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INCUMBENTS IN THE GERMAN ENERGY TRANSITION

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Abstract

This paper was led by the question: 'To what extent did energy producers in Germany alter their business strategy according to the preferences of the German 'Energiewende' between 2000 and 2016?' Primarily, it was to outline the energy producers' business strategy as a result to the Energiewende within 2000 and 2016 within a comparative case study of the 'big four' electricity producers RWE, E.On, EnBW and Vattenfall.

Information and data collection was be done including the use of qualitative methods, especially with regard to interviewing techniques, existing knowledge and company data from incumbents' annual reports. This study generated new background material, while evaluating the time span between 2000 and 2016. It showed how far energy producers in Germany have been taking steps to alter their original business strategy as an effect of the set resource portfolio drawn from the energy transition.

Theory expected a causal relation between the Energiewende and business strategy, which could be confirmed for the cases. The Energiewende was a cause for changes in the incumbents' business strategy to a *great extent*. This is especially true, when stating a conclusion on the evaluation of all stated expectations. The Energiewende was responsible for innovation in incumbents' business strategy to a *certain extent*. The transition was responsible for pressures to address the transition's core elements to the *most significant extent* (increasing the share of renewables, decreasing CO2 emissions, phasing out of nuclear energy and increasing energy efficiency in Germany). Furthermore, with regard to entrepreneurial decision-making, the Energiewende was responsible for increased economic risks and costs to the *most significant extent.* In addition, the Energiewende was responsible for regulatory uncertainties and missing planning reliability to a *great extent*.

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1. Background

The German energy transition, the so-called 'Energiewende', was originally launched in 2000 in order to expand the share of renewable energies. After 2000, the transition concept has been changed and extended several times. Fossil and nuclear resource bases needed to change to renewables in order to make electricity supply sustainable.

The policy ambitions of the Energiewende will lead to structural changes in electricity supply which will seriously affect activities of current stakeholders. As part of the German economy, especially electricity producers were affected. So far, they have been concentrating on the production of electricity involving nuclear energy and fossil fuels. Within the energy transition, however, a business strategy focusing on those resources only will not be feasible anymore, but had to take into account the regulations introduced by the German government. Between 2000 and 2016, new targets have been set within the Energiewende. The formulated ambitions and announced changes similarly called for action. However, it was to the incumbents how to respond to the set targets.

This paper concentrates on the topic of incumbents in the German energy transition. It addresses how electricity providers made changes or not to their business strategy in the context of the German energy transition within the mentioned time frame. The research presented here will concentrate on a comparison of four companies' business strategy: the 'big four' German electricity producers RWE, E.On, EnBW and Vattenfall. Within ongoing transitions in the electricity sector, this research focusses on the problem of business strategy of incumbent electricity producers in the context of the German Energiewende. Companies on the one hand had to act on legally binding environmental targets and guidelines according to the Energiewende, whereas, on the other hand, they had to operate efficiently in producing electricity. The question is did they manage to balance both requirements and if not, why. So the the incumbents' strategic behavior plays a central role in how they responded to the ambitions and requirements of the Energiewende.

Research has been evaluating many aspects of the Energiewende, as it is a topic of major interest not only for German scholars, but all around the world. Especially the more general topic of energy transition is a highly debated one. Research in this context is, however, lacking to discuss business strategy change of incumbents. Academic literature rather focuses on electricity security, supply, emerging electricity companies and newly introduced technology. This paper will focus on the business strategy part of the Energiewende. It is of high academic relevance, as it addresses this gap within literature.

This paper analyzes the altering of business strategy of incumbents within the German Energiewende, and relies on an explanatory empirical question:

To what extent did energy producers in Germany alter their business strategy according to the preferences of the German 'Energiewende' between 2000 and 2016?'

In order to fully answer the main research question, all relevant sub-aspects have to be covered. These aspects can be constituted within the following sub-questions, that are later on being connected:

(1) *What are changing targets of the German energy transition that evolved between 2000 and 2016?*
(2) *What are the relevant aspects of business strategy of the incumbents given the answers on research question 1?*
(3) *According to the Energiewende's targets, what has been the 'big four's changing business strategy between 2000 and 2016?*

Research closely examines the relation between both variables, the German 'Energiewende' (y) and the energy producers' business strategy (x). The latter, business strategy, relates to incumbents' choice of applied production technology, their vision and goals, as well as the implementation of those. Concerning the independent variable, this study focuses on the electricity part of the Energiewende. For climate change reasons, electricity production needs to switch to renewable energies. Focusing on this change, this paper analyzes the change (or not) from the incumbents to renewables with respect to business strategy. In particular, it is focused on strategies developed by incumbent actors between 2000 to 2016.
This thesis starts off with a theoretical background on energy transition and the concept of business strategy (in a changing environment). In order to later examine on the topic of incumbents in the German Energiewende, one is then discussing theory on the relationship between energy transition and the business strategy of energy incumbents. Finally, derived expectations are being stated. Within the data section of this paper, the study's operationalization, data collection method as well as its analysis is to be presented. The analyses itself is focused on an assessment of the changing targets of the German energy transition, the relevant aspects of business strategy of the incumbents and the relationship between energy transition and business strategy of energy incumbents. Within the latter, all previously stated expectations are being taken into account. The thesis closes with the conclusion, where the research question is to be answered.

2. Theory

Theory relevant to the topic on incumbents in the German energy transition relates to transition research as well as strategic management. Both approach are to be set in the context of sustainable development, which emphasize system innovation. Theory takes into account the relation between incumbents' business strategy and the German energy transition. Though it misses to specifically address the topic with regard to the changes made to the Energiewende over time.

While analyzing German transition policy, detailed insights into strategy transformation can are put forward within this research. Theoretical relevance is addressed when it comes to generating new background material evaluating the time span between 2000 and 2016. Involving the use of interviewing techniques, newly created data is added to existing literature.

Furthermore, also social relevance is taken into consideration within this paper. Electricity is an essential within developed countries, such as Germany. Its proper provision and security is highly important not only for the economy, but also for all other aspects of life. Transitions in the electricity sector therefore have high impact on society as well as other economic sectors. Especially when it comes to implementing the Energiewende's regulations into practice, it is the electricity producers turn to act. Earlier empirical findings focused on incumbents' strategic behavior only on a limited scale. Within a comparative case study, this research refers to the 'big four' incumbent electricity producers: RWE, E.On, EnBW and Vattenfall. With that, cases can be examined in-depth while using theory as foundation for interpretation. The topics relevant for this study are energy transition, business strategy (in a changing environment), as well as the relationship between energy transition and business strategy of energy incumbents.

2.1 Energy transition

Concerning the German Energiewende, one can refer to the more general concept of energy transition. Within this research, energy transition is understood as a transformation challenging global warming, that is shaped by developing decarbonization approaches within the energy system. One approach realizing this can be the creation of a sustainable power industry. (Luderer, 2012) It is politics that is in charge of legislative competence to framework a sustainable industry. In order to do so, targets and key actions regarding service security, competitive ability and environmental safety are to be introduced. (Kiyar, 2014)

The German Energiewende, that is being discussed within this paper, can be explained by the suggested features of an energy transition. The energy sector in Germany is highly regulated, whereas most responsibility rests upon the German government. Therefore, a mixture of stakeholders of the German energy sector are involved in the transition. With regard to the Energiewende, measures of decarbonization and the development of renewables have been introduced and changed over time. (Kiyar, 2014)

2.2 Business strategy (in a changing environment)

With regard to incumbents' strategic behavior and responses to the ambitions and requirements of the Energiewende, it is crucial to comprise the concept of business strategy.

Focusing on business strategy in a changing environment, primarily one needs to define 'business strategy' itself. In this study it is handled as '(…) ways that organizations define (to) approach (…) product-market domains and (to) construct structures and processes to achieve competitive advantage (Olson, Slater, & Hult, p.51).' Business strategy is to be distinguished between two dimensions: the entrepreneurial and the administrative/ technical dimension. The entrepreneurial dimension hereby includes the creation of customer value and defining the scope of market coverage. That relates to one major economic purpose of business strategy: profit-making. (Foxon, 2011) Though, this study distinguishes business strategy from 'business model' as the previous one being selected rather carefully. (Teece, 2010)

The concept of business strategy is understood to play a dominant role within a changing environment. Here, one can refer to innovation theory, whereby innovation in business strategy is assumed to include '(…) trial and error as well as ex-post adaptation (Richter, 2013).' In particular, the readaption in line with a company's external environment is another feature of innovation. In case much uncertainty and bounded rationality exists, profit-maximization is rather substituted by profit-orientation. Any possible economic losses can be decreased, if companies are assured of their strategy's future value. (Barney, 1986) The information that is necessary to do so can be derived either from analyzing one's competitive environment, organizational skills, or capabilities that are already in possession.

2.3 Relationship between energy transition and business strategy of energy incumbents

Theory states, that as a consequence of establishing greenhouse gas controls in order to fight climate change, also a market transition will develop (Hoffmann, 2005). Foxon (2011) mentions '(…) ecosystems, technologies, institutions, business strategies and user practices as key coevolving systems relevant for analysis of a transition to a sustainable low-carbon economy.' Altering any of these dimensions can ultimately result in developing causal influences (p. 2261-2263).

This research values the relationship between energy transition and business strategy of energy incumbents as interdependent. As the energy sector is highly regulated, also its market is very dependent on the set regulations. Policy is evaluated as having a great effect on entrepreneurial decision-making, while setting requirements on energy transition. Set targets are to be taken up by the energy companies within a voluntary cooperative approach. However, companies have to show abidance to the law, even though these intervene business strategy. Otherwise sanctions will limit entrepreneurial action of incumbents. (Kiyar, 2014) The influence of the energy transition on businesses strategy can be explained by taking into account particular effects on incumbents' strategic behavior, as described in the following.

Concerning innovation theory, '(…) a transition to a low carbon energy system will involve the innovation and deployment of low carbon technologies, business strategies relating to investment in these technologies, and market and regulatory frameworks that encourage such investment' (Foxon, p. 2265). Newly introduced business strategies involve incorporating rather environmental friendly and renewable energy sources. Incumbents found new corporations for the increased power efficiency and the development of renewables. Alternatively this can even result in adopting a completely new technology.

The Energiewende, implies the emergence of a two-sided business strategy: '(…) the divestment of fossil-based production (as well as) growth and investment in renewable production. (p. 9630-33)' Business strategy therefore incorporates '(…) operat(ing) conventional power stations as long as possible, but at the same time build(ing) up assets and knowledge in the field of renewable generation and other emerging markets within the energy industry' (Richter, p.1227-1228). As affordable large scale storage of electricity is still missing, fossil resources are expected to remain as a backup within the German resource portfolio. The companies will then most likely be able to offer spare provisions of traditional energy sources. (Frankfurter Allgemeine Zeitung, 2016)

However, it is essential that business strategy similarly secures present as well as future operations. Increased economic risks and costs affect incumbents' business strategy with regard to entrepreneurial decision-making. According to theory, only companies that do respond to a changing environment and stick to the set regulations of the Energiewende will be in an advantageous position. (Hoffmann, 2005)

Next to triggering innovation in technology and services, incumbents are also expected to develop and implement new rules and routines. (Wassermann, Reeg, & Nienhaus, 2015) Theory by Kiyar (2014) elaborates, that companies mainly respond with developing scenarios and predictions, that are comparable to each other. Therefore, also a detailed analysis of the political situation is of major importance. As the German energy transition's policy framework is lacking in planning reliability and investment incentives, incumbents might switch to other markets. Countering long investment periods, companies will decide on conservative assumptions or even within a wait-and-see attitude.

Regulatory uncertainties are estimated to be implied by the transition. These have an effect on incumbents' planning reliability. Companies therefore face economic risks that imply increased economic costs. Consequently, huge price increases will be an answer of business strategy. (Beveridge & Kern, 2013) Also, price volatility and lacking investment incentives will have an effect on incumbents' strategies. Rather, investment pressures in renewables are a result from the planned expansion of the renewable sector. (Kiyar & Wittneben, 2015)

2.4 Expectations

The here presented theoretical arguments are useful for developing expectations about this research's results. As derived from theory, one expects to find a causal relation between the Energiewende and business strategy. In order to catch the impact of the Energiewende on business strategy of the incumbents, the

following expectations can be falsified within this empirical research:

1. The Energiewende calls for innovation in incumbents' business strategy.
2. Under the Energiewende, incumbents face pressures to address the transition's core elements: Increasing the share of renewable resources in electricity production in Germany, decreasing CO2 emissions in Germany, phasing out of nuclear energy in electricity production in Germany and increasing energy efficiency in Germany
3. The Energiewende affects business strategy of incumbents with regard to entrepreneurial decision-making (increased economic risks and costs).
4. The development of regulatory uncertainties implied by the energy transition has an effect on incumbents' planning reliability.

This section concentrated on the theoretical background relevant for answering the research question. First, theory on energy transition (2.1) and the concept of business strategy (in a changing environment) (2.2) was being discussed. After that, passage 2.3 examined theory on the relationship between energy transition and the business strategy of energy incumbents. In the last part, 2.4, derived expectations were stated in order to be further examined on within this paper's analyses section.

3. Data/Documents

This section covers a description of all relevant data. By starting off with the operationalization, this study's research design is being addressed. Furthermore, one continues with presenting all methods of data collection. Finally, data analysis leads into the analyses part of this paper.

3. 1 Operationalization

Research covers a comparative case study design that is manifested to be non-experimental. The approach of a case study investigates a phenomenon in its real-life context. It provides new in-depth details and individual aspects, whereas data collection is highly guided by prior theory. More specifically, this case study includes a comparison of several cases, which are being selected on purpose and with an analytical focus. The weakness of such an approach is the existence of many variables contrasting to only a small number of cases. In order to reduce the amount of variables, one chose similar cases. Also, cases were chosen systematically and in accordance to theory. Though, sorting out rival explanations remains an obstacle within comparative case study design. Its strengths, however, allow an intensive analysis, that provides much more details than a rather general statistical analysis. (Lijphart, 1971)

The comparative case study design includes purposeful sampling within case selection. The cases that are selected are rich in information and offer great details on the topic of interests. Since covering all energy producers in Germany would not be feasible within an in-depth case study, incumbents' behavior can be examined more closely by selecting four specific cases. These are the 'big four' energy producers in Germany: RWE, E.On, EnBW and Vattenfall. They are in the center of this study, since they are the market leaders within energy production. Compared to the remaining population of German energy companies, the big four add up a huge market share. Together, they controlled 84% of power plant capacity and 86% of energy production within German energy supply in 2011. (Schiffer, 2011) As Figures 1 and 2 visualize, the big four own most of power generation from conventional stations, of power generation capacity and of the German market share. Also, their number of employees is huge. (Appunn & Russell, 2015)

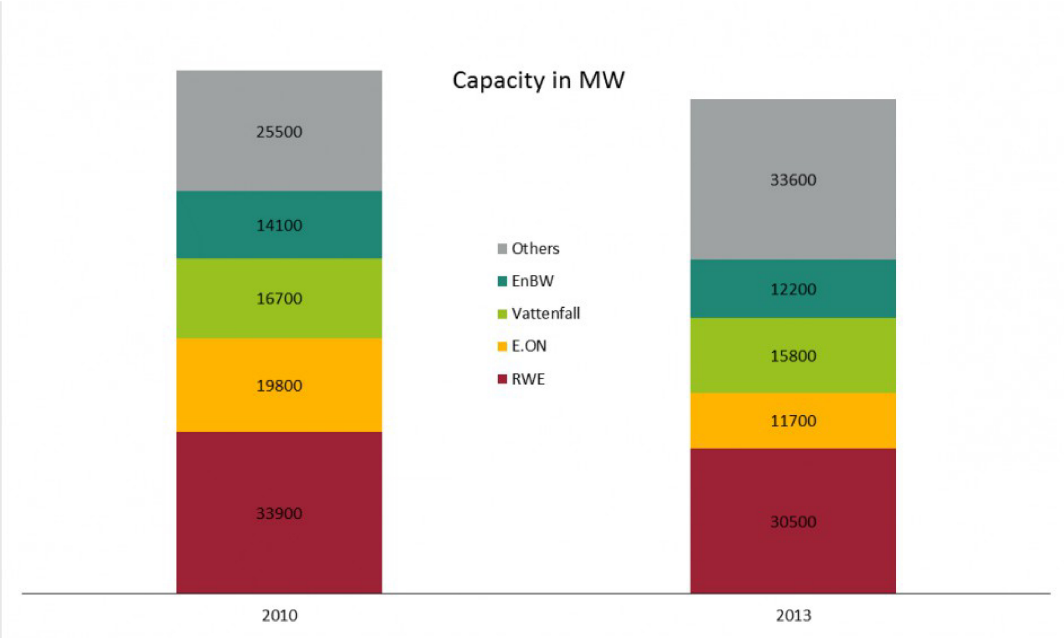

Figure 1 - Conventional power generation capacity of the four biggest German power producers 2010 and 2013.

