April 2018 ▌ WWEA Policy Paper Series (PP-02-18-B)

GERMANY

Denmark - **Germany** - The Netherlands - Spain - United Kingdom

Author: Faraimunashe Nkomo

WWEA
World Wind Energy Association

한국풍력산업협회
KWEIA KOREA WIND ENERGY INDUSTRY ASSOCIATION

Executive Summary

Today Germany is home to one of the most advanced wind energy markets of the 21st century. In the last three decades alone, there has been a surge in the financing, and deployment of wind energy technologies across the country. Notably, on the international arena Germany is ranked the third-largest market for wind energy, only after that of China and the United States (U.S). Within the European Union (EU), the German wind industry, and market have maintained a competitive edge, and has consistently retained their leadership position. What is also important to note is that wind energy continues to play a pivotal role in meeting electricity demand, guaranteeing, for instance, 60% of the electricity in more than four states (BWE, 2016). Decentralized, and community owned business models have constituted a significant proportion of the wind market share in Germany.

This is indeed a remarkable progress, especially for a country whose energy policy history has been underpinned by coal, and nuclear as the primary sources of energy generation and consumption. A desirable 100% renewable 'energy transition has been so difficult to achieve because of the momentum, path dependency, or obduracy, the existing system has exerted on new, and innovative actors, and policies (Sovacool, 2016). Nevertheless, what is important to note is that Germany owes its success, in establishing its wind energy sector, to a mix of public policies that have created enabling conditions for the wind energy industry, and market to thrive. The policy design of Germany's remuneration scheme, the Feed-In-Tariff (FiT) has provided transparency, longevity, and certainty for investors. A functioning financial services sector, an effort to improve grid connection guidelines, the government's commitment to funding research and development (R & D), as well as strong cooperation between the state, science sector, and the wind industry- are other explanatory factor s for success. This is not to say all is well in the wind industry. There are still multi-dimensional political, economic, social, cultural, institutional and technological complexities inherent in Germany's political-economy, and traditional energy sector, that make it difficult to maintain protracted innovation, and growth within the wind energy sector.

List of Figures

List of Tables

Index

BBNE	Vocational Education and Training for Sustainable Development
BIBB	Federal Institute for Vocational Education & Training
BMBF **(**Bundesministerium für Bildung und Forschung**)**	Federal Ministry of Education and Research
BWE (Bundesverband Wind Energie)	German Wind Energy Association
BMUB (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit)	Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety
BMWi (Bundesministeriums für Wirtschaft und Energie)	Federal Ministry of Economic Affairs & Energy
BNetzA (Bundesnetzagentur)	Federal Network Agency
CDU (Christlich Demokratische Union Deutschlands)	Christian Democratic Union
CSU (Christlich-Soziale Union**)**	Christian Social Union
CO2	Carbon Dioxide
DM	Duetsche Mark
DtA	Deutsche Ausgleichsbank
DW	Deutschewelle
EC	Europpean Commission
EEG	Erneuerbare-Energien-Gesetz EEG (Renewable Energy Sources Act)
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EU	European Union
EUR	Euro
EnWG	Energiewirtschaftsgesetz
FDP	Free Democratic Party
FiT	Feed-In-Tariff

FiP	Feed-in-Premium
GHGs	Greenhouse Gas Emissions
GTAi	Germany Trade & Invest (GTAI) (Agency of the Federal Republic of Germany).
GW	Gigawatt
IEA	International Energy Agency
IRR	Internal Rate of Return
IRENA	International Renewable Energy Agency
IPCC	Intergovernmental Panel for Climate Change
IPP	Independent Power Producer
IWES	Institut für Windenergie und Energiesystemtechnik/ Institute for Wind Energy and Energy System Technology
KfW	Kreditanstalt für Wiederaufbau (German Development Bank)
kWh	Kilowatt/hour
MW	Megawatt
NABEG	Grid Expansion Acceleration Act
OWT	Offshore Wind Turbines
PEP	Project Development Program
PPA	Power Purchase Agreement
R&D	Research and Development
REFIT	Renewable Energy-Feed-In-Tariff
RES	Renewable Energy System
SPD	Social Democratic Party of Germany
StrEG/ EFL	Stromeinspeisungsgesetz/'Electricity Feed-In Law'
SDL	'Systemdienstleistungen'(System Service Bonus)
UNFCCC	United Nations Framework Convention for Climate Change

U.S	United States of America
WMEP	Scientific Measurement and Evaluation Programme’
WTG	Wind Turbine Generators

Table of Contents

1.Introduction

Today Germany is home to one of the most advanced wind energy markets of the 21st century. In the last three decades alone, there has been a surge in the financing, and deployment of wind energy technologies across the country. Notably, on the international arena Germany is ranked the third-largest market for wind, only after that of China and the United States (U.S). Within the European Union (EU), the German wind industry, and market has maintained a competitive edge, and has consistently retained its leadership position. In 2015, for instance, the EU brought online some 12.8 GW of wind power capacity, of which more than half came from Germany alone (BWE, 2016). By July 2017, 27 914 wind turbines with a capacity of 48 024 MW were installed in Germany (Deustche Windguard, 2017). In comparison to the portfolio, at the end of the previous year, a capacity increase of about 5% was achieved (Deutsche Windguard, 2017).

What is also important to note is that wind energy continues to play a pivotal role in meeting electricity demand, guaranteeing, for instance, 60% of the electricity in more than four states (BMU, 2016). Decentralized, and community owned business models have constituted a significant proportion of the wind market share. This is indeed remarkable progress. The process of introducing public policies to support the financing, and deployment of wind energy was complex because of resistance primarily from the incumbent centralized energy regime that is dominated by the nuclear, & fossil fuel industry. Institutional legacies had been protecting the status quo, and political regulations, tax codes, and even banks and educational institutions had been supporting a carbon dependent energy system. Large sums of labour, capital, and effort had 'sunk' into the energy system, and making desirable and necessary policy change difficult to achieve. Given this background, it thus interesting to explore the factors that have led to the growth of Germany's on & offshore wind energy sector, and identifying those key public policies that can be useful for interested policy makers from other countries, who seek to also ensure successful growth of their countries' wind energy markets.

Purpose of the study

The main purpose of the study is to identify, and explore the key explanatory public policy prescriptions that have contributed to the market creation, and growth of Germany's wind energy sector. The main focus of the study will be on the regulatory frameworks, and policy tools that have been formulated, and enforced to promote the market uptake of wind energy technologies in Germany. The paper is interested in unpacking the political, economic, social, and technological factors, at the global, state, and local level, that have contributed to the creation and shaping of public policies that benefitted the wind energy industry in Germany. The paper also seeks to provide some empirical analysis by identifying barriers to wind energy policy implementation, as well as useful policy impacts, and outcomes of those policies. Finally, the paper seeks to provide the key public policies that have allowed Germany to create the necessary conditions, and enabling environment for wind energy. It is envisaged that these can serve as a guide for policy makers in nascent, and emerging wind energy markets, who also seek to expand wind power utilisation in their respective countries.

Outline of the Study

Section 2 focuses on the remuneration schemes that have been formulated, and enforced within Germany's wind energy market. The introduction of the S*tromeinspeisungsgesetz* (StrEG) /'Electricity Feed-In Law' (EFL) in the early 1990s will be identified as a key element in driving the market creation of Germany's wind energy sector. How StrEG was an effective policy tool, and its inadequacies will be discussed. What follows is a chronicle of the policy changes initiated during the turn of the century in 2000. Prime focus will be on the Renewable Energy Act (2000) (*Erneuerbare-Energien-Gesetz* (2000), or EEG), which also serves as the basis for today's renewable energy regulatory and policy framework. It will be emphasised the EEG's policy design played a pivotal role in enhancing transparency, longevity, and certainty for investors. Attention will also be given to how some reforms, and revisions to the EEG both enhance, and threaten the protracted growth of the wind energy sector. The potential risks posed by the introduction of auctions will particularly be scrutinised.

Section 3 will explore the various **grid connection rules and regulations**, and what role these have played in promoting wind energy. Under this section, some threats posed by Germany's ageing, and limited grid infrastructure, to the wind energy sector, will be discussed**. Section 4 & 5** will both, respectively, focus on **site designation rules**, and the role played by **planning & permit procedures**, as well as **Environmental Impact Assessments** (EIAs) in both enhancing, and constraining wind energy investments. The **social aspects of wind energy** will be discussed in **Section 6**. Here, it will be shown why it is of critical importance to maintain wind energy markets that involve local communities. Also, the various drivers and benefits that attract local communities, and ordinary citizens to pursue a decentralized, bottom-up, and community based development pathway in wind energy projects, will be identified. **Available wind data**, and some facts and figures of the market will be elaborated in **Section 7. Section 8, 9, and 10** will respectively focus on public policies that enhance **domestic industrial capacity, research and development (R & D), and wind energy exports**. Finally, the conclusion in **Section 10** is an **analysis on enabling conditions for wind energy**. Here, **future prospects of the German wind** energy market will also be discussed.

2. Remuneration Schemes for German Wind Power

Introduction

This section of the paper relates to the various remuneration schemes that have been adopted by Germany in an attempt to enhance an increased uptake of wind energy. The main focus of the discussion in this section will be on the design of Germany's policy tools which are feed-in-tariffs (FiTs), and recently an auction based system. An attempt will also be made to discuss some other policy tools Germany has relied on to enhance wind energy. These include direct investment in research and development (R&D), direct subsidies, and government sponsored loans.

Inroads to German Wind Energy Market

The development and growth of Germany's wind market did not occur in a vacuum. Political, economic, institutional, technological, and important socio-cultural forces necessitated the need to adopt a robust renewable energy regulatory and policy framework. For one to adequately understand the emergence, and growth of Germany's wind energy market, it is of paramount importance for one to understand it in tandem with the evolutionary process, '*Energiewende*'. The term Energiewende can simply be conceptualised as 'energy transition', or 'transformation of the energy system'. Energiewende is the main driving force behind Germany's change in policy direction, and efforts to redesign the substance of climate and energy regulatory frameworks. As an integrated policy, it covers all sectors of the economy, and society, with particular emphasis on the power, heating and transport sectors (IRENA, 2015).

Energiewende also involves a long-term strategy, and evolving process that encompasses a variety of aspects, aimed at transforming the German energy system primarily by deploying a greater share of renewable energy, and innovative solutions to energy efficiency. The relevance of Energiewende to the emergence, and growth of Germany's wind energy market is that; it reflects the broad consensus, and commitment that spans across Germany's political landscape, and society to pursue, and support regulatory and policy frameworks that ensure the upscale of renewables, like wind energy.

Window of Opportunity for a Wind Energy 'Niche'

A regulatory, and policy framework, that supported the market creation, and uptake of wind energy; was necessitated by a variety of political, economic, technological, environmental and socio-cultural factors that opened a window of opportunity. One potent stimulus was certainly West Germany's powerful social movements of the 1960s/70s. In the immediate post-war years, concerted efforts were made by various German governments in making nuclear energy, alongside coal, an important cornerstone of the German energy infrastructure. Energy security, reliability and affordability where at the core of the government's argument of pursuing an expansive nuclear energy program (Bruns & Ohlhorst, 2011).

However, the government's political commitment to nuclear energy nurtured nationwide social movements, and grassroots resistance, which organised and campaigned against the development of an energy pathway that was characterised by nuclear energy. A pro-environmental attitude, and increased public awareness of environmental issues fostered the growth and legitimacy of the social movements and their anti-nuclear energy position (Bruns & Ohlhorst, 2011).

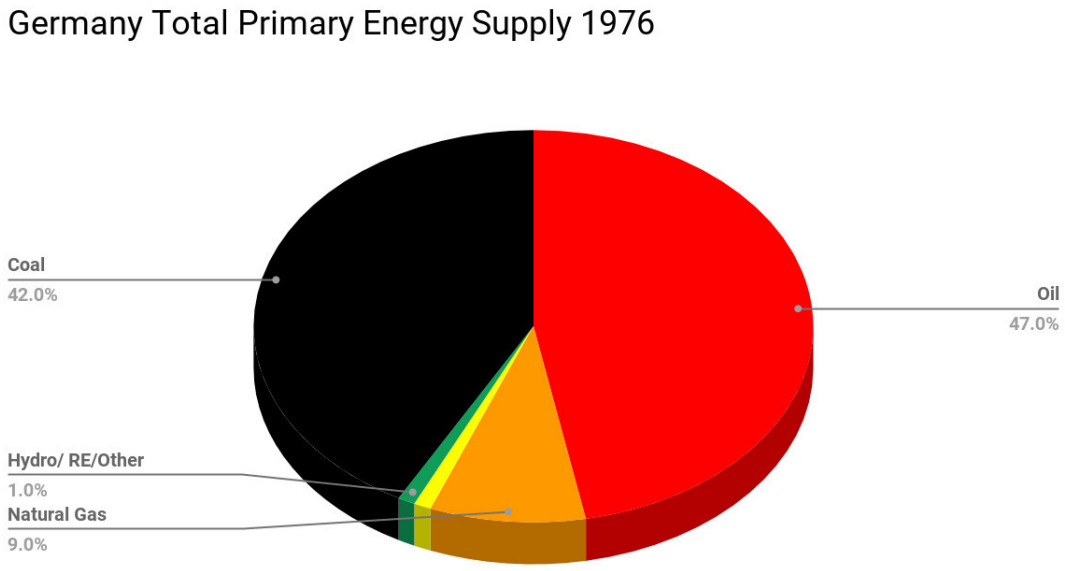


Figure 1: Total Energy Supply, Germany 1976 ***Source: Oil & Gas Security, IEA (2012)***

Publications such as Limits to Growth (1972), and *Energie-Wende*: *Growth and Prosperity Without Oil and Uranium (1980)* (Energie-Wende –*Wachstum und Wohlstand ohne Erdöl und Uran*) helped increase public awareness of environmental issues. In addition, the accident at the Chernobyl nuclear power plant in 1986 further amplified the already heated debate, and intensified the perceived risks of nuclear power among the German citizenry. It was also the oil price crises of the 1970s that precipitated the need to pursue sustainable energy pathways, based on renewables (Bruns & Ohlhorst, 2011).

These events had important implications that facilitated the eventual policy change in Germany's energy policy framework. First, these events were a vehicle for 'policy-oriented learning'. Policy-oriented learning can be understood as 'relatively enduring alterations of thought or behavioural intentions which result from experience and/or new information and which are concerned with the attainment or revision of policy objectives' (Sabitier, 1998). With the oil price crisis, and shortages resulting from the Arab embargo, and increased public awareness of environmental issues; there was now a desire to adopt energy policies, and technologies that guarantee affordability, and self-sufficiency. Ordinary Germans drew inspiration from the already thriving Danish wind energy sector which mainly comprised of cooperatives, and was already exporting Danish manufactured wind energy products to the U.S by the 1980s.

Furthermore, the aforementioned events made discussions about sustainable energy solutions a public policy priority, and also brought ordinary citizens to the forefront of the public policy debate regarding Germany's energy sector. It was during these years that a 'niche' emerged within the carbon intensive German electricity sector. A niche usually consists of a few people who gather to develop new radical and innovative ideas designed to challenge, and disrupt an incumbent (energy) system or regime. Niche actors, usually make a concerted effort to realise systemic changes and transitions. Through policy-oriented

learning and radical innovations, actors within a niche initiate and facilitate the introduction of 'new technologies, markets, ideas, practices and policies, which deviate from the dominant regime' (Geels & Schot, 2007).

