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Article

Ampel-Monitor Energiewende shows the pace of the energy transition must be accelerated significantly

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AT A GLANCE

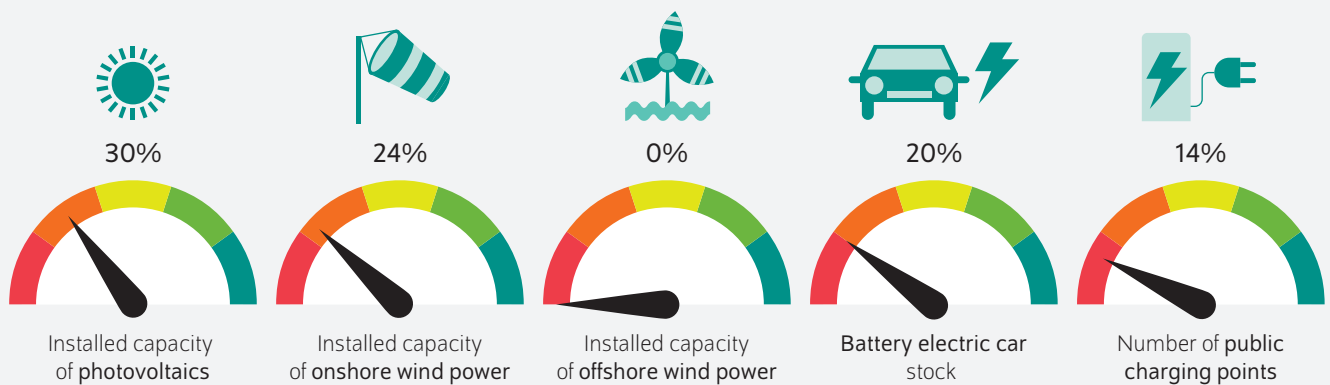
Ampel-Monitor Energiewende shows the pace of the energy transition must be accelerated significantly

By Wolf-Peter Schill, Alexander Roth, and Adeline Guéret

- German government coalition has set a series of concrete energy targets
- DIW Berlin's new *Ampel-Monitor Energiewende* provides open and continuously updated data on milestones achieved
- Gaps between current state and 2030 targets are especially large for renewable heat, electromobility, and green hydrogen
- Prompt and extensive measures in many areas are required to reach coalition targets
- The *Ampel-Monitor Energiewende* will regularly report on progress in various formats in the future

Current pace of the energy transition in Germany is far too slow to reach the 2030 targets

Example: The expansion pace of photovoltaics was most recently only 30 percent of the average pace that is needed to reach the 2030 target.



Source: Authors' calculations based on *Ampel-Monitor Energiewende* data.

Shown is the expansion pace trend of the last twelve available months compared to the average pace needed from now on to reach the 2030 targets.

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FROM THE AUTHORS

“The Ampel-Monitor Energiewende makes it clear that the current pace of the German energy transition is far too slow to reach the 2030 targets. The government must implement concrete, far-reaching steps promptly if it does not want to fall further behind the target path.”

— Wolf-Peter Schill —

MEDIA



Audio Interview with Wolf-Peter Schill (in German)
www.diw.de/mediathek

Ampel-Monitor Energiewende shows the pace of the energy transition must be accelerated significantly

By Wolf-Peter Schill, Alexander Roth, and Adeline Guéret

ABSTRACT

The so-called traffic light coalition is facing a challenge: it has set ambitious energy policy targets, but can only achieve them if the pace of the energy transition is increased significantly. To contribute to the current energy policy debate, the *Ampel-Monitor Energiewende* (Monitor of the Traffic Light Coalition's Energy Transition Targets) was developed at DIW Berlin. Based on open data, the *Ampel-Monitor Energiewende* currently uses 15 indicators to compare the government targets for 2030 and beyond with developments and progress to date. For almost all indicators, there is a large gap between current trends and government targets, especially for renewable heat, electromobility, and green hydrogen. Moreover, the expansion pace of onshore and offshore wind power has recently lagged significantly behind what is necessary to achieve the 2030 targets. Concrete and far-reaching policy measures must be implemented in a timely manner for the targets to be achieved. The *Ampel-Monitor Energiewende* will continually monitor the success of the traffic light coalition's policies.

The German government¹ has set a series of concrete targets for 2030 and beyond to drive forward the energy transition and to adhere to Germany's climate change commitments. Several quantitative targets have initially been specified in the coalition agreement.² Since then, new requirements have followed in draft legislation and various ministry publications, and in some cases, the targets in the coalition agreement have been concretized or become stricter (see Box).

As a part of the current energy policy debate, there is a great need to put the German government's energy targets into perspective in terms of developments to date and to track progress regularly. For this purpose, the *Ampel-Monitor Energiewende* was developed at the German Institute for Economic Research (DIW Berlin).³ The *Ampel-Monitor Energiewende* is a collection of data and analyses, including this Weekly Report, that is available on the DIW Berlin homepage in various formats.⁴ In this Weekly Report, the most important *Ampel-Monitor Energiewende* indicators are introduced and the government targets are discussed in the context of current developments.⁵

Continuously updated graphs based on open data

The *Ampel-Monitor Energiewende* is currently based on 15 indicators for renewable electricity generation, renewable

¹ The current German government consists of a coalition between the SPD, FDP, and Greens, commonly referred to as the *Ampelkoalition*, or traffic light coalition (based on the party colors of red, yellow, and green). The SPD and Greens are center-left, while the FDP are center-right.

