



## The German Energiewende – History and status quo



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### ABSTRACT

Industrialized nations rely heavily on fossil fuels as an economic factor. Energy systems therefore play a special part in realizing visions of future sustainable societies. In Germany, successive governments have specified their ideas on sustainable development and the related energy system. Detailed objectives make the vision of the *Energiewende* – the transformation of the energy sector – more concrete. Many Germans hope that the country sets a positive example for other nations whose energy systems also heavily rely on fossil fuels. A glance at the historical dimensions of this transformation shows that the origins of German energy objectives lie more than thirty years in the past. The realization of these goals has not been free from tensions and conflicts. This article aims at explaining Germany's pioneering role in the promotion of an energy system largely built on renewable energy sources by disclosing the drivers that have successively led to the *Energiewende*. To reveal these drivers, the historical emergence of energy politics in Germany was analyzed especially with respect to path dependencies and discourses (and their underlying power relations) as well as exogenous events that have enabled significant shifts in the political energy strategy of Germany.

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### 1. Introduction

In light of the global challenges of climate change, increasing greenhouse gas emissions, air pollution, the depletion of natural resources and political instabilities, the transition of national energy systems has become a major challenge facing energy policy making in many countries e.g., [1,2]. Reshaping fossil-based energy systems towards a high share of renewable energy sources is considered an important precondition for a sustainable global future [3–6]. In Germany, governments throughout the last 25 years have accepted this paradigm and put forth an energy policy that supports the development and integration of renewable energies e.g., [7,8]. Ambitious goals regarding the reduction of greenhouse gas emissions and the improvement of energy efficiency have been proclaimed [9,10]. This process of phasing out nuclear power in the short- and coal power in the mid-term is referred to as the German ‘*Energiewende*’ (energy transition). The realization of these goals has not been free from tensions and conflicts. Despite of the high risks inherent in such a transition,

Germany has assumed a pioneering role in transforming its energy system and, today, the *Energiewende* has reached a level that reveals its challenges. The developments in Germany have thus become a focus of global observation, and especially the efficiency and effectiveness of its instruments – in particular the EEG [8,11,12], the compatibility with the EU emission trading system [13], the need to integrate renewables into a pan-European electricity system [14], or the future design of the electricity market (e.g., the role of capacity markets or the reliability of electricity supply) [15–19] – have become subject of scientific and political debate.

Against this background, the article aims at revealing the specific circumstances, political motivations and social developments that have shaped and driven Germany's pioneering role in the promotion of an energy system largely built on renewable energy sources. To systematically elaborate this process, an in-depth policy analysis of the historical emergence of energy politics in Germany has been conducted. Focus of this analysis was set on the concept of path dependencies and the emergence of discourses and power relations as well as trends and exogenous shocks that have induced so-called windows of opportunity for enforcing significant shifts in the political energy strategy. This analysis reveals that the German energy transition has been an evolutionary rather than a revolutionary process. A multitude of technological, economic and social

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considerations and factors have shaped the according policies and social beliefs, so that a contentious political process has spurred changing power constellations towards strong economic leaders supporting renewables. Their impact on discourse dynamics has steadily driven all political parties towards favoring the nuclear phase-out and the *Energiewende*.

The remainder of this article is thus structured as follows. In the following Section 2 we briefly introduce the methods and research procedures. Based on the chosen research approach, in Section 3 the historical emergence of energy politics in Germany will be delineated in five sub-sections each representing chronological phases of political change. Within each of these phases, both the key political developments as well as their underlying discourses, actors and circumstances will be discussed. Finally, the paper concludes with a discussion of the research findings and its implications.

## 2. Research method

To understand the underlying circumstances and processes that have led to the emergence of the current energy political system in Germany, an analysis of the historical process that has brought forward the *Energiewende* was conducted. As part of this analysis, a special focus was set on investigating the changing positions of the different political parties, as well as the (economic, social and political) discourses and events that have created circumstances with a significant influence on the social opinion and political governance process. Methodically, the chosen research approach can thus best be described as a consolidated policy-analytical approach based on a qualitative analysis to reveal both path dependencies as well as specific circumstances that have led to so-called windows of opportunity for implementing significant shifts in the political perspectives.

### 2.1. Path dependencies and windows of opportunity

The concept of path dependence, i.e. in its broadest interpretation the understanding that 'history matters' e.g., [20,21,22], has its conceptual origins in the field of evolutionary economics e.g., [23,24–26]. Over time the concept has increasingly proved valuable for also analyzing "the world of politics" [27]. Although the concept of path dependence has rapidly gained popularity in many fields, clear definitions remain rare. In its classical sense, path dependence was defined as a sequence of events (occurring by chance or systematic force), which significantly affect an eventual outcome [25]. Antonelli [28] further specified this understanding by distinguishing between path dependence (i.e., a process depending only on the state in the preceding period) and past dependence (i.e., a process depending on all or at least a series of past states). Path dependence thus characterizes historical sequences in which contingent events may deterministically condition institutional patterns or changes e.g., [22,29]. Whether this occurs, significantly depends on the respective level of stability of the socio-cultural system. Socio-cultural systems generally become unstable with growing concern and dissent among the population (e.g., with respect to a certain political path) often reflected by an increasing public debate in the mass media. During such phases of instability or crises – often following unexpected exogenous events or shocks e.g., [30] – so-called 'windows of opportunity' occur within which even weak political impulses may invoke radical shifts e.g., [20,31]. Such crises thus provide opportune circumstances to implement significant policy changes [30,32]. In the absence of shocks, governments continuously work to intentionally prepare windows of opportunity [31]. Governance processes, however, are embedded

in a complex interweavement among political institutions and strong economic and socio-cultural dynamics [20]. The power relations among different actors and their perspectives thus significantly influence the policy process. In order to account for these dynamics, the analysis of path dependencies was complemented by a discourse analysis to reveal the impact of power relations and further factors of change on the development of energy policy in Germany.

### 2.2. Discourse analysis—power relations and factors of change

The term 'discourse' in its original meaning refers to a communicative discussion or dialog. In its early understanding, discourse analysis thus merely implied the narrow interpretation of the use of language and narratives [33]. As an analytical method of social science research, however, discourses have been defined to encompass social practices, i.e., "the complex mix of cultural norms, disciplines and rituals – which govern discursive formations" [34] and the corresponding "rules of formation" [35]. As such, the method of discourse analysis has – significantly influenced by Foucault [36] – evolved into a procedure that embraces a much wider context including the emergence and influence of power relations e.g., [33,34,37,38,39].

The political decision-making process has often been described as complex or contradictory e.g., [40]. Analyses have shown that political processes are often defined by critical moments or 'junctures' shaping social dynamics e.g., [41,42,43]. Especially against this background, discourse analyses have become a standard approach to examine the decisive elements of policy processes including institutional governance and power structures [33]. Especially in the context of global environmental politics the importance of discourses has recently been highlighted e.g., [44,45,46].

The discourse analysis as underlying this article thus draws on the process of tracing the genesis of the German energy policy, its key developments, political constellations, social structures as well as endogenous and exogenous impact factors. An argumentative discourse analysis sets focus on the discursive strategic behavior of actors and institutional patterns and their potential to trigger political change e.g., [46]. In our research this specifically implied the identification of different power constellations during the various periods of energy political history in Germany and their impact on the policy path. Applying a discourse analysis to do so allowed tracing the discourse dynamics to the timing and sequencing of events and decisions that determined the evolution of the *Energiewende*. Focus of our research was thus to reveal the specific circumstances that enabled the *Energiewende* and the institutions, actors and discourses that have shaped its outcome.

## 3. The historical emergence of energy politics in Germany

The analysis has shown that the initiating origins of the *Energiewende* date back more than 30 years. To impart a comprehensive, yet tangible understanding of the political process, the historical emergence of energy policy and its key developments in Germany will be conciliated in the following five sections each discussing specific periods of time from the 1950s until today. For each of these periods, the relevant changes in political and social power constellations as well as endogenous path definitions (e.g., the introduction of political measures) and exogenous events (e.g., economic trends or unexpected incidents) have been identified and implicated into the policy process of the *Energiewende*.

### 3.1. Energy and environmental politics before 1980

#### 3.1.1. Energy policy in West Germany since the 1950s<sup>1</sup>

Before the establishment of the Federal Republic of Germany (West Germany) in 1949, an autonomous German energy policy did not exist. At the time, energy policy was not considered an independent policy field, but constituted an essential part of economic policies. Consequently, the energy policy efforts of the first West German government under Chancellor Konrad Adenauer (CDU (Christian Democratic Party), 1949–1963) focused primarily on the economic necessities in post-war Germany: the first objective was to reconstruct the energy infrastructure in general and to overcome the prevailing energy shortage. In this regard, West Germany pursued a strategy of focusing on domestic energy sources such as lignite and hard coal (“coal economy”), aiming for a power and energy supply as affordable and secure as possible [47] (Table 1a).

