SRU German Advisory Council on the Environment

Shaping the Electricity Market of the Future

Key recommendations

November 2013

Introduction

***1.** Climate-neutral electricity generation is both necessary and possible. It is necessary because the Federal Republic of Germany, together with the other member states of the European Union, has committed itself to the target of reducing greenhouse gas emissions by at least 80 per cent from 1990 levels by 2050. This is the industrialised countries' minimum contribution to the internationally agreed target of preventing global average temperature from rising more than 2°C above pre-industrial levels. This target can only be achieved by moving to a power system essentially based on renewable sources, as substantial emission reductions are easier and less expensive to implement in the electricity sector than in other sectors.

At the same time it is technically possible to meet electricity requirements entirely from renewable energy sources by 2050. And this while ensuring a high level of supply security. This will be possible at costs which in the long term will be lower than those of conventional power supplies, since fossil fuel prices will in all probability rise in the coming decades, despite shale gas production in the USA. In agreement with many other reports for Germany and the EU, the German Advisory Council on the Environment (SRU) drew attention to this in 2011 in its special report on "Pathways towards a 100 % renewable electricity system".

The special report "Shaping the electricity market of the future" is intended to extend the line of the 2011 special report and address issues concerning the organisation of the electricity market. The central concern of this new special report is to put forward ideas for a new organisation of the market that not only offer answers to the current challenges, but are also compatible with the long-term goal of a renewables based power system. As a first stage, this paper provides a summary of the SRU's main recommendations.

Energy supply in Germany is going through a period of radical change. In 2010 and 2011 the German Government approved climate objectives and renewable energy expansion targets for the period up to 2050 and decided to phase out nuclear power by 2022. Although this system of objectives was supported by a broad political consensus transcending party boundaries, there are widely differing views about how the transition should be organised in practice. The public debate focuses on security of supply and the cost of promoting renewable energy. Many contributions to this debate lose sight of the fact that in the long term the energy supply system needs to be built on a foundation of renewable energy if the climate objectives are to be achieved. They focus on short-term solutions and in some cases advocate a fundamental change in the renewable promotion system or moves to curb the expansion of renewable energy and new mechanisms for promoting conventional power stations.

The SRU, by contrast, is primarily concerned with the question of how to assure the continuous expansion of renewable energy so that the long-term goals can be achieved as well. Central topics here are energy efficiency and the funding of investments in renewable energy systems, storage facilities and the supporting infrastructure, such as grids. The focal issues in the special report are: To what extent can the electricity market ensure the expansion of renewable energy and of storage and demand side management, and what supplementary measures are needed to achieve this?

For an electricity market largely dominated by renewable energy, the answers to these questions need to be different from those appropriate to the present situation. The SRU has therefore decided to adopt a backcasting approach that works backwards from the goal in view: First it identifies plausible characteristics of a future electricity market based on renewable energy. Then it proposes steps for the transition that are in line with the long-term perspective.

The energy market of the future

***2.** The SRU assumes that in several decades' time wind energy and photovoltaic systems will be the main technologies of a future energy system. At times of strong winds or bright sunshine, electricity generation from renewable sources will be very high, but in different weather conditions or at certain seasons or times of day it may be low. Such fluctuations may take place very quickly, may cover a considerable range, and are only foreseeable to a limited extent. The entire energy system will have to adapt to these new challenges by becoming more flexible. To this end, the market system needs to send the right signals.

In the long term there are many ways of adapting to these challenges:

– Firstly, the demand for electricity – especially industrial and commercial demand – should respond more flexibly to fluctuations in generation, thereby making a contribution to load balancing.

– Secondly, further expansion of the long-distance power grid should make it possible to balance supply and demand over large areas. In addition to optimisation of the national grid, a factor of special importance here is the expansion of cross-border transmission lines. Greater EU-wide integration of power grids can increasingly help to ensure that different national supply and demand profiles balance each other out.

– In order to achieve the climate objectives, the demand for energy in all sectors of use (heating, transport and industrial processes) should increasingly switch to electricity as the most important form of energy. The present separation of sectors will disappear. An increasingly integrated overall energy system will emerge with many new flexibility options. This will make it possible to divert temporary surpluses of electricity into other use sectors (e.g. heat or electric mobility). It will also enable the market to absorb temporary very high levels of electricity generation.

