The energy and research policy framework conditions for renewable energies in Germany

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For 20 years now, Germany has been expanding renewable energies with the support of state incentive instruments. What is the reasoning behind the systematic retention and refinement of these instruments over this period with the aim of creating a reliable basis for the successful development of renewable energies?

With a share of around 10% for renewable energies in the German energy mix (2008), Germany has indeed made good progress, as renewable energy sources are largely domestic. However, the high share of 90% for fossil fuels provides motivation to further speed up the shifting of energy production in favour of renewable energy sources.

Reasons for the promotion of renewable energies in Germany

Germany is dependent on energy imports to a considerable degree. Almost three-quarters of the total energy consumed must be imported from abroad. The dependence on a small number of supplier countries – e.g. Russia – is increasing. The risk of political dependencies due to the increasing importance of energy is thus also increasing. Reducing the dependency on imports is thus an important aim of German energy policy.

Another reason for supporting renewable energies is the inability of the free market to integrate the high consequential costs of climate change into current energy prices. The costs of environmental damage, damage to health, the disposal of waste from nuclear and coal-fired power plants, and the costs of security measures and of conflicts for energy raw materials are not yet reflected in our energy prices to an appropriate degree. Support for renewable energies, which would avoid the majority of the consequential costs described in the first place, thus helps avoid financial burdens on future generations.

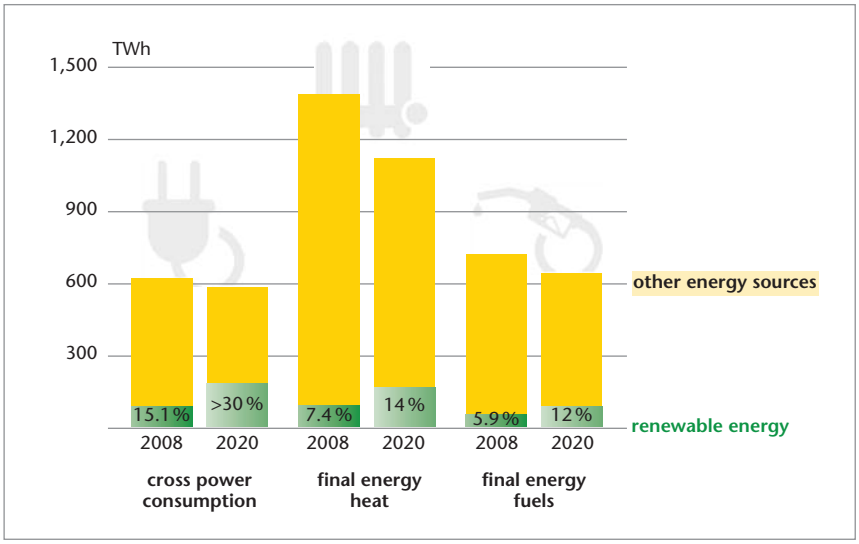


Figure 1
Targets for the expansion of renewable energies in Germany up to 2020

Source: German Federal Ministry for the Environment (2009)

The European Union has set binding targets for the expansion of renewable energies by the year 2020. Member states must achieve a total of 20% of their energy supply from renewable energy sources. Germany, with 18%, is slightly below the average. The German figure is made up of a share of at least 30% of power generation, 14% of heat provision and 12% of fuel supply.

However, the main reason for the promotion of renewable energies in Germany is the economic-technological factor. With the introduction of Germany's Electricity Feed-in Act in 1990 and its development into the Renewable Energy Sources Act (EEG) that came into force in April 2000, a strong new industry gradually established itself. The fact that renewable energy technologies have been able to compete on the market has led to economies of scale and increases in efficiency. State support has meant that German companies have been able to establish a technological advantage that will become increasingly important in the light of future climate protection agreements. In 2008, German companies achieved turnover of almost €29 billion from the installation and operation of equipment and another €12 billion from exports.

The innovations that have resulted are now available to the whole world in order to reduce CO_2 or help even the smallest units in developing countries to achieve self-sufficiency of energy supply.

Technologies that are close to being market-ready are supported by incentive systems such as electricity feed-in tariffs, premium models or fuel quotas; other technologies that are not yet ready for the market require fundamental research that is mainly conducted by scientific institutes and universities.

