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AN IMPACT ANALYSIS OF THE AMENDED RENEWABLE ENERGY SOURCES ACT

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Abstract

Countering the climate change and supporting environmental protection is a well committed task by the European Union and its Member States. Taking Germany as an example, it presents a successful growth of renewable energy sources (RES). In terms of deployment rates for photovoltaic technologies (PV), Germany has reached a top position among its European neighbours. The Renewable Energy Sources Act (EEG) is the legal basis and main driver to overcome the diffusion of renewable energy sources. The *'Energiewende'* predicts a 40-45% share of green energy production until 2025. Not only the share of RES, but also competitiveness with fossil fuel in the long run is appointed. But is the stimulation of renewables a costly affair. The EEG has been amended multiple times to redefine the subsidy amounts. Within the last amendment, the regulatory instruments experience a distinct shift. Using the design characteristics by Jenner et al. (2013), this research carries out an analysis of the likely impacts of the renewed legislation on the stimulating policy instruments. The major trade-offs between the legislations are presented. Given the topicality of the amendment at this point in time, likely effects of the impacts are suggested.

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1. Introduction

In response to climate change and scarcity of fossil fuels, renewable energies receive increasing attention and substantial support through policies which intend to stimulate the deployment of such. Reason for this deployment of RES are aims which are i.e. addressed in the EU legislations Directive 2009/28/EC. This legislation is one driving factor for the energy transition and legal basis for national legislation. It is stated the energy transition implies a reduction of the dependency on imported fossil fuels, decreasing emissions, and a higher efficiency of energy sources (European Parliament, 2009). Therefore, renewable energy sources play a crucial role to reach this aim of sustainable and clean energy production.

Especially the photovoltaic industry was successful in its development and benefited from the supportive, and relatively stable market environment created by different regulations. Speaking for the German case, legislation reached an output of being at the international first place with 7.604 GW PV power installed in 2012 (Campoccia, Dusonchet, Telaretti, & Zizzo, 2014). Not only the PV technology, but all RES are intended to be integrated in the competitive market in the long-run. Stimulating policies shall support the diffusion of RES, bringing them in a financially attractive market position. Therefore, different policy designs can be chosen. As one example, feed-in tariffs (FIT) have been perceived as a development driver of RES technologies (Held, Ragwitz, & Haas, 2006).

The German government intends to limit the use of fixed remunerations and further implemented an auction to determine of future subsidy amounts. Not only the subsidy amount, but also the deployment capacity is desired to be more controllable and more in line with market developments under the new framework. The motion might be a reasonable step to pursue since it is the regulating authority's task to balance the stimulating instruments. Setting subsidies to high overcompensates the RES, a subsidy which has been set to low hinders the diffusion. But profound criticism for these intentions was expressed by the BEE (Union of the PV industry in Germany/Bundesverband Erneuerbare Energien e.V.). The BEE claims within their positioning the step towards a tendering procedure would drastically damage the industry, that the aims of the energy transition could have been reached within the old frame of the EEG (Bundesverband Erneuerbare Energien e.V., 2016) The institute of future energy systems (Institut für ZukunftsEnergieSysteme) carried out a research on behalf on Greenpeace, arguing that by the amendment the energy transition would not be supported but hindered (IZES, 2013). These arguments are the basis of motivation for this research. It will be examined to what extent this amendment influences the approach of the legislation. Therefore, both legislations will be examined and compared. Following, the impact of the amendment on the regulatory instruments will be assessed. Having the trade-offs at hand, likely implications of such can be suggested.

2. Research question and sub-questions

Having stated an overview of the problem background, research questions for this paper can be derived. Above the main research question, is broken down into several sub questions. These sub questions are intended to be the pillars of the above standing one.

RQ: *What is the likely impact of the legislative change from EEG 2014 to EEG 2107 for the PV sector on the energy transition?*

In addition, a set of sub-questions shall support the general line of reasoning. To better grasps the impact, the first sub-questions intends to answer the question of: "*How will the amendment affect the levelized cost of electricity?"* The levelized cost of electricity (LCOE) is an important factor which gives insight of how attractive an investment in PV is in the long run. The estimation of such takes market prognoses and learning curves into account.

The second sub-question addresses the amount of deployment under the new regulation. Motivation for this question is the share of PV in the total RES mix used in the energy transition. Put in a question it reads as follows: "*What outcomes will the amendment have on the future PV deployment?*" It is important to keep the deployment in focus as is supports the objective of the energy transition by implementing RES.

3. Theoretical framework

The European Union and the Member States are committed to promote the use of renewable energy generation to meet international and EU wide obligations to encounter the problems of climate change (Behn, Fauchald, & Letourneau-Tremblay, 2017). So far, the major barrier for the RES deployment is the cost disadvantage compared to electricity from fossil or nuclear fuels. Without governmental support and left alone to market forces, RES would result in a limited diffusion (Haas et al., 2008; Menanteau, Finon, & Lamy, 2003). This competition with conventional sources is intended and embedded in the EU Directive 2009/28/EC. To reach the target of competition with conventional energy sources, Article 2 (k) of Directive 2009/28/EC defines the implementation of stimulating instruments making renewables financially attractive. Regulation in form of stimulating policies is key. Yet, there is no consensus on what regulatory design may deliver the best results (Haas et al., 2008). The regulator is free to choose between distinctive instruments to support the deployment for a viable use of RES. At such, a variety of actors is involved in the interplay of RES deployment. These can be the regulators, the end-users, the producers, or the investors, they all have a certain interest which is to be balanced by regulations. Before it is outlined how these roles are affected by the diverse policy designs, the general design types are described in the following.

3.1 Design elements of instruments

To promote the diffusion of RES, a variety of different policies can be used. Research emphasises on the different dimensions promoting strategies can function in. Haas et al. (2008) examined different regulatory designs and a classification of these dimensions was established. In general, one can allocate the strategies to four different dimensions in which RES are stimulated. These are the dimensions of regulatory vs. voluntarily, direct as well as indirect. Within these categories several subdivisions can be found. Within regulatory and voluntary strategies, the distinction between a focus on investment and generation based policies is made. Additional, within the dimension of direct strategies, a further distinction between price-driven and quantity-driven strategies is made (Haas et al., 2008; Jenner, Groba, & Indvik, 2013; Menanteau et al., 2003). Beginning with indirect and voluntary strategies, these are according to Haas et al. (2008) simply voluntary agreements made between the parties involved. This type of strategy involves no penalty in case of breaching the common line, thus has a soft-law characteristic. The other side of indirect strategies to promote are of regulatory nature, such as environmental taxes, or the simplification of authorization procedures. As the title suggests, they do not regulate directly but shape the environment of the objective in a more convenient way. Like that, diffusion burdens are taken away indirectly. For the interest of this paper and the regulatory perspective, indirect strategies such as environmental taxes, voluntary agreements, or connection charges are excluded from this study. It was indicated in the introduction that the main concern relates to direct regulation approaches.

The perhaps most prominent strategy to promote the diffusion of RES is a form of direct regulations. Again, the same sub-classification in this branch is made as well, splitting up direct regulations in either focussed on investment, or directly based on generation. Among direct strategies a further distinction is made. A distinction in the regulatory, direct strategies is made between price-driven and quantity-driven schemes. Examples for these types of direct policies are a feed-in tariffs (FIT) or for quantity-driven policies, quotas, also referred to as renewable portfolio standards (RPS) (Jenner et al., 2013). Feed-in tariffs can be defined as a price regulation tool (price-driven) based on generation, aiming at marginalising the gap between production costs of fossil fuels to renewables. The monetary amount needed by RES to work costs covering, or revenue generating is guaranteed by subsidies. They are applied as a contract with the effect that the payment for electricity received by the generators increases for each kilowatt-hour produced. FITs are, in contrast to RPS, specifically adjusted for a technology to level different deployment rates and production costs among the RES. Having this flexibility, FITs are the most prominent example of stimulating policies in use across the developed nations (Jenner et al., 2013).

But, as the specific designs indicates, there is a diversity of different paths to be taken stimulating RES. Having the first distinction made, it is now to narrow the scope and distinguish between certain characteristics within these dimensions. As an example, research has put a focus on the general effectiveness of the FITs, leaving out the distinctive design features and different market characteristics they function in. FITs can differ significantly among each other and it is of importance to look deeper in the specific regulation characteristics. Jenner et al. (2013) stress on this examination shortage and carried out a research based on the classification established by Haas et al. (2008). By doing so, the afore described distinctions by Haas et al. (2008) are used to better classify the approach. Following, the policy approach is linked with the design features carved out by Jenner et al. (2013) found within the schemes. The research focusses on these design diversities and these have been clustered to set up a benchmark between stimulating policies. As mentioned, the following policy characteristics are adopted from Jenner et al. (2013) for this paper:

Their research presents design categories renewable subsidies may differ amongst each other. According to Jenner et. al. (2008), RES subsidy price structures (1) can be either a fixed subsidy paid or a premium. The fixed-price guarantees a specific, fixed price for electricity fed into the grid, whereas the premium tariff adds a premium to energy sold to the grid to the generators. Usually, these amounts are expressed as Euro per kilowatt-hour (€/kWh). FITs can therefore be allocated to generation based and price-driven strategies as no quantity goals are expressed within these kinds of contracts (Haas et al., 2008). Another design distinction can be found in the allocation of the subsidy costs, or CAPEX responsibility (2). Generators who sign the FIT contract are entitled to feed preferably green energy over conventional sources to the grid. The incurring price difference is either paid by state budget, or allocated among end-users of electricity. The cost containment (3) is the next characteristic to be addressed. To limit the costs paid for the transition, some countries limit (cap) the total annual amount of green energy to be deployed, or the total tariffs that might be awarded in a year. But also, the duration of the contract (4) needs to be regarded while examining different types of renewable subsidies. The durations differ and stand in relation to the amount of subsidy paid. Often a trade-off between duration and magnitude comes into play while contracting this characteristic. Either a short contract duration with a high tariff paid, or a longer contract period with according lower subsidies. Talking about amounts, the next substantial design difference can be found in such. The subsidy amount, or price magnitude (5) is an important indicator whether a deployment pays off. The magnitudes differ among the countries subsidising the diffusion of RES, but can a difference also be found among different technologies stimulated. Determining factors for the amount are further the cost of generation, the location, the size of the system, and the host' purpose to build. Finally, the subsidy contract often implies an attenuation (6). As the stimulating policies intend to bring RES in a viable market position, the subsidies are gradually reduced according to the years after the policy was enacted (Jenner et al., 2013). Price-driven schemes encompass the advantage of a quick penetration of the market as the production costs drops below the electricity-price-plus-premium. Combined with other incentives and taxes which level the impact of conventional sources, direct and price-driven strategies are one of the most effective ways to deploy RES in theory (Haas et al., 2008).

