

**Influence of the German Renewable Energy and Climate Policies on  
Onshore Wind Energy Generation:  
*Implementation Options in Cameroon***

A thesis approved by the Faculty of Environmental Sciences and Process Engineering at the Brandenburg University of Technology in Cottbus-Senftenberg in partial fulfilment of the requirement for the award of the academic degree of Doctor of Philosophy (Ph.D.) in Environmental Sciences.

By

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**Einfluss der Deutschen Erneuerbar Energie- und Klimapolitik auf die  
Inland-Windenergieerzeugung:**

***Umsetzungsmöglichkeiten in Kamerun***

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## DECLARATION

I hereby declare that this dissertation is the result of my original research carried out at the Brandenburg University of Technology (BTU) Cottbus - Senftenberg, Germany within the framework of the PhD programme Environmental and Resource Management. I hereby admit that this dissertation has never been published by another person or submitted to any examination board for the award of any other degree. All the sources used have been duly acknowledged.

Emmanuel Wanki Ateghang

Cottbus, February 2016

## **DEDICATION**

I dedicate this research to my son, William Chitashi Campilan, and my late mum, Margaret Ngum. They have been my prime source of motivation and my quintessence of success.

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## ABSTRACT

The German government has set ambitious targets for wind energy expansion and has implemented policy schemes aimed at facilitating market deployment of wind-generated electricity. Data on German wind energy market has shown that, wind energy generating capacity is increasing correspondingly towards the targeted values. Germany is the largest wind energy market in the EU (wind energy accounting for about 10% of the total electricity consumption in Germany) with an installed capacity of about 38.2 GW onshore by the close of 2014. The success of these policies has prompted other countries globally to adopt similar support schemes for renewable energies. However, the rapid growth of wind energy generation in Germany equally faces numerous challenges. Some of these problems are inherent to the wind energy technology while others are caused by the very policies instruments used to support wind energy expansion, such as limited availability of designated areas for wind energy development, non-uniform regulations, and rising prices. The objective of this research, therefore, is to assess the impact of the German energy and environmental policies on onshore wind energy development and to explore implementation options of the German model in Cameroon.

This research has examined the German onshore wind energy sector from a policy perspective based on existing literature, semi-structured interviews with major stakeholders, a case study of Brandenburg and a survey, with the aim of investigating the acceptance of wind energy and challenges the developers are facing.

Based on the study results, it can be affirmed that the future growth of the German onshore market will come from flexible government policies, which may offer fewer incentives to investors. Indeed, the cost of electricity from renewable energy technologies in Germany is in some cases already below retail rates. There is the need, therefore, to pursue strategic programmes that enhances market integration of wind energy. Furthermore, the study results equally shows that the German feed-in tariff based support scheme in its current form, cannot be implemented in Cameroon. This is because, the purchasing power of the Cameroonian population and the economic constraints of the government, makes it difficult or even impossible to adopt the current EEG model in Cameroon where often, basic needs are subsidized.

## ZUSAMMENFASSUNG

Die Bundesregierung hat sich für den Windenergieausbau ehrgeizige Ziele gesetzt. Deutschland verfügt über einen großen und stetig wachsenden erneuerbaren Energiemarkt, gefördert durch das Erneuerbare-Energien-Gesetz (EEG), welches risikoarme Investitionen in Windenergie ermöglicht. Deutschland ist der größte Windenergiemarkt in der Europäischen Union (EU) und der drittgrößte weltweit mit einer installierten Leistung von etwa 38.2 GW. Allerdings gibt es viele Herausforderungen für den Ausbau von Windenergie, wie die begrenzte Verfügbarkeit von ausgewiesenen Gebieten für Windenergieerzeugung und die steigenden Strompreise. Das Ziel dieser Arbeit ist es, die Auswirkungen der deutschen erneuerbaren Energie- und Klimapolitik auf Onshore-Windenergieerzeugung zu bewerten und die Umsetzungsmöglichkeiten des deutschen Modells in Kamerun untersuchen.

In diese Arbeit wird die deutsche Onshore-Windenergiebranche aus politischer Sicht auf der Grundlage bestehender Literatur, strukturierten Interviews mit wichtigen Akteuren, einer Fallstudie in Form einer Umfrage im Bundesland Brandenburg mit dem Ziel, die Akzeptanz von Windanlagen zu untersuchen und die Umsetzungsoptionen des deutschen Modells in Kamerun zu erkunden untersucht.

Basierend auf den Ergebnissen der Arbeit kann bestätigt werden, dass das zukünftige Wachstum des deutschen Onshore-Windenergiemarkts mit Hilfe von flexibler Marktinstrumente ermöglicht wird, die möglicherweise weniger Anreize für Investoren anbieten. Tatsächlich sind die Kosten für Stromerzeugung aus Onshore-Windenergie in Deutschland zurzeit so günstig, dass sie manchmal unter dem Börsenstrompreis liegen. Darüber hinaus zeigen die Ergebnisse der Arbeit, dass ein auf Einspeisevergütung gestütztes Fördersystem in seiner in Deutschland realisierten Form in Kamerun nicht umsetzbar ist. Dies liegt daran, dass die Kaufkraft der kamerunischen Bevölkerung und die wirtschaftlichen Zwänge der Regierung es schwierig oder sogar unmöglich machen, das EEG-Modell in Kamerun umzusetzen.

## LIST OF ABBREVIATION

<b>ABBREVIATION</b>	<b>MEANING</b>
AEE	Agentur für Erneuerbare Energien (Agency for Renewable Energies)
AER	Agence d'Electrification Rurale (Rural Electrification Agency)
AfDB	African Development Bank
ALUCAM	Aluminium Du Cameroun (Cameroon Aluminium Company)
ARE	Alliance for Rural Electrification
ARSEL	Agence de Régulation du Secteur de l'Electricité (Electricity Sector Regulatory Agency)
BAFA	Bundesamt für Wirtschaft und Ausfuhrkontrolle (Federal Office of Economics and Export Control)
BauGB	Baugesetzbuch (Federal Building Code)
BauNVO	Baunutzungsverordnung (Federal Building Ordinance)
BayBO	Bayerische Bauordnung (Bavarian Building Regulation)
BbgBO	Brandenburgische Bauordnung (Brandenburg Building Code)
BBSR	Bundesinstitut für Bau-, Stadt- und Raumforschung (Federal Institute for Research on Building, Urban Affairs and Spatial Development)
BDEW	Bundesverband der Energie- und Wasserwirtschaft (German Association of Energy and Water Industries)
BEE	Bundesverband Erneuerbare Energie (German Renewable Energy Federation)
BImSchG	Bundes-Immissionsschutzgesetz (Federal Immission Control Act)
BImSchV	Verordnung zur Durchführung des Bundes-Immissionsschutzgesetzes (Ordinance on approval process of the Federal Immission Control Act)
BMU	Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit (Federal Ministry of Environment, Nature Conservation and Nuclear Safety)
BMVBS	Bundesministerium für Verkehr, Bau und Stadtentwicklung (Federal Ministry of Transport, Building and Urban Development)
BMWi	Bundesministerium für Wirtschaft und Energie (Federal Ministry of Economy and Energy)
BNatSchG	Bundesnaturschutzgesetz (Federal Nature Protection Act)
BNetzA	Bundesnetzagentur (Federal Network Agency)
BWE	Bundesverband WindEnergie (German Wind Energy Association)
BW-LBO	Baden-Württemberg Landesbauordnung (Building code of the federal state of Baden-Württemberg)
CDM	Clean Development Mechanism
CEEPA	Centre for Environmental Economics and Policy in Africa
CFCs	Chlorofluorocarbons
CH <sub>4</sub>	Methane
CIA	US Central Intelligence Agency
CO <sub>2</sub>	Carbon dioxide

COP	Conference of Parties
CPDM	Cameroon People's Democratic Movement
CREF	Cameroon Renewable Energy Fund
dena	Deutsche Energie-Agentur (German Energy Agency)
DESTATIS	Statistische Bundesamt (Federal Office of Statistic)
DIBt	Deutsches Institut für Bautechnik (German Institute for Construction Technique)
DIW	Deutsches Institut für Wirtschaftsforschung (German Institute for Economic Research)
DNR	Deutsche Naturschutzring (German League for Nature, Animal and Environment Protection)
DPDC	Dibamba Power Development Company
DRC	Democratic Republic of Congo
EC	European Commission
EDC	Electricity Development Corporation
EEG	Erneuerbare-Energien-Gesetz (Renewable Energy Sources Act)
EEX	European Energy Exchange
EIA	Environmental Impact Assessment
EU	European Union
FE	Final Energy
FFH	Fauna-Flora Habitat
GDP	Gross Domestic Product
GESP	Growth and Employment Strategy Paper
GG	Grundgesetz (German Basic Law or German Constitution)
GHG	Greenhouse gas
Gt	Giga ton
GVA	Gross Value Added
GW	Gigawatts
GWh	Gigawatthour
GWP	Global warming potential
HCFCs	Hydrochlorofluorocarbons
HEP	Hydroelectric power
H-F	Havelland-Fläming
HFCs	Hydrofluorocarbons
IMF	International Monetary Fund
INDCs	Nationally Determined Contributions
IPCC	Intergovernmental Panel on Climate Change
IPP	Independent Power Producer
ISE	Fraunhofer Institute for Solar Energy Systems



IWES	Fraunhofer Institute for Wind Energy and Energy System Technology
km	kilometer
km/h	kilometres per hour
KPDC	Kribi Power Development Company
kV	kilovolt
KW	kilowatt
kWh	kilowatt-hour
LEP B-B	Landesentwicklungsplan Berlin-Brandenburg (Berlin-Brandenburg State Development Plan)
L-S	Lausitz-Spreewald
LUGV	Landesamt für Umwelt, Gesundheit und Verbraucherschutz (Brandenburg Agency Environment, Health and Consumer Protection)
MINEE	Ministère de l'Eau et de l'Energie (Ministry of Energy and Water Resources)
MINFI	Ministry of Finance
MNR	Ministry of Natural Resources (Canada)
MOP	Meeting of the Parties
MW	Megawatt
MWh	Megawatthour
N <sub>2</sub> O	Nitrous oxide
NEP	Netzentwicklungsplan (Grid Development Plan)
NIMBY	Not-In-My-Back-Yard
NREAP	National Renewable Energy Action Plan
NWCC	National Wind Coordinating Collaborative (U.S. consensus-based collaborative)
O-S	Oderland-Spree
OVG	Oberverwaltungsgerichts (Higher Administrative Court)
PDER	Plan Directeur d'Electrification Rurale (Rural Electrification Master Plan)
PDSE	Plan de Développement du Secteur de l'Electricité (Electricity Sector Development Plan)
PE	Primary energy
PFCs	Perfluorocarbons
P-O	Prignitz-Oberhavel
ppm	Parts of the atmosphere per million
PRSP	Poverty Reduction Strategy Paper
PV	Photovoltaics
RegBkPIG	Gesetz zur Regionalplanung und zur Braunkohlen- und Sanierungsplanung (Law on Regional Planning, Brown Coal and Rehabilitation Planning)
REN21	Renewable Energy Policy Network for the 21 <sup>st</sup> Century
ROG	Raumordnungsgesetz (Regional Planning Act)
RPG	Regionale Planungsgemeinschaft (Regional Planning Board)

SAC	Structural Adjustment Credit
SDL	Systemdienstleistungsbonus (System Service Bonus)
SF <sub>6</sub>	Sulphur hexafluoride
SONEL	Société Nationale d'Electricité (National Electricity Company)
SPA	Special Protected Areas
StromEinspG	Stromeinspeisungsgesetz (Electricity Feed-in Act)
TAK	Tierökologischen Abstandskriterien (Ecological Distance Criteria)
TSO	Transmission System Operator
TW	Terawatt
TWh	Terawatthour
U-B	Uckermark-Barnim
UBA	Umweltbundesamt (Federal Environmental Agency)
UEIA	US Energy Information Administration
UNFCCC	United Nations Framework Convention on Climate Change
US	United States
UVPG	Umweltverträglichkeitsprüfungsgesetz (Environmental Impact Assessment Act)
VwVfG	Verwaltungsverfahrensgesetz (Administrative Procedures Act)
VZBV	Verbraucherzentrale Bundesverband (Federation of German Consumer Organisations)
WBGU	Wissenschaftliche Beirat der Bundesregierung Globale Umweltveränderungen (German Advisory Council on Global Change)
WE	Wind Energy
WEC	World Energy Council
WT	Wind Turbine

### **CONVERSION TABLE**

Kilo	= k	= 10 <sup>3</sup>
Mega	= M	= 10 <sup>6</sup>
Giga	= G	= 10 <sup>9</sup>
Tera	= T	= 10 <sup>12</sup>
Peta	= P	= 10 <sup>15</sup>
Exa	= E	= 10 <sup>18</sup>
Watt	= W	For power and electricity

# 1 INTRODUCTION

## 1.1 GENERAL STATEMENT

The German energy policy is governed by three basic principles; namely, security of energy supply, competition in supply, and environmental protection (Knopp, 2008). An instrument used by the German Government to achieve its energy policy objectives is the Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz - EEG).<sup>1</sup> The purpose of the EEG is “to facilitate a sustainable development of energy supply, to reduce the costs of energy supply to the national economy, also by incorporating external long-term effects, to conserve fossil fuels and to promote the further development of technologies for the generation of electricity from renewable energy sources”.<sup>2</sup> The push to deploy and expand the use of renewable energies in Germany is aimed, in turn, at achieving its climate policy obligations.

Energy supply networks have been in transition since the early 1990s. Ambitious national and international climate protection objectives have raised the political profile of energy strategies, introducing systematic resource management of energy supply. Climate policies have been very instrumental in the upward trend of renewable energies (Monstadt, 2000). Germany has become one of the world’s leading wind energy producers over the past twenty years (BWE, 2011).<sup>3</sup> Wind energy development and utilization is entering a new phase of existence. In the previous phases, focus was on scaling up domestic generating capacity of wind. With the costs of electricity from wind turbines far from cost competitiveness then, Germany established a policy design that provided impetus for rapid scale-up of wind energy generating facilities. The next phase marks an evolution of German wind generated electricity toward “grid parity” where government policy is more flexible and may offer fewer incentives to investors. Indeed, in terms of “grid parity”, the cost of electricity from renewable energy technologies in Germany is in some cases already below retail rates<sup>4</sup> (Fulton, et al., 2012; Müsgens & Grothe, 2013). With the shift in paradigm from the scaling up of wind electricity generating facility towards consolidation and attainment of grid parity, there is the need therefore to pursue strategic programs that facilitate the market integration of these technologies.

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<sup>1</sup> Renewable Energy Sources Act in the version promulgated on 21<sup>st</sup> July 2014 (Federal Law Gazette I p. 1066), last amended by Article 1 of the Act of 22<sup>nd</sup> December 2014 (Federal Law Gazette I p. 2406).

<sup>2</sup> The purpose of the EEG is defined in §1 para. 1 EEG.

<sup>3</sup> BWE is the German Wind Energy Association (Bundesverband Windenergie e.V - BWE).

<sup>4</sup> Particularly large capacity wind energy installations and small photovoltaic systems.

While the electricity sector in Germany is facing huge challenges in terms of environmental and climate protection, the situation in a developing country like Cameroon is different. The major challenges of the electricity subsector in Cameroon are those of quantity and quality of supply. Electrification rate in Cameroon is relatively low and supply is insufficient to meet national demand (World Bank, 2014). Furthermore, electricity installations are old, inefficient, and dilapidating because of poor or in many cases lack of maintenance. These have led to constant blackouts and rationing over long periods of the day since 2001 (Journalism++, 2013; Pineau, 2005). This result to low industrial output and the reluctance of foreign investors to invest in an otherwise potentially lucrative country like Cameroon.

## **1.2 SIGNIFICANCE OF RESEARCH**

In-depth studies on the impact of energy and environmental policies on renewable energy development in general and wind energy in particular is a significant research area for five main reasons.

Firstly, the importance of properly protecting the natural environment for survival and improve quality of life makes a proper policy system a vital issue. One major tool used by the German government to achieve its environmental and energy objectives is the intensive development of renewable energy facilities. Hence, to assess the success of these policies, a review of their impacts would be very significant.

Secondly, a well-defined energy and environmental policy is important for social and economic reasons because they are often an arena for intense political and social conflict, and a significant influence on business activity. In addition to the environmental aspects of the energy and environmental policies, their economic perspectives are of major significance. There is intensive capital investment in research and development of new technologies (renewable energy technologies) for environmental protection. These huge investments have played a major role in job creation and economic turnover.

Thirdly, the effectiveness of policy objective is difficult to evaluate because of the maze of legal and scientific complexities - including large gaps in information and technology uncertainty (Mallon, 2006). A successful evaluation of these policy frameworks would be of major significance.

Furthermore, possibilities of knowledge transfer to developing countries are relatively rarely attempted. Many are times in which technologies have been introduced into developing countries without proper knowledge of the prevailing cultural and administrative structure.

This has most often resulted to failures in the breakthrough of these technologies in these countries which otherwise should have been very successful. Furthermore, wind energy is already competitive under certain conditions<sup>5</sup> compared to conventional generation methods. A study on policy framework with respect to renewable energies - wind energy in particular<sup>6</sup> - potential in Cameroon would be very important to evaluate the possibility of implementing such a technology.

Last but not the least, the significance of this topic is that evaluating whole or selected parts of a policy framework is an integral component of wider government policy cycles and planning processes. Contextually, a policy is a position taken and communicated by government that recognises a problem and states in general what will be done about it. A policy must therefore, be accepted by the society. Change would be very difficult to effect if the society is not ready for it (Mallon, 2006). Policy processes are usually based on a cyclical process with four major stages: problem-framing, policy-framing, policy implementation, and policy monitoring and evaluation. Evaluating the effectiveness of a policy framework makes an essential contribution to the system constantly evolving and changing in response to new information (Dovers, 2005). Just as the environment, society and life are continuous and constantly changing, this is an ongoing and difficult task with no endpoint or final solution.

### **1.3 MOTIVATION**

Global climate change is a menace that is already having initial discernible impacts upon humankind and nature. According to the German Advisory Council on Global Environmental Changes (Wissenschaftliche Beirat der Bundesregierung Globale Umweltveränderungen - WBGU), the highly ambitious global climate protection goals will not be able to entirely prevent or counteract all the consequences of global warming (WBGU, 2009). The effects of climate change are already noticeable in most continent of the world (see section 1.3.1 for impacts in Germany), and they will continue to increase if no counter measures are taken (IPCC, 2013). These impacts include rising sea levels, increased extreme weather events such as hurricanes, accelerated loss of biodiversity and ecosystems, acidification of oceans, and increase rate of desertification. Owing to the inertia of the climate system, these developments can no longer be prevented entirely. These adverse effects are already

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<sup>5</sup> At good onshore locations, it is possible to generate electricity from wind energy economically. However, the hub height has to be very high, up to 200 meters high today. As a rule of thumb, approximately 1% increase in yield per meter hub increase (Lütkehus & Salecker, 2013).

<sup>6</sup>Wind is the most advanced of all renewable energy technologies. The technology keeps rapidly improving, and costs of generation from onshore wind installations have continued to fall. It can already be competitive where wind resources are strong and financing conditions are favourable (Müsgens & Grothe, 2013).

profound in developing countries particularly, with the most vulnerable groups such as the poor being the hardest hit (IPCC, 2014).

After the climate change meeting in Montreal,<sup>7</sup> the scientific case for anthropogenic climate change is complete and very compelling. The debate is not whether climate change is happening, rather how quickly. The causes, development and future projections of carbon dioxide (CO<sub>2</sub>) emission and climate change are summarized in the five consecutive reports<sup>8</sup> of the Intergovernmental Panel on Climate Change (IPCC). Atmospheric CO<sub>2</sub> has increased since the pre-industrial era from about 280+/- 10 parts of the atmosphere per million (ppm) around 1750, at first slowly and then progressively faster to a value of 367ppm in 1999 (IPCC, 2001a). Global data from Mauna Loa, Hawaii and South Pole shows that CO<sub>2</sub> has risen continuously since then, reaching to 390.5 ppm in 2011 (IPCC, 2013). During the pre-industrial era, variations in CO<sub>2</sub> concentrations were between 260 ppm and 280 ppm and never exceeded 300 ppm. Since 1959 when the first and continuous measurement of atmospheric CO<sub>2</sub> were made, it has been confirmed that the atmospheric concentration of CO<sub>2</sub> is increasing because of anthropogenic CO<sub>2</sub> emissions (WBGU, 2009). CO<sub>2</sub> emissions from fossil fuel combustion and industrial processes contributed about 78 % of the total GHG emission increase from 1970 to 2010 (IPCC, 2013).

Rise of greenhouse gas<sup>9</sup> (GHG) concentrations in the atmosphere leads to global warming,<sup>10</sup> which is responsible for climate change. The WBGU reported that if global warming exceeds the mean temperature of 2°C, it would lead to precarious, irreversible, and practically uncontrollable consequences for both humanity and nature (WBGU, 2009). In order to prevent this, cumulative CO<sub>2</sub> emission until 2050 needs to be capped at 750 Giga tons (Gt). Cumulative anthropogenic CO<sub>2</sub> emissions between 1750 and 2011 were 555 Gt, of which around 43% has accumulated in the atmosphere, 28% in the oceans, and 29% in natural terrestrial ecosystems (IPCC, 2014). Based on the amount of GHGs that has already been emitted by humans, the present composition of the atmosphere would in the long-term

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<sup>7</sup> Eleventh Session of the Conference of the Parties (COP 11) to the UNFCCC and First Meeting of the Parties to the Kyoto Protocol in Montreal (COP/MOP 1), Canada from November 28 to December 10, 2005 (UNFCCC, 2006).

<sup>8</sup> Issued in 1992, 1995, 2001, 2007 and 2014.

<sup>9</sup> Greenhouse gases include: carbon dioxide (CO<sub>2</sub>); methane (CH<sub>4</sub>); nitrous oxide (N<sub>2</sub>O); hydrofluorocarbons (HFCs); perfluorocarbons (PFCs); sulphur hexafluoride (SF<sub>6</sub>); chlorofluorocarbons (CFCs) and hydro chlorofluorocarbons (HCFCs).

<sup>10</sup> Each greenhouse gas has a different capacity to cause global warming, depending on its radiative properties, molecular weight and the length of time it remains in the atmosphere. The global warming potential (GWP) of each gas is defined in relation to a given weight of carbon dioxide for a set period (usually 100 years). GWPs are used to convert emissions of greenhouse gases to a relative measure (known as carbon dioxide equivalents: CO<sub>2</sub>-equivalents). The GWP of GHGs currently used are carbon dioxide = 1, methane = 34, nitrous oxide = 298, and sulphur hexafluoride = 22800; hydrofluorocarbons and perfluorocarbons comprise a large number of different gases that have different GWPs (IPCC, 2013).

lead to global warming of 1.3°C; there is so far an observable global warming of 0.8°C (WBGU, 2009). Hence, prevention of climate change within the meaning of the objective of the United Nations Framework Convention on Climate Change (UNFCCC) is to stabilize the amount of CO<sub>2</sub> emissions within a given period and at a level that would prevent dangerous anthropogenic interference with the climate system (UNFCCC, 2011).<sup>11</sup>

In order to reach a new universal climate agreement that is applicable to all, the twenty-first session of the Conference of the Parties (COP21) and the eleventh session of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol took place in Paris, France from 30<sup>th</sup> November to 11<sup>th</sup> December 2015. Prior to the conference, the parties agreed to set a goal of limiting global warming to less than 2°C compared to pre-industrial levels (UNFCCC, 2009; WBGU, 2009).<sup>12</sup> In line with this target, the Climate Change Conferences in Warsaw, Poland, in 2013 and Lima, Peru, in 2014 enabled essential progress towards COP21 in Paris. All the States were requested to submit their Intended Nationally Determined Contributions (INDCs) towards reducing greenhouse gas emissions ahead of COP21.<sup>13</sup> On 3<sup>rd</sup> December 2014, the German cabinet adopted the Climate Action Programme 2020. The goal of the German Government, according to the programme, is to cut its GHG emissions by at least 40% compared with 1990 (BMU, 2014). In 1990, about 1,250 million tonnes CO<sub>2</sub> equivalent were emitted; the target for 2020 is therefore 750 million tonnes. According to the latest estimates, Germany emitted about 912 million tonnes CO<sub>2</sub> equivalent in 2014 (BMU, 2015). This equates to a reduction of about 27% relative to 1990. The conference negotiated the so-called Paris Agreement.<sup>14</sup> The agreement will become legally binding if joined by at least 55 countries, which together represent at least 55% of global greenhouse emissions (UNFCCC, 2015).<sup>15</sup>

The challenges of climate protection are connected and inseparable with the ever-increasing demand for energy worldwide. Globally, the energy sector is the highest emitter of GHGs, which have been identified as the major culprits in climate change (Mallon, 2006; IPCC, 2014). Global energy consumption has increased rapidly in the last 50 years and is expected

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<sup>11</sup> Article 2 of UNFCCC: The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a period sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.

<sup>12</sup> The Climate Change Conference in Copenhagen, Denmark (COP15/CMP5) recognised the common objective of keeping the increase in global temperature below 2°C.

<sup>13</sup> Decisions 1/CP.19 and 1/CP.20 paragraph 2b of the COP.

<sup>14</sup> Document FCCC/CP/2015/L.9/Rev.1.

<sup>15</sup> Through ratification, acceptance, approval, or accession.



to continue in the next 50 years. However, significant differences are expected to be seen between the last 50 years and the next. The past increase was caused by increased rates of industrialization in North America, Europe, and Japan; and relatively cheap fossil fuels; while the picture for the future has been made more complex by the fact that, while energy demand/consumption in these countries is expected to stabilize,<sup>16</sup> additional factors have entered the equation (UEIA, 2013). These additional complicating factors include the very rapid increase in energy intensity of newly industrialized countries, the expected depletion of fossil fuel resources in the near future, and the global climate change (Yogi & Kreith, 2008).

Policy-makers are looking for ways to slash emissions and the need for effective renewable energy policy-making is becoming ever more important. Arguably, continuing to build more power plants that push tons of carbon into the atmosphere is a gross act of suicide, and renewable energies are the best option we have so far; they are safe, secure, scalable, and sovereign forms of energy supply. If they meet our future energy needs in due course, that is wonderful. However, if they do nothing more than just buy us more time while better technologies are evolve, that is equally good. In both ways, we still have the same urgent need for renewable energy development. Quote from a prominent renewable energy activist and scholar - Karl Mallon (2006) - says:

*“I offer this comfort which doubles as a caution: whatever happens, the human race appears destined to achieve a low-emission future, either through a new industrial revolution which will include renewable energies, or through economic depletion and collapse, as the cost of climate impacts unrelentingly takes their toll. The outcome for the global atmosphere may be the same...”*

Humanity already possesses effective technical and industrial expertise to redress the carbon and climate problem. These include, among others: the introduction of renewable energy technologies, efficient end use of electricity and efficiency in our transport systems.

Renewable energy technologies have deployed rapidly in Germany since 1990 largely because of environmental and energy policies adopted by the federal government and the European Union (EU). For example, installed wind energy capacity has grown by more than

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<sup>16</sup> The U.S. Energy Information Administration (UEIA) projects in its International Energy Outlook 2013 that growth in world energy use will come from countries outside of the Organization for Economic Cooperation and Development (OECD). Between 2010 and 2040, primary energy use per capita is expected to change little from its 2010 level of 196 million British thermal units in the OECD but grows from 50 million British thermal units to 73 million British thermal units per capita in non-OECD countries (UEIA, 2013).



2,000% since 1990, biomass by more than 500%, and solar photovoltaic installations by more than 15,000% (Runci, 2005). While the 1990 baseline for each of these technologies is low, the steady rise of renewable energy in Germany has been phenomenal. According to the German Federal Ministry of Economy and Energy (Bundesministerium für Wirtschaft und Energie - BMWi), the Federal Government plans target 80% by 2050 (BMWi, 2012). The majority of this renewably generated electricity is expected to come from wind energy. In terms of actual watts of electricity generated, wind energy generation has experienced the most rapid growth of all the renewable energy resources available in Germany (BMU, 2011).

### **1.3.1 IMPACTS OF CLIMATE CHANGE IN GERMANY**

In Germany, the annual average temperature increased by about 0.8 to 1.0°C between 1900 and 2000. However, this warming did not occur linearly. During 1900 to 2000, temperature increase during spring, summer, autumn and winter was 0.8°C, 1.0°C, 1.1°C, and 0.8°C, respectively (Zebisch, et al., 2005). The probability of occurrence of heat days in the months of July and August has risen over the last one hundred years, and especially markedly during the last twenty years at almost all weather stations in Germany. The number of ice days, however, has not changed significantly. The probability of occurrence of an extremely hot summer, such as in the year 2003, increased in the course of the 20<sup>th</sup> century by more than a factor of 20. Nevertheless, 2003 was an extraordinary year even for today's standards. It was the hottest year in Germany since the beginning of weather recording. With summer temperatures of 3.4°C above the 30-year mean, 2003 also exhibited the strongest summer anomaly. Moreover, the year 2003 was exceptionally dry. The continuing long-term dry phase between February and August was extraordinary (Zebisch, et al., 2005).

Annual average precipitation increased by 9% between 1900 and 2000. In this period, precipitation decreased slightly in the summer (by 3%). During spring, autumn, and winter precipitation increased by 13%, 9%, and 19%, respectively. The intensity and frequency of occurrence of extreme rainfall events increased especially during the last forty years of the 20th century. In general, this trend is more pronounced in the winter than in the summer (Zebisch, et al., 2005). Snow days in Germany has decreased uniformly at a rate of 0.5 days per year during 1950 to 2000. Since 1950, a decrease by 30 to 40% in the duration of snow cover has been observed in altitudes below 300m in Bavaria and Baden-Württemberg. In the medium altitudes (300 to 800m), the decrease was 10 to 20%. In higher altitudes over 800m, only small decreases were observed, due to increased winter precipitation and sufficiently low temperatures for snowfall (Zebisch, et al., 2005). About wind speed, there is

a tendency of increased probability of occurrence of extremely high daily wind speed maxima (greater than 17m/s) during winter, and decreased occurrence of such maxima in summer (Zebisch, et al., 2005).

## **1.4 PROBLEM FORMULATION**

The rapid growth of wind energy generation equally faces numerous problems, which if not dealt with could hinder or even stop further expansion of this technology in Germany. Some of these problems are inherent to the wind energy technology while others are caused by the same policies that are meant to promote renewable energies.

### **1.4.1. DISTORTED COMPETITION**

The competitive situation between conventional energy generation forms and renewable energies is strongly distorted in the reality. The price development mechanism for electricity from fossil energy carriers does not take into consideration the economic and ecologic consequences of the threatening global warming (Wanki & Zschiegner, 2014). The direct costs and the cost of the necessary measures to address global warming are not components of the electricity price in the market. They meet the consumer nevertheless in form of taxes, which are used also in this sense as a measure against global warming. Same applies to electricity from nuclear power plants. Cost on risk management and disposal of nuclear waste is regularly not directly incorporated into the electricity pricing policy, but will ultimately be co-financed through tax revenues (BWE, 2012; Wanki & Zschiegner, 2014). As a result, there exists a de facto artificial splitting of the electricity price into the pure production cost on one side and the external costs on the other. Only the production cost is regularly taken into account in the competitive price of fossil generated electricity.

The situation is different with renewable energies.<sup>17</sup> There is no such artificial splitting of the price. The electricity price is rather the sum total of the costs of the generation and the costs of the necessary subsequent measures. This is so because the use of renewable energies is already designed according to their principle to cause as few as possible to no negative environmental effects in the course of their generation. In this respect, possible negative environmental effects that could offset price intensity have already been eliminated. In addition, the licensing requirements for renewable electricity generation projects provide that, permission is granted only if the operator takes over a decommissioning obligation.<sup>18</sup>

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<sup>17</sup> Renewable energies according to the legal definition in § 5 No. 14 EEG 2014, are hydropower including wave and tidal, wind energy, solar energy, geothermal and biomass energy including biogas, landfill gas and sewage gas as well as the biodegradable fraction of waste from households and industry.

<sup>18</sup> According to §35 para. 5, sentence 2 and 3, of the Building Code (BauGB).

That is, the financial obligation of an unproblematic removal of the installation at the end of its operation period for large renewable energy projects according to § 35 para. 5, sentence 2 and 3, of the Building Code (BauGB)<sup>19</sup> is a precondition for granting a construction permit. Therefore, the economic operation of the installation must immediately consider these costs from the onset, which would obviously influence the final price of the electricity. Unlike the conventional forms of energy generation, payment for electricity generated from renewable energy carriers is not limited only to the electricity generation costs, but also extensively covers the potential decommissioning cost from the onset.

#### **1.4.2. ELECTRICITY PRICE AND STORAGE FACILITIES**

The EEG is based on two fundamental ideas. First, it ensures that electricity generated from any renewable energy installation must be fed as a priority into the transmission grid system. Second, the EEG obliges the transmission system operator (TSO), regardless of price fluctuations in the electricity market, to pay fixed feed-in tariffs to the renewable energy installation operator for the electricity fed into the grid. The difference between the respective market price and the feed-in tariff will be refinanced through a surcharge on every kilowatt-hour (kWh) consumed by customers called EEG surcharge (see section 3.10) - particularly household costumers (Salje, 2014).

This problem is further exacerbated by two factors; first, when high-wind periods are met with periods of low electricity demand in the electricity market, the financial repercussions are crippling. During high-wind periods, operators of conventional power stations would have to disconnect their plants from the grid.<sup>20</sup> That is, fossil electricity generators would have to disconnect the large coal and nuclear power stations from the grid due to the statutory priority of renewable energies and the merit-order-effect.<sup>21</sup> However, the start-up and shutdown procedure is lengthy and expensive (dena, 2012; Mogren, 2010). With only a few hours of strong winds, it is often not worth the effort for the operator. As a result, the amount of electricity in the grid increases rapidly within a short period, prices plunge at the European Energy Exchange (EEX),<sup>22</sup> and electricity generators offer customers at the EEX money in

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<sup>19</sup> Federal Building Code in the version promulgated on 23<sup>rd</sup> September 2004 (Federal Law Gazette I p. 2414), last amended by Article 1 of the Act of 20<sup>th</sup> November 2014 (Federal Law Gazette I p. 1748).

<sup>20</sup> According to the priority given to renewable energies in the EEG.

<sup>21</sup> The merit-order-effect determines which electricity source sells first at the EEX. In principle, electricity from the source with the lowest marginal cost (cost of raw materials) is first sold. Electricity from renewable energy sources are first sold because of their low marginal cost (zero fuel cost).

<sup>22</sup> The European Energy Exchange – EEX – in Leipzig is the main market for selling and buying of energy products in Germany. EEX operates a market platform for a broad range of energy and related products: power, natural gas, CO2 emission rights and coal.

addition to the electricity, in order to take off the excess amount of electricity in the grid system (Dohmen & Reuter, 2010).

Second, the lack of storage facilities for excess electricity during periods of high-winds and low electricity demand. A perfect example of this situation was encountered in December of 2009. A huge storm concocted around the North Sea on Christmas day. Meteorologists recorded wind speeds of up to 90 kilometres per hour (km/h). At the same time on the EEX, dealers and customers registered a phenomenon that had long played a rather theoretical role. The price of electricity on the spot market turned within a few hours into negative territory. Anyone who purchased electricity during this period, received not only the electricity free, but also received a premium. Between 11:00 PM and 12:00 midnight approximately, a megawatt hour (MWh) of electricity was sold at minus €199. Few hours later, the price plunged to a day's low of minus €203. On this single day, a professional buyer's account could have been credited €14 million (Dohmen & Reuter, 2010). Generally, an excess of generation causes the system frequency to rise whilst an excess of demand causes the system frequency to fall (Auer & Keil, 2012). Therefore, when high-wind periods are met with periods of low electricity demand, excess electricity is fed into the grid, which is capacity deficient.<sup>23</sup> In 2009 alone, 127 GWh were lost - of which 98.7% was from wind energy - because grid operators had to shut down wind parks. Such losses increased compared to the previous year by 70%, but this accounted only for 0.34% of the injected wind power (Auer & Keil, 2012; World Economic Forum, 2013). Household costumers in Germany unfortunately do not benefit from these negative prices, rather they also pay for the loss. The feed-in tariffs paid by grid operators to renewable installation operators is passed-over to German household costumers even if the electricity is not consumed in Germany.

Meanwhile, the EEG surcharge on every kWh of electricity consumed has now risen to 5,277 cent/kWh in 2013 from 2,047 cent/kWh in 2010 (Übertragungsnetzbetreiber, 2013). Data on energy price trends from the German Federal Office of Statistic (DESTATIS) shows that electricity prices (household and industry) in Germany is among the highest in the EU (DESTATIS, 2014; Eurostats, 2013). Figures 1.1 and 1.2 below depict the trend and comparison of household and industrial electricity prices in six major EU member states.

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<sup>23</sup> See the section on the grid system above.

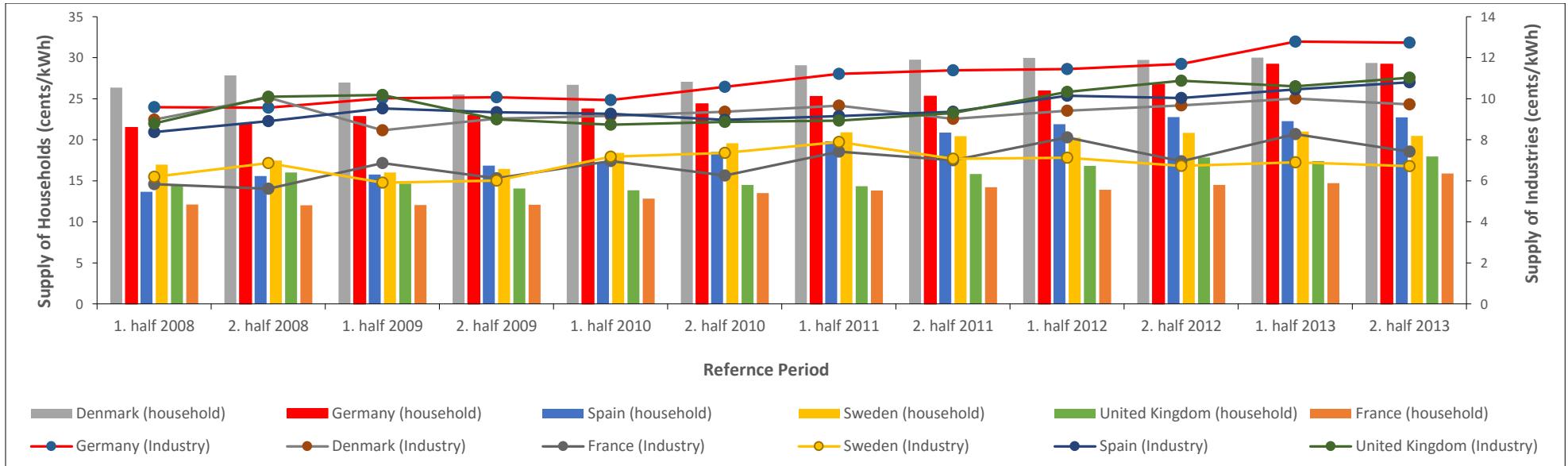


Figure 1.1: Electricity price trends of six major EU states, 2008-2013

Courtesy: Wanki, data from (DESTATIS, 2014)

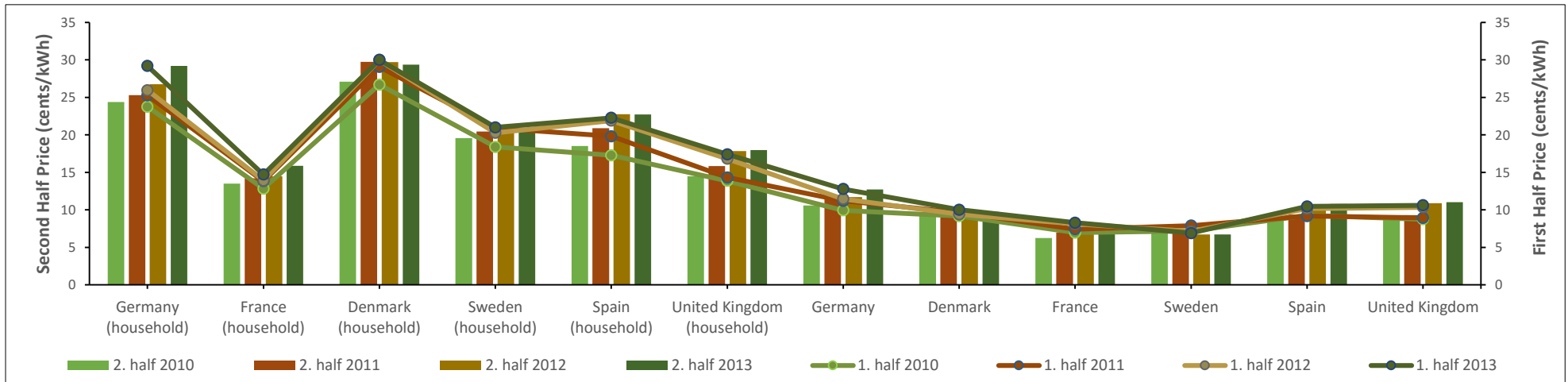


Figure 1.2: Comparison of household electricity prices in six major EU states

Courtesy: Wanki, data from (DESTATIS, 2014)

### **1.4.3. TRANSPARENCY AND ACCEPTANCE**

Although opinion polls regularly report a high level of public support for the expansion of renewables (VZBV, 2013),<sup>24</sup> acceptance of this technology dwindles regularly among certain segments of the population. This is caused mainly by the growing size of onshore wind parks; large investments – particularly for offshore projects – which inevitably end up in the electricity bills of households, accompanied by the negative impacts on the landscape. Furthermore, the increasing anonymization of investors affects the transparency of wind energy projects and consequently, social acceptance of wind energy projects. Additionally, the wind industry stakeholders should note that the acceptance of wind energy installations by a community does not depend alone on their convictions concerning climate change, but equally on the financial benefits that accompany these installations. For, a man will not say “yes” if paying his bills at the end of the month depends on him saying “no”.

### **1.4.4. LAND AVAILABILITY**

The first and most important component of wind park project is a location. Selecting a suitable site for a wind park is complex, time consuming, and involves multiple disciplines working on parallel paths. Financing, government permits, land use restrictions, land use plan and design are some of the major challenges that has to be completed before construction can begin. Onshore wind park construction projects are large and heavy in nature, which requires large land surfaces (Lütkehus & Salecker, 2013).<sup>25</sup> This feature of wind parks makes the process of suitable site selection for wind park development projects very complex and time consuming. This is mainly due to the potential impacts of wind parks on human health, on wildlife, on air transportation and to certain extend on military installations (radar stations).

### **1.4.5. LANDSCAPE INTRUSION**

The character and quality of landscapes help define the image of a region, its sense of place that differentiates it from other regions. It is the dynamic backdrop to people’s lives (Lütkes, 2011). The construction of windmills in the landscape (either singularly or as collections of windmills in wind parks), has, in some instances, raised community concerns about the

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<sup>24</sup> Federation of German Consumer Organisations (Verbraucherzentrale Bundesverband – VZBV).

<sup>25</sup> According to the directive “Wind Energy Facilities; Exposures and Stability Proofs for Tower and Foundation” of the German Institute for Construction Technique (Deutsches Institut für Bautechnik, DIBt), the minimum distance between two adjacent wind turbines depends on the siting with regard to the prevailing wind direction and the wind turbine type (DIBt, 2012). A common rule of thumb specifies three to five rotor diameters in cross wind directions and six to eight rotor diameters in main wind direction as a minimum spacing between the individual turbines. This feature of wind parks makes the availability of relatively large land surfaces for wind development projects very problematic.

appropriateness of their siting and their impact on landscapes. Both windmills and their ancillary infrastructure (electricity transmission lines, substations, and access roads) can affect the landscape character and scenery of a place. According to the Deutsche Naturschutzring (DNR), given the scale and size of wind turbines and wind farms, and their contrast with the landscapes in which they are developed, it is not surprising that their effects on scenic and character elements are perhaps the most contested of all values (DNR, 2005).

Due to the constant movement of the rotor blades in the field of view, the landscape dominated by clear horizontal lines loses the impression of calm (DNR, 2005). Individually, wind energy facilities generate minimal impact on the landscape. However, it is as collections of windmills in wind parks that wind energy facilities have the greatest potential impact on character and scenery. According to a study, the number of turbines are found to have a greater effect on landscape character than the size of windmills (Australian Wind Energy Association, 2007).

#### **1.4.6. IMPACT OF WINDMILLS ON AVIFAUNA**

Wind energy projects have the potential to affect birds directly (i.e. collision mortality) and indirectly (i.e. disturbance and avoidance). In order to maximize the potential of wind turbine, windmills should be built in open, exposed areas where there are high average wind speeds (Ratzbor, 2011; Everaert & Stienen, 2007). This means that they are often planned in upland, coastal, and offshore areas, thus potentially affecting important habitats of birds.

Direct Effects: Birds, particularly large predatory and migratory birds, may be injured or killed through collisions with turbine blades and towers, transmission wires and meteorological towers. For nocturnal birds, mortality may also arise from physical exhaustion associated with light-induced disorientation (DNR, 2005). Factors contribute significantly to avian mortality at wind energy projects are (DNR, 2005):

- Bird density in an area and their behaviours (e.g. flight displays)
- Landscape features especially ridges, valleys, and landforms such as peninsulas and shorelines that bridge bird movement.
- Poor weather conditions.

Indirect Effects: Birds may be displaced from suitable habitat by wind energy projects at any stage in their annual cycle. Displacement may be due to (DNR, 2005):

- Loss of feeding and breeding areas, or migratory stopovers, during construction and operation of wind parks.
- Active avoidance of structures, human activity, noise, or infrastructure.



Quality of breeding habitat may also be diminished by fragmentation effects (e.g. openings in contiguous habitat to accommodate turbines and transmission lines) that may lead to changes in predation and parasitism levels or to adverse effects on area-sensitive species. According to the Ministry of Natural Resources (MNR) Ontario - Canada, the extent of avoidance behaviour is species-specific, and may lead to reduced energy intake through lost feeding opportunities (MNR, 2011).

## **1.5 HYPOTHESIS FORMULATION**

The planning, approval, construction, and operation of wind energy projects in Germany are regulated at different levels, by different legal statutes and by different governmental institutions. This is because the different project stages lie under the responsibility of different federal state ministries or authorities<sup>26</sup> and these ministries are responsible for different state policies. At the federal level, the Federal Ministry of Economy and energy (BMWi) is responsible for the energy policy. This ministry is also in charge of the support for renewable energies. Environmental policy issues and the construction of energy generation installations are coordinated by the Federal Ministry of Environment, Nature Conservation, Building, and Nuclear Safety (BMU). Furthermore, the Federal State Governments bear the responsibility of implementing federal laws. They are also in charge of granting licences within their jurisdiction. The Federal States may also take their own measures in the field of energy policy. The cross-linkages between federal ministries and between federal government and Federal State authorities in wind energy projects put a high degree of interdisciplinarity on any research in such projects. This means responsible authorities have to work in conjunction with a variety of regulations, ordinances, and expert opinions. This constellation portrays the complexities involve in wind energy development and utilization.

This research therefore hypothesizes that the development of Wind energy - as well as other renewable energy sources - can only be promoted through the institution of various incentives (technical, socio-cultural, environmental, and above all economic) and corresponding control instruments, which minimise the impacts of wind energy projects on its immediate ecosystem.

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<sup>26</sup> According to §83 following of the German constitution.



## **1.6 RESEARCH QUESTIONS**

The research investigations are guided by the following questions:

- Are the adopted energy and spatial planning policies enough to enhance and control respectively the expected expansion of onshore wind energy in Germany?
- Does the development and use of wind energy in Germany play an important role in its economic and climate performance?
- How can social acceptance of wind energy projects be enhanced?
- Can the Renewable Energy Sources Act be a model for the deployment of renewable energy sources in Cameroon?

## **1.7 REASEARCH OBJECTIVES**

The following objectives are designed to address the problems identified and the research questions. To this effect, the research intends to:

1. Evaluate the EEG as a support instrument for wind energy development.
2. Assess the success of the German spatial planning policy as a control instrument for wind energy generation.
3. Quantify the economic and climatic effects of wind energy development.
4. Survey the acceptance of wind energy among the population in the Federal State of Brandenburg.
5. Explore possibilities of promoting the growth of renewable energy resources in general and wind energy in particular in Cameroon based on the German feed-in tariff model.
6. Offer recommendations for further actions.

## **2 RESEARCH METHODOLOGY**

### **2.1 GENERAL STATEMENT**

The success of wind energy cannot be reduced solely to technical or economic factors. The orientation of federal and federal states' policies and the wide acceptance of the technology among all relevant groups are of significant importance to the development of wind energy resources. The institutional framework conditions - which will contribute to achieving the development goals of wind energy - of the federal and federal states' governments must also be accepted and implemented by the regional, municipal, and local actors.

This chapter presents an explicit methodology of the research. The chapter accentuates the strategies used in collecting data. The research data is from primary as well as secondary sources. This chapter unriddles the approaches used in collecting primary data, which are qualitative and quantitative research approaches and provides an in-depth analysis of the instruments employed in both approaches of data collection. The chapter equally provides an insight into the case study area, which is the Federal State of Brandenburg in the Southeastern part of Germany. Analytical assessments of statutory texts as well as relevant secondary literature also constitute a major part of the methodology. The last section of this chapter gives an insight into the method of data analysis. This section shows that primary data collected was qualitatively (interviews) and quantitatively (questionnaires) analysed. The following sections provide an elucidation of the respective components of the research objectives.

### **2.2 RESEARCH APPROACH**

In carrying out this research, both qualitative and quantitative research methods were used. The key difference between these two methods is their flexibility. Typically, quantitative researches are inflexible. In quantitative methods such as questionnaires, for example, all participants are asked identical questions in the same order. Categorized responses from which participants may choose are "closed-ended" or fixed. The advantage of this inflexibility is that it allows for meaningful comparison of responses across participants and study sites. However, it requires a thorough understanding of the important questions to ask, the best way to ask them, and the range of possible responses. The data format in this case is predominantly numerical, obtained by assigning numerical values to responses.

Qualitative researches are generally more flexible. They allow greater ease and adaptation of the interaction between the researcher and the study personnel. Qualitative methods ask

mostly “open-ended” questions that are not necessarily worded in exactly the same way with each participant. With open-ended questions, participants are free to respond in their own words, and these responses tend to be more complex. Furthermore, the data received from this method is primarily textual.

The reason for using both approaches in this research is mainly that adequate and in-depth analysis of the research objectives were only possible with the use of both methods. The instruments applied in gathering primary data in the qualitative approach included semi-structured interviews (executed in German language), conferences, and personal observations. As for the quantitative approach, the appropriate instrument used was questionnaire (executed in German language). Relevant secondary quantitative data on: recent wind energy development,<sup>27</sup> the economic,<sup>28</sup> environmental, and social impacts of wind energy utilization<sup>29</sup> in Germany and in Land Brandenburg was relied on. The researcher equally relied on expert assessment of environmental, energy and planning policy texts, cases, and secondary review of relevant secondary texts. Both qualitative and quantitative methods aided in generating data that was used in bolstering or refuting data derived from literature review to realise the research objectives.

Therefore, the research objectives were distributed as follow, with respect to the chosen research method:

- Assessment of the energy (objective 1) and spatial planning (objective 2) policies were achieved using the secondary qualitative (literature review) and primary qualitative (semi-structured interviews) methods.
- Quantifying the economic and climatic effects of wind energy development (objective 3) was achieved using the secondary quantitative method.
- The acceptance of wind energy within the locals (objective 4) was achieved using the primary quantitative (questionnaires) and primary qualitative (semi-structured interviews) methods.
- Implementation possibilities (objective 5) was achieved using the secondary qualitative (literature review) and secondary quantitative method.

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<sup>27</sup> Cumulative installed capacity, annual installed capacity, share in electricity supply and share in total energy supply.

<sup>28</sup> Turnover and capital saved through the substitution of imported energy.

<sup>29</sup> CO<sub>2</sub> emissions avoided and employment.

## 2.3 STUDY AREA: LAND BRANDENBURG

The focus of this research is the State (Land) of Brandenburg, which is located in the Southeast region of Germany and is one of the federal states that were re-created in 1990 upon the reunification of the former West Germany and East Germany. Brandenburg surrounds but does not include the national capital and city-state Berlin. The state has a surface area of 29,477.16 km<sup>2</sup> (Brandenburg Government, 2013). Land Brandenburg, which was once the centre of the East German lignite mining, is still dominated by the fossil energy sector. With the shrinkage of the lignite industry after reunification (Jungjohann & Morris, 2014),<sup>30</sup> thousands lost their jobs (Deutscher Bundestag, 1999). At the same time, however, numerous projects and initiatives have developed in the renewable energies sub-sector, which reflects, inter alia, the enormous potential of the huge open pit reclamation areas. The history of this innovative energy region also has an effect on the perception and use of wind energy in particular and renewable energies in general. This makes Land Brandenburg particularly interesting as a research area.

Through the Act on the Introduction of Regional Planning and the Lignite and Rehabilitation Planning Act<sup>31</sup> (RegBkPIG)<sup>32</sup> five Regional Planning Boards<sup>33</sup> (RPG)<sup>34</sup> were formed in the Federal State of Brandenburg. RPGs are public entities whose roles are to determine and support the process of regional planning. The main tasks of the RPG is to establish regional plans, update, modify, and supplement them (Brandenburg Government, 2013). They are equally responsible for creating sectorial maps for wind energy development, as long as they fit into the overall development plan of the region.