In the case of Germany, the early wind energy niche consisted of private, mainly idealistic citizens such as farmers, and small cooperatives. They were interested on how to ensure safe and reliable energy supply, from decentralised wind power plants. As a result of the niche's efforts, and without much government support, bottom-up driven, decentralized small wind farms were developed and operated across Germany in the 1970/80s (Bruns & Ohlhorst, 2011).

The S*tromeinspeisungsgesetz* (StrEG) /'Electricity Feed-In Law' (EFL)

The Introduction of a Renewable Energy Feed-In-Tariff (REFiT)

The first regulatory and policy framework to promote the market uptake of wind was enforced on 1 January 1991. This was the S*tromeinspeisungsgesetz* (StrEG) /'Electricity Feed-In Law' (EFL). This was a price driven policy tool that regulated the purchase and price of electricity generated by independent renewable power producers (IPPs). The law set in motion a precedence that enabled wind energy generators to feed electricity into the grid, and in turn have public utilities purchase and pay for wind generated power (IEA, 2017). Under StrEG, a yearly fixed remuneration rate known as the Renewable Energy Feed-In-Tariff (REFiT) was introduced. The annual REFIT was based on utilities' average revenue per kilowatt-hour (kWh). Remuneration for wind producers was set at 90% of the average retail electricity rate, while for other renewable energy sources, compensation was set at 65-80%, depending on plant size, with smaller plants receiving a higher payment level (IRENA, 2013). A high remuneration rate for wind during these years reflected the already potential commercial viability, and economic competitiveness of wind energy technologies.

Policy	• Electricity Feed-In-Law (EFL)/ Stromeinspeisungsg-esetz (StrEG) (1991).
Policy Type	• Financial incentive • (RE)FiT
Key Elements	• FiT • Ensured grid access for RETs • Obliged utilities operating the public grid to pay for purchased renewable generated energy
Complementary Policy Tools	• State subsidies & grants • Research & Development
Policy Impact & Outcomes	• FiT signalled security for investors • Addressed barriers to RET deployment & grid access • New entrants in energy market, community RE players emerge.

	• Increased social support, and local acceptance

Table 1: Summary of Electricity *Feed-In-Law(EFL)/ Stromeinspeisungsg-esetz* (StrEG) (1991).

StrEG helped address some serious barriers to the deployment of wind energy technologies in the early 1990s. StrEG ensured that the majority of players in the nascent wind energy market, most of whom were new to the electricity market, small, decentralized, and vulnerable in comparison to the dominant traditional players of the energy sector (centralised, public utilities); enjoyed various forms of support and protection from the government. As a result, there was a rising interest in erecting wind trubines. The REFiT stimulated enthusiasm, and for ordinary citizens, cooperatives and communities, it guaranteed an acceptable internal rate of return (IRR). Most importantly the StrEG of 1991 paved way for the opening up of Germany's grid infrastructure to private wind energy generators. At a time when there was a lot uncertainty, about the commercial feasibility of renewable enrgy, the provisions spelt in StrEG reduced wind project risks, increased investor confidence, and allowed cheaper access to finance for interested investors.

Complementary Policy Tools under StrEG

The introduction, and market creation for wind energy was successful in the 1990s also because of some complementary policy tools that were implemented alongside StrEG. Investment in wind power installations was also spurred by subsidies, for instance from the domestic, state-owned development bank, the *Deutsche Ausgleichsbank (DtA)*, which offered low-interest, government guaranteed loans for new wind power development. These loans amounted to nearly DM 6 billion (EUR 3.1 billion) in total between 1990 and 1998 (Bechberger & Reiche, 2004).

Similarly, there was the '250 MW Wind Programme'. This was a demonstration and market creation programme for wind power initiated by the Federal Ministry of Education and Research (BMBF). It intended to support the installation, and operation of wind turbines at suitable sites, through the provision of grants and subsidies (Bruns & Ohlhorst, 2011). It was initially initiated in June 1989 as the '100 MW Wind Programme', and was extended to the 250 MW Wind Programme in February 1991. One can argue that the expansion of the programme from 100 MW to 250 MW signalled that wind energy had the potential to be economically competitive, and was worthy of greater innovation, and policy support. The programme mainly involved a guaranteed payment of EUR 0.04/kWh for the electricity produced, which was subsequently reduced to EUR 0.03/kWh) (IEA, 2017).

In addition, a 'Scientific Measurement and Evaluation Programme' (WMEP) was part of the 250 MW support scheme. All turbines that received financial support were monitored for ten years for their usefulness, reliability, and safety (IEA, 2017). The programme's grants, and the operating subsidies directly ensured the introduction of 362 MW of wind power to the market by 2006 (IEA, 2017). Thus, one can note that complementary state funded projects, signalled the political commitment of government growth of the wind market. This, without doubt, was a major contributing factor to the success of StrEG as a policy tool for

financing and deploying wind energy. Together with the 250 MW wind programme of the BMBF, StrEG helped the wind power sector to reach a market breakthrough.

StrEG: Policy Impact & Outcomes

The regulatory changes brought about by StrEG facilitated the emergence of a 'niche' wind energy industry. This niche was backed by both public and private sources finance and investment. It benefited from national subsidies, and a favourable RE FiT. The niche was an evolving cluster of wind IPPs in which ordinary citizens, and community based actors played a pivotal role in both the financing, and the organisational structure of decentralized, and grid connected onshore wind energy projects. It is also important to note that under StrEG, the installed onshore wind power capacity nearly centupled from about 48 MW in 1990 to 4,443 MW in 1999 (Bruns & Ohlhorst, 2011). Thus, one can note that StrEG contributed well to the market creation, and expanded generation capacity of wind energy.

There are number of reasons why StrEG contributed to such a 'quantum-leap' of the German wind energy market. The introduction of the REFiT was an important factor. The REFiT encouraged a wind energy development pathway that was bottom-up driven, decentralised and community owned. A bottom-up approach without doubt signalled a new era in the energy sector of Germany. Previously energy matters were a policy matter in which citizens had no role, and for which solutions were generated through a top-down approach. REFiT also offered security of investment which attracted ordinary citizens, and also enabled them to easily access finance to invest in RETs. Such opportunities that were made possible through the REFiT contributed to increased social support, and local acceptance of wind energy in the areas of deployment. StrEG was also complemented by other government support programs in the form of subsidies, and grants for R & D.

Without early political commitment, and complementary support programmes from the government, StrEG's potential to succeed would have been undermined. There were however notable weaknesses inherent in StrEG. One prime example is that it did not make it mandatory for electricity utilities to accept electricity from third parties or from renewable sources. Such fissures or policy loopholes necessitated the need for reforms to improve certainty, and reduce risks in the wind energy market. This led to some reforms at the turn of the new millennium to Germany's young renewable energy regulatory, and policy framework.

Renewable Energy Sources Act-2000 (Erneuerbare-Energien-Gesetz (EEG)

Background

Both at the global, and state level, there were a number of political, economic, and social factors worth recognising, that led to the coming to life of the Renewable Energy Sources

Act/ (Erneuerbare-Energien-Gesetz (EEG) of 2000, the successor to the StrEG. In 1992, Germany was among the 154 countries to sign the United Nations Framework Convention on Climate Change (UNFCCC) in Rio de Janeiro, Brazil. The signing of this international agreement signalled Germany's commitment to taking comprehensive climate mitigation measures. Similarly, in 1998 Germany signed the Kyoto Protocol, committing the country to a 21% reduction in greenhouse gas emissions (IRENA, 2015). As most of Germany's greenhouse gas emissions came from the energy sector, long-term strategies had to be formulated and enforced to reform the energy sector and reduce carbon emissions.

Moreover, during the mid-1990s two reports further increased political and public awareness about the need to redesign energy policies, and help Germany adapt to, and mitigate climate change. The First Assessment Report (1990) by the Intergovernmental Panel on Climate Change (IPCC) signalled the threat posed by increasing levels of greenhouse gases to governments across the globe. Similarly, the need to tackle climate change gained cross-party consensus, after the first climate *Enquete Commission* of the German Parliament. On the political front, the CDU (*Die Christlich Demokratische Union Deutschlands*) /CSU (*Die Christlich-Soziale Union*) and FDP (*Die Freie Demokratische Partei*) lost its majority to a coalition of the SPD (*Sozialdemokratische Partei Deutschlands*), and the Green Party after the German federal elections of 1998. This electoral cycle brought the expansion of renewables and an immediate atomic phase-out to the top of the political, and public policy agenda. These issues had been the political focus of the Greens since the party's foundation, and being in government enabled them to make their fair contribution to profoundly redesigning Germany's energy policy (*Hake, et al., 2015)*.

In 1998, the German Energy Industry Act (Energiewirtschaftsgesetz) was enforced, and it required the liberalisation of the electricity market which was dominated by monopolies in generation, grid infrastructure, as well as transmission and distribution. The EU directive concerning common rules for the internal market in electricity was the main driving force behind the liberalisation of the electricity market (Bruns & Ohlhorst, 2011). Before the liberalisation of the electricity market, electricity utility companies, who also owned, and operated the electricity grid had relied on the fact that they had no "obligation for general connection and supply" of third-party electricity, as stipulated in the StrEG (Hake, et al., 2015). With the new regulations, the monopolies of the big energy companies had finally been broken, and this created yet another window of opportunity for favourable policy prescriptions that would improve the market uptake of wind energy. Consequently, The Renewable Energy Act (*Erneuerbare-Energien-Gesetz*, or EEG) was adopted in 2000 serving as the basis for today's renewable energy regulatory and policy framework.

EEG Phase One: 2000-2009

Renewable Energy Sources Act-2000 (Erneuerbare-Energien-Gesetz EEG-2000)

Guaranteed FiT, & Priority Grid Access

One policy implication that followed liberalization of the German electricity market was the sharp decline in electricity prices that ensued. This might have been a positive development

for electricity consumers, but certainly not for wind energy investors, and developers. Since StrEG linked the remuneration rate for wind energy to the average price of electricity, the profitability of many wind energy projects was weakened, as a result of the declining electricity price (Hake, et al., 2015). This reduced investor confidence in the future of the wind market.

For that reason, when the EEG of 2000 was formulated, and enforced; it decoupled the remuneration rate from the average price of electricity per kilowatt-hour (kWh). The EEG's remuneration rate was pegged a lot higher than that of StrEG, and it was also based on a fixed, regressive, and technology specific FiT (IRENA, 2015). Another important provision of the EEG stipulated that the FiT was to be guaranteed for a period of 20 years. The remuneration scheme of the EEG of 2000 also included a fixed, feed-in premium (FiP) paid for every kWh from wind energy sold on the electricity market. With the FiP system, wind energy operators had an incentive to sell electricity on the market, and also benefit when the prices were high on the market (IRENA, 2015). One can thus note that the remuneration scheme under the EEG of 2000 was an important policy tool that attracted investors. The high FiT, and complementary FiP reduced project risk, improved the bankability of projects, and eased access to loans particularly for small renewable energy players that were interested in a decentralised, bottom-up, and community based development pathway.

Under the policy provisions of the EEG, among other renewables, wind now had priority access to the grid. Grid, transmission and distribution operators were obliged to preferentially dispatch wind generated electricity over electricity from conventional sources like nuclear power, coal, and gas (Wasserman et al., 2012). The FiT, preferential grid access and the long-term power purchase agreements (PPAs) between renewable energy producers and grid operators provided the provisions for investment protection. These new policy provisions continued to largely benefit small to medium investors, such as energy cooperatives (*Genossenschaft*), farmers, local communities, and ordinary citizens who wanted to invest in wind energy projects, as they could easily access finance, and earn profits as a result of the support provided for in the new legislation.). Three years after the enforcement of the EEG (2000), wind power plants with a total installed capacity of around 14,350 Megawatts (MW) fed German electricity grids. This is a more than 150% increase in wind energy capacity, signalling investor confidence in the market.

Policy	• Renewable Energy Sources Act-2000 (Erneuerbare-Energien-Gesetz EEG-2000).
Policy Type	• Financial incentive (FiT)
Key Elements	• Decoupled REFiT from average rate of electricity/ kWh • REFiT was now fixed, regressive, & technology specific • 20 year power purchase agreements (PPAs) • Preferential grid access for RETs • Obliged utilities operating the public grid to purchase & pay for renewable

	generated energy ● Surcharge provision (EEG-Umlage). However key national industries, energy intensive users exempted from levy.
Complementary Policy Tools	● State subsidies & grants ● Research & Development
Policy Outcome & Impact	● By 2003,Wind power plants with a total installed capacity of around 14,350 Megawatts (MW).

Table 2: Summary of Renewable Energy Sources Act/ Erneuerbare-Energien-Gesetz EEG (2000)

'Differentiated Tariffs', & Regressive Element

It should also be noted that under the EEG framework, all remuneration rates paid by electricity utilities were increased, although on different scales, depending on the technology, capacity or location of the plant (Bechberger & Riche, 2004). When the EEG (2000) was enforced, remuneration rates for wind energy plants were increased by only 10 %, from 8.25 to 8.78 euro ct/kWh. This is in stark contrast with solar photovoltaic power which increased by over 500% from 8.25 to 50.62 euro ct/kWh (Bechberger & Riche, 2004). The limited remuneration rate for wind energy can be attributed to the maturity of wind technologies, which were a reflection of the commercial viability, and economic competitiveness of the technology.

The EEG did not only differentiate tariffs based on the type of the renewable technology. It also differentiated tariffs according to the scale/capacity, and electricity yield. Within the wind energy market, this made it possible for larger wind plants to receive lower remuneration rates, and wind turbines in (risky) low-wind areas to receive higher remuneration rates (Runci, 2005). When basing the remuneration rate on the electricity yield, the EEG ensured that during the first five years of operation, wind turbines were granted a premium price of 9 euro ct/kWh (Runci, 2005). Thereafter, a monitoring and evaluation exercise was to be carried out under which site quality was evaluated against predefined performance standards. If a site yielded at least 150% of the (predefined performance) standard, then the guaranteed tariff was reduced to 6 euro ct/kWh. For sites yielding less than 150%, the 9 cent rate was to be extended by two months for every 0.75% that the yield falls below the 150% mark (Runci, 2005). These policy measures without doubt promoted the development, and operation of wind energy installations on lower quality sites, that would be otherwise considered unprofitable.

Such policy provisions also ensured that, weaker sites were compensated at a rate that guaranteed continued operation, while stronger sites were not over-compensated. The higher rates for remuneration also provided incentives for the development of onshore sites that were less windy than coastal areas, and allowed inland wind developers access to credit that would otherwise not be available. For offshore wind plants, commissioned before the end of 2006, a higher remuneration rate was to be paid for nine years (Runci, 2005). This was done so as to compensate the higher investment costs associated with offshore wind.

An annual degression rate was also added to the EEG of 2000. From 2002 new installations of wind energy would receive lower tariffs (-1.5%), and the amount was to be reviewed consistently (IEA, 2017. This provision would prove to be a vital element in ensuring that EEG laws were compatible with EU state aid laws, especially given the fast pace at which wind energy matured.

