

DIW Weekly Report

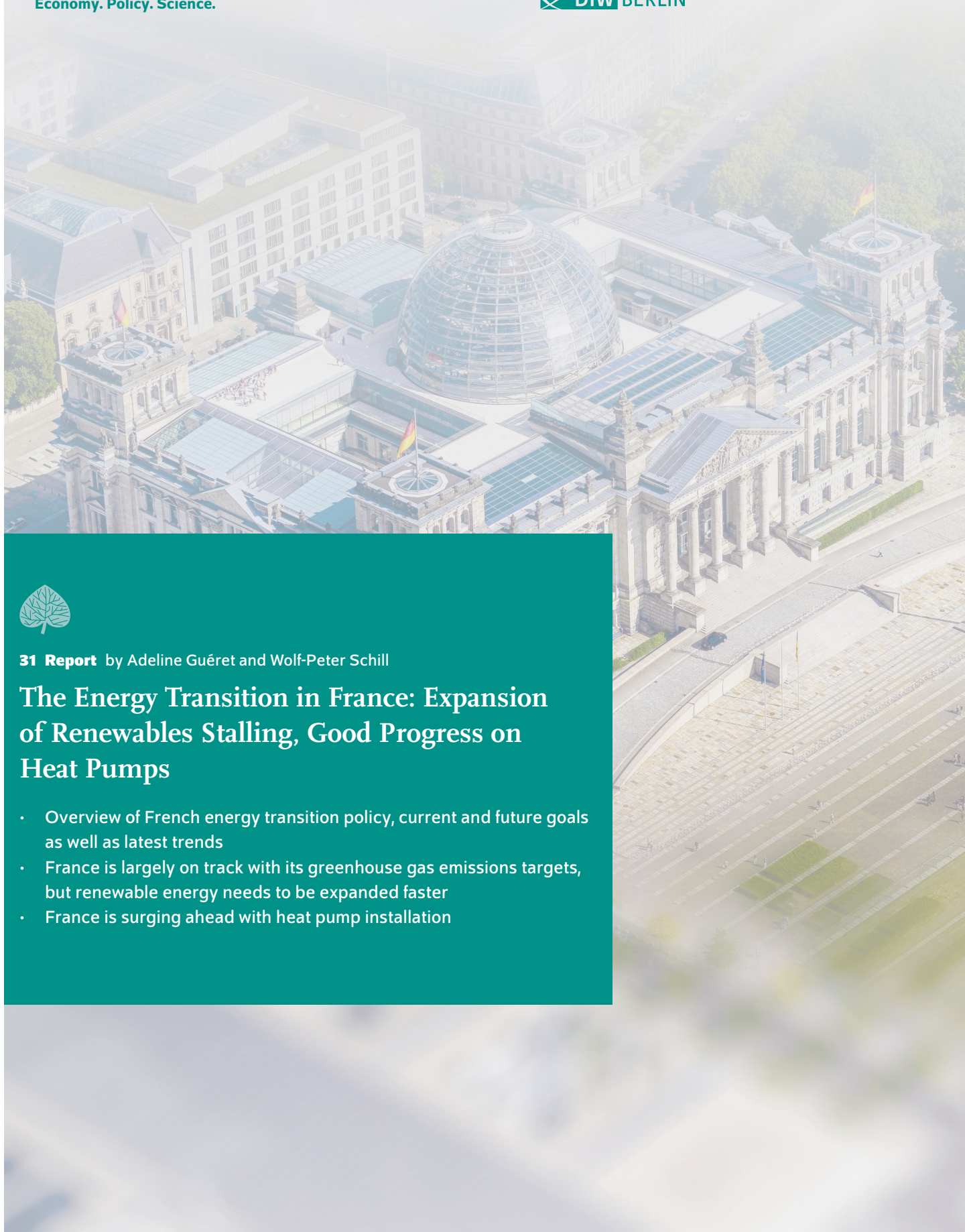
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31 Report by Adeline Guéret and Wolf-Peter Schill

The Energy Transition in France: Expansion of Renewables Stalling, Good Progress on Heat Pumps

- Overview of French energy transition policy, current and future goals as well as latest trends
- France is largely on track with its greenhouse gas emissions targets, but renewable energy needs to be expanded faster
- France is surging ahead with heat pump installation

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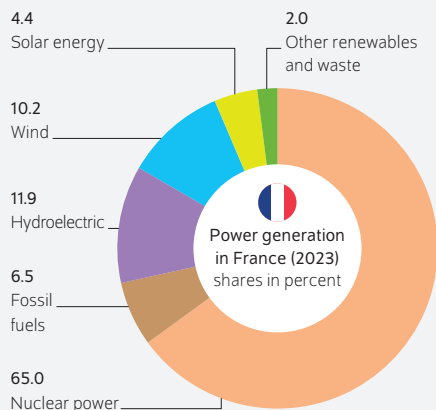
AT A GLANCE

The Energy Transition in France: Expansion of Renewables Stalling, Good Progress on Heat Pumps

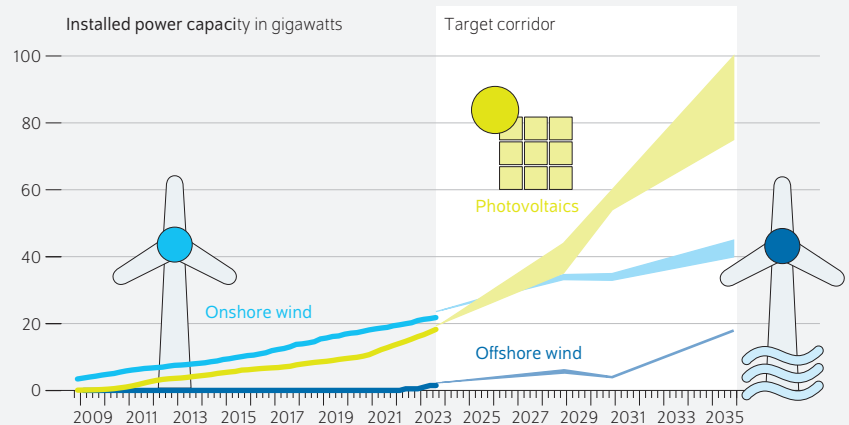
By Adeline Guéret and Wolf-Peter Schill

- Overview of French energy transition policy, current and future goals as well as latest trends
- France is largely on track with its greenhouse gas emissions targets, but renewable energy needs to be expanded faster
- France is surging ahead with heat pump installation
- Stark differences between Germany and France on energy transition in the power sector
- Similar challenges for both countries on heating and transport

France relies heavily on nuclear power, needs to expand renewable energy capacities faster to achieve its targets



Source: own diagram based on Réseau de Transport d'Électricité.



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FROM THE AUTHORS

“The results of the energy transition in France have been mixed so far. Even though France is relying on nuclear power, both now and in the future, it still needs to expand renewable energy capacities faster in order to achieve its climate goals.”

