

The significance of renewable energy sources for a sustainable energy policy in Germany

Results of a study by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

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Objective

As part of this study, we have compiled a package of measures to ensure the effective development of renewable energy sources (RES) in the power and heating markets, by encouraging competition between the various technologies and conventional energy technology within the competitive framework of a liberalised European energy market, whilst at the same time minimising the levels of public funding required. To this end, we evaluated a large number of monetary, legal and other measures, and formulated proposals for their further development. The measures employed by various EU states to promote renewable energy sources were also analysed.

Key targets for the year 2010

The analysis is based on two scenarios for the expansion of RES - "Continuation of current measures" and "100 % increase by the year 2010". This permits a quantitative analysis of the required expenditure and intensity of the mechanisms employed. The former scenario refers to a trend development, whereas the latter is based on the assumption of a 100 % increase in the proportion of renewable energy sources by the year 2010 as a fundamental requirement of sustainable energy supply. The unanimous conclusion of the various climate protection scenarios available is that, whilst energy saving and the increased use of combined heat and power generation represent the major contribution to climate protection in the short to medium term, a significant role will be played by renewable energy sources in the longer term. Our formulated target of a 100 % increase aims to prepare for this.

If this target is achieved, by the **year 2010, renewable energy sources will account for around 10 % of the demand for power and 2.5 % of the final energy demand for fuels**. The largest single contributor will be biomass (including biogases), accounting for just under 30 TWh/a final energy, followed by wind power, which will generate some 25 TWh/a (equivalent to an output of 12 000 MW_{el}). Hydropower, which is currently the leading source of renewable energy, will rank third with 23 TWh/a (**Figure 1**). Photovoltaic technology, solar thermal collectors and geothermal energy, whose contributions are currently minimal, will have increased approximately tenfold by 2010.

In order to reach the target of a 100 % increase by 2010, annual **investments** in new RES installations must be stepped up from approximately € 1.8 billion per annum in 1999 to € 3.3 billion per annum in 2010, a **cumulative total of € 32 billion**. These investments will create **some 25,000 additional jobs, as well as reducing CO₂ emissions by just under 20 million t/a**; on the other hand, they will also generate additional costs compared with conventional energy supply, because most RES technology is still more expensive than current forms of energy supply. These additional costs add up to an average of € 1.3 billion per annum