– Finally, other long-term flexibility options lie in the mutual convertibility of various forms of energy (e.g. power-to-gas) and a wide variety of storage options in Germany and abroad. These permit further load balancing.

What these combinations of different load balancing options mean for the electricity market is that even at times of high generation there will be opportunities to use electricity outside the electricity market in the strict sense (e.g. for gas production). Even in a future dominated by renewable energy, the resulting demand will almost always lead to a positive market price. Although renewable energy will thus be able to generate considerable earnings on the market, it will very probably not be able to recover its capital costs in full. Insurance-like solutions, such as reserves or storage facilities for rare occurrences of longer periods of very low feed-in, are unlikely to succeed in paying for themselves via the energy-only market.

On the whole, there will in the long term, i.e. in several decades' time, still be a need for a combined payment for renewable energy, insurance-like reserve services and supplementary infrastructure. This payment is made up of a price per kilowatt hour determined by the existing electricity market, and a supplementary contribution which meets the additional finance required. The framework for determining this contribution, like the ratio of the two payment components, depends on future costs, technologies and market conditions and is therefore impossible to predict at present.

These structural elements of an electricity market for renewable energy that can be foreseen in the long term make it possible to draw conclusions about steps for a gradual transition towards a more market based approach.

Reform of electricity market organisation

1 Ensuring continuity during transition

***3.** The Renewable Energy Sources Act (EEG) is a successful model and a driving force behind the German *Energiewende* (transformation of the energy system). At comparatively low cost, it has triggered substantial growth of renewable energy. This success story is spreading beyond Germany's boundaries. Similar systems have been introduced in many other countries. At present this development is one of the encouraging factors in international climate policy. The *Energiewende* provides answers to the foreseeable increase in fossil fuel prices and the risks and serious environmental follow-on costs of the present power generation structure, and offers a perspective for a sustainable energy supply system. The transformation of the power generation system is also a great opportunity for Germany as source of innovation.

There is nevertheless a need for reform. With regard to intermittent generation from renewable energy sources there is a short-term need both for the conventional power plant portfolio to adapt as speedily as possible to the new flexibility requirements, and for the renewable energy sources to adapt – as far as technically and economically practicable – to the requirements of the market. To this end the renewable energy sources must increasingly be exposed to market signals. Moreover, other challenges arise from the cost of promotion and, in the medium term, security of supply.

Within these constraints the SRU advocates cautious reforms that will make it possible to maintain the dynamic development of renewable energy at a sustainable high level. This is indispensable in view of the longer-term political objectives and the potential of renewable energy. At the same time care should be taken to avoid measures that are obviously incompatible with the long-term climate objectives, e.g. subsidising new coal-fired power stations or keeping existing ones in service on a long-term basis.

2 Subordinating conventional power generation to the needs of renewable energy

***4.** The growing proportion of renewable energy makes great demands on the flexibility of conventional power generation. This has to adapt to the intermittency of wind and solar power. At present there is a surplus of non-flexible capacity due to nuclear and lignite power stations. This results in low spot market prices, exports of surplus power to other countries, and profitability problems for gas-fired power stations. However, gas power stations are needed as a flexible means of meeting the residual load requirement. For this reason a variety of promotion mechanisms are currently under discussion with a view to ensuring the availability of flexible generating capacity, and hence long-term security of supply despite the profitability problems on the electricity market.

The SRU is of the opinion that it is first of all necessary to exhaust those options which effectively address these challenges and at the same time strengthen the functional capacity of the energy market.

These options include incentives for greater demand flexibility on the part of major industrial consumers in particular. They have a variety of technical means of reducing their electricity consumption in times of low power supply. Making the market more flexible, especially to reinforce the role of short-term markets with better integration of the grid operator, could help to cater for the rapid fluctuations in supply which are difficult to predict exactly. In the short term, expanding transmission line capacity between German and its neighbouring countries could make a contribution to greater security of supply.