— Adeline Guéret —

MEDIA



Audio Interview with Adeline Guéret (in German)
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The Energy Transition in France: Expansion of Renewables Stalling, Good Progress on Heat Pumps

By Adeline Guéret and Wolf-Peter Schill

ABSTRACT

The energy transition is a major challenge for both Germany and France. This Weekly Report provides an overview of the short- and long-term goals as well as current developments and trends in France's energy and climate policy. It reveals that France is largely on track with its greenhouse gases targets and is also making good progress on installing heat pumps. However, its expansion of renewable energy capacities is falling short. Differences in the energy policies of France and Germany are most apparent in the power sector: While France is prioritizing nuclear power, Germany is relying heavily on renewable energy. For France to achieve its climate goals, it will have to expand renewable energy faster. One challenge faced by both countries is their planned electrification of mobility and space heating.

France's energy policy is currently undergoing an update process. A new climate bill for the next five years is to be adopted in the coming months. A strategy paper, relevant for future planning in the energy sector, was published at the end of November 2023 and opened to public consultation (Box). This Weekly Report outlines the energy policy goals and measures of the French government and compares them with progress made so far using selected indicators. It also highlights the individual similarities and differences with the energy transition in Germany.¹

Mixed results for overarching goals so far

As with Germany, France's energy and climate policy goals are geared to European requirements. Implementation of the European Fit for 55 package² is particularly important here. It includes more ambitious targets for reducing greenhouse gas emissions and increasing the share of renewable energy in Europe.³

Greenhouse gas emissions targets are currently being mostly met

At the European level, the goal is to make the EU climate neutral by 2050. In addition, according to the latest revised targets, net greenhouse gas emissions⁴ must now be reduced to 55 percent of 1990 levels by 2030.⁵ In France, the goal of becoming climate neutral by 2050 has been enshrined in

¹ On the German energy transition, see Wolf-Peter Schill, Alexander Roth, and Adeline Guéret, "Ampel-Monitor Energiewende shows the pace of the energy transition must be accelerated significantly," *DIW Weekly Report*, no. 27 (2022): 371–379 (available online; accessed on January 8, 2024). This applies to all other online sources in this report unless stated otherwise; up-to-date figures and diagrams are available on the *Ampel-Monitor Energiewende* website at any time (in German; available online).

² European Commission, "Fit for 55: Delivering on the proposals," (2023) (available online).

³ The following charts and further analyses, including those relating to energy efficiency targets and other aspects, such as green hydrogen, are provided in the Open Energy Tracker (available online). Parts of the Open Energy Tracker and this Weekly Report were developed as part of the research projects "Ariadne" 1&2 (03SFKSN0 & 03SFKSN0-2) and "Distribution effects and incentive effects of coordinated climate and social policy" (FIS. 03.00016.21).

⁴ Including carbon sinks, i.e., after taking land use, land-use change, and forestry into account.

⁵ European Commission, *Stepping up Europe's 2030 climate ambition* (2020) (available online).

Box

Legislative framework for the energy transition in France

A cornerstone of the legislative framework for the energy transition in France is the act on the energy transition for green growth (*Loi relative à la transition énergétique pour la croissance verte*)¹ from August 17, 2015. This law was passed in the run-up to the UN Climate Change Conference (COP21) that took place in Paris in December 2015. This act made it mandatory among other things, for the French government to develop a national decarbonization strategy (*Stratégie Nationale Bas Carbone*,² SNBC) for the first time as well as a multi-annual energy program (*Programmation Pluriannuelle de l'Énergie*,³ PPE). Both programs contain quantitative targets for a series of subsectors. They are intended to help France reduce its greenhouse gas emissions, become more energy efficient, and increase its share of renewable energy.

The decarbonization strategy (SNBC) sets out a long-term goal for greenhouse gas emissions and short-term emissions budgets for three successive five-year periods. These budgets set upper limits for total greenhouse gas emissions that may not be exceeded in the respective period. The strategy must be revised every five years, whereby one part of the upper limit set in the previous strategy must be amended and a new upper limit proposed for the next five-year period. The first SNBC set an emissions limit for the periods from 2015 to 2018,⁴ from 2019 to 2023, and from 2024 to 2028. The second SNBC revised the upper limit set for the period from 2019 to 2023 and from 2024 to 2028, and introduced a new upper limit for the period from 2029 to 2033. The third SNBC should currently be drafted by the government.

The multi-annual energy program (PPE) is based on a similar principle. It sets out plans for two five-year periods and is reviewed

every five years. It sets targets specifically for the energy sector, with a lower and an upper target value being defined in each case.

Some provisions of the act from 2015 were amended by the Energy and Climate Act⁵ of November 8, 2019.⁶ Since then, it has represented another cornerstone of France's energy and environmental policy. In particular, it led to the government being mandated to pass a law every five years (*Loi de programmation quinquennale sur l'économie et le climat*), which sets out in detail the targets and priorities of its energy and climate policy for the next five years. The first five-year law should have been adopted by July 1, 2023,⁷ but the government did not meet this deadline. The new French energy and climate strategy (SFEC)⁸ was published only on November 22, 2023. This strategy contains, among other things, quantitative targets that are likely to be included in the next multi-annual energy program (PPE3). At the end of December, the first draft version of the energy sovereignty act was published, which is intended to serve as the energy block of the previously mentioned first five-year law.⁹

After President Emmanuel Macron was re-elected in May 2022, two different ministries were responsible for energy and environmental issues: The Ministry for the Energy Transition and the Ministry of Ecological Transition and Territorial Cohesion. In addition, a General Secretariat for Ecological Planning was set up, which reports directly to the Prime Minister. After the government reshuffle on January 9, 2024, the Ministry for the Energy Transition was suppressed, and the energy portfolio was transferred to the Ministry of Economy and Finance.

¹ Légifrance, *Loi n° 2015-992 du 17 août 2015 relative à la transition énergétique pour la croissance verte*, 2022 (available online).

² Ministère de la Transition écologique et solidaire, *Stratégie Nationale Bas Carbone* (2020) (available online).

³ Ministère de la Transition écologique et solidaire, *Programmation Pluriannuelle de l'Énergie* (2020) (available online).

⁴ The first SNBC was revised from 2018 to 2019 due to the adoption of the Energy and Climate Act and the new climate neutrality target. As a result, the first budget only covers four years instead of five.

⁵ Légifrance, *Loi n° 2019-1147 du 8 novembre 2019 relative à l'énergie et au climat* (2019) (available online).

⁶ The objectives and provisions provided for in the various energy-related laws are summarised in the French Energy Code. If a law amends certain objectives that were provided for in a previous law, the corresponding article of the Energy Code is amended (available online).

⁷ Légifrance, *Article L100-1 A of the French Energy Code* (2023) (available online).

