period	1970-2025 (5 year steps from 2010)
Region	World (Emerging Economies, Transitional Economies, Mature Market Economies)
Model	SAGE EIA, System for the Analysis of Global Energy Markets (2005).
Description	In the scenario for high economic growth rates different assumptions are made depending on the state of the economy. For mature economies a growth rate of 0.5 percentage point above the reference case was assumed. Outside the industrialized world (except the Former Soviet Union), growth rates of one additional percentage point compared to the reference case were assumed.
Population World	+1.0% (2002-2025)
Population Europe	+0.1% (2002-2025) for Western Europe -0.2% (2002-2025) for Eastern Europe
Growth World	+4.6% (2002-2025)
Growth Europe	+2.5% (2002-2025) for Western Europe +5.0% (2002-2025) for Eastern Europe
Oil price	US$$_{2000}$/bbl 22.50 / 29.15 / 31.67 / 32.93 (2003/2010/2020/2025)
	There are no deviating price assumptions for the high economic growth case.

6.1.3.3 EIA Low Economic Growth

Scenario name	EIA Low Economy
Short Key	EIA Low05
Published	2005
Source	http://www.eia.doe.gov/oiaf/ieo/
Period	1970-2025 (5 year steps from 2010)
Region	World (Emerging Economies, Transitional Economies, Mature Market Economies)
Model	SAGE EIA, System for the Analysis of Global Energy Markets (2005).
Description	In the scenario for high economic growth rates different assumptions are made depending on the state of the economy. For mature economies a growth rate of 0.5 percentage point above the reference case was assumed. Outside the industrialized world (except the Former Soviet Union), growth rates of one additional percentage point compared to the reference case were assumed.
Population World	+1.0% (2002-2025)
Population Europe	+0.1% (2002-2025) for Western Europe -0.2% (2002-2025) for Eastern Europe
Growth World	+4.6% (2002-2025)
Growth Europe	+2.5% (2002-2025) for Western Europe +5.0% (2002-2025) for Eastern Europe
Oil price	US$$_{2000}$/bbl 22.50 / 29.15 / 31.67 / 32.93 (2003/2010/2020/2025)
	There are no deviating price assumptions for the high economic growth case.

6.1.3.4 EIA Kyoto Protocol Case

Scenario Name	EIA Kyoto Protocol
Short Key	EIA Ref05
Published	2005
Source	http://www.eia.doe.gov/oiaf/ieo/
Period	1970-2025 (5 year steps from 2010)
Region	World (Emerging Economies, Transitional Economies, Mature Market Economies)
Model	SAGE EIA, System for the Analysis of Global Energy Markets (2005).
Description	The Kyoto Protocol case assumes that energy use will not vary from the reference case forecast for Annex I countries that are not expected to participate in the treaty (the United States and Australia, for example) or for countries that are not required to make reductions according to the terms of the treaty (China and India, for example). As a result, only the projections for energy use in the Annex I nations committed to participating in the Kyoto Protocol are changed in the Kyoto Protocol case.
Population World	+1.0% (2002-2025)
Population Europe	+0.1% (2002-2025) for Western Europe -0.2% (2002-2025) for Eastern Europe
Growth World	+3.9% (2002-2025)
Growth Europe	+2.0% (2002-2025) for Western Europe +4.1% (2002-2025) for Eastern Europe

Scenario Name	EIA Kyoto Protocol
Oil price	US$$_{2000}$/bbl 22.50 / 29.15 / 31.67 / 32.93 (2003/2010/2020/2025)
Key Results	
Carbon emissions	For the participating Annex I group, total energy demand in the Kyoto Protocol case is projected to be 108 Gtce lower than in the reference case in 2010, and almost 144 Gtce lower in 2025, assuming that the Kyoto targets remain constant over the entire forecast period

6.2 Evaluation of Scenarios

6.2.1 Socio-Demographic Perspectives

(1) All scenarios assume a population growth of 1.0% p.a. worldwide over the projection period of 25 or more years. The world population is assumed to expand from 6.2 billion to almost 8,1 billion in 2030. Population growth will slow down progressively over the projection period, mainly due to falling fertility rates in developing countries.

(2) The population growth-rate assumptions are drawn from the most recent United Nations population projections contained in the *World Populations Prospects: the 2002 Revision.* The UN growth expectations were slightly slower than in the 2000 revision, partly because of the HIV/AIDS epidemic (IEA).

(3) The population of the developing economies will continue to grow most rapidly, by 1.2% per year from 2002 to 2030, though it is significantly lower than the average rate of 2% during the last three decades. The share of the world population living in developing countries will nonetheless increase from 76% to 80% in 2030 (IEA).

(4) Population in transition economies and EU 10 is expected to decline. EIA expects a slight negative annual growth rate for Eastern Europe (-0.2%) while the population in Western Europe is almost stable (0% (IEA) or 0.1% (EIA))

6.2.2 Economic Framework

(5) Economic growth is by far the most important driver of energy demand. Global economic growth is assumed to average 3.2% (2002-2030[11]) by IEA, the rate dropping in the last decade of the projection period, as developing countries' economies mature and population growth slows. EU trends is expecting a slight lower economic growth (2.9%), while EIA is projecting a significant higher growth of 3.9% worldwide. It has to be taken into account that EIA 2005 is the most recent study which was analysed. EIA argues that the growth

11 all GDP data of the WEO is expressed in US$ of the year 2000, using purchasing power parities rather than market exchange rates. PPPs compare costs in different currencies of a fixed basket of traded and non traded goods and services.

projection is higher because economic growth in the most regions was higher than expected, at least in most regions of the world.