Having gained an overview of the price-driven design characteristics, the generic quantity-driven design features will be outlined next. The line between quantity-driven and price-driven can be difficult to draw, since quantity-driven policies can also imply financial remunerations. The RES are still linked to high expenses when being compared to conventional power technologies (Kylili & Fokaides, 2015). Determining between them is the presence and importance of the goals linked to the strategy.

As the name suggests, quantity-driven mechanism function not through a price regulation in the first place but by regulating the amounts to be deployed. By doing so, these policies still support the diffusion financially. Policymakers set a desired goal of deployment capacity. The desired capacity can be published in e.g. an auction and participants are invited to place their bids. This strategy is also known as tendering procedure (TP). Among the investment focussed, quantity-driven mechanism participants bid for an investment grant. On the other side, generation based auctions set up a desired amount of capacity to be deployed and participants place their bids in a form of cost per electricity unit, i.e. €/kWh, produced (Kylili & Fokaides, 2015). Awarded bids are gain a guarantee for a tariff.

But as the auction mechanisms imply a race to the minimum price, it can result in no subsidy remaining after the auction has ended. If a subsidy amount remains after the auction, it is granted for a in the auction condition specified time. The specification of duration therefore provides security for investors (Haas et al., 2008; Kylili & Fokaides, 2015). Contrary to FIT, quantity-driven strategies such as TP are suitable for gaining control about the amount to be deployed and subsidised. The bidding process focusses on the price per electricity unit (€/kWh) a competitor states to realise within a project (Menanteau et al., 2003). Furthermore, depending on the kind of procedure applied, a control about the number of applications can be gained, if desired. In this case, a restricted auction procedure, which contains a restriction by the application of several tendering rounds, can be applied. Open procedures on the other hand are not restricted and each bid received must be regarded. In addition, the call for auctions can be adjusted to specific needs for a project (SIGMA, 2011). As an example, the United Kingdom, Ireland, and France made use of such a bidding process (Jenner et al., 2013).

However, these mechanisms differ in the level of incentives such as the transaction costs. The auctions require, compared to price-based mechanisms, larger efforts for the regulator as well as for the generator in terms of project preparation and selection procedures. The effort of managing the auction thus frees the authority of market estimations of the future market conditions to set the right tariff rate (Kylili & Fokaides, 2015). Another difference can be found in the level of remuneration under the two mechanisms. By participating at a TP, purchase prices are considerably lower due to the pressure of competition. According to Menanteau (2003) and Mitchell (2000), a general weakness of FIT are limited incentives to lower the costs, whereas these incentives are clearly attributed to auctions. This price competition results, according to Menanteau et al. (2003), in a limited capacity to install. The power prices compared at the level of wind energy are about the half for TP compared to FIT. Some advantages can be distributed to auction mechanisms as well. According to Kylili and Fokaides (2015), a fair auction can reveal the true costs, given the competition amongst potential investors. These true costs have a positive influence on the investors trust, and further increases the competition among them, which result decreases the energy prices.

For the further examination of the legislations the design characteristics are clustered as presented in table 1.

Table 1

Characteristics	Design attributes
1. Price characteristics	Price structure and CAPEX responsibility
2. Subsidy characteristic	Cost containment and price magnitude
3. Time characteristics	Duration of the contract and attenuation

The theory suggests that the effectiveness to regulate depends on firstly on the chosen mechanism and secondly, on the specific design features of such. Price-based or quantity-based mechanisms have been presented and differ in their approaches to regulate the deployment of RES, resulting in different outcomes for the generators.

It is then of importance how these dimensions differ in their design characteristics. Breaking the theory down to the topic addressed in this paper, it leads to a distinction between generation based and investment driven categories. Furthermore, a distinction between quantity-driven and price-driven design categories is made. The aim to integrate RES in the competitive market is stated. Therefore, the subsidies must be minimised. This can be realised in a transparent market with genuine competition over time (Klemperer, 2002).

The theoretical framework for this paper is set up and the design features of the German legislation will be examined in this regard. Put differently, the regulatory environment in both EEG 2014 and EEG 2017 will be examined. The application of the theoretical framework can be seen below figure 1.

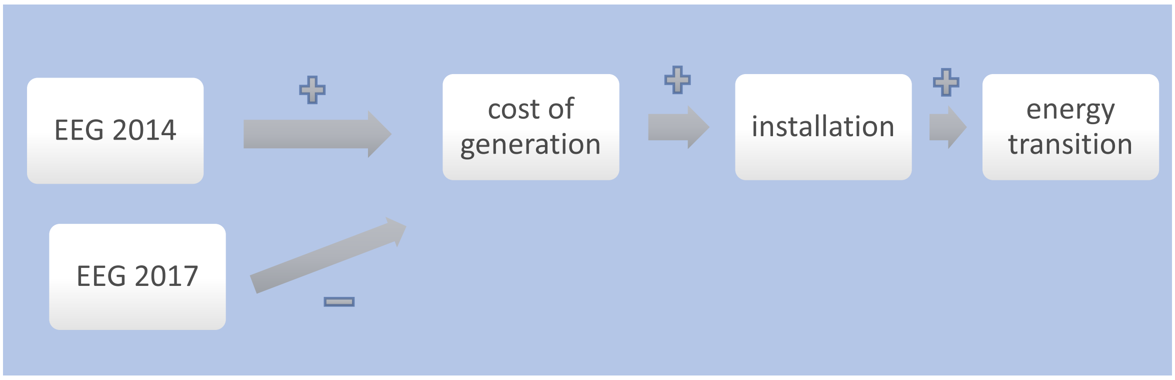

Figure 1

4. Methodology

Having stated the research problem, as well as the objectives of the theoretical framework the next step is to develop a design that will guide the further research. Besides the research design, the data collection and operationalisation will be explained to arrive at a prediction of the legislative change and its effects.

4.1 Research Design

Considering the question of explanatory nature, a case study dealing with the shift in national legislation implemented by the German federal government will be conducted. This paper attends to investigate the statement of the lobby group BEE whether the legislative change leads to a disaster for the PV deployment in Germany. Thus, the aspiration to apply the results on another case is not intended.

Different approaches were considered to answer the research question appropriately. Ultimately, the decision to carry out a time-series design was made. A cross-sectional design was also brought into consideration, but as the national legislative change concerns the German energy transition, a broader scope of investigation was neglected. The specific design characteristics of the legislations determine the outcomes, these relations are thus unlikely to be found elsewhere in the exact same setting. The research question further breaks down to one branch of the mix of technologies applied to carry out the energy transition. Regarding the limited resources available for this paper, only the PV technology under direct regulations is put in focus. The reason to focus on PV is on the on hand the rapid growth this technology has experienced and on the other hand, and more importantly, the highest potential of cost reduction among all other RES (Chowdhury, Sumita, Islam, & Bedja, 2014).

The impact of the amendment on other RES used in the energy transition is to be examined in further research. Coming back to the design of choice, the measurement of the regulation's impact must be carried out under EEG 2014 and EEG 2017, displaying to legal frameworks to arrive at an evaluation whether the new legislation is tailored more efficiently to close the price gap between PV and other energy sources.

To be able determining what kind of scheme was applied in the two legislations, the first step in the analysis will be to examine which mechanism of the before mentioned correspond with the instruments laid down in EEG 2014 and EEG 2017. Deriving from that, the design characteristics presented in chapter 3.2 will be consulted to display the differences and trade-offs. Having these at hand, likely impacts of the mechanisms with their differences in the designs will be presented as far as possible to at this point.

To date, only limited experience with auctions on RES in Germany has been made, solely a model testing has been conducted in the PV sector. Hence, a time-series design comparing most common design features of both legislations adopted on different theoretical scenarios is most convenient regarding the set of circumstances in this case.

4.2 Data

A collection of existing, relevant, and recent information on this topic supports the research with necessary knowledge regarding the environment of stimulating policy instruments is use.

The current state of research will be acquired and adopted on the situation to evaluate the outcomes ex-ante EEG 2017. In addition, research and reports presenting primary and secondary data sets will be used to display e.g. PV's levelized cost of electricity.

To gain an understanding at which point the secondary data is used, an analysis of the EEG will be presented. As a response to the Directive 2009/28/EC, the German Federal Government has translated the obligations of having a 18% share of renewable energy production by 2020 into to the EEG. The Directive 2009/28/EC indicates a EU-wide share of green energy supply of 20% by 2020. For reaching this aim, the Directive breaks down specific shares for each Member State to fulfil within this time framing.

Indeed, the EEG developed out of the environmental protection and sustainability aims embedded in the Treaties of the European Union, but became more precise through the Directive 2009/28/EC.

As the amendment of the EEG is solely concerning the German energy transition, the EEG will therefore be the main legal source to be examined. The EEG regulates all RES, hence the focus will be on the paragraphs which regulate the policy designs of concern. These will be highlighted and examined in the following chapter. To feed both time periods of the examination, the paragraphs of the EEG 2014 and EEG 2017 regulating the PV deployment will be examined. A time-series which goes beyond that scope would be inappropriate since the line of reasoning compares latest outcomes of EEG 2014 and EEG 2017. It is of interest to examine the impact of the amendment to then suggest implications of the amendment.