Source: https://www.cleanenergywire.org/factsheets/german-utilities-and-energiewende

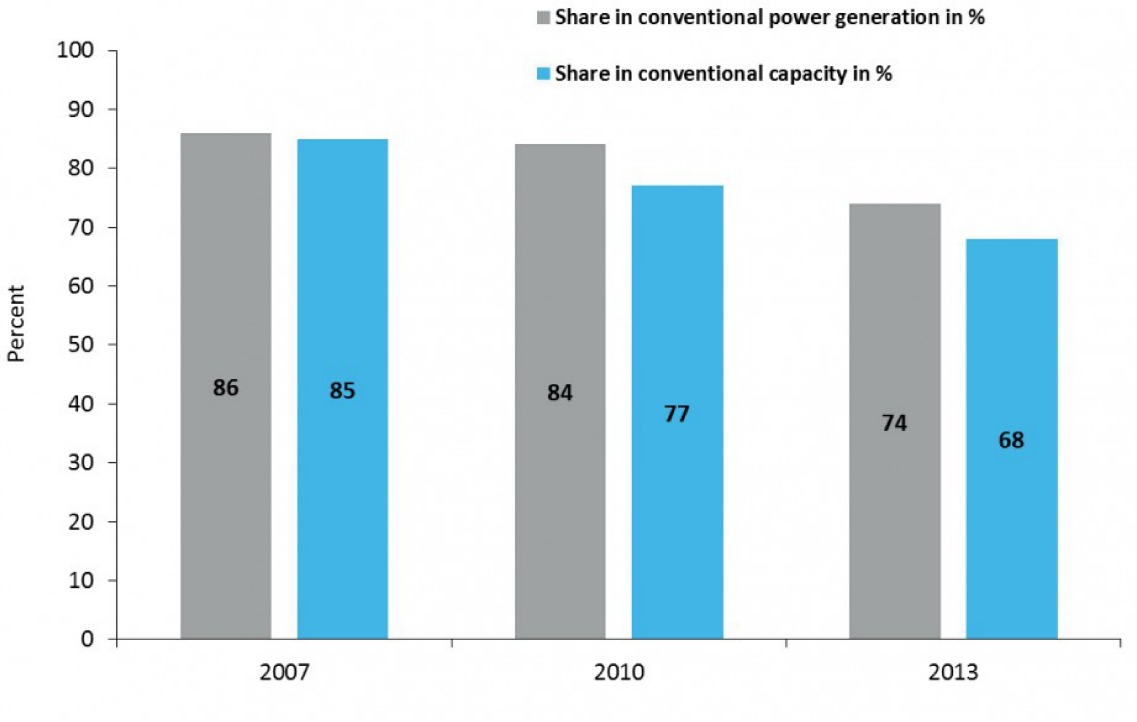

Figure 2 - Accumulated shares of the four largest utilities (RWE, E.ON, EnBW and Vattenfall) of the conventional power station capacity and conventional power generation in Germany.

Source: https://www.cleanenergywire.org/factsheets/german-utilities-and-energiewende

The four companies will be studied as individual cases. Since the number of cases is limited and the focus on the German energy sector is specific, generalizability to other sectors or countries is not possible to be undertaken. Rather 'deep data' is generated, revealing information, which is greatly based on the four particular contexts. In order to properly analyze the causal relation, several methods are being undertaken. Primarily, causality will be answered by interviewing representatives of the four companies. Furthermore, one will make use of literature during desk research. That will involve the use of the companies' publications and annual reports, expressing what activities happened at what point of time.
The comparative case study is featured by a longitudinal approach. It involves an analysis of the time frame 2000 to 2016. Primarily, one will distinguish the steps taken in the German transition policy in 4.1 in order to operationalize the independent variable. However, the dependent variable can only be operationalized after having described the content of the transition policy within section 4.1. By answering research question 1, it is then possible to fully operationalize the dependent variable within section 4.2 and measure it along with the relevant aspects of business strategy of the incumbents in section 4.3. When examining businesses strategy, the German energy transition will be considered as the common independent variable. Finally, one will examine the relationship between the German energy transition and the incumbents' business strategy in section 4.4 by comparing the cases' pattern and matching pattern to theory.

3.2 Data collection

Information collection within this research's case study includes the use of qualitative methods, especially with regard to combining desk research and interviewing methods. While using a variety of data types, construct validity is increased. Compatible data sources were combined into one single database. Doing so, the questionnaires were transcribed and coded. All collected data was merged in a way that eventually also translated German into English language.

On the one hand, the analysis involved data collection using existing records and the theory that is being mentioned earlier in this paper. These records were first of all scanned within a content analysis. The desk research focused on a review of literature on the topics that answer the stated sub-questions. In order to analyze the companies' responses in business strategy, the components of the German energy transition have been stated out front. These components were drawn from literature by Buchan (2012), Kiyar & Wittneben (2015), Beveridge & Kern (2013) and Hake (2015).

Moreover, when operationalizing the dependent variable, including 'hard data' was of major importance when it comes to elaborating how business strategy actually altered. This data, for example on electricity production, the share of renewables in turnover and annual profit, or planned investments in renewables, was retrieved from the big four's annual general meetings, their annual reports and other publications. Most data was gathered from the annual reports from the years 2001, 2003, 2005, 2008, 2010, 2011, 2012, 2013 and 2015.

Furthermore, while using interviewing techniques, newly created data was added to existing literature. This was done by sending questionnaires to the incumbent companies. Unfortunately, it was not feasible to conduct face-to-face interviews, as the incumbents could not find a fitting time frame. The persons, who were consulted within the companies were representatives and spokespersons from different divisions, such as from the Senior Management for Board Affairs, the Public Relations Department for Renewable Energy Efficiency, Start-up and Co-investments, or the Management for Energy Economics and Policy.

The framework of the questionnaires were drawn in a structured manner. They incorporated a standardized set of questions that were identical to all four companies. Therefore, comparable data from the individual incumbents could be collected. Consequently, a controlled comparison within a structured way of analysis of the derived answers was enabled. Having examined and interpreted all the answers to the questionnaires, it was possible to connect the derived data to the information from existing literature as well as from the annual reports.

3.3 Data analysis

Data analysis continues with a content description of the integrated data. This research's coding is guided by theory within a deductive approach. In order to properly answer the causality question, all data sources are to be analyzed within the timeline of the Energiewende. Here, the aim is to trace some pattern in the qualitative data. After that, data is to be brought into connection with theory using the method of pattern-matching. Therefore, all previously stated expectations that were derived from theory are to be checked for the individual cases. After that, cases are being compared. Finally, it can be concluded, whether taken steps in the Energiewende influenced business strategy and whether the variables are causally related.

This section covered a description of all relevant data. The first passage, 3.1, covered a detailed operationalization of this study. In 3.2 all relevant data collection methods were stated. Finally, passage 3.3 covered on the approach of data analysis.

4. Analyses

In order to answer the stated research question, all relevant data and documents are being analyzed. First, one refers to the changing components of the German Energiewende to further examine the independent variable. After that, analyses concentrates on the dependent variable, incumbents' business strategy, with an examination of the relevant aspects of business strategy of the incumbents given the answers on research question 1. Finally, changes in the incumbents' strategic behaviour is to be traced in order to then assess the relationship between energy transition and the incumbents' business strategy.

4.1 Changing components of the German energy transition

As there are worldwide efforts undertaken in order to fight global warming, climate targets are being set up. These targets, introduced by the governments, similarly imply a transformation of the energy system towards decarbonization and renewables. The German government is especially involved into activities of the electricity sector, where it is mainly in charge when it comes to setting up a framework for electricity provision regulations. Consequently, the electricity system is intertwined in an interrelation between authorities and private corporations. (Kiyar, p. 122)

The German energy transition policy, the so-called Energiewende, is the major regulatory framework towards an energy transition in Germany. It was launched in 2000 and consists of the following core elements:

- ***Core element 1**:* Increasing the share of renewable resources in electricity production in Germany
- ***Core element 2**:* Decreasing CO2 emissions in Germany
- ***Core element 3**:* Phasing out of nuclear energy in electricity production in Germany
- ***Core element 4**:* Increasing energy efficiency in Germany

While taking into account these core elements, German transition policy, however, incorporated specific changes during time. Between 2000 and 2016 German Governments introduced, amended and extended the energy transition policy. These specific changes within German transition policy, can be categorized within the above described core elements of the Energiewende, as visible in Table 1. In the following passages, the changing targets are further being explained, while the Energiewende's core elements are being used as structuring device. Consequently, one addresses to answer research question 1: 'What are changing targets of the German energy transition that evolved between 2000 and 2016?'

Categorization of specific changes within German transition policy	
	Year of policy
Core element 1	2000, 2004, 2007, 2009, 2010, 2012, 2014
Core element 2	2007, 2010
Core element 3	2002, 2010, 2011
Core element 4	2007, 2010

Table 1 – Categorization of specific changes within German transition policy.
Source: Own

4.1.1 Core element 1: Increasing the share of renewable resources in electricity production in Germany

In *2000*, the Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz (EEG)) set fixed feed-in tariffs (Einspeisevergütung) for electricity from renewable sources. Therefore, the share of renewable energies in German electricity generation had to be increased. These fixed tariffs were decoupled from previous electricity prices and guaranteed for a period of 20 years.

In *2004*, a second amendment to the EEG was introduced to reduce the feed-in tariffs for wind turbines and adjust European legal requirements. (Kiyar & Wittneben, 2015; Beveridge & Kern, 2013; Hake, 2015)
In August *2007* the Integrated Energy and Climate Program (IKEP) was introduced to further develop renewable energies. The share of renewables in electricity generation should be increased to 30 percent. With that, a sustainable, climate-friendly energy supply was aimed at by 2020.
In *2009* the EEG was amended and revised, aiming to substantially slow any further rise in costs, to systematically steer the expansion of renewable energy, and to bring renewable energy more and more to the market. (Kiyar & Wittneben, 2015; Hake, 2015)
In September *2010* the Energy Concept (Energiekonzept) was concluded. Renewables should provide 18% of the gross final energy by 2020 and 60% by 2050. A 20% reduction in primary energy use by 2020 and 50% by 2050 was aimed at. (Beveridge & Kern, 2013; Buchan, 2012)
In *2012* the EEG was again revised to systematically steer the expansion of renewable energy. The share of renewables was projected to reach 40-45 percent by 2025 and 55-60 percent by 2035.
In August *2014* another amendment to the EEG set expansion paths for wind energy, biogas power and solar energy. The monitoring process, 'Energy of the Future', was introduced to observe the development of this transition continuously and in detail. (Kiyar & Wittneben, 2015; Hake, 2015)

4.1.2 Core element 2: Decreasing CO2 emissions in Germany

In August *2007* the Integrated Energy and Climate Program (IKEP) was introduced and stated that German CO2 emissions were to fall by 40 percent. With that, a sustainable, climate-friendly energy supply was aimed at by 2020.

In September *2010* the Energy Concept (Energiekonzept) was concluded. It set a 40% reduction in greenhouse gases emissions by 2020 and 80-95% by 2050 (compared to 1990). (Beveridge & Kern, 2013; Buchan, 2012)

4.1.3 Core element 3: Phasing out of nuclear energy in electricity production in Germany

In *2002*, the Act for the Orderly Termination of the Use of Nuclear Energy for the Commercial Generation of Electricity was developed in order to ban the construction of new commercial nuclear power plants in Germany. The operating time of existing power stations was similarly restricted to 32 years of the station's start-up. Nuclear energy was to be banned by 2022. From 2005 on, the delivery of spent fuel elements for reprocessing and restriction of nuclear waste disposal to final storage was to be banned.
In October *2010* the Atomic Energy Act (AEA) concluded to refuse the 2000 nuclear phase-out. Rather a significant extension (12 years on average) of the lifetimes for nuclear power plants was announced, as the government considered nuclear power to be a "central bridge" for the shift to a sustainable energy supply. The last reactors now would produce electricity until about 2036. The simultaneous introduction of a tax on nuclear fuels for the power utilities was set to finance an Energy and Climate Fund to support renewables. (Beveridge & Kern, 2013; Buchan, 2012)
In March *2011* a nuclear moratorium with reference to precautionary security of the Atomic Energy Act was launched to temporarily shut down the oldest German reactors. The lifetime extension for the German nuclear power plants was suspended for an initial three months. In August 2011 the 13th amendment of the AEA announced a complete phase-out of nuclear power by 2022. (Beveridge & Kern, 2013; Buchan, 2012)

4.1.4 Core element 4: Increasing energy efficiency in Germany

In August *2007* the Integrated Energy and Climate Program (IKEP) was introduced. Energy efficiency was to be increased significantly and the German power plants were to be modernized. With that, a sustainable, climate-friendly energy supply was aimed at by 2020.
In September *2010* the Energy Concept (Energiekonzept) was introduced. It included a 10% reduction in electricity use by 2020 and 25% by 2050, calling for increased energy efficiency. (Beveridge & Kern, 2013; Buchan, 2012)

4.2 Relevant aspects of business strategy of the incumbents

After having examined the German transition policy in the previous section, it is now possible to operationalize the dependent variable: business strategy of the incumbents. Consequently, one addresses to answer research question 2: 'What are the relevant aspects of business strategy of the incumbents given the answers on research question 1?' Overall, business strategy is to provide the incumbent with advantages in facing the market transition. Changes in the incumbents' external environment have to be tackled sufficiently. According to the principle of adaptation, the incumbents' strategy has to cope with external changes and their structure and behavior to follow on the needed requirements. Hence, the aspects relevant for an analyses of business strategy result from assessing internal (organizational structures and arrangements) as well as external factors (customers and the broader business environment). (Teece 2010, p. 192) These are being displayed when examining more general business elements, such as turnover, profit, employees or customers. Also, business innovation, economic risks and costs as well as regulatory uncertainties and missing planning reliability are to be elaborated.

Next to the mentioned rather general aspects, business strategy is to be analyzed according to the integrated core elements of transition policy: First, it suggest an examination of introduced products and technologies producing less greenhouse gases. That similarly reflects on core element 1 and 2.

Relevant aspects of business strategy, Core element 1		
Year of policy	Year of strategy	Aspect of analysis
2000	2001	Fixed feed-in tariffs from renewable sources
2004	2005	Reduced feed-in tariffs for wind turbines
2007	2008	Increased share of renewables to 30 percent; Sustainable, climate-friendly energy supply by 2020
2009	2010	Systematic expansion of renewable energy
2010	2011	Expansion of renewables to 18% by 2020 and 60% by 2050
2012	2013	Renewables reaching 40-45 percent by 2025 and 55-60 percent by 2035
2014	2015	Expansion of wind energy, biogas power and solar energy

Table 2 – Relevant aspects of business strategy of the incumbents, Core element 1.
Source: Own

Within the analysis of incumbents' strategies, one needs to focus on an adaption towards increasing the share of renewable resources in electricity production in Germany in line with *core element 1* (Table 2 above). That includes undertaken changes from fossil fuels and nuclear energy to wind power, biomass, and solar energy. Business strategy of 2001 is to be evaluated on effects of the fixed feed-in tariffs from renewable sources. Strategy following on reduced feed-in tariffs for wind turbines is the aspect of analysis for business strategy of 2005. Another relevant aspect is the support for an increased share of renewables to 30 percent as well as for a sustainable, climate-friendly energy supply by 2020 (business strategy of 2008). The strategy of

2010 needs to be evaluated on a systematic expansion of renewable energy, whereas it is the relevant aspect for business strategy of 2011 to focus on an expansion of renewables to 18% by 2020 and 60% by 2050. Concerning 2013, strategy is to be analyzed with focus on the support of renewables reaching 40-45 percent by 2025 and 55-60 percent by 2035. Moreover, effects on strategy with respect to the expansion of wind energy, biogas power and solar energy is to be elaborated (business strategy of 2015).