The EEG Surcharge/levy

Another important cornerstone of the EEG of 2000 is the surcharge provision (*EEG-Umlage)*. The EEG surcharge is the mechanism that finances the FiT, and its objective is to equitably share the costs of trading renewable energy on the market. It also aims to ensure greater compliance with European state aid rules by ensuring that there is greater independence, of renewables, from government budgets (IRENA, 2015). The surcharge is based on the difference between the wholesale market price for power on the electricity market, and the FiT, as well as the FiP. All electricity consumers pay the EEG surcharge except industries vital to international trade, and energy intensive users, who only pay about 2% of the surcharge although using 25% of Germany's power (IRENA, 2015). Ensuring that energy intensive industries pay a relatively lower EEG surcharge in comparison to other electricity consumers seeks to protect, and retain the international competitiveness of Germany’s industries. Furthermore, independent renewable power operators who produce and consume (prosumers) their own electricity are exempted from the surcharge.

By covering the difference between the market price achieved, and the FiT, the EEG surcharge was without doubt an important instrument that attracted investments in the wind energy market. The policy design of the EEG surcharge made huge strides in attempting to equitably distribute costs of financing renewables between different actors within the electricity market (IRENA, 2015). Although the EEG surcharge has been an important vehicle to the market uptake of wind energy; it poses some threats to the continued growth of the renewable energy market in its entirety. It was a matter of heated public policy debate, especially on the eve of the 2017 German federal elections. This is because, except in 2015, the surcharge has been increasing since its inception in 2000.

The main driver of the increase in the surcharge has been the declining wholesale electricity prices, which have been slumping sharply in recent years due to a strong build-up in renewables, leading to overcapacity in markets, especially when the sun shines and the wind blows strongly. Consequently, as the surcharge makes up the difference between the wholesale market electricity prices and guaranteed FiTs, the EEG surcharge increases when the market price falls (Wasserman, 2012). This without doubt leaves the German electricity consumer most vulnerable, and facing higher electricity prices. Politicians, not to mention various actors in the renewable energy scene, such as electricity producers, scientists and associations, are becoming increasingly concerned about this correlation. The fear is that the traditional high acceptance of and public support for renewable energy technologies like wind in Germany may decrease as a result of rising energy prices (Wasserman, 2012).

Renewable Energy Sources Act/ Erneuerbare-Energien-Gesetz (EEG 2004).

In 2002, Germany passed amendment of the Nuclear Energy Act (2002), aimed at reducing dependence on nuclear energy. This was yet another reason to explore ways in which the EEG could be improved so as to increase the market uptake of renewables, decarbonise the energy sector, and ultimately phase out nuclear generated power. Consequently, the Renewable Energy Sources Act of 2004 (Erneuerbare-Energien-Gesetz EEG) (EEG 2004) was adopted. The Act of 2004 replaced the EEG of 2000. The amended EEG of 2004 maintained the prior act's general principles. The purpose of the amendment was to primarily spell out the new renewable energy targets of the German government. Under the new provisions of the EEG of 2004, there was to be an increase in the share of renewable energies in the total electricity supply to at least 12.5% by the year 2010 and to at least 20% by the year 2020 (IRENA, 2015).

Policy	• Renewable Energy Sources Act/ Erneuerbare-Energien-Gesetz (EEG 2004)
Policy Type	• Financial incentive • FIT
Key Elements	• New RE targets • Payments under the EEG only compulsory if electricity is generated exclusively from renewable energy • Immediate priority to connecting installations for the generation of electricity from renewable energies • Grid operators take on the necessary costs for upgrading the grid • Operators of renewable energy installations to agree on the management of energy generation with grid operators. This mitigated potential conflicts • Installations with a capacity of 500 kW or more are measured and recorded (new codes & standards) • Increased FiP for new RE power plants • Payments for wind energy also depend on the local wind conditions on site and whether the energy is generated on land or offshore.

Table 3: Summary of Renewable Energy Sources Act/ Erneuerbare-Energien-Gesetz (EEG 2004)

The most important aspects of the 2004 amendments were the new codes and standards which stipulated that only electricity generated from increased capacity benefits from premium payments. However, the premium rates for existing plants (operating at an increased capacity) were to be lower than those for new plants (IEA, 2017). This policy prescription incentivised wind energy operators to either expand their existing projects or install new ones.

For wind energy generation, the period of time over which an FiP (EUR 0.032/kWh) was to be added to the standard FiT (EUR 0.055/kWh) was shortened. The regression tariff for new

projects was set at 2% rather than the previous 1.5%. The adjustments in the degression rate mirrored a learning curve for wind energy technologies. The degression rate also helped cap profits, and lower costs for consumers.

Finally, off-shore plants on line before the end of 2012 were to get a standard FiT of EUR 0.0619/kWh, and also a 12-year FiP of EUR 0.0291/kWh (IEA, 2017). The policy provisions that underpinned the EEG of 2004 enabled wind power to be a major driving force enhancing the potential of Germany to meet its renewable energy targets for 2020.

EGG Phase One- 2000-2009: Policy Impact and Outcomes.

One can convincingly argue that during the first phase of the EEG (2000-2009), Germany successfully established an FiT policy design that provided transparency, longevity and certainty to investors (TLC) (DB, 2012). Transparency was enhanced by putting in place modest degression rates, which ensured that adjustments to the FiT occurred at regular intervals. The 20 year-long PPAs between power utilities, and wind energy generators reduced project risks, made wind energy projects more bankable and enhanced longevity. Last but not least, the FiT, FiP, and priority grid access enhanced certainty, and investor confidence. During the first phase of the EEG, Germany's wind energy sector had also made its fair contribution to fighting climate change. In 2006, wind energy accounted for the largest share of electricity production from renewable sources, (around 5.6% of Germany's gross electricity consumption) (Büsgen & Dürrschmidt, 2007). This alone achieved a reduction of around 20 million tonnes of CO2. In 2007, the wind share increased to 6.4% of Germany's electricity consumption (Büsgen & Dürrschmidt, 2007).

EEG Phase Two: 2009-2012

2009 Amendment of the Renewable Energy Sources Act (EEG 2009)

With the EU Directive on the promotion of the use of energy from renewable sources (Directive 2009/28/EG) the binding EU-wide target for renewables had been stated. As a result of the new directive, 20 % of energy had to be from renewable energy sources, including biomass, hydro, wind and solar power, by 2020. The EEG of 2009 sought to help Germany meet these targets. The amendment of 2009 stipulated a higher FiT for wind energy, and put in place other measures to stimulate the development of both onshore and offshore wind power (IEA, 2017). Under the EEG of 2009, the FiT for onshore wind farms was increased from EUR8.03 to EUR9.2 cents/kWh for the first 5 years of operation, and EUR 5.02 cents/kWh after that. In line with the degression rate, the tariff was also to be decreased every year for new installations by 1%, as opposed to the previous 2% (IEA, 2017). Most importantly, the EEG reforms of 2009 increased the repowering bonus (*Repoweringbonus*), to support the replacement of old turbines with new ones. The remuneration rate for repowered turbines was to be increased by EUR 0.5 cent/kWh (IEA, 2017).

There were also two important standards that were put in place, and had to be met by wind power plant operators so as to benefit from the repowering bonus. First, only turbines located in the same administrative district, and at least ten years old could benefit from the

repowering bonus. It was also important for the new turbine to have at least twice, but no more than five times the original turbines capacity. An additional system service bonus was granted for specified technical contributions (*Systemdienstleistungen*/ *SDL*), including the ability to maintain voltage if the transmission grid fails (IEA, 2017).

Policy	• Renewable Energy Sources Act/ Erneuerbare-Energien-Gesetz (EEG 2009).
Policy Type	• Fnancial incentives (Feed-in tariffs/premiums)
Key Elements	• A higher feed-in tariff for wind energy, and other measures to stimulate the development of both onshore and offshore wind power • FiT for onshore wind farms was increased from EUR 8.03 to EUR 9.2 cents/kilowatt-hour (kWh) for the first 5 years of operation, and EUR cents 5.02/kWh after that • Increases the repowering bonus, to support the replacement of old turbines by new ones • Offshore wind, the initial tariff is set at EUR cent 15 /kWh until 2015. After that it is set to decrease to EUR cent 13/kWh for new turbines, decreasing by 5% per year.
Policy Impact & Outcomes	• Commissioning of the *Alpha Ventus* offshore test site • Germany European leader in wind energy, with 25,777 MW total capacity installed at the end of 2009.

Table 4: Summary of Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz EEG) (EEG 2009).

For offshore wind, the amendments increased the tariff substantially in comparison to previous years. The initial tariff was set at EUR cents 15 /kWh until 2015. After that it was set to decrease to EUR cent 13/kWh for new turbines, thus decreasing by 5% per year (IEA, 2017). An increased remuneration rate was instituted so as to counter the fact that offshore expansion took place at a significantly slower pace than planned, primarily as a result of the 2008 financial crisis, and also that this was relatively a new field of investment (Bruns & Ohlhorst, 2011).

The new legislative provisions that fell under the 2009 EEG, especially the bonus for repowering, without doubt provided incentives that spurred research, innovation, and technological development of wind energy technologies. What is also certain, and is of paramount importance is that the FiT, market premiums, and 'bonuses' were crucial financial incentives that attracted further investments to the wind energy market.

The strength of the EEG of 2009 was that the tariff system was flexible, and designed to respond to market dynamics, as well as the level of technology maturity (IRENA, 2015). The new EEG (2009) also put in place some measures of insurance, which would protect wind energy operators against unfair management practices by grid operators. Grid operators were not only required to expand the grid, but also to optimise its management. Failure to

comply with these requirements could lead to claims for damages by any renewable power producer willing (IRENA, 2015).

EGG Phase Two- 2009-2012: Policy Impact & Outcomes

A significant milestone during the second phase of the EEG was the 2010 commissioning of the *Alpha Ventus* offshore test site, complementing the research initiative called "Research at Alpha Ventus" (RAVE). This offshore test site aimed, and proved to be useful in acquiring fundamental technical and environmental information for the future expansion of offshore wind energy (IRENA, 2013). In 2011, during the course of the year, new wind turbines having a total nominal power of 2051 MW (onshore and offshore) were installed. This meant that at the end of 2011 a total of about 22,200 wind turbines were installed in Germany generating 28,818 MW (IWES, 2012).

EEG Phase 3: 2012-2014/2016

Background

In September 2010, the German government published the 'Energy Concept' (2010). The Energy Concept provides the long-term (up until 2050) political timetable for the transition of the country's energy supply system (IRENA, 2013). Following the publication of the Energy Concept (2010), Germany now aims at reaching the following minimum shares of renewable energy in electricity supply 35% by 2020; 50% by 2030; 65% by 2040; 80% by 2050 (IRENA, 2015). It should also be noted that the Energy Concept document clearly states that wind energy is an important component of this transition. Such recognition can be attributed to the 'favourable conditions for wind power, especially offshore wind that needs to be further exploited. In addition, the maturity and established global capacity of wind power, makes wind generated energy more cost competitive relative to other renewable sources. Finally, following the Fukushima nuclear disaster, the German government committed to itself to phasing out nuclear power, and redesigning energy policy so as to increase the market uptake of renewables. For that reason, the EEG of 2009, was amended and replaced with a new act in 2012.

Renewable Energy Sources Act (EEG 2012)

Under the amended EEG of 2012, the basic principles of the EEG, in particular priority purchase, transport and distribution of electricity generated from renewable energy sources as well as statutory feed-in compensation, remained unchanged. The feed-in tariff structure for onshore wind also remained mainly unchanged. The FiT of EUR Cent 8.93/kWh) was to be decreased every year for new installations by 1.5%, as opposed to one percent in the EEG 2009 (IEA, 2017). The system service bonus was to increase in 2014 for new wind installations, and 2015 for existing facilities. The repowering bonus of EUR Cent 0.5/kWh (to support the replacement of old turbines by new ones) was to be restricted to wind turbines that were put into operation before the year 2002 (IEA, 2017).

For offshore wind, the FiT remained at EUR Cent 15/kWh. The tariff for new turbines was not to be decreased before the year 2018 (instead of 2015 initially). The rate of regression for offshore wind projects was set at 7%, instead of 5%. To accelerate repayment of investment

in offshore wind farms an optional FiT model was introduced, which offered an initial FiT of EUR Cent 19 /kWh paid for 8 years (standard model was EUR cent 15/kWh for 12 years) (IEA, 2017).

Policy	• Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz EEG) (EEG 2012).
Policy Type	• Financial incentives (FiT)
Key Elements	• In agreement with 'Energy Concept', new RE targets incorporated in EEG of 2012 • Priority purchase, transport and distribution of electricity generated from renewable energy sources as well as statutory feed-in compensation, remains unchanged. • Market integration, system integration and grid integration of RETs gain considerably in importance, of RETs • FiTstructure for onshore wind remains mainly unchanged. • For offshore wind, the initial tariff remains at EUR Cent 15/kWh. • To accelerate repayment of investment in offshore wind farms an optional feed-in tariff model was introduced, which offers an initial tariff of EUR Cent 19 /kWh paid for 8 years (standard model: EUR cent 15/kWh for 12 years).
Policy Impact & Outcomes	• Favourable policies for offshore wind encouraged investments i.e. Kreditanstalt für Wiederaufbau (KfW Bank) unleashed a EUR 5 billion programme to promote offshore wind farms

Table 5: Summary of Renewable Energy Sources Act/ Erneuerbare-Energien-Gesetz (EEG 2012).

A number of further supporting measures outside the EEG were taken to stimulate offshore wind energy. The most important being the loan programme of the German state owned bank *Kreditanstalt für Wiederaufbau* (KfW Bank). In 2012 KfW unleashed a EUR 5 billion programme to promote offshore wind farms (KfW, 2016). Certainly such support helped sustain the growth of the wind energy market in Germany especially for new and complex offshore wind technologies whose project risks were still relatively high, and which private commercial banks are still being very cautious about. Thus, one can note that with the ushering in of the 2009 EEG amendments, there is increased support for offshore wind projects. This is because offshore wind energy features some of the highest load hours amongst all renewable technologies. In addition, against the increasing scarcity of onshore sites with abundant and consistent wind characteristics, offshore wind is becoming increasingly attractive (EY, 2015).

2014 Amendment of the Renewable Energy Sources Act (EEG 2014)

The 2014 Amendment of the Renewable Energy Sources Act (EEG) entered into force in August 2014. The 2014 revision of the Renewable Energy Sources Act stipulated a binding expansion corridor. RES technology expansion corridors for onshore wind energy were set at

2.5 GW of net additions annually, while those for offshore wind energy were set at between 6.5 GW and 7.7 GW additions until 2020 (800 MW per year) (IEA, 2017).

Policy	• Renewable Energy Sources Act/ Erneuerbare-Energien-Gesetz (EEG 2014).
Policy Type	• Financial incentive (FiT)
Key Elements	• RES gross electricity consumption share is set to increase • RES technology expansion corridors: Onshore wind energy – 2.5 GW of net additions annually; Offshore wind energy – 6.5 GW to 7.7 GW additions until 2020 (800 MW per year) • Mandatory direct marketing • Market premium • Starting from 2017 renewable energy generators will receive financial support via tenders. The rules of tenders are not yet agreed on. • RES generators with a capacity up to 500 kW commissioned before 1st of January 2016 are supported via fixed feed-in tariffs. • It lays the foundation for tendering of support from 2017 onwards; • It removes several subsidies and exemption for energy-intensive consumers and "prosumers
Policy Impact & Outcomes	• Paradigm shift from FiT to auction based system.

