Investing in the Recovery and Transition of Europe's Coal Regions

White Paper

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Foreword

In Europe, the transition to clean energy is accelerating. As the economics of coal come under pressure, it is clear that current market dynamics and political forces are putting cleaner, more economical energy sources at the center of Europe's power system. In the past three years, 15 European countries have committed to phasing out coal from their energy mix and over 130 existing coal-fired plants have closed or announced their retirement.

Europe has shown strong climate leadership, committing to climate neutrality by 2050 and stepping up its efforts to transition away from coal. And especially in light of the COVID-19 crisis – a respiratory disease that is exacerbated by the very pollutants that coal creates -- we have both an opportunity and an urgent need to rebuild a sustainable, healthier, and more resilient global economy. To achieve this, national governments, regional authorities, mayors and communities alike will play an important role in delivering a just transition, leaving no citizen behind.

At Bloomberg Philanthropies, we believe in a carbon-free future, one that will avoid the dangerous impacts of climate change, bring cleaner air, and protect public health. In an effort to speed Europe's transition to clean energy, and as part of our partnership with the European Commission Coal Regions in Transition Platform, we have released together with BNEF an in-depth analysis on Bulgaria, Czechia, Poland and Romania, showing how current market conditions and existing policies can accelerate the transition away from coal to cleaner, more affordable sources of energy. The BNEF paper maps least-cost transition pathways revealing the untapped economic gain that will result from a speedy transition towards cleaner energy. For these critical countries, the report outlines how the transition to renewables can unlock 54 billion euro in investments and create 45,000 jobs -- just the kind of stimulus the economy needs to recover from COVID-19.

Looking ahead and beyond current levels of ambition, the European Green Deal and the enhanced recovery package can advance climate action in these countries and other European coal regions by supporting the deployment of cheaper and cleaner energy sources. If we're going to create a sustainable global economy that can withstand the challenges we still face, recovery efforts must go hand-in-hand with climate ambition and bold action. Now is our chance to achieve an even faster transition away from coal and towards a 100% clean energy economy.

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Share of zero-carbon generation reached by Poland, Czechia, Bulgaria and Romania in 2030, in least-cost scenario

-48%

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-50%

Change in coal power generation across the four countries in 2030 from 2018

The energy transition in Europe is at a crossroads. The European Union is aiming to increase its climate ambition to a 55% reduction in emissions from 1990 levels by 2030. A faster reduction of power sector emissions and increased electrification of energy demand are crucial to delivering these goals. The EU, like the rest of the world, is also dealing with one of the most severe public health and economic crises in history, resulting from the Covid-19 pandemic. The interests of Europe's coal regions are aligned with the climate and economic imperative of the EU more than ever before. The decarbonization of Europe's remaining coal-reliant power systems would create billions of euros of clean energy investment opportunities that could be part of a green recovery.

- Poland, Czechia, Romania and Bulgaria are among the EU's most coal-intensive economies that have not yet defined a plan to phase-out the fuel. Between them, they have more than 50GW of coal and lignite still on the grid, and this accounts for nearly two-thirds of Europe's coal capacity not covered by a coal exit policy.
- As the economics of coal power generation come under growing pressure, governments and utilities will need to review in earnest their energy transition strategies for the next decade. Following a least-cost power system development model can help better manage transition costs, and free budgetary funds to mitigate the socio-economic impact of phasing out coal.
- In this white paper, we model two power system outlooks for each country: a least-cost scenario, and a scenario based on each country's National Energy and Climate Plan (NECP).
- The least-cost scenario is policy-agnostic. It assumes no increase in EU climate targets or reform to the EU emissions trading system would enable higher prices. The increased climate target for 2030 currently under discussion would call for a faster switch from coal to clean power generation. This scenario also uses BNEF's 2Q 2020 EU ETS carbon price forecast which, without reform, point to a dip in the price of allowances in the second half of the decade, causing coal generation, and emissions, to increase at the expense of gas.
- The results of the least-cost scenario show that significantly more ambitious 2030 renewables targets are already possible. Poland, Czechia, Romania and Bulgaria could reach a 47% share of renewables generation by 2030 compared to 31% achieved by their NECPs .
- The energy transition could unlock nearly 50 billion euros of new clean energy investment in Poland, Czechia, Romania and Bulgaria, creating a sustainable source of economic growth and employment, as well as helping those countries raise their climate ambition.

Highlights of country-level modelling results

Poland

- In our least-cost scenario, the capacity mix transforms from two-thirds coal and lignite to less than one third over the next decade, while renewables capacity more than triples.
- Poland adds nearly 30GW of wind and solar, for 27 billion euros in new investment.

- By 2030, Poland reduces power sector emissions by more than 40% from 2018 levels.
- The capacity mix targeted in Poland's NECP has a more limited impact on emissions, which drop by just 19% from 2018 to 2030, compared to 40% in the least-cost scenario.

Czechia

- In our least-cost scenario, coal capacity drops by half between 2018 and 2030, while renewables capacity triples. Over half of this new renewables capacity is onshore wind.
- Czechia adds just over 8.2GW of solar and wind, for 7 billion euros in new investment.
- Czechia's 17% renewables target is not met in the NECP scenario, because of the priority given to solar over onshore wind, despite the much higher capacity factors of the latter.
- In the NECP scenario, more coal is left in the system and its generation rises again as carbon prices fall in the second half of the 2020s. This results in emissions reduction of just 22% from 2018 levels, compared to 39% in our least-cost scenario. The ambition of Czechia's NECP is likely to be increased as a result of the conclusion of the country's coal commission.

Romania

- In the least-cost scenario, the share of coal in the capacity mix falls from 26% in 2018 to just 3% after 2027, whilst wind and solar account for 40% of the capacity mix.
- Romania adds 10GW of new solar and wind capacity, for 8.5 billion euros in new investment.
- Romania's NECP envisages just 6GW of new renewables coming online over the next decade, in addition to a new nuclear unit. This scenario, that requires more investment, sees emissions fall in by 65% from 2018 to 2030, compared to 71% in the least-cost scenario.

Bulgaria

- In the least-cost scenario, the share of renewables in generation increased to just under 50% by 2030 sees almost, while zero-carbon electricity generation reaches 82%.
- Romania adds 8GW of new solar and wind capacity, for 11 billion euros in new investment
- Bulgaria's NECP envisages a 30% share of renewables in final electricity consumption by 2030, but the scenario based on the NECP's capacity targets does not reach this goal.
- Coal closures, combined with investment of in new gas and renewables in the NECP scenario, allows Bulgaria to reduce its annual power sector emissions by 20% from 2018 to 2030. This is considerably less than the 70% achieved in the least-cost scenario.

Table 1: Key results from least-cost power sector development scenario

	Poland	Czechia	Romania	Bulgaria	Combined
Renewables build, 2020-2030	29GW	5.9GW	10.0GW	7.7GW	52.6GW
Renewables investment, 2020-2030, euros 2018	27.0 billion	5.8 billion	5.7 billion	6.2 billion	45 billion
2030 renewables share of generation	49%	28%	64%	49%	47%
2030 zero-carbon share of generation	49%	67%	80%	82%	63%
Change in annual emissions, 2018 vs 2030, percentage	-42%	-47%	-71%	-70%	-48%
Change in annual CO2 emissions, 2018 vs 2030, absolute	-57.0 Mt	-24.0 Mt	-17.0 Mt	-16.0 Mt	-114.0 Mt

Source: BloombergNEF

Section 2. Introduction

The energy transition in Europe is at a crossroads. The EU is aiming to increase its climate ambition to a 50-55% cut in emissions from 1990 levels by 2030. A faster reduction in power sector emissions and the increased electrification of energy demand are central to delivering this goal. The maturity and competitiveness of the clean energy sector, investor demand for green assets, the resilience of the EU ETS market, the age of Europe's coal fleet, cheap gas, and public demand for cleaner air, are some of the enablers of the faster decarbonization of electricity envisioned by the EU for this decade.

Increasingly it looks like the EU will leverage Covid-19 recovery spending to build a cleaner, more resilient economy.

The EU, as the rest of the world, is also dealing with one of the most severe public health and economic crises in history – resulting from the Covid-19 pandemic. Member states and the EU are coming together to mobilize trillions of euros of funding for liquidity measures and stimulus in order to engineer Europe's recovery. Increasingly, it is looking like the EU and member states, more than any other region in the world, will leverage this recovery spending to build a more resilient economy, increase digitalization and accelerate the low-carbon transition. Fortunately, some of the preparation needed to make possible a green recovery was already underway.

EU member states have reached the final year of their "20-20-20" goals framework enacted in 2009. It called for a 20% cut in greenhouse gas emissions from 1990 levels, a 20% share of renewables in final energy consumption, and a 20% improvement in energy efficiency, all by 2020. A 2030 target to reduce emissions by 40% from 1990 levels was adopted by the European Council in 2014. With greenhouse gas emissions already 23% below 1990 levels in 2018, the first joint climate change mitigation effort of EU member states can be considered a success, even if individual countries underachieved on some of the targets. Through the process of meeting these targets, the EU built an increasingly reliable carbon market, designed policies to procure and incentivize clean energy, and regulations to better integrate variable electricity on the grid.

The fact that emissions have been decreasing faster than anticipated when the targets were set, but not fast enough to deliver on the goals of the Paris Agreement, explains why the EU is aiming to raise its 2030 climate ambition. The new European Commission, appointed at the end of 2019 and presided by Ursula von der Leyen, laid out in the EU Green Deal its proposed measures to deliver a faster decarbonization. The envisioned changes call for a step-change in wind and solar deployment rates, and the reduction of generation from fossil fuels. Clean power is central to the EU's net-zero strategy.

Never before have the interests of Europe's coal regions better aligned with the common goals of the EU.

Newer member states, whose climate goals under the 2020 targets were set lower in light of the economic and industrial context at the time, will need to scale clean energy investment to unprecedented levels. To create space for this new source of power generation, preserve the financial balance of their power sectors, and succeed in reducing emissions, member states will also need to enable the closure of fossil fuel generation capacity. This means first and foremost that of plants relying on coal, with their high emissions and increasingly challenged economics.

Never before have the interests of Europe's coal regions better aligned with the common goals of the EU. The decarbonization of Europe's remaining coal reliant power systems creates the need for billions of euros of clean energy investment that could be part of recovery investments. The

25% of the EU budget and stimulus plan that must be 'green', includes an exceptional raising of 'just transition' funding from 7.5 billion euros to 40 billion euros. This could help fund a leap in power sector development and emissions reduction, and help the EU to meet its climate ambition.

To help European recovery and energy transition plans, BNEF, with the support of Bloomberg Philanthropies, is releasing this white paper detailing a least-cost power sector development scenario for four key economies of Central and Eastern Europe: Poland, Czechia, Romania and Bulgaria.[1] This research is the first time BNEF has used its New Energy Outlook (NEO) modelling tools to explore the transition of these power markets. The results of the analysis reveal that following an economic rational, this group of countries is already well placed to play a leading role in delivering Europe's green recovery, and that even more can be achieved if the EU and member states commit to raising their 2030 climate goals.

2.1. Approach

In order to identify where opportunities lie over the next decade, BNEF's least-cost, policy-agnostic scenario identifies an optimized energy mix for Poland, Czechia, Romania and Bulgaria through 2030. As a reference point, we model the capacity mix each country outlines in its current National Energy and Climate Plan (NECP). That helps identify if resources could be allocated more effectively than planned, or whether the power sector might be decarbonized at a faster rate than is foreseen. These scenarios are built using the same modelling tools used in our NEO report, our flagship annual long-term economic analysis of the future of energy.

The New Energy Outlook's methodology

Focused on the electricity system, NEO combines the expertise of over 65 in-house, country and technology-level specialists in 12 countries to provide a unique assessment of the economic drivers and tipping points that will shape the sector to 2050.

Importantly, NEO does not assume any new policies or subsidies. Nor does it predict that aspirational government climate targets will be met. It does include carbon pricing where schemes already are in place; other policies are allowed to run their course in the near term before being removed. This approach means the analysis can pinpoint the economic drivers and tipping points that will shape the future system.

Technology costs underpin our economic analysis. BNEF regularly updates the levelized costs of electricity (LCOEs) for new power plants. These include the cost of capital, operations and maintenance, financing, fuel and carbon. On top of this, we evaluate resource availability and market operating conditions to work out expected capacity factors that – in the case of renewables – take account of curtailment.

Pooling a wide range of regularly updated data points, BNEF differentiates technology costs by country and region. LCOEs are then projected to 2050 using our understanding of technology experience curves, fuel and carbon price forecasts, and resource curves for renewables. We then apply our power system model, NEFM, to solve for a generation mix that minimizes system costs while meeting peak demand. This sheds light on what options will prove the most competitive in the short, mid and long term.

NEO also makes assumptions on electricity consumption. By using a dynamic baseline forecast, the model captures the evolving relationship between GDP and electricity demand.

[1] The order in which Poland, Czechia, Romania and Bulgaria are listed throughout the note follows power system size, with Poland the largest.

The resulting gross electricity generation figures factor in net exports, transmission & distribution losses and auxiliary use. The analysis reflects our view on the electrification of certain sectors of the economy.

NEO 2020 will go out in October 2020 in an expanded format. The new-look report will go beyond our established assessment of the power sector, to offer a perspective on the future of the entire energy and emissions economy to 2050. A Paris Climate Scenario maps different electrification and technology pathways to meet a climate-safe 1.5 degree global carbon budget. Until then, the Executive Summary of the 2019 report can be accessed here.

2030 scenarios presented in this white paper are not a forecast, but demonstrate what is possible from a technical and financial perspective.

The 2030 scenarios produced by the model for this white paper are not a forecast, but instead demonstrate what is possible from a technical and financial perspective. The next decade will require bold, sometimes difficult decisions both on developing new capacity and retiring existing power plants. As any other major transformation and infrastructure roll-out of this scale, there are real life frictions and indirect costs that these scenarios cannot account for. However, they demonstrate that there are undisputable economic and environmental gains to be made from more rapid deployment of clean power and the closure of uneconomic fossil fuel capacity.

Evaluating NECPs

The NECP process foresees member states reviewing their targets every two years. However, it will be important to take a realistic perspective as early as possible on what can and cannot be achieved over the next decade, in order to avoid the costs of inaction. Delaying the building of economic clean energy capacity, and fossil fuel plant retirements, would make reaching the climate goals more expensive. Given the importance of clean energy in the future of the power sector, it is also better to have a steady stream of projects coming online, rather than to follow a stop-and-go approach as witnessed in several European markets in the past. This will also fit in better with anticipated power plant retirements and help to ensure security of supply. On the social side, the economic drivers shaping the power system for the next decade will have consequences that need to be anticipated and addressed strategically, both in terms of new opportunities, and the transition of jobs tied to assets that will be decommissioned. This research aims to help this dialogue by comparing the economic and power indicators resulting from the transition outlined in current NECPs to the least-cost pathway resulting from our NEO analysis.

