Germán Bersalli, Christof Schiller, Thorsten Hellmann, Leonard Mussler, Johan Lilliestam

Meeting Climate Targets:

How Far have Leading Countries Progressed in the Transition to Carbon-free Energy for Heating, Road Transport, and Electricity?

Even pioneering nations lag in systemic change toward full decarbonization, yet their examples show that acceleration is possible. Our sectoral analysis highlights specific opportunities for, and barriers to, climate policy reform in Denmark, Norway, the United Kingdom, and Germany.

1. Introduction

Achieving the energy transition and shifting from fossil fuel-based energy systems to renewable energy sources and greater energy efficiency is undoubtedly one of the key tests of the international community's ability to meet the ambitious climate goals set by the Paris Agreement of 2015. It is also a litmus test for governments' ability to effectively manage complex societal and economic transformation processes, within a limited timeframe and without losing public approval.

BertelsmannStiftung

Nearly ten years after the Paris Agreement set climate goals, where do leading countries stand in realizing the energy transition? Are the changes in each country's energy system comprehensive enough to be on track for climate neutrality by mid-century? To date, there has been a lack of theory-driven evaluation approaches to identify key indicators for measuring progress in the energy transition, both within and between countries, and to place them in a systemic framework for action.

In this Policy Brief,[1] we present a theory-driven systemic evaluation approach for the electricity, road transport, and heating sectors. This approach enables a systematic, theory-driven comparison of potential barriers and opportunities for successful decarbonization both within and between countries. Our evaluation framework is applied to four countries: Denmark, Norway, the United Kingdom and Germany. While no country has fully completed the energy transition, each has made significant advancements in specific sectors, offering valuable lessons from both successes and failures across cases.

In the following, we show why it is advisable for governments to adopt a comprehensive yet targeted evaluation approach that relies on more than emissions data. We then present key findings from our country comparison, examining the current state of energy transitions in Denmark, Germany, Norway, and the United Kingdom, and identifying opportunities and barriers to reform in each. In the three sectors – heating, road transport, and electricity – at least one country has made significant progress toward sectoral carbon neutrality. Achieving full decarbonization by mid-century seems attainable if governments can better align policy targets, deploy zero-emission technologies, and adapt regulations and infrastructure accordingly. Finally, we explore best practices in Denmark (heating and electricity) and Norway (road transport), highlighting valuable insights and political strategies to accelerate the transition to a decarbonized energy future more effectively. We conclude with an outlook.

2. Measuring climate transition progress: Tracking emissions alone is not enough

To meet the temperature targets of the Paris Agreement, carbon emissions must reach net zero by 2050. In Europe, the European Climate Law (European Parliament and European Council 2021) enshrines the goal of achieving climate neutrality by 2050, as set out in the European Green Deal. This objective requires not just reducing carbon emissions but fully eliminating them, necessitating a transformation of all energy-related sectors toward zero-emissions pathways. The deadline for decarbonizing each sector may vary, as some sectors are easier to decarbonize than others. Electricity is relatively advanced in the transition toward net zero (Victor et al., 2019), with mature, cheap zero-emission technologies already available. Moreover, early decarbonization of electricity can facilitate decarbonization in other sectors through partial or total electrification.

In this study, we use 2035 as a benchmark for achieving zero-carbon emissions in Europe's electricity sector, consistent with modeling exercises (Boitier et al., 2023; IEA, 2021b). For passenger road transport and heating, we set 2045 as the target year for reaching zero emissions (Plötz et al., 2021), reflecting the slower progress in these sectors compared to electricity.

These long-term goals raise the question of how to measure progress: How do we know if a sector is progressing well in its transformation toward zero emissions? Which indicators should we use? Due to the necessarily rapid pace of required reforms, measuring progress in energy transition efforts cannot rely solely on lagging indicators such as sector-specific emissions data or the status of renewable energy expansion. These indicators capture the outcome of past developments, sometimes with considerable delay, and do not allow for timely adjustments in critical areas impacting future emissions or the development of new technolo-

1 This Policy Brief presents the key findings of the "Assessing Zero-Emissions Energy Transitions: A Systemic View" study by Germán Bersalli et al. The full study is available at: https://www.bertelsmann-stiftung.de/de/publikationen/publikation/did/assessing-zero-emissions-energy-transitions. A complete list of additional sources can be found in the bibliography at the end of this Policy Brief.

gies. Therefore, alongside these lagging indicators, we need early warning indicators to assess the alignment of infrastructure and institutional developments, as well as the level of public support for transition efforts. Moreover, technological revolutions, such as the energy transition, often follow a disruptive, non-linear trajectory. Focusing exclusively on lagging indicators risks missing the speed and dynamics of these complex economic transformations, as they overlook underlying systemic processes of change.

The set of key indicators used to monitor progress toward a successful energy transition should include both retrospective metrics and those that identify potential opportunities and challenges within political, technological, and societal systems. In addition to emission reductions and the expansion of clean energy in various sectors, we need indicators that can assess national developments in market integration, the economic viability of new technologies, the adequacy of infrastructure and of political and regulatory environments. For instance, when assessing a country's regulatory environment, it is essential to determine the extent and effectiveness of fossil fuel phase-out measures, whether through political mandates, regulatory adjustments, or mechanisms such as increasing the cost of fossil fuels. Without phase-out measures, clean and fossil-based energy sources could coexist for an extended period, undermining decarbonization efforts. Finally, a sector-specific analysis of the energy transition is vital to identifying the unique challenges and opportunities within each sector which, in turn, allows for targeted actions that maximize the benefits and minimize the risks encountered during the transition.

The three areas explored in our study – technology, infrastructure, and a country's regulatory and political environment – exert mutual influence on each other. This means, for example, that clean technologies must become competitive enough to replace old fossil fuels. For new technologies to succeed, a country's (physical) infrastructure must keep pace with future requirements and deployment scenarios. At the same time, regulations and policies must credibly and effectively promote the replacement of fossil fuels with clean energy. For each of the three dimensions – technology, infrastructure, and regulation – we identify the most critical variables and assign one or more sector-specific key indicators.

The following sector-specific analysis of each country is guided by these overarching questions:

1. **Policy targets:** Are sector-specific decarbonization goals, including those related to technology and infrastructure, aligned with the national goal of carbon neutrality by mid-century?

2. **Phase-out of fossil fuels:** Is the country reducing carbon intensity and phasing out carbon-intensive technologies at a pace sufficient to achieve net zero by mid-century?

3. **Deployment of new technologies:** Is the deployment rate of new technologies consistent with national climate neutrality goals? Are new technologies cost-competitive with fossil fuel technologies, or are they nearing cost-competitiveness, both nationally and internationally?

