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ALLIANZ RESEARCH

THE EU UTILITY TRANSITION: A PATHWAY POWERED BY SOLAR AND WIND

10 November 2021

EULER HERMES

Allianz

EXECUTIVE SUMMARY

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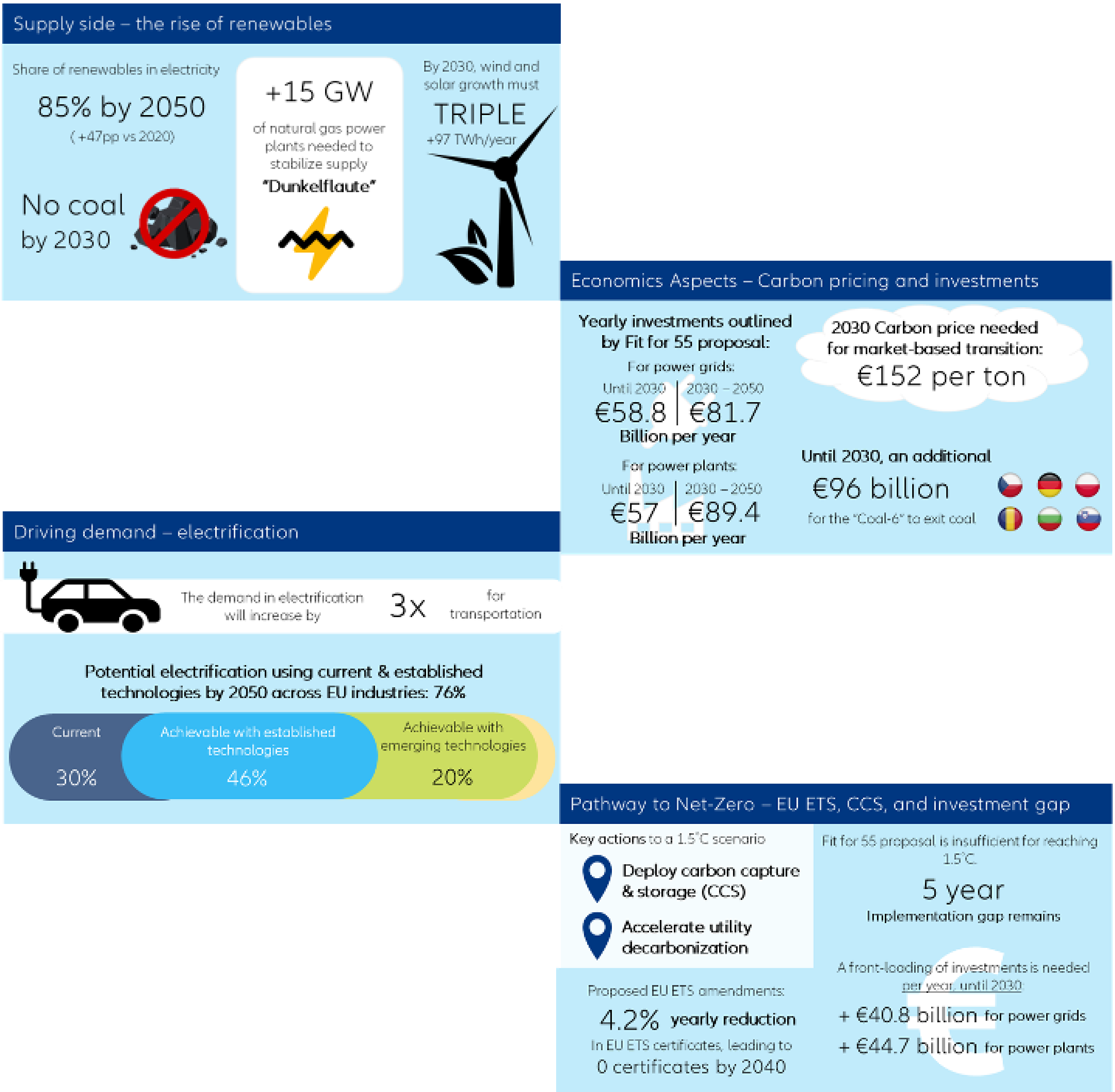
Electrification is the key to decarbonization in the EU. The utilities sector is a key focus area if climate neutrality is to be reached by 2050: Electricity demand is increasing and will reach record highs, driven by transportation and industries where the electrification rate is projected to rise from 30% to 60% by 2030. If established technologies are implemented, the electrification rate could reach as high as 76% by 2050. As a consequence, growth for wind and solar photovoltaics must triple.

Yet renewable energy isn't ramping up fast enough to meet rising electricity demand. While 2020 was a landmark year, with renewables overtaking fossil fuels to become the main source of electricity in the EU (38% of electricity generation), hydropower and bioenergy have stalled and 2020 also saw the largest decrease in nuclear generation since 1990, a trend that is expected to continue as countries set national phase-out targets. This highlights the need for a solar and wind ramp-up, especially as the EU's recent ‚Fit for 55' proposal has set a target for the share of renewable electricity of at least 60% by 2030 and 85% by 2050. But even leaders in solar and wind development (Denmark, Ireland, Germany, Spain) still have a long way to go as phasing out coal by 2030 remains a key challenge: An additional 100GW of wind and solar photovoltaics, as well as 15GW of "hydrogen ready" gas power plants, are needed for its replacement. As a result, we find that the 'Fit for 55' proposal faces a five-year implementation gap.

To stay in line with the 1.5°C warming pathway, a front-loading of investments of EUR40.8bn per year is needed until 2030 for the power grid and EUR44.7bn per year for power plants. In addition, the coal phase-out will require an additional EUR131bn across the EU, which should be broken down to EUR83bn (63%) going towards wind, EUR30bn (23%) towards solar and EUR19bn (14%) towards new gas plants. Of this total investment, EUR96bn will need to go to the Coal-6 countries — Germany, Poland, Romania, Czech Republic, Bulgaria and Slovenia — which have set coal phase-out dates past the 2030 deadline. In addition, by 2030, a carbon price of EUR152 per ton is needed to induce a market-based transition.

Carbon capture and storage (CCS) technologies can help sectors decarbonize quicker, but deployment must be sooner and accelerated. In order for the ‚Fit for 55' pathway to be compliant with a 1.5°C scenario, either the CCS technology must be deployed across industry and utilities at a large scale over the next 10 years or the utility sector must decarbonize even faster than proposed to allow for more emissions certificates to be used for industry, buying time for CCS to pick up.

Investment needs for the EU utility sector transition



ELECTRIFICATION IS THE KEY TO DECARBONIZATION

Electrification is everywhere: in transportation, industry, our buildings and services. And as the world becomes even more electrified, the power sector's transition to renewable sources of energy will play a critical role in emissions reduction. That's because even though final energy demand is expected to decrease over time, global primary energy production will still need to increase as the transformation of electricity for storage and synthetic fuels faces conversion losses. In 2015, electricity was responsible for around 23% of final energy demand, but it is expected to rise to 29-31% in 2030 and to 46-50% by 2050 (with an additional 20% contributing indirectly by producing power-to-liquids (hydrogen, e-gas, e-liquids, see Appendix for detailed decomposition of current energy balance flow), see Figure 1, opposite.

Electrification is being driven by demand growth primarily from the transportation sector, followed by the industry and residential sectors (see Figure 2, opposite).

The EU's recently proposed 'Fit for 55 '(Ff55) legislation[1] expects demand from the transportation sector alone to increase by a factor of 2.5-2.9, with the growing market of electric vehicles and charging infrastructure[2] expected to require an additional 104TWh by 2030 and 488TWh by 2050, compared to 2015 levels. For the residential sector, the emergence of electric heat pumps for heating and cooling is the main driver, with the share of electricity in residential energy demand likely to rise from 25% today to 45-60% by 2050. For the industrial sector, electricity could be brought up to 76% of total final energy consumption if established technologies are incorporated into current processes, which would help in contributing to additional reductions in Greenhouse gas (GHG) emissions (43%) and energy losses (7%)[3]; (see Figure 3, p. 6).

But how exactly will this rising demand for electricity be met?

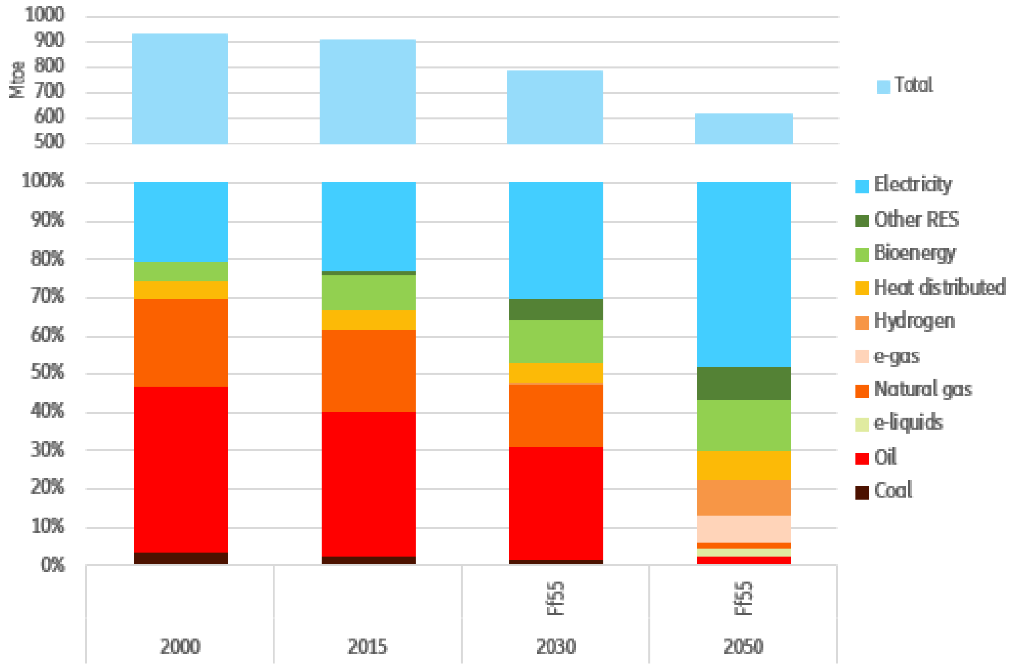
The answer is through wind and solar photovoltaics. Technological maturity coupled with rising CO2 prices are driving down their relative costs, making them ready for deployment across Europe. At the same time, the electrification of industries in particular requires the development of green hydrogen, produced from renewable electricity. In the steel sector alone, for example, transitioning to net-zero would need approximately 400TWh of electricity, which is seven times the amount used today. Of this, an estimated 62.7% (~250TWh) would be used to produce 5.5mn tons of hydrogen. Green hydrogen will also be crucial in decarbonizing the chemical industry, especially in ammonia production. Considering that demand will grow as ammonia is utilized as an alternative fuel for shipping, the production of ammonia from green hydrogen is critical.

However, ramping up green hydrogen is a complex task, demanding tight coordination between European countries and regulations in which carbon contracts for difference will have a central role. Developing the necessary infrastructure will also require close cooperation with regions outside of the EU as the necessary capacity won't be available within the EU. This provides an opportunity to support economic growth and political stability, for instance in African countries that have ideal conditions for the expansion of renewable capacities.

