Country Study - Germany

1 Germany in numbers

1.1 Economic and industrial structure

For a long time, Germany's energy system has been based on large coal and nuclear power plants to assure a steady and cost-efficient base load power supply. This energy system was built with massive infrastructure investments creating path dependence. Since the liberalisation of the market in the late 1990s this costly infrastructure is controlled by a very profitable and powerful oligopoly. The ambitious renewable energy targets of 60% renewables energy and 80% electricity by 2050 undermine the profitability of this oligopoly. Hence, the so-called conventional energy coalition - especially this oligopoly - wants to maintain the status quo and slow down the *Energiewende*, while the beneficiaries of the upcoming system - the sustainable energy coalition - try to accelerate the energy system transformation. Accordingly, both coalitions have a large interest to influence policy decisions in their favour. This means firstly that they try to set the agenda for energy policy, secondly that they lobby at legislative veto points, and thirdly that they constrain the implementation of policies.

Germany ranks by GDP as the fourth-largest economy in the world. In 2002, the country was the second largest consumer of electricity in Europe. In 2015, its electricity production totalled 645.6m kilowatt hours. The primary energy supply in Germany is based on a broad mix of different energy sources, which has changed in recent years, particularly at the expense of coal and natural gas, and renewable energies. Fossil fuels (mineral oil, coal, natural gas) account for almost 80% of primary energy consumption. In the area of electricity generation, brown coal is the most important source of energy with a share of almost 25%. Renewable energies are gaining in importance - today, every fourth kilowatt hour consumed is based on electricity from renewable energies.

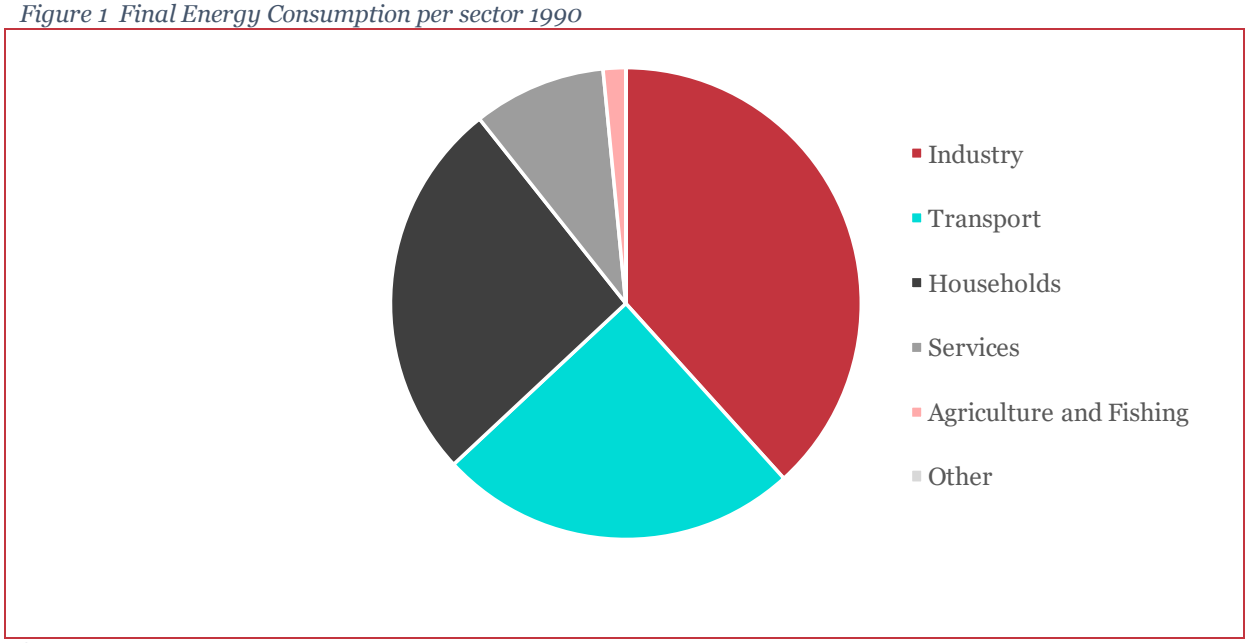
Since Germany only has relatively low reserves of energy fuels, essential parts of the energy supply must be covered by imported energy. This applies in particular to crude oil, which comes to almost 100% from foreign sources, as well as to natural gas which has to be imported by nearly 80%. Although coal has been still the most important source of energy in 2015, the importance of renewable energies continues to grow. While in 1990 only 4% of total electricity came from renewable energies, it was already 29% in 2015. Nuclear energy, on the other hand, loses relevance. In 1990, 28% of the total electricity was generated from nuclear energy, while this share fell to 14% in 2015.

In the industry sector, final energy consumption declined noticeably from 1990 onwards. This is mainly due to the decline in industry in the new federal states between 1990 and 1993. However, the development of consumption in recent years has also declined, so that industry is no longer the most consumption-intensive sector.

Approximately two-thirds of the final energy consumption is required for **process heat**. Mechanical energy, for example, for the operation of motors or machines, accounts for about a quarter of the consumption, space heat has only a small share. In the **transport sector**, fuel consumption has risen slightly in the last 25 years. Since 1990, **private households** also need more energy. The room heat now accounts for about three quarters of the energy consumption in households, since over the years, among other things, the living space to be heated has increased. The sector of **trade, commerce and services** also depends on the heating behaviour. Space heat here accounts for half of the final energy consumption. At the same time, the current share is relatively high, which is due to the increased use of lighting and mechanical energy. Since 1990, however, the final energy consumption has also declined in this sector (UBA, 2010).

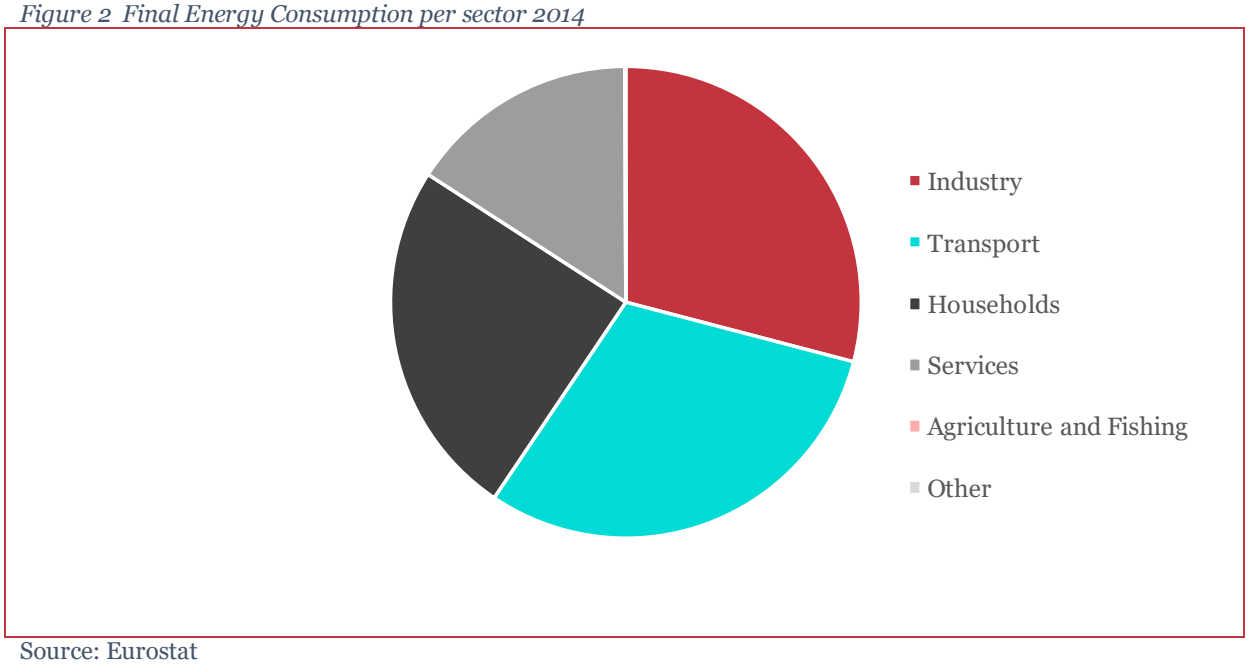
1.2 Main indicators on energy generation and usage