4. **Infrastructure development:** To what extent is the state of infrastructure and its development aligned with the deployment of zero-carbon technologies?

5. **Regulatory framework:** To what extent do the country's regulations (removal of climate-damaging subsidies, acceleration of approval processes) facilitate the energy transition?

3. Accelerating energy transition: The current state of play in Germany, Norway, Denmark and the United Kingdom

Electricity

Germany

Germany's **policy targets** for expanding renewable energy correspond in principle with the goal of producing 100% of its electricity from renewable sources by 2035. However, coordinating the expansion of the

Electricity transition

		Germany	Norway	Denmark	United Kingdom
Targets	Align with the phase-out of fossil fuel-based electricity by 2035	partially sufficient	sufficient	sufficient	partially sufficient
	Align with goal of 100% zero carbon electricity by 2035	sufficient	sufficient	sufficient	sufficient
	Align with expansion of transmission grid and renewable energy	partially sufficient	partially sufficient	sufficient	partially sufficient
	Align with expansion of distribution grid and renewable energy	insufficient	partially sufficient	evaluation is not possible	partially sufficient
	Align with increasing storage capacities and expansion of renewable energy	partially sufficient	partially sufficient	partially sufficient	partially sufficient
Phase-out of fossil-fueled technologies	Reduction in CO2 emissions (electricity) aligns with zero emissions by 2035	partially sufficient	partially sufficient	partially sufficient	partially sufficient
	Reduction in CO2 intensity (electricity) above OECD average	insufficient	sufficient	sufficient	sufficient
	Reduction in fossil fuel-based electricity sufficient to achieve target	partially sufficient	sufficient	sufficient	partially sufficient
Phase-in of zero-carbon technologies	PV is cheaper than the cheapest fossil fuels for electricity generation	sufficient	evaluation is not possible	sufficient	sufficient
	Wind is cheaper than the cheapest fossil fuels for electricity generation	sufficient	evaluation is not possible	sufficient	sufficient
	Capacity added for solar and wind is sufficient to achieve national target	partially sufficient	sufficient	partially sufficient	partially sufficient
	Renewable energy share growth aligns with zero carbon electricity by 2035	insufficient	sufficient	sufficient	partially sufficient
Infrastructure	No curtailment of renewables despite renewable electricity growth	insufficient	sufficient	insufficient	insufficient
	Expansion of the transmission grid sufficient to achieve national target	insufficient	sufficient	partially sufficient	evaluation is not possible
	Expansion of the distribution grid sufficient to achieve national target	partially sufficient	evaluation is not possible	evaluation is not possible	evaluation is not possible
	Energy storage rate higher than the EU average	partially sufficient	sufficient	partially sufficient	sufficient
Regulatory framework	Negative prices no longer occur	insufficient	partially sufficient	insufficient	insufficient
	No subsidies for coal and natural gas	insufficient	sufficient	insufficient	insufficient
	Duration of approval procedures (wind) complies with EU guidelines	partially sufficient	evaluation is not possible	evaluation is not possible	evaluation is not possible
	Majority of residents support expansion of renewables	sufficient	evaluation is not possible	sufficient	evaluation is not possible

sufficient | partially sufficient | insufficient | evaluation is not possible

Source: Authors' elaboration.

BertelsmannStiftung

country's infrastructure is challenging due to the lack of official targets for distribution grids and electricity storage capacities.

While Germany has made progress in **phasing out fossil fuel-based electricity**, it is not enough. From 2017 to 2022, the share of fossil fuels in the electricity mix (50 % in 2022) decreased by only 1.2 percentage points annually. To achieve a complete phase-out by 2035, an annual reduction of at least 3.8 percentage points is required. Although the **adoption of new technologies** like photovoltaics and onshore wind energy has led to lower electricity generation costs, the expansion rate remains insufficient to meet the 2030 capacity target

of 360 GW. Achieving this target would require an annual increase of 28.4 GW in newly installed solar and wind capacity, whereas the actual increase from 2018 to 2022 was only 6.8 GW per year.

Urgent action is needed to **expand and modernize the grid infrastructure**, particularly with regard to transmission lines, which saw no growth between 2017 and 2022. The inadequacy of the existing grid infrastructure is evident in, for example, the continued curtailment of renewable energy generation.

With regard to the **regulatory environment**, the drastic increase in state subsidies for natural gas has proved counterproductive. Although these subsidies decreased somewhat from $921 million in 2017 to $779 million in 2021, they surged to $10 billion in 2022 in the wake of the energy crisis. The persistent occurrence of negative electricity prices also highlights the need for political intervention to address market distortions.

Achieving 100% renewable electricity generation by 2035 is thus feasible but requires addressing the identified challenges, such as aligning infrastructure development with renewable energy targets and increasing grid flexibility. Maintaining high levels of public support for the transition is also essential.

Norway

Norway's **policy target** is to increase the share of renewable energy in its electricity mix to 100% by 2030. Although formal targets for expanding the country's transmission and distribution networks as well as storage capacity are lacking, the initiatives outlined in the 2023 System Development Plan emphasize the importance of grid infrastructure to accommodate the growing share of renewable energy sources.

Significant progress has been made in **phasing out fossil fuel-based electricity generation**. Norway successfully completed the phase-out of coal-fired power generation by 2023. The share of fossil fuels in electricity generation (2022 < 1%) could also be reduced to zero in the coming years, as could CO_2 emissions. In 2022, carbon intensity stood at 26 gCO_2/kWh – far below the EU average – and continues to decline. Hydropower remains Norway's dominant energy source, but the increasing **use of new technologies**, particularly wind energy, enhances the resilience of the power system. The government's offshore wind energy plan, introduced in May 2022, aims to reach a capacity of 30 GW by 2040, nearly matching Norway's current total electricity generation capacity.

A strong **grid infrastructure** has successfully supported uninterrupted electricity generation from renewable energies. The transmission network has almost doubled in the last five years, growing from 6,850 in 2018 to 13,250 km in 2023 (circuit length ≥ 220kv). Connecting grids with neighboring countries have also been expanded. Negative electricity prices have been uncommon in Norway. However, the fact that the occurrence of negative prices has increased in 2022-2023 shows that more storage capacity and flexibility options are needed to accommodate increasing variable electricity generation. **Government subsidies** for coal have been all but eliminated, and natural gas subsidies remain very low, even during the 2022 energy crisis.

