Energy, Sustainability and Society

FORUM

Open Access

The German *Energiewende* and the role of the EU: are misfits an Achilles heel of the energy transition in Germany?

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Abstract

Background The aim of the energy policy proclaimed by all German federal governments since the Fukushima incident of 2011 is a fundamental transformation of the national energy system towards renewable (excluding nuclear) energies. However, since German energy policy is embedded into a European multilevel governance system, not only national but also European forces shape the German *Energiewende*.

Main text By analysing the complex political and legal interlinkages, this study identifies fits and misfits between national and European policy initiatives in functionally related energy fields. First, it finds broad coherence between the EU and German energy transition objectives. Objectives deviate in one area, the phase-out of nuclear power in Germany which is not paralleled at the EU level. Secondly, it observes more extensive misfits around the preferred policy instruments that have pressured Germany to change. This concerns instruments tied to the support of renewable energy and the operation of electricity networks in support of the transition. Here, the German policy approach saw a misfit with internal energy market regulations in the EU.

Conclusions Whereas European adaptation pressure caused a shift in the German renewable energy support policy, resulting in a slowdown in the expansion of renewable energies, EU pressure to end coal subsidies helped accelerate the phase-out of coal in Germany.

Keywords Energiewende, Germany, European union, Nuclear and coal phase-out, Renewable energies, Energy networks

Background

After the Fukushima incident in 2011, the Federal Government of Germany launched a series of ambitious policy targets labelled as "energy transition" (*Energiewende*) with the aim of establishing a sustainable national energy system based on replacing fossil fuels and nuclear power with renewable energies. Since Germany is integrated into a complex multilevel energy governance system [1], this meant that national policies would have to be adapted to those established at the EU level. These comprise major climate and energy policy packages, adopted in 2009 with objectives set for 2020, in support of a

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union-wide energy transition [2]. The ecological transformation and the European Green Deal play a pivotal role in the current development of energy transitions towards 2030 and 2050, particularly in the context of increasing alignment between national and European policies. The Green Deal has not only intensified the objectives for Germany's *Energiewende* but also established new standards and requirements that must be implemented at the national level. These developments have resulted in greater harmonisation of national policies with EU directives, thereby exerting pressure on Germany's *Energiewende* to adapt to accelerated transformation goals.

The case of Germany's *Energiewende*, particularly in terms of its implementation and integration within the EU context, can offer valuable lessons for similar transformation processes. The German approach, initially tailored heavily to national circumstances, had to increasingly adapt to EU-wide directives, and this presented both challenges and opportunities. The needto integrate national specificities into a broader European framework underscores the importance of flexibility and adaptability in policymaking. At the same time, the German case demonstrates how the Europeanisation of energy policy, as outlined in the Green Deal, enabled national strategies to be expanded and strengthened by incorporating them into the wider framework of climate and energy objectives.

This paper applies a policy misfit framework based on the Europeanisation literature to analyse evolving points of friction between EU and German energy transition policies and the consequences for the specific German *Energiewende* policy approach. It traces policy developments over time in order to investigate the evolving policy fits and misfits as well as the corresponding policy adaptation. Which policy misfits have been removed through policy adaptation with what consequences for the German *Energiewende*? Which of the main misfits still exist as the EU and now Germany adapt to their accelerated energy transition ambitions for an energy transition by 2030, and how might these ambitions affect German *Energiewende* policies?

To answer these questions, this paper applies comparative method and process tracing. Evolving fits and misfits between German and European energy policies are measured by comparing national and EU rules and regulations as they have unfolded in time [3]. To investigate whether and how EU-level policies put adaptation pressure on Germany and influenced national policy development, the paper traces policy processes at both levels, looking at the sequences of events and elements of interaction between the EU and German politics. In doing so, it tries to disentangle EU influence from the national determinants of Germany's energy transition policies from 2011 onwards [1, 4, 5].

The data used in this study have been collected from desk research, involving an extensive review of existing studies on EU and German policy developments, public policy and legislative documents at both levels, public materials provided by the European Commission and the German government on their web pages, and media articles. Synthesising existing data from multiple sources has provided a comprehensive understanding of the energy transition processes at the German and EU levels and enabled testing the validity of the data (data triangulation). The study is limited to investigating the interaction of European and national levels in policy areas crucial for the German *Energiewende*: the phase-out of nuclear and coal-based power, the promotion of renewable energies, the construction and use of energy networks, and the differentiation of policy objectives from policy instruments and measures. Chapter 2 takes a closer look at the ideas of the fit/misfit theory and outlines how the theory can be applied to the analysis. Chapter 3 looks at the major landmarks of the policy approach taken to energy transition in Germany and traces related European initiatives and regulations that evolved in parallel. This forms the basis of the fit/misfit analysis. Chapter 4 concludes.

Main text

The misfit approach and its implications for the German energy transition

Drawing on a multilevel governance perspective [1], this analysis employs the misfit approach as a conceptual lens to investigate the interplay between European and national policy processes. Within the broader framework of Europeanisation research, 'misfit' here refers to the degree of divergence between the EU policy instruments and objectives and those prevailing at the national level. In this context, misfit can be defined as the extent to which the means employed by the European Commission—such as regulatory instruments or policy strategies—contradict or challenge the goals, institutional arrangements, or implementation capacities at the domestic level. This divergence is not merely a technical incongruity but may generate significant political and institutional pressure for adaptation within member states. The degree of misfit is thus a central explanatory factor for both resistance and transformative change in domestic policymaking.