However, the most important individual objective – over and above the phasing-out of nuclear power – is to reduce the overcapacity of power stations that are not flexible for economic or technical reasons, in order to create better market conditions for flexible power stations, especially gas-fired ones. This applies in particular to power generation from lignite, which is also relatively inflexible and very CO_2-intensive. The success of the *Energiewende* is therefore crucially dependent on an adequate CO_2 price signal.

3 Substantially raising CO_2 prices

***5.** A high CO_2 price level will speed up the urgently needed process of structural change in the conventional power plant portfolio. It is the most important lever for increasing the competitive strength of flexible and relatively low-CO_2 gas-fired power stations compared with coal-fired power stations. A higher CO_2 price increases the production costs of fossil-fuel power stations. This raises spot market prices – which benefits highly efficient and flexible power stations in particular – and thereby improves the functioning of the electricity market. Thus a strong CO_2 price signal should be introduced before making any far-reaching and risky intervention in the market such as the various capacity mechanisms currently under discussion.

At present the CO_2 price is determined by the European emissions trading scheme. Owing to an over-generous supply of emission allowances, especially as a result of the economic recession in the EU, the price of emission allowances has slumped in recent years.

The SRU therefore recommends the German Government to take action at European level to urge effective measures to restore the incentive function of the emissions trading scheme. In particular, this includes – as well as the temporary withdrawal of emission allowances during the current trading period

("backloading") – an ambitious European climate objective for 2030. This should form part of a consistent overall climate- and energy policy package, which must also be compatible with the long-term objectives for 2050.

If moves for a speedy reform of the European emissions trading scheme are unsuccessful, Germany should follow the British example and introduce a national minimum carbon tax. This would best be done by abolishing the exemptions for power generation plants in the Energy Tax Act. The level of taxation must also be geared to the specific carbon content of the individual fuels. Last but not least, the German Government could consider using regulatory instruments to reduce CO_2 emissions by power stations and to make power supply more flexible.

4 Strengthening the European dimension of the *Energiewende*

***6.** Right from the start, the *Energiewende* has been embedded in a European context. It is also a contribution to the objectives approved by the European Union in 2008 for climate action, renewable energy expansion and greater energy efficiency by 2020. The task of updating these objectives for 2030 is currently on the agenda of the European Union. Ambitious European targets for all three aspects of energy and climate policy are of vital national interest in order to create a climate of certainty for investment and planning, promote convergence of the Member States' policies, and avoid competition-law risks in relation to the – still much needed – promotion of renewable energy. To ensure continuity and be able to take account of interactions between the three objectives, the EU should focus on a triad of targets for 2030 as well.

The SRU therefore recommends the German Government to advocate a European climate objective for 2030 that seeks to reduce greenhouse gas emissions by at least 45 per cent compared with 1990 by means of measures within the EU. The renewable energy share of gross final energy consumption should be increased to at least 40 per cent. Full advantage should be taken of the existing energy efficiency potential, which permits a reduction of up to 50 per cent in primary energy consumption compared with 2010. This should be enshrined in binding targets. Depending on their own national targets and abatement costs, individual countries such as Germany can and must exceed these targets.

5 Ensuring security of supply in conformity with the market

***7.** The growing proportion of renewable energy and Germany's decision to finally phase out nuclear power by 2022 present new challenges for ensuring security of supply. Under current market conditions, neither the construction of new flexible gas power stations nor the continued operation of existing ones is assured. To ensure the provision of adequate and flexible generating capacity, various approaches to capacity markets and a strategic reserve are currently under discussion. In the final analysis, capacity markets are mechanisms for subsidising new power plants or maintaining existing ones, or they provide incentives to invest in flexibility options. The strategic reserve is a safeguard against supply shortage situations. Under this instrument, power stations that would otherwise be withdrawn from the market are kept as a reserve.

Introducing capacity markets involves risks. If they are not designed correctly, e.g. if the need for new power plants is overestimated or there are no requirements regarding flexibility or limiting CO_2 intensity, there is a risk that the transformation of the power supply system will be brought to a halt or that the cost of promoting it may be excessive. Nevertheless, one cannot exclude the possibility that a capacity market may be necessary for security of supply in the medium term. However, every new intervention in the market needs thorough prior investigation in order to avoid incorrect design.