Development of research support

Since 1973, the German federal government has been preparing energy research programmes. The currently applicable, fifth energy research programme is entitled "Innovation and new technologies". It was initially intended to cover the period 2005 to 2008, and was then extended to 31/12/2010.

In the initial period up to 2008, the programme was given a support budget for fundamental research of €1.7 billion. Although support for renewable energies and energy efficiency grew – at a low level – up to 2008, most of Germany's research funding is still spent on nuclear technologies, including the decommissioning of plants and research on nuclear fusion.

The four federal ministries responsible for energy issues – i.e. the Ministries of Research, the Environment, Economics and Agriculture – spent a total of €161.2 million in 2008 on institutional support and support for specific renew-

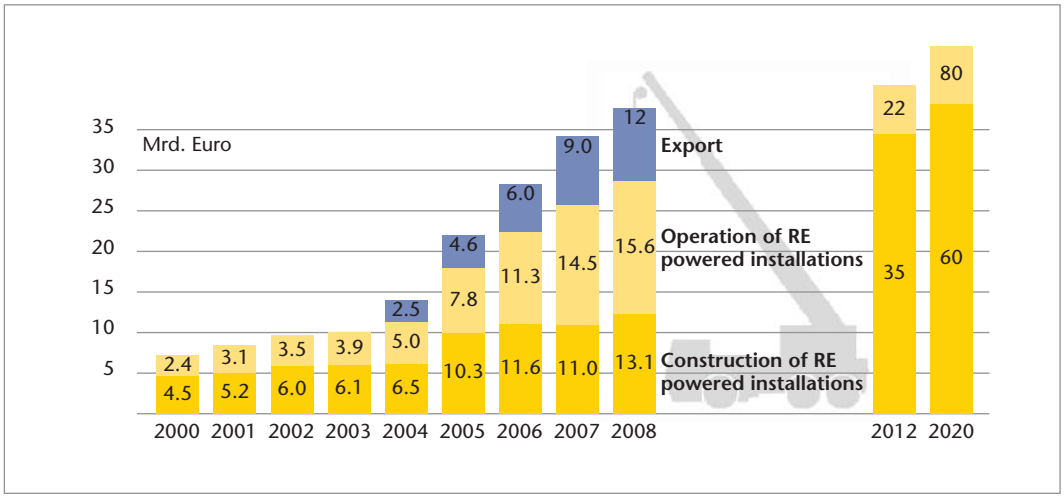


Figure 2
Turnover for the renewable energies sector in Germany

Source: German Renewable Energy Agency

able energies projects. This funding was used for the following purposes:

1. Reduction of costs by increasing efficiency and achieving economies of scales by optimising production processes and improving product lifecycles
2. Development of new technologies
3. Sustainable expansion of renewable energies by investigating ecological and social effects

Technologies for system integration and wind power are becoming more important as part of the project support. Photovoltaics had a 44.1% share of the budget in the 2005-2008 support period, but this figure dropped to 26.3% for project support approved in 2008. On the other hand, the area of system integration has now grown from around 0% to 18.7%, while the wind power area has increased from 21% to 26.6% driven mainly by offshore wind power. This development shows that the processing of large amounts of energy, the storage associated with this, and the intelligent control of energy consumption are becoming increasingly important.

Conversely, less support is being provided for fundamental research as the various technologies become more competitive on the market. In this phase, market incentive instruments become technology and innovation drivers. The German Renewable Energy Sources Act (EEG), which provides for defined tariffs over a period of 20 years for electricity fed in from renewable sources, has proven one of the most successful support measures worldwide.

How the feed-in tariff works

The German Renewable Energy Sources Act (EEG) came into force on 1 April 2000, and has been the most important factor in the increase of the share of renewable energy sources in the electricity supply from around 6% initially to about 16% in 2009. The act follows the principle of cost-covering remuneration, and for this reason it must be monitored and updated continuously.