Table 6: Summary of Renewable Energy Sources Act/ Erneuerbare-Energien-Gesetz (EEG 2014)

Mandatory Direct Marketing

The EEG amendment of 2014 retained the market premium. However, the market premium was only to be issued to wind energy generators that directly market their energy, on the wholesale electricity market, either independently or through a direct marketer (Grau et al., 2015). However, there are some limitations to the direct marketing provision, even though the provision retains a market premium that creates an incentive to maximize the market value of generation, and to master wholesale market operations (DB, 2012). In particular, two changes that arise from the now-mandatory direct marketing have a major impact. On one hand, the fact that operators must bear the costs of forecast deviations leads to increasing and unstable operating costs (Grau et al., 2015). On the other hand, due to site-specific wind power profiles that could differ from the average wind power output profile in Germany, the combination of electricity market price and market premium can fall below the former FiT (Grau et al., 2015). Such operational risks threaten the viability of the wind market.

Phase 4:"The Paradigm Shift": The Renewable Energy Sources Act (EEG 2017). From FiT to an Auction Based Remuneration System

On 8 July 2016, the (new) German Renewable Energy Act 2017 (Erneuerbare-Energien-Gesetz 2017, EEG 2017) (the EEG 2017) was adopted. After having been finalised, the new legal framework came into force on 1 January 2017. It will have a significant impact on the German renewable energy market, including onshore & offshore wind development. The EEG (2017) is a further development of the previously applicable Renewable Energy Act 2014 which already aimed to deliver an increase on the level of renewable energy sources in German power productions while simultaneously reducing the energy cost for consumers.

Policy	• Renewable Energy Act (EEG 2017)
Policy Type	• Financial incentive • Monitoring, Regulatory Instruments • Obligation schemes/ Codes and standards
Key Elements	• Paradigm shift, with FiT being discarded in favour of auction based remuneration system. • only those renewable installations that have won a tender will receive payment for power supplied • Every renewable to get tailored auction design • Government maintains 2014 'deployment corridor • Auctioning a specific amount of capacity volume each year • Small renewable installations of under 750 kW capacity will not participate in tender, but will continue to receive FiT • Under certain conditions, installations from other European countries can participate in the auctions for 5% of the annually installed capacity.
Complementary Policy Tools	• Special rules to protect community project developers • Deployment corridor
Policy Outcome & Impact	Some esults of first auction for onshore wind installations: • Auction significantly oversubscribed • Greater share of citizens' energy companies • Limits reached in the network expansion area • Few disqualifications

Table 7: Summary of Renewable Energy Act/Erneuerbare-Energien-Gesetz (EEG 2017)

Some of the key features of the EEG (2017) are:

1. The introduction of an auction system for nearly all renewable energy sources (onshore wind, offshore wind, photovoltaic and biomass). This marks the major change, allowing for a more market driven electricity system.
2. Onshore wind farms can only participate in auctions if the permit under the Federal Immissions Control Act (Bundesimmissionsschutzgesetz) has been obtained.
3. There is the introduction of a so-called "centralised model" for offshore wind installations. The ministry proposes centralised (Danish) model to ensure sufficient competition and to make site planning, installation approvals and grid connections more cost effective and dovetailed.

The 2014 EEG announced a switch from feed-in tariffs to auctions as the principal support scheme for renewable electricity. From 2017 onwards, funding rates for renewable will be determined via a market-based auction scheme. Under an auction based system, project developers who participate in the auction typically submit a bid with a price per unit of electricity at which they are able to realise the project. The auctioneer evaluates the offers on the basis of the price and other criteria and signs a power purchase agreement (PPA) with the successful bidder (IRENA, 2015). Proponents of the auction based remuneration scheme put forward that auctions lead to real price discovery, and drive down costs.

Limitations of Auction Based System: High Transaction Costs.

Auction based systems could hinder wind market development from 2017 onwards. Wind energy excepts are sceptical whether auctions for wind allow Germany to achieve the three main goals of cost reduction, diversity of players and target achievement within the renewable energy sector. Auction based instruments have been criticised for their high transaction costs, both for auctioneers and bidders (IRENA, 2015: 15). Transaction costs include 'costs for collaterals (deposits) for project developers, costs due to longer project development times because of the process duration of tenders, and costs incurred by bidders that subsequently fail to win in the tender' (Gau, 2014).

These high costs without doubt discourage small, and local level players in pursuing community wind projects. On the other hand, established commercial firms and global operating utilities, with strong balance sheets and strong industry experience are more capable of taking part in the competitive bidding process. Consequently, the traditional electricity system, characterised by a few central generators transmitting and distributing electricity to millions of consumers would be replicated in Germany's wind energy market if the auction based remuneration systems remains the long-term 'basic law' of financing, and deploying wind energy. (Jairy, Martin & Ryor, 2016). A wind energy market structure that is

centralized, and has few players does not help create an absolutely free market but often leads to higher prices for the consumer (Gsänger, 2016).

Auction Design & Capacity Volume	Prerequisites for Onshore Wind	Prerequisites for Offshore Wind
• The Federal Network Agency (Bundesnetzagentur) responsible for competitive bidding process. • Starting in 2017, three to four rounds of auctions per year (for solar PV and onshore wind). • Participants place single, sealed bids. Bidders have to lodge a security deposit to ensure that only serious bids are submitted. • Auctions will follow the pay-as-bid principle, i.e. the amount of funding corresponds to the individual bid placed. • The lowest bids will be accepted until the volume of capacity auctioned is reached. A maximum price will be published in advance. • Successful installations will receive the funding rate with which they won the bid for 20 years. • Special rules for citizen energy projects: They have to participate in the auction system (unless they are too small) but enjoy certain benefits, e.g. they will automatically receive the highest feed-in tariff accepted in the tender, rather than their own (possibly) lower bid.	• Bidders will have to get their projects approved under the Federal Immission Control Act (late-stage auctions). • Onshore project developers will have to lodge a smaller security deposit. Installations shall be completed within two years. • Existing, small, local cooperatives with a minimum number of individuals to be exempted from providing the costly permission under the Immission Control Act before making a bid and will get other financial privileges. • Price level to be determined by frequent auctions. • Stringent annual capacity volume for onshore wind installations will be set at 2.8 GW per year in 2017-2019 and at 2.9 GW after 2020, taking into account the 45 percent renewables target for 2025.	• Introduction of the 'centralised model' • Between 2021 and 2024 a transitional auction model will apply. Offshore wind expansion will remain at 15 GW by 2030. The capacity volumes auctioned per year will be in line with this target and will be around 500 MW per year between 2021 and 2022; 700 MW between 2023 and 2025 and 840 MW annually from 2026 onwards.

Table 8: Key elements of the auction/ competitive bidding system under the EEG (2017)

Auctions undermine support for wind energy

Auctions also threaten to diminish the support for wind, which up until now has been very high. Local communities and ordinary citizens, have tended to support wind energy projects because of the direct benefits that they accrue, such as financial profit, jobs, and more democratic control (Gsänger, 2016). Since from auctions mainly benefit large, and globally operating corporations, they exclude local communities and ordinary citizens (Gsanger, 2016). Without local participation and support, the potential of the wind energy market to sustain its development, and growth pathway will be compromised.

Auctions also tend to promote the financing, and deployment of large-scale, centralized, commercial wind farms. This is in big contrast to the bottom-up, and decentralised business model that has been a core tenet of the FiT remuneration scheme of the EEG. Decentralised approaches to wind energy development are beneficial in that they are physically, and economically more efficient than the monopolistic, and centralised business model (Gsänger, 2016).

Attempts to realise community wind under auction system

Given that an auction remuneration system undermines the potential of a diversity of bidders, the German government introduced special rules for community wind power in its first onshore wind auction, which was held in May 2017. The objective of these special rules were to ensure greater involvement of local communities, and retain the now threatened community wind projects, and small wind parks that play an important role in the broader wind energy market of Germany.

Preferential treatment was given to projects of at least ten individuals, and where the local citizenry owns the majority of the shares. In addition, there were also lower qualification requirements for local communities to take part in wind energy auctions. For instance, while other bidders must present a permit according to the Federal Emission Control Act, such projects can participate without this permit (Klessmann & Tiedmann, 2016). This was seen as a positive element, since obtaining the permit is a lengthy and expensive step which has previously hindered the ability of some projects to realise commercial operation (Klessmann & Tiedmann, 2016). A longer realisation period, was also put in place for community based players. Their realisation period is two years longer than the regular one which lasts for thirty months. Finally, under a preferential price rule, community wind projects' remuneration rate is higher than other successful individual bidders (Klessmann & Tiedmann, 2016).

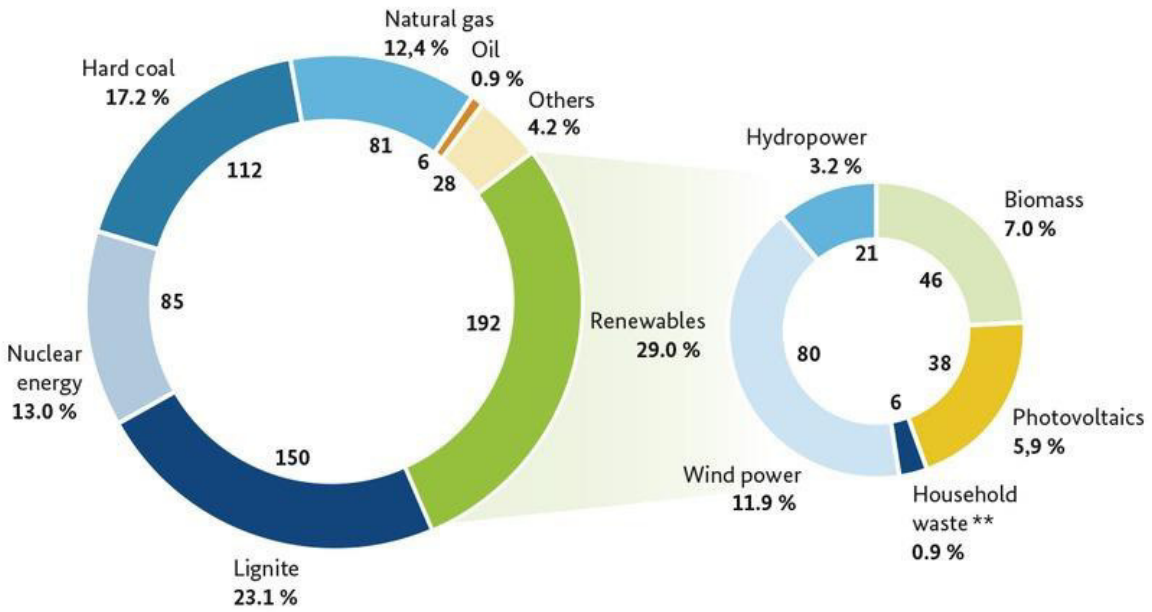
In spite of the special provisions, the preferential treatment element did little to enhance the meaningful realization of a bottom-up driven, and decentralized community owned wind farms. Around 95% of the successful bids in 2017 fell under the EEG definition of "community energy" but it came out that in fact they were not really such projects but backed by a few large companies (WWEA, 2018). Evidence suggests that the "energy communities" that won the bids appeared to consist of employees of professional project developers, who managed to gain an advantage by working with a cooperative (Klessmann & Tiedmann, 2016). The special rules for communities also created substantial disadvantages

for other bidders. This raises resentment, and conflicts between actors within the wind energy market (Klessmann & Tiedmann, 2016).

Several project developers created “energy communities” so as to benefit from the advantages. This without doubt undermines the protracted growth of a bottom-up, and decentralized community wind development pathway (Klessmann & Tiedmann, 2016). It also compromises the ability to pursue, and realise a just, and equitable transition through which communities, and citizens can benefit from meaningful ownership of community wind farms, and the numerous economic, environmental, and social benefits associated with community wind projects. Earlier on in the paper, it was suggested that the policy design of REFIT fostered transparency, longevity, and certainty for investors in Germany’s wind energy market. Given the latest results of the German wind energy auctions, it is very questionable whether an auction based remuneration system will be able to maintain, or surpass high standards that have been set within the German wind energy market, for instance high employment figures in the renewable energy sector, high EU market-share, and the diversity of players that have been able to have a stake in the market.

EEG Phase Three-2012-Present: Policy Impact & Outcomes

By 2016, 45 % of all the produced power from renewables in Germany came from wind energy. This was equivalent to 18 % of renewable energy in the EU-15 in the same year (BMU, 2009). In the first half of 2017, 108 offshore wind turbines (OWT) with an installed capacity of 626 MW fed into the grid for the first time (Deutsche WindGuard, 2017). The majority of the newly feeding OWT were installed in 2017.



* Preliminary figures ** Regenerative part

Figure 2: Gross electricity generation in Germany in 2016*, status: March 2017 **Source: BMWi**

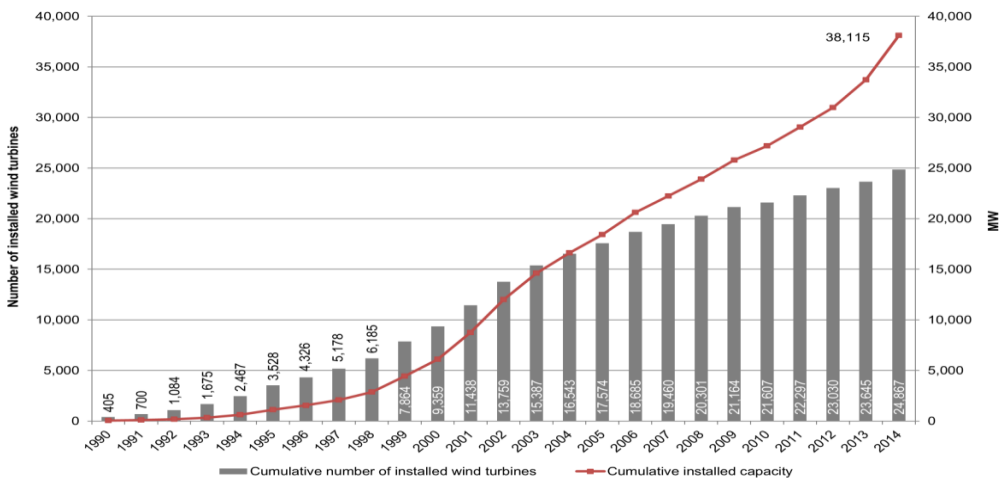


Figure 3: Development of the wind energy sector in Germany **Source: (Sunak, Höfer, Siddique, Madlener, De Doncker, 2015)**

3.Grid connection regulations

Milestones

As a result of the growing share of renewables, issues related to market integration, system integration and grid integration have gained considerable importance. How costs to grid integration are distributed, and the administration of grid infrastructure is of vital importance to the positive perception, stability and growth of the wind market in Germany. Nevertheless, when deliberating on the success of Germany's wind energy sector, decreasing technological costs, and a plethora of financial incentives that have attracted investors are often cited as explanatory factors. However, the role played by the legislative provision of the EEG in setting in motion favourable grid connection regulations that benefit wind energy should not be underestimated. Under the EEG regulatory framework, the four transmission system operators in Germany (*TenneT, 50Hertz Transmission, Amprion and TransnetBW*) are primarily responsible for the secure operation of grid infrastructure (BMWi, 2017).

Moreover, the transmission system operators are supervised by the Bundesnetzagentur (Federal Network Agency), which for example authorises grid expansion and grid-use fees. The EEG, since its inception, has not merely ensured the opening-up of the grid to renewables such as wind. The new grid connection regulations of the EEG require grid infrastructure operators to grant priority, non-discriminatory access to renewables, as well

as purchase, pay, and transmit renewable energy generated power. Such measures, without doubt, helped sustain the growth of the wind market (BMWi, 2017).

