1. History of electricity market regulation and competition

The energy transition is a fundamental regulatory intervention in the energy supply, and in particular in power generation. On first sight, the change of the energy mix to renewable sources is a primary technological challenge. However, this involves a development of the regulatory system, which may lead to a renewed and far-reaching transformation of the economic order on the electricity market. The decisions on the Energiewende (energy transition) intervene in a regulatory structure that has changed significantly in recent decades. This applies in particular to the role of competition in the electricity industry. The electricity market looks back on a long and varied tradition of different regulatory concepts. In most cases, monopolistic structures and strict regulation dominated, and last but not least, competition could have a stronger impact on an open German electricity market. Different phases can be distinguished:\(^2\)

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(a) *Foundation in competition*  
The first years of building power generation facilities and the use of electricity in electrical appliances was marked by private initiative. Sales of electrical systems could only succeed if an appropriate power supply was available. The first local structures of a power system were created on private initiative.

(b) *Expansion in monopoly*  
It was not until the end of the 19th century that the first municipal power generation companies were founded. With the development of large-scale facilities and long-range transmission possibilities, a centrally structured power supply was created, which was subject to strong state influence. It was mostly dominated by large integrated utilities and their subsidiaries, which offered a variety of system functions, i.e. the generation, transport and distribution of the electricity from a single source. Also, characteristic were state ownership structures, regional territorial monopolies and state price regulation, which followed the principle of cost-plus regulation. For example, the costs of generating electricity, including a reasonable return, could be passed on to consumers. Competition for customers could not take place and associated efficiency improvements could not be realized due to the lack of incentives.

(c) *Liberalisation and opening up to competition*  
After several unsuccessful attempts to liberalize the European electricity markets, the market opened up at the end of the 1990s. In Germany, this was implemented with the amendment to the Energy Act of 1998 and further liberalization steps. Characteristic of the competitive market organization were the privatization of the main companies, the dissolution of the territorial monopolies and thus the possibility of competition for the end consumer as well as the establishment of a power exchange to organize the competitive market at the generation level. The prerequisite for this was the creation of non-discriminatory access to the grid in
order to enable competition at other stages of the value chain (generation, trade, distribution).³

(d) Energy transition

The Energiewende redefined various fundamentals of the electricity industry. These include, in particular, the political requirements for the phasing out of nuclear energy and the goal of largely meeting the demand for electricity through renewable energies. In addition to the competition related legislation, the Renewable Energy Sources Act (EEG) is the central element, with the help of which the conversion, in particular of the power supply, should succeed. This removes growing shares of the electricity supply from competition. The price mechanism cannot work properly when taxes sum up to 50 percent of the retail price and the wholesale price is influenced by growing subsidies. As a result, competition is being pushed back as an organizing principle on the electricity market.

2 What is the energy transition?

After some intense discussions in 2009, the German government has decided on a new national energy concept in 2010.⁴ The cornerstone of this concept was to increase the share of renewable energies in the electricity production to 80% as of 2050. This also means to reduce other energy sources to not more than 20% of electricity consumption. While the market share of the different fossil fuels has not been discussed, the future of nuclear energy was the most critically disputed part of the strategy. The liberal-conservative government did not revoke the decision a former coalition of green party and social democrats has made in 2000 to phase-out of nuclear. However, the 2010 concept included a prolongation of about 12 years for nuclear power plants. Nuclear energy was supposed to bridge the period of time until renewables could provide the larger part of all electricity consumed without producing additional carbon emissions.