Land Brandenburg, due to its topography, has very favourable conditions for the use of wind energy. Brandenburg has a high penetration of wind energy and presented a more cost and time-effective way to execute the survey. The state has developed into a major wind energy region in Germany, due to its many wind favourable areas with relatively low population densities.<sup>35</sup>

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<sup>30</sup> Overall, German coal consumption has decreased by a third since 1990. A significant share of this reduction goes back to modernization efforts in former East Germany in the early 1990s, efficiency gains in industry, and a switch away from coal briquettes for domestic space heating.

<sup>31</sup> Gesetz zur Einführung der Regionalplanung und der Braunkohlen- und Sanierungsplanung - RegBkPIG.

<sup>32</sup> RegBkPIG in the version promulgated on 8<sup>th</sup> February 2012 (Brandenburg Law Gazette I/12, no. 13), last amended by Article 9 of the Act of 11<sup>th</sup> February 2014 (Brandenburg Law Gazette I/14, no. 7).

<sup>33</sup> § 3 para. 2 RegBkPIG.

<sup>34</sup> Regionale Planungsgemeinschaften.

<sup>35</sup> The federal state of Brandenburg has the second largest installed capacity of wind turbines after the federal state of Lower Saxony in Germany (BWE, 2010).



Figure 2.1: The Five Regional Planning Communities in Land Brandenburg

(Brandenburg Government, 2013).

## 2.4 PRIMARY DATA

Primary data for this research was collected using quantitative as well as qualitative research instruments. Prior to primary data collection, permission was demanded from the public order office (Ordnungsamt) of the respective municipalities of the regional planning communities. Furthermore, the premises of the regional city councils were also solicited. This was to facilitate movement around these regionals and interaction with the population. Primary quantitative data - data that covers the opinion of the regional population - was gathered through questionnaires. Primary qualitative data - expert opinions on technical and policy issues - was collected through semi-structured interviews and conferences. The

generated data was thoroughly evaluated in the process of data analysis. Furthermore, data was equally generated through personal observations and formal discussions.

#### 2.4.1 PRIMARY QUANTITATIVE DATA

In order to get an overview of the past and current state of wind energy in Germany, extensive background research was carried out. Based on this literature review, a questionnaire was developed (see Appendix I). To ensure the reliability and validity of this research instrument, draft questionnaire together with the research hypothesis were given to the supervising professor and five research assistants at the Brandenburg University of Technology Cottbus-Senftenberg. This was to fine-tune the questions for easy understanding by the respondents and to guarantee the quality of the evaluation.

To determine the sample size of the quantitative research, four parameters that significantly influence the determination of a representative sample population were evaluated:

- **The level of precision**, also called sampling error or confidence interval, is the margin of error that one can tolerate. It represents the range in which the true value of the population is estimated to be. This range is often expressed in percentage points. For the purpose of this research, the confidence interval was placed at  $\pm 4\%$ .
- **The confidence level** or risk level is the amount of uncertainty one can tolerate. Confidence level is based on ideas encompassed under the Central Limit Theorem.<sup>36</sup> The key idea is that when a population is repeatedly sampled, the average value of the attribute obtained by those samples is equal to the true population value. Confidence level is expressed in percentages and 98% confidence level was used for this research.
- **The population size** represents the total population available from which to choose the sample size. The population of land Brandenburg was determined to be 2,522,000 inhabitants (Amt für Statistik Berlin-Brandenburg, 2010)
- **The degree of variability (population heterogeneity)** expresses how skewed the population is. It refers to the distribution of attributes in the population. The more heterogeneous a population, the larger the sample size required to obtain a given level of precision. The less variable (more homogeneous) a population, the smaller the sample size. Note that a proportion of 50% indicates a greater level of variability than either 20%

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<sup>36</sup> The central limit theorem states that, given certain conditions, the arithmetic mean of a sufficiently large number of iterates of independent random variables, each with a well-defined expected value and well-defined variance will be approximately normally distributed, regardless of the underlying distribution (Rice, 2006).



or 80%. Due to the heterogeneity of the population<sup>37</sup> of Brandenburg (Bertelsmann Stiftung, 2008), 50% degree of variability was used in this research.

The sample size for this research was then calculated with the aid of these parameters using the internet based online sample size calculator “Raosoft”. The calculated sample size was 846. However, in order to ensure uniformity, one thousand copies of the questionnaires were produced and randomly distributed, 200 copies in each of the five RPG.<sup>38</sup>

The questionnaire consisted of four sections, each focusing on a specific aspect. Section A of the questionnaire was meant to provide background information of the respondent. That is, demographic and social characteristics of the respondents. Section B was meant to gauge the inclination of respondents to wind energy. The aim here was to obtain information on the acceptance of wind parks in the neighbourhood. Section C was aimed getting the respondents perception on sustainability characteristics of wind energy utilization while Section D was designed to obtain the respondent perception of policies aimed at promoting the expansion and use of wind energy. The questionnaire was “close-ended” and the questions were designed using Likert scaling technique<sup>39</sup> (Bertram, 2009). The answers to the posed questions were scaled, with eight possible answers.

#### **2.4.2 QUESTIONNAIRE DISTRIBUTION**

Distribution of the questionnaires was effected using the “Drop-off and Pick-up” method of self-administered questionnaires approach, where the questionnaires were delivered and collected personally rather than by mail. The advantages of personal delivery and collection make it worthy of evaluation for survey research projects conducted by both commercial firms and university researchers (Allred & Ross-Davis, 2011).

#### **2.4.3 PRIMARY QUALITATIVE DATA**

The aim of the qualitative data collection was to get the assessments of major experts involve in wind energy both at the state and national levels and an impression of the wind energy situation in Land Brandenburg. The interviews were prepared and performed between March 2010 and May 2013. The expert interviews served both the extraction of

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<sup>37</sup> A heterogeneous set of people are a group of people of different kinds - of races, of appearances, of tastes, etc. It is one containing subpopulations of different types. It is diverse in kind or nature.

<sup>38</sup> The sample size does not change significantly when the population number is above one hundred thousand and since the population of each region surpasses one hundred thousand, the need for uniformity is justifiable.

<sup>39</sup> This is a psychometric response scale used primarily in questionnaires to obtain respondent’s preferences or degree of agreement with a statement or set of statements. Likert scale is a non-comparative scaling technique and is one-dimensional (only measure a single trait) in nature. Respondents are asked to indicate their level of agreement with a given statement by way of an ordinal scale.

additional information and the identification of different perspectives on the development of wind energy.

It was very gratifying that almost all the interlocutors selected based on these criteria created time from their busy schedule for the interview<sup>40</sup>; the questions were answered very open and the answers – as expected – were very helpful as they represent a knowledge base that can only be chiselled out using this instrument. Eight interviews in total were conducted:

- **Dr. Günter Hälsig:** Head of Department of Environment, Climate Change, Sustainability in the Brandenburg Ministry of Environment, Health and Consumer Protection (12.03.2010)
- **Arne Mogren:** Head of Public Affairs; Vattenfall AB - an energy utility company in Germany (16.03.2010).
- **Frauke Thies:** EU Energy Policy Adviser, Greenpeace (17.03.2010).
- **C. Maluszczak:** Head of RPG Lausitz-Speewald (31.05.2010).
- **T. Berger-Karin:** Planer at the Prignitz-Oberhavel RPG (09.11.2010).
- **Rüdiger Rietzel:** Head of RPG Oderland-Spree (11.11.2010).
- **B. Kempe-Samsami:** Policy Department member, German Wind Energy Association (10.04.2013).
- **Felix Rehwald:** Enercon spokesperson, Enercon Germany - the largest wind energy operator in Germany (10.04.2013).

The interviews were carried out using a prepared guideline (see Appendix II).<sup>41</sup> In line with the research questions of this study, the questions were focused on the factors influencing wind energy development and the future challenges of wind energy utilization.

## 2.5 SECONDARY DATA

Secondary data collection was done through a combination of numerical data and document review. The numerical data and documents were collected primarily from the relevant stakeholders (associations, government/state agencies, etc.). These data comprised mainly of issued (press) reports, statistics, scientific studies, parliamentary documents (laws and regulations), and internet publications.

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<sup>40</sup> Each interview lasted between 15 minutes to 2 hours. However, most lasted about 30-45 minutes.

<sup>41</sup> While the interview guide provided a set of prepared questions, the sequence of these questions was, however, open. Furthermore, the questions could be modified, depending on the area of expertise of the interviewee. In some cases, questions other than those on the interview guide were introduced.



Statistical data collected from the German Wind Energy Association provided the necessary insight into the growth in capacity, size and number – both at national and state levels – of wind energy. Annual reports from the Federal Ministry for Economic Affairs and Energy (BMWi); the Federal Ministry of Environment, Nature Conservation and Nuclear Safety (BMU); and the Federal Agency for Statistics provided significant information on the environmental (CO<sub>2</sub> emission reduction), economic (turnover and export), and social (employment) benefits of wind energy development. Furthermore, reviews of books from libraries, scientific studies, legal documents and internet articles helped for instance to facilitate tracing of the innovation biography of wind energy in Germany, the legal framework conditions and instruments to promote wind energy utilization and the challenges encountered.

## **2.6 DATA ANALYSIS**

Data analysis entails converting all results from the field to a common denominator by simple statistical methods. Applicable and measurable data (both quantitative and qualitative) emanating from the obtained field data was systematically analysed to ensure its validity, reliability, and representativeness.

The questionnaire results were collected by filling the questionnaire data in tables. After which, quantitative analysis was conducted by summarizing all the data and calculating the percentage of the choices for each question. Furthermore, content analysis was also used to determine the presence of certain concepts and topics. The content analysis provided an avenue to understand the social reality in terms of public acceptance of wind energy development in a subjective but scientific manner. The questionnaire was analysed and the data graphical represented using “Microsoft Excel”.

## 3 RENEWABLE ENERGY POLICY EVALUATION

### 3.1 GENERAL STATEMENT

The objective of creating an environmentally friendly energy supply system is the focal point of the German energy and climate policies. The German government is using a three-pillar model of energy conservation, efficient use of energy and the intensive deployment of renewable energies to meet these energy and climate protection challenges (BMU, 2011).<sup>42</sup> Wind energy constitutes a significant building block in the deployment of renewable energies.<sup>43</sup> The rapid expansion of wind energy is the result of comprehensive government programmes to support and open up the market. A significant breakthrough in the development of wind energy in Germany was achieved with the adoption of the EEG on the 17<sup>th</sup> March 2000, which replaced the Electricity Feed-in Act (Stromeinspeisungsgesetz – StromEinspG) of 7<sup>th</sup> December 1990. The EEG created the necessary economic framework conditions to facilitate the successful entry of wind energy into the market, thereby aiding in the achievement of the key climate policy goals with regard to the sustainability of energy supply (Salje, 2008).

This chapter provides a detailed evaluation of the instruments employed to promote the utilization of wind energy. The chapter will therefore evaluate the wind energy support statutes in order to determine the impact of these incentives on wind energy generation in Germany. This is aimed at achieving objective one of this research and to partly provide possible solutions to the problems related to competition and electricity prices.

### 3.2 BACKGROUND

Pursuant to European Commission Directive 2009/28/EC<sup>44</sup> on the promotion of the use of energy from renewable energy sources (RES Directive),<sup>45</sup> the federal government submitted in autumn 2010 a National Renewable Energy Action Plan (NREAP).<sup>46</sup> The submitted NREAP estimated the share of renewable energies in gross final energy consumption to be 19.6% in 2020 using 2005 as the base year for the overall estimation. With regard to individual sectors, the action plan stipulated a 15.5% share of renewable energies in the

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<sup>42</sup> This research deals only with the expansion of renewable energies: specifically, wind energy.

<sup>43</sup> The share of the main sources of electricity generation from renewables in 2020 will be as follows: wind energy 48%, biomass 23%, 19% photovoltaics, and hydropower 9% (BMU, 2010).

<sup>44</sup> Article 4 of 2009 RES Directive.

<sup>45</sup> Directive 2009/28/EC (Official Journal of the European Union, L 140 of 5.6.2009, p. 16-62) of the European Parliament and of the Council of 23<sup>rd</sup> April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC (Official Journal of the European Union, L 283 of 27.10.2001, p. 33-40) and 2003/30/EC (Official Journal of the European Union, L 123 of 17.6.2003, p. 42-46).

<sup>46</sup> The NRESAP sets out how German federal government plans to achieve its national renewable energy target in the three sectors: electricity, heating and transportation.

heat/cooling sector, a share of 38.6% in electricity and a share of 13.2% in transport by 2020 (German Government, 2010; BMU, 2010).

Concerning the electricity sector, the strongest expansion will take place using wind and solar energy. In 2020, the share of wind energy in electricity from renewable sources will amount to 48 % (German Government, 2010).

On 28<sup>th</sup> September 2010, the German government adopted an ambitious Energy Concept, which significantly strengthened and extended the NREAP. The concept laid down the main strategic targets of the energy and climate policy for the period up to 2050 and equally formulated guidelines for an environmentally sound, reliable, and affordable energy supply and provided a road map to the transition of the German energy supply system. The Energy Concept was based on a dual strategy, which envisaged reduction in energy demand, by significantly increasing energy efficiency while the remaining demand for energy would be covered by renewables. The concept adopted the following energy and climate policy goals (BMU, 2011; BMWi, 2012):

- Reduction in GHG emissions by 40% by 2020, 55% by 2030, 70% by 2040 and by 80 to 95% by 2050, compared to reference year 1990.
- Decrease in primary energy consumption by 20% by 2020 and by 50% by 2050.
- Increase in energy productivity by 2.1% per year compared to final energy consumption.
- Electricity consumption to decrease by 10% by 2020 and by 25% by 2050, compared to 2008.
- Heat demand in buildings to reduce by 20% by 2020, while primary energy demand is to fall by 80% by 2050, compared to 2008.
- Renewable energies are to achieve an 18% share of gross final energy consumption by 2020, a 30% share by 2030, 45% by 2040 and 60% by 2050.
- Renewables are to have a share of at least 35% in gross electricity consumption by 2020, a 50% share by 2030, 65% by 2040, and 80% by 2050.

With these targeted goals, the federal government has set the bar against which the implementation of its energy concept has to be measured in future. The Concept focuses on the establishment of renewable energies as a cornerstone of future energy supply; energy efficiency; the creation of an efficient grid infrastructure for electricity and integration of renewable energy sources; energy upgrades for buildings and energy efficient new

buildings; as well as the introduction of one million electric vehicles on the road by 2020 and six million by 2030 (BMU, 2011). As such, the Energy Concept represents a market-driven, technology-neutral framework for transforming the national energy supply system (Bals, et al., 2010).

### **3.3 RENEWABLE ENERGY SOURCES ACT of 2000 (EEG 2000)<sup>47</sup>**

The EEG of 2000 introduced a new dimension in the promotion of renewable energies<sup>48</sup> in Germany. The necessity of the EEG resulted, inter alia, from the increasing numbers of windmills and Germany's climate obligation in the wake of the Kyoto Protocol to reduce GHG emissions by 2012 by 21%.<sup>49</sup> The EEG is thus a concretisation of the country's constitutional environmental protection objectives according to Art. 20a of the Basic law (Grundgesetz - GG)<sup>50</sup> and the transposition of its international climate obligation into national law (Salje, 2008).

The EEG 2000 contained twelve paragraphs. Art. 1 EEG postulated the objective of achieving a doubling of the share of renewable energies in electricity consumption in Germany by 2010.<sup>51</sup> For the first time the priority of electricity generated from renewables compared with conventionally generated electricity was prescribed by law. Articles 3 and 11 EEG handle the purchase and payment obligations, in which a five-stage control structure for connection, inspection, compensation, grid expansion and nationwide equalization was standardised. Articles 4 to 8 EEG contained the statutory minimum remuneration for electricity from hydropower, landfill, mining and sewage gas, biomass, geothermal energy, wind energy and solar energy.<sup>52</sup> The EEG, as a result, abolished the regulation contained in the StromEinspG, which limited the feed-in at preferential rates of electricity from windmills to a maximum share of 5% of overall output. This was aimed at putting an end to fears of excessive financial burdens to grid operators in wind energy favourable areas. The amount of compensation for the individual renewable energy sources was differentiated in terms of

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<sup>47</sup> Federal Law Gazette I, page 305 of 29<sup>th</sup> March 2000.

<sup>48</sup> §5 No. 14 EEG 2014 defines renewable energies as hydropower - including wave energy, tidal energy, salt gradient and flow energy, - wind energy, solar radiation, geothermal energy, energy from biomass - including biogas, biomethane, landfill gas and sewage treatment gas, as well as the biodegradable fraction of municipal waste and industrial waste.

<sup>49</sup> Within the UNFCCC-Kyoto Protocol scheme, the then 15 member states of the EU received a general emission reduction target of -8% in comparison with the 1990 GHG emission level (Art. 4 of the Protocol). The burden sharing (European Council Decision 2002/358/EC) took place between the 15 Member States on a sector-based allocation principle including the energy sector, the industry and domestically oriented sectors.

<sup>50</sup> Basic Law for the Federal Republic of Germany in the revised version published in the Federal Law Gazette Part III, classification number 100-1, as last amended by the Act of 11<sup>th</sup> July 2012 (Federal Law Gazette I p. 1478).

<sup>51</sup> This equates to a share of 12.5% by 2010 (BMU, 2004).

<sup>52</sup> For electricity from wind energy, the remuneration ranged between 6.19 to 9.10 cents/kWh.

technology and installed capacity (Salje, 2014). However, remuneration of wind-generated electricity depended on the capacity and location of the wind energy installation. Location dependent remuneration of onshore wind-generated electricity was based on a technology-neutral reference yield model. This remuneration was paid for a period of up to twenty years per windmill.<sup>53</sup> Besides, degressive rates<sup>54</sup> were incorporated into the remuneration scheme, starting from 2002, for newly commissioned installations (Salje, 2014). The EEG also offered scope for altering the remuneration rates for future installations if it was deemed necessary.<sup>55</sup>

The EEG supported the development of wind energy and equally regulated the German electricity market. However, contrary to popular misconception, this is not done through the granting of subsidies. The EEG has no specific emblem of subsidization. Besides, the EEG lacks the sovereign dominated regulation of the state-citizen-relationship, which is a precondition for subsidization (Wanki & Zschiegner, 2014). The EEG regulates only the relationship between the grid operator and the feeder, each as legal entities of private law. With respect to grid operators, it standardizes two significant limitations: first, the connection obligation of the grid operator is justified by virtue of existence of a necessity to connect to the grid – regardless of the existence of a contract.<sup>56</sup> The obligation of the grid operator to connect wind energy installations as well as receiving electricity generated by these installations and feeding it into the grid system results from this regulation. Secondly, the EEG contains significant limitations on the content of the legal relationship between the feeder and the grid operators, called feed-in agreements (Salje, 2008).

Though this version of the EEG proved to be a success (BMU, 2003), the law failed to address shortcomings associated to grid connection. The electricity supply utilities possessed a statutory monopoly on transmission and feed-in of electricity,<sup>57</sup> which permitted them to determine the conditions for feed-in of electricity from windmills through a so-called “Association Agreement”.<sup>58</sup> Due to the fluctuating output of wind-generated electricity, the grid operators had little interest to feed the electricity generated by renewable installations into the grid. Though grid connection was legally authorized,<sup>59</sup> the law offered no incentives

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<sup>53</sup> §9 Para. 1 EEG 2000.

<sup>54</sup> §7 Para. 3 EEG 2000. The annual degression of wind energy was 1.5%.

<sup>55</sup> §12 EEG 2000.

<sup>56</sup> §3 Para. 1 EEG 2000.

<sup>57</sup> §10 para. 1 EEG 2000 in conjunction with §16 EnWG of 24<sup>th</sup> April 1998.

<sup>58</sup> A non-binding regulation called “Association Agreement” existed. The “Association Agreement” prescribed an uncommitted feed-in tariff of about 9 Pf / kWh. For transmitted electricity, however, the installation operator had to pay 25 to 27 penny (Tacke, 2004).

<sup>59</sup> §10 para. 2 EEG 2000.

for grid operators, who arguably were often unwilling to fund the necessary expenses for grid expansion and new transformers. Furthermore, the clearing office (Clearingstelle)<sup>60</sup> did not have the powers to offer legally binding solutions in cases of dispute.

The EEG has to date been amended four times and the amended versions entered into force on 1<sup>st</sup> August 2004, 1<sup>st</sup> January 2009, 1<sup>st</sup> January 2012 and 1<sup>st</sup> August 2014 respectively.

### **3.3.1 RENEWABLE ENERGY SOURCES ACT of 2004 (EEG 2004)<sup>61</sup>**

The first amendment of the EEG in August 2004 had as objective to increase the share of total energy supply from renewables to at least 12.5% by 2010 and at least 20% by 2020.<sup>62</sup> The EEG 2004 was also meant to implement the EU Directive on the promotion of electricity from renewable energy sources of September 2001 (BMU, 2004).

The 2004 EEG incorporated several new provisions. A common provision for purchase, transmission, and payment of remunerations was added, which prohibited grid operator from making their connection, transmission and payment obligations dependent on the conclusion of a contract.<sup>63</sup> This effectively outlawed all “Association Agreements”. The hardship clause<sup>64</sup> was introduced to regulate the situation of energy-intensive industries in July 2003 and was extended to cover more enterprises and the time limit was removed.<sup>65</sup> Power-intensive manufacturing companies were covered by the hardship clause if their power consumption was greater than 10 GWh<sup>66</sup> and their ratio of electricity costs to gross value added exceeded 15%.<sup>67</sup> However, the resulting additional burden on the remaining final consumer (mostly household consumers) was not supposed to exceed 10% per calendar year. Furthermore, the initial remuneration rate for onshore windmills was lowered by 0.1 cents and the base rate was set at 0.5 cents/kWh in order to reflect developments in wind technology (Salje, 2008).

EEG 2004 provided a new boost for electricity generation from renewable energy sources. By 2008, their share in gross electricity consumption was about 15%. Wind energy alone

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<sup>60</sup> Pursuant to §10 para. 3 EEG 2000, a clearing office was established in the Federal Ministry of Economics and Technology to clarify disputes between grid operators and renewable energy installation operators.

<sup>61</sup> EEG in the version promulgated on 21<sup>st</sup> July 2004 (Federal Law Gazette I p. 1918), last amended by Article 1 of the Act of 7<sup>th</sup> November 2006 (Federal Law Gazette I p. 2550).

<sup>62</sup> §1 EEG 2004.

<sup>63</sup> §12 para. 1 EEG 2004.

<sup>64</sup> §16 EEG 2004.

<sup>65</sup> First Act amending the EEG (Federal Law Gazette I, page 1459 of 16.7.2003).

<sup>66</sup> Previously 100 GWh.

<sup>67</sup> Previously 20%.



accounted for about 44% (BMU, 2008). This rapid increase simultaneously led to an increase in the EEG surcharge. The resulting additional burden on the final consumers exceeded the fixed EEG limit of 10% and consequently energy-intensive industries had to participate in the EEG surcharge. This in turn led to increasing industrial cost. The German parliament, as a result, decided in September 2006 to cancel the 10% ceiling. The energy-intensive industries were unconditionally guaranteed a rate of 0.05 cents/kWh retroactively from 1<sup>st</sup> January 2006 (BMU, 2008), which resulted to persistent higher electricity cost on the remaining final consumers.

### **3.3.2 RENEWABLE ENERGY SOURCES ACT of 2009 (EEG 2009)<sup>68</sup>**

The 2009 EEG amendment had the objective of increasing the share of renewables in electricity supply by 2020 to a level of at least 30%.<sup>69</sup> This was mainly to make the law compatible with EU regulations.<sup>70</sup> The amendment of 2009 represented a fundamental and comprehensive review of previously existing EEG. The most significant changes related to the rules on the hardship clause compensation in case of non-supply due to capacity bottlenecks<sup>71</sup> and to direct marketing of electricity from renewable energy sources.<sup>72</sup> The EEG 2009, however, retained the basic structure of the 2004 version. With respect to onshore wind energy, the major changes included:

1. *Higher remuneration and lower rate of depression*<sup>73</sup>: This provision was mainly due to price increases for raw materials, especially steel and copper (BMU, 2008).
2. *New Repowering bonus system*<sup>74</sup>: The conditions for repowering were improved in order to tap the existing potential more extensively. The initial remuneration were increased by 0.5 cent/kWh. Conditions for receiving the repowering bonus were modified: repowered wind turbines must be located in the same or neighbouring administrative district and be at least ten years old, the new turbine needed to have at least twice but no more than five times the original turbines capacity, and one or more converters had to be completely replaced (BMU, 2008). With the adjustment, an economic incentive was specifically set for repowering at sites where early repowering was economically

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<sup>68</sup> EEG in the version promulgated on 7<sup>th</sup> November 2006 (Federal Law Gazette I p. 2550), last amended by Article 1 of the Act of 25<sup>th</sup> October 2008 (Federal Law Gazette I p. 2074).

<sup>69</sup> §1 Para. 2 EEG 2009.

<sup>70</sup> Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC (Official Journal of the European Union, L 140 of 5.6.2009, p. 16-62).

<sup>71</sup> §12 EEG 2009.

<sup>72</sup> §17 EEG 2009.

<sup>73</sup> §29 EEG 2009.

<sup>74</sup> §30 EEG 2009.

attractive after expiry of the higher initial tariff rate. In addition, excessive bonuses in very good locations were eliminated, as they could no longer benefit from the transferability of the initial tariff rate (Salje, 2008).

3. *The new System Service Bonus (Systemdienstleistungsbonus - SDL)*<sup>75</sup>: The SDL was aimed at instigating feeders to install equipment in their facilities, which improved grid compatibility. SDL bonus for new windmills was set at 0.5 cent/kWh in addition to the initial remuneration while old windmills commissioned after 1<sup>st</sup> January 2002 receive 0.7 cent/kWh over five years if upgraded by 31<sup>st</sup> December 2010 (BMU, 2008).
4. *Grid extension and losses*:<sup>76</sup> Grid operators were obliged not only to extend the grid,<sup>77</sup> but also to optimise and enhance the existing grid. Failure to comply could lead to claims for losses by anyone willing but unable to feed-in (BMU, 2008).

While the law's impact on wind energy expansion was enhanced by this version, it did little or nothing to slow or stabilize the growing EEG surcharge.<sup>78</sup> Electricity cost for household consumers and small industries increased steadily, which was partly due to the increasing EEG surcharge (Müsgens & Grothe, 2013). As a result, the EEG of 2009 was amended in 2010.<sup>79</sup> This was due to the realisation that the capital costs of photovoltaic (PV) systems had reduced as the technology matured. A major feature of the amendment was the lowering of feed-in tariffs for new PV systems (BMW, 2015). This measure did not show significant impact on the rising EEG surcharge. It, however, marked the first attempt to orientate the EEG towards market conditions.

### **3.3.3 RENEWABLE ENERGY SOURCES ACT of 2012 (EEG 2012)**<sup>80</sup>

The amendment of 2012 represented a fundamental and comprehensive review of the EEG of 2009. The EEG of 2012 was linked to the energy concept of the Federal Government of 28<sup>th</sup> September 2010, which stipulated expansion targets of the electricity sector in the EEG. Accordingly, the share of renewable energies should be at least 35% of gross electricity generation by 2020, 50% by 2030, 65% by 2040, and 80% by 2050.<sup>81</sup> The objective was to increase the share of RE sources in the total gross final energy consumption by at least 18%

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<sup>75</sup> Article 29 Para. 2 sentence 4, Article 66 Para. 1 No. 6 together with Article 64 Para. 1 No. 1 EEG 2009.

<sup>76</sup> Articles 9 and 10 EEG 2009.

<sup>77</sup> This was the case in the EEG 2004.

<sup>78</sup> See section 3.10.

<sup>79</sup> The First Act amending the Renewable Energy Sources Act of 11<sup>th</sup> August 2010 was promulgated in the Federal Law Gazette (Federal Law Gazette I, p. 1170 of 17<sup>th</sup> August 2010) and entered into force on 1<sup>st</sup> July 2010.

<sup>80</sup> The Act Amending the legal framework for the promotion of electricity produced from renewable energy sources (Federal Law Gazette I, p. 1634 of 28.7.2011) entered into force on 1<sup>st</sup> January 2012.

<sup>81</sup> According to §1 Para. 2 EEG 2012.



by 2020.<sup>82</sup> As of December 2011, renewable energies accounted for 11.9% of total gross final energy consumption in Germany (BWE, 2013).

Significant in the amended law was its re-orientation to market and grid system integration. The aim was to optimise the electricity sector, i.e. to improve the interaction between renewable and conventional energy sources, and the consumers. The optional direct marketing model (market premium system), which was instituted in the EEG of 2009, was broadened.<sup>83</sup> This was an incentive for renewable installation operators to operate their installations market-oriented (Salje, 2014). Besides, a 20% minimum proportion of fluctuating renewable energy sources (wind and solar) was introduced (BMW, 2015). This amendment signified a complete policy re-orientation from the support of renewable energy expansion towards market integration. This was partly to curb the ever-increasing EEG surcharge. Unfortunately, the effects of this amendment, with respect to reducing the EEG surcharge were not observable.<sup>84</sup>

### **3.3.4 RENEWABLE ENERGY SOURCES ACT of 2014 (EEG 2014)<sup>85</sup>**

Following the decision of the German Government in 2011 to phase out nuclear energy,<sup>86</sup> the EEG was and continues to be the cornerstone of the German energy transition. As a result, the share of renewable energies in net electricity consumption has increased drastically in Germany, reaching about 28% in 2014 (Wirth, 2015; BMW, 2015). However, the rapid expansion also resulted in a rise in the EEG surcharge.<sup>87</sup> Additionally, the previous versions of the EEG allowed high energy-intensive companies in Germany to file for exemptions, decreasing the number of final customers sharing the burden of the EEG surcharge.<sup>88</sup> The rising electricity prices prompted the German government to reform the EEG once more. The EEG 2014 changes fundamentally the framework conditions for the support of renewable energies, which may lead to the end of the feed-in tariff model from 2017 onward (Salje, 2014).

The EEG amendment of 2014 has 104 articles and 4 annexes, covering 55 pages in the Federal Law Gazette. Its transitory provisions are longer than the original EEG. It further

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<sup>82</sup> In accordance with §1 Para. 3 EEG 2012.

<sup>83</sup> §§33a to 33h EEG 2012.

<sup>84</sup> The EEG surcharge in 2014 for non-privileged final consumers was 6.24 cent/kWh (Salje, 2014). This is an increase of 0.963 cent/kWh compared to 2013, which stood at 5.277 cent/kWh (Übertragungsnetzbetreiber, 2013).

<sup>85</sup> Federal Law Gazette I, p. 1066 of 21<sup>st</sup> July 2014.

<sup>86</sup> Federal Parliament (Bundestag - BT) Circular (Drucksache - Drs) 17/6246 of 22.6.2011; abbreviated BT-Drs 17/6246

<sup>87</sup> Though the feed-in tariffs were adjusted during the previous amendments between 2004 and 2012, feed-in tariffs for renewable energy generation have a duration of up to 20 years; thus even though the feed-in tariff is reduced, older renewable energy generation is locked into the higher rates.

<sup>88</sup> §40 to §44 EEG 2012.

develops the 2010 energy concept: the act aims to constantly and cost effectively increase the share of renewable energy sources in the German electricity supply. According to the amendment, renewable energies shall account for 40% to 45% share of gross electricity consumption by 2025, 55% to 60% by 2035 and for 80% by 2050.<sup>89</sup> The latest reform is very much influenced by EU law, especially regarding compliance with EU state aid rules (Salje, 2014). The EEG 2014 entered into force on 1<sup>st</sup> August 2014. The following sections present a detail analysis of the policy changes in the current version of the EEG.

### **3.4 CONNECTION AND PURCHASE OBLIGATIONS**

The central obligation of grid operators is to enable access to the grid system to wind generated electricity. The grid operators are obliged to immediately and as a priority connect installations generating electricity from wind to that point in their grid system which is suitable in terms of the voltage and which is at the shortest linear distance from the location of the installation, provided no other grid system has a technically and economically more favourable grid connection point.<sup>90</sup> The existence of the actual requirements of Art. 8 para. 1 of the EEG justifies the contractual obligation between the potential feeder and the grid operators to meet the connection obligation. The only exception is when a grid expansion is economically unreasonable.<sup>91</sup> The EEG, thus, guarantees a high-level access of wind energy to the general electricity market.

Moreover, the grid operator is obliged to and without culpable delay, after receipt of a connection request, submit to the feeder a timetable for the establishment of grid connection, the information required for testing the grid connection point, upon request, the grid system data required to test grid compatibility and a cost estimate within eight weeks.<sup>92</sup> The EEG, however, does not specify any deadlines by which the grid operator shall carry out the grid stability test. Should the grid operator culpably violate the connection obligation, this can result in damage claims from the contractual obligation according to Articles 280 and 281 of the German Civil Code.<sup>93</sup>

Wind energy installations have priority connection to the grid system. The priority is in relation to installations generating electricity from fossil or nuclear energy sources. Practically, this means that the grid operator should not reject a connection desire with

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<sup>89</sup> §1 para. 2 EEG 2014.

<sup>90</sup> §8 para. 1 EEG 2014.

<sup>91</sup> §12 para. 3 EEG 2014.

<sup>92</sup> §8 para. 5 EEG 2014.

<sup>93</sup> Civil Code in the version promulgated on 2<sup>nd</sup> January 2002 (Federal Law Gazette I p. 42), last amended by Article 4 para. 5 of the Act of 1<sup>st</sup> October 2013 (Federal Law Gazette I p. 3719).

reference to the grid load, unless the load is caused solely by the supply of electricity from renewable energy sources (Salje, 2014). In practice, it is frequently the case that there is a grid overload when there are still installations generating energy from conventional energy sources in the grid system. Hence, this is not just a connection obligation on the grid operator but also a corresponding pressure to keep the grid free of conventional electricity to the extent necessary for the connection of electricity from renewable sources. This is ultimately an expression of the legislative purpose of the EEG to support a sustainable energy transition.

The grid operator equally has the statutory obligation to purchase, transmit, and distribute the wind-generated electricity.<sup>94</sup> The grid operator is obliged to purchase, transmit, and distribute the entire quantity of electricity from wind energy installations as a priority. The grid operator therefore, cannot refuse to purchase, transmit, and distribute wind-generated electricity based on grid overload as long as feeders of non-renewable energy carriers are still connected to the grid. The purchase obligation is therefore considered a direct legal obligation simply because of the existence of an actual feed-in situation due to the EEG.

The rapid development of wind energy on one side and the existing partial lack of suitable transmission lines on the other side have increasingly led to situations where grid security is threatened by excess supply. In order to prevent damage to the grid and to ensure the reliability of electricity supply, the so-called “feed-in management”<sup>95</sup> instrument is earmarked in the EEG.

### **3.4.1 FEED-IN MANAGEMENT**

Feed-in management signals a departure from the priority principle. Grid operators are entitled to take technical control over wind energy installations that are equipped with a remote control device to avoid grid overload in their respective grid area including the upstream grid. On this basis, the grid operator can determine which installations must reduce their feed-in in order to avoid grid congestion. As a result, those installations whose actual feed-in are expected to affect grid security strongest would be disconnected. In practice, virtually any installation above the minimum limit of 100 kW may be affected by a reduction in the feed-in, thus all installations must possess appropriate technical equipment for the remote-controlled reduction of the feed-in load.<sup>96</sup> Prior to taking control over an installation, the grid operator should notify the operator no later than the day before on the

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<sup>94</sup> §8 Para. 1 EEG 2014.

<sup>95</sup> §14 EEG 2014.

<sup>96</sup> §14 paragraphs 1 and 5 EEG 2014.

extent and the duration of technical control, if it is predictable that the measure will be taken (Salje, 2014). After the control measures, the grid operator shall inform the installation operator about the actual dates, the respective extent, the duration, and the reasons for the assumption of technical control and, upon request, provide evidence that the measure was necessary. In the event that the grid operator violates his obligations regarding feed-in management, plant operators may demand compensation for the damage incurred.<sup>97</sup> The purpose of feed-in management is therefore to reduce the regulatory measures to a calculable necessary minimum with respect to the operational security of the grid and thus, largely reduce the operational and economic costs (BMU, 2008).

According to the Federal Network Agency<sup>98</sup> (Bundesnetzagentur - BNetzA), the volume of unused electricity due to feed-in management more than tripled in 2011, to about 421 GWh, compared to 2010 (BNetzA, 2013). This rapid increase is directly linked to the unabated increase in capacity of renewable energy sources and the slow progress of grid expansion. Feed-in management was applied primarily, 97.4% of the cases, to wind energy installations and, to a minor degree, to biomass, photovoltaic, and cogeneration installations. Relative to total feed-in from EEG installations, unused energy in 2011 amounted to a share of 0.41%. The corresponding value as a proportion of total wind energy feed-in was 0.89% (BNetzA, 2013).

### **3.4.2 HARDSHIP CLAUSE<sup>99</sup>**

If the installation operator cannot feed all the electricity he generates into the grid due to feed-in management, he has to be compensated for 95% of his lost income minus any expenses saved. If the lost income exceeds, in a single year, 1% of the income for that year, the operators affected should be compensated for 100% of their lost income from that date<sup>100</sup>. The hardship clause therefore helps to minimize the financial consequences of feed-in management on the installation operator by preserving the claim of payment during the installation control periods. The sum total of compensation payments made in 2011,

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<sup>97</sup> §12 Para. 3 EEG 2014.

<sup>98</sup> The BNetzA is responsible for further development of the infrastructure on the markets for electricity, gas, telecommunications, post office and, since 1<sup>st</sup> January 2006, the railroads. This will be accomplished by liberalising and deregulating the corresponding markets. It is vested with effective procedures and instruments for implementation of these regulatory goals, including informational and investigative rights as well as graduated possibilities for sanctions. Since 2011, the Federal Network Agency has also taken over the duties in the area of the Grid Development Plan. The Federal Network Agency uses efficient planning and approval procedures for accelerated implementation of this expansion requirement in the high voltage grid.

<sup>99</sup> §15 EEG 2014.

<sup>100</sup> §15 Para. 1 EEG 2014.

corresponding to the volume of unused electricity, amounted to about 33.5 million Euros (BNetzA, 2013).

However, the hardship clause regulation leaves out some potential problems that may lead to litigations. There are no provisions for payment claim when wind-generated electricity is not connected to the grid by the grid operator due to ongoing maintenance or expansion measures, pursuant to Art. 8 para. 4 EEG 2014 in combination with §12 EEG 2014. Besides, the use of the phrase “lost income” gives room for different interpretations, which may lead to legal disputes. This is because the legislator does not precise if the lost income is in relation to the price sold to the direct marketer or the price of the electricity sold by the direct marketer in the electricity spot market. Given that, prices in the spot market can change several times within a day and the lost income incurred by the installation operator may be recovered by the direct marketer later in the spot market. Though these are suppositions, this possibility, however, exist, and may lead to disputes.

The following sections detail changes introduced by the recent amendment of the EEG and ends with the chapter discussion (section 3.11), which analyses these changes for their effectiveness.

### **3.5 MANDATORY DIRECT MARKETING AND REMUNERATION**

In 2009, the EEG instituted for the first time voluntary direct marketing.<sup>101</sup> Installation operators could sell the electricity generated by their installations to third parties on a calendar-monthly basis directly if they had reported this to the grid operator before the start of the previous calendar month. The 2014 reform of the EEG introduces a mandatory shift from a fixed feed-in tariff to a market premium system.<sup>102</sup> In order to lower the EEG surcharge and better integrate renewable energy into the market, operators of renewable energy facilities are obliged to market their generated electricity directly, either independently or through a direct marketer. The EEG 2014 contains two ways of direct marketing:<sup>103</sup> direct marketing with the purpose of receiving a market premium (subsidised direct marketing) or direct marketing without receiving a subsidy (other direct marketing). These forms are mutually exclusive.<sup>104</sup> The precise calculation of the market premium and the amount of the premium are defined in Annex 1 to the EEG.

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<sup>101</sup> §17 EEG 2009.

<sup>102</sup> §19 EEG 2014.

<sup>103</sup> §19 para. 1 EEG 2014.

<sup>104</sup> §20 para. 1 EEG 2014.

The market premium option signifies a paradigm shift for the promotion of wind energy. Installation operators are to receive an incentive to become active market participants. Operators receive premiums, which essentially cover the difference between the feed-in tariff and the average market price. Direct selling takes place only on a calendar monthly basis. The grid operator on whose grid the installation is connected to or through whose grid the electricity is transmitted pays the market premium to the installation operator. Mandatory direct marketing has led to the introduction of new terminology “applicable value”,<sup>105</sup> which is used to classify the basis on which financial support is calculated in the EEG. The applicable value for onshore windmills depends on the rated output or the installed capacity of the wind turbine.<sup>106</sup> Until 31<sup>st</sup> December 2016, the market premiums will be determined by reference to the feed-in tariff amounts (Salje, 2014). Exceptions to the mandatory direct marketing regulation are permitted only in the following cases:

- Small renewable energy installations, particularly installations commissioned before 1<sup>st</sup> January 2016 with an installed capacity of less than 500 kW<sup>107</sup> and installations commissioned after 31<sup>st</sup> December 2015 with an installed capacity of less than 100 kW<sup>108</sup>
- If the direct marketer is not available (e.g. because of insolvency) the installation operator is paid a so-called “default remuneration” (Ausfallvergütung). The default remuneration only covers 80% of the applicable remuneration.<sup>109</sup>

The EEG sets the initial payment (first 5 years from start of operation plus the extension time<sup>110</sup>) of onshore windmills<sup>111</sup> at 8.9 cents/kWh and the base tariff at 4.95 cents/kWh. The system service bonus and the repowering bonus have been deleted.<sup>112</sup> Feed-in tariffs are paid for a period of 20 years in addition to the year the power plant went into operation.<sup>113</sup>

### 3.5.1 REFERENCE YIELD

The reference yield is a location dependent means to foster each wind energy installation separately.<sup>114</sup> This is intended to open up the generation of electricity from wind parks in economically unattractive locations. The reference yield is the quantity of electricity, which

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<sup>105</sup> §23 EEG 2014.

<sup>106</sup> §23 para. 2 No. 2 EEG 2014.

<sup>107</sup> §37 para. 2 No. 1 EEG 2014.

<sup>108</sup> §37 para. 2 No. 2 EEG 2014.

<sup>109</sup> §38 para. 2 EEG 2014.

<sup>110</sup> Based on the reference yield.

<sup>111</sup> §49 EEG 2014.

<sup>112</sup> §30 EEG 2012.

<sup>113</sup> §22 EEG 2014.

<sup>114</sup> Appendix 2 EEG 2014.

each specific type of wind energy installation would yield during five years of operation if it were built at the reference site.<sup>115</sup> The reference yield is calculated in accordance with the generally accepted rules set out in the Technical Guidelines for Wind-Powered Installations, published by the “Fördergesellschaft Windenergie und andere Erneuerbare Energien.”<sup>116</sup>

Generally, sites with relatively poor wind potentials are paid higher initial tariffs for a longer period before they drop down to a base payment. The amount of time that wind turbines are paid under the higher initial tariffs is calculated using the reference yield. In principle, higher initial tariff is extended by one month for each 0.36% of the reference yield by which the installation yield falls short of 130% of the reference value.<sup>117</sup> However, if the reference yield of the installation is less than 100%; higher initial tariff is extended additionally by one month for each 0.48% of the reference yield by which the installation yield falls short of 100% of the reference site.<sup>118</sup> This new two-stage reference yield model differentiates itself significantly from the EEG 2012 model.<sup>119</sup> For EEG 2012, a generator that produces less than 150% of the reference yield over five years receives a two-month extension until it reaches 150% of its reference yield.

The EEG 2014 continues to use the reference yield model; however, some significant changes have been incorporated. First, the EEG 2014 introduces a new two-stage reference yield model, which reduces the higher initial tariff period compared to that under EEG 2012. Extensions would be month-to-month, rather than two months. Second, the formula for the calculation of reference yield has been extended pursuant to Art. 49 para. 2 sentence 3 EEG 2014. Therefore, 80% of reference yield becomes an effective minimum. The EEG 2014 results in shorter tariffs across the board. Only very strong (150%) and very weak (80%) yields relative to the reference yield would be indifferent. Projects yielding 130% of reference yield would face the largest cut, 88%. Table 3.1 below compares the duration of higher initial tariff payment for generators with a range of production levels relative to reference yields. The EEG 2012 and 2014 tariffs last 20 years.

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<sup>115</sup> The reference site is a site determined by means of a Rayleigh distribution with a mean annual wind speed of 5.5 m/s at a height of 30m above ground level, a logarithmic wind shear profile, and a roughness length of 0.1m (Appendix 2 No.4 EEG 2014).

<sup>116</sup> Appendix 2 No.2 EEG 2014.

<sup>117</sup> §47 para. 2 sentence 2 EEG 2014.

<sup>118</sup> §47 para. 2 sentence 3 EEG 2014.

<sup>119</sup> In EEG 2012, higher initial tariff was extended by two months for each 0.75% of the reference yield by which the installation yield falls short of 150% of the reference site.



**Table 3.1: Duration of higher initial tariffs under 2012 and 2014 reference yield models**

Output relative to reference yield (%)	Duration of higher initial tariff (Years)		
	EEG 2012	EEG 2014	% Change
150	5.0	5.0	0
140	7.2	5.0	44
130	9.4	5.0	88
120	11.7	7.3	60
110	13.9	9.6	45
100	16.1	11.9	35
90	18.3	16.0	14
80	20.0	20.0	0
		<b>Average change</b>	<b>35.8</b>

Courtesy: Wanki

### 3.5.2 INTRODUCTION OF TENDERING

The market premiums for onshore wind energy will be determined by reference to its feed-in tariff amounts until 31<sup>st</sup> December 2016. The EEG 2014 provides that, as from 2017, the remuneration entitlement and amounts applicable to all forms of renewable energy plants shall be determined by means of competitive tendering.<sup>120</sup> Given that the EEG 2014 does not outline the modalities of the tendering process, this opens up the possibility of a further amendment before tendering can take place. In order to gain experience in this respect, tenders are to be carried out for open landscape solar installations (installations that are not constructed in, on or close to a building or other facilities). For this purpose, a nominal output of up to 400 MW annually shall be tendered and the BNetzA is responsible for organizing the tendering procedure.<sup>121</sup>

### 3.6 EXPANSION CORRIDORS AND DEGRESSION

According to the current EEG, renewable energies shall account for 40% to 45% share of gross electricity consumption by 2025, 55% to 60% by 2035 and for 80% by 2050. In order to achieve this, expansion corridors to ensure the controlled growth of wind energy, solar energy, and biomass has been implemented in the regulation.<sup>122</sup> For onshore wind energy, the net annual growth corridor target is from 2,500 MW to 2,600 MW.<sup>123</sup> To monitor the expansion corridor, the BNetzA has established a new central installation register, in which all onshore energy installations must be registered in order to be liable for compensations.<sup>124</sup> To ensure compliance with the expansion corridor, so-called “breathing caps” have been introduced for onshore wind energy (BMW, 2015). The breathing cap concept adjusts the

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<sup>120</sup> §2 para. 5 EEG 2014.

<sup>121</sup> BNetzA organised the first tendering event on the 15<sup>th</sup> April 2015. The outcome of the tender process showed that the average remuneration obtained (9.17 cent/kWh) was higher than the then administratively fixed applicable value of 9.02 cent/kWh in direct marketing (BNetzA, 2015).

<sup>122</sup> §3 EEG 2014.

<sup>123</sup> §29 para. 1 EEG 2014.

<sup>124</sup> §6 EEG 2014.



remunerations depending on the extent to which newly installed wind capacity is in line with the expansion corridor. This means financial support for onshore wind energy under the EEG 2014 is controlled quarterly as of 2016 using their degression rate and can increase or decrease if growth exceeds or falls below the corridor targets.<sup>125</sup> The tariffs for new wind installations are subject to quarterly degression, which reflect technical progress and cost reductions. The applicable quarterly degression for onshore wind energy from 1<sup>st</sup> January 2016 is 0.4%.<sup>126</sup>

### **3.7 SPECIAL EQUALISATION SCHEME**

In principle, the regulatory provisions covering the costs of the feed-in tariffs apply to everyone. However, the EEG provides for a reduction of the EEG surcharge with the special equalization scheme<sup>127</sup> for energy-intensive companies and rail operators. This is to mitigate competitive disadvantages of high-energy prices on energy intensive industries and railroad operators. This scheme specifically relieves certain electricity-intensive companies and rail operators from the obligation to purchase electricity generated within the scope of the EEG and thus relieves them of the corresponding EEG surcharge. The EEG 2014 special equalisation scheme is the result of intensive discussions with the European Commission, as the commission dimmed the scheme to be against EU state aid rules (Salje, 2014). In line with the EU Guidelines on State Aid for Environmental Protection and Energy 2014-2020,<sup>128</sup> eligible undertakings are those exposed to a risk to their competitive position due to the costs resulting from the EEG support of renewable energy. They are listed in Annex 4 of the EEG 2014 as “List 1” and “List 2” companies.

The EEG 2014 stipulates that, the amount of electricity consumed at a delivery point by a company listed in Annex 4, for which the EEG surcharge has to be paid must exceed 1 GWh in the last calendar year.<sup>129</sup> Undertakings can apply for an EEG surcharge reduction if the ratio of electricity costs to gross value added at factor costs amounts to 16% for list 1 companies (as of 2016: 17%), 20% for list 2 companies. Applicants have to operate a certified energy and environment management system. For these companies, the EEG surcharge can be limited by the Federal Office of Economics and Export Control (BAFA) upon application. Applications for the limited EEG surcharge have to be handed in with the

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<sup>125</sup> §29 para. 3 and 4 EEG 2014.

<sup>126</sup> §29 para. 2 EEG 2014.

<sup>127</sup> Chapter 2 EEG 2014.

<sup>128</sup> Official Journal of the European Union, C 200 of 28.6.2014, p. 1-55.

<sup>129</sup> Pursuant to §60 para. 1 or §61 EEG 2014.

necessary documentation by 30<sup>th</sup> June of the given year. The BAFA decision will take effect as of 1 January of the following year for the duration of one year (BAFA, 2014).

In 2006, about 282 companies within the scheme saved the sum of about 410 million Euros. This figure had increased to 734 by 2012, with savings of about 2.36 billion Euros (BAFA, 2014). The extra costs for non-privileged electricity consumers certainly rose accordingly. The electricity bill of an average household rose by around €18 a year in 2012 alone because of this industry privilege scheme. Data from the BAFA shows that, 1,716 companies were (partially) exempt in 2013. The number of exempted companies rose to over 2,098 in 2014 (BAFA, 2014). Figure 3.1 shows the growing number of enterprises that have been exempted from the EEG surcharge system and the increasing share of electricity they consume: since 2010, the number of companies exempted has increased from 570 (86,594 GWh) to 2,098 (107,101 GWh) in 2014.

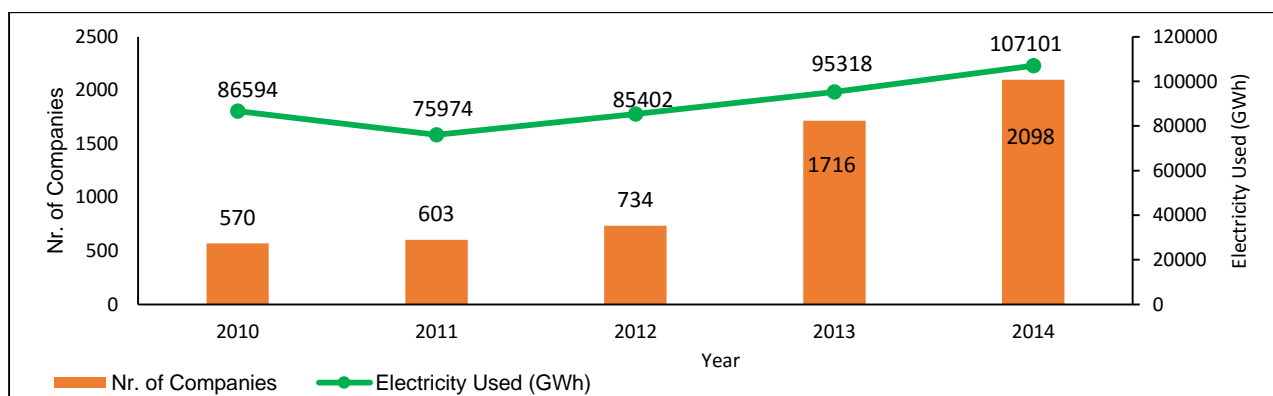


Figure 3.1: Number of companies exempted from EEG surcharge, 2010-2014

Source: (BAFA, 2014)

### 3.8 SELF-SUPPLY

In the previous versions of the EEG, electricity generated by the consumer was not subject to the EEG surcharge.<sup>130</sup> The steady increase in EEG surcharge made it commercially more attractive to consume self-generated electricity, without having to pay the EEG surcharge. Above all, the idea of taking part in the energy transition process and the avoidance of CO<sub>2</sub> emitting energy sources is of significant importance to these consumers (Morris & Peht, 2014). In EEG 2014, self-suppliers who use new renewable energy installations have to pay a reduced EEG surcharge.<sup>131</sup> The new provisions for renewable energy installations stipulates that the reduced surcharge rate will initially be 30% through 2015 and then raised

<sup>130</sup> §33 para. 2 EEG 2012.