The five core elements of the EEG were defined after a ten-year learning period (1990-2000) with the Electricity Feed-in Act, which was the predecessor of the EEG, and they continue to apply today:

- **Priority for EEG electricity:** Every system for the generation of electricity from renewable sources must be connected to the electricity grid by grid operators. Every kWh of electricity may be fed into the grid and is transmitted to consumers.
- **Defined remuneration:** Every kWh of electricity from renewable energy sources receives a guaranteed tariff, which in turn makes it possible to calculate the payback period for the investment in equipment.
- **Long period of applicability:** The remuneration applies for a 20-year period, which gives investors a high degree of yield security. During this period, operators are free to opt out of EEG tariffs or opt back in again, depending on whether higher prices can be obtained on the open market.
- **Technology-specific support:** Each technology offers different advantages that cannot only be measured in terms of current economic performance. The other factors include the maturity of the technology, the technology's potential for the future, the suitability for the location, and issues relating to landscape and nature conservation. The principle is thus to support each technology (PV, wind, biomass, ...) with its own different tariffs in order to cover the respective costs of each technology.
- **Degression:** In order to speed up learning effects and avoid windfall gains, an annual reduction of the initial tariff has been specified. This innovation pressure helps all technologies to gradually approach grid parity, i.e. a price level which reflects that paid by end users.

A significant factor in the EEG's success has been and continues to be the fact that it is independent of the government's current budgetary policy. As the feed-in tariffs are fully financed by a levy system between producers, grid operators and consumers, there is no "EEG budget"

that is subject to the whims of overall budgetary decisions.

This situation also helps provide the financial security desired by investors for the development of larger projects. This independence must continue as it is.

Costs and benefits of the EEG

Additional costs for society as a whole are of course also associated with the EEG, as it compensates for the difference between the lower market price for conventional energies and the costs for renewable energies. If the entire EEG levy of €4.5 billion for 2008 is considered per kWh unit of electricity, every consumer had to pay an extra 1.1 cents, which represents around 5% of the average consumer electricity price. When this figure is considered per average household in Germany, additional costs of around €3 per month arose.

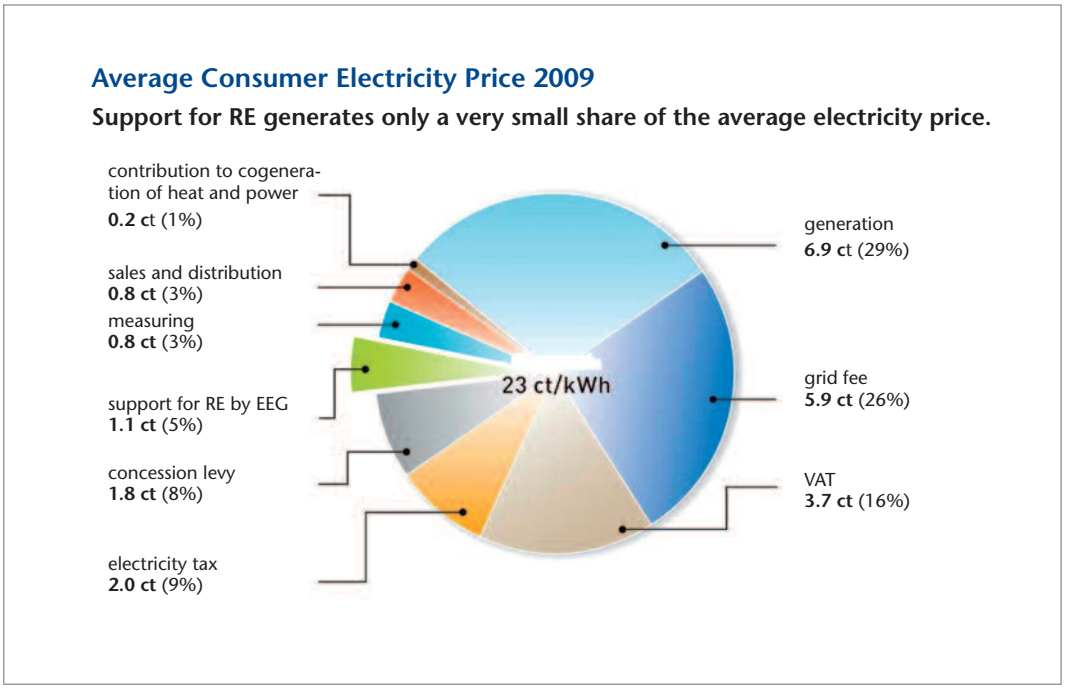
On the other hand, the support for renewable energies has led to a remarkable boom for the industry. Alongside the €40 billion in turnover thanks to investments, operation and exports, the sector has also created 280,000 jobs so far.

