

General Overview of German Energy Sector

►Socio-economic Background

Germany has the largest population amongst the eu member countries with a population in the year 2000 of 83 million out of an eu total of 376 million. The life expectancy at birth is 77.17 years. The population density is 230/km² and the per capita gdp is 21,484.3 usd. The contribution of agriculture (primary production) to the total gdp is just 1%, while that of industry is 31.8% and services 67.2%. The unemployment rate was pegged at 9.6% while germany's balance of trade stood at +61.0 billion usd.

In general the economy has performed well in 2000 with a growth rate which was 1.5% in 2000, but growth faltered in 2001 since manufacturing output contracted whilst the inflation rate was 1.9%, the highest in several years. Inflation is directly attributed to the escalating energy costs, especially gasoline costs in the last few years. The reason for inflation is partly a result of the significant economic restructuring challenges faced by Germany, the rigid regulatory mechanisms and labour market plus one of the world's largest tax burdens.

►Energy Background

Consumption

As early as 1913 Germany with 15.7% of world manufacturing production was second only to USA (35.8%) and consequently demand for power was high. As the population increased so did demand for power. In 1999, Germany consumed 14,194 PJ making it one of the largest energy consumers in the world. However, German primary production of total energy consumed declined from 6,219 PJ in 1990 to 3,792 PJ in 1999, making Germany the largest energy importer in Europe. Average primary energy consumption per capita in 1990 and 1999 were 188 and 171 GJ. The key energy indicators are summarised in Tables 0-1 and 0-2 (at the end of this section) and energy consumption in Germany is presented in Figure 0-1 by fuel type.

Production

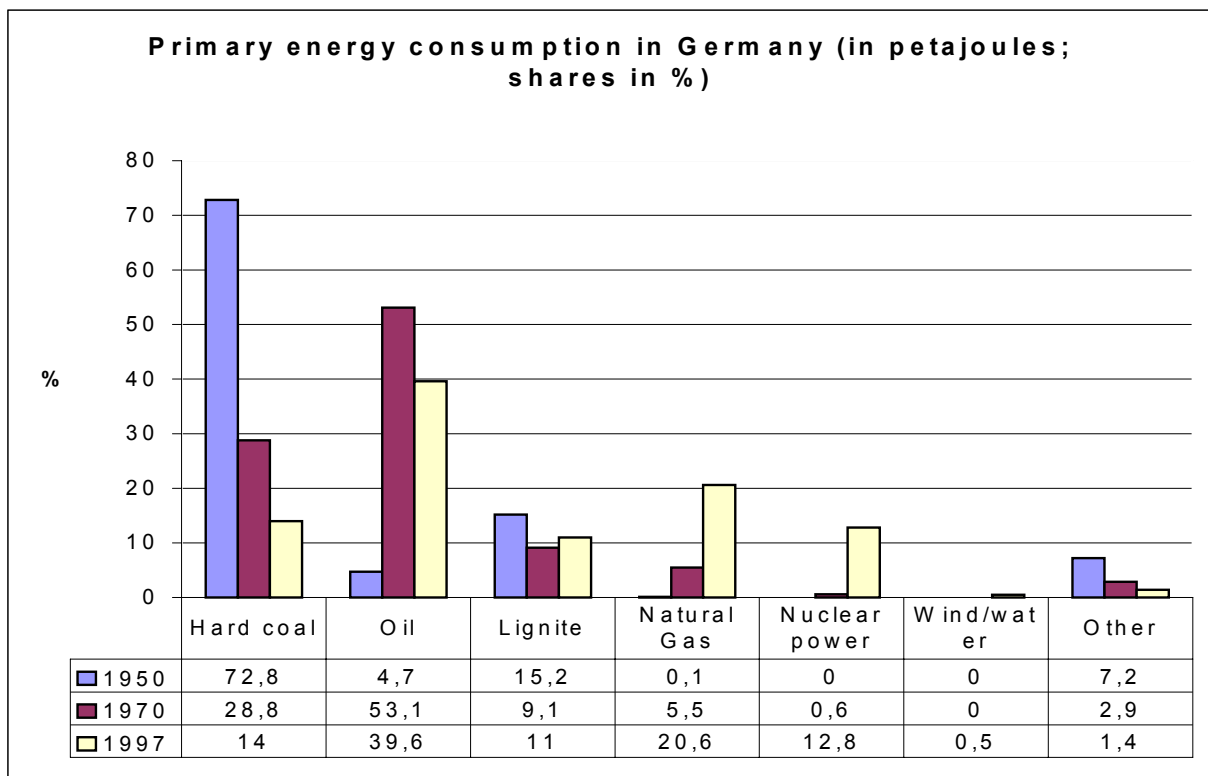
Germany's share of the total energy produced in Europe was 17.32% in 1999 or 3,792 PJ. The country's main source of energy is in the form of coal, whereas other fuel types have to be imported which makes Germany a highly energy import reliant country. Summaries of production capacity for different fuels is described below:

