First part:

The German Renewable Energy Sources Act (German: Erneuerbare-Energien-Gesetz ; EEG)

In the year 2000 the federal Ministry for Economic Affairs and Energy introduced the German Renewable Energy Source Act to promote green energy to make the power supply of Germany more environmentally sound and climate-friendly and to become less dependent on the import of fossil fuels. This should be achieved by enabling young technologies to enter the market with support provided by the state. In the initial version of the act this was done by providing fixed feed-in tariffs for each kWh produced. The technologies covered were wind, water, landfill and mine gas, photovoltaic, biomass and geothermal energy. Beside that a purchase guarantee was introduced and the renewable energies were given a priority feeding-in into the grid. This enabled the technology for renewable energies to emerge from a niche. After the accident of Fukushima in 2011 and the German decision to phase out nuclear energy this act got even more important to support the German energy transition and to reach the goal of a 35% share of renewable energies of the German electricity consumption in 2020. In 2014 the act was revised to adapt to the new conditions and requirements that appeared after 14 years of this support scheme. Main reason for the adjustments was the cost increase because of the “EEG surcharge” up to €22bn in 2013 (Lang M., Lang A. 2015). Through the use of mandatory direct marketing with market premiums and the reduction of the feed-in tariffs in each following year a cost reduction should be achieved. For example for photovoltaic installations up to 1 MWp the remuneration declined from 16.50 ct/kWh in 2012 to 12.15 ct/kWh in 2015 (JM ProjectInvest 2016). Beside that they introduced quantity targets for the annual increases to better manage the expansion of the renewable energies and started Pilot auctions to bring them closer to the marketplace (BMWI 2016a). Since the start of the act the share of renewable energies of the gross electricity consumption in Germany increased from 6.2% in the year 2000 to 31.6% in 2015 (BMWI 2016b). The renewable energies developed rapidly and do not represent a niche technology anymore. Therefore new adjustments to the EEG are needed to fit the new requirements and forward the market integration on a new level. Hence for 2017 the Federal Ministry of Economic Affairs and Energy is working on a new edition of the German Renewable Energy Sources Act. The main focus is on comprehensive introduction of the competitive tendering for all renewable energies and determination of fixed expansion corridors.

Federal association of wind energy in Germany (Bundesverband WindEnergie)

The federal association of wind energy in Germany is one of the biggest association for renewable energies in the world. It is promoting the sustainable and efficient expanding of wind power in Germany. The vision is to have 100 percent renewable power in Germany (BWE 2016a). To achieve that they work together with the

decision-makers to ensure good basic conditions for wind energy in the German market. That is why there is a special interest of the association for proposed adjustments and changes to regulations concerning the wind power like the German Renewable Energy Sources Act.
The proposed new edition of this act in 2017 has a strong influence on the wind industry in Germany. In particular the changes concerning the introduction of competitive bidding and the new quantitative targets proposed at a level of gross instalment of 2,800 MW for the years till 2019 and 2,900 MW for 2020 for onshore wind power calculated by a special formula. There is a high risk that the new act strongly curb the expansion of wind energy by introducing stronger limits than needed to ensure energy security and a good grid connection. Wind industry could experience a downturn with less investments taking place. It would not only slow down the energy transition in Germany but with this restrictions it will not be possible to comply with the climate goals set in the Paris agreement 2015. There are no reasonable grounds to limit the expansion in some grid areas. The federal association of wind energy wants to ensure that even after the EEG reform of 2017 the wind energy in Germany is not restricted in its growth opportunities, that it stays attractive for future investments and contributes to the success of the energy transition. The aim of this paper is to point out the need for higher instalment rates of onshore wind power plant and set the basis for the renegotiation of the "deployment corridors" for the next years and the used formula.