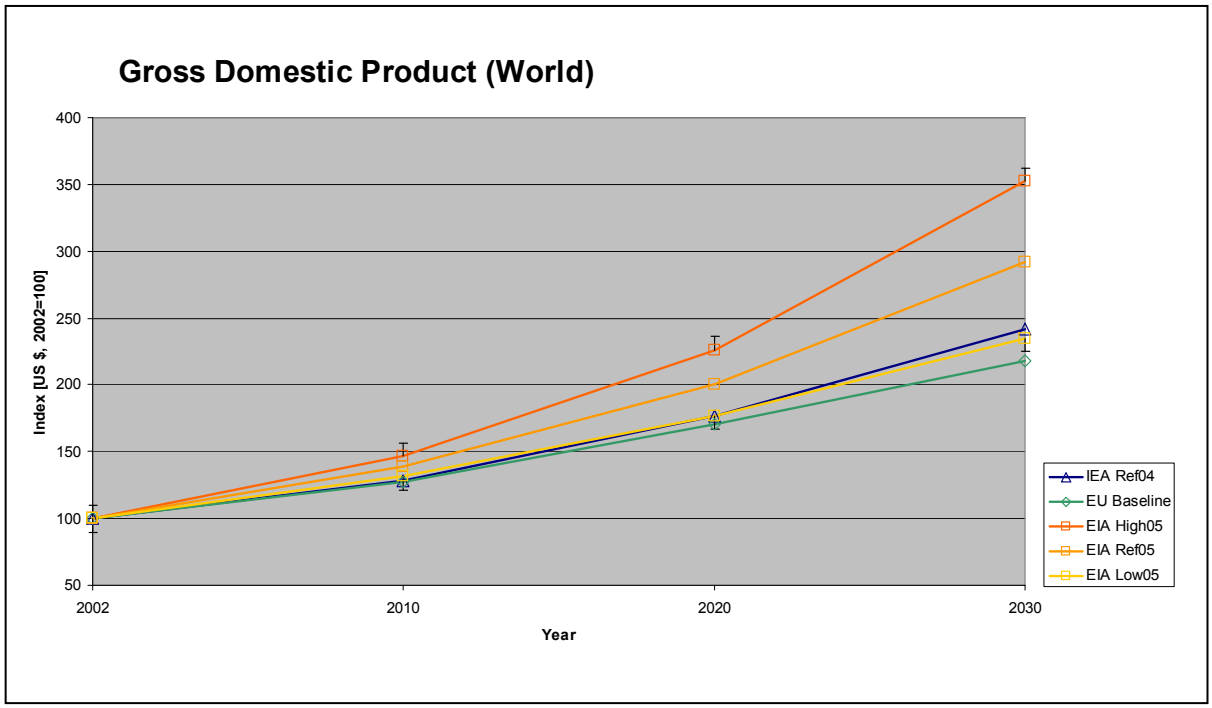

figure 6.2-1 *Gross Domestic Product (World) according to different growth scenarios*

(6) While economic projections might differ among the institutions concerning the global perspective, the forecast for the European economy is more comparable – at a lower level: for Europe all institutions are projecting a lower economic growth averaging around 2.0% for Western Europe (2.0% (EIA) to 2.3% (EU)) and higher growth rate for the East European countries (3.5% to 4.1%). IEA however sees not a higher growth than 2.0% p. a. for the whole continent (cp. figure 6.2-2).