<sup>131</sup> §61 EEG 2014.

to 35% for 2016. These reduced rates will apply only during these two years. Installations that are commissioned later will pay a reduced EEG surcharge of 40% from 2017.<sup>132</sup>

This new provision of the EEG is in contradiction to the principle of the Act itself. The EEG is based on the polluter pays principle. This means final consumers using polluting energy sources pay for the consequences/impacts of this energy source. Therefore, implementing a levy on consumers who invest in clean energy forms, whether for economic or climatic reasons, sends the wrong message and contradict the very principle of the EEG.

### **3.9 STATE OPENNING CLAUSE (Länderöffnungsklausel)**

In the course of amending the EEG, the federal government also amended Art. 249 BauGB (para. 3 was inserted to Art. 249 BauGB)<sup>133</sup> by introducing the "Länderöffnungsklausel", which allows the federal states to restrict the privileged status of onshore wind energy.<sup>134</sup> Art. 35 BauGB allows building in outskirts areas not regulated by a zoning plan only in a limited number of cases. According to Art. 35 para. 1 No. 5 BauGB, projects that may receive a building permit are those that serve research, development or the use of wind or hydro energy. This privileged status may now be restricted pursuant to the new opening clause in Art. 249 para. 3 BauGB.

The federal state of Bavaria is the first to make use of the state opening clause. The amendment of the Bavarian Building Regulation (Bayerische Bauordnung – BayBO) entered into force on 21<sup>st</sup> November 2014 (Albrecht & Zschiegner, 2015).<sup>135</sup> Because the Art. 82 BayBO prescribes a minimum distance of windmills to residential housing of ten times the total height of the windmill, the amendment has become known as the "10-H-rule" (Albrecht & Zschiegner, 2015; Fülbier, et al., 2014).

This new provision in the federal building code might in some cases lead to a drastic reduction of appropriate areas for onshore wind energy projects. Using the federal state of Bavaria as an example, a modern windmill with a total height of 200m would need a minimum clearing to residential areas of 2,000m. A research published by the Federal Environment Agency (Umweltbundesamt - UBA) in 2013 shows that, at a minimum clearing to residential areas of 2,000m nationwide, all that remains of the federal territory for wind

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<sup>132</sup> §61 para. 1 EEG 2014.

<sup>133</sup> Federal Building Code in the version promulgated on 23<sup>rd</sup> September 2004 (Federal Law Gazette I p. 2414), last amended by Article 1 of the Act of 20<sup>th</sup> November 2014 (Federal Law Gazette I p. 1748).

<sup>134</sup> §35 para. 1 No. 5 BauGB.

<sup>135</sup> Bavarian Building Regulation in the version promulgated on 14<sup>th</sup> August 2007 (Bavarian Law Gazette I p. 588), last amended by Article 1 of the Act of 17<sup>th</sup> November 2014 (Bavarian Law Gazette I p. 478).

energy generation is 0.4% (Lütkehus & Salecker, 2013). According to a study by the Federal Institute for Research on Building, Urban Affairs and Spatial Development (Bundesinstitut für Bau-, Stadt- und Raumforschung - BBSR) in 2013, about 0.44% of the federal territory has so far been designated for wind energy development and this area will be exhausted by the end of 2015. The study equally predict that, to achieve the renewable energy targets for 2020, double the designated federal territory is needed, i.e. 0.88% (BBSR, 2014). Therefore, if all the federal states should implement a similar regulation as the federal state of Bavaria, the Germans should wish good-bye to the energy transition. However, this is not likely, as the remaining federal states have already declared that they will not make use of the state opening clause.

### **3.10 EEG SURCHARGE (EEG-Umlage)**

The costs of financing renewable energy in Germany by the final consumer is called EEG surcharge.<sup>136</sup> The EEG surcharge is the mechanism that finances the feed-in tariffs system (Salje, 2014). The surcharge is actually the difference between the wholesale market price for electricity on the electricity exchange and the fixed remuneration rate for renewable energies. It is paid by all consumers of electricity with the exception of energy intensive industries and rail operators. The EEG surcharge increased from 2.05 cent/kWh in 2010 to 6.24 cent/kWh in 2014 (BMW, 2014). According to the German Association of Energy and Water Industries (Bundesverband der Energie- und Wasserwirtschaft - BDEW), the real costs of supporting renewable energy have only increased from 2.39 to 2.54 cent/kWh, i.e. by just 13%, during this period (BDEW, 2014). In 2013, the total EEG surcharge amounted to € 20.4 billion. In 2014, the EEG surcharge was set at 6.24 cent/kWh (BMW, 2014). Apart from the modest increase in the pure costs of renewable energy support, the following factors are primarily responsible for the rise in the EEG surcharge:

1. The expansion of energy privileges for energy-intensive companies: The amendment to the EEG in 2012 allowed the federal government to expand the special equalization scheme to a significant extent. The number of privileged companies exempted since 2010 rose from 570 to 2,098 in 2014 (see section 3.7 above). The German Renewable Energy Federation (Bundesverband Erneuerbare Energie - BEE) claims that industry privileges accounted for 1.26 cent/kWh of the EEG surcharge for 2014 (BEE, 2013).
2. The reduction in market price of electricity: A significant factor contributing to this decline of market prices is the growing amount of electricity generated from renewable energy,

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<sup>136</sup> §78 EEG 2014.

curtailing expensive fossil fuel plants from the market and lowering the current market price of electricity (due to the Merit-order-effect<sup>137</sup>). Electricity spot market prices dropped from 7 cent/kWh in 2008 to 3.7 cent/kWh in 2013 (BEE, 2013). The fall in the spot market price increases the EEG surcharge. This is because of the calculation method<sup>138</sup> of the EEG surcharge; defined in the EEG.<sup>139</sup> The fall in the market price of electricity accounted for 1.45 cent/kWh of the EEG surcharge of 2014 (BEE, 2013).

3. Expenditure on the market premium amounted to 0.13 cent/kWh of the EEG surcharge in 2014 (BEE, 2013).
4. Equalisation of the negative balance. In 2013, the EEG account moved into negative territory (BMW<sub>i</sub>, 2014). This was because spot market prices fell more sharply than forecast and led to lower revenue for the renewable electricity sold on the market than predicted. The equalisation of the negative balance resulting from forecasting errors when calculating the EEG surcharge for 2013 accounted for 0.86 cent/kWh of the EEG surcharge for 2014 (BEE, 2013).

### **3.11 CHAPTER DISCUSSION**

The transition brought about by the increasing shift from fossil and nuclear energy carriers has to reduce the external costs resulting from their use in future. Wind energy usage is an economic sector with enormous growth potential. In this respect, the wind industry is already and will continue to assert its lasting impact on the socio-economic sector.

#### **3.11.1 ANALYSIS OF THE EEG SURCHARGE AND ELECTRICITY PRICE**

The results of the survey showed that, for those whose support for wind parks in neighbourhoods is dependent on certain conditions (58%), 46% would permit windmills in their backyard against low electricity bills (see Figure 6.15). In addition, of the 18% that are unwilling to opt for green electricity, 54% reasoned that green electricity is expensive (see Figure 6.19). As far as electricity end users - other than the exempted energy intensive industries - are concerned, the EEG is a long way from achieving its purpose of reducing economic cost. In fact, there has been a substantial increase of the EEG surcharge in recent

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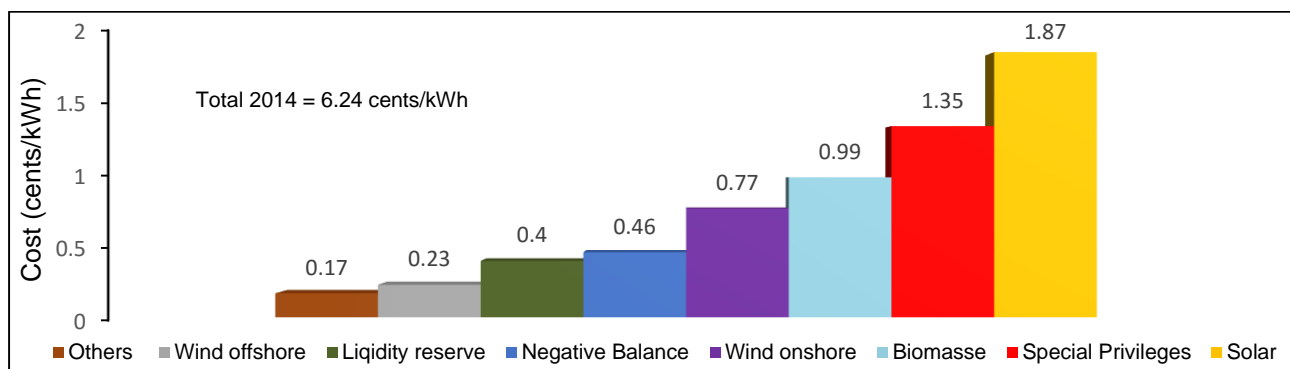
<sup>137</sup> The merit order is a way of ranking power plants in the electricity market. Installations with the lowest marginal costs are the first to be brought online to meet demand, followed by those with higher marginal costs in ascending order until all demand is met. The marginal costs of wind and solar energy installations are close to zero, as they do not have to buy fuel. Therefore, in the energy market, they always come online and thus oust more expensive fuel dependent plants. The merit-order-effect lowers the market price of electricity (BMW<sub>i</sub>, 2014).

<sup>138</sup> §54 EEG 2012.

<sup>139</sup> When renewable energies lower the market price, the difference between the feed-in tariff paid for electricity generated from renewable energy sources and the revenue from the sale of this electricity on the market becomes larger. This increases the surcharge.

years, from 2.05 cents/kWh in 2010 to 5.277 cents/kWh in 2013. It constituted a share of 18% of the total final consumer price for private electricity customers in 2013 (BMW, 2014). In 2014, the EEG surcharge was 6.240 cents/kWh representing a 0.963 cents/kWh increase from 2013 (Übertragungsnetzbetreiber, 2013).

The amount paid as EEG surcharge results from a complex interplay of factors, some of which stem from the EEG legislation (feed-in tariffs and special privileges for energy intensive industries) and some of which originate from other policy areas (e.g. very low CO<sub>2</sub> prices under the EU emission-trading scheme), as well as the decreasing wholesale electricity prices and carry-over from the previous year (Kempe-Samsami, 2013). Without any doubt, the support for renewable energies is having an impact on the EEG surcharge. However, the significance of this impact is relatively minimal. According to a study by the Fraunhofer Institute for Solar Energy Systems (ISE), the EEG surcharge increased almost fivefold between 2009 and 2014, while the compensation payments for renewable energies have only slightly more than doubled during this period (Mayer & Burger, 2014). Figure 3.2 below depicts the composition of the EEG surcharge in 2014.



**Figure 3.2: Composition of the EEG surcharge for 2014**

Courtesy: Wanki, data from (Übertragungsnetzbetreiber, 2013)

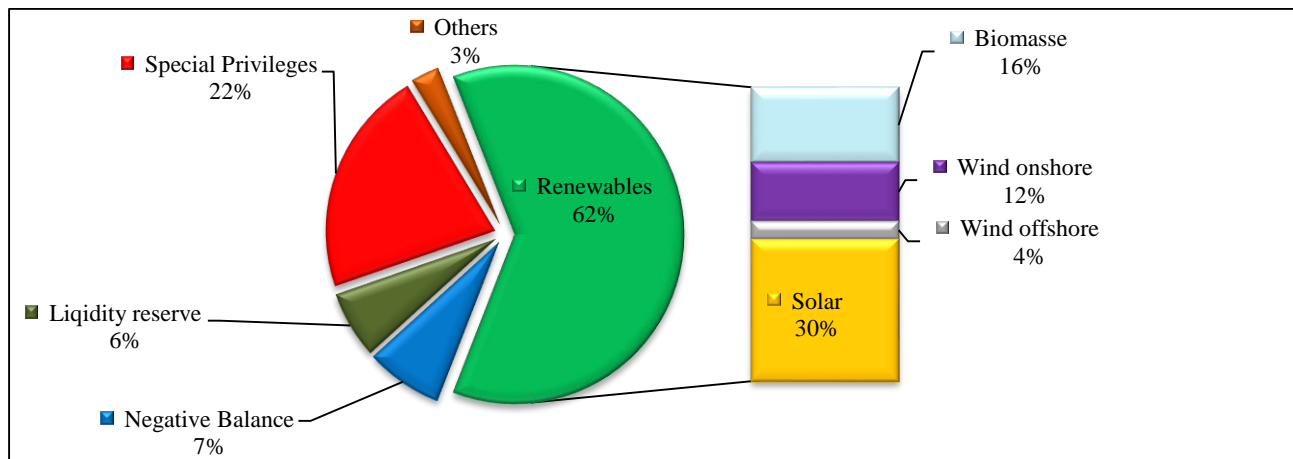
The following subsections evaluate the different factors that contributed to the increase in the EEG surcharge and consequently the electricity price for 2014.

### 3.11.1.1 Expansion of Renewable Energies

The EEG guarantees a statutory remuneration per kilowatt-hour of electricity generated to operators of renewable energy installations by the grid operator, because they feed the electricity into the grid system.<sup>140</sup> The expenses incurred for the remunerations are later refinanced through the sale of electricity to the end user. This revenue is, however, not sufficient to refinance the compensation payments. The difference between the sales

<sup>140</sup> §34 to §39 EEG.

proceeds and the compensation payments is then transferred to electricity end user in the form of the EEG surcharge. All end consumers who purchase electricity from the public grid system pay per kilowatt-hour of electricity consumed a corresponding rate. Figure 3.3 shows the share of each renewable energy source to the EEG surcharge of 2014.



**Figure 3.3: Share of each renewable energy source to the EEG surcharge of 2014**

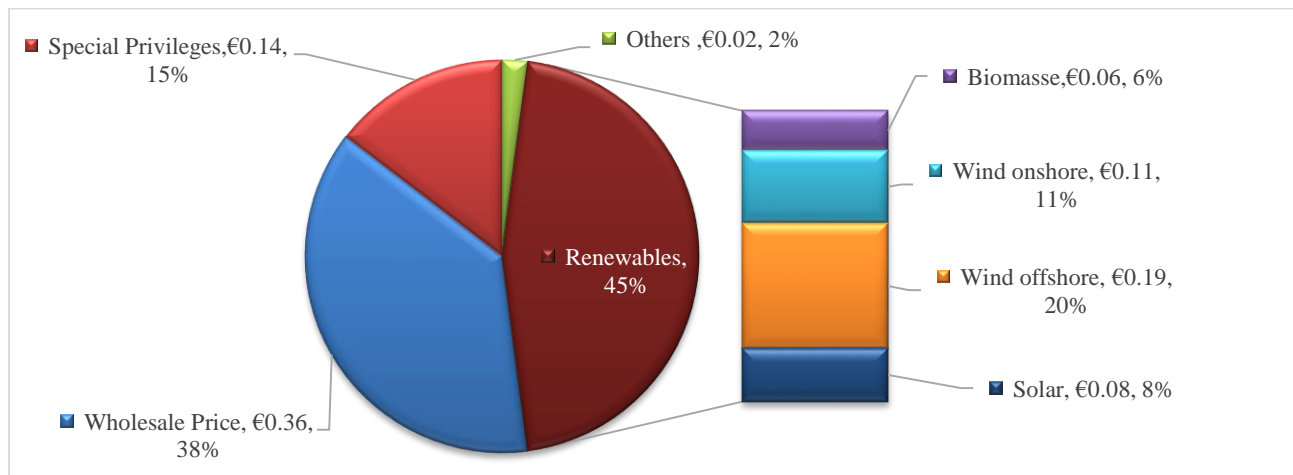
Courtesy: Wanki, data from (Loreck, et al., 2015)

Renewable energy sources contributed about 62% of the EEG surcharge of 2014, which represented the majority share of the surcharge. However, in terms of the respective constituents of the surcharge, solar energy (30%) and special privileges given to energy intensive industries (22%) had the highest impact on the surcharge, contributing together more than 50%. Onshore wind energy contributed only 12% to the EEG surcharge in 2014. Given that onshore with generated about 54.7 TWh of electricity in 2014 (BMW, 2015), by far the highest of all renewable energies, with a comparable installed capacity with solar energy, its relatively minimal share in the surcharge could signify the competitiveness of onshore wind energy in the open market. That is, a significant share of the generated electricity was sold directly in the exchange market with passing to the feed-in tariff system. This shows that the EEG surcharge is no longer the proper measure of the price paid for the expansion of renewable energy. It is equally not a proper indicator of the cost of the energy transition process in Germany.

With respect to the contributions of the individual constituents to the increase in the EEG surcharge in 2014 compared to 2013 (see figure 3.4), renewable energies contributed about 45%, of which a mammoth share of this renewable contribution came from offshore wind energy (about 20%) and onshore wind energy accounted for 11% of the increase. Surprisingly, the impact of solar energy was minimal relative to onshore wind energy. This could be associated to the fact that onshore wind energy registered its highest annual growth



in 2014 as investors rush to take advantage of feed-in tariff model before it is replaced by the tendering model from 2017.



**Figure 3.4: Contributions to the increase in EEG surcharge in 2014 compared to 2013**

Courtesy: Wanki, data from (Loreck, et al., 2015)

### 3.11.1.2 Falling Wholesale Prices of Electricity

The notion that increasing wind energy penetration (and renewable energies in general) is causing the EEG surcharge to increase is distorted. The reduction in the spot market price poses a problem for the EEG surcharge because of the calculation method. The EEG surcharge is then calculated as follows: “the costs (the remuneration paid to operators of renewable energy installations) minus the revenue from the sale of EEG electricity on the electricity exchange market” (Übertragungsnetzbetreiber, 2013). This formulation illustrates a major flaw in the calculation of the EEG surcharge, which has nothing to do with the actual cost of supporting renewable energies. That is, the lower the wholesale electricity price on the exchange market, the higher the differential costs that are passed on to the end consumer. The wholesale electricity price depends on both the fuel used to generate electricity and the cost of CO<sub>2</sub> under the EU emission-trading scheme (Loreck, et al., 2015), i.e. factors that are independent of the expansion of electricity generation from renewable energy sources. The excessively low prices for CO<sub>2</sub> credits play a key role in this falling trend. Operators of coal-fired power plants buy emission credits very low and are thus able to sell their electricity for low prices on the spot market. In the second quarter of 2013, CO<sub>2</sub> certificates were available for around €4 to €5 per tonne. The real CO<sub>2</sub> costs, as estimated by the German BMU and the UBA, are closer to €80 per tonne (BMU, 2015). However, the expansion of renewable energies also affects wholesale price: the more electricity generation from renewable energy sources is fed into the grid system, the less electricity from



conventional power plants is needed.<sup>141</sup> Therefore, the most expensive convention energy sources are replaced by renewable energy sources, which have a lower marginal cost, thereby reducing the wholesale price for electricity. This means that renewable energy lowers market prices and simultaneously becomes a victim of its own success due to the flawed calculation method. Figure 3.4 above shows that falling wholesale prices alone accounted 38% of the increase in the EEG surcharge in 2014.

### **3.11.1.3 Energy-Intensive Industry Privileges**

The number of energy intensive companies partly or completely exempted (special equalisation scheme) has more than doubled between 2010 and 2013 (see Figure 3.1). In 2013, only 47% of German industries paid the complete EEG surcharge while 14% were completely exempted from the scheme and the rest paid a limited share of the surcharge. Consequently, the EEG surcharge has been increasing significantly every year and the majority share of the surcharge (35.3%) is carried by household consumers while the industries pay only 29.9%. The special equalisation scheme was devised to avert negative competitive effects of the EEG - crucial in this regard is whether competitors are also subject to similar policies. The scheme should be reconsidered because it is presently not ideal. For example, industries with an annual electricity consumption of at least 100 GWh only make a contribution of 0.05 cents/kWh. Figure 3.3 and 3.4 depict that, with 22%, special privileges granted to industries accounted for the highest share of the EEG surcharge in terms of the individual components and also accounted for 15% of the increase in the surcharge in 2014 compared to 2013. When one takes the falling wholesale prices induced partly by increased renewable electricity generation into account, such companies are likely to profit more from the EEG. The total sum of saved by these industries due to the exemptions from the EEG surcharge have increased from approximately € 2.7 billion in 2011 to now EUR 5.1 billion in 2014 (BAFA, 2014).

The amendment does not adequately address the costs for previously installed renewable energy installations, as high long-term electricity feed-in tariffs are locked for the next two decades. Prior to the amendment, the former German environmental minister Klaus Töpfer and other experts argued for the creation of a fund to pay for pre-existing debts (Altschuldenfonds) in 2013 (Dehmer & Eubel, 2014). This Altschuldenfonds (financed with public funds) would be used to pay costs associated with financing and incentivising renewable energy. This would allow those costs to be removed from the utility bills of

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<sup>141</sup> Merit-order-effect.

consumers. Hence, a reduction of electricity prices and a relief from future cost increases. While the Altschuldenfonds will ultimately be financed through overall taxes, a creation of such fund would spread the costs of financing renewable energies more evenly. The companies that so far had been exempt from paying the EEG surcharge would contribute to the costs through their overall tax rate without increasing their energy costs, making this a fairer process overall.

#### **3.11.1.4 Equalisation of the Negative Balance and Liquidity Reserve**

The grid system operators publish in autumn of every year the EEG surcharge applicable for the following year. This means that they have to create forecasts for all relevant revenue and expenditure in the following year in order to calculate the differential costs and thus the necessary surcharge level. However, the real development of the forecast figures may vary. Depending on the direction of these deviations, it may result in a surplus or deficit of the EEG account of the grid system operator. If the account balance is negative, the new EEG surcharge does not consider only the expansion of renewable energies in the following year paid, but also the deficit balance on the account.<sup>142</sup> For this reason, the grid system operators are entitled to include a liquidity reserve in the calculation of the EEG surcharge to ensure that payments of feed-in tariffs. This liquidity reserve is used to reduce intra-year credit needs under the EEG and therefore lowers the interest costs incurred within the EEG (Loreck, et al., 2015). The cost for balancing the EEG account made up 7% of the EEG surcharge of 2014 while the liquidity reserve against 2015 made up 6% (see figure 3.3). In 2013, the EEG account moved into negative territory. This was because wholesale prices fell more sharply than forecasted and led to even lower revenue for the renewable electricity sold on the market than predicted (Übertragungsnetzbetreiber, 2013).

#### **3.11.1.5 Policy Pitfall**

The relatively high increase in the EEG surcharge equally finds its roots in government policies, which have not been able to reverse the trend of increasing electricity prices. From August 2012, the installed capacity of photovoltaics (35.651 GW) surpassed that of wind energy. However, electricity generation from wind energy installations almost doubled that of photovoltaics in 2013 (see figure 5.2). As a result, the solar sector received 54% of all feed in tariffs (highest) and generated only 26.2% of all EEG electricity while onshore wind energy received only 16.6% of all feed in tariffs and generated 41.5% (highest) of all EEG

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<sup>142</sup> §62 EEG.

electricity.<sup>143</sup> Geographically, Germany has a higher wind energy potential than solar and should consequently concentrate more resources to support the wind sector, whose impact on household price is minimal.

The amendment does not adequately emphasize on electricity storage. Increasing energy storage for variable renewable energy is a key issue in Germany. Yet, pumped storage,<sup>144</sup> for example, actually suffered from the initial EEG, which did not include it in the feed-in tariff and which levied providers of pumped storage with the EEG surcharge, treating them as end-users (Asendorpf, 2013). During the subsequent amendment, pumped storage was exempted from the EEG surcharge, but were not able to receive feed-in tariffs. The amendment of the EEG falls short of incentivising any kind of storage, which will be needed to balance intermittent renewable energy.

### **3.11.2 EXPANSION CORRIDOR**

While it is understandable that the depression rate (0.4%) increase if the quarterly installed capacity falls above the expansion corridor,<sup>145</sup> when the quarterly installed capacity falls below the expansion corridor, however, there is still a depression - although subtle.<sup>146</sup> Even with a fall below the expansion corridor by 200 MW, the remuneration is shortened in the following quarter. Only when it falls below the expansion corridor by more than 400 MW does the remuneration in the following quarter remain constant. Effective reaction to negative developments occurs only when contraction exceeds 600 MW. Besides, the reference period for an investor considering a possible starting quarter for remuneration is the period following the last calendar day of the eighteenth month and before the first calendar day of the fifth month preceding a point in time pursuant to Art. 29 para. 2 (Salje, 2014). Therefore, the tariff for the respective quarter is announced five months in advance, whereby the reference period for the tariff calculation is 18 months preceding the publication date. This means that the investor has only five months between the fixing of the remuneration and the commissioning of the wind turbines, which is arguably short considering the complexities of onshore wind energy projects. This has the potential of reducing investor confidence and placing a risk on investment.

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<sup>143</sup> See “Erneuerbare Energien und das EEG: Zahlen, Fakten, Grafiken (2013)”:

[http://www.bdew.de/internet.nsf/id/17DF3FA36BF264EBC1257B0A003EE8B8/\\$file/Foliensatz\\_Energie-Info-EE-und-das-EEG2013\\_31.01.2013.pdf](http://www.bdew.de/internet.nsf/id/17DF3FA36BF264EBC1257B0A003EE8B8/$file/Foliensatz_Energie-Info-EE-und-das-EEG2013_31.01.2013.pdf).

<sup>144</sup> One storage method that is currently available on a larger scale in Germany.

<sup>145</sup> §29 para. 3 EEG.

<sup>146</sup> §29 para. 4 EEG.

Furthermore, a purpose of the EEG is to promote cost-effective expansion of renewable energies. The BMWi in its explanation of the EEG amendment says: “*in order to lower the costs for the further expansion of renewable energy, the new Renewable Energy Sources Act focuses on less expensive technologies such as wind energy and photovoltaics*” (BMWi, 2015). Presently, onshore wind energy is one of the most cost-effective renewable energy in Germany (Salje, 2014). Introducing limitations to the growth of onshore wind energy using an expansion corridor is in actual contradiction to the purpose of the EEG. Furthermore, there is no research nor calculation model to support the assumption that these expansion corridors are enough for Germany to achieve its target of 80% share of renewable energies in gross electricity consumption by 2050.

### **3.11.3 DIRECT MARKETING**

The EEG 2014 provides for a mandatory direct marketing for all wind energy installations over 500 kW capacity and from 2016 for all new windmills over 100 kW installed capacity.<sup>147</sup> Thus, the operator is prompted to provide the wind energy directly and autonomously for sale. As of August 2014, over 87% of all installed wind capacity were in direct marketing (Fraunhofer, 2014). Therefore, the introduction of mandatory direct marketing for wind energy bears less risk compared to the other changes in the EEG. In addition, the partial withdrawal of the fall back provision according to Art. 38 EEG 2014 enhances the marketing process, because investors could place significant risk charges as investment security on the direct marketer in order to cover their investments in the case of possible market failure. However, this provision equally strengthens the position of direct marketers, as wind energy generators would incur a 20% remuneration reduction if the generator chooses to market the electricity through the grid operator.<sup>148</sup> This makes the remuneration of wind generated electricity to rely increasingly on individual contracts, resulting to a loss in predictability and transparency - how this will be reflected in risk calculations and capital spending, remains to be investigated.

While direct marketing can be considered a good step towards market integration of renewable energies, EEG 2014 introduces an applicable value to the electricity generator, creating an uncertain operating cost. An onshore wind energy operator will incur additional operating cost if the output deviates from the rated output of the wind turbine. Due to the

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<sup>147</sup> §37 para. 2 EEG.

<sup>148</sup> §38 para. 2 EEG.

fluctuating nature of wind energy generation, this makes the applicable value unpredictable. This makes the predictability of cash flow available for debt servicing difficult.

### **3.11.4 TENDERING**

The EEG 2014 for the first time includes the political commitment by 2017 at the latest, to introduce general tendering procedures for the financial support of electricity from wind energy. To gain experience, the EEG provides pilot tenders for ground-mounted photovoltaic systems.<sup>149</sup> The corresponding statutory provisions include a variety of specifications for this tender procedure.<sup>150</sup> The "stop-and-go" nature of tendering may lead to unpredictability in the market, as feed-in tariffs of the next round of tendering will be difficult to foretell. This can create an unstable investment environment, which may threaten the success of the energy transition process. Besides, several studies have been published that deal critically with the planned tender and experiences abroad with tendering procedures are mixed (Fraunhofer IWES, 2015); the expected positive effects of tendering were rare and the implementation difficult. In addition, tendering may not maintain the diversity of stakeholders, particularly "citizen wind park" operators may be discriminated systematically as they are not open to the capital market compared to their corporate counterparts (Fraunhofer IWES, 2015).

Furthermore, the development of wind energy projects threatens to stagnate as long as the basic conditions and procedures for tendering are not known. Given that approval under the BImSchG must be in place until the end of 2016 in order to qualify for remunerations within the currently applicable market premium, the report of the Federal Government on the current photovoltaic pilot project on tendering is to be submitted in June 2016,<sup>151</sup> is clearly too late for a meaningful start of tendering in 2017. Besides, the experience of ground-mounted PV system tender may only be partially transferable to wind energy. The significantly longer planning and approval periods, and significantly higher specific planning and development costs for onshore wind energy projects are likely to lead to differences in approach.

If the first tendering session is anything to go by, then results of tendering did not show a reduction in the applicable value of solar energy. Rather, the outcome of the tender process showed that the average remuneration obtained (9.17 cent/kWh) was higher than the

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<sup>149</sup> §55 EEG.

<sup>150</sup> §88 EEG.

<sup>151</sup> §99 EEG.

administratively fixed applicable value of 9.02 cent/kWh in direct marketing (BNetzA, 2015). This scenario effectively increases the EEG surcharge.

### **3.12 CHAPTER CONCLUSION**

The current EEG is aimed at increasing, in a sustainable manner, the share of renewable energies in the electricity supply in Germany to at least 80% by 2050. The EEG has generally proven to be successful in promoting the expansion of renewable energies in Germany. The EEG 2014 has created a more predictable framework for the expansion of renewable energies. This will in turn foster the rapid market integration of renewable energies, which signifies a stepwise reduction of feed-in tariffs and consequently electricity prices as well. Its economic efficiency is, however, still controversial. The short- and medium term effects of the amendment on the electricity market appear to be limited because the number of installations and periods that are affected by the legislation is limited for now. In contrast, the effects on financing costs could be significant due to the long-term investment cycles of the renewable energy industry and the high level of uncertainty regarding future electricity prices.

Concerning wind energy, the EEG 2014 reduces earning opportunities for future wind energy generators through changes to the feed-in tariff scheme. These changes are likely to increase the cost of capital needed to finance new wind energy facilities. Three proposed changes would have the greatest impact on earnings and capital cost. First, EEG 2014 allocates balancing costs to wind facility operator, creating an incremental and uncertain operating cost. Second, EEG 2014 compensates the wind facility operator at the market price, plus a premium, the combination of which may be less than under EEG 2012. Finally, the third change amends the reference yield model: a system used to mitigate the risk of underproduction resulting from unfavourable siting of the wind energy installation and poor weather conditions. These changes could, in the long run, have an adverse impact on energy price. Besides, the EEG and the technical regulations are not yet adequately prepared for an increasing use of storage facilities. Storage in the EEG is neither politically nor legally outlined properly.

The Federal Ministry of Economics announced shortly after the EEG reform of 2014 further steps, which signifies further amendment of the EEG in 2016 to enable technology-specific expansion of renewable energy systems.

## 4 WIND ENERGY PLANNING

### 4.1 GENERAL STATEMENT

As part of its energy and climate policy, the German Government has set short, medium, and long-term binding targets to expand its share of renewable energies in gross final energy consumption.<sup>152</sup> The highest contributor will be wind energy. According to the German National Action Plan, the shares of renewable energy sources in electricity generation by 2020 will be as follows: wind energy 48%, biomass 23%, photovoltaics 19% and hydropower 9% (BMU, 2010). To achieve these targets, the government has adopted a series of regulations aimed at fostering and at the same time controlling the expansion of wind energy in Germany.

Onshore wind energy experienced a boom following its designation in the BauGB as a privilege installation<sup>153</sup> in outskirt areas in 1997 (Bruns, et al., 2008).<sup>154</sup> A survey by the Forsa Society for Social Research and Statistical Analysis (Forsa) on behalf of the Federation of German Consumer Organisations (Verbraucherzentrale Bundesverband – VZBV) shows that there is a broad social consensus in Germany with regard to the energy transition process (VZBV, 2013).<sup>155</sup> Nevertheless, a detailed understanding of how the new energy landscape would look like is not yet possible. An integral part of this landscape would in any case be wind turbines, of which onshore wind energy development possesses a considerable potential. To succeed, the transition process would have to tap this potential.

Against this background, this chapter will analyse the contribution of regional planning together with the different control instruments to the expansion of onshore wind energy utilisation. The chapter will analyse legislation on planning and construction, emission control, and nature protection in order to determine the impact of these policies on wind energy generation in Germany. This is aimed at achieving objective two of this research and equally provide a detailed analysis of the problems concerning land availability as well as windmill impact on avifauna.

### 4.2 REGIONAL PLANNING REGULATION

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<sup>152</sup> §1 para. 2 and 3 EEG 2014.

<sup>153</sup> §35 para. 1 No. 6 BauGB 1997.

<sup>154</sup> Federal Building Code in the version promulgated on 23<sup>rd</sup> November 1994 (Federal Law Gazette I p. 3486), last amended by Article 2 para. 2 of the Act of 30<sup>th</sup> July 1996 (Federal Law Gazette I p. 1189).

<sup>155</sup> The survey result is in unison with another survey executed by TNS Infratest Institute and Scholz & Friends Agenda (Hilmer & Dittko, 2013).



The essence of planning is to structure space in order to attain the goal of balanced regional development (Hentschel, 2010). These goals differ with respect to planning level and range from specific requirements relating to the use of land in local urban development planning to guidelines advanced by federal regional planning policy (Hentschel, 2010). In Germany, there exist clear regulations guiding the planning and control of wind energy projects. The purposes of regional planning, which take into account the functions of the ecosystem,<sup>156</sup> are elaborated and implemented by a range of regulations on three levels: federal planning, state regional planning, and regional planning (von Hauke, 2011). These regulations provide the guiding principles on land use planning in which they aid in the identification of appropriate areas for specific land use requirements.

At the federal level, the Regional Planning Act (Raumordnungsgesetz – ROG)<sup>157</sup> is the guiding law for land use planning. ROG is therefore a control instrument used for the designation of sites for regionally significant projects and for the resolution of potential spatial conflicts, particularly conflicts in relation to environmental and nature protection. These are aimed at avoiding urban sprawls and maintain effective infrastructure patterns.<sup>158</sup> The guiding concept of regional planning in Germany is based on sustainable spatial development, which harmonizes the social and economic demands on land with its ecological functions and results in a permanent, larger scale and balanced order of equivalent living conditions in the sub-regions. Generally, federal regulations for planning control of wind turbines are directed towards state regional planning, community development planning, as well as the specific project planning.

At the federal state level, state regional planning regulations are the instruments used for the coordination of the different interregional and regional spatial needs including the needs of wind energy. Federal state regional planning is aimed at establishing and safeguarding equivalent and healthy living and working conditions in all parts of the state (von Hauke, 2011). Its objective is to lay down principles and binding goals in regional plans, which are prepared based on all regionally significant sectorial plans pertaining to specific projects in accordance with Art. 3 para. 1 no. 6 ROG. The instrument used in state regional planning in Brandenburg is the Berlin-Brandenburg State Development Plan (Landesentwicklungsplan Berlin-Brandenburg - LEP B-B).<sup>159</sup> Each federal state is responsible for developing planning

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<sup>156</sup> §1 para. 1 ROG.

<sup>157</sup> Regional Planning Act in the version promulgated on 22<sup>nd</sup> December 2008 (Federal Law Gazette I p. 2986), last amended by Article 9 of the Act of 31<sup>st</sup> July 2009 (Federal Law Gazette I p. 2585).

<sup>158</sup> §1 para. 2 sentence 1 ROG.

<sup>159</sup> §8 ROG.



rules within its jurisdiction: the federal states create regional plans for the different sub-regions, which provide for orderly management of spatial development.<sup>160</sup> In the federal state of Brandenburg, regional planning is the responsibility of the Regional Planning Boards (Regionale Planungsgemeinschaften - RPG).

#### **4.2.1 REGIONAL PLANNING PROCESS AND WINDMILLS**

According to Art. 1 of the Regional Planning Ordinance (Raumordnungsverordnung-RoV)<sup>161</sup> and Art. 35 BauGB, windmills are privileged installations in undesignated outskirt areas (Außenbereich). However, unlike public projects, private projects with no public interest are required to provide possible alternatives for location. If both the proposed location and the evaluation in the regional planning process are identical pursuant to Art. 4 ROG, the plan will anyway still need an approval before execution can commence.

##### **4.2.1.1 Stipulations in the Regional Plan**

According to Art.8 para. 7 ROG, the following categories of areas intended for wind parks have been identified:

1. Priority area (Vorranggebiet): This is an area reserved for specific regionally significant functions or uses and other land related uses in this area is excluded unless it is compatible with the priority functions, uses or objectives of the planning.
2. Reserve area (Vorbehaltsgebiet): This is an area reserved for a specific regionally significant function or use, which in the balancing of competing regionally significant functions and uses has priority over the others.
3. Suitable area (Eignungsgebiet): This is an area that is suitable for a specific regionally significant project, which according to Art. 35 BauGB can only be located in outskirt regions and are excluded elsewhere in the planning area.

##### **4.2.1.2 Preparatory Land Use Plan (Flächennutzungsplan)**

The preparatory land use plan outlines the development envisaged for the entire municipal territory.<sup>162</sup> Municipalities can control space in their localities using the preparatory land use plan especially in undesignated outskirt regions where wind energy is privileged.<sup>163</sup> This is to prevent the proliferation of windmills in the outskirt regions.<sup>164</sup> It is executed through the designation of “priority zones” or “concentration zones” for wind energy generation in order

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<sup>160</sup> §8 para. 5 ROG.

<sup>161</sup> Regional Planning Ordinance in the version promulgated on 13<sup>th</sup> December 1990 (Federal Law Gazette I p. 2766), last amended by Article 5 para. 35 of the Act of 24<sup>th</sup> February 2012 (Federal Law Gazette I p. 212).

<sup>162</sup> §5 BauGB.

<sup>163</sup> According to §5 para. 2b BauGB.

<sup>164</sup> According to §5 and §35 para. 3 No. 3 BauGB.

to concentrate the windmills and create space in outskirts regions (von Hauke, 2011). As a precondition for designating concentration zones, an overall plan concept must be developed.<sup>165</sup> The construction of windmills outside the concentration zones, though within the suitable areas, is forbidden pursuant to Art. 35 para. 4 BauGB and can only be permitted through approval in a building inspection process by the municipality. It should be noted however that wind turbines that are built as minor ancillary facilities, including those in the concentration zones on land use plans are not affected.<sup>166</sup>

#### **4.2.1.3 Binding Land Use Plan (Bebauungsplan)**

The binding land use plan provides specific significance to the preparatory land use plan through the clear area definition of land use. The binding land use plan contains legally binding specifications controlling urban development structures: in this case wind energy installations.<sup>167</sup> It is adopted through a municipal statute. The binding land use plan is the main instrument for implementing local government planning, and constitutes the basis for measures needed to implement the BauGB (Hentschel, 2010). BauGB allows a wide range of content in binding land-use plans, of which an exhaustive list is, provide in Art. 9 BauGB. The admissibility of a project can be decided based on a qualified binding land use plan, but it must contain the minimum specifications listed in Art. 30 BauGB. For an onshore wind energy project, the admissibility of projects can also be definitively decided pursuant to Art. 30 para. 2 BauGB. However, it is permissible only if it does not contravene other local public interests (von Hauke, 2011).

#### **4.2.2 REGIONAL PLANNING IN THE FEDERAL STATE OF BRANDENBURG**

Regional plans contain amongst others suitable areas for wind energy generation. Federal states are delegated to issue regulations guiding the assignment of wind energy suitable areas. This legislature on regional planning has been transposed into the Brandenburg legislation.<sup>168</sup> RegBkPIG stipulates the creation of five RPG in the federal state of Brandenburg (see figure 2.1). The five RPG are Havelland-Fläming, Lausitz-Spreewald, Oderland-Spree, Prignitz-Oberhavel, and Uckermark-Barnim planning boards.<sup>169</sup> According to Art. 4 para. 2 RegBkPIG, the mandatory task of the regional planning authorities is to draw up, expand, change and complete a regional plan. The law also gives the RPG the

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<sup>165</sup> OVG Berlin-Brandenburg 2 A 5.10.

<sup>166</sup> According to §14 para. 1 and 2 BauNVO.

<sup>167</sup> §8 para. 1 BauGB.

<sup>168</sup> Land Brandenburgs Law on Regional Planning, Brown Coal and Rehabilitation Planning (Gesetz zur Regionalplanung und zur Braunkohlen- und Sanierungsplanung - RegBkPIG).

<sup>169</sup> See §3 para. 2 RegBkPIG.

possibility to create factual (sachliche) or spatial (räumliche) sector plans (Teilpläne) in accordance with the countervailing principle (Gegenstromprinzip) of ROG,<sup>170</sup> while ensuring that the sectors fit into the balanced overall development concept of the region. That is, the sector plan is not in conflict with other developmental or conservation projects. Based on a regional development concept, regional actors should be placed in the position to promote the development of the region through a network of synergetic actions.

The RPG has to make concrete regional and interdisciplinary specifications without interfering in the planning activities of the municipalities and the civil rights of private individuals.<sup>171</sup> Therefore, if the regional planning process or an intended regional project contradicts other private and public activities in a manner that cannot be balance in accordance with Art. 4 para. 3 ROG, the project permit could be rejected.<sup>172</sup> A perfect example is the rejection of the factual sector plan, "Wind energy usage" of the Havelland-Fläming region by the Berlin-Brandenburg Higher Administrative Court (OVG Berlin-Brandenburg).<sup>173</sup>

Site selection and the construction of windmills in Brandenburg are regulated through decrees, directives, circulars, and notices from the responsible ministries to the subordinate authorities (regional planning agencies). These decrees or directives have no legal significance but serve as a recommendatory guide to planners (i.e. they are administrative tool with no effects outside of the authority). Table 4.1 below gives a comprehensive overview of degrees and directives issued by the state government to regulate wind energy projects.

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<sup>170</sup> §1 para. 3 ROG.

<sup>171</sup> §7 para. 2 ROG.

<sup>172</sup> Federal Administrative Court (BVerwGE) 125, 176,139, recital 69.

<sup>173</sup> Judgement of 14<sup>th</sup> September 2010, OVG Berlin-Brandenburg in Berlin. Case number: 2 A 1.10, 2.10, 3.10, 4.10 and 5.10.

**Table 4.1: Planning Regulations for Wind Energy Projects in Brandenburg**

DOCUMENT	MAIN FEATURES	LEGAL STATUS	YEAR
Degree on state planning and nature protection assessment of windmills in the state of Brandenburg.	Taboo areas	§ 21 BbgNatSchG, § 20 BbgNatSchG, RL 92/43 EWG (FFH-Richtlinie), RL 79/409 EWG (EGVSRL), § 10 BNatSchG	1996 and amended in 2002
	Restriction areas	§ 10 Absatz 2 Nr. II BNatSchG, Rote Liste Brandenburg, Bonner Konvention.	
	Suitable areas		
	Compensation tax	Part IV section 4.110 4.5	
Circular on legal assessment of windmill constructions (Windmill Decree)	Introduction of Environmental Impact Assessment	Federal Law on Environmental Impact Assessment	1997
Regional planning, construction planning and building law assessment of wind turbines	<ul style="list-style-type: none"> <li>– Assessment of territorial influence, processes of spatial planning for assessment</li> <li>– Identification of suitable wind energy areas in regional planning</li> <li>– Legal effect of the requirements of binding regional planning</li> <li>– Legal effect on establishment of suitable areas in the regional planning objectives</li> <li>– Assessment of wind energy projects in terms of the objectives of regional planning</li> </ul>	BauGB ROG RoV BlmSchG RegBkPIG	2001 and amended in 2002
Circular on ensuring the achievement of the objectives of regional plans to control the use of wind energy	Guidelines	§ 35 BauGB, § 15 ROG, § 10 BlmSchG, § 1 RoV and § 2 Abs. 4 RegBkPIG	2003
Ecological distance criteria for the installation of wind parks in Brandenburg (TAK)	Defines distance of wind parks to protected biospheres.		2003
Recommendations to the regional planning agencies for the identification of suitable areas, "Wind Energy"	<ul style="list-style-type: none"> <li>– Energiestrategie 2020</li> <li>– Increase of total surface area for wind energy</li> </ul>		2009
Circular on ensuring the implementation of the objectives of regional planning to control the use of wind energy		ROG, RoV, and BlmSchG	2010

Courtesy: Wanki

The first of such decree issued at the state level in Brandenburg was the "Wind Energy Decree" (Windkafterlass) of 1996,<sup>174</sup> which required the regional planning boards to develop an overall concept for their planning area. The concept envisaged the division of the

<sup>174</sup> Wind Energy Decree of 24<sup>th</sup> May 1996 (Official Journal of Brandenburg No. 26, p. 617).

planning area into three main groups according to the Art. 10 of the Federal Nature Protection Act (Bundesnaturschutzgesetz - BNatSchG)<sup>175</sup> and the Berlin-Brandenburg State Development Plan (Landesentwicklungsplan Berlin-Brandenburg (LEP B-B)).<sup>176</sup> These groups are taboo area, restriction area and suitable area.

1. Taboo areas: These are areas with very high conflict potential such as:

- Nature Protection Areas (Naturschutzgebiete)
- Special Protected Areas (SPA) e.g. Fauna-Flora Habitat (FFH)
- Species protection areas (Artenschutzgebiete)
- Conservation areas (Landschaftsschutzgebiete)

Conservation areas with less quality natural environment are not classified as taboo areas. These areas can be assigned to restriction areas. The construction of individual windmills or wind parks in taboo areas is absolutely forbidden.

2. Restriction areas: These are areas with moderate to high conflict potential such as:

- Areas with high landscape profiles
- Rest areas for birds
- Breeding areas
- Conservation areas not classified under taboo areas

The construction of single windmills and wind parks in restricted area in compliance with the requirements of the regional planning and in consultation with nature conservation authority is in principle permitted. The individual cases have to be examined and weighed with the impacts and effects of wind energy utilization. In balancing the interests of wind energy use, the size and number of the individual windmills should be considered and where necessary alternative and compensatory measures taken. If alternative and compensatory measures are not possible, a compensatory payment is determined for each investment. The value of the compensatory payment, including possible maintenance costs depends on the scope of measures for prevention and control.<sup>177</sup>

3. Suitable areas: These are areas with low to moderate conflict potential. These include all areas that are not defined as restriction or taboo areas. The construction of individual windmills and wind parks in this area are permitted, if it complies with the conditions

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<sup>175</sup> Federal Nature Protection Act in the version promulgated on 29<sup>th</sup> July 2009 (Federal Law Gazette I p. 2542), last amended by Article 4 para. 100 of the Act of 7<sup>th</sup> August 2013 (Federal Law Gazette I p. 3154).

<sup>176</sup> LEP B-B of 31<sup>st</sup> March 2009 (Brandenburg Law Gazette II, p. 186).

<sup>177</sup> According to Part IV section 4.1 to 4.5 of the Wind Energy Degree of 1996.

stipulated in the Wind Energy Decree and the provisions of the Federal Immission Control Act (Bundes-Immissionsschutzgesetz - BImSchG),<sup>178</sup> which is the binding law for the licensing procedure.

### **4.3 BUILDING PERMIT LEGISLATION**

The construction of windmills in Germany prior to the 1997 amendment of BauGB occurred without any strategic planning; the locations for windmill construction were mainly decided in agreements between the wind energy operators and the local municipalities, which led to a scattered placement of the wind turbines (Bruns, et al., 2008). The privileging of wind energy projects in undesignated outskirt areas is regulated in the current BauGB.<sup>179</sup> The control of wind energy projects through the designation of sector plans for wind energy development presupposes that these projects are regionally significant projects.<sup>180</sup> According to Art. 3 no. 6 ROG, a developmental project or plan is not regionally significant only because of the space taken up, but also when the support functions of the area are affected by the project. This can already be the case with a single windmill in an area. However, the significance of the installation is to be assessed on an individual basis. In this case, not only the dimension of the windmill is a decisive indication, but also the context of the surrounding landscape profile, as well as the function and character of the landscape are taken into consideration (von Hauke, 2011). For planning assessment, it is crucial to determine in which planning areas the windmill is to be built and how many installations are concerned. When sensitively applied, proximity to natural monuments, breeding and resting places of impact endangered bird species, and routes of bats are strictly forbidden in accordance with the BNatSchG, because of the highly visible wind energy installation (Hentschel, 2010). Less sensitive areas that are already pre-loaded by other technical installations like electricity transmission lines area in principle permissible in undesignated outskirt regions. However, the territorial influence of windmills cannot be determined in isolation from the objectives of the zoning plan or the binding land use plan; rather, the provisions of Art. 35 BauGB provide the necessary measure of assessment to the permitting authorities. The purpose of land use planning/management is to prepare and control the

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<sup>178</sup> Federal Immission Control Act in the version promulgated on 8<sup>th</sup> April 2013 (Federal Law Gazette I p. 734), last amended by Article 9 of the Act of 2<sup>nd</sup> May 2013 (Federal Law Gazette I p. 1274).

<sup>179</sup> Federal Building Code in the version promulgated on 23<sup>rd</sup> September 2004 (Federal Law Gazette I p. 2414), last amended by Article 1 of the Act of 20<sup>th</sup> November 2014 (Federal Law Gazette I p. 1748).

<sup>180</sup> §35 para. 2 BauGB.

usage of municipal land in a manner that is in accordance with the provisions of the law.<sup>181</sup> This control is mainly in reference to the zoning plan and the binding land use plan.<sup>182</sup>

#### **4.3.1 WINDMILLS IN OUTSKIRT AREAS (Außenbereich)**

BauGB allows in principle, if public concerns or private interests are secure and does not jeopardise further development,<sup>183</sup> the erecting of windmills in undesignated outskirts areas. Through this privileging by assigning windmills explicitly in outer regions, the legislator has somehow created a balance between the private interest of installation operators and the public interest of the concerned municipality.<sup>184</sup> The legislator has therefore provided the municipalities the possibility of controlling the creation of wind parks in their respective jurisdictions. According to this scheme, the establishment of wind parks precludes negative impacts on public interest through the creation of concentration zones. The regional planning boards and municipalities can therefore control and assign specific areas within their jurisdiction for wind parks.

#### **4.3.2 WINDMILLS IN INNER AREAS (Innenbereich)**

Legal admissibility of windmills in non-planned but built-up areas is regulated by Art. 32 para. 2 BauGB. Windmills may be permitted as commercial installations in industrial, and in some cases (if designated in the binding land use plan), commercial areas, must be assessed on individual basis. Nevertheless, its legal admissibility must be examined, particularly, in individual cases with the auspices of the principle of mutual consideration (von Hauke, 2011). Restrictions in this case arise from other commercial or industrial users, such as offices, that find a permanent wind turbine in the region as an optical hindrance. Because of the extent of windmill construction sites, required distance from inhabited areas and conflicts of interest in the neighbourhood such as noise and dark ambient conditions (shades), the construction large windmills in inner regions is practically impossible.<sup>185</sup> In individual cases, however, the construction of a windmill as a minor ancillary facility is possible when the system fits within the characteristics of the neighbourhoods, does not affect the landscape, and is pollution free. This can be the case in old non-planned commercial or industrial areas.<sup>186</sup>

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<sup>181</sup> §1 para. 1 BauGB.

<sup>182</sup> §1 para. 2 BauGB.

<sup>183</sup> §8 para. 7 no. 3 ROG.

<sup>184</sup> §1 para. 4 no. 1 ROG.

<sup>185</sup> §34 para. 1 BauGB and §5 BImSchG.

<sup>186</sup> §14 para. 2 BauNVO and §22 BImSchG.



Regional planning and the building permit regulation have contributed significantly to the rapid expansion of onshore wind energy by identifying the potential conflicts of land usage at an early stage in planning and creating a reasonable balance. Art. 35 BauGB, as the main instrument of planning control, has enhanced this expansion through its portrayal of windmills as privileged installations in undesignated outskirts regions. However, this regulation equally has a limiting effect on wind energy development. This is because the preclusive effects of this regulation has priority over the positive designation of windmills as privileged installations. Lawsuits and judgements on wind energy planning have shown that a reasonable number of zoning plans are close to the boarder of rather having an inhibiting effect on wind energy development.<sup>187</sup>

#### **4.4 LICENSING OF WINDMILLS**

The licensing of wind energy projects is regulated by the Federal Immission Control Act (BlmSchG), and licensing depends on the provisions stipulated in the fourth Ordinance on approval process of the Federal Immission Control Act, (vierten Verordnung zur Durchführung des Bundes-Immissionsschutzgesetzes - 4<sup>th</sup> BlmSchV).<sup>188</sup> The purpose of BlmSchG is to protect people, animals and plants, soil, water, the atmosphere, as well as cultural and other property against harmful impacts of wind energy utilization (Hentschel, 2010). According to Art. 11 of the ninth Ordinance on approval process of the Federal Immission Control Act, (Neunte Verordnung zur Durchführung des Bundes-Immissionsschutzgesetzes - 9. BlmSchV),<sup>189</sup> the authority responsible for issuing the authorization shall seek the views of all authorities whose area is affected by the project. These opinions can be taken into account in the preparation of the permit. The approval authority must therefore ensure coordination of the regulatory process and the content and remedies (Storm, 2011).