Federal Ministry for Economic Affairs and Energy

The Federal Ministry for Economic Affairs and Energy as part of the government is not only responsible for strengthening the German market and ensure a sustainable progress but also for reforming the energy system and promoting the German energy transition by designing the needed legal regulations and requirements. So firstly it is the important decision maker for the named issue as it proposes the changes for the EEG but beside that it is also the ministry in charge for concerns of industries concerning their business, which also relates to the issue. It is one out of fourteen ministries having the executive power in Germany. Depending on their decisions, interests and agenda settings the budget of the ministry is spend. For 2017 expenses of € 2.4 Mio. are planned for the sector of energy and sustainability (BMWI 2016c). This is represents one third of the overall budget of the ministry for 2017.

Second part

Written comment on the proposed EEG 2017 by the federal association of wind energy in Germany

Commitment of the German Government to the climate goals of the Paris Agreement 2015

The German Government has ratified the Paris agreement in September 2016 and therefore committed itself to the goals of the agreement. The key element is to limit the increase of global temperature to 1.5°C by a drastic reduction of global emissions (European Commission 2016). For achieving this experts agree on the need to have zero emissions as early as in the year 2040 (Quaschning V. 2016). Already before this agreement the German government approved the goal to have 40 – 45 percent less emissions in 2020 compared to the numbers of 1990. Unfortunately until now only a 27 percent reduction is achieved. To still fulfil the goal a threefold increase of the activities is needed (Kersting S. 2016). Beside that it is controversial if this goal is still ambitious enough concerning the Paris agreement. Therefore this 45 percent should not be seen as a maximum but rather as a minimum. It is evident that to achieve the goals for 2040 even with the use of the CCS technique, which is still controversial especially concerning the economic efficiency, the use of fossil fuels as the main primary energy sources has to be reduced to nearly zero. To substitute this sources more renewable energies are needed to ensure a stable energy supply. Currently the share of renewable energies on the primary energy supply is only 12.6 percent. That shows clearly that the instalment of renewable energies needs to be accelerated to achieve a decarbonised energy supply in 2040. For using renewable energies in a high share it is important to know the different potentials of each source of renewable energy for the German energy supply to make the right decisions. The conditions for energy from water power plants is very small in Germany and already developed. Secondly in nearly all models made by institutions like Fraunhofer for the future energy systems in Germany the geothermal sector is not taken into account as it is not financial feasible because of the high investment costs (Henning H. et. al. 2013). Furthermore the potential of solar thermal energy especially for the heat sector in Germany is very limited to some regions with high solar radiation (FfE 2016). Therefore the overall potential is very small as well. Concerning primary energy from biomass the potential of using organic waste material is already exhausted. Wood as a source for energy is already used for two-third therefore the biggest potential is with the cultivated biomass (FNR 2016). However the estimations about this potential differ between less than 200 TWh (Fraunhofer IWES 2015, p.1) and up to 500TWh (FNR 2016). These numbers are always related to the technical potential of the source. Problematic is here the usage competition for the agricultural area as some of the calculations were based on assumptions about a declining need for area of the agricultural industry. Therefore it is not clear if the whole potential can be exploited. The remaining energy demand has to be covered by energy from solar and wind power plants, which have the biggest potential in Germany and are the most cost efficient sources. In the following section the needed capacity of wind will be calculated for two different scenarios concerning the decarbonisation of the heat, transport and electricity sector for the year 2040. These results will be confronted with the planned corridors for renewable energies of the EEG 2017.

The importance of a coupling of the energy sectors and the resulting energy capacity

It is undisputed that for a successful energy transition and achievement of the climate goals not only the electricity sector needs to be decarbonised but to the same extend the heat and transportation sector. The decarbonisation of these sectors will lead to an increasing demand for electricity because the potential for directly generating heat from solar thermal energy and the geothermal sector is limited as well as the production of bio fuels with the help of biomass compared to the high demand (Quaschning V. 2016, p. 13). Therefore the potential of wind and solar energy has to be made available for the other sectors with the help of for example the power to gas or heat technology. To estimate the total electricity demand for the future each sector will be looked at separately. The following numbers are based on two studies. The Fraunhofer IWES institute is calculating with more conservative numbers with the ambition to reduce greenhouse gas emission by 80 percent until 2050, whereas the University of Applied Science in Berlin is following a very ambitious scenario with a reduction of 100 percent until 2040.

