Study

On Behalf of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

Economic Analysis and Evaluation of the Effects of the Renewable Energy Act

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Summary

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Content

7 Summary

The support of electricity generation from renewable energy sources (RES) in Germany thus far has been very effective. The 2010 target of a 12.5% share of renewable energy in electricity generation, which had been agreed upon in the European framework, was reached three years early in 2007. Beyond the increasing share of RES in electricity generation, additional economic aspects are relevant for the evaluation of the German support policies. Among these are the costs and benefits of the support as well as indirect effects on quantities and prices in the respective markets.

The share of RES in electricity generation (RES-E) in Germany will be doubled in the next decade. In August 2007, the German government decided, within the framework of the Integrated Energy and Climate Program, to increase the share of RES-E from 25% to 30% by 2020. This will help Germany reach the overall, 20% by 2020, renewables target set by the European Council in 2007. This increase will pose larger challenges for maintaining an efficient, renewables support policy and achieving improved integration of RES in the energy sector. This being said, the opportunities for restructuring the sector towards long-term sustainable development are enhanced.

This study analyzes the effects of the Renewable Energy Sources Act (EEG). Macroeconomic effects, as well as effects on individual companies, are considered. The analysis focuses on the electricity markets and reflects the interactions of the different environmental policies and their mutual impacts. Additionally, the study analyzes alternative support policies and develops suggestions for further improvement of the current legislation and framework conditions.

7.1 Development of RES in Germany and economic impacts (Lead: DLR Stuttgart)

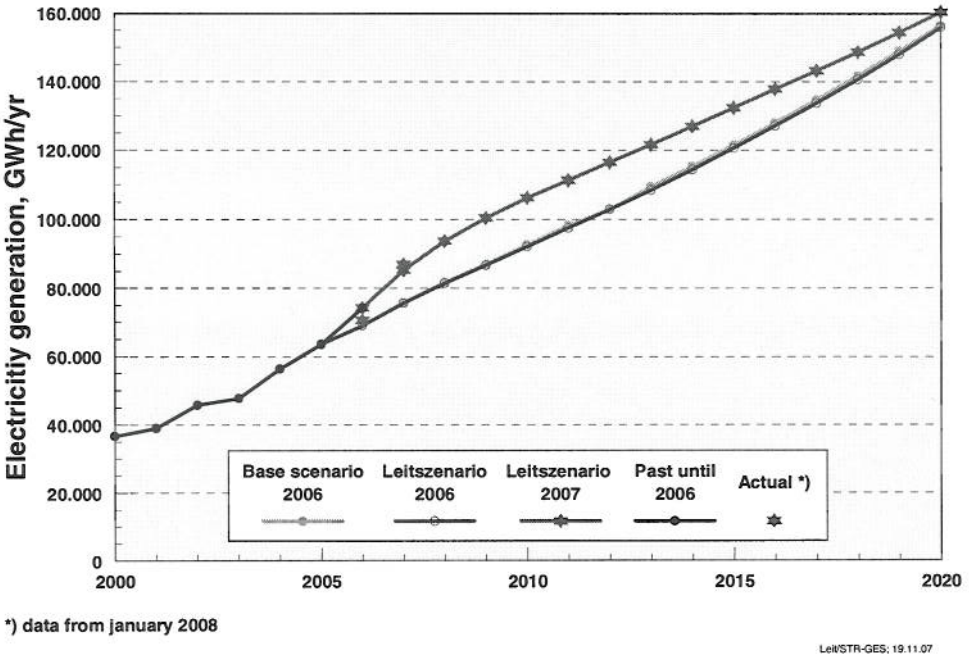
The dynamic development of RES in the German electricity sector can, for the most part, be attributed to the German Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz, EEG). In hindsight, one also has to state that this development occurred over a long time period; the fact is that substantial growth of RES started roughly 20 years after the first oil price shock. But, by 1993, RES contributed more than 20 TWh/a and exceeded the boundaries of the hydropower potentials in Germany. Since then, the contribution of RES to electricity generation has more than tripled to exceed the 80 TWh/a threshold in 2007. Growth accelerated and exhibits high rates (average 1990 – 2000: 6.9 %/a; average 2000 – 2006: 10.6 %/a).

Similar dynamic development has also been observed in terms of the employment effects in the renewables sector. Gross employment was approximately 170,000 in 2005 for all branches of the sector; 120,000 of these jobs have been in the sectors supported by the EEG. In 2006, these numbers rose to a total of 230,000 jobs—134,000 in the EEG-sectors.

To determine whether future objectives are to be met, and how, one needs to develop different scenarios that reflect different framework conditions. The scenarios used in this study are: the "Base Scenario 2006;" the target-oriented scenario "Lead Scenario 2006;" and the updated version of the latter, the "Lead Scenario 2007" (these last two scenarios are also referred to as "Leitszenario" 2006 and 2007, respectively, in the figures). These scenarios provide a platform for the analysis of the effects of the current boom in RES, especially in the electricity sector. Current targets, in terms of RES shares, and CO_2 reductions are included and result in a restructuring of the energy sector.

The scenarios assume RES electricity generation in the range of of 156 to 160 TWh/a in 2020, corresponding to a 27.5% share of gross electricity production (Figure 7-1). The scenarios describe a future development of RES which is necessary to stabilize the developing national markets and to safeguard sufficient opportunities in international markets. Several studies have shown that the current growth dynamics must be sustained in the electricity sector, and increased in the heat sector, so that renewable energy technologies become successful competitors in the respective markets in the near future. The ability to compete can be seen as an indicator, in the long-term, of the success of the current environmental and energy policies.

Figure 7-1: Development of the electricity generation from RES until 2020 in different scenarios



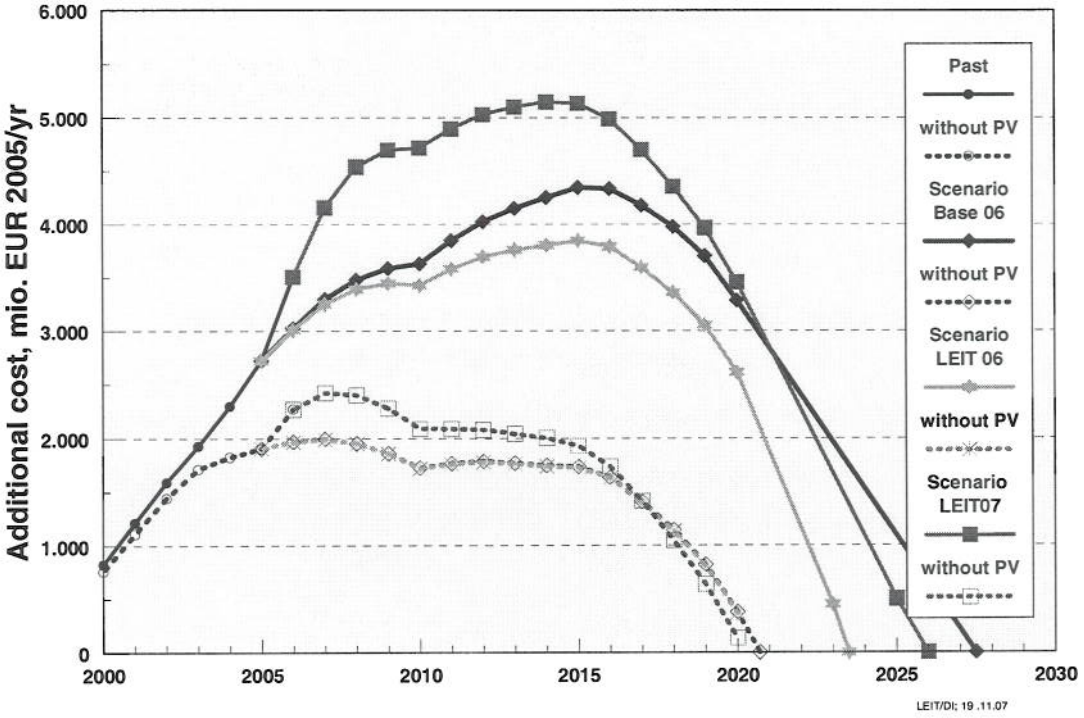
Net employment in the RES sector strongly depends on stable or growing export opportunities. The balance of all economic effects—including the strongest negative effect, for example, the so-called "budget effect" from the additional costs of RES that have to be borne by the consumers—is positive in scenarios with realistic or optimistic export assumptions. Without success in the international markets, the resulting positive impact would be significantly smaller.