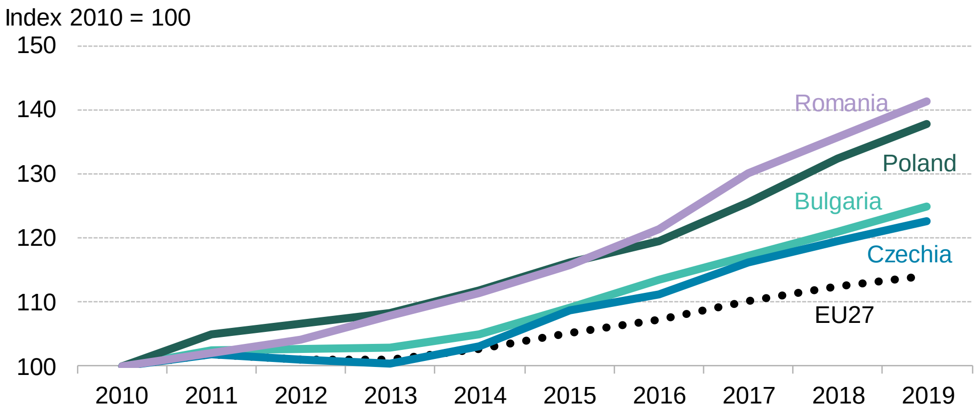
2.2. Scope

EU member states will need to accelerate renewables deployment and coal phase-out plans if the bloc hopes to meet its 2030 and 2050 climate goals.

Each EU member state will need to ramp up its ambition for the next ten years, if the bloc's 2030 and 2050 climate goals are to be met. Member states relying heavily on coal for their power generation or industrial processes face a radical transformation of their energy supply. Germany, which has Europe's largest coal fleet, is in the process of finalizing its plan that sets the coal phase-out date to no later than 2038. A draft coal law being debated by parliament would see the closure of some 46GW of coal plants. The phase-out is the result of protracted consensus seeking, and its conditions will require substantial public investment. Some 40 billion euros will go to coal regions; plant operators and owners will receive considerable compensation.

This report focuses on four member states whose energy transition outlook is less well documented than that of Germany, but whose efforts are also critical to meeting the EU's climate goals. Poland, Czechia, Romania and Bulgaria have been amongst the most dynamic European economies in recent years (Figure 1). Their economies have been growing and living standards improving almost continuously since they joined the EU. Unemployment levels have hit record lows, with the highest joblessness rate of the four in Bulgaria at 4.1% in 2019, and Czechia the lowest in the EU at 2%, against an EU27 average of 7.4%. Strong economic growth, combined with some degree of exemption from climate regulation awarded to member states that joined the EU in 2004 or later, has meant that emissions have not been declining significantly in recent years.

Figure 1: Gross domestic product at market prices



Source: Eurostat

This is also true for the power and heat sector in Poland, Czechia and Bulgaria, where coal generation has kept its central role in the generation mix (Table 2). Romania has reached a high share of zero-carbon generation thanks to a short-lived renewables boom over 2011-2014, but decarbonization has stagnated since the government introduced retroactive tariff cuts in 2014.

Table 2: Key country indicators

Metrics	Poland	Czechia	Romania	Bulgaria	EU averages
Power mix, 2019	79% coal	43% coal	24% coal	43% coal	19% coal*
	13% zero-carbon	49% zero-carbon	60% zero-carbon	52% zero-carbon	51% zero-carbon
	8% other	8% other	16% other	5% other	20% other
2020 renewables share in power consumption, target	15%	14%	43%	21%	31%
2030 renewables share in power consumption, target	27%	17%	49%	30%	Na
Clean energy investment, 2010-2019	10.5 billion euros	2.9 billion euros	5.2 billion euros	3.9 billion euros	36.4 billion euros
Power sector emissions, 2018 (MtCO2)	155	44	20	22	Na
Total emissions per capita, 2018 (tCO2e)	11.0	12.2	6.0	8.3	8.6

Source: Entso-e, European Commission, Eurostat, NECPs, IEA. Note: EU power mix numbers refer to 2018.

Poland

Poland relies most heavily on coal, but has also generated considerable momentum in renewable energy over the last year. Its auction program is gathering pace and bringing in competitive prices for onshore wind and solar. However, its updated 2040 power sector targets were released in November 2019, and still envision more than 23GW of coal and lignite online in 2030. Although the coal sector has been experiencing a long-term slowdown in output and growth, the discussion on decarbonization remains political. Governments have historically been careful not to antagonize unions, and so have avoided any explicit announcements on a coal phase-out.

European Council conclusions from mid-December exclude Poland from a goal of net-zero by 2050, but stated an aim to return to the issue in 2020. Additional 'just transition' funding included in the green recovery plan will help Poland in reconsidering its climate and energy strategy.

Czechia

Discussion on the future of the power sector in Czechia is at a crucial stage. The country's Coal Commission is preparing a detailed plan for coal phase-out, looking at the timeline, associated regulatory steps, and transition mechanisms in mining regions. The results of this study should be ready by the end of 2020, and BNEF hopes the least-cost scenarios detailed in this white paper will contribute to this discussion ahead of the release of the plan.

Half of the country's fleet is powered by coal, which was also responsible for around half of electricity generation in 2018. The country has acknowledged the inevitability of a phase-out, but anticipates some coal remaining in the system through 2050.

Romania

Romania enjoyed a brief blossoming of renewables early in the last decade, installing 3GW of onshore wind, but subsequent subsidy cuts stalled the market. Nearly 6GW of coal remain on the system. There is no sign of coal retirement announcements beyond acknowledgement in the NECP that just over 1GW of coal are to close between 2020 and 2030. Some plants have already ceased to operate due to increasingly uncompetitive economics. Romania's fleet is also home to some of Europe's oldest and most polluting coal plants, and recent concerns about domestic air quality have made the conversation on coal generation even more urgent.

Bulgaria

Bulgaria generated 40% of its power in 2018 from a coal fleet that has the EU's highest emission intensity. Much still needs to be done to prepare the country's energy transition, both in terms of support for renewable energy sources and in terms of any discussion of phasing out coal. The size of the fleet and the fact that Bulgaria is still in the early stages of its energy transition make it a key market to address. The country has potential for both wind and solar, and costing renewable sources versus fossil fuels provides a fruitful starting point for the discussion.

Section 3. Drivers

The evolution of the power systems in Poland, Czechia, Romania and Bulgaria is driven by a combination of economics, and EU and national level policies. EU targets have required the adoption of national targets for emissions and the share of renewables in the power mix, while the EU has also mandated increasingly strict limits on a range of air pollutants. Domestically, concerns about energy security and support for the coal mining industry have caused some inertia on energy technology choices, but all countries have had their first experiences with renewables. Economics are increasingly lining up to support EU climate policy goals. Carbon prices, competition from gas and renewables, lower demand due to Covid-19, and the aging of coal power plants, are causing financial and technical challenges for coal asset owners across Europe.

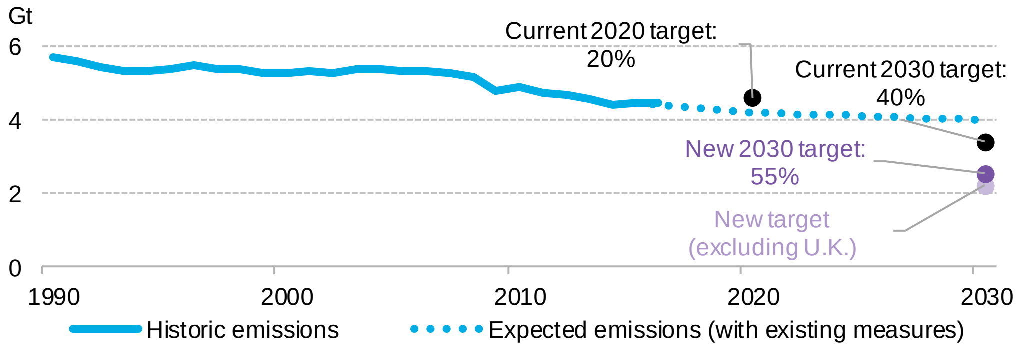
3.1. Policy

EU climate ambition

The EU's latest targets set out in the Green Deal will require an acceleration of the energy transition across Europe.

The EU prides itself on having one of the most ambitious climate policies in the world, and the group of countries now aims to agree on a common goal to reach net-zero emissions by 2050. For 2030, the EU hopes to raise targets to an emissions reduction of 50-55% from 1990 levels. This would mean cutting the EU's carbon emissions by an additional 0.8 metric gigatons of carbon dioxide equivalent (GtCO2e), equivalent to the current annual emissions of the entire economy of Germany, on top of the 1GtCO2e already pledged to be cut by 2030 (Figure 2).

Figure 2: Annual EU emissions, current and proposed target reductions from 1990 baseline



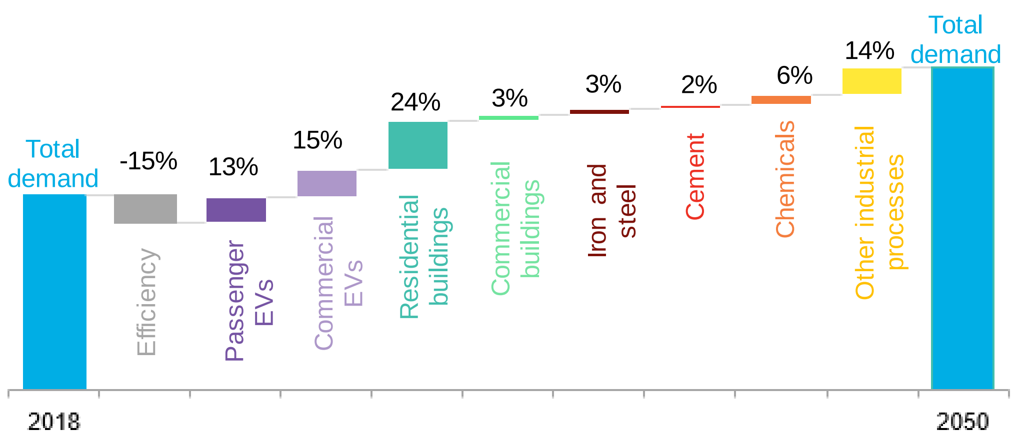
Source: European Environment Agency, European Commission, BloombergNEF

While an economy-wide transformation is necessary to reach such high rates of decarbonization, it is the power sector that will be the cornerstone of the EU's transition to a low-carbon economy. The focus on power reflects the availability of competitive generation technologies that can be scaled to increase the share of zero-carbon electricity, and also the opportunity to electrify a growing share of energy demand in transport, buildings and industry. The potential of green hydrogen (hydrogen produced from clean power), increasingly recognized and supported by the EU and member states, also depends on there being plentiful clean electricity in the future.

A note on electrification, or sector coupling

It is likely that the power sector will need to play a more significant role across the economy if Europe is to achieve its climate targets. BNEF has published a more ambitious electrification pathway for transport, buildings and industry, in a typical northern European market. This pathway is based on both economic drivers and policy – and explores the impacts of 'sector coupling' on the power sector. The full findings are publicly available in our white paper: *Sector Coupling in Europe: Powering Decarbonization*, published in partnership with Statkraft and Eaton. In the sector coupling pathway, by 2050 electricity demand in a country like the U.K. or Germany is nearly double what it would be without sector coupling, with the majority of demand increase attributable to the electrification of transport and buildings demand (Figure 3).

Figure 3: Change in total electricity demand in Northern European archetype based on stylized sector coupling pathway



Source: BloombergNEF

High penetration of renewables in the power sector by 2050, combined with a bigger role for direct and indirect electrification in other parts of the economy, makes possible substantial cuts in emissions. A scenario with sector coupling results in a 63% reduction in emissions across power, transport, buildings and industry by 2030 compared to 1990 levels: steeper than the EU-legislated target of 40% and proposed increase to 50-55%. By 2050, this reduction would extend to 83% below 1990 levels,

Renewables targets

The EU's energy sector target of achieving a 32% share of renewables in energy consumption by 2030 was set before the new and more ambitious 2030 emissions reduction target was proposed in the Green Deal. This creates a gap between the current proposals of some member states in their 2030 National Energy and Climate Plans, and the emissions reduction they will need to achieve under the enhanced target. All four countries reviewed in this white paper proposed relatively low 2030 renewable deployment goals in their initial NECP.

From a power sector perspective, the 2030 targets framework differs from the one used for 2020 in a number ways. Member states do not need to commit to binding national renewables targets. Instead, the Commission checks that the sum of efforts proposed by member states is sufficient to meet the EU's climate goals, via a monitoring process that lets member states adjust their NECPs every two years. Through this process, the Commission is hoping to spur more collaboration between member states. It recognizes the need to be able to adjust plans over time, as progress towards the goals is affected by changes in the economic and technological context. Similarly, a specific, binding share of renewables in power has not been set, as changes in the rate of electrification, and decisions to rely on nuclear, make setting such a target less easy. BNEF estimates that variable renewables' share in the EU power mix will need to increase to at least 55% by 2030 to align with the EU's targets for climate and renewables in final energy.

Just Transition

Additional incentives for energy transition are to be offered through the EU's Green Deal and green recovery packages. The Just Transition Mechanism is one of the newest, set out in the Green Deal in December 2019. It allocated 7.5 billion euros to support regions and territories with heavy reliance on carbon-intensive activities. This would support reskilling workers and help regions diversify their economies beyond fossil fuels. This focus completes the series of financing tool available to power transition investments in the EU, including the Cohesion Fund, Connect Europe Facility, European Regional Development Fund or Invest EU. For a full review of EU funding possibilities in the energy sector, see here.

The EU's proposed green recovery plan would more-than-quadruple these funds to 40 billion euros. To receive funding through the mechanism, applicants need to present a Just Transition Plan, which must be in line with the EU's climate neutrality goals. This may be a more effective strategy to encourage energy transition, rather than the open-ended NECPs.

When potential spending is examined on a national basis, Poland comes out on top, followed by Germany (Table 3). The minimum aid intensity for the available funds is up to 32 euros per capita, from 2 euros previously. As of May 2020, some 18 countries had made requests for support through the Just Transition Mechanism.

Table 3: Top beneficiaries of the Just Transition Mechanism

Country	Coal phase-out date	Share of coal in the power mix	Investment earmarked through the JTM (euros billion)
Poland	n/a	77%	8.0
Germany	2038	36%	5.2
Romania	n/a	23%	4.5
Czechia	n/a	48%	3.4
Bulgaria	n/a	40%	2.7

Source: BloombergNEF, European Commission

40 billion euros for the Just Transition Mechanism will help mobilize more investment in coal-reliant countries and accelerate transition.

Emissions limits

Increasingly tight EU air pollution standards are putting pressure on old coal plants that will need to either invest in new filtering technologies or limit their lifespan. A significant amount of these retrofit investments have not yet been completed, despite the 2021 compliance deadline.

The EU industrial emissions directive (IED) standards for 'best available technologies' set out new pollution limits for sulfur dioxide (SO_2), nitrogen oxides (NO_x) and dust for all large combustion power plants, to be implemented by 2016. Member states could delay the compliance date for specified power plants up to 2021 under different derogations, or by stating planned technology upgrades in the country's Transitional National Plan. Combined-heat-and-power plants have the option of applying derogations until 2023.