⁸ Ministère de la Transition Énergétique, *Stratégie Française pour l'Énergie et le Climat* (2023) (available online).

⁹ Thomas Chemel, "Comment l'avant-projet de loi de souveraineté énergétique décortique les objectifs climatiques," *Contexte*, January 4, 2024 (available online).

energy law code.⁶ In comparison, Germany intends to be climate neutral by as early as 2045. The new EU target for 2030 has not yet been implemented in France. For 2030, it still plans to cut gross emissions by 40 percent over 1990 levels. This target also forms the basis of the current emissions budget. For the period 2015 to 2018, the target was 442 million tons of CO₂ equivalent (MtCO₂-eq) per year. At an average of

456 million tons of CO₂ equivalent per year, this target was not met during the four years in question (Figure 1).⁷

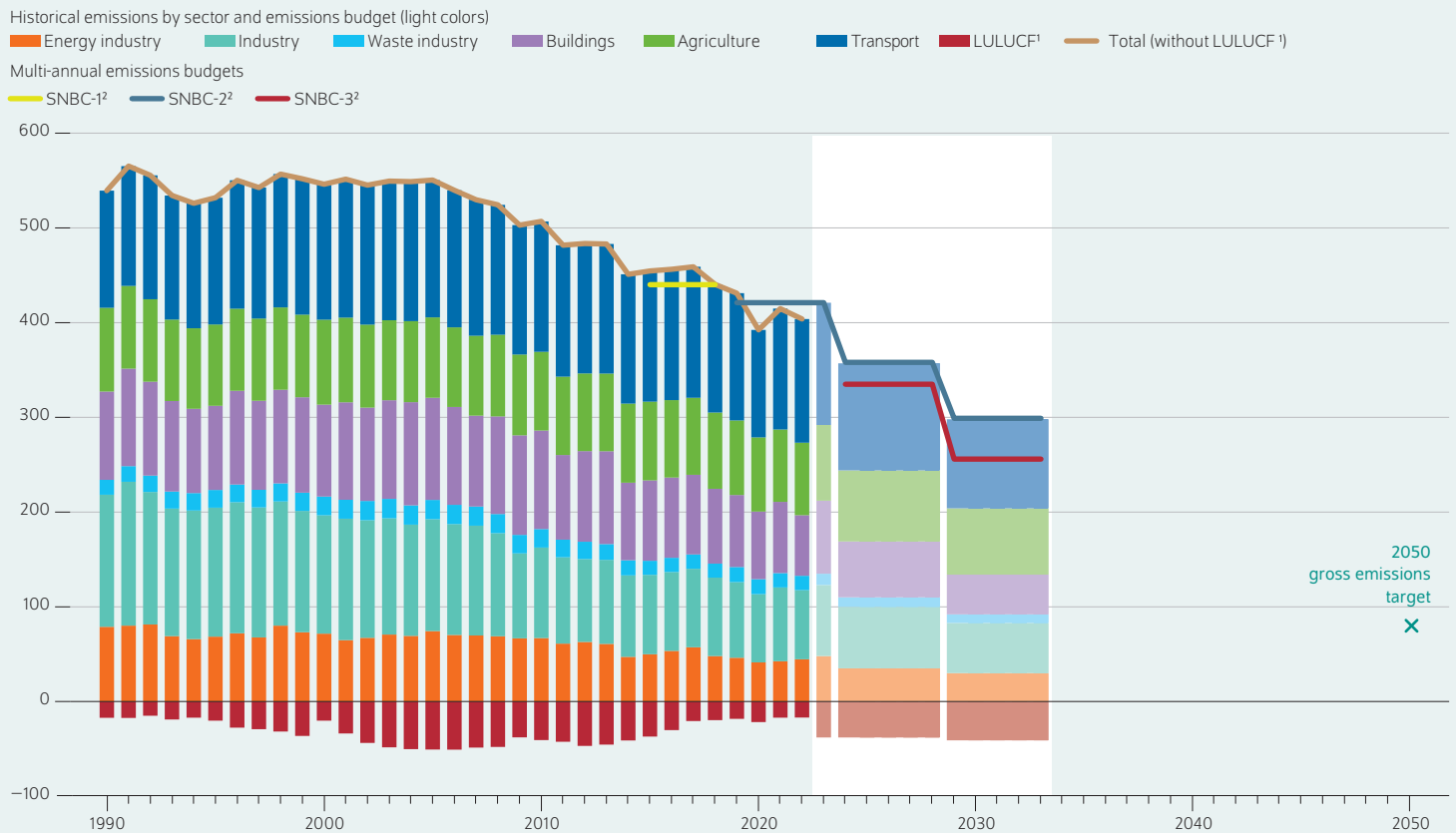
The second emissions budget, which relates to the five-year period from 2019 to 2023, sets an upper limit on gross greenhouse gas emissions of 421 million tons of CO₂ equivalent

⁶ Légifrance, *Article L100-4 of the French Energy Code* (2023) (available online).

⁷ Centre interprofessionnel technique d'études de la pollution atmosphérique (CITEPA), *Tableau de bord des engagements climat*, (2024) (available online). See also Haut Conseil pour le Climat (HCC), *Rapport annuel* (2023): 65 (available online).

Figure 1

France's greenhouse gas emissions and emissions budgets by sector

In millions of tons of CO₂ equivalent

1 LULUCF: Land use, land-use change, and forestry

2 SNBC: National decarbonization strategy

Source: CITEPA (Secten) (available online), PNEC2023 (available online), Ministère de la Transition Énergétique (available online). Here, the emissions budgets presented in the Integrated National Energy and Climate Plan are considered to be those of the SNBC-3.

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France sets its emissions reduction targets in five-year budgets.

per year.⁸ This corresponds to around 6.5 tons per person. This is considerably less than in Germany, whose emissions amounted to around nine tons per capita in 2022. Between 2020 and 2022, gross emissions in France remained below the emissions budget. However, these findings should be interpreted with caution since both the COVID-19 pandemic and the energy price crisis occurred in this period, which led to a significant reduction in energy consumption and therefore emissions. Furthermore, net greenhouse gas emissions in 2019 and 2021 were above the indicative yearly limits set. This is due to, among other things, the fact that the reduction in greenhouse gases from forestry was less than planned. Overall, net emissions in France were therefore slightly above the target in the period from 2015 to 2021 (more recent data is not yet available).⁹

⁸ Ministère de la Transition Énergétique, *Ajustement technique des budgets carbone* (2022) (available online).

⁹ Haut Conseil pour le Climat (HCC), *Rapport annuel* (2023): 65 (available online).