Certainly, the stimulating policies have been implemented prior to the EEG 2014. The concern of this research the likely future effect of the legislation prior to EEG 2017, without the amendment. Connecting these effects with the new legislation on the same scenarios allows to estimate the largest trade-offs, hence, legislations prior to EEG 2014 can be neglected. Therefore, only the EEG 2014 and the EEG 2017 are included in the data for the dependent variables. Since the latest version of the EEG was implemented, a specific legislation ordering the legislative adjustments was added. The order called '*Freiflächenausschreibungsverordnung*', in short FFAV, includes the specific regulations for the policy mechanism. Hence, not all design characteristics concerning the auction mechanism can be found in the EEG 2014. Therefore, the FFAV is used as a data source as well. In addition to research and legislation dealing with stimulating instruments, reports from different institutions, such as reports from the Federal Ministry for Economics and Energy, or empirical data by the German Federal Statistical Office, are used to present the environments the different designs have created.

Connecting these different strings, a picture derives and a statement about the likely impacts of the amendment can be expressed.

4.3 Operationalisation

To arrive at a reasonable analysis and profound conclusion about the effects of the amended the variables need to be carefully operationalised. The measurement of the variables intends to present a picture of the cost environment the different legislations create. Before the analysis can be carried out it must be defined in what kind of policy framework the variables are embedded. Therefore, the initial distinction established by Haas et al. (2008) is used.

The independent variable in this case study is the cost environment of PV installations which relates to the different legislations. To compare both, the independent variable ‘levelized cost of electricity’ is chosen. This variable has the advantage to include all costs generated over a lifetime of a project. As described before, it is to marginalise the cost gap between PV and other energy sources. According to Chowdhurry et al. (2014), the highest cost reductions can be realised in PV due to the rise of energy prices from conventional energy sources and grid overload. Therefore, a cost measure expressing the influence by different design strategies is best suitable.

Having set up the measure of the independent variable, the dependent variables will now be defined. The dependent variables evolve from the before mentioned design characteristics of stimulating regulations by Jenner et al. (2013).

This choice is made to compare both legislations with the same benchmarks at hand. To measure the impact of the amendment the clustered variables developed in the theory section will be used. These variables intend to best capture the effects on the independent variable. As the energy transition, especially the PV sector, is linked with high costs, the decrease of costs is of special interest.

The first dependent variable is measured by the price characteristic of the remuneration contract. As the energy transition is linked to high costs, an interest whether the structure of remuneration has changed towards more efficiency is given. These can be either be paid as a fixed amount or as a premium orientating at market prices. The second measure is the allocation of the costs which arise through the remunerations. It is to find whether a change in the subsidy responsibility has been made.

Secondly, the subsidy characteristics will be examined. Price-driven mechanisms are portrayed to be costly, whereas the quantity-driven schemes are used to reveal the true costs of compensation. The cost containment therefore indicates whether a cap of either price for subsidies or a cap of deployment has been installed to limit the development. Linked to that is the price magnitude. This measure will examine whether a change in the subsidy amounts has been made within the legislative change.

Lastly, the third dependent variable is measured by the subsidies’ time characteristics. The duration of the contract defines the length of subsidies paid. It reflects a security for the investors and depicts one factor determining the riskiness to invest. This is important responsibilities from additional deployment adds up to existing contracts. Furthermore, contracts for fixed amounts cannot react to a decline in prices and therefore run the danger to overcompensate. In reaction to the decline in prices an attenuation is included. Future deployments usually receive less remuneration. To measure how drastic the change is, this measure is included as well.

5. Definitions - Legal bases of national legislation

The analysis starts with a diagnosis of which regulative mechanism corresponds with the legislative instruments at hand. Again, according to Haas et al. (2008), there are four types of instruments possible. The first is defined to be an investment focussed, price-driven strategy (1- IPD). The second strategy focusses also on investment, but is regulated through a quantity-driven approach (2- IQD). Third, generation based strategies which are driven by the price (3- GPD), and lastly, generation based strategies which are regulated by a quantity (4- GQD). These are the four groups and a law review of both legislations will determine to which group included instruments can be assigned. While allocating these legislations to the strategies in question, some design characteristics are consulted to make a distinction more concise.

5.1 The EEG 2014 – Definition of strategy

As mentioned before, the EEG regulates the matters of all RES used in Germany. Finding the paragraphs in the legislation which define the supporting instruments is the first step, matching them with the corresponding characteristics. The basis for a stimulation of the RES can be found in §1 (1) EEG 2014. This paragraph states the intention, amongst others, to support the sustainable energy sourcing and the according technologies. How this entitlement for support is realised can be found in § 19 EEG 2014. Section one of this paragraph provides the legal basis for a facilitation for the producers towards grid operators regarding production of energy, solely from RES. In this sentence, a first distinction can be made. As the law provides support for generated energy, and not a direct support for investments in this technology, a generation based instrument can be defined.

The second step is to define whether the legislation orientates on a price-driven or quantity-driven scheme. The generator can further choose between different facilitations. To examine whether these are linked on a price-driven or quantity-driven approach the conditions of such must be outlined. The choice is to be made between a feed-in premium, or a feed-in tariff which is defined in section one §19 (1) EEG 2014. The premium tariff is laid down to stimulate a direct marketing of electricity from RES. That means that the producer can, different to the FIT, market the generated power directly at the spot market. This is defined in § 34 EEG 2014. Whereas the calculation of the premium tariff is defined in appendix 1 EEG 2014. The premium volume (expressed as cents/kWh) is calculated monthly. The estimation is taking into account the energy market price of the specific month and the driving value (specific price per kWh, descending each month for new installations) This value is a central benchmark and will be further explained in the following. The premium equals the driving value minus the market value. This estimation solely describes the premium paid. Besides the premium, the producer receives the revenue from selling the electricity at the market. The total revenue under the FIP is therefore the premium and the generated revenue from the spot market. The discount rates for the driving values are defined in §31 EEG 2014. The discount rates stand in relation to a deployment corridor, specifying a certain amount of deployment per year, and a cap of total deployment. Depending on the deployment, the attenuation is greater if that corridor is exceeded. The digression is reduced or zero, if the deployment has fallen short slightly, or more significantly. Either way, the premium is only paid for electricity which is directly sold at the market. Under the FIT, the network operator is, on the other hand, obliged to buy the energy from the producer. The biggest difference between FIP and FIT is therefore the security of FIT to receive a monthly, more predictable remuneration, as the FIP orientate on the monthly changing market energy prices. For the FIT, § 51 of the same legal basis coordinates the remuneration according to kWh produced and functions as a benchmark (driving value). According to this paragraph, PV installations i.e. with a capacity of up to 10 MW are remunerated with 9,23 cents per each kilowatt-hour produced. In German the "anzulegende Wert", the driving value, is therefore a central control element within the legislation. Also under this support scheme an attenuation is included and is regulated by the same paragraph as used for the FIP (§ 31 EEG 2014). The attenuation is a special character of the law, and will be outlined in the next chapter.

While looking at larger PV installations, another regulation has been installed in EEG 2014. In §§ 55 and 88 EEG 2014 the legal basis for a future auction mechanism for the remunerations has been implemented. The articles in the EEG do not yet indicate a specific size of capacity to be auctioned, a general deployment limit is merely indicated in § 31 (1) to be between 2400 and 2600 MW per year. This is again the same paragraph used for FIT as well as for FIP. Emphasising, the paragraphs concerning auction mechanisms are merely included to provide an empowerment for ordinance for future regulation. In addition to EEG 2014, the ordinance FFAV (Freiflächenausschreibungsverordnung) has been added, regulating the future auction mechanism. From the FFAV can be extracted, that a yearly deployment of 400 MW is to be auctioned (§ 1 FFAV). While looking at the specific volumes, a different picture occurs. In 2015 a deployment volume of 450 MW is appointed, whereas a year later the volume decreases to 300 MW (§ 3 (1) FFAV). To gain experience for the following legislation (the ordinance is intended to stimulate further law making in this regard), a pilot project testing the auction mechanism for the German PV deployment has been established under the FFAV. The FFAV is strongly tied to the EEG 2014 and only applies for PV installations with a capacity between 100 kW and 10 MW (§ 6 FFAV) which are defined as free-field installations. The connection can be seen at the use of the deployment corridor of § 31, as well as the use of the driving remuneration value of § 51 EEG 2014. Thus, the auction mechanism has not been fully established and should be regarded as an add-on to the EEG 2014. Worth to mention is the exclusion of § 31 EEG 2014 (the monthly attenuation) according to § 13 FFAV for the auctioned capacities.

A classification according to Haas et al.'s (2008) strategy framework is difficult to establish, given the quantity characteristics of the price-driven instruments in use. The issue occurs because of the deployment channel and the implementation of the auction ordinance. The corridor is clearly a limitation in deployment and might be interpreted as a quantity driven approach. But, FITs are granted to large extent. Since the FFAV is still an add on to the legislation and not (yet) a firm part, the definition remains on a price-, and not quantity-driven approach. Under this legislation the deployment starts to be limited, but is the focus more on the remuneration than on the deployment capacity itself. Besides, also the FFAV orientates on the deployment channel for conventional remuneration of PV and did not establish an own quantity amount per se as the deployment capacity is still linked to the EEG 2014. Summing up, the design characteristic of the stimulating instrument in EEG 2014 can be defined as GPD (generation based, price-driven).