Norway faces the challenge of expanding its electricity system and integrating new flexibilities to meet the growing demand driven by rapid electrification in sectors such as transportation, heating, and, to some extent, manufacturing. A significant obstacle to achieving climate goals is resolving the "Norwegian paradox": continuing high levels of domestic oil production while pioneering the transition to renewable energy sources. Norway plans to maintain and even expand its oil production and extraction activities. The country's largest emitters are the oil industry (25%), the transportation sector (33%), and other energy-intensive industries (Hagen, Lund-Tønnesen and Schøyen forthcoming).

Denmark

Denmark's **policy target** is to increase the share of renewable energy to almost 100% by 2030, focusing on significantly boosting offshore wind capacity and quadrupling onshore wind and photovoltaic (PV) capacities. In addition, the country's Power-to-X strategy (PtX) targets up to 6 GW of hydrogen electrolysis capacity by 2030.

The share of fossil fuels in Denmark's electricity generation significantly decreased from 29.5% in 2018 to 18.6 % in 2022, resulting in a 19.5% reduction in CO_2 emissions from electricity production during this pe-

riod. Denmark plans to phase out coal power by 2030, with all existing coal plants having set closure dates (the last being Nordjylland in 2028). Assuming the country continues along this trajectory, it could achieve the **phase-out of fossil fuel-based electricity generation** by 2029.

The share of renewable energy in the electricity mix could reach 100% by 2028 (2022: 81%). The significant reduction of the levelized cost of electricity (LCOE) for solar and wind energy (offshore wind LCOE decreased by 26% between 2017 and 2022) has facilitated the continuing expansion of new technologies. However, Denmark needs to accelerate the expansion of solar and wind energy if it is to meet ambitious renewable energy targets.

Despite the country's robust and interconnected **electricity infrastructure**, grid bottlenecks (particularly in neighboring countries) have occasionally constrained wind generation and led to negative electricity prices. The transmission network has not expanded quickly enough to keep up with demand. However, recent ambitious grid plans, which are consistent with renewable energy targets, indicate improvements in the coming years.

United Kingdom

The United Kingdom's **policy targets** include phasing out coal-fired power generation by 2024 and generating 100% of its electricity from renewable sources (primarily offshore wind) and nuclear power by 2035. However, there is no clear strategy for phasing out gas generation or specific targets for expanding transmission and distribution networks.

Regarding the **phase-out of fossil fuel-based electricity**, the UK's carbon intensity in power generation is decreasing, but the pace of emissions reduction needs to accelerate to reach zero emissions by 2035. Between 2017 and 2022, CO_2 emissions fell by 18.5%, but the average annual reduction is still below the required rate to achieve zero emissions by 2035. While coal use has been nearly eliminated, there is still resistance to the gradual phase-out of gas.

Renewable energy sources, such as wind and solar power, have become the most cost-efficient electricity generation options due to ongoing cost reductions. The share of renewables in electricity generation increased from 29% in 2017 to 41% in 2022. However, the growth of renewable electricity generation is not keeping pace with the necessary benchmarks to achieve zero-emission electricity by 2035, indicating a need for further action in **deploying new technologies.**

Although the transmission network has expanded, the limitations placed on renewable energy generation highlight the inadequacies of the grid infrastructure. Progress is evident in electricity storage, with 2.6 GW operational, 3.7 GW under construction, and 25.7 GW in development as of March 2024.

The occurrence of negative prices and high subsidies for fossil fuels indicates a **need for regulatory action**. While coal subsidies are low and will end with the phase-out of coal, gas subsidies, particularly those increased during the 2022 energy crisis, have risen significantly.

Road transport

Germany

Germany's transition strategy for the transportation sector is insufficient to meet the Paris Climate Agreement targets. Although the country aims to have 100% of new cars sold to be CO_2 emission-free by 2035, this deadline should be moved up to 2030 in order to achieve zero road transport emission by 2045. Additionally, there is no clear goal or strategy for phasing out existing internal combustion engine (ICE) vehicles.

As for the **phase-out of fossil fuel-based vehicles in the road transport sector**, emissions in Germany decreased by 3.6% per year from 2016 to 2021, meeting the benchmark for achieving zero emissions by 2045. However, part of this reduction is due to the temporary drop in emissions observed during the COVID-19 pandemic. In addition, the share of ICE cars in the total vehicle fleet declined from 98% in 2019 to 92% in 2023, but the annual reduction rate of 1.6% falls short of the 4.2% linear trajectory needed to meet the benchmark. In 2022, electric vehicles (including hybrids) accounted for 31% of total car sales, but this figure fell to 24.5% in 2023. This share marks a significant increase compared to only 3% in 2019 and is almost aligned with the required **progress in new technology adoption**. How-

ever, the persistent price difference between electric and ICE vehicles raises doubts about the potential for substantial increases in EV sales in the coming years.

Germany needs to act quickly to expand its charging infrastructure, which is currently insufficient to support the growing number of EVs. While 17,700 new charging stations were installed in 2022, achieving the set targets would require 124,000 new stations annually. Overall, Germany's progress toward an emission-free road transport sector is clearly inadequate and further efforts are needed to reduce the share of cars in total inland passenger transport (89% in 2021) and electrify the remaining fleet.

Norway

Norway is making rapid progress toward an emission-free road transport sector. The National Transport Plan 2022-2033 and the Climate Plan 2021-2030 set ambitious **policy targets** for emission-free vehicles, such as requiring all new passenger cars and light commercial vehicles to be emission-free by 2025, in line with the Paris Agreement scenarios.

In targeting an **emission-free transport sector**, Norway reduced transport-related CO_2 emissions by 22% between 2016 and 2021, exceeding the reduction needed for a linear trajectory toward zero emissions by 2045. One reason for this positive development is that the share of ICE vehicles in the total fleet dropped significantly from 86% in 2018 to 67% in 2022. However, in line with a negative EU trend, the share of passenger-car transport is increasing. The Norwegian government has responded by aiming to reduce the growth of passenger-car transport to zero in major urban areas.