Increasing the export market is also necessary to compensate for the limitations of the domestic markets. Investment in electricity generating RES plants increased from €4 billion in 2000 to a top value of €10 billion in 2006. Photovoltaics contributed significantly to this increase. Investment in all other technologies has leveled-out since 2002, although biomass surpassed wind energy in terms of investment. Total investment until 2020 is expected to reach between 5 and 7 billion €/a; photovoltaic (PV) technologies will still exhibit notable cost reductions in an increasingly satiated market. After 2020, investments will increase and will be around €10 billion per year in the long term.

When analyzing the additional costs of RES in comparison to electricity prices, it is also worth considering PV separately. Despite the considerable increase of the shares of all other technologies in electricity generation, from 69 TWh/a in 2006 to 148 TWh/a in 2020, the additional costs of these technologies decrease from €2.3 billion in 2006 to €2 billion in 2015

and approach zero by 2020. RES technologies will therefore be fully competitive by 2020 and will have a cost-decreasing effect in the electricity markets and on the economy. The additional costs have been calculated based upon prices for energy from fossil sources that, given the most recent developments, follow a rather moderate path (data in 2020: crude oil = 75 $\$_{2000}$/bbl; CO_2-price = 20 €/t). The additional costs shown in Figure 7-2 therefore represent more of an upper boundary.

Figure 7-2: Additional costs of the RES increase in the electricity sector, prices development path C: 2020 = 75 $\$_{2000}$/bbl; 20 €/t CO_2)



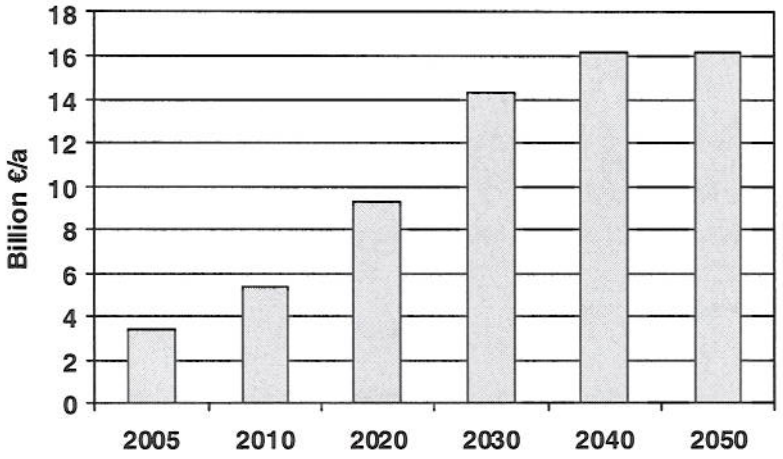
In contrast, further increases of PV call for rather long-term investments. The additional costs for PV alone will rise from the current 1.2 billion €/a, depending on the level of the increase, to 2.5 to 3.3 billion €/a by 2020; thereafter, the additional costs for PV fall to approximately 1 billion €/a by 2030 und reach zero by 2040. However, it is important to note that due to "grid parity"—the point at which PV costs equal electricity costs for households—market competitiveness is reached before the additional costs reach zero.

The additional costs reflect installed capacities of 20-21 GW in 2030 and 25-26 GW in 2040. Therefore, the current growth rates of annual investments in PV that between 2000 and 2006 were around 55%, can be expected to slow. Market growth must then shift to other technologies, such as wind energy, geothermal energy and, in the long-term the joint European efforts

for long-distance imports, in order to develop the large potentials for electricity from RES in a timely manner.

The additional costs of RES have to be compared to benefits, such as the mitigated external costs and other positive effects, of the increasing shares of renewable energy. Following the path outlined in the scenario above, we expect that the annual mitigation of external costs will increase from 3.4 billion €/a in 2006 to 16 billion €/a by 2050 (**Figure 7-3**)

Figure 7-3: Annual mitigation of external costs by RES



Clearly, the overall balance of positive and negative economic effects has already reached zero. Future economic benefits of increasing shares of renewable energy will be significant. In the electricity sector, prime costs, that would otherwise steadily increase, will be stabilized. Therefore, a thorough analysis of the different instruments available for the internalization of externals costs is called for in order to create effective, future-oriented energy policy.

7.2 Analysis and evaluation of the effects of the Renewable Energy Act from the perspective of individual companies (Lead: ZSW Stuttgart)

The following analysis and evaluation of the effects of the Renewable Energy Act from the perspective of individual companies focuses on manufacturing companies, service companies in planning and development, RES system operators as well as the financial sector, i.e. banks.

A survey was carried out in order to directly gather the perspectives of the firms in the RES sector. 105 companies have been included in the survey, these included: manufacturers of

systems and components; planners; developers; service companies for operations and maintenance (O&M); as well as system operators in the fields of wind energy, photovoltaics, biomass, biogas, hydropower and geothermal systems. In order to estimate the number of active companies in the RES sector, available registers of the respective trade associations, published sector guides and lists of exhibitors at relevant trade fairs were analyzed (Table 7-1). The analysis focused on German companies, which are exclusively or predominantly active in the area of RES power generation. It is assumed that the main market actors present themselves through these channels and therefore the result of the analysis serves as an indicative number of active German RES companies.

Table 7-1: Number of RES companies

Sector	Manufacturers				Planning & Development	Service companies (O&M)
	Components (exclusively RES)	Components (not-exclusively RES)	Complete systems	Total		
Photovoltaics	54	15	30	99	83	25
Wind energy	21	30	17	68	68	46
Hydro power	0	0	0	0	0	0
Geothermal	0	0	0	0	0	0
Biomass	3	0	42	45	59	24
Total	78	45	89	212	210	95

With respect to market coverage, the survey among RES companies focused more on wind energy, photovoltaics, and bio energy manufacturers. Survey results in other sectors can only be regarded as representative within limits because of the relatively small number of surveyed companies. However, it is possible to draw conclusions regarding the extent to which the survey results of the individual companies reflect macroeconomic developments as well as the extent to which they reliably characterize the experience of current players in the RES industry.

The results are complemented by an analysis of annual reports from 2000 to 2006 by 19 companies (mainly photovoltaic and wind energy companies) and 8 expert interviews with banks.

Survey results – RES companies

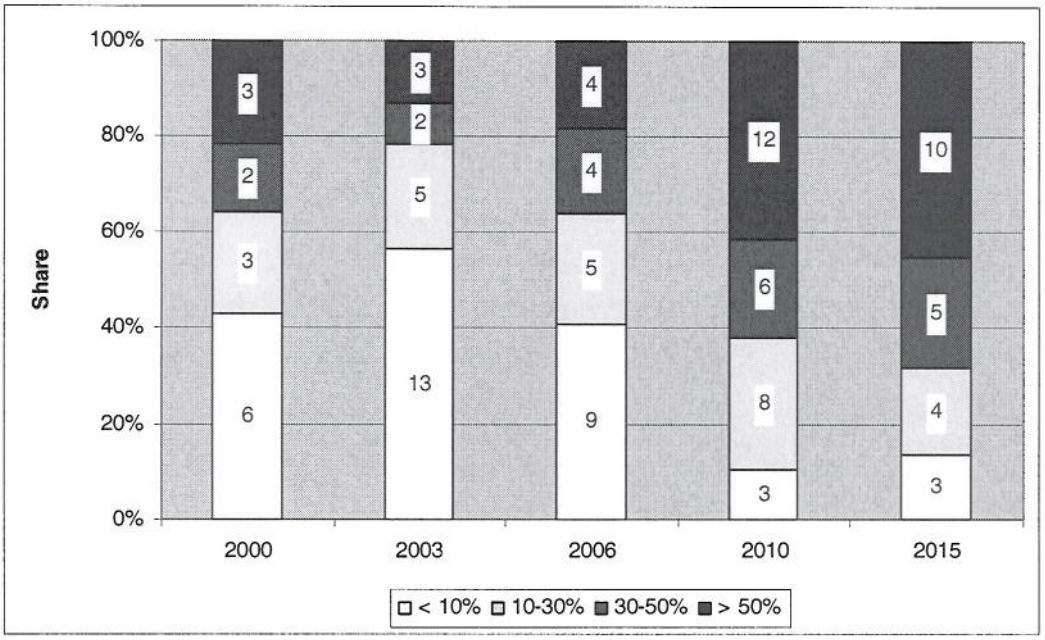
The survey's results confirm that the RES sector exhibits high growth rates, increasing internationalization of markets, increasing investment volumes and employment. The RES sector

therefore has developed into a relevant economic force. The participating firms stress the positive impact of the Renewable Energy Act (EEG) on sector development. The EEG creates reliable framework conditions, provides investment and planning security and stabilizes demand through the fixed tariff system. The surveyed companies emphasize the role of the EEG as a model to many countries worldwide and highlight the fact that Germany has a reputation and advantage as a first mover. A similar dynamic growth development is expected in the international markets.