The heat sector
With 4840 PJ the heat sector represented 56 percent of the final energy demand in Germany in the year 2014 (BMWI 2016d). A small part of this demand can be covered by biomass, solar thermal power plants and geothermal heat in the future. Deducting this share and taking into account an increase in efficiency over 40 percent in the space heating and of approximately 30 percent for industrial processes the remaining demand for electricity in the heat sector for the year 2040 will be round about 400 TWh in the ambitious scenario (Quaschning V. 2016, p.19) and up to 230 TWh for the conservative scenario (Fraunhofer IWES 2015, p. 32). This includes not only the space heating and warm water but also process heat for the industry. The biggest part will be covered by electric heat pumps as the most efficient technology. Beside that the methane produced in the Power-to-Gas process is used as a substitute for the natural gas.

The transportation sector
With 2630 PJ the transportation sector represented 30 percent of the final energy demand in Germany in the year 2014 (BMWI 2016d). In general it can be said that a complete decarbonisation of the transportation sector is probably not possible within 23 years as over 90 percent of the energy needed is still covered by fossil fuels. Nevertheless it is possible to have enormous reductions of the emissions caused by

this sector. Beside the increase of efficiency and a promotion of public transport the shift to electro mobility plays an important role. The complete substitution of the fossil fuels by biofuels is impossible as there is not enough agricultural area available. For a really ambitious scenario with a radical decarbonisation of the transportation sector 337 TWh of electricity are calculated (Quaschning V. 2016, p. 25). More conservative studies are suggesting that an electricity demand of up to 170 TWh is needed (Fraunhofer IWES 2015, p.30).

Electricity demand in 2040

The goal for the conventional electricity demand is a reduction of 25 percent until 2050 in comparison to the numbers of 2008. The remaining electricity demand for 2040 would be a little bit higher than 400 TWh. In the study from the University of Applied Science in Berlin this number is said to be 500 TWh in the year 2040 taking into account high conversion losses (Quaschning V. 2016, p. 28). Summing this up, following the ambitious scenario with a 100 percent reduction of greenhouse gas emissions this would result in an electricity demand of 1240 TWh. The more conservative scenario results in a total demand of around 800 TWh (Fraunhofer IWES 2015, p. 1).

It has to be said that the above presented numbers can only present estimates about the final electricity demand. Especially factors like the population and economic growth as well as the development of different technologies are hard to predict and have a influence on the final demand. Different assumptions about these factors influence the outcomes. Nevertheless it can be assumed that the current electricity production of 646 TWh in 2015 (DESTATIS 2016) has to be increased by at least 30 percent and covered completely by renewable energies to achieve a notable reduction of emissions. Depending on the scenario and the assumptions made, probably even an increase of more than 90 percent is necessary for a complete decarbonisation.

Table 1: Development of the renewable electricity production until 2040 considering the proposals for the EEG 2017

	Proposed annual installed capacity in GW	Installed capacity in 2040 in GW	Full load hours h/a	Renewable electricity production 2040 in TWh
Onshore	2,8 (gross)	56	2200	123
Offshore[1)]	0,85 (net)	24	4200	100
PV	2,5 (gross)	50	950	48
Biomass	0,1 (gross)	3	5500	17
Water power	0,05 (net)	7	3800	27
Sum				**315**

Source: own calculations with numbers from the EEG 2017, AfEE (2016a) and Quaschning V. (2016).

Gross: including repowering

[1)] offshore goals: 6.5 GW till 2020 and 15 GW till 2030

Calculating the electricity production from renewable energies for the year 2040 by taking the proposed “deployment corridors” from the EEG 2017 the result of 315 TWh (see table 1) would not even cover the current demand for electricity with around 550 TWh (BDEW 2016) and by far not the demand needed for a decarbonisation in the heat and transportation sector in the near future.