After the ratification of the Paris Agreements in 1955, which made West Germany a (partly) sovereign state and established its integration into NATO and the Western European Union, the government was keen to establish atomic energy as a second pillar of the energy supply system. In 1955/56, the Federal Ministry for Nuclear Affairs and the German Atomic Commission were established. In 1957, further important decisions were made. By joining the EURATOM (European Atomic Energy Community), launching of the first national nuclear program (“Eltviller Programm”) and commissioning the first research reactor (imported from the USA) at Munich University of Technology, West Germany tried to catch up with the international nuclear industry. At the same time, the emerging crisis in the German coal industry (falling prices for oil and coal imports made many collieries unprofitable) encouraged politicians to assume that nuclear energy should be promoted to secure the German energy supply. On 1 January 1960, the Act on the Peaceful Utilization of Atomic Energy and the Protection against its Hazards finally came into force. The act regulated the planning and approval process for the construction of NPPs (nuclear power plants).

Lutz Mez [48] accurately sums up the situation in the late 1950s: “Initially, the nuclear program was regarded an integral part of a general industrial policy to re-establish Germany as a viable force in international markets, summarized as the so-called ‘Modell Deutschland’.” To make this strategy a success, the government provided financial start-up support for energy companies, hoping this would generate a strong private-sector commitment to nuclear energy. However, German energy companies proved to be more skeptical regarding the use of nuclear power than expected. Energy suppliers doubted that economic profits would be possible and pointed out that the need for investments in the years to come simply was too high [49]. Even the government’s assurance that companies would be reimbursed for the additional costs of NPPs (compared to the construction of conventional power plants), hardly generated any more private capital for the nuclear sector. Nevertheless, a general belief emerged in German politics and society that – in the long run – nuclear power would become an energy source with great “social significance” [50].

The competition between mineral oil and domestic hard coal intensified in the 1960s. Even a massive coal priority policy characterized by coal subsidies and heavy taxation of petroleum products did not succeed in ensuring the competitiveness of German hard coal. By 1970, the share of mineral oil in West Germany’s primary energy consumption had risen to 53 percent. With increasing dependence on imports and a growing global integration of West Germany, politicians considered nuclear energy once

again to be an important backbone to secure domestic energy supply [47]. Consequently, the second national nuclear program (“Spitzingsee Programm”) was launched in 1963, this time on a four year basis. Besides basic research on fast breeders, the program concentrated on the education and training of nuclear physicists, radiation protection experts and engineers. Financially, West Germany continued to make considerable funds available: until 1967, the federal government invested a total of DM 5.3 billion in research and development to promote the commercial use of nuclear energy. In 1965, the government finally decided to initiate the “experimental storage” of radioactive waste in the disused Asse mine in Lower Saxony (in spite of doubts about the suitability of the site). This decision eliminated one of the last hurdles to widespread commercial use of nuclear power, namely, the (still) unsolved question of final radioactive waste disposal [50]. The various measures of German nuclear policy proved to be effective. In 1967, NPPs at Würgassen and Stade marked the first purely commercial production of nuclear power. At this point, “German producers had caught up with the world market standards, and between 1968 and 1989 more than 24,000 MW of nuclear capacity were put on line” [48].<sup>2</sup> The belief in technical progress was still unquestioned in the late 1960s/early 1970s and nuclear energy was popular, even across party lines. Nuclear power had become a widely accepted “contemporary technology” [50].<sup>3</sup>

In the 1970s, Christian Democrats, SPD (Social Democrats) and Liberals (FDP), the so-called established parties, retained their generally positive attitude towards nuclear energy. As part of the third national nuclear program, which was initiated by the Grand Coalition (CDU/CSU/SPD, 1966–1969), almost DM 6.2 billion was invested in nuclear technology between 1967 and 1972 – more than in the two previous nuclear programs [50]. Continuing the energy policies of the Grand Coalition, the Social-Liberal coalition (SPD/FDP, 1969–1982) under Social Democratic Chancellors Willy Brandt and Helmut Schmidt tried to cover the expected further growth in electricity demand by expanding nuclear energy (4th nuclear program 1973–1976). The oil price crisis of 1973/74 seemed to underline the importance of nuclear power for West German energy security. The government committed itself to solving the problem of nuclear waste management. The German Concept for Radioactive Waste Disposal (“Entsorgungskonzept”) of 1974 obligated the industry to reprocess used nuclear fuel and to organize the interim storage of nuclear waste. As a site for final repository, a salt deposit in Lower Saxony (Gorleben) had been explored since 1979.<sup>4</sup> Although the expansion of nuclear capacities reached its peak in the 1970s (15 reactors with a total capacity of 17,000 MW were installed), nuclear energy was by no means still regarded as the technology of the future. Especially after the Harrisburg incident in 1979, it was instead seen as a quite dangerous, but absolutely necessary part of German energy supply.

#### 3.1.2. Anti-nuclear protests and the green movement in the 1970s

“In no other country was the environmental movement influenced so strongly by the conflict over the civilian use of nuclear energy as in Germany. Other topics of the environmental movement have come and gone: water protection, speed limits, dying forests, biodiversity, climate change. But nuclear energy was an issue that repeatedly led to large, often radical protests in the past”

<sup>2</sup> However, with 24,000 MW, only half of the originally projected 50,000 MW capacity was realized.

<sup>3</sup> In this article, all direct citations from texts in German were translated by the editors.

<sup>4</sup> After an “exploring phase” in the 1980s, commissioning was scheduled for the end of the 1990s.

<sup>1</sup> This part of the article focuses only on West German energy policy.

**Table 1a**  
Overview of path defining developments, discourses and power constellations.

Time	Path defining developments	Discourses and power constellations
After 1949		<ul style="list-style-type: none"> <li>• Reconstruction of the energy infrastructure with focus on domestic lignite and hard coal</li> </ul>
1955	Paris agreement	<ul style="list-style-type: none"> <li>• Objective to make atomic energy the second pillar of the energy supply system</li> </ul>
1955/56	Federal Ministry for Nuclear Affairs and German Atomic Commission established (1st German Nuclear Program in 1955)	
1957	Germany joined the European Atomic Energy Community (EURATOM)	
1960s		<ul style="list-style-type: none"> <li>• German coal policy insufficient for making hard coal competitive</li> <li>• Nuclear energy considered an important backbone for domestic energy supply</li> </ul>
1963	2nd German Nuclear Program (Spitzingsee Programm)	
1966–1969		<ul style="list-style-type: none"> <li>• Grand coalition among CDU/CSU and SPD</li> <li>• CDU, SPD and FDP retain their generally positive attitude towards nuclear energy</li> </ul>
1967	3rd German Nuclear Program	
1969–1982		<ul style="list-style-type: none"> <li>• Social-liberal coalition continues the energy political path of the grand coalition and further expands nuclear energy</li> </ul>
1973/1974	4th German Nuclear Program	<ul style="list-style-type: none"> <li>• The oil price crisis furthers the importance of nuclear power</li> <li>• Government commits itself to solving the problem of nuclear waste management (“Entsorgungskonzept”)</li> </ul>
1979	Harrisburg incident	<ul style="list-style-type: none"> <li>• Perception of nuclear energy changes from “the technology of the future” to “a quite dangerous, but absolutely necessary part of Germany energy supply”</li> </ul>

[51]. Why did the anti-nuclear movement become such a strong social force in Germany? (Table 1b).

In the late 1960s, an extra-parliamentary opposition (APO), dominated by socialist student groups, launched protests against the Vietnam War, the government-planned Emergency Laws (Notstandsgesetze) and the so-called “CDU state” (chancellors of the conservative CDU held office between 1949 and 1969 without interruption), creating an “anti-authoritarian” intellectual climate, which later encouraged criticism of economic growth and nuclear energy as well. This new social milieu was no longer willing to accept the conventional values of most Western industrialized nations. The new social movement of the 1968 generation laid the ideological and personal foundations for citizens’ initiatives, protest groups and other non-parliamentary political circles. They formed in large numbers in the 1970s, often with an ecological background. The increasing environmental awareness in West Germany e.g., [52] was linked to the publication of classic bestsellers of environmental literature like Dennis Meadows’ “Limits to Growth” or E.F. Schumacher’s “Small is Beautiful” [53–55]. In previous years, the federal government had already made some efforts in this policy field due to pressing problems in the areas of waste management and air and water pollution. German politics set a new ecological agenda, only a short time before the rise of the

environmental movement. A flurry of legislative activity in the early 1970s was the consequence. The government’s new interest in ecology and the growing interest of Germans in environmental protection issues were mutually dependent and motivated various social groups to form new organizations. From then on, pressure groups like the Friends of the Earth Germany (BUND) (successfully) tried to influence West German environmental and energy policies. They all had a least one thing in common: they were (and still are) opposed to nuclear energy.