Firms surveyed have continuously increased their returns since the start of the EEG in 2000. Similar high annual growth rates are expected in the future. 90% of the respondents consider the German market as a continuously important key selling market. They cite the EEG as the main reason for the positive development thus far and credit the EEG for their positive outlook. The increasing returns for RES firms come alongside increasing numbers of employment in the RES sector. The respondents have more than doubled their workforce since 2000. In the future, the majority of companies expect to be able to create more employment annually, too.

The respondents see themselves in a good starting position for sales of products and services internationally. Systems manufacturers, in particular, judge their products to be competitive in the growing international markets for RES facilities, in the long run. Almost 40% of manufacturers already realize export quotas of 30% or more. In 2015, more than two thirds of the surveyed manufacturers expect export quotas of more than 30%, almost half of them expect quotas of more than 50% (Figure 7-1).

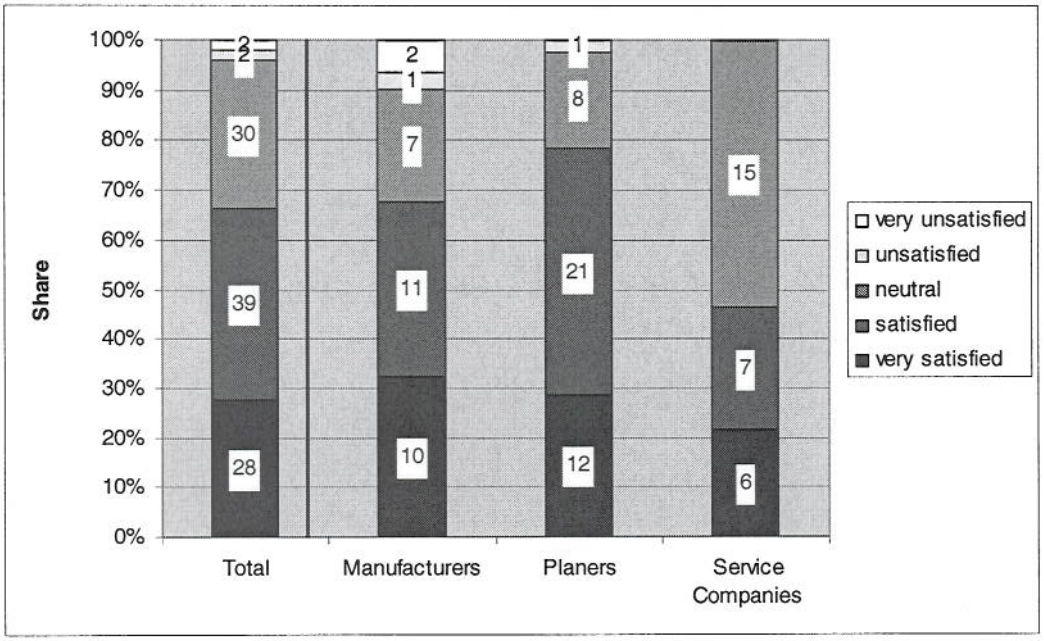
Figure 7-1: Realized and expected export quotas of manufacturers (n=29)



The majority of the surveyed companies assume that their investment volume will grow over the next years. The firms plan to expand their production capacities in the short- and the long-term; they also plan to drive R&D continuously forward.

Acceptance of the Renewable Energy Act in its current form is very high among the surveyed companies. Two-thirds of the firms are "very satisfied" or "satisfied" with the EEG (Figure 7-2). EEG characteristics that address the economics of RES-E, such as guaranteed purchase and transmission of generated power as well as the fixed tariff, are considered especially important.

Figure 7-2: Satisfaction with the EEG (n=101)



Possible changes to the EEG, especially a sharper degression, are viewed critically. The transparency and comprehensiveness of the EEG rules, with its orientation towards the state-of-the-art of the respective technologies, are important factors for the companies. Furthermore, planning security is emphasized as an important issue. Many companies would appreciate longer periods without legislative changes because the risk of the changes is detrimental to long-term planning and the added insecurity increases risk and acts as a deterrent to possible investors.

Results from the analysis of annual reports

Examination of annual reports confirms that the companies in the RES sector that were analyzed exhibit a very high growth of returns and employment since 2000. There is a trend towards increasing internationalization with growing export quotas. The analysis confirms that the firms invest in production capacities as well as R&D to secure or increase their market share.

The annual reports confirm the fundamental importance of the EEG, i.e. the reliable political framework conditions it provides, in creating demand in the German market. At the same time, reliance upon policies is pointed out as a disadvantage and more activities in international markets are suggested to diversify risks.

Survey results - Banks

The RES sector is an interesting market for the financial sector in terms of opportunities for profits, increasing volumes of investment and the growing internationalization of markets. The relevance of the EEG for the development in Germany is largely emphasized, because it provides investment and planning security for investors due to reliable framework conditions. In the future, international markets are assumed to become more relevant. Overall RES is considered a dynamic sector for the future.

Reflecting their main activities, the surveyed banks see the largest opportunities today in the fields of wind energy and photovoltaics in terms of both market appeal and return expectations. Expectations are also higher for foreign markets than for the German domestic market. The wind energy market is increasingly characterized by strong competition dominated by large institutional investors. Bio energy has not yet established a similar industrial structure with respective competition, therefore higher future returns are expected in this sector compared to that of wind or solar energy.

Barriers to the expected positive market development are mainly identified in the wind energy and the biomass sectors. The wind energy sector faces legal questions, i.e. conditions for repowering onshore, as well as questions regarding the setting of tariffs, i.e. tariffs for wind energy offshore. Biomass, while a renewable resource, is not freely available; the associated prices risk causes basic problems for bio energy.

A basic requirement for financing a power generation investment is the economic performance of the individual power generation facility. Of equal importance is the state-of-the-art of the respective technology. The majority of banks reject financing if the technological risks are unclear; for the most part, the private banking sector does not consider itself a promoter of innovations in the RES sector. However, industries and technologies that are already established in the market receive financing. Innovative technologies and advancements in existing technologies have to be promoted through alternative financial sources.

For the surveyed banks, the reliability of the political framework in RES-E is important. The principle of degression, i.e. a declining tariff, depending both on the state-of-the-art of the technology and the respective market maturity, is considered as a sound means to motivate increases in productivity and decreases in costs.

Conclusions

The results of the survey and the analysis of the annual reports essentially complement each other. The analysis shows that the RES sector has developed into an important economic sector characterized by high growth rates, a growing internationalization of markets, and increasing volumes of investment and employment. The surveyed companies place high importance on the EEG for this development. This piece of legislation sets reliable framework conditions that provide security for the markets in terms of planning and investment as well as support for the demand side by the guaranteeing of tariffs for renewable-sourced generation. The firms stress that the EEG can serve as a model worldwide and that Germany is currently recognized as a leader in the future development of RE. Consequently, a similar dynamic growth is expected on an international scale.

