
Energiewende: What do the new laws mean?

Ten questions and answers about EEG 2017, the Electricity Market Act, and the Digitisation Act

BACKGROUND



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IMPRINT

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Electricity Market Act, and the Digitisation Act

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Preface

The transformation of Germany's electricity sector through the adoption of renewable energy – known in German as the *Energiewende* – is in full swing. Between 2000 and 2015, the share of Germany's electricity consumption covered by renewables rose from 6.5 to 31.6 per cent. By 2050, the German government plans to raise this share to at least 80 per cent.

As part of these efforts, the German federal government, together with the Bundestag, has amended a number of important regulations. The most important are:

- **The German Renewable Energy Sources Act (EEG):** An amended EEG was passed in 2016 and slated to come into effect at the beginning of 2017 (henceforth referred to as EEG 2017).
- **The Electricity Market Act (*Strommarktgesetz*):** This act, which passed into law at the end of July 2016 after three years of talks, further modernises the electricity market.
- **The Act on the Digitisation of the Energy Transition (*Digitalisierungsgesetz*):** Passed in the summer of 2016 by the German Bundestag and Bundesrat, this law provides for the introduction of smart meters that promote the *Energiewende*.
- **Federal Requirement Plan Act (*Bundesbedarfsplanggesetz*):** Dating from 2016, this act updates the list of urgent transmission-grid expansion projects and sets forth new rules for deploying underground power lines.
- **Combined Heat and Power Act 2016 (*Kraft-Wärme-Kopplungsgesetz 2016*):** This act represents the amended version of legislation promoting combined heat and power. In August of 2016, Germany came to an agreement with the EU Commission on the legal aspects of state aid.
- **Incentive Regulation Ordinance (*Anreizregulierungsverordnung*):** This ordinance, passed in June of 2016, rewrites regulations on costs that grid operators can bill to customers.

The changes to these regulations have been and continue to be accompanied by hopes for and concerns about the progress of Germany's *Energiewende*. While the German federal government sees the package of laws and directives as a fundamental and indispensable requirement for a successful continuation of the *Energiewende* and hopes for more competition in the expansion of renewable energy, others fear a slowdown or even a failure of the country's transformation efforts.

The main changes concern the EEG, the Electricity Market Act, and the Act on the Digitisation of the Energy Transition. In this background paper, Agora *Energiewende* explains the most important elements of these new regulations and analyses how they will affect the transformation of the German energy sector.

Content

1	How much renewable expansion does EEG 2017 provide for?	6
2	How is renewable energy funded by competitive bidding?	9
3	Which special regulations exist for small-scale installations and for projects from citizen-owned energy cooperatives?	11
3.1	Definition of energy cooperatives	11
3.2	Special regulations for citizen-owned energy cooperatives	11
3.3	Additional regulations for small actors	12
3.4	Better conditions possible for tenants' electricity supply projects	12
4	How does grid expansion relate to renewables expansion?	13
4.1	Expansion of underground power lines	13
4.2	Peaking shaving: an instrument for grid planning	13
4.3	Limits for additional onshore wind turbines in grid expansion areas	14
4.4	Power-to-Heat in CHP plants for eliminating grid congestion	14
5	What is the basic idea of the new Electricity Market Act?	17
5.1	Recouping investment in new capacity via price spikes on the electricity market	17
5.2	More electricity market flexibility for improving wind and PV integration	18
6	How do the standby reserves work to safeguard the electricity market?	21
6.1	Capacity reserve	21
6.2	Grid reserve	21
6.3	Lignite Standby Reserve	22
7	How will the lignite standby reserve affect climate protection efforts?	23

Content

8	Where and when will smart meters be installed?	25
9	What does the new legislation mean for the economy and for society?	27
9.1	Is security of supply ensured?	27
9.2	How are costs for funding renewables shaping up?	27
9.3	How are electricity prices and the EEG surcharge shaping up?	28
9.4	What will change for the economy and for consumers?	31
9.5	What will change for the energy industry?	31
9.6	How will the new regulations affect power system structure and its diversity of actors?	32
10	What do the new regulations mean for current Energiewende targets?	33
10.1	Will renewable energy targets be reached?	33
10.2	Will climate targets be met?	34
10.3	What is the future of the Energiewende?	36
	Appendix	37

1 How much renewable expansion does EEG 2017 provide for?

EEG 2017 reaffirms the objectives of previous amendments to the EEG, or Renewable Energy Sources Act. Like EEG 2014, it calls for a rise in the share of renewables in gross electricity consumption from 31.6 per cent at the end of 2015 to 40–45 per cent by 2025, to 55–60 per cent by 2035, and at least to 80 per cent by 2050.¹

EEG 2017 also stipulates the following annual levels of added capacity for individual technologies:

- **Onshore wind power:** Starting in 2017, gross output is to increase by 2,800 megawatts a year. Starting in 2020, the annual increase is 2,900 megawatts.
- **Photovoltaics:** For solar power, the gross increase of installed capacity is to be 2,500 megawatts a year. Of this, 600 megawatts are to be put out to tender. The remaining 1,900 megawatts are reserved for small- and mid-sized rooftop installations (no larger than 750 kilowatts each). They are to be promoted as before with EEG funding. EEG 2017 also contains provisions for on-site power generation and use.
- **Offshore wind power:** EEG 2017 reaffirms previous expansion targets: increasing the installed offshore capacity to 6,500 megawatts by 2020 and to 15,000 megawatts by 2030. Should the expansion exceed targets by 2020 (market actors expect 7,700 megawatts), the capacity put out to tender in 2021 will be reduced accordingly.
- **Biomass:** From 2017 to 2019, the gross output of biomass facilities is to increase by 150 megawatts

each year. Between 2020 to 2022, the increase is set for 200 megawatts a year. EEG 2017 allows for further EEG funding to existing facilities after the original 20-year subsidy period comes to an end.

- **Hydropower, geothermal, biogas from landfills, wastewater treatment, and marshes:** Because the intensity of competition is regarded as low for these technologies in the coming years, EEG 2017 exempts these technologies from auctions and maintains the fixed feed-in tariff. As a result, no added capacity targets have been set for these technologies.

All these added capacities are **gross** figures. The net increase – the actual increase in renewable energy capacity – results from the gross increase in each technology minus the loss of power from old facilities put out of commission. In the coming years, this will be increasingly relevant for onshore wind turbines and biomass power stations. Many of them were installed during a boom between 1996 and 2005 and will soon begin exiting the subsidy phase, after which they are expected to be put out of commission.

EEG 2017 does not provide for any automatic mechanism with which capacities won in bids but never realised can be “replenished” in subsequent auctions. Capacity added in a certain period thus depends directly on the realisation rate of the projects that win tenders. In the past, delayed or never realised projects have been a weakness of the tender process in many countries.² Nevertheless, the tender process under EEG 2017 is likely to achieve a high realisation rate, thanks to its specific design.

¹ See AG Energiebilanzen (2016): Bruttostromerzeugung nach Energieträgern in Deutschland.

² See IRENA/CEM (2015): Renewable Energy Auctions – A Guide to Design.

If one assumes a 90-per cent realisation rate for onshore wind power and photovoltaics and a 100-per cent realisation rate for offshore wind power and biomass,³ the reference scenario projects a total installed capacity of 138 gigawatts (net) of renewable energy in the reference scenario by 2025.⁴ By 2035, it will climb to around 164 gigawatts. The projected installed capacity will boost generation from renewables in the next two decades. The reference scenario expects generation to rise to around 264 terawatt hours (net) per year by 2025 and to around 312 terawatt hours per year by 2035 (Figure 1).

The following picture results for the individual renewable technologies:

→ **Onshore wind power:** At the end of 2015, onshore wind farms generation totalled around 42 gigawatts, currently the largest share of installed capacity for renewable energy.⁵ In 2015, they produced a total of around 71 terawatt hours of

electricity.⁶ The reference scenario projects the installed capacity to increase to around 53 gigawatts by 2025 and to around 58 gigawatts by 2035. Likewise, the generated volume of electricity is expected to increase to more than 97 terawatt hours by 2025 and to 119 terawatt hours by 2035.

→ **Photovoltaics:** The installed capacity of photovoltaic systems amounted to around 40 gigawatts at the end of 2015. In the reference scenario, installed capacity increases to over 61 gigawatts by 2025 and to around 75 gigawatts by 2035. Electricity generation from photovoltaic systems in 2015 amounted to around 39 terawatt hours. By 2025 it is expected to reach 57 terawatt hours; by 2035, around 70 terawatt hours.

→ **Offshore wind power:** The installed capacity of offshore wind farms is expected to rise from around 3 gigawatts (as of the end of 2015) to around 11 gigawatts by 2025. By 2035, the installed capacity will likely rise to more than 18 gigawatts. Electricity production from offshore wind farms is expected to rise from around 8 terawatt hours in 2015 to around 44 terawatt hours in 2035. In 2035, offshore electricity production is expected to rise to around 75 terawatt hours.

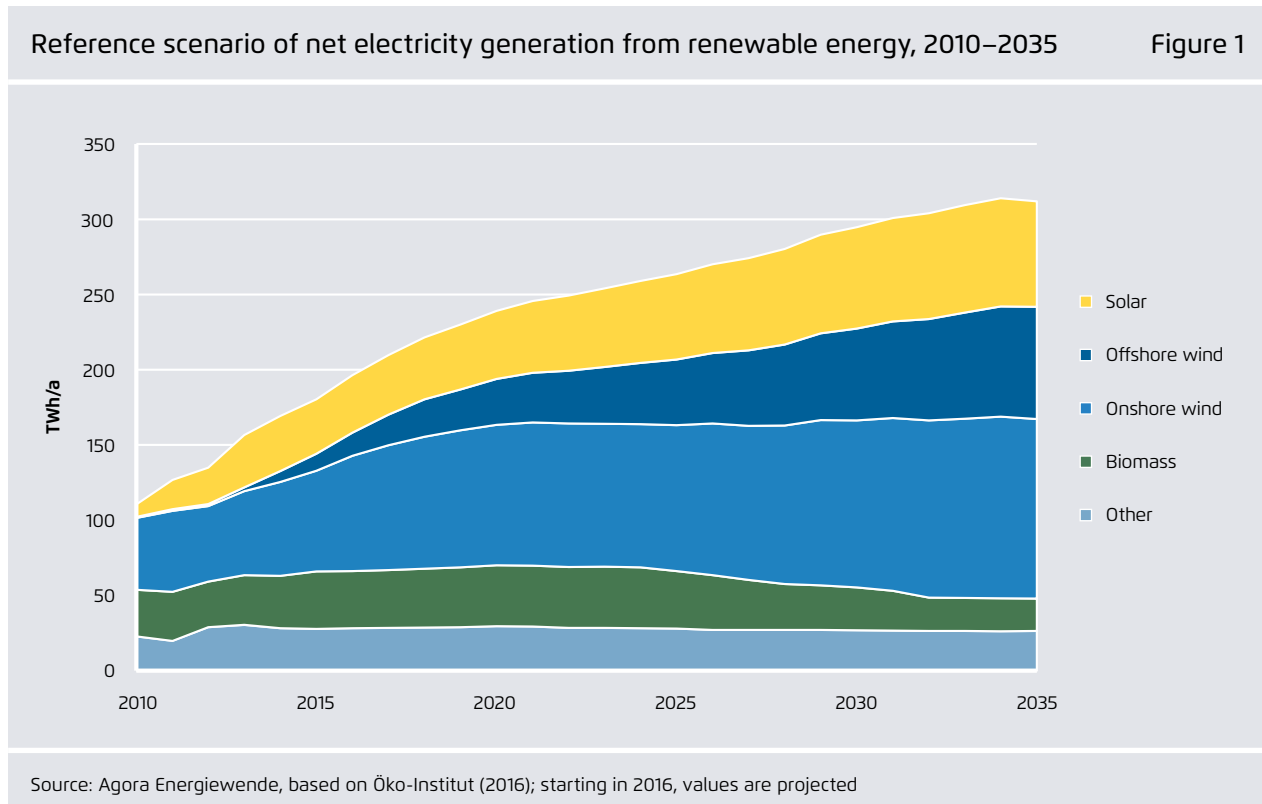
→ **Biomass:** The installed capacity of biomass facilities currently amounts to just over 6 gigawatts. Due to the limited funding for biomass, the installed capacity is likely to remain more or less constant until 2025. By 2035 it is expected to sink to around 4 gigawatts. Electricity production follows an analogous trajectory. In 2015 it amounted to around 38 terawatt hours. It is projected to remain at this level until 2025. By 2035, electricity production from biomass power stations is expected to sink to around 22 terawatt hours.