² SPD, Grüne, FDP, *Mehr Fortschritt wagen. Bündnis für Freiheit, Gerechtigkeit und Nachhaltigkeit. Koalitionsvertrag 2021 – 2025 zwischen der Sozialdemokratischen Partei Deutschlands (SPD), BÜNDNIS 90 / DIE GRÜNEN und den Freien Demokraten (FDP)* (2021) (in German; available online).

³ Development of the *Ampel-Monitor Energiewende* began at the end of 2021 under the project name "KoaVTracker," as the traffic light coalition's first energy targets were formulated in the coalition agreement (*Koalitionsvertrag, KoaV*). Since then, the government has set additional targets that go beyond the coalition agreement, making it necessary to rename the project.

⁴ Cf. the *Ampel-Monitor Energiewende* on the DIW Berlin website (in German; available online). The main homepage of the *Ampel-Monitor Energiewende* and most of its content is in German. There is also a homepage in English, currently with limited content (available online). We aim to provide English translations of the most important analyses in the future, starting with this Weekly Report.

⁵ The *Ampel-Monitor Energiewende* was developed as part of the BMBF-funded research project Ariadne, FKZ 035FK5N0.

Box

Selection of relevant documents and legislation for the *Ampel-Monitor Energiewende*

In the coalition agreement from November 24, 2021,¹ the SPD, the Greens, and the FDP set a number of quantitative targets for 2030 in the energy sector, including the share of renewable energy in the electricity and heat sectors, the installed capacity of PV and offshore wind plants (but not onshore), the provision of land for onshore wind energy, the battery electric car fleet, and electrolysis capacity. In addition, quantitative targets for onshore wind energy and heat pumps were specified in the Federal Ministry for Economic Affairs and Climate Action's *Eröffnungsbilanz Klimaschutz* (review of Germany's current climate action status).²

The Easter Package,³ including a series of planned legislation, was presented on April 6, 2022.⁴ An important component of the Easter Package is the EEG amendment,⁵ which includes specific targets

1 SPD, Grüne, FDP, *Mehr Fortschritt wagen. Bündnis für Freiheit, Gerechtigkeit und Nachhaltigkeit. Koalitionsvertrag 2021 – 2025 zwischen der Sozialdemokratischen Partei Deutschlands (SPD), BÜNDNIS 90 / DIE GRÜNEN und den Freien Demokraten (FDP)* (2021) (in German; available online).

2 BMWK, *Eröffnungsbilanz Klimaschutz* (2022) (in German; available online).

3 BMWK, *Überblickspapier Osterpaket* (2022) (in German; available online). The package's formal title is *Planungsbeschleunigungspaket I*.

4 Of particular relevance here are amendments to the EEG and WindSeeG. In addition, the Easter Package includes various other laws and regulations in energy law.

5 Deutscher Bundestag, "Entwurf eines Gesetzes zu Sofortmaßnahmen für einen beschleunigten Ausbau der erneuerbaren Energien und weiteren Maßnahmen im Stromsektor," Drucksache 20/1630 (2022) (in German; available online).

for installed PV capacity and onshore wind capacity that are more stringent than those set out in the coalition agreement. These include two-year specific interim targets until 2030 and longer-term targets beyond that.

On June 15, 2022, the Summer Package was announced,⁶ which is dedicated to onshore wind energy expansion. Among other things, it includes a bill to increase and accelerate the expansion of onshore wind turbines with clearly specified territory targets compared to the coalition agreement.⁷

At the European level, there are a number of older renewable energy and energy efficiency targets. In addition, there are new proposals under the "Fit for 55" package and the "REPowerEU" package developed in the wake of the Russian attack on Ukraine. However, these legislative initiatives often do not produce binding sub-targets for individual countries or the targets are less ambitious than those of the traffic light coalition. Therefore, European targets currently have no direct influence on the indicators recorded in the *Ampel-Monitor Energiewende*.

6 Bundesregierung, "Planungen und Genehmigungen beschleunigen, Transformation voranbringen," press release no. 212 from June 15, 2022 (in German; available online). The package's formal title is *Planungsbeschleunigungspaket II*.

7 BMWK, Entwurf eines Gesetzes zur Erhöhung und Beschleunigung des Ausbaus von Windenergieanlagen an Land (2022) (in German; available online).

heat, electromobility, hydrogen, and energy consumption (Table). The government targets are visualized using interactive graphs and are compared with the current state on a regular basis. Indicators are based on publicly available data that are updated either monthly or annually. A selection of figures have been published on the DIW Berlin homepage.⁶ All indicators and the underlying data are open source and available on the Open Energy Tracker platform, which is regularly updated and expanded.⁷

For illustrative purposes, a linear progression between the status at the beginning of the current legislative period and the respective target year is usually shown,⁸ as the exact paths to achieve these targets were generally not specified in concrete terms by the government. For most of the indicators, projections of current trends are also displayed. These projections are generally based on the trend of the past 12 months as well as the trend from 2017 to 2021.⁹

6 Cf. the *Ampel-Monitor Energiewende* on the DIW Berlin website.

7 The data is available in the Open Energy Tracker based on GitLab in German, English, and French, and is freely usable under an open license (available online).

8 The end of November 2021 is assumed as the start date for the traffic light coalition. In regard to the target year, it is assumed that the targets must be achieved by December of a target year.