Windmills with total height<sup>190</sup> greater than 50m (No. 1.6, 4<sup>th</sup> BlmSchV), require a license pursuant to Art. 4 BlmSchG.<sup>191</sup> According to No. 1.6 of the 4<sup>th</sup> BlmSchV, wind parks with windmills taller than 50m must be subject to a permit process. If the wind energy project concerns less than 20 windmills (designated with letter "V" in Annex 1 of the 4<sup>th</sup> BlmSchV),

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<sup>187</sup> OVG Koblenz, judgement of 20<sup>th</sup> February 2003 (1A - 11406/01) and OVG Berlin-Brandenburg, judgement of 21<sup>st</sup> November 2012 (Az. 11, p. 38).

<sup>188</sup> 4. BlmSchV in the version promulgated on 2<sup>nd</sup> May 2013 (Federal Law Gazette I p. 973, 3756), last amended by Article 3 of the Ordinance of 28<sup>th</sup> April 2015 (Federal Law Gazette I p. 670).

<sup>189</sup> 9. BlmSchV in the version promulgated on 29<sup>th</sup> May 1992 (Federal Law Gazette I p. 1001), last amended by Article 5 of the Ordinance of 28<sup>th</sup> April 2015 (Federal Law Gazette I p. 670).

<sup>190</sup> The total height of the plant refers to the highest wingtip i.e. hub height plus blade length.

<sup>191</sup> Federal Immission Control Act in the version promulgated on 8<sup>th</sup> April 2013 (Federal Law Gazette I p. 734), last amended by Article 9 of the Act of 2<sup>nd</sup> May 2013 (Federal Law Gazette I p. 1274).

the project is subject to a simplified permit process pursuant to Art. 19 BImSchG.<sup>192</sup> For projects with 20 or more windmills (designated with letter “G” in Annex 1 of the 4<sup>th</sup> BImSchV), the project is subject to a formal permit process pursuant to Art. 10 BImSchG.<sup>193</sup> The numbering is based on the list of projects subject to Environmental Impact Assessment (EIA) regulated in “Annex 1” of the Act on Environmental Impact Assessment (Gesetz über die Umweltverträglichkeitsprüfung - UVPG).<sup>194</sup> For wind energy projects that are subject to an EIA screening in accordance with the UVPG (projects with total height greater than 50m), an EIA is carried out only in conjunction with permit applications.<sup>195</sup> It is used for deciding on the admissibility of these projects (Hentschel, 2010).

The decision regarding the license should be made within three, for a simplified permit, to seven, for a full permit, months after submission of all required documents (Storm, 2011). A license is valid for the lifetime of the windmills, but a new license is required if a windmill is repowered (Fest, 2010). Wind energy development projects must equally follow state regulations concerning maximum height allowances for the turbines and minimum distances to houses, sensitive areas, and/or restricted areas. In the federal state of Brandenburg, clearing distances are regulated with the “Ecological Distance Criteria” (Tierökologischen Abstandskriterien - TAK).

## **4.5 ONSHORE WIND ENERGY POTENTIAL**

According to the German Federal Government, cited by the Fraunhofer Institute for Wind Energy and Energy System Technology (IWES), onshore and offshore wind energy generating capacity is planned to grow to a total of ca. 45,000 MW by 2020 and 85,000 MW by 2050 (IWES, 2012). Therefore, an assessment of the German wind energy potential (both in the availability of suitable land area for wind energy generation and actual wind situation inland) is necessary to forecast whether these policy targets are achievable.

### **4.5.1 WIND SITUATION**

Approximately 25% of solar radiation arriving at the lower layers of the atmosphere is converted to kinetic energy of wind (Belyaev, et al., 2002). Electricity generation with wind energy is achieved by the conversion of the kinetic energy of wind by the wind turbine into electricity. Wind turbines are mounted on a tower to capture the most energy. At 40 meters

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<sup>192</sup> No. 1.6.2, 4<sup>th</sup> BImSchV: licensing procedure without public participation.

<sup>193</sup> No. 1.6.1, 4<sup>th</sup> BImSchV: licensing procedure with public participation.

<sup>194</sup> Act on Environmental Impact Assessment in the version promulgated on 24<sup>th</sup> February 2010 (Federal Law Gazette I p. 94), last amended by Article 10 of the Act of 25<sup>th</sup> July 2013 (Federal Law Gazette I p. 2749).

<sup>195</sup> §6 and §10 BImSchG.

or more above ground, they can take advantage of faster and less turbulent wind (Khartchenko, 2004). The generated wind energy is a function of several parameters; important among them are air density, rotor-blade-sweep area, wind velocity, tower elevation, and time (Kruger, 2006). Wind energy is the most widely used renewable energy for generating electricity in Germany. Its use has greatly increased within the last two decades. The wind resource in Germany is good for the use of wind energy especially near the coast and in the high altitudes of the midlands. Table 4.2 below shows the operating range of a windmill.

**Table 4.2: The operating range of a wind turbine**

<b>Wind speed</b>	<b>Wind strength</b>	<b>Usability</b>
< 3 m/s (11 km/h)	0–2	<i>Barely usable</i>
3–5 m/s (11–18 km/h)	3	<i>Limited use</i>
5–25 m/s (18–90 km/h)	3–9	<i>Very usable</i>
> 25 m/s (ab 90 km/h)	10	<i>the wind turbine stops</i>

Source: translated from (Schmidthals, et al., 2013)

In the highlands, where numerous sites with regularly high wind speeds occur, the use of wind energy is technically possible. However, this is in many cases prohibited on ecological basis (landscape and nature conservation), technical reasons (strong turbulent winds, icing), and economic reasons (high construction, transportation, and maintenance costs).

#### **4.5.2 LAND SURFACE POTENTIAL**

A number of conditions must be evaluated when estimating the feasibility of wind energy generation in an area. First up is the wind resource (see section 4.5.1 above). In regions or locations where wind gusts or weak winds prevail, the construction of windmills is not advisable (Schmidthals, et al., 2013). Equally, the social and environmental impacts, the technical feasibility, and economic viability is considered. Furthermore, not all locations with high wind speeds are suitable for wind energy generation. In addition to structural problems,<sup>196</sup> the competition for land with other land use projects in the densely populated regions of Western and Southern Germany prevent the construction of windmills in these regions. Besides, the feeding of the electricity generated from the wind energy installations brings technical and economic problems, when a wind favourable location is too far away from medium- or high-voltage grid system or the grid capacity is not sufficient to transport the wind power. However, increasing tower heights of windmills and the larger dimensions of the turbines, efficient operation has enhanced the usage of windmills in areas that were previously unfavourable for wind energy exploitation (Klaus, et al., 2010).

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<sup>196</sup> Especially in the highlands of southern Germany.

The Federal Environment Agency (Umweltbundesamt – UBA) carried out a study in July 2010, in which the energy supply system of Germany based on 100% renewable energies was modelled (Klaus, et al., 2010). For onshore wind energy, the study assumed wind energy installations to have a hub height<sup>197</sup> of 135m and a nominal capacity between 1.8 to 5 MW depending on their respective location.<sup>198</sup> It was equally assumed that, a minimum distance of 600m to residential housing would have to be observed.

Based on the assumptions made and the turbine type selected, the study concluded that 49,361km<sup>2</sup>, or 13.8% of the federal territory, is in principle suitable for wind energy generation (see Table 4.3 below). This area potential would allow the installation of turbines with a total capacity of 1,188 GW and an annual power output of around 2,898 TWh with a national average 2,440 full load hours. This value is considerably higher than the median capacity utilisation of 1,700 full load hours over the past five years in Germany (Lütkehus & Salecker, 2013).

**Table 4.3: Wind energy potential for Germany determined by the UBA study**

	Area potential		Capacity potential [GW]	Output potential [TWh]	Mean full load hours [h/a]
	[km <sup>2</sup> ]	Share			
<b>North</b> Berlin, Brandenburg, Bremen, Hamburg, Mecklenburg-Western Pomerania, Lower Saxony, Saxony-Anhalt, Schleswig- Holstein (= 38.9 % of German territory)	22,851	16.4%	526	1,378	2,621
<b>Central</b> Hesse, North Rhine-Westphalia, Rhineland-Palatinate, Saxony, Thuringia (= 30.7 % of German territory)	11,200	10.2%	287	728	2,540
<b>South</b> Baden-Württemberg, Bavaria, Saarland (= 30.4 % of German territory)	15,310	14.1%	375	791	2,108
<b>Germany overall</b>	<b>49,361</b>	<b>13.8%</b>	<b>1,188</b>	<b>2,898</b>	<b>2,440</b>

Source: (Klaus, et al., 2010).

However, settlement areas and the requisite protective distances have a significant influence on land surface potential. The study showed that a 200m increase of the minimum distance to residential areas from 600m to 800m decreased the land surface potential by a third. Besides, doubling the distance from 600m to 1,200m reduces the determined area potential by 75% and at a distance of 2,000m, all that remains of the federal territory for wind energy generation is 0.4 % (see Table 4.4 below).

<sup>197</sup> Height of the wind turbine above the ground, not including the length of the rotor blades.

<sup>198</sup> In effect, the calculations were based on two types of wind turbines, a high-wind energy turbine with a capacity of 3.4 MW, and a low-wind turbine with a higher hub height and a greater rotor diameter possessing a capacity of 3.2 MW (Lang, 2013).

**Table 4.4: Influence of distance to residential buildings on the land surface potential**

Distance to residential areas	600m	800m	1000m	1200m	2000m
Area potential	13.8%	9.1%	5.6%	3.4%	0.4%
Proportion of determined area potential	100%	66.3%	40.9%	24.8%	2.8%

Source: (Klaus, et al., 2010).

### 4.5.3 AVIAN MORTALITY THROUGH COLLISION WITH WINDMILLS

Wind energy's ability to generate electricity without many of the environmental impacts associated with conventional energy sources (e.g., air pollution, water pollution, mercury emissions, climate change) could benefit birds, bats, and many other plant and animal species. However, possible impacts of windmills on birds, bats, and their habitats have equally been documented. The construction and operation of wind energy installations have the potential to affect bird and bat. Populations of many bird and bat species are experiencing long-term declines, due partly to habitat loss and fragmentation, invasive species, and collisions with Windmill blades. Windmills generally affect birds in two major ways: direct mortality from collisions and indirect impacts from avoidance of an area, habitat, and behavioural effects (see section 1.4.6). For bats, only direct mortality resulting from collisions and barotrauma<sup>199</sup> has been demonstrated (NWCC, 2010). That notwithstanding, there are very few extensive and systematic observation programmes with a monitoring character in Germany. However, the Ornithological Office of the Brandenburg State Ministry of Environment, Health and Consumer Protection (Landesamt für Umwelt, Gesundheit und Verbraucherschutz - LUGV) has since 2002 been collecting data on collisions of birds and bats with windmills in Germany (LUGV, 2014). Besides, the BMU between 2007 and 2011 provided €1 million for researches into the mortality of birds caused by windmills. The research figures show that 146 red kites, 163 buzzards, 25 gold crests, 87 pigeons, and 30 mallards were found within these years between German windmills (Ismar, 2011).

#### 4.5.3.1 Bird Mortality

As of 4<sup>th</sup> April 2014, 1,965 birds have been killed by onshore windmills. Distributed among the different species of birds, the mortality rate varies significantly. The “buzzard” (*Buteo buteo*, Mäusebussard) accounted for the highest mortality of about 255 followed by the “red kite” (*Milvus milvus*, Rotmilan) with about 232 mortalities. All other bird species registered mortality numbers ranging between one and 91 (Dürr, 2014). This hints to a fact that predator and diurnal birds have a higher probability of colliding with windmills during flights. There are also regional differences in bird mortalities from wind energy installations in Germany. Brandenburg possesses significantly the highest bird mortality caused by collision with

<sup>199</sup> Barotrauma is a phenomenon where by an animal experiences rapid pressure changes that cause severe internal organ damage.

windmills in Germany, with about 767 birds killed (Dürr, 2014) representing 39% of total mortality, followed by Saxony-Anhalt with 238 mortalities (Dürr, 2014) representing 12% of total birds killed by windmills in Germany (see Figure 4.1).

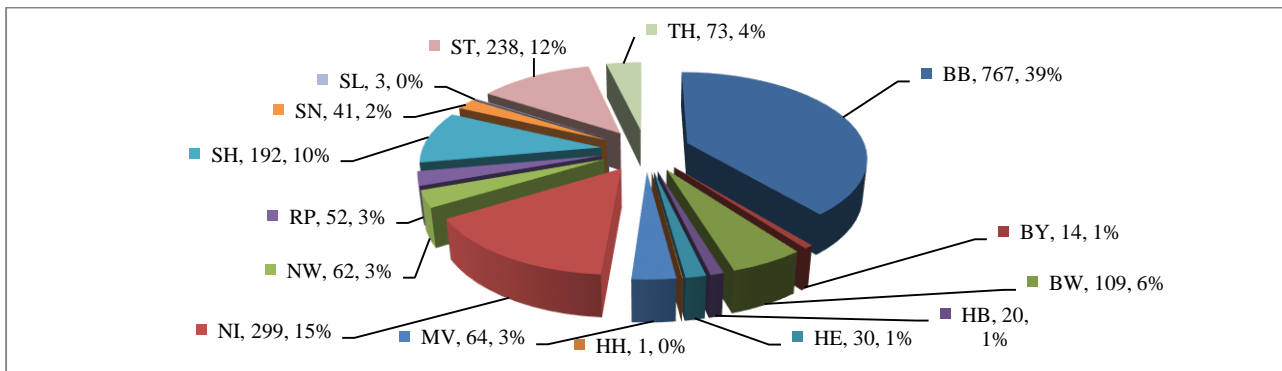


Figure 4.1: Regional Distribution of bird mortalities in Germany, 2002-2014<sup>200</sup>

Courtesy: Wanki, data from (Dürr, 2014)

#### 4.5.3.2 Bat Mortality

About 2128 bats have been killed through collision with windmills in Germany since the data collection began in 2002. Like the birds, there are differences in mortality number among the different bat species (see Table 5.6).<sup>201</sup>

Table 4.5: Bat mortalities at wind turbines in Germany, 2002-2014

Scientific Name	Common Name	German Common Name	Total
<i>Nyctalus noctula</i>	Noctule	Großer Abendsegler	726
<i>N. leislerii</i>	Common Noctule	Kleiner Abendsegler	110
<i>Eptesicus serotinus</i>	Serotine	Breitflügelvedermaus	43
<i>E. nilssonii</i>	Northern Bat	Nordfledermaus	3
<i>Vespertilio murinus</i>	Parti-coloured Bat	Zweifarbvedermaus	89
<i>Myotis myotis</i>	Greater mouse-eared Bat	Großes Mausohr	2
<i>M. dasycneme</i>	Pond Bat	Teichfledermaus	3
<i>M. daubentonii</i>	Daube ton's Bat	Wasserfledermaus	5
<i>M. brandtii</i>	Brandt's Bat	Große Bartfledermaus	1
<i>M. mystacinus</i>	Whiskered Bat	Kleine Bartfledermaus	2
<i>M. brandtii/mystacinus</i>	Bart Bat spec.	Bartfledermaus spec.	1
<i>Pipistrellus pipistrellus</i>	Common Pipistrelle	Zwergfledermaus	439
<i>P. nathusii</i>	Pipistrelle	Rauhautfledermaus	564
<i>P. pygmaeus</i>	Soprano Pipistrelle	Mückenfledermaus	45
<i>Pipistrellus spec.</i>	Pipistrelles spec.	Pipistrellus spec.	36
<i>Hypsugo savii</i>	Alpine Bat	Alpenfledermaus	1
<i>Barbastella barbastellus</i>	Barbastelle	Mopsfledermaus	1
<i>Plecotus austriacus</i>	Grey long-eared Bat	Graues Langohr	6
<i>Plecotus auritus</i>	Brown long-eared Bat	Braunes Langohr	5
<i>Chiroptera spec.</i>	Walker's Bat	Fledermaus spec.	46
<b>Total</b>			<b>2128</b>

<sup>200</sup> BB = Brandenburg, BY = Bavaria, BW = Baden-Württemberg, HB = Bremen, HE = Hesse, HH = Hamburg, MV = Mecklenburg-Western Pomerania, NI = Lower Saxony, NW = North Rhine-Westphalia, RP = Rhineland-Palatinate, SH = Schleswig-Holstein, SN = Saxony, SL = Saarland, ST = Saxony-Anhalt, TH = Thuringia, B = Berlin.

<sup>201</sup> The "Noctule" with scientific name *Nyctalus noctula* has the highest mortality, with 726 mortalities, followed by the "Common Pipistrelle" with scientific name *Pipistrellus pipistrellus* and the "Nathusius Pipistrelle" bats with scientific name *Pipistrellus nathusii* with 439 and 564 mortalities respectively (Dürr, 2014).



There are equally differences in the regional distribution of mortality number of bat through collision with windmills, with the state of Brandenburg still topping the list for bat mortality. According to Figure 5.11, Brandenburg has so far registered 845 mortalities, followed by Lower Saxony and Saxony with 270 and 260 mortalities respectively (Dürr, 2014). Mortality pattern in Brandenburg is similar to the national pattern where the Noctule bat (418) leads followed by the Nathusius Pipistrelle bat (217) and the Common Pipistrelle bat (92) respectively (Dürr, 2014).

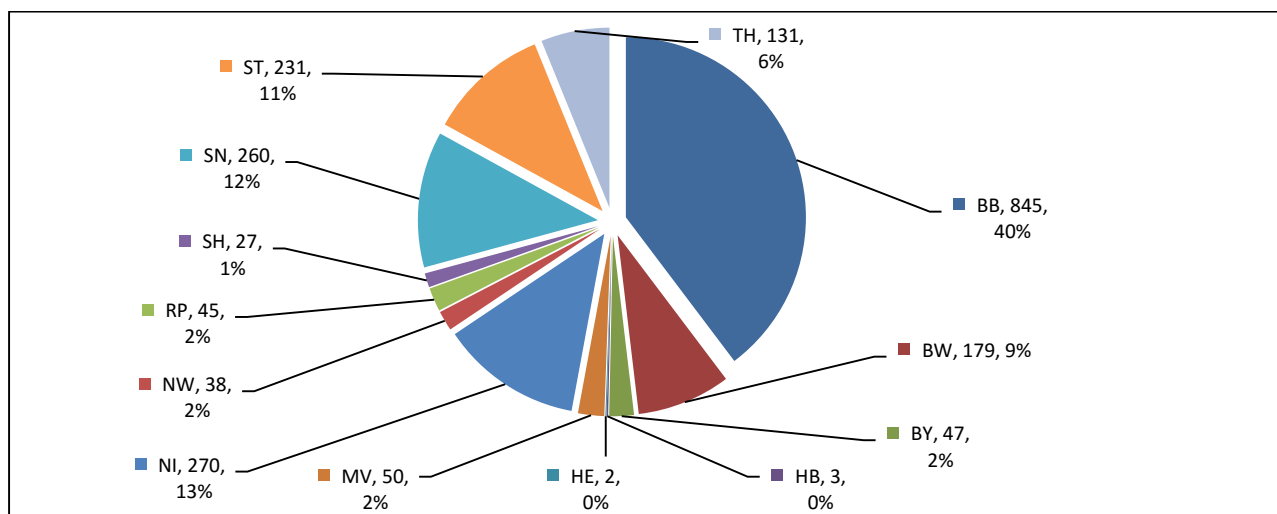


Figure 4.2: Regional Distribution of bat mortalities in Germany, 2002-2014

Courtesy: Wanki, data from (Dürr, 2014)

## 4.6 CHAPTER DISCUSSION

According to Carsten Maluszczak, one of the expert interviewee, the fundamental issue with wind energy projects is that the siting decision affects a multitude of stakeholders, as opposed to just one customer or one investor (Maluszczak, 2010). Hence, the siting decision needs approval by several stakeholders, not only by the investor. Constructing a wind park soon becomes a local political decision, because it affects the local community in several ways. The question of acceptability is at stake for all actors involved in the decision making process. This is further complicated when the investors are not the surrounding residents, rather investors from abroad and large energy companies, as is the case in Brandenburg. Who is the investor? Is the investor from within the community? Does the local community have significant influence in the process? Is specific local, tacit knowledge used or is the community only expected to say “yes”? These questions become pertinent during the implementation of siting decisions. Communities have the tendency of being suspicious of wind energy projects whose investors are from outside or large energy utility companies (Mogren, 2010; Rehwald, 2013).



In order to achieve, at least, a passive acceptance of wind energy project in a locality, the local community has to be convince that the energy transition process is reasonable and that the project generally bring advantages over conventional generating forms of energy supply. Second, the personal benefit plays a role as mentioned above. In most cases, these concerns the financial aspects (see question 6b of survey; figure 6.15).

#### **4.6.1 SITING PROCEDURE**

This is associated with the fairness of the siting process for wind suitable areas in the regional plans or in the zoning plan, i.e. whether interests, needs and objections have been considered and sufficient information on the procedure for transparency were provided. The survey highlights the importance of fair processes with regard to community acceptance of siting decisions (see Figure 6.25). Perceived issues of injustice in the siting process were in part the basis for the annulment of the regional plan for wind energy development in the Havelland-Fläming region; as the RPG could not explain why windmills were permitted in the “Nauener Platte” and not in the “Teltower Riesefeldern” (Reichelt, 2010). Different sections of a community are likely to be influenced by different aspects of justice, e.g. outcome fairness, outcome favourability and process fairness (Thies, 2010). Outcomes that are perceived to be unfair can result vehement opposition, damaged relationships and divided communities particularly when decisions are made which benefit some sections of the community at the perceived expense of others. According to Rietzel (2010) of the Oderland-Spree RPG, a planning concept that is applicable to all areas of the region brings the element of fairness in the siting process. Besides, the openness of the siting process for local involvement and the flexibility and open mindedness of external stakeholders are crucial.

#### **4.6.2 COST DISTRIBUTION**

This concerns how fair the social cost or impacts (landscape changes and wildlife conservation) and the benefits (financial profits) of onshore wind energy development are distributed.

##### **4.6.2.1 Landscape Intrusion**

Landscape is valued for many reasons. For instance, its specific landscape quality, scenic beauty, tranquillity or wildness, recreation opportunities, nature conservation or historic and cultural associations. A wind park is usually sited in exposed places that are open, high and relatively prominent, in order to take advantage of maximum wind capture. The most distinctive characteristics of a wind park are typically its collection of tall, often uniformly

spaced turbines, each with moving blades that change orientation according to wind direction. These features make wind energy projects a nuisance to some sections of the population. The survey shows that, 29% of the respondent who do not want wind parks in their neighbourhood, base their opposition on the impact of windmills on landscape (see Figure 6.13). This is due to the visibility and visual impacts of a wind park. However, the perception of the impact of wind parks on landscape among the population varies, (following the English idiom that “*beauty lies in the eyes of the beholder*”), to some a wind park may seem to threaten its surroundings, while others may view it as an exciting, modern, or even futuristic addition with symbolic associations with clean energy and sustainability. This is supported by the fact that wind energy still attracts a high level of public acceptance (see Figure 6.7). Whether agriculture, industrial development, or urban planning: since time immemorial, human activities have shaped the landscape and has always subject it to new changes. It is not long ago that water and windmills belonged to our cultural landscape. How the changes in the landscape are perceived is subjective. The use of wind energy has to be weighed against the impacts of continuous fossil and nuclear energy generation. There is nothing better to describe this impact than climate change.

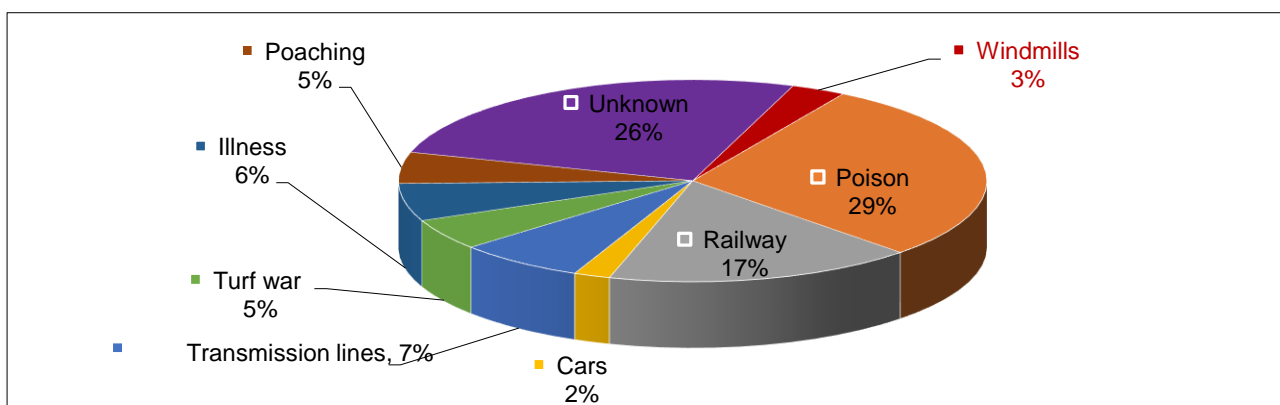
#### **4.6.2.2 Impact on Wildlife (Avifauna)**

Windmills, like any other land use project, posses' a risk factor to birds and bats; Wind energy projects have the potential to affect birds and bats directly (i.e. collision mortality), and indirectly (i.e. disturbance and avoidance). According to LUGV, several birds and bats have been killed by onshore windmills within the past decade (see Figure 4.1 and Table 4.5). The survey revealed that the impact of windmills on avifauna was the third reason (in terms of share of respondents - 17%) why opponents of wind energy do not want windmills in their neighbourhoods (see Figures 6.13 and 6.14).

However, such general knowledge on the consequences of wind energy utilization on avifauna cannot be used to make conclusions on the dimension of the problem. One has to assess in details, if the observed impacts of wind energy utilization on avifauna are single sporadic events, which have little or no effects on the natural balance and the life of these animals or if the observations increase the death rate of these animals and distort the natural regime. A study by the German League for Nature, Animal Protection and Environment (Deutscher Naturschutzring - DNR) has shown that most common birds in Germany slightly avoid windmills when in search for feeding grounds and breeding sites; flying as close as 80m from windmills (DNR, 2005). This means that, windmills rarely have an impact on the feeding and breeding habits of birds. However, elaborate protective measures have to be in

place to protect these birds from flying into windmills. According to TAK, wind parks have to be constructed at a distance of 1 km from feeding grounds and breeding sites. However, the killing of birds and bats via collision with windmills is actually minimal when compared with other land use projects. Birds have a higher probability of being killed through collision with trains, cars and buildings, poisoning, transmission lines, illnesses, territorial fights and poaching (Ratzbor, 2011).

Figure 4.3 shows that windmills accounted for only 3% of all Sea Eagles killed in Land Brandenburg between 2002 and 2007. Collisions with wind turbines are generally so rare that it does not affect the population sizes or local inventory of individual bird species significantly.



**Figure 4.3: Causes of death of Sea Eagles in Land Brandenburg, 2002 to 2007**

Courtesy: Wanki, data from (Ratzbor, 2011)

It is worth noting that, the operation of wind parks, as is the case with any infrastructure project, cannot completely avoid certain impacts on avifauna and the natural regime, even if comprehensive control regulations are adopted (as is the case in Germany) to regulate the construction and operation of wind parks.

### 4.6.3 ASSOCIATED TECHNOLOGY

The attitude of the local community towards wind energy technology can be influenced by previous experiences with the technology in their neighbourhood as well as by the mass media (Zoellner, et al., 2008). As demonstrated in the survey (see figure 6.7), wind energy technology enjoys a high level of acceptance among the population. However, this does not translate to the willingness of the local communities or individuals to actually provide land for windmills. Of importance in this context is the contribution of wind energy installations to the local economy for the common good in addition to the climatic benefits of wind energy expansion (see section 5.3). A decisive factor here, which is equally supported by the results of the survey in Brandenburg, is the degree to which the local community is integrated into the planning, construction and operation of the windmills (Mattes, 2014). That is, the

operator model (e.g. Civil Partnership, Limited Liability Company, Registered Cooperative etc.) as well as the seat of the company (in the region or external). The results of the survey showed that the willingness of the local community to accept windmills in their neighbourhood increases significantly if they are able to equally profit from the wind energy installations in their neighbourhood (see figures 6.11 and 6.15). These local economic benefits include the net profits of the companies involved, the employment of local individuals as well as the income and business taxes paid to the municipality (see section 5.4). A study by the Federal Ministry of Transport, Building and Urban Development (Bundesministerium für Verkehr, Bau und Stadtentwicklung - BMVBS) has shown that the regional gross added value increases significantly when the local community participate directly in local renewable energy projects and the operating company is based in the region (BMVBS, 2011). Consequently, this will enhance the acceptability of these projects. In the town of Sonnewalde - a town in the Elbe-Elster district, in Southwestern Brandenburg - for example, the wind park operator, WSB-Projekt GmbH, in 2009 decided to construct four windmills within the municipality. In order to quell local resistance to the project, the planner in exchange for local acceptance promised to construct the facilities 2,000m from the nearest residential area and also promised to annually donate 10,000€ for the municipal electricity bills (Pöttsch, 2010). This offer was positively welcomed by the inhabitants and the project was approved by the local authorities. In practical terms, there is no 100% acceptance. Nonetheless, it is possible to win heart and minds of a large majority.

#### **4.7 CHAPTER CONCLUSION**

Wind energy plays an ever-increasing role in electricity generation in Germany. The basic rationale behind this trend is to avoid negative externalities common to conventional electricity generation technologies, as well as waste and risks from nuclear energy. For wind energy to play an effective role in electricity generation, however, windmills have to be constructed in large numbers, which renders them more spatially dispersed and, therefore, in greater proximity to consumers than conventional power plants. This greater proximity of windmills to consumers has negative externalities itself, notably negative impacts on landscape aesthetics and on avifauna. Against this background, this chapter evaluated the control (spatial planning) measures setup to mitigate the effects of windmills in neighbourhoods and equally investigated the effect of the physical presence of windmills on landscape and avifauna in Germany.

Spatial planning for the development of onshore wind in Germany primarily takes place at the regional and local level. Considering the policy agenda on wind energy expansion in

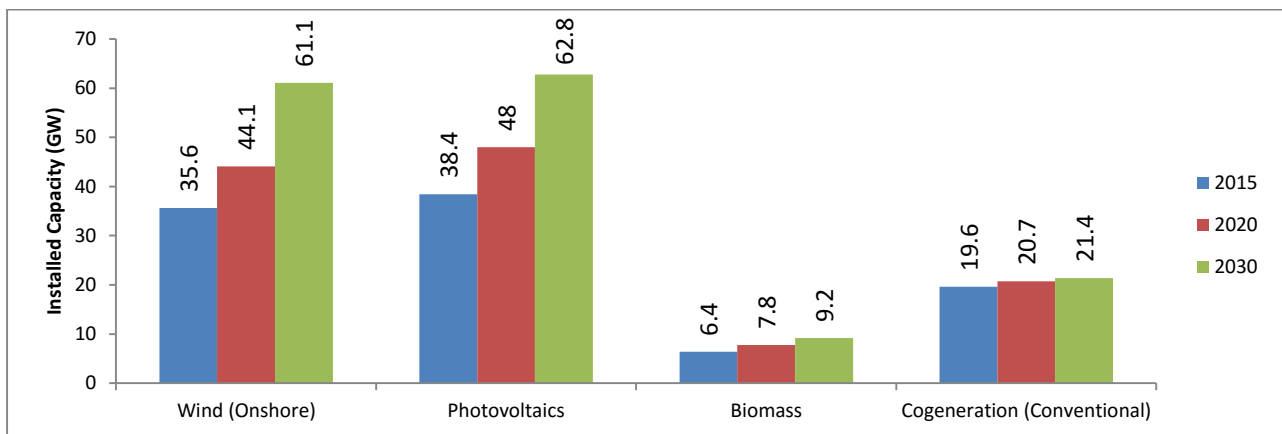
Germany and the effects of its large-scale usage, the planning regulation for wind energy expansion plays a key role in its realisation and public acceptance. The Federal Regional Planning Act and the Federal Building Code provide a general framework within which the local regions, who have primary responsibility for planning issues, act on the development of wind parks. For the protection of local residents and affected housing areas, safety distance regulations are applied, which are bound to the windmill height and the wind park size. Currently, almost all of these distance regulations are defined as static distance values. Besides, the Federal Regional Planning Act requires the identification of different categories of areas to inform planning. Essential in this planning approach is the determination of priority and exclusion areas for the use of wind energy based on functional criteria. By delineating priority areas for wind parks in regional plans or delineating preference zones in land use plans, regional and local authorities can define where it is (and is not) in the public interest to develop wind parks. The research therefore concludes that this spatial planning approach has been fundamental in reducing conflicts between the local communities and the development of wind energy projects.

Concerning landscape intrusion of windmills, the result of the research shows that the impact of windmills on landscape is subjective. The cultural landscape of Germany is largely determined by settlement, industry and infrastructure. It has changed over time and will still change (irrespective of the presence of windmills). The perception of such changes is also a matter of personal attitude: While some people worry windmills would harm the beauty of the landscape, others feel that windmills are elegant and positive symbols of a better and cleaner future (see section 6.2.2). The research further concludes that the impact of windmills on avifauna is minimal when compared with other land use projects. Birds have a higher probability of being killed through collision with trains, cars and buildings, poisoning, transmission lines, illnesses, territorial fights and poaching than with windmills.

## 5 GERMAN WIND ENERGY STATUS

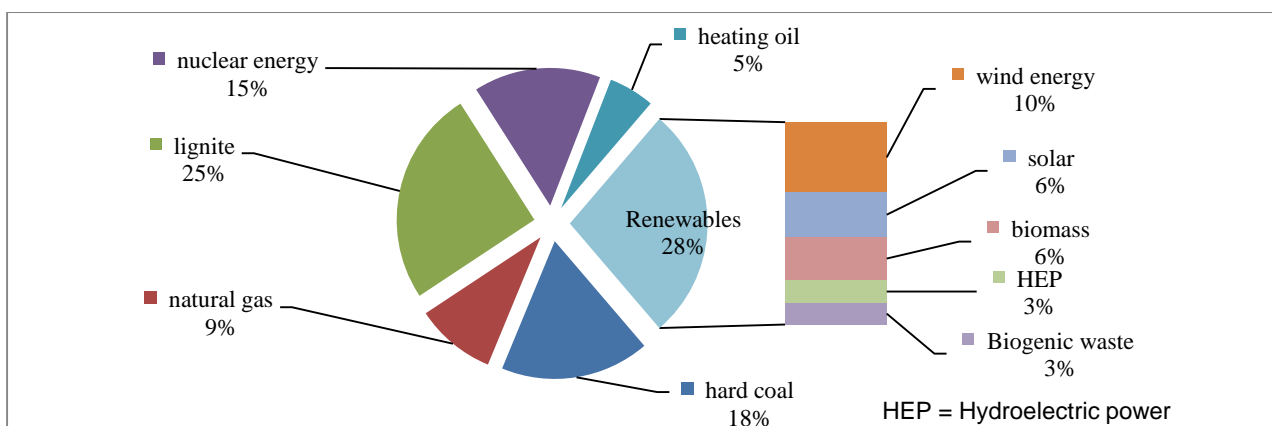
### 5.1 GENERAL STATEMENT

As the energy transition policies in Germany approach their first target year, 2020, policy makers are focussing attention on maintaining investor confidence in onshore wind energy beyond 2020. Data on German wind energy market has shown year after year that wind energy generating capacity is increasing correspondingly towards the targeted values (BWE, 2014; BMWi, 2015). Worth noting, it is encouraging to confirm that in 2012 Germany met and exceeded the targets foreseen in their 2020 trajectory. Figures 5.1 and 5.2 show the expansion targets for renewable energy generation in the Grid Development Plan (Netzentwicklungsplan - NEP) for electricity in Germany until 2030 with respect to energy source and the share of renewable energies in gross electricity consumption in 2014 respectively.



**Figure 5.1: Expansion targets for renewable electricity in Germany until 2030**

Courtesy: Wanki, data from (BMU, 2011; BMU, 2013)



**Figure 5.2: Share of renewables in gross electricity consumption in 2014**

Courtesy: Wanki, data from (BMWi, 2015)

The effects of the cutbacks in the feed-in tariff support scheme for renewable energies, made because of the ever-increasing electricity prices for residential consumers, will

become more visible in the coming years. For example, it is already clear that, despite substantial technology cost reductions, the German solar PV market has stagnated following re-adjustments of the feed-in tariff scheme for solar PV and high competition from other markets (Bermer, 2014). In the coming years, Germany has to prove that its energy transition policy can be achieved with affordable electricity prices for households, trade, and industries. This requires political courage. The lack of a spirited initiative on the part of legislator to design a new electricity market that established a flexible range of products and services based on renewable energies could severely slow down the energy transition process (BWE, 2015).

That notwithstanding, the market for German onshore wind energy installations is experiencing growth. The following chapter evaluates with the aid of graphs, figures and tables, the energy, socio-economic and environmental influences of wind energy utilization in Germany. This is aimed at achieving objective three of this research.

## 5.2 ONSHORE WIND ENERGY EXPANSION IN GERMANY

Onshore wind energy is one of the driving forces behind the energy transition in Germany. In the last two decades, it has evolved from the niche and presently accounts for a major share of the total renewable generating capacity in Germany (see Figure 5.3).

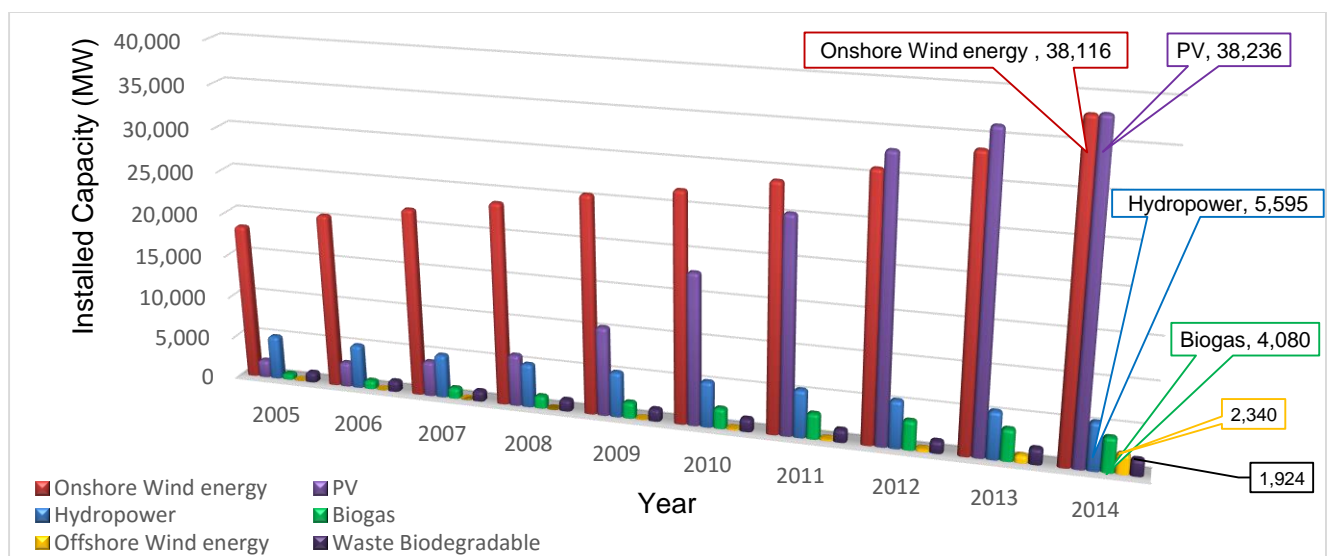
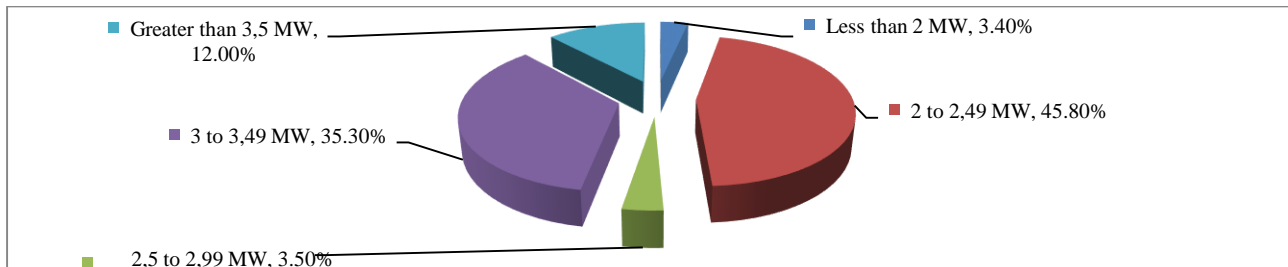


Figure 5.3: Installed clean electricity generating capacity in Germany

Courtesy: Wanki, data from (BMW, 2015)



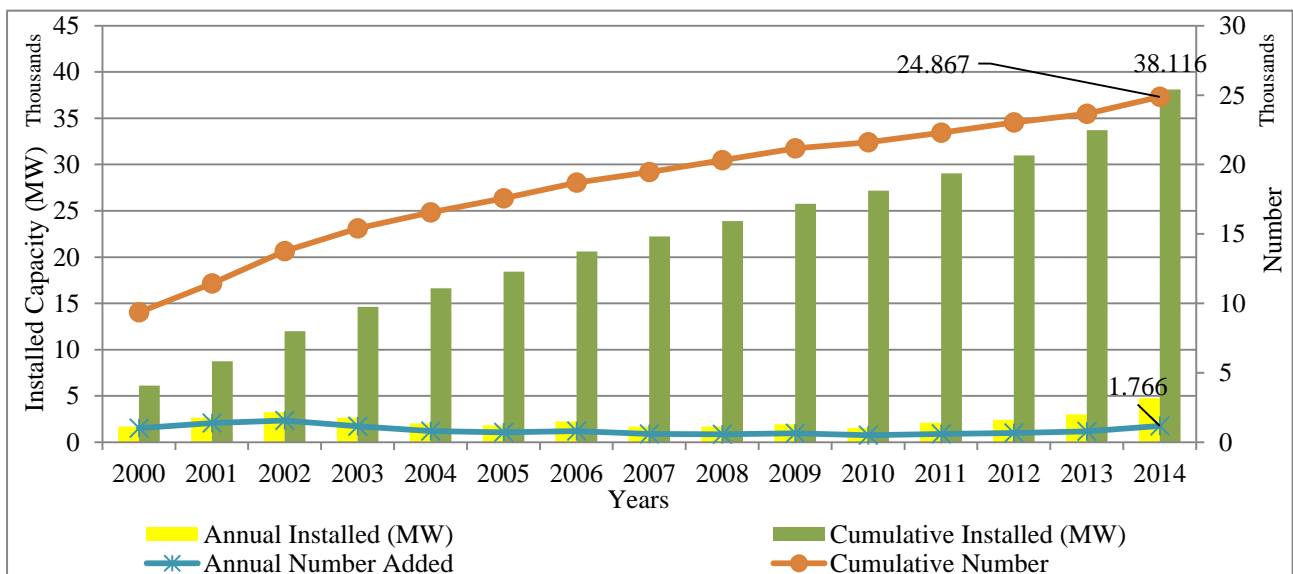
Following the adoption of the StromEinspG in 1990, onshore wind energy initially experienced rapid annual growth, which has in recent years stabilized at an average of about 2,000 MW per year (IWES, 2014). However, an initial maximum was achieved in 2002 when more than 3,100 MW onshore wind energy capacity was installed. The high growth rates in 2002 can be interpreted as a positive, time-delayed response to the EEG, which came into effect in April 2000 and technological advancement in wind turbine development. Figure 5.4 depicts the distribution of installed system capacity of wind turbines in Germany in 2013.



**Figure 5.4: Share of installed system capacity of WT in Germany in 2013**

Courtesy: Wanki, data from (BWE, 2014)

In 2014, 1,766 onshore windmills with a total capacity of about 4,751 MW (the highest annual installed capacity so far) were erected in Germany. Hence, 24,867 onshore windmills with a total capacity of 38,116 MW were operating in Germany by the end of 2014 (see Figure 5.5).



**Figure 5.5: Development of Onshore Windmills and Installed Capacity in Germany**

Courtesy: Wanki, data from (BWE, 2015)

This relatively enormous expansion owes its success mainly to three factors:

1. The growing importance of repowering and offshore wind energy deployment,
2. The availability of additional areas for wind energy expansion in some federal states such as Bavaria,

- The revision of the Renewable Energy Sources Act (EEG) also has a significant influence. As far as possible, many project plans are accelerated in order to be able to benefit from the favourable remunerations under the existing EEG.

For the preceding years, the total number of windmills installed in 2013 (with an installed capacity of 3,592 MW) equate to an increased gross annual capacity addition of about 47% compared to 2012 (Ender, 2014). As a result, the cumulative wind energy generating capacity increased by 9.7% from ca. 31,000 MW to 34,179 MW (IWES, 2014). Repowering projects made a significant contribution to the expansion of onshore wind energy development. Their share in new installations is ca. 20%, supported mainly by the use of repowering bonus certificates stipulated in the EEG 2012 (Ender, 2014).

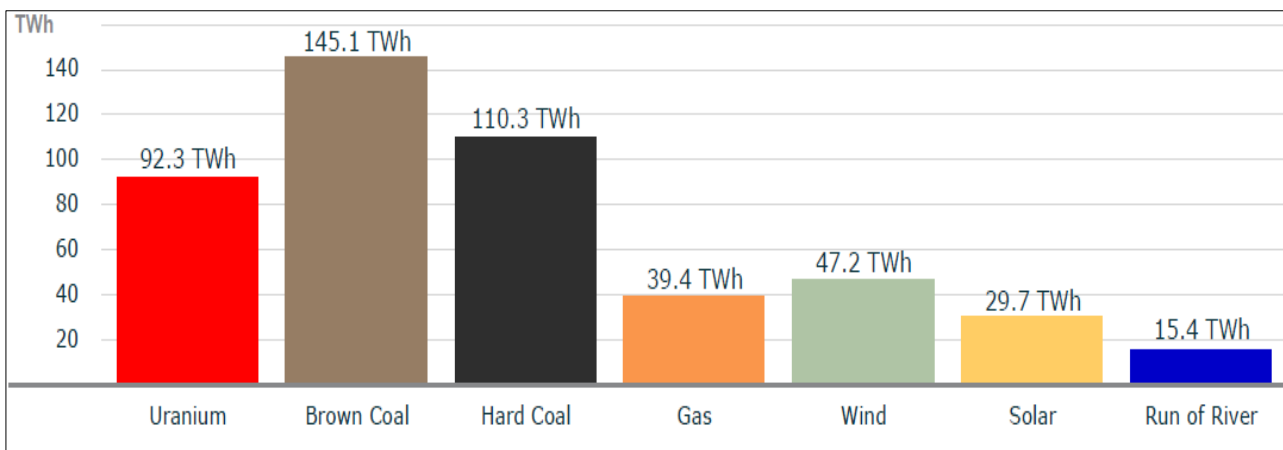
Wind-generated electricity in Germany amounted to 47,400 GWh in 2013, compared to 2012 when 50,670 GWh of electricity were generated by windmills (see Table 5.1). The contribution of offshore wind energy to the total electricity generation was 906 GWh or 1.9%. If one includes the considerable capacity growth in 2013, it is clear that 2013 was poorer from a wind energy feed-in standpoint than 2012. In contrast to 2012 (8.4%), wind energy accounted for about 8% of total electricity consumption in 2013 (IWES, 2014).

**Table 5.1: Electricity generation from Wind Energy in 2012 and 2013**

Parameter	Unit	Onshore		Offshore		Total	
		2012	2013	2012	2013	2012	2013
Electricity feed-in	TWh	49.95	46.50	0.72	0.91	50.70	47.40
Percentage of total electricity demand	%	8.2	7.8	< 1.0	< 1.0	8.4	8.0

Source: Derived from (IWES, 2014)

While the installed capacity of photovoltaics (35.651 GW) slightly surpassed that of wind energy from August 2012 (Burger, 2014), electricity generation from wind energy installations was far more than that of photovoltaics in 2013 (see figure 5.6 below)



**Figure 5.6: Electricity Generation in Germany, 2013**

Source: (Burger, 2014)

With a gross inland consumption of about 599.8 TWh (BMW, 2014), Wind turbines generated about 47.2 TWh in 2013. This represents about 8% of overall electricity consumption. Figure 5.7 depicts the growth of the share of wind energy (WE) in primary energy (PE), final energy (FE) and electricity consumption.

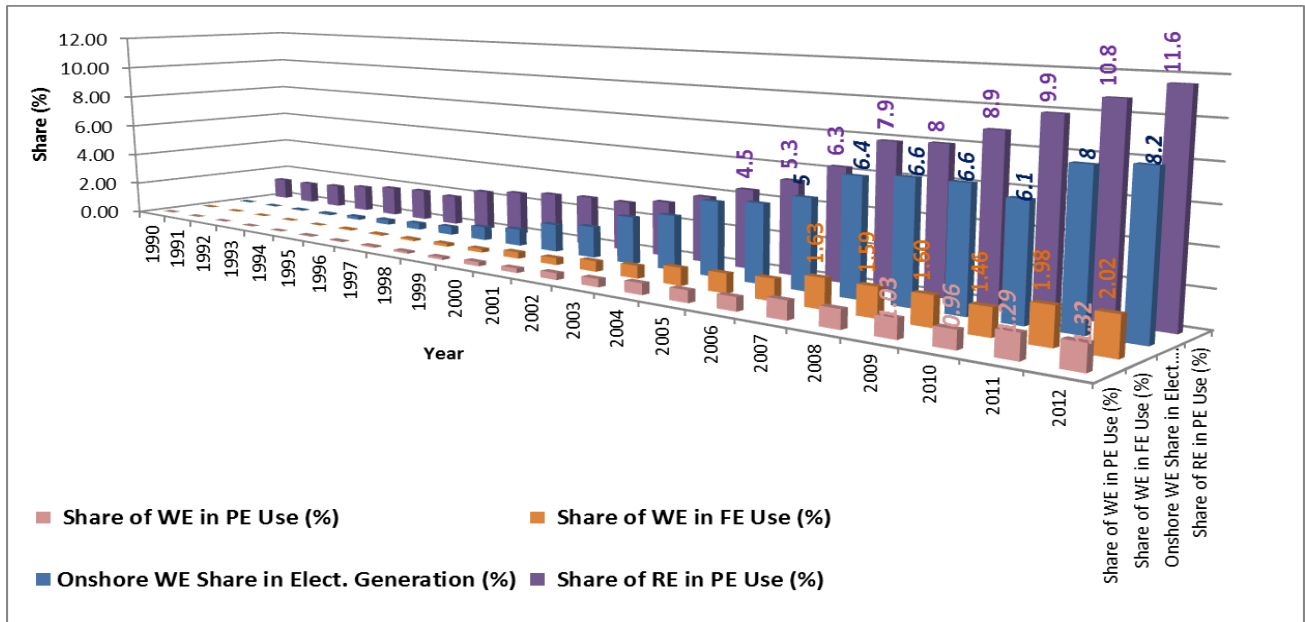


Figure 5.7: Growth in the share of wind energy in energy supply in Germany

Courtesy: Wanki, data from (BWE, 2015; BWE, 2011)

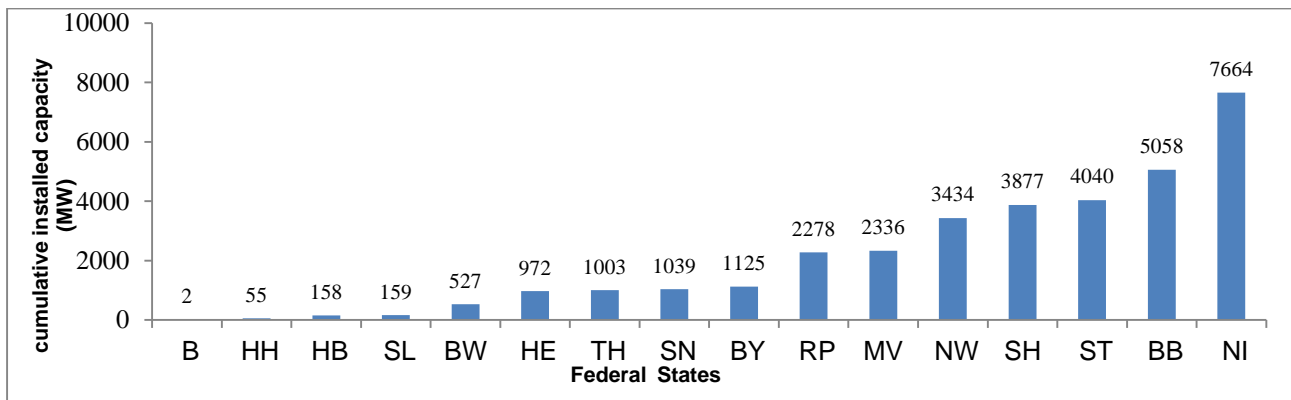
### 5.2.1 REPOWERING AND DISMANTLING

It is worth mentioning that there are no comprehensive values for dismantled wind turbines. The values provided for dismantled and repowered windmills are estimates and only show the available repowered and dismantled windmills. It can be assumed that not all repowering and dismantling efforts of 2013 are covered in this research. Actual repowering and dismantling numbers are likely to be higher than the figures presented in this study. Hence, for the windmills erected in 2013, 269 were identified as repowered. With an installed capacity of about 766 MW, this equates to a repowering share of at least 25% of the total new installation of 2013. Besides, 416 windmills were dismantled in 2013 with a total capacity of about 258 MW (Lüers, et al., 2014). Repowered windmills possessed an average capacity of 2,849 kW, while the average dismantled windmills had a capacity of 620 kW (BWE, 2014).