This demonstrates clearly that for complying with the climate goals from the Paris Agreement the targets for the “deployment corridors” for the next years have to be set higher instead of lowering them to ensure a stable and constantly high instalment of the renewable energies in Germany. Otherwise the increased need for electricity in the future can not be covered sufficiently. Roughly an annual instalment of 4 GW is needed to at least cover the demand calculated in the conservative scenario (Fraunhofer IWES 2015, p. 42). For the more ambitious scenario the proposed new instalment of onshore wind power plants is 6.3 GW (Quaschning V. 2016, p.34), which may be too high to be realized. In 2016 the gross instalment for onshore wind power will be between 4 – 4.4 GW and our experts expect a gross instalment of 4.3 - 4.9 GW for the year 2017 for onshore wind power (Zelinger M. 2016). So actually the above presented number of 4 GW is realistic if policy is supporting this development. Taking a realistic scenario where 2 percent of the area of Germany can be used for onshore wind power production this would result in approximately 200 GW installable capacity for Germany (Quaschning V. 2016, p. 31).

Challenge of grid integration

For a successful energy transition the grid modification and extension is crucial. The current delays must not be a hindrance for the further instalment of the renewable energies. Especially the optimization and strengthening of the grid are aspects that can be realized on a short-term to increase flexibility (BWE 2014, p. 8) hence there should be a strong focus on that in the next years. In the following there will be examples for measures that can be implemented on a short-term for increasing the grid strengthening and beside that approaches will be pointed out that increase efficiency and reduce the overall need for grid extension.

It is important that grid operators are obliged to implement the NOVA principle, which is about grid optimization before strengthening and extension, in a timely manner. For the better integration of wind power especially measures like temperature monitoring and high temperature wires can be used for this as they increase the transmission performance enormously. Both measures can be used in the transmission and distribution grid. Because the NOVA principle contributes to cost efficiency and a higher acceptance it will accelerate the grid adjustment. To further decrease the need for grid extension feed-in management should be taken into account. One possibility for that is the relinquishment of feeding in the last kilowatt. A reduction of the feed-in peaks by 31 percent, which would only lead to a loss of annual output by 2 percent could reduce the needed transmission performance by 30 percent (BWE 2014, p. 12). This feed-in management should be remunerated in terms of a grid service for operators. Another aspect that is reducing the actual needed grid capacity is the use of a simultaneity factor of wind and photovoltaic smaller than one, which should be calculated specifically for different regions (BWE 2014, p. 14). To further expedite the needed expansion the use of so called “feed-in grids” is very useful in areas where the capacity of renewable energies already is higher than the actual load. The advantages of those grids are the simple grid structure with a consistent use of 110kV (BTU 2013, p. 34).

Another important point is to make the power supply from conventional plants more flexible by reducing the Must Run basis. Currently the must run capacity is hindering the renewables to fully feed in their electricity. In case of excess capacity it happens that in most of the times renewable production will be switched off instead of regulating conventional power plants (Greenpeace 2016). To reduce the needed must run capacity of conventional power plants renewable energies have to be used for system relevant services. Especially biomass but also wind power plants are able to deliver these services. Already now modern wind power plants can contribute to frequency and voltage stability as they are very suitable for flexible output reduction and also for the provision of reactive power (Khalil Al-Awaad A. 2009, p.80). To fully enable them to do so the regulation concerning the balancing markets have to be adapted as fast as possible (AEE 2016b). Therefore especially the auction mechanisms for balancing power must become more flexible by having shorter tendering time periods and unsymmetrical tendering for the three balancing phases (BWE 2014, p. 27). Furthermore the usage of storage systems will decrease the needed must run capacity. This will decrease the excess capacity in the grid, stabilize the grid furthermore and reduce the need for limiting renewable energies in their outputs. Last but not least the promotion of the energy sector coupling will help to use excess capacity for heat or the transport instead of switching off renewable energy power plants. The proposals made on that by the federal association of wind energy can be found in the research paper “Umschalten statt Abschalten”.
These above presented aspects are only a few examples that demonstrate the efficiency potentials and possible short term measures in the current electricity grid. Grid operators as well as scientist are confirming these existing efficiency potentials (BWE 2016b). Therefore it is not comprehensible why there should be a special restriction for the new instalment of wind power plants in some regions because of grid instability.

