Social Sustainability

►Indicator 3: Households with Access to Electricity

In Germany, virtually all households have access to electricity and mostly from the grid. The only houses that are not connected are some remote cabins in the mountains which rely on their own generators or renewable energy sources for electricity. Additionally, despite rising prices for crude oil (i.e. an increase of 40% in prices in 1990) gasoline and diesel, electricity prices have in general shown a sharp decrease as a consequence of improved market efficiencies resulting from market liberalisation between 1999 and 2001. Reductions in prices after liberalisation of energy markets were not so significant for households as they were for industry. Household electricity prices between 1990 to 1999 shown in Table 3-1, were nearly stable with minor changes

Table 3-1. Selected gross energy prices for household electricity in US cent / kWh

	1990	**1995**	**1996**	**1997**	**1998**	**1999**
Electricity Prices [Pfennig/kWh] [5]	24.56	29.11	28.00	28.55	26.71	29.53
Electricity Prices [US cent/kWh]	16.38	20.31	18.03	15.93	15.93	15.16

Source: ENERDATA, World Energy Database

As a result, the percentage of annual expenditures for household energy in relation to the annual income has been decreasing over the last decade as shown below in Table 3.2.

Table 3-2. Expenditures[6] for energy in German households in % of total income (Old Federal States)

	1991	**1993**	**1995**	**1997**	**1998**
Old Federal States					
Type 1[7]	7.3	7.5	6.9	6.5	6.2
Type 2 [8]	6.0	5.9	6.1	6.1	5.5
Type 3 [9]	4.6	4.6	4.4	4.6	4.1
Average	*6.0*	*6.0*	*5.8*	*5.7*	*5.3*

Source: Energiedaten 2000, Wirtschaftsministerium

Table 3-3. Expenditures for energy in German households in % of total income (New Federal States)

	1991	**1993**	**1995**	**1997**	**1998**
New Federal States					
Type 1	-	7.5	6.7	6.5	6.4
Type 2	-	7.6	6.9	6.8	6.2
Type 3	-	6.5	5.7	5.8	5.3
Average	-	*7.2*	*6.4*	*6.4*	*6.0*

Source: Energiedaten 2000, Wirtschaftsministerium

[5] Prices in Pfennig / kWh have been calculated using the corresponding exchange rates per year

[6] Expenditures for electricity, gas, heating oil, district heat, and others as averages for selected households participating in annual economic calculations

[7] Average household of 2 persons (retired persons or recipients of social welfare payment) with low annual income

[8] Average household of 4 persons (workers and employees) with a medium income

[9] Average household of 4 persons (employees, academics, civil servants) with a higher annual income

Calculating Vector Value for Indicator 3
In order to calculate the indicator the following data was used.

Fraction of households with access to electricity in 1990 and 1998 = 100%
Number of households with access to electric power in 1990 = Total number of households in 1990

X = Y = 34.9 Million

Number of households with access to electric power in 1998 = Total number of households in 1998

P = Q = 37.5 Million

Full access to electricity by households (100%) represents the centre of the star and therefore the sustainability objective. The vector is calculated by the equation:

$$I\ (1990) = 1 - (X/Y) \text{ and}$$
$$I\ (1998) = 1 - (P/Q)$$

which solves to 0 in the case for Germany and sustainability objectives reached.

▸Indicator 4: Investment in Clean Energy

Germany's most efficient instrument for the promotion of renewable energies is the Erneuerbare Energien-Gesetz (EEG; Renewable Energies Act). It was approved by Parliament in an earlier form almost unanimously in 1991 and was adapted to the conditions of the liberalized electricity market in 1999. It forces electricity grid operators to buy electricity from renewable sources from any producer at fixed prices which the grid operator then charges from the companies selling electricity using its power lines. The EEG, its predecessor law and other key national programmes as compiled in Table 4-1 are the main reasons for the boom in wind and other renewable energies in Germany. They caused numerous private investors to become power producers themselves and gave them an effective instrument against reluctant grid operators to get decent prices for their clean electricity.

Subsidies, on the other hand, are imposed on hard coal in Germany for instance which are not considered as expenditures at the federal level since the guidelines for the observer report do not explicitly define how subsidies should be accounted for. The federal government gets more money from imposing eco-taxes on renewable energies than it spends subsidising them. The renewables boom caused by the EEG also increases eco-tax revenues for the federal government. There is a labyrinth of subsidies for renewables on state and municipal level, which is very difficult to quantify. Roughly 1.5 billion DM (0.68 billion USD including both national expenditures and local investments) was invested in clean energy in 1999.

Table 4-1. Key national programmes to promote renewable energy use in Germany

Programmes [10]	**Time span**	**Total invested amount**
Market stimulation Programme to foster renewables	1994 – 1999 1999	45.12 Mio USD 90.33 Mio USD (annually)
100,000 solar roof programme	1999 – 2004	451.7 Mio. USD + 1.13 Mio USD additionally generated investments
Programme to promote solar energy use in parishs	1999	4.5 Mio USD
Ecotax imposed on renewable energies	annually	Negative: US$360-400m tax income

Source: Frithjof Staiß: Annual Year Book Renewable Energies, 2000

In order to determine the share of clean energy investments out of total energy related investments both private investments and federal government expenditures on R&D were considered. R&D is being supported according to the following main themes:

- Increase profitability of photovoltaic and specific annual electricity generation
- Development of wind power facilities for potential offshore application
- Geothermal applications
- Support the use of biomass, Combined Heat & Power, fuel cells and solar thermal
- Energy saving related to processes in industry

[10] The list of national government programmes is not complete but illustrates the largest programmes in terms of total investment in renewable energy use. Regional government investment programmes differ enormously between regions and are not explicitly listed. In total, regional governments have provided roughly 400 Mio USD for clean energy use and research between 1991 to 1997. A key area of investment was local heat production from solar and biomass, unfortunately disaggregated data on expenditures was not available at the time of writing this report.