Overall, despite the context of pressing demand, the ramp-up of renewables isn't taking place as fast as it should in the EU.

1 The Fit for 55 legislation, announced in July 2021, aims to reduce greenhouse gas emissions by 55% by 2030.
2 For more information on the transportation sector, see our report Transport in a zero-carbon EU: Pathways and opportunities.
3 Source: Getting Fit for 55 and set for 2050 by ETIP Wind (2021)

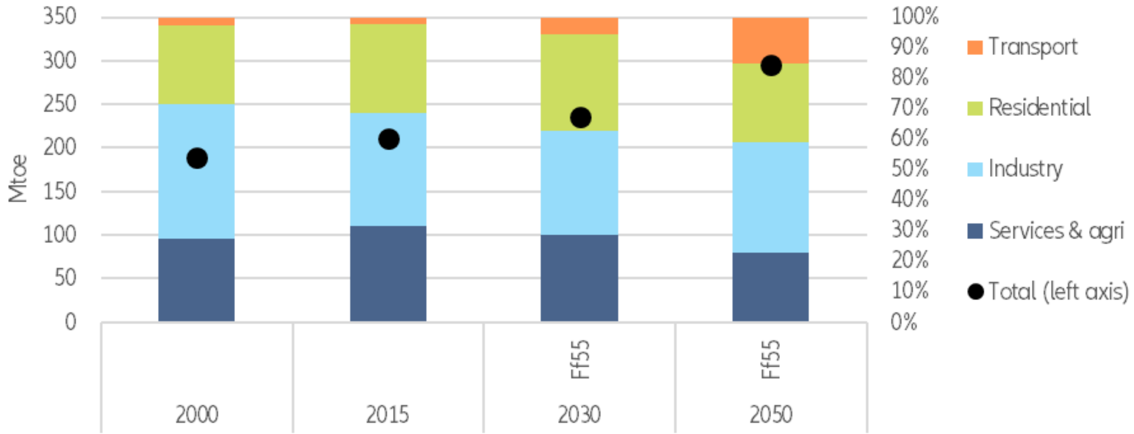
Figure 1: Final energy demand in the EU by energy carrier



Mtoe = million tons oil equivalent

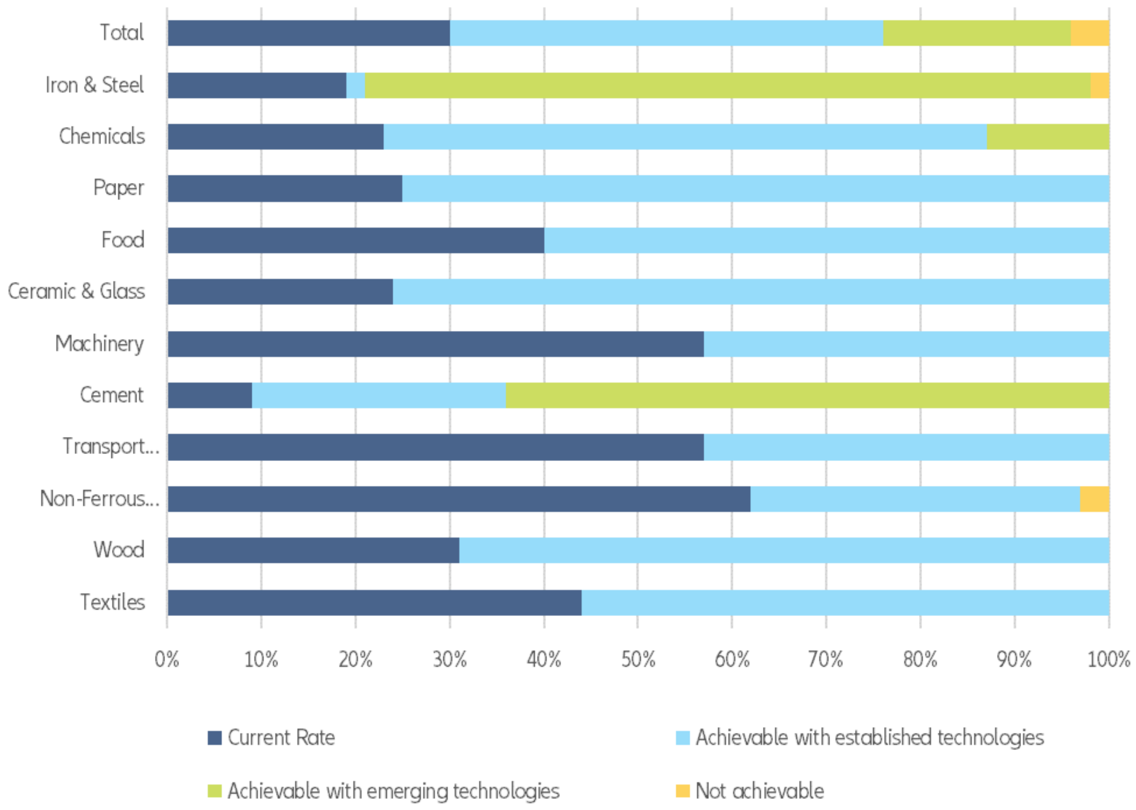
Source:s Allianz Research, European Commission.

Figure 2: Final electricity demand (EU-27) by sector



Source: European Commission..

Figure 3: Potential electrification in EU industries



Source: ETP Wind.

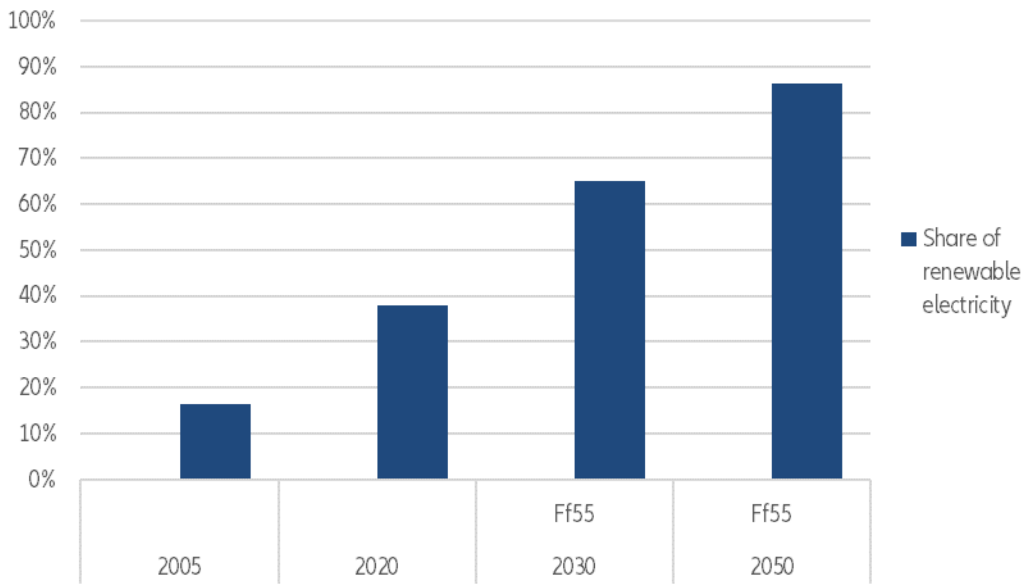
THE RISE OF RENEWABLES AND FALL OF FOSSIL FUELS

For renewable electricity, 2020 was a landmark year. For the first time, renewables overtook fossil fuels to become the main source of electricity in the EU (38%)[4]. Together, wind and solar generated one-fifth of the EU's electricity production, while coal contributed to 13% (nearly halving since 2015). In terms of total generation, wind led the way (+5% since 2015 to 14% in 2020), followed by solar (+2% since 2015 to 5% in 2020).

However, hydropower and bioenergy have stalled, and 2020 also saw the largest decrease in nuclear generation since 1990 (-10% across the EU), a trend expected to continue as countries set national phase-out targets: Germany by 2022, Belgium by 2025, Spain by 2030 and France by 2035 (to half of its electricity mix from 67% currently)[5]. This highlights the need for to ramp-up solar and wind.

To meet the EU's Ff55 ambition of a reduction of greenhouse gas emissions by 55% in 2030, renewables will play a large role, reducing GHG emissions by around 70% (vs. 2015 levels) in the power sector. By 2030, the electricity sector will see the highest share of renewables, with over 60% in all Ff55-compliant scenarios. By 2050, power generated from renewables is expected to exceed 85% (see Figure 4).

Figure 4: Share of renewables in electricity (EU-27)



Source:s Allianz Research, European Commission.

4 *Source: The European Power Sector in 2020, AGORA (2021).*

5 *These plans might come under review in the context of the current energy price crisis. In October 2021, for example, French President Emmanuel Macron announced plans to expand and invest in small modular nuclear reactors (EUR1 billion until 2030, see France 2030 Plan.*

Electricity can be measured in two different ways: installed capacity and production. The installed capacity, normally measured in gigawatts (GW), refers to the maximum output of electricity that can be produced under ideal conditions. On the other hand, production refers to the amount of electricity produced over time in terawatt hours (TWh). The share of solar and wind production is expected to grow the most, from 13% in 2015 to 48% in 2030, and eventually 67% by 2050 (Figure 5).

Although wind energy will be the largest source, providing around 34-35% of all electricity in 2030, it will also need the highest installed capacity over the long term, mostly onshore: more than 1000GW by 2050 compared to 2015 levels (Figure 6).

From 2010 to 2018, renewable electricity growth was around only +3% per year (approximately 38TWh/year), which is not enough to meet future needs. Therefore, growth must triple for 60% to be met in 2030. In addition, the Ff55 ambitions will still have to be carried over in the national energy climate plans of the EU member countries (see Figure 7, opposite).