On the whole, the SRU considers the proposed strategic reserve to be the more suitable instrument, since this represents the smallest intervention in the energy market. Removing from the electricity market those power stations that only operate in the event of power shortages will improve the earnings potential in this market.

6 Ensuring a more objective debate about the cost

***8.** One frequently voiced justification for a basic need to reform the EEG is that it gives rise to high electricity costs and that steps must be taken to halt their continued growth. However, this debate confuses a number of different arguments. Firstly, it explains the increase in electricity prices in recent years as being due entirely to the expansion of renewable energy. Secondly, the discussion focuses on an indicator that is unsuitable for determining the actual cost of promoting renewable energy. Thirdly, it exaggerates the resulting social problems and the overall importance of such developments for the economy as a whole.

The SRU expressly warns against such misinterpretations. The doubling of the price of household electricity over the last decade was due above all to the rise in fossil fuel prices. Moreover, the EEG surcharge is not a suitable indicator of the cost of renewable energy. One reason for the increase in the surcharge – as the difference between feed-in payment and market price – is that the cost of the generous exemptions for a number of industrial companies is allocated to all other electricity customers. Another reason for the rise is, paradoxically, that spot market prices are going down because of falling CO_2 prices and the increasing amounts of renewable energy fed into the system. However, neither of these effects is a

cost of promoting renewable energy. Incorrect indicators could lead to misguided reforms that might slow down the expansion of renewable energy and thereby endanger the overall objective of the *Energiewende*.

The SRU therefore recommends introducing a better indicator of whether or not the renewable energy portfolio is becoming less expensive. A suitable candidate for this purpose would be the average EEG payment for new installations. A comprehensive macroeconomic cost concept should also be used. This must compare the total costs attributable to renewable energy with the costs – and especially the external costs – arising from the construction and conversion of fossil energy supply facilities (differential cost approach).

7 Reforming the variable market premium

***9.** The EEG originally funded the renewable energy sources by means of fixed feed-in tariffs. This was criticised because in this model power generation does not react flexibly to market signals. Thus, in 2012 the option of selecting a variable market premium was introduced. The variable market premium pays for that portion of renewable energy costs which is not covered by market income. Since market prices are subject to large fluctuations and are difficult to predict for decades ahead, the amount of the variable market premium is adjusted to average spot prices, thereby cushioning part of the market risks for renewable energy sources.

Other direct marketing models (e.g. fixed market premium or auctioning) pass on excessive market risks to the renewable energy sources, thereby considerably increasing the cost of refinancing and hence the cost of promotion. Proposals of a more far-reaching nature such as quota models risk interrupting the development process. Moreover, they are also more expensive than differentiated technology-specific promotion.

The SRU therefore recommends introducing the variable market premium as a binding basis for all new installations. Since its introduction in 2012, as much as half the capacity from renewable sources has been transferred to direct marketing, and in the case of onshore wind energy the figure is as high as 80 per cent. Practical experience is thus available which holds promise of a smooth transition.

However, the SRU recommends modifying the basis for calculating the premium in a way that increases the incentive to gear installations to the maximisation of market revenues and not of the amount of electricity generated. The SRU envisages calculating the variable market premium in such a way that producers can, under realistic conditions, expect at least the same income as at present with the fixed feed-in tariff. The realisable market revenues and the market premium should be calculated on the basis of suitable technology-specific and site-specific indicators. Instead of a 20-year limit on promotion, a limit on the number of kilowatt-hours promoted should be used. As yet it is still possible to increase the absolute amount of funding received by gearing the installation to maximise the number of kilowatt-hours produced in the 20-year promotion period. By contrast, the kilowatt-hours contingent implies a similar absolute remuneration for all installations. This ensures an overall income, even if payments are no longer made when electricity is not fed in. The level of the market premium must nevertheless be continuously adjusted to the actual development of technology costs and must be geared to a portfolio of renewable energy sources that is both inexpensive and reasonable from an energy system point of view.