In 2016, over 80% of Czech, Polish, Romanian and Bulgarian coal and lignite plants were not compliant with the 2021 standards, as estimated by consultancy DNV GL. Few plants have undergone renovations since. As of June 2020, there are non-compliant coal and lignite plants operating in Poland, Czechia, Romania and Bulgaria. Their owners face a choice between costly retrofits and ceasing to operate them before 2022 (Table 4). For some power plants, already under financial pressure, the only possibility to cover these costs would be through state support. The Polish government is directly supporting modernizations through its capacity mechanism.

Table 4: Estimated costs for retrofitting non-compliant power plants

Country	Bulgaria	Czechia	Poland	Romania
Hard coal, million euros	74	186	1,094	147
Lignite, million euros	191	561	595	459

Source: DNV GL

Significant volumes of coal capacity are at the very end of their permitted lifespan. In Poland, eight plants, with over 5GW cumulative installed capacity, are operating under a limited lifetime derogation. In Bulgaria and Romania, 174MW and 700MW respectively are operating under this derogation, with permissible operating hours expected to run out in the next two years. After that, the power plant will either have to retire or its owners invest in new filtering technologies. This could lead to early retirements of coal and lignite plants, or to retrofit investments that are financially risky due to uncertainty surrounding future operating hours of coal plants.

In Poland, historical reliance on coal to meet baseload demand has led to concerns that coal closures will create an adequacy gap.

Domestic policy drivers

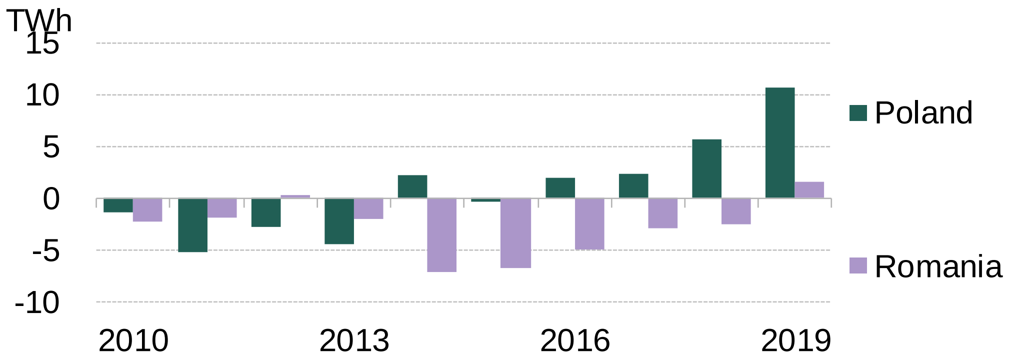
Concerns about system adequacy, security of supply and energy independence tend to dominate the discussion about the short- to medium-term evolution of the power sector. For example, Poland has historically been wary of natural gas generation, as Russia was the main market from which it can procure gas. A slow improvement of the situation between Russia, Ukraine and the EU, and, more importantly, the opening of new gas supplies, notably with Poland's first LNG import terminal, are helping alleviate some of these concerns. Still, the key justification in public policy discussions for Poland's continued reliance on coal is to guarantee security of supply.

There are concerns that Poland's capacity mechanism is mostly extending the lifetime of coal power plants, not incentivizing the building of cleaner replacement capacity.

The reliance on coal to meet significant portions of baseload demand in each of these countries has also raised concern about system adequacy, as coal assets age and as they are ill-suited for power systems with high demand and supply fluctuations. Poland has adopted a capacity mechanism beginning in 2021, to provide generators additional compensation for availability – though there are concerns this is mostly extending the lifetime of coal power plants, and not incentivizing the building of cleaner replacement capacity. Of the total capacity that will receive payments through the mechanism in 2021-2024, just 21% will go to new plants, of which coal accounts for the vast majority. In the future, EU state aid rules restrict the awarding of capacity payments to plants that do not meet emissions intensity criteria that de facto exclude coal plants.

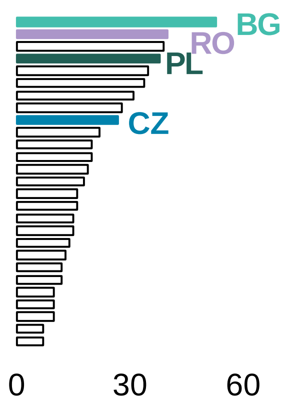
The political clout of the mining industry across the four countries also continues to play a role in elections and the direction of energy policy. To date, it has not been possible to secure the support of unions tied to the coal industry without committing to continued use of the fuel. The coal industry also still plays a significant role in the economy of individual regions such as the Jiu Valley in Romania and Silesia in Poland. Until recently, governments have preferred to commit to preserve a role for coal, than to put together the measures and funding needed to manage the inevitable structural changes faced by these regions and communities.

Figure 4: Net electricity imports



Source: Eurostat, Entso-e, National Institute of Statistics Romania, BloombergNEF

Figure 5: Air pollution attributable death rate, per 100,000 population, EU27



Source: WHO. Note: BG=Bulgaria, RO=Romania, PL=Poland, CZ=Czechia

While energy independence acts as a centerpiece for their energy policies, Poland, Czechia, Romania and Bulgaria have all seen their reliance both on electricity and hard coal imports increase in recent years. This challenges the argument that coal generation is a measure of energy independence, and that the industry will continue to provide employment in the long term. Lower demand for coal and rising infrastructure costs have seen prices rise for domestically sourced hard coal (see below). In the power sector, the higher costs of coal generation overall have driven wholesale power prices up. Poland and Romania have both become net electricity importers in recent years (Figure 4), while in Bulgaria imports in the first four months of 2020 grew more than 60% compared to the same period in 2019. Czechia remains a net exporter country thanks to its nuclear generation capacity and key role as a transit country with large interconnector capacity.

Policy makers are increasingly feeling pressure from their populations on air quality. The issue of smog is generating public awareness and momentum. Reliance on coal for power generation and heating brings Bulgaria, Romania, Bulgaria and Czechia to the top of the EU's list of member states with the poorest air quality. In the WHO's analysis of deaths that can be attributed to ambient air pollution, Bulgaria and Romania top the list in the EU27, with Poland the fourth highest and Czechia number nine (Figure 5). While dialogue around cleaning up air quality has tended to center around the transport industry and home heating, the conversation is shifting to a broader acknowledgement that continued reliance on coal power also needs to be addressed. Citizens across Europe, including in Bulgaria, Czech Republic, Romania and Poland, have pursued or attempted to pursue court cases to protect their right to clean air.

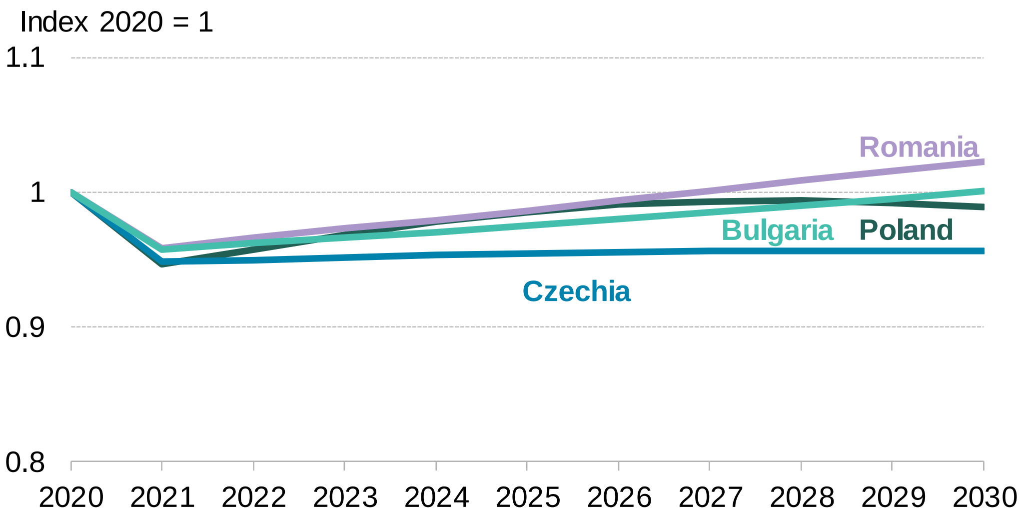
3.2. Economics

Policy intervention such as fossil fuel subsidies, capacity payments and compliance exemptions have long softened the impact of fundamental changes in energy economics on the power system of Poland, Czechia, Romania and Bulgaria, This has been not without a cost to the public budget and consumers. Competition from zero-marginal cost renewables, low gas prices and rising carbon prices are all accelerating a reduction in the role for coal in the power mix over the next decade. Periods of low power demand due to Covid-19 have laid bare the trends pressuring coal-fired power generation. Keeping underutilized coal assets online has a clear impact on the finance of utilities, the states, and/or consumers, depending each country's regulation. Czechia, Romania, Poland and Bulgaria will all need to come to terms with these dynamics, in order to keep the cost of their power systems in check, and accelerate the transition towards lower-carbon generation.

Demand

While power demand has generally risen modestly over the last decade across Poland, Czechia, Romania and Bulgaria, the protracted impact of Covid-19 is likely to depress this growth. In general, pre-coronavirus, most OECD countries would have anticipated moderate or negative demand growth, reflecting improved energy efficiency, modest economic expansion and ongoing retreat from energy-intensive industries. Our expectations are driven by economic output, which we see slowing, and population. Poland, Bulgaria, Romania and Czechia have all seen stagnant-to-negative population growth in recent years. For this white paper, we applied an adjustment to our demand projections to take into account the impact of Covid-19 (Figure 6).

Figure 6: Change in electricity demand expectations in Covid-19 Scenario 2



Source: BloombergNEF

Our Covid-19 scenarios

BNEF is using three scenarios to explore how the Covid-19 pandemic might develop globally, and its impact on our coverage areas. The scenarios reflect the high degree of uncertainty over the future spread of the new coronavirus, and the many unknowns surrounding how national healthcare systems will cope and how government responses will unfold. As such, they chart a wide range of possibilities in terms of how long the pandemic will last, and how long countries will have to maintain intervention measures that impact economic activity.

Scenario 1: single-wave pandemic

In this scenario, affected countries introduce suppression measures that bring their outbreaks under control within three months. These measures are highly disruptive to economies, but are largely successful (though perhaps not everywhere). After three months, countries relax their interventions, with some targeted measures remaining in place. These waves are staggered around the world so most of the impacts are confined to 1H 2020, though some bleed into 3Q.

Economic recovery is well underway in much of the world from 4Q 2020. In many countries, stimulus measures are enough to keep a good portion of the workforce in place and keep businesses from going bankrupt. Some travel bans may remain in place, targeting countries that have not managed to control their outbreaks.

Scenario 2: multiple-wave pandemic

In this scenario, Covid-19 outbreaks continue or return over 3Q-4Q 2020, and require repeated efforts from governments to bring under control. The behavior of the virus in this scenario mirrors roughly what happened in the 1918 flu pandemic. Countries have 2-3 major waves over the course of a year and/or have to repeatedly use social distancing and other tactics over this period. The re-introduction or maintenance of suppression / social distancing measures, potentially on a rolling basis, hinders economic recovery during 2020.

The virus is largely under control in early 2021, *and economic growth returns in 2Q 2021.* Recovery is slower than in scenario 1. The length of the pandemic has led to many bankruptcies and displaced workers, and fiscal stimulus has not been able to fill the gap. Consumer sentiment is low for a while and demand takes time to pick up.

Scenario 3: enduring pandemic

In our third scenario, there are repeated waves of outbreaks in countries, each requiring varying levels of suppression and other measures into 2021. There are many waves because each only infects a small portion of the population, or because reinfection is possible. Governments enter a cycle of on-and-off intervention measures. Over time these become more targeted and efficient as testing becomes more widespread and systems are put in place.

After about 18 months (mid-2021) a treatment or vaccine is successfully scaled up and brings the pandemic under control. *Economic recovery begins in Q4 2021* but is severely hindered by the damage done to businesses and consumer confidence over 18 months.

For the purposes of this white paper

Whilst the chance of single-wave pandemic with a quick recovery are fading, European member states have successfully rolled-out various levels of social distancing measures that helped them manage the initial infection peak and progressively re-open their economies. As result, this white paper uses Scenario 2 for its power demand projections to 2030.

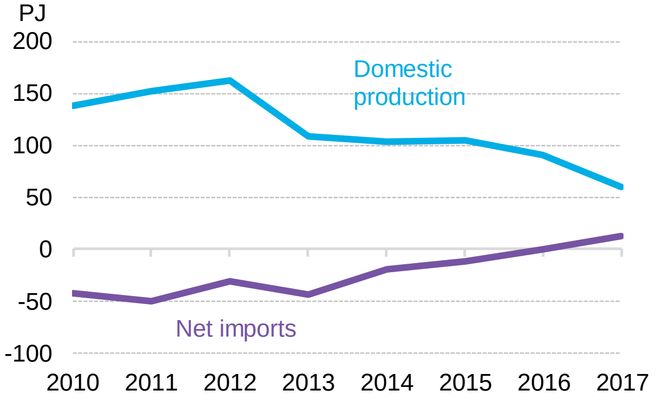
Fossil fuel pricing and competitiveness

Coal

In 2017, around 80% of Polish hard coal mines were unprofitable, according to a study from the European Commission.

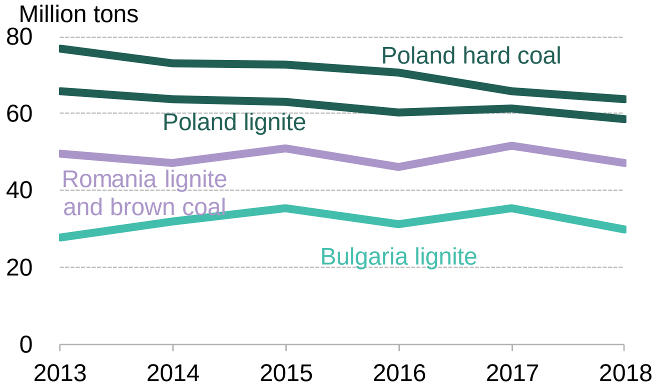
Where Poland, Czechia, Romania and Bulgaria still rely on coal for a significant share of electricity, the costs of the fuel are trending upward. Local production in all cases is not as cost-competitive as it once was – lower demand means lower production, and higher cost, as mines are less able to benefit from economies of scale. Extraction also becomes more costly across Europe as mines are being exhausted. Investments in new mining sites and improved technology also require substantial capital, whilst the pool of investors and lenders committed to the sector has decreased markedly in recent years. In Poland, a European Commission report estimated that around 80% of hard coal mines were unprofitable as of 2017. The trends is likely to have worsened since. Local opposition to the creation of new mines is also growing, and securing a growing number of legal and political wins. As a result of these challenging conditions for domestically sourced coal, imports have risen whilst domestic production is falling.