Misfit is not an objective condition solely identified by the researcher; rather, it becomes politically salient when EU initiatives confront entrenched national preferences or established policy trajectories. It may manifest as a conflict between EU-driven objectives and national priorities, or between supranational instruments and existing domestic governance mechanisms [6]. The misfit hypothesis posits that the likelihood and nature of domestic policy change are contingent upon the degree

of compatibility between EU and national policy frameworks [7]. When there is a high degree of fit—meaning the EU policy aligns closely with national practices—adaptation pressure remains low, and compliance is more probable, but there is often a lack of any substantial policy transformation. Conversely, significant misfit can generate strong adaptation pressure, potentially leading to either implementation failure or profound domestic reform. In the case of the German energy transition (*Energiewende*), it can be hypothesised that the presence of a misfit between the EU energy and climate policies and the national strategies may function as a catalyst for change. Specifically, if EU-level ambitions and instruments substantially exceed those of the German policy framework, this misalignment could provoke political conflict, institutional adjustment, or even a recalibration of national policy goals.

However, misfit can also serve as a driver for innovation, compelling domestic actors to develop new strategies and instruments that bridge the gap between national and European expectations. Moreover, member states often seek to 'upload' their policy preferences to the EU level to avoid future misfit and the associated adaptation costs [8]. When such efforts fail, reluctance to 'download'—or give up— incongruent policies may follow. Nonetheless, where enforcement mechanisms or other forms of supranational pressure are robust, misfit may ultimately result in substantive domestic policy change. Thus, this study explores the hypothesis that misfit between the EU and German energy policy—defined as the contradiction between the European level means and domestic policy aims—creates adaptation pressure that may either reinforce or disrupt the trajectory of the *Energiewende* (see overview in Table 1).

Central *Energiewende* policies in Germany and parallel policy developments at the European level

The German government's announcement of an "accelerated energy transition" in the summer of 2011, to be known as the *Energiewende*, included targets for the reduction of greenhouse gas emissions, an expanded share of renewable energies, and concurrently, a reduced share of fossil fuels. A phase-out date of 2022 for nuclear power was also set. Complementing policies aimed to accelerate the development of energy networks needed to link new large-scale generation of renewables (wind power in the north) to areas of main demand in the south and west. The decision was a milestone in a policy process already decades long. Phase-out of nuclear power had been on the agenda since the 1970s [9]. Reducing the share of coal in the energy system followed stronger ambitions in German climate policy from the 1990s and was centred primarily on removing national coal subsidies. Renewable energy support policies date back to the 1980s. The need to complement the energy transition by strengthening national and international electricity networks has long been acknowledged through various initiatives to accelerate grid planning and licensing. In the following, developments in these policy fields are traced alongside presentations of parallel policies evolving at the EU level.

Table 1 Overview of the misfit approach: fits and misfits in the German Energiewende— conceptual and policy-level interactions with the EU

Type	Fit	Misfit
Conceptual / structural	Shared principles, structures, or strategic goals → e.g. climate neutrality, energy, efficiency, decarbonisation	Contradictory paradigms or institutional preferences → e.g. market vs. state-based mechanisms, role of nuclear energy
Policy / instrumental	Alignment in regulatory instruments → e.g. Just Transition Mechanism, EU ETS reforms	Operational conflicts in instruments or frameworks → e.g. feed-in tariffs vs. EU rules, grid operation restrictions

Nuclear energy policy—from a good to a poor fit

Germany introduced nuclear power in the 1950s, supported by a broad-based political and popular consensus. Concurrently, the 1957 EURATOM Treaty was established as one of the founding pillars of what would become the EU. Common policies under this treaty involved joint research and development (R&D) and safety standards, with substantial funds allocated by the EU, contributing to lowering the costs of nuclear energy [10]. Alignment of German and EU nuclear power policy continued until the early 2000s, when a red-green coalition government agreed that nuclear power production should be gradually phased out. The agreement emerged from a waning political consensus on nuclear energy that had been crumbling since the 1970s, under the influence of a growing anti-nuclear environmental movement and with an anti-nuclear Green Party becoming the first of its kind to win seats in a national parliament in Europe [11]. Political disagreements continued; in 2009, a returning centre-right government decided that nuclear power would continue beyond the agreed phase-out date as a bridging technology until renewables could be reliably supplied. This policy was short-lived, however. After the nuclear accident in Fukushima in 2011, which provoked new large anti-nuclear demonstrations, the government reinstated the phase-out decision of the previous red-green coalition government and decided on a gradual shutdown of all 17 reactors by 2022, established as part of German law [12]. Despite this extended political agreement, discussions continued as to whether reducing German CO_2 emissions without nuclear power would become too costly. The party-political consensus was

maintained, however, and full phase-out was completed with only a short delay.

