

6. Germany

6.1 Households

In 1998, there were over 37.5 million households in Germany (Table 6.1), and this number is expected to increase by around a further 1.5 million by the year 2010 – representing a relatively low rate of growth compared to other countries (SB, 1999). One-person households account for more than one third of the total number of German households (Eurostat, 1998).

Compared with the rest of Europe, Germans are considered to have relatively high standards of living. Germany also has one of the lowest rates of poverty, however economic disparities are apparent on a regional level, i.e., between the former East and West Germany (Eurostat, 1998). The majority of German households (59%) rent their homes, and the differences in home-ownership between low-income and more affluent groups are particularly pronounced, as in other northern European countries. Most households live in apartments (units within a multi-family dwelling), and those living in single-family dwellings tend to be the more affluent. With Denmark, the UK, Luxembourg and Belgium, German households are among the most spacious in the EU (Eurostat, 1998).

Table 6. 1: Household data (Germany)

		Year	Source
Number of households	37,532,000	1998	SB, 1999
Number of households in 2010	38,708,000	2010	SB, 1999
Average household size	2.4	1995	Eurostat, 1998
% 1-person households	35%	1995	Eurostat, 1998
Average floor area	83 m ²	1995	Prognos, 1995
% owner-occupying households	41%	1995	Eurostat, 1998
% in single houses	39%	1995	Eurostat, 1998

6.2 Natural gas

The development of the German local distribution network, as in the UK and France, was encouraged by the earlier production and utilisation of town gas (Mabro and Wybrev-Bond, 1999). From the early 1970s, the number of households in West Germany using natural gas expanded at an annual rate of over 300,000, and a similar positive trend began in the former East Germany in the early 1990s (Figure 6.1). Today, over 15 million German homes use natural gas for space heating (Ruhrgas, 1999). However, the construction of a local distribution network in former East Germany is proving difficult, because many households in the new Länder are already served by a district heating system. It is therefore expected that natural gas will take a long time to penetrate the household sector in the new Länder (Estrada *et al.*, 1995). The German gas industry anticipates further noticeable gains in the residential and cogeneration sectors in the short and medium term (UN-ECE, 1997), however residential demand for natural gas has been projected to stagnate after the year 2000 (Prognos, 1995).

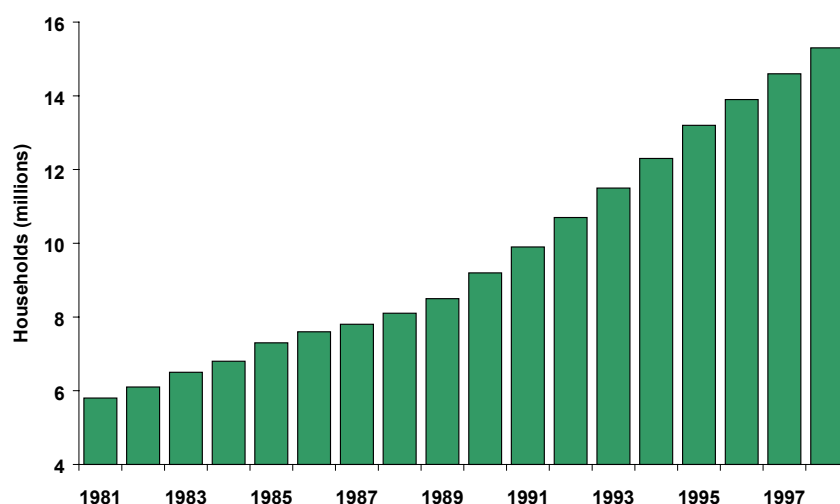


Figure 6. 1: Number of households in Germany using natural gas for space heating

Source: Ruhrgas, 1999

The German natural gas industry has a clear legislative foundation and is highly liberalised (UN-ECE, 1997). Ruhrgas is the largest transmission company, and there are more than 600 gas distribution companies operating on the regional and local supply level (Table 6.2). This means, however, that less network expansion can take place than might be the case if distribution was dominated by one large company (Stern, pers. comm.). Besides the supply of natural gas, about 80% of the utilities also supply district heat, electricity and/or water to their customers (IER, 1998).