5.2 The EEG 2017 – Definition of strategy

This chapter defines the stimulating strategy of the EEG 2017. This legislation, too regulates all the RES used in Germany and does not include a side legislation (ordinance) to govern the auction as it was the case in the EEG 2014. This legislation is the successor of EEG 2014 and has been, according to market changes and experiences made under the ordinance implemented in EEG 2014, changed. It is now up to examine how this auction mechanism was implemented and to what extent the strategy framework is changed. Again, the first paragraphs of the legislation state the intentions. Briefly, the aims of having a share of between 40 to 45 percent of green energy produced by 2025 did not change, also the definitions of RES remained constant between EEG 2014 and 2017. The first crucial motion can be found in the principles in § 2 EEG 2017 though. Whereas the EEG 2014 defines a focus on financial support instruments with lower costs in § 2 (3) EEG 2014, the EEG 2017 formulates the use of an auction mechanism to detect an appropriate level of subsidies paid in § 2 (3) EEG 2017. The same paragraph further defines a sustain of the competitor variety within the frame of auctions. This is an important and distinct shift. The principle to lower the costs of the transition was present in EEG 2014 and this intention was supported by the ordinance to implement an auction mechanism. By then, the auction was to be tested for large free-field solar parks. The auction mechanism now has become a firm part of the legislation. To what extent the implementation of this auction mechanism changes the policy approach will be outlined in the following.

Besides the new tool (auction) for the detection of remuneration amounts, the EEG 2017 as well includes the opportunity for direct marketing, laid down in § 19 (1) by granting premium tariffs as well as feed-in tariffs. Again, the first distinction between investment-focussed and generation-based instruments can be made. Paragraph 19 EEG 2017 defines valid claims for a payment based on production of energy from renewable sources. That indicates a support for generation, and not a direct support for investments. Like this, the instruments in use are distinct from investment-focussed policies and are of generation-based nature.

A further distinction between a price- or quantity-driven approach is to be made. Worth to mention here is the cut in costs. What was intended already in EEG 2014 becomes more present within this legislation. The cost cut of remuneration becomes latest visible when looking at the regulation of the FITs, laid down in § 21 EEG 2017. A change regarding the time span of a year in which FITs are paid got included. According to the size of installations a distinction is made. If the installation capacity exceeds 100 kW, a claim for remunerations is only granted for six months a year and under certain exceptions. This kind of remuneration is no longer defined as an “Einspeisevergütung” (FIT), but as an “Ausfallsvergütung” (loss-compensation). These special conditions will be given a closer examination in the next chapter. A difference in control must be presented though. FITs are entitled with a preference over conventional sources, thus grid operators must take the PV energy under the FIT. Contrary, FIPs are not entitled with this preference since the produced energy is traded at the spot market. It is then possible to shut down FIP installations remotely (§§ 19, 20 (2) EEG 2017). Both, FIPs and FITs are calculated via the driving value of § 38b and § 48 EEG 2017. Comparing the driving values of both legislations it becomes apparent, that the initiating driving value for new installations experienced a cut as well. What has been 9.23 cents per kW/h in § 51 EEG 2014, is now cut down to 8.91 cents per kW/h in § 48 EEG 2017. Likewise, comparing PV installations with a capacity of 10 kW, a decrease in the driving value is visible. In 2014, 13.15 cents per kW/h was to be expected for a new installation subsidy, whereas in 2017, 12.70 cents per kW/h are subsidised.

Coming back to the implementation of the auction mechanism, the perhaps most significant change is the obligation to participate in the auction regarding solar installations above 750 kW. In § 22 (3) EEG 2017 the obligation for producers desiring subsidies to tender is laid down. To receive a FIT, PV operators must participate and be awarded in an auction set up by the Federal Network Agency.

Besides the auctions, the deployment channel is defined, as in EEG 2014, and can be found in § 4 (3) EEG 2017. An annual total PV deployment of 2500 megawatts is set as a guideline. A specific share of this deployment volume is opened for tendering and laid down in § 28 (2) EEG 2017. Resulting in an annual tendering volume of 600 megawatts. This amount is split up into three auction rounds over a year.

Indeed, this volume of 600 MW applies only for large solar installations, but was the definition of such rephrased. Auctions under EEG 2014 were merely intended for free-field PV installations (§ 55 EEG 2014), whereas in EEG 2017 no further distinction between the nature of deployment project is made. Correspondingly, also the remuneration of (large) PV installations on e.g. roofs is to be estimated via the auction. The auction under FFAV only applied for free-field installations, whereas now the scope for a quantitative regulation has broadened (§ 30 (2) EEG 2017).Determining in EEG 2017 is only the capacity to be installed and might have been therefore slightly increased from 400 MW (FFAV) to 600 MW (EEG 2017).

Another important indicator for a likely instrument shift is laid down in § 49. This paragraph regulates the attenuation of the driving values. As governed in EEG 2014, the driving values alter according to exceeding or short-coming in the deployment volumes. Within the EEG 2017 the total limit of 52 GW became more concise. In § 49 (5), a complete cut of the driving value is intended. This cut is concerning all new installations which initially fall under § 19 EEG 2017. Put differently, this cut concerns both, FIP and FIT. The cut of the driving value is made if the registered and subsidised deployment exceeds the 52 GW for two months. In the beginning of the second month, the driving value is cut to zero. Resulting, new installations will no longer receive subsidies after the limit has been exceeded significantly. Indeed, this paragraph was also included in EEG 2014. New in the EEG 2017 is the section 6 of § 49 EEG 2017. This paragraph states a duty of the German Federal Government to present a new agenda in a timely manner before the limit has been reached. Deriving, it can be concluded that the limit of deployment capacity is now more present and the legislation more focussed on deployment quantity. However, it is worth to mention the type of deployment considered while computing the deployment. The calculation is based on gross deployment of PV and not the net deployment. That means that in § 3 (14) only new installations are added up, neglecting older installations which might went off the grid or were replaced.

Summarising, the classification established by Haas et al. (2008) appoints a distinction between specific instruments. Within the definition of EEG 2014 and EEG 2017 the scope has been broadened for this paper. By doing so, several instruments, which one for each can correspond to different strategies, have been clustered. This is necessary to present the general perception of both legislations and the likely changes in outcome. However, while defining the strategies only a slight, although distinct shift derives from the comparison. The auction has been present as an ordinance in EEG 2014, whereas the mechanism was slightly reshaped and adopted as a firm part in EEG 2017. Important here is the extension of the objectives to be auctioned, and the obligation to participate at such for gaining access to remuneration. Besides of the auction, the other stimulating instruments of EEG 2014 prevail in EEG 2017 although under different conditions. These new conditions have been presented to be more quantity oriented since more installations are remotely controllable in the future. Also, the redefined agenda for the case of reaching the deployment ceiling indicate a quantitative interest. The presence of the concern for quantitative development allows the statement of a general strategy shift from price-driven towards quantity-driven. How this orientation towards quantity reflects in the specific design characteristics will be examined in the next chapter. By doing so, the before mentioned design characteristics will be assessed and compared in detail.

6. Design characteristics

Having examined the general type of strategy applied in both legislations, the examination will now focus on the design characteristics. The major changes in the design characteristics of the remuneration models between the legislations will be presented. Again, the six design features were grouped into price-, subsidy-, and time- characteristics. While examining each of the groups, both legislations are treated within one grouping. In the end of chapter 6 an illustration of the key findings will be presented.

6.1 Price characteristics

The first group deals with the price characteristics of the remunerations paid. As already mentioned, the group assembles of fist, the price structure and secondly, the CAPEX responsibility. The price structure defines the design of how a remuneration is paid, either fixed or as a premium for direct marketing. Within the EEG 2014 smaller installations of up to 750 kW could be supported via a FIT or FIP. For free-field PV parks above 750 kW the new auction applied, for other types of installations of that capacity conventional mechanisms applied.

EEG 2017 regulates differently. For PV installations up to 100 kW, a fixed remuneration is still granted, whereas for installations between 100-750 kW a duty for direct marketing has been installed. Hence, a shift from FIT to FIP has been installed and intends a step towards more competition. Therefore, FITs no longer apply as an opportunity for these installation capacities, with one exception. The regulating authority protects the producer by the implementation of a loss-compensation. Direct marketing can imply a trade via marketing agency which deals the green energy at the spot market on behalf of the producer. In case the agency must e.g. announce an insolvency, the loss-compensation functions as a limited FIT. Up to six months of a year a fixed remuneration can be paid (loss-compensation) to support the producer with income short comings triggered by the agency's insolvency. This process is defined in § 21 (1) sentence 2, in combination with § 53 EEG 2017. Worth to mention, the loss-compensation is not the full FIT amount, but reduced by 20%. By implementing this obligation for direct marketing, it is appointed to introduce the PV energy gradual in the competitive markets and gain control about energy sourced from PV.

However, the premium for both legislations is computed via the afore described driving value and is set by the regulating authority (Federal Network Agency). The premium which is paid to the producer assembles of the driving value, subtracting the market price. What is left from this balance is paid as a premium to the producer. Therefore, the premium stands in direct relation with the energy market price. If the market price of energy decreases, a higher premium is paid. Vice versa, a lower premium is paid if the spot market price is on a high level, therefore the sales revenue increases.

Again, to gain a remuneration for PV installations above 750 kW (the distinction between free-field PV installations and other types/places has been removed in EEG 2017) the operator must participate in an auction in which the remuneration amount is determined. Installations above 10 MW are excluded from any subsidy (Fraunhofer ISE, 2017).