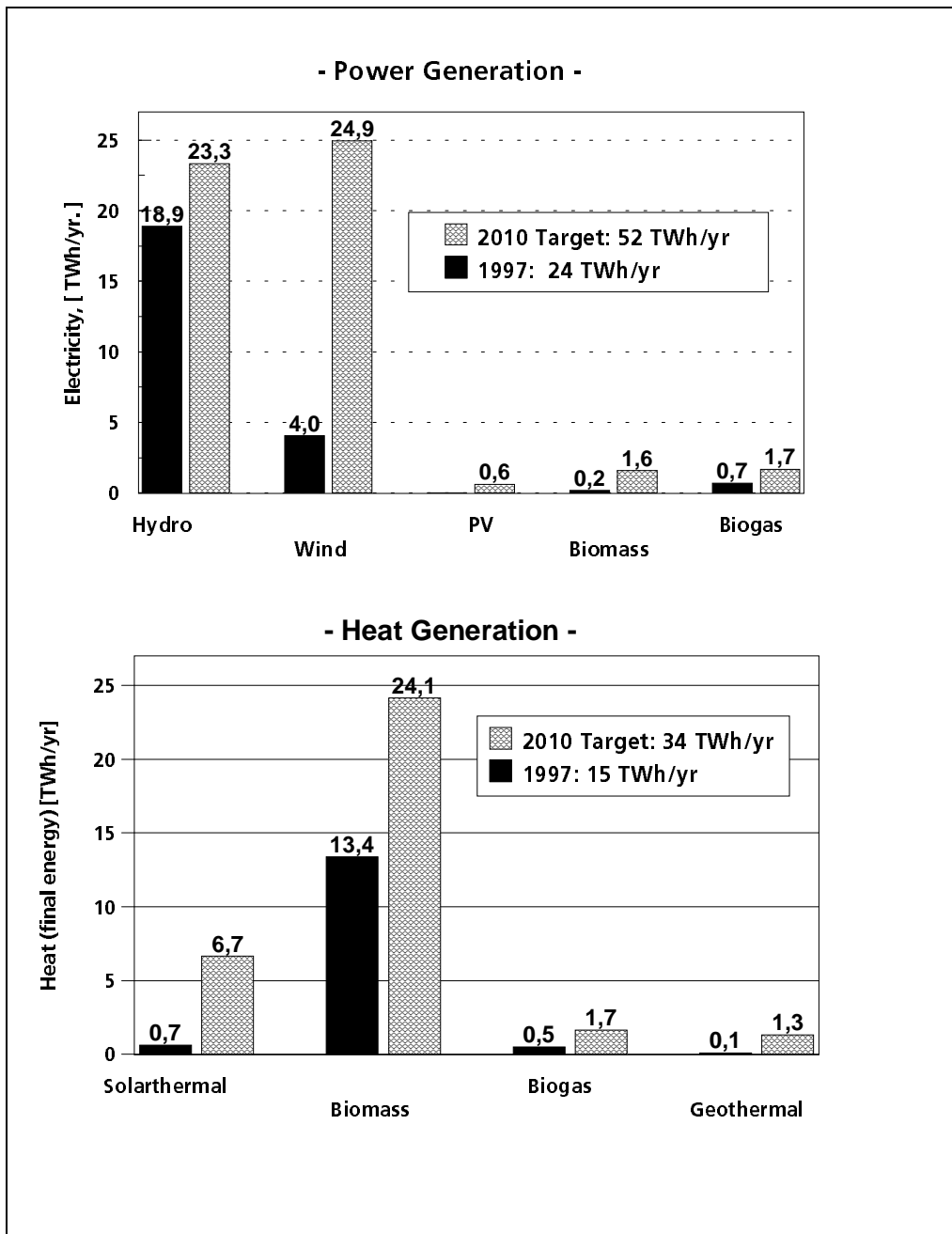


Figure 1: Expansion in renewable energy sources in the power and heating markets by the year 2010 (right-hand bars) compared with the current structure (left-hand bars).

in the period 2000 to 2010, assuming a real increase in real average power prices from 5.1 cent€/kWh to 6.5 cent€/kWh, and in heating prices from 4.4 cent€/kWh to 5.4 cent€/kWh. If prices increase more sharply, the additional costs will be reduced accordingly. Although these additional costs may appear high, they translate into an average increase of just 0.064 cent€/kWh on total energy consumption for power and heating, or **0.128 cent€/kWh_{el} for power and 0.051 cent€/kWh_{th} for fuel**. These figures are low when compared with the taxes

on these energy carriers and the usual price fluctuations.

Package of measures designed to expand renewable energy sources by the year 2010

The subsidy programmes adopted and introduced in 1999 (such as the 100,000 roofs initiative, a € 100 million subsidy programme) and the launch of the ecological tax reform, combined with the existing measures, particularly the highly successful Electricity Feed-In Law (StrEG), together provide an **excellent basis** from which to give the necessary boost to the expansion of renewable energy sources. Many factors favour the continued use of proven, established mechanisms, in a modified form where necessary. New mechanisms must meet two key requirements: They must be capable of integrating as smoothly as possible with existing measures, and they must be compatible with the competitive framework of the liberalised European energy market.

When formulating the package of measures, the power market and the heating market were addressed separately, because there are considerable differences between the two, both in terms of structure and in terms of the level of support for renewable energy sources. Whereas the principal emphasis in the power market is on developing an established and successful group of mechanisms **without threatening the market momentum which has developed in recent years as a result of diverse activities**, in the heating market, a comparable development of renewable energy sources is still largely in its infancy.