Figure 7: Coal productions vs imports, Czechia



Source: CZSO, BloombergNEF

Figure 8: Coal production, Poland, Romania, Bulgaria



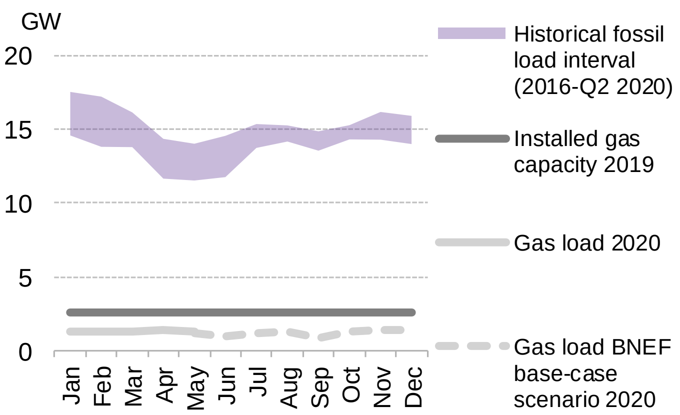
Source: Statistics Poland, Eurostat, National Statistical Institute Bulgaria, BloombergNEF

Natural gas

Natural gas has already made significant headway in displacing coal generation across Europe. Installed capacity of gas-fired plants in Poland, Czechia, Romania and Bulgaria is much lower than in other countries in Western Europe, but low gas prices are still causing coal-to-gas fuel switching in these markets. To date, all of this fuel-switching has been happening across existing assets, and is likely to continue to do so at least for the next few years.

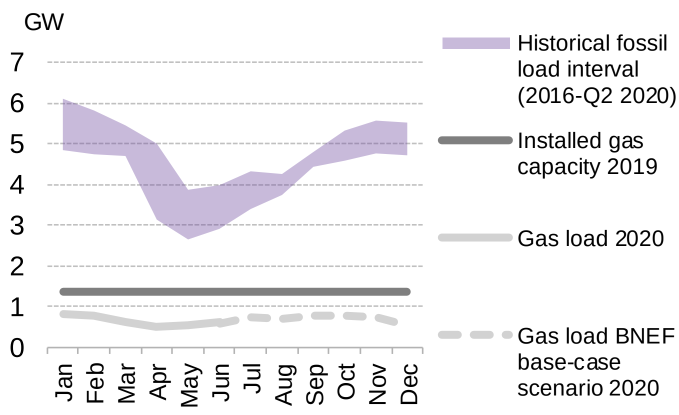
In 2019, gas accounted for around 9% of the average fossil fuel load in Poland (Figure 9) and 13% in Czechia (Figure 10), up from 5% and 8% in 2015. In both countries, the gas fleet's average utilization rate was approximately 50% over the course of the year. Gas prices typically decline in the summer as heating needs decrease, and in July 2019 the share of gas in fossil fuel generation rose to 21% in Czechia. The current fleet offers the potential for further coal-to-gas fuel switching, as plants could reach average annual utilization rates of 85%. This could see gas generation increase by 20% (4.1TWh) in Poland, and by 40% (4TWh) in Czechia.

Figure 9: Fuel switching potential, Poland



Source: BloombergNEF

Figure 10: Fuel switching potential, Czechia



Source: BloombergNEF

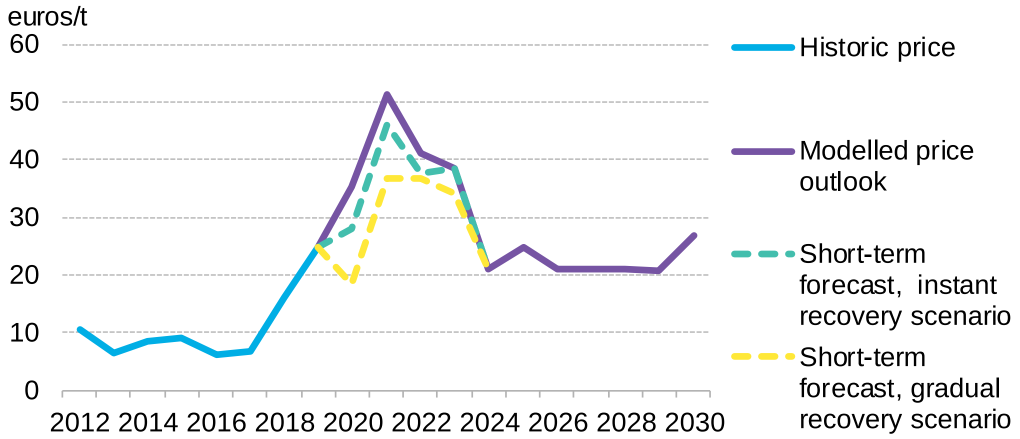
Over the first five months of 2020, as electricity demand has been squeezed by Covid-19, the trend of coal-to-gas fuel switching has intensified in Bulgaria, Czechia, Poland and Romania. The share of gas generation has increased despite a decline in absolute fossil generation. In Poland, gas generation did not react strongly to the decrease in demand, with a dip of just 10%, whereas lignite and hard coal fell by more than 30% and 20% respectively. A similar trend has been seen in Czechia and Bulgaria. Bulgaria's gas generation almost doubled during the first five months of 2020, compared to the same months of 2019, and gas reached a record high of 15% as a share of fossil fuel generation in March 2020. In Romania, gas overtook coal and lignite generation in January 2020, to represent 55% of fossil fuel generation. Romanian gas generation was 20% lower over January to May 2020 than in the same period last year, but coal generation dropped three times as much, at 60%.

BNEF expects this trend to continue, with gas offering a competitive source of generation due to oversupply in the global gas market and a drop in demand as a result of Covid-19. BNEF estimates that the European benchmark gas price will remain at a competitive level against lignite for the next three years – and that gas prices could drop as low as 5 euros per megawatt-hour during the summer of 2020, from an average price over 15 euro/MWh in the past three years.

Carbon prices

The most significant pressure point for coal generators is their exposure to the European carbon market. In the past two years, carbon prices per unit of electricity have overtaken the fuel costs for lignite plant in both Czechia and Bulgaria. The carbon intensity of coal and lignite can be twice as high as that of natural gas, meaning gas' economics are less impacted by carbon prices. Despite demand dropping due to Covid-19, the carbon price has recovered and BNEF analysis suggests that it will quickly reach levels only slightly below our modelled price outlook (Figure 11).

Figure 11: Medium- and long-term EUA price projections, annual averages



Source: BloombergNEF. Note: Short-term forecasts in response to Covid-19 are preliminary.

Coal plants' exposure to the rising price of EU carbon allowances (EUAs) is a major pressure point that began to squeeze operating margins in 2018 and 2019. This trend is likely to continue, as the carbon price is expected to rise over the coming years in response to the reduced supply of EUAs. The annual emissions cap dictates that from 2021 the number of available allowances will decrease each year by 2.2%, and surplus allowances will be placed into the Market Stability

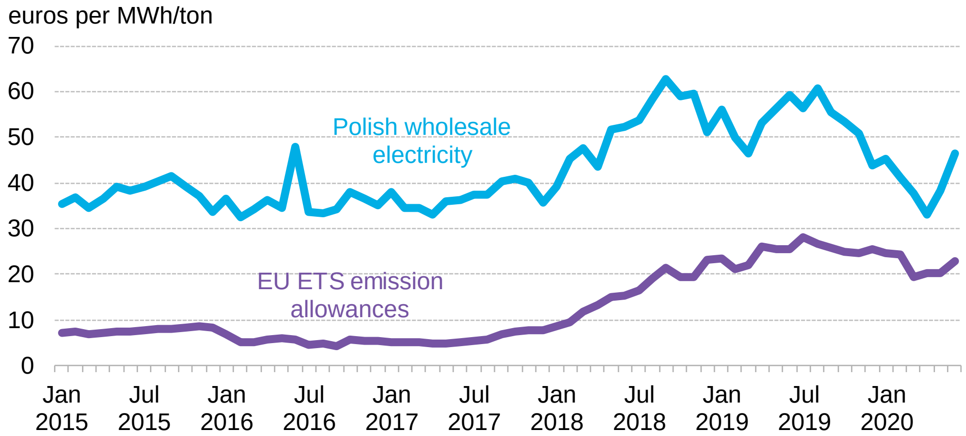
Reserve, preventing them from being traded. The EU ETS will undergo several legal reviews between now and 2022, which could lower the cap for allowances further and drive prices up.

Post-2025, the carbon price is likely to rise beyond BNEF's forecast, if the EU ETS is reformed in accordance with Europe's more ambitious green deal targets.

Even without reform, BNEF expects the EUA price to rise and stay above current levels until early 2025, although this will depend on the pace of economic recovery after Covid-19 (Figure 11). BNEF currently forecasts an EUA price decline after 2025, as overall emissions and thus EUA demand could fall. However, this post-2025 forecast will likely be revised upward if the European green deal includes more ambitious 2030 targets and the EU ETS is reformed accordingly.

Bulgaria, Czechia, Poland and Romania were eligible to distribute free emission allowances to power plants until 2019. In that year, Polish utilities PGE and Tauron received only 1-2% of their ETS allowances for free, down from over 25% in 2015. For Czech utility CEZ, the share of free allowances decreased from 22% in 2018 to 12% in 2019, which led to a 70 million-euro increase in spending on carbon allowances. Romanian company Oltenia received 11% of allowances for free in 2019. Bulgarian power plant Bobov Dol still received 25% free allowances in 2019, whereas the country's largest lignite plant, Maritsa East, did not receive any free allowances. Utilities' overall spending on ETS can vary depending on how successful their hedging strategies are, but the trend is decisively towards an increase as a result of there being fewer free allowances, and higher prices. The strong correlation between Polish wholesale power prices and those of EUAs shows how the country's high reliance on coal translates into higher energy prices for consumers (Figure 11).

Figure 12: Monthly average wholesale power prices in Poland and EUA prices



Source: BloombergNEF. Note: EUA prices in euros/ton of CO2, wholesale electricity price in euros/MWh

From 2020 onwards, free allowances are not distributed to power generators, except in Romania and Bulgaria, which joined the EU after Poland and Czechia and will continue to make use of transitional free emissions allowances until 2030. The savings made from the free allowances are to be invested in clean technologies and upgrading existing plants. As of 2019, CEZ had completed investments of approximately 35 million euros to fulfil these conditions.

All four countries are beneficiaries of the EU Modernisation Fund, which is funded by EU ETS revenue and aimed at helping ten Eastern European countries to meet their 2030 climate and energy targets. The Modernisation Fund is expected to net revenue of up to 14 billion euros over 2021-2030. Czechia and Romania have opted in to transfer additional allowances to the Modernisation Fund in exchange for further investment support.

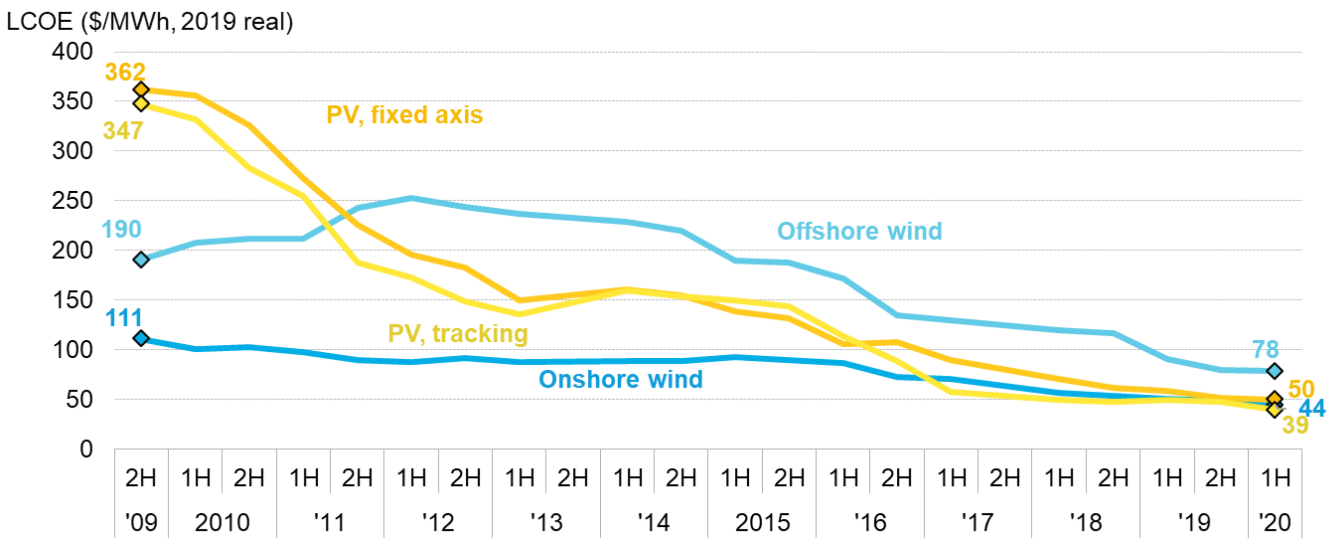
Competition from renewables

Improvements in renewables equipment prices mean cost reductions are felt across the world.

Zero-marginal cost renewables have changed the landscape dramatically over the last decade for the provision of new bulk generation, raising the competitive pressure on existing fossil assets. The least-cost options for new build have shifted from coal and gas to onshore wind and PV. Today, all major economies have at least one of the variable renewable technologies, if not both, outcompeting new-build coal and CCGT plants on a dollar-per-MWh basis. The main reason for this shift is equipment costs. The cost of wind turbines has fallen 40% since 2014, while they can extract 20% more energy from the same location. Crystalline PV modules are now almost 70% cheaper than five years ago, while the cost of inverters is down 54%.

BNEF's global benchmark LCOEs are now below $50MWh, with onshore wind down 9% just since 2H 2019, to $44/MWh; and fixed-axis PV at $50/MWh, down 4% from 2H 2019 (Figure 13). Our global benchmark for offshore wind is $78/MWh, including transmission costs.

Figure 13: Global benchmark LCOEs for PV and wind



Source: BloombergNEF

One barrier to unlocking lower and lower prices for renewables in less mature markets is cost of capital. Whereas financing costs can make up more than half of the levelized cost of electricity for renewables, this share is much lower for fossil fuels. However, as the case of Poland has shown, stable policy support can help compress financing costs, in particular in the EU where interest rates are low, and investor appetite for green assets is at an all-time high. BNEF's levelized cost of onshore wind in Poland has dropped from $114/MWh in 2014 to $58/MWh in 1H 2020.