The sometimes violent protest against the civilian use of nuclear power quickly became the most visible and influential group within the environmental movement. Local protests against the construction of NPPs at Breisbach (1971) and its alternative plant site at Wyhl (1973–1975) can be considered starting points of a nationwide anti-nuclear movement. After the construction of the NPP Wyhl was approved by the authorities, the protests intensified, and peaceful forms of protest alternated with methods of civil disobedience. Wyhl became “the birthplace of the national anti-nuclear movement” [51]. The nationwide protests reached their peak in the 1970s with violent demonstrations at Brokdorf, Grohnde (NPP sites) and Gorleben (location for the national disposal center) in the years 1976/77 and demonstrations in Hanover and Bonn in 1979, both with more than 100,000 participants. At the end of the 1970s,

**Table 1b**  
Overview of path defining developments, discourses and power constellations.

Time	Path defining developments	Discourses and power constellations
Late 1960s		<ul style="list-style-type: none"> <li>• Extra-parliamentary opposition (APO) creates an “anti-authoritarian” intellectual climate and lays the ideological and personal foundations for citizens’ initiatives, protest groups and other non-parliamentary political circles with ecological motivations and anti-nuclear sentiments</li> </ul>
Early 1970s		<ul style="list-style-type: none"> <li>• Ecological pressure groups begin to influence West German environmental and energy policies</li> <li>• German government sets a new ecological agenda</li> </ul>
Late 1970s	Protests against construction of NPPs at Breisbach (1971) and Wyhl (1973–1975), Brokdorf and Grohnde (1976–1977), Hanover and Bonn (1979); Gorleben (1979) Three Mile Island accident (March 28, 1979)	<ul style="list-style-type: none"> <li>• Protests (sometimes violent) constitute the starting point of a nationwide anti-nuclear movement</li> <li>• By the end of the 1970s, the anti-nuclear movement becomes a national political player fueled by the Three Mile Island accident</li> <li>• Results in the founding of the Green Party in 1980 with the vision of an alternative path of energy policy beyond nuclear and fossil energy</li> <li>• Failing governmental efforts to convince the nuclear power critics that German NPPs were safe and necessary</li> </ul>

the anti-nuclear movement had become a national political player. The anti-nuclear movement, environmental groups and large sections of the peace movement also played a key role in the founding process of the German Green Party. As a left-wing holding party, the Greens became *the* place to go for heterogeneous socio-political groups like gay rights and women's rights activist, socialist and Maoist groups and, as one of the most influential party wings, environmental activists. The Green Party was founded in 1980 and was elected to the Bundestag in 1983. The immediate shutdown of all German NPPs was one of its key policy objectives.

### 3.2. Energy and environmental politics in the 1980s

#### 3.2.1. Ending the pro nuclear consensus

Governmental efforts to convince the population, and especially the nuclear power critics, by means of argument that German NPPs were safe and necessary failed in the second half of the 1970s. Quite the contrary, the accident at Harrisburg and the escalating protests against the planned nuclear waste repository at Gorleben in 1979 mobilized the anti-nuclear movement even more. Nevertheless, all three German parties in the national parliament remained pro-nuclear, although more and more critical voices were heard within the SPD (Table 1c).

In 1980, the Enquete Commission (select committee) on "Future Nuclear Energy Policy", initiated by the Bundestag, presented an interim report on its work [56]. Four different scenarios of the future power supply were considered to be technically and economically feasible; two of them excluded nuclear energy. The majority of the committee concluded that the use of nuclear power was not necessary, if West German energy demand were to decrease and alternative energy sources were developed. These results, which were heavily criticized by the CDU/CSU, served as a first indication that a "paradigmatic change in energy policy away from nuclear power" [48] would be possible in the future. In the early 1980s, the German environmental movement became much stronger, and debates about dying forests due to "acid rain" and the nascent climate change discussion led to a further expansion of the environmental movement in regional parliaments and in German society. At the same time, low-level energy prices made it seem unlikely that a further expansion of nuclear capacities in West Germany was necessary [47]. In this unfavorable climate for nuclear power, the Green Party won 5.6 percent of the votes in the national elections of 1983. The Greens had called for an immediate nuclear shutdown during their election campaign. The anti-nuclear

movement now also had become an explicit voice and important factor within the national parliament, even though the Green Party still faced a phalanx of the three pro-nuclear parties CDU/CSU, SPD and FDP, which together held about 95 percent of the seats. It was not until April 1986 that this constellation was to fundamentally change and the isolation of the Green Party would end.

The Chernobyl nuclear disaster outraged large sections of the public and the media and led to important changes on various socio-political levels:

- (1) Even though the government stated after the accident that – due to different reactor designs – no safety findings were transferable to the situation in Germany from the accident sequence in Chernobyl [50], the CDU-led coalition, in office since 1982 under Chancellor Helmut Kohl, responded quickly to the new situation: To demonstrate its ability to act in the nuclear field, the government established the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). The new ministry now combined the previously dispersed federal environmental and nuclear competences. Nevertheless, the paradigm of the necessity of nuclear power was not questioned by the governing parties CDU/CSU and FDP.
- (2) Regarding the acceptance of nuclear energy, a sudden change of mood shook the German public. Inadequate information policy and a disorganized management of the consequences of Chernobyl by the German authorities played into the hands of nuclear critics. Polls now showed that, for the first time, a majority of the population approved of a "phase-out of nuclear energy". In the weeks after the Chernobyl disaster, 86 percent of Germans were in favor of a nuclear phase-out, including 17 percent who plead for an immediate end to the civil use of nuclear energy [57].
- (3) The Chernobyl aftermath did not only break up the already fragile "coal-nuclear consensus" in society, but also ended the nuclear consensus among the three established parties that had shaped German energy policy over the past three decades. Driven by new party members who focused on environmental issues and considering the change of mood in the population, the Social Democrats turned anti-nuclear. The German party system was now divided into two camps with opposing views on future energy policy. While CDU/CSU and FDP continued to advocate nuclear power and only

**Table 1c**

Overview of path defining developments, discourses and power constellations.

Time	Path defining developments	Discourses and power constellations
1980		<ul style="list-style-type: none"> <li>• Majority of the Enquete Commission on Future Nuclear Energy Policy concludes the use of nuclear power was unnecessary in West Germany, if energy demand decreased and alternative energy sources were developed</li> </ul>
early 1980s	Energy prices are extremely low; environmental awareness increases (e.g., dying forests, acid rain, climate change)	<ul style="list-style-type: none"> <li>• Gives rise to a paradigmatic change in energy policy away from nuclear power</li> <li>• Perception that further expansion of nuclear capacities is unnecessary</li> <li>• German environmental movements become much stronger</li> </ul>
1983		<ul style="list-style-type: none"> <li>• The Greens call for an immediate nuclear shutdown in their election campaign and are elected into the Bundestag in 1983</li> <li>• The three pro-nuclear parties (CDU/CSU, SPD and FDP) together still hold about 95% of the seats</li> </ul>
1986	Chernobyl nuclear disaster	<ul style="list-style-type: none"> <li>• Outraged large sections of the public and the media</li> <li>• Reactions in Germany:               <ol style="list-style-type: none"> <li>(1) Government stated that due to different reactor designs situation was not transferable to Germany, but established the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)</li> <li>(2) For the first time a majority of the population (86%) approved of a "phase-out of nuclear energy"</li> <li>(3) Ended the nuclear consensus among the three established parties – the Social Democrats turned anti-nuclear</li> </ol> </li> </ul>
late 1980s		<ul style="list-style-type: none"> <li>• Nuclear power loses its status as an innovative technology and is increasingly seen as a discontinued line</li> </ul>

pointed out the need to make German NPPs safer, SPD and the Greens called for a phase-out.

Although the Kohl government (1982–1998) still regarded nuclear energy as the important second pillar of energy supply, the second half of the 1980s showed that nuclear power had completely lost its status as an innovative technology and was increasingly seen as a discontinued line. The late 1980s and early 1990s became the years of failed nuclear projects. For example, with the cancellation of the project for a German nuclear reprocessing plant at Wackersdorf (Bavaria) in 1989, attempts by the nuclear industry to close the German fuel cycle finally failed, and no new NPPs were planned. On the eve of German reunification, the nuclear sector of West Germany now “only” consisted of a large number of well-functioning NPPs with a high availability for generating electricity.