Relevant aspects of business strategy, Core element 2		
Year of policy	Year of strategy	Aspect of analysis
2007	2008	40 percent fall in CO2 emissions by 2020; Sustainable, climate-friendly energy supply by 2020
2010	2011	40 percent fall in CO2 emissions by 2020; Reduction of 80-95% by 2050

Table 3 – Relevant aspects of business strategy of the incumbents, Core element 2.
Source: Own

Decreasing CO2 emissions in Germany, *core element 2*, is to be tackled by analyzing business strategy of 2008 and 2011 (Table 3 above). Business strategy is to be in line with the suggested 40 percent fall in CO2 emissions by 2020 (compared to 1990). Moreover, it is to be assessed, if the incumbents supported a sustainable, climate-friendly energy supply by 2020 within their business strategy of 2008. Aspects relevant for examining the business strategy of 2011 again relate to the suggested 40 percent fall in CO2 emissions by 2020. In addition, it is to be traced, if strategy promotes a reduction of 80-95% by 2050.

Relevant aspects of business strategy, Core element 3		
Year of policy	Year of strategy	Aspect of analysis
2002	2002/2003	Banning the construction of new commercial nuclear power plants in Germany; Limited operation of existing power stations to 32 years; Closure of nuclear plants by 2022; Banning of the delivery of spent fuel elements for reprocessing and Restriction of nuclear waste disposal to final storage from 2005 on
2010	2010/2011	Extension of the lifetimes for nuclear power plants, with 12 years on average; Electricity from nuclear plants to remain until 2036; Tax on nuclear fuels
2011	2011/2012	Nuclear moratorium and temporarily shut down of the oldest reactors; Suspension of the three-months lifetime extension for nuclear power plants; Complete phase-out of nuclear power by 2022

Table 4 – Relevant aspects of business strategy of the incumbents, Core element 3.
Source: Own

With respect to *core element 3*, one need to assess on responses to the phasing out of nuclear energy in electricity production within incumbents' business strategy (Table 4 above). Followingly, it is to be traced, if strategy incorporates banning the construction of new commercial nuclear power plants in Germany, the

limited operation of existing power stations to 32 years, the closure of nuclear plants by 2022 and the banning of the delivery of spent fuel elements for reprocessing and restriction of nuclear waste disposal to final storage from 2005 on (business strategy of 2002/2003). Business strategy of 2010/2011 is to include the extension of the lifetimes for nuclear power plants, with 12 years on average. Electricity from nuclear plants can now be stated within strategy to remain until 2036. Also, the tax on nuclear fuels is a relevant aspect when analyzing the incumbent's business strategy of 2010/2011. In 2011/2012, it is to be traced, if the companies reacted to the nuclear moratorium and temporarily shut down the oldest reactors. Also, business strategy of 2011/2012 should incorporate the suspension of the three-months lifetime extension for nuclear power plants. Moreover, the reaction to the complete phase-out of nuclear power by 2022 is an aspect that is to be analyzed within the incumbents' business strategy.

Relevant aspects of business strategy, Core element 4		
Year of policy	Year of strategy	Aspect of analysis
2007	2008	Modernization of German power plants
2010	2011	10% reduction in electricity use by 2020 and 25% by 2050

Table 5 – Relevant aspects of business strategy of the incumbents, Core element 4.
Source: Own

Finally, effects of *core element 4*, increasing energy efficiency in Germany, are to be examined within business strategy (Table 5 above). Here, relevant aspects of strategy are the modernization of German power plants (business strategy of 2008) as well as the support for the 10% reduction in electricity use by 2020 and 25% by 2050 (business strategy of 2011).

4.3 Business strategy of energy incumbents

The policy ambitions in the context of the Energiewende developed structural changes in the electricity sector. Considering this, electricity producers are affected by the numerous regulatory modifications. In order to catch the impact of the Energiewende on business strategy of the incumbents, the stated expectations are to be falsified within this empirical research.

In order to most specifically the incumbents' strategic responses, one incorporates the annual reports of the years after targets have been introduced. Alternatively, if targets could be addressed in incumbents' reports right away, also the annual reports of the exact year of policy are being used. This is done by including the companies' strategies as well as their resource portfolios by taking into account the relevant generating capacities. In addition, one refers to the incumbents' statements within the send questionnaires. Consequently, one addresses to answer research question 3: 'According to the Energiewende's targets, what has been the 'big four's changing business strategy between 2000 and 2016?'

4.3.1 Innovation in incumbents' business strategy

It is expected that the Energiewende calls for innovation in incumbents' business strategy. When examining several elements between 2000 and 2016, all companies agree, that the number of employees, and the number of production sites in Germany and abroad changed over time. Moreover, RWE, EnBW and Vattenfall state changing numbers of industrial and private customers within electricity provision. Furthermore, EnBW suggests that its corporate structure as well as the composition of its shareholders changed over time. (Question 1)

	Number Of employees		**Profit In million**		**Turnover In million**		**R&D budget In million**	
	2000	2015	2000	2015	2000	2015	2000	2015
RWE	152,132	59,762	1,212	-170	47,918	48,599	541	101
E.On	186,788	56,490	2,762	-6,377	93,240	116,218	661	34
EnBw	27,327	20,288	351	124.9	11,400	21,166.5	15	29.9
Vattenfall	13,123	28,567	5,189	-19,766	31,695	164,510	481	422

Table 6 – Incumbents' Number of employees, Profit, Turnover and R&D budget in 2000 and 2015.
*Source: RWE Annual Report 1999/2000 (p.1, p.73, p.46, p.20), 2015 (p.1, p.183); E.On Annual Report 2000 (p.1, p.34), 2015 (p.1); EnBW Annual Report 2000 (p.1, p.25)*in DM, 2015 (p.1, p.37); Vattenfall Annual Report 2000 (p.1, p.21)*in SEK, 2015 (p.5, p.31)*in SEK*

Next to the changes mentioned by the companies, also other elements altered during time. When analyzing

the incumbents' annual reports of 2000 and 2015, also changes in turnover and the budget for R&D can be traced. As shown in Table 6 above, the number of employees decreased for all companies except Vattenfall. Profit as well decreased over time, with respect to all of the incumbents. In 2015 most of the companies were even in debt. Turnover increased for all of the incumbents. When it comes to innovation, budget spent on R&D is most important. Budget altered for all incumbents, with decreased spending for RWE, E.On and Vattenfall. Contrastingly, EnBW raised its R&D budget between 2000 and 2016. Question 2 highlights the significance of the energy transition for changes in the company (1= not significant at all, 10= highly significant). RWE and E.On rate the effect of the Energiewende on changes in the company as 9 out of 10, while EnBW rates it with 8 and Vattenfall with a 10. Hence, all incumbents evaluate the significance as (rather) high. With respect to questions 16 and 17, it was asked, if the companies were in an advantageous position by sticking to the set regulations of the Energiewende. RWE and Vattenfall abstained from answering the question, while E.On and EnBW approved that by sticking to the regulations, their companies were in advantage. E.On explained, that this was enabled due to its 'international experience with different subsidy regulations'. Being involved in the Energiewende's regulatory framework through the membership in professional organizations, like the BDEW, EnBW could also obtain an advantaged position.

Resulting from the transition's core elements, the companies were asked what measures they took in order to keep their earning capacity. Following, with regard to the the core element of increasing the share of renewables, all respondents invested in new capacities, as visible in Table 7 below. E.On, EnBW and Vattenfall invested in onshore and offshore wind. EnBW moreover invested in '(…) direct marketing of renewable energy and virtual power plants as well as in the development of grid infrastructure in order to increase transport capacity of power from Northern to Southern supplies'. With regard to core element two, decreasing CO2 emissions, the RWE mentioned that it developed new products as a result. Also, it invested in new technologies like CCS. E.On and EnBW put forward the measure of finding energy efficiency solutions for industrial customers while EnBW invested in charging infrastructure for electric vehicles and the expansion of gas sector flexible and low emission technology. Vattenfall responded by selling all its coal energy plants. Concerning the third core element, it turned out that EnBW responded to the phasing out of nuclear energy by setting-up experience and know-how in the decommissioning of nuclear power plants. The company also took measures for the receipt of security of energy supplies. RWE, E.On and Vattenfall did not mention any measures. In addition, the core element of increasing energy efficiency was addressed by the companies. RWE described the development of new products for customers as a derived measure. These were for example also investments in charging infrastructure for electric vehicles as well as in low emission technology (EnBW). Once again, energy efficiency solutions were highlighted as consequent measures (E.On, EnBW). EnBW also stated the expansion of the gas sector as derived action. For Vattenfall, energy measures were included in all business areas. (Question 13)

Incumbents' measures to keep their earning capacity				
	Measure			
	RWE	E.On	EnBW	Vattenfall
Core element 1	Investment in new capacities	Investment in new capacities (onshore and offshore wind)	Investment in new capacities (onshore and offshore wind, direct marketing Of renewable energy and virtual power plant, develop-ment of grid Infrastructure)	Investments in wind energy
Core element 2	Developing new products; Investment in new Technologies like CCS	Finding energy efficiency Solutions for Industrial customers	Finding energy efficiency Solutions for industrial customers; Investment in charging infrastructure for electric vehicles and the expansion of gas sector flexible and low emission Technology	Selling all coal Power plants
Core element 3	-	-	Setting-up experience and know-how in the decommissioning of nuclear power plants; Receipt of security of energy supplies	-
Core element 4	Development of new Products	Energy efficiency Solutions	Investments in charging infra-structure for electric vehicles as well as in low emission technology; Energy efficiency solutions; Expansion of the Gas sector	Measures within all Business areas

Table 7 – Incumbents' measures to keep their earning capacity.

Source: Questionnaire, answers to question 13

Finally, the incumbents evaluated on innovation in business strategy as an effects of the targets set by the Energiewende on a scale of 1-4 (1= agree, 4= disagree). All of the companies agreed on the statement. (Question 19)

4.3.2 Pressures to address the transition's core elements

Under the Energiewende, it is expected that incumbents face pressures to address the transition's core elements. Also, a changed resource portfolio in favor of renewables and in disfavor of nuclear energy is expected. When asking for changes in the resource volume for electricity production of the companies between 2000 and 2016, none of the incumbents stated to use peat. All other resources' volume was declared by RWE, EnBW and Vattenfall to have changed over time. (Question 3)

	Nuclear power In %		**Conventional power In %**		**Renewable power In %**	
	2000	2015	2000	2015	2000	2015
RWE	33,50	14,75	62,00	75,42	4,50	9,83
E.On	28,87	28,16	61,14	55,33	9,99	16,51
EnBw	35,98	22,69	37,81	49,46	26,21	27,85
Vattenfall	11,67	1,73	74,93	79,06	13,40	19,21

Table 8 – Incumbents' resource volume for electricity production in 2000 and 2015.
*Source: RWE Annual Report 1999/2000 (p. 65), 2015 (p. 45)*Oil included in renewables/others; E.On Annual Report 2000 (p. 56), 2015 (p. 221); EnBW Annual Report 2000 (p. 36), 2015 (p. 67); Vattenfall Annual Report 2001 (p. 19)*Year 2001 instead of 2000 as Vattenfall AB owned only shares in the Hamburgische Electricitäts-Werke AG (HEW) on the German market, 2015 (p. 164)*Electricity and heat*

When comparing the incumbents' resource volume of 2000 (Vattenfall: 2001) and 2015, certain changes are noticeable in Table 8 above. The share of nuclear power decreased for all energy producers. Especially RWE and Vattenfall decreased their nuclear power volume considerably. Their shares in 2015 were more than half of the original shares in 2000 (Vattenfall: 2001). With respect to the resource volume of conventional power for electricity production, RWE, EnBW as well as Vattenfall mark increasing shares over time. Only E.On's share in conventional power decreased from 2000 to 2015. Concerning shares in renewable power, all incumbents state increasing percentages in 2015 compared to 2000 (Vattenfall: 2001). That is particular true for RWE and E.On, which count about twice as much of the original shares in 2015. In particular, E.On and EnBW agreed on an increase in the volume of wind energy and PV in Question 3. Furthermore, EnBW stated an increase in biomass and a decrease in hydro power over time. Followingly, question 4 incorporates the significance of the energy transition for changes in the energy resources of the incumbents (1= not significant at all, 10= highly significant). All four companies examined the effects on changes in their resources as rather high. RWE scored an 8, E.On a 9 and EnBW and Vattenfall even a 10.

Coming to the German transition policy, specific changes exist between 2000 and 2016, as described in the previous section. However, these core elements are to be individually assessed when it comes to examining the expectations of pressures in renewables.

4.3.2.1 Core element 1: Increasing the share of renewable resources in electricity production in Germany

The share of renewable power in the companies' resource portfolio increased over time, as already discussed in 4.3.2. All incumbents also confirmed, that their shares increased in 2016 compared to 2000. (Question 5) Hereby, it was asked, if the foreseen shares of renewable power in the resource portfolio changed for 2020, 2025 and 2050 under the influence of the energy transition policy. All incumbents approved that foreseen shares of renewable power changed for all three years. (Question 6) Also, the significance of the energy transition for changes in favor of renewables was stated by the incumbents (1= not significant at all, 10= highly significant). They rated it to be rather high, with RWE scoring it with an 8, E.On with a 7 and EnBW and Vattenfall with a 10. (Question 7) Finally, the incumbents evaluated on pressures in renewables as an effects of the targets set by the Energiewende on a scale of 1-4 (1= agree, 4= disagree). RWE, EnBW and Vattenfall agreed on the statement, while E.On tended to disagree that pressures in renewables resulted from the set targets. (Question 19)

When analyzing core element 1 of German transition policy, the following years of strategy and relevant aspects of analysis are being considered:

Relevant aspects of business strategy, Core element 1		
Year of policy	Year of strategy	Aspect of analysis
2000	2001	Fixed feed-in tariffs from renewable sources
2004	2005	Reduced feed-in tariffs for wind turbines
2007	2008	Increased share of renewables to 30 percent; Sustainable, climate-friendly energy supply by 2020
2009	2010	Systematic expansion of renewable energy
2010	2011	Expansion of renewables to 18% by 2020 and 60% by 2050
2012	2013	Renewables reaching 40-45 percent by 2025 and 55-60 percent by 2035
2014	2015	Expansion of wind energy, biogas power and solar energy

Table 2 – Relevant aspects of business strategy of the incumbents, Core element 1.
Source: Own

Incumbents' strategic responses to increasing the share of renewable resources in electricity production in Germany are now being analyzed within the above mentioned years, visible in Table 9 below.