3 Compared with experiences outside Germany, a 90-per cent realisation rate is high, but Germany's tendering design for wind turbines and PV installations justifies this figure. First, the realisation rate for offshore wind parks is practically 100 per cent, since the state is responsible for project planning and meeting the prerequisites for permits, so that operators can begin construction directly after winning the tender or sell it to another entity for realisation. The situation with the planned bioenergy projects is likely to be similar. Many of these exist already and are now bidding for 10-year subsidy extensions.

4 These calculations are based on assumption of the reference scenario of the EEG Surcharge Calculator, which the Öko-Institut developed for Agora Energiewende. See Öko-Institut (2016): EEG-Rechner. Berechnungs- und Szenarienmodell zur Berechnung der EEG-Umlage. With regard to the further expansion of renewables, the reference scenario assumes that 90 per cent of the capacities put out to tender for onshore wind and photovoltaics will be realised, and that 100 per cent of capacities for offshore wind and biomass will be realised. For renewable energy technologies for which no added capacity targets have been set, the reference scenario assumes that expansion will continue at a similar level to past years. The scenario also assumes that renewable energy installations will have a lifespan of 20 years – the length of the funding phase for renewables. After that point, they are expected to shut down. One exception is PV, whose installations are expected to have a lifespan of 25 years. More details on the scenario assumptions can be found in Öko-Institut (2016). The EEG Surcharge Calculator is available for online use at www.agora-energiewende.de.

5 See AGEE (2016): Zeitreihen zur Entwicklung der erneuerbaren Energien in Deutschland.

6 See AG Energiebilanzen (2016).



→ **Hydropower, geothermal, biogas from landfills, wastewater treatment, and marshes:** In 2015, the installed capacity from these technologies totalled 6 gigawatts, with most of that coming from hydro-power plants (as of the end of 2015). Since most of the expected expansion in these areas will offset the dismantling of existing plants, the installed total capacity is expected to remain around the same over the period under consideration. The same applies to the resulting electricity production, which is expected to persist at around the same level as that of 2015 – that is, 27 terawatt hours.

2 How is renewable energy funded by competitive bidding?

In 2017, the payment system for the most important renewable energy technologies in Germany will switch from feed-in tariffs to auctions. From then on, funding for renewables will be competitively determined by a floating market premium for a period of 20 years from the start of operation. The Federal Network Agency (*Bundesnetzagentur*) is responsible for the competitive bidding procedure. The new regulations cover all offshore wind farms, solar power installations, and onshore wind farms with an installed capacity of over 750 kilowatts and biomass plants with an installed capacity of over 150 kilowatts. Only in the biomass sector can existing plants take part in the bidding so as to be able to afford operation after the original 20-year funding period expires. For hydropower and geothermal stations and for plants for biogas from landfills, wastewater treatment, and marshes there will continue to be no bidding procedure, since the added capacity is projected to be too small in the foreseeable future to ensure sufficient competition.

Germany's federal government assumes that more than 80 per cent of future added capacity will be put out to tender.⁷ To take part in the auctions, bidders must fulfil technology-specific criteria and make security deposits to ensure that winning projects are quickly realised.⁸

To better integrate renewable energy within Europe, the EU Commission will open competitive auctions for plants in other Member States of the European Union. These outsiders will have the chance to bid on five per cent of Germany's annual added capacity targets. To qualify, bidders must be from countries with similar reciprocal regulations that have signed appropriate international treaties and are capable of physically importing power to Germany.

The decisive criterion for winning an auction is the bid for the market premium (i.e. subsidy to be received) in euros per megawatt hour. The amount of funding is determined by the pay-as-bid procedure. That is, every bidder receives the same level of subsidy offered during the auction.

Generally, the following added capacities will be put out to tender:⁹

→ **Onshore wind power:** The annual gross increase of 2,800 megawatts from 2017 to 2019 and the 2,900 megawatts annually after 2020 will be put out to tender in three or four annual bidding rounds. For onshore wind farms, a single-stage "reference model" will be introduced to ensure that expansion is distributed evenly. All participants bid for a reference location with a wind speed of 6.45 meters per second at 100 meters. Winners will be selected based on their bids for this standard location. The actual market premium will later be determined using a location-dependent correction factor. Worse locations will receive a higher premium; better locations receive a lower premium. The highest premium for auctions in 2016 was

⁷ The following sources will receive a fixed market premium without tendering bids: wind and PV installations whose capacity is less than 750 kilowatts; biomass plants whose capacity is less than 150 kilowatts; plants that produce electricity from hydropower, geothermal energy, or from biogas from landfills, wastewater treatment, and marshes; and pilot wind energy parks with an installed capacity of 125 megawatts that show key technological advances or innovations.

⁸ Installations that have been approved by December 31, 2016 but have yet to be into operation receive the market premium without having to tender a bid if operations begin within a certain technology-specific transition period.

⁹ In order to keep to planned capacity levels, the amount of added capacity put out to tender will be adjusted based on how many projects are realized from past auctions and on how many small-scale installations have been added.

7.00 cent per kilowatt hour for the reference location. In the following years, the highest premium will be calculated as 8 per cent higher than the average value of the highest bids in the past three auction rounds.

→ **Photovoltaics:** Starting in 2017, a total of 600 megawatts per year will be put out to tender in 3 rounds at 200 megawatts each. The maximum premium corresponds to the feed-in value for small ground-mounted installations that are not subject to the bidding procedure. As of August 2016, it amounts to 8.91 cents per kilowatt hour. It declines monthly depending on added capacity, in accordance with a flexible cap. The higher the added PV capacity is in total, the greater the decline. Based on the results of the most recent PV pilot auctions, values dropped significantly. Between April 2015 and August 2016, average premiums declined 21 per cent, from 9.17 cents per kilowatt hour to 7.23 cents per kilowatt hour.

→ **Offshore wind:**

- In 2017 and 2018, there will be auctions for 1,550 megawatts each. They are open only for existing projects that received planning and go-ahead approval by 1 August 2016. The winning projects must go into operation between 2021 and 2025 and produce 500 megawatts yearly in 2021 and 2022 and 700 megawatts per year from 2023 to 2025.
- Starting in 2021, auctions for between 700 to 900 megawatts will be held annually. Starting in the 2026, the added capacity target will be 840 megawatts. To better steer the expansion between the North Sea and the Baltic Sea and coordinate it with grid expansion, starting in 2021 the state will carry out land-use planning. Bids will then be tendered for these pre-screened areas. (This procedure is known as the Danish model.)
- The maximum premium for electricity from offshore wind farms amounts to 12.00 cents per kilowatt hour for the tender rounds in 2017 and 2018. Starting in 2021, the highest premium corresponds to the lowest bid that won in 2018. As with other technologies, the premium period runs for 20 years.

→ **Biomass:** New and existing power plants can participate in auctions of 150 megawatts each in 2017, 2018, and 2019 and of 200 megawatts each in 2020, 2021, and 2022. New power plants receive a maximum premium of 14.99 cents per kilowatt hour. For existing plants, it is 16.90 cents per kilowatt hours. In each case, the annual degression is 1 per cent. For existing plants, the new funding period is limited to 10 years. To promote flexibility, biogas plants receive a “flexibility premium” of 40 euros per kilowatt for total installed capacity. In return, the plants receive a market premium only for 50 per cent of the maximum amount of electricity that can be produced in a year. This is to ensure that plants produce electricity primarily when there is little wind and solar power in the system.

The law also provides for two additional types of auctions. Between 2018 and 2020, technology-neutral auctions will take place at 400 megawatts each for PV and onshore wind farms. During this time, another type of bidding is also planned – “innovation auctions” with a volume of 50 megawatts each per year for technological innovations that serve the grid or the system generally.

3 Which special regulations exist for small-scale installations and for projects from citizen-owned energy cooperatives?

EEG 2017 is the first EEG to explicitly acknowledge the role of citizen-owned renewable energy facilities. EEG 2017 makes it easier for energy cooperatives in onshore wind energy to take part in bidding. In case they win the tender, they also receive the highest market premium bid in the auction. The point is to compensate for structural disadvantages that energy cooperatives have relative to institutional investors. For instance, energy cooperatives lack portfolios with multiple wind parks to disperse risk; developing individual projects is labour intensive; and it is more difficult for actors to coordinate their activities.

3.1 Definition of energy cooperatives

According to EEG 2017, three criteria define energy cooperatives:

- They consist of 10 natural persons who are members or shareholders;
- at least 51 per cent of votes are from natural persons whose principal residence is in the urban municipality or rural district in which the wind turbines are to be erected; and
- no member has more than 10 per cent of the vote.

3.2 Special regulations for citizen-owned energy cooperatives

The special regulations for energy cooperatives comprise four main parts:

- **Simplified bidding:** As a rule, wind energy project bidders must have previously obtained go-ahead approval as stipulated by the German Federal Emissions Control Act (*Bundesimmissionsschutzgesetz*). This approval arises from the permit process in the planning of wind turbine locations and bundles together numerous individual permits (nature conservation, species protection, aviation

law, German building law). But there's an exception to this rule for energy cooperatives that plan wind power projects with up to 18 megawatts capacity and up to six turbines. To participate in the bidding, the energy cooperatives need only submit a yield assessment, information about the number of planned turbines, and proof of usage rights for the project land. Moreover, the energy cooperatives must demonstrate that neither their cooperative nor any one of their members has tendered a winning bid for an onshore wind power project in the 12 months prior to the bidding.

- **Reduced initial security deposit:** Energy cooperatives that tender a bid must deposit an initial security of 15 euros per kilowatt of capacity with the Federal Network Agency. Energy cooperatives that place a winning bid must then pay a second security deposit of 15 euro per kilowatt. "Normal" projects must deposit an initial security of 30 euros per kilowatt, though they do not have to deposit a second security after winning the auction.
- **Increased bid value:** Energy cooperatives automatically receive the value of the highest bid of the auction if they win. Practically, this means a higher certainty of winning the tender, as energy cooperatives can tender a bid that covers only their costs without factoring in profit. The expectation is that their members will still turn a profit from the difference between their bid and the highest bid tendered in the auction. Other wind park operators receive only the bid value they tender (pay-as-bid).
- **Local municipalities have the right to participate in the cooperative:** To be able to receive payment, an energy cooperative must demonstrate that it offered the local municipality or a full subsidi-

ary of the local municipality a chance to purchase a 10-per cent stake in the cooperative. Whether the municipality accepts the offer or not does not affect the cooperative's right to receive remuneration.

3.3 Additional regulations for small actors

In addition to making it easier for energy cooperatives to take part in auctions, EEG 2017 stipulates that facilities with a capacity of less than 750 kilowatts will receive the feed-in tariffs as before, though the payments will be up to 0.4 cent per kilowatt hour lower than those prescribed by law. This amount roughly corresponds to what plant operators who receive the market premium must pay to service providers for direct distribution of electricity. This fee is omitted when the feed-in tariff is laid claim to.

EEG 2017 also stipulates that the federal government must offer forms of advising and support for small actors but does not specify the form it should take.

3.4 Better conditions possible for tenants' electricity supply projects

Finally, EEG 2017 defines better conditions for tenants' electricity supply projects. The law gives the government power to enact secondary legislation, which the federal government must then implement. The goal is to exempt projects in which tenants of multi-family buildings draw energy from on-site installations from having to pay the full EEG surcharge. Previously, the situation has been lopsided, with tenants drawing on-site electricity under 10 kW completely exempt from the EEG surcharge and those drawing on-site electricity over 10 kW only partly exempt (65% now, 50% starting on 1.1.2017) from the EEG surcharge. The same is true for companies who generate electricity on site for their own needs. The new regulation gives them the same sort of conditions as those received by tenants' electricity supply projects.

4 How does grid expansion relate to renewables expansion?

EEG 2017 and the Electricity Market Act contain various instruments to better coordinate planning for grid expansion and for renewables expansion. The need for better coordination arose from the criticism that a network expanded “until the last kilowatt hour” is neither fair for residents affected by the new power lines nor economically efficient. The new regulatory changes also seek to address considerable delays in grid expansion, which has plagued the projects planned in 2009 Power Grid Expansion Act (*Energieleitungsbaugesetz*, EnLAG) and the projects described in the 2015 Federal Requirement Plan Act (*Bundesbedarfsplangesetz*, BBPIG). Of the almost 8,000 kilometres of high-voltage power lines planned, only around 700 kilometres have been built as of the first quarter of 2016.¹⁰ These pieces of legislation provide three answers to these challenges. First is the rejection of the previous approach (“until the last kilowatt hour”) in network planning. The second is the rejection of another previous approach: expanding renewable energy without regional oversight. The third is that power from renewables in areas of grid congestion should be deployed for district heating networks (as power-to-heat) if power would otherwise have to be curtailed. Moreover, regulations for the expanded use of underground power lines – meant to accelerate grid expansion – were introduced as part of the Federal Requirement Plan Act.