By its phase-out decision, Germany parted company with most of the other 13 nuclear power states in the EU [13]. Only Belgium and Spain followed Germany in deciding to phase out nuclear power (by 2030), the former opting to postpone such a phase-out after Russia invaded Ukraine [14]. Several countries—most notably France, but also Finland and Poland—chose to expand their nuclear capacities, while Sweden lifted its moratorium on the construction of new nuclear power plants. Germany's new policy stance also meant diverging from the EU's nuclear policy. Emphasising technological neutrality and overarching energy policy goals such as energy security and decarbonisation [15], the EU continued its policy path of supporting R&D and safety regulations for nuclear power, suggesting a latent preference for maintaining nuclear power as a viable option within the Union's energy mix [16]. More recently, the EU has included nuclear power in its taxonomy regulations as an option to help to reduce greenhouse gas emissions [17]—a policy Germany chose not to support.

However, while facilitating a role for nuclear power in the all-European energy transition, the EU did not seek to reverse the German nuclear phase-out decision [17]. The legal and real influence of the EU on the member states is rather limited, reflecting different positions and interests among the EU member states and their insistence on keeping full competence to decide over their national energy mixes [11]. However, the prevailing institutional discourse and the continued support for nuclear energy research and safety governance, aimed at retaining technological leadership and ensuring the availability of nuclear power to meet the ambitious CO_2 reduction targets, set for the period between 2030 and 2050) [16, 18], means that a misfit can be observed—not in terms of formal EU opposition to Germany's policy, but as a structural and strategic divergence between Germany's national policy trajectory and the implicit orientation of the European energy policy.

This divergence illustrates Germany's failure to upload its national energy transition model, which included the phase-out of nuclear power, to the European level. While the European Commission does not officially frame Germany's nuclear phase-out as a failure requiring correction, its policy choices and investment strategies imply an underlying tension between the national and supranational levels. The Russian invasion of Ukraine in 2022 and the ensuing energy crisis have further reinforced this tension by strengthening the political support within the EU for maintaining nuclear energy as part of a resilient and diversified energy strategy. Whether this ongoing misfit will exert tangible influence on Germany's transition policy remains an open question. However, the EU's sustained openness to nuclear energy may indirectly increase the likelihood of agreement on more stringent union-wide CO_2 emission reduction targets—targets that Germany must meet without the support of nuclear energy, thereby potentially intensifying adaptation pressures on its national energy policy.

Coal energy policy—evolving towards a better fit

Lignite and hard coal were historically considered the backbone of industrial development and welfare in Germany and many other parts of Europe. At the EU level, the European Coal and Steel Community (ECSC) formally established by the Treaty of Paris in 1951 became the first supranational institution through which the European Union ultimately unfolded. Through this treaty the EU, in its former guise, allocated major funds to projects aimed at increasing the competitiveness of European coal assets. The Treaty of Paris expired in 2002, and the member states agreed to continue devoting the ECSC's assets exclusively to research and innovation in the sectors related to the coal and steel industry, creating the Research Fund for Coal and Steel (RFCS). Germany increasingly saw that its hard coal resources lacked competitiveness compared to the country's imports. Hence, to keep up extraction, subsidies and other forms of state intervention were gradually introduced as important parts of the national coal policy. However, the increasing saliency of the climate change problem in the 1990s turned the focus to the negative externalities of coal production and use, and the removing subsidies evolved as a priority measure in international climate policy. The red-green government elected in 1998 agreed on a long-term reduction of fossil-based power generation and the modernisation of the power plant fleet with more efficient and climate-friendly technologies but did not remove hard coal subsidies. Instead, in 2003, the government secured a continued base subsidy for the coal industry [19]. Concurrently, the EU's climate policy was extended. The European Parliament and Council encouraged reforms and a gradual phase-out of coal subsidies [20].

In 2003, the EU adopted the directive that established the joint European Emissions Trading System (EU ETS). This 'cap and trade' system set a fixed total amount of greenhouse gas emissions, allocated as CO_2 allowances to all participating installations that had trade surplus allowances on the market. In the two first trading periods (2005–2007 and 2008–2012), the EU member states set the upper limit for CO_2 emissions in national allocation plans, and the CO_2 allowances were issued free of charge. Germany actively lobbied for such national control and managed to also upload mechanisms to compensate energy-intensive industries for the indirect costs (through higher electricity prices) of a higher carbon price, considerably neutralising the effectiveness

of the system [21]. The German national plan provided large energy companies with free and abundant CO_2 allowances and fuel-specific benchmarks that favoured lignite-fired power plants in particular [22, 23]. The EU ETS would evolve as the principal policy instrument for reducing carbon emissions with potential impacts on the role of coal in the German energy mix, but in 2007 the grand coalition government in Germany announced that national hard coal subsidies would not be phased out before 2018 [19].