Although the average price of an electric car in 2023 was around two and a half times higher than the price of an ICE vehicle, EV sales have skyrocketed in recent

Road transport transition

		Germany	Norway	Denmark	United Kingdom
Targets	Phase-out of ICE vehicles by 2045	insufficient	insufficient	insufficient	insufficient
	Zero-emission vehicles will account for 100% of car sales by 2030	partially sufficient	sufficient	partially sufficient	partially sufficient
	Number of charging stations sufficient for zero-emissions by 2045	partially sufficient	sufficient	insufficient	partially sufficient
Phase-out of fossil-fueled technologies	Reduction in CO2 emissions (road transport) aligns with zero emissions by 2045	sufficient	sufficient	insufficient	sufficient
	Reduction in ICE vehicles (road transport) aligns with target	insufficient	sufficient	partially sufficient	insufficient
	Share of cars in total passenger transport falling faster than EU average	insufficient	insufficient	insufficient	insufficient
Phase-in of zero-carbon technologies	EVs are less expensive than ICE vehicles	partially sufficient	partially sufficient	insufficient	partially sufficient
	Trajectory in share of EV sales aligns with national target	sufficient	sufficient	sufficient	partially sufficient
	Trajectory in share of EVs in total car fleet aligns with zero emissions by 2045	partially sufficient	sufficient	partially sufficient	partially sufficient
Infrastructure	Charging points ratio is 1:10 or higher	insufficient	insufficient	insufficient	insufficient
	Growth in charging points sufficient to achieve target	partially sufficient	sufficient	partially sufficient	partially sufficient
Regulatory framework	No subsidies for oil/ICE vehicles	insufficient	partially sufficient	insufficient	partially sufficient

sufficient | partially sufficient | insufficient | evaluation is not possible

Source: Authors' elaboration.

BertelsmannStiftung

years. In 2022, 79% of all car sales were EVs, and an additional 10% were plug-in hybrids. At the same time, new gasoline and diesel cars are increasingly disappearing from the market in favor of **new technologies.** This development is due in particular to the granting of financial benefits for electric vehicles. Although Norway's public **charging infrastructure** is inadequate compared to EU guidelines, the installation of new charging points is progressing rapidly alongside the growth of the EV fleet.

If current trends continue, and present legislation remains in place, EVs will be close to 100% of new car sales by 2025, putting Norway on track to decarbonize its personal transport sector well before 2045. However, the country still faces challenges in reducing its heavy reliance on cars for passenger transport, despite the need to develop more sustainable alternatives such as trains and buses.

Denmark

Denmark's overall progress in decarbonizing its road transport sector is insufficient to meet the Paris Agreement targets. National **policy targets** aim for 100% of new car sales to be emission-free by 2035, but this deadline should be moved up to 2030 in order to achieve zero road transport emissions by 2045. Denmark also has no clear goals for phasing out ICE vehicles or expanding the country's charging infrastructure.

Although the country successfully reduced its transport-related CO_2 emissions by 7% between 2016 and 2021, a reduction rate twice as high is needed to **achieve an emission-free transport sector** by 2045. Progress in phasing out ICE vehicles is also inadequate, with ICEs accounting for 87% of the total stock in 2023. The share of passenger-car based transport increased from 81% in 2016 to 87% in 2021, which points to challenges in promoting alternative transportation modes.

Although the average price of EVs remains higher than ICE vehicles, the **adoption of EV technology** has accelerated in recent years. From 2022 to 2023, EV sales more than doubled, reaching a market share of 46% (including plug-in hybrids).

Denmark also needs to improve its public **charging infrastructure**, which featured only one public charging station per 35 EVs in 2021. To reach the government's goal of 1 million EVs by 2030 (up from 210,000 in 2022), approximately 67,000 public charging stations would need to be installed, requiring the current annual installation rate of 2,260 new chargers in 2022 to double in the coming years.

United Kingdom

The United Kingdom's transition to an emission-free road transport sector is not progressing quickly enough to meet the Paris Agreement targets. The UK government's original policy targets aimed for 100% of new car sales to be electric by 2030, which was compatible with achieving zero road transport emissions by 2045. However, in 2023, this goal was pushed back to 2035, making it no longer aligned with the target. Furthermore, the United Kingdom also lacks a clear goal for phasing out existing ICE vehicles.

On a positive note, transport-related CO_2 emissions fell by 20% between 2016 and 2021, which is significantly faster than the linear trajectory required to reach zero emissions by 2045. However, **phasing out fossil fuel-based technology** is slow, with the share of ICE vehicles in the total fleet annually decreasing by only 1.8% from 2019 to 2023 (from 98% to 91%), whereas a 4.1% annual reduction is needed to meet climate goals.

Despite the average price of an EV in 2023 being about twice that of a mid-sized ICE vehicle, sales of **EVs** have risen rapidly in the United Kingdom. In 2022, EVs accounted for 23% of total car sales, which corresponds with an annual increase of 5.6% per year from 2018 to 2022 and thus aligns with the necessary annual growth rate of 5.7%.

The condition of the public **charging infrastructure** and its expansion are seen as partially insufficient. In 2021, the country recorded one public charging station per 21 EVs, which is significantly less than the 1:10 specified in the EU directive. Although the installation of public charging stations increased from 2,500 in 2018 to 13,900 in 2022, the installation rate is still too low to meet future demand.

Heating sector

Germany

Germany's **policy goals** for decarbonizing the building sector present a mixed picture. There are targets for installing new heat pumps and increasing the share of carbon-free heating systems which, in principle, align with the goal of achieving zero-emission heating by 2045. In 2023, the government set new targets for heating system installations, with changes to the building energy law mandating a shift toward heating systems that source more than 65% of their energy from renewables. This effectively bans the installation of new gas or oil heating systems, as they cannot meet this requirement. However, the rule will only apply to new buildings within newly developed residential areas starting in January 2024. For existing buildings and new constructions outside these areas, gas and oil heating systems can still be installed until the respective municipality develops a plan for transitioning to climate-neutral heating. This may involve options like expanding district heating. Large cities must submit their plans by 2026, while smaller towns have until 2028. However, there are still no clear targets for phasing out fossil fuels in existing heating systems, nor are there targets for buildings with thermal energy storage.

Heating transition

		Germany	Norway	Denmark	United Kingdom
Targets	Phase-out of oil and gas heating systems by 2045	insufficient	sufficient	sufficient	partially sufficient
	Timetable for expansion of heat pumps consistent with zero emissions by 2045	sufficient	sufficient	sufficient	sufficient
	Share of climate-friendly heating consistent with zero emissions by 2045	sufficient	sufficient	sufficient	partially sufficient
	Energy efficiency of buildings consistent with zero emissions by 2045	sufficient	partially sufficient	sufficient	insufficient
	Renovations of buildings consistent with zero emissions by 2045	sufficient	insufficient	sufficient	insufficient
	Thermal energy storage capacity in buildings consistent with zero emissions by 2045	insufficient	insufficient	insufficient	insufficient
Phase-out of fossil-fueled technologies	Reduction in CO2 emissions (building use) aligns with zero emissions by 2045	insufficient	sufficient	partially sufficient	insufficient
	Reduction in the share of oil and gas heating sufficient to achieve target	insufficient	sufficient	partially sufficient	insufficient
Phase-in of zero-carbon technologies	Heat pumps are less expensive than gas boilers	insufficient	sufficient	sufficient	insufficient
	Heat pump installation numbers align with target	partially sufficient	sufficient	sufficient	partially sufficient
	Share of buildings with climate neutral heating sufficient to achieve zero emissions by 2045	insufficient	sufficient	partially sufficient	insufficient
Infrastructure	Rate of decline in energy consumption aligns with target	sufficient	sufficient	sufficient	insufficient
	Growth rate of homes equipped with energy efficiency measures aligns with target	evaluation is not possible	evaluation is not possible	evaluation is not possible	evaluation is not possible
	Growth rate of homes with energy storage aligns with target	evaluation is not possible	evaluation is not possible	evaluation is not possible	evaluation is not possible
Regulatory framework	Share of buildings using smart meters/tariffs is above EU/OECD average	insufficient	sufficient	sufficient	sufficient
	No subsidies for investment in fossil fuel-based heating	sufficient	sufficient	sufficient	partially sufficient