Incumbents' strategic responses to relevant aspects of transition policy, Core element 1	
	Measure
RWE	2001: share renewables 3,50%; first wind farm, plans on biomass 2005: share renewables 9,76%; investments in wind, hydro and biomass 2008: share renewables 9,80%; renewable energy subsidiary RWE Innogy, more than triple its renewable generation by 2012 2010: share renewables 8,23%; 30 % in renewables by 2025, renewable electricity substantially increased by 2014 instead of 2012, extend in wind, biomass, solar thermal power and hydro 2011: share renewables 8,96%; share of renewables to 20 % by 2020, spending about 4 billion from 2012 to 2014, especially wind, biomass and hydro 2013: share renewables 8,48%; invest about €1 billion in renewables from 2014 to 2016, focus on wind and PV, becoming the most trusted and high-performing partner for transformation 2015: share renewables 9,83%; investments in wind and large-scale solar projects
E.On	2001: share renewables 11,74%; renewables part of key areas, biomass and wind 2005: share renewables 13,43%; investments in biomass, wind and hydro 2008: share renewables 13,45%; research into renewables, subsidiary E.ON Climate & Renewables was founded, share in renewables by 24% by 2030 2010: share renewables 12,29%; investments of €1.1 billion in renewables for 2011, spend on onshore wind, contribution to to bringing about the transition 2011: share renewables 14,52%; renewables as foucus of growth, especially offshore wind, investments in wind, solar, biomass and marine energy 2013: share renewables 11,40%; renewables as important earning source, primarily wind, solar and biomass 2015: share renewables 16,51%; investments in wind, PV and bioenergy
EnBW	2001: share renewables 27,69%; investments in biomass, PV and wind, hydropower increased, EnBW environmental tariff 2005: share renewables 23,24%; rebuilding of a hydro power stations as Germany's largest construction project in the field of renewable energies 2008: share renewables 23,79%; share in renewables 20% by 2020, continue in geothermal, PV and biomass 2010: share renewables 19,96%; share of renewables to 20% by 2020, focus on hydro, wind and biomass 2011: share renewables 23,00%; renewables to around 3,000 MW by 2020 2013: share renewables 23,09%; 2020 corporate strategy 'Energiewende. Safe. Hands on.', development of wind and hydro, by 2020 renewables should rise to more than 40% 2015: share renewables 27,85%; operation and expansion of wind and hydro, double the share of Renewables to more than 40% in 2020
Vattenfall	2001: share renewables 13,40%; increasing bioenergy, wind power and energy recovery from waste 2005: share renewables 19,65%; investments in wind and biofuel, development of new sustainable generation technology for wind 2008: share renewables 19,05%; new power plants for generating wind power, bioenergy and ocean energy, 'Making electricity clean: operations climateneutral by 2050 2010: share renewables 20,00%; investments in renewables, especially in wind, hydro and biomass, 8 TWh generated from wind and biomass by 2020 2011: share renewables 21,51%; proportion of renewables to be increased substantially, 40-50% co-combustion of biomass in coal-fired power plants by 2020 2013: share renewables 20,57%; new capacity in solar energy, wind and biomass 2015: share renewables 19,21%; further development of wind, solar power and hydro

Table 9 – Incumbents' strategic responses to relevant aspects of transition policy, Core element 1.

Source: Annual reports RWE, E.On, EnBW, Vattenfall 2001-2015

In *2001*, RWE stated an 'upgraded commitment to renewable energies', especially with commissioning its first wind farm. Also, building a biomass power plant was scheduled. Its strategy did not comment upon the fixed feed-in tariffs (RWE 2001, p. 64-65) The share of renewable energies in its portfolio amounted to 18,50%. (Appendix, Table A) E.On included building and operating generating facilities that use renewables into its key areas. Biomass and wind energy projects were especially in focus, though the company did not address the fixed feed-in tariffs in its strategy (E.On 2001, p.50-51) Concerning E.On's generation capacity, 11,74% were regarded as energies from renewable and other sources. (Appendix, Table A) With investments in plants based on biomass and wind power, '(…) EnBW successfully repositioned itself within the area of renewable energies'. The proportion of hydropower in its electricity generation was increased and photovoltaic plants were operated. Also, it covered on the fixed feed-in tariffs within its introduced EnBW environmental tariff that offers its customers electricity from renewable sources. Its eco-electricity is also to be made more attractive and to be expanded. Hereby, EnBW '(…) participates in the Europe-wide trial trade with certificates (RECS) for electricity from (renewables).' (EnBW 2001, p. 51-52; p. 74-75) 27,69% of its energy generation capacity amounted from renewable and other energies. (Appendix, Table A) Vattenfall answered to the introduced policy by increasing the proportion of renewable energy within 'bioenergy, wind power, decentralised energy solutions and energy recovery from waste (…)'. However, it did not explicitly answer to the fixed feed-in tariffs. (Vattenfall 2001, p.5-6) That resulted in a share of renewable and other energy of 13,40% within its energy generation. (Table A)

In *2005*, RWE described renewables as '(…) an integral part of (its) power generation portfolio'. The company also planned to invest '(…) additional amounts of capital to increase their share in (the) generation mix'. Wind power, hydro and biomass projects played a major role when it comes to investments in renewables. (RWE 2005, p. 90) The reduced feed-in tariffs for wind turbines were not addressed in the report. 9,76% of its share belonged to energy generation capacity from renewables and other sources. (Appendix, Table A) In 2005 E.On owned and operated renewable sources in Germany and the rest of Central Europe. That included energy from biomass, wind and hydroelectric plants. Within its long-term strategy for managing (its) generation assets, (E.On) planned to make considerable investments (…) to operate a flexible generating fleet with a balanced energy resource mix. (E.On 2005, p. 84) The company did not comment on the reduced feed-in tariffs. In 2005, its portfolio consisted of 13,43% renewables and other sources. (Appendix, Table A) In 2005, EnBW agreed on rebuilding one of its hydroelectric power stations, which was '(...) Germany's largest construction project in the field of renewable energies'. (p. 13) Its strategy did not take into account the changes in the fixed feed-in tariffs. The share of renewable and other sources amounted to 23,24%. (Appendix, Table A) Vattenfall stated in its Annual Report of 2005, that 'in light of (…) a transition to (a) stricter legislation, the relevance of (its) ambition to lead the industry in environmental issues has been further underlined'. Therefore, the company planned on obtaining a leading role in renewable electricity generation with continuing investments in wind power and biofuel. (Vattenfall 2005, p. 9) Also, the 'continued development of new sustainable generation technology (carbon dioxide-free

power plant, offshore wind power)' was decided on. The reduced feed-in tariffs for wind turbines were not addressed in the report. (Vattenfall 2005, p. 39) The company's renewable share and other sources added up to 19,65%. (Appendix, Table A)

In *2008*, RWE established its renewable energy subsidiary, RWE Innogy, with a special focus on wind power. (p. 20) The subsidiary supports the company's top priority: the modernization of its power plant portfolio with considerably stepping up its electricity generation from renewables. (RWE 2008, p. 35-37) By 2012 its '(…) goal is to more than triple (its) renewable generation base to 4.5 GW (...)'. (p. 55) RWE's generation from renewables and other sourced summed up to a share of 9,80%. (Appendix, Table A) In 2008, E.On generated an '(…) increasing share of our electricity from climate-friendly sources like renewables (…) (and supports) (...) research into energy efficiency and renewables'. (E.On 2008, p. 15) Existing renewable operations are to be expanded. (E.On 2008, p. 35) Further generation technologies like hydroelectricity, wind farms, biomass and solar-thermal energy are being supported, as government subsidy programs make investments in renewables more attractive. Also the subsidiary E.ON Climate & Renewables was founded in 2008. (E.On 2008, p. 41) The company aims at increasing its share in renewables by 24% by 2030. (p. 7) The generation capacity from renewables and other sources built a share of 13,15% in 2008. (Appendix, Table A) EnBW stated to '(..) support Germany's climate protection targets (and) intend(s) to increase the share of renewable energies in (its) generation portfolio to 20% by 2020. (EnBW 2008, p. 16) Also, it acknowledges the potential for wind power generation off the German coast, where the company build several offshore wind farms. Also, EnBW currently builds a hydroelectric power station, being '(...) currently Germany's largest construction project in the area of renewable energies'. Its activities in the fields of geothermal, photovoltaic and biomass power are to be continued. (EnBW 2008, p. 17) In 2008, renewable and other sources accumulated to a share of 23,79%. (Appendix, Table A) By 'significantly increas(ing) investments in low-emitting energy generation', Vattenfall plans to build new power plants for generating wind power, bioenergy and ocean energy. (Vattenfall 2008, p. 7-9) Its strategy 'Making electricity clean' focuses on the company's climate vision: '(…) to make Vattenfall's operations climateneutral by 2050'. Vattenfall supported introduced goals for climate protection '(...) and (was) committed to being one of the European companies that makes the greatest contribution toward them. (p. 4) Renewables and others summed up to a share of 19,05%. (Appendix, Table A)

In *2010*, RWE set the target to base 30 percent of its electricity generation capacity on renewables by 2025. (RWE 2010, p. 7) Through modernizing and expanding its generation portfolio, the company wanted to '(...) enlarge its renewable electricity generation base substantially' by 2014 instead of 2012, which was originally planned. The production of electricity from wind, biomass, solar thermal power and hydroelectric power plants stood in the center of its investments. (RWE 2010, p. 53) 8,23% of generation capacity were designated being renewables and others. (Appendix, Table A) E.On planned investments of €1.1 billion in its Renewables Generation Segment for 2011. In Europe, that was to be spend on onshore wind farms. (E.On

2010, p. 54) Investments in network assets increased '(…) because of higher investments in distribution networks, particular in conjunction with Germany's Renewable Energy Law'. (p. 30) The policy objectives of the German government were firmly in view of the company. Within its strategy, E.On planned on '(…) mak(ing) a very substantial contribution to to bringing about the transition to a climate-friendly energy supply (…)'. (p. 49) Its share in renewables and other sources covered 12,29%. (Appendix, Table A) EnBW '(…) intend(ed) to increase the share of renewable energies (...) to around 20% by 2020'. (EnBW 2010, p. 21) The focus was on hydro-electric, wind farms and biomass. (EnBW p. 48) Renewables and other sources accumulated to 19,96%. (Appendix, Table A) Vattenfall made '(…) major investments primarily in renewable energy generation and in wind power in particular. In ten years, wind power is expected to account for 10%–15% of generated electricity in Germany, the Netherlands and the Nordic countries.' (Vattenfall 2010, p. 20) The company declared that it will increase the share of low CO2-emitting and renewable electricity generation, with a certain focus also on hydro power and biomass. (p. 30) Within its renewable energy production it set the '(…) target to achieve 8 TWh of electricity generation from wind and biomass by 2020, compared with 3.9 TWh in 2010'. (p. 60) 20,00% was the share in renewables and other sources in 2010. (Appendix, Table A)

In *2011*, RWE planned on increasing the share of renewables to at least 20 % by 2020. It mentioned to focus 'above all on the expansion of renewable energy' with spending about €4 billion from 2012 to 2014. RWE Innogy was then to be '(…) operating power generating facilities with a total of 4.5 GW of capacity by the end of 2014'. Onshore and offshore wind farms were highlighted as the central renewables including also biomass and hydroelectric power to some extent. (RWE 2011, p. 30-31) No target was set for 2050. In that year, the share of renewables and others accounted for 8,96% of the total generation capacity. (Appendix, Table A) E.On declared renewables as the focus of its growth in Europe, especially with respect to offshore wind energy. This growth was to be continued in the coming years with plans on investing € 7 billion in renewable energies. (E.On 2011, p. 2) The company did not mention any targets for 2020 or 2050. However, it stated to aim at playing a leading role in the renewable sector. Next to wind energy, it also incorporated investments in solar, biomass and marine energy into its 2011 strategy. (p. 7) 14,52% of E.On's total generation capacity was listed as renewable and others. (Appendix, Table A) EnBW was '(…) putting even more emphasis on expanding renewable energies'. The share was planned to be increased by around 3,000 MW by 2020. (EnBW 2011, p. 38) A key strategic move was thereby securing its position as 'low-carbon generator'. No target was set for 2050. (p. 5) In 2011 the share accounted for 23,00% renewables and other sources. (Appendix, Table A) In 2011 Vattenfall's strategy was based on '(…) the development of environmentally sustainable energy production (that) require(d) substantial investments in changing the composition of the production portfolio'. (Vattenfall 2011, p. 7) 'The proportion of plants in which energy is produced in an environmentally sustainable manner (was to be) increase(d) substantially (…).' (p. 8) The company's target was to achieve 40–50% co-combustion of biomass in coal-fired power plants by 2020. No target was set for 2050. (p. 15) 21,51% of its generation capacity was based on renewables and others.

(Appendix, Table A)

In *2013*, RWE continued to include the expansion of electricity produced from renewable sources into its strategy: 'RWE Innogy is expected to invest a total of about €1 billion in the expansion of renewable energy from 2014 to 2016'. In Germany, the focus lies on wind turbines as well as PV. (RWE 2013, p. 35-36) Its related mission statement took into account the ambitious political goals regarding climate protection and the expansion of renewable energy whereby RWE aimed at '(…) becoming the most trusted and high-performing partner for the sustainable transformation of the European energy system'. One of its strategic goals stated to '(…) successfully contribute to the sustainable transformation of the European energy system'. (p. 32) No targets for expanding renewables in 2025 or 2035 were stated by the company. A share of 8,48% was designated to renewables and other sources. (Appendix, Table A) E.On declared to make renewables an important source of its earnings due to expanding its businesses in that field. (E.On 2013, p. 3) Furthermore, it was convinced that '(…) climate protection can be mutually compatible elements of a successful business strategy (…).' Hence, expanding its operations in renewables accounted for one part of the company's strategic development. (p. 12) Primarily wind, solar as well as biomass were stated as growth areas. (p. 13) No targets for expanding renewables in 2025 or 2035 were stated by the company. Its share in renewables and others covered 11,40%. (Appendix, Table A) Within EnBW's 2020 corporate strategy 'Energiewende. Safe. Hands on.', EnBW wanted to actively implement the '(…) sustainable energy supply of the future on a basis that (was) also (..) ecologically responsible'. That included the further development of wind and hydropower. (EnBW 2013, p. 43-44) By 2020 the share of renewable energies in its installed capacity should rise up to more than 40% with total of 5 GW in installed renewable energy capacity. (EnBW 2013, p. 49-50) No targets for expanding renewables in 2025 or 2035 were stated by the company. 23,09% was the share of renewables and other sources in 2013. (Appendix, Table A) Vattenfall acknowledged growth in renewable energy as important factor. (Vattenfall p. 14) The company planned on building new capacity in the form of solar energy, wind power and biomass. (Vattenfall 2013, p. 17) Vattenfall did not mention any targets for expanding renewables in 2025 or 2035. Its share in renewables and other sources amounted to 20,57%. (Appendix, Table A)

In *2015*, RWE's electricity produced from renewable sources remained to be expanded within its strategy. The company planned on investments in wind technology and wants to '(…) take on large-scale solar projects in the future'. (RWE 2015, p. 21) Renewables and others added up to a share of 9,83%. (Appendix, Table A) E.On's annual report of 2015 suggested to focus on onshore and offshore wind as well as PV solar. (E.On 2015, p. 13) 'Through 2015 (its) investments in wind, solar, and bioenergy projects totaled more than €10 billion. These investments ma(de) (its) energy mix viable for the future by steadily increasing (the) proportion of renewable sources.' (p. 49) Concerning renewables and other sources, a share of 16,51% was stated. (Appendix, Table A) EnBW included the operation of wind farms in its strategy of 2015, with which it could provide '(…) clean and sustainable electricity every year for more than 500,000 households. This

figure (was declared to) rise to more than three million in just a few years.' In addition, it stated to operate and maintain its 67 hydropower plants. (EnBW 2015, p. 7) In utilising the natural resource of sun, the company included all renewable resources in its Renewable Energies segment. These energies are to be expanded as part of its future business model. (p. 19) 'EnBW aims to more than double the share of its generation capacity accounted for by renewable energies from 19% (based on the reference year of 2012) to more than 40% in 2020.' (p. 23) A share of 27,85% renewables and others was noted. (Appendix, Table A) Vattenfall's key priorities were the growth in its renewable generation while striving to improve its resource use '(...) along the entire value chain, from fuel, energy use, water and chemicals, to waste and by-products'. That included the further development of wind, solar power and hydro power. (Vattenfall 2015, p. 21) 19,21% of the total electricity generation capacity resulted in renewables and others. (Appendix, Table A)

4.3.2.2 Core element 2: Decreasing CO2 emissions in Germany

When analyzing core element 2 of German transition policy, the following years of business strategy and relevant aspects of analysis are being considered:

Relevant aspects of business strategy, Core element 2		
Year of policy	Year of strategy	Aspect of analysis
2007	2008	40 percent fall in CO2 emissions by 2020; Sustainable, climate-friendly energy supply by 2020
2010	2011	40 percent fall in CO2 emissions by 2020; Reduction of 80-95% by 2050

Table 3 – Relevant aspects of business strategy of the incumbents, Core element 2.
Source: Own

Incumbents' strategic responses to the decreasing CO2 emissions in Germany are now being analyzed within the above mentioned years, visible in Table 10 below.