In 2008, the EU decided to reform the EU ETS as main policy instrument to achieve the jointly agreed objective of reducing the EU greenhouse gas (GHG) emissions by 20% by 2020 (as compared to 1990) [2]. For the third trading period (2013–2020), EU-wide cap and uniform allocation rules were decided, with most emission allowances to be auctioned rather than allocated for free. However, as the market was oversupplied with emission allowances, prices for CO_2 certificates remained at the low level of around 5 €/t for years. Even after the *Energiewende* decision in 2011, any faster phase-out of coal subsidies or of coal energy as such was not initially the focus of national political debates in Germany. Rather, the phase-out decision of nuclear energy supported the argument that fossil power plants would become increasingly needed for security of supply. In 2012, in order to promote a higher price to incentivise CO_2 reductions, the EU proposed a temporary reduction of emissions-trading certificates, a move known as "backloading". The proposal was highly controversial within the German government and no unified position could be reached, delaying the decision at the EU level. In 2015, the EU member states, including Germany, agreed to introduce a Market Stability Reserve (MSR) as a first step towards gradually reducing the surplus in emissions trading and eventually transferring them to a reserve in 2019. The combination of low allowance prices, low international coal prices, and retained subsidies meant that Germany saw its share of coal-based electricity remain static and, despite the reforms for the third trading period, experienced higher emissions from its ETS sectors [21].

As it became clear in 2014 that Germany would miss its 2020 climate target if no additional policy measures were taken, debates about the future of coal intensified. However, various political initiatives to reduce coal-fired power generation (e.g., climate levy, Klimaschutzplan 2020) were politically unenforceable due to massive resistance from energy companies, energy-intensive industries, and the lignite-mining states [24]. In 2014, the EU agreed to continue its ambitious climate policy by cutting GHG emissions by 40% by 2030. To achieve this, a reform of the EU ETS would be needed, and it was proposed by the Commission in 2016. After more than two years of negotiations, a comprehensive reform of the EU ETS was adopted in 2018. The package included doubling the number of allowances annually transferred to the MSR. From 2023, the volume of the MSR would be limited to the previous year's auction volume. All allowances exceeding this limit will be cancelled. These reforms significantly strengthened the effectiveness of European emissions trading. After having been largely ineffective, CO_2 prices started to increase significantly in 2018.

Against this backdrop, adaptation pressure increased on Germany, which saw the phase-out of coal again move to the centre of public debate, supported by a growing climate protection movement. In 2018, the multi-stakeholder Commission on Growth, Structural Change and Employment was established by the German government to develop a roadmap for the phase-out of coal and to shape the structural change in the lignite-mining regions. In 2020, the German parliament eventually adopted the coal exit law, which provides for a phase-out by 2038, or at best even by 2035. It lays down a capacity reduction pathway for the German coal power plants, distinguishing between lignite and hard coal. For lignite, the German government has agreed on a timetable for the shutdown of each power plant unit with the power plant operators and the affected federal states. Meanwhile, the coal exit law foresees an auction system for hard coal-fired power plants. To contribute effectively to climate protection, the coal exit law also allows for the cancellation of freed-up certificates in the EU ETS. Congruence and fit can now be observed in the shape of the EU's new Just Transition Mechanism (JTM) and Germany's plan to help structural reform of former coal regions. The German government plans to support regions with up to 40 billion euros by 2038, with a further 4.35 billion euros paid to power plant operators. At the level of the EU, the Just Transition Mechanism (JTM), which is part of the Green Deal Investment Plan, will provide 100 billion euros for the most affected regions over the period from 2021 to 2027, in order to cushion the socio-economic impact of the transition.

Summing up, German and EU coal-related policies have evolved in parallel with varying degrees of fit and misfit. For decades, policies at both levels were allied in aiming to increase the competitiveness of domestic coal resources against cheaper imports. At the EU level, major R&D resources were allocated for this purpose; at the national level, hard coal subsidies also became important. From the 1990s, however, the European Commission urged the removal of national coal subsidies to secure level playing conditions in the internal energy market and increasingly as a climate policy measure. This was often resisted by coal-dependent member states, including Germany. With the phase-out of coal subsidies postponed, the EU-wide ETS evolved as the EU climate policy instrument with strongest potential influence on the role

of coal in the German energy system through its demand for national measures to achieve EU-wide CO_2 emission reduction targets. In its initial phases, the functional deficits of the system created an oversupply of allowances and low allowance prices, and as a result had little impact on the German energy system. In order to protect its coal and manufacturing industries, Germany was among the member states that ensured the system had such deficits. At a later stage, however, Germany sided with the EU to remove the functional deficits which meant that, in 2018, allowance prices rose sharply, contributing to the acceleration of a market-driven coal phase-out in Germany. As such, we observe a stronger fit through a higher level of German support for EU ETS reforms. With national GHG emissions remaining and the competitiveness of coal pressured by EU policies, Germany initiated a political discussion that culminated in a roadmap for the phase-out of coal. Here, far-reaching congruence has emerged between the EU and Germany with extensive funding policies to help structural reform in coal-dependent regions.