sufficient | partially sufficient | insufficient | evaluation is not possible

Source: Authors' elaboration.

BertelsmannStiftung

Progress is being made in **phasing out carbon-intensive technologies**, but it is not fast enough. For example, CO_2 emissions in the building sector decreased by an average of 0.65 megatons per year from 2017 to 2022, but achieving zero emissions by 2045 requires an annual reduction of 5.4 megatons. Moreover, the surge in natural gas consumption (+14% between 2017 and 2021) complicates efforts to achieve emission reduction goals.

The pace of **deploying carbon-free technologies** is also insufficient. Although the number of newly installed heat pumps rose from 98,000 in 2018 to 236,000 units in 2022, achieving the goal of six million heat pumps by 2030 requires the installation of around 500,000 units annually. This slow expansion is partly due to the substantial investment cost of heat pumps.

On a positive note, regarding **infrastructure**, building efficiency has improved. Germany's energy consumption decreased by an average of 2.2 kWh/m² between 2016 and 2021, surpassing the EU benchmark of -1.3 kWh per year.

Although the share of households with smart meters is still very low (0.3% in 2021), a **regulation** introduced in 2023 mandates a nationwide rollout of smart meters with specific deadlines (20% rollout by the end of 2025, 50% by 2028, and 95% by 2030). Also, from 2025 onward, all electricity providers will be required to offer dynamic tariffs. The abolition of subsidies for investments in heating systems powered by fossil fuels is another positive development.

Norway

Norway's heating sector is rapidly transitioning to net zero. In 2016, the country introduced a ban on installing fossil fuel-based heating systems in new buildings, and since 2020, heating with mineral oil has also been prohibited in existing buildings. However, the government has yet to set **policy targets** for renovating existing buildings or for heat storage systems.

Norway's heating system is almost entirely based on renewable energy, which has drastically advanced the **phase-out of fossil fuels** in the housing sector. Coal use was eliminated 2006, and gas and oil use has declined substantially. Furthermore, CO_2 emissions from direct energy use in buildings continue to decrease and are expected to be completely eliminated in the coming years.

In 2021, 60% of households were equipped with heat pumps, the highest percentage worldwide, and the high annual installation rate (155,000 new units in 2022) is expected to lead to 100% market penetration in the coming years. The rapid expansion of heat pumps has been facilitated by cheap and clean electricity, high taxes on fossil fuels, generous government subsidies for households, and the ban on fossil fuel boilers.

A look at the country's **building infrastructure** shows that the energy efficiency of residential buildings has improved significantly in recent years. Energy consumption per square meter decreased by an average of 2.2 kWh/m² annually from 2015 to 2020, far exceeding the EU benchmark of -1.3 kWh/m².

Norway boasts nearly 100% smart meter penetration in the heating sector, a result of stringent government **regulation**. In 2011, the National Directorate for Water Resources and Energy mandated that all customers must be equipped with smart meters by 2019.

Denmark

Overall, Denmark, like Norway, is making significant progress in transitioning its building sector to emission-free heating. **Policy goals** defined at an early stage in the process have proved essential here. Key initiatives include a ban on the installation of oil and gas boilers in new buildings since 2013 and the requirement to use renewable energy sources in new and existing buildings.

However, the **phase-out of fossil fuels** (especially natural gas) and the reduction of CO_2 emissions in the building sector are not proceeding quickly enough to achieve zero emissions by 2045. Although CO_2 emissions decreased by 14% from 4.3 million metric tons in 2017 to 3.7 million metric tons in 2022, the annual reduction rate was only 0.074 million metric tons CO_2, which is well below the minimum reduction of 0.16 million metric tons needed to reach zero emissions by 2045.

Nonetheless, the progress made in **introducing emission-free technologies** and increasing the share of buildings with climate-neutral heating is worthy of

attention. For instance, the installation of heat pumps increased by 78% between 2018 and 2022. The government also plans to further expand district heating in certain regions.

Infrastructural requirements such as the energy efficiency of buildings have also improved. The average reduction in the energy intensity of residential buildings from 2016 to 2021 was 2.8 kWh/m² per year, which is well above the EU benchmark of -1.3 kWh/m².

Thanks in large part to **regulatory measures,** 100% of buildings were fitted with smart meters by 2022. Denmark has also ended subsidies for heating systems powered by fossil fuels.

United Kingdom

The United Kingdom's efforts to transform the heating sector are currently insufficient to ensure zero emissions by 2045. Although the government has set deadlines for the commissioning of new fossil fuel boilers and introduced ambitious **policy goals** for the installation of heat pumps, it has not established targets for energy consumption per square meter or the renovation rate of buildings. In a move counterproductive to fostering energy transition in the building sector, the government scrapped planned regulations for minimum energy efficiency standards (MEES) for rental properties and other initiatives in September 2023.

CO_2 emissions from direct energy use in buildings increased by 0.3 metric tons of CO_2 per year from 2017 to 2022, whereas achieving the zero-emissions goal requires an annual reduction of at least 3.2 metric tons. The slow **phase-out of fossil fuels** in the heating sector contributes to this, with a decrease in the use of oil and coal but an increase in natural gas consumption, which remains the main source for heating.

The **adoption of climate-friendly technologies** is also insufficient. Although the number of installed heat pumps increased by 130% between 2018 and 2022, the overall numbers still fall short of national targets. The government aims to install 600,000 heat pumps per year by 2028, but only 60,000 were installed in 2022. The fact that conventional gas heating systems are much cheaper than heat pumps is proving to be a hindrance in this context.

Infrastructural measures are also imperative to improve the energy efficiency of residential buildings. Energy consumption per square meter in 2021 was 167 kWh/m², the same as in 2016, while achieving the benchmark requires an annual reduction of 1.3 kWh/m².