Challenges: Limited Grid Infrastructure

However Germany's limited grid infrastructure is a potent hurdle that can potentially undermine the positive growth that has been experienced within the wind energy market. Currently, Germany has an infrastructure backlog of more than 7,500 kilometres (km) of transmission grid, which need to be upgraded, or constructed anew in the next few years (BMWi, 2017).

In 2015 almost 2,300 MW of offshore wind energy was put into operation (Wind Monitor, 2017). What is however interesting is that this extraordinarily great amount was not able to be adequately fed-in to the grid, because of a grid infrastructure completion backlog (Wind Monitor, 2017). Grid congestion, in some instances, have contributed to wind turbines having to be switched off, in spite of prevailing favourable wind resources in the areas of wind energy production (Oltermann, 206). Such developments do little to ensure the commercial viability of wind farms.

Grid Restrictions

To address problems related to grid congestion the German government has opted for a radical policy measure, in the guise of 'grid restrictions'. What this essentially means is that the German government has restricted the deployment of wind turbines exactly where the majority of the country's high wind sites are located. The government has imposed limits on the addition of new capacity in the so-called 'grid expansion area' (Agora Energiewende, 2017). The annual addition of new capacity is currently limited to 58 per cent of the average expansion over the three previous years. This also translates to a limiting onshore wind power expansion in northern parts of the country to 902 MW annually until at least August 2019 (Agora Energiewende, 2017). Such a policy risks undermining the German government's capacity to meet its renewable energy, and CO2 reduction targets. The drawback of such a policy tool is also that it reinforces prevailing negative perceptions about wind energy. For instance, to some extent, it implies that wind energy is the main driver of grid congestion. This is not the case, as it will be explained later.

Legislative Responses for Grid Infrastructure

To ensure that wind energy facilities in the North Sea and the Baltic can be coordinated and rapidly connected to the power lines, and transported to high-demand regions in the central, and southern states; a series of development plans and legalisation have been passed. These include the *Offshore Grid Development Plan*, and *Electricity Grid Development Plan*, which were drafted by the four major transmission system operators, and approved by the Federal network Agency (BNetzA) (BMWi, 2015). The *Grid Expansion Acceleration Act* (NABEG) and the *Energy Act* (EnWG) passed in 2011, are also other laws enforced with the purpose of accelerating the urgently needed expansion of the grid which would also benefit the wind market too.

However, it is still uncertain to what extent these legal instruments will facilitate a rapid expansion, of the grid that will benefit the wind energy market. For grid infrastructure to be developed, and operate, a lot of administrative rules and regulations have to be met by the transmission companies responsible for developing the grid. These include Strategic Environmental Assessment, Federal Requirement Plans, Federal Sectoral Planning, and Planning Approval Proceedings (BNetzA, 2017). All these approvals are necessary, for the development of a sustainable grid network. The rules, regulations, and proceedings can be cumbersome, and potentially stall grid expansion. Such limited progress in grid expansion will hamper the effective, and efficient market uptake, and performance of wind energy, both onshore and offshore.

Financing of grid connection, and grid extension

A contentious issue in Germany are the high costs associated with grid expansion. In expanding the grid two policies are usually adopted. A *technical* tool can ensure the market integration of renewables by investing in technological development, and innovative grid infrastructure such as smart grid technologies, energy storage and more flexible generation technologies (IRENA, 2015). On the other hand an *economic* regulatory framework is adjusted to account for the cost structure, so as to allow for new services and revenue channels, and to support new business models (IRENA, 2015). Both tools have been adopted by the German government in expanding the grid. In line with the economic approach, the EEG (2009) set in place provisions concerning the financing of grid connection and grid extension. Its provisions stipulated that the costs for grid connection have to be paid by the plant operators whereas possible costs for upgrading the grid must be borne by the grid operator.

To finance the grid, the transmission system operators in Germany set a ‘grid fee’, which is supervised, and authorised by the Bundesnetzagentur (Federal Network Agency). In September 2016, the transmission system operating companies announced an 80% increase in the grid fee for 2017. The grid fee has been increasing at a rate that made it higher than the EEG surcharge. Figure 2 below shows the cost impact of the grid fee (light green bars) compared to the EEG surcharge (dark green) over the last three years in an average German household (Morris, 2016).

An increase in electricity levies/ fees, can potentially increase the negative perception, and local acceptance of renewables like wind. Some of the grid operating utilities have convincingly argued that increased generation capacity of wind, has fuelled grid congestion, and precipitated the urgent need for grid expansion. However, this argument does not hold true. This is because conventional power plants often have PPAs, meaning that they can continue to sell electricity to their contractual buyer even when prices on the power market are very low (Morris, 2016). So grid congestion is brought about not by wind alone, but the combination of all clean energy technologies, and all conventional power sources.

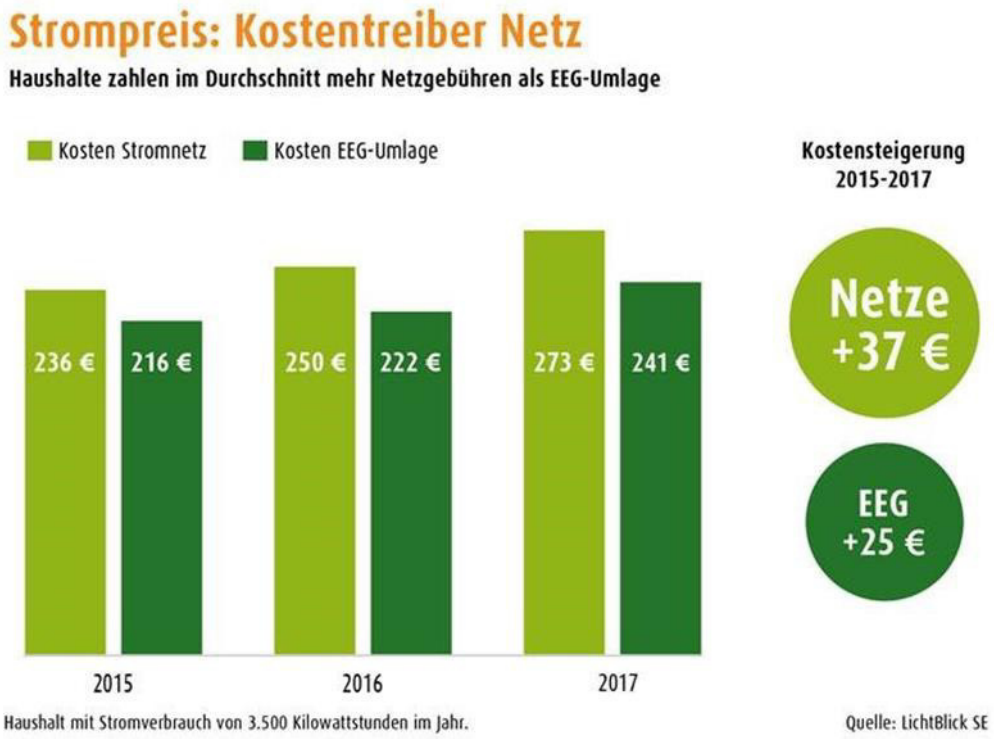


Figure 4: Comparison of grid fee, and EEG surcharge **Source: Lichtblick**

Nonetheless, with regards to the 80% grid fee hike, the Federal Network Agency stepped in and played its regulatory role in capping the profit margins of transmission operating companies (Morris, 2016). It should also be noted that for the settlement of any dispute in relation to grid costs, the Federal Ministry of Economics and Technology (BMWi) also established a clearing centre, with the involvement of the parties concerned (IEA, 2017). Thus, one can note that, in the administration of the grid, where there is potential between renewable energy generators, grid infrastructure operators, and end-users; the role of government departments and regulators is key to managing explosive conflicts that can threaten the stability and viability of a market.

4. Site designation

Finding suitable sites for wind farms is a complex decision-making problem, involving several, and sometimes conflicting, criteria and multiple objectives. For instance, a number of legislative, & policy prerogatives have to be taken into account on different levels. These include the BauGB, BauNVO, BImSchG, UVPG, ROG, Luftverkehrsgesez, state building codes (Landesbauordnung), BNatSchG1, conservation acts of the states and the state specific decrees (*Erlasse*). In the case of potential investments in onshore & offshore wind farm

[1]**BauGB** (Baugesetzbuch/ Federal Building Code); **BauNVO** (Baunutzungsverordnung/ Federal Land Utilisation Ordinance);**BImSchG** (Bundes-Immissionsschutzgesetz/ Federal Immission Control Act); **UVPG** (Das Gesetz über die Umweltverträglichkeitsprüfung/ Environmental Impact Assessment; **ROG** (Raumordnung/ Regional planning); **LuftVG** (Das Luftverkehrsgesetz/ Air Traffic Act**;** **BNatSchG** (Das Gesetz über Naturschutz und Landschaftspflege, kurz Bundesnaturschutzgesetz/ Federal Nature. Conservation Act)

projects in Germany, site designation also strongly depends on a thorough site assessment that aims at meeting technical, economic, environmental, and social acceptance-related criteria (TU Berlin, 2017).

The site pre-selection procedure for wind farms in Germany is most commonly based on an exclusion approach ("Positivauswahl") which is derived from legal and factual aspects. For instance, in considering a potential site for a wind farm, areas are excluded which lack sufficient average wind speeds, as well as areas where wind farm siting is restricted, such as residential areas, natural resources areas (flora-fauna-habitat (FFH) areas4), water bodies, or federal highways and other roads. In some cases, also buffer zones, i.e. minimum distances, around the aforementioned areas, are excluded according to German legislation (TU Berlin, 2017).

After the consideration of all restrictions, and the associated exclusion of those areas, the remaining areas are examined individually. In this step, location-specific considerations will be included to assess whether a site is suitable or not. However, each federal state issues its own policy regarding the siting assessment of wind farms. As a consequence, minimum distances between wind turbines and residential areas, for instance, may vary substantially across the sixteen federal states of Germany (TU Berlin, 2017).

Site designation in Germany, the allocation of wind farms is determined by prerogatives set out in planning & permission processes & procedures such as the regional plan **(Raumordnung)** and the urban land use plans **(Kommunale Bauleitplanung)**, as well as the zoning plan **(Flächennutzungsplan)** and local development plan**(Bebauungsplan**)

The general planning process for onshore wind energy.

The development of onshore wind is strongly based on the planning process. It is important for one to note that, the planning and permitting process is not exactly comparable in between the states (Länder). The table below gives an overview of the basic planning procedure considerations for onshore wind farms.

Planning Stage	Key Elements
Regional Planning (Raumordnung)	● Planning stage at state level ● Seeks to cater for diverse interests i.e. all municipalities involved in the regional planning process have to be consulted & their interests to be considered ● Regional planning consists of the regional development plan (Landesentwicklungsplan) adopted by a federal state, & the regional plan (Regionalplan) stating its goals & intentions. ● Regional planning societies designate priority (Vorranggebiete) & suitability areas (Vorbehaltsgebiete) in cooperation with the nature conservation authorities ● Priority sites are chosen by taking a number of factors into account such as the availability of wind, reachability of conduction cables, spatial compatibility & availability of points of delivery. The exact location is chosen by the investor supported by Micrositing
Urban land use planning (Kommunale	● Deals with the planning process at municipality level. ● Regional planning targets have to be incorporated within urban land use plans.

Bauleitplanung)	● Urban land use planning is regulated through the German Federal Building Code (Baugesetztbuch, BauGB). It regulates the preparation and the organisation of all land uses in the municipality. ● Public consultations, & availability of key infrastructure i.e. grid infrastructure, influences site designation. ● Results of Environmental Report necessary for urban land use planning.
Zoning plan (Flächennutzungsplan)	● Determines which facilities could be developed at which site. ● Wind farms are designated within concentration zones (§35 Paragr. 3 Phrase 3 BauGB), which follows the principles of effective use of space and protection of free space. ● Obligatory to discuss why areas should be excluded from the concentration zones. ● The zoning plan contains basic regulations about height (§16 Paragr. 1 BauNVO). ● Zoning plans have to be developed from the local development plan (§ 8 Abs. 2 BauGB)
Local development plan (Bebauungsplan)	● The targets mentioned within the zoning plan have to be adapted in the local development plans, in which the previous concentration zones are now designated as special building areas after § 11 Paragr. 2 BauNVO.

Table 9: Overview of the basic planning procedure considerations for onshore wind farms.

Onshore wind farm development also enjoys certain privileges in Germany's legislation that guides the planning process. For instance, under the German Federal Building Code (Baugesetztbuch, BauGB), onshore wind parks are privileged (§35 Para. 1 No. 5 BauGB). The Federal Building Code is the most important legal source for German urban development law, and it continues to be a key regulation impacting on onshore wind power development. Under this law, wind energy plants are categorised as "privileged projects" and local authorities are required to designate specific priority or preferential zones for wind projects. However, although onshore wind farm development has privileged recognition, there is a vast number of other land uses such as settlement areas, nature conservation areas etc. that are competing for available space (TU Berlin, 2017). Additionally the decrees of the states lead to a further reduction of potentially available priority areas. In several regions, height restrictions inhibit the installation of turbines at the best height for their operation, where they could yield the maximum amount of energy (GWEC, 2010). This without doubt undermines repowering schemes. In 2010, the Federal government and some states started to reconsider the authorisation conditions to allow continuous development of onshore wind, and have entered into discussions with local and regional planning authorities.

Relevant Permission Specifications for onshore wind

The permission process for onshore wind energy is, to a large extent, uniquely affected by the Federal Emissions Control Act (Bundes-Immissionsschutzgesetz, BImSchG), which includes regulations concerning shade and noise emissions, (but solar parks are not affected by this law) (TU Berlin, 2017). In the following the relevant permission specifications are listed:

Regulation/ Permission	Key Elements
State Building Order (Bauordnungsrecht)	● Developers should obtain clearances towards buildings and property lines (i.e. height restrictions).

	• Many state specific regulations.
Federal Nature Conservation Act (BNatSchG**).**	• Prohibits development in nature conservation areas (NSG), national parks and core zones of biosphere reserves. • Prohibits development within landscape conservation areas (LSG) and nature parks. Also depends on the protection targets and the state.
Federal Emission Control Legislation (BImSchG)	• Regulates **noise**: Using the area specific thresholds that are listed in the TA Lärm • Regulates **shade:** i.e. not more than 30 hours per year or 30 minutes per day. • Regulates **formation of ice**
Natura 2000 (§§31ff BNatSchG)	• Regulated by "Verschlechterungsverbot" after §33 Paragr. 1 BnatschG. • States that in case of possible significant impacts, an impact assessment is mandatory (§34 Paragr. 1 BNatSchG); • If there are significant impacts there is the possibility of an exception after §34 Paragr. 3 BnatSchG.
Biotope protection (§30 BNatSchG)	• Wind turbines are generally prohibited • Exception if the impact can be compensated (§30 Paragr. 3 BNatSchG).
Species Protection	• It is prohibited to hurt, disturb or kill species after §44 Paragr. 1 No. 1-3 BNatSchG ("artenschutzrechtliches Verbot").
Impact mitigation regulation (§14ff BNatSchG)	• Carried out to compensate the environmental impacts. • Seeks to identify, & describe impacts on landscapes & nature, and compares the need for compensation and the realized compensation.
Decrees (''Erlasse'') of the states (''Länder'')	Almost every state developed at least one decree, but it could also be a coaction of more than one e.g. Schleswig-Holstein features one basic decree and additionally one species specific document.