However, there is often an overlooked trade-off that comes with expanding wind and solar PV: increased competition for space and land, which adds to biodiversity concerns. Land is valuable and the agriculture industry is a critical component of our ecosystem – its role in storing carbon, providing a habitat for biodiversity and the foundation of our food system is invaluable but this does not mean it cannot be used in

Figure 5: Power production in EU-27, TWh

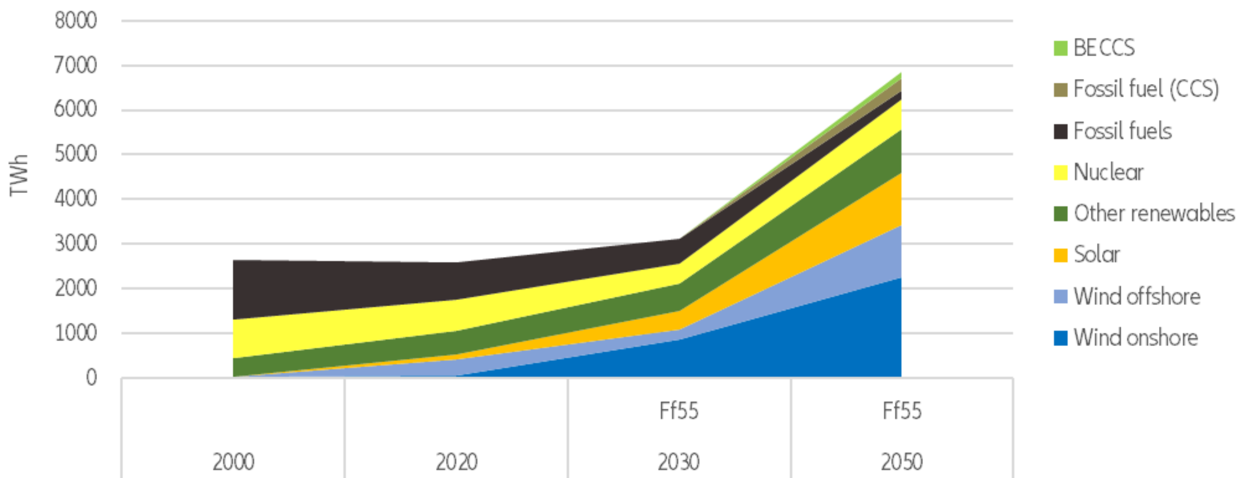
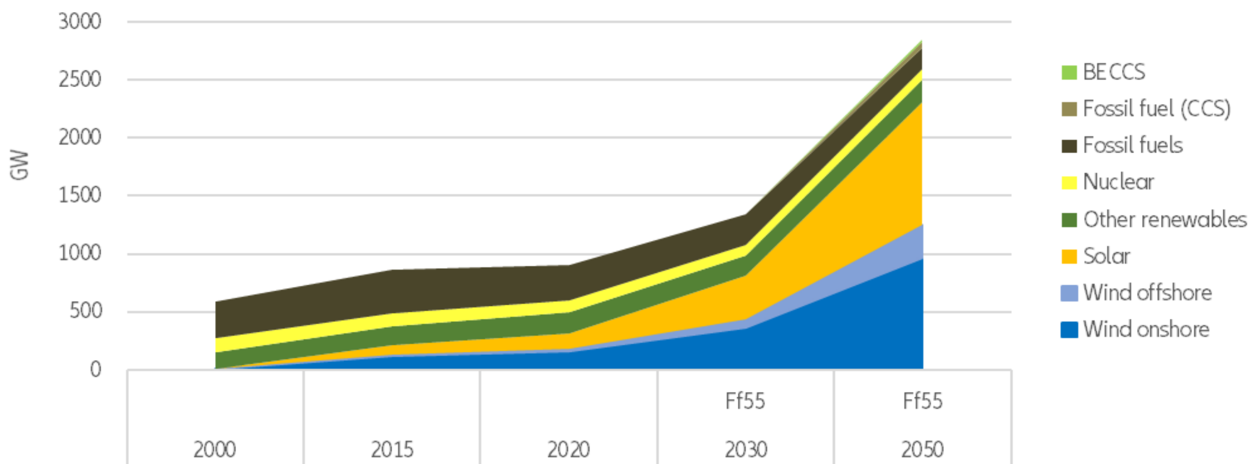
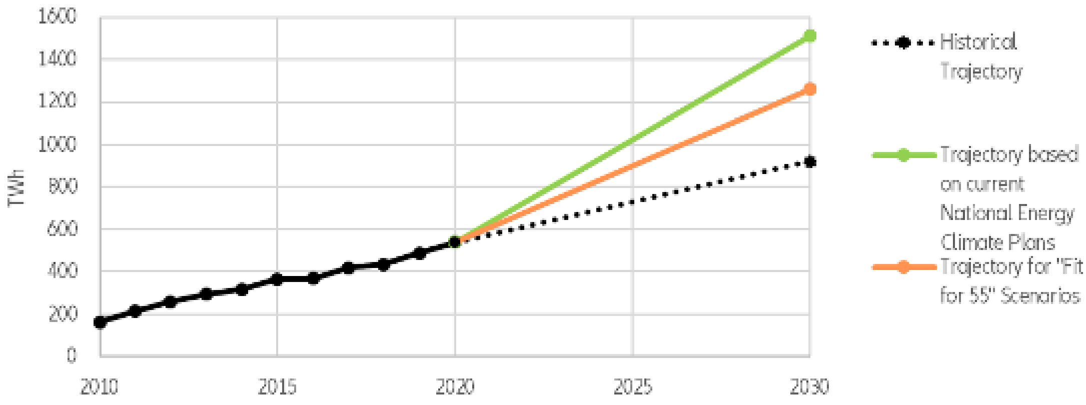


Figure 6: Installed power production capacity in EU-27, GW



Sources (for figures 5 & 6): Allianz Research, European Commission..

Figure 7: Solar and wind generation growth in EU-27



Source: AGORA.

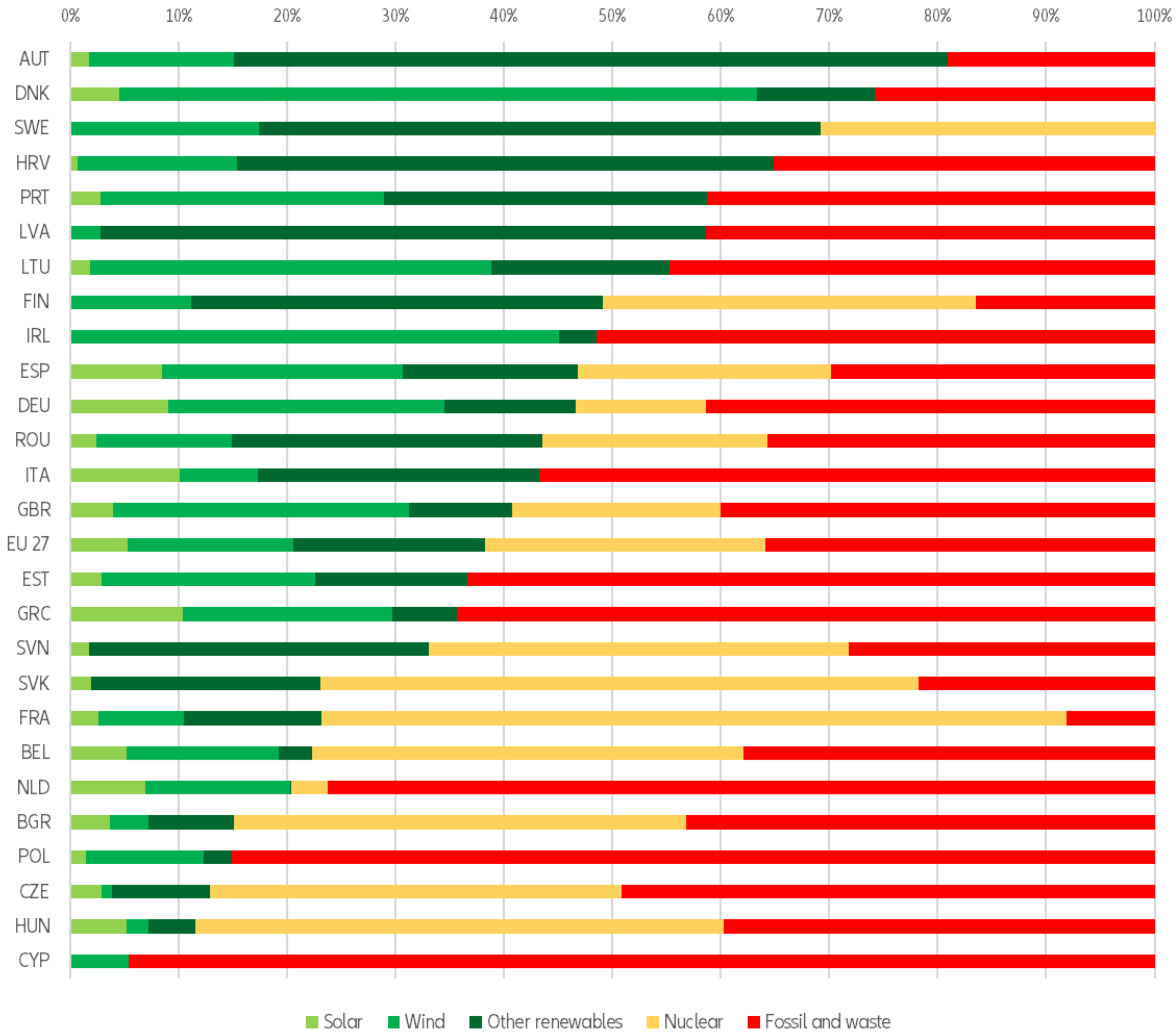
sector-coupling with our energy production. This will require a rethinking of agricultural zoning with respect to the co-use of land for agriculture, energy production and carbon storage. Goals for co-use include agri-photovoltaics (the combined use of agricultural land for photovoltaic energy production, e.g. by installing solar panels on stilts above meadows) as well as agri-forestry (e.g. planting energy wood stripes within fields). The potential solutions to these conflicts, such as rooftop-photovoltaics or the above mentioned agri-photovoltaics, come with additional costs, and the essential step would be to create and promote carbon markets that provide sound revenues to incentivize investments in the co-use activities. Looking at individual member countries, we find clear leaders and laggards when it comes to solar and wind development. For electricity production, Denmark is a clear EU leader as it generated 62% of its electricity from wind and solar in 2020. Following (rather far) behind are Ireland (35%), Germany (33%) and Spain (29%)[6] (Figure 8, page 10).

In contrast, Italy, Bulgaria and the Czech Republic have seen very limited growth since 2015 despite having excellent conditions for solar and wind power generation. But even "leaders" still have a long way to go as the phasing-out of coal is a key challenge. In all main policy scenarios, coal will need to be completely phased out by 2030 to achieve a 55% emission reduction. Although coal generation fell by -20% on average across the EU in 2020, laggards such as Poland only observed an -8% reduction. And most coal-reliant countries are not planning a complete phase-out before 2038: While Germany has announced a more ambitious 65% national renewable target for electricity by 2030, it is also one of the six EU member states that has not yet decided on to phase out coal before 2030, along with Poland, Romania, Slovenia, Bulgaria and the Czech Republic. Based on current national policies, 38GW of coal capacity will remain after 2030 in these countries. The reliance on coal persists because there is a trade-off between GHG emission-reduction and stabilized supply in Europe: Generating power from wind and solar PV is highly dependent on the weather conditions and fluctuations occur throughout the year. Dunkelflaute, the German term to describe the time of year when there is little wind and sun to generate power, is a real concern for the European continent in the winter months, especially as that is when energy demand also peaks. This combined with below par weather conditions could create an intermittent supply of renewable electricity, which in turn could result in volatile energy prices, similar to those seen this quarter[7]. In the case of Germany, supply security during Dunkelflaute is balanced by nuclear power, lignite and hard coal. Using coal power plants is convenient because they are flexible enough to provide balancing power and operative reserves as needed[8].

6 Source: The European Power Sector in 2020, AGORA (2021).
7 See our report *Energy prices & inflation: Backwardation keeps inflation expectations anchored*.
8 Though they are not nearly as flexible as gas power plants, as you can see in the Appendix on load gradients, minimum load and start up times of power plants of different technologies. Gas power plants are the better option for energy systems with high penetration of intermittent renewables.