9 Trends are calculated using the ordinary least squares (OLS) method.

To put the German government's targets and the progress made into perspective, they are compared with results from the scenario analyses of the Ariadne Project, one of the Kopernikus projects funded by the Federal Ministry of Education and Research (*Bundesministerium für Bildung und Forschung, BMBF*).¹⁰ These scenarios were designed and calculated by a group of energy modeling teams and depict different paths to climate neutrality for Germany in 2045.¹¹ This report does not include individual model results, but reference is made to the range or corridors of all results.¹² Since data for the Ariadne scenarios are generally only available in five-year increments, the data for the intermediate years were interpolated linearly. The results of the Ariadne scenarios are available until 2045, thus allowing for a longer-term view of plausible developments in the respective indicators.

The *Ampel-Monitor Energiewende* is not a static product, but rather a collection of data and analyses that will develop over time together with the government targets. It does not claim

10 Cf. The Ariadne Project homepage (in German; available online).

11 Gunnar Luderer, Christoph Kost, and Dominika Sörgel, *Deutschland auf dem Weg zur Klimaneutralität 2045 – Szenarien und Pfade im Modellvergleich (Ariadne-Report)* (Potsdam Institute for Climate Impact Research: 2021) (in German; available online).

12 The Open Energy Tracker also contains further information on Ariadne scenarios, in particular the results of the lead model relevant for the respective indicator.

Table

Indicators of the Ampel-Monitor Energiewende

Sector	Indicator	Source
Renewable electricity generation	Installed PV capacity	AGEE-Stat monthly and quarterly data (in German; available online)
	Installed onshore wind capacity	AGEE-Stat monthly and quarterly data (in German; available online)
	Share of land designated for wind turbines	Federal/State Cooperation Committee Report (in German; available online)
	Installed offshore wind capacity	AGEE-Stat monthly and quarterly data (in German; available online)
	Share of renewable energy in electricity sector	BMWK energy data (available online)
Renewable heat	Heat pump stock	EurObserv'ER (available online) and BWP (in German; available online)
	Share of renewable energy of final energy consumption for heating	AGEE-Stat time series (in German; available online)
Electromobility	Battery electric car stock	KBA (in German; available online)
	Share of battery electric vehicles of monthly new registrations	KBA (in German; available online)
	Public charging points	Bundesnetzagentur (in German; available online)
	Battery electric vehicles per public charging point	KBA (in German; available online) and Bundesnetzagentur (in German; available online)
	Electrified share of rail traffic	Deutsche Bahn AG (in German; available online)
Hydrogen	Installed electrolysis capacity	International Energy Agency, Hydrogen Projects Database (available online)
Energy consumption	Net natural gas imports to Germany	International Energy Agency, Gas Trade Flows (available online)
	Fossil primary energy consumption	BMWK energy data (available online) and AGEV (in German; available online)

Note: The table shows the status as of July 2022. The indicators can be adjusted and expanded on an ongoing basis.

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to be exhaustive in terms of energy policy targets and the indicators can be adjusted or expanded as necessary.

Traffic light coalition planning significant expansion of renewable energy infrastructure

In terms of renewable electricity generation, the traffic light coalition has set specific performance targets for photovoltaics (PV) and wind energy expansion and the share of renewable energy sources of electricity consumption.

Photovoltaic capacity should nearly quadruple by 2030

As part of the currently planned amendment to the Renewable Energy Sources Act (*Erneuerbare-Energien-Gesetz*, EEG), the German government has presented an expansion target of 215 gigawatts (GW) for PV in 2030 (Box). In December 2021, the installed capacity was 58 GW, only a quarter of the target. Thus, an average of 1.44 GW per month will need to be added until the end of 2030 to achieve the target, with an increasing expansion path from 2022 to 2026 (Figure 1). This expansion must be net, i.e., taking into account the plants that will be taken off the grid in the future. At 0.45 GW per month, the expansion trend of PV capacity over the past 12 months was significantly lower. At this pace, only around 108 GW of capacity would be added by the end of 2030. The target of 215 GW will require a rate of expansion more than three times faster than the past 12 months' trend, and nearly five times faster than the trend from 2017 to 2021. However, the expansion path proposed in the EEG amendment only envisages just under 0.6 GW per month for 2022,¹³ which

has already been achieved due to higher capacity additions in February and March. After 2030, PV capacity should grow significantly to 400 GW in 2040. The government targets are at the upper end of the corridor spanned by the Ariadne Project scenarios, and even above it in 2040, so they tend to be more ambitious.

Onshore wind power should be doubled by 2030

The planned EEG amendment envisages a target of 115 GW of installed onshore wind capacity in 2030. At the end of November 2021, capacity was only half as high at nearly 56 GW. To reach the target, an average of 0.54 GW per month net must be built until the end of 2030. The trend over the past 12 months was only 0.13 GW per month; thus, the expansion pace must be quadrupled. The proposed expansion path for 2022 in the EEG amendment only envisages expansion of around 0.2 GW per month;¹⁴ currently, however, not even this target is being reached. After 2030, the government plans to further increase capacity markedly to 157 GW in 2035 and to 160 GW in 2040. The coalition's targets for onshore wind power expansion are around the middle of the Ariadne scenario corridors, and are thus similarly ambitious. This corridor is wider than the photovoltaics corridor, meaning that the models deviate from each other significantly in the case of onshore wind.