Figure 10: Overview of the basic permission procedure considerations for onshore wind farms

Offshore wind planning & permission process

With the exhaustion of land space for onshore wind energy and the possibility of generating up to two times the electricity demand of the entire European Union, the potential for offshore wind energy seems promising. The German federal government believes that offshore wind has an important role to play in the future of German electricity supply and has ambitious plans for installing 10,000 MW of offshore wind capacity by the year 2020. **Table 11** is a summary of the policy & legal environment for Maritime Spatial Planning (MSP) & offshore renewables.

Policy & Legal Env.	**Key Aspects**
Strategy on the Use of Offshore Wind Energy (2002)	• First government strategy to increase the share of offshore wind power to up to 15 per cent of total German electricity consumption by 2025/2030 (equal to 20-25 GW).

The Renewable Energy Sources Act (EEG)	● Regulates the compensation for electricity produced by renewable energies along differentiated technology bands. ● Initial tariff for offshore wind: 0.13 €/kWh, plus 0.02 €/kWh for electricity from installations commissioned prior to 1 January 2016
The Energy Concept of September (2010)	● Short–term measures to support the expansion of offshore wind energy, e.g. including a € 5 billion Federal loan programme for offshore wind farms, a grid planning platform, etc.
MSP (Maritime Spatial Planning) (2008)	● Definition of categorized areas: e.g. priority and reserved areas for shipping, pipelines and sea cables, priority areas (with preclusive effect) for offshore wind energy use.
Maritime Spatial Plan for the Exclusive Economic Zones (EEZ) in the North and the Baltic Sea of (2009)	● Definition of designated priority areas for shipping, pipelines and cables and the use of offshore wind energy (shipping is granted priority over the other uses. ● Natura 2000 areas are defined as no go areas for wind energy use.
MSP in territorial waters (12 nm zone)	● Competence of the coastal states (Länder).

Table 11: Policy and legal framework for MSP and offshore renewables

Offshore wind energy is still a relatively young technology and finds itself in very different stages of development and deployment. In its energy concept, the German government has made the accelerated development of offshore wind energy a priority for action. They forecast about 75 billion Euros of investments to develop 25 GW offshore wind power by 2030. Having learned many lessons with onshore wind energy in Germany, offshore is, in comparison, facing potentially different problems. Indeed, the designation of priority areas within the Exclusive Economic Zone (EEZ) could accelerate the permission process.

Planning in the 12 nautical mile zone for offshore wind

There is a difference between on and offshore wind parks when it comes to the designation of priority areas. Onshore planning follows the land use plans already mentioned which contain concentration zones etc. Within the 12 nautical mile zone (territorial sea) the planning of offshore wind facilities is under the responsibility of the (federal) state regional plan. In addition, the Federal Control and Pollution Act provides the basis for the approval procedure in German territorial waters (TU Berlin, 2017).

In addition to granting permission for the construction and operation of wind turbines, the state is also responsible for the administration of grid connections within the 12 nautical mile zone. Projects within this zone are quite attractive, since the water is not very deep. Nevertheless, environmental specifications make it nearly impossible to be granted permission for an offshore wind project this close to the coast (TU Berlin, 2017). This is because the impact on the environment and the landscape are very high. The offshore wind parks (Nordergründe) in the North Sea & in the Baltic Sea are currently the only approved projects in Germany to date. As priority areas for offshore wind have only been designated

in the Exclusive Economic Zone (EEZ) and the high environmental restrictions in the 12 nautical mile zone, it can be assumed that there will not be many approaches to build offshore turbines within the 12 nautical mile zone.

Planning in the exclusive economic zone (EEZ)

Beyond the 12 nautical mile zone is the EEZ, where planning takes place according to federal law. The basis for the construction of offshore wind turbines within the EEZ are the UN Convention on the Law of the Sea from 1982 and the German Federal Maritime Responsibility Act (Seeaufgabengesetz). The approval process is based on the German decree for sea installations (Seeanlagenverordnung). The responsible Agency for offshore wind energy approvals is the BSH (Federal Maritime and Hydrographic Agency)**. Table 12** below illustrates the approval procedure for offshore wind energy farms in the EEZ contains the following steps:

First Stage	• Competent authorities like the regional Waterways and Shipping Directorates and the Federal Agency for Nature Conservation are informed about the project application and asked to comment
Second Stage	• Larger number of Stakeholders get involved in the process; the public has the possibility to inspect the planning documents. • A project presentation is offered to the project planner during an application conference.
Environmental Impact Assessment (EIA)	• On the basis of the environmental studies, the applicant prepares an Environmental Impact Assessment (EIA) and a risk analysis.
Standard Investigation Concept (StuK)	• This analysis contains the potential impact risks within the construction, operation and deconstruction phase, as well as goals for the investigation of the protection of fish, birds and marine mammals and landscape modification • The standard investigation concept gives a framework for the most important requirements for the approval of an offshore wind project. It considers the following issues: **Construction phase** (i.e. disturbances by vehicles and machines for construction, visual and auditive impacts); **Operating phase** (i.e. electrical and magnetic fields possible pollution through escaping oil; barrier effect for migratory birds and fish); **Deconstruction phase** (i.e. pollutant emissions); **Environmental protection; & Grid connecti**on.
Final Stage	• The BSH reviews whether the requirements for granting approval have been met, • If approval has been granted, a notification of approval is issued.

5. Environmental Impact Assessment

Strict requirements for nature conservation are taken into account both when planning areas dedicated to wind power and when approving a specific location for specific turbines.

European, German, and state legislation define standards for protecting the ecosystem, landscapes, and individual species (BWE, 2016). In Germany, Germany's Federal Nature Conservation Act (BNatSchG) plays the most important role in defining guidelines to protect the environments. Nevertheless, regional planning guidelines alone prevent the development of wind energy projects in valuable locations.

A wind energy project developer has to comply with German law by undergoing an Environment Impact Assessment (EIA) for a specific project. Legislation regarding environmental impact assessments is based on the European guidelines for such assessments. An assessment is absolutely required for projects with at least 20 turbines. Smaller projects only need to conduct one after a preliminary assessment that is communicated by the authorities in charge of approval (BWE, 2016). An environmental impact assessment provides a framework for assessing the effects a project has on environmental aspects that require protection and also includes an evaluation of alternatives.

Requirements for sharing information with the general public ensure that citizens have an understanding of the project (BWE, 2016). A strategic environmental assessment is conducted at the level of regional / land use planning to designate priority and concentration zones. This assessment helps ensure that significant environmental effects potentially arising from plans and programs are taken into account even before a project is actually implemented. As these plans and programs are further developed, information is shared with the public early on (BWE, 2016).

Barriers to effective EIA

If the impact is designated as 'significant', this can lead to a rejection of the project. The problem that arises for planners is that there is no common or standardised definition of the term ‘significant’ and thereby misunderstandings can arise whether the impact has to be taken into consideration in the permitting process. This leads to case-by-case decisions about the significance of certain environmental impacts, so that it is difficult to predict whether a project will be permitted or not, resulting in a legal uncertainty for the investors. A standardised determination of ‘significance’ is best achieved through the definition of quantitative threshold values. Also, a contentious issue has always been how to deal with cumulative environmental impacts. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. **Table 13** below is a summary of the relevant laws and regulations that determine the compilation of an EIA.

Assessment	Relevant Law	Key Elements
Environmental Report	• An essential part of the comprehensive plan. BauGB § 3, Para. 1: ‘Residents have to be informed early about the project and are allowed to give their opinion’. • BauGB § 4, Para. 1: Public agencies (Träger öffentlicher Belange) need to be engaged and can give statements. These comments should be taken into consideration.	• Identifies, describes and evaluates impacts to the environment that are caused by the project and proposes compensation measure. • Report includes the impact assessment of the project, protected species assessment (habitats assessment) (FFH-Verträglichkeitsprüfung), European protected species assessment (Artenschutzfachliche Prüfung) and the Impact Mitigation Regulation (Eingriffsregelung).

Comprehensive Plan/ Bauleitplan	• BauGB § 2, Para. 4 • BauGB § 1, Para. 5 & 6	• The environmental report is an essential part of the comprehensive plan. • Comprehensive plans will ensure sustainable development, protection of the environment, natural resources and the landscape scenery. • Responsible for enhancing climate protection, & harmonising social, economic and environmental needs.
Strategic Environmental Assessment	• Regulated by § 14b of UVPG, and § 9 of ROG	• Informs regional development plans adopted by a federal state, and regional land use plans. • Assessment consists of the Environmental Report.
Professional Requirements	• BImSchG • TA Lärm • TA Luft	• Seeks to determine whether wind and solar parks require a license due to BImSchG, TA Lärm, TA Luft • Critical element of permission process i.e. ensures RE project is consistent with zoning laws • The BImSchG plays the most important role, because nearly all types of plants are regulated through it. Only when plants are regulated by other laws, the BImSchG does not come into operation.
Environmental Impact Assessment, (EIA)	• § 3a-c and Appendix 1 of UVPG	• Designed to develop & identify environmental consequences of a newly planned project and of any project-related activities. • Assessment has to be integrated into the permission procedure • Public has to be informed and their statements have to be taken into consideration • The EIA has to be finished before the permit to develop project is issued
Nature Protection Assessments	• Prohibitory Provisions of § 19 of BNatschG • EU Habitats Directive or the • EU Birds Directive	• Focus on protected areas, species, biotopes • Expert contributions are needed if a protected species are present at the project site. • Plants should not cause conflicts with the protection and conservation goals • Habitat assessment is necessary according to Art. 6 Para. 3 EU Habitats Directive and the EU Birds Directive Development occurs when the overall interests outweigh the nature protection interests because of urgent reasons
Impact Mitigation Regulation	• BauGB	• Defines measures to avoid, compensate and mitigate compensate the environmental impact • The identified compensation measures are binding as a

		result of the decision process

*Environmental Impact Assessment Act/ Umweltverträglichkeitsprüfungsgesetz (UVPG)
*Federal Immission Control Act/ Bundes-Immissionsschutzgesetz, (BImSchG)
*Federal Regional Planning Act (Bundesraumordnungsgesetz) (ROG)
*German Federal Building Code/ Baugesetztbuch (BauGB)

*Technical Instructions on Air Quality Control / Technische Anleitung zur Reinhaltung der Luft (TA Luft)
*Technical Instructions on Noise Protection /Technische Anleitung zum Schutz gegen Lärm, (TA Lärm

*Prohibitory Provisions (Verbotstatbestände)

6.Social Aspects of Wind Energy in Germany

Community Wind in Germnay

A unique, and interesting aspect of Germany's wind energy sector is that the majority of operating wind farms in country are community owned. According to the Renewables Energy Policy Network for the 21st Century (REN21), community wind can be conceptualised as an approach that 'involves a community initiating, developing, operating, owning, investing and/ or benefiting from a project' (REN21, 2016). Thus one can note that at the crux of the community wind model are common strands that can be identified and are characteristic of community wind. These include majority 'local stakeholder or community ownership; majority of project profits benefitting community; and voting control rests with community-based organisation' (WWEA 2016&2018).

Community wind projects are thus essentially those that are to a large extent developed by, owned by and deliver socio-economic benefits for citizens organised around communities (WWEA, 2016, IRENA 2018). Community wind projects are different from commercial wind farms which have profit-making as the main motive. The main actors in commercial wind projects are usually large, (globally) operating utilities and project developers' (WWEA, 2016).

Organisational Structure of Community Wind

There are various possible ownership models, organisational structures and legal vehicles for pursuing community wind. These include 'limited partnerships, cooperatives, voluntary associations, community trusts, informal community groups, and social enterprises' (Walker & Simmocke, 2012; Seyfang & Smith, 2007). The popularity, and adoption of business models varies between contexts. In an advanced economy such as Germany, cooperatives, and closed-end funds/ limited partnerships are common in the community wind. Limited partnerships aim to raise equity capital through a large number of investors, and are based on a legal framework that limits the liability of investors, and protects private assets from losses (Schick, 2016). On the other hand, cooperatives are jointly owned and democratically controlled businesses. Schick (2016) points out that the

constitution and operation of cooperatives is usually based on 'voluntary and open membership, democratic member control, and direct financial and socio-economic benefits for members (Schick, 2016: 7).

Drivers and Benefits of Community Wind

Importance of the Feed-In-Tariff

The single most important driver of Community Wind can be attributed to the guaranteed feed-in tariff introduced on the federal level by the Renewable Energy Sources Act (EEG). However the German government's increasing commitment to fully enforce an auction based remuneration system threatens to kill decentralised, community based, renewable energy investment. Auctions primarily disadvantage smaller players such as local communities, and energy cooperatives, as they find themselves having to compete for bids against more experienced market players with a higher competitive advantage (WWEA, 2016, WWEA 2018).

Economic Rationale

Revenue generation, and increased income for local communities is a key factor that drives community wind development (IRENA 2018). On a global scale the cost of wind energy technologies has been increasingly decreasing, making it cost competitive and an economically viable choice for investment with a high internal rate of rate (REN21, 2016). For groups such as local farmers, Grid connected community wind can generate income that can augment other activities such as farming, and offers a sustainable and profitable investment option (REN21, 2016). Finally, employment opportunities are created during the construction, operation and maintenance stages of community wind projects (REN21, 2016). Hence, in times of stagnant economic growth, and low unemployment, community wind contributes to the diversification of employment opportunities.

Moreover, the organisational structure, production and consumption processes of community wind projects are often distributed or decentralised, thus allowing for the provision of services to homes, small businesses and community buildings which would otherwise be too far away from centralised grid infrastructures (Seyfang & Smith, 2007). Distributed generation of electricity from dispersed, generally small-scale systems that are close to the point of consumption is advantageous in that it reduces the cost of electricity (REN21, 2016).

Local Development

Moreover, community wind farms with profound local ties secure revenue generation for local tax authorities, and spur community and local socio-economic development. At a time when most governments are experiences budgetary constraints, tax revenues from community wind farms can be channelled towards a whole host of developmental goals and priorities. These can improvement of infrastructure, and finance for local schools.

Lower Electricity Prices

Community wind creates the possibility of lower electricity prices for consumers. Electricity produced by onshore wind turbines can be further lowered through community owned wind power simply because, community owned wind farms require lower land payments than private 'absentee-owned' commercial wind projects (Albizu, Maegaard & Kruse, 2015). Furthermore, combining community wind with storage solutions would help address resource variability, and ensures a reliable supply of energy at low costs (Albizu, Maegaard & Kruse, 2015). Community wind projects also guarantee lower electricity prices because electricity is used or sold directly to the local utility, thus providing long-term energy price stabilization (DOE, 2012). Community wind projects thus offer protection to consumers from volatile energy prices.

Energy Democracy

Community wind farms ensure that, the local citizenry has an opportunity to influence, and be key decision makers in areas of the project such as the siting, and sizing of projects (REN21, 2016). Thus, community wind signals a marked departure from large-scale commercial wind farms, and traditional centralised fossil fuel plants, 'which provide communities with little to no influence over the sustainability of their energy supply' (REN21, 2016). Through increased local control of energy generation, community wind projects thus facilitate the realisation of an energy system that is democratic, and inclusive. This without doubt also enhances community acceptance of renewable energy projects in general.