In the financing sector, the surveyed banks confirmed that the RES sector has developed into an interesting area of activity regarding expected returns on investment, increasing investment volumes, and the increasing internationalization of markets. High future growth rates are expected with an emphasis on the increasing relevance of foreign markets. The EEG is deemed to be central to German market development, with special emphasis placed on the provision of reliable framework conditions and the resulting high investment and planning security.

The RES sector in Germany has established a high-performance production and service industry structure—including manufacturers, planners, developing firms, etc.—and this development has been supported by the reliable framework the EEG provides.

The main aspects to keep in mind regarding the future design of the EEG have been identified as follows:

- Continuity and transparency: Investment and planning security ought to continue being provided by reliable tariff structures.
- Continuous technology evaluation: The state-of-the-art of the supported technologies ought to be observed and evaluated following transparent criteria.
- Target-oriented incentives: Support criteria design has to be technology specific and degressive to motivate productivity increases and cost decreases.

- Suitable framework conditions: The legal requirements, especially for power generating facilities and for grid access, have to be improved.

7.3 Analysis and evaluation of the effects of the EEG in the German electricity sector (Lead: IZES Saarbrücken)

The future development of the EEG, with the goal of securing a steadily increasing share of RES in the electricity sector in Germany, requires a deeper analysis of the total electricity sector including the interdependence of the grid infrastructure (network) and the different market sectors. The focus hereby lies on the requirements of integration, regarding the network, as well as access to the different electricity market sectors. Therefore, in addition to institutional and conceptual questions, as well as questions concerning market design, the economic effects of the EEG, and its respective incentive structures, on the different actors have to be analyzed.

Network integration

The integration of distributed generation (DG) plants into the system relies on a cooperative and transparent relationship between network and DG plant operators.

From the network operators' point of view, network integration has to distinguish between grid access, grid connection and the use of grids. Network operators are also concerned with grid operation and maintenance and grid extension. Each aspect has to systematically incorporate the current, and future, RES electricity production plants.

Regarding the grid connection, shallow connection charges have been identified as economically efficient; the respective regulation framework and local incentives for DG operators send the best economic signals for network integration of a growing number of DG plants. The criteria from the energy law—non-discriminatory, transparent, and objective—are, to a very large extent, fulfilled as well.

It has been suggested that there sometimes exists a possible conflict between EEG supported plants and combined heat and power plants (CHP) concerning the priority of grid access. The analysis shows that this conflict is rather theoretical as of yet, but could gain importance in the future if the necessary grid extensions do not keep up with the expansion of EEG supported systems. Switching off different plants to secure stable network operation can be part of a future network management strategy if it includes capacity increasing actions as well as

demand side management measures systematically. If management of the network is understood in this comprehensive way it leads to an optimal network operation and extension strategy.

Regarding the use of the grid, one has to take into consideration the fact that grid charges, regulated on the basis of an incentive regulation regime, are the predominant income source for network operators. For the future integration of EEG plants into the whole electricity system, the actual design of network regulation is fundamentally decisive for fully incorporating both EEG plant operators and network operators.

The calculation method used to determine the avoided network charges has been agreed upon by the legislator and provides a reliable basis for DG operator calculations. From an economic perspective, the avoided network charges have to be counterbalanced with the feed-in tariffs. There are significant regional discrepancies and the method is applied differently; this possibly leads to an undervaluing of the avoided charges and therefore an overvaluing of the amounts spent for the support by the EEG.

The priority rules for RES that are built into the EEG have some effects on the European grid system. The resulting coordination problems have to be mutually solved by the countries impacted.

Market integration

The payment mechanism of the EEG guarantees a fixed tariff for a time period of 20 years for any eligible RES plant. EEG electricity is then indirectly sold by the transmission systems operator (TSO) as a base load delivery to all suppliers. The growing share of RES in the electricity supply however calls for a better integration into the electricity system and into the different market sectors.

RES plants do have reserve capacities and can adjust to different loads. Therefore, they can increase supply or shutdown capacities on demand. This even holds for RES plants with fluctuating production, such as wind energy turbines. Marketing RES-E in markets such as the balancing market, e.g. reserves for minutes or seconds, therefore makes sense and is advantageous.

Self-marketing of electricity from EEG plants has not been ruled out explicitly by legislation. Self-marketing is a strategy that can contribute to the added value and help to realize those

projects which could not be operated economically when supported by the tariff alone. Having the ability to switch between the EEG tariff prices and market prices at the power exchange without any priornotification, however, could also lead to increased network charges because the system services of the TSOs could become more costly. Operators of large systems have started to work with the TSOs and the national regulator (Bundesnetzagentur) to develop a solution to this problem.

The lack of transparency in the transformation process from RES fed-in power to base load delivery has been widely criticized—in this process RES-E from various sources is combined and transformed into a constant band of power. The Bundesnetzagentur started to open up this process to competition. Their recent suggestion partly improves the situation, but the TSOs remain the sole agents in the procedure. No competition with third parties is planned. Thus, any possible improvement beyond the status quo hinges on the willingness and capability of the Bundesnetzagentur's oversight.

The burden sharing mechanism of the EEG has been criticized by outside experts as well as market participants for its lack of transparency and its non-market character. This criticism led to demands to modify the mechanism or do away with it and adjust the tariff system. Thus far the proposed replacement models and approaches are not convincing in the form they have been suggested. Depending both on the relevance of the criticism and the risks of the suggested models, ultimately a decision will have to be made between more market orientation on the part of the DG operators and efficient marketing by third parties within the current feed-in solution.

Effects on the existing generators

The feed-in of electricity from EEG plants and the obligation of the network operators to purchase this electricity decreases the demand for conventional electricity. This impacts the electricity prices at the power exchange via the so-called "merit order effect." Assuming a perfect market where price equals marginal costs, and that all prices for electricity follow the power exchange prices, the merit order effect could have yielded a decrease in the expenditure for electricity of approximately 5 Billion Euro in 2006, according to a study by Fraunhofer ISI. To what extent this effect is observable in the real, liberalized market depends on the actual relationship between marginal costs of the last power plant in the merit order and electricity

prices. If prices are higher than the marginal costs, the market power of the producers would thwart the price decreasing effect of the merit order effect.

The composition of the power plant mix will be changing thoroughly over the next years, triggered by energy political framework conditions such as the phasing out of nuclear energy and the climate protection targets, as well as by the aging state of existing power plants. A study by Öko-Institute and Arrhenius Institute simulated the resulting German power plant mix based upon two scenarios. In these scenarios it was found that only gas and steam power plants are capable of a recovery of the investments and the fixed costs. Hard coal plants and lignite plants can only recover half of the fixed costs because they yield on average less than 5000 hours of operation; economic production starts at 5500 full capacity operation hours. The political framework conditions such as the targets for renewable energy, cogeneration and efficiency will play an important role in power plant expansion decisions to avoid the risks of stranded investments.

The effects of the special adjustments made according to §16 EEG, which are decisive for the allocation of the burden sharing among electricity consumers, have also been analyzed. Since the results are published in the experience report for the EEG, the reader is referred to that publication.

7.4 Analysis and evaluation of the EEG in combination with other instruments for the protection of the climate, the environment and natural resources (Lead: DIW Berlin)

The promotion of RES electricity by the EEG is a part of a comprehensive energy and environmental political strategy. Due to possible intersections and indirect interaction with other instruments for the protection of the climate, the environment and natural resources, the design and the application of the respective policies have to take these interactions into account and the measures have to be adjusted if necessary.

Figure 7-4 shows the aspects that have to be considered for an analysis of these interactions. Of particular importance is the interaction of the EEG with the European Emission Trading System, the flexible Kyoto mechanisms (CDM, JI), energy taxes, the promotion of cogeneration, the regulative framework and further instruments for the promotion of renewable energy.