### 3.2.2. Economic growth without oil and uranium? first ideas and pilot projects for an energy transition

The idea of an energy transition with a shift away from both fossil and radioactive fuels in Germany was born over 30 years ago – the history of renewable energies in Germany even dates back to the 1970s. As a response to the first oil crisis and inspired by the research projects of the Carter administration in the United States, the R&D program on energy launched by the Ministry of Research and Technology in 1974 spent about DM 10 million for research on renewables. Individual technologies, especially PV (photovoltaics), were supported, but a goal-oriented development combined with a general concept for a sustainable energy supply clearly was not in sight [47]. In 1977, an incentive system was introduced, which provided a governmental investment subsidy of 25 percent for solar panels and heat pumps. The energy program projected a possible renewable capacity of 2 percent of the general electric power consumption in the year 2000. The energy program of 1981 saw a potential of up to five percent in 2000 [50]. By 1982, a total of DM 150 million had been invested in renewables. The investments in PV and wind turbines were mainly due to the social pressure on the government not to count on coal and nuclear energy alone and to consider a diversification of energy sources to improve energy security. However, politics and industry greatly doubted that renewable energies ever could become a major source of electricity. Consequently, the Kohl government cut research funds for renewables up to 1986 by half as part of its financial consolidation measures (Table 1d).

In contrast, it was political and economic studies and major technical pilot projects by the German energy companies that gained widespread attention in the 1980s. Even though the term

“Energiewende” had not been used in the 1970s, “the discussion about an alternative path of energy policy, beyond nuclear and fossil fuels, goes back the post-1968 movement” [58]. In 1980, this discussion finally motivated the authors of the recently founded Eco-Institute (Öko-Institut) to describe core elements of an “energy revolution” [59], which came close to present-day conceptions of a low-carbon society. The energy industry invested in a few flagship projects such as “Growian” (**Große Windenergieanlage**, big wind turbine), commissioned in 1983. Due to a number of technical problems, Growian was long regarded as one of the greatest failures in the history of wind energy, since it raised serious doubts about the use of large-scale wind turbines in general. But back then, Growian seemed to have served its purpose for the German power companies, who wanted to continue to rely on coal, oil and nuclear energy. In 1981, the German newspaper “Die Welt” quoted a member of electricity utility RWE’s board with the words: “We need Growian [...] to prove that it is not working” [47]. Renewable projects such as Growian served as alibis for the pro-nuclear lobby. Failed projects were to show NPP critics that there were no realistic alternatives to nuclear power and coal.

However, the notion that a low-CO<sub>2</sub> energy supply could soon be necessary and that renewables therefore would play a key role in future energy systems already emerged in the 1980s. In the second half of the decade, a general debate about the consequences of the greenhouse effect took place in the West German media. Even the national parliament committed itself to the issue. From 1987 on, the Enquete Commission on “Preventive Measures to Protect the Earth’s Atmosphere” worked on a report on future energy and climate policies. The report was submitted in 1990 and formed the first basis for the German pioneering role in climate protection policies.

### 3.3. Energy and environmental politics in the 1990s

#### 3.3.1. Climate change as an important issue

The political constellations regarding nuclear power that had evolved in the 1980s after the Chernobyl disaster basically remained unchanged in the 1990s. The CDU-led government stood by its position that the construction of more NPPs would only be possible if there was a broad consensus in the German society in favor of nuclear energy. The attitude of the population towards the use of atomic energy, however, was still negative. Furthermore, economic reasons (high investments, growing market competition) made an expansion of German nuclear capacities highly unlikely. Nevertheless, the government affirmed that at least the existing NPPs would stay on line until the end of their projected lifetime [50] (Table 1e).

**Table 1d**

Overview of path defining developments, discourses and power constellations.

Time	Path defining developments	Discourses and power constellations
1974/77	Ministry of Research and Technology launches an R&D programme for research on renewables	
1977	Introduction of an incentive system for solar panels and heat pumps (minor impact)	
1980		<ul style="list-style-type: none"> <li>• Authors of the Eco-Institute (Öko-Institut) describe the core elements of an “energy revolution”, coming close to the current conceptions of a low-carbon economy</li> </ul>
1981	Kohl (CDU) government cuts research funds for renewables up to 1986 by half as part of its financial consolidation measures	
early 1980s		<ul style="list-style-type: none"> <li>• Political and economic studies and major technical pilot projects by the German energy companies gain widespread attention</li> <li>• Used by critics to raise doubt about renewable energies</li> </ul>
1983	Industry-initiated flagship projects (e.g., Growian wind power station) reveal technical problems	
1990		<ul style="list-style-type: none"> <li>• Report by the Enquete Commission on “Preventive Measures to Protect the Earth’s Atmosphere” forms first basis for German climate protection policies</li> </ul>

**Table 1e**  
Overview of path defining developments, discourses and power constellations.

Time	Path defining developments	Discourses and power constellations
1990s		<ul style="list-style-type: none"> <li>• Political constellations regarding nuclear power remain unchanged in the 1990s</li> <li>• CDU-led government affirms that existing NPPs would stay on line until the end of their projected lifetime</li> </ul>
early 1990s		<ul style="list-style-type: none"> <li>• the awareness of the problem of global warming continues to grow in all parties</li> <li>• first (global and EU) emission targets are introduced</li> </ul>
1998	German ratification of the UNFCCC	<ul style="list-style-type: none"> <li>• Can be considered as the starting point for Germany climate policy</li> <li>• Growing consideration of climate change causes re-evaluation of hard coal and lignite as energy sources in politics and society</li> <li>• Basic consensus among German parties on climate protection goals emerges</li> <li>• All parties in their election manifestos confirm the need for faster development of renewables</li> <li>• Trenches on nuclear energy remain:               <ul style="list-style-type: none"> <li>- Government of CDU/CSU and FDP still in favor of nuclear power (calling it a climate-friendly energy source)</li> <li>- Opposition of SPD, Greens and the post-communist PDS call for a nuclear phase-out</li> </ul> </li> </ul>

In the early 1990s, the awareness of global warming continued to grow in all parties, naturally influencing the debate on energy policy as well. In the fall of 1990, the commission on “Preventive Measures to Protect the Earth’s Atmosphere” presented its final report [60]. It proposed specific goals for the reduction of energy-related CO<sub>2</sub>-emissions. Up to 2005, global emissions should decrease by 5 percent, EU emissions by 20 percent and emissions in Western industrialized countries (with an exceptionally high output) by 30 percent. The objectives for 2050 were even more ambitious: the report suggested a reduction of global emissions by 50 percent and by 80 percent in the EU and Western industrialized countries. Since the government included these obligations as part of its official energy and environmental platform, Germany set international standards in climate policy [61]. The report by the select committee and the ratification of the UNFCCC (United Nations Framework Convention on Climate Change) two years later can both be described as starting points for a German energy policy which was increasingly dominated by climate change issues. This development also opened up new vistas for renewable energies. The growing concern about the consequences of climate change caused a re-evaluation of the energy sources of hard coal and lignite in politics and society. Both were considered to have poor carbon footprints, which now led to their long-term intensive use being questioned. Renewables, on the other hand, were seen as almost climate-neutral energy suppliers, which made their expansion a promising measure to combat global warming. At the same time, more and more voices claimed that renewables could actually contribute to German supply security against the background of an uncertain future for conventional energy sources.

While a basic consensus among German parties on climate protection goals emerged in the 1990s, the trenches on the question of the use of nuclear energy stayed consistently deep. The government of CDU/CSU and FDP still was in favor of nuclear power, the opposition of SPD, Greens and the post-communist PDS called for a nuclear phase-out. The fact that CDU/CSU and FDP considered nuclear power to be a climate-friendly energy source entrenched

these positions. For the government parties, climate protection became a central argument for the continuing use of nuclear energy. On the eve of the national elections in 1998, it was still primarily the different view on nuclear energy that separated German parties in energy policies. In contrast, the need for an increased and internationally coordinated climate protection policy was recognized by all parties. Furthermore, as shown by a glance at the election manifestos of 1998, all parties stated that a faster development of renewables was desirable.

### 3.3.2. Paving the way for renewables? Governmental energy policy measures 1990–1998

The governmental energy policy from 1990 to 1998 pursued two primary goals: Firstly, the acceptance and disposal of the environmental and energy political legacies of former East Germany including the integration of the former East German federal states (“Neue Länder”) into an all-German energy system and, secondly, a better integration of renewables into the electricity market. After reunification, the German government sought to redesign the energy system of the former German Democratic Republic (GDR – East Germany). The primary energy consumption of East Germany had been based almost exclusively on the use of solid fuels such as lignite (65 percent). Fuels such as oil (20 percent), natural gas (10 percent) and nuclear power (3 percent) played only a minor role. In power supply, the share of lignite had been even higher (80 percent, nuclear power constituted 10 percent). Surprisingly, the government was able to transfer the structures of the West German energy system to the Neue Länder fairly smoothly. With one exception all nuclear power plants in East Germany were shut down. The ecological effect of the transfer of the energy system and environmental standards from West to East Germany was a drastic decrease in the emissions of pollutants and greenhouse gases. The collapse of East German industry had contributed to this as well (Table 1f).