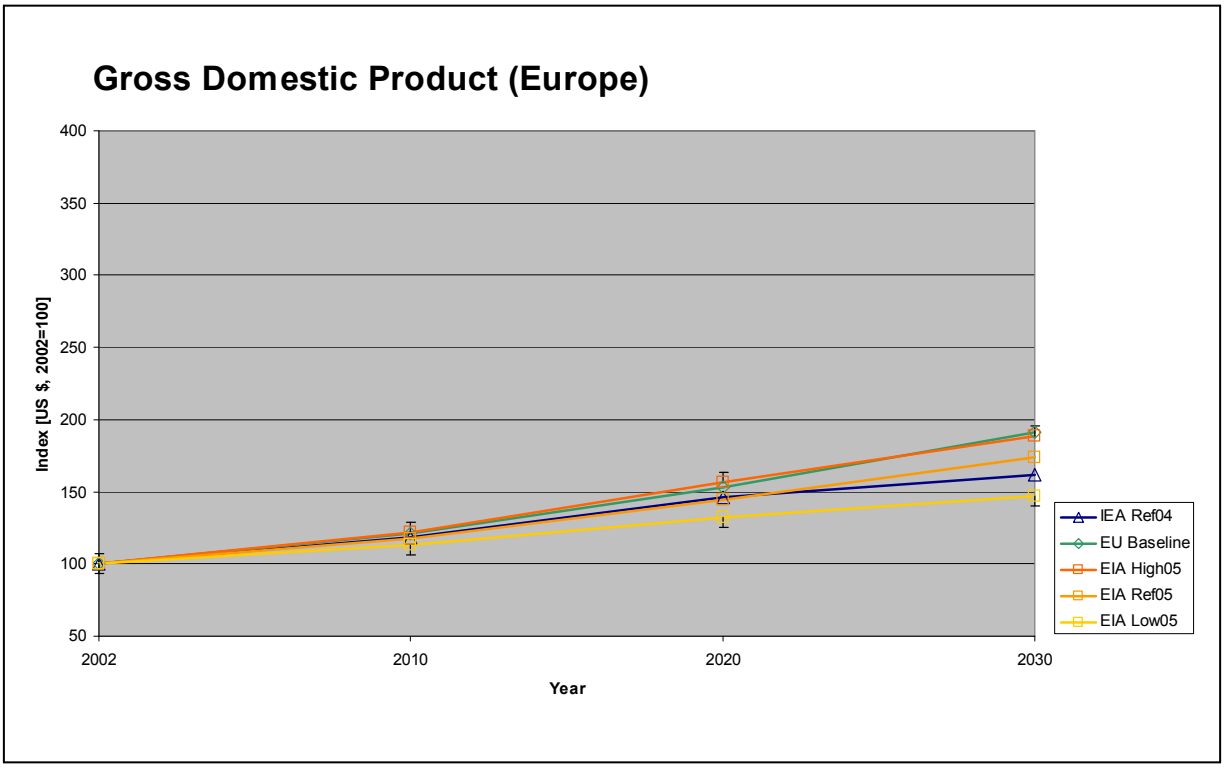

figure 6.2-2 *Gross Domestic Product (Europe) according to different economy scenarios*

6.2.3 Prices

(7) Assuming the continuation of world market development and taking a conventional view on fossil fuel reserves, world energy resources develop moderately as no supply constraints are likely to be experienced over the next 30 years (under Baseline conditions). Gas prices broadly follow oil prices, but rise faster due to their clean and high use efficiency. Factors as a more gas-to-gas competition and a greater integration of the gas markets (with more LNG) exert downward pressure on gas prices.

(8) With fossil fuel prices projected to remain relatively low, the costs of generating energy from other fuels are not expected to become competitive; as a result, much of the increment in future energy demand in the reference case is projected to be supplied by oil, natural gas, and coal.

(9) In the IEA reference scenario the average crude oil import price is assumed to fall back from current highs to $22 (US$$_{2000}$) until 2006 and then climb steadily up to $$_{2000}$ 29. The same expected EU trends, with an price level of $$_{2000}$ 27.5. EU scenario, however was constructing an additional high price scenario with a price of $$_{2000}$ 33.5 in 2030. It has to be taken into account that these works were published in 2004 or even 2003 (IEA, EU scenarios, EU trends resp.)

(10) The continuously high oil price level gave reason to rethink and to adopt oil prices in case of the EIA 2005 report. International Energy

Agency reacted as well in its recently published World Energy Outlook 2005.

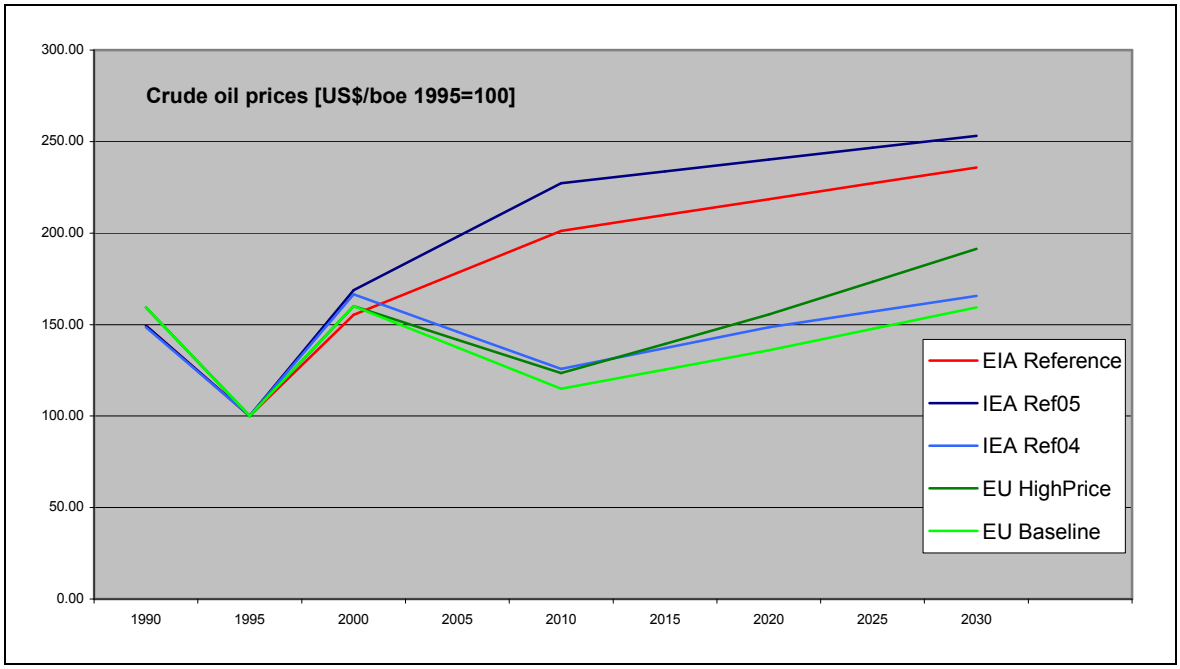

figure 6.2-3 *Prices for Crude Oil (Europe) according to different price scenarios*

(11) IEA Gas prices are assumed to move broadly in line with oil prices. Overall, long-term gas prices are likely to increase due to the introduction of the EU ETS. McKinsey (2003) estimates that the EU gas border price in 2014 will be 15 % higher due to CO_2 regulation [ECN 2005] .

(12) In all scenarios Steam coal prices are assumed to average around US_{2000}$ 36 $/t to 40 $/t through 2010, and to stay constant or to rise very softly thereafter, to US_{2000}$ 44 $/t in 2030. The market structures are not expected to change dramatically over the next 30 years. Coal import prices by region show much less divergence and are expected to converge towards the end of the period for different regions.

(13) Rising oil prices will raise the cost of transporting coal and might be offsetting the expected reduction in the cost of mining coal, as low-cost countries continue to rationalise their industries [IEA 04].