The second half of the price characteristics is the CAPEX (capital expenditure) responsibility. Upfront, each consumer of electricity pays for the energy transition via a specific share in the electricity bill in Germany. This share in the electricity bill accounts for all RES remunerations. Only the procedure subsidising the PV sector will be examined here. The amounts for the subsidies are regulated via different stages and occurring cost are passed on amongst the actors involved. This mechanism is called ‘EEG-Umlage’, EEG-levy in English. The first stage is in between the producer and grid operator. The grid operators assure that the produced energy is brought to the grid, thus have the obligation to preferably buy electricity from RES (§§ 12-14 EEG). This accounts solely for the FIT. The defined remuneration must be paid as soon as a RES is connected and supplies to the grid. This opposes costs for the grip operators. In the second stage, grid operators sell the energy to transmission grid operators and receive the remuneration which has been paid to the producer before. In the third stage, the transmission grid operators sell the green energy at the spot market. At the spot market, the energy from RES competes with energy from conventional sources. As the sales revenue might not level up with the remunerations paid to the grid operators, the EEG-levy closes this gap between the prices of RES-E and conventional sources. The power suppliers which lastly provide electricity to the end consumers source the electricity indirectly (via the transmission grid operators) from the spot market and do not purchase the electricity directly from the transmission grid operators. At this stage, the costs for remunerations is paid by the transmission grid operators. To free these from the costs, the consumers pay the EEG-levy to the power suppliers, which then transmit the levy to the transmission grid operators (Fraunhofer ISE, 2017). This mechanism differs slightly although distinctive for the FIP. The generated electricity takes the same path as afore described, but does a FIP only applies for energy sold at the spot market and is, contrary to the FIT, not treated preferably over conventional energy sources. As laid down in § 20 (2) EEG 2017, condition for a FIP entitlement is the remote controllability. In case of an energy surplus at the sport market (at which energy under FIP is directly marketed) the PV plant output must be remotely decreasable.

As mentioned, the EEG-levy accounts for the all remunerations and is laid down in in §§ 56-69 EEG. According to § 3 (2) AusglMechV (“*Ausgleichsmechanismusverordnung*”- levy ordinance), the transmission grid operators are obliged to calculate and publish the next year’s levy at October 15th. An overview of these over the years can be seen in the figure below.

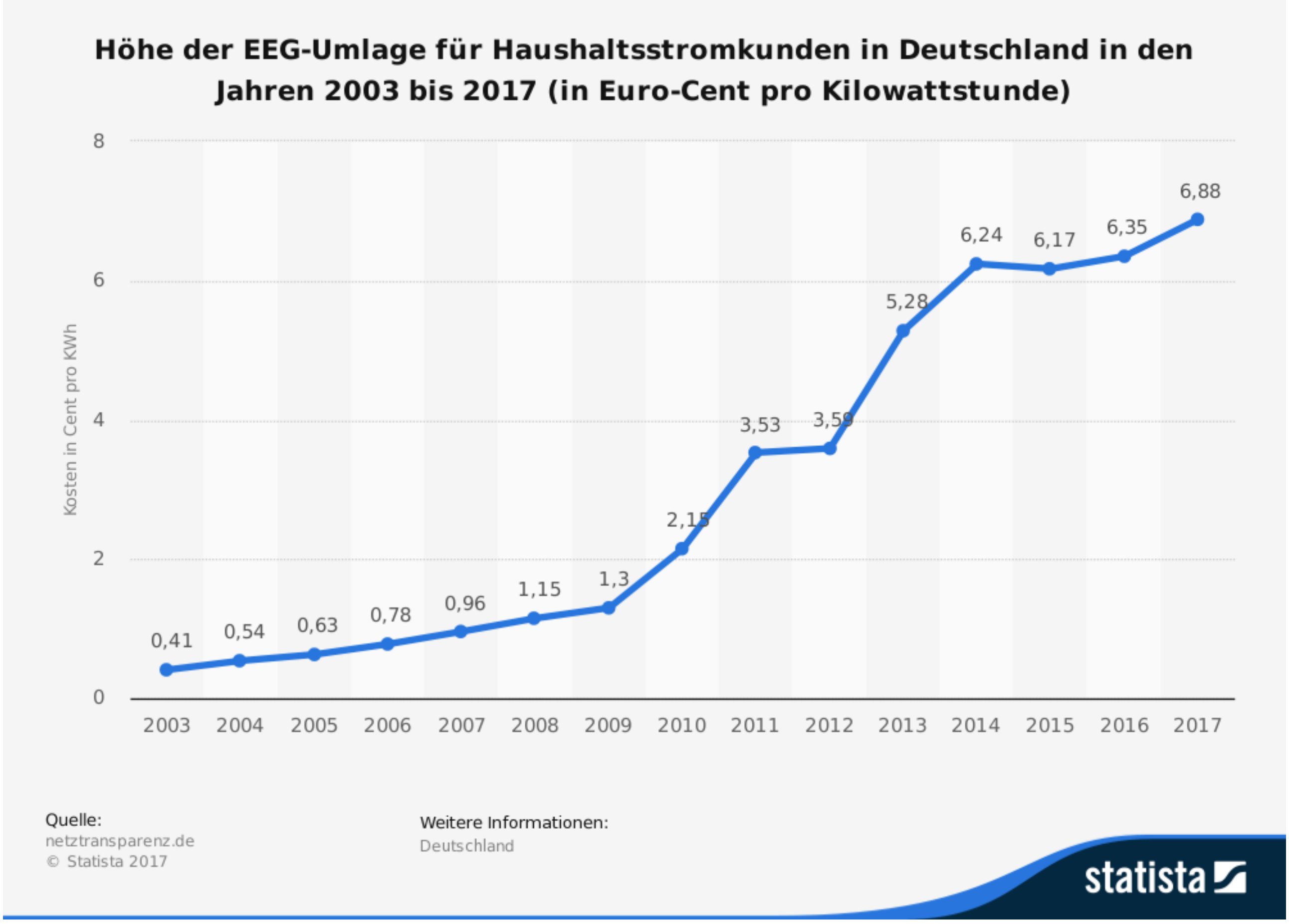

Figure 2 *Souce:https://ezproxy2.utwente.nl:3435/statistik/daten/studie/152973/umfrage/eeg-umlage-entwicklung-der-strompreise-in-deutschland-seit-2000/ (Retrieved at: June 27th, 2016)*

The table provided by Statista provides an overview of the EEG-levy (in cents) per kWh which has been paid by the end-consumer (non-privileged) over the years. In addition, the agency of transmission grip operators (ÜNB: Übertragungsnetzbetreiber; engl. Transmission grid operators) publishes the estimated levies at https://www.netztransparenz.de/EEG/EEG-Umlage (accessed on June 28th, 2016).

But a distinction between different types of consumers accountable for the EEG-levy is made and applies for both legislations. Electricity consumers are divided in two groups. The first groups are consumers e.g. households, the second group assembles of businesses with a high energy consumption. Legislation has been created (laid down in § 60a in combination with § 63 EEG) to free these high intense consumers from the EEG-levy to a certain degree. The consumption of these businesses was estimated to be at around 20% of the total energy share in 2015 (Fraunhofer ISE, 2017). Yet, these businesses are not totally freed from the levy. As an example, a business which uses 100

GWh/month pays a levy of merely 0.05 ct/kWh. But the share of businesses which make use of this privileged status increased. Between 2012 and 2014 this share has almost tripled, from 734 to 2098 business which are registered for the privileged status. A relief of €5.1 billion for the industry in 2014. The share of the total energy consumption of these privileged businesses was 22.6%. According to the relief, these businesses only account for a share of 1.7% of the EEG-levy responsibilities in 2014. In turn, this increases the levy burden for normal end-consumers like small businesses and households. (Mayer & Burger, 2014). Another discrepancy occurs while looking at the development. The EEG-levy has been 1.33 ct/kWh in 2009. With this amount, an EEG remuneration of €10.45 billion has been paid to the producers. With a EEG-levy of 6.24 ct/kWh in 2014, an EEG remuneration of €21.95 billion has been paid. The value increased almost by factor five, whereas the remunerations to be paid merely doubled. The actual support of the RES and the EEG-levy are therefore diverging. But, these amounts account for all RES as the EEG-levy paid by end-consumers does not distinct between the technologies. As the deployment corridor for PV has been installed, the annual levy sum of €10-11 billion for this technology is expected not be exceeded (Fraunhofer ISE, 2017, § 49 (5) EEG). A graph provided by Fraunhofer ISE displays the development of the levies paid for PV installations alone. The installed PV capacity in GW is displayed on the left axis, the PV remuneration in Euro billion is on the right.

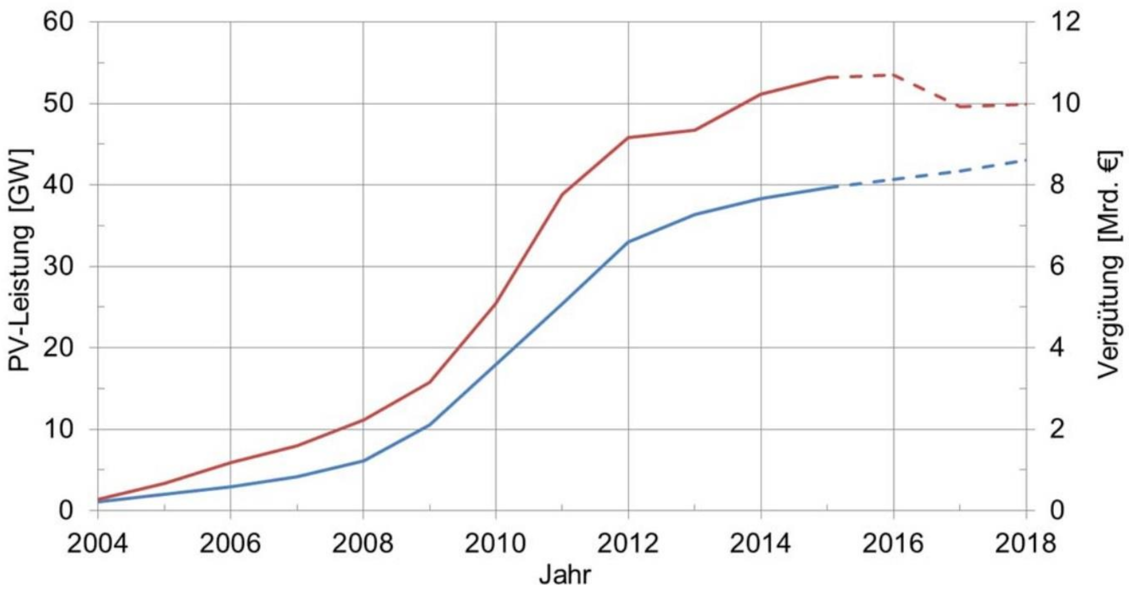

Figure 3 - installed PV capacity in GW & total remuneration amount in € billion - (Fraunhofer ISE, 2017, p. 13)

Linking the CAPEX responsibility to the installed auction mechanism, new administrative costs to estimate the remuneration arise. To keep the administrative costs for the authority as low as possible, auction fees in forms of assurances have been installed. To keep the investment risk for the participants at a low level, the assurances are paid in two stages. The amount stands in relation with the amount to be auctioned. Again, the minimum amount to be auctioned is 750 kW. The first assurance is to be paid while placing a bid, the second must be paid as soon as the bid is awarded. Under the FFAV these assurances were laid down in § 7 (first assurance) and § 15 FFAV (second assurance). The first assurance was set at €4 per kW. The second assurance, in case the bid is awarded, amounts €50/kW. The assurances can be halved, according to § 6 (4) b) c), in combination with § 3 (2) BauGB and § 30 BauGB, if the project is already permitted by the construction authority. According to § 16 (4) 1), 2) FFAV the assurance must be given back if the auction was not awarded or the project withdrawn.