Figure 7-4: General scheme of the interaction analysis

- Political objectives
  - overlap, relation between targets
- Coverage of political instruments
  - scope (e.g. plants, activities)
  - region (e.g. national, EC)
  - time (temporary, long term, permanent)
- Political agents
- Impacts
  - direct effects
  - indirect effects
- Evaluation criteria
  - effectiveness, efficiency, distributional aspects
  - practicability, political feasibility
- Coordination between instruments

Emission Trading System (ETS)

The European ETS that started in 2005 developed into a central element of the climate protection policy. The ETS cannot, however, replace target-oriented support of renewables. Aside from climate protection, the EEG addresses multi-faceted policy goals in the realms of energy, technology and the environment such as security of supply, sustainability and innovation. ETS is a general instrument aimed at reducing greenhouse gas emissions, particularly carbon dioxide, and can be expected to have little impacts on the expansion and development of healthy renewable energy markets, since the financial incentives are too low and the investment risk is too high. ETS favors proven, mature and cheap (in the short-term) technologies with little incentive for fostering domestic capacity, diversity of supply or long-term sustainability. A sustainable restructuring of the energy sector and the necessary technological development are not provided for under the ETS. The current support of RES aims at the development of markets for the respective technologies and at the cost-decreasing learning effects in the production and the operation of the plants. ETS alone could not attain this as it essentially puts a price on emission reductions, and other beneficial aspects of renewable energy are not quantified.

The EEG and the ETS interact in and impact upon the renewable energy market, the CO_2 certificate market, and the electricity market. With guaranteed purchases of the generated electricity and a feed-in tariff, emissions trading does not yield any additional incentives for an increase in renewable energy as long as the electricity price, including the (opportunity) costs of the certificates, is lower than the tariff. However, with both in place, additional costs decrease and economic renewable energy technologies become independent of the support at an earlier time. In the case of self-marketing, either in an Optional Bonus Model proposed for the EEG or by direct sales, emission trading can enforce the support mechanism through higher electricity prices. In a quota system, such as the British Renewables Obligation, the ETS does not lead to an increased use of renewable energy, since an increase in electricity prices is offset by a decrease in the price of green certificates (used to meet the quota) and the price effect is compensated for with respect to the total payment.

Irrespective of the support mechanism, renewable energy reduces power plant CO_2 emissions and the demand of certificates from power plant operators on the European CO_2 market. With a given emission cap the CO_2 price decreases and CO_2 emissions can be shifted to other trade sectors or to other European countries. Therefore, EEG and ETS conflict in the effects on

global warming if the cap is not adjusted downward to reflect the positive climate impact of renewable energy. Since CO_2 prices are incorporated into the electricity prices, a decreasing CO_2 price lowers the electricity price and enforces the price-decreasing merit order effect.

For the coordination of support policies and emission trading, the EEG's contribution to the CO_2-reduction has to be integrated into the national allocation plan or the determination of the emission cap at the EU level, respectively. The European Commission also demanded this integration in its guidelines for the preparation of national allocation plans, to prohibit emission caps set too high. In retrospect, the amount of certificates allocated for the first trading period (2005-2007) was too high. Due to the CO_2 reduction effect from the EEG, which had not been integrated and foreseen, the prices of certificates and electricity were lower than they would have been without this effect. For the second trading period (2008 – 2012), following restrictions by the EU Commission, the cap was set much lower, explicitly to reflect the contribution of renewable energy. Under such conditions, the ETS and the EEG can both legitimately contribute to reaching the greenhouse gas reduction targets. Additionally, the long-term and more demanding post-Kyoto targets become feasible due to the increase of renewable energy and its support by the EEG and to the lowering of the emission cap. Therefore, it is of critical importance that the contribution of RES is included in the calculation of the ETS caps, irrespective whether the caps are to be fixed by the Member States or within a European Directive in the future.

Flexible Mechanisms

The project-oriented mechanisms (CDM and JI) of the Kyoto protocol are designed to lead to cost decreases in global climate change mitigation by being more flexible means of reaching the goals and by being integrative of more countries in the process. Implementing cleaner technologies in developing countries not subject to initial reductions targets through the CDM and countries subject to reductions targets implementing projects in countries also required to reduce through the JI should also contribute to reaching sustainable development goals quicker. These mechanisms can overlap with a national policy for the support of certain technologies. Direct overlaps are possible between the EEG and JI projects undertaken by other countries in Germany. Such overlaps have to be considered in the registration phase. Overlaps between the EEG and JI should be ruled out in the future through appropriate changes to legislation (the EEG and ProMechG). JI projects that do not intersect with the EEG can be carried out in Germany as an addition to the EEG. Furthermore, national promotion policies im-

prove the supported technologies through learning effects and therefore improve the potential of CDM and JI projects in other countries.

The main interactions between the flexible mechanisms and the support policies stem from the link of JI and CDM to the Emission Trading Scheme, because the certificates from greenhouse gas reductions (CER, ERU) are accounted for in the ETS. The use of the flexible instruments opens the market, increases the supply of certificates and contributes to price elasticity. In the opened trading system, the supported electricity generation from RES results in larger CO_2 reductions, even if the emission caps are unchanged. However, even with flexible mechanisms, the contribution of RES has to be integrated into the allocations plans. Only the downward adjustment of the caps leads to a productive interaction of EEG, ETS and the flexible Kyoto mechanisms.

Energy taxes

The objective of the ecological tax reform is two-fold. On the one hand, fossil fuels are made more expensive to reflect their external costs, which provides incentives for energy savings and the use of renewable energy, on the other hand, employment is supported through decreasing the burden of the additional costs of labor. The eco tax gives incentives for energy savings and the use of renewable energy for heat and transportation purposes and therefore complements the effects of the EEG in other areas. In the electricity sector itself the eco tax does not give any impulses leading to an increase in RES, especially since electricity sales from RES are fully taxed.

After the last adjustment of the German energy tax system to the EU Directive, gas and oil inputs into electricity generation are no longer taxed, similar to the coal inputs before this revision. This creates no incentive for the use of RES. As a compensation for the full taxation of RES electricity fed into the grid, RES, particularly used for heating, is supported by the market incentive program (MAP). A tax exemption for RES electricity would be justified in the face of the low external costs of RES, but difficult to implement from the tax systematic aspects. As long as the feed-in tariffs are effective, there would be no additional incentives for enforced use of RES due to a tax exemption.

Support of CHP

The German CHP law supports the use of combined heat and power generation, which makes the use of primary energy more efficient and leads to CO_2 reductions, through access, purchase and tariff obligations for the grid operators. The financial incentive comes from payments (bonuses) in addition to the market electricity price. The CHP law (KWKG) of 2002 contributed largely to the retrofit of existing CHP facilities. However, the target of a CO_2 reduction of at least 20 million tons between 1998 and 2010 cannot be reached this way. Currently a draft for a new KWKG is proposed to increase the support of this technology. Additionally, CHP is supported by special allocation rules for emission allowances under the ETS.

The KWKG excludes plants that are supported by the EEG; no direct overlap is possible. However, the support of CHP and of RES can conflict in the field of priority grid access. In addition, indirect interactions between the EEG, the ETS, the eco tax and the KWKG result in cumulated price effects for consumers of electricity from the public grid.

Other regulation

To avoid obstacles to the increase of RES, all additional regulation has to be analyzed that can interact with the EEG. Germany has seen a change in several areas of regulation to improve the conditions for a strong build-up of RES, these include: privileges for wind and hydro power plants since 1996; amended rules for plants if certain planning instruments declare the area for feasible; privileges for small (up to 500 kW) biomass systems; basic clarification of protected areas at sea; the law for the acceleration of infrastructure planning and the addition to the respective legislation for off-shore wind energy. Room for improvement can be seen in the regulative framework for the build-up of wind power. Some conflicts prevail and should be straightened out in a transparent manner and on the federal level. Legal security has to be created for off-shore wind regarding the permission conditions. Furthermore, there is a need for clear rules on the future uses of off-shore sites by competing projects.

Additional instruments for the use of renewable energy

Additional measures to the EEG support RES on a federal, state and community level. They are targeted at market introduction in electricity generation, heat and transport sectors as well as the support of R&D. This bundle of measures contributes to reaching a high overall share of RES.