Renewable energy policy—from a limited to a very good fit

When the red-green coalition government, in power from 1998, proposed a gradual phase-out of nuclear power, a parallel objective was to increase the share of renewable energy in the national energy system. The main policy instrument adopted was the Renewable Energy Law (*Erneuerbare-Energien-Gesetz*, EEG) that introduced a 20-year guaranteed feed-in tariff for energy producers, providing stable remuneration of investments independent of the market price. The system provided high planning and investment security for suppliers, including small-scale suppliers, as they could not be forced out of the market by the established suppliers. All renewable energy sources—including those not close to marketability—would be promoted. The whole policy package started a boom in investment in, and production of, renewable energy [25]. At the EU level, in 1997 the European Commission suggested EU targets to increase the share of renewable electricity by 2010 and a joint harmonised support system (tradable certificates) to align renewable energy with internal energy market policies. When adopted as the 'EU Renewable Electricity Directive' in 2001, Germany supported non-binding national targets for renewable electricity but not the joint EU-level support system. Feed-in tariffs already in place in Germany had brought about a rapid expansion of renewables and became the model for the wide diffusion of such systems in Europe in the following years [26]. From 2006 to 2009, the EU discussed, proposed, and decided to reform its energy and climate policies. For 2020, targets were set for CO_2 emissions, the share of renewable energy, and efficiency (20-20-20% targets). When drafting the new Renewable Energy Directive, the Commission again proposed an EU-wide support system in the form of tradable guarantees of origin [2]. Germany agreed on the proposed binding national targets for renewable energy but again fended off the EU's efforts at creating and EU-wide market-based support system. Despite disagreement among coalition members from the CDU/CSU and later the FDP, succeeding governments maintained the feed-in system as Germany's main renewable energy support system.

The European Commission continued its fight against the feed-in tariffs. In a 2012 communication, it emphasised the increasing policy incoherence problems between the Renewable Energy Directive and Internal Energy Market (IEM) legislation, specifically that fixed tariffs (feed-in tariffs) were not compatible with the IEM principle of market-based price formation [27]. Moreover, the Renewable Energy Directive granted priority access to renewables and combined heat and power (CHP). It allowed member states to exempt renewable power generation from balancing responsibilities, conflicting with general IEM principles in the Electricity Directive. At this point (2012), Germany enacted the first substantial changes in the mode of promoting photovoltaics [28]. A cap was introduced on how much solar power would be supported, with the aim of slowing down the pace of investments and costs to consumers [29]. In 2014, the Commission achieved a breakthrough in its fight against feed-in tariffs through revised state aid guidelines, which confirmed their phasing-out and their replacement with market-based tendering systems as default—with exemptions allowed for small-scale facilities [30]. In a follow-up reform of the German Renewable Energy Act (EEG) in 2014, a paradigmatic shift in the promotion of renewable energy occurred. The feed-in tariff system was replaced by quantity-based capacity control (growth corridors for individual technologies) and mandatory direct marketing for most producers. This meant a significant slowdown in the pace of investments, for biomass and photovoltaics technologies in particular [29]. From 2016, the German EEG shifted the renewables support system further towards compliance with the EU state aid guidelines [31]. This move, from feed-in tariffs to market-based tendering, changed the beneficiaries of the German support system. Small-scale investors, whose participation and remuneration in investments had been regarded as important to secure popular support for the energy transition, could not bear the administrative costs of participating in the tendering system which was designed to benefit major commercial companies. Changes to the EEG in 2017 established the new tendering system, strongly oriented towards the actor and market structures of the centralised energy

system and, in its current design, tending to slow down the deployment of renewable energy in Germany [24, 31].

Since then, the EU has reformedits legislation several times. In 2018, the reform of the EU Renewables Directive set a binding target at EU level for renewables to reach a share of at least 32% of total energy consumption by 2030. Furthermore, it was cementing changes already made in the 2014 state aid guidelines by removing priority access for renewables to the grid and installing balancing obligations for suppliers, except for the very smallest suppliers. On the other hand, the revised directive, and parallel revision of electricity legislation, enshrined the principle that active consumers, small-scale investors, and local energy communities were important for the transition and should be ensured an equal standing in energy markets, with further regulatory development to be carried out. New changes to the EU's Renewables Directive in 2023 increased the target for renewables by 2030 to 42% and established new energy sharing rights for prosumers and consumers.

In response to the EU's 32% target for renewable energy set in 2019, Germany proposed, as a national contribution, a 30% share of energy from renewable sources in gross final energy consumption in 2030 [32]. Despite setting national targets below that of the EU, primarily because of low levels of renewable heat and transport, Germany set ambitious targets for renewable electricity. The EEG 2021 anchored the target of 65% renewable energies in gross electricity consumption by 2030. Moreover, both electricity supply and electricity consumption are to become greenhouse gas neutral before 2050. New changes to the EEG in 2022 enshrined the new government goal of having 80% renewable power in the mix by 2030 and almost 100% green electricity by 2035. Whether these goals can be achieved under the conditions of an auction system that has tended to slow down the expansion of renewables by reducing investment security for (small) energy providers is, however, an open question [24, 31]. When the EU increased its renewable energy target to 42% by 2030, Germany's response was to secure around 40% of energy consumption by renewables.