With the creation of the Federal Ministry for the Environment as a political player within the core executive, the increasing

**Table 1f**  
Overview of path defining developments, discourses and power constellations.

Time	Path defining developments	Discourses and power constellations
1990s		<ul style="list-style-type: none"> <li>• The former 1968 generation now holds important functions in government, agencies, associations and especially in the media; form a strong lobby group campaigning for renewables</li> <li>• Municipalities and advocacy groups call for a nationwide implementation of market-integration aids for renewables</li> <li>• A small group of CDU/CSU members of the German parliament started the legislative process for an Electricity Feed-in Act in collaboration with parts of the Green parliamentary group</li> </ul>
December 1990	Act on the Supply of Electricity from Renewable Energy Sources into the Grid (Stromeinspeisungsgesetz, StrEG)	<ul style="list-style-type: none"> <li>• StrEG determined a duty of acceptance and required energy companies to pay a minimum price for third-party electricity generated from renewable energy sources in their areas of supply</li> </ul>

importance of environmental organizations and the growing socio-political influence of people from the 1968 generation (who now had important functions in government, agencies, associations and especially in the media), a strong lobby group that campaigned for further research, development and grid integration of renewables emerged in the late 1980s and early 1990s. Municipalities and advocacy groups such as Eurosolar or the Inland Wind Power Association increasingly called for a nationwide implementation of market-integration aids for renewables. A small group of CDU/CSU members of the German parliament (from areas in Germany which benefited from the use of wind turbines and hydropower plants) took up the demands of this new lobby and started the legislative process for an Electricity Feed-in Act in collaboration with parts of the Green parliamentary group, the Federal Ministry of the Environment and the Federal Ministry of Research [47].

Since 1979 there had been a non-binding feed-in-agreement between government and private sector power companies. According to the agreement, the power companies were not obligated to accept electricity from third parties or from renewable sources and only paid remuneration in accordance with the principle of avoided costs [62]. The Act on the Supply of Electricity from Renewable Energy Sources into the Grid (Stromeinspeisungsgesetz, StrEG), passed on December 7, 1990, now determined that there was a duty of acceptance and required that energy companies paid a minimum price for third-party electricity generated in their areas of supply. The prices for electricity from hydropower, landfill gas and biomass waste materials amounted to 75 percent of the average proceeds, the prices for electricity from solar panels and wind turbines to 90 percent [50]. The share of the costs for this system was borne by the power companies themselves. Even though the compensation rates for renewable electricity were significantly improved by the StrEG, they could not ensure a cost-effective operation of large-scale wind turbines. Nevertheless, the StrEG had laid the groundwork for the market integration of renewables, although it was not able to trigger a boom in this sector due to the linking of compensation rates to average electricity prices.

### 3.4. Turning points and continuity: energy policy measures 1998–2009

#### 3.4.1. The coalition agreement of SPD and Green Party in 1998

A change in government followed the national elections in 1998. After 16 years, the CDU/CSU and FDP government lost its majority to a coalition of SPD and Greens (“red-green coalition”) under the new Chancellor Gerhard Schröder (1998–2005) (Table 1g).

For the first time in German history, a party which focussed on ecology became part of the federal government. In the nearly twenty years since their establishment, the Greens had been consistently pleading for an expansion of renewable energies and an immediate end to the use of atomic energy, declaring ecological sustainability to be one of their fundamental principles. In the coalition negotiations with the SPD, who in principle were anti-nuclear as well, the decommissioning of all German NPPs as soon

as possible became the most urgent energy-related campaign promise of the Greens, without which an agreement would not have been possible. The Green Party was able to claim a partial negotiation success regarding the nuclear power phase-out. Since the majority of the SPD opposed an immediate shutdown of German NPPs due to concerns about increasing electricity prices and the loss of jobs in the nuclear industry, the red-green coalition came to a compromise. The coalition agreement presented a roadmap to prepare for a nuclear power phase-out: “The withdrawal from the use of nuclear energy will be extensively and irreversibly regulated by law within this legislative period [...], the new government will invite the utility companies to talk about a new energy policy, steps to end the use of nuclear energy and further nuclear waste management, and, if possible, to decide on these issues in a consensus. [...] the coalition will introduce an act in which the phasing out of nuclear energy is regulated, without any compensation payments; therefore, the operating licenses will be limited in time” [63]. In the matter of Gorleben, the Greens were able to implement a passage within the agreement that articulated doubts about the suitability of the salt deposit and announced that the exploration phase would be interrupted. Other sites should be explored nationwide. The coalition agreement also announced projects in the fields of energy legislation and renewables: “The new government will ensure a future-proof, environmentally friendly and cost-effective energy supply. Renewable energies and energy efficiency have priority [...]. The government believes that the entry into new energy structures will be characterized by growing economic dynamics, which will be further supported by redesigning the energy laws. This includes, in particular, non-discriminatory grid access and the creation and safeguarding of fair market opportunities for renewable domestic energies through a clear legal regime and a fair distribution of the costs of these sustainable energies” [63]. The climate protection goals of the previous government were confirmed in the agreement. Without a doubt, the 1998 coalition agreement between Social Democrats and Greens must be described as a turning point in German energy policy.

#### 3.4.2. Nuclear power phase-out and Renewable Energy Act in 2000

After long and difficult negotiations, a nuclear phase-out without compensation payments, the Agreement between the Federal Government and the Power Utilities [64], was resolved on June 14, 2000. The lifetime of existing NPPs was limited to 32 years on average, and on this basis every NPP was granted a so-called residual electricity volume. The effective date for the beginning of the remaining terms was determined retrospectively on January 1, 2000. As a reference quantity a total of 160.99 TWh per year had been set. Thus, only a total of about 2.6 million GWh of electricity should be produced in German NPPs after 2000. However, the government made it possible to transfer left-over power quantities from unprofitable (older) to profitable (younger) power plants. In April 2002, this “negotiated law” came into force as the Act for the Orderly Termination of the Use of Nuclear Energy for the Commercial Generation of Electricity [65]. It placed the agreement between politics and power companies on a legal basis and furthermore prohibited the construction of new NPPs in Germany, imposed a 10-year moratorium on the exploration of the Gorleben salt deposit, demanded regular safety checks of NPPs, restricted nuclear waste to be disposed directly in a final storage and banned the reprocessing of German nuclear fuels abroad as of July 2005. Although it was considered to be a success that regression payments could be avoided through the nuclear consensus, the flexibility of the agreement made it impossible to set a specific date for the final end of nuclear energy. Mez sums it up: “From a certain perspective, the agreement may be interpreted as a quasi-quota for

**Table 1g**

Overview of path defining developments, discourses and power constellations.

Time	Path defining developments	Discourses and power constellations
1998		<ul style="list-style-type: none"> <li>• After 16 years of CDU/CSU/FDP government, a new coalition SPD/Greens</li> <li>• The expansion of renewables and an immediate atomic phase-out had been the political focus of the Greens since the party's foundation</li> </ul>



nuclear energy which the German nuclear operators have been granted by the government by way of guaranteeing the continued operation of existing plants” [48].

In addition, an amendment or replacement of the StrEG of 1990 was a major concern of the Green Party in government. After the adoption of the EU Electricity Market Directive of 1997, the Kohl government had already reformed the German Act on Energy Management (Energiewirtschaftsgesetz) in 1998. Before this reform, the monopoly energy companies and thus the owners of the German electricity grids had relied on the fact that they had no “obligation for general connection and supply” of third-party electricity. With the new regulations, the monopolies of the big energy companies had finally been broken. However, the liberalization of the German electricity markets led to a sharp decline in electricity prices. Since the StrEG linked the reimbursements for renewable energies to the average price of electricity, many renewables became even more unprofitable than before, which had a negative impact on the scope for investments and growth in the renewable sector. To stop this development and to stimulate the growth of renewables in Germany again, the red-green coalition now sought to decouple the payments from the current price of electricity [62]. The result was the Act on Granting Priority to Renewable Energy (Renewable Energy Act, EEG), which came into force in March 2000 and replaced the StrEG [66].

The EEG introduced fixed feed-in tariffs (Einspeisevergütung) for electricity from renewable sources, now decoupled from current electricity prices and a lot higher than under the StrEG. The grid operators were obligated to accept electricity from third-party renewables, to feed in the electricity and to pay the fixed prices. Wind power tariffs, for example, now amounted to 9.10 Ct/kWh in the first five years and subsequently to 6.19 Ct/kWh, and power from photovoltaic systems to 50.6 Ct/kWh to 48.1 Ct/kWh. The fixed tariffs were guaranteed for a period of 20 years. The costs arising from the EEG were distributed between all energy consumers. In 2004, a second amendment to the EEG was implemented, reducing the feed-in tariffs for wind turbines and adjusting European legal requirements. Nonetheless, both the German markets for photovoltaics as well as for wind energy continued to grow into the largest markets in Europe [67]. The issues of climate change and climate protection were explicitly mentioned in the EEG and named as reasons for the increased support for renewable energies (Table 1h).

