

E N E R G Y



Export Initiative

Renewable energies are becoming an increasingly important job creation engine. Between 2004 and 2005 alone, the number of jobs in this sector rose from 157,000 to 170,000. In addition to the steady expansion in Germany, increasing exports of German technology are generating enormous growth rates. Since 2002, the German Energy Agency (Dena) has been helping companies enter world markets through its Renewable Energy Export Initiative. Among other things, it develops marketing strategies and organizes meetings of experts. Dena also presents up-to-date information on interesting export markets in detailed national profiles: German firms can currently access data on more than 40 countries. The German Energy Agency has also put together a multilingual presentation on renewable energies for fairs and exhibitions outside Germany. The programme has certainly been successful. Some 50% of the world's hydroelectric power stations are based on German know-how. Exports account for 80% of the industry's revenues. In 2005, the German wind power industry was responsible for roughly half of the total world market volume of more than twelve billion euros. Solar cells from Germany have a world-market share of 16%.

Dates

In collaboration with German Chambers of Commerce Abroad, the DENA Export Initiative is also presenting German companies with renewable energy technologies abroad: June 26-30 in Jakarta/Indonesia, September 11-15 in Tunis/Tunisia, September 18-22 in Copenhagen/Denmark, September 25-29 in Mexico City/Mexico and October 23-27 in Moscow/Russia. Details of further events are available at: www.exportinitiative.de

OVERVIEW

The Energy Mix of the Future

Environmental protection, economic viability and security of supply are the central pillars of a new energy policy strategy for Germany. Industry and the federal government are planning to invest billions in energy

The prices of oil and gas are skyrocketing, reserves of fossil fuel are coming to an end and the fight against the greenhouse effect has been far from won: energy is the topic of the moment. What will the energy mix of the future look like? How can the supply of raw materials be assured in the future? These questions are being asked both by international organizations, such as the G8, and national governments. April 3 saw the advent of a new overall energy policy strategy for Germany: Federal Chancellor Angela Merkel invited representatives of politics and industry to an energy summit at the chancellery. The energy strategy, whose central pillars are security of supply, economic viability, competitiveness and environmental compatibility, will be formulated by mid-2007 in a number of high-level meetings. The first summit was already highly successful: German companies intend to invest a total of 70 billion euros in the energy supply sector by 2012. Some 40 billion euros will be spent on renewable energies, 30 billion euros on new power plants and grids. In addition to this, the federal government will also be supporting energy research with two billion euros. One thing is clear: despite differences of opinion among the coalition partners, the phasing out of nuclear energy will be continued during the legislative term until 2009 as laid down in the coalition agreement.

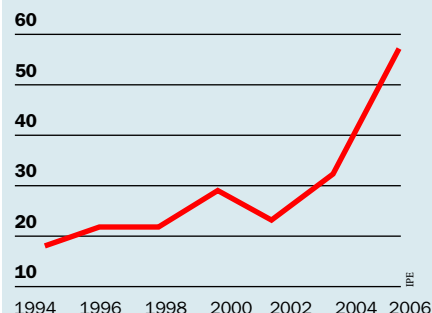
Renewable energies are one of the most important components of the new energy strategy. They represent the key to greater independence from fossil fuels. Biomass, wind power, solar energy and fuel cells will be the energy sources of the future. Currently, however, oil and gas are still dominant:

Primary Energy Mix in Germany in 2005 (in %)

Petroleum	36.0
Natural gas	22.7
Coal	12.9
Nuclear energy	12.5
Lignite	11.2
Renewable energies	4.6
Others	0.1

With renewable energies accounting for 4.6% of total energy consumption, Germany is near the top of the international league table. By 2010, their share of total electricity production should already reach at least 12.5% – and 20% by 2020. Biomass will account for a large proportion of this figure. It should therefore come as no surprise that a national “bio-raw material strategy” was a major topic at the Berlin summit.

Crude Oil Price (in US dollars per barrel)

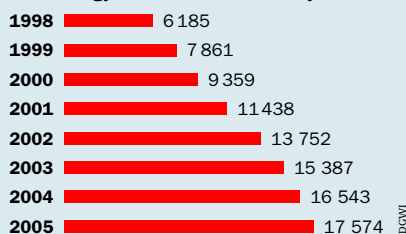


After all, biomass is the “all-rounder” among renewable energy sources. It can be used to produce not only fuels, but also heat and electricity. And no other energy source is as versatile. Whether rapeseed, reeds, liquid manure or cow dung, practically all organic raw materials are excellent suppliers of energy. Compared with petroleum and natural gas, biomass reduces emissions of greenhouse gases, is constantly available and independent of wind and weather. Just how innovative German businesses are in the field of renewable energies is demonstrated by Choren Industries, a company based in Freiberg, east Germany. In conjunction with Shell, the firm is investing hundreds of millions of euros to produce SunDiesel. The raw materials for this environmentally friendly fuel are primarily wood, straw and agricultural waste. The liquid energy source is regarded as the world's cleanest diesel fuel: SunDiesel produces 30-50% less emissions than fossil diesel. Furthermore, it is tar-free, biodegradable and considered carbon dioxide-neutral: when burned, the new fuel only releases the same