To sum up, we observe EU and German renewable energy policies evolving over time. This is similar to the development of coal energy policies. A fundamental consensus on pushing for renewable energies has existed since the EU launched its first Renewable Electricity Directive in 2001. In 2008, the EU-wide goal of increasing the share of renewable energies in total energy consumption to 20% by 2020 was in line with Germany's targets at the national level. Regarding later expansion targets up to 2030, Germany's targets align with EU targets, while, specifically for renewable electricity, Germany has chosen to pursue more ambitious targets than the EU. The fit between German and European renewable policy objectives can be seen as a negotiation success of Germany and like-minded countries as front-runners in this area. In contrast, huge misfits have grown up over a long period between Germany and the EU regarding how to support renewable energies. Introduced in Germany with the Electricity Feed-in Act (1990) and the Renewable Energy Act (2002), feed-in tariffs have increasingly been attacked by both the European Commission and other EU member states as incompatible with principles and rules for the internal energy market. Early on, the European Commission tried to prescribe a competing quota system as market-compatible, criticising in particular the German decision to go with feed-in tariffs [33]. Germany nevertheless managed to uphold its feed-in tariffs until 2014. After that year, the European Commission played a stronger role in shaping the EEG 2014 through the negotiations that took place in the background of national legislative processes. As a result, the EEG 2014 was largely harmonised with the requirements of the new state aid guidelines aimed at creating a level playing field in the internal energy market. Using the leverage of European state aid law, the European Commission thus finally succeeded in enforcing its preference for a market-based tendering system. Thus, the Commission used its competence in the field of competition law to exert pressure in a policy area that falls under the competence of the member states [31]. The effect of closing the misfit was, however, reduced investment in renewable energy, specifically from small-scale self-consumers and energy communities. Acknowledging the important role of such actors in increasing the acceptance of the transition, the EU provided new legal rights and asked its member states to promote the role of such actors in amendments to renewable energy and internal energy market legislation in 2018 and 2023 [34].

Electricity network policies—varying and persisting misfits

The German energy transition's primary focus on renewable electricity implies a need to secure capacity on national electricity networks for the transfer of power from producers to consumers. Germany has long suffered from constrained network capacity (congestion), reflecting that the best location of renewable electricity production (north of the country) exhibits a mismatch with the location of the main electricity load (south and west of the country) [35]. The phase-out of nuclear and coal-based power in the south and west has aggravated network congestion problems and highlighted the need for constructing new power lines. Facilitating the planning and authorisation of major north-south power line construction projects has long been the primary focus of German electricity network policy.

EU-level energy network policies have evolved to promote the expansion of cross-border networks and to

ensure that existing networks are used to support cross-border trade in the Internal Energy Market. The EU Electricity Directive of 1996 established the principle that electricity networks should be operated as a common carrier system, meaning non-discriminating access for consumers and producers when seeking out efficient trade deals. To increase trade volume across European borders, capacity on cross-border networks had to be strengthened and already existing capacity fully used to support efficient trade. EU policies to strengthen cross-border energy networks from 1995 included a very limited support mechanism for investment in trans-European energy infrastructure (TEN-E). Concerning how existing energy networks in the EU should be operated, the 2003 Electricity Regulation settled the principle that cross-border networks should be used at maximum capacity in support of cross-border trade—institutional changes were then adopted to push this principle [36]. EU energy network policies have seen later reforms reflecting the existence of a persistent lack of network investments and non-optimal use of networks to ensure efficient market trade. To push cross-border network investments, in 2002 the EU decided that by 2010 all member states should have cross-border network capacity constituting at least 10% of the nationally installed generation capacity [11]. EU TEN-E policies later evolved to concentrate EU funding on priority projects and to allow funding for congested national networks that hindered cross-border power flows, including for German network projects to improve north-south flows. A 2013 reform meant that the EU could cover part of investment costs through the 'Connecting Europe Facility' mechanism.

Despite such EU aid, investments in north-south power lines in Germany experienced continued delays due to local opposition and coordination problems between the multiple state (*Länder*) authorities involved in approving state-passing power lines [24]. Only a fifth of the lines long planned at the federal level—embedded in the Bundesbedarfsplangesetz (BBPIG) and Energieleitungsausbaugesetz (EnLAG)—had been completed by the fourth quarter of 2020 [37]. Delayed investments caused serious congestion problems on German networks. The increasing volume of renewable and non-renewable power produced in the north of Germany was thus diverted through the networks of neighbouring countries to re-enter Austria and Germany in the south (loop flows), causing congestion also in these networks [38, 39]. Over time, in order to solve congestion problems in their domestic grids, German network operators developed a practice of cutting the flow of power on interconnectors, thus reducing capacity for cross-border trade, and effectively favouring trade deals within Germany over cross-border trades [38]. More radical and highly controversial measures to deal with the congestion problems, such as splitting the German market into a northern and southern bidding zone to let higher prices in the south give stronger incentives for accelerating grid construction, have been abandoned by successive governments in Germany [40].

A major reform of EU market legislation was enacted in 2019, aimed at counteracting the network operators' practice of cutting cross-border network capacity to solve internal network congestion problems, thus preventing cross-country trade [38]. After several rounds of negotiations, a highly controversial rule was adopted, stipulating that at least 70% of the capacity on cross-border networks should be made available for efficient trade by 2020 [36]. Germany was instrumental in hindering a higher target and in bringing in the possibility, in order to buy time for sorting out its congested national network, to postpone implementation until 2026 [36]. Should congestion remain a problem in the German network so as to prevent compliance with the 70% rule by 2026, network operators may face new costs from remedial actions, which will ultimately be passed on to consumers. Or it will result in a possible decision to split the German market that may cause far higher electricity prices for consumers in the south of the country [36].