The EEG is the most important support instrument of RES in Germany. Several additional measures exist and differ with respect to the strategy, the technologies, instruments used, the target group or the financing system. The Market Incentive Program (MAP) of the Federal Government supports heat applications. The support in this sector is being reinforced by new RES heat legislation. The biofuel increase is being accelerated with the help of quotas. Due to relatively high CO_2 mitigation costs and shortcomings in the greenhouse gas reduction potential, the intensity of the biofuel increase has to be reconsidered. Still, the combination of several instruments will be necessary, also in the future, to ensure a steady increase of the share of RES. A balance of the levels of support and the most efficient mitigation of greenhouse gas should be respected.

Public support of R&D does play a significant role. Together with market introduction instruments it can trigger innovations, which open up new technological possibilities, contribute to cost decreases and carry industrial and political weight.

7.5 Analysis and evaluation of the EEG in comparison to other instruments for the support of RES-E (Lead: DIW Berlin)

Support systems and their variants

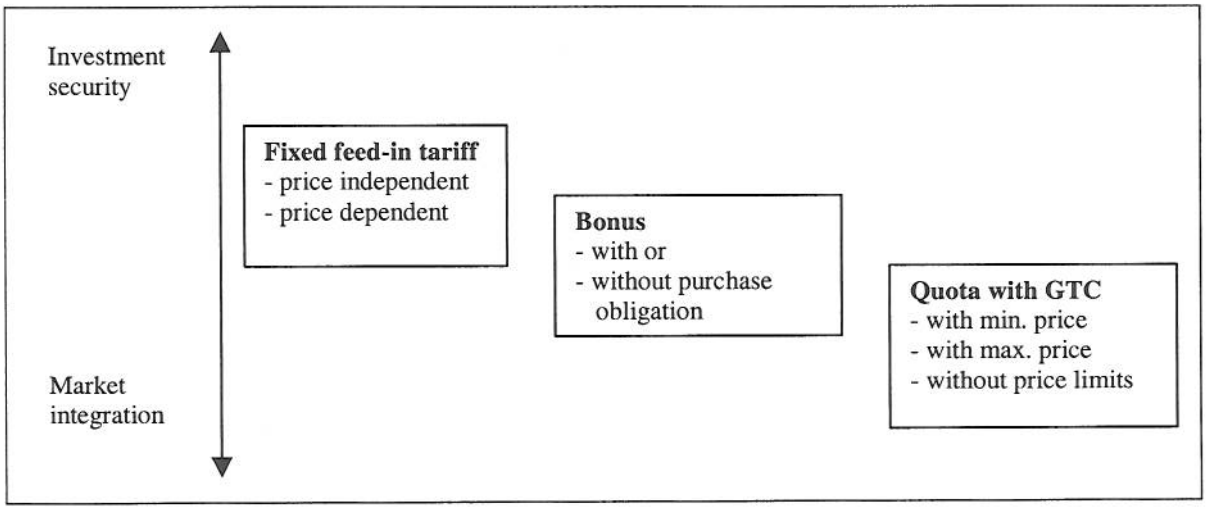
Alternatives to the German Feed-In Tariff (EEG) as a means of supporting RES, such as supplements to the price (bonuses), quotas with tradable certificates, and tenders, are discussed. These models also make use of and add to the existing market systems with the goal of giving financial support to renewable energy.

For a comparative evaluation of the support models, the criteria of effectiveness and of efficiency in reaching given targets are most important. Risks and transactions costs should also be regarded, as should the dynamic effects of the market, technology and cost development. Additional criteria include: the practicability and acceptance of the instrument, distributional and competition aspects, and the compatibility with national and European strategies and measures.

The basic RES-E promotion models exhibit similar effects from a static perspective. While tariffs and bonuses determine both the price and the quantities in the market, quota or tenders set the quantities and leave the price to the markets. Under certain assumptions both model types result in the same prices and quantities. From a dynamic perspective, however, the in-

struments differ markedly, in particular if risk aspects are introduced. From the investors' point of view, the planning security is maximal in a feed-in tariff system with guaranteed purchases of the respective quantities (Figure 7-5). Due to the low risk, feasible financing conditions for the projects are possible. The bonus model includes higher risks, because only the bonuses are fixed and the market price fluctuates. The highest risks are found in the quota model with tradable certificates, because the development of the certificate price creates additional risk. Tenders are risky before the tender is given to the investor and low for successful bidders.

Figure 7-5: Variants of support models with regard to the dependence on market prices



More market oriented support systems as quota with tradable green certificates (GTC) can lead to more intensive competition between electricity companies and to strong incentives for the economic integration of the systems. A special role is played by the question of direct marketing of the electricity, which creates additional opportunities and risks for the plant operators.

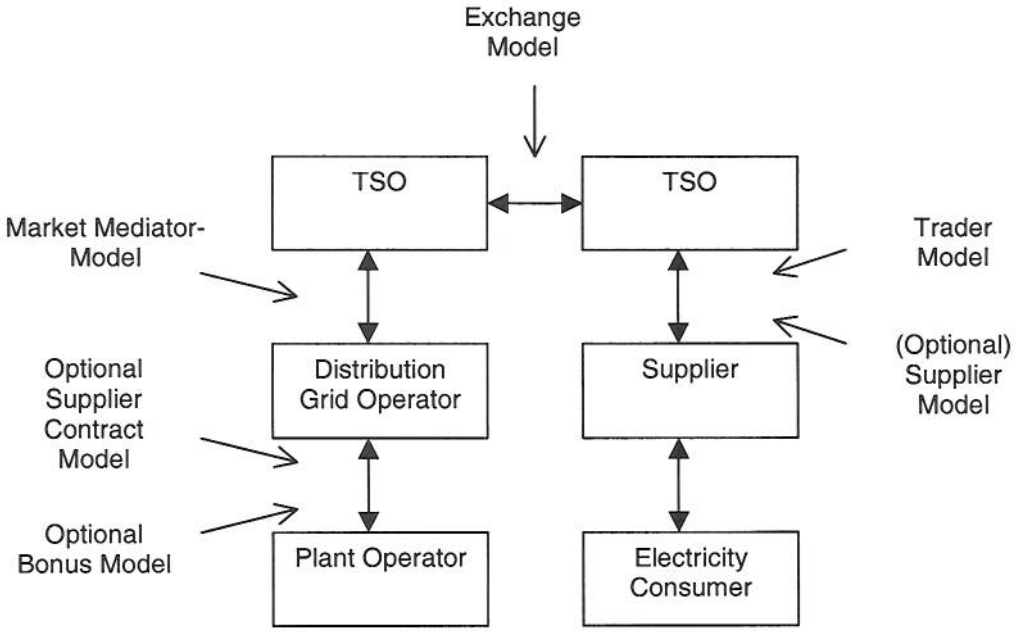
Apart from the investment and demand security (e.g. purchase obligations) the design of a support instrument has to answer the question, should the support differ by technologies? and if so, how strongly? Currently, differentiated support is necessary in order to give incentives for a wide palette of technologies. Especially those technologies, which are as of yet relatively expensive but exhibit large potential for cost decreases and applications in the future, should be included. Technology specificity decreases windfall profits and helps to avoid unnecessary large profits (producer rents from the support) and therefore reduces the financial burden on

consumers. Technology specificity is possible in all models, but more easily implemented in price instruments than in quotas.

Moreover, the support should be degressive in time. This ensures on the one hand that the financial burden will be reduced in the future and on the other hand it gives important incentives for cost reductions. Price models can implement a reduction of the tariffs or the bonuses depending on the commissioning year of the plant. Quotas have to increase the quantities and decreasing certificate prices shall be reached in this model through the competition of the suppliers. However, a prediction of future certificate prices, as has been pointed out, is very risky.

The support of renewable energy in all models calls for financing and burden sharing mechanisms between the plant operators, the grid operators, the electricity suppliers, traders and consumers. Quota models create this mechanism through the market for certificates, on which the demand for certificates comes from the obligated power utilities and the supply from plant operators. A bonus model can implement the burden sharing by passing the costs through to the electricity consumers according to their respective consumption. Tariff systems as the EEG additionally roll over the physical electricity from the plant operators via the grid operators and TSOs to the energy suppliers, basically taking the time profile of the electricity fed into the grid into account.