Figure 1 Final Energy Consumption per sector 1990



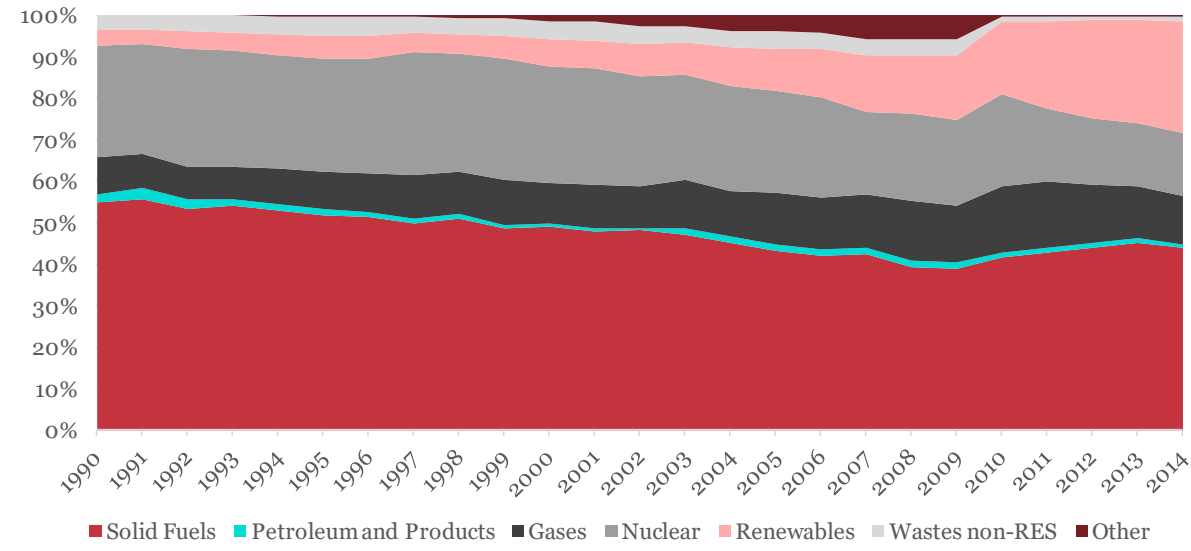
Source: Eurostat

Figure 2 Final Energy Consumption per sector 2014



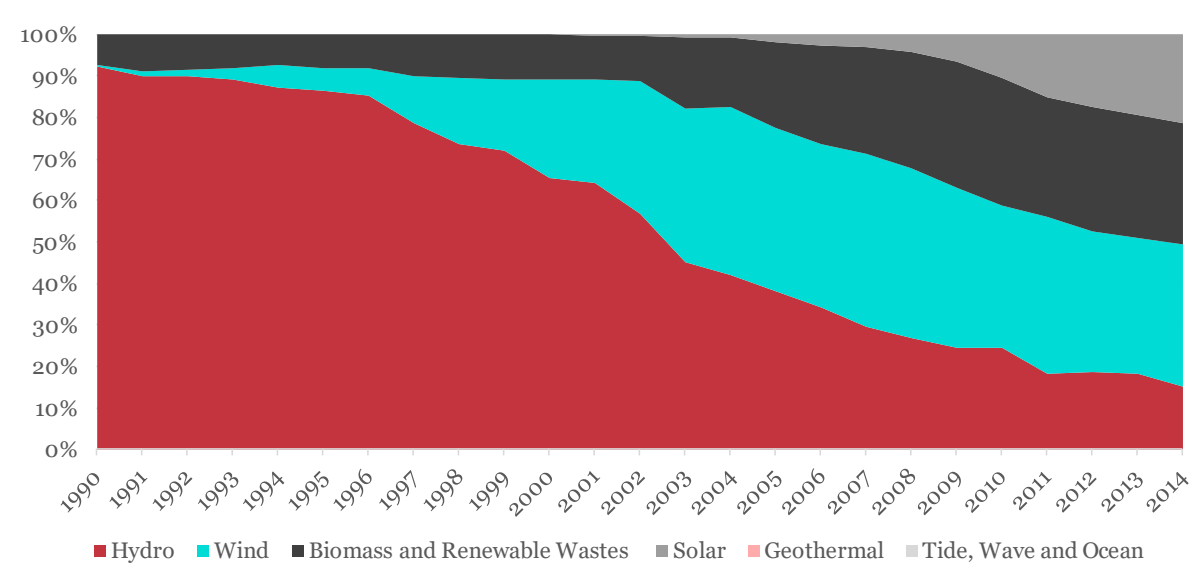
Source: Eurostat

Figure 3 Gross Electricity Generation by Fuel



Source: Eurostat

Figure 4 Gross Electricity Generation Renewables



Source: Eurostat

2 Culture and history around energy policy

2.1 Policy history, informal rules and structures, events that shaped the country's energy transition

The key drivers of the energy turnaround in Germany

The energy turnaround (*Energiewende*) is based on a technological transition process from a fossil fuel based energy system to a post-fossil energy system. But the *Energiewende* is not only technology-driven, the energy turnaround is a complex transition process affecting society. The *Energiewende* is embedded in institutional reforms and it modifies traditional constellations and interactions of actors

involved in the process. As one of the world's most ambitious and comprehensive national energy transition initiatives, the *Energiewende* in Germany has attracted massive attention in policy circles outside Germany. The opinions range from positions that consider it as a model to be emulated to ones of harsh criticism dismissing the German energy transition as illusionary and over-costly. To provide grounded insight for comparable energy transition processes elsewhere, it is therefore necessary to understand the historic origins and key drivers that have changed the energy system in the German context.

For a long time, the energy industry in Germany was a field of less specialised actors: large energy supply companies, municipalities, and the federal and regional and government policymakers. This has changed significantly. The *Energiewende*n is a task for a large variety of actors with very different spatial perspectives and interests. These include land circuits, regional planning centres, network operators, energy utilities, energy cooperatives, plant manufacturers, municipalities, consultancy and research facilities and other actors in the field of renewable energy, as well as protest groups, and environmental initiatives against the expansion of renewable energies.