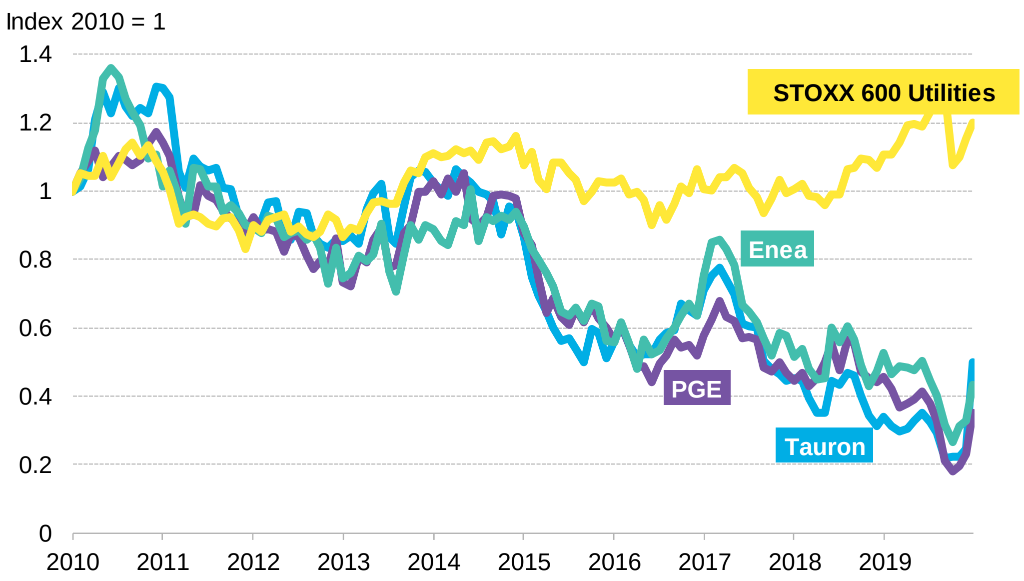
Utilities

Utility companies are feeling the pressure to upgrade their generation portfolios in line with changing energy economics. Direct and indirect costs associated with relying primarily on merchant coal power plants for revenue are mounting. This has encouraged a number of companies in Central and Eastern Europe to announce their transition away from coal, not without causing controversy. PGE, Poland's largest utility, has said it plans a coal exit in no more than 25 years, and that it aims to invest in 3.5GW of offshore wind in the Baltic Sea.

Investors concerned about ESG criteria are hesitant to sink money into companies that maintain high exposure to coal.

Recent discussions in Poland around spinning off the country's coal assets suggest that utilities are serious about restructuring in order to unlock investment to drive renewables. Deputy Prime Minister Jacek Sasin said on June 18, 2020: "It seems that the idea to spin off coal assets from power groups is a good one." Poland is considering the creation of a state-owned entity that would buy up the coal assets of all Polish utilities, allowing them to offload the liability tied to these assets and focus on clean energy instead. Tauron, which is one of Poland's most indebted utilities, with almost 3 billion euro in borrowings at the beginning of 2019, stated in its 2019 strategy that a shift towards renewables might help it attract new funding and investor confidence. Enea's acting CEO, Pawel Szczeszek, said the company will "welcome with interest" plans for reform and is "aware that changes in the power industry are needed." Shares in Polish utilities have underperformed against their European peers over the last five to six years, as they failed to convince investors that they had a strategy to reduce their exposure to increasing carbon prices (Figure 14). News of a potential spin-off of coal assets immediately saw their share prices rise.

Figure 14: Share price of Poland's top four utilities, compared with market peers



Source: Bloomberg Terminal

In Czechia, CEZ has been divesting from fossil fuel assets in south-eastern Europe, and aims to reshape its portfolio around renewables. CEZ has opted for selling its Poceady lignite plant, requiring costly retrofits, rather than closing the plant. EPH, one of the last buyers of coal power plants in Europe, has widened its portfolio to include some wind farms, biomass and solar installations, of which 15MW are in Czechia.

The structure of utilities in Romania and Bulgaria has typically been centered around one fuel or technology, with one company holding most coal assets and another company concentrated on hydro or nuclear power. Recent market liberalization could begin to shift this pattern. Romania's Hidroelectrica announced in May that it plans to develop offshore wind, and the country's Termoelectrica is recovering from bankruptcy and selling off uneconomical coal plants. State-controlled Romgaz and OMV Petrom, the former traditionally focused on supplying gas and the latter on producing oil and gas, have recently invested in large gas power plants to replace coal.

In Bulgaria, utilities are facing a losing battle as the EU court of justice ruled that the state may not allow indefinite derogations for pollutants. Bulgaria's BEH is not entirely reliant on coal thanks to its stake in the National Energy Company NEK, which owns the majority of hydropower assets in the country, but it has yet to announce a strategy for the closure of its coal assets. Bulgarian firm AES, owner of the large Galabovo lignite plant and a 156MW wind farm, previously announced investments in PV projects around 2010-12, but most of these projects have since been stalled. Pressure from the EU, national policy and support for renewables might change the current investment strategies of Bulgarian utilities.

Table 5: Utilities coal, renewables and emissions indicator comparison

Company	Share of coal/lignite capacity (2019)	Renewables targets – share of generation by 2030	Carbon intensity (tCO2/MWh)
PGE	76%	Approx. 18-25%	0.88 (2019)
Tauron	75%	65%	0.73 (2019)
Enea	92%	33%	0.61 (2018)
CEZ	42%	20%	0.39 (2019)
EPH	50%	n/a	0.50 (2019)
BEH	20%	N/A	0.39 (2015)

Source: BloombergNEF, company filings, Bloomberg Terminal

3.3. Outlook

BNEF defines the LCOE as the long-term offtake price on a per-MWh basis to achieve the required equity hurdle rate for a developer, taking into account total capital, operating and finance costs over the life of the project. Our LCOE estimates exclude costs of grid connection and transmission, as well as all subsidies and incentives, though we do include carbon prices where schemes are already in place.

The LCOE of new coal and gas-fired power plants is affected more by fuel and carbon prices, conversion efficiency and plant utilization than upfront capex or financing rates. And while the efficiency of the plant is fixed, utilization is not guaranteed and can vary significantly. In the last few years, a combination of weak electricity demand growth and rising solar and wind penetration has lessened the need for large, new coal- and gas-fired generators in most developed countries. Even in emerging economies like India and China, over-capacity and weaker-than-expected demand growth, plus problems with fuel availability, keep many new plants underutilized.

Tipping point 1: new solar and wind vs new coal and gas

The first indicator we focus on is known as 'tipping point one' – the moment when new-build renewable power becomes cheaper than building and operating a new fossil-fuel power plant. This tipping point appears to be mostly behind us, including in Poland, Czechia, Romania and Bulgaria (Figure 15, Figure 16, Figure 17, Figure 18). The LCOEs of new fossil assets are primarily driven by fuel and carbon prices, and most crucially by utilization, as we look at the lifetime of the asset and how its utilization over time can be expected to generate revenue. Growing renewables penetration cause the operating hours of fossil plants to be squeezed, which pushes up the LCOE. Considering the current cost-competitiveness of solar and wind plants, and their contrasting cost trajectories compared to new fossil fuel plants, these renewable technologies are expected to meet most of the need for new bulk generation. New gas plants can play the role of flexibility providers where existing dispatchable capacity is not sufficient. The expectation that renewables increasingly limit the operating hours of fossil fuel plants, a crucial driver of LCOEs, means that in some cases tipping point one exceeds by far the new build cost of renewables. We do not plot cases where the LCOE for new fossil fuels exceeds 120 euros/MWh in the charts below.

Figure 15: Cost of new onshore wind and utility-scale PV vs new coal and gas, Poland

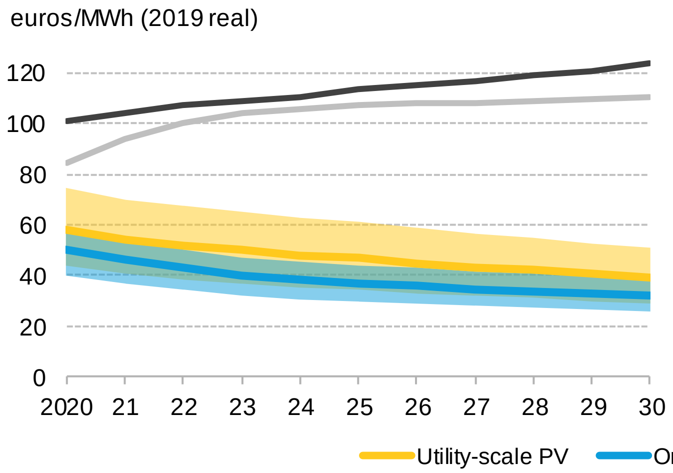


Figure 16: Cost of new onshore wind and utility-scale PV vs new coal and gas, Czechia

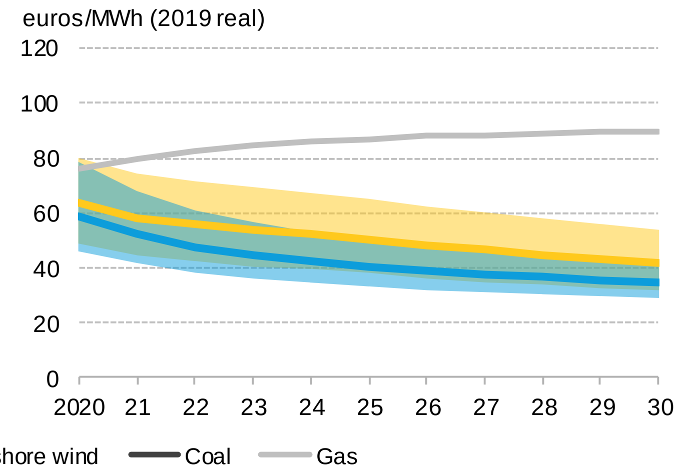


Figure 17: Cost of new onshore wind and utility-scale PV vs new coal and gas, Romania

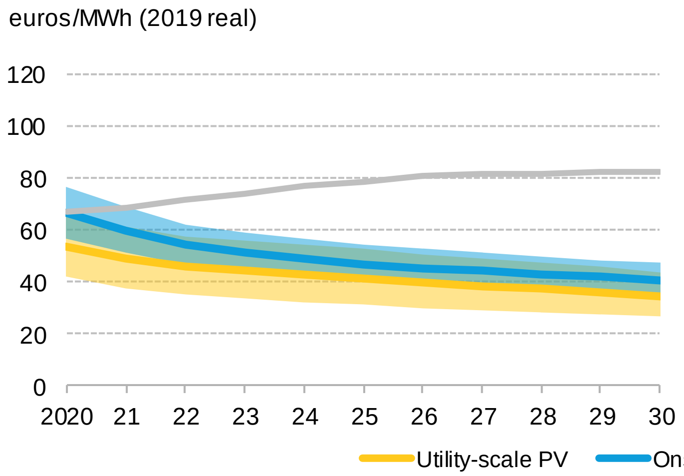
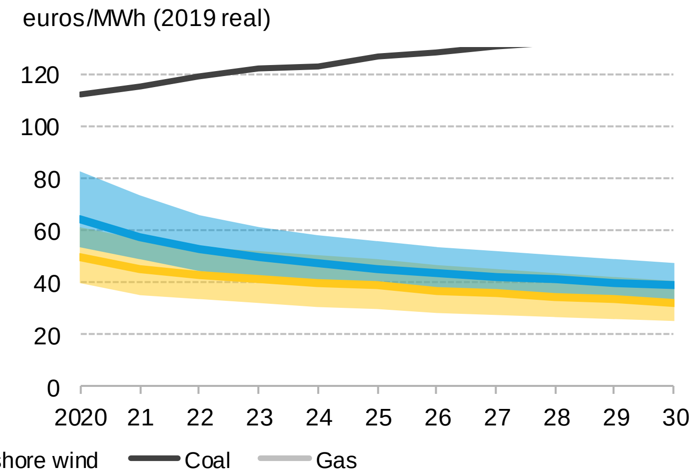


Figure 18: Cost of new onshore wind and utility-scale PV vs new coal and gas, Bulgaria



Source: BloombergNEF. Note: Where coal or gas do not appear, tipping point one has already been reached and we do not plot values so far off the scale. This occurs when running hours would be so low for new fossil build that the economics cannot be compared within our usual range.

Tipping point 2: new solar and wind vs existing coal and gas

The second driver of our outlook is the second tipping point, which occurs when it becomes cheaper to build new onshore wind or PV than to run an existing coal or gas plant that provides bulk electricity (Figure 19, Figure 20, Figure 21, Figure 22). Once the LCOE of solar or wind falls below the short-run marginal cost of an existing fossil fuel plant, it makes economic sense to replace it with a new unit of renewables capacity – if it is not needed to ensure security of supply. This is where all the economic drivers outlined above compound to impact the running costs of fossil assets. In power systems with moderate or no demand growth, as has been the case in Europe, tipping point 2 is when decarbonization accelerates.

Figure 19: Cost of new onshore wind and utility-scale PV vs operational cost of coal and gas, Poland

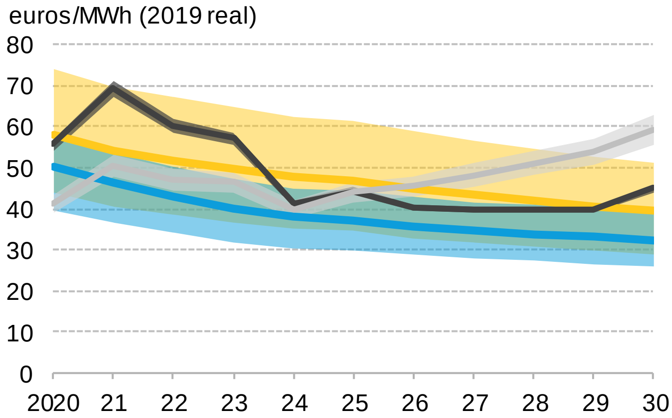


Figure 20: Cost of new onshore wind and utility-scale PV vs operational cost of coal and gas, Czechia

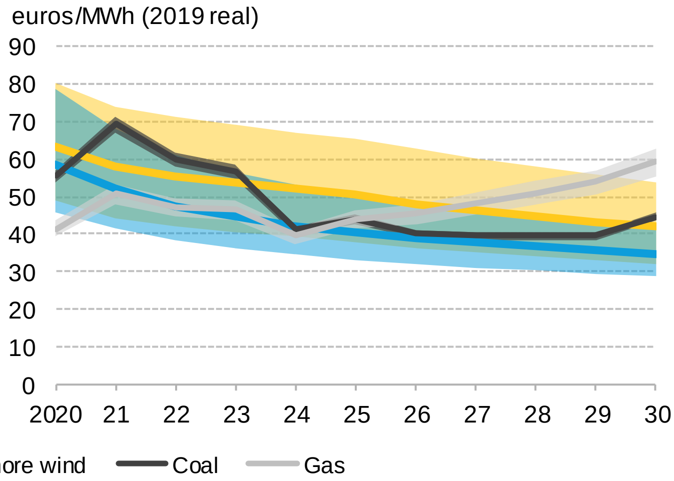


Figure 21: Cost of new onshore wind and utility-scale PV vs operational cost of coal and gas, Romania

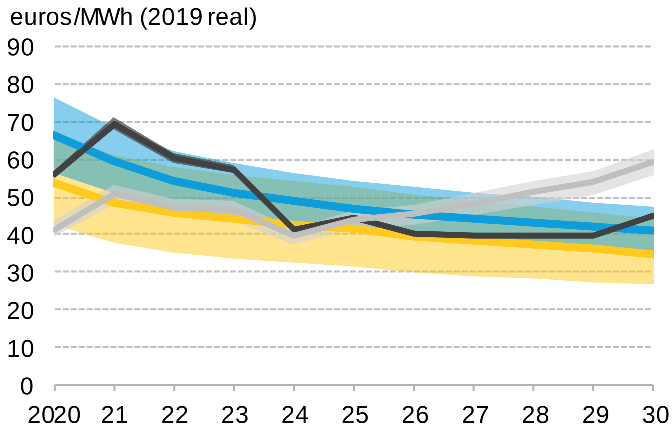
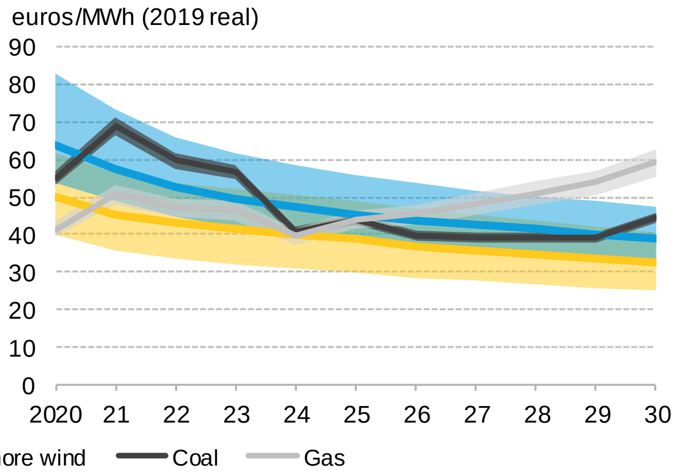


Figure 22: Cost of new onshore wind and utility-scale PV vs operational cost of coal and gas, Bulgaria



Source: BloombergNEF

Still tipping point two is not a "cliff face", where once it is reached there is no going back. In practice, there are many reasons why deployment of renewables may fail to accelerate at this point, and existing fossil fuel plants continue to generate. This includes uncertain market price signals for new renewables build, and the fact that gas and coal plants can operate at reduced output. We also did not factor in capacity mechanisms or cold reserves, choosing instead to look at the real costs incurred by assets themselves. This also helps to assess the system's adequacy without such out-of-market compensation. Lastly, a lower carbon price in the second half of the 2020s also causes coal's running costs to fall, in our modelling.