As a result, back-up renewable capacities are needed: After all, base-load power plants like coal power plants with more than 5000 yearly full-load hours get decommissioned for wind power plants with typically less than 2000 full-load hours or photovoltaic installations with typically less than 1000 full load hours[9]. In this context, total installed capacity needs to increase by more than twice the rate than generation. To phase out coal by 2030, an additional 100 GW of wind and solar PV capacity is needed across the EU, as well as 15GW of flexible gas power plant capacity[10]. This requires approximately EUR131bn in additional cumulative investment across the EU until 2030, with 63% (EUR83bn) going towards wind, 23% (EUR30bn) towards solar and 14% (EUR19bn) towards new gas plants. Of this, 73% (EUR96bn) is required by the six most coal-reliant countries, with Germany (EUR35bn) and Poland (EUR34bn) needing the most additional investment to complete their coal exit (Fig. 9, opposite).

Figure 8: Europe's share of electricity generation in 2020, by country

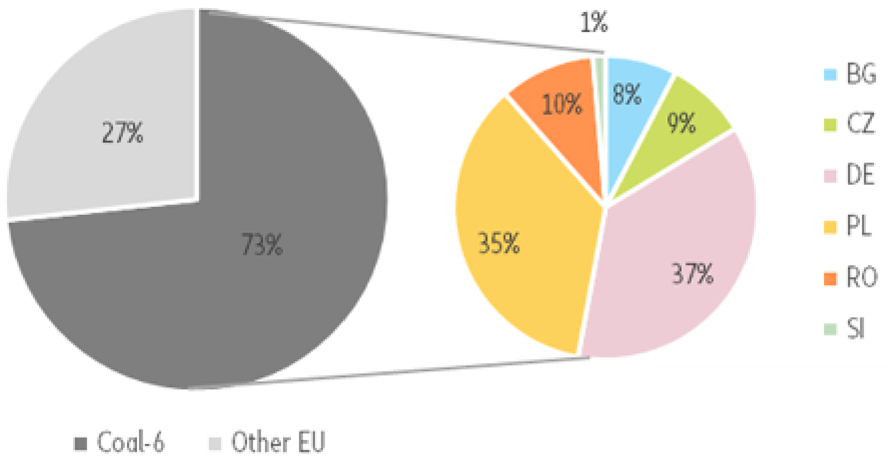


Source: Allianz Research.

9 For more information check Mats de Groot Wina Crijns-Graus and Robert Harmsen "The effects of variable renewable electricity on energy efficiency and full load hours of fossil-fired power plants in the European Union", Energy Brainpool "Flexibility needs and options for Europe's future electricity system" and Matthias Huber, Desislava Dimkova and Thomas Hamacher "Integration of wind and solar power in Europe: Assessment of flexibility requirements".

10 Source: Phasing out coal in the EU's power system by 2030, AGORA (2021).

Figure 9: Distribution of additional investment (EUR131bn total) for a 2030 coal exit



Source:s AGORA;, Allianz Research..

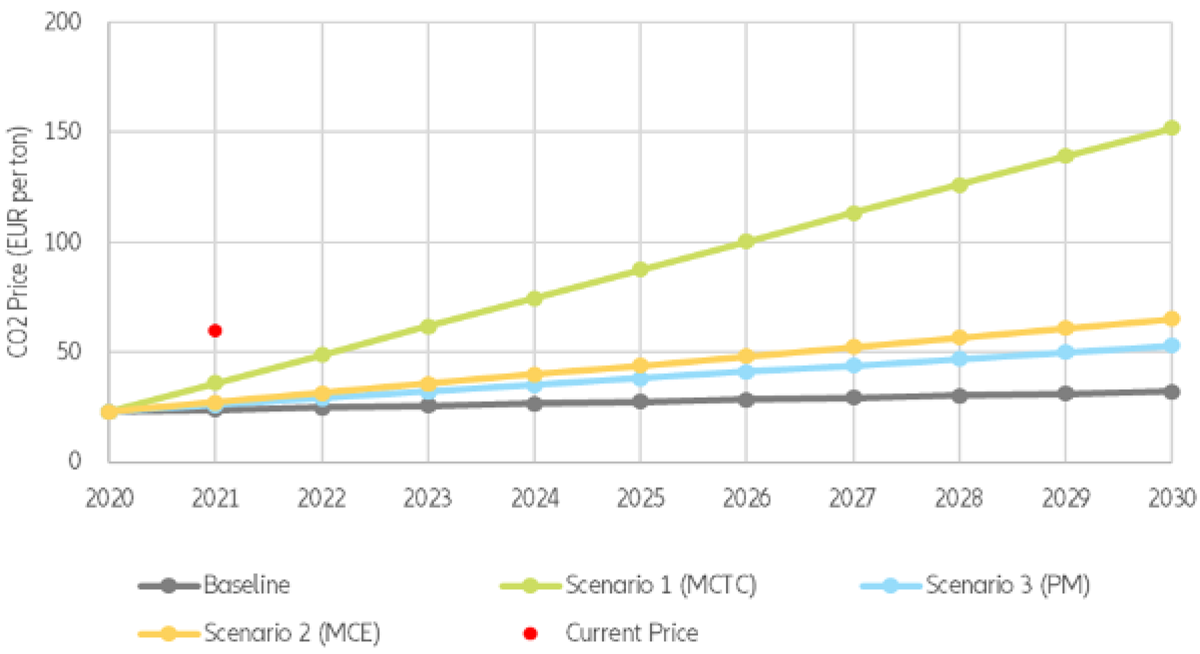
Box: Carbon pricing for a market-based coal exit

Carbon pricing will also play a key role in driving renewables supply and incentivizing the coal exit by 2030. In AGORA's analysis of a complete 2030 coal exit, three possible policy scenarios were identified with carbon price targets by 2030 (see Figure 10).

In the first, the "market-based coal to clean" (MCTC) scenario, the coal exit as well as the renewable expansion are driven by the EU ETS price. In the second, the "market-based coal exit" (MCE) scenario, only the coal exit is driven by the EU ETS while the renewable expansion is driven by additional EU or national support payments. In the third, the "policy mix" (PM) scenario, EU ETS prices are insufficient to ensure a market-driven coal exit by 2030,thus national mandatory decommissioning policies have to complement the efforts and additional support payments are needed as well for a sufficient renewable expansion. The scenarios suggest that for a market-based coal exit as in scenario two, a carbon price floor of EUR65 per ton is needed by 2030, which was in fact already reached temporarily this year.

Based on this, if scenario one is followed and we observe a carbon price of approximately EUR152 per ton in 2030, the price of lignite would be most affected. The base price of EUR50 per ton SKE (SKE stands for the German SteinKohleEinheit, meaning hard coal unit, and expresses an energy content equivalent of burning 1kg of hard coal) would see the current carbon price premium of almost EUR200 per ton SKE increase to almost EUR500 per tonSKE[11]. On the other hand, such a carbon price would increase the carbon price premium for gas from about EUR12 per MWh to about EUR30 per MWh of primary energy content, which has to be put into perspective against the gas price that rose from EUR16 per MWh in February 2021 to EUR116 per MWh in October 2021[12].

Figure 10: CO2 price projections for a coal exit by 2030, by scenario



Sources: AGORA, Allianz Research.

11 Source for base price assumption: AGORA and Umweltbundesamt. Hard coal is more expensive, with local German production costs of above EUR180/ton or EUR180/tonSKE.

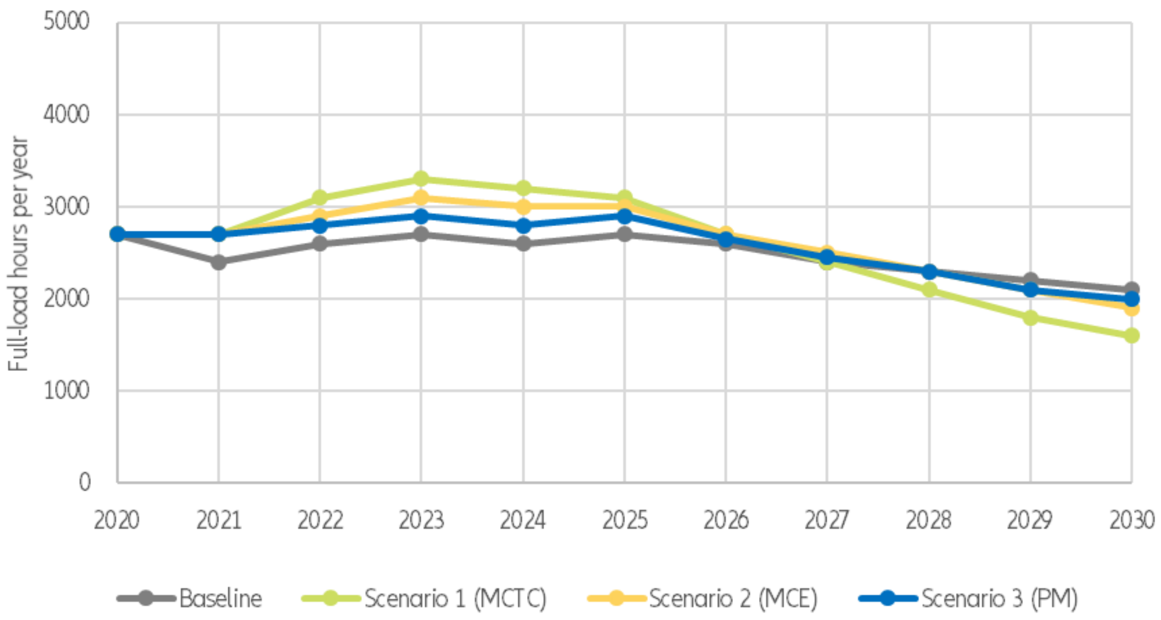
12 Assuming a current EU ETS price of EUR60 and emissions per primary energy content of around 201kg/MWh for gas and of 3250kgCO2/tonSKE for lignite. This is per produced kWh of electricity equivalent to around 433kg/MWH for gas and 1093kg/MWh for lignite.

New gas power plants are needed primarily to cover the system's flexibility demands: in times of low renewable electricity generation, gas power generation will step in to fill demand, replacing coal to stabilize electricity supply[13]. These new gas power plants should also be "hydrogen-ready", i.e., they can be converted and retrofitted to run on (green) hydrogen once a market is developed for its production and distribution. Still, it should be noted that this is a mid-term solution with limited utilization: From 2023 to 2030, the utilization of these gas power plants is expected to decrease from around 3000-3400 to 2000 yearly full-load hours, which means that by 2030, these plants will only be utilized around 22% of the time (see Figure 11).

This decrease in full-load hours results in an increase in the levelized cost of electricity[14] (LCOE) by around EUR20/MWh to approximately EUR100/MWh (see Figure 12, page 14).

Yet the bill of the coal exit doesn't stop here. In order to be on the safe side, strategic reserves are needed. At present, policies for strategic gas reserves are left up to the individual member states to decide for themselves: there is no coordinated approach by the EU. AGORA estimates that if countries want to cover domestic peak loads with their own capacities, an additional 4GW of strategic reserves would become necessary: 3.4GW for Germany[15], 600MW for Bulgaria, 100MW for the Czech Republic and 300MW for Romania. This requires an additional EUR14bn, bringing the total to EUR145bn additionally needed until 2030.

Figure 11: Utilization of gas power plants at full-load



Sources AGORA,.

13 See also Appendix on load gradients, minimum load and start up times of power plants of different technologies to see how well-suited gas power plants are for volatile electricity demands.