The opposition parties CDU/CSU and FDP criticized the energy policy of the red-green coalition. The nuclear phase-out and the EEG were rejected by the majority of CDU/CSU and FDP party officials and members. An energy policy consensus in Germany still was not in sight. This became obvious when the Enquete Commission on “Sustainable Energy Supply under the Conditions of Globalization and Liberalization”, initiated by the Bundestag, presented its final report in 2002. The parties of the Bundestag expressed very different views on how a low-carbon energy supply could be reached, as shown by the numerous dissenting opinions on nuclear power in the report [68]. In 2003, the “Scientific Advisory Council on Global Environmental Changes (WBGU)” presented its report on an “energy transition” [69]. Here, the ideas for a transformation of the energy system became more and more concrete. In the following years, however, essential elements of these ideas on an energy transition became popular among all German parties.

#### 3.4.3. Grand coalition and “climate chancellor” Merkel 2005–2009

In the national election campaign of 2005, which ultimately led to the replacement of the red-green coalition by a government of CDU/CSU and SPD under CDU (Chancellor Angela Merkel), heated discussions about the nuclear phase-out and the EEG continued.

However, the language used by the parties had become more moderate. The CDU/CSU no longer plead for abolition of the EEG, but rather suggested an increase in the efficiency of its instruments. Only the FDP was still fundamentally opposed to the EEG.<sup>5</sup> Since the CDU/CSU had changed their attitude towards the EEG and the SPD wanted to hold on to its current energy policy, the act was not affected by actions of the new CDU-led government. Quite the contrary, the coalition agreement laid down new ambitious targets for the development of renewable energies. The share of renewables in electricity generation was set to increase to at least 12.5 percent by 2010 and to at least 20 percent by 2020. In addition, a further expansion of offshore wind turbines and a faster development of power grids were decided [70]. However, the fundamental disagreement between the two parties on nuclear power remained unchanged. Therefore, the status quo, the nuclear phase-out and its timeframe, remained untouched. With a view to the development of renewable energies and the deal on nuclear power, the first Merkel government thus stood largely for continuity in energy policies (Table 1i).

With respect to climate policy, the grand coalition showed even more initiative than all its predecessors. The Stern report published in October 2006 and the IPCC report in February 2007 on the consequences of global climate change convinced the German government that an immediate global response was required [62]. As a result, Merkel appeared on the international stage as a passionate climate politician. Due to pressure from the German government during the German EU Presidency in the first half of 2007, the EU-leaders agreed on the 20-20-20 target to be achieved by the year 2020. According to the agreement, the EU’s greenhouse emissions should be cut by 20 percent compared to 1990, energy efficiency should increase by 20 percent and the share of renewables in total energy consumption should rise to 20 percent [71]. Only three months later, at the G8 summit in Heiligendamm, Merkel succeeded in committing the member states to a common declaration for international climate protection that noted that the member states were “seriously considering” the reduction of global CO<sub>2</sub>-emissions by 50 percent by 2050. In the German media, Merkel quickly became known as the first “climate chancellor”.

The government also took national measures to improve Germany’s contribution to international climate protection. In August 2007, the grand coalition agreed on an IKEP (Integrated Energy and Climate Program). The program proposed a further development of renewable energies, a significant increase in energy efficiency and the modernization of German power plants as cornerstones of a sustainable, climate-friendly energy supply. The climate protection goals proposed went far beyond the 20-20-20 objectives of the EU: by 2020, German CO<sub>2</sub> emissions were to fall by 40 percent and the share of renewables in electricity generation should increase to 30 percent (heat generation: 14 percent). The program consisted of 29 measures: i.e. amendments to the Energy Management Act and the Energy Saving Act, increased support for power-heat coupling and raising energy standards for new buildings by 30 percent [72]. The fact that energy efficiency was considered a central part of the path to a climate-friendly energy system was underlined with the passing of the Renewable Energies Heat Act in 2009, which prescribed that new buildings should be supplied with a certain percentage of renewable energies.

During the grand coalition from 2005 to 2009, climate protection and energy policy had finally become dominant political issues. The government provided political continuity in the field, basically confirming the energy policy measures of the red-green

<sup>5</sup> Even in this party some regional and local politicians supported wind and PV subsidies.

**Table 1h**  
Overview of path defining developments, discourses and power constellations.

Time	Path defining developments	Discourses and power constellations
2000	Agreement between the Federal Government and the Power Utilities for nuclear phase-out without compensation payments; lifetime of existing NPPs limited to 32 years on average	
April 2002	Based on above agreement, Act for the Orderly Termination of the Use of Nuclear Energy for the Commercial Generation of Electricity	
March 2000	Renewable Energy Act (EEG): fixed feed-in tariffs for electricity from renewable sources	<ul style="list-style-type: none"> <li>• Opposition parties (CDU/CSU and FDP) criticize energy policy of the red-green coalition</li> <li>• The nuclear phase-out and the EEG were rejected by the majority of CDU/CSU and FDP party officials</li> </ul>
2003		<ul style="list-style-type: none"> <li>• WBGU report on the “energy transition” concretize the transformation of the energy system</li> <li>• Essential elements become popular among all German parties</li> </ul>

coalition. However, a consensus on the question of the further use of nuclear energy between parties was still pending.

### 3.5. Back and forth? Energy policy measures since 2009

#### 3.5.1. “Energiekonzept” and lifetime extension for nuclear power plants in 2010

The energy policy situation before the national elections in 2009 was as follows: all parties represented in the Bundestag, even the FDP, now accepted the ambitious German climate protection goals and were in favor of support for renewable energies by the EEG. In nuclear policy, however, there continued to be two camps. On one side, SPD, Greens and the Left (Die Linke, formerly known as PDS) wanted to maintain the nuclear phase-out agreement of 2000. On the other side, CDU/CSU and FDP wanted to rely on nuclear power as an inexpensive and safe “bridge” to the age of renewables. They were thus in favor of a significant but limited lifetime extension for German NPPs. Christian Democrats and Liberals won the election. In its coalition agreement, the new government under Chancellor Merkel confirmed – in principle – the energy policy path that had been taken by the previous two administrations. However, the new government sought to follow a new approach of a so-called non-ideological, technology-open and market-oriented energy policy. The consequence of this approach was the rejection of the 2000 nuclear phase-out and the announcement of a significant extension of the previously defined lifetimes for NPPs (Table 1j).

However, the lifetime extension for NPPs by the new government cannot be regarded as an isolated energy policy measure. It was embedded in the first governmental, scenario-based concept for a future energy supply. In September 2010, the Merkel government presented its “Energiekonzept” to the public [73]. The

concept once more proclaimed very ambitious climate protection targets for Germany: by 2020, greenhouse gas emissions were to be reduced by 40 percent and by 2050 by at least 80 percent compared to 1990. The “development” path to a low-carbon future furthermore envisaged a reduction of greenhouse gases by 55 percent up to 2030 and by 70 percent up to 2040. By 2020, the share of renewables in gross energy consumption should increase to 18 percent and to 60 percent in 2050. By 2020, the share of renewables in gross electricity consumption should rise to 35 percent, to 50 percent in 2030, to 65 percent in 2040 and to 80 percent in 2050. Ambitious goals in increasing the energy efficiency of buildings and for private motorized transport were also part of the energy concept. Important measures for the development of the sector of renewables were further support for wind energy (offshore and onshore), a better use of renewable energy for heating and cooling, better integration of renewable energies into the energy supply, a qualitative and quantitative expansion of electricity grids, and the further development and promotion of new energy storage technologies [73]. The energy concept of the government also included a passage, which was later commonly [see also 10a, p. 3] – and falsely – referred to as “the phase-out of the nuclear phase-out”: “In order to shape this transition we still need nuclear power for a limited period and will therefore extend the operating lives of nuclear power plants by an average of 12 years.” [73]. With the energy concept, the CDU/CSU/FDP government committed itself to the transition process to a renewable energy era, the political challenge of climate change and the role of Germany as the leading country driving innovation in this field. However, the government considered nuclear power to be a “central bridge” for the shift to a sustainable energy supply. A bridge that would ensure security of supply and economic efficiency of the energy system [74]. In