### 5.2.2 REGIONAL DISTRIBUTION

The StromEinspG laid down the priority feed-in and remuneration of electricity generated from wind between 1991 and 2000. This allowed profitable operation of windmills at wind energy suitable locations. Consequently, this led - in the mid-1990s - to the first wind energy boom in the German coastal regions. Continuous technological advancement resulted in

ever more windmills being built inland and in the low mountain regions of southern Germany. There are endeavours in most German states to utilize wind energy.



**Figure 5.8: Cumulative Capacity of windmills in the German Federal States<sup>202</sup>**

Courtesy: Wanki, data from (Ender, 2014)

Figure 5.8 depicts the cumulative installed capacity of windmills in the different federal states in 2013. Lower Saxony, Brandenburg, and Saxony-Anhalt have the largest cumulative wind energy generating capacity. Half of the total cumulative onshore wind energy generating capacity of Germany is found in these three states. Lower Saxony with 7,664 MW of installed capacity is at the top of the list by the end of 2013. The second and third places were occupied by Brandenburg and Saxony-Anhalt with 5,058 MW and 4,040 MW cumulative installed capacity respectively (Ender, 2014). In general, 46% of the cumulative capacity was installed in the German central region at the end of 2013, while 42% was located in the northern region. The remaining 12% capacity was installed in the Southern Region. The share of the cumulative capacity has increased by about 1 % annually since 2008 (Lüers, et al., 2014).

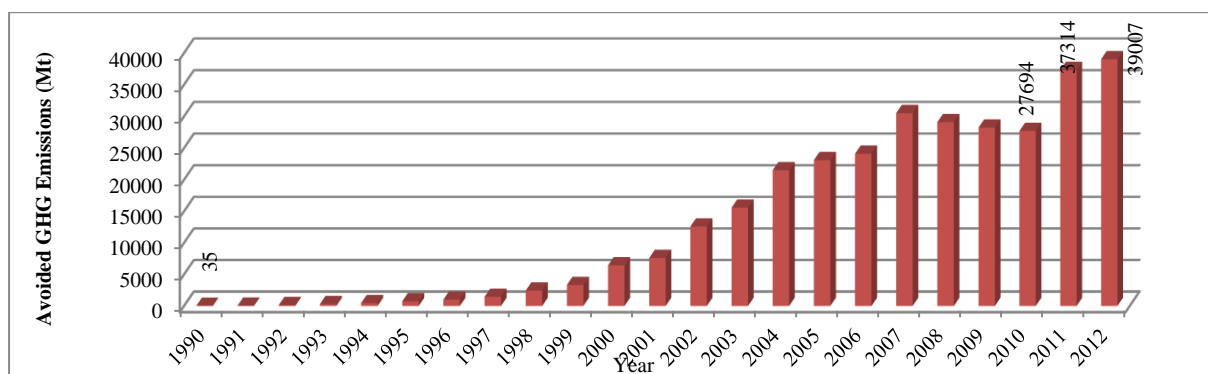
### 5.3 AVOIDANCE OF ENERGY-RELATED EMISSIONS

One of the most important reasons for the development and use of wind energy is its contribution to climate protection. On 3<sup>rd</sup> December 2014, the German cabinet adopted the Climate Action Programme 2020. The goal of the German Government, according to the Climate Action Programme 2020, is to cut its GHG emissions by at least 40% compared with 1990 (BMU, 2014). In 1990, about 1,250 million tonnes CO<sub>2</sub> equivalent were emitted; the target for 2020 is therefore 750 million tonnes. According to the latest estimates, Germany emitted about 912 million tonnes CO<sub>2</sub> equivalent in 2014 (BMU, 2015). This equates to a reduction of about 37% relative to 1990. The degree to which GHG emissions

<sup>202</sup> B = Berlin, BB = Brandenburg, BW = Baden-Württemberg, BY = Bavaria, HB = Bremen, HE = Hesse, HH = Hamburg, MV = Mecklenburg-Western Pomerania, NI = Lower Saxony, NW = North Rhine-Westphalia, RP = Rhineland-Palatinate, SH = Schleswig-Holstein, SL = Saarland, SN = Saxony, ST = Saxony-Anhalt, TH = Thuringia.

are avoided depends on the type of fossil energy carrier that is substituted. In all sectors of energy consumption, (electricity, heat, and transport) fossil fuels were replaced with renewable energy.

According to figures released by the BMU, total avoided energy-related GHG emissions in 2012 amounted to about 145 million tons of CO<sub>2</sub> equivalents. The electricity sector accounted for 101.1 million tons, of which 81.6 million tons came from renewable electricity quantities assigned for EEG compensation claim (BMU, 2013). Onshore wind energy accounted for about 40 million tons CO<sub>2</sub> equivalent of avoided GHG emissions in 2012 (BMW, 2014). This represents an increase in avoided GHG emissions, using onshore wind energy, of about 4.5% compared to the previous year (ca. 37 million tons CO<sub>2</sub> equivalent). Figure 5.9 depicts the evolution of avoided energy-related GHG emissions through their substitution with onshore wind energy.



**Figure 5.9: Development of avoided GHG emissions by onshore wind energy, 1990 until 2012**  
 Courtesy: Wanki, data from (UBA, 2013; BMU, 2007; BMU, 2013)

Furthermore, according to calculations made by the UBA that were published in October 2013, the utilization of onshore wind energy accounted for about 42 million tons CO<sub>2</sub> equivalent of avoided GHG emissions in 2012 (UBA, 2013). Moreover, the emission-free operation of onshore wind energy installations equally contributed significantly to the reduction of other air pollutants in 2012 (see Table 5.2).

**Table 5.2: Emission footprint of electricity from onshore wind energy in 2012**

	Avoided Emissions (t)	Emissions (t)	Emission balance (t)	Avoidance factor (g/kWh)
GHG (CO <sub>2</sub> -Eq.)	42,403,987	437,572	41,966,416	781.39
CO <sub>2</sub>	38,898,407	403,934	38,494,473	716.74
CH <sub>4</sub>	134,679	1,477	133,202	2.48
N <sub>2</sub> O	587	8	578	0.01
SO <sub>2</sub>	19,819	662.96	19,156.21	0.36
NO <sub>x</sub>	27,726	1,000.06	26,726.25	0.50

Source: Wanki, derived from (UBA, 2013)

## 5.4 SOCIO-ECONOMIC IMPORTANCE

### 5.4.1 INVESTMENTS IN WIND ENERGY GERMANY

Researches financed by the BMU in 2013 and the BMWi in 2014 showed that investment in renewable energy technologies in Germany fell for the third year in succession in 2013 following the record figure of €26.4 billion for investment in installations in 2010. At €16.09 billion, investment was 20% down on 2012 with €20.21 billion investment (O'Sullivan, et al., 2014; O'Sullivan, et al., 2013). The greater part of this drop is not due to a decrease in annual installed capacity, rather due to the continuing decline in prices for photovoltaic systems. Unlike photovoltaics, investment in windmills was higher in 2012 (see Figure 5.10). These investment figures are results based on the first assessment of the Working Group on Renewable Energies-Statistics (Arbeitsgruppe Erneuerbare Energien-Statistik - AGEE-Stat) published for 2013 (BMWi, 2014).

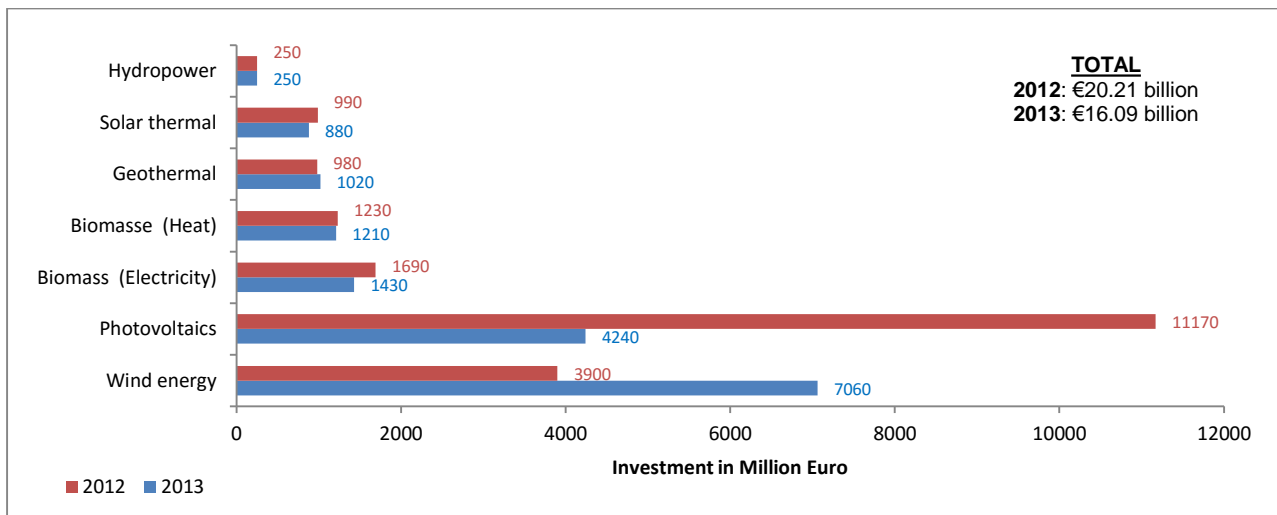
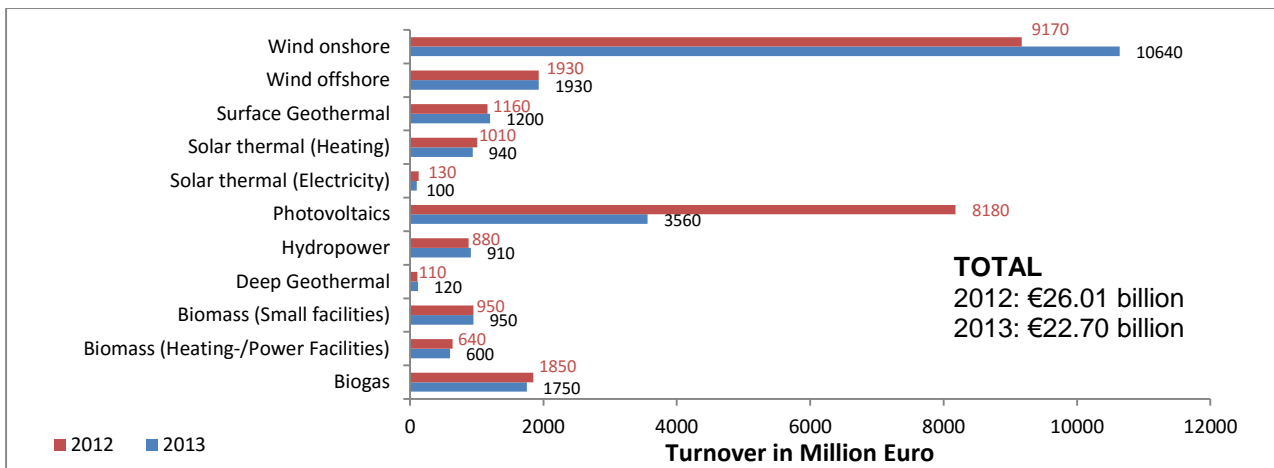


Figure 5.10: Investment in renewable energies in 2012 and 2013

Courtesy: Wanki, data from (BMWi, 2014; O'Sullivan, et al., 2014)

### 5.4.2 TURNOVER FROM WIND ENERGY IN GERMANY

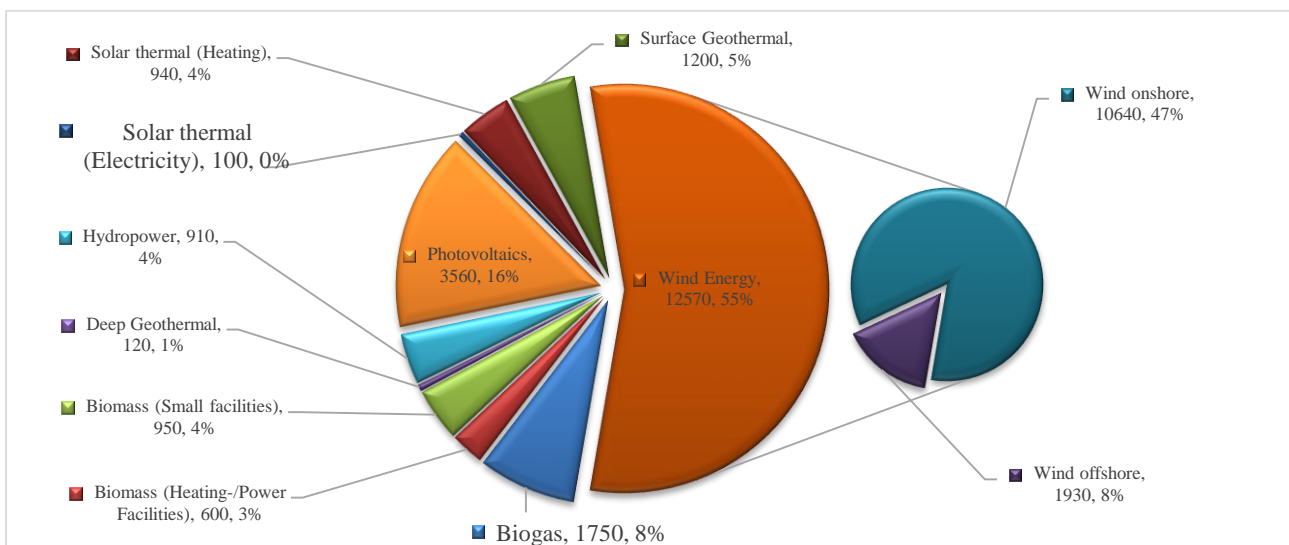
Generally, turnover from renewable energy facilities and their associated components in Germany was about €22.7 billion in 2013. Likened to 2012 (€26.01 billion), this represented a decrease by almost 13% (O'Sullivan, et al., 2014). As was the case with investments, the largest decline was booked by the photovoltaic industry, with a drop in turnover by about 56%. However, the declined was not to the same extent as the investment (-62%). The biogas, solar thermal power plants, and Biomass (heating- / power facilities) equally posted declines in turnover (see Figure 5.11).



**Figure 5.11: Turnover from renewable energies in 2012 and 2013**

Courtesy: Wanki, data from (BMWi, 2014; O'Sullivan, et al., 2014)

The most significant increase in turnover was from the onshore wind energy branch in 2013, while turnover from the offshore branch remained the same as the previous year. Generally, the wind energy industry recorded turnover of about €12.5 billion, which represents almost 55% of total turnover in 2013. Onshore wind energy alone accounted for 47% of overall turnover from renewables in 2013 (see figure 5.12).



**Figure 5.12: Share and turnover (in million euros) from renewable energies in Germany, 2013**

Courtesy: Wanki, data from (O'Sullivan, et al., 2014; Mattes, 2014)

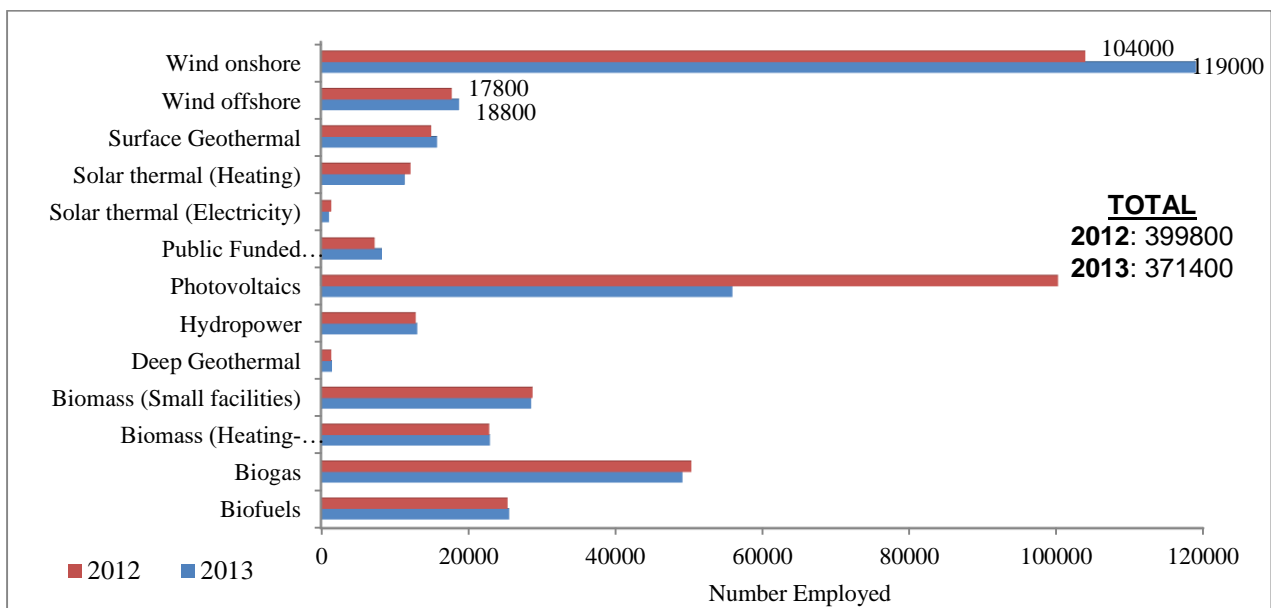
### 5.4.3 PUBLIC REVENUE FROM WIND ENERGY

Incomes from investment in and turnover from the wind energy industry are impacted by various taxes and social security contributions in Germany. These taxes and social security contributions flow into public coffers, and serve as an importance source of revenue for many municipalities. According to a research published by DIW, estimated results of tax and social security revenue show that the wind energy industry had a significant effect on public revenue in 2012. Overall, a total amount of taxes and social security contributions from production of new wind turbines amounted to about €3.39 billion in 2012 (Mattes, 2014).



#### 5.4.4 JOB CREATION IN THE WIND ENERGY INDUSTRY

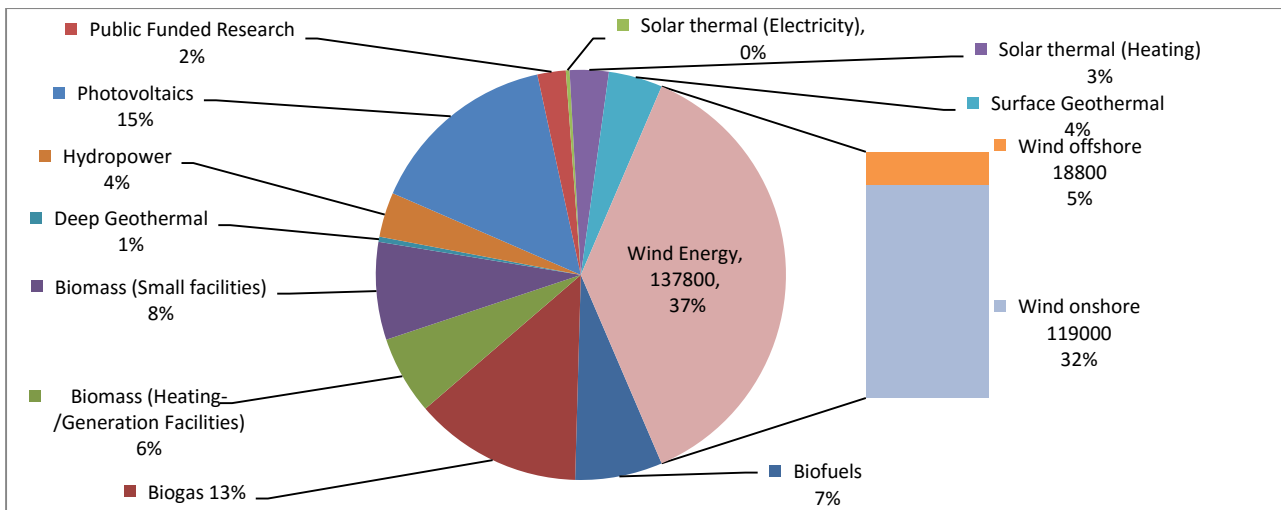
Renewable energies are major creators of jobs in Germany. Their continuous expansion has led to a substantial growth in employment. According to the third report on employment from the renewable energy sector, gross employment in 2013 amounted to about 371,400 people (O’Sullivan, et al., 2014). The wind energy with approximately 137,800 jobs contributed 37% to the gross employment in 2013 followed by biomass (126,400 jobs) with 34%. Employment in publicly funded research and management has a share of nearly 2% (8,300) of gross employment. Likened to 2012 with 399,800 jobs (O’Sullivan, et al., 2014), Overall employees in the renewable energy sector fell by 7% on the previous year (see Figure 5.13).



**Figure 5.13: Employment in Germany’s renewable energy sector, 2012 and 2013**

Courtesy: Wanki, data from (O’Sullivan, et al., 2014; Mattes, 2014)

Among renewable energies, wind energy has been a class of its own in recent years with respect to employment. The wind energy industry in 2013 employed about 137,800 people (see Figure 5.14). This is a 13% increase compared to the previous year (121,800 people). Onshore wind energy remained the highest employer (32%) with 119,000 employees in 2013, which represents an annual growth rate of about 86% within the last decade.



**Figure 5.14: Employment shares in Germany's renewable energy sector in 2013**

Courtesy: Wanki, data from (O'Sullivan, et al., 2014; Mattes, 2014)

### 5.4.5 GROSS VALUE ADDED (GVA) OF WIND ENERGY IN GERMANY

While investment, turnover, public revenue, and employment provide an indication of the economic significance of wind energy, a definite measure of the economic performance of wind energy can only be provided by the GVA of wind energy in the German economy. This is because GVA is an important part of the GDP (Mattes, 2014).

According to the DIW study, the German wind energy industry in 2012 provided a gross value added effect of €10.67 billion (direct and indirect effects),<sup>203</sup> to the German economy.<sup>204</sup> Besides, induced effects<sup>205</sup> provided an additional 3.81 billion euros, resulting to a total gross value added at basic prices effect of €14.48 billion (Mattes, 2014).

## 5.5 CHAPTER CONCLUSION

The relevance of this chapter to this study was to use numerical data to evaluate the success of the German renewable energy and climate policies in fostering the expansion of wind energy (as well as other renewable energy technologies) in Germany. The findings presented in this chapter depict that wind (renewable) energy has rapidly entered the mainstream of electricity generation in Germany and equally plays a leading role in mitigating global climate change as well as in the socio-economic performance of the

<sup>203</sup> Direct effects refer aspects of the wind energy industry that have direct influence on the gross value added such as employment and public revenue. Indirect effects on the other hand refer to the effect on value added, which results from the demand of the wind energy sector for goods and services. For example, indirect effects include the impact on those workers employed in upstream industries such as the steel industry, as steel production constitutes an important input for the construction of new wind turbines.

<sup>204</sup> The demarcation between the wind energy industry and their suppliers is statistically difficult to grasp, as manufacturers of wind turbines in part have very different production intensity. Therefore, a clear differentiation between direct and indirect effects in the case of the wind energy industry is difficult, so that the sum of the two effects cannot be reported separately as independent variables.

<sup>205</sup> Induced effects refer to the effect resulting from spending the income generated from direct and indirect effect (multiplier effect).

regional and local populations. This provides a vehement prove that the EEG has been very successful in propagating the expansion and use of onshore wind energy in Germany and has been very instrumental in curbing CO<sub>2</sub> emissions. From the data evaluated, three major points can be deduced.

First, the expansion of onshore wind energy has happened quickly. Germany has moved in shifting its electricity consumption toward renewable energy. Between 2000 and 2014, cumulative installed capacity of onshore wind energy grew from 6,095 MW to 38,116 MW, representing an annual average growth rate of 2,722.6 MW per year. By the end of 2014, renewable energies provided more than a quarter (28%) of gross electricity consumption, with onshore wind energy accounting for 10%. The shift has happening more quickly than anyone anticipated in 2000 when German lawmakers approved the EEG. In fact, recent amendments to the law has been partly aimed at controlling the growth of wind (renewable) energy. In addition to the low wholesale prices for electricity, the surcharge on electricity has helped investors pay for the initial investments and this has been key to the success of the energy transition process.

Second, the rapid expansion of onshore wind energy has enabled Germany meet its climate protection policy obligation set by the EU. Onshore wind energy accounted for about 40 million tons CO<sub>2</sub> equivalent of avoided GHG emissions in 2014. Generally, renewables offset an estimated 148 million tons of CO<sub>2</sub>-equivalent emissions in 2014; of which 109 million tons was in the electricity sector alone (BMU, 2015). This shows that, wind energy (together with other renewables) contributes significantly to CO<sub>2</sub> emission reduction in Germany.

Finally, the EEG induced expansion of wind energy boosts jobs and economic growth. In 2013, the wind energy industry accounted for about 137,800 jobs in Germany. Besides, German industries made massive investments in wind energy, and the energy transition has not slowed Germany's global competitiveness. The most obvious winners from are small and medium-size businesses and citizen groups that invested heavily in onshore wind energy. The hands-on and grass-roots-focused engagement is making the energy transition process popular and possible. In the process, it has democratized the electricity sector, empowering citizens and small businesses in an area once dominated by multinationals.

Matching these points against the purpose of the EEG as stipulated in §1 para. 1 EEG, one can conclude that the EEG has been very successful in achieving its energy sustainability and climate protection goals.

## 6 SOCIAL ACCEPTANCE OF ONSHORE WIND ENERGY

### 6.1 GENERAL STATEMENT

Concerns about climate change and scarcity of fossil fuels has propagated wind energy high on the policy agenda in Germany. As windmills are spreading, social acceptance is, however, one factor that can potentially be a barrier to the achievement of the renewable energy targets. While debates on social acceptance are not completely new to the energy sector - e.g. demonstrations against nuclear power plants and nuclear waste storage facilities in the 1980s (Heymann, 1995) - this issue needs to be urgently addressed if the onshore wind energy expansion targets are to be achieved successfully.

The acceptance of wind energy is affected, among other factors, by local perceptions of wind energy, its importance, a desire for equitable processes (transparency), the potential for human and environmental impacts, and socio-economic factors e.g. "electricity price" (Moula, et al., 2013). Policy is a fundamental element influencing each of these variables and is particularly important because it governs precisely how wind energy affects a country and the local communities where projects are sited. Policy development in Germany occurs at the national, federal state and local levels; whereby the actual policy design and instruments depend on the institutional arrangements of each federal state. All three levels - in principle - interact and enter into dialogue with one another (countervailing principle), as well as with the diverse array of communities and stakeholders.

This chapter surveys the level of acceptance of wind energy with respect to policy development, electricity price, and public perception. Additionally, emphasis is placed on respondent's awareness, opinion about the cost of renewable electricity and willingness to pay for clean energy. The analysis of policy aspect of social acceptance was done with the aid of semi-structured interviews and questionnaires, the cost factor was analysed with the aid of the questionnaire as well as the detail evaluation of the electricity pricing mechanism, and public perception (see chapter two above). The purpose of the chapter is to achieve objective four of the research.

Results of the analysis provide a treasure trove of knowledge in many ways. For example, they provide us an important avenue to know the problems faced by planners at local level and the steps that could be taken to enhance onshore wind energy expansion. Finally, the results aid in analysing public attitude towards onshore wind energy.

NOTE: The focus of this field study is the Land Brandenburg (BB), which is divided into five Regional Planning Boards (RPG).<sup>206</sup>

## 6.2 SURVEY APPROACH

Survey activities were carried out from September 2010 to December 2010 for primary quantitative data collection (questionnaire) and from March 2010 to April 2013 for primary qualitative data collection (semi-structured interviews). The survey was conducted principally within the five RPG of Land Brandenburg though three semi-structured interviews were conducted externally - the interview with Arne Mogren was done in Berlin while those with Birte Kempe-Samsami and Felix Rehwald were executed in Hannover during the Hannover International Industrial Exposition 2013. The questionnaire respondents (1,000 individuals) were distributed evenly among five RPG in Brandenburg, i.e. 200 questionnaires in each region.

The questionnaire comprised of ten questions classified under three subtopics:<sup>207</sup> demographics (section A), perception (section B), and policy (section C). In the questionnaire, three questions (in section A) were addressed to acquire background information of all the interviewees i.e. sex, age group and educational status of the interviewees. The ratio of the interviewees for section A is shown in Figures 6.1 to 6.6. In section B, six questions were asked to gauge acceptance of the wind energy in Brandenburg. The six questions are classified into two groups, from question four to six (Figures 6.7 to 6.16) on perception of wind energy and from question seven to nine (Figures 6.7 to 6.24) to measure the interviewees' awareness (sustainability) of wind energy. Finally, section C asked one question on regional policy with respect to the siting of wind energy suitable areas (Figures 6.25 and 6.26). In addition, some qualitative conclusions can also be deduced based on the quantitative analysis, as the percentage will indicate certain challenges and truth about the study area.

### 6.2.1 BACKGROUND INFORMATION

Figure 6.1 shows that more male counterparts were willing to participate in the survey than females. Though the difference was minimal, of the 1,000 respondents to the survey, 545 were males (54.5%) while 455 were female.

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<sup>206</sup> Havelland-Fläming (H-F), Lausitz-Spreewald (L-S), Oderland-Spree (O-S), Prignitz-Oberhavel (P-O), and Uckermark-Barnim (U-B) planning authorities.

<sup>207</sup> The questionnaire is found in appendix I and II.

**1. Gender distribution of respondent**

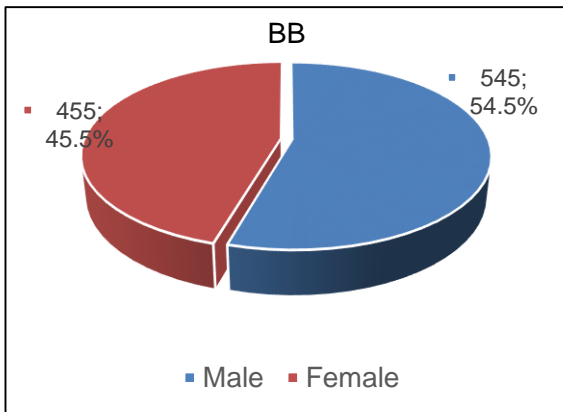


Figure 6.1: Sex of respondents in BB

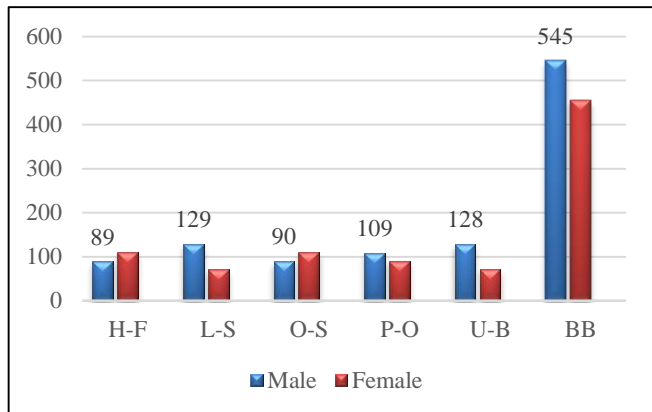


Figure 6.2: Sex of respondents in BB regions

This gender distribution of respondent is normal, since Brandenburg has a higher male population. Therefore, the probability of meeting a male respondent is higher. According to the German Federal Office of Statistics (DESTATIS), a female go for 1.25 males in Brandenburg (DESTATIS, 2011). However, this trend was not unique within the RPG, while the share of male respondents were higher in U-B and L-S regions, the share of male and female respondent was equal in the P-O region and there were more female respondents in O-L and H-F regions (see Figure 6.2).

As shown in Figures 6.3 and 6.4, respondents were chosen from different age groups in order to have an idea of the impact of age on the willingness to participate in the survey. The survey found that the level of participation seems to correlate with age, with the active segment of the population (in age groups of 18-28, 29-38 and 39-48) being more supportive than others.

**2. Age group of respondent**

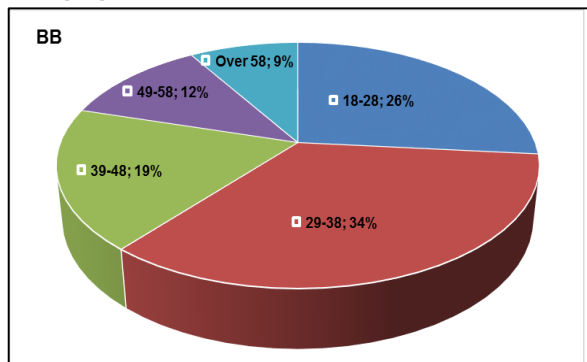


Figure 6.3: Age group of respondent in BB

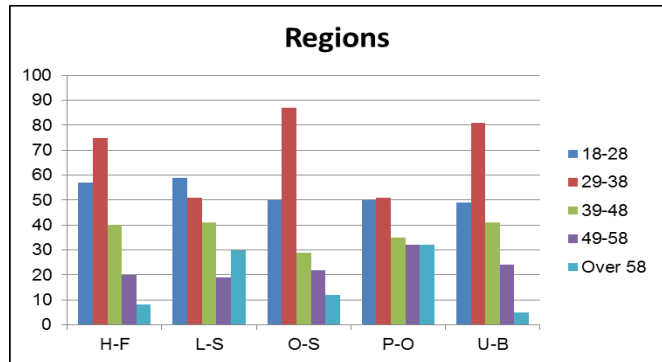


Figure 6.4: Age group of respondent in BB regions

This suggests that respondents from these age groups are more willing to participate in seeking solutions to environmental problems, which may affect them, as they get older. This

trend was almost the same in the regions, with slight changes only in the L-S and P-O regions.

Figures 6.5 and 6.6 shows that the interviewees came from a well-educated segment of the population, signifying a high level of social awareness as well as a high literacy level.

**3. Education status of respondent**

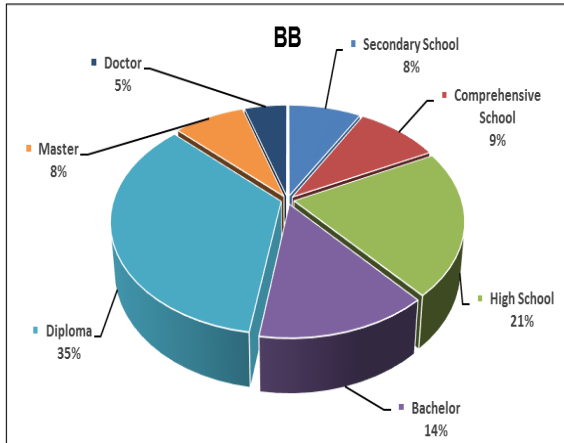


Figure 6.5: Education status of respondent in BB

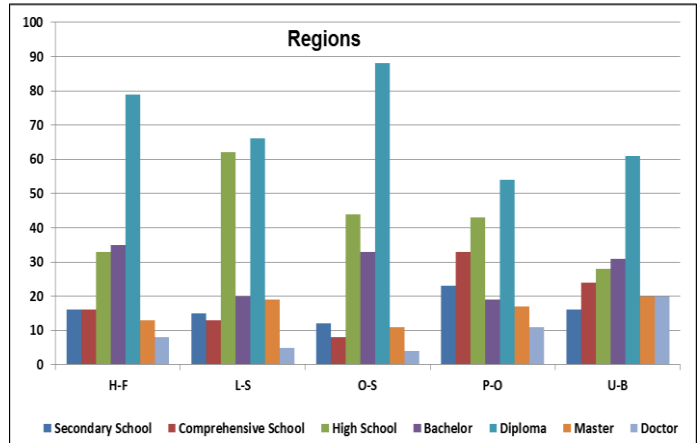


Figure 6.6: Education status of respondent in BB regions

**6.2.2 RESPONDENTS PERCEPTION OF WIND ENERGY**

Question four represented an important social aspect of the survey, i.e. the perception of wind energy. This question focused on the importance of local wind energy generation. As depicted in Figures 6.6 and 6.7, 82% of respondents had a positive perception (acceptability) of wind energy, of which, 33% considered wind energy to be very important. Whereas for 49% of the respondents, wind energy is important for Brandenburg. This result proves that wind energy enjoys a significantly high acceptability in Brandenburg. This positive trend is equally reflected in the different regions, though with slight differences.

**4. I believe that the expansion and use of wind energy in the state of Brandenburg ...**

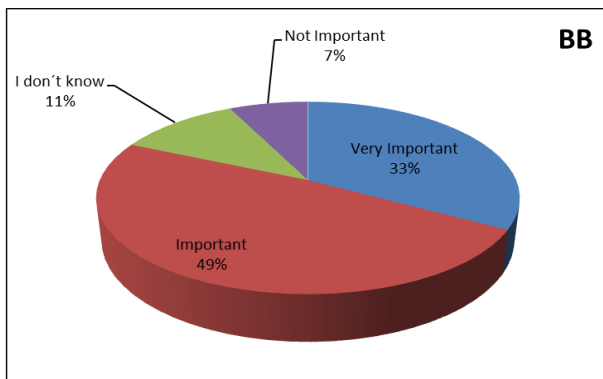


Figure 6.7: Perception of wind energy in BB

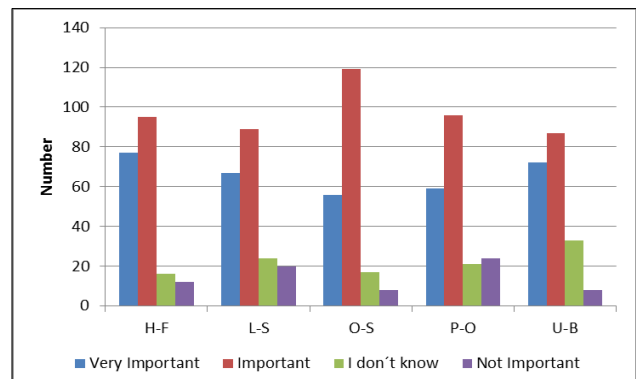


Figure 6.8: Perception of wind energy in BB regions

Question five deals with the aspect of distance. This question was set deliberately to assess if the respondent is affected directly by the impacts of wind parks. Furthermore, information



could be obtained as to whether the respondent's answers were based on personal experiences or on secondary information. As shown in Figure 6.9, 52% of respondents do not live within 1,000m to a windmill. While only 9% live within this range.

5. How far is your apartment from the closest windmill?

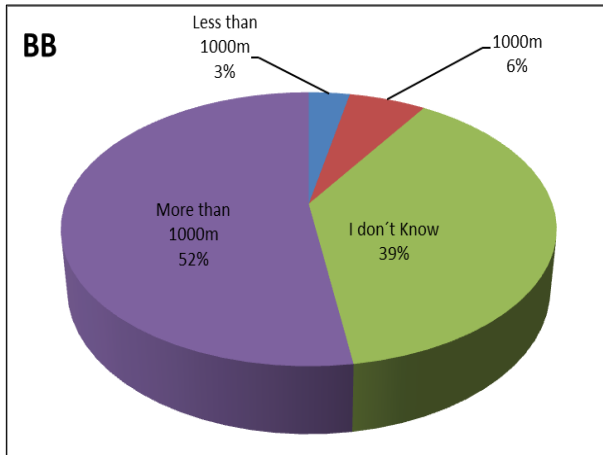


Figure 6.9: Distant of respondent to nearest windmill, BB

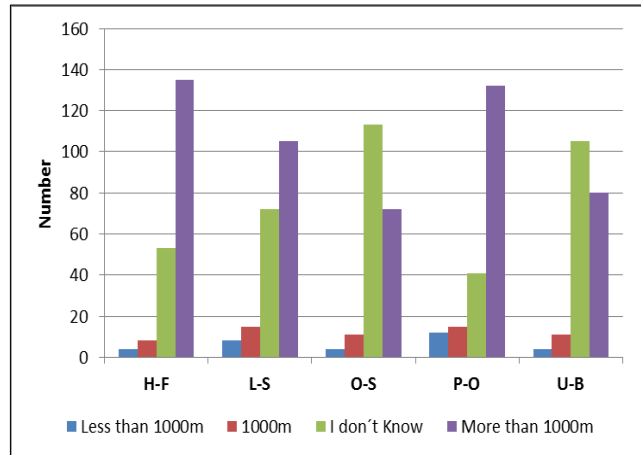


Figure 6.10: Distant of respondent to nearest windmill, BB regions

Windmills within 1,000m to residential areas are generally rare in Brandenburg and are mostly those that were constructed in the nineties or early 2000 prior to the publication of the “Ecological distance criteria for the installation of wind parks in Brandenburg” (TAK) in 2003. Strange enough, a significant share of 39% answered “I don't know”. This suggests that they do not live near a windmill and can therefore, be added to the share of the population living above the 1,000m range, i.e. 91% of the population do not live within 1,000m of a windmill. This may equally suggest that this group of respondents find it difficult to estimate distance. However, this direction of reasoning in this case is not plausible; given that humans have the tendency of underestimating distances (Plumert, et al., 2005; Ziemer, et al., 2009). Consequently, a windmill or wind park in the vicinity would rather have the tendency of being place within the 1,000m range instead of the answered “I don't know”. Therefore the plausible suggestion would be that, the answered “I don't know” means there are no visible windmills or wind parks in the area. Figure 6.10 shows that the regional trends are similar to that of the overall Brandenburg state. This question clearly demonstrates that a large majority of the population is not directly affected by wind energy projects, and their perception of wind energy is vastly influenced by secondary information. This emphasizes the importance of larger scale information dissemination for awareness purposes.

6. If you had a plot in a wind suitable area, would you permit the construction of a wind park it?

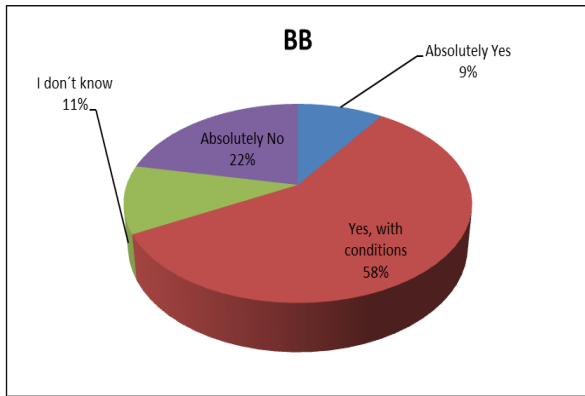


Figure 6.11: Respondents willingness to allow WT in the neighbourhood, BB

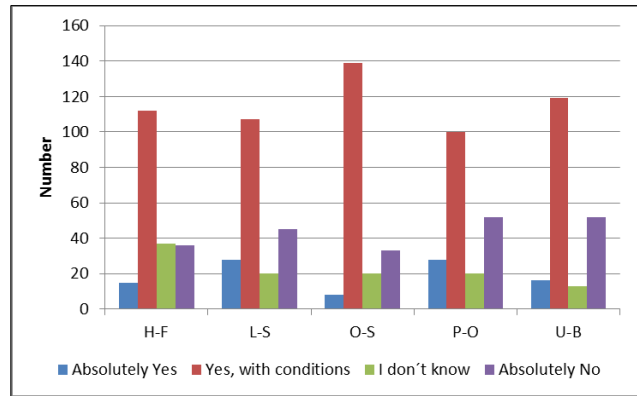


Figure 6.12: Respondents willingness to allow WT in the neighbourhood, BB regions

The sixth question is trickier. It was noted in one of the expert that people resist having windmills in their backyard<sup>208</sup> (Berger-Karin, 2010). Hence, this question was framed to know what people think about having wind parks as part of their neighbourhood. As shown in Figures 6.11 and 6.12, the majority of respondents, 58%, said they would conditionally permit the construction of windmills in their neighbourhood, while 9% gave an unconditional yes. However, a meaningful 22% of respondents refused to have windmills as part of their backyard. Thus, people are not sure about accepting them as part of everyday scenery. This could be because they have not seen it as a common practice in their own neighbourhoods so far. This however, indicates how perceptions of fairness and levels of trust are implicated in the social acceptance of wind energy developments. The uncertainty of some people to having windmills in their backyard was expected, which may be due to other factors. Therefore, two follow-up questions were deliberately placed asking:

- a) If your answer to question 6 is “No”, why?
- b) If your answer to question 6 is “Yes with conditions”, which conditions?

The results were somehow predictable. Of the 22% that absolutely rejected windmills in their neighbourhood, see Figures 6.13 and 6.14, 39% said their opposition is because of sound emissions from windmills, 29% said windmills destroy the landscape, 17% gave impact on birds and bats as reason, while only 9% and 6% gave large size and simple dislike respectively as reasons for their opposition. This result proves that, in order to increase the acceptance of windmills in neighbourhoods, much still has to be done to improve the environmental impacts of wind energy. As for those whose support for wind parks in their neighbourhood is dependent on certain conditions (see Figures 6.15 and 6.16), 46% would permit windmills in their backyard against low electricity bills, 24% against the payment of

<sup>208</sup> A phenomenon commonly referred to as “Not in my backyard” or “NIMBYISM” (Ibitayo, 2008).

property rights (usage cost), 23% against a share of the profits, and 7% had other reasons. This result highlights the importance of economic performance of the local population to social acceptance of wind energy installations. The results of question six somehow contrast with the high share of acceptance of wind energy in question four. This vividly demonstrates that environmental action is not influenced only by desire and consciousness. Other factors such as cost and expense considerations play an equally important role.

**a) If your answer to question 6 is “No”, why?**

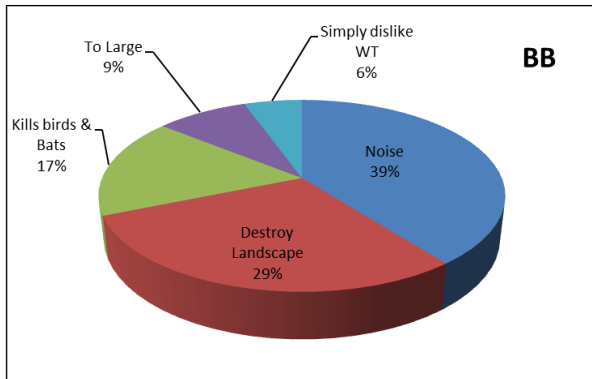


Figure 6.13: Reasons against wind parks in BB

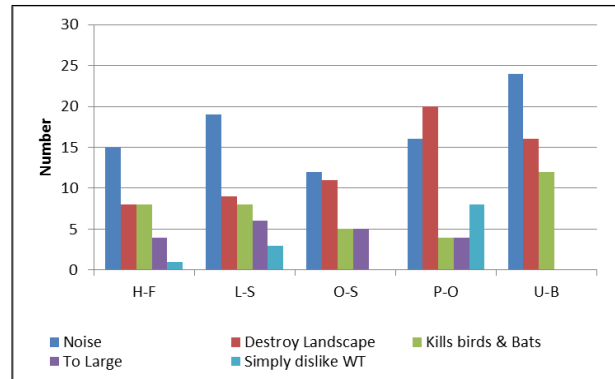


Figure 6.14: Reasons against wind parks in BB regions

**b) If your answer to question 6 is “Yes, with conditions”, which conditions?**

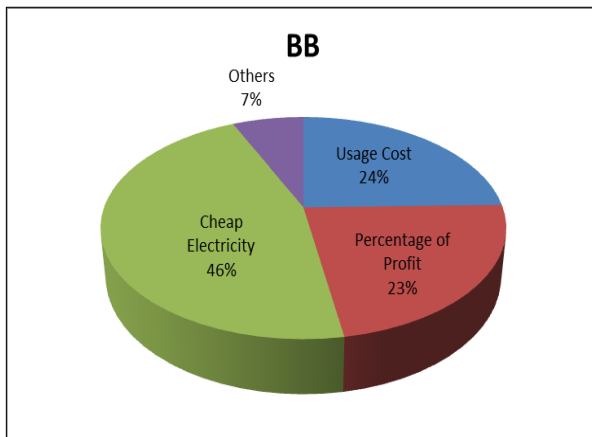


Figure 6.15: Conditions for accepting wind parks in BB

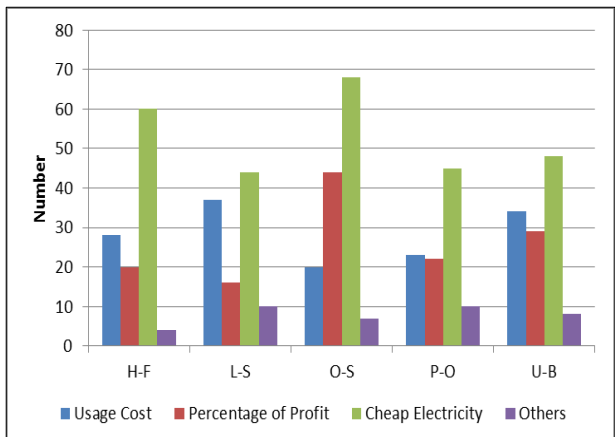


Figure 6.16: Conditions for accepting wind parks in BB regions

Question seven uses a highly marketed key word “green electricity”. It is possible that respondents relate more to the “green electricity” concept than wind-generated electricity concept or vice versa. Furthermore, it provided a possible evaluation of the respondent willingness to pay for alternative generation forms. Here, as depicted on Figures 6.17 and 6.18, 64% of respondents answered with “yes”, 18% were unsure while the remaining 18% said “no”. Of the 18% that are unwilling to opt for green electricity, 54% reasoned that green electricity is expensive (see Figures 6.19 and 6.20).

7. Would you opt for green electricity?

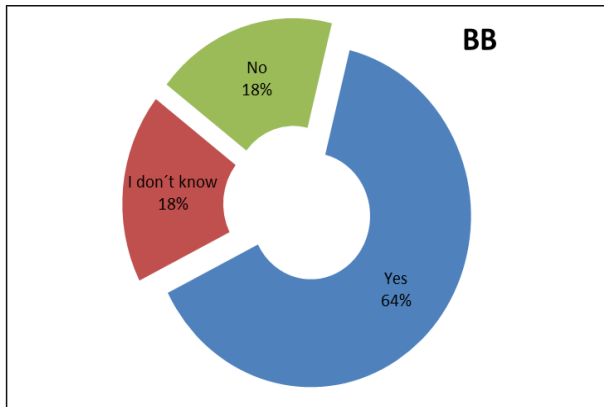


Figure 6.17: Willingness to pay for green electricity in BB

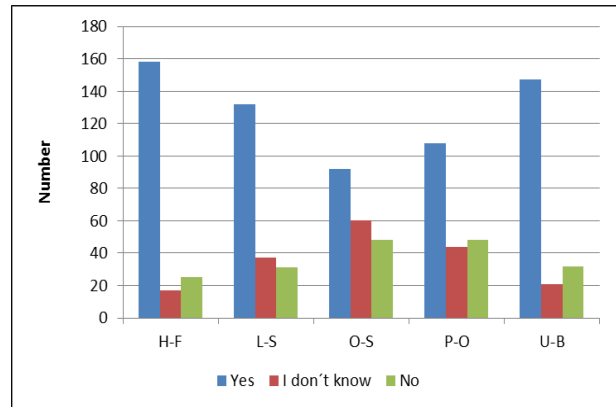


Figure 6.18: Willingness to pay for green electricity in BB regions

When no, why?

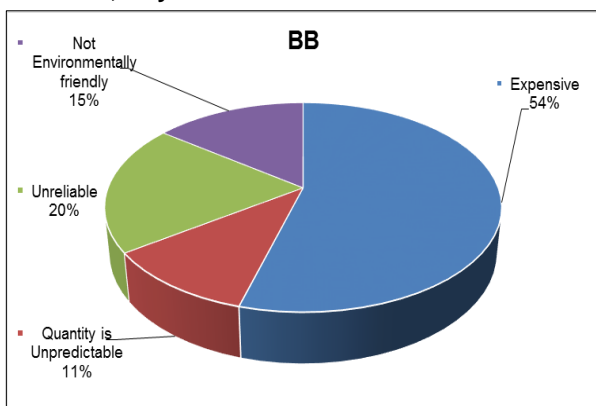


Figure 6.19: Reasons against green electricity in BB

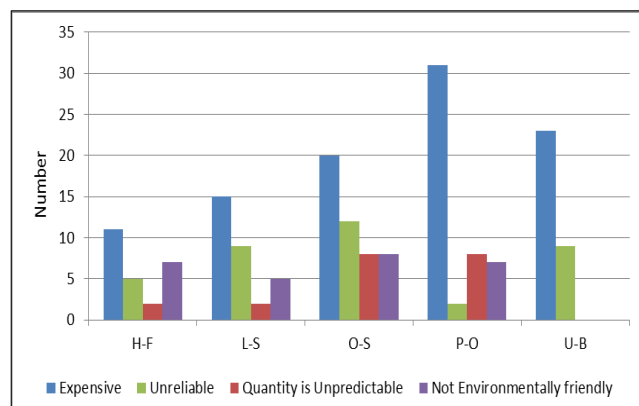


Figure 6.20: Reasons against green electricity in regions

The results of this question are in strict contrast to the reality in Germany. A study published by the Agency for Renewable Energies (AEE) found that only 18% of German households get their electricity completely from renewable sources (Hilmer & Dittko, 2013). This result equally confirms the supposition that the EEG surcharge is a major factor in the development of wind energy.

Question eight deals with awareness regarding climate change as a global issue. This question was set deliberately to introduce the concept and need of using wind energy technology towards better environment. Majority of respondents, 86%, think wind energy play a major role in the reduction of CO<sub>2</sub> emissions. Of which, 51% are of the opinion wind energy is very important as shown in Figures 6.21 and 6.22. This suggests that people are generally aware of climate change and do want to prevent it.