14 A measurement of total cost divided by energy/electricity generated by an asset over its lifetime.

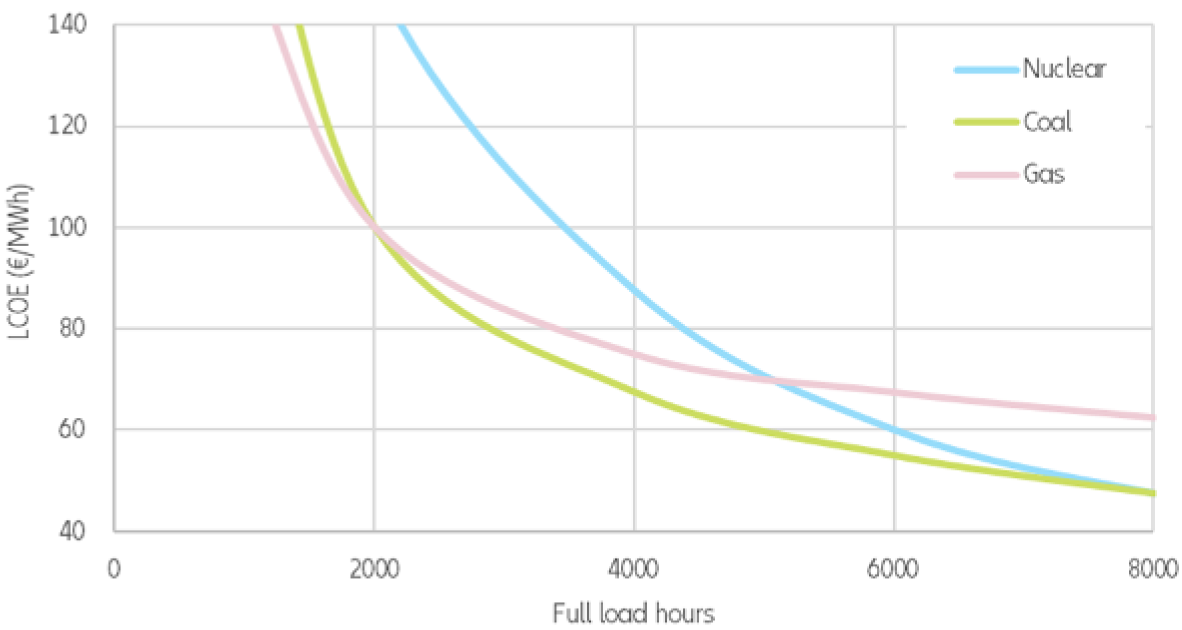
15 For reference, Germany already has approximately 30GW of net installed electricity generation capacity for gas, which is about 13% of total installed capacity in 2021.

Storage solutions can also provide 'additional stability and flexibility to the electricity supply chain. Currently, pumped hydropower and batteries are used for storage but increasing demand from industry and transport will create a market for storing electricity in batteries or converting it into hydrogen. Hydrogen can subsequently be converted in power-to-gas (PtG) or power-to-liquid (PtL) processes for better transportation and storage. Consequently, from 2030 to 2050, installed electrolyser capacity to produce hydrogen is expected to grow from around 12-13GW to 528- 581GW (Figure 13, opposite).

The expected expansion of hydrogen production and storage capacity compliments well the "hydrogen-ready" gas power plants that will be used for power-supply stabilization. Ramping up the hydrogen production is particularly challenging. It is important to note that although carbon prices are the most powerful and effective way to advance the green transition there are some cases – for example path dependencies resulting from long investment cycles or the establishment of markets for new technologies – where additional instruments might be required, namely so-called carbon contracts for differences (CCfD). When infrastructure projects require a carbon price beyond the implemented levels to be competitive versus their fossil fuel-based alternatives, carbon contracts for difference provide an additional financial benefit that compensates for the difference and makes the project attractive for investors. CCfDs are thus a crucial instrument in establishing the hydrogen market.

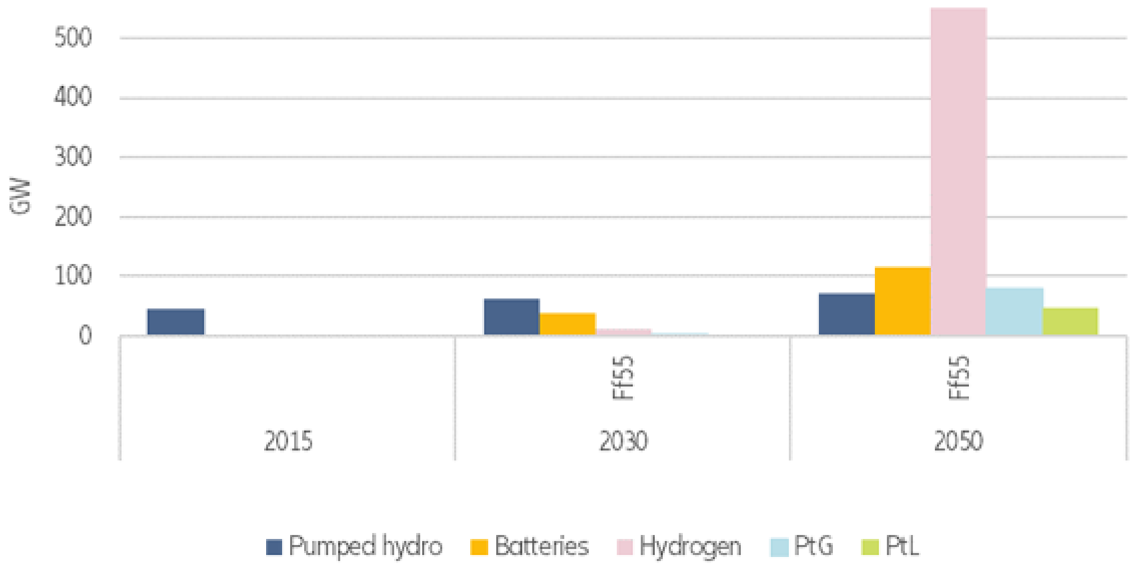
Market flexibility is the best solution for intermittent solar and wind generation. Although Europe's internal electricity market has been liberalized since the late 1990s, countries are also taking additional steps to support the EU market as their national markets have benefited from using cross-border electricity trade and lower prices. The merging and integration of regional and national markets needs to be strengthened, as well as their digitalization, as they could increase supply security and decrease costs via trading. Therefore, a large amount of investment must be made to make our grids smarter, increase the transmission capacity and strengthen network infrastructure to ensure that countries can take advantage of future electricity trading (investment figures are explored further in section 3, p. 16 ff).

Figure 12: Levelized generation costs by technology



Source: Allianz Research.

Figure 13: Electricity storage capacity



Source: European Commission.

THE INVESTMENT GAP:
FIT FOR 55, BUT NOT FOR 1.5°C

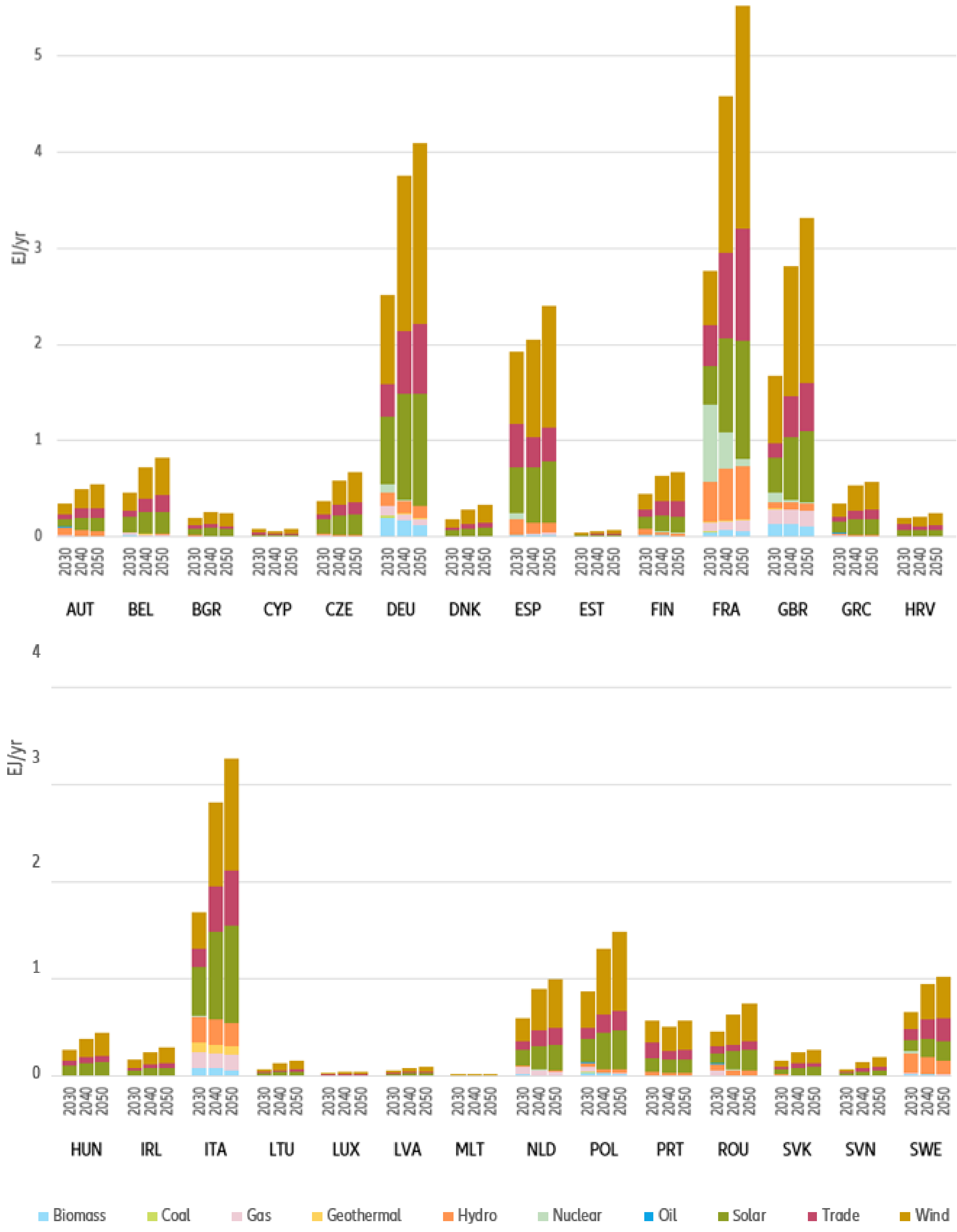
In the EU, planned investments into the energy system are still falling short. In the power sector, IRENA estimates that the approximately EUR84.7bn that is already planned to ramp up renewables and address power grids and system flexibility will not be enough to support a net-zero economy. On top of this, an additional average of approximately EUR40.7bn per year is needed until 2050[16], for a total investment of EUR125.4bn per year. Support for renewables should be about EUR67.4bn per year, while EUR48.4bn per year should go towards power grid flexibility. The Ff55 proposal estimates even larger investments are needed: approximately EUR58.8bn per year until 2030, followed by EUR81.7bn per year until 2050 for power grids, which is in line with estimations by ETIP Wind[17]. One of the largest challenges with the power grid is capacity expansion and optimization to allow for smooth cross-border electricity flow. Today, Europe has approximately 50GW of cross-border capacity, but the European Network of Transmission System Operators for Electricity (ENTSO-E) has called for 85GW of additional capacity to be added by 2030. Current development plans have projects in the pipeline that should add an additional 70GW by 2030, worth approximately EUR50bn, which is still 15GW short of ENTSO-E's proposal. In Germany alone, an estimated investment of EUR61-65bn is needed to optimize and develop the existing AC grid, add devices to steer power-flow and add new DC connections to support domestic and cross-border electricity transportation needs[18]. These advancements depend on the progress in digitalization and the availability of skilled personnel. The roll-out of smart meters and prosumer or community electricity models requires adequate regulatory frameworks for data protection, building law and zoning regulations, a reduction of bureaucracy and the acceleration of approval processes.