The energy concept 2010 has defined a set of objectives beyond the expansion of renewables and the phase-out of nuclear. Energy efficiency was supposed to be increased, electricity consumption should have been reduced. Other objectives did not have a specific measure, but were nevertheless important. All three dimensions of the energy trilemma – or energy triangle, as it is called more optimistically in German – should be considered. Energy supply should be economical, reliable and environment – or climate – friendly. The latter is the main objective of the energy transition itself. Security of supply must also be preserved. German consumers in private households are used to a very high standard of security, power failure is a very rare event. But what is more important is security of supply for commercial consumers of electricity. Even a short time power failure of seconds or less and voltage fluctuations (brownout) are risks for industrial production. Energy intensive industries like aluminium production depend on a very stable supply, high precision industries face significant dropouts of production if electricity is not reliable. For many companies, the hard shutdown of production machinery, that takes place in a blackout situation, is another important problem. When production cannot be stopped in a controlled way, time and costs for restarting the machinery are much higher. A breakdown of power supply of a few seconds can affect industrial production for hours. To ensure security of supply, a combination of measures is necessary: the existing high voltage grid must be extended to transport electricity from the north of Germany (with huge wind power capacities) to the south (with huge demand from industrial consumers), back-up capacities and storage systems must be developed and installed to keep the balance short-term and long-term (the winter time with hardly any power from wind and sun is critical), demand must become more flexible and capacities for power import should be available.

The economic dimension is even more difficult as the energy transition has to meet the requirements of an economy with a large share of value added in the manufacturing sector, which is more energy intensive and which has to compete on world markets with companies from countries without an energy transition. If Germany wants to be an example for a climate friendly transition from a fossil fuelled electricity system to one based on renewable energy sources, it must demonstrate that this is possible without harming the industrial base of economic prosperity. The economic dimension of the en-
energy trilemma has two aspects: private and industrial consumers. For private households, additional costs on the energy bill are important, and the distribution of burden among different households can matter. For industrial consumers, it is important to limit additional costs and to keep electricity prices not too much above prices in competing countries. The energy concept of 2010 did not define a clear objective regarding state burden on electricity of competitiveness, but it was clear that the economic costs are an important criterion of energy policies. Therefore, it is at least an informal objective of the energy transition to keep costs at a reasonable level.

The term “energy transition” or “Energiewende” became popular after the political reactions to the nuclear disaster in Fukushima, Japan (although the term is much older: First books with the title “Energiewende” have been published in 1980).\(^5\) The accident in the nuclear power plant after an earthquake and tsunami was a shock for the German energy policy and reopened the debate about the future of nuclear energy.\(^6\) Although German nuclear power plants are far away from coastlines and therefore there is no threat of a tsunami and an accident like it happened in Japan, trust in safety of these power plants was destroyed in large parts of the population. If a high technology country like Japan cannot control the risks, who could? The Federal Government in Germany reacted to the public pressure to withdraw the decision to extend the operational time of nuclear energy – a decision that has not been popular a year before. Therefore, it was decided to shut down a significant number of nuclear power plants immediately.\(^7\) For the other sites, fixed shutdown dates have been defined, the last nuclear facilities will be closed by the end of 2022.

The new phase-out timetable is similar to the first plan from 2000, although in that first phase-out decision quantities of electricity production have been allocated to each power plant. The difference


\(^7\) See ibid.
to the 2010 energy concept is more significant, as one of the key pillars – the extended use of nuclear as part of the energy mix – has been removed from the concept. However, all the rest of the energy concept has not been changed. The objectives for renewable energies remained unchanged, therefore the share of fossil fuels in the non-renewable fraction of electricity production had to be increased. As the commitments to mitigate greenhouse gas emission have not been adapted either, the switch from nuclear to coal or natural gas increased the pressure for other sectors like transport and household heating to reduce emissions faster than planned.

The original energy concept has defined a long-term goal and several milestones for the transformation of electricity production from a fossil and nuclear energy mix to one based on renewable energies. In the long run, renewables should have a share of 80% or more of electricity consumption in Germany. Milestones have been defined for every decade between 2010 and 2050. These objectives have not been changed in the energy transition in 2011 and can be described as one of the fundamental commitments of the "Energiewende" (Figure 1). In 2014, two corridors have been introduced for the years 2025 and 2035. The centre of these corridors has been exactly on the planned growth path as defined in 2010 and 2011. The idea behind the corridors was to introduce an upper limit for renewables as it is more expensive to invest in renewables early than waiting for the years with cheaper costs for windmills and solar panels. In the year before the corridors haven been defined, there was a high increase of new solar capacities as panel prices dropped much faster than the guaranteed feed-in-tariffs, making solar investments very profitable but increasing the subsidies needed, paid for by the energy consumers.