8. Do you think that wind energy plays an important role in the avoidance CO<sub>2</sub> emissions?

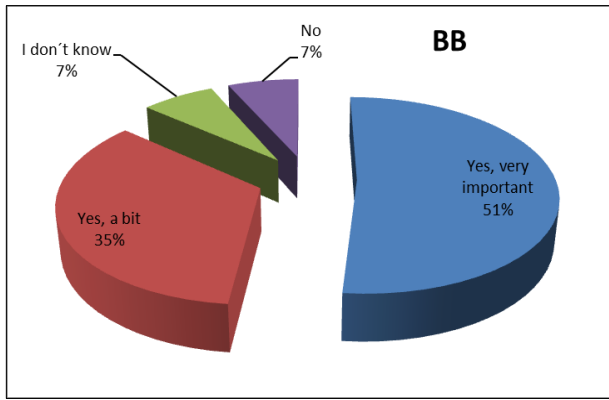


Figure 6.21: Climatic importance of wind energy in BB

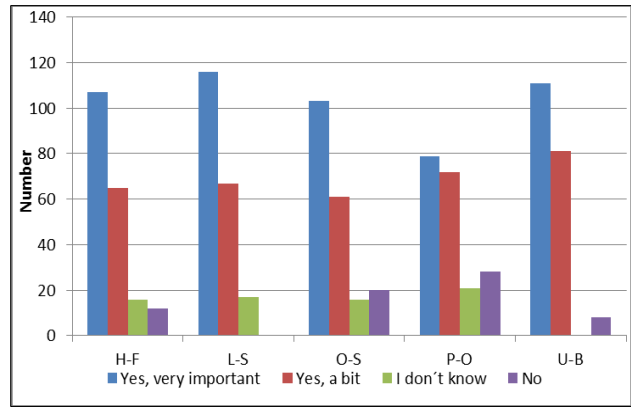


Figure 6.22: Climatic importance of wind energy in regions

Question nine was placed to gauge the respondent's awareness to the economic importance of wind energy deployment. Data portrayed in Figures 6.23 and 6.24 show that 48% believe wind energy is an important economic factor in Brandenburg.

9. Do you think that wind energy plays an important role in the economy of Brandenburg?

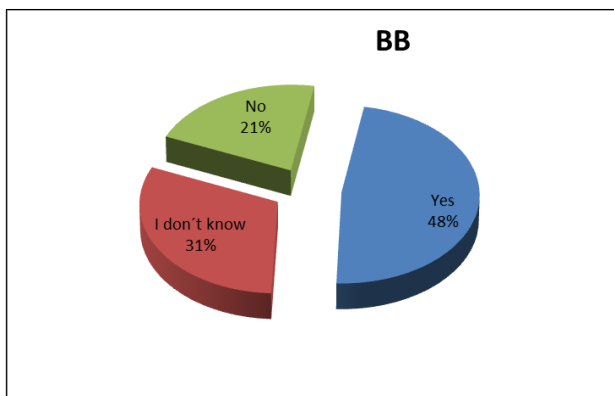


Figure 6.23: Economic importance of wind energy in BB

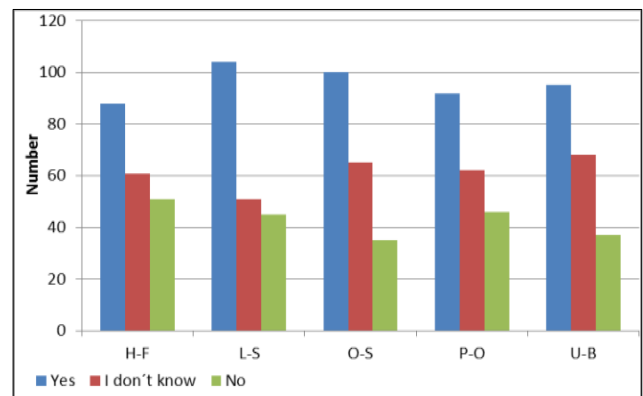


Figure 6.24: Economic importance of wind energy in regions

However, the share of the population, which were not sure of what to say, 31%, was surprising. Given that, revenue from wind energy in recent years is the highest among renewable energies; this result depicts a high degree of unawareness and the low level of information dissemination.

### 6.2.3 RESPONDENT PERCEPTION OF SITING POLICIES

It is clear from question four that wind energy enjoys a very strong support from the citizens. What about the support of the policies, particularly those regarding the siting of wind suitable areas? In the survey, people were asked if the siting process for wind suitable areas was executed properly (question 10). This question produced the most astonishing result. As shown in figures 6.25 and 6.26, 60% knew nothing about the siting process, 31% said the siting process is not executed properly and only 9% were of the opinion that the siting process is executed properly.

10. Do you think that the selection process for wind suitable areas is executed properly?

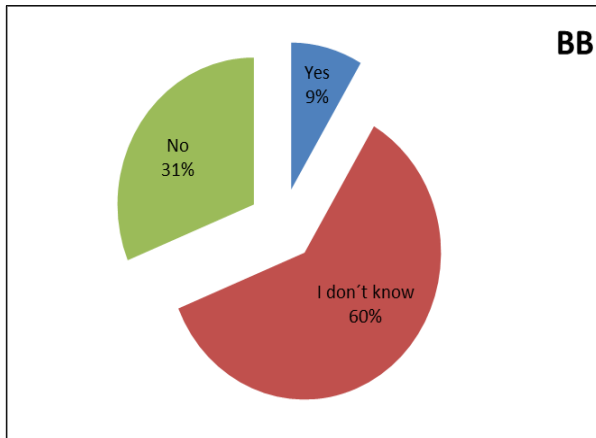


Figure 6.25: Impression of the siting process in BB

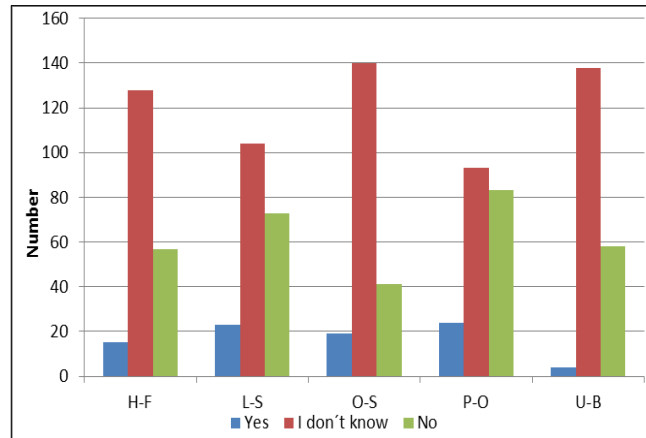


Figure 6.26: Impression of the siting process in BB regions

The result portrays a vivid example of improper integration of the population in the planning and to certain extends execution of wind energy projects in Brandenburg. Given that the regional plans for wind energy use of the Lausitz-Spreewald (L-S)<sup>209</sup> and Havelland-Fläming (H-F)<sup>210</sup> regions were declared void by the OVG Berlin-Brandenburg, the respond to question ten is a vehement reminder of how the lack of transparency can negatively influence the execution of a project and equally abate social acceptance. In both cases, the reasons for rejecting the plans - among others - were irregularities in the siting process and the absence of an overall planning concept (Juris, 2007; Juris, 2010).

When no, why?

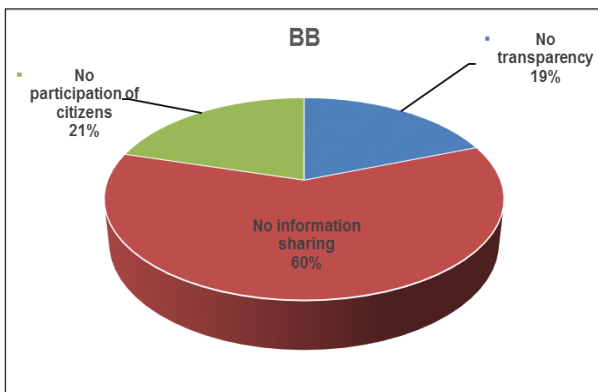


Figure 6.27: Reasons for negative response in BB

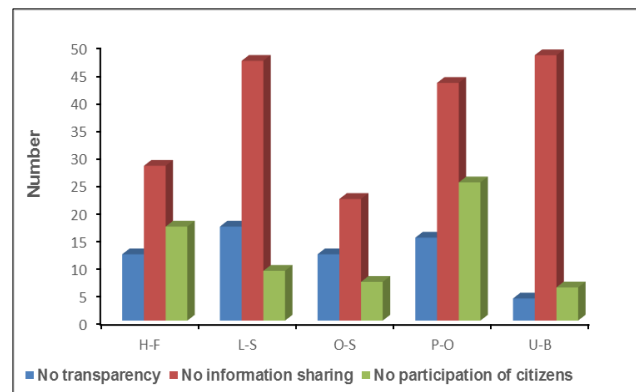


Figure 6.28: Reasons for negative response in the states

A follow-up on question 10 (why no) shows – both in the regions and in the state – clearly that the authorities are not doing good enough to integrate the population into the decision-making process (see Figures 6.27 and 6.28). About 60% of those who said no in question 10 believe information from the authorities on planning is hard to come by while 21% and

<sup>209</sup> Judgement of 21<sup>st</sup> September 2007, OVG Berlin-Brandenburg Berlin. Case number: 10 A 9.05.

<sup>210</sup> Judgement of 14<sup>th</sup> September 2010, OVG Berlin-Brandenburg Berlin. Case number: 2 A 1.10 , 2.10, 3.10, 4.10 and 5.10.

19% think there is no public participation and no transparency in the decision-making process respectively.

### 6.3 CHAPTER DISCUSSION

The energy transition process in Germany represents a democratization of energy supply and provides local communities and individuals the opportunity to become electricity generators. These communities are often the impetus for a comprehensive change in consciousness, when it comes to the generation and consumption of energy. Given the increasing decentralisation of energy supply in Germany, the acceptance of wind energy installations among local communities has become an important aspect of the energy transition process. The survey in Brandenburg shows that wind energy generally enjoys a high degree of acceptance among the population (see figure 6.7). Besides, previous nationwide surveys done in Germany by the Institute for Social Research and Statistical Analysis (Forsa) in 2009; and the market research institute, "TNS Infratest" in 2011, have shown that, the majority of people tend to agree with the idea of public support for wind energy and equally significantly accept<sup>211</sup> the wind energy technology (VZBV, 2013 ; Hilmer & Dittko, 2013). However, the conflict potential of new wind energy projects is equally observable (see figures 6.11 and 6.13). This has led in the past to strong opposition from "citizen initiative groups" against new onshore wind energy projects, which has in some cases hindered these projects or at least delayed them (Walter, et al., 2011). Base on the relatively high level of acceptance for wind energy portrayed by the survey, one can deduce that the opposition is not directed towards the wind energy technology per se, rather to the construction of wind parks in the neighbourhood.

The problem encountered here is the phenomenon known as "Not-In-My-Back-Yard" or simply "NIMBY" (Ibitayo, 2008) - as Berger-Karin (2010) puts it "the St.-Florian-Principle" (das Sankt-Florian-Prinzip): "Holy St. Florian, spare my house, set fire to others" (Walter, et al., 2011). The NIMBY idea suggests that, people have positive attitudes towards wind energy until they are actually confronted with it, at which point they oppose it for other reasons. However, question six of the survey shows that, the support or rejection of windmills in Brandenburg is minimally related to the technology itself. While landscape changes and noise are dominant in the decision to reject onshore wind energy projects (see Figure 6.13), acceptability of windmills in neighbourhoods' increases when the local

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<sup>211</sup> In the more recent of the two surveys, the expansion of renewable energies had an average nationwide acceptance level of 95%, with 98% share in Brandenburg, while the national acceptance for windmills in neighbourhoods was 60% with a share of 69% in Brandenburg.



community equally benefits from the windmills in their neighbourhood. Opening-up possibilities for community involvement in investments in wind energy projects enhance socio-political acceptance. According to Birte Kempe-Samsami of BWE, if locals can be intimately involved in either the siting process or the investment, such as in community wind parks, the level of acceptance will be improved significantly (Kempe-Samsami, 2013). Therefore, the NIMBY phenomenon is not as prevalent as it is often assumed. Generally, the scale of wind energy projects and the dominant significance of landscape qualities of the site require decision making that fully recognises the importance of local factors by adopting a collaborative approach to siting.

In this context, two forms of acceptance are to be distinguished: an active and a passive acceptance that are associated with a positive rating of wind energy projects in neighbourhoods (Zoellner, et al., 2008). While advocates and planners of wind energy projects often speak of acceptance, if no active resistance exist, opponents or critics of such projects believe acceptance exist only when there is active advocacy and support from the affected population (Schweizer-Ries, et al., 2011). While tolerating or endorsement of a project does not involve any form of active campaign, active acceptance includes an active action, such as a financial contribution to the project. Likewise, a negatively rated project may also take the form of passive or active resistance (Schweizer-Ries, et al., 2011). While the survey did not make any direct distinction between passive and active acceptance, the relatively moderate share of “I don’t know” answers to certain question (particularly questions 4 to 10) could possibly allude to a certain degree of passiveness in the population.

### **6.3.1 COMMUNITY ACCEPTANCE**

Based on the results of the survey, it appears that there is high level of social acceptance for low-emitting wind energy technology (see Figure 6.7). However, the reality at the local or community level exhibits some apparent discrepancies with the publicly stated support for wind parks and local opposition (see Figure 6.13), thus, creating a social gap. The deployment of wind energy has impact on the surrounding environment. The social gap may be partially explained by the environmental trade-off between global gains, for action on climate change, and local bearing of the external costs, where windmills are located (Thies, 2010). The positive gains through lower GHG emissions from wind-generated electricity occur on a national and international scale, while the negative impacts are obvious to the local community. This social gap is furthermore exacerbated by an information gap, evidenced in the survey by the significant share of interviewees who were not certain of their response or responded with “I don’t know”. Therefore, enhancing the community’s

understanding of the need for wind energy to combat climate change and to gain local acceptance of wind energy technology is important. Perceptions and local stakeholder's acceptance are crucial, as public preference and consumer choice will play a critical role in determining the extent to which wind installations are tolerated (Hälsig, 2010). Kempe-Samsami (2013) equally noted that understanding the factors around acceptance and opposition to wind parks and their interactions can contribute to all processes from overall design of projects, the processes chosen for communicating to locals, project implementation, and ultimately to acceptance of windmills.

However, the discussion about the acceptance of windmills is in many cases only a consideration of their relationship with conventional energy sources. Arguably, the lack of acceptance in some cases could also signify a general lack of environmental awareness within the local population, or even their rejection of the concept of sustainable development. The expansion of wind energy plays a significant role in the National Renewable Energy Action Plan and the Energy Concept of the federal government (BMU, 2010; BMU, 2011). In fact, one of the reasons for the development and use of wind energy in Germany is its contribution to climate protection.

While environmental awareness/responsibility is high in certain regions, it could also be low in others. In principle, one can assume that a high level of environmental awareness promotes acceptance for wind energy. In addition to environmental awareness and the presence of sustainability issues within the society, the credibility of policies and strategies, such as the energy transition policy, is above all an important aspect. Such credibility in onshore wind energy, despite its reputation as a means of environmentally friendly and sustainable energy supply is, of course, not a given. For the successful implementation of the energy transition process therefore, the credibility of the process, the environmental awareness of the local community as well as the acceptance and openness of the local population to measures for sustainable development should be considered, in addition to the individual assessment of the wind energy project. These measures would enhance significantly the acceptance of wind energy projects within the local community.

### **6.3.2 PUBLIC PARTICIPATION**

One means of achieving acceptance, is the involvement of those concerned. If properly applied, it can strengthen the sense of justice, creating confidence in the project initiators and the understanding of economic benefits from the project (Dütschke & Wesche, 2015). In addition, critical aspects can be assessed and compromises worked out, thereby avoiding

conflicts. Question ten of the survey portrays a rather negative view of public participation and transparency in decision-making (see figures 6.25 and 6.27). The result portrays a vivid example of improper integration of the local population in the planning and to certain extends execution of wind energy projects in Brandenburg. This has a negative effect on the acceptability of wind energy projects in Brandenburg. The inclusion of the interests of stakeholders such as local population and associations during the planning and implementation phases of a wind project enhances public acceptance. However, the different ways of public participation should equally be considered. Generally, there are four distinct types: information, consultation, cooperation, and self-initiative (independent action) of the project initiator/planner (Schweizer-Ries, et al., 2011). The expert interviews showed that pro-active information of citizens at the earliest possible stage of planning and consultations are primordial in active public participation (Kempe-Samsami, 2013; Rietzel, 2010). On the other hand, cooperation and self-initiative contribute fundamentally to public acceptance (Schweizer-Ries, et al., 2011). Cooperation and self-initiative enhance the involvement of the local community in investment, planning and operation of wind energy projects. An important aspect of participation is the distinction between formal and informal public participation. The former refers to those participatory processes that are legally required (obligatory), whereas the latter refers to public participation that is not required by law and hence conducted on a voluntary basis (Zschiesche, 2012).

### **6.3.2.1 Formal Public Participation**

While the planning permission procedure concerns only administration that is carrying out the examination whether the project is needed, for authorisation process according to the BImSchG, the investor has a right to the permission, if he meets all legal requirements.<sup>212</sup> In the authorisation process according to BImSchG, the public can equally take legal action against the project. The applicant in a planning permission procedure on the other hand does not automatically have the right to the permission for his project, but is only entitled to a decision on the discretion of the relevant administration that is free of mistakes.<sup>213</sup> However, the public can pursue a legal examination of the decision in a planning permission procedure. Besides, environmental organisations have the right to challenge a planning permission in court if they deem provisions of the German environmental law are affected. The major elements of public participation in planning permission procedures as well as authorisation processes according to the Federal

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<sup>212</sup> §6 BImSchG.

<sup>213</sup> §72 VwVfG.

Immission Control Act are announcement of the project, putting the planning documents on display, objection phase and subsequently a hearing.<sup>214</sup>

However, a setback in the formal public participation procedures in Germany is that the public does not participate in the decision-making process, though there is sufficient availability of information. Besides, consultative set-ups are missing in formalised participation procedures, as participation methods used in participative technology assessment for local implementation such as round table discussions or dialogue processes have not yet been implemented in formalised public participation in Germany, which has placed public participation at prelitigation stage of a planning procedure (Schweizer-Ries, et al., 2011). Zschesche (2012) notes that, public participation takes place for only one in three authorisation processes according to BImSchG and for planning permission procedures, the number is significantly higher (about 80 to 90%).

### **6.3.2.2 Informal Public Participation**

While the established public participation is mainly used in the planning phase, informal participation, in principle, can be used in all phases of a project (Schweizer-Ries, et al., 2011). Given that early involvement of the local population in wind energy projects is essential, informal participation plays a special role in this regard. In practice, often both formal and informal processes are similar, as far as their approach to the public is concern. However, there is no solid data regarding the influence of the public on any of these procedures, as no evaluable empirical studies on this issue have been carried out in Germany (Zschesche, 2012). Besides, informal participation procedures equally has its own challenges, e.g. the acceptance of the results of informal participation processes by the concerned community cannot be guaranteed. This is because the fairness of the process depends on the degree of transparency at which the project planner/investor is operating.

Finally, a form of participation, which is becoming increasingly important particularly in wind energy projects, is the financial participation in the form of “community wind parks” (Kempe-Samsami, 2013). The population has the opportunity to participate in the form of profit-sharing rights, funds, or cooperatives. The “community wind park” model of planning, implementing, and operating wind energy projects strengthens the interest wind energy, facilitates the financing of the project and encourages local initiatives into energy supply. The financial contribution is therefore an effective method of using direct support of the population to achieve acceptance of wind energy. This form of public participation could be

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<sup>214</sup> §10 BImSchG.

associated to the cooperation or self-initiative (independent action) form of participation (Schweizer-Ries, et al., 2011). A high degree of participation by the local population in a wind energy project can possibly signify a high financial involvement as well as a high acceptance. At the same time, this lowers the risk of conflict, since the benefits of intense public participation last over a long period.

## **6.4 CHAPTER CONCLUSION**

Social acceptance in the context of wind energy is a very relevant topic for the implementation of the energy transition towards a high share of renewable energies. General support for wind energy installations persists; however, local resistance against single grid projects has surfaced in past years. Combining the figures collected in the survey with the qualitative information obtained from the expert interviews, the study concluded that enhanced public participation should be introduced in order to overcome opposition and to increase acceptability. Furthermore, the data collected from the survey shows that the more community locals there are in the financing structure, the more positive the impact on social acceptance of the project.

Generally, a large proportion of the population in the Federal State of Brandenburg are very open to wind energy. Overall, almost two thirds of the respondents were favourable to wind energy expansion. In fact, 82% consider onshore windmills positive. This result is in line with a representative survey conducted in 2011 by TNS Infratest, which found that 94% of German citizens want more renewable energy. Furthermore, the data collected from the survey shows that, in addition to greater independence from fossil fuels, the positive effects on climate and the local economy equally enhanced social acceptance of wind energy facilities. Indeed, NIMBY ("not in my back yard") is less of a problem. Nonetheless, there are some sections of the population, though small, that do not want to have windmills built nearby for a wide range of reasons.

The integration of the local community in the financing mechanisms of the project or sharing the financial benefits will translate to higher level of acceptance from the local population towards the project. The social acceptance of wind turbines is especially great where local citizens were able to reap part of the profits, which could be through direct investments in community-owned wind parks or private partnerships. If wind energy is to continue to grow, great local acceptance will be one of the main challenges. Community ownership will play a crucial role here. The inclusion of the local population in an early phase of planning helps dispel myths and ensures that projects can rely on a broad support.

## **7 COMPARATIVE STUDY: CAMEROON**

### **7.1 GEOGRAPHY AND CLIMATE**

Cameroon is a unitary republic located in the Western part of Central Africa. With a total surface area of about 475,440 km<sup>2</sup>, the country extends over 1,200 km from latitude 2° North to 13° North and over 800 km from longitude 3° East to 16° East (CIA, 2013; Ngnikam, 2009). Formerly divided between France and Britain, Cameroon gained its independence through a two-stage process in 1960 and 1961 to become the Federal Republic of Cameroon. In 1984, the country was renamed the Republic of Cameroon. It has been under the Presidency of Paul Biya and his Cameroon People's Democratic Movement (CPDM) Party since 1982 and enjoys relatively high political and social stability in the region (CIA, 2013). Cameroon has a population of about 22.3 million inhabitants and is divided into ten regions that are again divided in divisions, subdivisions and districts (World Bank, 2014). However, corruption and low income are major problems still plaguing the country (World Bank, 2011).

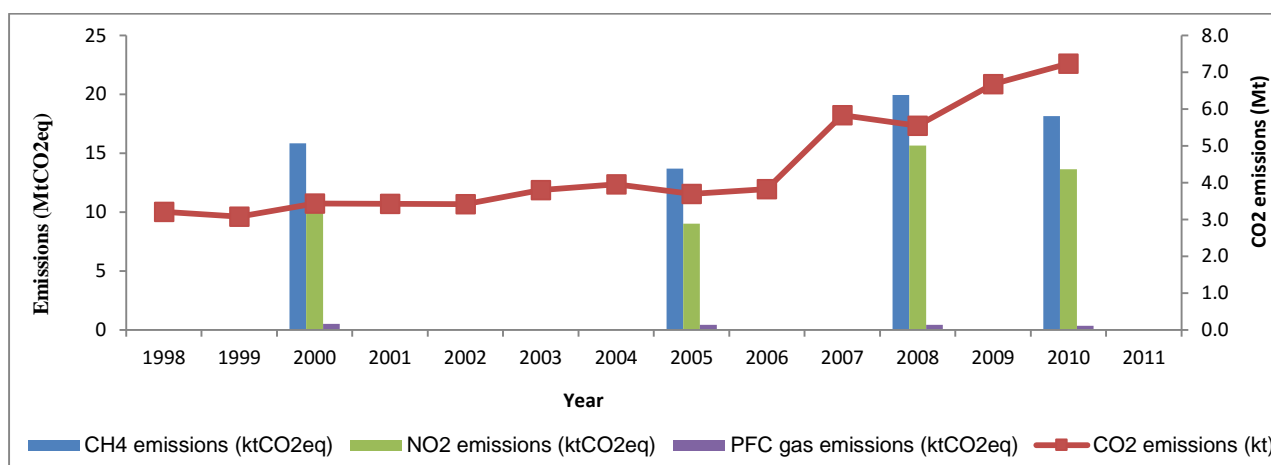
### **7.2 ENVIRONMENT AND CLIMATE CHANGE**

Cameroon is often described as "Africa in miniature". This is because it represents all the major geographical, climatic and vegetation related characteristics of the African continent, i.e. coastal, desert, mountain, rainforest, and savannah regions (Norrington-Davies, 2011). The coastal plain extends over 150 km from the Gulf of Guinea and is characterised by a hot and humid climate with a short dry season. The Southern plateau is dominated by the equatorial rainforest with a less humid climate than the one in the coastal plain. In general, Cameroon has a humid climate with extensive rainfalls of about 3,000 mm/year in the Northwest and up to 8,000 mm/year on the slopes of Mount Cameroon (Ngnikam, 2009). Cameroon is a resource rich country heavily dependent on revenues generated from oil, timber, and agricultural products. Cameroon is vulnerable to a number of diverse climate change impacts. According to the Centre for Environmental Economics and Policy in Africa (CEEPA), average temperatures in Cameroon have been increasing since 1930 with a net increase between 1930 and 1995 of 0.95°C (CEEPA, 2006). Average rainfall has also decreased by 2% per decade since 1960. These changes have been linked to extreme weather conditions across the country. The Northern Sudano-Sahelian region is experiencing increased incidences of drought and desert advancement that have scorched large expanses of land, whilst the Southwest coastal and rainforest regions have

experienced increased periods of prolonged rainfall that have led to flooding (Molua & Lambi, 2007).

Cameroon has been subjected to considerable pressure regarding its biodiversity and biological resources: 27.5% of forests are degraded; the deforestation rate of 0.9% per year is the highest in Africa; and the arable land area per inhabitant is continually decreasing (AfDB, 2010). Increased temperatures and prolonged drought in the Northern regions have resulted in the migration of local populations into neighbouring countries or further south in search of water and arable land. Crop yields have been affected by a shortened rainy season and an increase in temperature (Molua & Lambi, 2007).

Carbon dioxide emissions in Cameroon stem mostly from the energy sector - the burning of fuel-wood and waste residues, and fossil fuels refining and combustion - and the manufacture of cement. They include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring. In 2011, about 85% of all CO<sub>2</sub> emitted in Cameroon came from the consumption of liquid fossil fuels (World Bank, 2014). However, when compared to an industrialized country like Germany, CO<sub>2</sub> emissions in Cameroon are relatively very low. Figure 7.1 shows the evolution of GHG emissions in Cameroon.



**Figure 7.1: Evolution of GHG emissions in Cameroon**

Courtesy: Wanki, data from (World Bank, 2014)

Cameroon is a signatory country of the UNFCCC and Kyoto Protocol. Thus, it is committed with the international community to help stabilize the concentrations of GHGs in the atmosphere to an extent that would prevent dangerous interference of human activities with the climate system.

### 7.3 STATE OF THE ENERGY POLICY

The economic history of Cameroon, which has directly shaped the energy policy of the country, can be divided into four periods: the pre-oil periods from 1963 to 1977, the oil boom



period from 1978 to 1986, the recession period from 1987 to 1993 and the post-devaluation period from 1994 until date (Pineau, 2005). The World Bank and the International Monetary Fund (IMF) in 1989, adopted structural adjustment programs, following the catastrophic fiscal situation of Cameroon at the end of the 1980s, which were aimed at adapting the economy to prevailing international conditions. Projects within these programmes were financed by the World Bank and IMF through “Structural Adjustment Credit (SAC)” that came with binding conditions and recommendations (Pineau, 2005; World Bank, 2004). SAC I, 1989-1994 (\$150 million) and SAC II, 1996-1999 (\$150 million) had as objective to restore internal and external balances with the view to ensuring sustainable and equitable growth. These programmes have determined significantly the policy direction of Cameroon. This is particularly true for the energy policy in this case, which has a relatively higher impact on economic growth.

The energy policy of Cameroon is executed by the Ministry of Energy and Water Resources (MINEE) has the following objectives (MINEE, 2013):

1. Ensure energy independence.
2. Ensure security of supply mainly by diversification.
3. Promote and increase access rates of renewable energies.
4. Energy efficiency and conservation.
5. Attract investments via liberalization of economic activities, competitive rules, and involvement of private capital.
6. Integrate CDM in project portfolios, as a strategy to raise finances.

In order to implement the World Bank and IMF recommendations,<sup>215</sup> the government of Cameroon published a series of strategy papers aimed at liberalizing and enhancing the energy sector.

1. **Poverty Reduction Strategy Paper (PRSP) and Long-term Energy Sector Development Plan (PDSE 2030):**<sup>216</sup> The central objective of these policy documents are to significantly reduce poverty, with a strong and sustainable economic growth, increased efficiency of public expenditure, more effective targeting of its poverty reduction policies and improvement in overall governance. Consequently, development of the energy sector is seen as a factor for attracting investment and strengthening growth. The Government, under the PDSE 2030, aims at achieving a 75% total and 20%

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<sup>215</sup> Particularly, SAC III. These recommendations are the preconditions for lending financial assistance.

<sup>216</sup> See documents at: <http://www.imf.org/external/pubs/ft/scr/2003/cr03249.pdf>.

rural electrification rates by 2030. Another objective of the government is to achieve financial stability. For instance, over the last years the Government has sharply reduced subsidies on kerosene and gas used for industrial purposes (British High Commission-Cameroon, 2013).

2. **Cameroon Vision 2035:**<sup>217</sup> Cameroon has the following vision for the next 20 years: "*Cameroon: An Emerging, Democratic and United Country in Diversity*". Cameroon's development objectives under the Vision 2035 envisage significant investments in the energy sector, with the inclusion of renewables. The policy goals of the government are to ensure energy independence through increased production and delivery of electricity, petroleum resources and to ensure their contribution to economic development. A major initiative of the "Vision 2035" is to achieve universal access to electricity. The first ten years of implementation (2010-2020) are covered by the Growth and Employment Strategy Paper (GESP). The strategy aims at improving security of supply at the lowest cost possible, ensuring reliability of energy services and building the capacity of energy stakeholders. The Government has set a target of achieving 4,000 MW of hydropower-installed capacity by 2020 (Foreign & Commonwealth Office, 2013).
3. **Rural Electrification Master Plan (PDER):** The PDER aims at electrifying 660 localities principally through the extension of the interconnected grids, the rehabilitation and construction of isolated diesel power plants and mini-hydro plants as well as the development of a regional grid (ARSEL, 2013).

However, regulations adopted by the Cameroonian Government have been sector specific, rather than a holistic energy policy approach, directed mostly towards the electricity sector.

### 7.3.1 ELECTRICITY SECTOR REGULATION

The majority of regulatory interventions in the energy sector in Cameroon so far has been directed towards the energy sector, as it has been identified by the government as a significant prerequisite for economic development. In line with World Bank and IMF recommendations, the Cameroonian Government in 1998 initiated a reform programme aimed at privatizing the electricity sector.<sup>218</sup> As development of the energy sector is seen as a factor for attracting investment and strengthening growth.

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<sup>217</sup> See document at: [http://www.minepat.gov.cm/index.php/fr/modules-menu/doc\\_download/106-vision-2035-du-cameroun](http://www.minepat.gov.cm/index.php/fr/modules-menu/doc_download/106-vision-2035-du-cameroun).

<sup>218</sup> Following many reform failures in the first half of the 1990s (Pineau, 2002), arguably due to lack of a concise government strategy and high level of corruption within the ministries and the public companies.

Consequently, Law No. 98/022 governing the electricity sector was adopted by the government on 24<sup>th</sup> December 1998 (MINEE, 2013). This law stipulates that, activities in the electricity sector, particularly hydroelectric power, shall be placed under one of the following legal regimes:<sup>219</sup> concession; licence; authorization; declaration and free scheme. Law No. 98/022 stipulates that all electricity generation, transmission, and distribution activities shall be done under a concession, unless otherwise provided by this law. The concession agreement determines the duration and conditions of the contract.<sup>220</sup> The operators of hydroelectric power stations, the grid system, and distributors shall be selected in accordance with a procedure, which shall be fixed by regulation. The law equally established the Electricity Sector Regulatory Agency (ARSEL),<sup>221</sup> which ensures the regulation, control and monitoring of activities in the electricity sector. Furthermore, licences shall be awarded for independent generation of electricity, sale of high and medium voltage electricity and the import/export of electricity.<sup>222</sup> ARSEL is responsible for processing applications for licences. Independent electricity generators are obliged to generate and sell electricity to distributors or industrial consumers (ARSEL, 2013). Law No. 98/022, however, failed to provide a clear direction with respect to renewable energy sources. Instead of specific legislation to promote renewable energy in general or specific clean technologies, there is rather a general legislation concerning the electricity sector.<sup>223</sup>

The government policy aims at getting the country out of under-development, through the implementation of the PRSP of 2003 and the long-term Energy Sector Development Plan (PDSE) of 2005. The promulgation of Law No. 2011/022 of 14<sup>th</sup> December 2011 governing the electricity sector, which effectively replaced its predecessor, Law No. 98/022 of 24<sup>th</sup> December 1998 governing the electricity sector, reorganized the electricity sector in Cameroon. The new law was aimed, among others,<sup>224</sup> at increasing the share of renewables in the electricity mix of Cameroon and promoting independent power producers (IPPs) in the electricity supply system (Bilé, 2014).

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<sup>219</sup> §11 para. 1 of Law No. 98/022.

<sup>220</sup> §12 & §13 of Law No. 98/022.

<sup>221</sup> §41 of Law No. 98/022.

<sup>222</sup> §22 to §29 of Law No. 98/022.

<sup>223</sup> In its Title IV, Chapter I, law Nr. 98/022 stipulates that ARSEL and the Rural Electrification Agency (AER) are in charge of the promotion and the follow-up of the use of the primary sources of energy, in particular renewable sources.

<sup>224</sup> Further key points of the new regulation include transfer of the transmission concession and transmission operations to a government owned entity and transfer of storage dams and water management responsibility to a governmental entity.

### 7.3.2 PROMOTION OF RENEWABLE ENERGIES

Articles 63 to 65 of Law No. 2011/022 allude to the fact that renewable energies contribute to meeting the energy needs of consumers and contribute to the protection of the environment and security of supply. The following are considered as renewable energies: solar thermal and photovoltaic, wind energy, exploitable hydropower streams with output exceeding 5 MW, biofuels, geothermal energy and tidal energy.<sup>225</sup> Art. 59 para. 2 imposes the use of renewable energy in the implementation of the decentralized rural electrification programme. This law also imposes the obligations for the energy utility to buy all renewable energies produced; however, the price is not fixed in this document.<sup>226</sup> Although they are prescribed by the regulations in force, renewable energies, with the exception of hydropower, are almost inexistent in Cameroon.

### 7.3.3 INDEPENDENT POWER PRODUCERS (IPPs)

Law No. 2011/022 provides in Art. 29 that the following fall under the regime of a license: IPP, sale of very high, medium, and high voltage electricity and import/export of electricity. Besides, the law delegates ARSEL to receive and process applications for licenses relating to the activities of IPP and transmits them to administrative authorities.<sup>227</sup> Furthermore, IPPs are responsible for the generation and sales of electricity to distributors.<sup>228</sup> Licenses to sell electricity of very high, high and medium voltage, as well as independent production, and import/export of electricity, can be only granted only to operators that are technically qualified and that provide proof of sufficient financial guarantees for these activities.<sup>229</sup>

### 7.3.4 INSTITUTIONS

**Electricity Sector Regulatory Agency (ARSEL):**<sup>230</sup> ARSEL was created by Decree Nr. 99/125 of 15<sup>th</sup> June 1998. ARSEL is tasked with monitoring and regulating the electricity sector. Its principal missions are to monitor the activities of the electricity sector, monitor the sector's financial equilibrium and approve tariffs, examine concession licence applications, authorise electricity generating and distribution in rural areas, protect consumers, and promote competition and facilitate private sector involvement in the sector.<sup>231</sup>

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<sup>225</sup> §63 of Law No. 2011/022.

<sup>226</sup> §64 to §70 of Law No. 2011/022.

<sup>227</sup> §30 of Law No. 2011/022.

<sup>228</sup> §31 of Law No. 2011/022.

<sup>229</sup> §34 of Law No. 2011/022.

<sup>230</sup> See: <http://www.arsel-cm.org/>.

<sup>231</sup> §72 to §74 of Law No. 2011/022.

**Rural Electrification Agency (AER):**<sup>232</sup> Created by the Law No. 98/022 of 24<sup>th</sup> December 1998, AER is a public administrative establishment, with legal and financial autonomy. Its functioning is governed by Decree No. 99/193 of 8<sup>th</sup> September 1999. AER is under the technical supervision of MINEE, and the financial supervision of the Ministry of Finance (MINFI). AER is responsible for promoting rural electrification across the country (MINEE, 2013). AER promotes rural electrification by providing operators and users with the technical, and possibly financial, assistance required for development of renewables. The agency acts as a rural electrification consultancy for the State and, hence, develops community management mechanisms for renewables, and organises the rural populations benefiting from electrical installations.

**Electricity Development Corporation (EDC):**<sup>233</sup> EDC is a public assets holding company created by Decree No. 2006/406 of 29<sup>th</sup> November 2006 with the state as the sole shareholder. EDC is subject to the laws, regulations, and practices governing public limited companies in Cameroon. Initial capital of EDC was set at five billion francs CFA (about €7.6 million). The statutory purposes of EDC are to manage on behalf of the State, public entities in the electricity sector; the study, preparation or execution of State infrastructure projects in the electricity sector; and participation in the promotion and development of public and private investment in the electricity sector (EDC, 2011).

**Cameroon Renewable Energy Fund (CREF):**<sup>234</sup> Created in 2005, the fund is financed by AfDB. CREF was set up to contribute to the investment needs and, through the demonstration effect, catalyse the additional investment required to build sustainable renewable energy installations across Cameroon, particularly in the rural areas that are not supplied by the national grid (AfDB, 2010).

**Electricity Supply Utilities:** There are three electricity supply utilities in Cameroon, which function as Public-Private Partnerships (PPP).

1. Dibamba Power Development Company (DPDC): DPDC is jointly owned by AES Corporation (56%) and the Government (44%). Constructed in 2009, it comprises the operation of an 86 MW Heavy Fuel Oil-fired (HFO) thermal power plant project in Yassa-Dibamba (Douala) (Bilé, 2014).

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<sup>232</sup> See: <http://www.aer.cm>.

<sup>233</sup> See: <http://www.edc-cameroon.org/>

<sup>234</sup> See: <http://www.afdb.org/en/news-and-events/article/african-renewable-energy-fund-aref-launched-with-100m-committed-capital-and-anchor-investments-from-afdb-and-sefa-12901/>

2. Kribi Power Development Company (KPDC): KPDC is jointly owned by AES (56%) and the Government (44%). Constructed in 2013, KPDC is located approximately 10 km, by road, north of the coastal town of Kribi and generates a capacity output of 216 MW (Bilé, 2014), by burning natural gas provided by the National Hydrocarbon Corporation (SNH).
3. AES-SONEL:<sup>235</sup> The electricity law of 1998 and its complementary Electricity Decree<sup>236</sup> in 2000 paved the way for the liberalization and privatisation of the state-owned electricity utility, National Electricity Company (SONEL), which was the sole generator and distributor of electricity in 2001. The government recognized that its electricity sector urgently needed to be expanded and modernized. The dependence solely on hydropower left the country vulnerable to frequent blackouts due to poor maintenance, mismanagement, and insufficient capacity. While growth in demand from both industry and households was strong, few resources were available to invest in the sector. In response, the government undertook reforms of the power sector, including privatization of SONEL. In July 2001, AES Corporation, a US based global power company, acquired 56% of SONEL's equity, and entered into a 20-year concession. The new company, AES-SONEL was granted a monopoly over transmission and distribution throughout its concession area in Cameroon and the right to own up to 1000 MW of installed capacity.

#### Operational Status

- AES-SONEL has an installed generation capacity of 929 MW (AES-SONEL, 2010): 732 MW of hydroelectric capacity and 197 MW of thermal capacity.
- The grid system connects 24 stations and includes (AES-SONEL, 2010): 1,944.29 km high voltage (HV) lines, 15,081.48 km medium voltage (MV) lines and 15,209.25 km low voltage (LV) lines.
- The distribution network comprises (AES-SONEL, 2010): 11,450 km of lines of 5.5 to 33 KV; and 11,158 km of lines of 220 to 380 KV.
- AES-SONEL has more than 780,000 customers of which approximately 45% live in the cities of Douala and Yaoundé. Besides, the company operates the country's first emergency response 85 MW capacity Heavy Fuel Oil-fired (HFO) thermal power plant in Limbe, which was commissioned in 2004 (AES-SONEL, 2010).

On the 23<sup>rd</sup> May 2014, the British investment fund Actis Energy took over all of AES Corporation's assets (AES-SONEL, KPDC and DPDC) in the electricity sector of Cameroon, and AES-SONEL was rebranded Eneo Cameroon S.A. Though the content of the

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<sup>235</sup> See: <http://www.aessoneltoday.com/>.

<sup>236</sup> Decree No 2000-464-PM of 30 June 2000 governing the activities of the electricity sector.



agreement has not been published, Actis has however indicated that it would be giving 5% of its capital to employees. Therefore, the share capital of the company was distributed as follows: Actis owns 51%, the employees own 5%, and the Cameroon Government owns 44% (Linge, 2014). Concerning the DPDC and KPDC thermal facilities, Actis would manage the two IPPs using its subsidiary Globeleq Africa Holdings. The acquisition of these two IPPs is covered in a separate Environmental and Social Review Summary (ESRS)<sup>237</sup>.

### 7.3.5 MAJOR STAKEHOLDERS

There are five categories of stakeholders in the electricity sector in Cameroon: Government authorities, the Power Utility Company, industrial users, IPPs, and external fund providers (see Table 7.3).

**Table 7.1: Major stakeholders in the electricity sector in Cameroon**

Category	Institution
Government Authorities	<ol style="list-style-type: none"> <li>1. President Steering Committee on Energy;</li> <li>2. Ministry of Water Resources and Energy;</li> <li>3. ARSEL: Power Sector Regulator;</li> <li>4. AER: Rural Electrification Agency;</li> <li>5. Coordinator of the Energy Sector Development Program (PDSE);</li> <li>6. Ministry of Environment: Delivers environmental compliance certificates which are a pre-condition to international funding of electricity projects;</li> <li>7. Ministry of Finance: State Guarantee provided by Minister of Finance is the key to most project financial clause; state budget is used to compensate AES-SONEL losses from unadjusted tariffs;</li> <li>8. Ministry of Economy: In-charge of investments planning and finance mobilization.</li> </ol>
Power Utility	AES-SONEL
Power users	ALUCAM <sup>238</sup> : consumes 34% of electricity generated in Cameroon.
IPPs	<ol style="list-style-type: none"> <li>1. Dibamba Power Development Company (DPDC)</li> <li>2. Kribi Power Development Company (KPDC)</li> </ol>
External Fund Providers	<ol style="list-style-type: none"> <li>1. World Bank: It has a long-standing engagement in the electricity sector in Cameroon. The World Bank is engaged in policy dialogue on sectorial planning, regulation and compliance with environmental and social safeguards.</li> <li>2. International Finance Corporation (IFC): This structure played an advisory role to the government in the privatization of SONEL.</li> <li>3. AfDB: The 2010-2014 Country Strategy highlights bank roles in Cameroon's electricity sector with two main programs: Lom Pangar; rehabilitation and strengthening of power infrastructure and rural electrification, Chad Cameroon electric connection.</li> <li>4. EXIM BANK China: As part of the growing role of Chinese contractors into the electricity sector, EXIM BANK China is funding the construction of the Lom Pangar hydro power plant.</li> </ol>

Source: derived from Foreign & Commonwealth Office (2013)

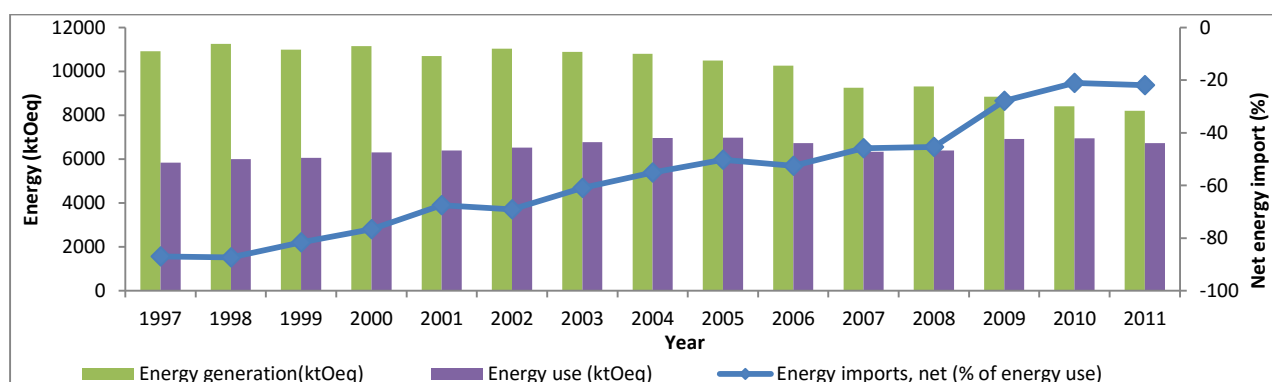
<sup>237</sup> See "Environmental and Social Review Summary - Kribi Project and Dibamba Project: Cameroon" of 20<sup>th</sup> February 2014. Document is available electronically as PDF attachment at: [http://www.miga.org/documents/ESRS\\_Kirbi\\_Dibamba\\_Feb\\_14.pdf](http://www.miga.org/documents/ESRS_Kirbi_Dibamba_Feb_14.pdf).

<sup>238</sup> ALUCAM (Aluminium Du Cameroun) is an aluminium smelter in Edéa, Cameroon commissioned in 1957. Both Rio Tinto Alcan and the Government of Cameroon own 46.7% each of the mine while the rest is divided between "Agence Française de Développement" (5.6%) and employees (1.1%). The smelter has a capacity of 100,000 tonnes of aluminium per year.



## 7.4 OVERVIEW OF THE ELECTRICITY SECTOR

Fuel-wood, hydropower and petroleum are the major sources of commercial energy in Cameroon. In 2011, energy production<sup>239</sup> was about 8,194 kilotons of oil equivalent (ktoe), of which households consumed 70%, 16% by transport, and 6% by the industrial sector. This represents a decrease of 2.5% compared with 2010 (8,405 Ktoe). Energy use<sup>240</sup> for 2011 stood at 6,720 ktoe, down from ca. 6,944 ktoe in 2010. Energy imports; net (percentage of energy use) in Cameroon was 21.94% in 2011 (World Bank, 2014).<sup>241</sup> Figure 7.2 depicts the development of energy supply in Cameroon from 1997 to 2011. Although Cameroon is an oil producing country, the proportion of imported petroleum products in national consumption increased considerably between 1990 and 2000, with imports rising beyond the 56% mark in 2000, before dropping again in 2003. Petroleum imports, which constitute the entirety of the country's energy imports, totalled 2,356 ktoe in 2007 (CIA, 2013). According to the World Energy Council (WEC),<sup>242</sup> Cameroon was ranked 82<sup>nd</sup> on the Energy Sustainability index in 2013. This means that Cameroon fell seven places in the Index compared to the previous year, a drop mainly driven by a relative decline in energy security.



**Figure 7.2: Development of energy supply in Cameroon from 1997 to 2011**

Courtesy: Wanki, data from (World Bank, 2014)

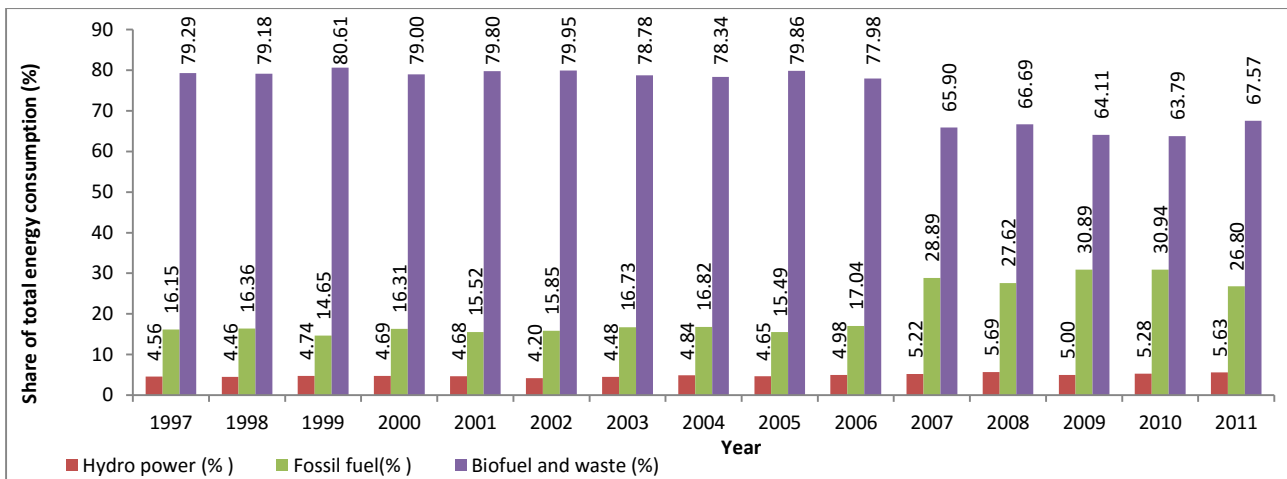
Renewable energy sources, particularly biomass, dominate Cameroon's energy balance. Despite the progress made in recent years to diversify the energy mix, biomass (about 68% in 2011) remains the predominant fuel source (see Figure 7.2).

<sup>239</sup> Energy production refers to forms of primary energy - petroleum (crude oil, natural gas liquids, and oil from nonconventional sources), natural gas, solid fuels (coal, lignite, and other derived fuels), and combustible renewables and waste - and primary electricity, all converted into oil equivalents.

<sup>240</sup> Energy use refers to use of primary energy before transformation to other end-use fuels, which is equal to indigenous production plus imports and stock changes, minus exports and fuels supplied to ships and aircraft engaged in international transport.

<sup>241</sup> Energy use refers to use of primary energy before transformation to other end-use fuels, which is equal to indigenous production plus imports and stock changes, minus exports and fuels supplied to ships and aircraft engaged in international transport. The negative value indicates that the Cameroon is a net exporter.

<sup>242</sup> See: <http://www.worldenergy.org/data/sustainability-index/country/cameroon/>



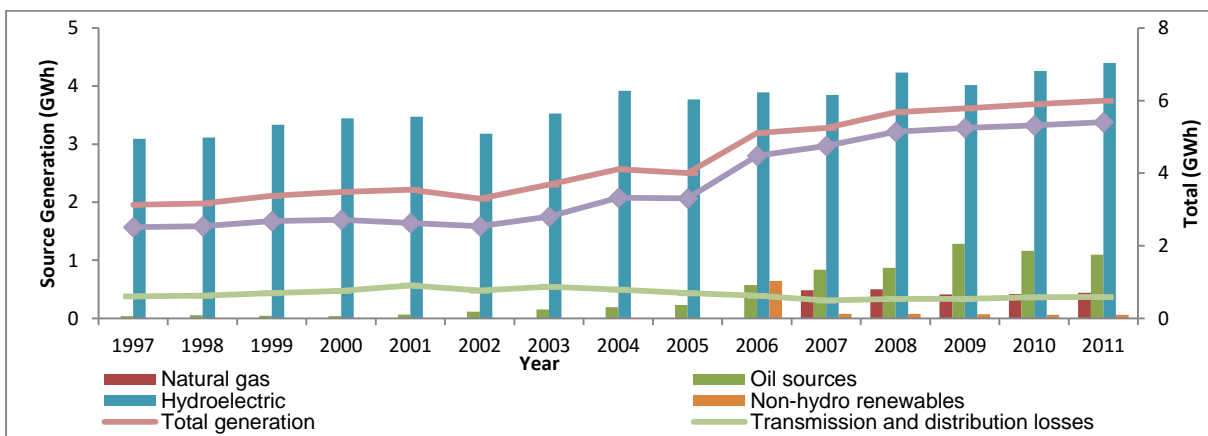
**Figure 7.3: Share of Cameroon's end energy use by source, 1997- 2011**

Courtesy: Wanki, data from (World Bank, 2014)

The demand for oil products remains the second largest (about 27% in 2011). For example, two-thirds of the rural population and 10% of the urban population used kerosene lamps for lighting (AfDB, 2010).

### 7.4.1 ELECTRICITY DEMAND

According to the Alliance for Rural Electrification (ARE), electricity represented only 7.3% of the total energy consumption in 2010 (ARE, 2013). In 2011, the country's electrification rate increased to about 54% from about 49% in 2010 (World Bank, 2014), thanks to the government's grid expansion efforts. However, while the focus on electricity access has had positive effects in urban areas, rural electrification rates stand at 19% (ARSEL, 2013). The low rate of rural electrification in Cameroon is due to the high costs of grid extension. In 2010, Cameroon's electricity demand was about 790 MW with a sharp upward trend of 7% per year corresponding to 50 MW of additional capacity; total electricity end-use stood at 5.4 GWh (Foreign & Commonwealth Office, 2013; World Bank, 2014). Figure 7.4 represents the consumption and generation patterns of electricity in Cameroon from 1997 to 2011.