In view of the serious additional environmental impacts and undesirable relocation effects, consideration should be given to discontinuing the promotion of cultivated biomass.

The SRU recommends having the level of the market premium determined by a public authority. This should work on the basis of politically decided objectives with regard to the levels of expansion and the renewable portfolio, in accordance with clear rules and in a transparent procedure. The fact that the feed-in tariffs are specified in the EEG has in the past prevented a sufficiently flexible response to market and cost developments. This can be achieved better by a solution where the market premium is determined by a public authority.

8 Bundling coordination in the Federal Chancellery

***10.** A large number of actors from politics, industry and society are involved in implementing the *Energiewende*. Even individual elements of the *Energiewende*, like the electricity market reform, are complex and require a great deal of coordination. And the need for coordination between the various elements is all the greater, e.g. between grid expansion and the growth of renewable energy, or between climate policy and the development of renewable energy sources. In this connection it is often suggested that responsibility for energy policy should be bundled in a separate energy ministry.

However, there are a number of arguments against this:

– The coordination requirements far exceed the competence of a single ministry. Decisions concerning the *Energiewende* are taken not only at federal level, but in a complex multi-level system, and implemented on a decentralised basis. There is thus a need for coordination not only between the federal ministries, but also between the federal and Bundesland level and between Germany and the EU.

– The *Energiewende* is not merely the responsibility of the economics and environment ministries.

Other ministries also play an important part, e.g. the ministries of transport, research or agriculture. It would be unrealistic to bundle all these tasks in a single ministry.

– Furthermore, inter-ministerial discussion of issues increases the transparency of the basis for political and technical decisions.

– And finally, each ministry acts as a point of contact for specific stakeholder groups. If these interests are spread among different ministries, there is competition between the ministries to innovate, and in recent years this has acted as a driving force behind the *Energiewende*.

Rather than creating an energy ministry, it would therefore make more sense to institutionalise these responsibilities under the policy-making powers of the Federal Chancellor. The SRU advocates establishing a steering body with the rank of a Minister of State within the Federal Chancellery. This function should be equipped with appropriate resources and should have the task of balancing interests between the ministries and optimising coordination between Federal Government, Länder and EU. This can strengthen the importance of the *Energiewende* as an overarching and cross-cutting task and as a national policy coordination task between the federal, regional and EU levels.

9 Transferring detailed control to federal authorities

***11.** The SRU recommends an increasing and systematic transfer of numerous concrete implementation tasks, the technical and economic basic knowledge and fine tuning of the *Energiewende* to the Federal Environment Agency and the Federal Network Agency. These two authorities should also be required to coordinate under the rule of common agreement.

It would overstrain the legislature to deal with the numerous technical parameters and the specific implementation tasks of the *Energiewende*, especially fixing and regularly adjusting the market premium, working out any necessary capacity mechanisms or implementing the emissions trading scheme. The legislature should focus on laying down the fundamental objectives, instruments, procedures and rules for the further process of the *Energiewende*.

10 Passing a Climate Change Act

***12.** Especially in view of the diversity of actors and levels involved and the great variety of interests, the *Energiewende* needs a clearly defined vision and a binding goal for the various processes which cannot be controlled centrally. For this reason the SRU recommends passing a Climate Change Act laying down the climate objectives for Germany up to 2050. The Climate Change Act should set out these objectives in ten-year steps. It should also formulate sectoral objectives for the climate-relevant sectors: transport, agriculture, industry, small scale industries, trade, and services, as well as heat. The Greenhouse Gas Emission Allowance Trading Act (TEHG) and other climate-relevant acts should be merged with the Climate Change Act. The objectives of this act should also be underpinned by a sub-statutory programme, which should be a mandatory requirement. This programme should lay down measures and regular monitoring processes. A Climate Change Act can improve the consistency of political decisions and reinforce broad public acceptance of climate and energy policy measures.

Outlook

***13.** The *Energiewende* is going through a critical transition phase. There is a need for reform, but the reforms must not risk interrupting the development process. One of the central political tasks for the coming term of parliament will be to find this balance between continuity and change.

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