The EEG 2017 reduces the assurances slightly and groups the two stages to €50/kW. The first assurance is set at €5 per bid kilowatt, whereas the second assurances is set at €45/kW. Under this legislation, only the second assurance can be halved, again, if the planning process is on a later stage and permitted by the construction authority (§ 30 BauGB). Again, assurances must be given back according to § 55 a EEG 2017 if the participant was not awarded or has withdrawn the bid.

Calculating an example to better present the trade-off between FFAV and EEG 2017. Given a capacity of 750 kW for both cases. Under the FFAV, the auction would impose a cost of €40,500 (€3,000 first stage + €37,500 second stage) to the participant, whereas under the EEG 2017 a cost of €37,500 (first stage €3,750, second stage €33,750) must be paid as assurance to the network agency.

Summarising can be stated the general principle of the remuneration design and CAPEX responsibility did not change fundamentally. But, some changes have been made. Certain duties to either market directly or participate in the auctions have been installed, the loss-compensation has been added. Regarding the auction responsibilities, slight assurance reliefs have been installed. The EEG-levy model did not change within the shift from EEG 2014 to EEG 2017. Merely the EEG-levy rates have changed as can be seen in the graph above. This is due to changing market prices and other RES, and influenced by change in the policy framework. Resulting, the EEG 2017 seems to have realised an increase in control over additionally capacity installed and electricity to be fed to the grid, and further a decrease in subsidy costs.

6.2 Subsidy characteristics

The subsidy characteristics assemble of the cost containment and the price magnitude. Referring to Jenner et al. (2013), some countries cap the maximum amount of FITs paid or the total capacity installed. In the case of Germany, a price cap for PV subsidies has not been installed in neither of both legislations. The German Federal Government makes use of a different design to limit the expenses for remunerations. As mentioned, the deployment corridor has been installed. Exceeding this corridor implies no further subsidies for new installations. In both legislations, the deployment corridor has been set at 52 GW of total PV deployment (§ 31 (6) EEG 2014 and § 49 (5) EEG 2017). The cap for deployment under the FIT remained on the same level in both legislations, therefore no shift in the cost containment took place within the amendment. Worth to mention here is the link to the exclusion of any subsidies for installations with a capacity above 10 MW (§ 37 (3) EEG 2017).

The second pillar of the subsidy characteristics can be found in the price magnitude. As has been displayed in the prior chapter, the price magnitude has experienced a shift. What has been 9.23 cents per kW/h defined in § 51 (2) EEG 2014 and § 8 (2) FFAV, is under EEG 2017 cut down to 8.91 cents per kW/h according to § 37b EEG 2017. As the major legislative change concerns the implementation of the auction for PV installation above 750 kW, the scope will now focus on this capacity. The afore mentioned values determine the starting value from which the participants begin to compete. If a bid for remuneration exceeds the driving value, the bid is excluded by the Federal Network Agency from the auction. Again, these starting values stand in relation with the deployment corridor and are altered accordingly. This is further examined in the chapter 6.3.

Coming back to the remuneration amounts granted via the auctions. To date, seven auction rounds have been processed. The results from the auction rounds can be seen in table 3 below. The first round under FFAV has been progressed with a pay-as-bid model. In this model, the price which was offered as a bid was in fact set as the remuneration amount. This model has the advantage that the operator has a certain price security, as the price signed at the bid is the price received in case the offer is awarded. It is further stated to be perceived as fair by the public (Klessmann et al., 2015). The negative aspect is a variety of different values according to the variety of offers. The calculation of the offer requires a good knowledge from the producer and is influenced by the competitiveness in the auction. In addition, pay-as-bid involves a certain the risk tolerance. According to Klessmann et al. (2015), the pay-as-bid system can lead to ineffectiveness. Given the case an operator with low costs sets a high price bid to gain most remuneration, and an operator with high costs places a low-cost bid. In this case, the competitor which in fact could realise the project for a smaller price, might not receive the bid (Klessmann et al., 2015). Arising from this inefficiency, weaker participants can gain an advantage over participants with lower prices (Klemperer, 2002). Under this circumstance, the pay-as-bid principle might be more appropriate for weaker participants, which is contrary to the perception of uniform pricing bringing more advantages to weaker participants due to fewer calculation efforts. Again, the pay-as-bid implies a well-executed calculation of the operational costs. As the different offers are not related to each other and merely the auctioned volume accounts, the likelihood for collective price agreements is low under pay-as-bid (Klessmann et al., 2015). In the second and third auction round, the uniform-pricing principle has been applied (Bundesnetzagentur, 2017). Uniform pricing on the contrary implies incentives for multi-project bidders to place bids at higher prices than needed. Placing several bids the market, in combination with price agreements with other competitors, the chance of pushing the remuneration to a high level is given (Klessmann et al., 2015).

After all, it has been observed that bidders are rather risk timid. Therefore, under a pay-as-bid model, lower remunerations might be reached than it would be the case as under a uniform-pricing model. Theoretically, participants under pay-as-bid are more likely to reveal their true costs than under uniform-pricing. The desire to increase the likelihood of being awarded is larger as the framing security of the uniform-pricing (highest offer accounts for all) is not given under this principle (Klessmann et al., 2015).

Finally, the price-as-bid method was translated in the new legislation. Paragraph 32 EEG 2017 regulates the awarding of the bids. The received bits are sorted beginning with the lowest offer, and this process continues until the auctioned volume is reached.

Table 2

Auction round	April 2015	August 2015	December 2015	April 2016	August 2016	December 2016	February 2017
Averaged rewards	9.17 ct/kWh	8.48 ct/kWh	8.00 ct/kWh	7.41 ct/kWh	7.25 ct/kWh	6.9 ct/kWh	6.58 ct/kWh

Source (Bundesnetzagentur, 2017, p. 9)

6.3 Time characteristics

The last group of the design characteristics assembles of the duration of the contracts and the attenuation of the subsidies. The contract duration for support is laid down in § 22 EEG 2014 and states a support for 20 years. The support begins with the activation of the instalment. In EEG 2017 the begin, duration, and termination is laid down in § 25. As before in EEG 2014 the duration for subsidy contracts of 20 years is defined. This accounts also for the contracts awarded through the auctions. Alike in EEG 2014, the entitlement for remuneration begins with the energy production of a PV installation (link to remuneration, based on generation). Summarising, no changes were made in the duration of the subsidy contracts.

The attenuation came into play earlier but will now be examined and compared in detail. Beginning with EEG 2014, the attenuation is laid down in § 31 EEG. Section one defines a gross deployment between 2400 and 2600 MW per year. This is important as the attenuation is stands in relation with these deployment capacities and the total cap of 52 GW mentioned before. In section two the attenuation is defined to be 0.5% a month, starting from September 2014. Additionally, the attenuation is levelled on the in section one mentioned deployment amounts each quartal of a year. Section three of the same paragraph sets an attenuation of 1% if the desired deployment is exceeded by 900 MW. The strongest attenuation of the driving value is reached at 4900 MW excess with 2.8%. But the attenuation is also cut down in case the deployment falls short. Section four of § 31 sets 0.25% attenuation in case the deployment target has been fallen short up to 900 MW. If the deployment target is fallen short by more than 900 MW, the attenuation is cut completely. Either way, the attenuation only accounts for new installations. If one installation took place in e.g. September 2014 and a second in October 2014, the latter receives, given a deployment as intended, 0.5% less remuneration paid than the prior. Either way, the remuneration is in both cases granted for 20 years.

Looking at the EEG 2017 the attenuation of the subsidies is laid down in § 49 EEG 2017. Again, the standard, monthly attenuation is set at 0,5%. The attenuation rate is also computed four times a year and is linked to the PV deployment of 2500 MW a year as well. Slightly different values can be found, but also as for the deployment volume, the numbers were rounded. The attenuation increases to 1% if the yearly deployment limit of 2500 is exceeded by 1000 MW, up to 2,8% if the deployment is exceeded by more than 5000 MW (§ 49 (2) EEG 2017). More sensitive is the cut of the attenuation in case deployment has fallen short. What has been 900 MW before, is now set at 200 MW, resulting in a 0.25 % monthly attenuation. Newly added is the trigger to add one-time 1.5 %, respectively 3.0 % to the driving value in case the deployment has fallen short by 800 MW, respectively 1200 MW (§ 49 (3) EEG 2017). This is an instrument which increases the price magnitude (driving value) in case the deployment is stagnant.

Summarising can be stated the time characteristics have been changed slightly. No changes in the contract duration was made, but in the attenuation mechanism. Especially § 49 (3) EEG 2017 is of importance in this regard. A shortcoming in deployment benefits new installations since the driving values increase by 3% in case of a deployment shortcoming of 1200MW (reverse attenuation).