An important prerequisite for the expansion of onshore wind energy is the availability of suitable land. According to the coalition agreement, two percent of national territory is to be designated for this purpose, although no target year is

¹³ Cf. Deutscher Bundestag, "Entwurf eines Gesetzes zu Sofortmaßnahmen für einen beschleunigten Ausbau der erneuerbaren Energien und weiteren Maßnahmen im Stromsektor," Drucksache 20/1630 (2022) (in German; available online).

¹⁴ Cf. Deutscher Bundestag, "Entwurf eines Gesetzes zu Sofortmaßnahmen für einen beschleunigten Ausbau der erneuerbaren Energien und weiteren Maßnahmen im Stromsektor," (in German; available online). In the case of onshore wind power, the BMWK presented a gross rather than a net expansion path in the graph on p. 135 of the document. The values have been scaled to give exactly the specified (net) capacity in each of the support years defined in paragraph 2.

mentioned. The current draft of the Onshore Wind Act specifies that this two-percent target is to be achieved by 2032, with 1.4 percent of territory to be covered by the end of 2026. It also specifies how the targets are distributed among the federal states.¹⁵ However, only 0.7 percent of national territory was legally designated for onshore wind energy at the end of 2020.¹⁶ Thus, the share must be nearly tripled.¹⁷

Offshore wind power stagnating recently; nearly quadrupled expansion planned by 2030

The coalition envisages offshore wind power capacity of at least 30 GW by 2030.¹⁸ In early December 2021, the installed capacity was only 7.8 GW, a quarter of the target. To achieve the expansion target, 0.20 GW on average per month net must be built until 2030. Over the past 12 months, however, no new offshore wind turbines have been connected to the grid. The trend for 2017 to 2021 was about 0.07 GW per month; this rate will need to almost triple to achieve the 2030 target. Even after that, installed capacity is expected to continue to grow strongly to at least 40 GW in 2035 and at least 70 GW in 2045. These targets are in the upper range of the Ariadne scenario corridor, which is even wider than the onshore wind power corridor. Until 2030, the German government's targets will be above the Ariadne scenarios. Until 2030, the German government's targets will be above the Ariadne scenarios.

Electricity sector to be 80 percent renewable by 2030 and nearly fully renewable by 2035

The traffic light coalition is attempting to increase the share of renewable energy of gross electricity consumption¹⁹ to 80 percent by 2030. According to the Easter Package, the electricity supply should be "nearly fully" renewable by 2035.²⁰ In 2020, the share of renewable electricity was 45.1 percent, while it was only 41.9 percent in 2021. However, these figures are not yet final (Figure 2).²¹ This decline is likely to be explained by two factors. First, in 2020, overall electricity consumption fell due to the pandemic, so that the share of renewables increased despite only minor capacity expansion. Then, in 2021, electricity consumption increased again.

15 BMWK, *Entwurf eines Gesetzes zur Erhöhung und Beschleunigung des Ausbaus von Windenergieanlagen an Land* (2022) (in German; available online).

16 BMWK, *Bund-Länder-Kooperationsausschuss* (2021) (in German; available online). The 0.7 percent refers to the lower corridor without double counting, i.e., land use designations either exclusively at the regional planning level or at the urban land use plan level.

17 A visualization of the territory targets can be found in the Open Energy Tracker (available online).

18 Bundesregierung, *Entwurf eines Zweiten Gesetzes zur Änderung des Windenergie-auf-See-Gesetzes und anderer Vorschriften* (2022) (in German; available online).

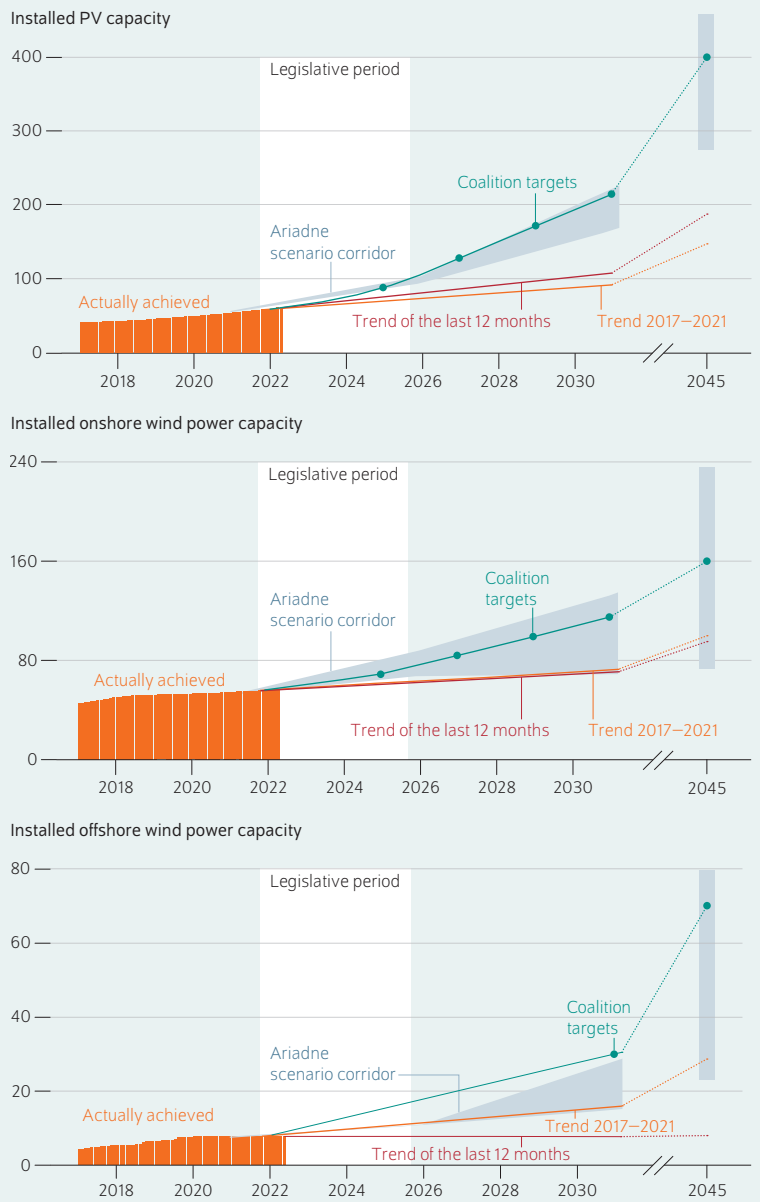
19 Gross electricity consumption is the total domestic electricity consumption including conversion losses. It is the sum of domestic (gross) electricity generation plus electricity imports minus electricity exports.