Table 6. 2: Natural gas (Germany)

		Year	Source
Number of connected households	14,720,000	1998	Eurogas, 1998
Proportion of connected households	42%	1998	Ruhrgas, 1999
Number of households connected per year	762,500	90-97	Ruhrgas, 1999
% Population living in gas supply area	93%	1998	IGU, 1998
Number of domestic suppliers	669	1998	IER, 1998

6.3 Domestic energy market

Since the mid 1990s, natural gas has taken the largest share of total final domestic energy consumption (Table 6.3). There has been a noticeable reduction in solid fuel consumption, as has occurred in other historical mining countries in the EU (France and the UK). This has been due not only to the high costs of coal exploitation and the removal of state subsidies, but to the increasing standards of living in new Länder, in which final domestic sector consumption of lignite has fallen dramatically (European Commission, 1999).

Table 6. 3: Fuel consumption profile for the German domestic sector, 1996

Fuel type	TWh	%
Coal	29.1	3
Oil	281.8	34
Natural gas	294.6	35
Combustibles, renewables and waste	13.8	2
Electricity	134.2	16
District heating	85.1	10
Total	838.5	100

Source: IEA/OECD, 1998b

In 1998, the German domestic sector received approximately 295 TWh of natural gas, representing 33% of the total national consumption of 895 TWh (Eurogas, 1998). Estimates of domestic fuel consumption by end use are shown for all major fuels in Table 6.4.

Table 6. 4: Breakdown of domestic fuel consumption (%) by major end-use, 1992*

Fuel type	Space heating	Water heating	Cooking	Other
Natural gas	86	11	3	0
Electricity *	20.5	11.7	7.6	60.2
District heating	87	13	0	0
Solid fuels (coal and wood)	11	0	0	0
Oil	90	10	0	0
Total	77	10	3	10

* All data refer to 1992 except for electricity (1996)

Source: Prognos, 1995; VDEW, 1997

Germany is unusual among the EU Member States for showing a continuous slow decrease in gross inland consumption over the period 1985-1996 (European Commission, 1999), a change which is also observable in the domestic sector. Energy use in private households was predicted by Prognos (1995) to grow by 5% between 1995 and the year 2000, after which point a reduction of 11% was projected by 2020 (Figure 6.2).

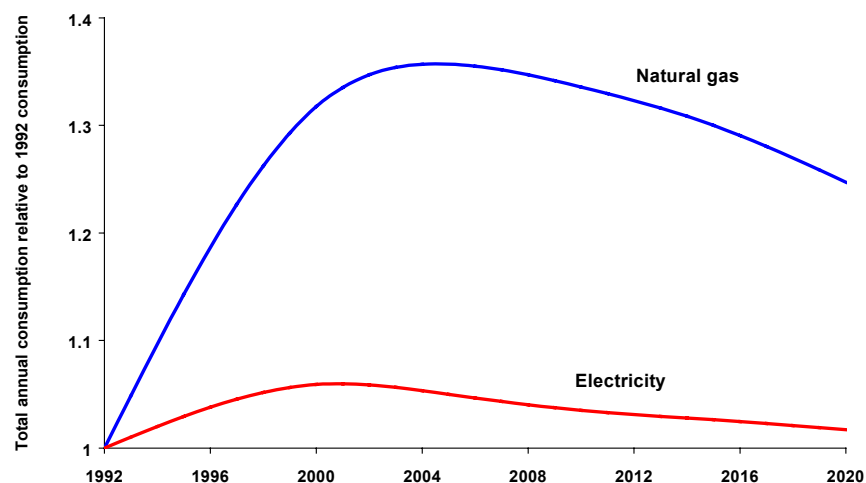


Figure 6. 2: Projected domestic sector consumption of electricity and natural gas up to 2020 (NB: base year = 1992) (Germany)

Source: Prognos, 1995

On a household level, there are significant differences in energy consumption between households in the Former East and Former West Germany (Table 6.5). This is associated with differences in the standard of living in the two regions, which can be expected to diminish with time, particularly in view of the rapid economic growth in the Former East Germany (VDEW, 1997).