The principal mechanisms chosen to promote renewable energy sources in the power and heating markets are listed in **Tables 1 and 2**. When selecting from a wide range of potential instruments, it is vital to adopt a pragmatic approach. The principal mechanisms cited under (1), which will make up the bulk of support for renewable energy sources in the foreseeable future, represent a continuation and adaptation of proven mechanisms in the respective market segments, thus ensuring the necessary degree of continuity. In the case of power generation from renewable energy sources, the mechanism in question entails modifying the Electricity Feed-In Law (StrEG), in keeping with the framework conditions of the European electricity market. In the case of the heating market, attention focuses initially on continuing the subsidy programme for small heat-generating systems. Although rather conventional, this was felt to be indispensable for developing and maintaining the necessary growth momentum in this field.

The principal mechanisms listed under (2) represent new components of German energy policy for both market segments, and are based directly on the competitive framework conditions of the European energy market. They play a key role in ensuring the future market expansion of renewable energy sources. The market "mechanism" for "green electricity" depends on the willingness of the market players to voluntarily pay more for this product. Its effectiveness will therefore depend largely on equitable grid access and transmission conditions, and on whether there are indications that the difference in cost between conventional and green electricity is likely to be reduced in the foreseeable future, e.g. as a result of exemptions from the ecotax.

Table 1: Principal mechanisms in the power market

(1) Modified Electricity Feed-In Law (StrEG)
<ul style="list-style-type: none">• Elimination of the hardship clause• Regulation of financing and compensation by means of a grid surcharge with a neutral effect on competition, or a levy on grid operators• Cost-based remuneration with fixed rates and time limits (whilst ensuring adequate amortisation of installations used at locations of average quality), differentiated according to different types of technology; reduced remuneration levels thereafter.• Inclusion of electricity supply company installations (with identical output limits for hydropower as for non-electricity supply company installations)• Inclusion of geothermal power generation and biomass combustion; increase in the output limit for biomass to 15 MW_{el}
(2) Boosting the market for green electricity
<ul style="list-style-type: none">• Exemption of renewable energy sources from the electricity tax where supplied to end consumers• Priority components for grid access; cheaper transmission conditions; making allowance for the specific properties of available energy sources when establishing electricity exchanges• Public consumers to set an example by purchasing green electricity• Support of private certification efforts• Creation of comparable and compatible rulings for other green electricity generation options (small combined heat and power installations)• Electricity eligible for remuneration in accordance with the StrEG is excluded from being marketed as green electricity.

Table 2: Principal mechanisms in the heating market

(1) Promoting subsidies for small installations
<ul style="list-style-type: none">• The established subsidy programme is to be maintained and stepped up slightly (continuation of the € 100 million programme; continuation of the <i>Länder</i> programmes)• For solar thermal collectors with a surface area of up to 50 m², fixed subsidy rates per square metre of surface area• For wood central heating systems with a heated area of up to 500 m² (new buildings and replacement systems), fixed subsidy rates per square metre of heated area• Subsidy rates of between 20 and 25 % of the investment initially, later falling
(2) Quotas for large installations
<ul style="list-style-type: none">• Compulsory quotas for generators, importers and wholesalers of fuels intended for heating• Issue of tradable certificates to plant operators depending on the quantity of heat generated from renewable energy sources.• Purchase of certificates by the fuel trade until the quotas have been met; the government to control compliance with quotas• Specification of maximum certificate prices (penalties) for incomplete fulfilment of quotas• Additional investment subsidies for solar district heating installations for a limited transitional period.