The decarbonization strategy (SNBC) also contains an estimate of emissions budgets by sector, which are consistent with the overall five-year budget. However, this breakdown is only indicative. One sector can emit more if this is offset by a greater reduction in emissions in another sector, as long as the overall budget is respected. In contrast, Germany has so far had targets for each sector. However, the current draft amendment to the Climate Protection Act will allow only one overall target to apply in future, similar to France.¹⁰

With around 129 million tons of CO₂ equivalent per year for the period from 2019 to 2023, the transport sector has the largest emissions budget. It is historically also the sector that has produced the most emissions. It is followed by the budget for agriculture (80 million tons CO₂ equivalent

¹⁰ German Bundestag, "Homepage on the amendment to the Climate Protection Act," (2023) (in German; available online).

per annum), buildings (77 million tons CO₂ equivalent) and industry (75 million tons CO₂ equivalent). The energy sector is the sector with the second-lowest emissions budget after waste.¹¹ The buildings and transport sectors will have to reduce their emissions the most: by around 45 and 30 percent respectively when comparing 2019 levels to the 2029–2033 period.

Sectoral emissions and sectoral targets in France differ greatly from those in Germany. In Germany, energy has traditionally accounted for the highest share of total emissions, which is primarily due to the high level of coal-fired power generation. It is followed by industry, as Germany has a particularly large amount of energy-intensive industry, and then by the transport and buildings sectors.

The implementation of new European targets for reducing net greenhouse gas emissions of at least 55 percent by 2030 will lead to a downward correction of France's emissions budgets for the years 2024 to 2028 and for 2029 to 2034. The Integrated National Energy and Climate Plan for France,¹² which was submitted to the European Commission for review in October 2023, sets out an average emissions budget for the period from 2024 to 2028 (2029 to 2034), which is six percent (14 percent) lower than in the current decarbonization strategy.

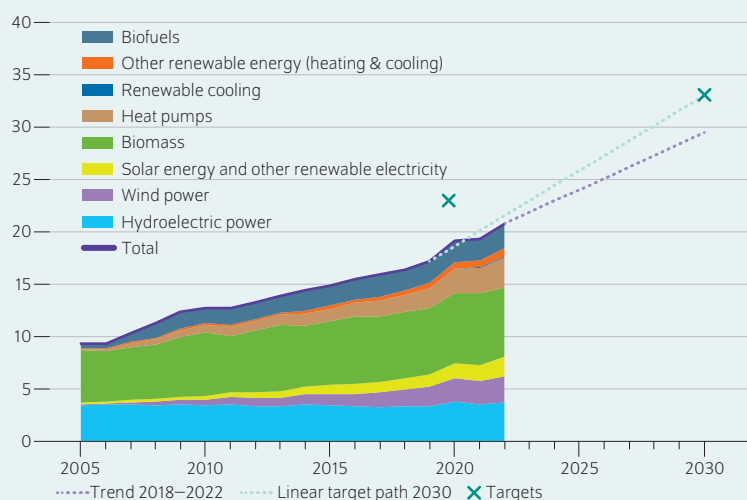
Renewable energy share too low

The European Renewable Energy Directive from 2009 contained binding targets for the share of renewable energy in gross final energy consumption for all Member States for the year 2020. The target for France was 23 percent, while for Germany it was 18 percent. However, France only achieved 19.2 percent and, as a result, was the only country in the EU to miss its target for 2020 (Figure 2).¹³

The most important renewable energy sources in France are renewable solid biomass and residential waste used for heat generation (32 percent of renewable gross final energy consumption in 2022), followed by hydroelectric power (18 percent). Heat pumps, wind power, and biofuels each account for around ten to 14 percent of gross final energy consumption from renewable energy sources.¹⁴ In Germany, biomass for heat generation has a similar share of energy supply from renewable energy sources as it does in France; in contrast, the

Figure 2

Share of renewable energy in gross final energy consumption in France In percent



Source: Ministère de la Transition Écologique et de la Cohésion des Territoires (available online); French Energy Code (available online); authors' calculations.

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The share of renewable energy in gross final energy consumption falls short of the targets.

share of wind and solar energy in Germany is much higher and the share of hydroelectric power is significantly lower.¹⁵

To implement current EU requirements, the French Energy and Climate Act of 2019 sets a target of at least 33 percent of renewable energy in gross final energy consumption by 2030.¹⁶ In 2022, this share was 20.7 percent;¹⁷ in Germany it was 20.8 percent. After the EU target was increased from 32 to 42.5 or even 45 percent,¹⁸ France is also expected to adjust its targets for 2030 accordingly. However, its recently submitted plan contains no adjustment of its targets so far. Instead, it sets a target for the share of carbon-free energy sources, which include nuclear power as well as renewable energy.¹⁹

Reducing fossil fuel consumption

In contrast to Germany, France has set explicit targets for reducing the consumption of primary fossil fuels. By 2030, it aims to have reduced its consumption by 40 percent over 2012 levels. This will require a considerable reduction in current consumption trends.²⁰

¹¹ Ministère de la Transition Énergétique, *Ajustement technique des budgets carbone* (2022) (available online).

¹² European Commission, *France – Draft Updated NECP 2021–2030* (2023) (available online).

¹³ Ministère de la Transition Écologique et de la Cohésion des Territoires, Service des données et études statistiques, "Les énergies renouvelables en France en 2022 – Suivi de la directive (UE) 2018/2001 relative à la promotion de l'utilisation des énergies renouvelables," (2023) (available online); and European Commission, "Assessment of the draft updated National Energy and Climate Plan of France," 3 (2023) (available online).

¹⁴ Ministère de la Transition Écologique et de la Cohésion des Territoires, Service des données et études statistiques, "Les énergies renouvelables en France en 2022 – Suivi de la directive (UE) 2018/2001 relative à la promotion de l'utilisation des énergies renouvelables," (2023) (available online).

¹⁵ Umweltbundesamt, "Erneuerbare Energien in Zahlen," (2023) (in German; available online).

¹⁶ *Légifrance*, Article L100-4 of the French Energy Code (available online).

¹⁷ The data for 2022 are preliminary. In 2021, the share was 19.4 percent.

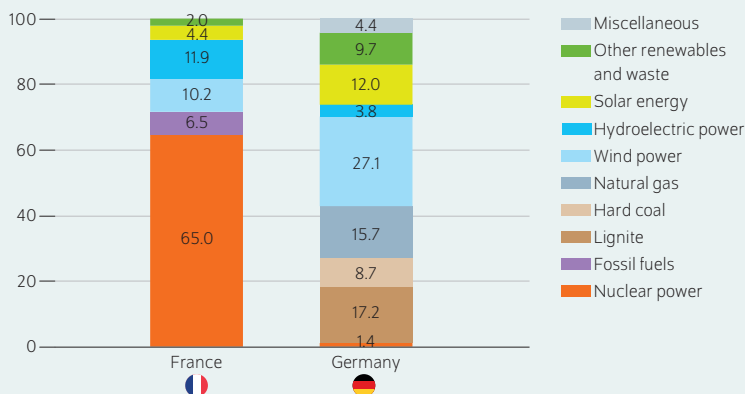
¹⁸ EU Directive 2023/2413, October 2023.