The table presents the results from the sup-chapters of chapter 6. Different to the expectations, the analysis presents slighter differences within the shift from EEG 2014 to EEG 2017 as expected.

Table 3 - Findings

Group	**Sub categories**	**Findings in EEG 2014**	**Findings in EEG 2017**	**Trade-off between legislations**
1. Price characteristics	Structure	Both, FIT and FIP for installations up to 750 kW possible, Auction for installations above 750 kW up to 10 MW	FIT for up to 100kW, 100-750 kW duty to FIP, loss-compensation, Auction for installations above 750 kW up to 10 MW	In EEG 2017 the FIT entitlements have been cut due to the direct market obligation, the participation at the auction was broadened and became slightly cheaper
	CAPEX	EEG-levy, auction assurances (e.g. 750 kW = €40.500)	EEG-levy, auction assurances (e.g. 750 kW = €37.500)	Note: increasing EEG-levy over the years; mechanisms unchanged, slightly reduces auction assurances
2. Subsidy characteristic	Cost containment	Cap of 52 GW	Cap of 52 GW	Remained on the same level,
	Price magnitude	9.23 ct/kWh, plus auction results	8.91 ct/kWh, plus auction results	Remuneration value was decreased, auction pushed subsidy below 7ct/kWh
3. Time characteristics	Duration	20 years contract	20 years contract	No change

	Attenuation	0.5% monthly, up to 2.8%, min 0.25%, or cut	0.5% monthly, up to 2.8%, min 0.25% (begins earlier), if deployment falls short drastically, the attenuation is reversed by up to 3%	Attenuation became more sensitive, decreasing quicker if deployment has fallen short, but adds up to 3% if deployment come short by 1200 MW. Stimulates market.

7. Synthesis and Discussion

In this chapter, the trade-offs between the legislations will be synthesised. Again, the policy approach distinction is based on the framework developed by Haas et al. (2008). Deriving from that distinction, the subsidy design characteristics of Jenner et al. (2013) were used to analyse the trade-offs. In the chapter defining the legislations, the regulatory scheme has been used to predict a general shift of the legislative approach and not for the definition of the instruments one for each. This fact diminishes the explanatory power to a certain degree. Nevertheless, the shift from a price-driven towards a quantity-driven regulatory approach can be confirmed. This earns support by several changes. First, and most significant, is the implementation of the auction mechanism as a firm part of the legislation. In addition to that, the extension of the PV installations which fall under the auction obligation. This section of the law is the strongest indicator for a shift towards a quantity-driven approach. Secondly, the agenda which has been included to regulate the situation in which the deployment cap has been reached. This presents an increased awareness for deployment amounts. However, different instruments which correspond to price-driven mechanisms prevailed. But looking at those, a tendency towards cutting costs becomes visible. Most significant in this regard is the rejection of FIT entitlements for deployment capacities of 100 kW to 750 kW. This has the effect that electricity generated from these capacities no longer receive a fixed subsidy amount but a premium for energy which is sold at the spot market. Even though price-driven mechanisms are still applied, the tendency to cut costs is present. It could be argued the shift did not happen as the increased use of FIP accounts to price-driven. But, according to Haas et al. (2008), financial instruments are included in quantity-driven approaches (auctions for subsidy amounts) as well. Determining is the interest. Even though financial aid is included, the focus now is more on the deployment capacity and control. Summarising, the auction as a firm part is a distinct approach of RQD. The cut it subsidies and orientation towards more price efficient subsidy forms allow a generic definition of a shift from regulatory price-driven, to a regulatory quantity-driven approach.

The first distinction is made. The German Federal Government amended the approach of the law regulating the development of renewable sources in Germany. Under the definition frame used in this regard a general shift became visible. To examine in which regards the specific instrument were changed, the before elaborated findings are now synthesised. Beginning with the subsidy structure. It got confirmed that the auction now has become a firm part of the legislation which implies a cut in costs in terms of remunerations. The first development of such were presented in table 2, the auction has pushed the subsidies for new installations below 7 ct/kWh. In addition, the scope for FIT entitlements has been narrowed. This can be linked to a decrease in subsidy costs since the share of systems for which the obligation to compensate becomes smaller in the future. Indeed, the FIPs are guaranteed as well, but is the obligation to feed the electricity to the grid not provided under this frame. Therefore, the first design characteristic change has a positive impact in terms of remuneration obligations.

The CAPEX responsibilities for the conventional model did not change, though a rise in the EEG-levy might be expected. That is due to future deployment of RES adding up to existing support contracts and decreasing energy prices at the spot market. Though, the EEG-levy responsibilities of PV have been presented to be capped. The implementation of the auction implies administrative expenses for the Federal Network Agency which are to be managed by auction assurances. These were slightly decreased while shifting from ordinance to legislation. This design characteristic is mixed. On the one hand, the model for the CAPEX responsibility did not change, on the other hand, rising costs in the general EEG-levy can be expected, additional costs for the producer arose due to the auctions. Therefore, the second design characteristic experiences a negative impact by the renewed legislation.

Under the cost containment no changes could be extracted. In both legislations, the total PV deployment cap of 52 GW is installed. The action volume was slightly increased, which is due to the extension of PV plants which are now to be auctioned. Summing up, the legislative change has a neutral impact on the design characteristic.

The price magnitude experienced a shift under the amendment. The driving value was decreased in the law, thus a facilitation for the EEG-levy can be derived for new installations. Additionally, the auction ordinance was adopted unchanged to a large extent. Therefore, the results of the pilot-project are representative and comparable with the first auction result under EEG 2017. The results of seven rounds present here too a decrease in the price magnitude. Therefore, the amendment has a positive impact on the price magnitude.

The subsidy contract duration for all instruments in use remained on same level. Remunerations are for 20 years under both legislations. Hence, this design characteristic experienced a neutral impact.

The attenuation experienced a shift. The design was made more sensitive towards excess and shortcomings in deployment, therefore an enhancement in regulating the deployment corridor can be accounted. Worth to mention in this regard is the generous surplus in the driving value (value which is usually attenuated) of 3% in case the annual deployment falls short by 1200 MW. Ultimately, the attenuation experienced a positive change.

Below a visualisation of the impacts. As can be seen, three out of six design characteristics were changed positively. Two out of six characteristics experienced no change, whereas only one characteristic experienced a negative shift. Thus, it can be argued that the amendment has a positive impact on the PV development in Germany under the examined design features. Especially the effectiveness in terms of costs stands out and would not have been feasible under the old legislation. The auction has pushed the subsidies below 7ct/kWh, the enlargement of FIP entitlements orientates closer at the market. Also, the amendment will likely have no impact on the deployment capacity as the deployment corridor sustained the amendment. To date, and according to the auction report by the German Federal Network agency, six auction rounds have been characterised through a high interest and were oversubscribed (BMWi, 2016). That means that even though a decrease in subsidies is given the interest and willingness to invest in PV remains present in Germany.

Design characteristic	**Subsidy structure**	**CAPEX responsibility**	**Cost containment**	**Price magnitude**	**Contract duration**	**Attenuation**
Change	Positive	Negative	Neutral	Positive	Neutral	Positive

Figure 4 - Valuation of trade-offs

The valuation of the impacts has been presented. It was suggested that by the amendment the subsidy costs for the PV development could be decreased and the level of competition sustained. To date, each auction round was oversubscribed and additional competition can be expected due to the increase of direct marketed PV power. The researchers Kost et al. (2013) developed a forecast of the levelized cost of electricity on behalf of the Fraunhofer ISE institute. As defined by Jenner et al. (2008), the subsidy amount stands in relation to the cost of generation. A lower cost of generation therefore requires less support.

As can be seen, the levelized costs of electricity (LCOE) is expected to decrease. The yellow frame in the graph depicts the cost development for PV. The presented estimations of the LCOE are potential development pathways on the basis of recent market development studies based on different scenarios and technology specific assumptions if learning curves and full load hours (Kost et al., 2013). The subsidy amount in the latest auction was pushed below 7 ct/kWh which is reflected in this graph. This corresponding relation is merely a suggestion and requires further evidence.