The concept of quotas on the heating market is a ground-breaking one. Because large heating installations based on renewable energy sources - which in the past have received no or comparatively little financial support - are an indispensable component of an effective expansion strategy, yet acceptance for adequate levels of public funding is estimated as low, a competitive, budget-neutral mechanism is suggested as a suitable means of achieving this. Because levy-financed supply regulations would not be possible in the heating sector, quota regulations would only be practicable in conjunction with tradable certificates. In this way, it would be possible to acquire practical experience of these mechanisms in a limited but largely homogeneous market segment, which could subsequently be applied to the heating market as a whole, and possibly the power market as well. Over the next few years, the success of the mechanisms listed under (2) will determine whether and where they are able to repress or even replace altogether the mechanisms listed under (1) for promoting renewable energy sources.

In addition to the principal mechanisms, a number of accompanying measures are also required in order to meet the target of a 100 % increase. These include **additional monetary measures** from public funding (primarily in order to provide support for biomass gasification technology for combined heat and power generation, which remains expensive, and to selectively expand the use of wind power at inland locations, photovoltaic technology and geothermal energy), topping up the research and development subsidy programme for renewable energy sources, and providing sureties. However, the bulk of the measures concern **legal action** designed to make it easier for renewable energy sources to penetrate the heating

market. Wider use of compulsory connection to the district heating networks is a particularly important aspect in this connection. In addition, **target group-specific marketing and information campaigns** also play a crucial role in the heating market. In order to facilitate and accelerate the complex processes involved in the planning, licensing and construction of district heating systems in particular (including networks), one proposal would be to create an independent **information office** (for example, a Federal Energy Agency), which would collaborate with the energy agencies of the individual *Länder*. **Clearing offices** are required for issues relating to the financing of electricity grid connection and multiplication costs.

A combination of the principal mechanisms listed under (1) and (2) for the power and heating markets provides adequate opportunities for effective progress when continuing to promote renewable energy sources against the background of ever-changing competitive and energy policy framework conditions.

Monetary impacts from the package of measures

The package of measures outlined here must be capable of mobilising the additional costs cited in order to compensate for the fact that most technology based on renewable energy sources is not yet cost-effective. The main aim is to create self-supporting markets in all areas, as far as possible, by the year 2010.

In monetary terms, the subsidy mechanisms will increase from a current level of € 500 million per annum to € 1.3 billion per annum by the year 2010 (**Figure 2**), equivalent to an average **100 % increase in the current level** over the full ten-year period. The heating market will see a comparatively higher increase in subsidies, so that by the year 2010, the power market will only account for 55 % of the total volume. Most importantly, there will be a clear shift in the dominance of budget-effective funding (i.e. subsidy programmes from the Federal Government and *Länder*), which accounted for € 190 million per annum in 1997, in favour of other mechanisms - namely, the "Modified Electricity Feed-In Law" and "Quotas for the heating market" - which have a direct impact on energy consumers. By 2010, these will account for around 70 % of funding, at € 920 million per annum (1997 approx. 40 %). The demand for budget-effective i.e. government-financed, funding will rise to a **maximum of € 380 million per annum (2010)**, which represents an increase of just **one-third against the current figure of € 220 million per annum** over a ten-year average. Voluntary contributions, which also include the market for green electricity and the anticipated contributions from power supply companies, are also highly significant.

For Federal Government subsidy programmes, it is anticipated that the current figure (€ 80 million per annum) will more than double (see Figure 2) by 2010 (an average of 65 %), whilst the various loan programmes are expected to show a 50 % increase (average increase of 35 %). The subsidy programmes of the *Länder* will also see a rising trend overall to compensate for the decline of recent years. By the year 2010, the entire package of measures will mobilise some € 11 billion in funding in the form of government programmes and consumer-based levying designed to boost the expansion of renewable energy sources.