Private investment in the energy sector is significant and primarily comprises investments in small scale entities or private households. Such investments are mainly undertaken by electricity utilities, suppliers, fossil fuel producing companies and renewable-energy entities. Data sources on private investments are however very limited. Data used for this report is based on publications by electricity utilities and suppliers. Table 4-2 and 4-3 illustrate federal government expenditures in R&D activities on the one hand and private sector investments in facility improvements on the other hand.

Terms for determining the social indicator of investment in clean energy have been defined as follows for Germany:

- ***Total energy related investments/expenditures*** includes all public and private investment/expenditures in fossil, nuclear and renewable energy. These investments include a) improvements of stationary power plants and transmission lines by electricity utilities and suppliers; b) exploitation of fossil and nuclear fuels and related activities; c) activities to increase the market share of renewables; and d) Research and Development (R&D) as a public expenditure.

- ***Total Investment/expenditure in clean energy*** is one element of ***total energy related investments /expenditures*** and includes investments undertaken by private or public sources to increase the market share of clean energy, that is, solar, wind, biomass and geothermal energy. It includes mainly R&D in renewables as a public expenditure as well as investments in personnel, equipment manufacture and supply. Figures for private investment in renewables were not available at the time of writing the report and therefore only public expenditures have been used for the vector calculation.

Table 4-2. Federal government expenditures in R&D in conventional and renewable energy use [Million DM] [11]

Federal government expenditures [12]						
	1991	**1993**	**1995**	**1997**	**1999**	**2000**
Conventional Energy Carriers (Coal, other fossil fuels, nuclear, large hydro)	871.2	659.0	524.0	496.7	544.0	529.7
Clean Energy Carriers (wind, geothermal, solar thermal, fuel cells, energy saving measures, photovoltaic, biomass)	332.5	355.6	302.4	294.4	317.7	304.6
Total	***1,203.7***	***1,014.6***	***826.4***	***791.1***	***861.7***	***834.4***

Source: Federal Ministry for Education and Research, Federal Report 2000

[11] In this case the currency does nor affect the results of the vector calculation therefore German Mark (DM) was used as currency for USD. This avoids taking exchange rates for the corresponding years into account.

[12] The term 'expenditures' has been used for investment to better characterise public funding since all money was spent for R&D. No regional government expenditures and expenditures of municipalities were taken into account since disaggregated data was not available. State subsidies on i.e. hard coal are not been accounted for investments in clean energy.

Table 4-3. Private investments in conventional electricity supply [Million DM]

Private investments						
	1991	**1993**	**1995**	**1997**	**1999**	**2000**
Power plant improvements	2,990.0	4,790.0	4,680.0	3,560.0	3,200.0	N/A
Distribution line improvements	6,150.0	7,800.0	7,060.0	5,900.0	5,000.0	N/A
Others (i.e. measurement equipment)	2,010.0	2,650.0	2,470.0	2,130.0	1,500.0	N/A
Total	***11,150.0***	***15,240.0***	***14,210***	***11,590***	***9,700.0***	N/A

Source: VDEW, Verband Deutscher Elektrizitätswerke "Strommarkt Deutschland 1999", Investments refer to non-renewable energy investments

N/A Not Available

Table 4-4. Total investments in conventional and clean energy use [Million DM]

Investment Source						
	1991	**1993**	**1995**	**1997**	**1999**	**2000**
Public	1,203.7	1,014.6	826.4	791.1	861.7	834.4
Private	11,150.0	15,240.0	14,210	11,590	9,700.0	N/A
Total	***12,353.0***	***16,254.0***	***15,036.4***	***12,381.1***	***10,561.7***	-

N/A Not Available

Calculation of Vector for Indicator 4

The HELIO International Guidelines for observers defines the standard "1" value as being the investment in clean energy in 1990 as a percentage of total energy related investment in 1990. The sustainability objective, the "0" value, is a target for government expenditure on clean energy expenditures to reach 95% of total energy-related investments.

Defining the variables :

X represents the investment in clean energy of any given year
W equals the value X in 1990 thus representing the upper limit of the vector value
Y represents the sustainability target which is defined as 95 % of clean energy investment and thus equals the sustainability objective which is the centre of the star.

X (1990) = W = 332.5 Million DM / 12,353.0 Million DM = 0.027 (2.7%)

X (1999) = 317.9 Million DM / 10,561.7 Million DM = 0.03 (3 %)

Z = 2.7% - 95 % = - 92.3

Actual calculation of the vector/s:

I (1999) = 3% - 95% / - 92.3 = 0.996
I (1990) = 2.7 % - 95% / - 92.3 = 1.0