Although the German *Energiewende* is commonly associated with the country's post-Fukushima national energy policy, it is neither a recent, nor a purely government-led phenomenon. The nuclear phase-out of 2011[1] only marks the latest in a series of policy actions in response to a history of nuclear scepticism that has long been entrenched in German society. This scepticism is also related to climate change and sustainable development, issues that have been prevalent in the public discourse for several decades, and not only with regard to energy policy issues. In fact, the public discourse about renewable energy was launched by concerned citizens already in the early 1970s. This debate, which started out as a marginal discourse, attracted some attention by a broader audience through the landmark publication "*Energiewende* - Growth and Prosperity without Oil and Uranium" in 1980, which not only coined the term, but also suggested some of the key instruments for promoting the renewable energies that still constitute Germany's energy policy today, such as priority grid access and long-term guaranteed feed-in tariffs to provide a stable investment framework for the expansion of renewable energies.

In order to analytically describe the key drivers of the transition, several different groups have to be distinguished. On the one hand, the four major energy suppliers (E.ON, RWE, EnBW, and Vattenfall) play an important role since they owned 82% of the energy production facilities by 2004 and produced about 90% of the electricity. Other groups that historically exerted a decisive influence on the transformation of the energy system have been civil society and political movements that started to shape in the aftermath of the Chernobyl reactor accident. The ecological and anti-nuclear movements certainly set the pace for the growing importance of environmental issues in national politics and formed the breeding ground for the first renewable energy diffusion policies that were adopted by the German government since the early 1990s. But even though the first programmes to promote photovoltaic power and the first feed-in tariff for wind, hydropower and certain bio-based energies both stimulated investments in some fields of renewable energy, their real impact was then only marginal. This changed with the passing of the Renewable Energy Act (EEG) in 2000. The EEG, which provided a more stable framework, has been particularly important for the development of investment-intensive technologies such as photovoltaics. On the other hand, the interplay of government in its law-making function in the field of electricity power supply legislation with the civil society and its attitude towards certain forms of electricity production also had important implications for the shaping of the path of the energy transition process in Germany.

Three phases of the Energiewende

To understand the German energy transition, it is important to distinguish three relevant periods. As the **first major phase** can be defined the period from 1998 to 2005. In 1998, the Law on Electricity

[1] The reactor meltdown in Fukushima in Japan was a turning point for Germany's energy groups. In March 2011, the Federal Government imposed a moratorium on several nuclear power plants. In August, eight reactors were permanently removed from the grid and the Bundestag took a decision about Germany's final exit from nuclear power generation by the end of 2022.

and Gas Supply (*Energiewirtschaftsgesetz* EnWG) was adopted, which also took into account a directive to liberalise the EU electricity market. This led to the emergence of the four players from previously eight incumbent power suppliers. With the adoption of the EEG in the year 2000, the government created incentives for renewable energies, which increasingly became a potential competition for the four big energy suppliers. Through the EEG, feeders of renewable energy were guaranteed a minimum remuneration for a period of 20 years in order to ensure planning security. The decisive factor was that renewable energy was not subject to the laws of the free market. This gave the new market entrants as drivers of the expanding renewable energy sector an advantage over the incumbent electricity producers. The Big Four, on the other hand, were faced with the dilemma that investing in renewable energy would be conducive to competing against their traditional (i.e. coal-based) electricity production. In early 2005, the European Parliament launched the ETS on CO_2 emissions. Nuclear power has also been subject to increasing political regulations. As a consequence, the building of new nuclear facilities was forbidden in the aftermath of the nuclear consensus in 2000.

The **second major phase**, which can be dated between 2005 and 2011, was characterised by the financial losses of the big four energy providers. In this phase, social movements from civil society also played an important political role, which increasingly questioned the legitimacy of coal production. By highlighting that in Germany ecological motives seem to be more important than economic necessities, the big four electricity power suppliers drew a gloomy picture of deindustrialisation and the declining international competitiveness of Germany. Through the change of government in 2005, they also took up their lobbying activities against the EEG.

The period from 2011 to 2013 can be defined as a **third phase** of the *Energiewende* in Germany, which placed the incumbent energy suppliers in an extremely disadvantageous situation. Three factors can be identified that significantly deteriorated their situation.[2] On the one hand, the reactor accident in Fukushima with the consequence of the immediate shutdown of 8 reactors in Germany and a new dealing with the topic of atomic energy. On the other hand, the big four had to accept further losses through the EEG. During this period, in which the unfavourable market developments exacerbated the economic woes of the Big Four, they also became increasingly aware of the mounting pressure political decision-makers are facing due to the general public disapproval of nuclear and coal-based energy. Since 2010, an increasing boom in the photovoltaic industry can be observed that has also been under continuous criticism by the big four energy suppliers.

In general terms, it can be affirmed that the German energy transition process has been (and continues to be) deeply anchored in the population. According to a recent opinion survey commissioned by the German Association of Energy and Water Industries (BDEW), the overwhelming majority of Germans continue to advocate the energy transition. 93% of the citizens declared that further expansion of renewable energies is "important" or even "extremely important". Renewable energy also performed above-average on the question of the acceptance of power stations in their own neighbourhood. 68% of the respondents rated renewable energies as "good" or "very good" at their own place of residence. For conventional power plants, approval was significantly lower: gas 25%, coal 7%, nuclear power 4%. At the same time, 69% of respondents expect electricity prices to rise as a result of energy consumption, which confirms the broad-based acceptance of the energy transition.

The *Energiewende*, launched by the Federal Government in 2011, is a large-scale political project. For the Scientific Advisory Board of the Federal Government “Global Change in the Environment” (WBGU) it is tantamount to a "great transformation" with a profound transformation of our society. However, local protests opposing individual energy projects – such as the expansion of wind power, the electricity grid or biomass cultivation – abound. In recent years, there have been numerous

[2] RWE's net profit fell by a quarter from 7.7 to 5.8b € in the energy turnaround year 2011. Industry leader E.ON even recorded a loss of 1.9b € after a profit of 6.3b € in the previous year. The reasons for this were not only profits lost from the operation of the nuclear power plants, but also one-time provisions for their decommissioning, the new nuclear fuel tax, high losses in the gas business and, in the case of E.ON, the recession in southern Europe.

protests against various projects in Germany regarding the concrete implementation of the establishment of renewable energies. Since this seems to contradict the high rate of consent to the need for renewable energies, such behaviour is usually identified in the German context with a "not in my backyard" mentality. Until now, three particularly relevant characteristics of such protest movements have been identified. On the one hand, a necessary change in personal lifestyle is feared. Also, the reasons for protesting against projects and instruments of energy production can be manifold. To summarise, the argumentation patterns of the opponents of the energy transition in the German context recurrently revolve around two central aspects: Transparency or more participation in planning procedures, and the importance of nature conservation and landscape aesthetics. Conflictive fields of action are: The construction of wind power plants, the installation of land photovoltaics, the expansion of the electricity grid, and the implementation of the EEG levy.

In sum, there are three factors that have been confirmed by our interview partners which decisively shaped the *Energiewende* process in Germany thus far. **First**, there is a growing variety of actors with specific interests in the energy market. Many new suppliers such as farmers, municipalities or non-industry companies are discovering the market for themselves.[3] But despite the large number of actors and their specific interests, the formation of coalition camps in established and new ones can be identified. The established ones in the energy market are grouped in the Federal Association of Energy and Water Management (BDEW), a huge network of 1.800 members from municipalities to energy groups with a diversity of interests and business models. The new actors have joined forces in the Federal Association for Renewable Energies (BEE), which is composed of 24 trade associations, such as the Federation of Solar Energy, whose members benefit greatly from the state's promotion policy. **Second**, the European Union urges to open the energy market. The process of opening and liberalising national electricity markets was mainly driven by the three EU internal market packages from 1996, 2003 and 2009. These led to an opening up of the existing national supply monopolies and thus to the emergence of competition in the end customer markets[4], to the unbundling of electricity networks and generation as well as to the establishment of national regulatory authorities – the Federal Network Agency (*Bundesnetzagentur*) in Germany and the creation of a central European Agency (ACER – Agency for the Cooperation of Energy Regulators) for their cooperation. **Third**, the power of renewable energy suppliers is increasing.