**Figure 7.4: Evolution of electricity consumption and generation in Cameroon, 1997- 2011**

Courtesy: Wanki, data from (World Bank, 2014)

The residential sector represented only 20% of electricity end-use. The industrial sector remained the largest electricity consumer in Cameroon with about 2.8 GWh in 2011, particularly the aluminium industry with 48% and extractive sectors with 18%. Electricity demand exceeds supply, thereby putting a brake on the economy, and deterring growth. This is insufficient to meet current demand and leaves an estimated shortfall of 50 to 100 MW (World Bank, 2012). However, many industries have invested in diesel generators for self-generation due to regular blackouts (ARE, 2013).

#### **7.4.2 ELECTRICITY SUPPLY**

In 2011, total generated electricity was about 6 GWh with a total installed capacity of around 1,926 MW. Approximately two thirds of grid-connected capacity (1,366 MW) in Cameroon came from hydropower. There are three large-scale hydropower plants with a combine capacity of 719 MW; Song Loulou (384 MW), Edéa (263 MW) and Lagdo (72 MW) combined with three upstream reservoirs on tributaries to the Sanaga river (World Bank, 2014; ARE, 2013). In 2011, hydropower contributed 73% of the total electricity; while fossil fuels contributed, 26% (see Figure 7.5). Auto-generators owned around 37% of the total installed capacity and generated 17% of the electricity (World Bank, 2014; ARE, 2013). Agro-industries also used biomass for auto-generation with a total power output of approximately 88 GWh per year. Furthermore, there are 26 isolated thermal plants with a total installed capacity of 15.3 MW and a total power output in 2011 of 42,765 MWh (ARE, 2013). Micro-hydropower stations with a total installed capacity of 515.5 kW have been constructed, mostly in the West Region<sup>243</sup> (Nfah & Ngundam, 2012). There is only evidence of a solar mini-grid developed by Global Village Cameroon (GVC) in the rural area of Nganha with an installed capacity of 9.5 kW to electrify 75 households as well as public buildings (ARE, 2013).

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<sup>243</sup> The micro-hydropower projects were executed by the NGO: Action pour un Développement Équitable, Intégré et Durable (ADEID) based in Bafoussam. See: <http://www.adeid.com/>

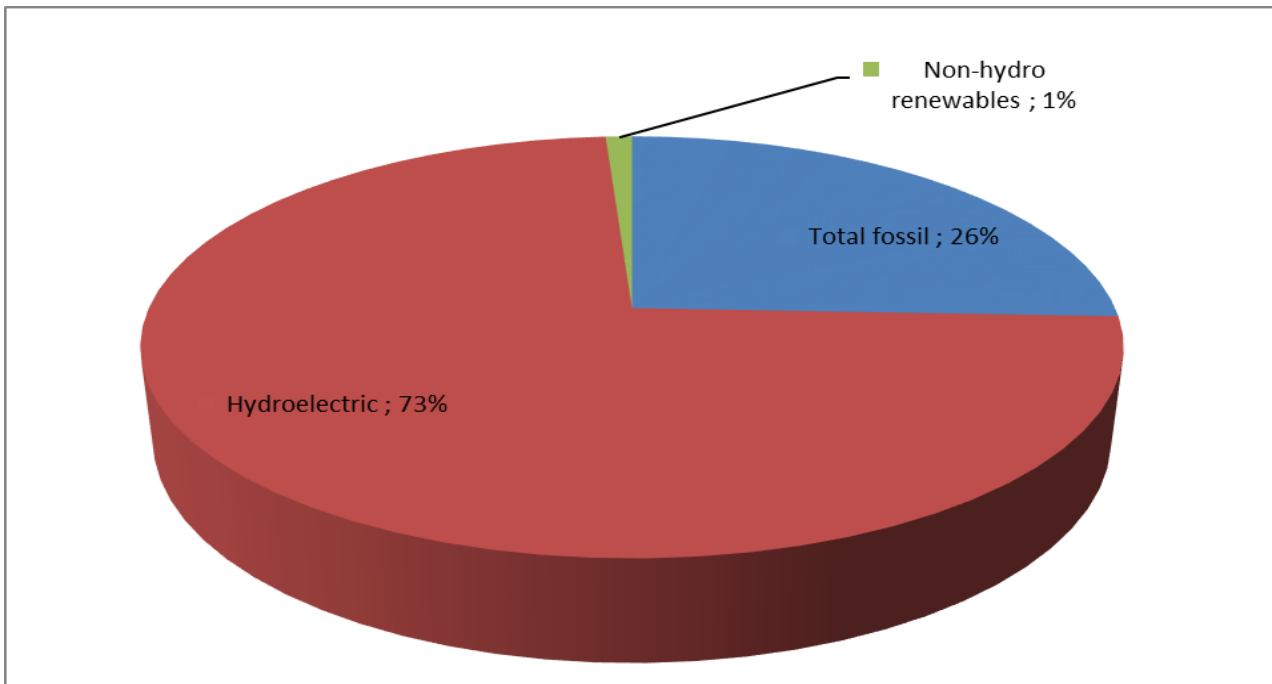


Figure 7.5: Share of electricity generation in Cameroon, 2011

Source: (ARE, 2013)

## 7.5 RENEWABLE ENERGY POTENTIAL

Cameroon has a rich and diversified natural resource base with enormous renewable energy potentials in the following domains: hydropower, wind, solar and biomass (Abanda, 2012).

### 7.5.1 HYDROPOWER

The hydropower potential of Cameroon is the second in Africa after the Democratic Republic of Congo (DRC). The gross theoretical potential is 294 TWh/year. Of this amount, 115 TWh/year is considered technically feasible while 103 TWh/year is economically feasible. The currently installed capacity represents only about 5.5% of the technically feasible capacity (Abanda, 2012).

### 7.5.2 WIND ENERGY

A thorough assessment of Cameroon's wind energy potential has never been made. However, pilot studies using meteorological data from the National Meteorological Department located in the Adamaoua Region of Cameroon have been carried out. Although the study focused only on the Northern regions of the country, the outcome vividly indicated that these regions possess exploitable wind potentials (Abanda, 2012). This potential decreases southwards, where wind speeds are in a decrease and are consequently not sufficient for the development of wind energy projects. Generally, the northern areas have average wind speed of 5-7m/s, while most of the country has insufficient wind speed for electricity generation with an average of 2-4 m/s at the height of 100 meter (Kovac, 2012).

### **7.5.3 SOLAR ENERGY**

Cameroon has an average solar radiation intensity of 240W/m<sup>2</sup> and mean annual hours of sunshine per year of over 3000 hours. The highest solar energy intensity is in the Northern region of the country with estimates of 5.8 kWh/day/m<sup>2</sup> while the rest of the country commonly sees 4.9 kWh/day/m<sup>2</sup> (Nfah & Ngundam, 2012).

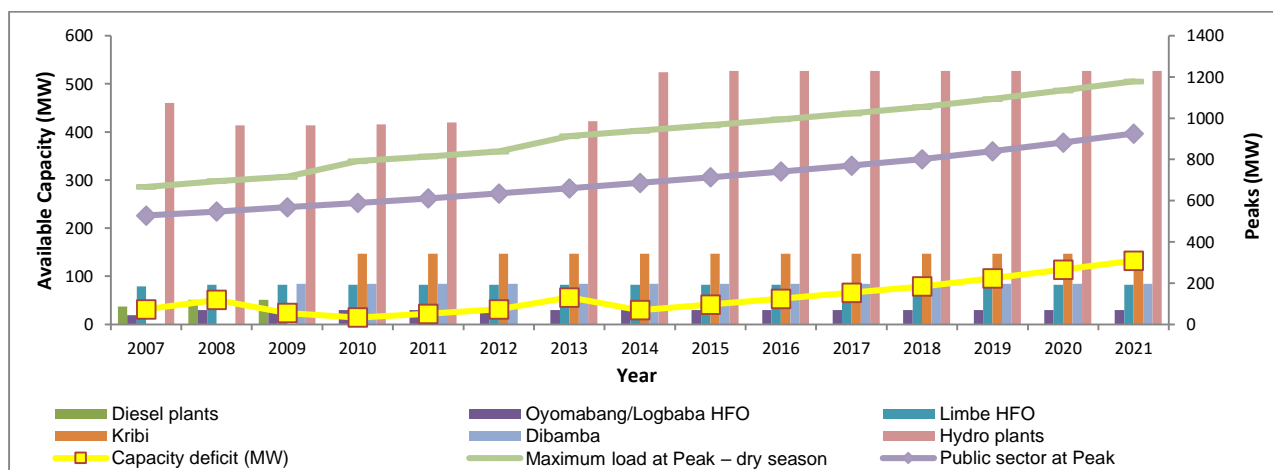
### **7.5.4 BIOFUEL**

Cameroon has a huge and untapped potential of biomass mainly from agriculture and forest logging. Its potential is the third largest in sub-Saharan Africa, with 25 million hectares of forest covering three-quarters of its territory. However, the unsustainable use of this resource has led to significant deforestation throughout the country, with an annual clearance rate of 200,000 hectares per year while the regeneration rate is only 3,000 hectares per year (Kovac, 2012). For the majority of the rural population in the country, biomass is primarily used for heating, cooking and light.

## **7.6 CHAPTER DISCUSSION**

Cameroon is facing an energy crisis (see section 7.4 above): the existing generation capacity cannot meet the growing demand for electricity. The electricity needed to power and grow the economy, drive local development and tackle urban and rural poverty is simply not there. Though electricity output capacity has increased continuously in recent years, electricity generation continues to be expensive in Cameroon. At about €0.15 per kWh, electricity generation costs in Cameroon are among the highest in Sub-Saharan Africa (ARSEL, 2013). The high generation costs are the consequences of two major factors; one is climatic based and the other is market based. First, the traditional energy solution has relied on fossil fuels, yet not only are they becoming unaffordable, but their historic consumption by industrialised nations and recently transition countries such as China and India is enhancing climate change. The resulting increase in the frequency and severity of floods and droughts has undermined the generation capacity of one of Cameroon's major energy sources – hydropower. Prolonged droughts in recent years have made hydropower less reliable, especially during dry seasons (Nganga, et al., 2013). As a result, generation is subject to fluctuation. Second, Cameroon relies for back-up generation in the dry season on diesel and the highly fluctuating international prices of crude oil has made the economy very vulnerable due to the fluctuating cost of diesel (World Bank, 2011).

While final consumer electricity tariffs are in the middle of the price distribution in Sub-Saharan Africa, they mask generous cross-subsidies to ALUCAM.<sup>244</sup> The average electricity tariff in Cameroon, at €0.075/kWh, fails to recover generation costs. The low and medium voltage consumer paid between €0.08 and €0.14/kWh in 2009, whereas ALUCAM benefitted from a tariff cap of 7 CFA francs per kilowatt-hour (less than €0.011/kWh) up to 2009 (World Bank, 2011). The situation has been exacerbated by weak operational performance and poor governance, which has affected the financial sustainability of AES-SONEL. Besides, transmission and distribution losses, peaking at 35%, are very high. In 2009, system losses drained \$167 million from AES-SONEL’s revenues (World Bank, 2011). Burgeoning illegal connections, decrepit metering systems, and outmoded billing software have compounded the situation (Ossono, 2014). Electricity deficit based on current installed capacity is around 130 MW and is expected to progressively increase, to about 309 MW by 2021 (see Figure 8.3), with growing domestic demand (Foreign & Commonwealth Office, 2013).



**Figure 7.6: Cameroon electricity deficit forecast**

Courtesy: Wanki, data from (Foreign & Commonwealth Office, 2013)

Electricity supply in Cameroon is very unreliable. Secondary data collected from “*Journalism++*” shows that from August 2012 to March 2013, the country experienced 8,337 blackouts (Journalism++, 2013). To combat erratic power supply, many firms generate their

<sup>244</sup> ALUCAM is the largest electricity consumer in Cameroon, accounting for 35–40% of the power produced. Under a 30-year agreement that ended in 2009, ALUCAM was guaranteed 145 MW of electricity during the dry season and 165 MW during the rainy season. A tariff cap of 7 CFA francs per kWh (around €0.023) until the end of 2009, compared to tariffs of €0.085/kWh and €0.18/kWh for medium and low voltage customers, respectively. These prices were exceedingly low in the context of chronic electricity problems throughout the country. The overall subsidies is estimated to be around €90 million per year, equivalent to about 32% of AES-SONEL’s revenue. Since the expiration of the agreement, power prices have been increased by 73% to 12.94 CFA francs, or €0.023/kWh. Even with the price increase, they still fall well below the operating costs of electricity generation at €0.10/kWh and the total cost of US cents 17 per kWh, adding to the cost recovery woes of AES-SONEL (World Bank, 2011).

own power. As much as 30% of the country's installed capacity is auto-generation. Around 67% of firms reported that power was a major constraint to business.

The Cameroonian Government recognises the urgency of the problem and have taken steps to address the electricity shortage. Ambitious visions have been published,<sup>245</sup> promising both a drastic increase in overall production capacity and improved access to electricity in urban and rural areas.<sup>246</sup> However, the government have chosen large-scale hydropower and fossil fuel (diesel) plants for electricity generation and centralised national grids for its distribution (see section 7.5 above). These large hydropower projects have negative social and environmental effects and prolonged droughts in recent years have made hydropower less reliable, especially during dry seasons (Nganga, et al., 2013). Furthermore, fossil fuels would only exacerbate climate change and its negative consequences to water supply, agricultural production, and overall livelihoods. Besides, climate change will lead to more extreme weather patterns in the near future, increasing the frequency and severity of floods and droughts while decreasing further the reliability of hydropower. Another pitfall of the government's policy direction is the concentration on a centralised grid system. The experience from Germany has shown that the expansion and optimization of a central grid system is time consuming and above all very expensive (BNetzA, 2013). Cameroon has a large dispersed rural population (Ndenecho, 2011), making the supply of these rural areas with electricity using a centralised grid a very expensive undertaking.

## **7.7 FEED-IN TARIFF MODEL FOR RENEWABLES IN CAMEROON**

Cameroon has abundant renewable energy potential (see section 7.6) and can benefit from the positive economic spill overs generated by renewable energy development, especially in rural areas with inadequate supply of electricity, where decentralized renewable energy technologies are likely to be more economical. Promoting the most potent renewable energy technologies in Cameroon as well as introducing a flexible mix of the existing centralised grid and an economically viable micro grid solution can help the country bypass the current fossil fuel based development pathway. This will not only modernise and enhance the energy supply system, but will equally avoid the environmental problems of fossil energy sources and the unnecessary cost of long-distance transmission lines to rural areas. Renewable technologies particularly wind and solar have extremely low operational costs and are often more cost-effective than conventional technologies in the long run (Burger, 2014; Deutsche WindGuard, 2013). However, the initial capital requirements are often very

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<sup>245</sup> The Poverty Reduction Strategy Paper (PRSP) and the Long-term Energy Sector Development Plan (PDSE 2030).

<sup>246</sup> The Rural Electrification Master Plan.



high and thus pose an obstacle for many investors. Therefore, to realize the full potential of renewables in Cameroon, there should exist an enabling policy environment, which encourages and supports investment. Renewable energy feed-in tariffs, as used by the German Government, have proven to be a successful policy tool in this respect. It encourages independent power producers (companies, communities and even individual citizens) to invest in renewable energy technology by guaranteeing that all the energy produced will be bought at a fixed and profitable price. The success of the feed-in tariff model can be judged by the fact that, about 65 countries have implemented some form of a renewable energy feed-in tariff (Morris & Pehnt, 2014); sub-Saharan African countries, for instance Kenya, Rwanda, Tanzania and Uganda have each implemented a form of feed-in tariff respectively (Nganga, et al., 2013). In the development of a renewable energy policy, nothing is more effective than learning from those countries that went through the same exercise. In Africa, we have a saying, *“If you want to travel fast, go alone. If you want to travel far, go together. If you want to reach your destination, go with someone who has been there before”*. The feed-in tariff model has proven to be very successful in promoting renewable technologies and is a model worth copying. However, the Cameroonian Government has to put in place a proper legal and regulatory framework to promote the deployment of renewable energy sources. This should be accompanied by fixed targets for each renewable energy technology.

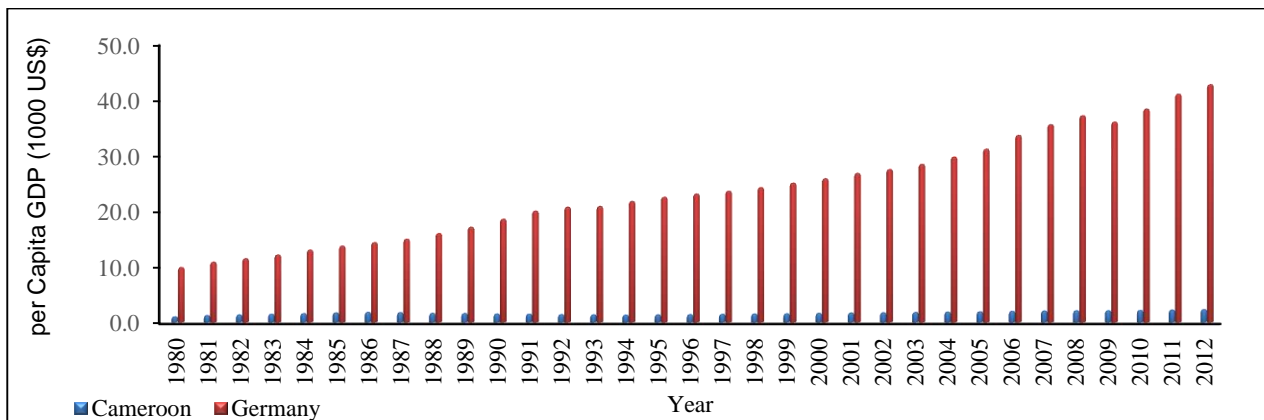
### **7.7.1 APPLICABILITY OF EEG MODEL IN CAMEROON**

Can the Renewable Energy Sources Act be a model for the increase of renewable energy sources in Cameroon? The EEG prepares the economical basis for construction, installation, operation, and guarantee of grid access of renewable energies by burdening consumers. This constellation alone makes the EEG model, in its current form, inappropriate for a developing country like Cameroon. The framework conditions of the EEG are payments by the end user of the market-entry costs of renewable technologies. This follows the polluter-pays-principle. Since the introduction of EEG in 2002 until the end of 2013, German electricity consumers have so far paid about €88 billion as EEG surcharge to support the deployment of renewable energies in Germany.<sup>247</sup> Given the purchasing power of the Cameroonian population and the economic constraints of the government, it is difficult or even impossible to adopt the EEG model in Cameroon where often, basic needs are subsidized. Figure 8.4 shows the comparison of GDP per capita of Cameroon and Germany.

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<sup>247</sup> See Deutscher Bundestag: Drucksache 18/242 at <http://dip21.bundestag.de/dip21/btd/18/002/1800242.pdf>

Furthermore, the resulting high electricity prices could hamper economic development and serve as an incentive to illegal connections.



**Figure 7.7: Comparison of the evolution of GDP per capita of Germany and Cameroon**

Courtesy: Wanki, data from (World Bank, 2014)

Second, the success of the EEG is because there are several control regulation in place to prevent conflicts that may arise with other land use projects. The situation in Cameroon is different as such control instruments are not available and when they are, they are either not suitable for renewable energies or not implemented.

Third, electricity supply to the population has an almost 100% coverage in Germany; meaning, the objective of the feed-in tariff policy is mainly for diversification of their energy supply system. On the hand, electrification rate in Cameroon stands at 54%, with just 19% rural electrification. Therefore, the primary policy objective of the Cameroonian Government should be directly more towards rural electrification and diversification should be a by-product of the policy.

Lastly, the EEG model is based on a centralised grid system, owing to the fact that the settlement structure in Germany is concentrated with agglomerated major cities. This makes it relatively easier to use a central grid system and it is arguably difficulty to create micro grid with these conglomerates. Cameroon has isolated cities with disperse rural populations. This makes a feed-in tariff model based on a centralised grid very demanding, given that the construction of overhead transmission lines over long distances is significantly more expensive than isolated micro grids.

### 7.7.2 FEED-IN TARIFF OPTION FOR CAMEROON

As clearly evaluated in section 8.5.1 above, the German feed-in tariff model cannot be implemented in Cameroon. However, given the sheer number of countries that have implemented a form of renewable energy feed-in tariff model, this shows that the feed-in

tariff concept is highly adaptable and can be adjusted to different national circumstances and a variety of policy preferences. It can thus function well in both developed and developing countries. While a major policy goal of the German EEG model is diversification of the energy supply system, a feed-in tariff model for Cameroon would most likely focus on the social aspects of electricity supply. I.e. improved access to electricity in rural areas. Based on this consideration, the policy goal described in this section for a renewable energy feed-in tariff concept in Cameroon would be to improved access to electricity in rural areas. In this light, the most important design elements considered in drafting such a legislation are: suitable renewable technologies, the appropriate financial mechanism, the appropriate grid system and the preparation of long-term renewable energy supply plans (with precise targets for each generation form) and spatial plans for renewable energy generation. These design elements are discussed in details in the following subsections.

#### **7.7.2.1 Eligible Renewable Technologies**

Cameroon has high renewable energy potentials (see section 7.6). However, in determining which renewable technologies are eligible for feed-in tariffs under the scheme, consideration has to be given to resource availability of each technology and the corresponding cost of the technology, since these technologies would principally be imported. Generally, hydropower, solar, wind and biomass technologies can be considered eligible technologies in Cameroon. However, these technologies should be introduced stepwise into the scheme, based on their potency and cost, i.e. a two-priority stage process. This is to minimise the initial cost of renewable energy introduction and maximise output. Besides, annual caps for newly installed capacity should apply to all technologies and the more expensive technologies introduces in the second priority tier. This method has been used successfully in Panama, where initially, solar energy was first introduced into the feed-in tariff scheme in 2008 (by 2011, electricity generation in Panama comprised 55% hydropower and 45% solar), followed by the introduction of wind energy in 2011 (Lopez, 2013; Palencia, 2012).

Such a system will function relatively well in Cameroon, as the country has a very high solar potential and the cost for solar technology has been falling dramatically in recent years. Besides, the existing hydro potential can equally be into the initial phase of the scheme. However, emphasis should be placed on micro hydro installation, given the recent seasonal fluctuations in rainfall and the adverse ecological effects of large hydropower dams. Wind energy resource, though currently more cost-efficient than solar, is relatively low in Cameroon. This makes it preferable for introduction into the tariff scheme at a later stage where policy goal should then be on diversification. As for biomass, the current high cost of

the technology (Mayer & Burger, 2014) may have a negative knock-on effect on the feed-in tariff scheme. Like wind energy technology, biomass technology should be introduced at a later stage in the scheme. Capacity caps for renewable technologies such as hydropower, wind energy, and large surface solar installations. For example, a combined total capacity of 10 MW per technology. This will allow small installations to receive more income per kWh than large facilities, making them more feasible and thus favouring local developers. This will be in line with the policy for small-scale decentralised generation. The use of capacity caps has proven to be a very cost and policy effective instrument in Rwanda (Nganga, et al., 2013).

### **7.7.2.2 Appropriate Financing Mechanism**

A major feature of the German EEG model is that additional costs caused by the policy are distributed equally among all electricity consumers (in principle). This burden-sharing mechanism permits the support of large shares of renewable electricity with only a marginal increase of the final consumer's electricity bill. No government financing is included under these conditions. The federal government only acts as a regulator of private actors in the electricity market. However, in the context of Cameroon with high levels of poverty, distributing the costs solely to final consumers is likely to have serious negative consequences and would jeopardise efforts to increase electricity access. Therefore, combined funding mechanisms such as funding from international climate change funds and subsidies for low-income households can be a more effective option. Funding from international climate change funds is currently used in Uganda to support the integration of renewable energies, while Ghana provides subsidies to low income households (Nganga, et al., 2013). This would significantly reduce the financial burden on the end consumer, while at the same time guarantee investment security. In order to control cost and further reduce the burden of the final consumer, "remuneration caps" should be adopted for each renewable technology particularly in the initial phase. The tariffs should be technology differentiated, whereby the technologies such as solar, which likely has the lowest overall cost and a relatively high potential, are prescribed a higher tariff cap than their relatively expensive counterparts.

### **7.7.2.3 Appropriate Grid System**

The lack of transmission capacity can seriously offset the deployment of renewables in Cameroon. The example of Germany shows that a proper functioning grid system is imperative for the development and integration of renewable energy technologies. The existing bottlenecks in the centralised grid system of Cameroon should not be an excuse to

restrict access for renewable electricity generators, but rather be an incentive to undertake much needed grid transformation in line with national electricity access plans and expected growth in electricity consumption. Given the disperse nature of the rural population, and the long distances between major cities, as well as the high investment cost for the extension and optimization of centralised grid systems, the Cameroonian government should rather support the constructions of isolated micro (decentralised) grids in the dispersed rural communities. These decentralised grids could later be interconnected to enable the transfer of generation surpluses from one community to the other, or to the existing centralised system. Concerning generation surpluses, the incorporation of a tariff cap in the feed-in tariff model has the added advantage that it controls the generating capacity of the dispersed communities, thereby keeping the isolated micro grid within its capacity during the initial phase of implementation. This eliminates the necessity of interconnecting the isolated grid during the early stages and consequently the cost for grid expansion measures. In addition to the micro grids being less expensive, they reduce transmission loss due to their short distances and maintain cost low, particularly when owned by the local communities, as levies for grid charges would likely be comparatively lower.

#### **7.7.2.4 Renewable Energy Supply and Spatial Plans**

The experience of the German EEG model shows that, the combination of the feed-in tariff legislation with ambitious targets for renewables has the merit of signalling long-term commitment to investors. Targets indicate that the support mechanisms will be in place for a certain period. The targets, in the case of Cameroon should be established for the short, mid and long term, thus establishing a pathway of how renewables can increasingly substitute fossil generating capacity already in place. For the short term, the targets should be modest in order to keep the financial burden on the population low.

Likewise, spatial planning at local levels should be developed, defining possible areas (regions) for renewable energy development (zoning plans). The plan should anticipate future renewable energy projects and the available resources, such as solar radiation, hydrology of the region and wind speed. Zoning helps organise physical space at the local level by stipulating where roads, industrial areas, and power plants should be located and considerably shortens the administrative process of renewable energy development by reducing the lead-time for siting, since suitable sites for renewable energy development have already been designated during the spatial planning process.

## 7.8 CHAPTER CONCLUSION

This chapter presented the evaluation of the progress made by Cameroon to foster renewable energies in its energy mix, as well as assess the possibility of using the German EEG model to promote the expansion of renewable energies. Cameroon has huge renewable energy potential that have not been developed. Electricity demand is higher than the supply. The reasons include the multiplicity of actors involved, the rise in population, the accumulation of policies of past decades, many of which may have made sense when they were proposed, but now impose unsustainable burdens, combined with projections of continued growth of energy demand globally and the greater threats posed by climate change. Cameroon's energy policy focuses on reliable electricity delivery in the urban regions and electrification of the rural areas. However, it is yet to developed policy roadmaps for renewable energy expansion, which can attract foreign and local investment in the renewable energy sector. Presently, Cameroon is only concentrating on hydropower development, despite the abundance of other renewable energy sources to tap into.

Yet, Cameroon also have an advantage. It can learn from experience and avoid some of the policy missteps of the countries like Germany that already have a successful renewable energy sector and have an opportunity to “leapfrog” directly to cleaner and more efficient technologies. From the discussion in this chapter, it is clear that renewable energy can play a role in reducing the energy demand, especially in the rural areas, where only 19% of the populations have accessed to electricity and minimizing the gap between energy demand and supply. For this to happen, proper renewable energy policies are needed in Cameroon to boost private and foreign investment in the sector for future development. Though the feed-in tariff scheme used in the EEG model in Germany is not suitable for Cameroon due to low-income state of the population, the model can, however, be modified to suit the economic state of Cameroon.

Cameroon can stimulate the market for the renewable energy systems by redirecting some of the subsidies given to certain industries, such as ALUCAM, reduce tax on imported renewable energy technologies, enhance technology transfer through multilateral partnerships with the developed world and bank loans for the local industry. This industry can serve the individuals and communities who can afford the investment, especially if renewable energy loans are introduced. It will be a niche market at first but it can be a start for the market. The most important factor for Cameroon is the institution of a policy framework aimed at promoting renewable energies.

Besides, there is serious need for the government of Cameroon to train local work force in renewable and create entrepreneurship funding for locals who are interested in venturing into this sector. Fortunately, many essential elements of a sustainable energy transition can be expected to mesh well with other critical development objectives, such as improving public health, broadening employment opportunities, nurturing domestic industries, expanding reliance on indigenous resources and improving a country's balance of trade.



## **8 CONCLUSION AND RECOMMENDATIONS**

### **8.1 SUCCESS OF THE EEG AS A SUPPORT INSTRUMENT**

The German Government has adopted the framework conditions, using the EEG, to enable the desired energy transition. The aim of creating a wind energy market that produces its own momentum for development has partly been achieved. The rapid increase in installed capacity of onshore wind energy in Germany is both a consequence and an impressive testament to the functionality of the EEG. In addition, the model that renounces unilateral subsidisation of the wind industry and intervenes in a regulatory manner in the electricity market, enables wind energy to be able to compete in the market, and is particularly useful in terms of longevity. Through the various control mechanisms such as the connection, transmission and payment obligations, as well as the degression of the minimum remuneration, the continuous development of renewable technologies will be actively managed and promoted. In so doing, it will prevent the EEG from being a comfortable pillow for renewable installation operators and developers. The enormous practical benefit of this concept is proven by the fact that Germany is currently one of the world's leading nations with regard to the development and manufacture of technologies for the generation of energy from wind energy resources. Besides, the feed-in tariff concept developed in Germany has been implemented in some form by about 65 countries globally.

However, if the energy transition is to be successfully completed, the path chosen by the EEG should be consistently pursued. The 2014 revision of the EEG - on the basis of reducing the financial burden on end consumers - incorporates the risk of derailing the energy transition process (as detailed in section 8.3). The energy transition policy is and will continue to be supported by small and medium size enterprises with tremendous economic investment volumes - which to a certain degree threaten their very existence. These enterprises are dependent on a long-term and above all predictable development of EEG because of their limited economic resources. Accordingly, some of the measures adopted in the EEG 2014 for onshore wind energy have little or no discernible reduction potential on cost to electricity consumers. By capping the annual expansion capacity, introducing a quarterly variable reduction of the level of remuneration as well as the commitment to market directly without proper fall back option, only worsen the financial constraints of electricity consumers in Germany. Hence, the declared aim of the EEG to make the expansion of renewable energies cost-effective is thwarted in this way. Adequate protection of legitimate expectations on investment is not given. In addition, the proposed remuneration reduction

using the modified reference yield model favours weaker wind locations and does not provide enough incentives to exploit fully the potential of better locations.

### **8.1.1 RECOMMENDATIONS**

1. The preconditions for continuous success of the wind industry in Germany has been the continuity and reliability of feed-in tariff mechanisms over the past two decades. The use of wind energy resources is increasingly associated with high technological progress, economic growth, and social prosperity. The move from a fixed feed-in tariff system to a less predictable tendering model, whose main features and procedure will be unknown until 30<sup>th</sup> June 2016, may threaten investment security of projects and significantly influence the development path of the energy transition process. In order to prevent stagnation in the expansion path of onshore wind energy consequently, the main provisions of the future tender procedures have to be fixed timely. Furthermore, to maintain the encouraging participation of the public through community wind parks, a binding lower limit for installed capacity should be adopted for mandatory participation in the tendering model.

Otherwise, the fixed feed-in tariff system should be maintained in order to consolidate the energy transition process. However, the system should be adjusted to technological growth and market conditions. In this regard, the implementation of obligatory direct marketing is a welcomed step but wind installation operators should be given a better fall-back option in order to make them less dependent on their direct marketer. For example, rather than losing 20% of the defined remuneration, the renewable operations who are forced by factors out of their control from direct marketing should receive 90% instead of 80% of the remuneration from the grid operator.

Concerning market conditions, there should be a gradual shift from technological differentiation of feed-in tariffs towards technological neutrality, particularly for the wind energy, photovoltaic and hydropower branches. This measure will enhance competition amongst the different generation forms.

2. The constant increase in the EEG surcharge since 2009 is because of a cocktail of factors that partly have nothing to do with the promotion of renewable energies. This ranges from the wrong calculation method of the EEG surcharge to policy shortcomings. Renewable energies should not be sold on the spot market for electricity with low prices driven by excess supply and cheap CO<sub>2</sub> certificate. They should rather be sold in a manner that reflects their quality. One way to do is to market via distributors, coupled with a return to

a physical transfer method for calculating the EEG surcharge (as was the case until 2009). However, remunerations should reflect actual market conditions, e.g. by including short time bands, which reflect current market situation.

3. The adoption of an expansion corridor for wind energy is likely against the purpose of the EEG, which in principle is for the support of cost efficient renewable technologies. Wind energy being presently the most cost-efficient in Germany should be exempted from this regulation. However, if a "breathing cap" must be maintained, the expansion path should be raised to a higher net value. In addition, the annual remuneration adjustments (i.e. adjustment of degression rate) should take effect immediately the installed capacity falls below the target range, i.e. as early as the first stage (until -200 MW). Besides, the degression steps should be carried out annually rather than quarterly.
4. The earnings potential of generators and direct marketers will depend on their ability to forecast periods of negative prices and to minimise strategically the number of periods where negative prices persist. Any further amendment to the rules should take into account whether the increase in financing costs caused by the rules is offset by efficiency gains for the economy as a whole and whether there are alternative mechanisms for improving flexibility, which could generate similar incentives at lower economic cost.
5. Comprehensive planning helps to identify the best locations for wind farms, and formal designations provide the highest degree of reliability and acceptance. The ambiguity of some regulatory instruments has left much room for fundamental discussions and indecisive action at regional and local levels. Planning at regional and local levels is much easier when it is not bothered by never-ending discussions on issues of national policy. Thus, targets for the usage of renewable energy sources should be clearly defined at each level of decision-making. This should be done in a top-down way. The essential point is that the regional level knows which contribution they are expected to deliver in order to reach national targets.

## **8.2 ACCEPTANCE OF WIND ENERGY**

The policy targets of the German Government for the short, medium, and long term require a substantial increase in installed onshore wind energy capacity in Germany. While public support for the wind energy development has and is still relatively high, as depicted by the survey, the situation in the local context is very complex. Social acceptance of wind energy, especially at the community level, features a great complexity of aspects and involves a great variety of stakeholders. Wind energy projects are specifically influenced by the

geography and the ecology of the area, ownership models, approaches for a fair distribution of costs and benefits, decision-making processes and communication methods. Furthermore, most of these influential factors are interlinked and depend on each other. As a result, every project is unique and strategies have to be adapted to the local situation, i.e. there is no recipe for social acceptance. The apparent opposition - or better termed "hesitancy" - of the local population towards windmills in their backyards is not totally bad, as it signals some shortfalls in the overall development process given the positive attitude of the public toward wind energy. However, if taken seriously from the beginning, i.e. at the start of project planning and siting, it may improve project acceptability to everybody's benefit.

### **8.2.1 RECOMMENDATIONS**

1. The feed-in tariff system of the EEG makes operation of windmills profitable. Local residents and municipalities want to participate equally in profits of turbine operators. The developers and operators of wind energy installations should involve the local population in sharing the financial benefits of wind parks within the community and the federal government should open up financing possibilities for community owned wind parks. This would significantly enhance the acceptance of windmills among the local population. However, it should be noted that the feed-in tariff mechanism was originally meant to foster growth and market integration, and not to provide extra income for local economies. Wrong decisions may be made if such financial interests are allowed to influence the planning and decision-making process. Therefore, planning, approval and licensing should not be intermixed with the financial interests of involved stakeholders.
2. Onshore wind energy development should not be dependent on the good will of the local population. The involvement of the public should not only begin at a stage of planning when proposals are mature and substantiated, but also when there are still alternatives to be considered. At the level of the authorities, the population should be involved in the legislation process particularly those regulating planning and licensing.
3. Suitable sites for wind energy development has so far not been the limiting factor for development of onshore wind energy. According to the UBA study of 2010, suitable site potential in Germany is estimated to be much higher than currently used surface area, which is a requisite for continued growth in this market. However, extensively defined location criteria and the recently adopted state opening clause have the potential to make the siting and licensing processes very cumbersome and restrict the available surface

for wind energy development. A consistent overall concept should be used during zoning to assess the appropriateness of an area for wind energy development. Besides, a clear distinction on a case-to-case basis should be made during licensing under BImSchG. Licensing under BImSchG should thus be used in respect to the different conditions (e.g. density of population, character of landscape, proportion of protected areas) of different regions. This does not only enhance public acceptance, but also reduces the bureaucratic process during licensing.

### **8.3 IMPLEMENTATION POSSIBILITIES IN CAMEROON**

Cameroon has enormous renewable energy potential to generate low-cost hydropower, while using the other renewable energy sources as back-up capacity and to supply off-grid rural areas, as well as become a major exporter of electricity to its neighbours. The solution to Cameroon's energy crisis calls for new types and a better mix of energy sources. What a paradox that a country with enormous renewable potential is rather investing in fossil energy sources for electricity generation. The rapid growth of renewables in Germany shows that, renewable energy technologies are increasingly viable option to complement and eventually replace fossil fuels. Renewable sources such as the wind and solar are now being successfully employed on an industrial scale. Market trends released by the Renewable Energy Policy Network for the 21<sup>st</sup> Century (REN21) show prices have tumbled over the last decade for key technologies such as solar PV and onshore wind power and will continue to do so (REN21, 2014). Estimates from the World Bank show that, Cameroon would need to develop over 1,400 MW capacity to meet domestic demand, and an additional 831 MW in interconnector capacity. This would result in commercial gain through exporting over half the domestic electricity generation. Besides, an investment of \$2.6 billion to develop additional hydropower potential and interconnectors in Cameroon would yield an annual return of 12% (World Bank, 2011). A large share of renewables in the national energy mix will make the economy less dependent on fossil supplies, can help stimulate local employment, and can free up budget resources for other development goals.

The German EEG model has shown that renewable energy feed-in tariffs have the potential to transform not only energy systems but also societies in general. Nevertheless, the research has vividly demonstrated that the German EEG model cannot be implemented in Cameroon. Cameroon faces other social, political, and economic challenges than Germany. Nevertheless, if tailored to the Cameroonian context, renewable energy feed-in tariff model can successfully increase overall energy generation, boost economic development and improve access to electricity in rural areas. Moreover, a decentralized approach allows for

alternative ownership and governance models, as well as provides the opportunity to empower communities. However, if the financial burden for the policy is recuperated solely by raising energy prices for the end consumer, there is a risk of further excluding the poor rural communities from development opportunities.

### **8.3.1 RECOMMENDATIONS**

1. The overall aim of a Cameroonian renewable energy feed-in tariff policy as proposed by this research, i.e. increased access to electricity in rural areas and limited reach of the national grid, should be based on a decentralised grid system. The national government should establish a mini grid programme that has the potential to propel progress in expanding access to electricity in rural areas. Provisions should be made to encourage and support local ownership structures, because mini grids owned and managed by communities can allow far higher levels of local participation and development.
2. A major factor to the success of the feed-in tariff model in attracting investors is the tariff, which incorporates both the level and duration of payment. The model has to be in line with the overall policy objective. The model in Cameroon, therefore, should be based on the actual generation cost, which allows developers to choose the more appropriate technologies. A tariff based on cost of generation is likely to be cheaper than an avoided cost method if a broader cost-benefit analysis is taken into consideration. This is because it considers the country specific eligible technology and potential and the cost of these technologies.
3. Traditionally, incurred additional costs of feed-in tariffs are passed on to the end consumer. As detailed in this research, this may have negative consequences on the poor rural population in Cameroon. Therefore, the government must look for ways to protect poor customers.

The government should provide a monthly quota of relatively lower electricity rates to low income households. This will simultaneously serve as an incentive for energy efficiency and conservation. Another option is to cross-subsidise low-income households through minimal increase in tariffs or moderate ecological tax on fossil fuel product. Higher rates can also be adopted for households consuming above a certain kWh maximum per year. However, these options may not be able to cover all the costs of feed-in tariff scheme. Consequently, additional sources of funding, such as funding from international climate change funds or funding from Common Development Mechanism (CDM) projects, may also be solicited by the Cameroonian Government to protect the poor from higher prices.



## REFERENCES

- Abanda, F. (2012, September). Renewable energy sources in Cameroon: Potentials, benefits and enabling environment. *Renewable and Sustainable Energy Reviews*, 16(7), pp. 4557–4562.
- AES-SONEL. (2010). *La société*. Retrieved September 23, 2011, from AES-SONEL: <http://www.aessoneltoday.com/la-societe-presentation/la-societe-a-propos-d-aes-sonel.html>
- AfDB. (2010, January 21). *Country Strategy Paper 2010-2014: Cameroon*. Retrieved August 8, 2011, from African Development Bank Group: <http://www.afdb.org/en/documents/document/2010-2014-cameroon-country-strategy-paper-18567/>
- Albrecht, E., & Zschiegner, A. (2015). Landesgesetzliche Abstandsregelungen für Windkraftanlagen nach § 249 Abs. 3 BauGB auf dem rechtlichen Prüfstand. *Neue Zeitschrift für Verwaltungsrecht*, 34(16), 1093-1099 .
- Allred, S. B., & Ross-Davis, A. (2011, August). The Drop-off and Pick-up Method: An Approach to Reduce Nonresponse Bias in Natural Resource Surveys. *Small-scale Forestry*, 10(3), pp. 305-318.
- Amt für Statistik Berlin-Brandenburg. (2010). *Statistik Berlin-Brandenburg*. Retrieved April 04, 2010, from Brandenburg in Zahlen 2010: [http://www.statistik-berlin-brandenburg.de/produkte/faltblatt\\_brochure/brandenburg\\_in\\_Zahlen\\_de.pdf](http://www.statistik-berlin-brandenburg.de/produkte/faltblatt_brochure/brandenburg_in_Zahlen_de.pdf)
- ARE. (2013, December 4). *Country power market brief: Cameroon*. Retrieved June 8, 2014, from Alliance for Rural Electrification: [http://www.ruralelec.org/fileadmin/DATA/Documents/06\\_Publications/Market\\_intelligence/AEEP\\_Cameroon\\_Power\\_Sector\\_Market\\_Brief\\_EN.pdf](http://www.ruralelec.org/fileadmin/DATA/Documents/06_Publications/Market_intelligence/AEEP_Cameroon_Power_Sector_Market_Brief_EN.pdf)
- ARSEL. (2013). *Présentation du secteur électrique*. Retrieved January 13, 2014, from Agence de Régulation du Secteur de l'Electricité: <http://www.arsel-cm.org/donnees/presentation-secteur.pdf>
- Asendorpf, D. (2013, April 27). *Speicherkraftwerke: Wende rückwärts*. Retrieved September 22, 2014, from Zeit Online: <http://www.zeit.de/2013/17/pumpspeicherkraftwerke-energiewende>
- Auer, J., & Keil, J. (2012, January 31). *Moderne Stromspeicher: Unverzichtbare Bausteine der Energiewende*. Retrieved September 27, 2012, from Deutsche Bank Research Management: [http://www.dbresearch.de/PROD/DBR\\_INTERNET\\_DE-PROD/PROD0000000000284196.pdf](http://www.dbresearch.de/PROD/DBR_INTERNET_DE-PROD/PROD0000000000284196.pdf)
- Australian Wind Energy Association. (2007, June 27). *Wind Farms and Landscape Values*. Retrieved October 10, 2012, from Clean Energy Council of Australia: <http://www.cleanenergycouncil.org.au/mediaObject/CWFA/documents/ConsultationReport07-06-27FINAL/original/ConsultationReport07-06-27FINAL.pdf>
- BAFA. (2014, February 11). *Statistische Auswertungen zur „Besonderen Ausgleichsregelung“ des Bundesamtes für Wirtschaft und Ausfuhrkontrolle (BAFA)*. Retrieved March 25, 2014, from Bundesamt für Wirtschaft und Ausfuhrkontrolle: [http://www.bafa.de/bafa/de/energie/besondere\\_ausgleichsregelung\\_eeg/publikationen/statistische\\_auswertungen/index.html](http://www.bafa.de/bafa/de/energie/besondere_ausgleichsregelung_eeg/publikationen/statistische_auswertungen/index.html)
- Bals, C., Austrup, T., Burck, J., Koch, A., Medak, B., Pforte-von Randow, T., & Treber, M. (2010, September 16). *Analysis of the German Federal Government's Draft Energy Concept: Potentials Thwarted by Nuclear Power and Coal*. Retrieved January 11, 2011, from Germanwatch: <http://germanwatch.org/klima/ek-e.pdf>



- BBSR. (2014, May). *Windenergieanlagen und Raumordnungsgebiete*. Retrieved March 29, 2015, from Bundesinstitut für Bau-, Stadt- und Raumforschung: [http://www.bbsr.bund.de/BBSR/DE/Veroeffentlichungen/AnalysenKompakt/2014/DL\\_01\\_2014.pdf?\\_\\_blob=publicationFile&v=3](http://www.bbsr.bund.de/BBSR/DE/Veroeffentlichungen/AnalysenKompakt/2014/DL_01_2014.pdf?__blob=publicationFile&v=3)
- BDEW. (2014, February 24). *Erneuerbare Energien und das EEG: Zahlen, Fakten, Grafiken (2014)*. Retrieved July 15, 2014, from German Association of Energy and Water Industries: [https://www.bdew.de/internet.nsf/id/bdew-publikation-erneuerbare-energien-und-das-ee-g-zahlen-fakten-grafiken-2014-de/\\$file/Energie-Info\\_Erneuerbare%20Energien%20und%20das%20EEG%202014\\_korr%2027.02.2014\\_final.pdf](https://www.bdew.de/internet.nsf/id/bdew-publikation-erneuerbare-energien-und-das-ee-g-zahlen-fakten-grafiken-2014-de/$file/Energie-Info_Erneuerbare%20Energien%20und%20das%20EEG%202014_korr%2027.02.2014_final.pdf)
- BEE. (2013, September 4). *The EEG Surcharge for 2014: Background Paper on Components of the Surcharge, Development and Expected Level*. Retrieved July 22, 2014, from German Renewable Energy Federation: [http://www.bee-ev.de/fileadmin/Presse/Mitteilungen/20130904\\_EEG-Surcharge-2014\\_Background-Paper.pdf](http://www.bee-ev.de/fileadmin/Presse/Mitteilungen/20130904_EEG-Surcharge-2014_Background-Paper.pdf)
- Belyaev, L., Marchenko, O., Filipov, S., Stepanova, T., Solomin, S., & Kokorin, A. (2002). *World Energy and Transition to Sustainable Development*. Dordrecht: Kluwer Academic Publishers.
- Berger-Karin, T. (2010, November 9). Planer at the Prignitz-Oberhavel RPG of Brandenburg. (E. Wanki, Interviewer) Neuruppin.
- Bermer, J. (2014, February). Großer Handel kämpft mit kleinem Markt. *Sonne, Wind & Wärme*, pp. 56-61.
- Bertelsmann Stiftung. (2008, December 8). *Abwanderung aus Brandenburg geht zurück*. Retrieved November 12, 2015, from Bertelsmann Stiftung: [https://www.bertelsmann-stiftung.de/fileadmin/files/BSt/Presse/imported/downloads/xcms\\_bst\\_dms\\_26870\\_26871\\_2.pdf](https://www.bertelsmann-stiftung.de/fileadmin/files/BSt/Presse/imported/downloads/xcms_bst_dms_26870_26871_2.pdf)
- Bertram, D. (2009, October). *University of Belgrade*. Retrieved July 24, 2012, from Likert Scale: <http://poincare.matf.bg.ac.rs/~kristina/topic-dane-likert.pdf>
- Bilé, J. D. (2014, April 14). *Independent Producers joining public Utilities The Future of African Electricity supply?* Retrieved June 11, 2014, from Afrika-Verein der deutschen Wirtschaft e.V.: [http://www.energyafrica.de/fileadmin/user\\_upload/Energy\\_Africa\\_14/Presentation\\_8th%20erman-African%20Energy%20Forum\\_Bil%C3%A9\\_AES%20Sonel\\_Cameroon.pdf](http://www.energyafrica.de/fileadmin/user_upload/Energy_Africa_14/Presentation_8th%20erman-African%20Energy%20Forum_Bil%C3%A9_AES%20Sonel_Cameroon.pdf)
- BMU. (2003, June). *Aktualisierung des Berichtes über den Stand der Markteinführung und der Kostenentwicklung von Anlagen zur Erzeugung von Strom aus erneuerbaren Energien (Erfahrungsbericht zum EEG) vom 28. Juni 2002 durch das BMU*. Retrieved April 11, 2011, from Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit: <http://www.loy-energie.de/download/A-Drs%2015-15-121.pdf>
- BMU. (2004, August). *Amending the Renewable Energy Sources Act (EEG): Key provisions of the new EEG as amended on 21 July 2004*. Retrieved May 20, 2010, from Federal Ministry for the Environment, Nature Conservation and Nuclear Safety: [http://www.erneuerbare-energien.de/fileadmin/ee-import/files/english/pdf/application/pdf/eeg\\_begrueundung\\_en.pdf](http://www.erneuerbare-energien.de/fileadmin/ee-import/files/english/pdf/application/pdf/eeg_begrueundung_en.pdf)
- BMU. (2004, August). *Konsolidierte Fassung; der Begründung zu dem Gesetz für den Vorrang Erneuerbarer Energien*. Retrieved Januar 20, 2010, from BMU: [http://www.erneuerbare-energien.de/fileadmin/ee-import/files/erneuerbare\\_energien/application/pdf/eeg\\_begrueundung.pdf](http://www.erneuerbare-energien.de/fileadmin/ee-import/files/erneuerbare_energien/application/pdf/eeg_begrueundung.pdf)

- BMU. (2007). *Renewable Energy Sources in Figures - National and International Development*. Retrieved November 1, 2010, from German Federal Ministry of the Environment, Nature Conservation and Nuclear Safety: [http://www.bmu.de/english/renewable\\_energy/downloads/doc/5996.php](http://www.bmu.de/english/renewable_energy/downloads/doc/5996.php)
- BMU. (2008). *Begründung zu dem Gesetz für den Vorrang Erneuerbarer Energien (Erneuerbare-Energien-Gesetz – EEG)*. Retrieved May 20, 2010, from Federal Ministry for the Environment, Nature Conservation and Nuclear Safety: [http://www.erneuerbare-energien.de/fileadmin/ee-import/files/pdfs/allgemein/application/pdf/eeg\\_2009\\_begr.pdf](http://www.erneuerbare-energien.de/fileadmin/ee-import/files/pdfs/allgemein/application/pdf/eeg_2009_begr.pdf)
- BMU. (2010, August 4). *National renewable energy action plan*. Retrieved March 14, 2011, from Publications: <http://www.bmu.de/en/service/publications/downloads/details/artikel/national-renewable-energy-action-plan/>
- BMU. (2011, October). *The Federal Government's energy concept of 2010 and the transformation of the energy system of 2011*. Retrieved May 14, 2012, from Federal Ministry for the Environment, Nature Conservation and Nuclear Safety: [http://www.bmu.de/fileadmin/bmu-import/files/english/pdf/application/pdf/energiekonzept\\_bundesregierung\\_en.pdf](http://www.bmu.de/fileadmin/bmu-import/files/english/pdf/application/pdf/energiekonzept_bundesregierung_en.pdf)
- BMU. (2013, July). *Renewable Energy Sources in Figures: National and International Development*. Retrieved September 10, 2013, from Federal Ministry for the Environment, Nature Conservation and Nuclear Safety: [http://www.erneuerbare-energien.de/fileadmin/Daten\\_EE/Dokumente\\_\\_PDFs\\_/ee\\_in\\_zahlen\\_en\\_bf.pdf](http://www.erneuerbare-energien.de/fileadmin/Daten_EE/Dokumente__PDFs_/ee_in_zahlen_en_bf.pdf)
- BMU. (2014, December 4). *Background paper: Climate Action Programme 2020*. Retrieved February 11, 2015, from Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit: [http://www.bmub.bund.de/fileadmin/Daten\\_BMU/Download\\_PDF/Aktionsprogramm\\_Klimaschutz/aktionsprogramm\\_klimaschutz\\_2020\\_hintergrund\\_en\\_bf.pdf](http://www.bmub.bund.de/fileadmin/Daten_BMU/Download_PDF/Aktionsprogramm_Klimaschutz/aktionsprogramm_klimaschutz_2020_hintergrund_en_bf.pdf)
- BMU. (2015, March 3). *Treibhausgasemissionen in Deutschland im Jahr 2014*. Retrieved April 30, 2015, from BMU: [http://www.bmub.bund.de/fileadmin/Daten\\_BMU/Download\\_PDF/Klimaschutz/treibhausgasemissionen\\_deutschland\\_2014\\_bf.pdf](http://www.bmub.bund.de/fileadmin/Daten_BMU/Download_PDF/Klimaschutz/treibhausgasemissionen_deutschland_2014_bf.pdf)
- BMVBS. (2011). *Strategische Einbindung regenerativer Energien in regionale Energiekonzepte. Wertschöpfung auf regionaler Ebene. 18/*. Retrieved August 24, 2014, from Bundesinstitut für Bau-, Stadt- und Raumforschung: [http://www.bbsr.bund.de/BBSR/DE/Veroeffentlichungen/BMVBS/Online/2011/DL\\_ON182011.pdf;jsessionid=4D6E3E6791324B64938B19B20DF08C5E.live2053?\\_\\_blob=publicationFile&v=2](http://www.bbsr.bund.de/BBSR/DE/Veroeffentlichungen/BMVBS/Online/2011/DL_ON182011.pdf;jsessionid=4D6E3E6791324B64938B19B20DF08C5E.live2053?__blob=publicationFile&v=2)
- BMWi. (2012, March 25). *Erneuerbare Energien*. Retrieved April 01, 2012, from Bundesministerium für Wirtschaft und Technologie: <http://www.bmwi.de/BMWi/Navigation/Energie/Energietraeger/erneuerbare-energien,did=20918.html>
- BMWi. (2012, April). *Germany's new energy policy: Heading towards 2050 with secure, affordable and environmentally sound energy*. Retrieved June 4, 2013, from The Federal Ministry of Economics and Technology: <http://www.bmwi.de/English/Redaktion/Pdf/germanys-new-energy-policy,property=pdf,bereich=bmwi,sprache=en,rwb=true.pdf>

- BMWi. (2014, March 3). *Zahlen und Fakten, Energiedaten: Nationale und Internationale Entwicklung*. Retrieved May 20, 2014, from Bundesministerium für Wirtschaft und Energie: <http://www.bmwi.de/DE/Themen/Energie/energiedaten.html>
- BMWi. (2015, February). *Das Erneuerbare-Energien-Gesetz*. Retrieved from Bundesministerium für Wirtschaft und Energie: [http://www.erneuerbare-energien.de/EE/Redaktion/DE/Dossier/eeg.html?cms\\_docId=71120](http://www.erneuerbare-energien.de/EE/Redaktion/DE/Dossier/eeg.html?cms_docId=71120)
- BMWi. (2015, February). *Zeitreihen zur Entwicklung der erneuerbaren Energien in Deutschland 1990-2014*. Retrieved April 27, 2015, from Bundesministerium für Wirtschaft und Energie : [http://www.erneuerbare-energien.de/EE/Navigation/DE/Service/Erneuerbare\\_Energien\\_in\\_Zahlen/Zeitreihen/zeitreihen.html](http://www.erneuerbare-energien.de/EE/Navigation/DE/Service/Erneuerbare_Energien_in_Zahlen/Zeitreihen/zeitreihen.html)
- BNetzA. (2013, February 5). *Monitoring Report 2012*. Retrieved May 20, 2013, from Bundesnetzagentur: [http://www.bundesnetzagentur.de/SharedDocs/Downloads/EN/BNetzA/PressSection/ReportsPublications/2012/MonitoringReport2012.pdf?\\_\\_blob=publicationFile](http://www.bundesnetzagentur.de/SharedDocs/Downloads/EN/BNetzA/PressSection/ReportsPublications/2012/MonitoringReport2012.pdf?__blob=publicationFile)
- BNetzA. (2015, April 30). *Hintergrundpapier: Vorläufige Ergebnisse der ersten Ausschreibungsrunde für Photovoltaik (PV) - Freiflächenanlagen vom 15. April 2015*. Retrieved May 5, 2015, from Bundesnetzagentur: [http://www.bundesnetzagentur.de/SharedDocs/Downloads/DE/Sachgebiete/Energie/Unternehmen\\_Institutionen/ErneuerbareEnergien/PV-Freiflaechenanlagen/Gebotstermin\\_15\\_04\\_2015/Hintergrundpapier\\_PV-FFA\\_Runde1.pdf?\\_\\_blob=publicationFile&v=1](http://www.bundesnetzagentur.de/SharedDocs/Downloads/DE/Sachgebiete/Energie/Unternehmen_Institutionen/ErneuerbareEnergien/PV-Freiflaechenanlagen/Gebotstermin_15_04_2015/Hintergrundpapier_PV-FFA_Runde1.pdf?__blob=publicationFile&v=1)
- Brandenburg Government. (2013). *Land Brandenburg*. Retrieved April 29, 2013, from Landesportal Brandenburg: <http://www.brandenburg.de/cms/detail.php/lbm1.c.392425.de>
- British High Commission-Cameroon. (2013, September 6). *Cameroon Business Guides: Cameroon Doing Business Guides Part 2 - The oil and gas sector*. Retrieved April 11, 2014, from Foreign & Commonwealth Office: [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/237131/Cameroon\\_Doing\\_Business\\_Guides\\_Pt2.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/237131/Cameroon_Doing_Business_Guides_Pt2.pdf)
- Bruns, E., Köppel, J., Ohlhorst, D., & Schön, S. (2008). *Die Innovationsbiographie der Windenergie: Absichten Und Wirkungen von Steuerungsimpulsen*. Berlin: LIT Verlag.
- Burger, B. (2014, January 9). *Electricity production from solar and wind in Germany in 2013*. Retrieved March 25, 2014, from Fraunhofer Institute for Solar Energy Systems ISE: <http://www.ise.fraunhofer.de/en/downloads-englisch/pdf-files-englisch/news/electricity-production-from-solar-and-wind-in-germany-in-2013.pdf>
- BWE. (2010, July). *Positionspapier Des BWE Landesverbands Berlin-Brandenburg Zum weiteren Ausbau der Windenergie in Brandenburg*. Retrieved May 20, 2013, from Bundesverband WindEnergie: <https://www.wind-energie.de/sites/default/files/attachments/article/2010/bwe-berlin-brandenburg-fordert-ausbau-der-windenergie-brandenburg/bwe-positionspapier-1007-ausbau-windenergie-brb.pdf>
- BWE. (2011). *Installierte Windenergieleistung in Deutschland*. Accessed on 01.03.2012: Internet: <http://www.wind-energie.de/infocenter/statistiken/deutschland/installierte-windenergieleistung-deutschland>.