Equipment efficiencies have increased significantly. For example, modern wind turbines now produce 50 times more electricity than turbines in 1990 did, thanks to innovative technology, larger rotor diameters and greater hub heights.

The CO_2 emissions avoided by renewable energies in 2008 amount to around 72 million tonnes for the electricity sector alone. If the CO_2 emissions avoided by the heating and fuel sectors are also included, around 110 million tonnes of CO_2 in the atmosphere have been avoided. No other climate protection instrument apart from support for renewables can boast similarly high levels of CO_2 savings. The specific costs of the savings per tonne of CO_2 differ and are higher than for other measures in certain cases; however, the potential for development and cost reductions for these technologies is great, and the demand envisaged on the world markets is immense too.

Germany's systematic support for research is indeed showing the way: Technologies that are

Figure 3
Make-up of the average consumer electricity price in Germany in 2009
Source: BDEW (2009)



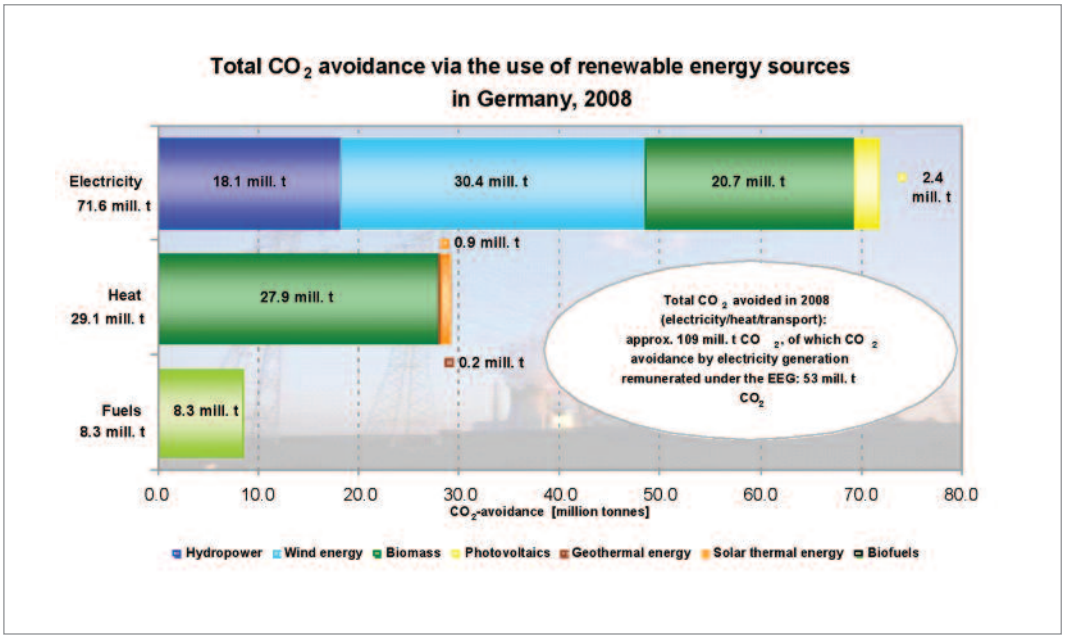


Figure 4
CO_2 avoidance thanks to renewable energies in Germany in 2008

Source: "Renewable energy sources in figures – national and international development" brochure from the German Federal Ministry for the Environment (2009)

not market-ready are developed by means of fundamental research, and technologies close to market maturity are launched with the help of incentives and are then subject to innovation cycles.

However, two weaknesses can be identified: With current funding of €161 million, fundamental research is not receiving the same level of financial support as in the USA or Japan, which are investing more heavily in their research capacity in the area of renewable energies. In addition, more effective research incentives must be developed in the areas of heat and fuels, which could potentially make major contributions to climate protection, in order to make progress here more quickly.