On a positive note, 56% of households were equipped with smart meters in 2022, and the government plans to install more than 50 million smart meters (electricity and gas) by the end of 2024. However, the country's **regulatory framework** is inconsistent. While climate-friendly heating systems (especially heat pumps) are subsidized, fossil-fueled heating systems also continue to receive financial support.

4. Good practices in reform – removing barriers, step by step

Electricity

Denmark stands out in our country sample for its planning progress in expanding and modernizing its electricity grids. Relative to other countries, the Danish system of government has long been strong in effective policy coordination, evidence-based policymaking, and civil society participation. Since 2009, Denmark has consistently ranked high in the Bertelsmann Stiftung's Sustainable Governance Indicators (SGI), which assess the sustainability of governance approaches in OECD countries. Denmark repeatedly stands out in the rankings with regard to the effective use of evidence-based policy tools (Bertelsmann Stiftung 2022). Denmark also leads the latest SGI-2024 ranking for "Governing with Foresight," which compares how well internal government tools, processes, and structures enable anticipatory governance (Bertelsmann Stiftung forthcoming).

Over the years, Denmark has gathered extensive experience with anticipatory, adaptive, and integrative planning approaches in its energy policy. The government has applied various instruments to manage regional

differences in electricity consumption, future demand, technical (capacity) requirements and flexibility needs (e.g., hydrogen and heat storage technologies) more effectively. For instance, in planning the electricity grid, the Danish Energy Agency creates 20-year forecasts of potential consumption and production behaviors, ensuring they align with policy goals and updating them annually (DEA 2023). Drawing on this forecast, Energinet, an independent public enterprise under the Danish Ministry of Climate and Energy, creates a long-term plan for future needs (Energinet, 2022a) and potential solutions (Energinet, 2022b). This plan details regional adaptation requirements. Citizen dialogue formats are then carried out on the basis of this long-term plan, with regular reviews and adjustments to grid planning. Energinet's transmission grid goals, which consider both solar and wind energy, aim for technological capacities to reach 44 GW by 2030, which are more ambitious than the recent national goals of 29 GW for solar and wind energy. This proactive grid expansion acts as a catalyst for increased use of renewable electricity generation in the future.

Denmark has also achieved significant cost reductions and a high level of industrial maturity in wind energy. Its leadership in wind power deployment and industry dates back to the 1990s and has been supported by the government's ongoing strategy adjustments and targeted policies, such as fixed feed-in tariffs and premium models, which support wind farm operators.

Denmark also employs integrative, anticipatory, and adaptive administrative procedures and structures to expedite approval processes and designate suitable areas for renewable energy projects. This applies to offshore wind energy, onshore wind turbines, photovoltaics, and power-to-x technologies. Offshore wind development follows a centralized one-stop-shop model managed by the Danish Energy Agency, which provides a single approval point. Maritime spatial planning, for example, offers a holistic approach to marine planning that reconciles the interests of nature conservation, fisheries and renewable energies. The same holistic approach is applied on land, with a 2023 national assessment identifying suitable areas for onshore wind turbines, photovoltaics, and power-to-x technologies. The government is also streamlining municipal planning with energy parks – combined wind, solar, and other technology sites – to accelerate deployment. An interministerial team formed in 2023 supports municipalities in accelerating the use of renewable energies and facilitating local transition processes.

Denmark currently has four funding mechanisms to promote local public approval for the construction of wind and solar projects (Danish Energy Agency 2024):

1. Under the Loss of Property Value Scheme, neighbors and citizens can be compensated by the owner of a renewable energy plant for any decrease in property value due to wind turbines and solar installations.

2. The Acquisition Option Scheme gives nearby homeowners the right to sell their property to the renewable energy facility owner if a property value loss of more than 1% is determined.

3. The Bonus Scheme entitles nearby neighbors of renewable energy facilities to receive an annual bonus based on the facility's production, paid by the facility owner.

4. The Green Fund Scheme requires renewable energy facility owners to pay a lump sum into a fund managed by the municipality where the facility is installed, benefiting the local community.

As a result, Denmark enjoys high public approval for its rapid progress in decarbonizing the electricity sector. According to the latest Eurobarometer survey, 93% of Danes believe it is important or very important for their national government to set ambitious goals for increasing renewable energy use by 2030, compared to 87% across the EU. In Germany, public support is slightly below average at 85% (Eurobarometer 2023: 68).

Road transport

Norway's success in decarbonizing its road transport sector is based on the country's ambitious goals, strategic planning, aggressive subsidies for emission-free vehicles, and rapid expansion of the charging infrastructure. The guiding framework for Norwegian transport policy is the National Transport Plan, updated every four years, which outlines the government's transport policy goals, strategies, and priorities for a 12-year period. This plan includes contributions from ministries, agencies, regional authorities, city governments,

businesses, industry, and interest groups (Norwegian Ministry of Transport 2021).

Norway is recognized as a global leader in adopting emission-free vehicles (Figenbaum 2023). In 2022, electric vehicles (including hybrid vehicles) accounted for 89% of total vehicle sales, which puts the country on track to meet its goal of 100% emission-free vehicles sales by 2025 (OECD 2022).

The rapid adoption of e-mobility is primarily due to generous financial incentives associated with the ownership or use of EVs (OECD 2019). A first step in 1990 involved exempting zero-emission vehicles from a registration tax which effectively doubled the price of a vehicle. In the years that followed, the incentive system was expanded to shift demand toward zero-emission vehicles (ZEVs) and increase their share of the car stock. Major measures with the greatest market impact have included registration tax benefits, VAT and annual ownership tax exemptions for EVs, as well as reduced tolls, parking, and ferry fees (Figenbaum 2023).

As the EV market has matured and the financial incentives have increasingly strained the Norwegian state's budget, some benefits have been reduced or eliminated. For instance, as of 2023, the VAT exemption for EVs applies only up to a price of NOK 500,000 (approximately € 42,500), with amounts above that subject to the full 25% VAT. In addition, an acquisition tax based on vehicle weight has been introduced for all vehicles (European Commission 2024).

Public investments in a dense network of charging stations have also facilitated the rapid adoption of emission-free vehicles (OECD 2022). For example, public funding has ensured the installation of charging stations along major roads at intervals of at least every 50 km. In 2017, the Norwegian government instituted a "charging right" for residents of multifamily buildings, requiring landlords or property owners to allow for the installation of charging infrastructure unless there are objective reasons against doing so (NOW GmbH 2023). Enova, a public company promoting environmentally friendly energy production, has significantly subsidized the development of publicly accessible charging infrastructure for light vehicles.