As seen in Figure 14, opposite, electricity production will not only need to shift to renewable energy sources, but must also increase across all European countries to achieve the 1.5°C goal. Consequently, power plants will need investments of approx. EUR57bn per year until 2030, followed by EUR89.4bn per year until 2050. In addition, around EUR602.5mn per year is recommended to ramp up electrolyzers for renewable hydrogen production – a key aspect to balance fluctuations in production caused by meteorological intermittencies. As previously mentioned, carbon pricing is the most effective tool to speed up the power transition. Another instrument is a credit-enhancement arrangement between a public player, such as a development bank, and a private investor. Public institutions must explore and use these public-private partnerships to the greatest extent possible because crowding in private capital is key to the green transition, especially in regard to speed: The secret to opening up markets to new technologies is a quick scaling-up to drive costs down. For that, a combination of the risk capacity of the public sector and the knowhow and capital of the private sector is essential.

As a direct result of the ramp-up of renewable capacities, generation costs are continuing to drop. ETIP estimates that by 2050, all wind energy forms will have a LCOE lower than EUR53/MWh, with onshore wind expected to be EUR33/MWh by 2030. In Germany, by 2030, the LCOE for onshore wind is expected to range between EUR30-70/MWh, while solar PV ranges from EUR20-80/MWh[19]. This is in line with the stable relationship between total global installed capacity and LCOE. The learning rate describes the cost reduction for a doubling of the installed capacity and lies between 10% and 36% for the considered technologies (see Figure 15, opposite).

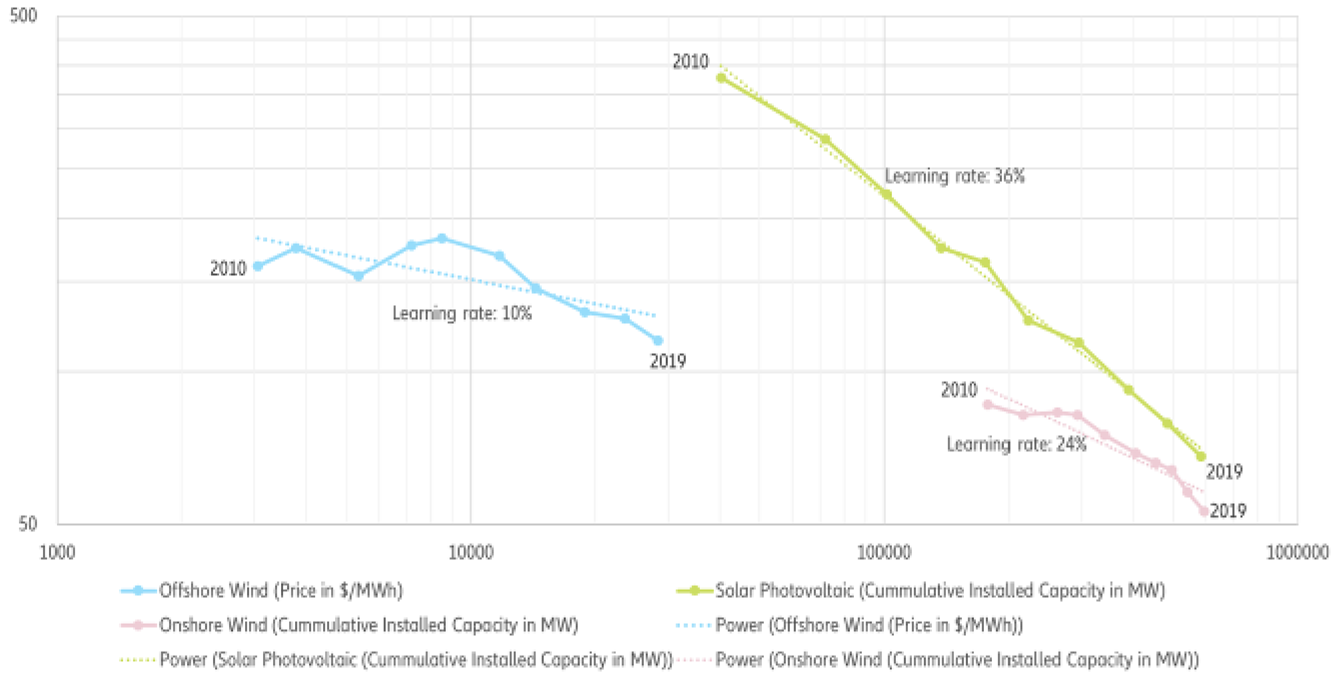
16 Source: Global Renewables Outlook: Energy Transformation 2050, IRENA (2020).
17 ETIP Wind estimated that grid investments need to average between EUR66–80bn per year over the next 30 years.
18 Source: Grid Development Plan 2030, Netzentwicklungs Plan Strom (2019).
19 Source: Levelized Cost of Electricity- Renewable Energy Technologies by Frauenhofer ISE (2021).

Figure 14: Evolution of electricity generation by technology in the EU-27 and the UK for reaching the 1.5°C goal



Source: Allianz Research.

Figure 15: LCOE of renewables (on logarithmic scale)



Source: Allianz Research.

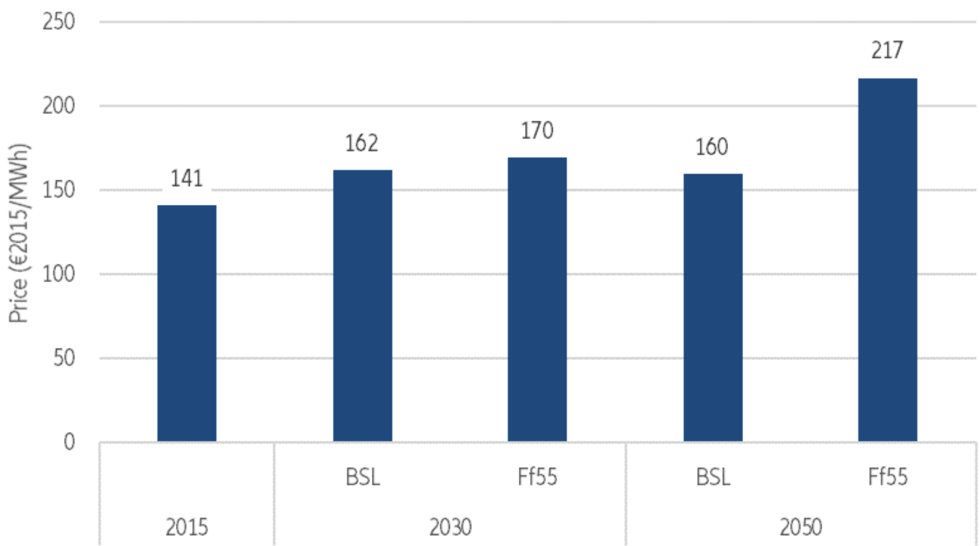
Box: What does the fuel transition mean for consumer electricity prices?

A common and valid concern in the fuel transition discussion is the effect on consumer prices of electricity. It is already necessary to raise prices for heating and gasoline, which will help incentivize and reduce energy consumption in households, but this is especially burdensome for low-income households. Considering for instance the average emissions of a German citizen of around 9 tons of CO2 per year, and a cost pass-through of EUR50 per ton of CO2, this could sum up to EUR1800 per year in a four-person household that is not able to adapt to lower emissions. It is therefore essential to use the revenues from carbon-pricing policies to compensate for financial hardships, securing a just transition. This is the double dividend of carbon prices: mitigating harmful greenhouse gas emissions by increasing emission costs while also generating revenues that can be used to financially compensate particularly burdened households. The latter should be done in two forms: direct lump-sum transfers like the so-called 'Klimaprämie' (climate bonus) and a stabilization of electricity prices, which would also particularly benefit lower income households. Based on the impact assessment of the Ff55 proposal, limited price increases for private consumers and small and medium enterprises are likely until 2030 (Figure 16).

By 2050, prices are expected to be approximately 35% higher than if current policies were to continue (the baseline 'BSL'). In addition to consumers, the rate at which industry electrifies its processes, which is key to decarbonization, is also heavily impacted by electricity prices. Besides the portfolio of support measures, including subsidies, loans and preferential tax write-offs, electricity prices will play a key role. Investments in electrification require electricity prices to increase much slower than the costs for emission-intense alternatives. This includes the expectations for electricity price developments. Thus, a credible regulatory framework is needed that decouples electricity price increases from carbon price increases. These price increases could be offset by decreasing taxes and levies on renewable electricity. For the first half of 2021, taxes contributed to an average of approximately 39% of the total price of electricity for consumers in Europe (Figure 17, p. 20).