6.2.4 Primary Energy Consumption

(14) All reference scenarios project increased consumption of all primary energy sources over the forecast horizon. The total increase lies within a small range of 18% to 21% ???

(15) Oil is expected to remain the dominant energy fuel throughout the forecast period, with its share of total world energy consumption remaining unchanged at 39 % through 2025. In the industrialized world, increases in oil use are projected primarily in the transportation

sector, where there are currently no available fuels to compete significantly with oil products. The *IEO 2004* reference case projects declining oil use for electricity generation, with other fuels (especially natural gas) expected to provide more favorable alternatives to oil-fired generation. [EIA 2004]

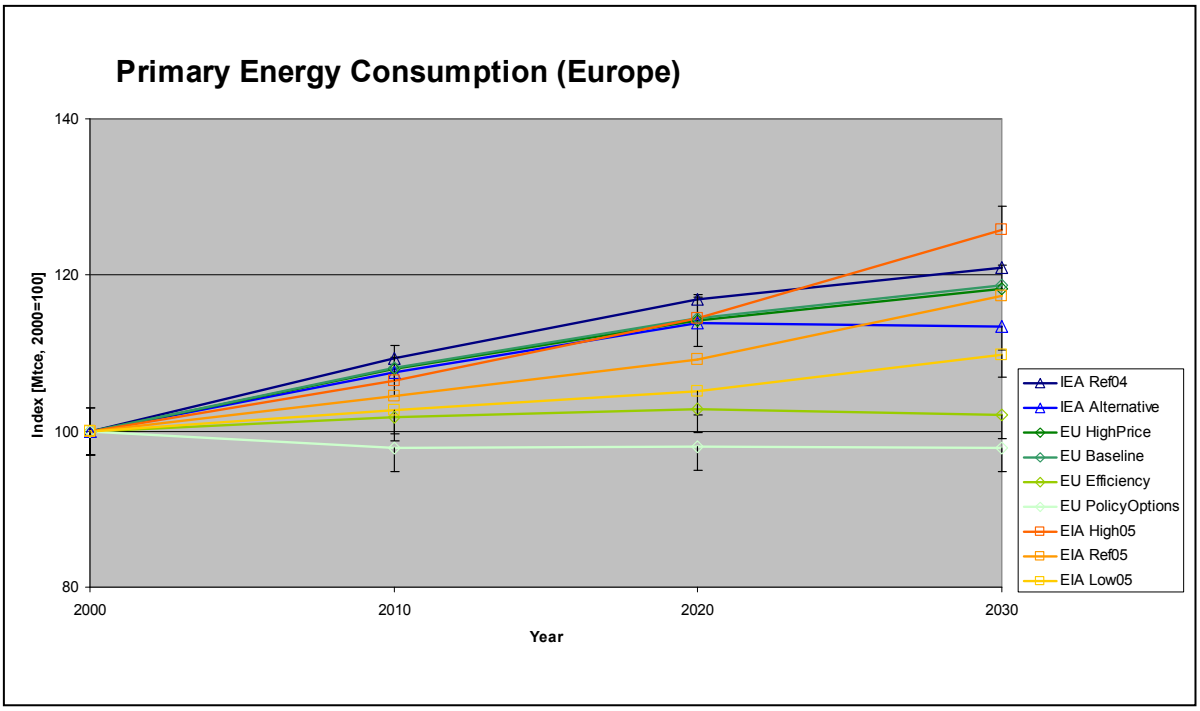

figure 6.2-4 *Primary Energy Consumption (Europe)*

(16) In the developing world, oil consumption is projected to increase for all end uses. In some countries where non-marketed fuels have been widely used in the past (such as fuel wood for cooking and home heating), diesel generators (as well as distributed generators, such as solar photovoltaics) are now sometimes being used to dissuade rural populations from decimating surrounding forests and vegetation - most notably, in Sub-Saharan Africa, Central and South America, and Southeast Asia.

(17) Because the infrastructure necessary to expand natural gas use has not been as widely established in the developing world as it has in the industrialized world, natural gas use is not expected to grow enough in the developing world to accommodate all of the increased demand for energy. [EIA 2004]

6.3 Prospect of Electricity Markets

6.3.1 Demand Side Dynamics

Conclusion	It can be concluded, that average annual growth rate of electricity consumption will be more than 2% in the New Member States and lower than 1,5% in the EU-15. An 40% increase is very likely to happen, if no further policy action is undertaken.

(18) ***World:*** The *International Energy Outlook 2005 (EIA 2005)* reference case projects that world net *electricity consumption* will nearly double over the next two decades. Over the forecast period, world electricity demand is projected to grow at an average rate of 2.6 % p.a., from 14'275 TWh in 2002 to 21'400 TWh in 2015 and 26'018 TWh in 2025 *[EIA 2005]*.

(19) More than one-half (59 %) of the projected growth in demand occurs in the ***emerging economies***, with the mature market and transitional economies accounting for 28 % and 14 %, respectively. Electricity use in the ***mature market economies*** is expected to increase more slowly than in the emerging and transitional economies, averaging 1.5 % per year in the *IEO 2005* reference case over the projection period. In the mature market economies, the electricity sector is well established, and equipment efficiency gains are expected to temper the growth in electricity demand *[EIA 2005].*

(20) Net electricity consumption in ***Western Europe*** is projected to increase in the *IEO 2005* reference case by an average of 1.3 % per year from 2'556 TWh in 2002 to 3'072 TWh in 2025. Among the countries of Western Europe, mature electricity infrastructures and slow population growth are expected to translate into relatively slow growth in demand for electric power over the 24-year projection period. Electricity demand growth in the region will, in part, be influenced by the progress it makes in liberalizing its electric power markets. *[EIA 2005]*

(21) ***Western Europe***'s electricity demand is projected to increase from 2,246 TWh in 2001 to 3,029 billion TWh in 2025 *[EIA 2005]*.