Table 6. 5: Average electricity consumption (kWh per household per annum, including space heating) for households in the Former East and Former West Germany

Region	Income level and household size		
	Low (2 persons)	Middle (4 persons)	High (4 persons)
New Länder	2040	2760	2796
Old Länder	2520	4056	4380
All Länder	3457		

Source: VDEW, 1996

Germany has the largest total electricity generation in the EU: 555 TWh in 1996, of which 134 TWh (24%) was consumed by the domestic sector (IEA/OECD, 1998b). Despite the large volume of consumption, only a small proportion of electricity (5% in 1995) is generated from renewable sources – hydro and wind (European Commission, 1999). Since 1980 there has been a slow but consistent fall in the use of coal, and an increase in the contribution of nuclear and renewables. Future increase in demand is likely to be met by hydro and renewables (forecasts of the share of renewables in total national energy use range from 7% to 50%) and nuclear generation will be phased out (IEA, 1999b). There is unlikely to be large-scale growth in the use of natural gas for power generation in the short or medium term (UN-ECE, 1997).

6.4 Space heating

It can be assumed that virtually all households connected to the natural gas network use natural gas for space heating (Table 6.6) (IER, 1998). Since 1994, it has been the most significant fuel for space heating both in terms of household penetration and actual consumption. Natural gas space heating is particularly popular for new dwellings, and was installed in 71% of new dwellings in 1995. Most households with gas space heating have a central heating boiler.

In 1996, condensing boilers accounted for around 18% of the total sales of natural gas-fired space heating systems (130,000 of 700,000), and nearly 27% in 1998 (IER, 1998; Ruhrgas, 1998). The total number of installed gas condensing boilers reached around 400,000 in 1996 (compared to the oil-fired condensing boiler stock of only 4,000), and nearly 764,000 by the end of 1998. This only represents around 2% of German households, and 5.2% of the total stock of gas-fired heating systems. Germany is considered to be a good potential market for condensing boilers, the main legislative barrier being condensate removal requirements which vary from region to region (IER, 1998).

Table 6. 6: Ownership of space heating systems by fuel type, 1996 (Germany)

Fuel type	% Households	Source
Natural gas	42	Ruhrgas, 1999
Electricity	8	VDEW, 1997

Natural gas and oil have the largest share of domestic space heating consumption (Table 6.7). The average household electric heating system consumes 10,145 kWh per year, while electric pumps and other equipment associated with central heating systems consume on average 300 kWh per year (VDEW, 1997). Prognos (1995) projected that the use of natural gas for space heating would increase, mainly at the expense of oil-fired heating. Electricity for heating was expected to level out after the year 2000; there is unlikely to be an increase in the proportion of owning households, though system efficiency will improve.

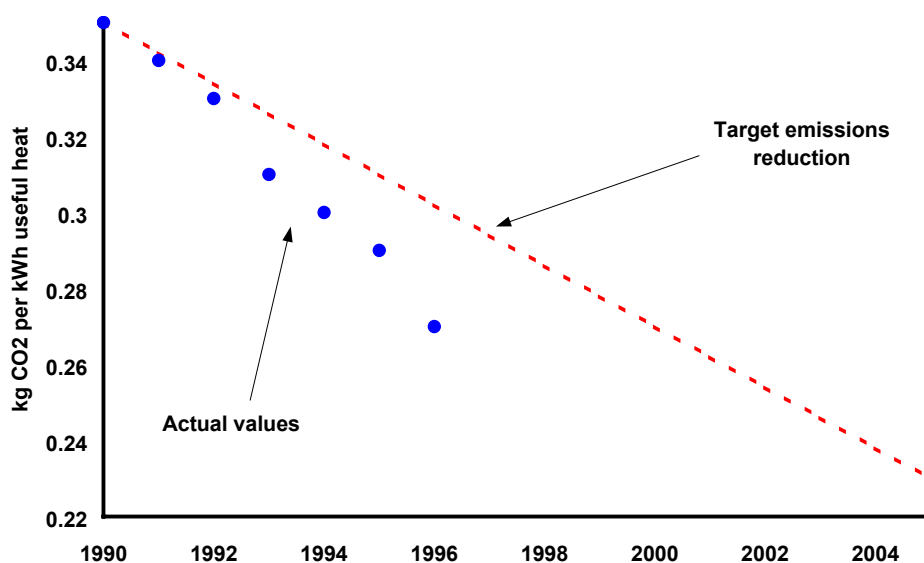
Table 6. 7: Projected (Prognos) fuel consumption for residential space heating, and actual (VDEW) electricity consumption for residential space heating, 1996 (Germany)