The minimum capacity factor for coal and gas plants to keep them online varies between markets, but in all cases the consequence of continued growth in renewables is the eventual retirement of fossil capacity. That may occur in chunks rather than following a smooth trend, leading to greater demand for new-build capacity, a further boost for renewables.

The short-run marginal cost is only one part of the story. Tipping point two means that new-build renewables displace running hours of the existing coal and gas fleets. In order to stay online, existing plants need to recoup both their variable operation costs (fuel, variable O&M, carbon) but also their fixed operation costs (mortgage payments, fixed O&M). With fewer run hours, fixed expenses need to be recouped over fewer MWh each year. As a result, fixed operation costs of the fleet increase on a euro-per-MWh basis. This effect and an increase in gas prices are the reason why gas becomes less competitive towards the end of the decade.

Impact on modeling

Tipping points one and two are the key drivers of our outlook, determining what capacity should be added and retired over the next decade. Over the next two years, where the lead time is too short for modelled projects, our analysis is based on our proprietary project database, which provides detailed insight into planned new build, retrofits and retirements, by country and by sector, and an assessment of policy drivers. Then the model uses the first and second tipping points to shape a least-cost optimization exercise, driven by the cost of building different power generation technologies to meet projected hourly and peak demand, country by country.

We concentrate this analysis on the period from now to 2030, as Europe looks carefully at its energy sector targets and considers yet another increase in ambition for this decade. We model a least-cost scenario that does not take into account any new policy targets or aspirations. We set reasonable limits on build and retirements, acknowledging the real-world constraints that each country faces. No capacity payments are included, nor strategic reserve considerations. Each existing power plant is treated as a revenue-optimizing player.

Our demand forecast has been updated to take into account the Covid-19 outbreak and resulting slowdown. We use BNEF's Scenario 2 that assumes the virus is not yet under control, and subsequent shutdowns may be necessary, with economic growth returning in 2021.

Each electricity system is essentially modelled as an island. Interconnector capacity is available, but at a premium price. This allows us to identify the most effective system for each country while ensuring its security of supply and energy independence. In reality, interconnection would likely lead to a greater share of renewables in all cases, as interconnection can help absorb variable renewables generation and increase price pressure on less competitive assets.

Section 4. Results

4.1. Poland

Least-cost

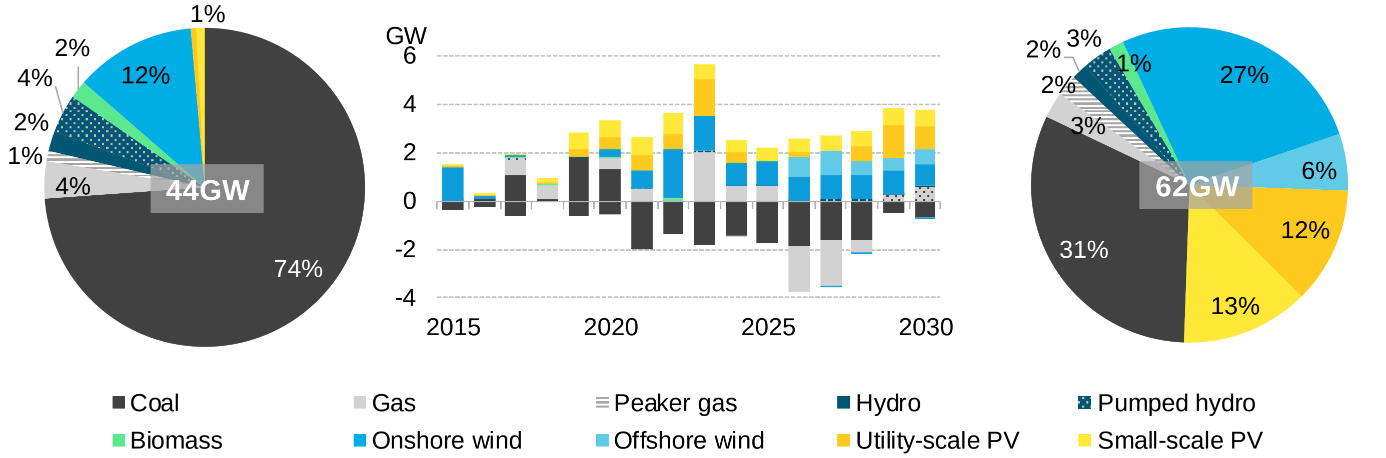
Coal makes up less than one third of installed capacity in 2030

The Polish power system grows more than 40% in absolute capacity terms from 2018 to 2030, and transforms from more than two-thirds coal and lignite to less than one third by the end of the decade (Figure 23). Renewables capacity more-than-triples in order to fill the gap. The largest share of the mix in 2030 is held by wind, with a combination of onshore and offshore. The competitive economics of onshore wind see Poland add just over 1GW per year, slightly less than the 1.36GW it installed in 2015, its record year. Offshore wind begins to come online in the second half of the decade, as projects that are already under development commission. PV capacity grows steadily, with a fairly even split between small-scale and utility-scale, thanks to favorable economics in a sector that is already growing rapidly.

Coal retirements accelerate, as in the near term, plants reach the end of their lifetime or run out of emission compliance derogations. Economic pressure also squeezes the margins of the oldest and less efficient coal and lignite assets. Additional pressure will come from retrofit requirements to comply with stricter emission limits. We have not taken these costs into consideration, but they will likely compel more capacity to retire rather than lead owners to make these costly investments, especially when the longer-term profitability of coal power plants is in doubt.

The least-cost power mix does see a role for combined-cycle gas capacity, though less than 2GW of this is modelled capacity whilst two 650MW blocs are already in the pipeline. Renewables additions and lower demand due to Covid-19 produce a situation of overcapacity, where the least efficient older gas plants are pushed out later in the decade as gas prices rise and carbon prices fall. Peaker gas is also added over 2029-2030 to provide additional flexibility to a system that by 2030 is made up of 61% renewables in installed capacity terms.

Figure 23: Evolution of installed capacity from 2018 to 2030



Source: BloombergNEF

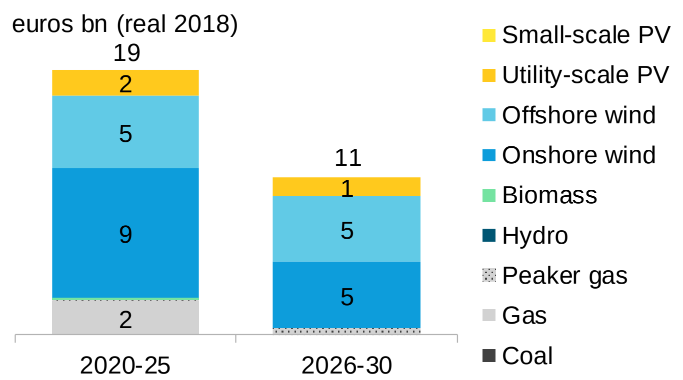
The nearly 30GW of renewables that are added over the next decade represent a 28 billion-euro investment opportunity (Figure 24). The majority of this goes to onshore wind, which could require 1.4 billion euros a year in asset finance. Offshore wind also attracts an additional 10 billion euros in investment, split across the decade. Low solar costs mean just over 3 billion euros investment in new capacity, a similar amount to that spent on new gas plants.

Poland is able to reach a share of 49% renewables in electricity generation by 2030 in a least-cost scenario.

This investment allows Poland to generate almost half of its electricity from renewable sources by 2030, achieving a share of 49% (Figure 25). Wind accounts for the largest renewables share, with 29% of electricity demand met by onshore wind and 10% by offshore wind in 2030. Solar PV adds another 8%. Coal and lignite together still make up the largest share of total power generation, accounting for 49% of the mix in 2030, down from 78% in 2018.

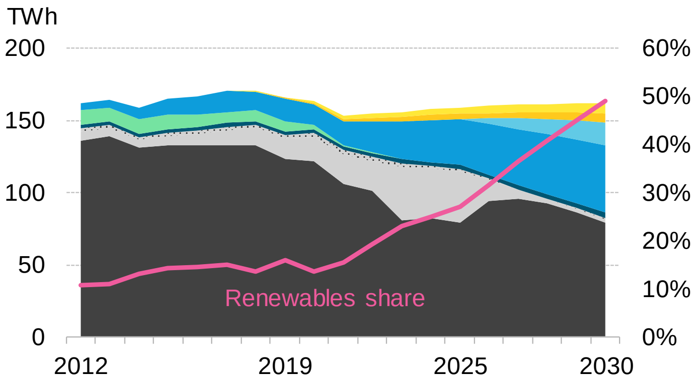
While gas generation picks up in the first half of the 2020s, the least-cost scenario that does not take into account any new policies sees CCGT nearly squeezed out of the power mix by 2030 because of stagnating carbon prices. Coal retirements and high carbon prices in the early 2020s create a gap for lower-cost gas generation, but there is a high risk of this capacity becoming stranded assets in just a few years' time. If Poland were to take a more aggressive approach to coal retirement, a longer-term role for gas generation would be more likely. Similarly, reform to the EU ETS that ensures carbon prices do not dip again in the second half of the decade would continue to push coal out of the mix, rather than allow a resurgence that eats into gas. If the EU's ambitious green deal targets are to be met, such a reform may be necessary.

Figure 24: New investment in capacity



Source: BloombergNEF

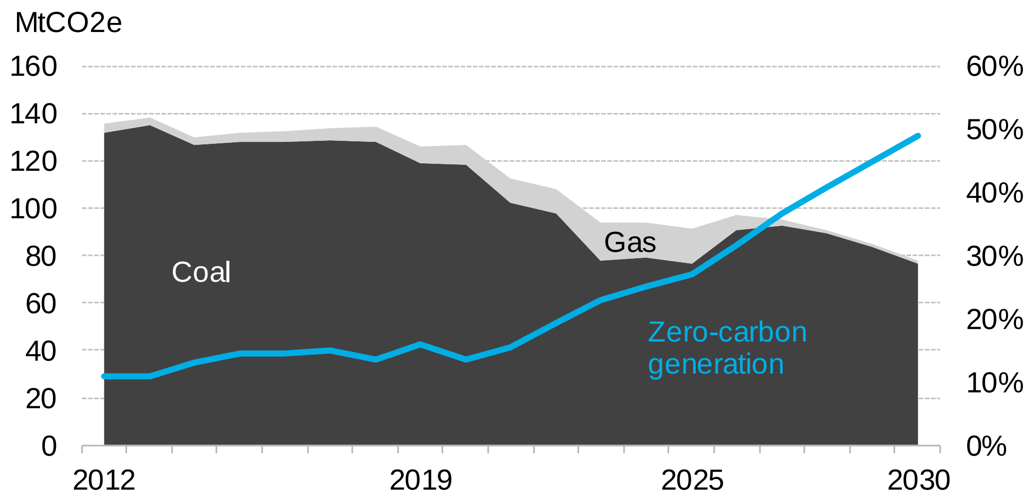
Figure 25: Generation mix and renewables share



Source: BloombergNEF

This least-cost scenario allows Poland to cut its power sector emissions by more than 40% from 2018 levels (Figure 26). The recovery in coal generation in the second half of the decade keeps this drop from being larger. An increased role for gas would mean higher emissions from that fuel over time, but would ultimately result in lower total emissions in the second half of the decade.

Figure 26: Power sector emissions and zero-carbon generation share

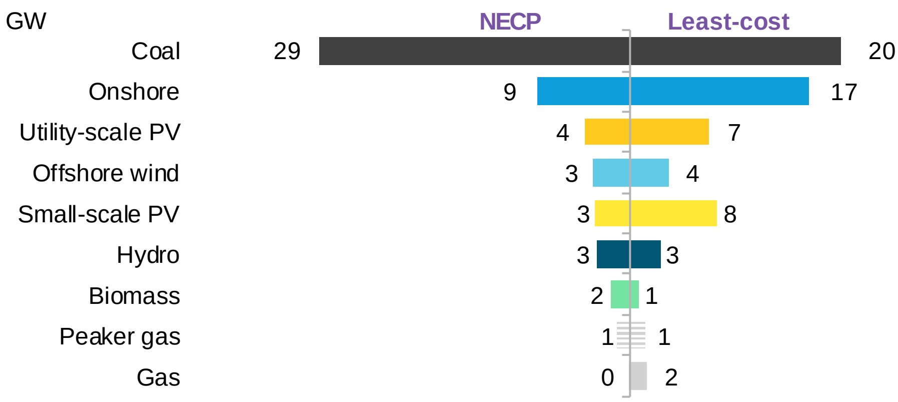


Source: BloombergNEF

NECP

Poland's current National Energy and Climate Plan focuses on adding new solar and offshore wind capacity in order to meet its 2030 renewables targets. The NECP envisions total coal capacity falling by just 5GW from 2020 to 2030, led by retirement of the oldest hard coal units. At the same time, however, additional capacity is still under construction. Although it is now clear that what would have been Poland's last coal project, Ostroleka C, will now proceed as a gas plant, we have modeled the scenario as laid out in the current NECP for consistency, with 930MW of new hard coal capacity coming online between 2020 and 2025.