In the following years, expansion of renewables was faster than expected. In 2017, 36.1% of electricity consumption came from renewable sources. According to the political framework, this value was only due in 2021. While the expansion of renewables is about four years early, other elements of the energy transition – and especially the grid expansion – are far behind schedule. As renewable production and grid infrastructure are complementary, it would be necessary to close this gap. Instead, the political parties that build the grand coalition of the Federal Government agreed on speeding up installations of renewable energies. Their share of electricity
consumption is supposed to grow up to 65% in 2030. This is 15 percentage points more than in the previous plan. According to the energy concept of 2010 and the Energiewende of 2011, the share of 65% should only have been reached in 2040. The new definition of 65% in 2030 means that the energy transition should reach that milestone ten years earlier than anticipated – which makes it even more difficult to keep costs moderate and to strengthen the electricity grid to adapt it to the needs of the new energy system.

Figure 1

Objectives: Expansion of Renewable Energies

3 Where are we now?

With the energy concept 2010 and the energy transition of 2011, the Federal Government has set a number of goals to be achieved by 2020 and beyond. A review of the achievement of these target shows that although the expansion of renewable energies is progressing faster than planned, most of the other developments are not on schedule. In order to reach the targets by 2020, the achievement levels would have to be three times as high as they are today. The gap to the target path has further increased in recent years. Espe-

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cially in terms of economic dimensions, there has been further deterioration in recent years.

The key indicators are analysed according to the procedure described by Bardt and Chrischilles.\(^{10}\) For the interim balance sheet of the energy transition, the focus is on the aspects of power management that are also the focus of public debate. At the same time the power is central to a more comprehensive energy transition which goes beyond electricity. Sector coupling should bring electrical power to other energy uses, especially heating and transport, which will strengthen the central role of the power market. For this interim status of the electrical energy transition, the current actual results of selected indicators will be compared with the values, which should have been achieved in order to achieve the goals set in 2020 in a linear progress since 2010. If the target path is exactly reached, the indicator is rated 100. If progress has been faster or slower since 2010, higher or lower values will be awarded. The goals for cost effectiveness and competitiveness are not development goals, but should not fall below existing levels. If, for example, the EEG surcharge exceeds the target level, this will be regarded as a missed target. A 100 percent overrun corresponds to a target achievement of zero.

The result is a mixed picture of the energy transition (Figure 2). The target level aimed at, compared to what was necessary for 2017, has only been reached at 33%. At the beginning of the last legislature it was a little better at 40%. The individual dimensions are diverse:

(a) The expansion of renewable energies in 2014 was already 20% above the level targeted for the year. In the meantime, exceeding the planned development has risen to 34%.

(b) The already delayed network expansion has not progressed faster than would have been necessary in a linear development. The target achievement level has fallen slightly from 42 to 41%.

(c) Little progress has been made in reducing emissions of total German greenhouse gas. Four years ago, half of the planned 2010-2014 savings was well realized. Since then, the pace of climate change has declined, reaching only 28% of the emission reduction that would have been necessary from 2010 to 2017 to reach the 2020 target at the same speed.

(d) The goal of reduced power consumption was also missed even more than before. While it was still 63 points in 2014, one-third less than the linear adjustment path, today it is three quarters below its original target of 24 points.

(e) The indicator chosen to measure cost effectiveness, for which there was an explicit objective description, the amount of the EEG-surcharge\textsuperscript{13}, has further deteriorated. According to the government, the surcharge, which is collected in order to subsidize renewable electricity production, should not exceed the level of 3.5 cents – in 2017 it was 6.9 cents. The target achievement level has fallen from 23 to just five points.

(f) In terms of competitiveness, the aim is that the price disadvantage of German industry should not rise compared to the European average compared to 2010. This goal has moved even further away. In 2010, the additional costs for industrial companies in various size categories averaged 12 percent, in 2014 it was 25 percent and in 2017 already 30 percent. The degree of target achievement has continued to fall in the negative range due to the more than 100% missing target from -15 to -53 points and is only 31 points, compared to 56 points in 2014. The competitive disadvantages have thus risen again.