Key stakeholders shaping the Energiewende

In Germany, a great variety of stakeholders shape the transition process of the *Energiewende*. This includes stakeholders from the different spheres of politics, business, science, and civil society initiatives. Important representatives from the sphere of science are the **research institutes**, such as for example the **German Institute for Economic Development** (DIW Berlin), the **German Centre for Aerospace** (DLR), or the **Fraunhofer Society for the Advancement of Applied Research**.

In the past, and even today, **lobbying associations** also played a major role in policy-making in the field of renewable energies. Particularly, the lobby groups associated with the Big Four play a prominent role here, as they are of relevance to the energy market as the central energy providers in Germany.

[3] For example, Volkswagen and Telekom have discovered the trend towards decentralised energy supply as a business segment. Both companies have recently been offering small-scale power plants to home-owners.

[4] The liberalisation, which was the result of a comprehensive paradigm shift, created competition both on the production side and on the consumption side in order to achieve lower prices, especially for industrial end users. The network in Germany, however, was not liberalised because of its property as a natural monopoly.

The lobbying has been done in two different ways. One variant has been top-down, in which contacts with high-ranking politicians such as ministers, for example, play an important role. Due to the already mentioned strong position in the German energy supply market, the CEOs of the Big Four have direct contacts with the ministers up to the Federal Chancellery. Their political influence is therefore particularly strong. Energy suppliers from the renewable energy sector do not yet have this influence due to the still missing contacts, which is why they prefer to follow the model of bottom-up lobbying. Their approach is geared towards reaching a certain quantity of politicians or policy shapers. In addition, one important avenue of influencing policy shapers is through the scientific employees of politicians, since they act as gatekeepers to the politicians. However, it is not only the contacts through which lobbying organisations have a bearing on the shaping of policy and decision making. The possibility of mobilising resources is also an important factor in this process. Obviously, the Big Four have a greater potential to mobilise financial resources and to use it for professional lobbying as opposed to the renewable energy providers. Interestingly, the influence of the lobby groups linked to the Big Four has steadily declined despite a stronger focus on the energy supply market and the greater mobilisation of resources. In particular, the civil society-based environmental movement has decisively contributed to this shift.

Table 1 – Stakeholder type mapping

	High power	**Low power**
High interest	• Nuclear industry / energy supply companies (RWE, E.ON, Vattenfall, EnBW) • Transmission network operators (50Hertz, Amprion, TenneT, TransnetBW) • Utilities • Industry associations (Federal Association of Energy and Water Management - BDEW, Federal Association of Industry – BDI, Federal Association of Renewable Energies - BEE, Association of Municipal Enterprises – VKU) • Research networks (Renewable Energies Research Network – FVEE) • Scientific institutions (German Institute for Economic Development – DIW, Helmholtz Association of German Research Centers, Max Planck Society)	• Farmers (German Farmers Association – DBV) • NGOs (Greenpeace, *Naturschutzbund Deutschland* – NABU, World Wide Fund for Nature – WWF) • Think Tanks (*Agora Energiewende*)
Low interest	• Labour organisations (German Trade Union Confederation – DGB)	

Since the production of wind, solar and bioenergy takes place mainly in rural areas on agricultural and forestry land, interest groups from agriculture, forestry and rural areas are also a significant voice in this process. Here, it is worth mentioning the strong influence of interest groups in support of renewable energy, such as the farmers[5] and the home-owners who are specifically interested in stable and favourable feed-in tariffs.

In general, the communication of interests in the process of shaping the *Energiewende* is very decentralised. This means that the focus of strategic lobbying activities is increasingly on regional and local projects, e.g. the construction of a wind park. If influence on the shaping of the transition to renewable energies is exerted at the level of cities, villages or regions, it is important to involve these

[5] For example, through the German Farmers Association DBV.

new actors with their specific interests. In this sense, one important actor that is carrying out lobbying activities at multiple levels, thus virtually reaching from the local mayor to chancellor Merkel, is the **Association of Municipal Enterprises** (VKU), in which nearly 400 enterprises are organised. The central focus of the VKU is on the overall economic development of the municipalities in which the companies are based. For example, the association is massively lobbying in favour of the promotion of a new type of cogeneration power station, which is widespread among the members of the VKU, generating energy and useful heat at the same time.

The following table lists some of the most important types of stakeholders that shape the *Energiewende* in Germany.

3 Formal rules and instruments

3.1 Laws and regulations

Plans, laws, and regulations with respect to energy and climate

The German *Energiewende* is nationally framed by two key documents, namely the **Renewable Energy Act** (EEG) and the **Federal Energy Concept**. These two documents state that Germany's nuclear power plants will be phased out by the end of 2022, and that its current energy system will become strongly reliant on renewable energy sources by the year 2050. The main sources of energy are expected by then to be solar energy, wind power, hydropower, biomass and geothermal energy. Specifically, the German Energy Concept sets out medium to long-term targets for the reduction of energy use and greenhouse gas emissions as well as clearly defined goals for the increase of energy efficiency.

The EEG is based on a series of German laws that originally provided a feed-in tariff scheme to encourage the production of renewable electricity. The Act came into force in April 2000 and has been adapted several times since. The original legislation guaranteed a grid connection, preferential dispatch, and a feed-in tariff set by the government for the duration of 20 years. The EEG was preceded by the Electricty-Feed-in Act from 1991. Since its enactment, the EEG has been credited with a swift uptake of wind power and photovoltaics. Beyond that, the Act has also covers biomass (including cogeneration), hydroelectricty, and geothermal energy. On balance, it has been regarded on the national and international level as an innovative and very successful policy instrument.

The German **Act on Electricity and Gas Supply** (*Energiewirtschaftsgesetz* - EnWG) came into effect for the first time in 1935 and was last revised in 2005. It contains basic regulations on the right of line-bound energy. The Act aims at ensuring the most efficient and environmentally compatible public supply with electricity and gas, which should as much as possible be safe, inexpensive, consumer-friendly and increasingly be based on renewable energies. In addition, the EnWG pursued the goal of implementing the existing energy legislation of the European Community.