**Table 1i**  
Overview of path defining developments, discourses and power constellations.

Time	Path defining developments	Discourses and power constellations
2005	Federal Election	<ul style="list-style-type: none"> <li>• Replacement of SPD/Green coalition by a government of CDU/CSU and SPD under Chancellor Merkel</li> <li>• Language of discussion about the nuclear phase-out and the EEG becomes more moderate</li> <li>• CDU no longer calls for abolition of the EEG, but for an increase in its efficiency</li> <li>• Only FDP is still opposed to the EEG</li> <li>• SPD wants to hold on to its energy policy</li> <li>• Coalition agreement lays down new ambitious targets for the development of renewable energies</li> <li>• Fundamental disagreement between the two parties (CDU/CSU and SPD) with respect to nuclear power</li> </ul>
2006/2007	Publications Stern report/IPCC report	<ul style="list-style-type: none"> <li>• Reports lead German government to an immediate response</li> <li>• Merkel enters the stage as a passionate climate politician and pressures EU-leaders to the 20-20-20 target by 2020</li> </ul>
2009	Federal Election Campaign	<ul style="list-style-type: none"> <li>• All parties in the Bundestag (incl. the FDP) accept the ambitious climate protection goals and favor the support for renewable energies and the EEG</li> <li>• Two camps on nuclear policy: <ul style="list-style-type: none"> <li>- SPD, Greens and the Left (die Linke, formerly known as PDS) want to maintain the nuclear phase-out agreement of 2000</li> <li>- CDU/CSU and FDP consider nuclear power as an inexpensive and safe bridge technology towards renewables</li> </ul> </li> </ul>

**Table 1j**  
Overview of path defining developments, discourses and power constellations.

Time	Path defining developments	Discourses and power constellations
2009	Federal Election	<ul style="list-style-type: none"> <li>• New government (CDU/CSU and FDP) largely continues the energy policy path of the previous government</li> <li>• Questions the timescale of the 2000 nuclear phase-out instead announcing a significant lifetime extension of existing NPPs</li> </ul>
September/October 2010	Government introduces its "Energiekonzept" and amends the Atomic Energy Act	<ul style="list-style-type: none"> <li>• Energiekonzept proclaims very ambitious climate protection targets and measures for Germany</li> <li>• Often - but falsely - referred to as the "phase-out of the nuclear phase-out": only the lifetime extension of existing NPPs by on average 12 years</li> <li>• Decision of the lifetime extension of NPP provokes great social protest and revitalizes the German anti-nuclear movement</li> <li>• SPD, Greens and the Left join forces with some trade unions and environmental organizations and organize large demonstrations against the new nuclear policy</li> </ul>

October 2010, the government amended the Atomic Energy Act [75], thereby increasing the total amount of residual electricity volumes and extending the NPPs lifetimes by 12 years on average. 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.

The decisions of the government for an extension of NPP lifetimes provoked great social protest and revitalized the German anti-nuclear movement. SPD, Greens and the Left joined forces with trade unions and environmental organizations and organized demonstrations with tens of thousands of participants. The opposition accused the government of causing great social conflict. However, it has to be emphasized that the federal government had only prolonged the use of existing nuclear power capacities in Germany. New investments and a further development of the technology or even the construction of new NPPs were not planned. Therefore, the Merkel government basically had retained the phase-out decision of the red-green coalition from 2000/2002.

### 3.5.2. Fukushima and the German energy consensus 2011

Since the 1980s, the German population, in comparison to other European countries, had been exceedingly skeptical about nuclear energy. Even the climate change debate did not modify that attitude substantially. It was this constellation that made the Fukushima core melt accident on March 11, 2011, an event that changed the government's view on nuclear energy fundamentally. After Fukushima, support for nuclear power in Germany dropped to about 20 percent, one of the lowest figures worldwide [76,77] (Table 1k).

The Fukushima accident led to almost hysterical reactions within the German media as well. This becomes clear if one compares the reactions in Germany with those in France and the United Kingdom [78]. In Germany, extra supplements of daily and weekly

newspapers were published; the disaster was documented by the minute. Even major newspapers which were politically close to the ruling parties criticized the nuclear policy of the CDU/CSU and FDP after Fukushima. The social and media response to the disaster applied pressure on the government. None of the usual justifications in favor of nuclear power seemed to work any longer [79]. Fukushima did not change the "objective" safety status of German reactors, but it did change the perception of nuclear safety on various social levels, even in former pro-nuclear groups. Additionally, in the upcoming regional elections in Baden-Württemberg and Rhineland Palatinate a huge success for the nuclear critical Greens was feared by the Merkel government, endangering the position of the CDU-led state administration in Baden-Württemberg. Against this background, the German federal government responded quickly to the accident: On March 15, 2011, after consultation with the Minister Presidents of those federal states where NPPs were located, Chancellor Merkel announced a "nuclear moratorium" with reference to a security paragraph of the Atomic Energy Act (precautionary security). The seven oldest German reactors were shut down temporarily (never to go online again). The lifetime extension for the German nuclear power plants was suspended for an initial three months. With these measures and despite some resistance in their parties, the CDU/CSU/FDP government had already performed a political U-turn. The decision against a prolongation of the use of nuclear energy had been made. In March 2011, the government initiated the work of the "Ethics Commission for a Safe Energy Supply", which was charged with developing a political consensus on nuclear policy after Fukushima [80]. The predictable result of the commission finally served as a legitimation for the final phase-out of nuclear power. It proposed a complete phase-out of nuclear power, if possible by 2021. The cabinet voted in favor of a final nuclear phase-out on June 6, 2011. In conformity with the public and the overwhelming majority in parliament, the Bundestag passed the thirteenth Amendment to

**Table 1k**  
Overview of path defining developments, discourses and power constellations.

Time	Path defining developments	Discourses and power constellations
March 11, 2011	Fukushima core melt accident	<ul style="list-style-type: none"> <li>• Changes the government's view on nuclear energy</li> <li>• Support for nuclear power in Germany drops to about 20%</li> <li>• Strong reactions in the German media (major newspapers criticize the nuclear policy of the CDU/CSU and FDP government)</li> <li>• The Merkel government fears the success of the nuclear critical Greens in the upcoming elections in Baden-Württemberg and Rhineland Palatinate</li> </ul>
March 15, 2011	<ul style="list-style-type: none"> <li>• Chancellor Merkel announces a "nuclear moratorium" with reference to a security paragraph of the Atomic Energy Act</li> <li>• The seven oldest German reactors were shut down</li> </ul>	<ul style="list-style-type: none"> <li>• Government initiates the "Ethics Commission for a Safe Energy Supply", which legitimized the political U-turn to phase-out nuclear power by 2021</li> </ul>
	13th Amendment to the German Atomic Act: permanent decommissioning of the seven oldest reactors and a nuclear phase-out by 2022	<ul style="list-style-type: none"> <li>• Abandoning the "nuclear power bridge" thwarts nuclear energy and accelerates the "Energiewende".</li> </ul>

the German Atomic Act [81] that led to the decommissioning of the seven oldest reactors and a nuclear power phase-out by 2022.

The decisions made in spring and summer 2011 shut down the “nuclear power bridge”, thwarted nuclear energy and accelerated the drive into the eco age. Ironically, it was the proponents of the extended use of atomic energy who decided to bring the nuclear age in Germany to an end and who now pleaded for an accelerated energy transition – together with SPD and Greens [79]. Fukushima had ultimately led to the formation of a political and social consensus on energy matters between all German parties [82]. For all of them, nuclear power was no longer an option. The nuclear phase out had become “an essential ingredient of Germany’s *Energiewende*” [83].

### 3.5.3. Grand coalition and readjustment of the *Energiewende*

The third grand coalition in the history of the Federal Republic that followed the national elections of 2013 signed its coalition agreement in December of the same year. The new government, again led by CDU chancellor Merkel, faces many problems with the implementation of the new energy system: the costs for electricity consumers, which result from the EEG apportionment, are increasing (Table 11).

In 2004, Environmental Minister Jürgen Trittin (Greens) had stated that the promotion of renewable energies through the EEG would cost an average German household no more than about one euro a month – “as much as a scoop of ice cream” as he put it. In 2013, it was nearly twenty times more e.g., [84]. Industry and energy providers point out that electricity supply shortages might occur due to the growing share of weather-dependent energy sources. Many conventional power plants which provide the base load are no longer able to operate economically. This applies in particular to modern gas-fired power stations, which were supposed to be “partners” of the renewables, but also to some hard coal power stations. At the same time, in recent years, more and more civil initiatives have formed in opposition to local energy transition projects. The expansion of the German power grids, which is necessary to manage the distribution of renewable power in the country, has not moved ahead as planned either.