amount of harmful greenhouse gases as the plants used in its production absorbed during growth. Choren managers have also been able to convince car makers DaimlerChrysler and Volkswagen with their worldwide patents. Both are supporting Choren Industries in the research field. From 2007 onwards, DaimlerChrysler will be delivering all diesel models with "sun in the tank".

Wind Energy Installations in Germany



Biomass is not only booming in Freiberg: 800 new biogas plants were installed throughout Germany last year alone. Almost ten billion kilowatt hours of electricity were generated from biomass in 2005 – four billion more than in the previous twelve months. In the long term, according to Federal Environment Ministry estimates, biomass will generate 10% of total electricity needs and 20% of supplied heat in Germany.

When it comes to **wind energy**, Germany is already a world champion: 18,000 megawatts of wind power are installed in the country. No other renewable energy source supplies more electricity than wind power. Roughly one third of the world's wind turbines and half of the wind power plants in the European Union are located in Germany. Wind power generates almost twice the amount of electricity that the capital city Berlin consumes in a year. Wind energy's share of Germany's total electricity supply will significantly grow from 2008 onwards: in two years' time, the construction of more than 30 offshore wind farms will commence in the North Sea and the Baltic Sea. It is envisaged that they will supply 25,000 megawatts of electricity by the year 2030. The German wind energy industry is also busily breaking records. Enercon, Nordex and Repower Systems are among the world's leading technology companies in this field. Repower Systems is the first wind turbine maker to produce a wind installation in the five-megawatt class – the largest and most powerful turbine ever made.

The German **solar industry** is also booming. It achieves sales of three billion euros and the market is growing by 20% a year. SolarWorld, one of the industry's top firms, even became market leader in the USA following its takeover of Shell's solar cell production a few months ago. Photovoltaic technology still has a great deal of potential in Germany: its share of the electricity supplied by renewable energy sources came to 1.6% in 2005. This figure is set to rise – German companies' latest developments will ensure that. By 2010, Berlin-based manufacturer Sulfurcell aims to be able to produce so-called thin-film modules for half the current cost. This new generation of solar cells is silicon-free. The engineers at Schott Solar are trying out entirely different approaches: they have developed semi-transparent thin-film modules that replace conventional window panes in buildings and generate electricity. The Fraunhofer Institute for Solar Energy Systems is going a step further. The modules developed by the scientists in Freiburg achieve an efficiency rating of 25% – more than every other kind of solar cell. The first of these third-generation modules should appear on the market in two years at the latest.

It will take much longer than that before **fuel cells** are ready for mass production – at least, in cars and trucks. The experts believe it will be 2020, at the earliest, before hydrogen-powered vehicles will be seen on the roads in large numbers. The oil age will then be over, because fuels cells transform hydrogen into electricity and heat in a totally emission-free way.

Renewable Energies in Germany
(Share of energy consumption)

	2004	2005
Electricity	9.4	10.2
Heating	5.2	5.4
Fuel	1.9	3.4

Engineers around the world – above all, in Germany – are working on their development. Prototypes of small fuel cells that supply mobile phones and laptop computers with energy will soon be ready for the market. Producers of central heating systems, like Vaillant and Buderus, are planning revolutionary changes in basement boiler rooms. They are working on stationary fuel cells that can supply houses with both heating and electricity. Planned date of introduction: 2007. Germany's energy mix will then be in for a shake-up.



Renewable Energy Law

Practically no other industry in Germany offers growth prospects as high as those of renewable energies. According to figures published by Bundesverband Erneuerbare Energien, 300,000 new jobs will be created by 2020. This development is largely due to Germany's Renewable Energy Law. This legislation lays down government-guaranteed minimum remuneration for electricity from renewable energy sources. The law aims to increase renewable energies' share of overall electricity production in Germany to at least 12.5% by 2010 and at least 20% by 2020. The most recent version of the law, which dates from August 2004, lays down a minimum payment of 9.5 cents per kilowatt hour for electricity generated from biomass for a period of 20 years. In 2005, payments arising out of the Renewable Energy Law cost some 2.4 billion euros. A recent study by the



German Aerospace Centre shows that this represents a good investment. In the same period, electricity from renewable sources prevented damage – for example, caused by emissions – worth 2.8 billion euros. The environmental impact of the Renewable Energy Law is impressive: in 2005, the statutory promotion of renewable energy sources reduced carbon dioxide emissions by 57 million tonnes. The target is 110 million tonnes in the year 2020.