¹⁹ Paul Messad, "France sticks to its guns, refuses to table 2030 renewable energy target," *Euractiv*, December 19, 2023 (available online).

²⁰ Open Energy Tracker (available online).

Figure 3

Power generation in France and Germany in 2023 In percent



Note: Natural gas, hard coal, and lignite are fossil fuels; the data for France does not differentiate between them. For Germany, gross electricity generation is shown without pumped storage. The data for both countries are preliminary.

Source: RTE (available online); AGEF (available online).

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In France, nuclear power plants generated around two thirds of electricity; in Germany renewable energy generated a good half.

Targets in the power sector

In 2023, nuclear power generated around 65 percent of France's electricity, followed by hydropower with 12 percent (Figure 3). Wind power and solar energy recently grew to ten and four percent of power generation, respectively. The total share of renewable energy in overall power generation was 18 percent. Coal- and gas-fired power plants continued on a downward trend and accounted for just under seven percent of power generation in 2023 (compared to ten percent in 2007).²¹ In 2023, only just over one percent of electricity generation in Germany came from nuclear power plants, while over half came from renewable energy sources. Coal- and gas-fired power plants together accounted for just under 42 percent.²²

Annual power generation in France (527 to 550 terawatt hours (TWh) in the period from 2000 to 2021) is usually well above annual consumption (425 to 499 TWh),²³ which makes it a net exporter of electricity.²⁴ The only exception was in 2022 when France became a net importer due to a temporary outage of a large portion of its nuclear power plants. Due to its high share of nuclear power, France's carbon intensity of the power mix is relatively small. Generated electricity emitted less than 50 grams of CO₂ per kilowatt hour. In Germany,

the figure in 2022 was more than six times higher due to the high level of coal-fired power generation.²⁵

In the French electricity sector, the current goal is to achieve a 40-percent share of renewable energy in electricity generation by no later than 2030. This share has risen steadily since 2015, from just under 19 percent in 2015 to 28 percent in 2022.²⁶ However, the trend for the years from 2020 to 2022 should be interpreted with caution, as 2022 was in many respects an exceptional year for the French electricity system because generation from nuclear and hydroelectric power plants was historically low. In Germany, the targets for renewable energy are significantly higher. The aim is to achieve a share of at least 80 percent of renewable energy in gross electricity consumption by 2030.

Growth in photovoltaics

For the photovoltaics sector, France's multi-annual energy program (PPE) sets a target of 20.1 gigawatts (GW) of installed capacity for 2023 and between 35.1 and 44 GW for 2028. By the end of September 2023, there were 18.3 GW of installed capacity, and no new data has been available since. This means that 1.8 GW would have to have been added between September and December 2023 for this target to have been achieved, which is the equivalent of more than what has been installed in the first three quarters of 2023. It can be assumed that this target will not be achieved. Nevertheless, expansion of the photovoltaics industry since the beginning of 2021 has accelerated significantly and the trend over the past 12 months is significantly above that of the past five years (Figure 4). The first draft of the third multi-annual energy program contains even higher targets of 54 to 60 GW in 2030 and 75 to 100 GW in 2035.

In comparison, Germany has an installed capacity of over 80 GW from photovoltaics. It plans to increase this figure to 215 GW by 2030 and to 309 GW by 2035. Relative to current population, the targets for 2035 in France correspond to around 1.1 to 1.5 kilowatt (kW) per capita. At around 3.7 kW per person, Germany's target for 2035 is around three times higher.

Slow expansion of onshore wind power

For onshore wind power plants, the current plans sets capacity targets of 24.1 GW for 2023 and 33.2 to 34.7 GW by 2028. At the end of September 2023, installed capacity amounted to 21.9 GW and was therefore 2.2 GW below the target that should have been achieved three months later. As a result, the target is likely to be missed. In contrast to photovoltaics, growth in onshore wind energy has not accelerated recently,

²¹ RTE, "Generation," (2024) (available online). Data for 2023 are preliminary.

²² AGEF, *Bruttostromerzeugung in Deutschland nach Energieträgern* (2023) (in German, available online).

²³ RTE, "Consumption," (2024) (available online).

²⁴ RTE, "Markets," (2024) (available online).

²⁵ RTE, "Annual Electricity Review 2022," (2024) (available online); cf. also Umweltbundesamt, *Entwicklung der spezifischen Treibhausgas-Emissionen des deutschen Strommix in den Jahren 1990–2022*, (2023) (in German, available online).

²⁶ Ministère de la Transition Écologique et de la Cohésion des Territoires, Service des données et études statistiques, "Chiffres des énergies renouvelables – Edition 2023," (2023) (available online).

as the trend over the past twelve months is roughly the same as the trend over the past five years. It is therefore essential to speed up the pace of expansion to achieve targets for 2028. This applies all the more if the increased targets from 33 to 35 GW of installed capacity by 2030 (and 40 to 45 GW by 2035) set out in the latest French energy and climate strategy (SFEC) are to be achieved.

In comparison, Germany currently has an installed capacity of around 61 GW from onshore wind power. This figure should rise to 115 GW by 2030 and to 157 GW by 2035. The French target for 2035 corresponds to around 0.6 to 0.7 kW per capita; Germany's target is around 1.9 kW per capita.

France's foray into offshore wind power

The expansion of offshore wind power in France began in the second quarter of 2022 with the commissioning of its first offshore wind farm off the coast of Saint-Nazaire with a capacity of 480 MW. Two further farms were connected to the grid by the end of 2023, increasing installed capacity to around 1.5 GW. However, this development will not be sufficient to achieve the target of 2.4 GW of installed capacity set for 2023. Hence, France first needs to make up a shortfall of around one GW; it must then install a further 2.8 GW within five years in order to achieve the lower target of 5.2 GW by 2028. To reach the upper target of 6.2 GW, around three times as much capacity as what has been installed to date would need to be added by the end of 2028. The new target recently proposed for 2030 of four GW is actually slightly below the lower target of the current multi-annual program plan; however, it is aiming to achieve much stronger growth up to 18 GW by 2035.