(22) The growth of electricity demand in ***Eastern Europe*** is higher: according to EIA an increase from 390 TWh (2002) up to 724 (2025) can be expected, summing to a total of 3'800 TWh for East and Western Europe (incl. Norway, Switzerland, Bulgaria, Romania and the Republics of Former Yugoslavia).

(23) Predictions of **IEA for EU 25** are similar to EIA's: for EU 25 an increase of *production* up to 3'900 TWh is expected in 2020 *[IEA 2004],* reaching 4'270 TWh in 2030. Transformation losses and own use are expected around 580 TWh, thus leaving 3'700 TWh for electricity consumption (2030). Including Switzerland (70 TWh), Norway (150 TWh), Bulgaria (36 TWh), Romania (70 TWh) IEA projections exceed 4'000 TWh and seems slightly higher than EIA's.

(24) ***EU scenarios*** (from 2004) forecast an electricity consumption of 3'900 TWh for EU 25 in 2030 and 4'180 TWh for EU 30 without

Turkey. An increase of electricity consumption from 113 TWh to 380 TWh is predicted for Turkey (336%)

(25) ***EU trends'*** forecast *(from 2003)* for the same time and region was higher a year before: 4'250 TWh for EU 29. As figures for EU-15 remain constant in ***EU scenario 2004,*** a 10% downscale modification has obviously been applied to EU 10 and Candidate Countries (Bulgaria, Romania, Turkey).

6.3.2 Power Generation

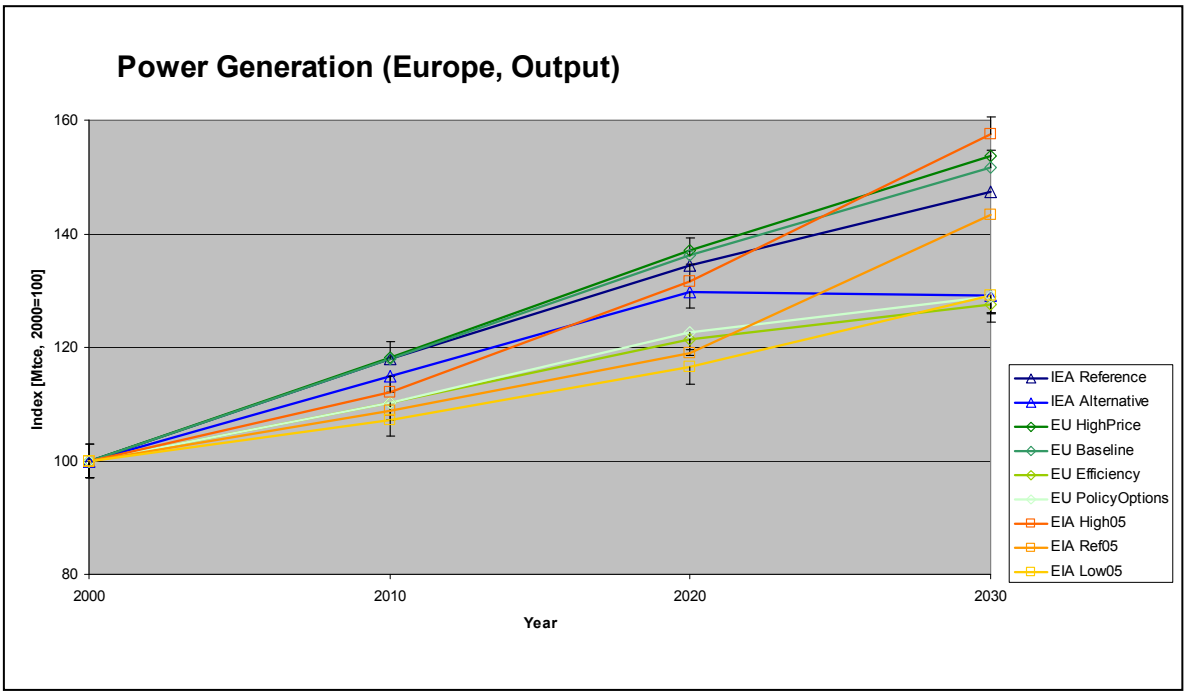

figure 6.3-1Power Generation in Europe According to Different Scenarios

(26) ***Oil*** is expected to become less important to the mix, particularly in countries where it has historically been high, notably Italy.

(27) ***Natural gas***—with its efficiency and environmental advantages over other fossil fuels—is projected to gain share throughout the region, as is renewable energy, given widespread government programs to support its expansion.

(28) ***Coal*** is expected to continue to lose market share in Western Europe, as it has for much of the past decade.

(29) With plans for upgrades and extending the operating lives of many nuclear reactors, ***nuclear power generation*** is projected to increase somewhat over the next decade, but planned retirements and few plans for new generating units are projected to reduce the potential for nuclear power after 2010. As a result, electricity generation from nuclear power is expected to decline precipitously from 2010 to 2025. Finland and France are the only Western European countries expected to construct new nuclear power plants in the *IEO 2004* reference case [EIA 2005]. Other European countries are expected to begin to retire nuclear capacity by the end of the forecast period. Both

Belgium and Germany have passed laws that require their nuclear power plants to be phased out.