- **Oil:** Germany is almost totally reliant on imports of oil, and produces only about 1.5% of what it consumes. However, it should be noted that German oil imports are diversified and approximately half comes from within the EU (including Norway) and Russia. Therefore, given European energy sector integration, consideration of pure import figure for Germany can be misleading but for the purposes of developing this report focusing on Germany, pure import figures have been used. Main users of oil in Germany are in the heating and transport sectors.
- **Gas:** Germany produces approximately 27 % of all natural gas it consumes and imports the remainder. Homes and non-commercial users account for 53% of the natural gas users while industry accounts for 38% and power stations 9%. Within the European Community Union Germany is second largest natural gas consumer. However, as for oil, German gas imports come exclusively from within the EU

(including Norway and CIS sources). The demand for gas is expected to increase as nuclear energy is phased out.

- Coal:** Germany’s main energy fuel sources is coal and as a result Germany is the third largest coal consuming country in the world behind USA and China. Hard coal production in Germany is still extremely subsidised and Germany is the world’s largest producer of lignite, accounting for 1/5th of the global output. However, coal production is expected to continue to decline¹ in the face of cheaper coal from abroad and a decision to halve current subsidies to USD 2.48 billion by 2005.

Figure 0-1. Primary energy consumption in Germany



- Renewable energy:** The contribution of renewables to energy supplies is approximately 2 % of total primary energy consumption and renewables contribute 7.5 % of total electricity production in 2001 (up from 4.1% in 1996). This figure is particularly high given that Germany has no large hydro-power potential, unlike other European countries. The highest rates of growth have been in wind energy². An Eco-Tax is levied on natural gas, heating oil, and electricity, as well as on road fuels

¹ Lignite production fell from 3,142 PJ in 1991 to 1,451 PJ in 1999.

² The total wind energy capacity installed in Germany in 2000 was 1,668 MW. There are 9,350 wind turbines in operation, producing 11.5 billion kWh of electricity and meeting 2.5% of domestic demand. The price support mechanism guarantees a set price for electricity generated from wind and this has spurred the growth of wind energy. Germany has targeted a one-third share of Europe’s wind power production goal of 60,000 MW by 2010.

(diesel, gasoline), but not on coal, and nuclear. The electricity tax has been 0.9 US cent a kilowatt hour since 1 April 1999. The tax on natural gas is 0.16 USD per 100 kWh. But considering that Germany emitted 227 million metric tonnes of C in 1999, renewable energy is being promoted. However, in order to compensate renewables to some extent from the negative impact of eco-taxes, the coalition agreed that all taxes from renewable energies would be channelled into a new Market Incentive Program for renewables (i.e. taxing renewables in order to support them). However, this program never received the full amount of eco-taxes from renewables (In 2000, eco-taxes from renewables were some DM800-900m, while the Market Incentive Program was set at DM300m. The government even proposed cutting it down to DM180m in 2002, but after public protests parliament instead increased it to DM400m). The result is that Germany's federal government actually receives considerably more money from taxing renewables than it spends supporting them, and these surplus eco-taxes outnumber all other federal subsidies for renewables.

- **Nuclear power:** Germany ranks 4th worldwide in the installed nuclear capacity, with 19 generating plants. The private company E.ON has stakes in 11 of these plants. The present coalition government was elected on a platform to phase out nuclear power (Social Democrats: 10 years, Greens: short-term). The government introduced a law to phase-out nuclear power plants by approximately 2021; in negotiations with the utilities they were guaranteed the right to produce about the same amount of nuclear electricity in the future as they have already produced, and that the government would refrain from unilaterally changing the fiscal circumstances for nuclear power, such as abandoning existing special tax privileges and government-backed liability ceilings, or introducing nuclear fuel taxes.
- **Electricity:** Germany produces more electricity than it consumes. In 1999 it produced 531.4 billion KWh of electricity, which represents 22.38% of the European production. 50% of electricity generated is from lignite and hard coal, 30% from nuclear energy, 9.8% from gas, 3.1% from hydro and 2.8 % by Wind. The governmental position (BMU) is that nuclear electricity is to be replaced by efficiency, cogeneration, natural-gas CC plants, and renewable electricity.