The achievement of these objectives should be ensured by several means and measures. This includes, among other things, an authorisation and notification obligation with the aim of limiting free price formation and ensuring the intervention right of the Federal Network Agency (*Bundesnetzagentur*) as the regulatory body. Furthermore, the electricity grid is regulated by the respective network operators under the authority of a state regulator (the Federal Network Agency) or the respective regional state regulatory authorities. These ensure that the networks are not misused. They also monitor the rules on network unbundling and the system responsibility of the network operators. Since January 1, 2009, they have also set the framework for incentive regulation. To further define the content of the EnWG,

several regulations have been adopted. The electricity network access regulation, the electricity network allocation, the electricity supply regulation, and much more.[6]

The **Renewable Energies Heat Act** (EEWärmeG) is a German Federal Law which, in addition to the Renewable Energy Act (EEG) concerning renewable energies and the biofuel law regulates the use of renewable energies in the field of fuels and the expansion of renewable energies in the heat and cold sector in the energy supply of buildings. It entered into force on 1 January 2009. The purpose of the EEWärmeG is to enable a sustainable development of heat and cold supply in the interests of climate protection, the conservation of fossil resources and the reduction of dependency on energy imports and to promote the further development of technologies for the use of renewable energies. The bill is also intended to help boost the share of renewable energies in final energy consumption for heating and cooling by 2020 to 14 percent. The Act is part of the **Integrated Energy and Climate Program** (IEKP), which was adopted by the Federal Government on 5 December 2007, and introduces an obligation to use renewable energies for new buildings for the first time nationwide. To this end, the EEWärmeG stipulates that the heat demand for new buildings to be erected be covered proportionally with renewable energies. The obligation consists of a usable area of more than 50 square meters. The addressees of this obligation are all owners of newly erected buildings, irrespective of whether they are public or private builders. The owner can decide which type of renewable energy is to be used. There are some minimum requirements. Thus, a certain minimum proportion of the total heat and / or cold requirement must be generated with renewable energies. The share depends on which renewable energies are used. When using thermal solar radiation energy, at least 15 percent of the building's heat and cooling energy needs to be covered by a thermal solar thermal system, while 50 percent of geothermal energies is used. The background to the different quotas is different investment and fuel costs.

In addition to the Act, the Federal Government is promoting measures to use renewable energies in the thermal market from the so-called **Market Incentive Programme** (MAP). The objective of the MAP is to support the market penetration of renewable heat and cooling technologies through investment incentives. In so doing, MAP primarily promotes the construction of plants for the use of renewable energies in existing buildings. Eligible are solar thermal plants, biomass plants and heat pumps as well as deep geothermal energy plants, heat networks and heat storage. With the improved and revised MAP, which entered into force in April 2015, the existing funding levels were expanded, the promotion was made more attractive and new, innovative technologies were included in the funding. The MAP is based on two pillars. On the one hand, on subsidies from the budget of the Federal Office of Economics and Export Control (BAFA) for smaller investments in private households and companies. These include solar thermal collectors on the roof, pellet heaters in the basement and efficient geothermal heaters in the garden for the heat pump in the house. On the other hand, the *Kreditanstalt für Wiederaufbau* (KfW) provides low-interest loans and repayment grants for large, commercial plants - which can be used for laundries, hotels or municipal self-employed enterprises, who invest in renewable process heat, build biomass cogeneration plants or heat networks designed for this purpose.

With the new **Energy Efficiency Incentive Programme** (APEE), since 1 January 2016, the Federal Ministry for Economic Affairs and Energy (BMWi) has been setting new standards in several areas to accelerate comprehensive modernisation. This aims to achieve further energy and cost savings, as well as a significant reduction in CO2 emissions. APEE also includes a so-called heating package: Additional subsidies are given to those who replace an outdated heating system with a modern, much more economical one – and at the same time optimise the heating system e.g. by insulating the heating pipes or installing modern thermostat heads.

With the **National Action Plan for Energy Efficiency** (NAPE), the Federal Government has presented a strategy to reduce primary energy consumption by 20 percent by 2020, and even halve by 2050. NAPE is therefore an important control instrument for energy efficiency policy in Germany. It is

[6] A further measure by the EnWG is the supply of final consumers by contracting constraints. This includes the supply to the general public, in particular by the grid connection claim and the network access claim of the last consumer as well as the obligation to contract the basic provider.

based on three pillars: energy efficiency in the building sector, energy efficiency as a return and business model, as well as an increase in self-responsibility to energy-efficient action. The central strategy of NAPE is based on the "Informing - Promoting - Demanding" model. All social actors are to be addressed, for example municipalities, businesses and consumers. Therefore, the special focus of NAPE is on the expansion of information and advisory services. To promote appropriate measures, a new competitive tender model for electricity efficiency and a support program for waste heat avoidance and waste heat utilisation were integrated into the model. Under the item "Demanding" (Fordern), the action plan commits large companies to energy audits and establishes standards for new plants and new buildings. In addition, companies should define joint efficiency targets in up to 500 energy efficiency networks and implement them in the group.

Means of monitoring

In order to monitor the development of the energy supply continuously and in detail and to intervene in the event of target deviations, the Federal Government has launched the monitoring process 'Energy of the Future'. This national monitoring accompanies the development of the energy transition process on an ongoing basis. The key question is: Where does the energy transition stand? What measures have been implemented? Which effects have been unfolded? And, will the goals be achieved?

The task of the monitoring process is first to summarise the multitude of available energy-related information and make it comprehensible. Already implemented measures are part of the analysis, as well as the question, in which areas future efforts are necessary. This gives an overview of the state of the energy supply every year. The monitoring process has three main tasks: overview, evaluation and outlook. It therefore continuously accompanies the development of the energy transition.

- Overview: The monitoring process provides a fact-based overview of the current status of progress with regard to implementation of the energy reforms. It condenses the reams of statistical information on energy that have been collected into a smaller, more manageable number of selected indicators.
- Evaluation: Ongoing reports analyse whether the tar- gets set out in the Federal Government's Energy Concept are being met and what effect the measures are having. In areas where the targets are likely to be missed, measures are proposed to enable these targets to be met.
- Outlook: The monitoring process also looks ahead to the next few years. To this end, the Federal Government produces summary progress reports every three years, presenting likely developments and deriving recommendations for action.

The annual monitoring report is the core of the energy transition monitoring process. It condenses the multiplicity of available energy-related information to a manageable number of selected parameters and makes them understandable. The data provide a fact-based overview of the progress made in the implementation of the energy transition.

The progress report is published every three years. It is based on a multi-year data base. In this way, more reliable trends are identified for possible further development. In addition, the existing measures for the implementation of the energy conversion are described and evaluated. Through more in-depth analyses and the reconciliation of the status quo and the quantitative and qualitative objectives of the energy concept, the achievement of the goals from the energy concept is being examined.

What regulations are debated?

The Federal Ministry of Economic Affairs and Energy (BMWi) has conducted a broad consultation process on the electricity market of the future. The focus is on the question of which electricity market design can ensure a safe, cost-effective and environmentally compatible supply of electricity, even with high proportions of renewable energies. The BMWi published a **Green Paper** process in October 2014, which as published in March 2015. The transparent procedure has attracted a great deal of

interest: associations, trade unions, businesses, research institutions, authorities and citizens have participated in the consultation. A total of around 700 comments were received.

The BMWi also comprehensively evaluated this consultation and subsequently published a **White Paper** that provides a detailed evaluation of the consultation. The contributions reveal clear trends: the participants expressed broad support for the measures proposed in the Green Paper and the capacity reserve. In the basic decision on an additional capacity market, the consultants have different positions. However, they share three concerns:

- The future electricity market design shall ensure security of supply;
- It shall limit costs, and
- It shall enable innovation and sustainability.

The existing electricity market is further developed into an electricity market 2.0. This basic decision is based on the consultation of the Green Paper, and numerous discussions with stakeholders in society. The BMWi rejects a capacity market and is committed to the liberalised European electricity market.