Incumbents' strategic responses to relevant aspects of transition policy, Core element 2	
	Measure
RWE	2008: 'More growth, less CO2', for 2012 a CO2 emission reduction by 20 % through 'avoidance measures' and lifetimes of nuclear power plant 2011: reducing CO2 emissions by more than 20 % by 2020 compared to 2005, constantly reduction As essential building block of strategy, taking high-emission plants offline
E.On	2008: generation from fossil fuels to be limited, new technologies, optimize facilities and processes, focus on post-combustion-capture making it commercial by 2020 2011: achieve its emission target with a 5-year delay (to halve carbon emissions from a 1990 baseline by 2020)
EnBW	2008: 65% being generated CO2 emission free, target of undercutting the national average for CO2 emissions on a permanent basis 2011: secure position as a low-carbon generator, CO2 emissions of 250-350kg/MWh by 2030
Vattenfall	2008: 'Making electricity clean' aimed at reducing its CO2 being climate-neutral by 2050, contribute to the target for CO2 emission 20% by 2020, reduce emissions by combining biomass with fossil fuels 2011: reduction of CO2 exposure, growth in low CO2-emitting energy production, limited to 65 million tonnes per year by 2020

Table 10 – Incumbents' strategic responses to relevant aspects of transition policy, Core element 2.
Source: Annual reports RWE, E.On, EnBW, Vattenfall 2001-2015

Within its continued strategy agenda 2012, 'More growth, less CO2' RWE manifested its medium-term development for *2008*: 'It focuses on profitable growth and reducing CO2 emissions, aiming to continue adding value.' That includes for 2012 a CO2 emission reduction by 20 %. That is to be achieved through 'avoidance measures' and the '(...) extent(ion) of the lifetimes of nuclear power plants (…), (as they) emit practically no carbon dioxide (…)'. (RWE 2008, p. 35-37) In 2008, E.On stated that its large share in the generation from fossil fuels that result in much CO2, is to be limited. 'New technologies will help us build a bridge to a lower-carbon future. First, we continually optimize our existing facilities and processes. Second, we develop key technologies that protect that environment and conserve resources.' Its main focus was on post-combustion-capture, which the company planned on making it commercial by 2020. Therefore, investments of €100 million were planned on. (E.On 2008, p. 15) EnBW argued 65% of its electricity being generated CO2 emission free. It '(…) set (it)self the target of undercutting the national average for CO2 emissions on a permanent basis.' Though EnBW did not comment on setting targets for the year 2020. (EnBW 2008, p. 15) Vattenfall's strategy 'Making electricity clean' aimed at reducing its CO2 emissions and being climate-neutral by 2050. (Vattenfall 2008, p. 6-8) As answer to the set climate target for CO2 emission (20% by 2020), Vattenfall supported the goal while being '(...) committed to being one of the European companies that makes the greatest contribution toward them.' Therefore, '(t)otal carbon emissions can be reduced by combining biomass with fossil fuels in conventional power plants'. (p. 4-5)

In *2011* RWE again aimed at reducing its CO2 emissions by more than 20 % by 2020 compared to 2005 (RWE 2011, p. 30-31) This constantly reduction was set as an 'essential building block' of RWE's strategy. To do so, plants with higher emission levels were taken offline. No targets were set for the year 2050. (RWE 2011, p. 118-119) E.On expected to achieve its emission target - '(…) to halve, by 2020, its European generation portfolio's specific carbon emissions from a 1990 baseline - five-years later'. The trend is as well consistent with the set targets for 2050. (E.On 2011, p.9) One of EnBW's key strategies stated to 'secur(e) (its) position as a low-carbon generator (…)'. (EnBW 2011, p. 38) By 2030, the company was to expect CO2 emissions of 250-350 kg/MWh. No targets were set for the years 2020 and 2050. (p. 18) Vattenfall also called for the reduction of '(...) CO2 exposure and growth in low CO2-emitting energy production (…)'. Its CO2 exposure was planned to be limited to 65 million tonnes per year by 2020, compared to the current level of 89 million tonnes per year. A limit was not set for the year 2050. (Vattenfall 2011, p. 7)

4.3.2.3 Core element 3: Phasing out of nuclear energy in electricity production in Germany

The share of nuclear power in the companies' resource portfolio decreased over time, as already discussed in 5.3.2. RWE, E.On as well as EnBW also confirmed, that the shares declined in 2016 compared to 2000. Vattenfall did not comment on the topic. (Question 8) Hereby, it was asked, if the foreseen shares of nuclear power in the resource portfolio changed for 2020, 2025 and 2050 under the influence of the energy transition policy. The shares for 2020 changed for RWE, EnBW and Vattenfall, while they did not vary for E.On. All incumbents approved a change in forseen share for the year 2025. The share for 2050 only changed for E.On; the other incumbents, RWE, EnBW and Vattenfall did not suggest a change. (Question 9) Also, the significance of the energy transition for changes in disfavor of nuclear power was stated by the incumbents (1= not significant at all, 10= highly significant). RWE and EnBW mentioned the Energiewende highly significant for changes in disfavor of nuclear energy. Vattenfall rated it with a 8. On the opposite, E.On rated it rather not significant, scoring it with a 3. (Question 10)

When analyzing core element 3 of German transition policy, the following years of business strategy and relevant aspects of analysis are being considered:

Relevant aspects of business strategy, Core element 3		
Year of policy	Year of strategy	Aspect of analysis
2002	2002/2003	Banning the construction of new commercial nuclear power plants in Germany; Limited operation of existing power stations to 32 years; Closure of nuclear plants by 2022; Banning of the delivery of spent fuel elements for reprocessing and Restriction of nuclear waste disposal to final storage from 2005 on
2010	2010/2011	Extension of the lifetimes for nuclear power plants, with 12 years on average; Electricity from nuclear plants to remain until 2036; Tax on nuclear fuels
2011	2011/2012	Nuclear moratorium and temporarily shut down of the oldest reactors; Suspension of the three-months lifetime extension for nuclear power plants; Complete phase-out of nuclear power by 2022

Table 4 – Relevant aspects of business strategy of the incumbents, Core element 3.

Source: Own

Incumbents' strategic responses to the phasing out of nuclear energy in electricity production in Germany are now being analyzed within the above mentioned years, visible in Table 11 below.

Incumbents' strategic responses to relevant aspects of transition policy, Core element 3	
	Measure
RWE	2003: share nuclear 16,78%; 2002: savings by changing the disposal procedure for nuclear waste 2011: share nuclear 12,47%; 2010: limited funds, no additional investment in renewables, considering taking legal action against the nuclear fuel tax, investments on retrofitting nuclear facilities, facilities were now to run 8-14 years longer 2012: share nuclear 13,06%; 2011: in 2010 €1 billion burden through accelerated nuclear phase-out, contering lack of security of supply resort to old oil-fired power plant in Austria, eight stations were affected by nuclear moratorium, three remaining reactors taken offline end of 2017, measures to secure financial strength by 2013, efficiency enhancements, streamlining capex programme, divestments, capital increase
E.On	2003: share nuclear 33,72%; 2002: contacts with two large European fuel reprocessing firms, development of next-generation nuclear reactors, safe and reliable operating of its nuclear power plants, decommissioning of Stade nuclear power station 2011: share nuclear 26,02%; 2010: brand image has deteriorated, business challenges expected, earnings development adversely affected by nuclear fuel tax 2012: share nuclear 26,84%; 2011: non-recurring adverse effect of €1.5 billion relating to shutdown, gradual phaseout delayed emission targets, generating capacity declined, adjusting financial forecast in half-year earnings release, carbon intensity increased, implementing earlier phaseout, filed a constitutional complaint against the 13th amendment, instituting administrative proceedings, legal action against tax
EnBW	2003: share nuclear 33,86%; 2002: gradual substitution of nuclear power by other sources, revision of safety management concept and gradually put into practice, Revision and extension of risk management system, preparation of dismantling concept for Obrigheim station 2011: share nuclear 24,87%; 2010: financial burdens from nuclear fuel rod tax, marginal positive effects from lifetime extension, with expiring tax in 2017 improved earnings, gross investments of €5.1 billion in 2011-2013 2012: share nuclear 24,87%; 2011: nuclear share decreased in 2012, shutdown of two nuclear power plants, redifined residual working lives of two remaining plants caused a direct effect on earnings, reworking its planning, sharpen focus of strategy, targets for growth and earning for 2012 and 2013 not feasible anymore, gradual restructuring of generation portfolio, safeguarding low-carbon position, increasing share in renewables, keeping capacity of around 15,000 MW
Vattenfall	2003: share nuclear 8,94%; 2002: strategy of 'Acting responsibly', linking phase-out to climate policy, Closure of power plant Stade commenced, processed the 'intermediate storage of nuclear fuel in Brunsbüttel 2011: share nuclear 0%; 2010: expandeding co-operation surrounding of jointly owned Krummel and Brunsbuttel nuclear power plans with E.On, lifetime extension of 8-14 years, tax caused to raise €165 million per year 2012: share nuclear 0%; 2011: charged with SEK 10.5 billion due to phase out, two plants (temporary) closed, nuclear power important role in other countries, plants' dismantling and demolition Planned, increasing plant availability of nuclear power plants, improving safety, conducting maintenance work more cost-effectively

Table 11 – Incumbents' strategic responses to relevant aspects of transition policy, Core element 3.

Source: Annual reports RWE, E.On, EnBW, Vattenfall 2001-2015

In *2002*, RWE highlighted that the intended nuclear phase-out will abolish a form of CO2-free power generation. (RWE 2002, p. 63) With respect to nuclear waste disposal, the company '(…) achieved savings by changing the disposal procedure (...). This (was) a result of the agreement on nuclear energy reached with Germany's federal government.' (p. 41) Nuclear energy amounted to 16,78% within RWE's total energy generation capacity in 2003. (Appendix, Table A) E.On's '(e)arnings were negatively impacted by one-off charges in the generation business (€310 million), mainly related to the unplanned shutdown of Unterweser nuclear power station and increased provisions for nuclear waste management.' (E.On 2002, p. 31) As a response, E.On entered into contracts with two large European fuel reprocessing firms. (p. 136) Still, the company fostered the development of next-generation nuclear reactors. (p. 73) E.On stated a safe and reliable operating of its nuclear power plants, ranking itself '(…) among the world's premier nuclear generators'. The company announced, that the '(…) Stade nuclear power station was decommissioned in November 2003'. (E.On 2003, p. 85) In 2003, 33,72% of its energy generation capacity amounted from nuclear energy. (Appendix, Table A) EnBW mentioned the gradual substitution of nuclear power by other sources to have a negative effect, as the company was unclear about the possibility to pass on the price increases. (EnBW 2002, p. 58) In order to tackle safety measures in its strategy, its safety management concept was thoroughly revised in 2002 and was being gradually put into practice. Also the existing risk management system was extended and revised. (p. 59) Until mid-2005 the operation of EnBW's Obrigheim station was being secured within an agreement with the government. Its dismantling concept was already being prepared. (p. 73) Concerning its generation capacity in 2003, 33,86% were regarded as energies from nuclear sources. (Appendix, Table A) Vattenfall referred to its strategy of 'Acting responsibly'. With that, the phase-out of nuclear power in (…) Germany must more clearly be linked to climate policy. (Vattenfall 2002, p. 5) Like E.On, also Vattenfall proposed that the 'closure of (the) first nuclear power plant Stade commenced'. Moreover, it processed the 'intermediate storage of nuclear fuel in Brunsbüttel'. (Vattenfall 2003, p. 45) The share of nuclear energy cumulated to 8,94% within the total energy capacity of 2003. (Appendix, Table A)

In 2010, RWE suggested that the new nuclear fuel tax in Germany will '(…) have a negative effect of an average of 600 to 700 million euros on (its) operating result (per year from 2011 to 2016), limiting the funds (it) can spend on investments and dividends'. (RWE 2010, p. 19) As negative effects were derived from the nuclear fuel tax and the nuclear fund, the company could not aim at making any additional investment in renewables. (p. 30) 'The nuclear fuel tax is proof of the fact that one can no longer speak of reliable political framework conditions in the energy industry.' (p. 38) So, the company considered on taking legal action against the tax. (p. 45) RWE, however, also commented on the extension of the lifetimes of German nuclear power plants. It evaluates the measure as trade-off with the substantial contributions to a state subsidy fund for renewable energy. Moreover, the company planned on spending money on retrofitting its nuclear facilities. Though, RWE concluded that burdens are to be faced in the years contrasting future financial advantages of the lifetime extension. (p. 38) The company mentioned that some of its facilities were now to

run 14 years longer, while others corresponded to a lifetime extension of about eight years. (p. 67) To 12,47% accumulated its nuclear share in 2011. (Appendix, Table A) E.On remarked that its '(…) brand image has deteriorated considerably as a result of the nuclear-energy debate in general putative billion-euro profits in particular'. (E.On 2010, p. 47) For the future, business challenges were expected by the company, whereby its '(…) earnings development will be adversely affected by Germany's nuclear-fuel tax (…)'. (p. 52) It did not specifically answer within its business strategy. The share of nuclear power accounted for 26,02% in 2011. (Appendix, Table A) EnBW also noticed financial burdens from the nuclear fuel rod tax. (EnBW 2010, p. 5) It commented with: 'Let's be clear about this: The positive effects anticipated from the extension of working life of nuclear power plants will not offset these additional burdens over the next few years. Only when the (tax) expires in 2017 will it be possible for the new regulations for nuclear power plants to improve earnings (…).' Followingly, the company acted with modifying its strategy towards gross investments of €5.1 billion over the period of 2011-2013. Its strategic responses consequently were set up in order to safeguard EnBW's scope of action and to being prepared for the future. (p. 6) EnBW's share of nuclear energy resulted in 24,87% in 2011. (Appendix, Table A) As strategic response, Vattenfall acted together with E.On in expanding its '(…) co-operation surrounding the jointly owned Krummel and Brunsbuttel nuclear power plans in order to quickly resume generation at the two plants and further optimise the facilities' operations'. (Vattenfall 2010, p. 34) Policy entailed a lifetime extension of 14 years for the Krümel and Brokdorf plants as well as 8 years for the Brunsbüttel power plant. Though, through 2016, the introduced tax was causing Vattenfall to raise €165 million per year. (p. 35) Nuclear energy did account for a share of 0% in 2011. (Appendix, Table A)