20 Bundesregierung, *Entwurf eines Gesetzes zu Sofortmaßnahmen für einen beschleunigten Ausbau der erneuerbaren Energien und weiteren Maßnahmen im Stromsektor* (2022) (in German; available online). What "nearly fully" means in concrete percentage terms is unclear. Taking into account electricity generation from non-biogenic waste as well as blast furnace and converter gas, a share of renewable energy of around 95 percent is probably plausible. In the final version adopted by the German parliament, the respective passage was deleted, yet it is still fair to assume that the government aims to increase the share of renewables in the power sector further after 2035.

21 BMWK, *Energiedaten* (2022) (in German; available online).

Figure 1

Expansion of photovoltaics and onshore and offshore wind power In gigawatts



Note: The net addition is shown taking into account old plants going off the grid. The gray bars represent the corridor of the results of the scenario analysis of Ariadne, which is funded by the BMBF as a part of their *Kopernikus* projects. Between individual target years for which data are available, annual trends were interpolated linearly.

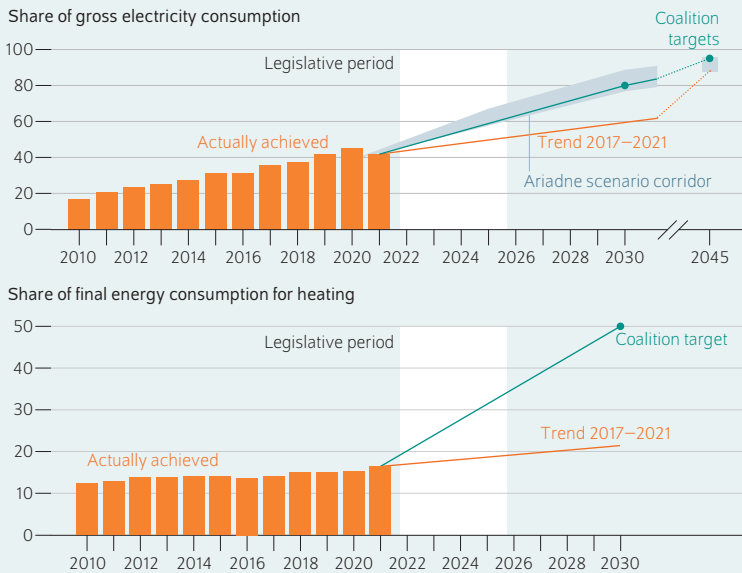
Sources: EEG 2023 draft, AGEE-Stat, Ariadne, authors' calculations.

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By 2030, the installed PV capacity and offshore wind power capacity must almost quadruple, while onshore wind power capacity must double.

Figure 2

Shares of renewable energy in the electricity and heating sectors
In percent



Note: The share of renewable energy of gross electricity consumption and of final energy consumption for heating and cooling is shown. Annual trends were interpolated linearly. No quantitative target has been specified for the electricity sector for 2035 onwards; a value of 95 percent has been shown here for illustrative purposes.

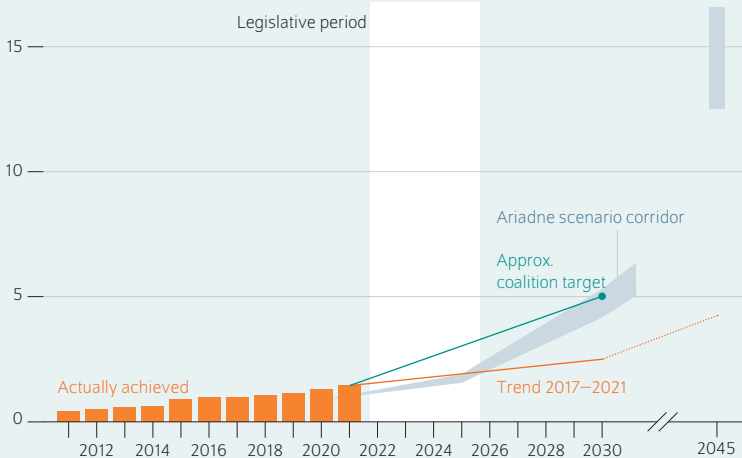
Sources: Coalition agreement, EEG 2023 draft, BMWK energy data, AGEE-Stat, Ariadne, authors' calculations.