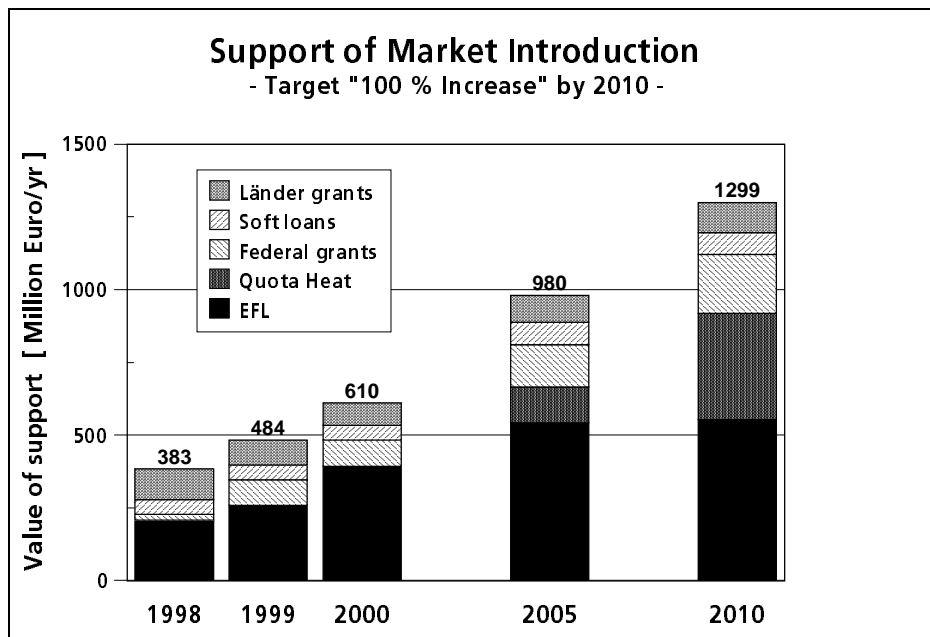


Figure 2: Development of the funding required for a 100 % increase in the contribution of renewable energy sources, classified according to the (modified) Electricity Feed-In Law, quotas (large heating installations), and budget-effective expenditure by the Federal Government and *Länder*

Over the same period, investments in new installations alone amount to almost three times this figure (€ 32 billion in total), and ten times higher than budget-effective funding. This ratio may be considered favourable for targeted start-up financing. As the difference in costs between energy systems based on renewable energy sources and conventional energy systems diminishes as a result of energy price increases or measures associated with the ecological tax reform (as a means of basing energy carrier prices more closely on the ecological reality), the funding which must be mobilised by means of additional mechanisms will be reduced accordingly.

Vital first steps towards implementation

The Electricity Feed-In Law (StrEG) has proven to be a particularly successful mechanism for promoting renewable energy sources in Germany. In the case of wind power, it was the triggering factor behind the market momentum of the Nineties. The hardship clause introduced with the last amendment to the StrEG in April 1998 demands immediate action to avert the risk of an abrupt halt in the present growth trends. In addition, the altered framework conditions of the European energy market urgently require the StrEG to switch to a competitive footing.

In this context, our key proposal is based on the consistent development of the StrEG, by introducing a cost-based, limited-period, degressive remuneration scheme for new installations based on selected RES technologies, and distributing the additional costs arising as a result of the StrEG **amongst all power consumers with a neutral effect on competition, by means of levying**. Although the previous ruling - assuming the mandatory distinction between grid operator level and power generator level - provided equal opportunities for electricity

companies, consumers faced regional imbalances because the grid operators required to pay remuneration simply retransferred their expenses to consumers in the respective grids. The recommendations outlined in the expert report on the further development of the StrEG were submitted to politicians and specialist organisations at the editing phase and discussed at length with them. There was an encouragingly high level of consensus on the draft act to promote power generation from renewable energy sources (Renewable Energy Act, EEG), which the experts therefore support.

Total sales of electricity distributed via the Electricity Feed-In Law (StrEG) amounted to approximately € 610 million per annum in 1999 (left-hand bar in **Figure 3**), € 360 million of which was attributable to revenue from electricity generated from renewable energy sources on the basis of market prices. The remaining additional or differential costs of € 260 million per annum were borne by the power consumers (right-hand bar). At current prices, this translates into an additional charge of 0.05 cent€/kWh (cf. curve and right-hand scale in Figure 3). The proposed amendment and expansion of the StrEG will cause sales to rise to more than € 2 billion per annum by 2010. However, the additional costs borne by the consumers will increase far less sharply to a maximum of € 500 per annum, i.e. approximately 0.1 cent€/kWh, based on the degressive costs of RES technology and a slight increase in the market price for electricity. Consequently, a modified StrEG is the most suitable mechanism for achieving an accelerated market development for biomass, geothermal power generation and photovoltaic technology, as previously observed with wind power.