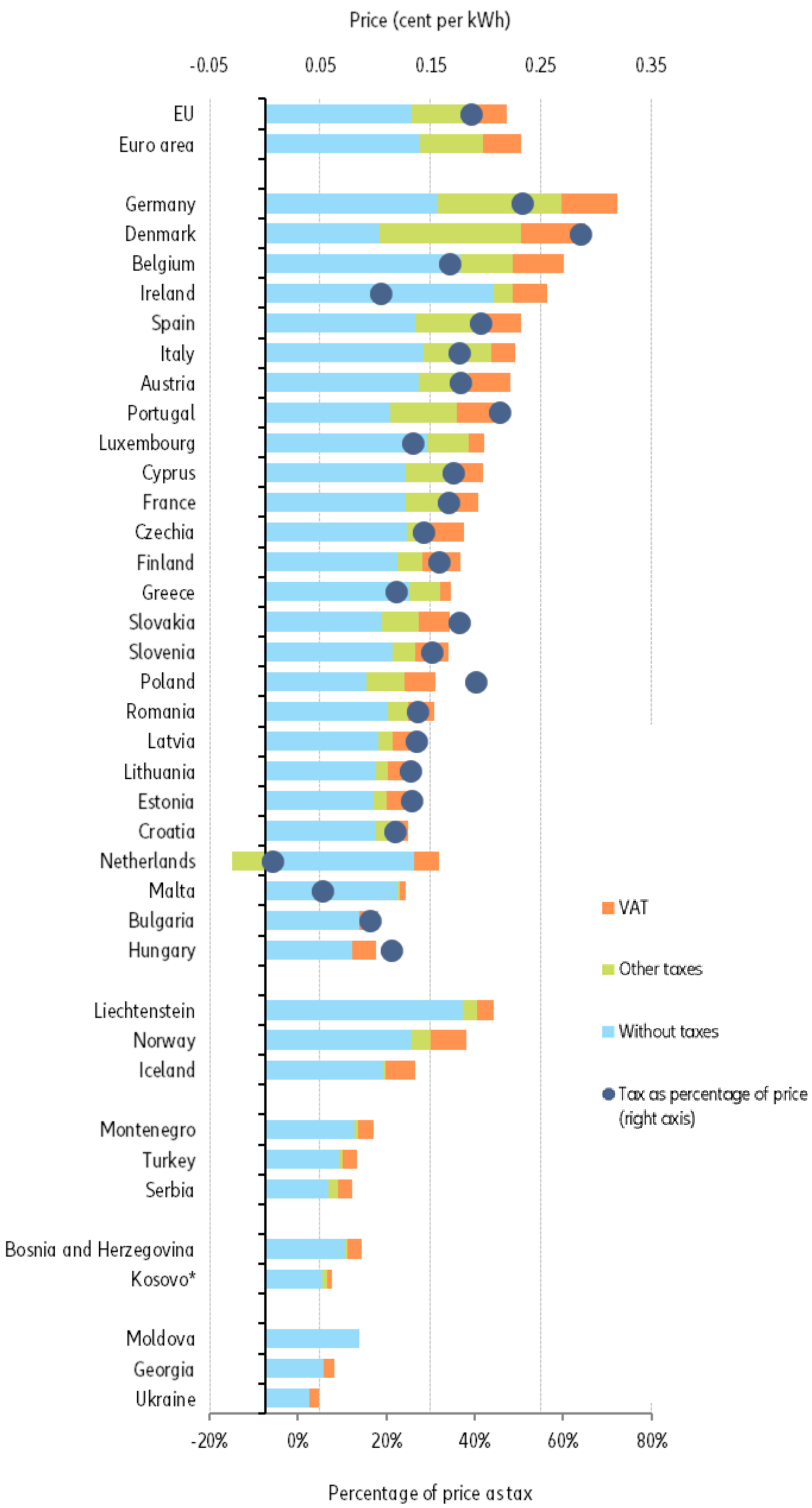
Germany experienced the highest cost at 32 cents/kWh, with taxes making up 51% of the price. Ff55 also proposes a review of the EU's energy-taxation framework, which was last updated in 2003. One of the key measures proposed that will be included in the review is that fuels will be taxed according to their environmental performance and energy content, rather than their volume, including the phasing-out of exemptions for certain products. This should make renewable fuels much more price-competitive for consumers. National actions are also underway: Germany recently announced that its renewable electricity surcharge (EEG) will be cut from 6.5 cents/kWh to 3.7cents/kWh starting in 2022, a nearly 43% reduction. This will provide relief for private households and SMEs, and it is even thought that the tax will be abolished over the next few years. Although this tax has been instrumental in funding the expansion of renewables over the years, the government is planning to pick up the tab through the general budget and income from the emissions-trading scheme. The ramp-up of renewables also has the potential to add an additional 440,000 to 1,212,000 jobs (under current policies and net-zero scenarios, respectively) by 2030, mostly in the bioenergy, wind and solar sectors.

Figure 16: Forecast for the average price of electricity in EU-27



Source: European Commission.

Figure 17: Breakdown of household electricity prices in the EU-27



Source: Eurostat.

THE PATHWAY TO 2050: THE ROLE OF EMISSIONS TRADING AND CARBON CAPTURE STORAGE

The emissions reduction proposed by the Ff55 regulation is ambitious, but additional revisions to the EU Emissions Trading Scheme (EU ETS) will help in strengthening an already established instrument for decarbonization. The EU ETS follows a cap-and-trade approach, where there is a cap on annual emissions across the EU and companies must hold an allowance for each ton of CO2 they emit each year. Currently, the EU ETS covers around 41% of the EU's GHG emissions and applies to more than 11,000 power plants and industry factories. With the new proposed legislation, the emissions reduction target for the EU ETS would change to -61% (previously 43%) by 2030 (vs. 2005 levels). This target means that the emissions cap must reduce by 4.2% (previously 2.2%) each year, starting in 2024. By 2040, there will be no more emission allowances (see Fig. 18, p. 22).

In addition, carbon capture and storage (CCS) can be especially valuable where electricity generation is expected to increasingly fluctuate from renewables, requiring the construction of new gas power plants. CCS technology coupled with hydrogen-readiness can make the argument for these plants as a more long-term, emission-free investment to secure a stable power supply.

With the recent changes proposed to the EU ETS as well and faster reduction of the emissions cap, CCS applications are on the rise. This technology is encouraged and already being applied across the EU, which recognizes CCS as a green technology, giving it access to European Green Bonds as a funding source.

Despite the advances in deployment and technological maturity, the EU Commission does not expect CCS to enter the market at a large scale before 2030. Rather, it is expected to enter closer to 2035 or 2040, with a carbon price of at least EUR200/tCO[20]. On the other hand, the Network for Greening the Financial System (NGFS) scenario assumes a much quicker rollout, arguing that the technology is mature and ready but lacks committed investment funding.

The later entrance of CCS in industry combined with an accelerated reduction timeline means that the utilities sector will play a more critical role in decarbonization. The pressure is on the sector to pick up the slack and decarbonize quicker to allow more allowances to be used for industry, which buys time for CCS to pick up across industry. In the case of our decarbonization scenario pathways, in which the impact of CCS technology is attributed to the utilities sector for the NGFS and Ff55 scenarios, a five-year implementation gap still exists to be compliant with a 1.5˚C warming scenario (Figure 19, p. 22)[21].

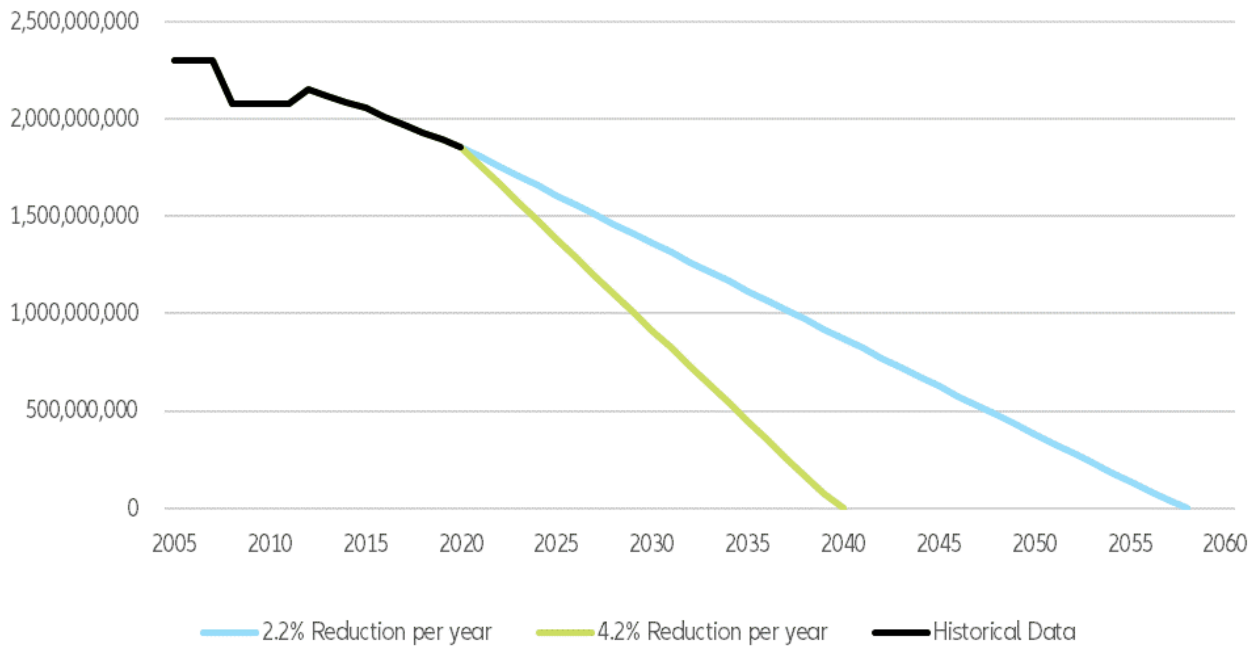
In the Ff55 and NGFS pathways, even negative emissions are observed, which is possible when CCS technology is used in bioenergy power plants[22]. To close this implementation gap, a front-loading of investments would be needed until 2030: an additional EUR40.8bn per year for power grids and an additional EUR44.7bn per year for power plants. By 2030, the coal exit must be complete and new gas power plants, essential to stabilize the supply of electricity from renewables, must be fitted with CCS to realize the 1.5˚C goal. By 2050, the Ff55 legislation is expecting around 6.2Gt of carbon emissions from the utilities sector, more than four times the budget allocated to utilities by NGFS (1.5Gt) and more than 15% of the total remaining carbon budget for the EU of 40Gt for staying below 1.5°C (NGFS, cumulative PIK path). As shown in Figure 20 (p. 23), this implies that the EU is overshooting the 1.5°C path by 4.7Gt until 2050.

20 Source: 2030 Climate Plan Impact Assessment, European Commission (2021)

21 In figure 19 NGFS refers to the Network for Greening the Financial System, PIK for the Potsdam Institute for Climate Impact Research, IIASA for International Institute for Applied Systems Analysis and PNNL for Pacific Northwest National Laboratory. The Ff55 EU TECH and Ff55EU LIFE scenarios extend the EU 2030 climate target plan for the long term scenario analysis.

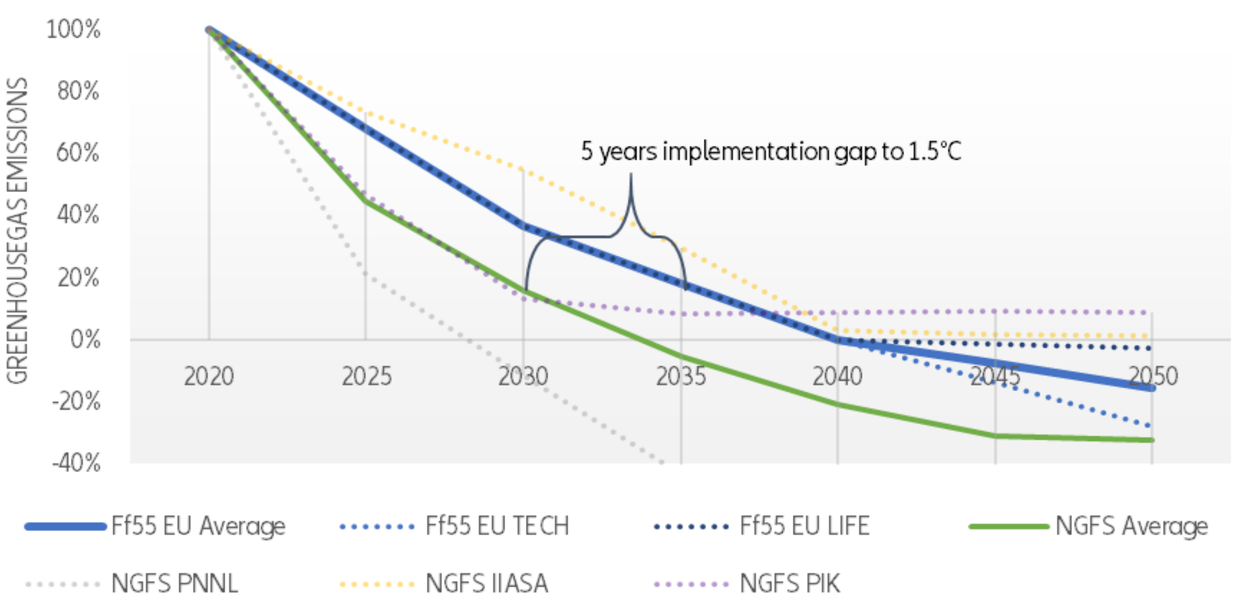
22 Although bioenergy plants are already considered renewable and carbon neutral because of their feedstocks, they still use combustion for power production. Thus they still technically emit carbon dioxide. Additional CCS applied at their combustion site will result in negative emissions as the used biomass has captured CO2 from the atmosphere while growing that is now not returned to the atmosphere but stored in a carbon sink.