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Reaching the 2030 target in the heating sector poses a particularly great challenge.

Figure 3

Heat pump stock
In millions of heat pumps



Note: Decentralized heat pumps for space heating. Annual trend interpolated linearly. The government has not specified an exact 2030 target, but it is likely to be roughly in the middle of the corridor of 4.1 to six million units.

Sources: Eröffnungsbilanz Klimaschutz, EurObservER (until 2020), BWP (2021), Ariadne, authors' calculations.

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The number of installed heat pumps must more than triple by 2030.

Second, the wind year 2021 was relatively poor. To achieve the 2030 target, the share must grow by over four percentage points annually on average from 2021. In comparison, the trend growth was only around two percentage points per year from 2017 to 2021.²² The coalition's targets for the share of renewable energy are within the corridor spanned by the Ariadne scenarios.

Ambitious renewable heat targets

In terms of renewable heat, the traffic light coalition plans a marked expansion of the heat pump stock as well as a massive increase in the share of renewable energy of heat generation.

Combination of heat pumps and renewable electricity crucial for the space heating sector

Heat pumps play a major role in many future scenarios, especially for the space heating sector, because they use electricity to make environmental heat usable and are thus very energy efficient.²³ The government did not set a concrete target for heat pump expansion in its coalition agreement. The Federal Ministry for Economic Affairs and Climate Action's *Eröffnungsbilanz Klimaschutz* (stocktaking of Germany's current climate action status) targets a corridor of "4.1 to 6 million heat pumps" in 2030.²⁴ The middle of this corridor, around five million heat pumps, can be presented indicatively as a coalition target. In 2021, there were around 1.4 million heat pumps in Germany, meaning around 0.4 million must be added annually until 2030, compared to a trend of just over 0.1 million per year from 2017 to 2021. The target is within the corridor that the Ariadne scenarios span in 2030. After 2030, the heat pump stock in the Ariadne scenarios continues to increase strongly, from nearly 13 to more than 16 million in 2030.

Drastic increase in share of renewable energy in heat sector needed

The coalition agreement envisages "a very high share" of renewable energy in heating, but does not include a concrete target, only aiming for half of heat generation to be carbon neutral by 2030. Nevertheless, this target can function as the renewable energy target because other options, such as imported carbon-neutral hydrogen or carbon capture, appear unrealistic for the heating sector by 2030. In 2021, the share of renewable energy of final energy consumption for heating

²² The shares of renewable energy of net electricity generation are also available in the Open Energy Tracker (available online). Thanks to a permanent update by Fraunhofer ISE, these are available practically without delay, in contrast to the shares of gross electricity consumption reported by the BMWK (in German; available online).

²³ Cf. Alexander Roth et al., "Expanding Solar Energy Capacity to Power the Transition to Heat Pumps," *DIW Weekly Report*, no. 22/23 (2022): 151–159 (available online).

²⁴ This figure is likely to refer to the provision of space heating in individual buildings, i.e., excluding large-scale heat pumps in heat grids and high-temperature heat pumps. At the "heat pump summit" on June 29, 2022, an expansion path was envisioned that is in the middle of this corridor, cf. BMWK and BMWSB, "Breites Bündnis will mindestens 500 000 neue Wärmepumpen pro Jahr," press release from June 29, 2022 (in German; available online).

and cooling was 16.5 percent in Germany.²⁵ Thus, this share must grow by nearly four percentage points annually until 2030 (Figure 2). Since 2012, it has risen by less than three percentage points overall, or by around 0.5 percentage points per year in the 2017 to 2021 trend. In this respect, the traffic light coalition’s plans for the heating sector appear to be particularly ambitious. One concrete measure for achieving the 2030 target is the plan to require new heating systems to be powered by at least 65 percent renewable heat as early as 2024.²⁶

Rapid electrification of cars planned

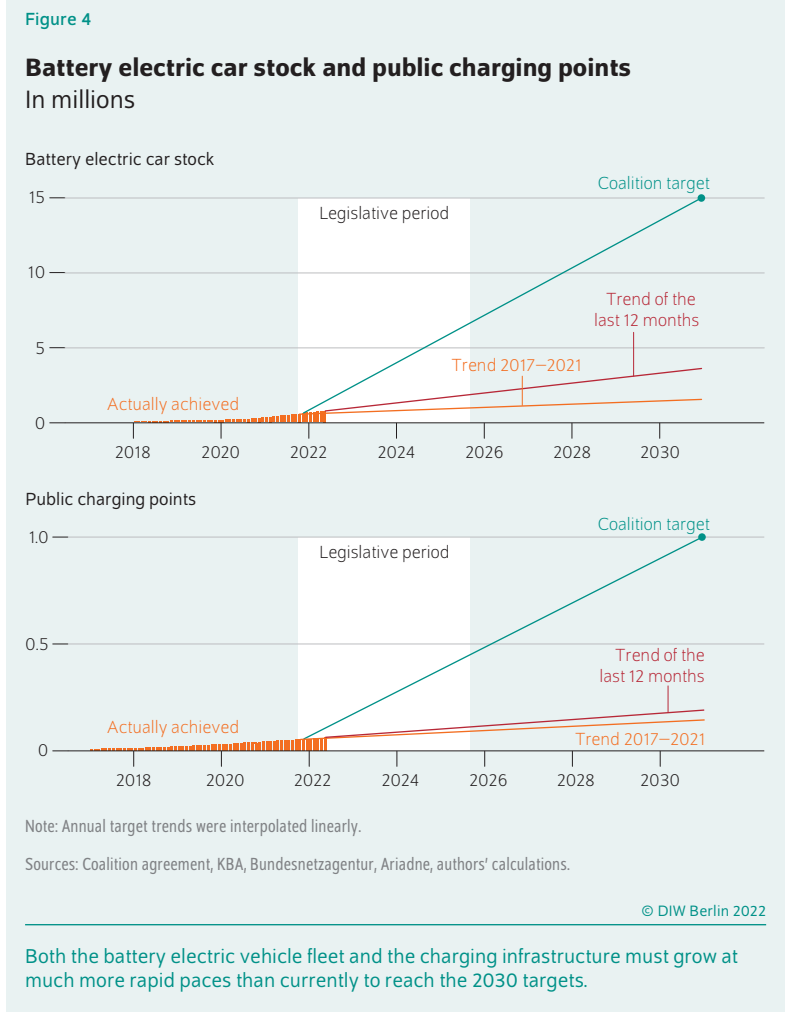
The traffic light coalition also envisages a massive expansion of the electric car fleet as well as the accompanying charging infrastructure.²⁷