The coalition agreement showed awareness of the problems and announced first solutions [85]. The development of renewable energies should be slowed down and should be limited to so-called “development corridors”: the share of renewables in the power supply was now projected to reach 40–45 percent by 2025 and 55–60 percent by 2035. The expansion of biomass power plants should be mainly limited to waste and residual substances, the feed-in tariffs for wind turbines were set to be reduced, both onshore and offshore. Also a stronger degression of feed-in tariffs and a greater market orientation were considered in the agreement. CDU/CSU and SPD also agreed to scrutinize whether large producers of electricity from renewable energies have to guarantee a base load portion of their maximum power feed in the future. In general, a further cost explosion for electricity consumers should be prevented through lower tariffs and a slower expansion of renewable capacities.

In August 2014, the Bundestag passed an amendment to the EEG-law. Although the grand coalition did not present a general concept to reform the current process of the energy transition nor undertook a paradigm shift, the amendment will change the development of renewables on various levels. The new EEG e.g. sets expansion paths for each energy source. Wind energy (onshore) capacities are set to increase by 2400 MW to 2600 MW annually; the expansion targets for offshore wind power are reduced from 10,000 MW to 6500 MW by 2020 and 15,000 MW by 2030. The increase of biogas power plants is now limited to 100 MW per year, with mainly residual materials to be processed. The feed-in tariffs for biogas are reduced heavily. Self-generated and self-consumed power from solar panels now will be charged with a tax (“sun tax”). Subsidies for PV-sites [37] will be granted through tendering instead of feed-in tariffs e.g., [86,87]. In addition, the special equalization scheme (exemptions for energy-intensive industries) was reformed.

It is safe to say that the new government considers political improvements in the area of renewable energy policy to be one of its most important tasks for this legislative period. The government has initiated the monitoring process “Energy of the Future” to observe the development of this transition continuously and in detail. This long-term process aims to monitor whether the measures of the *Energiewende* are being implemented successfully and whether the aims have been achieved [88]. In April 2014, the second monitoring report was published, showing mixed results. On the one hand, the report praises the development of renewables which is on target. On the other hand, CO<sub>2</sub> emissions are still too high and energy-efficiency measures have not proven as successful as necessary. The power systems are in the midst of radical changes. Their effects on costs and supply security, however, to date cannot be fully foreseen [89]. Despite some fears that were expressed after the decision for an accelerated nuclear phase out in the Fukushima aftermath, studies have shown that the impacts of the shut-down of the seven oldest NPPs were modest and that is likely that the nuclear phase out will proceed smoothly without capacity shortages [83].

The task of further enhancing the process of the *Energiewende* will certainly not be an easy one. Political and social resistance from lobby groups and circles who benefit from renewables are very likely. In addition, northern German states (profitable wind turbine sites) and southern states (profitable sites for biogas) will try to avoid further cuts. In this struggle, the logics of energy markets are no longer decisive. A fierce competition between regional and local politicians and numerous advocacy groups will be the consequence e.g., [90,91].

## 4. Discussion

From the 1950s to the 1970s, nuclear energy was perceived in Germany as *the* innovative energy technology, and public and political support was high. About 40 years ago, the situation began to change, and a national anti-nuclear movement evolved from grass-root activities protesting about one specific nuclear power project. After the Chernobyl catastrophe in 1986, the party

**Table 11**  
Overview of path defining developments, discourses and power constellations.

Time	Path defining developments	Discourses and power constellations
2013	National Elections	<ul style="list-style-type: none"> <li>• Grand coalition among CDU and SPD again under Chancellor Merkel</li> <li>• Government faces challenges related to the transformation of the energy system, e.g., increasing costs for electricity consumers, increasing civil resistance with respect to the implementation of local energy transition projects, challenges related to expanding the German power grids</li> </ul>
August 2014	Amendment of the EEG-law	<ul style="list-style-type: none"> <li>• New coalition agreement announces a slow-down in the development of renewable energies to so-called “development corridors”</li> <li>• First political and social resistance from lobby groups and circles who benefit from renewables emerges</li> </ul>

consensus on nuclear energy began to break up. Twenty-five years later, it was again a core melt accident that changed the political landscape in Germany. With the Fukushima accident, the constellation of two competing camps with different views on nuclear energy dissolved.

A closer look into the history of German energy politics, however, indicates that a consensus on the growing problem of global warming, the necessity of a low carbon energy system and the need for the development of renewables is much older. With the first ideas on an energy supply without oil, coal and uranium published in the early 1980s and the rise of the Green party around the same time, the *notion of an energy transition* as it is known today was planted in the German society.

People who had been part of the environmental movement of the 1970s now pursued careers in parties such as the SPD or Greens, in the media, in associations and trade unions. Their political dedication to environmental issues laid the *groundwork* for today's energy policy.

The *framework* for the development of Germany from an industrialized country that solely depended on coal, oil and uranium to a pioneer and “intellectual leader” [61] in renewable technologies, was set in the second half of the 1980s. The growing debate on climate change and its consequences and the commitment of the Kohl government to that issue created a new political atmosphere. From now on it was no longer possible to doubt that energy efficiency measures and research on renewables were necessary, even though no one could predict whether, at some point, renewables would be able to become a major source of electricity.

The *legislative work* to accelerate the development and market integration of renewables was done in the 1990s and the early 2000s. With the Electricity Feed-In Act in 1991, the amendment to the Energy Management Act in 1998 and the passing of the EEG in 2000, German politicians created instruments that became role models for other countries that want to increase their share of renewable energies. Today, the sitting grand coalition has started its *repair work* on the undesirable consequences related to the energy transition. In today's Germany, the model of a safe, clean and affordable energy supply explicitly excludes nuclear energy and concentrates on renewable energy sources. It is only the “radioactive legacy” of over four decades of nuclear power generation that still plays an important role in German energy policy.

The reasons for the special attitude of Germany towards nuclear energy are, as discussed, many and varied. What seems rather problematical, especially regarding the aspect of climate change, is the German focus on its own domestic policy measures and continuing massive support for just one “technology family” (renewables). Rick Bosman notes: “(I)t seems that the international dimension of the energy system receives too little attention. Up to now, most of the bargaining power of the German renewables advocacy has been aimed at adapting and introducing domestic policies. An inward-turning trend can be observed regarding energy policy ( ... ). Nonetheless, shifting focus to the European dimension could in fact be a vehicle with which to accelerate the transition. In future, instead of alienating its neighboring countries with unilateral decisions to exit from nuclear energy and prohibiting harmonization of support schemes, Germany and its powerful renewables advocacy should channel this power towards aligning its European partners in the energy transition” [92]. After the phase-out of nuclear power, public and scientific opinion assumes that CCS (carbon capture and storage) will fail in Germany [93] and the fracking mining technology to produce shale gas is very unpopular in Germany, although it might contribute to a sustainable electricity supply [89]. Taking into account that even the public acceptance of coal power declines significantly, the question is: Is a

transition to an energy supply with a share of 80 percent of renewables by the year 2050 realistic for an industrialized country like Germany? [94]. The international community is certainly keen to find the answer by monitoring developments in Germany.

With the five biggest parties now opposing the use of nuclear energy beyond the year 2022 and a society that is overly critical of NPPs, another *volte-face* that would consider nuclear power to be a crucial part of the “Energiewende” seems unlikely. The German energy policy, despite recurrent controversies, has shown – at least in the past decade – a high degree of continuity in its central aspects. It is “increasingly being influenced by a diverse and growing group of renewable energy supporters. These forces have resulted in the recent adoption of a policy to transform the nuclear- and fossil-fuel-dominated energy system into one based predominantly on renewable energy sources by 2050” [92]. The German Energiewende is thus not only politically and legally adopted, it is also fundamentally anchored in the public opinion. Basic confrontations about the prospects of the energy system as in the early 1980s are almost impossible to find today. The path is now strongly predefined and seems – at best – variable with respect to its currently very strict timescale. Given the political and social consensus on the Energiewende, the past has shown that only radical incidents or developments may lead to deviations from a pursued political path. With respect to the Energiewende, two conceivable developments might initiate such a shift: (a) the energy transition fails technologically (e.g., a sustained major blackout occurs that must plausibly be ascribed to the immaturity of renewables), or (b) the energy transition fails socio-economically (e.g., a sustained, significant increase in energy or, especially, electricity prices leads to considerable social unrest or endangers the economic competitiveness of the Germany industry). Though theoretically conceivable, from a current perspective both of these scenarios appear rather unlikely.

## 5. Conclusion

Objective was to investigate the German energy political development process with specific focus on the Energiewende and its emergence during the various periods of energy political history. As alluded to in the introduction, the analysis confirmed that the origins of the Energiewende date back more than thirty years in the past. In order to understand the drivers and specific circumstances that have led to this progressive energy political course in Germany, focus was set on systematically tracing political power constellations, social dynamics and their related discourse dynamics to the timing and sequencing of events and decisions. Based on this approach, those path defining developments were identified that have shaped the long road to a consensus on energy policy in Germany. Only three and a half years ago, following the Fukushima core melt accident, the “nuclear conflict” finally came to an end.

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