Fuel type	TWh
Natural gas (projected)	209
Oil (projected)	208
District heating (projected)	40
Coal (projected)	42
Electricity (projected)	36
Electricity (actual) *	30.3
Total (projected)	534

* Calculated on the basis of an average consumption of 10,145 kWh for space heating in the 8% of households with electric space heating

Source: Prognos, 1995; VDEW, 1997

Within the framework of the national goal to reduce CO₂ emissions, the German natural gas industry has committed itself to a voluntary agreement to reduce CO₂ emissions associated with space heating by 25% (compared to 1990 levels) in the Former West Germany (old Länder) and by 60% in the former East Germany (new Länder). This voluntary agreement is expected to speed up the growth of natural gas in the space heating sector, and to encourage the market share of condensing boilers (IER, 1998), and according to Ruhrgas (1999), the results so far appear to be promising (Figure 6.3).

**Figure 6. 3: Specific CO₂ emissions in the residential space heating sector and the German gas industry's voluntary agreement on Climate Protection**

Source: Ruhrgas, 1999

6.5 Water heating

The majority of households in Germany use electricity for water heating, including those households with access to the natural gas network (IER, pers. comm., 1999). Table 6.8 shows the estimated ownership domestic water heating equipment by fuel type in 1995. Oil or coal-fired storage boilers are quite common (GasTec, 1996).

Across Europe, centralised (or multi-point) water heating systems are the standard type. Germany provides an exception, in that a decentralised system of water heaters is more typical in German households. Water heating systems tend to be instantaneous rather than storage, and the appliances tend to be of relatively small volume compared to other countries. Around 73% of German electric water heaters have capacity smaller than 15 litres, and households tend to own several, one for each major point of use within the home. In 1997, 44% owned electric storage water heaters, of which around half had small instantaneous electric water heaters (around 11% of households had centralised electric storage systems). Many households which are connected to the natural gas network tend to use small instantaneous gas-fired water heaters (EVA, 1998b).

Table 6. 8: Estimated ownership of domestic water heating equipment by fuel type, 1995 (Germany)

Fuel type	% Households
Electricity	45
Natural gas	20
Oil (or coal)	30
District heating	5
Total	100

Source: GasTec, 1996

6.6 Cooking

In 1996, more than 80% of German households had an electric oven, and for 76% of households electricity was the only cooking fuel for both the oven and hob (Table 6.9). This proportion is expected to increase (VDEW, 1996). Microwaves, which tend to be purchased as a convenient addition to a cooker rather than as a complete substitute, were owned by 55% of households in 1996 (ZVEI, 1997). This level of penetration is unlikely to increase greatly.

Table 6. 9: Ownership of gas and electric cooking appliances, 1996 (Germany)

Appliance	% Households
Electric oven	81.2
Electric hob	76
Gas oven	19.3
Microwave	55.5

Source: VDEW, 1996; ZVEI, 1997

Table 6.10 gives the breakdown of cooking consumption by fuel type for 1992. Prognos (1995) projected that natural gas consumption for cooking would halve by 2020, that coal would decline from 700 GWh to 100 GWh in the same period, and that electricity would rise slightly until the year 2005, then slowly return towards 1992 levels.

Table 6. 10: National cooking consumption by fuel type, 1992 (Germany)

Fuel type	GWh	% share
Electricity	11,300	64
Natural gas	5,700	32
Coal	700	4
Total	17,700	100

Source: Prognos, 1995

6.7 Appliances and lighting

Table 6. 11: Ownership of domestic electrical appliances, Germany, 1996

Appliance type	% households
Fridge	-
Freezer	68
Fridge-freezer	-
Washing machine	94
Tumble dryer	26
Dishwasher	42
Microwave	55.5
TV (colour)	97
VCR	67

Appliance, 1997; ZVEI, 1997

Domestic electrical appliances and lighting (see Table 6.11 for ownership patterns) (excluding electric cooking) consumed almost 80 TWh in 1996 (Table 6.12) (VDEW, 1997). Prognos (1995) projected a gradual decrease in appliance electricity consumption up to 2020, from a 1992 baseline of 63.8 TWh (excluding cooking) to 58.4 TWh in 2020.