15 million electric cars by 2030

In its coalition agreement, the government set a target of “at least 15 million fully electric cars by 2030.” Since significant shares of fuel cell electric vehicles now seem implausible,²⁸ this target can be viewed as a target for pure battery electric cars (excluding plug-in hybrids). At the beginning of December 2021, there were around 587,000 battery electric cars in Germany.²⁹ To achieve the target of 15 million, an average of around 132,000 cars per month must be added until 2030 (Figure 3). In a 12 month trend, only around 28,000 electric cars per month have been added, which was partly due to problems in supply chains and long delivery times for electric cars. Thus, growth must quintuple. The depicted linear trend is purely for illustrative purposes; in reality, an s-curve expansion path can be expected.³⁰ One concrete measure to increase the battery electric car fleet, in addition to the purchase premiums currently granted,³¹ would be to ban new registrations of combustion engine vehicles, as is currently being discussed for 2035 at the EU level.

Charging infrastructure requires extensive expansion

In its coalition agreement, the traffic light coalition set a target of “one million public and accessible charging points by 2030 with a focus on fast charging infrastructure.” By November 2021, there were nearly 54,000 charging points



in operation, 46,000 of which were normal charging points and 8,000 of which were fast charging points (Figure 4). On average, around 8,700 new charging points must be added every month until 2030. Over the past 12 months, only 1,200 have been added monthly; thus, the expansion must increase sevenfold.

Based on the vehicle stock and charging infrastructure targets for 2030, there would be 15 battery electric vehicles per public charging point in 2030. Currently, nearly 12 electric cars share one public charging point. When only considering the fast charging infrastructure, there are currently about 80 electric battery vehicles per fast charging point.³²

Water electrolysis: from almost zero to ten GW by 2030

An “electrolysis capacity of around 10 GW in 2030” is listed as a target in the coalition agreement. As of October 2021, there were electrolyzers with only 61 megawatts (MW) capacity in operation in Germany (Figure 5). Consistent and more recent data are currently unavailable. Thus, around 90 MW on average per month must be built until the end of 2030.

²⁵ BMWK and AGEE-Stat, *Zeitreihen zur Entwicklung der erneuerbaren Energien in Deutschland* (February 2022) (in German; available online).

²⁶ Cf. draft wording, amendment to the Buildings Energy Act (2022) (in German; available online).

²⁷ The traffic light coalition is also planning a significant increase in the electrification of the railway network. Cf. the supplementary graph in the Open Energy Tracker (available online).

²⁸ Wolf-Peter Schill und Martin Kittel, “Grüner Wasserstoff in der Energiewende: Fokussierter Einsatz unverzichtbar,” Heise online, September 17, 2021 (in German; available online).

²⁹ Supplementary data on the shares of electric vehicles of monthly new registrations is available on the Open Energy Tracker (available online).

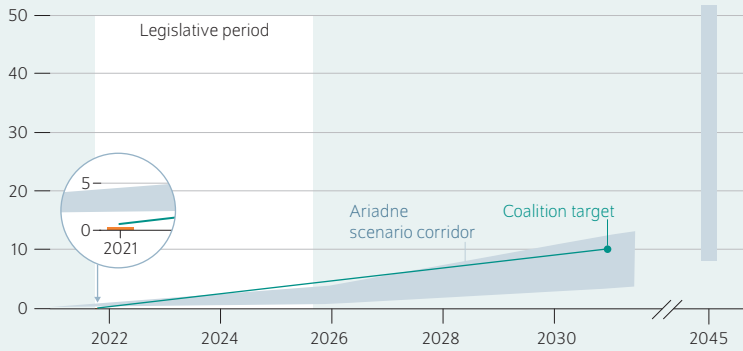
³⁰ Such a trend is also shown in the BMWK’s *Eröffnungsbilanz Klimaschutz* with regard to new registrations. Public data on stock scenarios that achieve the 2030 target are not available.

³¹ Vgl. Peter Haan, Adrián Santonja di Fonzo, and Aleksandar Zaklan, “Kaufprämien für Elektro-Pkw verändern Zusammensetzung des deutschen Automarkts,” *DIW Wochenbericht*, no. 15/16: 231–238 (in German; available online).