4.1 Expansion of underground power lines

At the end of December 2015 the current Federal Requirement Plan Act came into effect. It contains a total of 43 pilot projects for expanding transmission grids in Germany. Of them, 17 are regional or international in scope. An important change provided by the act is the expansion of regulations on the use of underground power lines. The act stipulates that high-voltage DC transmission lines must now be run underground instead of via transmission towers. In addition, AC grid expansion projects also have the option of using underground lines in sections. The idea is to test the use of underground lines in the AC transmission grid as part of these projects. Currently, underground power lines are used almost exclusively for medium- and low-voltage power. The advantage of underground lines over transmission towers is the lower visibility, which increases acceptance and in some cases accelerates realisation by eliminating potential legal action. Yet the use of underground power lines can – depending on location, cable length, soil consistency, and transmission technology (AC or DC) – lead to considerable additional costs over transmission towers.

4.2 Peaking shaving: an instrument for grid planning

The Electricity Market Act has introduced a new instrument for grid planning: so-called peak shaving. Previously, the grid expansion followed the premise that the grid should be geared towards the needs of all users. This means that infrequently occurring feed-in peaks from wind turbines or PV installations were responsible for dimensioning expansion. The new approach allows transmission system operators to design the expansion in a way that makes economic sense. The new Energy Industry Act implements this on two levels. On the one hand, the

¹⁰ The Federal Requirement Plan Act (BBPIG) currently calls for power lines totalling 6,100 kilometres in length. The Power Grid Expansion Act (EnLAG) contains plans for 1,800 additional kilometres. Of these, 65 kilometres from the BBPIG and 600 kilometres from the EnLAG have been erected, totalling around 700 kilometres of the 8,000 kilometres that are planned (BNetzA (2016)).

legislation gives distribution system operators more flexibility when planning the grid expansion. Operators now have the option of factoring in 3-per cent peak shaving for onshore wind and solar installations directly connected to their grids. The term “3-per cent peak shaving” means that the projected annual power generation per facility may be reduced by up to 3 per cent. On the other hand, the legislation *requires* that transmission system operators apply this peak-shaving factor when developing reference scenarios. The calculations for the grid development plan must also apply the 3-per cent rule.

4.3 Limits for additional onshore wind turbines in grid expansion areas

There are regions in Germany today in which transmission systems are under significant strain. This is often accompanied by grid congestion, throttling-down measures such as redispatching, and feed-in management for renewable energy installations. The new control instrument in the amended EEG focuses on production. The instrument limits the creation of additional onshore wind turbine in places where the transmission grids are nearly overloaded. The federal government will pass a directive by March of 2017 determining the network expansion areas for which the new regulation applies. To qualify, a grid expansion zone must be a contiguous region, may make up no more than 20 per cent of Germany’s surface area, and must be delineated along existing grid or district lines. Furthermore, it must be clear that added onshore wind capacity in the area will create an especially strong load on the transmission grid or exacerbate already existing load. Further criteria for defining a grid expansion area are the likely extent to which wind energy feed-in will have to be ramped down and the potential for adding onshore wind turbines. The government directive will then set a cap for additional capacity in the grid expansion area that can be bid on during competitive tendering in a given year. This cap equals 58 per cent of the average yearly additional onshore wind capacity put into operation between 2013 and 2015. The maximum bidding vol-

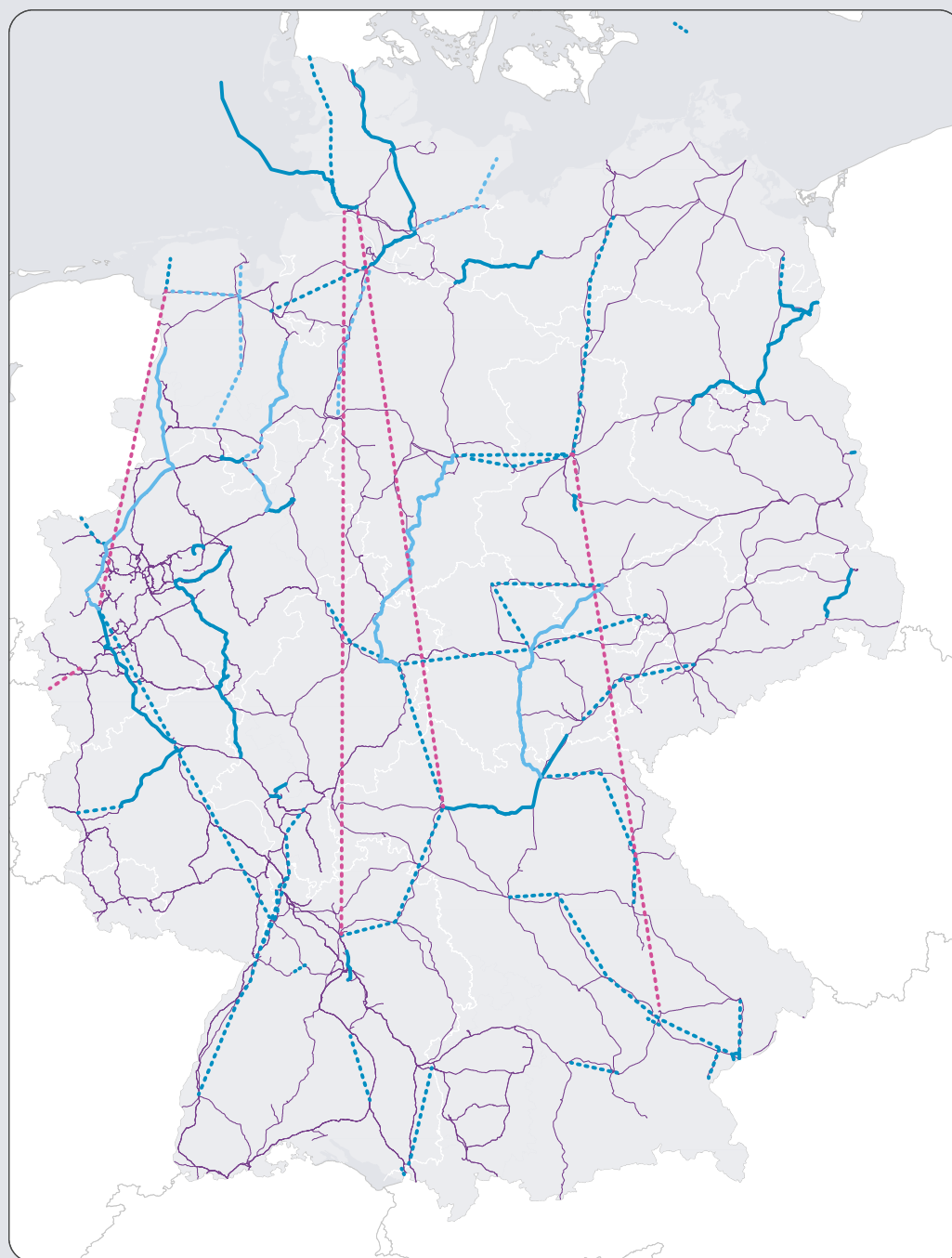
ume in the grid expansion area for the calendar year will then be evenly distributed among all auctions held that year. The defined grid expansion areas and their limits on added capacity will be evaluated by the Federal Network Agency at the end of July 2019 and then assessed every two years.

4.4 Power-to-Heat in CHP plants for eliminating grid congestion

In many regions of Germany, especially in Schleswig-Holstein, electricity from renewables must be periodically ramped down due to grid congestion, even as CHP plants continue to produce electricity from coal or gas and emit CO₂ in order to meet local heating needs. A new regulation in the Energy Industry Act stipulates that transmission system operators can sign agreements with CHP operators in grid expansion areas requiring that they ramp down their own electricity production and instead use renewable electricity to generate the needed heating via a power-to-heat facility. For a given grid expansion area, these agreements can total up to 2 gigawatts of reduced electricity production from CHP plants. To participate, CHP plants must be able to contribute affordably and efficiently to the elimination of grid congestion. Moreover, as noted, CHP plants must be located in a grid expansion area (see above), and must have been put into operation before 2017 and have an installed electrical capacity of at least 500 kilowatts. In return for their cooperation, CHP operators receive a one-time payment for the investment costs in a power-to-heat facility, an appropriate remuneration for reducing their electricity feed-in, and a rebate on the additional electricity they draw from the grid. The duration of the agreement is at least 5 years. Should transmission system operators require the full 2 gigawatts provided by law but cannot reach it in a given grid expansion area via agreements with CHP plants, the federal government must submit a proposal for a supplementary legal directive. This directive would then allow other technologies to ramp down their loads to help eliminate interruptions or dangers from high-voltage grid congestion.

Power line projects listed by the Federal Requirement Plan Act and the Power Grid Expansion Act

Figure 2



- Underground DC power line
- Underground AC power line
- Dotted line = linear distance
- Transmission towers
- Existing grid

Source: Agora Energiewende; based on Bundesnetzagentur (2016)

5 What is the basic idea of the new Electricity Market Act?

5.1 Recouping investment in new capacity via price spikes on the electricity market

The Electricity Market Act aims to ensure a reliable, cost-efficient, and environmentally friendly power supply as part of a modernised electricity market. The advances to the electricity market involve two power market segments: the energy-only market, in which quantities of electricity (in the form of megawatt hours) are traded for different delivery times, from 15 minutes to years in advance; and the reserve markets, which provide standby megawatt capacity for the energy-only market to exclude supply shortages.

One basic idea of the new legislation is to create stronger price signals for producers and suppliers on the energy-only market. To do this, power prices must reflect their true market value. That is to say, when electricity is in very short supply during a certain hour, prices should spike. This, in turn, creates incentive to activate peaking power plants or to reduce electricity demand.

For the most part, planned adjustments to the balancing energy market and the balancing energy mechanism will strengthen the price signals. The balancing energy mechanism sets the fines when producers and suppliers deviate from their reported power schedules.¹¹ The revised electricity market regulations stipulate that the price for balancing energy can jump as high as 20,000 euros per megawatt hour in times of extreme shortages, such as when buyers are

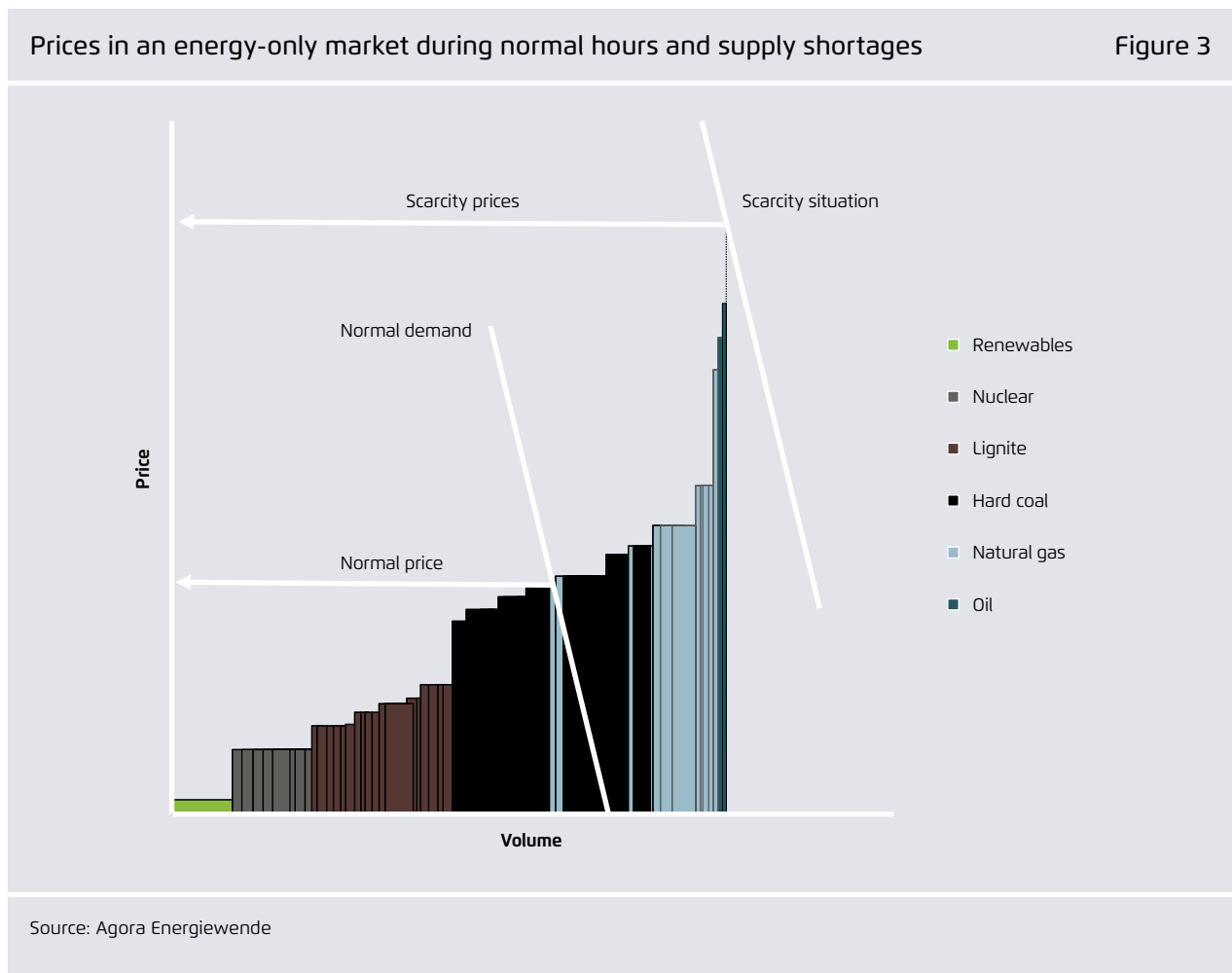
willing to pay for power on the market but can find no suppliers (leaving markets with leftover demand).¹² By comparison, the electricity price on the power exchange in 2015 averaged around 32 euros per megawatt hour.