In *2011*, RWE noticed a '(h)eavy burden on earnings through accelerated nuclear phase-out in Germany'. (RWE 2011, p. 1) These accumulated to more than €1 billion in 2010. The company admitted that it underestimated the speed of changes in its sector. However, '(n)o one could have foreseen the momentous burdens (it) would face. (…) Germany's taking 40 % of its nuclear power capacity offline at once does little to improve security. In fact, it le(d) to a lack of security – of supply. (…) To prevent blackouts, the transmission system operators actually had to resort to an old oil-fired power plant in Austria.' (p. 17) Moreover, RWE could no longer operate eight of its stations, as these were affected by the nuclear moratorium. Its three remaining reactors had to be taken offline at the end of 2017 (Gundremmingen B), 2021 (Gundremmingen C) and 2022 (Emsland). (p. 22) As strategic response, RWE introduced measures to secure its financial strength with introducing a package by 2013. Also, further '(…) efficiency enhancements, streamlining the capex programme, numerous divestments and a capital increase(...)' was undertaken. (p. 23) With the reversed extension of the lifetimes of its nuclear power plants, a major component of the company's CO2 reduction strategy was eliminated. (p. 30) Its share in nuclear energy amounted to 13,06% in 2012. (Appendix, Table A) E.On mentioned a '(…) non-recurring adverse effect of €1.5 billion relating to the early shutdown of nuclear power stations in Germany (…).' (E.On 2011, p. 2) Concerning the gradual phaseout of nuclear energy by 2022, E.On's emission targets were on delay. (p. 9) Moreover, its attributable generating

capacity declined mainly because of the nuclear fuel tax as well as the shutdown of nuclear capacity of the stations Unterweser, Isar 1, Krümmel and Brunsbüttel. (p. 19) As a response, the company adjusted its financial forecast already at the time of its half-year earnings release. (p. 24) Also, its carbon intensity increased. (p. 42) Though, 'E.On (was) implementing the political majority's decision on an earlier phaseout of nuclear energy. (…) In mid-November 2011, (it) filed a constitutional complaint against the thirteenth amendment of the Act to Germany's Constitutional Court (…).' Also it was instituting administrative proceedings and took legal action against the tax. (p. 56) E.On's share in nuclear power was stated to be 26,84% in 2012. (Appendix, Table A) EnBW recognized the progressing of the nuclear phase-out. (EnBW 2012, p. 57-58) With that, its share of nuclear power in electricity generation decreased in 2012 through the '(…) shutdown of the two nuclear power plants units KKP 1 and GKN I in spring 2011. (p. 47) The residual working lives of its two remaining plants were redefined, causing a direct effect on earnings. Also the nuclear fuel tax was stated to be influential. All negative influences forced EnBW to rework its planning, sharpen the focus of its strategy as well as to take action. (EnBW 2011, p. 5) The company's originally set targets for growth and earning for 2012 and 2013 were now not feasible anymore. (p. 7) It plans a '(...) gradual, well-planned restructuring of the generation portfolio (…)' with safeguarding its low-carbon position, increasing the share in renewables and keeping a generation capacity of around 15,000 MW. (p. 18) In 2012, 24,87% of the company's generation capacity was resulting from nuclear energy. (Appendix, Table A) Vattenfall's '(p)rofit was charged with SEK 10.5 billion as a result of the German decision to phase out nuclear power'. (Vattenfall 2011, p. 1) Its plants Krümmel and Brunsbüttel were ordered to temporary close and most likely not to be started again. (p. 2) 'Despite the phase-out of nuclear power in Germany, Vattenfall believe(d) that nuclear power will play an important role in tomorrow's energy mix (in other countries).' (p. 6) The company prepared the nuclear power plants for dismantling and demolition throughout 2011. 'Ahead of 2012, Vattenfall's main challenges lied in increasing plant availability – especially the nuclear power plants – improving safety and conducting maintenance work more cost-effectively. (p. 24) In 2012, 0% of its generation capacity resulted in nuclear power. (Appendix, Table A)

4.3.2.4 Core element 4: Increasing energy efficiency in Germany

When analyzing core element 4 of German transition policy, the following years of business strategy and relevant aspects of analysis are being considered:

Relevant aspects of business strategy, Core element 4		
Year of policy	Year of strategy	Aspect of analysis
2007	2008	Modernization of German power plants
2010	2011	10% reduction in electricity use by 2020 and 25% by 2050

Table 5 – Relevant aspects of business strategy of the incumbents, Core element 4.
Source: Own

Incumbents' strategic responses to increasing energy efficiency in Germany are now being analyzed within the above mentioned years, visible in Table 12 below.

Incumbents' strategic responses to relevant aspects of transition policy, Core element 4	
	Measure
RWE	2008: investment of €26 billion to expand and modernize energy infrastructure by 2012, modernization of environmentally friendly power plants, improving the efficiency of grids, Strategy Agenda 2012 set efficiency-enhancement goal with budget of €1.2 billion by 2012 2011: modernization of its power plants, investment programme covered on building efficient generation capacity, supporting efficient gas and coal-fired power plants, 'more sustainable' strategy improving efficiency of power plant fleet, €12 billion accounted for power plant new-build programme 2006-2014
E.On	2008: efficiency enhancement as decisive role for operations, investments in robust and efficient energy networks, R&D partnership with the RWTH Aachen University to foster energy efficiency, modernizing conventional generation fleet in Europe making it more efficient 2011: generation fleets as one of most efficient in Europe, Energy Roadmap 2050 includes energy efficiency as main decarbonization routines, project to increase the efficiency of biogas production
EnBW	2008: new hard coal power station in Karlsruhe with operating efficiency in excess of 46%, develop and implement innovative concepts for improving energy efficiency, optimise energy-related processes, enhancing efficiency of energy generation 2011: strategy included future orientated development enhancing efficiency, built highly efficient gas and steam turbine power station, efficiency project 'EnBW energy efficiency network' with savings of 859 million kWh since 2007, R&D focused on increasing energy efficiency in local water supplies, extracting heat from waste water and optimizing treatment plants
Vattenfall	2008: increasing efficiency of existing electricity production and distribution networks, construction of coal- and lignitefired power plants offering high level of efficiency 2011: continuous improvement of operating efficienc, review of production plants, optimise value plants, new 675 MW unit built Boxberg lignitefired plant improving the plant's efficiency, in Moorburg a hard coal-fired power plant under construction as one of the world's most modern and efficient coal-fired power plants, generally lauching steps for attaining higher fuel efficiency

Table 12 – Incumbents' strategic responses to relevant aspects of transition policy, Core element 4.
Source: Annual reports RWE, E.On, EnBW, Vattenfall 2001-2015

Energy efficiency was specifically addressed in RWE's strategy of *2008* whereby the company '(…) associate(d) climate protection and resource conservation not only with the production of energy, but also with its use'. RWE '(…) plan(ned) to invest about €26 billion to expand and modernize energy infrastructure by 2012 (...).' That implied the modernization of environmentally friendly power plants and improving the efficiency of its grid. (RWE 2008, p. 22-24) Its Strategy Agenda 2012 included an 'efficiency-enhancement goal' that covered a budget of €1.2 billion by 2012. In 2007 €200 million in savings were realized in line with the agenda. (p. 24) As part of its energy efficiency programme covering €150 million, free 'energy checks' were being offered for all German communities. Its related campaign 'An Idea from RWE'

highlighted products and services with which customers could reduce energy consumption and costs. (p. 140) Concerning energy efficiency in 2008, E.On acknowledged its enhancement as decisive role for its operations. Therefore, investments in 'robust and efficient energy networks' were to be tackled. (E.On 2008, p. 3) Its R&D partnership with the RWTH Aachen University was launched in order to foster energy efficiency and renewables. (p. 15) Hence, the company also respected the '(r)ising demand along with political demands for greater energy efficiency (…)' and incorporated the topic in its strategy. (p. 36) E.On was also modernizing its '(...) conventional generation fleet in Europe to make it more efficient. (p. 41) EnBW built a new hard coal power station at Karlsruhe Rheinhafen port with an output of around 900 MW, going into operation towards the end of 2011. 'State-of-the-art power station technology and engineering know-how facilitate an operating efficiency in excess of 46% and consequently much lower CO2 emissions compared with existing plants.' (EnBW 2008, p. 13) The company argued to develop and implement innovative concepts for improving energy efficiency. 'In the industrial field, (it was) working together with (its) customers in the EnBW energy efficiency networks to optimise energy-related processes and to achieve potential savings of up to 20%.' (p. 14) Furthermore, '(e)nhancing the efficiency of energy generation and reducing emissions (where) at the heart of research and development work at EnBW'. (p. 76) Concerning energy efficiency, Vattenfall increased the '(...) efficiency of existing electricity (…) production as well as of distribution networks.' Investments in low-emitting coal generation using CCS technology was to support this. (Vattenfall 2008, p. 9) It continued with the construction of coal- and lignite fired power plants in Germany, which offer a high level of efficiency and environmental performance. (p. 10)

Energy efficiency in *2011* was stated by RWE to be improved concerning the modernization of its power plants. (RWE 2011, p. 30-31) Its power plant portfolio and investment programme therefore covered on building efficient generation capacity. (p. 1) The company declared to be '(…) ready to take action as a partner in the transformation of the German energy market by staying (its) course for (...) efficient gas and coal-fired power plants (...)'. (p. 19) Within its 'more sustainable' strategy, it stated to improve the efficiency of its power plant fleet and to promote the conservation of energy by its customers (p. 30) Hence, about €12 billion accounted for the power plant new-build programme launched in 2006 until 2014. (p. 31) No targets in electricity reduction were stated for 2020 or 2050. E.On suggested its generation fleets as one of the most efficient in Europe. (E.On 2011, p. 7) Within its Energy Roadmap 2050, energy efficiency belonged to the company's main decarbonization routines. Thereby, electricity was expected to double its share of energy consumption by 2050. (p. 13) Also, E.On launched a project to increase the efficiency of biogas production. (p. 48) Though, no concrete targets in electricity reduction were stated for 2020 or 2050. Concerning energy efficiency, EnBW's strategy included a future orientated development with measures to enhance efficiency, divestitures and capital measures. (EnBW 2011, p. 38) The company built a highly efficient gas and steam turbine power station and planned to also include the region of Stuttgart in the future. (p. 6) Within its efficiency project 'EnBW energy efficiency network', the company is the market leader in Germany. The project totaled a saving of around 859 million kWh since 2007. (p. 35) In terms of R&D, EnBW focused on

increasing energy efficiency in local water supplies. Moreover, efficiency measures became more important for REG, '(…) such as extracting heat from waste water and optimizing sewage treatment plants'. (p. 47) No concrete targets in electricity reduction were stated for 2020 or 2050. Vattenfall's goal was it to achieve '(…) first-rate, efficient generation operations, meaning continuous improvement of operating efficiency. In 2011 '(…) Vattenfall performed a review of all its production plants. In cases where plants have been identified that do not generate a satisfactory return, measures have been taken or (were) planned in order to optimise the value of every power plant in (its) portfolio.' (Vattenfall 2011, p. 23-24) A new 675 MW unit was being built at the Boxberg lignite fired power plant in Germany, '(…) us(ing) state-of-the-art technology and material to improve the plant's efficiency and reduce CO2 emissions per kilowatt-hour'. It was planned to be commissioned in late 2012. Moreover was in Moorburg, Germany, a hard coal–fired power plant was under construction, providing an annual electricity generation of 11.5 Twh and to be commissioned by 2014. The plant was stated to be '(…) one of the world's most modern and efficient coal-fired power plants'. (p. 25) Also it launched steps for attaining higher fuel efficiency in making lignite-fired power plants more efficient. (p. 43) For 2020 or 2050, no concrete targets in electricity reduction were stated.

4.3.3 Increased economic risks and costs

The Energiewende affects business strategy of incumbents with regard to entrepreneurial decision-making (increased economic risks and costs). Concerning entrepreneurial risks and costs, RWE, EnBW and Vattenfall approved that there were risks and costs implied by the energy transition's policy. E.On abstained from answering the question. (Question 11) Question 12 then asked for the concrete risks and costs that resulted as a consequence of the transition's core elements, as visible in Table 13 below. Followingly, with regard to the the core element of increasing the share of renewables, RWE and E.On highlighted high cost of investments in technology as an effect. E.On stated, that this technology, like offshore wind, '(…) was not mature' by then. RWE and EnBW were concerned by the risk of regulatory uncertainty with regard to changes in regulation policies and laws, like the EEG. EnBW argued, it consequently had to focus on the design and construction of renewable power plants while also the '(…) wholesale price for power due to the increase of the capacity of renewable energy plants (decreased). Vattenfall stated being confronted with risks security supply as well as with regulatory risks. RWE and EnBW mentioned, with regard to core element two, decreasing CO2 emissions, that especially risks and costs for phasing out the conventional power plants developed. Moreover, EnBW stated that 'decarbonization (led) to (a) discussion about (the) modification of the power plant portfolio'. Again, Vattenfall was confronted with risks in security supply as well as with regulatory risks. E.On abstained from answering the question. Concerning the third core element, it turned out that RWE responded to the phasing out of nuclear energy by putting forward the risks and costs of nuclear provisions. The exist of nuclear provision resulted in a loss for EnBW, as 'financial risks and risks by deconstruction of nuclear power plants' developed. Moreover, EnBW argued that due to the following increased use of coal fired power plants, also its CO2 emissions rose. Vattenfall faced risks in security

supply, regulatory risks and a decline in its nuclear share. E.On abstained from answering the question. In addition, the core element of increasing energy efficiency implied the risks and costs for RWE to invest in new products. E.On stated that 'building up a new business model for customer solutions' became necessary, as well as decentralized energy and energy efficiency. EnBW put forward, that the decrease in electric power consumption and gas consumption reduces sale volume, which could lead to risks in the '(…) further development of infrastructure, especially in rural areas'. Again, Vattenfall was confronted with risks in security supply as well as with regulatory risks.

Risks and costs for incumbents implied by the Energiewende				
	Measure			
	RWE	E.On	EnBW	Vattenfall
Core Element 1	High cost of investments in Technology; Risk of regulatory uncertainty with regard to changes in regulation policies and laws, like EEG	High cost of invest-Ments in technology; Technoloy like off-shore wind was not mature by then	Risk of regulatory uncertainty with regard to changes in regulation policies and laws, like EEG; Focus on the design and construction of renewable power plants; The wholesale price for power due to the increase of the capacity Of renewable energy plants decreased	Security of Supply; Regulatory Risks
Core Element 2	Risks and costs for phasing out the conventional power plants developed	-	Risks and costs for phasing out the conventional power plants developed; Discussion about (the) modification of the power Plant portfolio	Security of Supply; Regulatory Risks
Core Element 3	Risks and costs of nuclear Provisions	-	Financial risks; Risks by deconstruction of nuclear power plants; Increased use of coal fired power plants and rise in CO2 Emissions	Security of Supply; Regulatory Risks; Decline In nuclear Share
Core Element 4	Investment in new products	Building up a new business model for customer solutions; Decentralized energy and energy efficiency	Decrease in electric power consumption and gas consumption reduces sale volume, which could lead to risks in the further development of infrastructure, especially in rural areas	Security of Supply; Regulatory Risks

Table 13 – Risks and costs for incumbents implied by the Energiewende.

Source: Questionnaire, answers to question 12

Finally, the incumbents evaluated on increased economic risks and costs as an effect of the targets set by the Energiewende on a scale of 1-4 (1= agree, 4= disagree). RWE, EnBW and Vattenfall agreed on the effect of increased economic risks and costs and E.On tended to agree as well. (Question 19)

4.3.4 Regulatory uncertainties and missing planning reliability

The development of regulatory uncertainties implied by the energy transition has an effect on incumbents' planning reliability. By asking, if regulatory uncertainties have an effect on the companies' planning reliability, all incumbents agreed that they do. RWE mentioned that was visible within the process of shutting down conventional power plants. Investments could only be taken within reliable supporting schemes, as E.On suggested. These were especially attractive to flow into renewables (EnBW). EnBW concludes that the design of the electrical market in general was affected by regulatory uncertainties. (Question 14 and 15) Question 18 addresses the aspect of similarly securing present as well as future operations within the incumbents' business strategy. EnBW examined that with an example from their targets in business strategy for 2020. Here, the company stated an 'increase in renewable energy (as well as a) grid compensate decline in conventional generation. Vattenfall mentions the development of new customer solution especially within decentralised options. Also partner models are used by the company. RWE and E.On abstained from answering the question. Finally, the incumbents evaluated on missing planning reliability as an effects of the targets set by the Energiewende on a scale of 1-4 (1= agree, 4= disagree). RWE as well as EnBW agreed on the effect of increased economic risks and costs. Also Vattenfall tended to agree. Contrastingly, E.On tended to disagree that missing planning reliability was an effect resulting from the energy transition. (Question 19)

4.4 Relationship between energy transition and business strategy of energy incumbents

Followingly, it is being concluded to what extent all expected strategic reactions of the companies have come into practise or not. First one elaborates on innovation in business strategy. Second, the expectation of being pressured to address the transition's core elements is to be confirmed or not. Also, it is to be stated, if the companies faced economic risks and costs. Finally, also regulatory uncertainties are taken into account. With the assessment of all stated expectations it is then possible to conclude on the main research question and to evaluate to what extent energy producers in Germany altered their business strategy according to the preferences of the German 'Energiewende' between 2000 and 2016.