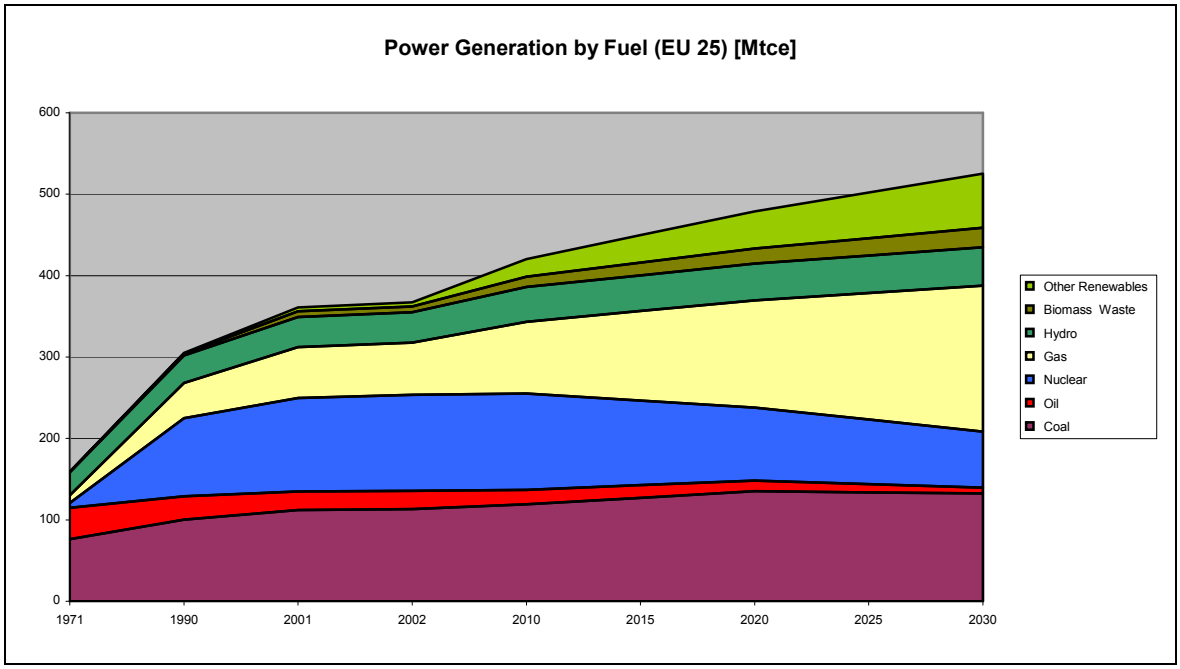

figure 6.3-2 *Power Generation in Europe (Synthesis of Different Reference Scenarios)*

(30) The global power sector will need 4'800 GW of new capacities to meet the projected rise in energy demand and to replace the ageing infrastructure until 2030 The total installed infrastructure is expected to increase from 3'500 to over 8'000 GW [IEA coal 2005]. For Europe a capacity of 200 GW is expected to be replaced until 2030. Including rising of electricity demand over the projection period, there is need for new power plant capacity in the EU-25 of about 500 GW by 2030.

6.4 Prospects for Coal

(31) Coal will continue to play a key role in the world energy mix in keep its global share in primary consumption. However this is mostly due to the increase in Asian countries, with China and India alone responsible for 68% of the increase in demand. IEA sees for OECD countries coal demand highly dependent on climate change policies.

(32) Coal demand in Europe will increase slowly in the first half of the period but then decline to slightly less than current. Demand is to be expected 816 Mt in 2030 compared to 822 Mt in 2002. Coal will continue to lose market share to natural gas in the power supply sector. The relative costs of coal will be influenced by environmental policies [IEA 2004].

(33) Coal is an important source of electricity generation in a number of the world's regional markets. Not surprisingly, the countries with the largest coal reserves have electricity markets dominated by coal.

For instance, the United States—with the largest share of the world's recoverable coal reserves—generates about one-half of its total electricity from coal. China, India, Germany, Poland, South Africa, and Australia all have substantial coal reserves, and in each case coal-fired generation accounts for more than one-half of electric power production. [EIA 2004].

(34) Russia has the world's second largest coal reserves and uses coal to produce one-third of its electricity at present. Russia has been able to diversify its electricity markets somewhat more than other coal-rich nations, because it also has ample natural gas and hydroelectric resources and a mature nuclear power program. But coal is expected to retain its importance in the region's electric power supply. Coal's share of the electric power market in the FSU is projected to increase slightly, from 23% in 2001 to 24% in 2025, as nuclear generation decreases [EIA 2004].

(35) In markets where coal has not been a particularly important contributor to electricity generation, there are unlikely to be significant increases in coal use. Canada, Mexico, Central and South America, and the Middle East all use coal for less than 20 % of their total electricity generation. Canada and Central and South America rely heavily on hydroelectric power for their electricity supplies, and Mexico and the Middle East rely on oil and natural gas. In each of those markets, coal is projected to account for less than 20 % of electricity generation in 2025 [EIA 2004].

(36) Competition from natural gas may erode coal's market share in some key countries, but coal's dominance is not likely to decline precipitously. Many of the countries of Western Europe are expected to reduce their use of coal for power generation, with increases in natural-gas-fired generation, renewables, and, in the case of France, nuclear power. Most notably, in Germany, coal's share of energy use for electricity generation was 49 % in 2001 but is projected to drop as natural-gas-fired generation and, to a lesser extent, renewable energy use continue to be added for new electric power capacity [EIA 2004].

(37) As Eastern European electricity markets begin to integrate with Western European markets with the expansion of the European Union (EU), coal use for electricity is also expected to decline. Coal's share of electricity generation in Eastern Europe is projected to fall from 58% in 2001 to 44% in 2010 and to 24% in 2025 [EIA 2004].