Summing up, we observe strong elements of fit between EU and German electricity network policies. Both have policy objectives to accelerate investments in the grid. German network policies have focused on removing national bottlenecks to drive the national energy transition, while EU policies, first and foremost, have aimed at facilitating trade in the internal energy market. The EU matches German policies in that financial assistance may also be provided to country-internal networks that need strengthening to avoid limiting cross-border electricity trade. The EU's definition of priority electricity corridors, including north-south electricity interconnections in Western Europe (NSI West Electricity), and its deployment of smart grids to help integrate renewable energy [41], match well with Germany's policy efforts to expand its north-south power lines to facilitate the *Energiewende*.

However, Germany's primary national focus does not fit fully with the EU's focus on strengthening transnational infrastructure. Here, Germany was long non-compliant with the 10% EU target set in 2002 and has seen higher pressure to invest from the new and binding EU target of 15% by 2030 adopted in 2014. However, the target alone has not been very coercive for Germany, given the relatively long timeline for compliance. Concerning policies and regulations on the operation of existing electricity networks, clear misfits have evolved between EU-level rules and German regulatory practices. To secure feed-in of nationally produced electricity, Germany has allowed the transmission system operators to give priority access to national generators, and due to grid

congestion has relied on the grid capacities of its neighbouring countries (Poland, the Czech Republic, France, the Netherlands, and Belgium) to transport power from the north to the south, forcing installation of phase shifters at the borders, which in turn has increased internal congestion within Germany. Misfits and EU adaptation pressure on Germany have intensified over time. The 2019-adopted target that a minimum of 70% of cross-border network capacity must be made available for trade in the market is challenging the nationally-oriented German *Energiewende* approach—piling pressure on Germany to adapt and align its national energy transition with that initiated for the whole of the EU, for which free trade of electricity across borders in the IEM is a fundamental element.

Table 2 Fits and misfits between EU and German energy policy

Policy field (objectives and instruments)	Fits between Germany and EU	Misfits between Germany and EU	EU effect the on German Energiewende
Phasing out of nuclear energy: objectives	-	EU not supporting phase-out, Germany as an outlier among EU member states	Challenging, but no strong effect
Phasing out of nuclear energy: instruments	-	No direct EU impact, indirect instruments: R&D funding, security standards, Taxonomy	Challenging, but no strong effect
Phasing out of coal energy: objectives	Congruence, reduction of coal subsidies and CO_2 emissions	-	Facilitating
Phasing out of coal energy: instruments	Just Transition Mechanism for coal regions	Pressure on coal subsidies, EU ETS requires national measures, functional deficits	Facilitating
Renewable promotion: objectives	Congruence, expansion of renewables	-	Facilitating
Renewable promotion: instruments	Forced congruence since 2014, tendering system	Conflict until 2014: feed-in tariffs versus quota system	Challenging Germany's national approach
Network expansion: objectives	Congruence, Trans-European Networks for Energy	-	Facilitating
Network operation: instruments	TEN-E, NSOG, NSI West Electricity	Resistance among Germany's neighbours regarding network transmission	Challenging Germany's national approach

Discussion

German energy transition policy is integrated into a complex European multi-level governance system. In addition to German national interests, those of other EU member states and interests institutionalised at the central EU level must be considered when analysing developments and the fate of the German *Energiewende*. This analysis shows that the specific national transition approach has variously evolved fits and misfits with EU policies. Several core objectives of the German energy transition are identified as developing a growing fit with EU objectives (coal phase-out, expansion targets for renewable energies and transnational grid expansion), thus playing a reinforcing and facilitating role for the German energy transition. Major congruence is also observed in various transition policy instruments (see Table 2) regarding support for former coal regions and stronger political backing in Germany for making the EU ETS a more forceful instrument for decarbonisation.

However, one can also find significant evolving and still existing misfits between national and EU-level policies, which have variously challenged the implementation of the German energy transition. For example, Germany stands largely isolated in the EU with its decision to rapidly phase out nuclear power. Even if the EU could not intervene directly due to a lack of its own competency in this area, it neither supported German policy objectives nor interfered in Germany's strategy. But, as a logical consequence, the stigma of being a maverick remains, and with that, poor chances for Germany to upload its energy transition approach to the European level. Clear discrepancies have also long evolved in the preferred instruments for supporting renewable energies and the modes of regulating the operation of transmission network systems. As to the former, Germany failed to upload at EU level its preferences for continuing the option of using feed-in tariffs. Instead, EU pressure to adapt national support policies to principles of the internal energy market brought about a shift in German support policy for renewables. Germany, which had long aimed at creating first-mover advantages for its industry in a market adapting to climate change, could no longer continue its specific way of subsidising renewables investors. Crucially, the country is still lagging behind other member states in various aspects of the EU market-based energy transition policy, two examples being the systems of CO_2 emissions trade where Germany has introduced special conditions for lignite and hard coal power plants and the modes of regulating network operating companies to support free trade in the internal energy market. Here, a notable continuous misfit are German regulations, which have upheld the opportunity for network operators to discriminate against the right of foreign producers to close trade deals by capping capacity on its

Table 3 Key findings on fits and misfits between the German *Energiewende* and EU energy policies

Conceptual/structural fit/misfit	Policy/instrumental fit/misfit
Broad conceptual alignment exists between Germany and the EU, particularly on overarching goals such as climate neutrality, energy efficiency, and decarbonisation.	The EU exerted significant adaptation pressure on Germany to adjust its renewable energy promotion tools, leading to the 2014 shift from feed-in tariffs to auction-based tendering systems.
A major exception is Germany's nuclear phase-out, which diverges from the EU's technology-neutral stance and continued nuclear support (e.g., EU Taxonomy classification).	EU competition and market regulations clashed with German instruments supporting energy networks, particularly regarding grid access rules and priority for national producers.
The EU's liberal, market-based governance paradigm contrasts with Germany's traditionally state-driven, interventionist energy policy legacy.	Stronger alignment emerged over time through Germany's support for EU ETS reforms and participation in Just Transition mechanisms.

international interconnectors. The hesitant positioning of Germany in several policy areas weakens its ability to set the agenda and unleash the power of the country on the European stage.