4.4.1 Innovation in incumbents' business strategy

It was expected that the Energiewende calls for innovation in incumbents' business strategy. The companies stated changes in several elements (number of employees, number of production sites, numbers of customers, corporate structure and composition of shareholders) whereas also their turnover and the budget for R&D fluctuated between 2000 and 2016. Therefore, the companies adapted to a changing environment with altering these elements within business strategy in order to maintain profit, or at least by being profit-oriented. Even though turnover increased, profit could not be maintained due to innovative behaviour of the incumbents. The budget spent on R&D is most important when it comes to increased innovation. However, RWE, E.On and Vattenfall decreased their budgets over time. Only EnBW raised its R&D budget and should have been therefore advantaged by its increased innovative condition.
The significance of the energy transition for changes in the companies was evaluate the significance as (rather) high. E.On and EnBW approved that by sticking to the set regulations of the Energiewende, their companies were in an advantageous position.
Concerning the transition's core elements, the preferences of core element one resulted in the investment in new capacities, as well as marketing strategies for EnBW. Core element two affected incumbents' strategies in the development of new solutions and products. Vattenfall responded by selling all its coal energy plants. Core element three affected the companies in developing know-how and the receipt of the security of energy supplies. Core element four resulted in the development of new products as well as the expansion of the gas sector for EnBW. Concluding, all four of the Energiewende's core elements caused altering business strategies of the incumbents with respect to innovation. New marketing approaches, products as well as know-how was developed. All of the incumbents agreed, that innovation in business strategy developed as an effect of the targets set by the Energiewende.

4.4.2 Pressures to address the transition's core elements

It was expected that under the Energiewende, incumbents face pressures to address the transition's core elements: Increasing the share of renewable resources in electricity production in Germany, decreasing CO2 emissions in Germany, phasing out of nuclear energy in electricity production in Germany and increasing energy efficiency in Germany. Therefore, a changed resource portfolio in favor of renewables and in disfavor of nuclear energy was expected. The resource volume for electricity production changed for all incumbents over time. With respect to the resource volume of conventional power for electricity production, RWE, EnBW as well as Vattenfall mark increasing shares over time. Only E.On's share in conventional power decreased from 2000 to 2015. The share of nuclear power decreased for all energy producers. Concerning shares in renewable power, all incumbents state increasing percentages. Hence, it can be confirmed that the Energiewende pressured in favor of renewables and in disfavor of nuclear energy. All four companies examined the significance of the energy transition for changes in their energy resources as rather high.

4.4.2.1 Core element 1

It can be confirmed that the share of renewable power in the companies' resource portfolio increased over time. The companies stated that also their foreseen shares of renewable power for 2020, 2025 and 2050 changed under the influence of the energy transition policy. All four companies examined the significance of the energy transition for changes in favor of renewables as rather high. The incumbents evaluated that, as an effect of the targets set by the Energiewende, pressures in renewables developed. Only E.On tended to disagree on the relationship.

The mentioned aspects of the policy targets of 2000, 2007, 2009, 2010 and 2014 were certainly addressed in the incumbents' business strategies. The companies thereby increased their share in renewables with respect to the fixed feed-in tariffs from renewables (2000). As answer to the policy of 2007, again shares in renewables were increased as well as the support for a climate-friendly energy supply announced. That also accounts for the systematic expansion of renewables within policy of 2009. Also the policy of 2010 in terms of answering to the target of renewable energy expansion by 2020 has been part of most business strategies. Only the target for 2050 was not mentioned in the strategies at that time. Finally, the aspect of enlarging wind,biogas and solar energy was tackled by the incumbents within altering business strategy.

The mentioned aspects of the policy targets of 2004 and 2012 were not directly incorporated into the strategies. That accounts for the specific aspect of policy in 2004 with respect to reduced feed-in tariffs for wind turbines, as well as for the policy of 2012, which set targets for 2025 and 2035. Answers of strategy were the general expansion of renewables without mentioning certain targets.

Followingly, the policy preference of increasing the share of renewable resources in electricity production in Germany has been taken up within incumbents' business strategy. Only E.On did not agree that the policy targets called for pressures in renewables.

4.4.2.2 Core element 2

The mentioned aspects of the policy targets of 2007 and 2010 were certainly addressed in the incumbents' business strategies. The companies thereby supported the target of decreasing CO2 emissions in Germany. As answer to the policy of 2007, targets for decreasing CO2 emissions were announced. Even though these did not all cover for 2020. Though, RWE set a target for reduction for 2012, E.On for 2020 and Vattenfall even for 2020 and 2050. EnBW did not rely on a target. Also the policy of 2010, in terms of answering to the aspect of setting targets for the years of 2020 and 2050, has been part of most business strategies. That was tackled by the incumbents within setting a target for 2020 (RWE, E.On, Vattenfall). EnBW set a target for reduction for the year 2030. Though, no company planned a target for 2050.
Followingly, the policy preference of decreasing CO2 emissions in Germany has been taken up within incumbents' business strategy.

4.4.2.3 Core element 3

It can be confirmed that the share of nuclear power in the companies' resource portfolio decreased over time. The companies stated that also their foreseen shares of renewable power for 2025 changed under the influence of the energy transition policy. The shares for 2020 changed for all incumbents, except for E.On. The share for 2050 did not change for the incumbents, except for E.On.
All four companies examined the significance of the energy transition for changes in disfavor of nuclear power. All companies mentioned the Energiewende rather significant for changes in disfavor of nuclear energy, except E.On rating it rather not significant.
The mentioned aspects of the policy targets of 2002, 2010 and 2011 were certainly addressed in the incumbents' business strategies. The companies thereby took into account the limitations in operating power plants in Germany as well as the restrictions of nuclear waste disposal (2002). The companies changed the disposal procedure for nuclear waste (RWE), signed contracts with fuel reprocessing firms (E.On), revised their safety and risk management concepts (EnBW) and processed on the storage of nuclear fuel (Vattenfall). Answers to the policy of 2010, the extension of the lifetimes for nuclear power plants with 12 years on average as well as the tax on nuclear fuels, were also announced by the companies. They all stated financial losses due to the introduced tax and commented on the lifetime extension of their power plants implying only marginal positive effects. As a response to the limited funds, RWE announced that no additional investment in renewables were feasible and it planned on taking legal action against the nuclear fuel tax.
The companies moreover took into account the policy of 2011. Business strategies were altered with regard to the nuclear moratorium and the temporarily shut down of the oldest reactors, the suspension of the three-months lifetime extension for nuclear power plants and the complete phase-out. Again, financial burdens developed for all incumbents. RWE contered the lack of security of nuclear supply with the resort of an old oil-fired power plant in Austria. Eight of its stations were affected by nuclear moratorium and three

remaining reactors were to be taken offline. Consequently, RWE had to plan on measures to secure its financial strength by 2013 with efficiency enhancements, a streamlining capex programme, divestments, and capital increase. E.On reacted by stating that the gradual phaseout delayed its set emission targets and the company had to adjust its financial forecast. Followingly, its carbon intensity increased. EnBW shut down two nuclear power plants, which caused direct effects on earnings. As a reaction, its focus of strategy was defined, however, the company's growth and earnings expected for 2012 and 2013 were not feasible anymore. Moreover, a gradual restructuring of its generation portfolio was planned. Also two of Vattenfall's plants were (temporarily) closed and other plants' dismantling and demolition was planned.
Followingly, the policy preference of phasing out of nuclear energy in electricity production in Germany has been taken up within incumbents' business strategy. Only for E.On the foreseen share of renewable power for 2020 did not changed under the influence of the energy transition policy. Also, RWE, EnBW and Vattenfall did not mention a relationship for the foreseen share of renewable power for 2050. Moreover, only E.On did not agree that the policy targets called for pressures in disfavour of nuclear energy.

4.4.2.4 Core element 4

The mentioned aspects of the policy targets of 2007 and 2010 were certainly addressed in the incumbents' business strategies. The companies thereby modified their strategy with respect to the modernization of their power plants (2007). As answer to the policy, RWE announced invest €26 billion to expand and modernize energy its infrastructure by 2012. E.On set efficiency enhancement as decisive role for operations with investments in robust and efficient energy networks as well as a R&D partnership. EnBW introduced a new hard coal power station with operating efficiency in excess of 46%. New concepts for improving energy efficiency and energy-related processes were developed. Also Vattenfall mentioned its continuous improvement of operating efficiency and the review of production plants. Also, the aspect of the included targets for 2020 and 2050 (2010) was tackled by the incumbents within altering their business strategy. Except E.On, the incumbents did not specifically comment on setting targets for 2020 or 2050. Though, RWE spend €12 billion for its power plant new-build programme in 2006-2014 that tackles efficient plants. E.On introduced its Energy Roadmap 2050, which included energy efficiency as decarbonization routines. For the future, EnBW's strategy was to include a future orientated development that enhances efficiency in building efficient plants. Also Vattenfall launched a future project of a hard coal-fired power plant that was to become one of the world's most modern and efficient coal-fired power plants.
Followingly, the policy preference of increasing energy efficiency in Germany has been taken up within incumbents' business strategy.

4.4.3 Increased economic risks and costs

It was expected that the Energiewende affects business strategy of incumbents with regard to entrepreneurial decision-making (increased economic risks and costs). RWE, EnBW and Vattenfall approved that. Several risks and costs that resulted as a consequence of the transition's core elements. Core element one caused cost of investments and immature technologies. With regard to core element two, risks and costs for phasing out the conventional power plants developed. Core element three caused risks and costs of nuclear provisions and resulted in financial risks. The core element of increasing energy efficiency implied the risks and costs of investing in new products and solutions as well as possible risks in the the development of infrastructure. All core elements caused risks in security supply as well as regulatory risks. All companies (mostly) agreed that increased economic risks and costs developed as an effect of the targets set by the Energiewende.

4.4.4 Regulatory uncertainties and missing planning reliability

It was expected that the development of regulatory uncertainties implied by the energy transition has an effect on incumbents' planning reliability. All incumbents agreed that regulatory uncertainties have an effect on their planning reliability. Within the process of shutting down conventional power plants, regulatory uncertainties affected RWE's planning reliability. EnBW concludes that the design of the electrical market in general was affected by regulatory uncertainties. Facing this, the companies had to similarly secure present as well as future operations within their business strategy. Hence, they increased their renewable energy and compensated their grid decline in conventional generation. Also, new solutions were developed.
All incumbents (mostly) agreed that missing planning reliability evolved as an effects of the targets set by the Energiewende. Only E.On tended to disagree that missing planning reliability was an effect resulting from the energy transition.

This chapter included an in-depth analyses of all relevant data and documents. In 4.1 one referred to the changing components of the German Energiewende over time. The dependent variable, incumbents' business strategy, was being analyzed in 4.2. Hereby, one assessed all relevant aspects of the incumbents' business strategy given the answers on research question 1. In 4.3 incumbents' business strategy was examined. In that context, all expectations were addressed. Therefore, one analyzed on innovation in incumbents' business strategy (4.3.1), on pressures to address the transition's core elements (4.3.2), on eventually increased economic risks and costs (4.3.3) and on the expectation of regulatory uncertainties and missing planning reliability (4.3.4). Finally, in 4.4, the relationship between energy transition and business strategy was examined.

5. Conclusion

This paper analyzed the altering of business strategy of incumbents within the German Energiewende, and relied on an explanatory empirical question:

To what extent did energy producers in Germany alter their business strategy according to the preferences of the German 'Energiewende' between 2000 and 2016?'

Primarily, it was to outline the energy producers' business strategy as a result to the Energiewende within 2000 and 2016 within a comparative case study of the 'big four' electricity producers RWE, E.On, EnBW and Vattenfall.

Theory expected a causal relation between the Energiewende and business strategy. On the one hand, the Energiewende calls for innovation in incumbents' business strategy, while incumbents also face pressures to address the transition's core elements. Moreover, business strategy of incumbents with regard to entrepreneurial decision-making (increased economic risks and costs) is affected by the energy transition. Finally, also the development of regulatory uncertainties implied by the Energiewende has an effect on incumbents' planning reliability.

Information and data collection was be done including the use of qualitative methods, especially with regard to interviewing techniques. Furthermore, research built on already existing knowledge and company data from incumbents' annual reports and involved theoretical concepts. This study generated new background material, while evaluating the time span between 2000 and 2016. It showed how far energy producers in Germany have been taking steps to alter their original business strategy as an effect of the set resource portfolio drawn from the energy transition.

In order to answer the main research question, the comparative case study took into account all previously stated expectations, which were to be falsified. The Energiewende was a cause for changes in the incumbents' business strategy to a *great extent*. This is especially true, when stating a conclusion on the evaluation of all stated expectations.

Concluding, the first expectation, 'the Energiewende calls for innovation in incumbents' business strategy', could be confirmed. The Energiewende was responsible for innovation in incumbents' business strategy to a *certain extent*. R&D did not increase over time whereas other elements changed naturally over time. Though, innovation in technology and resource portfolios was traced. All four of the Energiewende's core elements caused altering business strategies of the incumbents with respect to innovation. Though, only EnBW increased R&D, in the mentioned timeframe. Concerning the transition's core elements, the preferences of core element one resulted in the investment in new capacities, as well as marketing strategies for EnBW. Core element two affected incumbents' strategies in the development of new solutions and products.

Vattenfall responded by selling all its coal energy plants. Core element three affected the companies in developing know-how and the receipt of the security of energy supplies. Core element four resulted in the development of new products as well as the expansion of the gas sector for EnBW.

Also, it was also confirmed, that under the Energiewende, incumbents faced pressures to address the transition's core elements. The Energiewende was responsible for pressures to address the transition's core elements to the *most significant extent*. All incumbents incorporated the suggested core elements of the transition within their annual reports. Also with respect to the individual policy targets, business strategy elaborated on to a great extent. The policy preference of increasing the share of renewable resources in electricity production in Germany (Core element 1) has been taken up within incumbents' business strategy. Incumbents increased the share of renewable resources in electricity production in Germany. Only E.On did not agree that the policy targets called for pressures in renewables. Also the policy preference of decreasing CO2 emissions in Germany has been taken up within incumbents' business strategy (Core element 2). With respect to phasing out nuclear energy (Core element 3), the policy preferences have been taken up within incumbents' business strategy. The share of nuclear power decreased for all energy producers. This is limited regarding the foreseen shares and E.On did not agree that the policy targets called for pressures in disfavour of nuclear energy. Finally, the policy preference of increasing energy efficiency in Germany has been taken up within incumbents' business strategy (Core element 4).

Furthermore, the Energiewende affects business strategy of incumbents with regard to entrepreneurial decision-making (increased economic risks and costs). The Energiewende was responsible for increased economic risks and costs to the *most significant extent*. The companies stated great amounts of economic losses and risks. Several risks and costs resulted as a consequence of the transition's core elements for all four incumbents. Core element one caused cost of investments and immature technologies. With regard to core element two, risks and costs for phasing out the conventional power plants developed. Core element three caused risks and costs of nuclear provisions and resulted in financial risks. The core element of increasing energy efficiency implied the risks and costs of investing in new products and solutions as well as possible risks in the the development of infrastructure. All core elements caused risks in security supply as well as regulatory risks.

In addition, it was confirmed that the development of regulatory uncertainties implied by the energy transition has an effect on incumbents' planning reliability. The Energiewende was responsible for regulatory uncertainties and missing planning reliability to a *great extent*. Facing this, the companies had to similarly secure present as well as future operations within their business strategy. Only E.On tended to disagree that missing planning reliability was an effect resulting from the energy transition.

Merging the conclusion on all expectations, the main research question can be answered by the following:

> *'Energy producers in Germany altered their business strategy according to the preferences of the German 'Energiewende' between 2000 and 2016 to a great extent due to innovation, by addressing the transition's core elements (increasing the share of renewable resources, decreasing CO2 emissions, phasing out of nuclear energy and increasing energy efficiency in Germany), and by facing increased economic risks, costs and regulatory uncertainties.'*

This paper covers a comparative case study, meaning its results only account for the energy producers RWE, E.On, EnBW and Vattenfall. So, the findings are limited for the mentioned cases. Results were supported by material from the companies' annual reports as well as by the incumbents themselves in form of statements within send questionnaires. Analyzing business strategy was limited to these sources, as only the companies themselves can best evaluate on the causal relationship. They are engaged with the effects of the Energiewende in every-day operations.
The paper was guided by theory. Using the method of pattern-matching, all previously stated expectations that were derived from theory are confirmed for the individual cases. Hence, theory is even more verified and the newly developed data can even extend to the existing records.