Local Acceptance

Community wind fosters local acceptance of wind turbine deployments that take place in the vicinity of local communities. Community wind deployments have fewer problems obtaining planning permission than commercial modes of project development (Albizu, Maegaard & Kruse, 2015). This is because the community wind model invites ordinary citizens and local institutions as owners, and equal partners. Community wind is thus a key to addressing opposition, and resistance, as benefits will be shared throughout the local community (Albizu, Maegaard & Kruse, 2015, IRENA 2018). In addition to local acceptance, greater community cohesion, increased civic engagement and the deepening of local social capital are also often seen as positive outcomes of community wind projects, as individuals of a locality engage and cooperate in the development of one vision and one goal (REN21, 2016).

Awareness Raising

Community wind can be a successful means of addressing and raising awareness about environmental issues, at a local scale and level where people can engage (REN21, 2012: 139). Seyfang & Smith (2007) suggests that community wind projects have a 'catalytic effect' on participants and actors, educating them about the benefits of sustainable energy and development, and making them more aware of their own energy consumption practices in their own homes and daily lives thus raising awareness of profound environmental issues (Seyfang, Smith, 2007

In a nutshell, one can note that community wind has a wide array of socio-economic drivers, and benefits. Its greatest strength is that it contributes towards the delivery of sustainable

development goals on so many levels such as environmental sustainability, better health and poverty eradication. Community wind is one business model that enables low-income communities to significantly 'benefit from the way that energy is generated and distributed, resulting in a more equitable energy economy' (Walker & Simcock, 2012), and worthwhile contributions towards livelihoods, resilience, and basic rights (IRENA 2018).

7. Available Wind Data

Onshore Wind

In Germany, 790 land-based wind turbine generators (WTG) were installed in the first half of 2017 with a total capacity of 2 281 MW (gross). Compared to the first half of the previous year, this equals an increase of 11% in capacity installations (Deutsche Windguard, 2017). As of June 30, 2017, the cumulative turbine portfolio increased to 27 914 WTG with a total of 48 024 MW (Deutsche Windguard, 2017). This corresponds to a 5% increase in the cumulative installed capacity compared to the portfolio six months earlier.

In the first half of 2017, the average turbine capacity of the WTG was 1 143 kW, while the average dismantling age in the first half of 2017 was 16 years (Deutsche Windguard, 2017). One main reasons to dismantle a WTG is repowering. Due to the limited availability of area suitable for wind energy use, repowering is also carried out without an incentive by EEG bonuses. Lack of license for continued operation, and lack of economic viability were also decisive factors for decommissioning (Deustche Windguard, 2017).

In May 2017 the first tender for onshore wind energy took place. In total, in the year 2017 2.8 GW were to be tendered within three rounds. However 70 bids with 224 WTG respectively 807 MW were awarded tenders (Deutsche Windguard, 2017). Citizen-owned wind farms, as defined in the renewable energy act dominated with 65 accepted bids equalling 96% of the awarded capacity. However, evidence suggests that the "energy communities" that won the bids appeared to consist of employees of professional project developers, who managed to gain an advantage by working with a cooperative or local community (Klessmann & Tiedmann, 2016) respectively by making use of the insufficient community energy definition (WWEA,2018). Nevertheless, the accepted bids were between 4.20 and 5.78 ct/kWh. After the adjustment of the bid for the citizen-owned wind farms to the highest accepted bid, the average capacity-weighted award was 5.71 ct/kWh (Deutsche Windguard, 2017).

Offshore Wind

The Federal Government's objective is to reach 6.5 GW of offshore wind capacity by 2020. In the first half of 2017, 108 offshore wind turbines (OWT) with an installed capacity of 626 MW fed into the grid for the first time. This brought the cumulative capacity of OWT, to 4 749 MW by the end of the first half of 2017. This also translates to a 16% increase in comparison to the cumulative capacity of at the end of 2016. Installed at an average water depth of 35 m, the offshore wind turbines that were installed by July 2017 were 16% deeper than in the previous year. Also the average distance to shore of the new OWT is 88 km. OWT with the first feed-in in the first half of 2017 are on average 30% further from the shore

than those of 2016 (Deustche Windguard, 2017). The second tender for offshore wind energy in Germany will take place in early April 2018. A total grid connection capacity of 1 610 MW, of which 500 MW will be assigned to bids in the Baltic Sea, will be tendered.

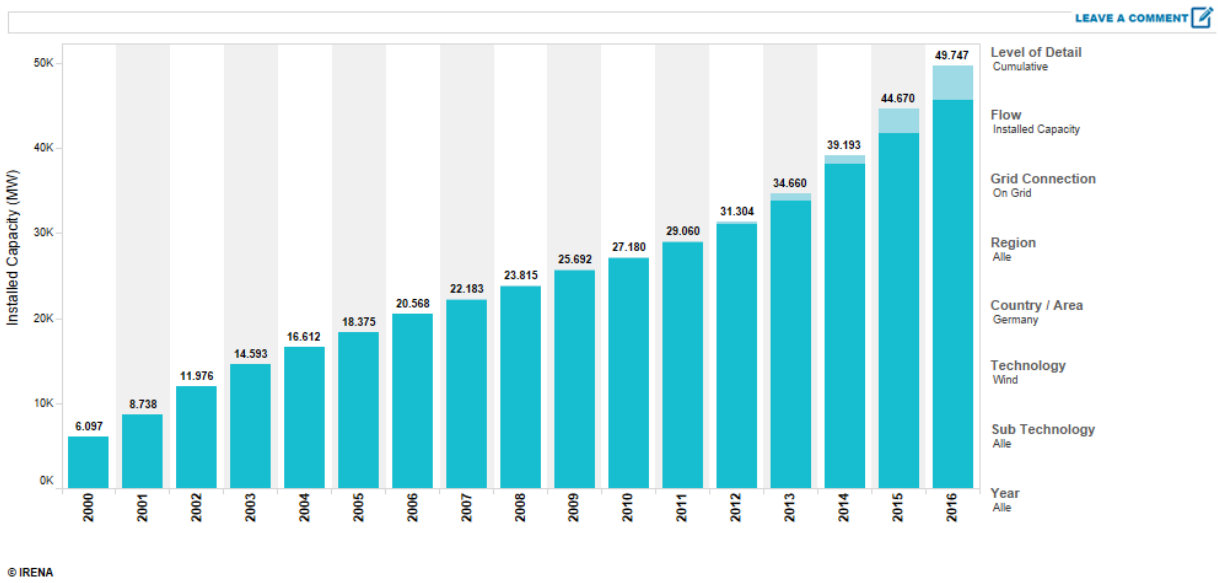


Figure 5: Total Annual Installed Capacity for Onshore and Offshore Wind in Germany: 2000-2016 Source: IRENA

8. Domestic Industrial Capacities

Germany records the largest number of technological patents in wind energy in the EU and hosts several leading global manufacturers of renewable energy components, particularly in wind energy (Ćetković & Aron Buzogány, 2016). Germany's domestic industrial capacity for onshore and offshore wind can be attributed to interacting policy schemes, most of which have already been discussed in the preceding chapters of this paper. The domestic industrial capacities for both onshore, and offshore wind has surged over the last four decades primarily because of policy incentives that have been in place to reduce investment, and operating costs for wind energy manufacturers, for wind energy operators, and various other service providers in the industry. The incentives are summarised in Figure 6 below.

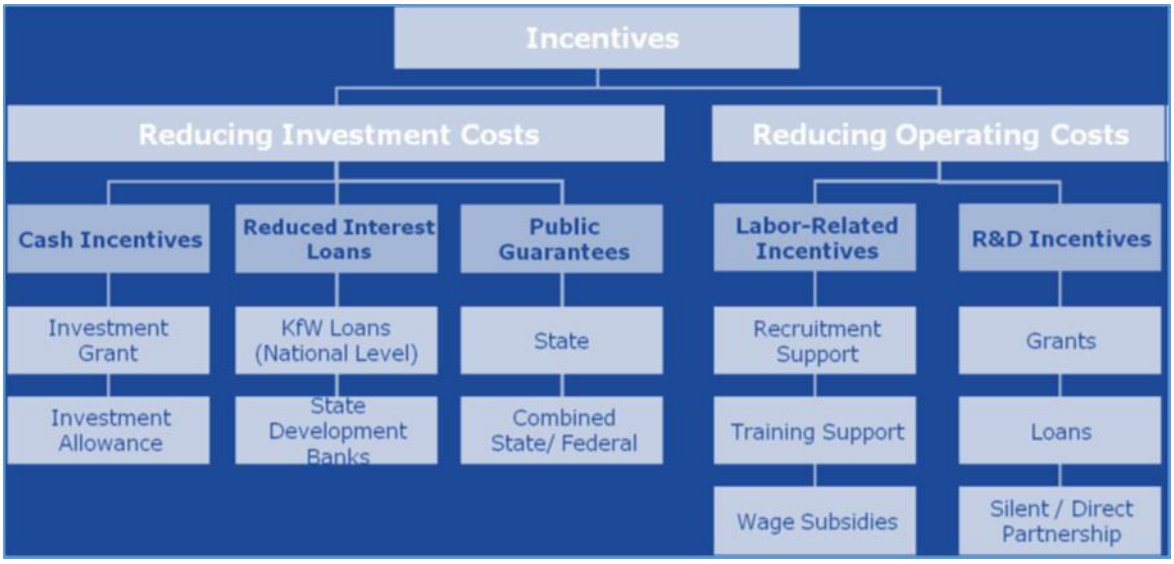


Figure 6: Types of incentives to support domestic industrial capacity in Germany.

Source: Grigoleit & Lenkeit (2012)

Supporting wind energy manufacturing clusters has helped Germany have a strong domestic industrial capacity. Close cooperation between Germany's R&D institutes and equipment manufacturers contributes towards an expansion of domestic industrial capacity, and also helps Germany maintain an internationally unparalleled competitive edge (Grigoleit & Lenkeit, 2012). For instance, many offshore wind industry networks are located along the coastline in Northern Germany. Already there is strong partnership, and cooperation between offshore wind project developers, and seaport operators along the German coastline, who are preparing to fulfil the infrastructure demands of the offshore wind energy sector (Grigoleit & Lenkeit, 2012). The expansion of the offshore wind domestic base has also been made possible because of policies such as the Exclusive Economic Zone (EEZ).

9. Research and Development (R&D), & Professional Development

Now that wind energy is an important part of the electrical generation mix, it is more important than ever to carry out carefully targeted research and development (R&D) to support the growing wind market, and increase the contribution of this clean energy source. Long-term R&D support has been continuously available for the wind power sector in Germany since the 1970s. Most support for R & D has been publicly financed, and now private finance is also playing a significant role. A recent highlight of an R & D initiative has been the 2010 opening of the Alpha Ventus offshore test site, complementing the research initiative called "Research at Alpha Ventus" (RAVE). This offshore test site was commissioned with the primary aim to acquire fundamental technical and environmental information for the future expansion of offshore (IRENA, 2013).

Energy research funding in Germany is based both on institutional funding of national research centres performing long-term fundamental research, and on project-oriented funding of individual research topics generally in cooperation between universities and

industry (EC, 2017). Institutional and project-oriented national funding of energy research involves several ministries. The Federal Ministry of Economics and Technology (BMWi) is responsible for the programmatic orientation of the energy research policy set out in the 6th Energy Research Programme of the German Government 2011 (EC, 2017). Due to its overall responsibility for economic, technology, industrial and energy policies, the Federal Ministry of Economics and Technology (BMWi) acts as the coordinating agency in setting the programmatic direction of the energy research policy and the Federal Government's Energy Research Programme. Regarding project funding, the BMWi is involved in applied energy research and demonstration (EC, 2017). The organisational structure of BMWi can be seen below in Figure 5.

Public R& D funding for the wind energy industry in Germany falls under the purview of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). The BMU is responsible for project funding of R&D in all renewable energies. In 2011, the BMU approved 74 research projects with a total funding amount of EUR 77 million (USD 99.9 million). In 2010, the BMU approved 37 projects with a total funding of EUR 53 million (USD 75.3 million).

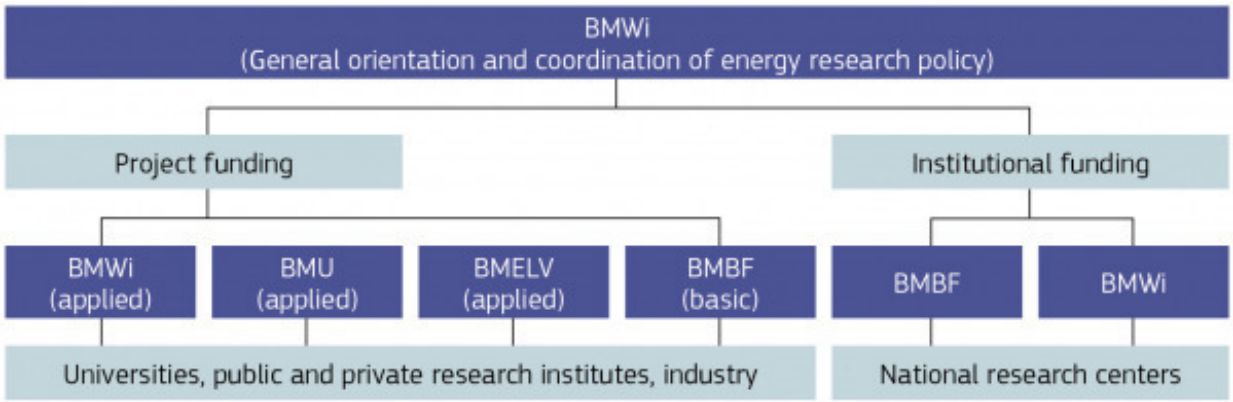


Figure 7: Organisational structure Federal Ministry of Economics and Technology (BMWi)

Source: European Commission

The activities of the 6th Energy Research Programme are supplemented by research institutions like the Fraunhofer Institute for Wind Energy and Energy System Technology (IWES). The IWES coordinates 45 research institutions and companies, which are involved in wind energy research. Currently an important topic of research is the foundations and support structures for an offshore wind turbine, which account for about a third of its capital costs (IRENA, 2013). On the other hand, the development of optimised turbines for special location circumstances and heightening the utilisation level of turbines will continue to be topics of central importance in the onshore market.

It is important to note that such research priorities are driven by some of the challenges that the German wind energy market is experiencing. With increasing restrictions on land on

which onshore wind farms can be developed, it becomes necessary to develop optimised turbines for special location circumstances with a low yield. Furthermore, innovative research projects are also currently concerned with topics such as wind farm controlling for optimising yields in those farms where turbines are placed close to each other. The focus of R & D is also oriented towards heightening the utilisation level of turbines, as wind turbines increasingly reach their lifespan, and repowering schemes on the top of the agenda for a lot of wind farms. Another central theme in wind market R & D is increasing the cost-efficiency of turbines. This has become a priority issue in R&D. Against the backdrop of political and public discussions and the organisation of the remuneration system, cost pressure continues to rise.