The electricity market 2.0 is implemented by means of 20 concrete measures. The free price formation on the electricity market is anchored in the **Act on Electricity and Gas Supply** (EnWG). At the same time, market operators receive stronger incentives to secure their electricity supplies. These first measures strengthen existing market mechanisms. This allows the electricity market to refinance the required capacities. Several further measures ensure flexible and efficient power supply. These include, for example, new fields of cooperation for the European electricity markets, the further development of the regulatory energy markets and the design of the grid charges, to enable this market-driven behaviour on the demand side. A capacity reserve secures the electricity market 2.0. In contrast to the capacity market, capacity reserves only include power plants that do not participate in the electricity market and do not distort competition and price formation.

An important example for a key debate in the context of the energy transition process in Germany has been focused on the expansion of the electricity network. Power grids are indispensable for the energy supply. They transport electricity from power plants to factories and households. But through the *Energiewende*, the points at which electricity is fed into the grid are being re-located. So far, a large part of the electricity that is fed into the grid came from coal-fired plants in the area of the Ruhr and nuclear power plants in southern Germany. So far, a large part of coal-fired power plants in the Ruhr and nuclear power plants in southern Germany are coming. However, nuclear power plants and fossil-based plants are increasingly being replaced by renewable energies. Most of these plants are expected to be in the north of Germany though, away from the main areas of consumption. The electricity should be transported through new power grid lines into the industrial conurbations in the west and south of Germany.

To avoid erroneous planning, the expected demand for new lines for the years 2022 and 2030 in Germany has been determined in the **Network Development Plan** (NEP), which is presented annually by the four transmission networks operating in Germany (50Hertz, Amprion, TenneT and TransnetBW) since 2012. The NEP is reviewed and confirmed by the Federal Network Agency. As a neutral authority, it is looking for the best possible expansion of the electricity grid.[7]

The NEP discusses the extent to which the transmission networks should be expanded over the next 10 to 20 years to transport the increasing share of electricity generated by renewable energies and to guarantee system security and grid stability. In the creation of the NEP, a multi-stage process is applied to inform and engage the public, i.e. associations, politicians, NGOs, downstream operators and municipalities, citizens' initiatives and private individuals, as well as the responsible government agency of the Federal Network Agency. This development process is divided into eight steps:

[7] The costs for operation and new construction are borne by consumers via grid charges. In 2011 they accounted for 20 percent of the electricity price. Network operators estimate that the expansion of the transmission network will cost around 20b € by 2022.

- The scenarios (expected changes over the next 10 to 20 years)
- Consultation of the scenarios (submission of a scenario at the Federal Network Agency - Consultation of the public and downstream network operators - Authorization of the scenario by the Federal Network Agency)
- First draft of a NEP
- Consultation of the first draft of the NEP (handover of the draft to the Federal Network Agency) Public consultation of the draft. Public participation in the dialogue on network expansion.
- Revision of the first NEP draft
- Review of the second NEP draft (including strategic environmental assessment - summary in an environmental report)
- Consultation of the final NEP draft
- Confirmation of the NEP by the Federal Network Agency (which is submitted to the Federal Government as a draft to the Federal Network, which then decides on the federal requirement plan, thus establishing the necessity and requirements of the measures)

Table 2 – Overview of policy instruments per function

Targets and regulations				
Target 2030				
Target 2050	• Reduction of energy consumption to 105.4 TWh	• Reduction of energy consumption to 497.5 TWh • Reduction of process heat by 42% • Better heat protection • Use of waste heat from industrial processes	• Increasing electro-mobility • Increasing the efficiency of vehicles • Distribution of plug-in hybrids • Final energy consumption should drop by 40% (compared to 2005) • Halving CO_2 emissions in air transport	• Reduction of total electricity consumption to 506 TWh
Special/additional regulations or targets				

3.2 Energy policy and instruments

The energy policy of the Federal Republic of Germany is geared to the overall objectives, which are defined by the energy demand, the climate and energy measures of the European Union and international obligations on climate protection. International commitments to climate protection result, for example, from the climate change convention or the Kyoto Protocol. Because of the link between the use of conventional energy sources such as coal, oil and natural gas and climate-friendly emissions of greenhouse gases, European and national energy policies are closely intertwined with climate policies.

The implementation of the overarching policy objectives is defined in Germany in the action plans or action programs. There is the National Action Plan on Energy Efficiency, the National Action Plan for Renewable Energies and the Action Program for Climate Protection 2020. These national action plans identify individual policy instruments at the federal level. There are also instruments which are implemented directly at European level, such as the European Union's emissions trading scheme. At the level of the federal states there are also energy policies and corresponding policy instruments. These policy instruments are all initiated by state action. In addition, there are also policy instruments which are wholly or partly initiated by non-state actors. These include, for example, voluntary agreements between economic operators to increase energy efficiency.

The energy policy instruments have their roots both in economic policy and in environmental policy. In addition, there are instruments of research policy and innovation policy. Research and innovation make an important contribution to addressing the challenges of energy and climate protection. In a broader sense, this also includes development policy instruments which are intended to ensure a global diffusion of renewable energies and access to energy for all. There are also references to energy policy on foreign policy and security policy. One example of this is initiatives to ensure the supply of gas and oil.

The German Renewable Energy Act (EEG) regulates the preferential supply of electricity from renewable sources to the electricity grid and guarantees their producers fixed feed-in tariffs. While the EEG proved to be highly successful regarding the expansion of renewable energies, its economic and ecological efficiency as well as partial aspects such as exemptions for the industry are controversially discussed.

With the EEG, network operators are obliged to take electricity from renewable energies as a matter of priority and, as a rule, to compensate them well above the market price. For this purpose, the law regulates the grid connection of systems in which electricity is produced from renewable energies. It also determines the remuneration paid by the plant operator for the electricity produced per kilowatt hour within a given period.

Against this backdrop, operators of renewable energy plants receive a fixed compensation or a so-called market premium for their electricity per the EEG. This creates a high degree of investment security for plant operators and leads to very low risk spreads (especially credit costs) for new investments. Reliable electricity sales also enable the energy market, which has so far been dominated by the four large energy suppliers. Renewable energies now cover a quarter of the electricity demand thanks to the EEG. They have become the most important supplier of electricity from a niche supplier. The funding structure of the EEG must be adapted to this situation. It is currently leading to overfunding and a disproportionate increase in the EEG levy within a short period. It also hinders the rapid marketability of renewable energies.

The legal digression of remuneration rates leads to a lower feed-in tariff for electricity from renewable energies, the later a plant is put into operation. This means that electricity from newly erected plants receives less subsidies than electricity from older plants. Plant operators can expect a fixed, legally guaranteed feed-in tariff for 20 years. EEG funding is digressive to stimulate developmental progress.

At present, the levy is 6.17 cents / kWh and increases by around 0.18 cents / kWh to 6.354 cents / kWh for 2016. Between 2012 and 2014, the EEG levy rose sharply from 3.59 cents / kWh to 6.24 cents / kWh.