R&D Expenditure

Public R&D expenditures on energy declined by nearly 30 % between 1991 and 2000, to approximately 0.377 billion USD not taking into account expenditures to support scientific institutions researching in the energy field. Due to the successful auction of UMTS licences, the German Government cashes in some 50 billion € in 2000/2001 – and from this extra revenue, a special energy RD&D programme was funded (so-called ZIP) which is around 100 million € in 2001-2003. Special emphasis is given to offshore wind, biomass, geothermal, and solar-thermal electricity. The decline has been a direct consequence of the financial challenges associated with German reunification. Private R&D investments grew however by 5% between 1995 and 1997. Germany relies increasingly on natural gas to meet energy demand (both for environmental and economic reasons), and is further reducing subsidies for coal and phasing out support for other fossil energy programs. Currently, the prime areas of German investment is to support renewable energy and energy efficiency programmes. R&D in these areas, accounted for 14% of the energy budget in 1981 but now accounts for 36% of public energy R&D.

Climate Change and Environment

Global climate change has become a major factor in German energy policy. Germany's national climate target, announced by Chancellor Helmut Kohl during the first Conference

of the Parties (CoP 1) to reduce CO₂ emissions by 2005 by 25%, compared to 1990. This national CO₂ reduction goal has remained official policy after the change in government in 1998, but it remains uncertain whether it will be achieved – as for now, the reduction is around 18%, but energy demand is growing, and the carbon intensity as well (due to new lignite-fired power plants). Under the Kyoto Protocol and the European Union's Community internal burden sharing strategy on Climate Change, Germany has committed itself to a 21% reduction in greenhouse gas emissions from 1990 levels by 2008-2012. Liberalisation of the electricity sector has had only minimal impact on the environment, but emissions of CO₂ are decreasing and fell from the 1990 level of 400 Mt to 325 Mt, and energy related SO₂ emissions fell from 2800 kilo tons to 409 kilo tons in 1999. Also that of NO_x fell from 576 kilo tons to 250 kilo tons. Particulate matter emissions fell from 469 kilo tons to 29 kilo tons.

Table 0-1. Key energy indicators for 1999

Total energy consumption	14,194 PJ (3.6% of world consumption)
Energy related C-emissions	227 million metric tons (3.7% of world total)
Per capita energy consumption	171 GJ
Per capita C-emissions	2.8 metric tons (USA 5.5 metric tons)
Energy intensity	7.68 MJ/\$ (USA 13.3 MJ/\$)
Carbon intensity	0.12 metric tons/1000\$ (USA 0.19 metric tons/1000\$)
Sectoral energy consumption	Industrial 41.9% , Residential 24.2%, Transportation 21.5%, Commercial 12.3%
Sectoral C emissions	Industrial 37.4% , Residential 24.5%, Transportation 25.6%, Commercial 12.5%
Fuel share of energy consumption	Oil 39.4%, Coal 23.7%, Natural Gas 21.5%, Nuclear 13.0%, Others (including renewables) 2.4%
Fuel share of carbon emissions	Oil 45.1%, Coal 36.3%, Natural Gas 18.6%
Renewable energy consumption	312 PJ

Source: Energiedaten 2000, BMWi; EIA 2001

Table 0-2. Key figures in the energy scenario of Germany

- see next page -

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Year	Population <i>(Million)</i>	Gross GDP <i>(Billions of 1990 US\$)</i>	Primary energy consumption <i>(per \$ of GDP)</i>	Primary energy cons. <i>(1000 barrels/day of oil equivalent)</i>	Primary energy prod. <i>(1000 barrels/day of oil equivalent)</i>	Oil Consumption <i>(1000 barrels per day)</i>	Imports of oil <i>(1000 barrels per day)</i>	Oil costs import <i>(Billion US \$)</i>	Natural Gas Production <i>(Billion cubic meters)</i>	Hard Coal Production <i>(Million metric tons)</i>	Brown Coal and Lignite Production <i>(Million metric tons)</i>	Electricity Production <i>(Billion kWh)</i>	Installed nuclear electricity generating capacity <i>(1000 MW)</i>
1850	35.3												
1900	56.0												
1950	68.4												
1970	77.7			6300	3500	2,570	2885		14	118.02	371.49	310.3	8.4
1980	78.3	1202.2	9.4	7370	3685	2,605	3137	35.1	27	94.49	389.73	467.6	10.4
1990	79.4	1503.6	7.6	7100	3325	2,715	2652	21.8	16	76.55	357.47	549.9	22.4
1993		1714.7	8.19		2109	2,840	2904	19.6	19	64.17	221.8	525.7	22.7
1999			7.28	13.8Btu	5.34Btu								
2000	83.4	1920.7				2,770	2,631						

Source : EIA DOE Data, 2000