³² A supplementary figure is available in the Open Energy Tracker (available online).

Figure 5

Installed electrolysis capacity
In gigawatts



Note: Data as of October 2021. Annual trend interpolated linearly.

Sources: Coalition agreement, International Energy Agency, Ariadne, authors' calculations.

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When the traffic light coalition took power in December 2021, only a very small electrolysis capacity was available in Germany.

As in the case of battery electric vehicles, the depicted linear trend is purely illustrative. In reality, an s-curve expansion path can be expected. The 2030 target is in the upper corridor of the Ariadne scenarios. The German government has not yet set concrete targets for the years after 2030. The Ariadne scenario corridor remains very wide in 2045 due to the existing uncertainty on the long-term role of domestic hydrogen electrolysis.

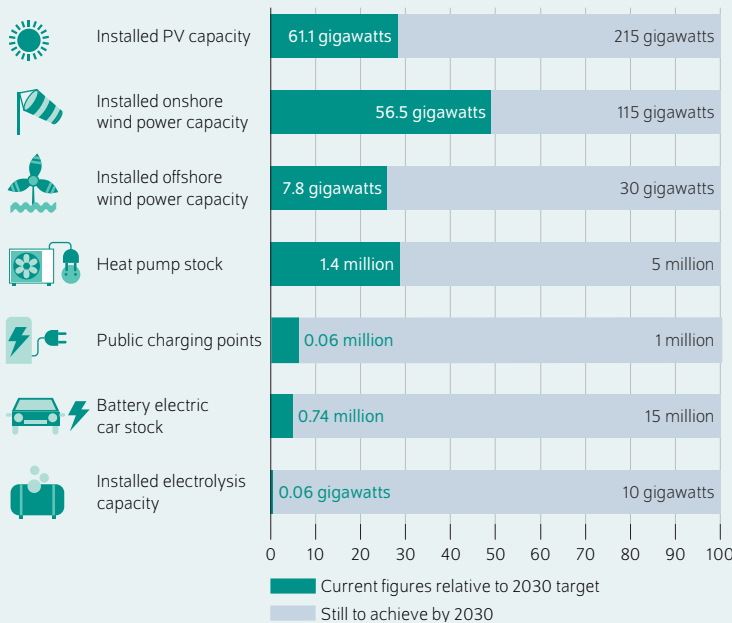
Which areas require a lot of action in particular?

The *Ampel-Monitor Energiewende* shows that there is a large gap between the current state and the government targets for 2030 in all indicators observed. The gaps in electromobility and green hydrogen are the largest, followed by the capacity expansion of offshore wind power, PV, and heat pumps (Figure 6).

In addition, there are differences in current expansion paces described above. Comparing the expansion pace of the past 12 months with what is necessary to achieve the 2030 targets shows that both onshore and offshore wind power lag substantially behind photovoltaics (Infographic on first page), which indicates a particularly urgent need for action on wind power.

Figure 6

Comparison of current status with 2030 targets for various indicators
In percent



Note: Data for photovoltaics and wind power is from April 2022; for heat pumps, end of 2021; for electromobility, May 2022; and for electrolysis, October 2021.

Sources: Coalition agreement, EEG 2023 draft, AGEE-State, Eröffnungsbilanz Klimaschutz, EurObserv'ER, BWP, KBA, Bundesnetzagentur, International Energy Agency, authors' calculations.

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Current green hydrogen and electromobility capacities have a particularly long way to go.

Conclusion: Ampel-Monitor Energiewende contributing to a fact-based energy policy debate

By providing up-to-date, open energy data and comparing it with the German government's targets, the regularly updated *Ampel-Monitor Energiewende* contributes to an informed, fact-based energy policy debate. Individual indicators, such as the monthly expansion pace of renewable energy infrastructure or the growth of the battery electric vehicle fleet, could also be used as leading indicators of the success of climate policies, as they are available much more promptly than emissions data.³³

Since most of the government targets considered are within or even above the corridor of the Ariadne scenarios, these targets should, in principle, be compatible with pathways to climate neutrality in 2045 based on current knowledge. The extent to which this also applies to climate neutrality scenarios that, for example, provide even greater detail on sector coupling or reflect the upheavals in the energy markets currently caused by Russia's attack on Ukraine, remains the subject of research and is being further investigated within the Ariadne project, among others.

Based on the developments in recent years, it should not be assumed the coalition targets will be easily reached. Development must increase significantly in all areas to achieve the 2030 targets; this applies especially to the share of renewable energy in the heating sector, the growth of the

³³ Cf. Daniela Fietze, Mats Kröger, Thorsten Müller, and Karsten Neuhoff, "An Effective Federal Climate Change Act Needs Leading Indicators," *DIW Weekly Report*, no. 43 (2021): 327–335 (available online).

electric battery vehicle fleet and its corresponding charging infrastructure, and the increase in electrolysis capacity. Here, the gap between the current state and the targets is particularly large. In addition, the pace of both offshore and onshore wind power expansion has recently lagged considerably behind what would be required.

Accordingly, concrete and comprehensive measures are needed very promptly, especially to achieve the 2030 targets. Various relevant legislation is currently on the table. The measures must also be effective in the longer term, as significant expansion is necessary in all areas even after 2030 to achieve climate neutrality in 2045.

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LEGAL AND EDITORIAL DETAILS



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