In an energy-only market, investments in new peaking power plants typically occur when prices frequently spike due to supply shortages. These prices are caused when generation is at full capacity and demand exceeds supply. The resulting price is not determined by the short-term production costs of the last available power plant but by the costs for the consumers who forgo the electricity. (Figure 3 illustrates spiking energy prices when supply is low.) Revenues from high prices can be used to recoup investment in peaking plants, which are deployed only several hours a year but generate high margins in these hours. If prices spike frequently, they create an incentive for the construction of new power plants or for investment in load shifting measures on the demand side.

Price spikes from supply shortages depend on several factors: price formation on the electricity market must be free and unrestricted by regulatory ceilings (a basic principle underlying the Electricity Market Act); electricity market demand must respond flexibly to price signals so as to allow for market equilibrium (the new legislation eliminates some of the barriers to flexibility but by no means all of them; see question 6); the availability of conventional power plants must be limited; the feed-in from renewables must be limited due to weather; and demand must be very high (as on very cold winter evenings).

¹¹ Electricity producers and suppliers form balancing groups to manage their supply and usage profiles and register them with transmission system operators. Whenever the reported schedules differ from actual feed-in and output, transmission network operators must offset the discrepancy using balancing energy. The balancing groups must compensate for the resulting costs by paying a fine.

¹² When capacity reserves are used (see below), the balancing energy price increases to twice the technical price ceiling on the intraday market. Currently, the retrieval of reserve energy would mean an energy price of at least 20,000 euro per megawatt hour.



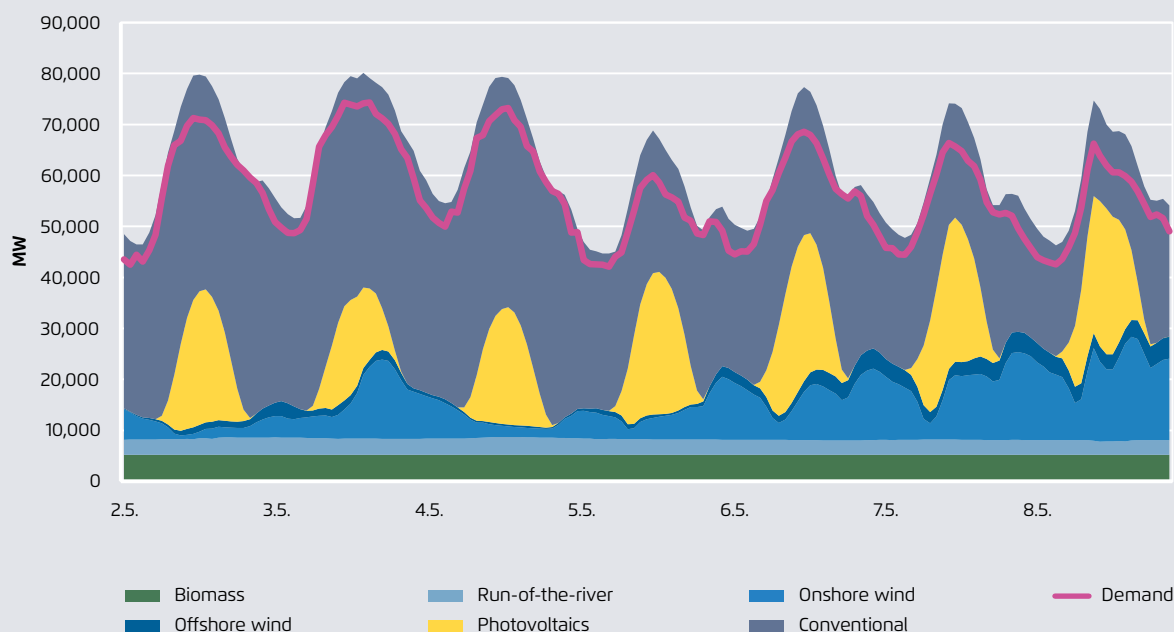
Due to these variables, investments that rely on the added revenue from price spikes face great uncertainty. As a result, it is impossible to guarantee that the electricity-only market can generate sufficient capacities in all situations and to preclude load shedding and brownouts. In situations where capacities do not suffice, the second segment for electricity market reform comes into play: the reserve markets. (For more, see question 6).

5.2 More electricity market flexibility for improving wind and PV integration

As wind power and PV gradually become the central pillars of Germany's power supply, flexibility required for handling intermittent renewables has become the power system's new guiding principle. The part of power supply that can be managed (adjustable power plants, flexible demand, energy storage) serves as a kind of mirror for energy levels from wind and PV. When feed-in from these renewables is high, the rest of the system must "power down"; when feed-in is low, the rest of the system must either quickly increase feed-in or reduce demand (Figure 5). Electricity market regulations play a decisive role in fostering flexibility.

Power generation and usage in Germany, 2 to 8 May 2016

Figure 4



Source: Agora Energiewende; The flexibility requirements of the power system result from the fluctuating power generation from wind and PV. For instance, between 3 pm and 9 pm on Wednesday, 4 May, conventional power plants had to increase their share of the power supply from 53 per cent to 81 per cent. By 3 pm on Thursday, they had to reduce their power share to 29 per cent.

To make the electricity market more flexible, entry barriers to the balancing energy market must be eliminated for load shifting and renewables. The only specific measure stipulated in the Electricity Market Act is allowing special service providers to sell load-shifting potential to the balancing energy market from another balancing group. Other measures have not yet been designated.¹³

At the same time, Germany's Federal Network Agency is authorised to reorganise the pricing models and pay for some of the provision costs of balancing energy by raising its prices as well as by using grid fees. Both are meant to allow stronger price spikes in the short-time day-ahead and intraday markets during supply shortages.

¹³ Other barriers include the lead times for balancing energy products and their run times. Currently, lead times can take weeks and have run times of up to 48 hours. Both restrict the efficient creation of flexibility. A switch to shorter-run products (daily auctions, hourly products) is not provided for in the new legislation. The Federal Network Agency has begun a consultation procedure on the design of the balancing energy market.

6 How do the standby reserves work to safeguard the electricity market?

The Electricity Market Act provides for three partly interlinked reserves to meet market demand when power supply is low: the grid reserve, the capacity reserve, and the lignite standby reserve.

The reserves are meant to address political fears (which may or not be well founded) that an advanced energy-only market might lack capacities for meeting demand (see question 5). (It should be noted that reserves do not reduce risks for market participants, who face multiple uncertainties.¹⁴) In addition to allaying fears, the grid reserve has the primary purpose of alleviating north-south grid congestion in Germany, while the lignite emergency reserve mainly contributes to climate protection efforts.

6.1 Capacity reserve

The capacity reserve safeguards the electricity market when transmission system operators notice that demand exceeds supply. Starting in the winter of 2018/19, 2 gigawatts will be placed on reserve. Every two years after, the Federal Ministry for Economic Affairs and Energy will review the quantity of reserve volume and adjust it when necessary. The capacities are put out to tender and based on the results are paid as cleared annually. The costs are then passed on to consumers via grid fees. If the capacity reserve is activated, however, then those markets in which demand could not be covered by sufficient purchases of supply are “punished” with

high balancing energy prices (20,000 euros per megawatt hour; see question 5). Electricity from plants that are part of the capacity reserve may not be sold on the market. Moreover, power plants cannot re-enter the electricity market after leaving the capacity reserve system. This prevents the capacity reserve from indirectly affecting electricity market prices.

6.2 Grid reserve

The grid reserve, enacted into law in 2012, provides extra power when congestion prevents enough electricity from passing from northern Germany to southern Germany. In this way, it ensures reliable grid operation in southern regions. The grid reserve is made up in part of power plants in southern Germany and in neighbouring countries that would otherwise be non-operational or shut down. Each year, the Federal Network Agency sets the capacity of the grid reserve based on a report submitted by the transmission system operators. The most important parameters are the volume of capacities available on the market in southern Germany and status of network expansion. For winter 2016/17, the Federal Network Agency set aside 5.4 gigawatts for the reserve. By 2018/19 that number is expected to fall to around 1.9 gigawatts on account of the new power lines – in particular, the Thuringia Electricity Bridge – that will have been installed by then. Should the grid reserve be unable to be covered by existing power plants, the Electricity Market Act provides for up to 2 gigawatts of new plants to be erected for the grid reserve. The need for more plants will be assessed in January of 2017, with any competitive bidding to open in April of 2017. Operators of the new plants must ensure that they will be up and running by the winter of 2021/22.

The grid reserve is linked with the capacity reserve. The plants of the grid reserve can take part in bidding

¹⁴ For instance, participants do not know whether prices during shortages will be high enough to recoup investment in new plants. This is why some markets such as that of the United Kingdom or Texas feature mechanisms that artificially raise ceiling prices shortly before supply shortages occur, ensuring sufficient investment security. A capacity reserve alone has no influence on investment security; it merely provides standby capacities when market demand exceeds supply.

for capacity reserve and used accordingly. (Payment occurs exclusively within the framework of the capacity reserve.) It is likely that the grid reserve will be phased out once grid congestion in Germany is eliminated.

6.3 Lignite Standby Reserve

The new Electricity Market Act also places several old lignite-fired power plants with a total capacity of 2.7 gigawatts on standby reserve. The transfer will take place gradually over three years beginning in October of 2019. The plants will remain on emergency reserve for 4 years and subsequently shut down for good. To increase supply security, the power plants must, at the behest of transmission system operators, be made ready for operation within 10 days, or 240 hours.

The emergency reserve is the last resort for ensuring supply security. The plants receive a remuneration funded by grid fees. The costs for the lignite emergency reserve is estimated at around 1.6 billion euros. Many experts doubt whether lignite standby reserve will ever be put to use.

7 How will the lignite standby reserve affect climate protection efforts?

The primary function of the reserves provided for by the Electricity Market Act is to safeguard the energy-only market. The lignite standby reserve has the additional function of aiding climate protection efforts (see question 6).