Overall, there is an overachievement of the goals for the expansion of renewable energies. Here too the rate of expansion is further above what was planned with the energy turnaround. By contrast, reducing emissions, expanding the network and reducing fuel consumption are not even possible half as fast as needed to meet the 2020 targets. It looks even worse regarding objectives of efficiency and competitiveness.

The last legislative period has created important competitive elements in the promotion of renewable energies with the call for renewable energy. However, measurable progress was not achieved in the main objectives. On the contrary, the gap to one's own goals on the path to the energy transition has continued to increase.

\textsuperscript{13} See Bundesministerium für Wirtschaft und Energie: Der Weg zur Energie der Zukunft – sicher, bezahlbar und umweltfreundlich – Beschluss der Bundesregierung, Berlin 2011.
4  Next challenges

The change of an existing regulatory framework is not any done in one step. Interventions can always lead to unwanted side effects and can lead to disorders that lead to new interventions. The introduction of the EEG is a good example of this. If there is a need for change for the electricity market, the resulting reform must follow clear principles that make it possible to calculate further changes. For the design of the future regulatory framework of the electricity market, the following regulatory requirements and principles appear urgent:

(a) *Long-term orientation*

The concept for a market design must be long-term. A clear regulatory policy should replace the ongoing intervention in the markets and thus the primacy of process policy. Investments in energy systems have a duration of several decades. The development of future market principles should have a perspective of 20 years and more. This requires a clear orientation for market participants with long-term investments – whether as producers of fossil or renewable electricity produced on the supply side or as industrial consumers on the demand side. Such orientation must also be reliable over legislative periods and governmental constellations. On the basis of long-term ideas of order, the reform steps in the transformation process of the energy transition must also be derived.

(b) *Competition*

The future electricity market must be competitively organized in its essential elements; this applies to all suppliers and technologies. There must be long-term predictable cash flows for the provision of renewable as well as fossil power generation capacities that can be generated in perspective without subsidies (except for the price signal of emissions trading).

(c) *Price signals*

Renewable energy plants need to be involved in the revenue risk and the market risk more, for instance by linking the payment streams to scarcity signals in the electricity market or long-term at the secured capacity contribution. What is required is a market and value-based remuneration of renewable energies, which stimulates the optimization of the overall system.
(d) **Demand flexibility**

To stabilize the balance between electricity generation and electricity consumption, not only flexibility in electricity production and, if necessary, storage but also demand is needed. The flexibilization of demand or demand side management must be able to be integrated into future market models.

(e) **Sector coupling**

Power generation is only one – nevertheless important – part of the energy system. Electrical power can be used in different appliances and sectors and can be used to link the different sectors. This sector coupling based on renewable energies would help to reduce emissions on sectors like transport and heating, but it would also help to manage the flexible supply of renewables as transport and heating (and partly cooling) have a significant potential as energy storage capacities.

(f) **Technology neutrality**

The market environment must not provide for permanent differentiation for specific technologies. For a transitional period, special rules or subsidies, in particular renewable energies, will be necessary. But even within these differentiations should be limited to what is necessary. In addition, these subsidies must be regressive and the special rules must be provided with a clear exit strategy.

(g) **Carbon emissions market**

The European market for greenhouse gas emission allowances remains the key mechanism for integrating the cost of carbon dioxide emissions into electricity production. Politically defined emission targets are achieved, and costs are priced into the decision-making calculus of the investors.

(h) **Europeanisation**

Without a European internal electricity market, important efficiency advantages and competitive effects cannot be realized.14 Future market models must not oppose an internal electricity market but must be compatible within Europe. Electricity trading across European borders not only creates a more efficient generation mix, it also increases the security of supply and is therefore a declared objective of the European Union.

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tion to the local network expansion, sufficient cross-border network capacities and their efficient management are necessary.

The German energy transition has been planned as a national project, but it very much relies on being integrated into the European grid and the European market. The integration allows to compensate for fluctuation in the domestic power supply – however this is not an unlimited potential. The European perspective is also necessary in order to use the most efficient places to produce wind and solar power, which very much depends on the natural environment and local factors. Finally, the European market is essential for economic reasons: An integrated European electricity market increases competition between power suppliers and it reduces cost differences for the consumers.