Financial aspects

Referring to the aim of the government to reach cost efficiency for the renewable energies the onshore wind energy as the most cost-effective renewable energy source is important and should therefore not be restricted. Although the onshore wind energy represents nearly half of the generated electricity by renewable energies its share on the EEG allocation is smaller than 20 percent (BWE 2016c). A high share of onshore wind on the total renewable energies will therefore help to decrease costs for the EEG allocation (DIHK 2016, p. 19). To achieve the economically most efficient result there should be no preference for wind poor regions as this will lead to higher costs. An equal framework for all regions should be set up. As already pointed out in the section above with the help of efficiency measures for the grid there is no need to restrict some regions in the north on there instalment of wind power plants as it is done in the current proposal of the EEG 2017.

Importance of the wind energy industry for Germany

The wind industry is the most important employer in the renewable energy sector with a share of 42 percent (BWE 2016d). 2014 the employment increased by 8 percent to over 150,000 employees (BWE 2016e, p.4). Beside that the industry invested € 9.7 billion in the year 2015 and therefore represents the renewable energy sector with the highest investments as well (Strom-report 2016). During the last years the wind energy sector has developed to an important industry for Germany what makes clear that the initial support was a success. Meanwhile the tax revenues exceed the state support (ZWS 2013). In order for Germany to stay an attractive location for the wind energy industry there has to be investment certainty for the companies. In general it can be said that the amount of amendments made to the EEG before are not giving the needed certainty for planning. Now with the new design finally there are some clarifications especially about the tendering process but one point where there are still open questions is the tendering quantity for onshore wind power. Using the proposed formula to calculate the amount of installed capacity new for every single year (BMWI 2016e) involves too many uncertainties for investors. Beside that the results from this formula could be less expedient than expected. That is because the formula is based on the gross electricity consumption in the year 2025. As previously mentioned there are a lot of uncertainties about its development. Parameters like the coupling of energy sectors, economic development or digitalization of the economy will influence the actual value. Secondly for calculating the generated power by already existing plants for the year 2025 assumptions have to be made about how many of the now existing plants have been shut down by than (BMWI 2016e). The formula can not represent these two points in an appropriate way. Another critical point is the calculation of the gross instalment instead of the net instalment and the use of this calculated value for the actual tendering capacity. Taking into account the proportion of already accepted bids that are not going to be realized (around 10 percent) there is a high risk in not realizing the initial calculated number and finally have less installed capacity than needed. Therefore the federal association of wind energy in Germany is advising to have fixed targets in terms of net instalment for the next years that represent the actual need for onshore wind energy instead of using a formula. This will give the industry the needed certainty for planning and investments as well as promote innovation and help to achieve planned emission reduction in the given time frame.

Final statement

Concluding, the federal association of wind energy in Germany demands consistent development of onshore wind energy. The “deployment corridor” for onshore wind energy has to be set at least at the level of the EEG 2014 with a yearly net instalment of 2.500 MW as this is completely acceptable with the grid stability and absolutely necessary for achieving the set targets. However to comply with the climate goals of Paris and to promote the energy sector coupling there is the strong recommendation to have at least a yearly gross instalment of 4.000 MW, which is complying very well with the forecasts from the industry for 2016 and 2017. The second demand on the federal Ministry for Economic Affairs and Energy is the use of fixed net instalment targets for at least the next three years instead of calculating annual varying volumes with the presented formula. This especially is important for minimizing the uncertainties for investors in this business. The government should promote the transition of the energy system as an important factor for the economy, innovation and the export sector and must not restrict the onshore wind power as its most important and efficient performer. With a stricter limitation on the instalment capacity the EEG 2017 will thwart the achievement of the national and international goals on the climate protection.

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