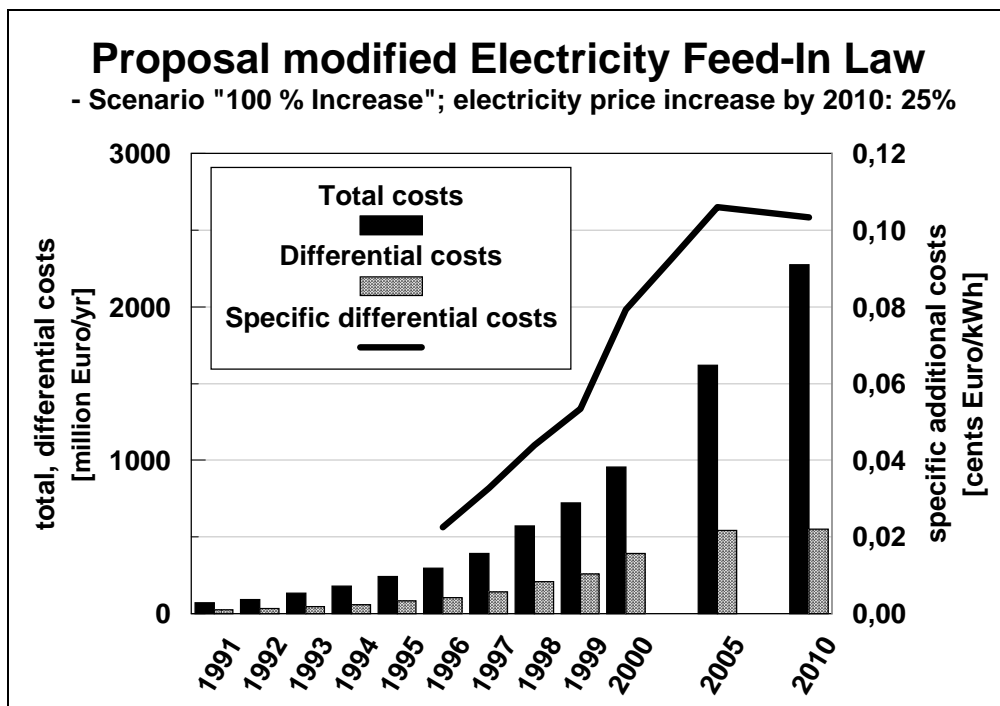


Figure 3: Development of total sales and differential costs with the current Electricity Feed-In Law and a modified Act from the year 2000

Implementation of the Renewable Energy Act - accompanied by additional provisions to improve the market opportunities for "green electricity" - could make a far-reaching contribution towards achieving the important climate protection target of a 100 % increase in power generation from renewable energy sources. Even then, however, the expansion of renewable energy sources is not self-perpetuating. Farther-reaching measures are required in the heating market, which has been largely neglected in the public perception, despite its significant potential. The same applies to measures with a major influence on global energy supply and opportunities for German export markets (e.g. in the field of solar power stations and specially adapted technologies for the sunniest regions of the globe).

In this study, the experts have endeavoured to identify those aspects of renewable energy resources where action is needed, and highlight their significance to climate protection. As such, the study is intended, not only to serve as a source of information, but also to encourage political decision-makers to take concrete steps above and beyond the proposals formulated in conjunction with the Renewable Energy Act - i.e. in the sense of sustainable policies on climate, technology and the labour market.

The unabridged version of the study can be found on the Internet at <http://www.dlr.de/tt/system>

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