With the market for light vehicle charging stations now mature and most stations built under market conditions, the government believes no further subsidies are necessary. Nonetheless, to ensure that the expansion of charging infrastructure keeps pace with the growing market penetration of electric vehicles and to support the electrification of heavy vehicles, Norway launched a National Charging Strategy in 2023. The strategy focuses on expanding fast-charging points and improving legal conditions related to land use, grid access, and user-friendliness of the charging infrastructure.

Grid operators are required by the owner-tenant law to promptly provide any customer with a grid connection with the capacity they require. To facilitate this, application processing for grid licensing will be expedited and efficiency increased through enhanced digitalization efforts. In addition, national planning guidelines will support municipalities in designating suitable areas for charging infrastructure.

If no capacity is available in the existing grid, the network provider must promptly invest in necessary upgrades, with costs fully or partially borne by the customer. The strategy also calls for the improved user-friendliness of charging stations through standardized pricing information, easy comparison between operators, cashless payment options, and real-time data on station status and availability in a database. Charging will also be bookable for bus and truck drivers (Norwegian Ministry of Transport 2023). Despite this progress, the political strategy for the further development of alternatives to road transport must be intensified in order to reduce the high dependency on cars in individual passenger transport.

Heating sector

Denmark's heating transition began in the late 1970s during the oil crisis with a focused expansion of district heating and the establishment of the Danish Energy Agency. The agency has supported this transition through energy plans, regulations, standards, and data for local heat planning. High taxes on fossil fuels further promoted the expansion of district heating, making fossil fuels increasingly uneconomical for heating buildings. By 2022, the effective energy tax for heating purposes was equivalent to €10 per kilowatt-hour for gas and oil, while electricity for heating was nearly untaxed (IEA 2023: 38). Forty years after the heating transition began, a ban on installing oil and gas-pow-

ered boilers in new buildings was introduced, but only after alternative heating solutions were widely adopted.

Today, about two-thirds of households in Denmark are connected to a district heating network, with 60% of the energy generated from renewable sources such as biomass, biogas, photovoltaics, geothermal energy, and electricity (State of Green 2023). Long-term loans from the Municipal Loan Fund under non-commercial conditions and mandatory connections have mitigated investment risks and promoted the expansion of district heating. A unique feature of the Danish approach is that the heat price is determined by the nonprofit principle or the necessary cost principle. Consequently, the average heat price is almost the same regardless of the heat density in a supply area, making it relatively high compared to other countries (Johansen and Werner 2022). To maintain the attractiveness of district heating compared to other renewable energy options, the Danish parliament introduced a price cap in early July 2024 that brings heat prices in line with the cost of a heat pump, along with more favorable asset write-off rules for operators (Devine 2024).

The Danish government currently provides four subsidy pools to support the gradual phase-out of oil and gas-powered boilers. These pools help households invest in heat pumps, encourage district heating alternatives, and transition away from the natural gas grid.

One of these subsidy pools, which is essentially a "scrappage" program for oil and gas-powered boilers, promotes a subscription-based solution for the operation of a heat pump. When households switch from an oil or gas boiler to a heat pump, their service provider manages the removal of the old boiler and oversees the installation and maintenance of the new heat pump. Homeowners typically pay a registration fee, a fee for the heat consumed, and a monthly subscription fee for up to ten years (the binding period). For Danish homeowners, subscribing to a heat pump is much less expensive than purchasing one, as the service provider receives a subsidy of up to DKK 25,000 (about €3,350) per house from the Danish government. The solution was inspired by the concept of district heating, which involves a subscription price and a connection fee, and the homeowner is not actively involved in the practical details of heat supply (cf. Danish Energy Agency 2020).

5. Outlook

Assessing sectoral climate transitions based solely on emissions reduction is insufficient. In some cases, substantial CO_2 reductions can create the appearance that the transition is well underway and on track for full decarbonization by 2050 or sooner. However, emissions reductions can sometimes result from measures that are not genuine steps toward zero emissions, such as shifting from coal to gas power or other lower-carbon technologies.

In this Policy Brief, we have outlined the key components of a theory-driven, holistic yet focused evaluation framework to assess progress in zero-emission sectoral energy transitions. For each energy-related sector (electricity, road transport, and heating), it is essential to see the decline of carbon-intensive technologies and the rise of zero-emission alternatives, supported by broader systemic changes. New infrastructure must be developed in parallel with or even ahead of technology deployment, especially where existing infrastructure is inadequate for carbon-free systems. Simultaneously, regulatory reforms must enable the transformation by facilitating the integration and widespread adoption of zero-emission technologies by households and businesses. Only when emissions reductions are driven by such systemic changes can a country be considered on track to zero emissions.

As demonstrated, even though system change remains insufficient in most cases, each of the three sectors examined has at least one country that has made substantial headway toward emission-free operations.

Denmark and Norway are on track to complete their transitions to green electricity and heating. Norway is also nearing completion of its shift to e-mobility. As was shown in the previous two sections, these two countries have aligned their policy targets, institutions, policy instruments, and respective infrastructures in a coherent manner. A stable political consensus has supported the transformation in both countries across different political constellations over time. This shows that it is possible, in principle, to accelerate the transition in these sectors and to achieve full decarbonization by mid-century.

Germany and the UK, however, are not yet on track to complete their transitions to green electricity, heating, and road transport in time. Both countries still have considerable ground to cover in these sectors. While Germany has expanded renewable energy, further acceleration is needed, including setting official targets for upgrading and expanding distribution grids and electricity storage capacities, as well as better aligning the transmission network with renewable energy goals. The UK, for its part, needs a clear strategy for phasing out gas in electricity generation and specific targets for expanding its transmission and distribution networks. Moreover, countries require more coherent policy strategies to accelerate the road transport and heating transitions, such as by supporting the rapid deployment of charging infrastructure and redirecting subsidies from carbon-intensive to carbon-free options.

Overall, the slow progress in developing a future-proof energy infrastructure remains the most significant barrier to achieving a decarbonized energy system. Accelerating the upgrade and expansion of modern transmission and distribution networks, as well as energy storage systems, is crucial. Denmark's latest electricity transmission plans are a good example of how to align infrastructure deployment with ambitious renewable energy targets. Maintaining public support is also vital, for example, by assisting households that may struggle to afford the sometimes high costs of the transition.

Identifying and addressing barriers to change, as well as catalysts for progress, represents a key opportunity for climate action. The transformation to a carbon-free energy system is a multifaceted and complex process, involving numerous technological, political, social, and economic factors. While it may not be feasible to capture all these factors and their interactions, we hope that the evaluation framework proposed here marks a step forward in how we assess progress in these socio-technical transformations. We also hope that future research will further develop each dimension of change and that this framework can be applied to other countries and sectors.