In summary, this study has investigated the evolving fits and misfits between the German and European energy transition approaches and their effect on the German *Energiewende*. In some respects, policy fits have contributed to facilitating rather than challenging the German transition approach. In other respects, policy misfits have put pressure on Germany to shift its policy towards a closer fit, with varying effects either facilitating or challenging the German transition. However, in yet other respects, misfits have continued with adaptation pressure on Germany still being applied. One can observe the direction of influence (downloading or uploading) in the multi-level system varying across policies. Main misfits observed historically have been tied to German policies that have not been aligned with principles adopted for the EU internal energy market. Firstly, the German support policy for renewables saw a misfit that was eventually corrected with a required policy change which had the effect of at least temporarily slowing down the expansion of renewable energies in Germany. Secondly, substantial misfit can be observed in EU rules and German practices for operating electricity networks for the transition, an area where adaptation pressure from EU regulations will accentuate in the coming years. EU regulations seek to establish a well-functioning electricity market by reducing restrictions on exchange and trade in power across borders in Europe, a practice that German transmission system operators have engaged in order to secure the operations of their networks.

Conclusions

Reflecting the findings of this study, the European Green Deal appears less a departure from existing EU energy and climate policies and more a consolidation and intensification of already evolving governance dynamics. The case of Germany's *Energiewende* demonstrates how national energy transitions—particularly when ambitious and institutionally distinct—cannot be viewed in isolation from the supranational policy frameworks within which they operate. Our analysis shows that the interaction between the EU and German energy policy has been characterised by shifting patterns of fit and misfit across multiple policy fields (see overview in Table 3). While alignment in objectives has been achieved in key areas such as the phase-out of coal and the expansion of renewable energy, considerable divergences remain at the level of policy instruments and regulatory mechanisms. Germany's approach to renewable energy support, with its emphasis on feed-in tariffs and decentralised participation, has long conflicted with the EU's market-based orientation and internal market rules. This misfit was not only institutional but also ideational, reflecting divergent preferences regarding the role of the market versus the state in enabling socio-technical transformation. Similarly, persistent tensions in electricity network operation reflect the clash of Germany's nationally focused infrastructure logics with EU efforts to foster cross-border electricity trade and maximise interconnector capacity. The eventual policy shifts observed—most notably in the reform of the EEG after 2014 and Germany's support for EU ETS reforms—illustrate how sustained EU adaptation pressure can shape national transition paths, particularly when backed by legal instruments such as state aid rules or emissions trading regulations.

At the same time, our findings underscore that misfits are not inherently obstructive. In several domains, they have functioned as triggers for institutional innovation, policy learning, and recalibration. Even where Germany's preferences initially diverged from those of the EU, the interaction process has, in some cases, led to new forms of alignment—albeit not without trade-offs. For example, the shift from feed-in tariffs to auction-based tendering brought Germany into closer compliance with EU law but weakened investment security for small-scale actors, with implications for energy democracy and social acceptance. This illustrates that the effects of policy alignment are not uniform but context-dependent and multi-layered. The German case also shows the limitations of 'uploading' national preferences to the EU level. In areas where Germany lacked coalition partners or where EU institutions had strong competencies, such as competition law, Germany was ultimately unable to maintain its distinctive approach. Conversely, in areas such as nuclear policy, where the EU's competences are limited and

political positions among member states diverge, Germany has been able to preserve its course, albeit at the cost of diminished influence and strategic isolation.

In conclusion, the German *Energiewende* provides a rich example of how domestic energy transitions are negotiated and reshaped within a multi-level governance context. While alignment in objectives can facilitate transformation, persistent misfits—particularly at the level of instruments and institutional practices—remain key drivers of both conflict and change. The ongoing evolution of EU governance, especially under the Green Deal agenda, is likely to increase the frequency and intensity of such interactions. Future research should continue to explore how member states navigate these pressures, the conditions under which convergence occurs, and how EU governance mechanisms can be designed to support both policy coherence and respect for national diversity.

Acknowledgments
We would like to thank an editor at Elsevier Language Editing Services for proofreading the article.

Author contributions
Per Ove Eikeland, Stefan Wurster, Jörg Radtke and Christina Köhler-Tschirschnitz wrote the main manuscript text.

Funding
This work was supported by the Research Council of Norway [grant numbers 280960, 302576]. The research did not receive any specific grant from funding agencies in the commercial or not-for-profit sectors.

Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
Not applicable.

Competing interests
The authors declare no competing interests.

Received: 12 January 2025 / Accepted: 19 December 2025
Published online: 27 January 2026

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