The fact that well-trained staff are in short supply is a major problem for the whole wind sector. There's a shortage of good staff across the wind energy servicing sector. There has been efforts by both the public and private sector (manufacturers and independent power producers) to enhance professional development. For instance, the Federal Institute for Vocational Education and Training (BIBB) with funding from the Federal Ministry of Education and Research (BMBF) is promoting seven projects for "Vocational Education and Training for Sustainable Development" (BBNE). In the project, for example, the training needs of experts specializing in offshore wind energy plants will be catered (EC, 2017). Similarly, qualified servicing personnel are in demand for the new offshore projects off the German coast. Private companies like Siemens are training their own service engineers (for offshore wind farms) at its training centre in Bremen and making use of the synergies in the company's other service areas (BWE, 2014). Thus one can note that, though the public sector has a robust framework for research & development, as well as professional development of personnel within the wind energy sector. The private sector also steps in to fill in the gaps that emerge as a result of inadequate government support in the above mentioned areas.

10. Export Promotion Policies

The Federal Ministry for Economic Affairs and Energy and German Trade and Invest Agency have been active in facilitating with the support to domestic wind companies in their positioning in external markets. A case in point is the Renewable Energies Export Initiative, which operates under the Ministry for Economic Affairs and Energy (Ćetković & Buzogány, 2016). The Energy Export Initiative offers specific manager training programmes for foreign executives and innovation seminars in selected universities abroad in the pre-market phase. They aim to promote knowledge on innovative technologies in the fields of renewable energy and energy efficiency and thus to improve the environment for exports of technologies from Germany (BMWi, 2017)

The Project Development Programme (PEP) is another development flagship export promotion policy through which wind energy benefits. The programme is intended for developing countries and emerging economies, and it helps German companies to realise specific projects in all market development phases in South-East Asia and Sub-Saharan Africa. Furthermore, the Programme is to contribute to fostering technology cooperation and know-how and technology transfer (BMWi, 2017). However if Germany's export promotion policies are to succeed, a concerted effort should also be made to maintain

strong domestic market, characterised by stable policy environment, expansion and greater innovation in manufacturers and service providers.

11. Conclusion

In the final analysis, one can note that the market creation, and growth of Germany's wind energy market has been an evolutionary process, rather than revolutionary. Most importantly, to adequately understand the success of the German wind energy market, one has to do so in tandem with the Energiewende. Several endogenous, and exogenous perturbations, from both the global and state level were identified has factors that shaped a window of opportunity that helped wind energy emerge as a sustainable energy solution for Germany. Nevertheless, the continued necessity to expand the Germany's wind energy market now primarily stems from global, and state level climate, and energy pressures.

One lesson that can be drawn from the study is that the growth of Germany's wind market cannot be reduced to one yardstick. A plethora of regulatory, and public policy tools have been formulated and implemented to facilitate the market uptake of wind energy in Germany. However, the role that has been played by the implementation of a REFIT, since the 1990s, cannot be underestimated. The policy design of REFIT has fostered transparency, longevity, and certainty for investors. With the REFIT policy, cost reductions have been witnessed in the wind energy market, and lower prices for wind generated power realised. Moreover, today Germany is home to one of the most advanced wind energy markets of the 21st century. In the last three decades alone, there has been a surge in the financing, and deployment of wind energy technologies across the country.

Notably, on the international arena Germany is ranked the third-largest market for wind, only after that of China and the U.S. Within the EU, the German wind industry, and market has maintained a competitive edge, and has consistently retained its leadership position. It is very questionable whether an auction based remuneration system will be able to maintain, or surpass these high standards. Countries that have relied on the auction system, to date, have not yet reached Germany's levels of installed, and generation capacity in the wind energy sector.

Social support, and local acceptance are vital elements for the survival of the wind energy market. The FiT has enabled farmers, local communities, and cooperatives to access finance, and invest in wind energy projects. In turn this has enabled ordinary Germans to be owners, decision makers, producers, and consumers for wind energy projects. It is against this background that one can argue that the FiT, as a policy tool, has also bridged the gap between innovation and sustainability. Apart from a permanent policy change from the FiT to an auction based system, there are other public policy problems that undermine the success of Germany's wind energy sector. Limited grid infrastructure, and lengthy, and complex site designation and environmental permits remain challenges. In a nutshell, the challenges are at once political, economic, social, cultural, institutional and technological.

Analysis on enabling conditions for wind energy

An empirical analysis reveals that a diverse mix of policy tools contribute, and form the basis of an enabling policy and regulatory framework that leads to the successful market creation, financing and deployment of wind energy. **A clear and effective pricing structure/ remuneration scheme** is one key element of success. From the genesis of wind energy deployments in Germany, the Feed-In-Tariff (FiT) has played a pivotal role in guaranteeing transparency, longevity, and certainty for investors. The steps taken to revise and redesign the FiT have contributed to greater investment security, certainty, and market stabilisation for both the local wind industry and its investors. Reviewing, and adjusting the FiT since its promulgation in the 1990s has also led to real price discovery for wind generated power.

The FiT has had the advantage of enabling local communities, and ordinary citizens to be key actors in the wind energy sector. This has also helped **enhance local support, and social acceptance of wind energy from local communities**. A stable regulatory framework in Germany has facilitated relatively easy access to loans and credits for wind energy investors (Ćetković & Buzogány, 2016).

Under the EEG **Monitoring, Evaluation, and Reporting** of wind energy market trends helped with the various policy revisions, and amendments of the EEG in the sixteen years of its existence. Gathered feedback, has helped enhance necessary adjustments, and degression rates, to the FiT. This in turn has helped spur innovation in the industry, and ensure cost-reduction for wind energy.

A functioning finance sector proved to be critical in supporting growth within the wind energy sector in Germany. Germany's wide network of **regional and locally-embedded banks**, have played an important role in availing funds for decentralised, community owned wind a reality (Ćetković & Buzogány, 2016). On the other hand the offshore wind energy sector has benefitted from the role played by the state, mainly through the roll out of state loans, and grants in the billions of euros.

Clearly defined grid connection rules that regulate behaviour, and interaction between grid operators, wind power producers, and consumers is another factor that has contributed to the success of wind power. Clearly defined grid connection rules minimise explosive conflicts that can arise between utilities, electricity producers and consumers. For wind power generators **priority access to the grid, and long-term PPAs** attracted further investments to the wind market. However issues related to grid integration, and limited grid infrastructure are causing delays and adding risk to future projects.

Wind energy project developers have benefitted from sites designation laws that have demarcated land specifically for wind farms in various federal states. However, investments have begun to stall because of limited designation sites for wind energy, and also permitting procedures that continue to be complex and need to be streamlined. Nevertheless, site designation rules, building codes, and EIAs are policy measures that show how **effective rule of law, as well as transparency in administrative and permitting processes is a key element for success.**

Additional measures for boosting the supply and competitiveness of wind energy technologies in Germany have included public spending on R&D activities that promote cooperation in the form of clusters and alliances between business, academic and non-academic research institutes (Ćetković & Buzogány, 2016). Advancements in the wind energy sector should be also attributed to strong industrial base and the developed system of state-enhanced industrial promotion together with the locally-embedded **state–market–society coordination mechanisms** (Ćetković & Buzogány, 2016). Finally, an expression **of political commitment on the part of the government.** Renewable energy, and climate change goals of up to 2030 have acted as a provision for long-term certainty for both the offshore and onshore developments.

Policy advocacy had improved. Throughout the 1990s associations, local groups and societies were founded with the aim of improving and enhancing political support for the infant technologies and their commercialisation: it was a coalition of various, mainly new actors that managed to influence the federal government to develop innovative policy instruments designed to support the expansion of renewable energy technologies.

12. Bibliography

Agora Energiewende (2017): *Future cost of onshore wind. Recent auction results, long-term outlook and implications for upcoming German auctions.*

Albizu, G., Maegaard, P., Kruse,J. 2015. Community Power for the world. Kammersgaardsvei: Folkceter Print.

Bruns & Ohlhorst, Wind Power Generation in Germany- a transdiscplinary view on the innovation biography *The Journal of Transdisciplinary Environmental Studies vol. 10, no. 1, 2011.*

BMWi. 2017. Export initiatives: Finding new markets. https://www.bmwi.de/Redaktion/EN/Dossier/export-initiatives.html BWE. 2016. Wind power and nature conservation

BMWi Federal Ministry for Economic Affairs and Energy (BMWi). 2015. The energy transition – a great piece of work - Making a success of the energy transition On the road to a secure, clean and affordable energy supply. https://www.bmwi.de/Redaktion/EN/Publikationen/making-a-success-of-the-energy-transition.pdf?__blob=publicationFile&v=6

BNetzA. 2017. How it works: Grid expansion in five steps. https://www.netzausbau.de/EN/5steps/en.html

BWE. 2015.German Wind Energy Association. 2015. Yearbook Wind Energy.

Ćetković, S & Buzogány, A. 2016. Varieties of capitalism and clean energy transitions in the European Union: When renewable energy hits different economic logics. Climate Policy. Vol. 16,No.5: 642-657. http://dx.doi.org/10.1080/14693062.2015.1135778 .

Deutsche Bank (DB). 2012. The German Feed-In-Tariff: Recent Policy Changes. September. DB Research.

Deutsche Wind Guard. 2017. Status of Land Based Wind Energy Development in Germany. http://www.windguard.com/_Resources/Persistent/c9af16a017d028b15fc7453b88176e10542214c1/Factsheet-Status-Land-baseed-Wind-Energy-Development-1st-half-2017.pdf

Deutsche Wind Guard. 2017. Status of Offshore Based Wind Energy Development in Germany. https://www.wind-energie.de/sites/default/files/attachments/page/statistics/factsheet-status-offshore-wind-energy-development-germany-1st-half-2017.pdf

European Commission. 2017. Germany. Energy Research Knowledge Centre. https://setis.ec.europa.eu/energy-research/country/germany

EY. 2015. Offshore wind in Europe Walking the tightrope to success.

Federal Environmental Agency (UMWELTBUNDESAMT). 2007. Development of an Ecological Strategy for Onshore and Offshore Wind Power Use

Fraunhofer Institute for Wind Energy and Energy System Technology (IWES). 2011. Wind Energy Report 2011.

Geels, F.W. 2010. Regime Resistance against Low-Carbon Transitions: Introducing Politics and Power into the Multi-Level Perspective. Theory, Culture, & Society. Vol.31, No.31: 21-40. http://journals.sagepub.com/doi/full/10.1177/0263276414531627

Geels, F. W & Schot, J. 2007. Typology of sociotechnical transition pathways.Research Policy.Vol.36:399–417.https://is.muni.cz/el/1423/jaro2013/HEN621/um/S5a_-_Geels_Schot_2007_Typology_of_STS_pathways.pdf

Grau, T. 2014. Comparison of Feed-in Tariffs and Tenders to Remunerate Solar Power Generation Deutsches Institut für Wirtschaftsforschung. Discussion Paper 1363. http://www.ssrn.com/link/DIW-Berlin-German-Inst-Econ-Res.html.

Grigioleit, T, & Lenkeit, D. 2012. The Renewable Energy Industry in Germany: A glance at industry promotion policies in selected energy sectors.

Gsänger, S. 2016. The global trend towards auctions – will it kill decentralised renewable energy? Windtech International.

Hake, F.H., Fischer, W., Venghaus, S., & Weckenbrock, C. 2015. The German Energiewende – History and Status Quo Forschungszentrum Jülich, Institute of Energy and Climate Research - Systems Analysis and Technology Evaluation (IEK-STE), D-52425 Jülich, Germany. http://www.fz-juelich.de/SharedDocs/Downloads/IEK/IEK-STE/DE/Publikationen/preprints/2015/preprint_10_2015.pdf?__blob=publicationFile

International Energy Agency (IEA), 2017 https://www.iea.org/policiesandmeasures/pams/germany/name-21002-en.php

IEA. 2017. 250 MW Wind Programme https://www.iea.org/policiesandmeasures/pams/germany/name-21700-en.php

IRENA. 2015. Renewable Energy Integration in Power Grids Technology Brief IEA-

International Renewable Energy Agency (IRENA). 2013. 30 Years of Policies for Wind Energy Lessons from 12 Wind Energy Markets.

https://www.irena.org/DocumentDownloads/Publications/IRENA_GWEC_WindReport_Full.pdf (Accessed 18/10/2017)

IRENA. 2013. 30 Years of Policies for Wind Energy Lessons from 12 Wind Energy Markets World Wind energy Association (WWEA). 2016. Headwind and Tailwind for Community Power: Community wind Perspectives from North-Rhine Westphalia and the World. February. World Wind Energy Association (WWEA) Paper Series. Bonn: WWEA.

IRENA (2015), Renewable Energy Prospects: Germany, REmap 2030 analysis. International Renewable Energy Agency (IRENA), Abu Dhabi, www.irena.org/remap

IRENA. 2017. INSPIRE-Featured Dashboard**.** **http://resourceirena.irena.org/gateway/dashboard/**

IRENA. 2018. Coallition for Action. Community Energy: Broading The Owneship of Renewables

International Renewable Energy Agency (IRENA) & Clean Energy Ministerial (CEM) . 2015.. Renewable Energy Auctions – A Guide to Design http://www.irena.org/menu/index.aspx?mnu=Subcat&PriMenuID=36&CatID=141&SubcatID=603

Moriss, C. 2016. Grid prices in Germany rise faster than renewables. https://energytransition.org/2016/11/grid-prices-in-germany-rise-faster-than-renewables/

Neddermann, B, & SchorerLand, T. 2015. Requirement Values for Wind Farm**s** Poster 9.5 Proceedings DEWEK 2015 – 12th German Wind Energy Conference – 19-20 May 2015, Bremen.

Oltermann, P. 2016. Germany takes steps to roll back renewable energy revolution. https://www.theguardian.com/environment/2016/oct/11/germany-takes-steps-to-roll-back-renewable-energy-revolution

Seyfang, G & Smith, A. 2007. Grassroots Innovations for Sustainable Development: Towards a New Research and Policy Agenda. Environmental Politics, Vol. 16, No. 4: 584 – 603 http://www.tandfonline.com/doi/abs/10.1080/09644010701419121 (Accessed: 03/07/2017).

Sovacool,B.K. The history and politics of energy transitions: Comparing contested views and finding common ground. Working Paper 8. United Nations University World Institute for Development Research. https://www.econstor.eu/handle/10419/146275 (Accessed: 10/05/2017)

Wasserman, S., Hauser, W., Klann, U., Nienhaus, K., Reeg, M., Rhiel,B., Weimer-Jehle,. W. 2012. Renewable Energy Policies in Germany: Analysis of Actors & New Business Models as a reaction to the redesign and adjustment of policy instruments. https://www.researchgate.net/publication/312157222_RENEWABLE_ENERGY_POLICIES_IN_GERMANY_ANALYSIS_OF_ACTORS_AND_NEW_BUSINESS_MODELS_AS_A_REACTION_TO_THE_REDESIGN_AND_ADJUSTMENT_OF_POLICY_INSTRUMENTS

WWEA.2016. Headwind and Tailwind for Community Power: Community wind Perspectives from North-Rhine Westphalia and the World. February. World Wind Energy Association (WWEA) Paper Series. Bonn: WWEA

World Wind energy Association (WWEA). 2016. Headwind and Tailwind for Community Power: Community wind Perspectives from North-Rhine Westphalia and the World. February. World Wind Energy Association (WWEA) Paper Series. Bonn: WWEA.

World Wind Energy Association

World Wind Energy Association e.V.

Charles-de-Gaulle-Str. 5
53113 Bonn
Germany

Tel: +49-228-36940-80
Fax: +49-228-36940-84

wwindea.org
community.wind
small-wind.org