Figure 18: EU ETS emissions reduction cap



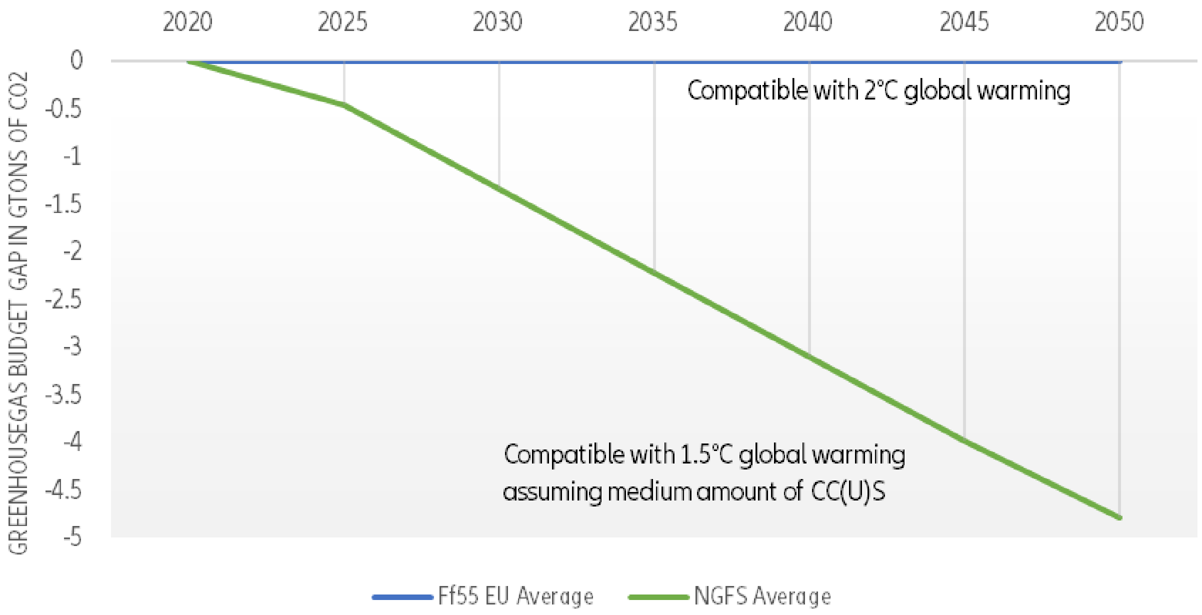
Source: Allianz Research.

Figure 19: Emissions pathway for utilities: Implementation gap



Source: Allianz Research.

Figure 20: GHG budget gap pathway



Source: Allianz Research.

A FAIRYTALE ENDING?

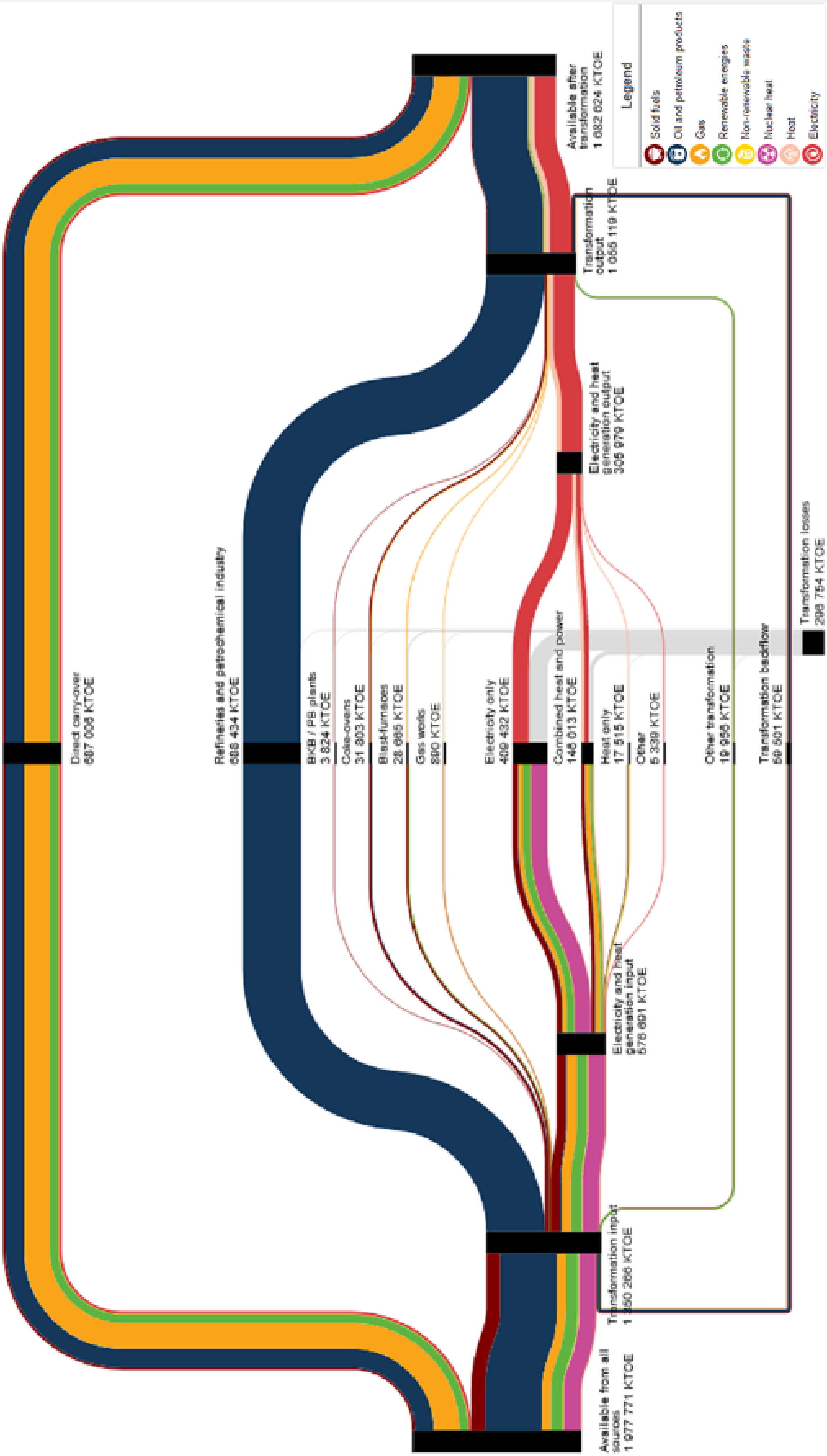
Electricity is at the core of the energy transition. Renewables are on the rise and fossils are falling: Wind and solar energy are cheaper today than their dirty equivalents from coal, gas or oil, and their prices are continuing to drop. But the installed capacity of wind and solar must triple by 2030 if the EU wants to be prepared to supply the new demand in electrification across sectors, mostly in transportation and industry. Availability and utilization are the next challenges. To meet the expected energy demand, the development of wind and solar PV must speed up substantially and "smart" power grids must be ready and digitalized for domestic and cross-border trading when weather conditions are not ideal.

This requires the allocation of sufficient areas, which will cause land-use conflicts. The potential solutions to these conflicts, such as rooftop- photovoltaics or agri-photovoltaics, come with additional costs. In general, the expansion of renewables is exposed to acceptance issues, "not in my backyard" mentalities and lengthy approval processes. In particular, biodiversity and climate protection are often conflicting issues. For a better balance, biodiversity and climate change need to be viewed and assessed as a joint concept that is not focused on a local assessment but accounts for the larger national and international picture. Decision processes must speed up, and the participation of local citizens and communities in the financial benefits can boost acceptance.

The dirty dependence on coal for supply stabilization must stop by 2030 if a 1.5°C climate scenario is to be achieved. As coal profitability and CO2 prices in the EU ETS are directly linked, the best solution would be to reach emission prices in the EU ETS that drive coal power plants completely out of the EU market by 2030 and thus also prevent carbon emission leakage to other EU countries. Research suggests an increase of the EU ETS price of up to EUR152 per ton by 2030 to be necessary for this. To achieve the accelerated coal phase out, an additional EUR131bn is needed across the EU until 2030, with EUR96bn specifically for the coal-6 countries to complete their exits. The gap that coal leaves behind must be filled by an additional 100GW of wind and solar, plus an additional 15GW of new gas power plants. These "hydrogen-ready" gas power plants are critical in ensuring a stabile supply of electricity when weather conditions are not ideal, especially during Dunkelflaute.

Despite the promising advances that the Fit for 55 proposal would imply for the climate, there is still an implementation gap of five years, between what is proposed and a 1.5°C warming pathway. This existing gap has dire investment consequences. To stay in line with the 1.5°C warming pathway, the following additional investments would need to be front-loaded until 2030: EUR40.8bn per year for power grids and EUR44.7bn per year for power plants. Emissions reduction is steep, but not steep enough: proposed amendments to the EU ETS would result in no emissions certificates left in 2040, which is 17 years earlier than the current yearly reduction rate. This is where CCS technologies can help sectors decarbonize quicker, but deployment must be sooner and accelerated. In order for the Ff55 pathway to be compliant with a 1.5°C scenario, either a CCS technology must be deployed across industry and utilities at a large scale in the next 10 years or, alternatively, the utility sector must decarbonize even faster than pro-posed to allow for more emissions certificates to be used for industry, buying time for CCS to deploy.

Appendix A: EU-27 energy balance flow in 2019



Source: Eurostat.

Appendix B: Load gradients, minimum load and start up times of power plants of different technologies.

Fuel and technology	Maximum change (during full load)	Minimum load	Start-up time from cold
Hard coal - steam	2 - 8 %/min	20 - 50%	4 - 8 h
Lignite – steam	2 - 8 %/min	40 - 70%	6 - 15 h
Nuclear – steam	5 - 10 %/min	50 - 60%	12 - 25 h
Gas – steam	6 - 12 %/min	ca. 40%	2 - 5 h
Gas – turbine	10 - 25 %/min	none	ca. 20 min
Gas – combined cycle	4 - 10 %/min	20 - 40%	1 - 5 h

Source: : European Commission "Study on the impact assessment for a new Directive mainstreaming deployment of renewable energy and ensuring that the EU meets its 2030 renewable energy target - Task 3.1: Historical assessment of progress made since 2005 in integration of renewable electricity in Europe and first-tier indicators for flexibility"

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