By introducing the standby reserve, Germany was aiming for a 40-per cent reduction in greenhouse gas emissions from 1990 levels by 2020. In the fall of 2014, a forecast for 2015 indicated that Germany would fall short of this target by around 6 to 7 percentage points

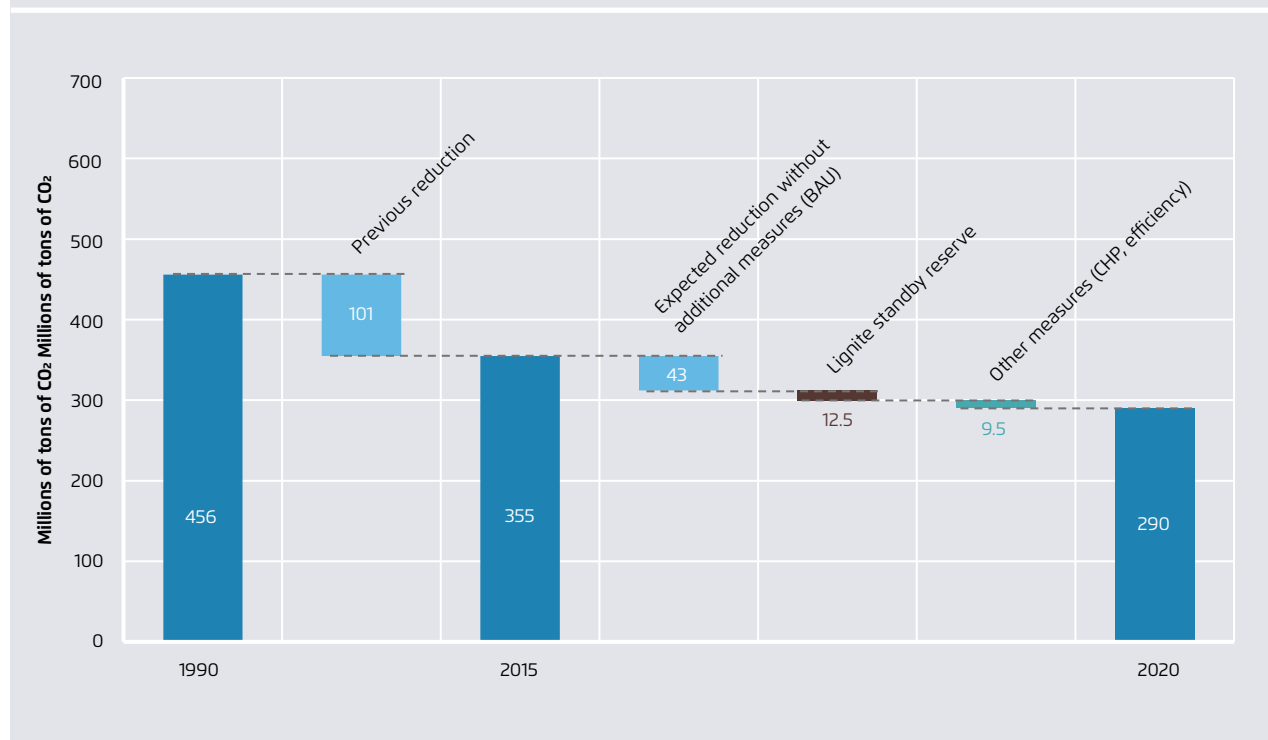
unless additional measures were passed. The following December the government proposed the Climate Action Programme 2020, which set forth additional measures in all sectors to close the projected gap.¹⁵ The programme wants to cut an additional 22 million tons of CO₂ in the electricity sector relative to the reference scenario by 2020.¹⁶ Somewhat more than half of these

¹⁵ See BMUB (2014): Aktionsprogramm Klimaschutz 2020.

¹⁶ The electricity sector includes emissions from electricity production and emissions from CHP generation.

CO₂ emissions in the electricity sector, 1990–2020, and the effects of additional climate measures included in the Climate Action Programme 2020

Figure 5



Source: BMUB (2014), Öko-Institut (2016), Agora Energiewende

22 million tons should be eliminated by the transfer of 2.7 gigawatts of power from lignite-fired power plants to emergency standby reserve.¹⁷

If by mid 2018 it becomes likely that CO₂ savings from the lignite standby reserve will lie under 12.5 million tons, the operators of lignite-fired plants must, together with the Ministry for Economic Affairs and Energy, define further suitable climate protection measures to cut CO₂ in the lignite industry (up to 1.5 additional million tons). The other 9.5 million tons of cuts in the electricity sector provided for in the climate action programme are to be met with stronger funding for CHP and additional efficiency measures.

¹⁷ The 12.5 million tons are projected net savings. This means that the additional emissions expected from fossil-fuel-fired power plants to compensate for the lignite plants placed on reserve have already been factored in.

8 Where and when will smart meters be installed?

The *Energiewende* will bring a strong rise in the number of actors that interact across all areas of the power system – from production and transmission to consumption. Currently, around 1.5 million PV installations and 26,000 wind turbines directly supply power to the distribution grid at high, medium, and low voltage. There are four transmission grid operators and 880 distribution grid operators responsible for reliable and efficient grid operation. Reliable and efficient operation is more important than ever before due to the complexities of handling bidirectional power exchange, a result of the increasing share of electricity from decentral, fluctuating generation. At the same time, consumers will become more active – for example, through the deployment of energy-efficient appliances or the provision of flexible loads. In the future, variable utility service rates and the visualisation of electricity usage will provide important incentives for steering consumer behaviour. As the importance of power system coordination increases, so do the requirements for metering, communication, and monitoring, bringing with them enormous amounts of grid, production, and usage data. The **Act on the Digitisation of the Energy Transition** sets forth the rollout of smart-meter devices needed for proper coordination.

A smart meter is an electronic device that measures power usage and grid use times. A smart-meter gateway connects the device with other smart meters and other parts of the power system such as renewable energy installations and CHP plants.¹⁸ Due to the sensitivity of the data, the communication network linking the smart meters must be reliable and secure.

German legislation defines different implementation periods for smart meters depending on the generation and usage class (Table 1). In most cases, demand over 6,000 kilowatt hours requires the installation of a smart meter. Most private households use less than this, so are exempted from this requirement. The average four-person family uses around 4,200 kilowatt hours a year. (These households won't be required to replace their mechanical meters with smart meters until 2032.) Smart meters are also required in new construction and in buildings that have undergone major renovation.

Customers who use less than 6,000 kilowatt hours have the option of installing a smart meter. Since the additional benefit of smart meters for households with small demand levels is low, the annual fee for using the device is capped at a relatively low rate relative to standard charges. For instance, households that consume up to 2,000 kilowatt hours annually pay only 23 euros per year; households that use between 2,000 and 3,000 kilowatt hours pay 30 euros per year; households that pay between 3,000 and 4,000 kilowatt hours pay 40 euros per year; and households that use 4,000 to 6,000 kilowatt hours pay 60 euros per year. Examples of optional use include property owners who equip an entire building with smart meters as part of a modernisation project, or when meter operators decide to equip every house on a given street. In both these cases, permission from end consumers is not required. Individual consumers may voluntarily decide to install smart meters (for example, to take advantage of variable tariffs). But when smart meters are installed voluntarily, the caps on yearly charges do not apply.

Consumers who use more than 6,000 but less than 10,000 kilowatt hours per year have, starting in 2020, 8 years to install a smart meter. Consumers who use

¹⁸ German legislation refers to smart meters as "intelligent metering systems."

more than 10,000 but less than 100,000 kilowatt hours per year have 8 years beginning in 2017. Users with very large demands of over 100,000 kilowatt hours per year have 16 years from 2017. The reason customers in this usage class are granted a longer implementation period is because they are already equipped with consumption metering devices (*registrierende Lastgangmessung*, or RLM) that can be used for visualisation, variable tariffs, and balancing area coordination (*Bilanzkreistreue*).

Another area of smart-meter implementation concerns controllable devices (*steuerbare Verbrauchseinrichtungen*). These devices are subject to the flexibility mechanism described in § 14 a of the Energy Industry Act (*Energiewirtschaftsgesetz*, or EnWG): in return for reduced grid fees, end consumers (typically

large industrial customers) agree to let these appliances be switched off whenever grid supply becomes critical. Devices under this agreement must have smart meters installed in 2017.

A special case for smart meters is electric vehicles, because metering systems for recording energy usage can be installed in them directly. Electric vehicles are exempted from the requirements of the Act on the Digitisation of the Energy Transition until the end of 2020.

Operators of facilities that produce electricity must install smart meters when output exceeds 7 kilowatts. The idea is that larger facilities have potential benefits for the power system as a whole. As with customers, there are different fee caps for electricity producers.

Implementation period for smart-meter rollout by usage and production

Table 1

	Usage class	Implementation period
Usage	Usage ≤ 6,000 kWh/a	Optional installation of smart meters with capped annual fees; modern metering devices must be installed by 2032
	6,000 kWh/a < usage ≤ 10,000 kWh/a	Installation by 2028 (starting in 2020)
	10,000 kWh/a < usage ≤ 100,000 kWh/a	Installation by 2025 (starting in 2017)
	Usage > 100,000 kWh/a	Installation by 2033 (starting in 2017)
	Controllable appliances as described in § 14 a of the Energy Industry Act (EnWG).	Installation before participation in flexibility mechanism described in § 14 a of the Energy Industry Act (EnWG).
Production	Output > 7 kW	Installation by 2025 (starting in 2017)
	Output > 7 kW	Optional smart meters with capped annual fees; modern metering devices must be installed by 2032

Source: Agora Energiewende

9 What does the new legislation mean for the economy and for society?

9.1 Is security of supply ensured?

Yes. Power system reliability in Germany is extraordinarily high by international standards. In 2014, power outages for customers averaged only 12.2 minutes. Following a “belts and suspenders” approach, Germany’s new Electricity Market Act (*Strommarktgesetz*) has installed three partly inter-linked emergency reserves for ensuring power supply: a grid reserve, a capacity reserve, and a lignite standby reserve. Together, these reserves are very likely to prevent future widespread blackouts.

It is doubtful whether existing lignite-fired plants held on standby reserve will ever be used in view of existing power station overcapacity and other grid and capacity reserves. The lignite standby reserve is more of an environmentally motivated closure premium than a supply security instrument.

9.2 How are costs for funding renewables shaping up?

As in the past, **average feed-in tariffs for new renewable energy plants** are expected to continue their decline as technology costs sink. Competitive tendering will also lead to a reduction in any excessively expensive land leases for renewable energy installations.

The reference scenario provided by Agora’s EEG Surcharge Calculator¹⁹ expects the feed-in tariff for onshore wind farms to drop from its 2015 level of 9.0 cents per kilowatt hour to 5.4 cents by 2035. It also projects significant cost reductions in offshore wind farms, reducing feed-in tariffs from 19.7 cents per kilowatt hour in 2015 to 11 cents by 2035. Average feed-in tariffs for PV is expected to decline by 11.2 cents per kilowatt hour relative to 2015 levels, settling at around 8 cents per kilowatt hour on average.

¹⁹ See Öko-Institut (2016).

Average feed-in tariffs for new plants (ct2016/kWh) in the reference scenario

Table 2

	Ø Bestand bis 2014	2015	2025	2035
Onshore wind	9,3	9,0	7,4	5,4
Offshore wind	18,1	19,7	14,5	11,1
Photovoltaics	31,2	11,2	10,5	8,5
Biomass	18,0	18,0	16,2	14,7
Geothermal power	24,2	25,6	19,9	15,4
Hydropower	9,0	11,9	11,4	10,8
Ø Plant average	17,0	15,0	10,8	8,2

Source: Öko-Institut (2016)

These projected tariff values are conservative because they do not factor in additional savings resulting from auction system, where competitive tendering is likely to further reduce the costs of individual technologies. Based on the effects of similar systems for offshore wind farms in Denmark and the Netherlands as well as on the initial results of PV auctions in Germany²⁰ the following years can be expected to see considerable drops in generating costs for electricity (Figure 6).

Despite the sinking feed-in tariffs for new plants, the introduction of additional capacity and the ongoing payment obligations for pre-existing plants will raise total **annual remuneration costs for renewable energy** from its 2015 level of 27 billion euros to 32 billion at the beginning of 2020. From that point on, the costs will drop to around 20 billion per year in

2035 as the 20-year funding periods for old, highly subsidised plants come to an end.