Figure 7-6: Starting points of different models for the modification of the EEG balancing mechanism and for the marketing of RES electricity



To facilitate the physical roll-over and to improve marketing of RES electricity, currently several models are under scrutiny (supplier model, trader model, stock exchange model, mediator model), which differ mainly in the responsibility for marketing (Figure 7-6). The optional bonus model goes farthest in terms of self-marketing by the plant operators. However, even in this case physical roll-over would persist to some extent (depending on the number of plant owners who would not choose the bonus option).

European experiences

Electricity generation from renewable energy is currently supported with different instruments in the European Union. Meanwhile, the dominant instrument (17 Member States in EU-25 plus Italy for PV) is the feed-in tariff or the bonus model. Bonus models (most models optional) are currently used in Spain, the Czech Republic, Slovenia, Denmark, the Netherlands and in the near future in Estonia. Belgium, Italy, Sweden, Great Britain, Poland and Latvia introduced a quota system with tradable certificates (most do not differentiate between technologies). Tenders do not play any role as a main national promotion system in any EU country, but they are used as an additional system. Other instruments as credits, subsidies etc. are

used as complementary supports in most countries, only in Finland and Malta are they used as the main promotion instruments.

The following systems have been analyzed more closely:

- The tariff and bonus model in Spain (as a prototype for an optional bonus system that was changed in 2007),
- The quota model in Great Britain (as a prototype for a quota system, currently revised),
- Recent tenders in Portugal (as example for additions to a tariff system) and
- Tenders of off-shore projects in Great Britain and Denmark (as an additional special support instrument for large projects).

In *Spain*, a tariff system with a bonus model was introduced in 1998 and was revised in 2004 and 2007. Of special interest for the discussion in Germany are those revisions that have been introduced due to certain experiences with the system. In 2004, the system became more market-oriented by incorporating the basic principle of self-marketing. For improved market integration of RES, additional payments have been introduced. The connection of tariffs to a regulated average electricity price - similar to the former feed-in law (Stromeinspeisungsgesetz) in Germany - has been given up for fixed tariffs in cent per kWh. Nominal adjustments follow a consumer price index. The bonus option additionally has a mechanism that keeps the sum of bonus and price within certain boundaries. These boundaries, as well as the tariffs and the bonuses, are technology specific. The bonus option, which has to be selected for at least a year, has been selected by many - predominantly very large – plant operators. Especially in 2005, this was enforced by unusually high and increasing electricity prices that made the gap between price-plus-bonus and tariff wider and the bonus thus even more attractive. With normal price fluctuations, the tariffs may fluctuate moderately, but high fluctuations are avoided through the new boundary system.

Great Britain supports RES electricity since 2002 with a quota system with tradable certificates, the Renewables Obligation (RO). The decisive parameters for the effectiveness of the system are the quota itself and the penalty for non-compliance. In the RO system, the obliged parties can buy themselves out of the obligation by paying a penalty. This basically fixes an

upper boundary on the certificate price. Redistribution of the penalties collected is supposed to increase the incentive to fulfill the quota obligation by certificates. However, more than 20% (between 24% and 31%) of the quotas have not been filled in recent years. The expected effectiveness of quota models therefore cannot be validated empirically. Compared to tariffs the risks are higher and therefore the costs of the system tend to be higher. The sum of all components (including the avoided climate change levy) amounted to 11,8 Cent/kWh in 2005, which was much higher than the average German tariff.

The British quota system is technology "neutral" up to now. Therefore, the observable increase has been focused on "low cost" technologies. In 2005, 33% of the RES increase consisted of the use of landfill gas. Long-term targets, such as the share of RES of 20% by 2020, cannot be reached with this strategy. The British government currently revises the quota system and the revisions go into force in 2009. Apart from measures against too rapidly decreasing certificate prices, technology differentiation is a central element of the reform. For off-shore electricity, for example, 50% higher certificate units will be possible (Banding-Index 1.5). The index for the four technology bands planned reaches from 0.5 to 2.0. The revision includes features that have been considered essential for a quota system by some authors so far. The difference of such a better-designed quota system and a well-designed feed-in tariff system should diminish.

In *Portugal* renewable energy is supported by a tariff system. Additionally, tenders for large wind parks are used and they are planned for large biomass and photovoltaic applications. Increases in RES are currently hampered by scarce grid capacities and red tape. The tender system, in theory, should accelerate the increasing shares of RES. Apart from the direct support of electricity production, also other goals, e.g. industry and technology political goals, are considered.

Tenders play an important role for off-shore wind energy. The comparison of Great Britain and Denmark shows two different main functions of tenders: on the one hand, as a special support instrument for off-shore as in two recent projects in Denmark and on the other hand, as allocation mechanism for special rights to sea-use as in Great Britain, where the financial support is given separately through the RO system. These functions may, but do not have to, be connected.

According to the progress report of the European Commission, the current support mechanisms will yield a share of 19% in the EU-25 and miss the target of 21% by 2010. The Member States have progressed to differing degrees on the paths to reaching their targets. Leading countries, which most likely will reach their targets, are Denmark, Germany and Hungary. Another six countries, Finland, Ireland, Luxemburg, the Netherlands, Sweden, and Spain, have a realistic chance to reach their targets. However, most of the EU countries need considerably more efforts.

The differing success not only hinges on the chosen support instrument, but also on how sincere the targets are pursued and the legal and administrative barriers reduced. It is interesting, and perhaps significant, that among the leading countries none has a quota system. Of all countries with a quota model, only Sweden has a realistic chance to reach the target, while Great Britain and Poland, as well as Belgium, will have to make additional efforts. Less promising is the situation in the other countries with quota systems, such as Italy, where large administrative barriers prevail and Latvia, where the support strategy is not sufficiently implemented. Also among the countries with feed-in tariffs there are differing degrees of success. The relationship between the success and the use of an optional bonus model is not significant. Countries with a bonus do not systematically have less success than countries without a bonus.

Effectiveness and efficiency of the various support models differ across the suite of RES technologies. Quota models – especially due to their higher risk – result in higher costs for wind energy. A more than average increase of wind energy can only be found in countries with tariffs. But such comparisons are less strong for biomass applications, e.g. the quota led to strong support and increase of the use of land fill gas in Great Britain, whereas the wind potential is exploited to a relatively small extent. The majority of success stories of the support of RES electricity in Europe rely on feed-in tariffs (FITs), especially FITs that include technology-specific tariffs. Overall the European experience shows that no support system is clearly better than the EEG.

A complete, harmonized EU system with a common quantity or price model is not in sight, currently. Therefore, coordination of national support systems and cooperation between Member States are essential.

Optional bonus model as a possible compliment of the EEG

The experiences in Europe, thus far, lead to a closer consideration of the bonus model as a complement to the EEG in Germany. The market integration of RES could be improved and incentives for efficiency increases and more flexibility would be given, while the planning security basically would be kept in place.

Essential points for an optional bonus model for Germany consist of the technology specific differentiation and a real degression of the bonuses. Boundaries can keep the fluctuations of the total revenue from electricity price developments at bay. For the rolling over of the (remaining) electricity, a power exchange model can be considered, where transmission network operators sell EEG electricity on the market. The choice between the bonus model and the tariff has to be binding for one year and generally open to all plant operators. For small plants, a self-marketing system may be too complex. Large operators, for instance of wind parks, can be offered only the bonus system. Such an optional bonus model is the next step in the EEG's evolution and will not require a change of systems. In cooperation with other Member States, the harmonization of promotion principles could be carried further. The bonus model is closer to a technology-specific quota model and could facilitate the co-existence of different support schemes.

7.6 Proposals for the further development of the EEG (Lead: DLR Stuttgart)

The success of the EEG is a result of the high investment and planning security for investors and depends on the amount and the structure of the tariffs, which are oriented towards the costs of the respective technologies. The support of renewable energy serves the internalization of external costs and accelerates the technological development and cost reduction potentials. It also improves the competitiveness of the firms in the sector and contributes to the creation of sustainable employment. The EEG is one instrument in a mix of instruments which are targeted at greenhouse gas reduction and the restructuring of the energy supply system towards a less environment-burdening structure. Suggestions for the optimization of this support instrument have to be oriented at the future energy supply system and the long term impacts of current incentive structures. Against this background, suggestions have been developed reflecting the general framework conditions as well as different technology aspects. Table 7-2 gives an overview.