Table 3 – Overview of policy instruments per function

Instrument				
Economic	• Promotion through KfW and BAFA		• Vehicle tax exemption for ten years with a CO_2 emission below 50 grams per kilometre when purchased until December 31, 2015. • License plate: Drivers that own an electric vehicle as a second car only need one licence plate and save an insurance premium • Purchase premium for the purchase of an electric vehicle (responsible for this is the BAFA)	
Information, education, networks			• Research, development and demonstration are promoted at the national level. The federal government also provides support for education and training.	
Policy and regulations	• EU Directive 641/2009/EG • It is only permitted to use speed-controlled high-efficiency pumps • Energy efficiency strategy for buildings • Energy Saving Law (EnEG) • Heat costs regulation • Renewable Energies Heat Act (EEWärmeG)	• Law for the Conservation, Modernisation and Expansion of Combined Heat and Power (KWKG)	• Special parking spaces and loosening of access bans for electric vehicles • Possibility for electric vehicle drivers to use bus lanes • CO_2 limit for new vehicles • Improvement of cycling infrastructure	
Research and development				
Voluntary instruments				

3.2.1 Space heating

In Germany, around 40 percent of final energy is consumed in buildings, mainly for heating and hot water. The acquisition of a new heating system, such as a gas or oil condensing boiler, a combined heat and power plant or a district heating connection is supported by the *Kreditanstalt für Wiederaufbau* (KfW). The change from oil to a gas heating, or vice versa, is encouraged. Here, the promotion is

divided in two types, credit and subsidy, whereby the subsidy is granted only for buildings with up to two residential units. In contrast to all other individual measures (roofing, insulation, windows), the KfW offers separate packages for the optimisation of heaters and ventilation systems, which receive higher funding (15 percent instead of 10 percent). If these packages are combined with another individual measure, the total funding will be raised to 15 percent. If a heating system is to be deployed in which regenerative energies are used or the ambient energy is used, these systems are promoted by the BAFA. Contrary to the funding from the KfW, BAFA funding is applied can be applied for only after the installation of the heating system. To be eligible for funding, the building must not have been erected after 2009.

3.2.2 Industrial heat

Despite a predicted increase of industrial production of 35%, the total final energy consumption in the industry sector will decline by 2050. This means that the efficiency increases overcompensate the impact of the production increase.

The energy requirement to produce **process heat** continues to account for the largest share of industrial end-energy consumption. The energy consumption for producing process heat, which is related to the value added, will fall by an average of about 42% by 2050. Efficiency gains can be achieved with the use of electronic process control systems, heat recovery, reduction of exhaust gas losses, new process design and the substitution of fuel-driven furnaces by electric furnaces. The remaining process heat is provided by electricity, combined heat and power with biogas for high-temperature process heat, coke for iron production and other fuels.

The energy requirement for **mechanical energy** will be reduced by one third by 2050. This is achieved by the recovery of mechanical process energy, the adaptation of the plants to the actual requirements, measures to improve the efficiency as well as the dimensioning of motors and drive machines as required. Furthermore, efficient compact fluorescent lamps and light-emitting diodes enable the consumption of electricity for lighting purposes to fall significantly by 2050.

3.2.3 Transport

Based on the assumption that plug-in hybrids and pure electric vehicles will drive approximately half of the total passenger car kilometres by 2050. However, a broad introduction of electro-mobility also depends on the development of batteries that can produce the necessary range of pure electric vehicles at a reasonable cost.

3.2.4 Electrical power

In 2050, renewable energy will cover 60% of the final gross consumption and 80% of electric energy use. Energy efficiency will increase by 50% (as compared to 1990), and CO_2 emissions will drop by 80 – 95%.

4 Interaction and governance

The role of conventional versus renewable energy coalitions and networks

From an institutionalist perspective, Germany can be described as a coordinated market economy. In this context, political actors strive for unanimous policy decisions in accordance with the main stakeholder groups. Thus, there is a strong preference for dialogues, strategic concessions and trade-offs, allowing different actor groups and stakeholder networks to influence policy decisions. There are different actor coalitions with different interests in Germany. The 'conventional energy coalition' is driven by the aim to maintain the status quo of the energy system. Its main support comes from the private sector. This means an especially large part of the four big energy producers, the transmission system operators, the energy-intensive industries, as well as their aligned organisations. All these actors benefit largely from the current system, either because they own the current infrastructure or

because they fear financial losses, increasing costs and costly projects triggered by the transition process. Officially, they support the *Energiewende*, but they neither invest in it nor support it pro-actively. On the contrary, they argue that it should be slowed-down as the necessary technologies are still immature and the *Energiewende* is poorly conceived, making it too costly. Their most common arguments revolve around the possible economic consequences of the *Energiewende* and its costs. They often claim that the feed-in tariff is not a cost-efficient instrument that allows for increasing the shares of renewables. Instead, they call for quota regulations as a cheaper alternative. Furthermore, they criticise the market distortion that the preferential grid access for renewables constitutes, as well as the lack of incentives to optimise productivity in the light of guaranteed payments. From their perspective, the future need for conventional power supply is currently underestimated and conventional power plants will remain necessary to maintain a secure and steady power supply and to keep energy costs low for consumers and especially for the energy-intensive industries, which also provide numerous jobs. They argue that the current policies create inefficiencies and ask for more cost-efficient measures. For this reason, they criticise the currently decentralised investments and call for a European electricity market that allows, for instance, the production of solar power in southern Europe, electricity storage in Scandinavia, and the generation of wind power off-shore. On balance, they stress that at present the *Energiewende* is too costly and hampers German competitiveness.

The large utilities operators (*Stadtwerke*) and the transmission system operators try to influence policies in their favour using the aforementioned arguments, especially through public campaigns. On the one hand they do so individually and on the other hand they join forces as they did with the German Association for Energy and Water Industries (BDEW). In addition to this they get strong support from the energy intensive industries which highlight the volatility and costs of renewables, the resulting loss of competitiveness for the German industry, and eventually the damaging consequences for employment and tax revenues. This argument is especially put forward by the Association of the Industrial Energy and Power Industry (VIK) as well as the Union of Mining, Chemical and Energy Industry (IG BCE) and the Federation of German Industry (BDI)[8]. The 'conventional energy' coalition also cooperates with the *Initiative Neue Soziale Marktwirtschaft* (INSM) that tries to stress its impartiality, but is clearly a member of the 'conventional energy coalition'.[9]

The 'renewable energy coalition' comprises new market actors, some parties and politicians, as well as environmental groups. Strong political support for a progressive *Energiewende* comes primarily from political parties such as the Greens, large parts of the SPD, the Left, and parts of the CDU/CSU. The private sector advocates comprise companies benefiting from new market developments. These are especially the numerous renewable energy companies and their associations which are united in the German Renewable Energy Federation (BEE), but also the German Engineering Association (VDMA) as representative of the renewable energy manufacturers. Finally, various environmental groups and citizen initiatives advocate a fast energy transition.

The 'renewable energy coalition' argues that the current costs of the *Energiewende* should be considered as long-term investments that will pay off in the light of rising energy prices and decreasing costs for renewable energy equipment. Furthermore, they underline that today's prices for conventional energy neglect the large external costs from environmental damages or nuclear waste. If these costs would be included in current balances, renewable energy costs would already be competitive. They also stress the massive subsidies for nuclear, coal and large parts of other fossil fuels that have created the present and path dependency.

The institutional governance structure of the Energiewende

[8] The BDI alone represents 38 associations with about 100,000 companies and approximately 8 million employees.

[9] One interviewee stressed that the INSM works very effectively as a lobbying organisation that combines industry-related research and large PR campaigns to spread their positions.

An objection frequently raised against the *Energiewende* is that it is not properly organised. Criticism addresses the coordination between the Federal Government and the *Länder*, but also between Germany and its neighbouring states, or between the Federal Government and the European Commission. However, this criticism underestimates the diversified institutional governance structure that has been built in recent years, which also involves many stakeholders with a multiplicity of societal interests.