Figure 27: Capacity in 2030 by technology, NECP vs least-cost



Source: BloombergNEF, NECP

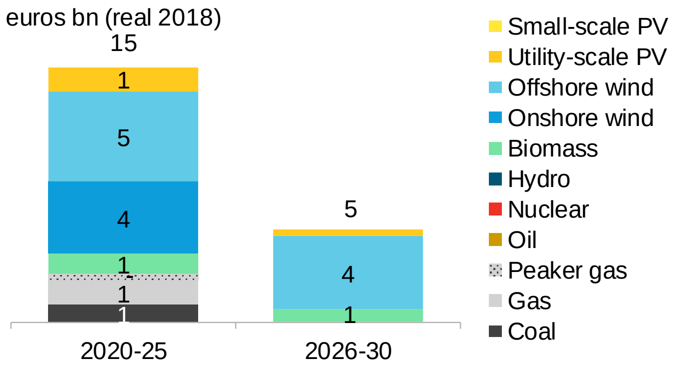
The total volume of installed coal and lignite capacity does still fall by 3.6GW from now until 2030, though Poland's current NECP sets out numbers for installed capacity of coal and lignite in 2020 as a 'starting point' that are much lower than actual installed capacity in 2019. We have modelled coal retirements so that coal capacity falls from 2020 to 2030 by the same order of magnitude as that laid out in the NECP. The NECP sees net lignite capacity down by less than 500MW from 2020 to 2030, and hard coal capacity down by 4.6GW.

Poland's NECP prioritizes offshore wind and PV at the expense of onshore wind. After the current pipeline of projects awarded at auction over the last several years, the NECP suggests that no new onshore wind will be built before 2030 (Figure 27). Instead, just over 3GW of offshore wind will be added, and around 6GW of PV. Renewables volumes overall are much lower than in the least-cost scenario, except for biomass. Investment in biomass represents 12% of the spend on new renewables capacity over the next decade, while accounting for just 6% of new capacity, and running at very low utilization due to high fuel costs. Granting subsidies to biomass plants could address this underutilization, but this would costlier than relying on wind and solar instead.

While the NECP targets additional combined-cycle gas capacity, and there are new gas projects already in the pipeline, this fleet is seen being heavily underutilized. This is because of the continuing presence of coal in the system along with lower carbon prices at the end of the decade. By 2030, it makes more sense to close CCGT capacity as coal generation picks up again. By limiting coal retirements to align with the capacity targets in the NECP, the system is oversupplied to the extent that low capacity factors drive up the LCOE of gas, and the model closes gas capacity, including new build.

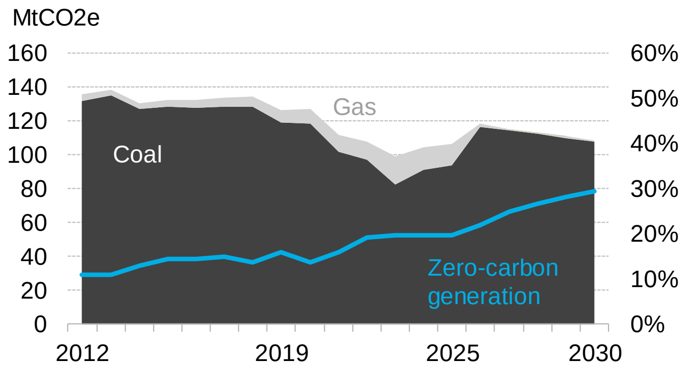
Poland's capacity mix laid out in the NECP locks the country into a more costly system, opting for coal generation with associated fuel, carbon and retrofit costs, and building gas plants that end up as stranded assets. In the NECP scenario, renewables attracts some 18 billion euros of new investment, with about half of this total going to offshore wind (Figure 28).

Figure 28: New investment in capacity



Source: BloombergNEF

Figure 29: Power sector emissions and zero-carbon generation share



Source: BloombergNEF

The addition of some 3GW of offshore wind and 7GW of PV, alongside the existing onshore wind fleet, allows Poland to exceed its 2030 target of 27%, to reach 30% renewables generation by that year (Figure 29). The impact on power sector emissions is less significant, because of the continued role of coal in the system. From 2018 to 2030, emissions fall by 19%.

Table 6: Comparison between least-cost and NECP scenario

	Least-cost	NECP
Total renewables build, 2020 to 2030	29GW	11.7GW
Investment in new renewables	27 billion euros	10.8 billion euros

	Least-cost	NECP
Share of renewables generation in 2030	49%	26%
Emissions reduction from 2018 to 2030 (share)	42%	14%
Difference in annual emissions in 2018 vs 2030 (absolute)	-57MtCO2	-19MtCO2

Source: BloombergNEF

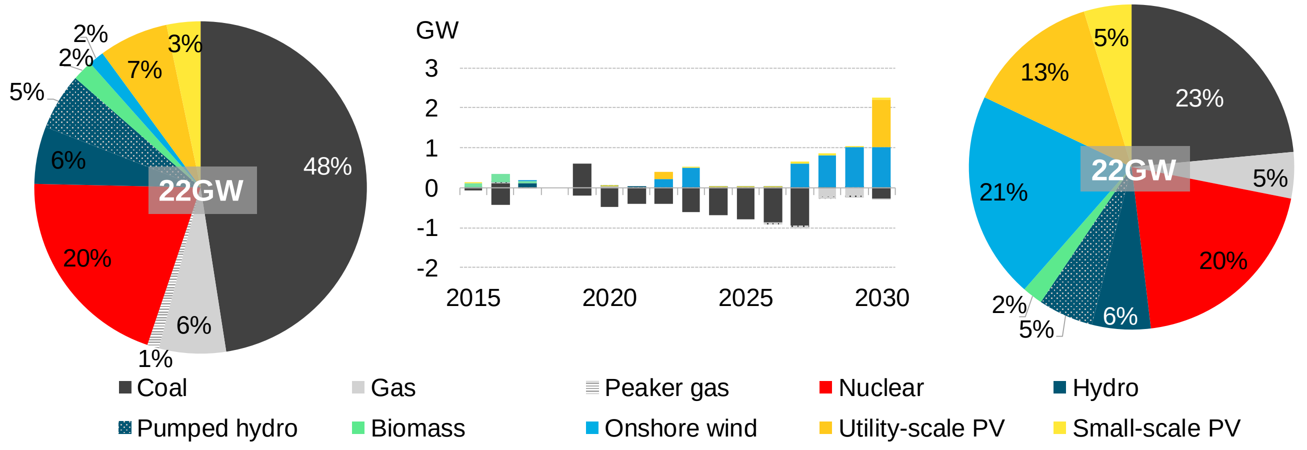
4.2. Czechia

Least-cost

The least-cost scenario sees coal and lignite capacity in Czechia drop by half from 2018 to 2030. This capacity is replaced with renewables, which triple by 2030. The total size of the system does not grow between 2018 and 2030, as the country is well interconnected and has little need for a large capacity reserve. After smaller additions of solar and wind capacity, no other new capacity is added until 2026, as demand growth is expected to be weak, as Europe recovers from Covid-19. The renewables build of 5.8GW is dominated by 4.1GW of onshore wind, the economics favoring wind over PV.

More than 4GW of new onshore wind capacity is an ambitious outcome for Czechia. But wind turbine technology is evolving and newer turbines can capture higher capacity factors and lower wind speeds. This could allow for such high wind deployment in Czechia if the right policies are introduced. Conservative estimates, taking into account social factors and using historical capacity factors and turbine designs, suggest that available land with good wind resources allows for approximately 2.3GW of installed wind capacity in Czechia, according to a study published in 2019. Newer turbines could, however, generate in locations with wind speeds historically considered to be too low, and larger wind turbines could be installed on current wind sites, making it possible for Czechia to deploy the 4.1GW onshore wind added in our least-cost scenario.

Figure 30: Evolution of installed capacity from 2018 to 2030



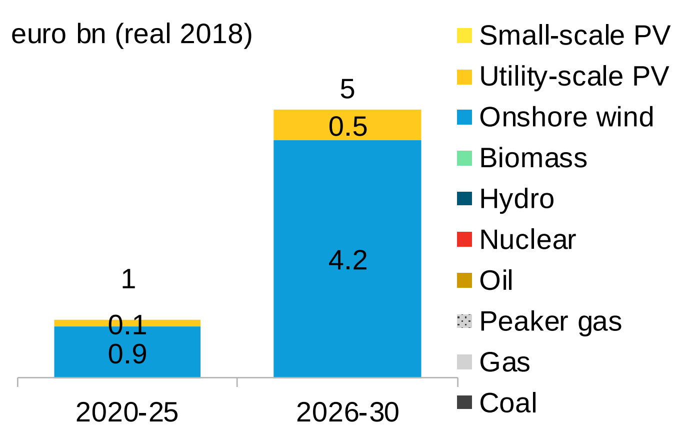
Source: BloombergNEF

A total of 6GW of lignite and hard coal plants come offline between 2020 and 2030, as carbon prices and the fleet's age makes continued operation uneconomic. All hard coal plants close by

2027, whereas newer and retrofitted lignite plants still remain online in 2030 due to lower fuel costs. With part of the lignite fleet remaining, the Czech power system has no need for new gas build. Some of these lignite plants will require additional investment to comply with EU emissions directives -- a cost that is not included in the modelled scenario. These retrofitting costs could lead to additional lignite plants closing or converting to gas.

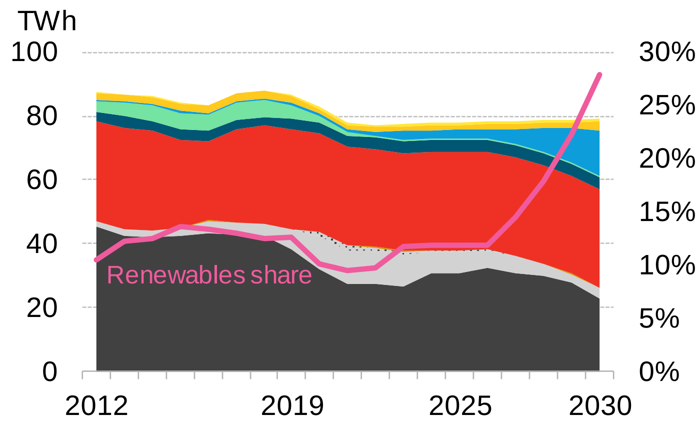
Almost 6 billion euros in new investment is unlocked in the least-cost scenario, with onshore wind installations attracting nearly 1 billion euros per year after 2025, as capital costs for new wind decrease (Figure 31). The chance of wind investments foreseen in the least-cost scenario becoming reality, however, depends on how the policy context develops, and whether or not local resistance to the installation of wind turbines can be overcome.

Figure 31: New investment in capacity



Source: BloombergNEF

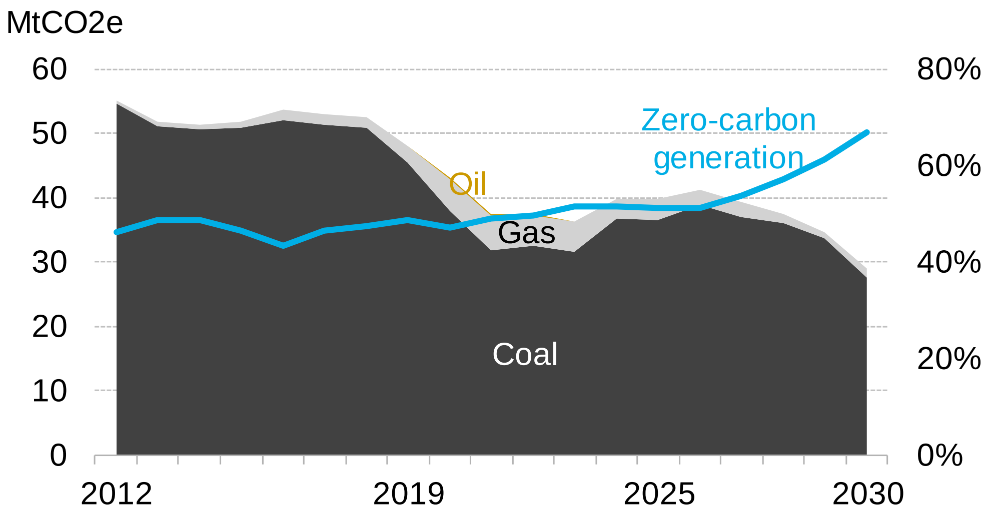
Figure 32: Generation mix and renewables share



Source: BloombergNEF

This investment allows wind to provide 18% of Czechia's electricity production by 2030, and sees the country achieve a 28% share of renewables generation in 2030, far exceeding the target of 17% renewables in electricity consumption proposed in the current NECP. Czechia's renewables share does not grow rapidly during the first half of the decade, as biomass generation falls due to high fuel costs, in the least-cost scenario. The addition of solar and onshore wind in the second half of 2020, however, makes the renewables share grow rapidly.

Figure 33: Power sector emissions and zero-carbon generation share



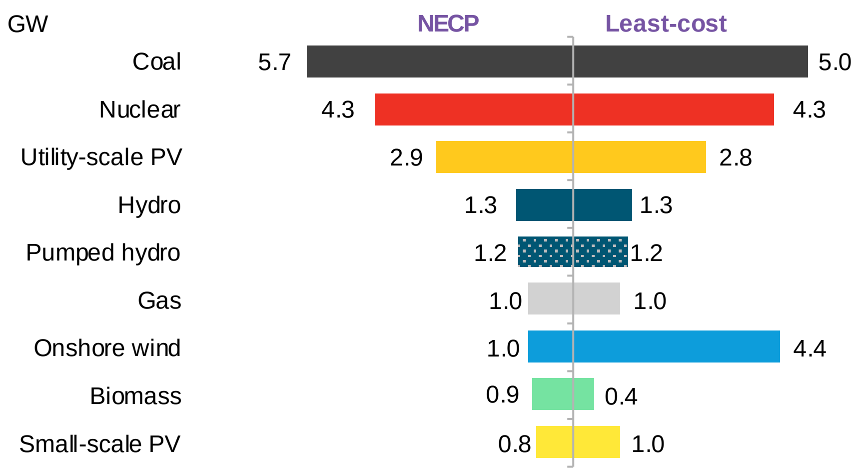
Source: BloombergNEF

The growth in renewables generation allows Czechia to reduce its power sector emissions by 45% from 2018 levels by 2030. The increase in wind generation by the end of the decade pushes out some coal generation, despite the carbon price being lower than in the mid-2020s. Changes in EU ETS regulation could see emission allowance prices giving gas a competitive edge after 2025, leading to even lower levels of coal generation, and further declines in emissions.

NECP

The Czech NECP prioritizes solar as it adds 1.8GW of PV but much less wind and biomass capacity. The NECP does not envision any other capacity additions and also does not lay out a plan for retiring any fossil capacity. Crucially, the wind sector's potential is left unexploited.