- BWE. (2011). *Installierte Windenergieleistung in Deutschland*. Accessed on 01.03.2012: Internet: <http://www.wind-energie.de/infocenter/statistiken/deutschland/installierte-windenergieleistung-deutschland>.
- BWE. (2012, August). *Was Strom wirklich kostet: Vergleich der staatlichen Förderungen und gesamtgesellschaftlichen Kosten von konventionellen und erneuerbaren Energien*. Retrieved September 1, 2013, from Bundesverband WindEnergie e.V.: [http://www.wind-energie.de/sites/default/files/download/publication/was-strom-wirklich-kostet/20120911\\_bwe\\_greenpeace\\_studie\\_stromkosten\\_final.pdf](http://www.wind-energie.de/sites/default/files/download/publication/was-strom-wirklich-kostet/20120911_bwe_greenpeace_studie_stromkosten_final.pdf)
- BWE. (2013). *BWE Industry Report: Wind Industry in Germany*. Berlin: BWE.
- BWE. (2014). *BWE Industry Report: The wind industry in Germany 2014*. Berlin: BWE.
- BWE. (2014). *Jahrbuch Windenergie 2014*. Berlin: Bundesverband Windenergie e.V.
- BWE. (2015). *Statistiken*. (BWE) Retrieved April 26, 2015, from BWE: <https://www.wind-energie.de/themen/statistiken/deutschland>
- CEEPA. (2006, August). *Climate Change and African Agriculture. Policy Note No.33*. Retrieved March 4, 2010, from The Centre for Environmental Economics and policy in Africa (CEEPA): <http://www.ceepa.co.za/docs/POLICY%20NOTE%2033.pdf>
- CIA. (2013). *the World Factbook: Cameroon*. Retrieved December 29, 2013, from Central Intelligence Agency: <https://www.cia.gov/library/publications/the-world-factbook/geos/cm.html>
- Dehmer, D., & Eubel, C. (2014, August 1). *Eine erneuerbare Reform*. Retrieved September 22, 2014, from Der Tagesspiegel: <http://www.tagesspiegel.de/politik/energiewende-eine-erneuerbare-reform/9300248.html>
- dena. (2012, December 11). *Ausbau- und Innovationsbedarf der Stromverteilnetze in Deutschland bis 2030 ( dena-Verteilnetzstudie)*. Retrieved February 11, 2013, from Deutsche Energie-Agentur GmbH (dena): [http://www.dena.de/fileadmin/user\\_upload/Projekte/Energiesysteme/Dokumente/denaVNS\\_Abschlussbericht.pdf](http://www.dena.de/fileadmin/user_upload/Projekte/Energiesysteme/Dokumente/denaVNS_Abschlussbericht.pdf)
- DESTATIS. (2011, May 9). *Bevölkerung nach Alter in Jahren und Geschlecht für Gemeinden*. Retrieved January 16, 2012, from Statistische Ämter des Bundes und der Länder: [https://www.zensus2011.de/SharedDocs/Aktuelles/Ergebnisse/DemografischeGrunddaten.html;jsessionid=1CB0367944F47146716B66844ED527ED.2\\_cid353?nn=3065474](https://www.zensus2011.de/SharedDocs/Aktuelles/Ergebnisse/DemografischeGrunddaten.html;jsessionid=1CB0367944F47146716B66844ED527ED.2_cid353?nn=3065474)
- DESTATIS. (2014, July 29). *Data on energy price trends - Long-time series - June 2014*. Retrieved August 19, 2014, from Statistisches Bundesamt: <https://www.destatis.de/DE/Publikationen/Thematisch/Preise/Energiepreise/EnergyPriceTrends.html>
- Deutsche WindGuard. (2013). *Kostensituation der Windenergie an Land in Deutschland (Vol. Berichtsnummer: SP13007A1)*. Varel: Deutsche WindGuard GmbH.
- Deutscher Bundestag. (1999, March 3). *Entschließungsantrag: Drucksache 14/465, 14. Wahlperiode*. Retrieved May 20, 2012, from Bundestag: <http://dip21.bundestag.de/dip21/btd/14/004/1400465.pdf>
- DIBt. (2012, October). *Richtlinie für Windenergieanlagen: Einwirkungen und Standsicherheitsnachweise für Turm und Gründung*. Retrieved February 22, 2014, from Deutschen Instituts für Bautechnik: [https://www.dibt.de/en/Departments/data/Aktuelles\\_Ref\\_I\\_1\\_Richtlinie\\_Windenergieanlagen\\_Okt\\_2012.pdf](https://www.dibt.de/en/Departments/data/Aktuelles_Ref_I_1_Richtlinie_Windenergieanlagen_Okt_2012.pdf)

- DNR. (2005, March 1). *Grundlagenarbeit für eine Informationskampagne "Umwelt- und naturverträgliche Windenergienutzung in Deutschland (onshore)"*. Retrieved December 12, 2010, from Naturschutzstandard Erneuerbarer Energien: [http://www.naturschutzstandards-erneuerbarer-energien.de/images/literatur/DNR\\_Analysebericht\\_2005%5B1%5D.pdf](http://www.naturschutzstandards-erneuerbarer-energien.de/images/literatur/DNR_Analysebericht_2005%5B1%5D.pdf)
- DNR. (2005, March). *Grundlagenarbeit für eine Informationskampagne "Umwelt- und naturverträgliche Windenergienutzung in Deutschland (onshore)" - Analyseteil* -. Retrieved September 27, 2012, from German League for Nature, Animal Protection and Environment: <http://www.dnr.de/downloads/naturvertraeglichewindkraft.pdf>
- Dohmen, F., & Reuter, W. (2010, March 08). Windiges Minus. *Der Spiegel*, pp. 84-85.
- Dovers, S. (2005). *Environment and Sustainability Policy: Creation, Implementation, Evaluation*. Sydney: The Federal Press.
- Dürr, T. (2014, April 4). *Auswirkungen von Windenergieanlagen auf Vögel und Fledermäuse*. Retrieved May 17, 2014, from Landesamt für Umwelt, Gesundheit und Verbraucherschutz: Brandenburg: <http://www.lugv.brandenburg.de/cms/detail.php/bb1.c.312579.de>
- Dütschke, E., & Wesche, J. P. (2015, March). *Status quo of social acceptance strategies and practices in the wind industry*. Retrieved April 26, 2015, from WISE Power: [http://wisepower-project.eu/wp-content/uploads/20150319\\_WISE\\_Power\\_Deliverable\\_2-2\\_final.pdf](http://wisepower-project.eu/wp-content/uploads/20150319_WISE_Power_Deliverable_2-2_final.pdf)
- EDC. (2011). *Présentation de l'entreprise*. Retrieved February 20, 2013, from Electricity Development Corporation: <http://edc-cameroon.org/francais/societe/presentation-8/article/presentation-de-l-entreprise>
- Ender, C. (2014, February). Wind Energy Use in Germany - Status 31.12.2013. *DEWI Magazin, Nr. 44*, pp. 35-46. Retrieved from Deutsches Windenergie Institut- DEWI.
- Eurostats. (2013, May 27). *Electricity and natural gas price statistics*. Retrieved May 28, 2013, from European Commission Eurostat: [http://epp.eurostat.ec.europa.eu/statistics\\_explained/index.php/Electricity\\_and\\_natural\\_gas\\_price\\_statistics](http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Electricity_and_natural_gas_price_statistics)
- Everaert, J., & Stienen, E. W. (2007). Impact of wind turbines on birds in Zeebrugge (Belgium). Significant effect on breeding tern colony due to collisions. *Biodiversity and Conservation, Volume 16, Number 12*, 3345-3359.
- Fest, P. (2010). *Die Errichtung von Windenergieanlagen in Deutschland und seiner Ausschließlichen Wirtschaftzone: Genehmigungsverfahren, planerische Steuerung und Rechtsschutz an Land und auf See*. Berlin: Duncker & Humboldt GmbH.
- Foreign & Commonwealth Office. (2013, September 6). *Cameroon Business Guides: Cameroon Doing Business Guides Part 1 - The power and energy sector in Cameroon*. Retrieved April 12, 2014, from UK Government: [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/237129/Cameroon\\_Doing\\_Business\\_Guides\\_Pt.1.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/237129/Cameroon_Doing_Business_Guides_Pt.1.pdf)
- Fraunhofer. (2014, August 1). *Laufende Evaluierung der Direktvermarktung von Strom aus Erneuerbaren Energien: 10. Quartalsbericht*. Retrieved June 10, 2015, from BMU: <http://www.erneuerbare-energien.de/EE/Redaktion/DE/Downloads/Berichte/direktvermarktung-quartalsbericht-10.html>



- Fraunhofer IWES. (2015). *Windenergie Report Deutschland 2014*. Stuttgart: Fraunhofer Verlag. Retrieved May 20, 2015, from [http://publica.fraunhofer.de/eprints/urn\\_nbn\\_de\\_0011-n-3396662.pdf](http://publica.fraunhofer.de/eprints/urn_nbn_de_0011-n-3396662.pdf)
- Fülbier, V., Grüner, A.-M., Sailer, F., & Wegner, N. (2014, July 27). *Die Länderöffnungsklausel im BauGB und ihre Umsetzung in Bayern: Neue Möglichkeiten für die Bundesländer zur Einschränkung der Außenbereichsprivilegierung durch pauschale Abstandsregelungen*. Retrieved January 11, 2015, from Stiftung Umweltenergierecht: [http://www.stiftung-umweltenergierecht.de/fileadmin/pdf\\_aushaenge/Forschung/WueBerichte\\_8\\_BauGB-Laenderoeffnungsklausel\\_Wind\\_final.pdf](http://www.stiftung-umweltenergierecht.de/fileadmin/pdf_aushaenge/Forschung/WueBerichte_8_BauGB-Laenderoeffnungsklausel_Wind_final.pdf)
- Fulton, M., Capalino, R., & Auer, J. (2012, September). *The German Feed-in Tariff: Recent Policy Changes*. Retrieved November 27, 2012, from DBResearch: [http://www.dbresearch.com/PROD/DBR\\_INTERNET\\_EN-PROD/PROD0000000000294376/The+German+Feed-in+Tariff%3A+Recent+Policy+Changes.pdf](http://www.dbresearch.com/PROD/DBR_INTERNET_EN-PROD/PROD0000000000294376/The+German+Feed-in+Tariff%3A+Recent+Policy+Changes.pdf)
- German Government. (2010, August 4). *Federal Republic of Germany: National Renewable Energy Action Plan in accordance with Directive 2009/28/EC on the promotion of the use of energy from renewable sources*. Retrieved May 11, 2013, from Renewable energy: [http://ec.europa.eu/energy/renewables/action\\_plan\\_en.htm](http://ec.europa.eu/energy/renewables/action_plan_en.htm)
- Hälsig, G. (2010, March 12). Head of Department of Environment, Climate Change, Sustainability in the Brandenburg Ministry of Environment, Health and Consumer Protection. (E. Wanki, Interviewer) Potsdam.
- Hentschel, A. (2010). *Umweltschutz bei Errichtung und Betrieb von Windkraftanlagen*. Baden-Baden: Nomos Verlag.
- Heymann, M. (1995). *Die Geschichte der Windenergienutzung 1890-1990*. Frankfurt am Main: Campus Verlag.
- Hilmer, R., & Dittko, K. (2013, August 28). *Meinungsmonitor Energiewende: Was erwarten die Deutschen von der Energiewende?* Retrieved March 4, 2014, from Scholz & Friends Group: [https://dl.dropboxusercontent.com/u/177288458/Scholz%20%26%20Friends%20Agenda/Meinungsmonitor%20Energiewende/130903\\_Meinungsmonitor%20Energiewende.pdf](https://dl.dropboxusercontent.com/u/177288458/Scholz%20%26%20Friends%20Agenda/Meinungsmonitor%20Energiewende/130903_Meinungsmonitor%20Energiewende.pdf)
- Ibitayo, O. (2008, November 18). *NIMBYism*. Retrieved September 10, 2014, from Encyclopedia of Earth: <http://www.eoearth.org/view/article/154752/>
- IPCC. (2001a). *IPCC Third Assessment Report: Climate Change; The Scientific Basis*. Cambridge: Cambridge University Press.
- IPCC. (2013). *Climate Change 2013: The Physical Science Basis-Working Group I Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. (T. D.-K. [Stocker, Ed.] Retrieved January 22, 2014, from Intergovernmental Panel on Climate Change: [http://www.climatechange2013.org/images/report/WG1AR5\\_ALL\\_FINAL.pdf](http://www.climatechange2013.org/images/report/WG1AR5_ALL_FINAL.pdf)
- IPCC. (2014). *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. (O. R.-M. Edenhofer, Ed.) Retrieved December 22, 2014, from Intergovernmental Panel on Climate Change: [https://www.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc\\_wg3\\_ar5\\_chapter11.pdf](https://www.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_chapter11.pdf)
- Ismar, G. (2011, March 20). *Mythos vom Massensterben: Windräder keine Vogelschredder*. Retrieved April 13, 2011, from NTV Online: <http://www.n-tv.de/politik/Windraeder-keine-Vogelschredder-article2542081.html>

- IWES. (2012, May 18). *Wind Energy Report Germany 2011*. Retrieved November 30, 2013, from Fraunhofer Institute for Wind Energy and Energy System Technology: Publication: [http://windmonitor.iwes.fraunhofer.de/bilder/upload/Windreport\\_2011\\_engl.pdf](http://windmonitor.iwes.fraunhofer.de/bilder/upload/Windreport_2011_engl.pdf)
- IWES. (2014). *Wind Energy Report Germany 2013*. (K. Rohrig, Ed.) Stuttgart: Fraunhofer Verlag. Retrieved from Fraunhofer Institute for Wind Energy and Energy System Technology.
- Journalism++. (2013). *The Cameroon electricity crisis*. Retrieved March 14, 2014, from Journalism++: <http://jplusplus.github.io/camcuts/>
- Jungjohann, A., & Morris, C. (2014, June). *The German Coal Conundrum: The status of coal power in Germany's energy transition*. Retrieved August 15, 2014, from Heinrich Böll Stiftung: [http://eu.boell.org/sites/default/files/german\\_coal\\_conundrum.pdf](http://eu.boell.org/sites/default/files/german_coal_conundrum.pdf)
- Juris. (2007, September 21). *Oberverwaltungsgericht Berlin-Brandenburg, 10. Senat, OVG 10 A 9.05 Urteil Normenkontrolle; Regionalplan; unterbliebene Ausfertigung; Unbeachtlichkeit*. Retrieved September 21, 2010, from juris: Das Rechtportal: <http://connect.juris.de/jportal/prev/MWRE080000276>
- Juris. (14. September 2010). *Oberverwaltungsgericht Berlin-Brandenburg 2. Senat. OVG 2 A 1.10: Urteil, Normenkontrolle. Regionalplan Havelland Fläming-Teilplan "Windenergienutzung"*. Abgerufen am 21. September 2010 von juris: Das Rechtportal: <http://connect.juris.de/jportal/prev/MWRE100003060>
- Kempe-Samsami, B. (2013, April 10). Policy Department, German Wind Energy Association. (E. Wanki, Interviewer) Hannover.
- Khartchenko, N. V. (2004). *Green Power: The Eco-Friendly Energy Engineering: -Fundamentals And Design*. New Delhi: Technip Books International.
- Klaus, T., Vollmer, C., Werner, K., Lehmann, H., & Müschen, K. (2010, July). *Energy target 2050: 100 % renewable electricity supply*. Retrieved June 30, 2012, from Federal Environment Agency Germany - UBA: Publication: <http://www.umweltbundesamt.de/sites/default/files/medien/publikation/add/3997-0.pdf>
- Knopp, L. (2008). *International European Environmental Law with Reference to German Environmental Law: A Guide for International Study Programs* (1<sup>st</sup> ed.). Berlin: Lexxion Verlagsgesellschaft;
- Kovac, P. (2012, November 16). *Cameroon: Country Report*. Retrieved May 22, 2013, from Laurea University of Applied Sciences: <http://www.laurea.fi/en/connect/results/Documents/Cameroon%20Country%20Report.pdf>
- Kruger, P. (2006). *Alternative Energy Resources: The Quest for Sustainable Energy*. Hoboken, New Jersey: John Wiley & Sons.
- Lang, M. (2013, June 12). *UBA Study on Big Onshore Wind Power Potential in Germany*. Retrieved January 23, 2014, from German Energy Blog: <http://www.germanenergyblog.de/?p=13285&print=1>
- Linge, I. (2014, May 28). *Cameroonian government and Actis make AES deal official*. Retrieved July 30, 2014, from Business in Cameroon: <http://www.businessincameroon.com/energy/2805-4847-cameroonian-government-and-actis-make-aes-deal-official>
- Lopez, B. D. (2013). Panama aims to support solar energy. *pv magazine online*. Retrieved December 20, 2014, from [http://www.pv-magazine.com/news/details/beitrag/panama-aims-to-support-solar-energy\\_100011178/](http://www.pv-magazine.com/news/details/beitrag/panama-aims-to-support-solar-energy_100011178/)



- Loreck, C., Haller, M., Hermann, H., & Cludius, J. (2015, October 15). *Analyse der EEG-Umlage 2014*. Retrieved December 14, 2014, from Öko-Institut e.V. : <http://www.oeko.de/oekodoc/1825/2013-495-de.pdf>
- Lüers, S., Rehfeldt, L., & Rehfeldt, K. (2014). *Status of Land-Based Wind Energy Development in Germany, 2013*. Retrieved May 8, 2014, from Deutsche WindGuard: [http://www.windguard.com/fileadmin/media/pdfs/UEber\\_Uns/Statistik\\_Ausbau\\_Windenergie/Statistik\\_Gesamtjahr\\_2013/Fact\\_Sheet\\_Onshore\\_Statistic\\_Year\\_2013\\_\\_final\\_corrected.pdf](http://www.windguard.com/fileadmin/media/pdfs/UEber_Uns/Statistik_Ausbau_Windenergie/Statistik_Gesamtjahr_2013/Fact_Sheet_Onshore_Statistic_Year_2013__final_corrected.pdf)
- Lütkehus, I., & Salecker, H. (2013, August). Onshore Wind Energy Potential in Germany: Current study by the Federal Environment Agency on the nationwide area and output potential. *DEWI Magazin, NO. 43*, pp. 23-28.
- Lütkes, S. (2011). Naturschutz und Windenergierechtliche Rahmenbedingungen und Perspektiven. In E. Brandt (Ed.), *Das Spannungsfeld Windenergieanlagen: Naturschutz in Genehmigungs- und Gerichtsverfahren: Problem (in) der Praxis. Methodische Anforderungen. Lösungsansätze* (pp. 15-25). Berlin: Berliner Wissenschafts-Verlag.
- LUGV. (2014, April 7). *Auswirkungen von Windenergieanlagen auf Vögel und Fledermäuse*. Retrieved May 20, 2014, from Landesamt für Umwelt, Gesundheit und Verbraucherschutz: <http://www.lugv.brandenburg.de/cms/detail.php/bb1.c.312579.de>
- Mallon, K. (2006). *Renewable Energy Policy and Politics. A Handbook for Decision-making*. London: Earthscan.
- Maluszcak, C. (2010, May 31). Head of Lausitz-Speewald RPG. (E. Wanki, Interviewer) Cottbus.
- Mattes, A. (2014, May 16). *Die ökonomische Bedeutung der Windenergiebranche. Modul 1: Windenergie an Land in Deutschland*. Retrieved May 30, 2014, from Deutsche Institut für Wirtschaftsforschung (DIW): [http://diw-econ.de/wp-content/uploads/2014/05/diw\\_econ\\_oekonomische\\_bedeutung\\_windenergie2.pdf](http://diw-econ.de/wp-content/uploads/2014/05/diw_econ_oekonomische_bedeutung_windenergie2.pdf)
- Mayer, J. N., & Burger, B. (2014, July 14). *Kurzstudie zur historischen Entwicklung der EEG-Umlage: EEG-Umlage könnte 2015 sinken*. Retrieved April 29, 2015, from Fraunhofer Institute for Solar Energy Systems ISE : <http://www.ise.fraunhofer.de/de/downloads/pdf-files/data-nivc-/kurzstudie-zur-historischen-entwicklung-der-eeg-umlage.pdf>
- MINEE. (2013). *Presentation of Cameroon*. Retrieved November 12, 2013, from National Renewable Energy Center of Mongolia: <http://nrec.mn/data/uploads/Nom%20setguul%20xicheel/Water/badrakh%20china/cameroon.pdf>
- MNR. (2011, December). *Birds and Bird Habitats: Guidelines for Wind*. Retrieved May 27, 2012, from Ministry of Natural Resources Ontario: [http://www.mnr.gov.on.ca/stdprodconsume/groups/lr/@mnr/@renewable/documents/document/stdprod\\_071273.pdf](http://www.mnr.gov.on.ca/stdprodconsume/groups/lr/@mnr/@renewable/documents/document/stdprod_071273.pdf)
- Mogren, A. (2010, March 16). Head of Public Affairs Vattenfall Germany. (E. Wanki, Interviewer) Berlin.
- Molua, E. L., & Lambi, C. M. (2007, September). *The Economic Impact of Climate Change on Agriculture in Cameroon*. Retrieved March 4, 2010, from World Bank eLibrary: <http://elibrary.worldbank.org/doi/pdf/10.1596/1813-9450-4364>
- Monstadt, J. (2000). *Die deutsche Energiepolitik zwischen Klimavorsorge und Liberalisierung. Räumliche Perspektiven des Wandels*. Hannover: Akademie für Raumforschung und Landesplanung, Arbeitsmaterial, Nr. 271.

- Morris, C., & Pehnt, M. (2014, January). *German Energy Transition: Arguments for a renewable energy future*. (D. L. Jungjohann, Ed.) Retrieved January 24, 2015, from Heinrich Böll Foundation: [http://energytransition.de/wp-content/themes/boell/pdf/en/German-Energy-Transition\\_en.pdf](http://energytransition.de/wp-content/themes/boell/pdf/en/German-Energy-Transition_en.pdf)
- Moula, M. E., Maula, J., Hamdy, M., Fang, T., Jung, N., & Lahdelma, R. (2013, October 1). Researching social acceptability of renewable energy technologies in Finland. *International Journal of Sustainable Built Environment*, pp. 89-98.
- Müsgens, F., & Grothe, O. (2013, July). *The influence of spatial effects on wind power revenues under direct marketing rules* (Vol. 58). *Energy Policy*. doi:10.1016/j.enpol.2013.03.004
- Ndenecho, E. N. (2011). *Decentralisation and Spatial Rural Development Planning in Cameroon*. Oxford: Langaa Rpcig.
- Nfah, E., & Ngundam, J. M. (2012, September). Identification of stakeholders for sustainable renewable energy applications in Cameroon. *Renewable and Sustainable Energy Reviews*, 16(7), pp. 4661–4666.
- Nganga, J., Wohlert, M., Woods, M., Becker-Birck, C., Jackson, S., & Rickerson, W. (2013, February). *Powering Africa through Feed-in Tariffs: Advancing renewable energy to meet the continent's electricity needs*. Retrieved November 17, 2014, from Heinrich Böll Stiftung: [https://www.boell.de/sites/default/files/2013-03-powering-africa\\_through-feed-in-tariffs.pdf](https://www.boell.de/sites/default/files/2013-03-powering-africa_through-feed-in-tariffs.pdf)
- Ngnikam, E. (2009, December). *Renewable Energies in West Africa: Regional Report on Potentials and Marktes – 17 Country Analyses*. Retrieved May 1, 2012, from Deutsche Gesellschaft für Internationale Zusammenarbeit (giz): <http://www.giz.de/expertise/downloads/gtz2009-en-regionalreport-westafrica-introduction.pdf>
- Norrington-Davies, G. (2011, March). *Climate Change Financing and Aid Effectiveness Cameroon Case Study*. Retrieved September 17, 2012, from The Organisation for Economic Co-operation and Development (OECD): <http://www.oecd.org/dac/environment-development/48458409.pdf>
- NWCC. (2010). *Wind Turbine Interactions with Birds, Bats, and their Habitats: A Summary of Research Results and Priority Questions*. Retrieved July 22, 2012, from National Wind Coordinating Collaborative: [http://www1.eere.energy.gov/wind/pdfs/birds\\_and\\_bats\\_fact\\_sheet.pdf](http://www1.eere.energy.gov/wind/pdfs/birds_and_bats_fact_sheet.pdf)
- O'Sullivan, M., Edler, D., Bickel, P., Lehr, U., Peter, F., & Sakowski, F. (2013, March). *Beschäftigung durch erneuerbare Energien in Deutschland: Ausbau und Betrieb - heute und morgen, zweiter Bericht zur Bruttobeschäftigung: Bruttobeschäftigung durch erneuerbare Energien in Deutschland im Jahr 2012*. Retrieved November 11, 2013, from Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit (BMU): [http://www.erneuerbare\\_energien.de/fileadmin/Daten\\_EE/Dokumente\\_\\_PDFs\\_/bruttobeschaeftigung\\_ee\\_2012\\_bf.pdf](http://www.erneuerbare_energien.de/fileadmin/Daten_EE/Dokumente__PDFs_/bruttobeschaeftigung_ee_2012_bf.pdf)
- O'Sullivan, M., Edler, D., Bickel, P., Lehr, U., Peter, F., & Sakowski, F. (2014, May). *Beschäftigung durch erneuerbare Energien in Deutschland: Ausbau und Betrieb - heute und morgen, dritter Bericht zur Bruttobeschäftigung: Bruttobeschäftigung durch erneuerbare Energien in Deutschland im Jahr 2013*. Retrieved June 2, 2014, from Bundesministerium für Wirtschaft und Energie (BMWi): [http://www.erneuerbare\\_energien.de/fileadmin/Daten\\_EE/Dokumente\\_\\_PDFs\\_/bruttobeschaeftigung\\_ee\\_2012\\_bf.pdf](http://www.erneuerbare_energien.de/fileadmin/Daten_EE/Dokumente__PDFs_/bruttobeschaeftigung_ee_2012_bf.pdf)

- Ossono, E. N. (2014, January 24). *Electricity in Cameroon – What is the way forward?* Retrieved June 11, 2014, from The Denis & Lenora Foretia Foundation: <http://www.foretiafoundation.org/wp-content/uploads/2014/01/ELECTRICITY-IN-CAMEROON.pdf>
- Palencia, R. (2012, August 28). *New Winds for Central America: Renewables Get a Boost in Panama*. (ReVolt) Retrieved December 20, 2014, from ReVolt: <http://blogs.worldwatch.org/revolt/new-winds-for-central-america-renewables-get-a-boost-in-panama/>
- Pineau, P.-O. (2002). Electricity sector reform in Cameroon: is privatization the solution? *Energy Policy*, 30, pp. 999–1012.
- Pineau, P.-O. (2005). Transparency in the dark: an assessment of the Cameroonian electricity sector reform. *International Journal of Global Energy Issues*, 23(2/3), pp. 133-168.
- Plumert, J. M., Kearney, J. K., Cremer, J. F., & Recker, K. (2005, July). Distance Perception in Real and Virtual Environments. *ACM Transactions on Applied Perception*, 2(3), pp. 216-233. Retrieved March 12, 2015, from [http://delivery.acm.org/10.1145/1080000/1077402/p216-plumert.pdf?ip=141.43.162.179&id=1077402&acc=ACTIVE%20SERVICE&key=2BA2C432AB83DA15%2E6F6E882F5B0ABB9A%2E4D4702B0C3E38B35%2E4D4702B0C3E38B35&CFID=675449922&CFTOKEN=23453595&\\_\\_acm\\_\\_=1431948046\\_8b3711ebcd2](http://delivery.acm.org/10.1145/1080000/1077402/p216-plumert.pdf?ip=141.43.162.179&id=1077402&acc=ACTIVE%20SERVICE&key=2BA2C432AB83DA15%2E6F6E882F5B0ABB9A%2E4D4702B0C3E38B35%2E4D4702B0C3E38B35&CFID=675449922&CFTOKEN=23453595&__acm__=1431948046_8b3711ebcd2)
- Pöttsch, T. (2010, March 7). Sonnenwalde bekommt einen Windpark: Windmüller locken mit attraktiven Angebot. *Lausitzer Rundschau/Finsterwalder Rundschau*, p. 20.
- Ratzbor, G. (2011). Naturschutzfachliche Grundlagen zu naturschutzrechtlichen Entscheidungen. In E. Brandt, *Das Spannungsfeld Windenergieanlagen - Naturschutz in Genehmigungs- und Gerichtsverfahren* (pp. 37-66). Berlin: BWV . Berliner Wissenschafts-Verlag.
- Rehwald, F. (2013, April 10). Press Officer; Enercon. (E. Wanki, Interviewer) Hannover.
- Reichelt, T. (2010, September 15). *Windkraft hier und überall*. Retrieved March 8, 2011, from Nachrichten Potsdam-Mittelmark: <http://www.pnn.de/pm/329828/>
- REN21. (2014). *The First Decade: 2004-2014. 10 Years of Renewable Energy Progress*. Retrieved March 30, 2015, from Renewable Energy Policy Network for the 21<sup>st</sup> Century e.V. : [http://www.ren21.net/Portals/0/documents/activities/Topical%20Reports/REN21\\_10yr.pdf](http://www.ren21.net/Portals/0/documents/activities/Topical%20Reports/REN21_10yr.pdf)
- Rice, J. A. (2006). *Mathematical Statistics and Data Analysis* (3<sup>rd</sup> ed.). Belmont: Duxbury Press.
- Rietzel, R. (2010, November 11). Head of the Oderland-Spree Regional Planning Board. (E. Wanki, Interviewer) Beeskow.
- Runci, P. (2005). *Renewable Energy Policy in Germany: An Overview and Assessment*. Maryland: Joint Global Change Research Institute. Retrieved March 13, 2010, from <http://www.globalchange.umd.edu/data/publications/PNWD-3526.pdf>
- Salje, P. (2008). *EEG: Gesetz für den Vorrang Erneuerbarer Energien: Kommentar*. (5<sup>th</sup> ed.). Köln: Carl Heymanns Verlag.
- Salje, P. (2014). *EEG 2014: Gesetz für den Vorrang Erneuerbarer Energien: Kommentar*. (7<sup>th</sup> ed.). Köln: Carl Heymanns Verlag.
- Schmidthals, M., Manjock, A., Twele, J., & Rathgeber, M. (2013, November). *Windenergie: Messung der Leistung und Bestimmung der Wirkungsgrade von Windenergieanlagen*. (BWE, Ed.) Retrieved February 19, 2014, from BWE: Publikationen: <http://www.windenergie.de/sites/default/files/download/publication/windenergie-unterrichtseinheit-physik/physikbroschuere.pdf>

- Schweizer-Ries, P., Zoellner, J., & Rau, I. (2011). Beteiligungsprozesse und Entwicklungschancen für Kommunen und Regionen. In F. E. (FVEE), *Transformationsforschung für ein nachhaltiges Energiesystem* (pp. 138-144 ). Berlin: FVEE. Retrieved September 29, 2013, from <http://www.fvee.de/fileadmin/publikationen/Themenhefte/th2011-2/th2011.pdf>
- Storm, P.-C. (2011). *Umweltrecht: wichtige Gesetze und Verordnungen zum Schutz der Umwelt*. 22. Auflage. Munich: Deutscher Taschenbuch Verlag.
- Tacke, F. (2004). *Windenergie. Die Herausforderung, Gestern-Heute-Morgen*. Frankfurt/Main: VDMA-Verlag.
- Thies, F. (2010, March 17). EU Energy Policy Adviser; Greenpeace. (E. Wanki, Interviewer) Berlin.
- UBA. (2013, October). *Emissionsbilanz erneuerbarer Energieträger Bestimmung der vermiedenen Emissionen im Jahr 2012*. Retrieved December 24, 2013, from [umweltbundesamt: http://www.umweltbundesamt.de/sites/default/files/medien/378/publikationen/climate\\_change\\_15\\_2013\\_emissionsbilanz\\_erneuerbarer\\_energietraeger.pdf](http://www.umweltbundesamt.de/sites/default/files/medien/378/publikationen/climate_change_15_2013_emissionsbilanz_erneuerbarer_energietraeger.pdf)
- Übertragungsnetzbetreiber. (2013, February 20). *EEG-Umlage 2013*. Retrieved May 27, 2013, from Informationsplattform der Deutschen Übertragungsnetzbetreiber: <http://www.eeg-kwk.net/de/EEG-Umlage.htm>
- UEIA. (2013, December 3). *Future world energy demand driven by trends in developing countries*. Retrieved May 20, 2014, from U.S. Energy Information Administration (UEIA): <http://www.eia.gov/todayinenergy/detail.cfm?id=14011>
- UNFCCC. (2006, March 30). *Report of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol on its first session, held at Montreal from 28 November to 10 December 2005 (FCCC/KP/CMP/2005/8)*. Retrieved August 11, 2011, from United Nations Framework Convention on Climate Change: <http://unfccc.int/resource/docs/2005/cmp1/eng/08.pdf>
- UNFCCC. (2009, December). *Copenhagen Climate Change Conference - December 2009*. Retrieved January 30, 2014, from UNFCCC: [http://unfccc.int/meetings/copenhagen\\_dec\\_2009/meeting/6295.php](http://unfccc.int/meetings/copenhagen_dec_2009/meeting/6295.php)
- UNFCCC. (2011, September). *Fast facts & figures*. Retrieved May 11, 2013, from United Nations Framework Convention on Climate Change: [http://unfccc.int/essential\\_background/basic\\_facts\\_figures/items/6246.php#convention](http://unfccc.int/essential_background/basic_facts_figures/items/6246.php#convention)
- UNFCCC. (2015, December 12). *Adoption of the Paris Agreement*. Retrieved February 1, 2016, from UNFCCC: <http://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf>
- von Hauke, S. (December 2011). Raumordnung für die Windkraftnutzung an Land: Ausbau erfordert neue Rahmenbedingungen. *Die Öffentliche Verwaltung-DÖV*, 64(23), S. 915-921.
- VZBV. (2013 , August 12). *Verbraucherinteressen in der Energiewende: Ergebnisse einer repräsentativen Befragung*. Retrieved September 21, 2014, from Verbraucherzentrale Bundesverband: [http://www.unendlich-viel-energie.de/fileadmin/content/Presse/Ergebnisse\\_forsa09.pdf](http://www.unendlich-viel-energie.de/fileadmin/content/Presse/Ergebnisse_forsa09.pdf)
- Walter, G., Krauter, S., & Schwenzer, A. (2011, March). Erfolgsfaktoren für die Akzeptanz von ErneuerbareEnergie-Anlagen. *Energiewirtschaftliche Tagesfragen, Heft 3* (61. Jahrgang), 47-50. Retrieved June 30, 2013, from [http://www.et-energie-online.de/Portals/0/Jahresinhaltsverzeichnis/jahresinhalt\\_2011.pdf](http://www.et-energie-online.de/Portals/0/Jahresinhaltsverzeichnis/jahresinhalt_2011.pdf)
- Wanki, E. A., & Zschiegner, A. (2014). The Renewable Energy Resource Act (EEG) as German Way of a Future-Oriented Energy Policy Change. In E. Albrecht, M. Schmidt, M. Mißler-



- Behr, & S. P. Spyra (Eds.), *Implementing Adaptation Strategies by Legal, Economic and Planning Instruments on Climate Change* (pp. 279-304). Berlin, Heidelberg: Springer-Verlag.
- WBGU. (2009). *Climate Change: Why two degree centigrade? Factsheet no. 2*. Berlin: WBGU.
- Wirth, H. (2015, January 7). *Recent Facts about Photovoltaics in Germany*. Retrieved April 21, 2015, from Fraunhofer Institute for Solar Energy Systems ISE:  
<http://www.ise.fraunhofer.de/en/publications/veroeffentlichungen-pdf-dateien-en/studien-und-konzeptpapiere/recent-facts-about-photovoltaics-in-germany.pdf>
- World Bank. (2011, September). *Cameroon's Infrastructure: A Continental Perspective. Policy Research Working Paper 5822*. Retrieved May 22, 2012, from World Bank:  
<http://elibrary.worldbank.org/doi/pdf/10.1596/1813-9450-5822>
- World Bank. (2012, March 1). *Project Appraisal Document: Cameroon - Lom Pangar Hydropower Project. Report No: 67174-CM*. Retrieved May 22, 2013, from World Bank:  
<http://siteresources.worldbank.org/INTCAMEROON/Resources/LPHP-PAD-Mar2012.pdf>
- World Bank. (2014). *World Development Indicators: Cameroon*. Retrieved June 14, 2014, from The World Bank Group.: <http://data.worldbank.org/country/cameroon>
- World Economic Forum. (2013, October). *Energy Harnessing: New Solutions for Sustainability and Growing Demand*. Retrieved December 2, 2013, from World Economic Forum:  
<http://www.weforum.org/reports/energy-harnessing-new-solutions-sustainability-and-growing-demand>
- Wüstenhagen, R., Wolsink, M., & Bürer, M. J. (2007, May). Social acceptance of renewable energy innovation: An introduction to the concept. *Energy Policy*, 35(5), pp. 2683–2691.
- Yogi, G. D., & Kreith, F. (2008). *Energy Conversion*. London: CRC Press.
- Zebisch, M., Grothmann, T., Schröter, D., Hasse, C., Fritsch, U., & Cramer, W. (2005). *Climate Change in Germany: Vulnerability and Adaptation Strategies of Climate-Sensitive Sectors*. Retrieved August 21, 2011, from Federal Environmental Agency (UBA):  
<http://www.umweltbundesamt.de/sites/default/files/medien/publikation/long/2974.pdf>
- Ziemer, C. J., Plumert, J. M., Cremer, J. F., & Kearney, J. K. (2009). Estimating Distance in Real and Virtual Environments: Does Order Make a Difference? *Attention, Perception, & Psychophysics*, 71(5), pp. 1095-1106. Retrieved March 12, 2015, from [http://download-v2.springer.com/static/pdf/35/art%253A10.3758%252FAPP.71.5.1096.pdf?token2=exp=1431951718~acl=%2Fstatic%2Fpdf%2F35%2Fart%25253A10.3758%25252FAPP.71.5.1096.pdf\\*~hmac=30663e93b14259b72d0933eed2fddd9e9b9e49317fe920424b8f99bf4f42486d](http://download-v2.springer.com/static/pdf/35/art%253A10.3758%252FAPP.71.5.1096.pdf?token2=exp=1431951718~acl=%2Fstatic%2Fpdf%2F35%2Fart%25253A10.3758%25252FAPP.71.5.1096.pdf*~hmac=30663e93b14259b72d0933eed2fddd9e9b9e49317fe920424b8f99bf4f42486d)
- Zoellner, J., Rau, I., & Schweizer-Ries, P. (2008, May). *Akzeptanz Erneuerbarer Energien und sozialwissenschaftliche Fragen: Forschungsprojekt der Forschungsgruppe Umweltpsychologie an der Otto-von-Guericke-Universität Magdeburg*. Retrieved September 29, 2013, from Otto-von-Guericke-Universität Magdeburg: <http://edok01.tib.uni-hannover.de/edoks/e01fb09/612638286.pdf>
- Zschesche, M. (2012, November). Assessing project approval procedures as formalised forms of public participation. *International Journal of Ethics of Science and Technology Assessment*, 9, pp. 145–156.

# APPENDIX

## I. QUESTIONNAIRE (original in German language)

Liebe Befragte(r), mein Name ist Emmanuel Wanki, Doktorstudent in Umweltwissenschaften und Verfahrenstechnik an der Brandenburgische Technische Universität, Cottbus-Senftenberg (BTU Cottbus-Senftenberg). Ich forsche auf dem Gebiet der Windenergieakzeptanz im **Land Brandenburg**. Ich wäre sehr dankbar, wenn Sie offen auf die folgenden Fragen antworten. Ihre Antworten sind von große Bedeutung für mein Promotionsvorhaben. Seien Sie versichert, dass alle gesammelten Daten einzig für akademische Zwecke genutzt werden. Vielen Dank im Voraus.

### **A: Demografie** (Bitte Antwort ankreuzen)

1. Geschlecht:

Männlich	Weiblich
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2. Altersgruppe:

18-28	29-38	39-48	49-58	Über 58
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3. Bildungsstand (bitte unterstreichen): **Hauptschule, Realschule, Abitur, Bachelor, Diplom, Masters, Doktor.**

### **B: Neigung zu Windenergie** (Bitte Antwort ankreuzen)

4. Ich halte die Nutzung und Ausbau von Windenergie im Land Brandenburg für...

Sehr wichtig	Wichtig	Weiß nicht	Nicht wichtig
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5. Wie weit ist die nächste Windenergieanlage von Ihrer Wohnung entfernt?

Unter 1000m	1000m		Weiß ich nicht	Über 1000m
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6. Wenn Sie ein Grundstück in einem Windeignungsgebiet hätten, würden Sie den Bau eines Windparks darauf erlauben?

Ja, auf jeden Fall	Ja, unter bestimmten Bedingungen	Ich weiß nicht	Nein, auf keinen Fall
--------------------	----------------------------------	----------------	-----------------------

a) Wenn nein, warum nicht?

Windanlagen machen störende Geräusche	
Windanlagen zerstören die Landschaft	
Windanlagen töten oder unterbrechen die Lebensweise von Vögeln und Fledermäusen	
Moderne Windanlagen sind zu groß für mein Geschmack	
Windanlagen stören die Fernsehempfang	
Ich will einfach keine Windanlagen auf meinem Grundstück	

b) Wenn ja unter bestimmte Bedingungen, welche?

Gegen Nutzungsentgelt	Gegen Anteil am Gewinn	Gegen billigen Strom	Sonstiges
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**C: Nachhaltigkeit** (Bitte Antwort ankreuzen)

7. Würden Sie sich für Ökostrom entscheiden?

Ja	Ich weiß nicht	Nein
----	----------------	------

Wenn nein, warum?

Ökostrom ist zu teuer	
Die Qualität von Ökostrom ist unvorhersehbar	
Ökostrom ist unzuverlässig	
In Ökostrom ist reiner Ökostrom nicht drin	

8. Denken Sie, dass Windenergie eine wichtige Rolle zur Kohlendioxid (CO<sub>2</sub>) Vermeidung spielt?

Ja, sehr wichtig	Ja, ein bisschen	Ich weiß nicht	Nein
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9. Denken Sie, dass Windenergie eine wichtige Rolle in Wirtschaftswachstum der Landes Brandenburg spielt?

Ja	Ich weiß nicht	Nein
----	----------------	------

**D: Politik** (Bitte Antwort ankreuzen)

10. Finden Sie, dass der Auswahlprozess für Windeignungsgebiete gut abgelaufen ist?

Ja	Ich weiß nicht	Nein
----	----------------	------

Wenn nein, warum nicht?

Keine Transparenz	
Mangelnde Information	
Bürgerbeteiligung findet nicht statt	



## Translated English Language Version

Dear respondent, my name is Emmanuel Wanki, a Ph.D. student in Environmental Sciences and Process Engineering at the Brandenburg Technical University, Cottbus-Senftenberg (BTU Cottbus-Senftenberg). I am doing a field survey on the acceptance of wind energy in the state of Brandenburg. I would be very grateful if you respond openly to the following questions. Your answers are of great importance for my PhD project. Rest assured that all data collected would be used only for academic purposes. Thanks in advance.

### **SECTION A: Demographics** (Tick where appropriate)

1. Sex:

Male	Female
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2. Age group:

18-28 Years	29-38 Years	39-48 Years	49-58 Years	Over 58 Years
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3. Level of education (Underline please)

**Hauptschule, Realschule, Abitur, Bachelor, Diploma, Master, Doctor**

### **SECTION B: Respondents Inclination to Wind Energy** (Tick where appropriate)

4. I consider the use and expansion of wind energy in the state of Brandenburg ...

Very important	Important	Not Important	Do not Know
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5. How far is your apartment from the closest windmill?

Less than 1000m	1000m	Do not Know	More than 1000m
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6. If you had a plot in a wind suitable area, would you permit the construction of a wind park it?

Absolutely yes	Yes, with conditions	I don't know	Absolutely No
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a) If your answer to question six is "No", why?

Noisy Noise	
Destroy landscape	
Kills birds & Bats	
Too Large	
Simply dislike WT	

b) If your answer to question six is "Yes, with conditions", which conditions?

Usage Cost	Percentage of Profit	Cheap Electricity	Others
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### **SECTION C: Respondents Perception and Sustainability** (Tick where appropriate)

7. Would you opt for green electricity?

Yes	I don't know	No
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When no, why?

Expensive	
Quality is Unpredictable	
Unreliable	
Not completely friendly	

8. Do you think that wind energy plays an important role in the avoidance carbon dioxide (CO<sub>2</sub>) emissions?

Yes, very important	Yes, a bit	I don't know	No
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9. Do you think that wind energy plays an important role in the economic growth of the State of Brandenburg?

Yes	I don't know	No
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**SECTION D: Policy Approach** (Tick where appropriate)

10. Do you think that the selection process for wind suitable areas is executed properly?

Yes	I don't know	No
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When no, why?

No transparency	
No information sharing	
No participation of citizens	

## **II. QUESTIONS OF INTERVIEW (original in German language)**

1. Welches Potential sehen sie für den weiteren Ausbau der Onshore-Windenergie vor dem Hintergrund der Ausbauziele der Bundesregierung?
2. Wie viele Kraftwerke werden in der kommenden Jahrzehnt jährlich und mit welcher Kapazität stillgelegt
3. In welcher Höhe lassen sich negative externe Kosten infolge des Energieverbrauchs für die Verstromung auf Basis von Kohle, Mineralöl und Erdgas beziffern?
4. Wie bewerten sie den Umstand, dass die EEG-Umlage unweigerlich ansteigt, wenn der Börsenpreis für Strom infolge vermehrter Einspeisung von Strom aus erneuerbaren Energien sinkt, und wie, deine Meinung nach, wird dieser Effekt am besten im Rahmen der Begrenzung der Umlagen Höhe berücksichtigt werden kann?
5. Welche Maßnahmen kann die Bundesregierung ergreifen, um Verbraucher stetig und detailliert über die tatsächlichen entstandenen Kosten der Energiewende zu informieren.
6. Wie schätzen sie die Entwicklung der EEG-Umlage für die kommende Jahre ein
7. Wie schwere ist es und was sind die größten Herausforderungen, eine Fläche in den Regionalplan zu integrieren?
8. Welche Kriterien nutzen Sie zum Identifizieren potentieller Windeignungsgebiete?
9. Was sind die größten Herausforderungen beim Ermitteln von Windeignungsgebiete?
10. Was sind die größten Herausforderungen um eine Genehmigung zu erhalten?
11. Wie wichtig ist die lokale Bevölkerung in das Projekt mit ein zu beziehen?
12. Was halten sie von den aktuellen energiepolitischen Rahmenbedingungen des deutschen Bundes Regierung?
13. Was denken Sie, wie wichtig ist Onshore-Windenergie für Deutschland?

## Translated English Language Version

1. Which potentials exist for the further expansion of onshore wind energy, in the context of the expansion targets of the Federal Government?
2. How many conventional power plants will be decommissioned in the next decade and with what capacity?
3. How do you quantify the negative external costs for energy generation from coal, oil and natural gas?
4. How do you assess the fact that the EEG surcharge inevitably increases when the market price for electricity, because of increased supply of electricity from renewable energy sources, decreases and how, in your opinion, can this effect be taken into account when trying to cap the EEG surcharge?
5. What steps can the federal government take in order to inform continuously consumers about the actual costs incurred by the energy transition?
6. How do you evaluate the development of the EEG surcharge for the coming years?
7. How difficult is it, and what are the biggest challenges in integrating an area in the regional plan?
8. What are the criteria you use for identifying potential areas suitable for wind?
9. What are the biggest challenges in determining suitable areas for wind?
10. What are the biggest challenges to get a permit?
11. How important is it to integrate the local population in a wind energy project?
12. What do you think of the current energy policy of the German government?
13. How important is onshore wind energy for Germany?