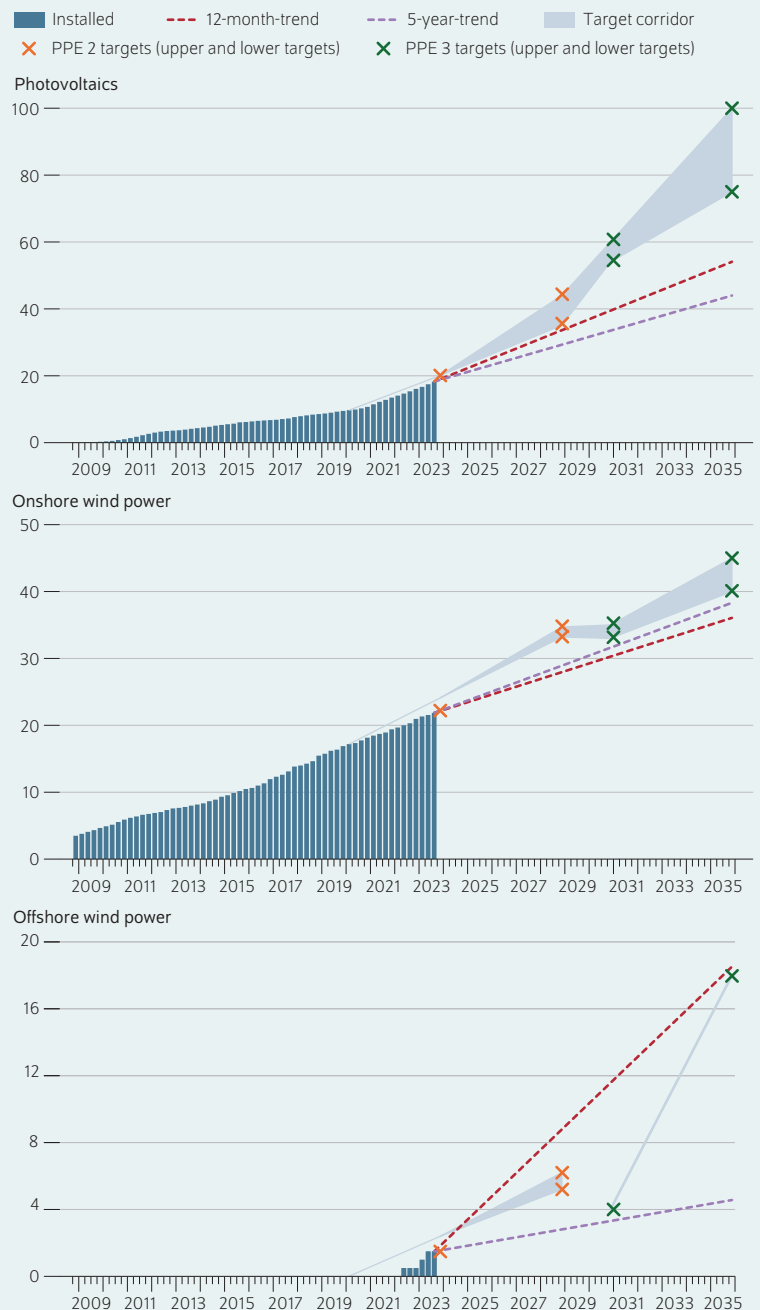
In comparison, Germany currently has an installed capacity of a good eight GW from offshore wind power. The plan is to reach 30 GW by 2030 and 40 GW just five years after that. In terms of targets per capita, France's new goal for 2035 is equivalent to 0.3 kW per capita, while in Germany this figure is nearly 0.5 kW.

Changing course on nuclear power

The 2015 legislation set a target for reducing the nuclear power share in total electricity generation for the first time. It was to be gradually reduced from 76 percent in 2015 to 50 percent by 2025. This target was then amended by the Energy and Climate Act of 2019, which pushed the target year back to 2035. In the end, this target was abandoned completely.²⁷ The upper limit of 63.2 GW for total nuclear power generation capacity was also abandoned. This legislative amendment reflects the vision of French President Emmanuel Macron and his government of an energy transition²⁸ in

Figure 4

Installed renewable energy capacity in France In gigawatts



Note: PPE2: second multi-annual energy program. PPE3: Here, the targets set out in the SFEC of November 2023 are considered to be those of PPE3. Quarterly figures are shown; no data is yet available for the last quarter of 2023.

Source: Ministère de la Transition Écologie et de la Cohésion des Territoires (available online); Ministère de la Transition Écologie et de la Cohésion des Territoires (available online); Ministère de la Transition Énergétique (available online); authors' calculations.

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The speed at which renewables are being expanded needs to increase significantly for France to meet its targets.

²⁷ Légifrance, "Loi n°2023-491 du 22 juin 2023 relative à l'accélération des procédures liées à la construction de nouvelles installations nucléaires à proximité de sites nucléaires existants et au fonctionnement des installations existantes," (2023) (available online).

²⁸ Emmanuel Macron outlined this vision, in particular, in his speech in Belfort on February 10, 2022 (available online).

which nuclear power is the cornerstone, which includes both extending the lifetime of existing reactors and constructing new reactors. In contrast, Germany completely phased out nuclear power in April 2023.

Transport sector: different trends in biofuels and electromobility

Due to the transport sector's high share in total GHG emissions, measures in this area are key to France's climate policy. Passenger vehicles, which account for more than half of greenhouse gas emissions in this sector, are particularly important.²⁹

In France there are around 39 million passenger vehicles³⁰ compared to around 49 million in Germany. The per capita figure is almost the same for both countries, with around 590 cars for France and 580 cars for Germany per 1,000 inhabitants.

Stagnation in biofuels

France aims to achieve a 15-percent share of renewable energy in transport fuel consumption by no later than 2030. In 2022, it achieved a share of nearly nine percent.³¹ Biodiesel made up around 72 percent of that figure followed by bioethanol with 27 percent.³² Compared along a linear target path between 2015 and 2030, the share recently achieved was 2.5 percentage points too low.³³ In addition, the trend in recent years has been stagnant or even downward. The use of biofuels has also been stagnating for years in Germany. Instead, both countries intend to rely heavily on electromobility in the future.

Electromobility: modest targets achieved

The multi-annual energy program also includes specific targets for the number of all-electric vehicles and plug-in hybrid passenger cars as well as for the number of publicly accessible charging points between 2023 and 2028. The plan is to have 660,000 all-electric vehicles and 500,000 plug-in hybrid passenger cars by the end of 2030;³⁴ these numbers are supposed to grow to three million vehicles and 1.8 million passenger vehicles, respectively, by 2028. The total number of all-electric vehicles exceeded one million at the end of

2023, so France has achieved this target by far.³⁵ With around 575,000 vehicles, the target for plug-in hybrids has also been comfortably achieved.³⁶

There are various support measures available to achieve these goals. One of these measures was the "ecological bonus" for purchasing a new or used electric vehicle (up to 7,000 euros) and a "conversion bonus" for purchasing a low emission vehicle if a less environmentally friendly vehicle is taken out of service (up to 6,000 euros).³⁷ In addition, a tax must be paid when a vehicle is first registered if the vehicle is classified as environmentally harmful (known as the "ecological penalty").³⁸ The level of the tax depends on how environmentally harmful the purchased vehicle is. Since January 2024, there has also been a social leasing offer for households under a certain income threshold and who have a sufficiently long commute. It allows them to lease an electric vehicle for 100 euros per month.³⁹

Germany has a target of 15 million all-electric battery powered passenger vehicles by 2030. Currently, there are only 1.4 million such vehicles on the road in Germany. Using a logistic progression path, indicative intermediary targets for 2023 and 2028 are around 1.8 million and then 10.1 million electric cars, respectively. These targets are significantly higher than those in France, but the actual growth in numbers is currently lagging behind the target path.⁴⁰ In terms of current passenger vehicle numbers, the French target for 2028 corresponds to a share of just under eight percent for all-electric vehicles. In Germany, the derived target for 2028 produces a corresponding share of just under 21 percent, and the 15 million electric cars envisaged by 2030 correspond to a share of just under 31 percent.