The core work in this institutional governance structure is carried out in three platforms, two of which have subgroups: a) the platform future-oriented energy networks, and b) the platform renewable energies. Representatives of the federal and regional state governments as well as representatives of business associations, individual (particularly exposed) companies, environmental, renewable energies and consumer associations as well as scientists from all relevant disciplines participate in the discussions of the platforms.

Based on the energy concept of the Federal Government, the Federal Ministry of Environment (BMU) initiated the **Renewable Energies Platform** in cooperation with the Ministry of Economic affairs and Energy (BMWi). This is a forum in which political, economic and social stakeholders are jointly developing solutions related to the challenges of the further expansion of renewable energies, particularly with a view to achieving a smooth and cost-efficient development of the overall energy supply system. Within the framework of the platform, crucial challenges are identified and concrete recommendations for action are to be developed. Implementation is the responsibility of the respective stakeholders. As far as the recommendations for action at the federal level are concerned, the Federal Government will decide on the further course of action. In June 2012, the Bundestag expanded the possibilities for participation of citizens to gain the acceptance of the population. The network is being consulted three times on the Network Development Plan (NEP) (see also 3.1) and the related scenarios which the network operators produce annually. Because the NEP contains only the start and end points of the routes and not yet the exact course of the grid lines, the comments at this stage still refer to more general objectives of energy policy. Examples are the reduction of electricity consumption, the quantity of new fossil power plants, or the spatial distribution of renewable energies in the federal territory.

In 2011, the Federal Ministry of Economics set up the **Power Plant Forum** (*Kraftwerksforum*), in which the federal, state, energy and environmental associations exchanged key energy questions relevant to electricity generation. From the outset, the focus of the meetings was on the debate about a viable design of the electricity markets. It was discussed whether, and if so, how, the framework for the wholesale electricity market should be organised to guarantee the security of the electricity supply in the future as well. The debate in the power plant forum took place based on a comprehensive expert assessment on the electricity market design, which the BMWi commissioned to the Energy Economics Institute of the University of Cologne (EWI). A close interlinking of the work in the power plant forum with the work in the platform Renewable Energies is ensured.

Another important component of the institutional governance structure of the *Energiewende* is the **Future-oriented Energy Networks Platform**. It usually meets every six months and is supported and prepared by nine working groups. The platform also receives important impetus from politics, science and society through an advisory council. The office of this platform is located at the BMWi. It supports and coordinates the work of the plenary, working groups, and advisory councils. The recommendations for action of the network platform are directed primarily at the Federal Government. It is then up to the government to examine implementation possibilities and, if necessary, to introduce legislation and prescription initiatives. Although the consultations in the network platform do not replace the deliberations and decisions in the Bundestag or the Federal Council (*Bundesrat*), they can however speed up the discussion processes there since many possible conflict points can be ruled out in the discussion of the platform in the run-up to the legislative process.

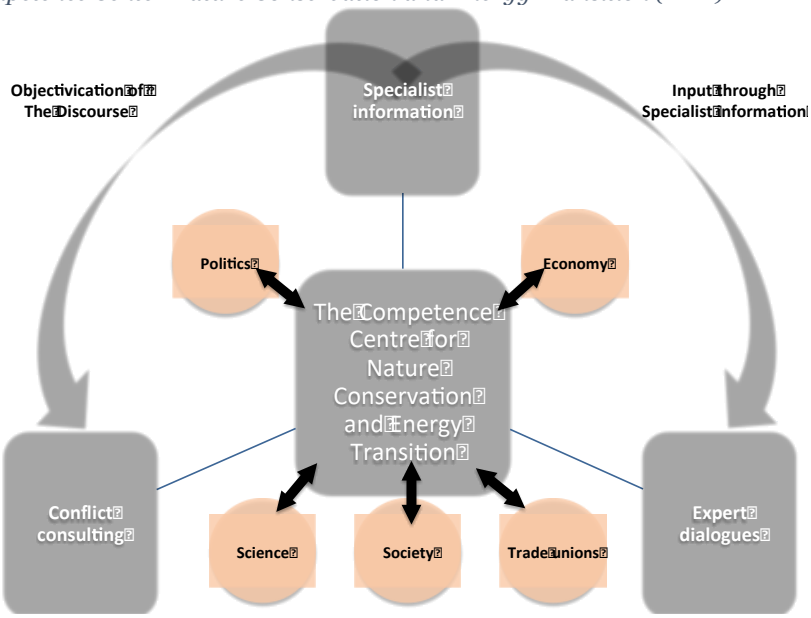
The Energiewende as a multi-level governance challenge

It is necessary to coordinate the *Energiewende* horizontally across the boundaries of ministries and policy areas. This is not only a governance challenge but also an opportunity to shape new alliances between a variety of actors and stakeholders involved in the shaping of this transition. Due to the multi-level governance structure of the *Energiewende* and the federal structure of Germany, there is a close exchange between the federal government and the *Länder*, as well as with representatives from the economy and society.

The coordination between the federal state and the *Länder* is carried out based on semi-annual meetings of Federal Chancellor with the Federal Minister of Economic Affairs and the heads of regional government. ***Energiewende* platforms** have been set up to involve a broad spectrum of actors from economy, science and society in the debate on a variety of themes revolving around the energy transition. In total, there are five such platforms on the topics energy networks, electricity market, energy efficiency, buildings, and research and innovation.

Experience also shows that the expansion of renewable energy and local networks cannot always be implemented without conflicts with nature conservation interests. To strengthen the dialogue between both groups of actors, the centre of competence Nature Conservation and Energy Transition (KNE) was set up. The thematic focus of the KNE is on "Subject Dialogues" (*Fachdialoge*), "Conflict Counselling", and "Expert Information". The department "Expert Information" collects primarily information and insights from scientists, lawyers, and industrial and political practitioners. The aim of the department is to make the debate about renewable energy more objective. The aim of the "Conflict Advisory" department is to provide workshops for municipal authorities, stakeholder groups and project planners starting in 2017. It offers strategies and procedures for the prevention of conflicts and a conflict-free implementation of projects. The *Fachdialoge* department, in turn, organises specialist dialogues in which joint position papers, procedures, methods and standards are developed. This is intended to serve as an equitable solution to specific problems.

Figure 1 – The Competence Center Nature Conservation and Energy Transition (KNE)



Source: Technopolis

Civil society networks as engine of the Energiewende

Public participation offers a substantial potential to facilitate the German *Energiewende*. Civil society and its various environmental organizations constitute an important backbone of the bottom-up energy transition project. In Germany, the renewable energy movement enjoys much credibility and support in society.[10] The 'renewable energy coalition' makes large efforts to maintain this overwhelming support for renewables as a powerful way to legitimate progressive energy transition policies. The various non-governmental environmental and civil society organizations like WWF, Greenpeace, BUND, DUH or Germanwatch play an important role in nourishing this support. In doing so, they make use of various forms of events, public statements, studies and campaigns, and most importantly they cooperate among themselves to spread their views. One significant example of this is the so-called *Klima-Allianz* that comprises 110 organizations with about 10 million members ranging from churches, development organizations, environmental organizations, trade unions, consumer protection organizations, youth associations and other groupings to promote sustainable development. In addition, there are energy specific private initiatives like the European Association for Renewable Energy or the Friends of Solar Energy Association (*Solarfo¨rderverein Deutschland*).

[10] A 2012 survey by TNS Infratest indicated that 70% of the respondents considered the stronger expansion of renewables very important and another 24% at least important.