Table 6. 12: National electricity consumption by major domestic appliances, 1996 (Germany)

Appliance	TWh	% share
Cold appliances, of which:	23.6	29.7
<i>Fridge</i>	<i>11.7</i>	<i>14.8</i>
<i>Freezer</i>	<i>11.9</i>	<i>14.9</i>
Wet appliances, of which:	10.9	13.7
<i>Washing machine</i>	<i>5.0</i>	<i>6.2</i>
<i>Tumble dryer</i>	<i>3.0</i>	<i>3.8</i>
<i>Dishwasher</i>	<i>3.0</i>	<i>3.8</i>
Brown goods	7.1	8.9
Lighting	9.6	12.1
Misc/other	28.1	35.5
All appliances	79.4	100%

Source: VDEW, 1997

Figure 6.4 shows the variation in average household electricity consumption for various domestic end-uses, with the number of persons in the household. As would be expected, hot water consumption per capita is independent of the number of people in the household. People living in one-person households recorded significantly less cooker use than large households.

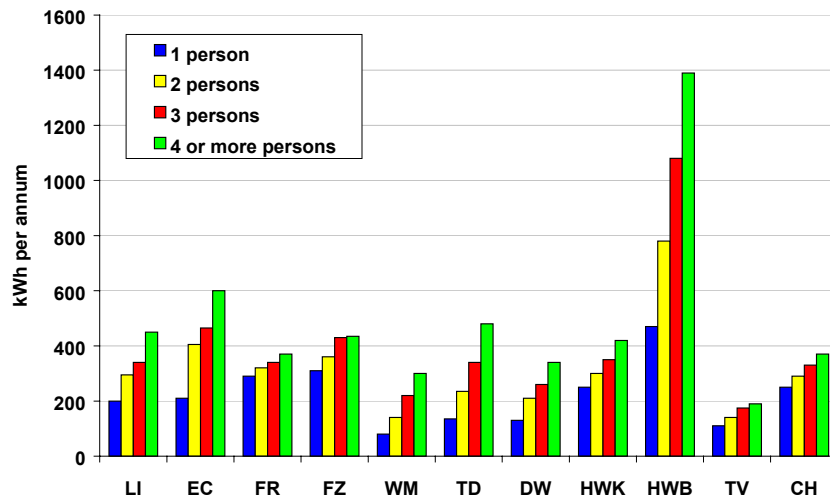


Figure 6. 4: Household appliance electricity consumption (kWh per household per year) by household size, 1995 (Germany)

Key: **LI** = Lighting; **EC** = Electric cooker; **FR** = Fridge; **FZ** = Freezer; **WM** = Washing machine; **TD** = Tumble dryer; **DW** = Dishwasher; **HWK** = Hot water (kitchen); **HWB** = Hot water (bathroom); **TV** = Television; **CH** = Central heating pump and associated equipment.

Source: *VDEW, 1997*

6.8 Policies and programmes for domestic energy efficiency

- Although there is no government policy specifically designed to achieve fuel-switching (IER, 1999), there are several utility promotion programmes for condensing boilers. These target both consumers and installer, and about half offer financial incentives. The rise in the condensing boiler market has been due at least in part to these promotion programmes, but attitudinal and legislative criteria are also relevant. Despite the financial advantages, many installers still do not recommend condensing boilers (IER, 1998).
- Germany has strong programmes for energy certification of buildings. The Federal Government provides financial assistance for on-site inspections to determine the possibilities for improving the heating system, thermal insulation, and the potential for use of renewables. Domestic heating equipment is required to undergo regular inspections. There are mandatory national standards for water heating systems, which were tightened up in the wake of the EU boiler Directive. There are no specific government policies on fuel switching, however some municipal utilities encourage the use of natural gas for cooking in order to reduce peak loads (IER, pers. comm., 1999).
- Because of the poorer average condition of housing in the Former East Germany, owner-occupied dwellings in the new Länder are eligible for tax breaks for the purpose of modernisation and repair, and the use of renewable energy. However, these tend to focus more on the building shell than on appliances and heating equipment.
- The German Consumer Association, AgV, is very actively providing an energy advisory service in 300 cities, and a variety of brochures on energy efficiency are produced by the Federal Government (IEA/OECD, 1998a).