The question of the ideal heating system is no longer important for thousands of Germans – they usually don't need one at all. They live in what are known as **passive houses**, in which the body heat of two adults normally suffices as a source of heating. Although that sounds like science-fiction, it actually only involves the efficient combination of a variety of technologies. These include effective insulation of the building's facade, triple glazing, solar collectors and an automatic ventilation system. At the heart of this system is a heat exchanger that warms incoming fresh air to room temperature before it flows into the house. The exchanger extracts the heat for this process from the exhaust air. Owners of passive houses don't have to worry about the debates on rising heating oil costs: a passive house needs 80% less heating energy than a low-energy house and more than 90% less than a conventional building. A passive house requires the equivalent of less than 1.5 litres of heating oil per square metre per year. Low-energy houses, whose environmental standards have been mandatory in Germany for all new buildings built since 2002, require between eight and ten litres. Uninsulated older buildings waste up to 40 litres. 6,000 passive houses a year are built in Germany. Their number will increase because the additional costs of passive-house construction, roughly 10%, have fallen significantly. Furthermore, the higher oil prices rise, the faster a passive house pays for itself. The Federal Government is also making sure of that. It is not only promoting new passive houses, but also supporting the modernization of existing buildings. If a house owner replaces an old heating system and improves the building's insulation at the same time, a loan can be obtained from the government-owned Kreditanstalt für Wiederaufbau (KfW) at favourable rates. The more energy saved, the lower the interest rate. With roughly 40 million units of housing in Germany, there is an enormous potential for energy-saving here.

The same potential is also literally lying under our feet: **geothermal energy** is the name of the natural resource that can supply energy around the clock independently of sun and wind almost all over the world without generating any emissions. Roughly 99% of the earth's mass is hotter than 1,000 degrees Celsius. Geothermal ener-

gy's potential is thus enormous. Theoretically, it would suffice to meet global energy needs for 100,000 years. Since the use of geothermal energy is strongly dependent on geological conditions, it is often simply too expensive to transform this natural energy into electricity or heat. In Germany, usable reservoirs of heat are located deep down in the earth. Exploiting them involves complex technology and is accordingly expensive. As a result, geothermal energy is – for the time being – only playing a minor role in Germany's energy supply system: in 2004, it only met 0.04% of primary energy needs. However, since prices for fossil fuels began to rocket and thanks to the support arising from the Renewable Energy Law, the geothermal energy sector is now growing by 14% a year. Currently, 24 large-scale geothermal energy plants with outputs of up to 20 megawatts are operating in Germany. The Essen-based Enro Group will be taking the industry into a totally new dimension from 2007: it is building Germany's largest geothermal power plant – with an output of 25 megawatts – in Brandenburg at a cost of 250 million euros. More and more house builders are also discovering the advantages of this environmentally

Wind	42,6
Water	34,6
Biogenic solid fuels	7,6
Biogas	5,1
Landfill gas	3,5
Biogenic share of waste	3,3
Photovoltaic	1,6
Sewage gas	1,4
Biogenic liquid fuels	0,2
Geothermal	0,0003

friendly energy source. They extract heating energy with the aid of geothermal probes that can reach up to 90 metres into the ground. They contain a liquid that absorbs heat deep in the earth and transfers it to a heat pump inside the house. 15,000 geothermal plants were installed in Germany last year – compared with an annual figure of 10,000 in previous years. Bundesverband Geothermie even expects up to 30,000 new geothermal units for 2006. Manufacturers, explains the industry association, are already working at full capacity.

Nuclear Power

The date had a symbolic character: on April 26, 2002, 16 years after the reactor accident at the Ukrainian nuclear power plant in Chernobyl, the Law on the Orderly Termination of the Use of Nuclear Energy for the Commercial Production of Electricity came into force in Germany. The governing SPD-Green coalition of the time laid the foundations for the phasing out of nuclear power: new atomic power plants may no longer be built and existing plants are subject to a regulated operating lifetime that is limited to a period of 32 years. Because the present governing grand coalition of CDU, CSU and SPD upheld the decision of the previous government in its coalition agreement – despite differences of opinion on the matter – the last German nuclear power station is due to be switched off in 2023. Currently, 17 atomic power plants in Germany supply 26% of the country's electricity demand. By 2020, however, in accordance with the phase-out legislation, its contribution will only be very small. Renewable energies are to take its place.



Information on the Web

www.bmu.de

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

www.erneuerbare-energien.de

Information on renewable energies in Germany

www.dena.de

German Energy Agency