9.3 How are electricity prices and the EEG surcharge shaping up?

Energy exchange prices (*day-ahead, base*) are historically low, around 27 euros per megawatt hour as of August 2016.²¹ This situation will not change significantly in the short term. In August, Phelix base year futures for 2019 were selling at only around 28 euros per megawatt hour.²²

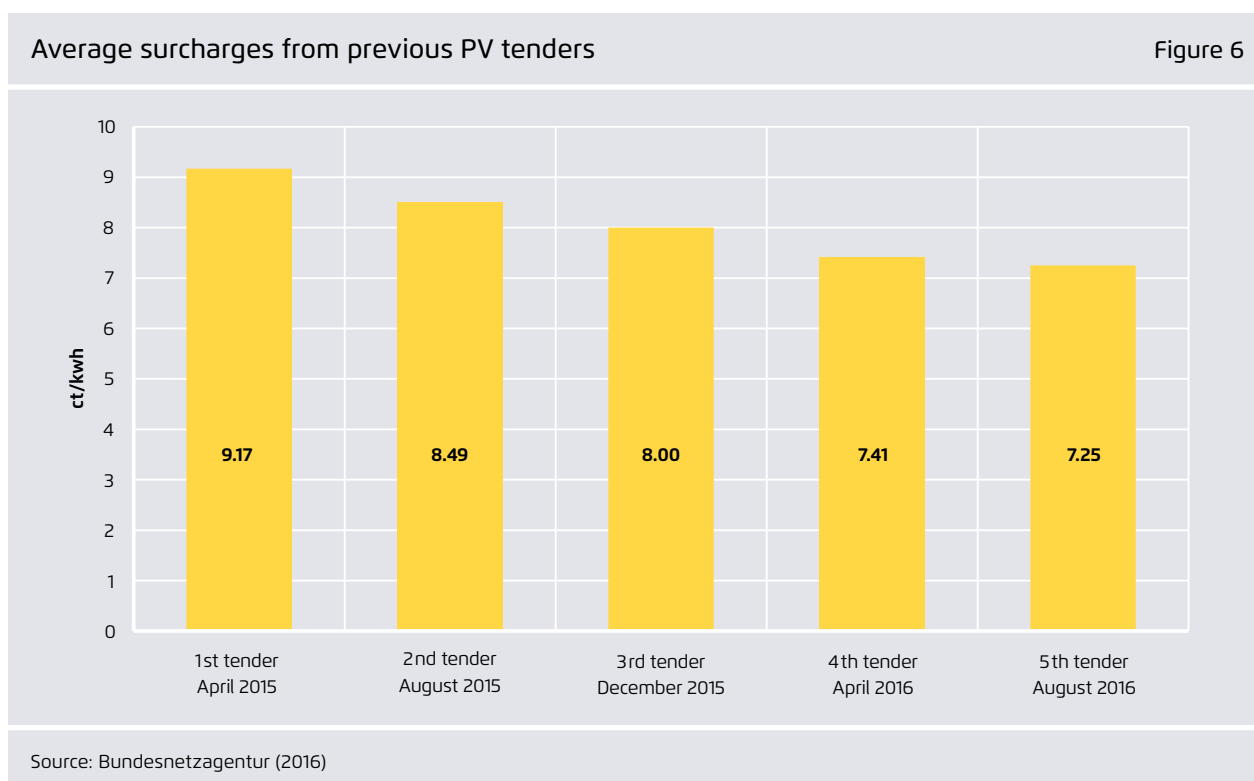
The low energy exchange prices are the result of a combination of factors:

- Low commodity prices for hard coal, natural gas, and carbon allowances

20 See Bundesnetzagentur (2016): Ausschreibungen zur Ermittlung der finanziellen Förderung von PV-Freiflächenanlagen.

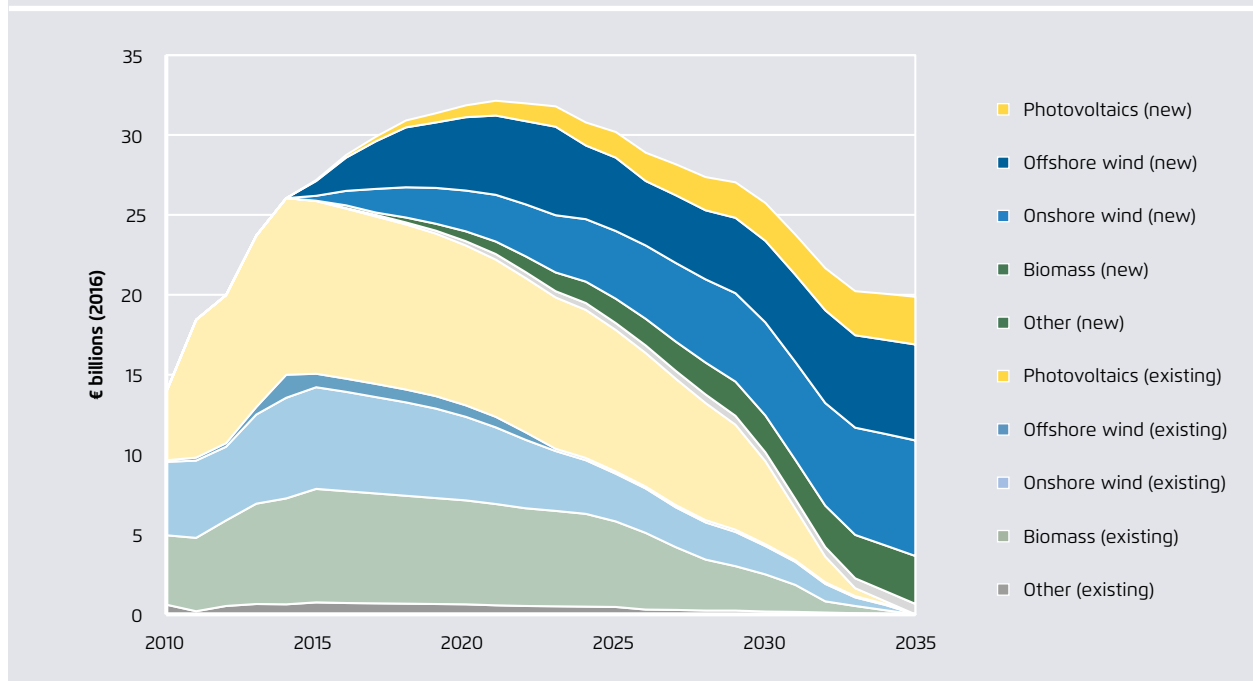
21 See EPEX Spot (2016): EPEX SPOT power trading results of August 2016.

22 See EEX (2016): Phelix Power Futures: Phelix Base Year Future.



Costs for funding renewable energy, 2010–2035

Figure 7



Source: Agora Energiewende, based on Öko-Institut (2016); starting in 2016, values are projected

- Increasing power generation from renewable energy
- Significant overcapacities in conventional power plants

The low energy exchange prices have brought advantages for large power users (especially for energy-intensive industries) that draw electricity directly from the power exchange and pay reduced fees and surcharges. By contrast, operators of conventional power plants have come under more and more pressure, with revenues sinking and many facilities operating under capacity.

In the medium term, a consolidation of the power supply is likely because overcapacities will gradually diminish as a result of the current system for competitive bidding. In accordance with the basic idea of the Electricity Market Act, scarcity and high energy exchange prices will occur more frequently for certain hours, which improves the revenues of

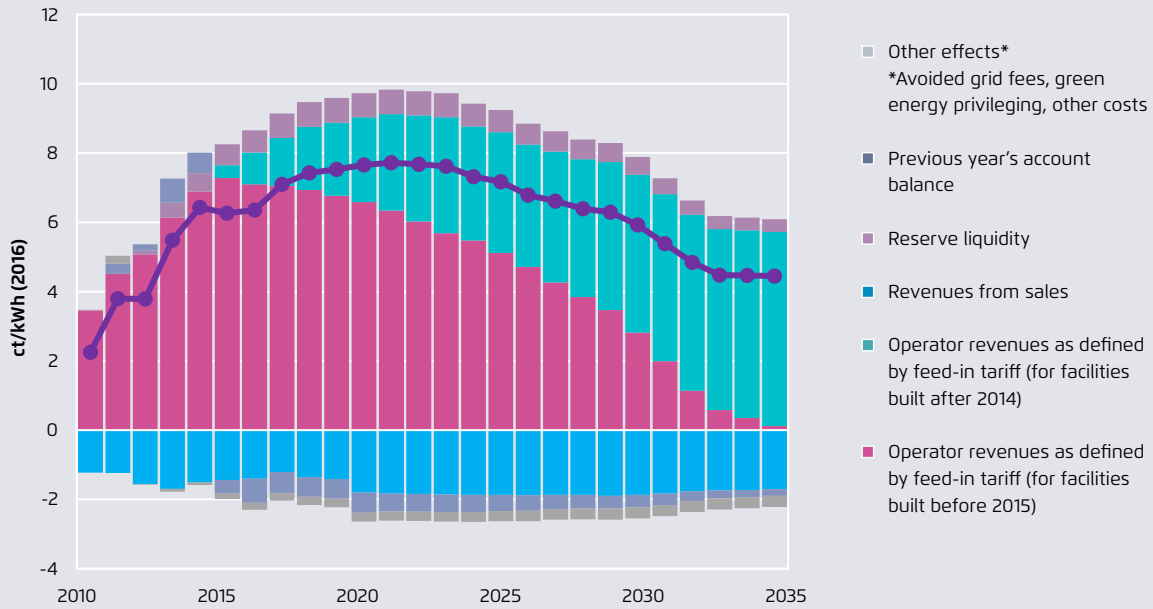
power plants that remain on the market. On account of the additional capacity from renewables, the average energy exchange price will in all likelihood remain at a moderate level. Agora's EEG reference scenario assumes that the energy exchange price will stabilise in the medium term at around 35 euros per megawatt hour.

The **EEG surcharge** is used to transfer the costs of funding renewable energy – after subtracting revenues from selling the electricity on the power exchange – to power users.²³ Like funding costs, the EEG surcharge will continue to rise until the beginning of the 2020s and settle at around 7.7 cents per kilowatt hour. As a result of sinking feed-in tariffs and the ending of the funding period for old plants, the EEG surcharge will sink considerably in the long

²³ Also considered are the costs for the liquidity reserve, the EEG account balance, and other effects such as avoided grid fees.

EEG surcharge and its most important determining factors, 2010–2035

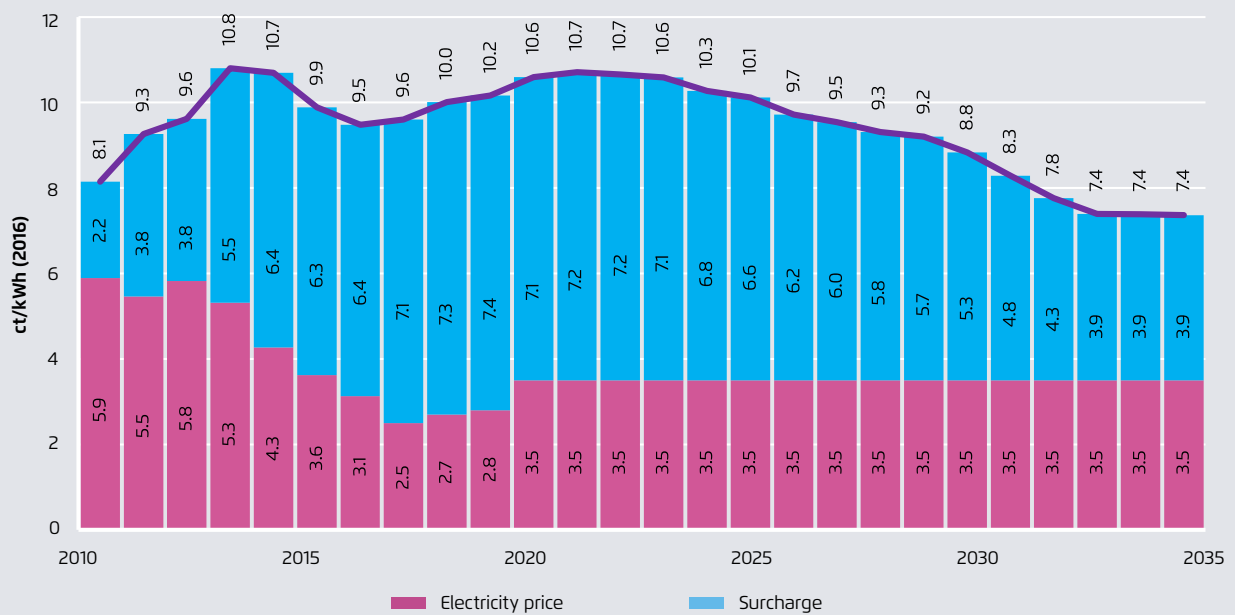
Figure 8



Source: Agora Energiewende, based on Öko-Institut (2016); starting in 2017, values are projected

Sum of energy exchange prices (Phelix Base Year Future) and the EEG surcharge, 2010–2035

Figure 9



Source: Agora Energiewende, based on Öko-Institut (2016); starting in 2017, values are projected

run and by 2035 reach a level of around 4.5 cents per kilowatt hour (Figure 8).

Accordingly, prices for end consumers not eligible for special tariffs (such as households) will rise in the next years by around 1 cent per kilowatt hour, reaching its maximum in the early 2020s (Figure 9). Because the **EEG surcharge and the energy exchange price** relate like two communicating vessels – low energy exchange prices mean a higher EEG surcharge and vice versa – electricity prices are mostly independent of energy exchange prices for consumers not exempted from the EEG surcharge.

9.4 What will change for the economy and for consumers?

The EEG 2017 changes neither the additional capacity targets for renewables nor EEG funding nor the exceptions for certain energy-intensive sectors of the economy. Accordingly, it will change little for the economy and for consumers. The most important change for electricity users is the introduction of smart meters. Smart meters will at first only be obligatory for a small minority of private households with an annual electricity consumption of more than 6,000 kilowatt hours starting in 2020. Households have 8 years to have the smart meters installed (Table 1). It is still open whether metering point operators will make use of the option allowing smart meters to be installed in households with under 6,000 kWh, assuming that the annual fees do not exceed the pre-defined limit in such cases. In some regions of Germany where innovative municipal utilities believe that smart meters will offer opportunities for new energy service market, this could be the case despite the relatively low fee ceiling.

Also open is how strongly the planned new regulation on electricity models will be adopted. Much will depend on the contents of the directive by the Federal Ministry for Economic Affairs and Energy, which will not go into effect until 2017.