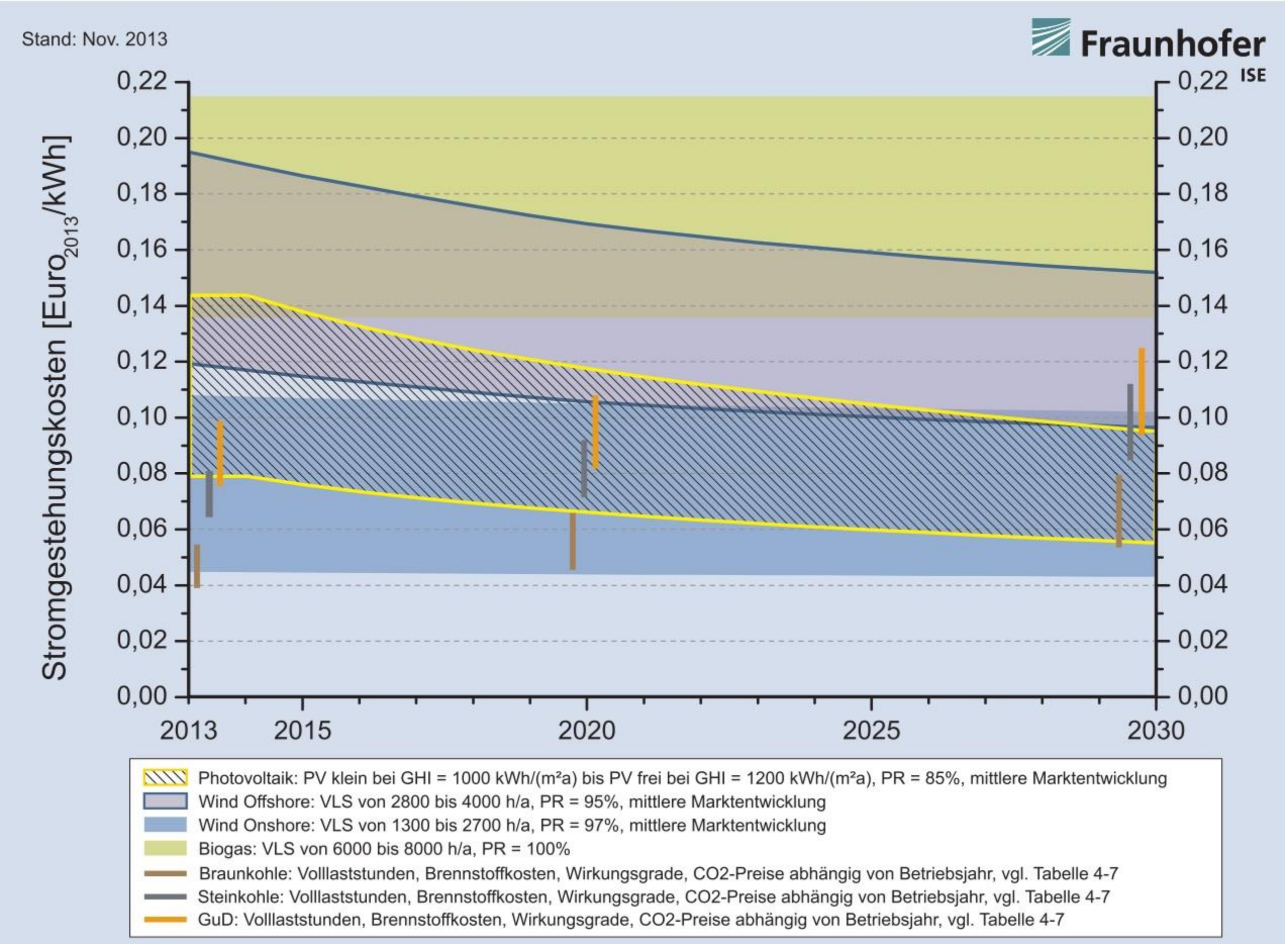

Figure 5- (Kost et al., 2013, p. 25) Retrieved at June 25, 2017 under: http://www.ise.fraunhofer.de/de/veroeffentlichungen/veroeffentlichungen-pdf-dateien/studien-und-konzeptpapiere/studie-stromgestehungskosten-erneuerbare-energien.pdf

8. Scientific and social contributions

The research of Haas et al. (2008) has been used to examine a shift from a price-driven to a quantity-driven policy approach within the German Renewable Energy Source Act. Jenner et al. contributed a distinctive pattern of design characteristics for stimulating instruments used to implement RES. Their research suggests an application of the developed design characteristics as an examination framework. This suggestion was taken up and a regulatory impact analysis was performed in this paper. Deriving, it was examined what kind of impacts (positive, negative, and neutral) the amendment has on each of the design features. Based on a position which has an interest in financial efficiency, at thee out of six design characteristics a positive impact was indicated. Jenner et al. (2013) expect that further research based on their scheme may provide insights. This research can contribute regarding the effectiveness of the auctions to limit the subsidy expenditures. Since the auction was implemented, the subsidy for PV installations with a capacity from 750 kw to 10 MW has been decreased by 2,33 ct/kWh. This is suggesting a future decrease but is to be verified by future research. Redesigning the price structure has limited the FIT entitlements. This change in design results in more market oriented deployment as the entitlement for a premium is only possible through a direct marketing. Additionally, this shift has freed the authority from the guarantee to feed PV energy from the grid to a certain degree (FITs must be fed to the grid, FIP competes).Resulting, this might lead to more competition in the energy market which might decrease the energy prices at the spot market. To date, no statement about this fact can be made given the timeliness of the amendment. The redesign of the attenuation suggests an enhancement in the instrument's sensitivity. The reverse attenuation might stimulate the deployment in case the subsidies are levelled too low. Besides, the deployment corridor of 52 GW remained unchanged and it is to be confirmed whether this mechanism will be used and to what extent it functions as intended.

It has been presented that the EEG-levy increased over the years. Considering the deployment cap for PV, the share of this technology in the EEG-levy is not expected to become larger. This compensation mechanism is highly complex. As it not only counterbalances subsidies for PV, but all kinds of RES used in Germany. However, even though the PV share was presented to be limited (€10-11 billion), the EEG-levy is expected to slightly increase. The transmission grid operators developed a EEG-levy forecast until 2021 as can be seen below.

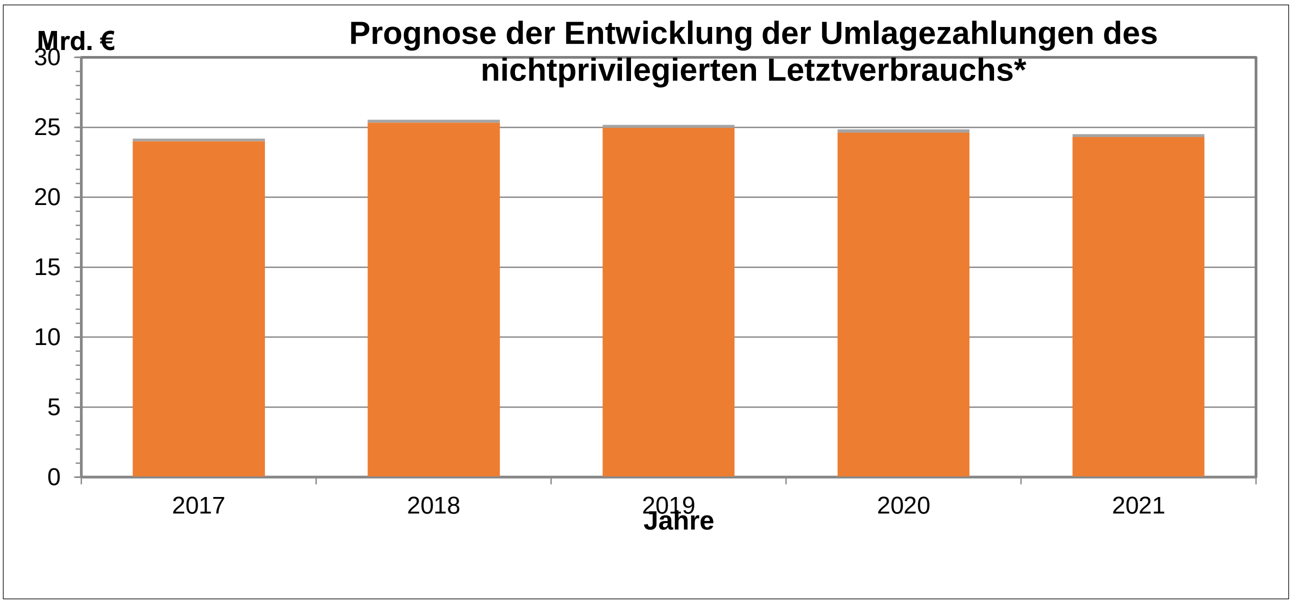

Figure 6 - EEG-levy prognosis (2017-2021) for non-privileged end-consumers in EUR billion (ÜNB, 2016) Retrieved at July 1rst, 2017, under: https://www.netztransparenz.de/portals/1/Content/Erneuerbare-Energien-Gesetz/Jahres-Mittelfrist-Prognosen/20161014_Mittelfristprognose_2017_bis_2021.xlsx

The EEG-levy is expected to increase until 2018, to then slightly decrease in the years after. This is of course, just a prognosis. It seems like that the obligation for direct marketing lowers the remuneration obligations but is this only limited confirmable. Both, FIT and FIP are calculated on the same basis (driving value). The difference is, that the FIT is guaranteed (produced electricity must be fed to the grid) and FIP only accounts for electricity which is sold at the spot market.

Whether a FIT or a FIP is paid makes therefore no difference in the subsidy as both are based on the driving value. FIP have the advantage to gain more revenue when the energy is sold. Both, the sales revenue and the premium are paid to the operator. But for both cases applies, when the market price for electricity lowers, the remuneration must increase as the gap between assured remuneration and sales revenue becomes larger. Therefore, it might be cheaper to have fewer FITs as these must be sold at the spot market. Contrary, FIPs can be shut down remotely whenever the energy demand is covered. Resulting, by the controllability the FIP systems lose the preference over conventional sources. The future share of systems which fall under this characteristic will increase due to the amendment. This might comfort the market power of fossil fuel. If fossil fuel can cover the demand it might lead to the incentive to shut down PV systems remotely as then no FIP subsidies must be paid. Having this suggestion in mind, it might be that through the obligation for direct marketing the energy transition is hindered as the preference for PV power was marginalised in the amendment. Due to limitations, this research has put the focus on direct regulations and the internal energy market. Indirect regulations may contribute to a more sustainable and more levelled energy transition. Future research may contribute and connect the reshaped direct instrument with indirect instruments to broaden the picture. The future scope might be further broadened to a wider market setting, including imports and exports of energy as well.

Taking this into account the character of the EEG 2017 opposes a mixed picture. On the one hand, it stimulates the market more effectively than under the EEG 2014, on the other hand it suggests the risk of hindering the sustainable use of PV power due to increased direct marketing. The future version of the EEG may have to address the increased amount of directly marketed PV installations. As suggested, the direct marketing may imply the effect that fossil fuel can push PV power out of the market. Assuming the remote controllability of direct marketed PV installations leads to less market entry power as they can be shut down if the energy demand is covered. Therefore, the German Federal Government might need to tailor a policy to counter that situation to assure a sustainable use and market share of PV power. Using more green energy therefore implies higher levy obligations. Resulting, another implication for the future EEG version might be a higher commitment of energy intense businesses to compensate for the EEG-levy. The levy was forecasted to further increase, thus the costs for the end-consumers are likely to increase as well, regardless to PV. The shares of end-consumers and privileged end-consumers has been presented and it might be fair to reallocate the levy expenses.

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