The applied research design involves the use of a case study, investigating the phenomenon 'incumbents in the German energy transition' in its real-life context. Its strengths are the provision of new in-depth details and individual aspects. Also, the cases were being selected on purpose and with an analytical focus, which makes the obtained data strength in being comparable. The weakness of such an approach is the existence of many variables contrasting to only a small number of cases. In order to reduce the amount of variables, one chose similar cases. Also, cases were chosen systematically and in accordance to theory. Though, sorting out rival explanations remains an obstacle within comparative case study design. However, further strengths are the possibility of conducting an intensive analysis, providing much more details than a rather general statistical analysis. No unexpected findings occurred with this research.

With respect to the derived results, a lot of similarities in terms of the incumbents' answers to the energy transition within business strategy were identified. So, they all confirmed the previously states expectations of altering strategic behaviour. Despite that, details in strategy slightly varied. Though, when conducting a comparative case study, this is not unusual. Diversing results rather better visualize the possible differences in between cases. Hence, the strategy responses of incumbents all covered on the Energiewende's policy targets, though they were embellished and incorporated into the company reports in different ways. This is, because business strategy is always exclusive, as it is an element that incorporates unique selling propositions. Hence, the particular realization and focus of tackling policy targets varied across energy producers.

Similarly, as the comparative case study design suggests many variables, it raises the question which other factors possibly have influenced the strategic behaviour of the incumbents. One explanation could be other undertaken measures in order to increase or maintain profit. Furthermore, there is a general notion towards incentives evolving from other fields of business. Also the image towards their consumers of offering 'clean eco-electricity' could have been an influential factor in altering business strategy. Finally, another variable influencing strategy could be the constant incorporation of unique selling propositions.

The here presented findings could be the possible starting points for future research on the topic. They indicate that it is necessary to conduct further research which might even exceed the broad field of incumbents in the German energy transition in order to extend the knowledge and to research more widely on this topic.

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7. Data Appendix

Q U E S T I O N N A I R E

Dear Sir and Madam,

My name is Julia Eckardt and I am a Bachelor student at the University of Twente in the Netherlands. For my Bachelor thesis, I am studying the impact of the German energy transition policy on the strategy and activities of German energy companies. In particular I am interested in the impact of the energy transition on the business opportunities of the companies between the year 2000 and 2016. For that reason I ask your kind cooperation by answering the questions of this questionnaire. I really appreciate your cooperation because without your help I will not be able to answer my research question.

Your answers will be treated confidentially and only used for my thesis research. For any additional information you can contact me or my supervisor at the University of Twente, Dr. Maarten Arentsen, associate professor energy innovation.

Answering the questions will take about 20 minutes of your time. You are free to answer the questions either in English or German language.

Thank you very much for your cooperation!

Sincerely,
Julia Eckardt

Introduction

Between 2000 and 2016 German Governments introduced, amended and extended the energy transition policy, Energiewende, consisting of the following core elements:

- Increasing the share of renewable resources in electricity production in Germany
- Phasing out of nuclear energy in electricity production in Germany
- Decreasing CO2 emissions in Germany
- Increasing energy efficiency in Germany

Questionnaire

You are kindly invited to answer all 20 questions below in reference to the mentioned core elements of the energy transition policy:

1. Did one or more of the following elements of your company changed between 2000 and 2016?

	Change yes/no?
1. Number of Employees	O yes O no
2. Turnover	O yes O no
3. Profit	O yes O no
4. R&D budget	O yes O no
5. Number of production sites in Germany and abroad	O yes O no
6. Number of industrial customers	O yes O no
7. Number of private customers	O yes O no
8. Other, _____	O yes O no
9. Other, _____	O yes O no

2. Could you indicate on a scale between 1 and 10 the significance of the energy transition for these changes in your company (1= not significant at all, 10= highly significant)?

1	2	3	4	5	6	7	8	9	10

2. Did the volume of resources your company used for electricity production change between 2000 and 2016?

	Change yes/no?	**Volume in 2000**	**Volume in 2016**
a) Peet	O yes O no O not used by company		
b) Coal	O yes O no O not used by company		
c) Natural gas	O yes O no O not used by company		
d) Nuclear	O yes O no O not used by company		
e) Wind	O yes O no O not used by company		
f) Biomass	O yes O no O not used by company		
g) Hydro	O yes O no O not used by company		
h) PV	O yes O no O not used by company		
i) Other _____	O yes O no O not used by company		
j) Other _____	O yes O no O not used by company		

3. Could you indicate on a scale between 1 and 10 the significance of the energy transition for the changes in the energy resources of your company (1= not significant at all, 10= highly significant)?

1	2	3	4	5	6	7	8	9	10

5. Could you indicate the share of renewable power in your resource portfolio?

	Share in %
a) 2000	
b) 2016	

6. Did the forseen shares of renewable power in the resource portfolio of your company change for 2020, 2025 and 2050 under the influence of the energy transition policy?

Forseen shares	**Change yes/no?**
a) for 2020	O yes O no
b) for 2025	O yes O no
c) for 2050	O yes O no

7. Could you indicate on a scale between 1 and 10 the significance of the energy transition for the changes in the energy resources of your company in favor of renewables (1= not significant at all, 10= highly significant)?

1	2	3	4	5	6	7	8	9	10

8. Could you indicate the share of nuclear power in your resource portfolio?

	Share in %
a) 2000	
b) 2016	

9. Did the forseen shares of nuclear power in the resource portfolio of your company change for 2020, 2025 and 2050 under the influence of the energy transition policy?

Forseen shares	**Change yes/no?**
a) for 2020	O yes O no
b) for 2025	O yes O no
c) for 2050	O yes O no

10. Could you indicate on a scale between 1 and 10 the significance of the energy transition for the changes in the energy resources of your company in disfavor of nuclear power (1= not significant at all, 10= highly significant)?

1	2	3	4	5	6	7	8	9	10

11. Were there entrepreneurial risks and costs for your company implied by the energy transition's policy?

O yes O no

12. If yes, which risks and costs resulted as a consequence of the transition's core elements?

Core element	Risks and costs
1. Increasing the share of renewable resources in electricity production in Germany	
2. Phasing out of nuclear energy in electricity production in Germany	
3. Decreasing CO2 emissions in Germany	
4. Increasing energy efficiency in Germany	

13. As a consequence of the energy transition's core elements, what measures did your company take in order to keep its earning capacity?

Core element	Earning capacity measures
a) Increasing the share of renewable resources in electricity production in Germany	
b) Phasing out of nuclear energy in electricity production in Germany	
c) Decreasing CO2 emissions in Germany	
d) Increasing energy efficiency in Germany	

14. Did regulatory uncertainties implied by the Energiewende have an effect on your company's planning reliability?

O yes O no

15. If yes, how?

_____

_____

_____

16. Was your company is in an advantageous position by sticking to the set regulations of the Energiewende?

O yes O no

17. If yes, why?

_____

_____

_____

18. How did your company's business strategy similarly secure present as well as future operations?

_____

_____

_____

19. Please rate what effects of the targets set by the Energiewende were implied on your company's entrepreneurial decision-making:

Effects	**1) Agree**	**2) Tend to agree**	**3) Tend to disagree**	**4) Disagree**
a) Innovation in business strategy				
b) Pressures in renewables				
c) Increased economic risks and costs				
d) Missing planning reliability				
e) Other _____				
f) Other _____				

20. I would like to end by asking: What is your position in the company?

_____

Thank you very much for your cooperation!

Please return the questionnaire via E-Mail.
If you are interested in the study's results, please remark that here: O yes O no
Your answers will be kept confidential.

Questionnaire.

Source:Own.

Energy generation capacity Germany in MW						Energy generation capacity Germany in %			
	Year	RWE	E.On	EnBw	Vattenfall	RWE	E.On	EnBw	Vattenfall
	2000								
Nuclear energy		.	8377	3674	.	33.50	28.87	35.98	.
Conventional power stations:		.	17744	3861	.	62.00	61.14	37.81	.
- Lignite		.	2077	.	.	.	.	.	.
- Hard coal		.	9794	.	.	.	.	.	.
- Natural gas		.	4721	.	.	.	.	.	.
- Oil		.	1152	.	.	.	.	.	.
Renewable energies/Other:		.	2900	2676	.	4.50	9.99	26.21	.
- Hydro		.	2854	2676	.	.	.	.	.
- Other		.	46	.	.	.	.	.	.
Total		.	29021	10211	.	100	100	100	100
	2001								
Nuclear energy		.	8437	3685	1622	18.50	33.91	34.22	11.67
Conventional power stations:		.	13524	4101	10410	44.80	54.35	38.09	74.93
- Lignite		.	2076	.	7440	.	.	.	.
- Hard coal		.	7230	.	1002	.	.	.	.
- Natural gas		.	3066	.	968	.	.	.	.
- Oil		.	1152	.	1000	.	.	.	.
Renewable energies/Other:		.	2920	2982	1861	3.50	11.74	27.69	13.40
- Hydro		.	2854	2982	1861	.	.	.	.
- Other		.	66	.	.	.	.	.	.
Total		.	24881	10768	13893	66.80	100	100	100
	2003								
Nuclear energy		5665	8473	5140	1409	16.78	33.72	33.86	8.94
Conventional power stations:		24636	13368	6718	11439	72.95	53.20	44.26	72.61
- Lignite		10413	1313	.	.	.	.	.	.
- Hard coal		10023	7416	.	.	.	.	.	.
- Natural gas		4200	3487	.	.	.	.	.	.
- Oil		.	1152	.	.	.	.	.	.
Renewable energies/Other:		3469	3289	3322	2907	10.27	13.08	21.88	18.45
- Hydro		.	3108	3226	2907	.	.	.	.
- Other		.	181	96	.	.	.	.	.
Total		33770	25130	15180	15755	100	100	100	100

Energy generation capacity Germany in MW						Energy generation capacity Germany in %			
	Year	RWE	E.On	EnBw	Vattenfall	RWE	E.On	EnBw	Vattenfall
	2005								
Nuclear energy		6308	8473	4843	771	18.88	33.07	34.54	5.10
Conventional power stations:		23848	13710	5919	11371	71.36	53.50	42.22	75.25
- Lignite		10135	1313	.	.	.	.	.	.
- Hard coal		9580	7451	.	.	.	.	.	.
- Natural gas		4133	3793	.	.	.	.	.	.
- Oil		.	1153	.	.	.	.	.	.
Renewable energies/Other:		3262	3440	3258	2970	9.76	13.43	23.24	19.65
- Hydro		.	3113	3226	2894	.	.	.	.
- Other		.	327	32	76	.	.	.	.
Total		33418	25623	14020	15112	100	100	100	100
	2008								
Nuclear energy		6295	8548	4846	771	18.86	34.13	32.31	4.83
Conventional power stations:		23816	13203	6585	12141	71.34	52.72	43.90	76.12
- Lignite		9608	1314	.	.	.	.	.	.
- Hard coal		10051	7475	.	.	.	.	.	.
- Natural gas		4157	3269	.	.	.	.	.	.
- Oil		.	1145	.	.	.	.	.	.
Renewable energies/Other:		3271	3292	3569	3039	9.80	13.15	23.79	19.05
- Hydro		.	2811	3472	2894	.	.	.	.
- Other		.	481	97	145	.	.	.	.
Total		33382	25043	15000	15951	100	100	100	100

Energy generation capacity Germany in MW						Energy generation capacity Germany in %			
	Year	RWE	E.On	EnBw	Vattenfall	RWE	E.On	EnBw	Vattenfall
	2011								
Nuclear energy		3901	5403	3333	0	12.47	26.02	24.87	0
Conventional power stations:		24582	12345	6986	11006	78.57	59.46	52.13	78.49
- Lignite		9799	852	.	.	.	.	.	.
- Hard coal		9555	6016	.	.	.	.	.	.
- Natural gas		5228	4599	.	.	.	.	.	.
- Oil		.	878	.	.	.	.	.	.
Renewable energies/Other:		2802	3015	3083	3016	8.96	14.52	23.00	21.51
- Hydro		.	2437	2770	2880	.	.	.	.
- Other		.	578	313	136	.	.	.	.
Total		31285	20763	13402	14022	100	100	100	100

Energy generation capacity Germany in MW						Energy generation capacity Germany in %			
	Year	RWE	E.On	EnBw	Vattenfall	RWE	E.On	EnBw	Vattenfall
	2012								
Nuclear energy		3901	5403	3333	0	13.06	26.84	24.87	0
Conventional power stations:		23172	11986	6995	11444	77.58	59.54	52.20	79.14
- Lignite		10331	852	.	.	.	.	.	.
- Hard coal		7632	5661	5021	.	.	.	.	.
- Natural gas		5209	4358	1154	.	.	.	.	.
- Oil		.	1115	.	.	.	.	.	.
Renewable energies/Other:		2797	2742	3072	3016	9.36	13.62	22.93	20.86
- Hydro		.	2165	2738	2880	.	.	.	.
- Other		.	577	334	136	.	.	.	.
Total		29870	20131	13400	14460	100	100	100	100
	2013								
Nuclear energy		3901	5403	3333	282	13.81	29.18	24.15	1.93
Conventional power stations:		21959	11004	7282	11340	77.71	59.42	52.76	77.50
- Lignite		10291	500	.	.	.	.	.	.
- Hard coal		6662	5279	5283	.	.	.	.	.
- Natural gas		5006	4121	1177	.	.	.	.	.
- Oil		.	1104	.	.	.	.	.	.
Renewable energies/Other:		2397	2111	3187	3010	8.48	11.40	23.09	20.57
- Hydro		.	1911	2845	2880	.	.	.	.
- Other		.	200	342	130	.	.	.	.
Total		28257	18518	13802	14632	100	100	100	100
	2015								
Nuclear energy		3908	4128	2933	282	14.75	28.16	22.69	1.73
Conventional power stations:		19984	8109	6394	12890	75.42	55.33	49.46	79.06
- Lignite		10221	500	.	.	.	.	.	.
- Hard coal		5352	3064	4831	.	.	.	.	.
- Natural gas		4411	3440	1180	.	.	.	.	.
- Oil		.	1105	.	.	.	.	.	.
Renewable energies/Other:		2604	2420	3600	3132	9.83	16.51	27.85	19.21
- Hydro		.	1923	2903	2880	.	.	.	.
- Other		.	497	697	252	.	.	.	.
Total		26496	14657	12927	16304	100	100	100	100

Appendix A – Incumbents' energy generation capacity in MW in Germany.

*Source: RWE Annual Report 2000 (p. 65), 2002 (p. 74)*Of 66.80% in-house generation, 2003 (p. 77), 2005 (p. 38)*Oil included in renewables/others, 2008 (p. 62)*Oil included in renewables/others, 2010 (p. 78) *Oil included in renewables/others, 2011 (p. 52)*Oil included in renewables/others, 2012 (p. 55)*Oil included in renewables/others, 2013 (p. 58)*Oil included in renewables/others, 2015 (p. 45)*Oil included in renewables/others; E.On Annual Report 2000 (p. 56), 2001 (p. 58), 2003 (p. 85), 2005 (p. 84), 2008 (p. 15), 2010 (p. 13), 2011 (p. 19**),** 2012 (p. 29), 2013 (p. 213), 2015 (p. 221); EnBW Annual Report 2000 (p. 36),*

*2001 (p. 61), 2003, 2005 (p. 111)*Generation mix in the EnBW group Electrical output, 2008 (p. 32)*Generation mix in the EnBW group Electrical output, 2010 (p. 38), 2011 (p. 40), 2012 (p. 47), 2013 (p. 32), 2015 (p. 67); Vattenfall Annual Report 2001 (p.19), 2003 (p. 49)*Electricity and heat, 2005 (p. 44)*Electricity and heat, 2008 (p. 124)*Business Group Central Europe (Germany and Poland) Electricity and heat, 2010 (p. 142)*Electricity and heat, 2011 (p. 130)*Electricity and heat, 2012 (p. 120)*Electricity and heat, 2013 (p. 130)*Electricity and heat, 2015 (p. 164)*Electricity and heat (The technical capacity of Krümmel nuclear power plant is 673 MW pro rata. However, Krümmel has no authorisation for power operation and is therefore reported as zero capacity.)*