Lastly, residents affected by power line planning in the transmission grid can rest assured that the new DC lines will not change the landscape as much as in the past, since most will be laid underground. The new planning needed for the underground lines may delay construction for several years.

9.5 What will change for the energy industry?

For large parts of the energy industry, the new set of regulations will have major repercussions. The change from state-defined feed-in tariffs to competitive bidding will bring fundamental changes, especially for investors in wind turbines and PV installations with an installed capacity of 750 kilowatts and for investors in and operators of bioenergy plants with a capacity of more than 150 kilowatts. Investors and project developers will no longer know in advance whether their projects will be realised. Moreover, the new regulations on the "single-level reference yield model" and on restrictions to new installations in grid expansion regions will affect the choice of location for new facilities. For many years now, large numbers of new wind turbines have been erected in northern Germany. Starting in 2019, this expansion is likely to slow considerably. Instead, more wind turbines will be added to central and southern Germany.

For some parts of the traditional energy industry, the new Electricity Market Act has dashed hopes for a capacity market in which power plants could have been paid for providing capacity. Instead, the energy market will continue to function for the most part as before. Nevertheless, the new Electricity Market Act stipulates that high price fluctuations on the energy exchange in times of shortage is not only possible but explicitly desired. Whether this will suffice to trigger investments in new power plants is unclear. Also new is the creation of an initial capacity reserve of 2 gigawatts to be put out to tender and the gradual transfer of lignite-fired power plants with a total capacity of 2.7 gigawatts to emergency standby reserve before

they are shut down for good in four years' time. Both cases involve interventions in the markets for limited volumes of power supply.

It is thus inevitable that sooner or later the market will begin to consolidate and a considerable part of conventional power plants will be shut down because they no longer bring in revenue. The resulting shortages in the electricity market bring additional revenues for power plants that remain on the market. The affected power plant operators will thus find themselves in a strategic dilemma. Those who shut down first will lose because doing so means that competing plants will reap revenue increases. Conversely, those who wait too long run the risk of losing money as their plants take losses. Hence, it is hard to say how market consolidation, regarded by many as necessary, will unfold.

9.6 How will the new regulations affect power system structure and its diversity of actors?

In past years, new actors were the main driving force behind the *Energiewende* in the electricity sector. The fundamental change of the power plant structure allowed many new players to enter the production side. Today, around 1.5 million PV installations and 26,000 wind turbines supply the public power grid with electricity. The amount of renewable energy contributed by German utility companies that have dominated the market in recent years is well below the country's total renewable energy levels, which now makes up close to one third of the generation mix. The future of the *Energiewende* thus depends on the existence of smaller players. Policies must be in place to ensure that those who did the most to add renewable capacities in past years can continue to do so in the future. At the same time, those policies shouldn't make it difficult for large companies to invest more in renewables than they have in the past. Given what's at stake, there has been much passionate discussion about how to maintain a diversity of players in the power system.

EEG 2017 takes this into account by making it easier for energy cooperatives to access the auction system. Whether the new regulations suffice to keep these actors in the game (the new EEG is the first EEG to explicitly define them) will only be clear after the first auction rounds have been concluded. The five pilot PV installation auctions that took place between 2015 and August 2016 included small bidders, natural persons, partnerships, and cooperatives, several of whom placed winning bids. EEG 2017 stipulates that only installations with capacities of 750 kilowatts and greater are open for auction; those below that capacity continue to receive feed-in tariffs. Consequently, private operators of small rooftop PV installations are practically unaffected by the new auction system. The regulations also help energy cooperatives remain in the wind sector by helping ease access.

The new Electricity Market Act allows special service providers to sell load shifting potential alongside energy providers in the balancing energy market. This could encourage new business models to emerge in the segment. The new service providers could also benefit from the gradual smart-meter rollout stipulated in the Digitisation of the Energy Transition Act.

10 What do the new regulations mean for current *Energiewende* targets?

10.1 Will renewable energy targets be reached?

EEG 2017 reaffirms the targets for **the share renewables in** Germany's gross electricity consumption set in EEG 2014: 40 to 45 per cent by 2025 and 55 to 60 per cent by 2035. In the past few years, more megawatts have been added to the power system from wind than from PV. EEG 2014 stipulated an increase of 2,400 to 2,600 megawatts per year for each technology. While wind energy performed considerably above target, with a gross added capacity of 4,750 megawatts in 2014 and 3,730 megawatts in 2015, PV energy fell noticeably short, dropping to 1,900 megawatts in 2014 and 1,460 megawatts in 2015. Nevertheless, the total share of renewables in gross energy consumption rose significantly during this time, bolstered in part by added offshore wind energy (529 megawatts in 2014; 2,282 megawatts in 2015²⁴). A similar development, if not as pronounced, is also expected for 2016–2018. Based on the current market trends, the reference scenario created by Agora's EEG Surcharge Calculator projects that on average onshore wind will grow by 3,400 megawatts per year; offshore wind, 950 megawatts per year; and PV, 1,600 megawatts per year. Starting in 2019, the added capacity is expected to accord with auction volumes, minus planned projects yet to be realised, which the EEG Surcharge Calculator estimates to be 10 per cent of the added capacity put out to tender for onshore wind and PV. (See Question 1.)

Whether this added capacity is enough to meet the climate targets as well as the medium-term renewable targets of 40 to 45 per cent by 2025 and 55 to 60 per cent by 2035 mostly depends on progress made in efficiency and sector integration, both of which will affect electricity consumption.

- If future increases in energy efficiency roughly balance out future increases in sector integration from new electricity applications (electric vehicles, heating), electricity demand will remain more or less at current levels through 2035. In this case, the share of renewables in gross electricity consumption would be 44.8 per cent in 2025 and 53.0 per cent in 2035. This result would meet the upper target range for renewables but fall short for the target range in 2035 (Figure 10). One must consider, however, that in the business-as-usual case (currently projected), increases in energy efficiency and electrification beyond traditional applications will be minor, which means that the heat and transportation sectors would fail to meet climate targets by significant margins.
- If the spread of electric vehicles and heat pumps is faster than projected in the business-as-usual case and exceeds advances in energy efficiency for traditional electricity use, demand will increase noticeable through 2035 relative to reference scenario values.²⁵ If demand increases by around 0.5 per cent annually starting in 2020, the share of renewables in gross electricity consumption will be 43.8 % in 2025 and 49.6 % in 2035. If demand

24 The leap in added power from renewables between 2014 and 2015 – the total increase was more than four times target levels – is attributable mostly to contributions from new facilities whose connection to the power system had been delayed.

25 An annual 0.5-per cent rise of gross electricity consumption starting in 2020 would yield a total of 630 terawatt hours in 2035. This rate of increase roughly corresponds to a business-as-usual development of traditional electricity demand and to a rise in new demand from sector integration in accordance with the climate model Klimaschutzzenario 80 (Fraunhofer ISI/Öko-Institut [2015]: *Klimaschutzzenario 2050. 2. Endbericht*).

increases by 1 per cent annually starting in 2020, the share of renewables in gross power use will be around 42.8 % in 2025 and only around 46 % in 2035.

With either of these scenarios, it is almost certain that renewables will meet 2025 targets – making up 40 to 45 per cent of the power system – in view of the fact that electricity demand is likely to remain constant. By contrast, the EEG target of 55 to 65 per cent by 2035 will not be met with the added capacity provided for today.

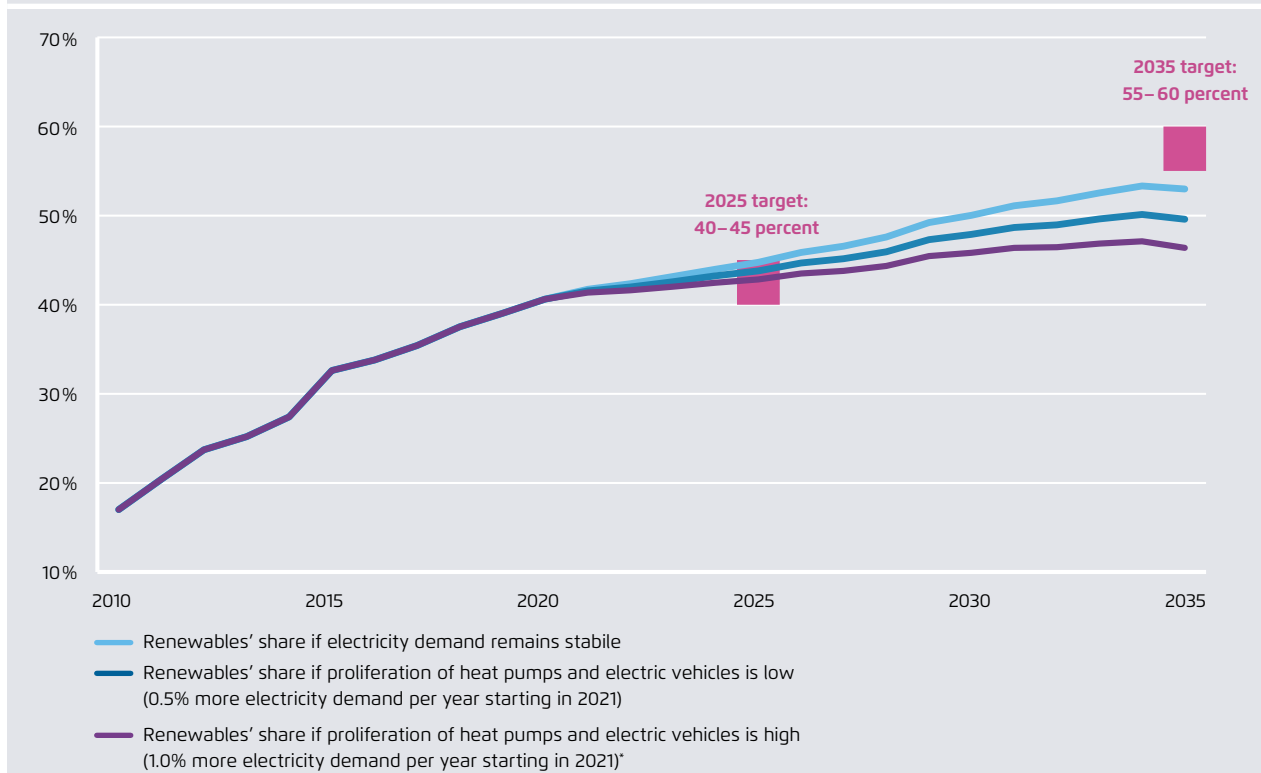
* An annual increase of 1 per cent starting in 2020 would yield a total of 670 terawatt hours in 2035 and correspond to a business-as-usual scenario for traditional electricity use but would follow the model projected by Klimaschutzszenario 95 for new electricity use.

10.2 Will climate targets be met?

The German government's 2020 climate target calls for a 40-per cent reduction of greenhouse gases below 1990 levels. In all likelihood, Germany will fall short of this goal unless further measures are taken. The new environmental legislation enacted in 2016 – the transfer of 2.7 gigawatts of lignite-fired power capacity to emergency standby reserve, the changes to the Combined Heat and Power Act (*Kraft-Wärme-Kopplungs-Gesetz, KWK-G*) as well as EEG 2017 – are far from closing the gap, which in 2014 government officials put at 6 to 7 percentage points. To meet the 2020 target, another 15 gigawatts from coal-fired plants would have to be removed from the power system, accompanied by a similar amount of emissions-lowering measures in the transportation sector.

Projected share of renewables in gross electricity consumption across various scenarios, 2010 to 2035

Figure 10



Öko-Institut (2016), eigene Berechnungen

The situation is similar with Germany's longer-term climate targets. If Germany is to cut greenhouse gases below 1990 levels by 55 per cent by 2030, by 70 per cent by 2040, and by 80 to 95 per cent by 2050, it will have to introduce additional measures drastically reducing emissions in the electricity, heating, and transportation sectors. For instance, reducing greenhouse gases below 1990 levels by 87.5% (the mean of the 2050 target corridor) would require nearly the complete decarbonisation of these three sectors. The reason is that emission cuts in agriculture and in the industrial manufacture of chemicals, steel, and cement are much harder to achieve, with only 60-per cent reductions expected by 2050 in these areas.

policies addressing them collectively. Bringing it about demands not only increased efficiency in the energy sectors but also a considerable expansion of electrification from renewable energy. Their key technologies here are expected to be electric vehicles, heat pumps, and electricity-based power-to-gas and power-to-liquid.