Bibliography

Bertelsmann Stiftung 2022. Sustainable Governance Indicators 2022. Evidence-based Instruments. Retrieved, 17 July 2024, from SGI 2022 | Good Governance | Executive Capacity | Evidence-based Instruments (sgi-network.org)

Bertelmann Stiftung 2024. Sustainable Governance Indicators 2024. Gütersloh. Bertelsmann Stiftung. Forthcoming.

Boitier, B., Nikas, A., Gambhir, A., Koasidis, K., Elia, A., Al-Dabbas, K., Alibaş, Ş., Campagnolo, L., Chiodi, A., & Delpiazzo, E. (2023). A multi-model analysis of the EU's path to net zero. Joule, 7(12), 2760–2782.

Danish Energy Agency 2020. How to be climate-friendly – Subscribe to a heat pump and scrap your old boiler. Retrieved, 18 July 2024, from 04_ens_faktaark.pdf

Danish Energy Agency 2023. Analyseforudsætninger til Energinet. Retrieved, 17 July 2024, from Microsoft Word - AF23 - Sammenfatningsnotat.docx (ens.dk).

Danish Energy Agency 2024. Promoting onshore wind power. Retrieved, 22 July 2024, from Promoting onshore wind power | The Danish Energy Agency (ens.dk).

Devine, Ayisha 2024. Danish Parliament Implements Price Cap on District Heating Sector. Retrieved, 18 July 2024, from Danish Parliament Implements Price Cap on District Heating Sector | en.365Nyt.

Energinet 2022a. Long-term Development Needs in the Power Grid. Energinet's long-term development plan 2022 – Needs analysis. Retrieved, 17 July 2024, from lup22_behovsanalyse_el_engelsk.pdf (energinet.dk).

Energinet 2022b. Possible Solutions for Electricity Needs. Energinet's long-term development plan 2022 – Solution catalogue. Retrieved, 17 July 2024, from lup22_losningskatalog_el_english.pdf (energinet.dk).

European Parliament and European Council 2021. Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law'). Document 32021R1119. Retrieved, 30 August 2024, from Regulation - 2021/1119 - EN - EUR-Lex (europa.eu).

European Commission 2024. European Alternative Fuels Observatory: Norway, from Incentives and Legislation | European Alternative Fuels Observatory (europa.eu)

Figenbaum, Erik 2023. The policy process behind Norway's BEVolution, from EVS24 (evs36.com)

Hagen, K., J. Lund-Tønnesen und M. Schøyen forthcoming. Norway Report. Sustainable Governance Indicators 2024. Gütersloh. Bertelsmann Stiftung.

IEA. (2021). Residential Heat Economics Calculator www.iea.org/data-and-statistics/data-tools/ residential-heat-economics-calculator

Johansen, Katinka and Sven Werner 2022. Something is sustainable in the state of Denmark. A review of the Danish district heating sector. Renewable and Sustainable Energy Reviews. 158 (April 2022): 1-15.

Norwegian Ministry of Transport 2021. National Transport Plan 2022-2033, from National Transport Plan 2022–2033 - regjeringen.no

Norwegian Ministry of Transport 2023. National Charging Strategy, from National charging strategy - regjeringen.no

NOW GbmH 2023. Dossier Norwegen, from NOW_E-Mobilitaet-international_Dossier-Norwegen.pdf (now-gmbh.de)

OECD 2022. Norway's evolving incentives for zero-emission vehicles, from Norway's evolving incentives for zero-emission vehicles | OECD

Plötz, P., Wachsmuth, J., Gnann, T., Neuner, F., Speth, D., & Link, S. (2021). Net-Zero-Carbon Transport in Europe until 2050—Targets, Technologies and Policies for a Long-Term EU Strategy. Karlsruhe: Fraunhofer Institute for Systems and Innovation Research ISI.

State of Green 2023. New Plans to expand the Danish District Heating Network. Retrieved, 18 July 2024, from New plans to expand the Danish district heating network (stateofgreen.com).

Victor, D. G., Geels, F. W., & Sharpe, S. (2019). Accelerating the low carbon transition, The case for stronger, more targeted and coordinated international action.

October 2024

Editor
Bertelsmann Stiftung
Carl-Bertelsmann-Straße 256
33311 Gütersloh
Telefon +49 5241 81-0
www.bertelsmann-stiftung.de

Contact
Dr. Christof Schiller
Senior Project Manager
Program Sustainable Social Market Economies
Telefon +49 30 275788-138
christof.schiller@bertelsmann-stiftung.de

Dr. Thorsten Hellmann
Project Manager
Program Sustainable Social Market Economies
Telefon +49 5241 81-81236
thorsten.hellmann@bertelsmann-stiftung.de

Responsible
Dr. Christof Schiller

Authors
Germán Bersalli: Research Institute for Sustainability – Helmholtz Centre Potsdam (RIFS), Potsdam, Germany; Sustainability Transition Policy, School of Business, Economics and Society, Friedrich Alexander University Erlangen-Nürnberg, Nuremberg, Germany.

Christof Schiller, Thorsten Hellmann, Leonard Mussler: Bertelsmann Stiftung

Johan Lilliestam: Sustainability Transition Policy, School of Business, Economics and Society, Friedrich Alexander University Erlangen-Nürnberg, Nuremberg, Germany

Citation note
Germán Bersalli/ Christof Schiller/ Thorsten Hellmann/ Leonard Mussler/ Johan Lilliestam (2024). Meeting Climate Targets: How Far have Leading Countries Progressed in the Transition to Carbon-free Energy for Heating, Road Transport, and Electricity? Policy Brief „Sustainable Governance in International Perspective" 2024/01. Gütersloh, Bertelsmann Stiftung.

The **Sustainable Governance in International Perspective** policy brief is a joint product of the Sustainable Governance Indicators SGI (www.sgi-network.org) and the Transformation Index BTI (www.bti-project.org) teams at the Bertelsmann Stiftung.

The **Transformation Index** assesses the quality of democracy, market economy and governance in 137 developing and transformation countries on a biennial basis.

The **Sustainable Governance Indicators (SGI)** assess the sustainability of policymaking and the quality of democratic governance in the key areas of economic, social and environmental policy in 30 OECD and EU countries every two years.

Infographics
Nicole Meyerholz, Bielefeld

Layout
Markus Diekmann, Bielefeld

Title
© kflgalore – stock.adobe.com

Printing
Hans Gieselmann Druck und Medienhaus GmbH & Co. KG

DOI 10.11586/2024115

ID2273