The target for publicly accessible charging points was set at 100,000 by 2023⁴¹ and 400,000 by 2030 (including 50,000 fast-charging points).⁴² This target for 2023 was already achieved in May of 2023. By the end of 2023, there were already 118,000 publicly accessible charging points in France, of which around 20,000 were fast-charging points with an power rating of more than 22 kW.⁴³

²⁹ Ministère de la Transition Écologique et de la Cohésion des Territoires, Service des données et études statistiques, "Chiffres clés des transports – Édition 2023," (2023) (available online).

³⁰ The most recent data are from January 1, 2023 (available online).

³¹ Ministère de la Transition Écologique et de la Cohésion des Territoires, Service des données et études statistiques 1, "Chiffres clés des transports – Édition 2023," (2023) (available online). More recent data are not yet available.

³² Ministère de la Transition Écologique et de la Cohésion des Territoires, Service des données et études statistiques, "Les énergies renouvelables en France en 2022 – Suivi de la directive (UE) 2018/2001 relative à la promotion de l'utilisation des énergies renouvelables," (2023) (available online).

³³ The corresponding visualization can be found on the Open Energy Tracker (available online).

³⁴ Légifrance, "Décret n° 2020-456 du 21 avril 2020 relatif à la programmation pluriannuelle de l'énergie," (2020) (available online).

³⁵ Avère France, "[Baromètre] Décembre 2023: le cap du millionième véhicule électrique est franchi!" (2024) (available online).

³⁶ This figure may also include plug-in hybrids that are not passenger vehicles.

³⁷ Ministère de la Transition Énergétique, "Prime à la conversion des véhicules et Bonus écologique 2023," (2024) (available online).

³⁸ Passenger vehicles with CO₂ emissions of more than 117 grammes per kilometre (available online).

³⁹ Ministère de la Transition Énergétique, "Prime à la conversion des véhicules et Bonus écologique 2023," (2024) (available online).

⁴⁰ Cf. Wolf-Peter Schill et al., "Mixed Mid-Term Review for German Traffic Light Coalition in the Energy Transition; Significant Effort Needed to Achieve Targets," *DIW focus*, no. 10 (2023) (available online).

⁴¹ Légifrance, "Décret no 2020-456 du 21 avril 2020 relatif à la programmation pluriannuelle de l'énergie," (2020) (available online).

⁴² Gouvernement français, *Dossier de presse (27.10.2023) – Déploiement des bornes de recharge, En route pour 2030!* (2023) (available online).

⁴³ Avère France, "[Baromètre] 118 009 points de recharge ouverts au public fin décembre 2023," (2024) (available online).

Germany plans to have one million publicly accessible charging points by 2030. According to the most recently available data, it has nearly 100,000 charging points.⁴⁴ That is fewer than in France, despite it having a larger number of electric cars on the road.

Buildings: high energy consumption, but comparatively low emissions

Buildings in France are responsible for almost half of final energy consumption,⁴⁵ almost two thirds of which is from residential buildings. However, the buildings sector only accounted for around 18 percent of greenhouse gas emissions in 2021 due to a high proportion of electric heating.⁴⁶ In 2021, more than a third of main residential buildings that year used electricity as their main source of energy for heating (including just under eight percent with heat pumps).⁴⁷ In Germany, space heating accounts for a slightly smaller share of final energy consumption than in France, at just under one third.⁴⁸ However, in 2022, heat pumps and storage heaters accounted for a significantly lower share of all domestic heating systems in Germany at just under six and two percent respectively.⁴⁹

France's strategy for reducing emissions in the buildings sector is based on further electrifying its heating systems and banning technologies with high emissions. In addition, energy consumption is to be reduced through improved building insulation. Since January 2023, new rental contracts for apartments in existing buildings can only be concluded if they meet a certain energy efficiency level.⁵⁰ Furthermore, the installation of heating systems that emit more than 300 grams of CO₂ equivalent per kilowatt hour has been prohibited since July 1, 2022, which means a de facto ban on the installation of new oil-fired boilers.⁵¹ Besides, the installation of natural gas heating systems in new single-family homes has been prohibited since 2022. They will also be banned in new apartment buildings from 2025. France was considering reducing the emissions ceiling from 300 to 150 grams of CO₂ equivalent per kilowatt hour. This would have resulted

in a ban on the installation of new gas boilers.⁵² However, the idea was abandoned in summer 2023.

Germany's coalition government (SPD/FDP/Greens) had originally set out plans in its coalition agreement that, from 2025, it would only allow new heating systems that are powered by at least 65 percent renewable energy. This start date was to be brought forward by one year, but after lengthy discussions relating to the Buildings Energy Act, it is now being postponed. Gas or oil heating systems may now continue to be installed in existing buildings until a heating plan is available in the respective municipality, which may take until June 2028 depending on the municipality.⁵³

Strong growth of renewable energy in the heating sector

By 2030, France aims to achieve a 38 percent share of renewable energy in gross final energy consumption for heating and cooling. In 2022, that share was 27.2 percent. The largest contribution was made by heating with wood in households (40 percent of energy consumption for heating and cooling from renewable energy sources), followed by heat pumps (27 percent), and biomass excluding wood (23 percent).⁵⁴ The share achieved was therefore slightly below the figure expected from a linear target path between 2015 and 2030.⁵⁵ However, the recent trend has been dynamic with the share of renewable energy rising from 21.4 percent in 2018 to 27.2 percent in 2022. If France can keep this pace up until 2030, it will achieve its target of 38 percent for that year. The increase was largely due to the expansion of heat pump installation, which progressed much faster in France than in Germany. One reason for the lower uptake of heat pumps in Germany is likely its higher household electricity prices. Furthermore, natural gas was long regarded as a "bridge fuel" in Germany, and the installation of new natural gas heating systems was even subsidized there until recently. In France, heat pumps have been subsidized for some time now.

The multi-annual energy program sets out specific goals for annual heat generation from heat pumps. The target for 2023 is just under 40 TWh per year, of which 35 TWh is to be provided by air-source heat pumps and just under five TWh by geothermal heat pumps.⁵⁶ In 2022, total heat generation from heat pumps amounted to 42.7 TWh (weather-adjusted to 47.6 TWh), which is well above the target. The main reason for this development was the recent significant increase

⁴⁴ Bundesnetzagentur, "Elektromobilität: Öffentliche Ladeinfrastruktur," (2023) (in German; available online).