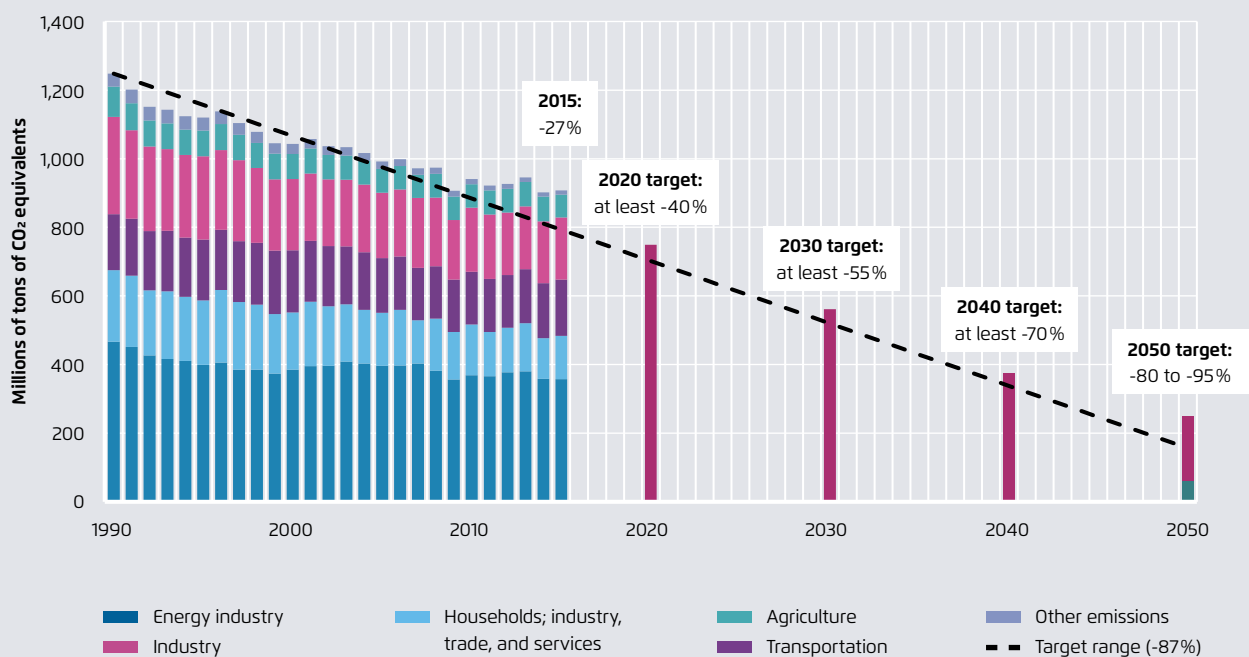
To reach Germany's longer-term climate targets, a rapid reduction of CO₂ in the electricity sector is unavoidable. In addition to increasing energy efficiency, German politicians will quickly have to agree on a roadmap for phasing out coal while introducing considerable added capacity in renewables.²⁶

A near total decarbonisation of the electricity, warmth, and transportation sectors requires more

26 See the plan proposed by Agora Energiewende (2016): 11 Eckpunkte für einen Kohlekonsens.

Greenhouse gas emissions by sector, 1990–2015, and climate targets for 2020, 2030, 2040, and 2050

Figure 11



Source: Agora Energiewende

10.3 What is the future of the Energiewende?

For the most part, the new laws from 2016 discussed in this paper bring to a close the changes in energy transition regulations expected in the current legislative period. The new regulations provide a framework for the next step in the *Energiewende*: increasing the share of renewables above the current 2016 level of around one third.

But already today, it is apparent that crucial decisions will be on the agenda in the legislative period that begins after German parliamentary elections in 2017 – decisions that will determine the future success of the *Energiewende*. Germany's 19th legislative period – from 2017 to 2021 – not only includes the year in which the first major targets are to be met (2020), but also the time when new legislation on renewable energy funding and electricity market design will be passed and decisive courses will be set for 2030. According to new energy policy, the targets for 2030 are lowering greenhouse gases by 55 per cent from 1990 levels and increasing the share of renewables in the power supply by at least 50 per cent. Standing in the way of reaching these goals are many imminent challenges, including the creation of a roadmap for phasing out coal-fired generation with a national coal consensus, creating a system of fees and surcharges, a fundamental reform of EU emissions trading, and a better linking of the electricity, heating, and transportation sectors.

Just as the federal government's 2007 Integrated Energy and Climate Programme defined the main points for 2020, the coming legislative period will pass a package of measures to set the correct course for reaching environmental targets for 2030. As before, the *Energiewende* remains an exciting yet challenging endeavour.

Appendix

How does EEG 2017 fit in with the legislation promoting renewable energy in Germany since 1990?

Since the 1990s, the expansion of renewable energy in Germany has been promoted by a regulatory framework that guarantees reliable conditions for investment to producers of electricity from sun, wind, biomass, hydropower, and geothermal plants. This regulatory framework, the German Renewable Energy Act (EEG) in particular, has been continuously modified over the years. Each new set of rules has sought to stimulate innovation, to speed technological development, especially successful cost degression, and to improve the integration of electricity from renewables into the grids and markets. With each new set of EEG rules, the target for renewables' share in the power system has been raised (Figure 12).

EEG 2000 introduced legislation that built on the Grid Feed-In Act (*Stromeinspeisungsgesetz*, *StromEinspG*) enacted in 1990. It introduced the most important principles for funding renewable power plants: fixed feed-in tariffs for 20-year periods, feed-in priority, privileged grid access, and a degression mechanism. The law aimed to double the share of renewables in electricity consumption by 2010, raising it to at least 12.5 per cent.

EEG 2004 differentiated feed-in tariffs by technology and raised the target share of renewables in the total electricity consumption to at least 20 per cent by 2020.

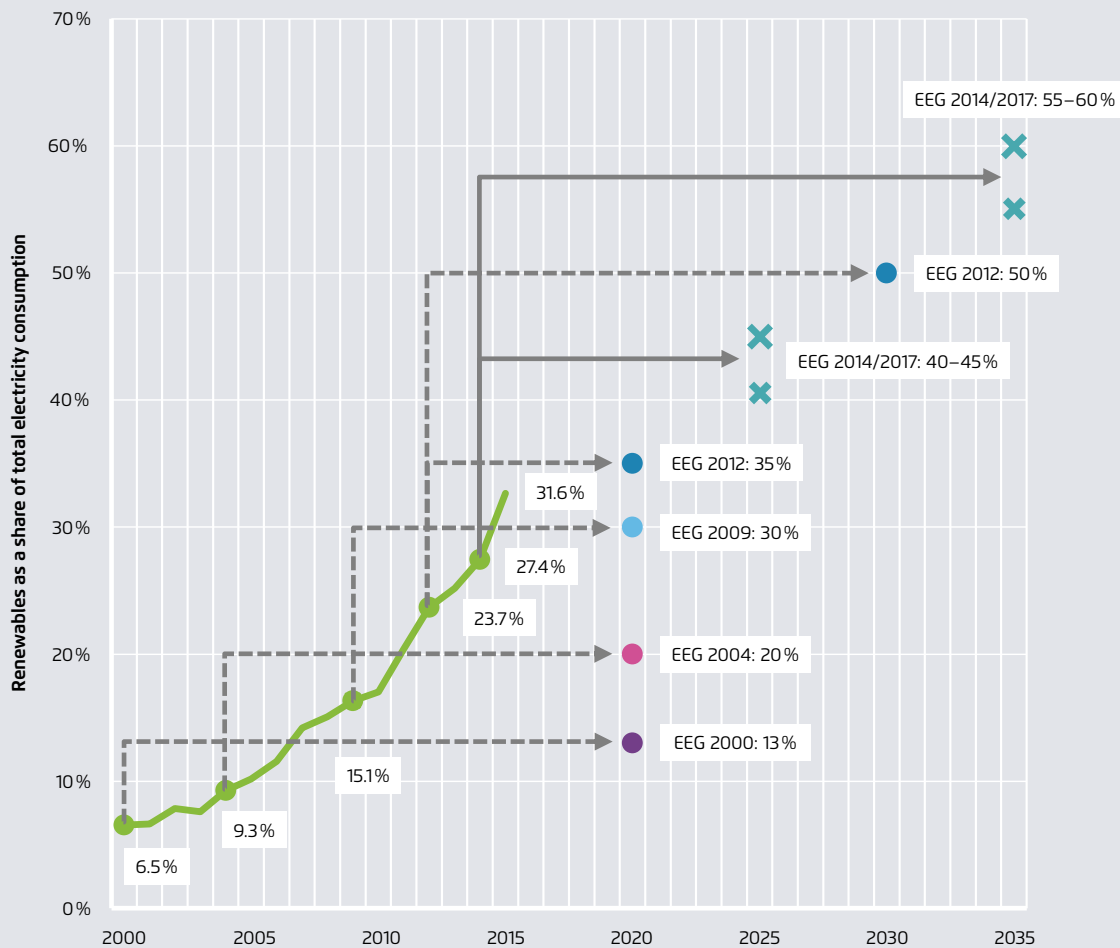
EEG 2009 introduced the first regulations on feed-in restrictions, allowing network operators to temporarily curtail power from renewable energy installations in case of grid congestion. The added regulations also provided for the compensation of affected operators. Finally, EEG 2009 called for at least a 30-per cent share of renewables in total electricity consumption by 2020.

EEG 2012 was the first set of amendments to the German Renewable Energy Sources Act after Germany's federal government and parliament, under the shadow of the recent Fukushima nuclear accident, pushed forward plans for sweeping new energy policies known collectively as the *Energiewende*. In preparing Germany's energy sector for a transition to renewables, EEG raised the target share of green energy in total electricity consumption to 35 per cent by 2020, and set targets for the renewable energy share in 2030 (at least 50 per cent), in 2040 (at least 65 per cent), and in 2050 (at least 80 per cent). The 2012 amendments modified the tariff system by introducing a market-premium model designed to encourage producers of renewable energy to sell their power directly to the market. Moreover, due to an enormous drop in PV prices, the legislation instituted a "flexible cap" on the creation of additional capacity beyond target levels. By automatically adjusting feed-in tariffs, the goal of the cap was to limit added PV capacity to between 2.5 and 3.5 gigawatts per year.

EEG 2014 slightly corrected the renewable energy targets set in 2012 without changing their basic trajectory. Since this legislation was passed, the targets for renewables' share in total electricity consumption have been 40 to 45 per cent by 2025, 50 to 60 per cent by 2035, and at least 80 per cent by 2050. EEG 2014 concentrated the additional renewable capacity on the most affordable technologies – onshore wind power and PV. It also introduced annual targets for each renewable energy technology to make additional capacity easier to forecast: 2500 megawatts for PV, 2500 megawatts for onshore wind, 800 megawatts for offshore wind, and 100 megawatts for bioenergy. EEG 2014 laid down various regulations to ease the market integration of new renewable power installations in accordance with EU guidelines for government aid. This included an obligatory market premium mechanism for all new large installations and the elimination of feed-in tariffs when the energy

Share of renewable energy in gross electricity consumption and the targets of EEG 2000, EEG 2004, EEG 2008, EEG 2012, EEG 2014, and EEG 2017

Figure 12



StromEinspG 1991

Introduction of a fixed feed-in tariff for renewables

EEG 2000

Goal: To double renewable capacity by 2010; fixed feed-in tariff with degressive payment amounts; feed-in priority; privileged grid access

EEG 2004

Goal: 20% renewables by 2020; Adjustment of feed-in tariff

EEG 2009

Goal: 30% renewables by 2020; Adjustment of feed-in tariff; rules to limit feed-in volumes

EEG 2012

Goal: Minimum 35% renewables by 2020, min. 50% by 2030, min. 65% by 2040, min. 80% by 2050; adjustment of feed-in tariff; introduction of a voluntary market premium model

EEG 2014

Goal: 40-45% by 2025, 55-60% by 2035; min. 80% by 2050; introduction of a mandatory market premium model for large plants; technology goals for wind and PV; pilot auctions for PV

EEG 2017

Goal: 40-45% by 2025, 55-60% by 2035; min. 80% by 2050; introduction of calls for tender for large plants, with exemption for citizen energy initiatives

Source: Agora Energiewende

exchange price is negative for more than six hours in a row. Moreover, EEG 2014 introduced a pilot auction system that put out to tender 400 megawatts of large-scale ground-mounted PV installations per year.

EEG 2017 makes the auction system introduced in EEG 2014 into the main financing instrument for projects in photovoltaics, wind energy (onshore and offshore), and biomass. It applies to installations with capacities of more than 750 kW, except in the case of biomass, where it applies to plants with capacities greater than 150 kW until 2019 and greater than 200 kW until 2022. EEG 2017 also introduces special regulations to make it easier for energy cooperatives to prequalify for participation in wind power auctions. Finally, it restricts the yearly added capacity of wind energy in regions with considerable grid congestion so as to better coordinate added capacity with grid expansion efforts.

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