(38) Enhanced climate protection policies as the Emissions Trading Scheme of the European Union are broadly considered to exert increasing pressure on the role of coal in power generation. However, work on all reports has been carried out in second half of 2004 and first half of 2005, with the system Emission Trading Scheme most recently implemented and the carbon markets not being liquid and mature. The most recent work the IEAs World Energy Outlook published in November 2005 with its focus on oil and gas producing countries of the Middle East and Northern Africa is neither working on coal nor examining the European markets in detail.

(39) Alternative scenarios as the EU *high price* show however significant implication on coal in power markets, as oil and gas prices are increasing. As high price oil is expected to be solely used for

transport and petrochemical industries, high price gas is expected to decrease (against reference expectations). Solid fuels are expected to gain increased competitiveness especially as fuel in supercritical coal plants. A longterm stabilised position of coal as a fuel for power generation can be expected as well for European markets.

7 Appendix

7.1 Glossary

7.1.1 Geographic and Political Clusters

EU Shortkey	Internat. Key	Country (Association)	Geographic	EU Status	EIA Region	OECD member	IEA member
	EU 25	**EU (25 Länder)**	Europe	EU 25			
	EU 15	**EU (15 Länder)**	Europe	EU 15			
	CandC	**Candidate Countries**	Europe	CandC			
	NC	**Neighbouring Countries**	Europe	NC	ME		
	EFTA	**European Free Trade Association**	Europe	EFTA			
	CIS	**Commonwealth of Indep. States (CIS)**	(Europe)		CIS		
	FSU	**Former Soviet Union**	(Europe)		FSU		
	EE	**Eastern Europe**			EE		
	WE	**Western Europe**			WE		
	ME	**Middle East**			ME		
	AL	**Albany**	Europe	NC	EE		
-	AND	**Andorra**	Europe				
	AR	**Armenia**	Europe		FSU (CIS)		
AT	A	**Austria**	Europe	EU 15	WE	OECD	IEA
	AZ	**Azerbeijan**	Europe		FSU (CIS)		
	BY	**Belarus**	Europe		FSU (CIS)		
BE	B	**Belgium**	Europe	EU 15	WE	OECD	IEA
	BIH	**Bosnia Herzegovina**	Europe	NC	EE		
BU	BG	**Bulgary**	Europe	CandC	EE		
HR	HR	**Croatia**	Europe	NC	EE		
CY	CY	**Cyprus**	Europe	EU 25	ME		
	CZ	**Czech Republic**	Europe	EU 25	EE	OECD	IEA
DK	DK	**Denmark**	Europe	EU 15	WE	OECD	IEA
EE	ESL	**Estonia**	Europe	EU 25	FSU (EU)		
FI	SF	**Finland**	Europe	EU 15	WE	OECD	IEA
FR	F	**France**	Europe	EU 15	WE	OECD	IEA
	GE	**Georgia**	Europe		FSU (CIS)		
DE	D	**Germany**	Europe	EU 15	WE	OECD	IEA
	GBZ	**Gibraltar**	Europe				
EL	GR	**Greece**	Europe	EU 15	WE	OECD	IEA
	HU	**Hungary**	Europe	EU 25	EE	OECD	IEA
	IS	**Iceland**	Europe	EFTA	WE	OECD	
IE	IRL	**Ireland**	Europe	EU 15	WE	OECD	IEA

EU Shortkey	Internat. Key	Country (Association)	Geographic	EU Status	EIA Region	OECD member	IEA member
IT	I	**Italy**	Europe	EU 15	WE	OECD	IEA
	KZ	**Kazakhstan**	Europe		FSU (CIS)		
LV	LV	**Latvia**	Europe	EU 25	FSU (EU)		
LI	LI	**Liechtenstein**	Europe				
LT	LT	**Lithuania**	Europe	EU 25	FSU (EU)		
LU	L	**Luxembourg**	Europe	EU 15	WE	OECD	IEA
		Macedonia (FYR)	Europe	NC	EE		
MT	M	**Malta**	Europe	EU 25			
	MD	**Moldova**	Europe		FSU (CIS)		
	MC	**Monaco**	Europe				
NL	NL	**Netherlands**	Europe	EU 15	WE	OECD	IEA
NO	N	**Norway**	Europe	EFTA	WE	OECD	IEA
PL	PL	**Poland**	Europe	EU 25	EE	OECD	
	P	**Portugal**	Europe	EU 15	WE	OECD	IEA
RO	R	**Romania**	Europe	CandC	EE		
	RUS	**Russia**	Europe		FSU (CIS)		
		San Marino	Europe				
		Serbia and Montenegro (FYR)	Europe	NC	EE		
	SK	**Slovakia**	Europe	EU 25	EE	OECD	
	SLO	**Slovenia**	Europe	EU 25	EE		
ES	E	**Spain**	Europe	EU 15	WE	OECD	IEA
SE	S	**Sweden**	Europe	EU 15	WE	OECD	IEA
CH	CH	**Switzerland**	Europe	EFTA	WE	OECD	IEA
TR	TR	**Turkey**	Europe	CandC	Middle E.	OECD	IEA
	UA	**Ukraine**	Europe		FSU (CIS)		
UK	UK	**United Kingdom**	Europe	EU 15	FSU (CIS)	OECD	IEA
	UZB	**Uzbekistan**	Europe		FSU (CIS)		
	V (SCV)	**Vatican**	Europe				