⁴⁵ Ministère de la Transition Écologique et de la Cohésion des Territoires, Service des données et études statistiques, "Chiffres clés de l'énergie – Edition 2023," (2023) (available online).

⁴⁶ Centre interprofessionnel technique d'études de la pollution atmosphérique (CITEPA), *Rapport Secten* (2023) (available online). Data for 2022 are preliminary and amount to 16 percent.

⁴⁷ Ministère de la Transition Écologique et de la Cohésion des Territoires, Service des données et études statistiques, "Tableau de suivi de la rénovation énergétique dans le secteur résidentiel," (2023) (available online).

⁴⁸ Umweltbundesamt, "Indikator: Energieverbrauch für Gebäude," (2023) (in German; available online).

⁴⁹ BDEW, "Wie heizt Deutschland 2023?" (2023) (available online).

⁵⁰ This refers to residential buildings with a final energy consumption for heating purposes of less than 450 kWh/m². Cf. Légifrance, "Décret n°2021-19 du 11 janvier 2021 relatif au critère de performance énergétique dans la définition du logement décent en France métropolitaine," (2021) (available online).

⁵¹ Légifrance, "Décret n°2022-8 du 5 janvier 2022 relatif au résultat minimal de performance environnementale concernant l'installation d'un équipement de chauffage ou de production d'eau chaude sanitaire dans un bâtiment," (2022) (available online).

⁵² Gouvernement français, *Dossier de concertation – Accélérer la décarbonation du secteur du bâtiment* (2023): 29 (available online).

⁵³ For a more in-depth discussion on heat pumps and the Buildings Energy Act, cf. episodes 7 to 9 of the *fossilfrei* podcast (in German; available online).

⁵⁴ Ministère de la Transition Écologique et de la Cohésion des Territoires, Service des données et études statistiques, "Les énergies renouvelables en France en 2022 – Suivi de la directive (UE) 2018/2001 relative à la promotion de l'utilisation des énergies renouvelables," (2023) (available online).

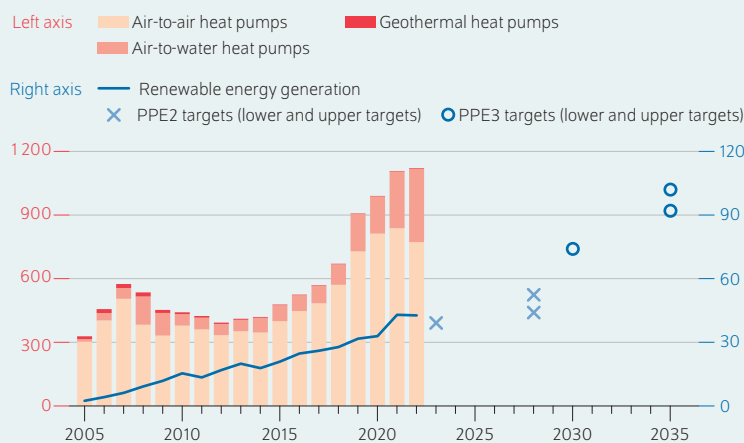
⁵⁵ The corresponding visualization can be found on the Open Energy Tracker (available online).

⁵⁶ Article 4 of Decree No. 2020-456 dated April 21, 2020, on multi-annual energy planning (available online).

Figure 5

Annual sales of heat pumps and renewable heat generation in France

In thousands of units (left axis) and terawatt hours (right axis)



Note: PPE2: second multi-annual energy program. PPE3: Here, the targets set out in the SFEC of November 2023 are considered to be those of PPE3.

Source: Ministère de la Transition Écologique et de la Cohésion des Territoires (available online); PPE2 (available online); Stratégie Française pour l'Energie et le Climat (available online).

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France is surging ahead with heat pump installation.

in sales of heat pumps in France, which saw over 1.1 million units sold in 2022, 770,000 of which were air-to-air heat pumps. If the trend from the past five years continues, the 2028 target (between 44 and 52 TWh) will be achieved early (Figure 5). In Germany, the annual increase in heat pumps is considerably lower. In 2022, only 236,000 heat pumps were installed;⁵⁷ half a million new heat pumps are expected to be installed each year from 2024.

Conclusion: Positive and negative developments in the French energy transition

France's energy and climate policy comprises a large number of short-, medium-, and long-term targets that are revised in five-year, structured planning processes. However, the French government is now behind schedule: France's new five-year law on energy and climate strategy should have been adopted at latest on July 1, 2023. An initial draft bill was submitted at the end of 2023 but was immediately criticized for its lack of specific targets for renewable energy.⁵⁸

France currently appears to be largely on track to reduce its gross greenhouse gas emissions, although this is certainly also due to the unique effects of the COVID-19 pandemic and the energy price crisis. In the buildings sector, France

appears to be meeting its targets, mainly due to the strong expansion of heat pumps.

It has not, however, met its renewable energy targets and progress over the last five years, particularly in the transport sector, is not very encouraging. In general, France is behind on all its targets to expand photovoltaics and onshore and offshore wind power. It is instead relying on nuclear power. This is a political decision, which clearly underlines the "écologie à la française" under Macron's presidency.^{59,60} However, if its targets for renewable energy are to be achieved, it will need to expand its wind and solar power plants significantly.

Although there are differences in the energy policy goals of France and Germany, there are also similarities. Greenhouse gas emissions are already significantly lower in France, but Germany is aiming to go climate neutral five years before France. In terms of mobility and space heating, both countries are focusing on electrification. While Germany's targets for electromobility are more ambitious, the number of electric cars and charging infrastructure clearly needs to grow faster in both countries. France is currently making faster progress than Germany on expanding heat pumps.

The differences are greatest in the electricity sector: While France is prioritizing nuclear power,⁶¹ Germany is relying heavily on renewable energy. France is also aiming to use more wind power and solar energy over the long term, but at a considerably lower level.

It would make sense for France to expand renewable energy faster. This would not only allow it to achieve its targets for renewable energy, which it has not met, but it would also help the country meet its climate goals and safeguard against the risks of using nuclear power. If there are further problems with existing power plants in the future or delays in constructing new reactors, an additional, increased expansion of renewable energy would be helpful. The risk that France would generate "too much" emission-free power as a result, appears to be low considering the strong growth in demand for renewable electricity expected in Europe.

⁵⁹ Which can be translated in English as a kind of "made in France ecology."

⁶⁰ Cf. Adeline Guéret, "Ecologie à la Macron": Handeln darf nicht nur ein Wort sein: Kommentar," *DIW Wochenbericht*, no. 40 (2023): 558 (in German, available online).

⁶¹ On the role of nuclear power in international energy scenarios, cf. Christian von Hirschhausen et al., "Energy and Climate Scenarios Paradoxically Assume Considerable Nuclear Energy Growth," *DIW Weekly Report*, no. 45 (2023): 294-301 (available online).

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