The future support mechanism should reflect the wide catalogue of energy, environmental and technology political objectives. The climate and energy program that has passed Cabinet December 5,2007 represents a starting point for the future support, though it is already obvious that more measures will be needed to reach the targets. Though the success of an instrument is less dependent on the basic decision between a quantity and a price oriented approach, there is no evidence to support leaving the successfully implemented German tariff system with the guaranteed tariff, the differentiation by technologies, the degressive tariffs and the evaluation scheme. The opposite is the case, a change of systems would significantly disturb the build-up of renewable energy in Germany and the established lead in the international marketplace.

At the European level, the allocation of the 20% target has to be clarified, because the allocation between heat, transport and electricity generation can be crucial for the respective instruments. In the medium-term, the infrastructure for physical electricity trade has to be improved. This holds especially true for electricity imports from beyond the borders of the EU, e.g. from regions in the Middle East and North-Africa. On the national level, the infrastructure has to meet the requirements of a sustainable energy supply and has to be supported by the respective incentives. Apart from incentive compatible conditions for grid access, a balanced feed-in management strategy has to be developed. Local production should be preserved as one of the strengths and benefits of renewable energy.

Part of the success of the EEG is the fact that some technologies have reached competitiveness due to secure demands and low investment risks. Their market integration will therefore be one of the important future topics. Two approaches have to be distinguished: the laissez-faire approach where direct marketing is possible, and the approach where market integration is systematically controlled and supported. Among the first type are discussions of the short-term leave from the tariff, which can be allowed during a transitional phase until a more systematic regulation is established. A settlement must be reached regarding how long the decision to leave the system can be binding. A first solution comes from the Federal Network Agency, which allows for a one month notice. Self-marketing can be supported by a bonus model, where RES electricity can be optionally sold at market prices (plus a bonus), e.g. for one year. The bonus should be oriented to the EEG tariffs, the market price for electricity and the specific value of the electricity profile. The role of distributed generation (DG) should not be disturbed by such a system which may be more attractive for large producers.

The adjustment of the support instruments always calls for an analysis of individual technologies. For example, wind energy is far advanced technologically in that it can fulfill requirements for network integration. For the reduction of feed-in fluctuations, here only very few additional incentives are necessary. However, more development, and therefore more support, is needed for off-shore wind parks. Photovoltaics will be dominated by private applications and large open-area systems. Private households can create revenues as soon as grid parity is reached and need net metering incentives. Biomass applications provide electricity that is easily adjusted to demand and CHP systems can produce heat and power very efficiently which increases the value of their output. However, CHP has the highest conflict potential regarding sustainability demands and has to be considered of limited potential. An integrated biomass strategy that takes these features into account, is most urgently needed; it is important that such a strategy prohibits competition for support among the different electricity, heat and transport applications.

In summary, we note, that increasing the share of renewable energy after 2020 requires substantial political action, if the restructuring process of the energy supply system shall proceed in a timely manner and RES shall be dominant in the future system. The necessary dynamics are already in place in the electricity generation with the established technologies (biomass, on-shore wind and photovoltaics). These dynamics have to be extended towards the other technologies (offshore wind, geothermal systems, European joint electricity system). In the heat sector, the new legislation and the increased volume of the MAP are a good start. The low requirements for RES heating, however, will not suffice to build the necessary dynamics and push the market e.g. for solar thermal heat applications. Efficiency has been recognized as an important prerequisite and first decisions were reached by the Government in 2007. Central conditions for a timely implementation of effective measures, to reach important political targets (doubling efficiency until 2020 compared to 1990), however, are not fulfilled. In principal, the targets can be reached, but further time loss in terms of the implementation of measures would narrow the time corridor significantly and could mean that the climate protection targets cannot be fulfilled in this timeframe.

Table 7-2: Synopsis: Proposals for the optimization of the EEG

General aspects of the promotion of RES:

- Regard the comprehensive catalogue of energy, environmental and technology political objectives for RES; quantitative long-term targets are necessary.
- Long-term oriented, steady and reliable promotion policy consists of R&D support, incentives for the market entry and diffusion as well as reduction of legal and administrative barriers.
- Concerted strategy for RES in electricity, heat and fuels
- Continuation of the price based approach in the electricity sector (EEG)
- General obligation of network operators for priority access and priority purchase of RES electricity
- Guaranteed tariff for a sufficient period
- Degressive tariffs
- Differentiation of tariffs with regard to technological specificities and costs
- Periodic evaluation of the support conditions
- Compensation (financial) for network operator to avoid distortions of the market
- Compensation for energy intensive industries to avoid distortions of the market

Optimization of the interaction of EEG and other political measures

- Overall economic instruments do not suffice.
- Emission reduction due to RES has to be accounted for in allocation plans for the ETS
- Other RES support necessary as complement
- Regulation to reduce barriers.

Co-ordination of promotion policies within the EU

- Complete harmonized community promotion scheme not necessary
- Burden sharing between MS urgent
- Trade with certificates of origin of limited use
- Possibly inter-country compensations to share burdens
- Improvement of the infrastructure for trans-border electricity trade
- Political preparations for electricity imports, e.g. from MENA-region

Fair and incentive compatible conditions for network access and use

- Shallow connection charges
- Setting of adequate accounting methods for the network regulation
- Publication obligation for access conditions
- Qualified benchmarking in the context of incentive regulation (number of DG facilities and their capacity fed-in relative to the maximum grid load)
- Inclusion of DG in the incentive regulation formula (of the ARegV)

Support of a balanced feed in management

- Increasing qualification of the RES priority
- Priority among RES
- Consideration of CHP
- Protection of local concepts
- Integration in comprehensive and active network management

Direct marketing and optional bonus model

- Direct marketing with short-term exit is temporarily and under certain conditions acceptable.
- Period of commitment should soon be politically decided (rev. EEG-draft: 6 months, BNetzA Nov. 07: 1 month); day-ahead option (9:00am should be discussed)
- Short-term direct marketing as a transitional provision, regulation and conditions have to be clarified.
- Replacement by optional bonus model any time soon (according to the Spanish system)
- Bonus based on EEG tariffs (technology specific and degressive), stock exchange future prices and the specific value of the electricity profile

Nation-wide equalization scheme

- Keep financial equalization scheme
- Physical roll-over should be decreased, e.g. with optional bonus model and exchange model.
- Transparent and competitive EEG electricity "upgrading" by TSOs according to guidelines of the Federal Network Agency (BNetzA)

Special suggestions: Wind energy

- Incentives for the reduction of fluctuations (e.g. bonus on storage)
- Incentives for the reduction of compensation energy
- Support for the first German off-shore projects
- Off-shore tariffs should start high and decrease rapidly.
- Support of repowering, i.a. through respective regulation for permissions

Special suggestions: photovoltaics

- Distinguish between large scale plants, integrated systems and on roof appliances
- Regard consumer structure, esp. with roof systems.
- Grid-parity as a milestone for net-metering (2015 - 2020)
- From 2020: self marketing of electricity from large systems.

Special suggestions: biomass applications

- Balanced support of renewable sources (NaWaRo) and residuals.
- Strong sustainability conditions for the generation and use of biomass
- Avoid use conflicts between the sectors heat, electricity, and transport, as well as over estimation of the overall potential.
- Integrated biomass strategy is necessary.
- International system of certificates (sustainability, origin) necessary.

Incentives for the system optimization

- Power plants: Merit Order Effect, change of the power plant structure, and the load structure of RES, political support of restructuring.
- Consumer: Load management, demand side management, increase of efficiency.
- Network structure and operation: Integration of RES into the concept and application of incentive regulation.

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From: Maria Romiti [m.romiti@ballarat.edu.au]
Sent: Monday, 18 August 2008 12:17 PM
To: Committee, ECA (SEN)
Subject: Senate Feed-in Tariff Bill

Feed in tariff.doc (29 KB)

Please see attached