7.1.2 Geopolitical Groups

EU 15	Austria (AT), Belgium (BE), Denmark (DK), Finland (FI), France (FR), Germany (DE), Greece (EL), Ireland (IE), Italy (IT), Luxemburg (LU), The Netherlands (NL), Portugal (PT), Spain (ES), Sweden (SE), United Kingdom (UK)
EU 10	Cyprus (CY), Czech Republic (CZ), Estonia (EE), Hungary (HU), Malta (MT), Lithuania (LT), Latvia (LV), Poland (PL), Slovakia (SK), Slovenia (SL)
Candidate Countries	Bulgaria (BU), Romania (RO), Turkey (TR), Croatia (HR)
EU Neighbours	Switzerland (CH), Norway (NO), Iceland (IS)

7.1.3 Definitions

Coking Coal	coal with a qualitiy that allows the production of coke suitable to support a blast furnace [IEA 2004b[12]]
Hard Coal	is reported as the sum of coking coal and steam coal if not indicated otherwise,
Other Bituminous	coal and Anthracite is a non-agglomerating coal with a gross calorific value greater than 23,865 kJ/kg on an ash-free but moist basis (IEA 2004b). ***Other Bituminous*** coal and ***Anthracite*** is reported in the category steam coal if not indicated otherwise,
Subbituminous	coal is a non-agglomerating coal with a gross calorific value greater than 23'865 kJ/kg and 17'435 kJ/kg containing more than 31% volatile matter on a dry mineral-matter-free basis [IEA 2004b]. ***Subbituminous*** coal is reported in the category brown coal in IEA literature, except some exceptions where it is reported as steam coal because of its high calorific value.
Lignite/Brown	coal is a non-agglomerating coal with a gross calorific value greater than 17'435 kJ/kg and and greater than 31% volatile matter on a dry mineral-matter-free basis [IEA 2004b]. (Oil shale combusted directly is reported in this category in IEA literature). ***Lignite*** is reported in the category brown coal (or vice versa).

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7.3 Selected Tables

table 7.3-1 Installed Power Plant Capacites in selected countries of EU plusBulgaria and Romania

Installed Power Plant Capacities	EU25	EU15	PO	CZ	BG	GE	UK	RO	NL	HU	ES	IT	FR
	[MWel]	[MWel]	[MWel]	[MWel]	[MWel]	[MWel]	[MWel]	[MWel]	[MWel]	[MWel]	[MWel]	[MWel]	[MWel]
Total	**696'146**	**615'164**	**31'407**	**17'332**	**11'997**	**124'669**	**78'538**	**19'369**	**20'791**	**8'708**	**68'879**	**78'255**	**116'199**
Nuclear	134'725	122'803	0	3'760	2'723	21'439	12'098	707	449	1'866	7'581	0	63'363
Conv. Thermal	404'576	346'004	29'099	11'423	6'759	80'365	61'872	12'414	19'421	6'788	37'310	56'053	27'387
Coal (>30 MWel)	182'831	141'945	28'233	8'950	5'230	52'291	29'050	7'020	5'442	1'634	12'751	11'352	8'940
Hard Coal (>30 MWel)	133'418	110'805	19'558	1'948	1'940	30'366	29'050	1'260	5'442	170	9'178	11'277	8'940
Lignite (>30 MWel)	49'413	31'140	8'675	7'002	3'290	21'924	0	5'760	0	1'464	3'573	75	0
Oil (>30 MWel)	10'589	9'668	0	0	0	1'756	1'041	0	220	587	1'227	2'462	1'028
Gas (>30 MWel)	98'660	95'907	700	233	0	9'431	26'897	0	7'471	1'294	9'611	25'364	3'453
Conv. Others	112'496	98'483	166	2'240	1'529	16'887	4'884	5'394	6'288	3'273	13'721	16'875	13'967
Renewables	156'845	146'357	2'308	2'149	2'515	22'865	4'568	6'248	921	54	23'988	22'202	25'449
[source: Eurostat Siemens prognos]													

Power Generation	EU25	EU15	PO	CZ	GE	BG	RO	UK	ES	HU	NL	IT	FR
	[GWh]	[GWh]	[GWh]	[GWh]	[GWh]	[GWh]	[GWh]	[GWh]	[GWh]	[GWh]	[GWh]	[GWh]	[GWh]
Total	**3'120'534**	**2'766'448**	**151'631**	**83'223**	**599'470**	**42'533**	**56'645**	**398'620**	**262'860**	**34'141**	**96'775**	**293'865**	**566'900**
Nuclear	973'674	898'234	0	25'872	165'060	17'280	4'906	88'686	61'875	11'013	4'018	0	441'070
Conv. Thermal	1'772'469	1'509'346	148'213	55'557	391'111	22'019	38'480	302'687	145'013	22'957	91'355	242'789	60'612
Coal	960'380	739'119	140'658	50'966	306'510	19'237	23'344	138'242	74'722	9'170	24'339	38'813	26'259
Hard Coal	664'542	524'786	84'720	50'668	144'052	4'525	0	138'242	68'817	307	24'339	38'813	26'240
Lignite and peat	295'838	214'333	55'938	298	162'458	14'712	23'344	0	5'905	8'863	0	0	19
Oil	162'391	150'451	2'456	368	4'677	789	3'633	7'017	24'002	1'626	2'858	75'986	8'673
Gas	581'596	553'599	4'359	3'726	65'773	1'987	11'500	150'707	40'601	11'967	60'008	122'604	20'627
Conv. Others	68'102	66'177	740	497	14'151	6	3	6'721	5'688	194	4'150	5'386	5'053
Renewables	374'391	358'868	3'418	1'794	43'299	3'234	13'259	7'247	55'972	171	1'402	51'076	65'218
[source: Eurostat Siemens prognos]													