Figure 34: Capacity in 2030 by technology, NECP vs least-cost



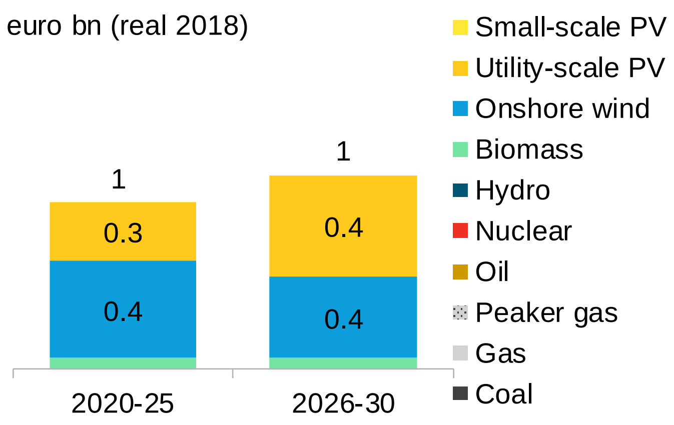
Source: BloombergNEF, NECP

New wind build reaches only 500MW, although onshore wind could play a more significant role than solar in the Czech power system due to its higher capacity factors. Historically, annual average wind capacity factors in Czechia have ranged from 23% to 25%, but with the improved technology of new turbines, they could reach up to 35% by the end of the decade. Solar in Czechia has average capacity factors around 11%, and this is not expected to significantly increase over time. However, expansion of wind capacity might face challenges due to negative public perception of wind turbines and local restrictions on building them, despite the favorable capacity factors.

Total investment in the NECP scenario is much lower than in the least-cost scenario. Just 2.6GW of renewables are added in the next decade, with 1.6 billion euros in investment unlocked. Despite solar capturing the larger share of added capacity, investments are divided approximately equally between solar and wind, as solar costs less for every megawatt installed.

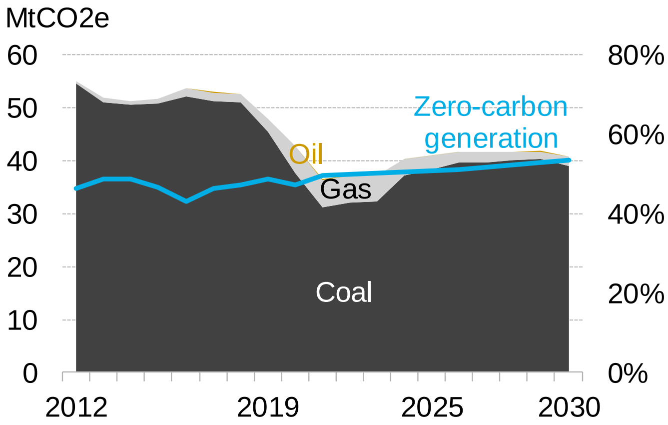
The capacity mix laid out in Czechia's NECP does not allow the country to increase its share of zero-carbon generation substantially, achieving just over 50% by 2030, with the existing nuclear fleet still the main provider of clean power. The renewables share remains a low 15%, falling short of Czechia's 2030 renewable generation target of 17%.

Figure 35: New investment in capacity



Source: BloombergNEF

Figure 36: Power sector emissions and zero-carbon generation share



Source: BloombergNEF

The capacity mix envisioned in the NECP includes almost 4GW of PV, but the power system offers little flexible capacity aside from 1.2GW of pumped hydro and a few peaking gas plants. As both nuclear and lignite are best suited for running flat out to provide baseload electricity, the reliance on these technologies in combination with PV leads to rising marginal curtailment levels of solar after 2027. Marginal curtailment reflects the curtailment of the latest added new PV unit. Although overall solar curtailment remains below 1%, marginal curtailment impacts the LCOE of PV in the NECP scenario. It ends up being higher than in the least-cost scenario. In reality, Czechia's robust interconnection capacity should help mitigate this impact.

Emissions drop quickly until the mid-2020s in the NECP scenario, but a fall in the carbon price sees coal generation rise again, with the result that by 2030, emissions are just 22% less than 2018 levels, although in 2023 emissions were almost 30% below 2018 levels. After 2025, forecasted increases in the gas price, and lower carbon allowance prices, risk reversing the trend of gas generation replacing coal generation. Coal-to-gas fuel switching could continue post-2025 if the ETS is reformed to meet the EU's new, more ambitious 2030 targets laid out in the green deal. If a larger share of the coal fleet retired, and was therefore unavailable after 2025, gas generation would likely remain at similar levels to that in the first half of the decade.

Table 7: Comparison between least-cost and NECP scenario

	Least-cost	NECP
Total renewables build, 2020 to 2030	5.8GW	2.6GW
Investment in new renewables	5.8 billion euros	1.6 billion euros
Share of renewables generation in 2030	28%	15%
Share of zero-carbon generation in 2030	67%	54%
Emissions reduction from 2018 to 2030 (share)	45%	22%
Difference in annual emissions in 2018 vs 2030 (absolute)	-24MtCO2	-12MtCO2

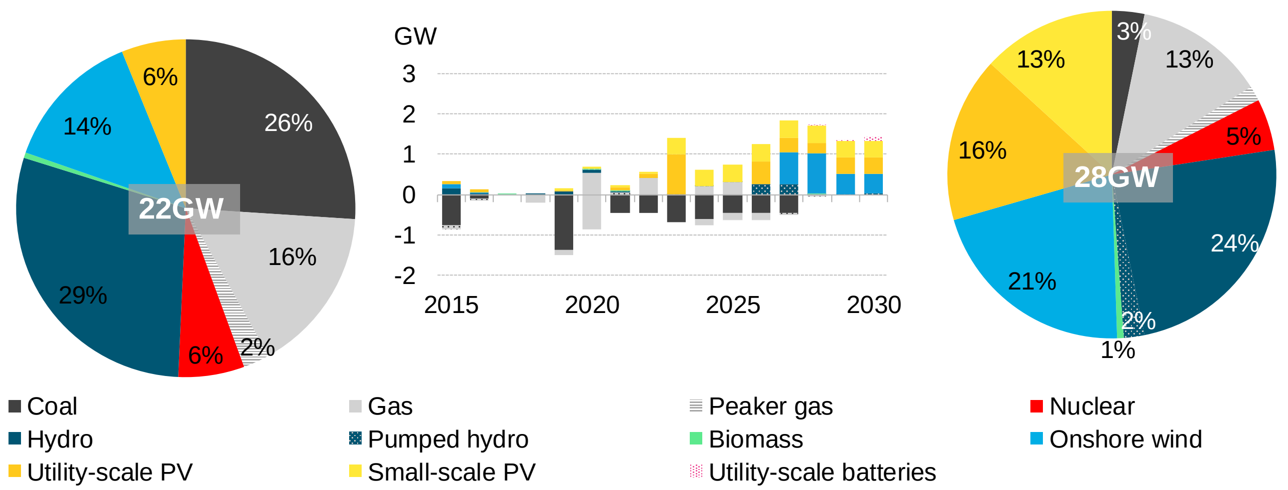
Source: BloombergNEF

4.3. Romania

Least-cost

The total size of the Romanian power system grows from 22GW to 28GW over the next decade in the least-cost scenario, with the addition of 10GW of new solar and wind capacity (Figure 37). By the end of the decade, wind and solar account for 50% of capacity, as onshore wind capacity doubles and solar grows fivefold from 2018 to 2030. Solar investments dominate at the beginning of the decade, but wind build increases after 2026 due to lower costs.

Figure 37: Evolution of installed capacity from 2018 to 2030

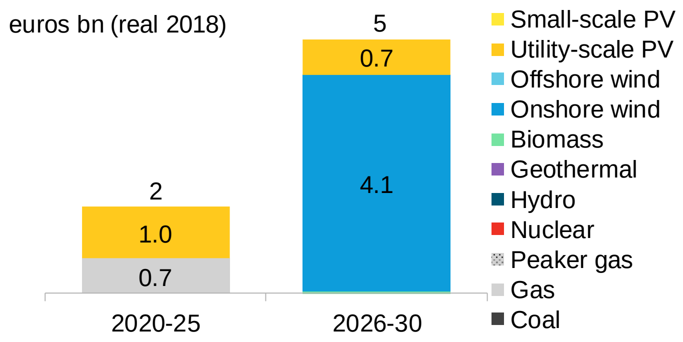


Source: BloombergNEF

The economics of the aging coal fleet worsen with rising carbon costs, prompting plants that have been operating for more than 40 years to retire over the next five years. The least-cost scenario shows only 900MW of the most efficient lignite units remaining online after 2027. The share of coal in the capacity mix falls from 26% in 2018 to just 3% towards the end of the decade. New gas capacity is added to replace retiring coal and older gas, but total gas capacity remains consistent at around 3.5GW, as some older gas units operating with lifetime derogations retire along with coal plants. Romania also has plans to replace some of its retiring coal capacity with new gas units, which help provide flexibility to the system. Overall, from a mix that is more than 40% fossil fuel in 2018, by 2030 Romania's capacity mix is less than 20% fossil fuel.

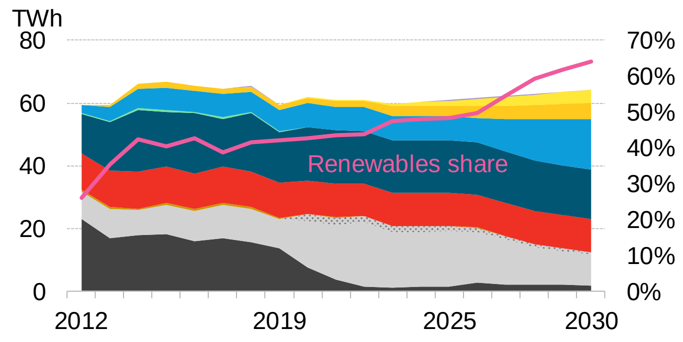
The growth in renewables capacity represents a 6.4 billion-euro investment opportunity, (Figure 38). The majority of investments occur after 2025 when wind and solar technologies become increasingly competitive and onshore wind investments total 4.1 billion euros between 2026 and 2030. This highlights the point that renewables may need some support, such as more evenly distributed auctions, if deployment is to start earlier on in the decade.

Figure 38: New investment in capacity



Source: BloombergNEF

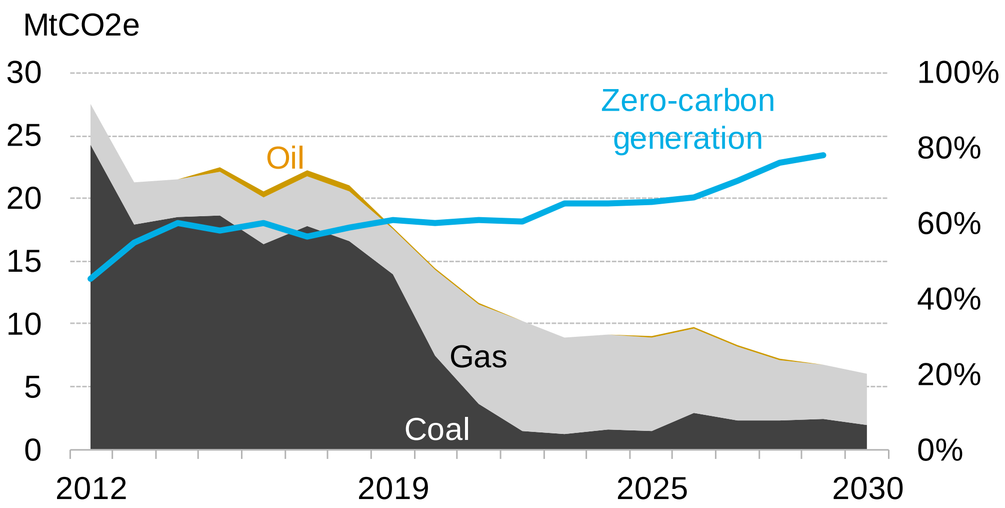
Figure 39: Generation mix and renewables share



Source: BloombergNEF

Installed capacity for solar grows faster than wind until 2025, after which wind capacity is significantly increased. But even before the large buildout of new wind capacity, wind generates more than twice as much as solar every year due to higher capacity factors (Figure 39). In the least-cost scenario, by 2030, some 64% of electricity generation comes from renewable sources, while 80% is zero-carbon thanks to the inclusion in that of nuclear generation. Coal generation decreases dramatically after 2022 as most capacity retires. Although the carbon price decreases after 2025, coal generation stays low as few units remain online. Gas generation is squeezed mainly by increased wind generation towards the end of the decade.

Figure 40: Power sector emissions and zero-carbon generation share



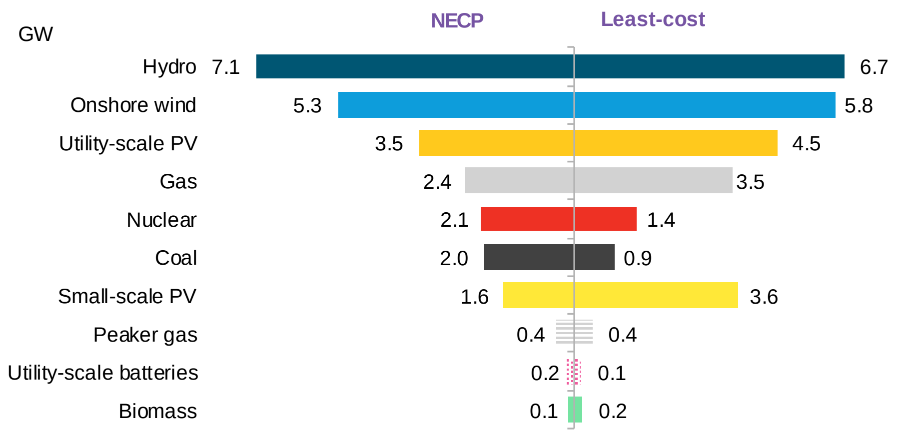
Source: BloombergNEF

Romania's hydro and nuclear fleet mean that the grid's emissions intensity is already slightly below the EU28 average, but the least-cost scenario allows for a further 71% reduction in power sector emissions (Figure 40). With an emission intensity of around 100gCO2/kWh in 2030, Romania's power sector would reach the 2017 levels of the top 10 least carbon-intensive countries in Europe, with an average emission intensity of around 60gCO2/kWh.

NECP

Romania's NECP expects 6GW of new renewables to come online over the next decade, in addition to a new nuclear unit. The NECP scenario and the least-cost scenario add similar amounts of new onshore wind capacity, but the least-cost scenario adds significantly more PV, both small-scale and utility-scale (Figure 41). Romania has favourable conditions for solar power, and a scheme for supporting rooftop solar was launched in 2019. With continued policy support, it is possible for the country to achieve the high solar deployment of the least-cost scenario. The NECP scenario adds new hydro and gas capacity, whilst seeing less coal retirements.

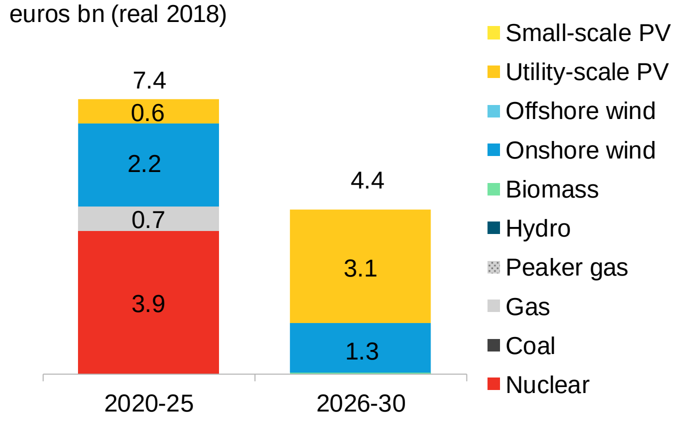
Figure 41: Capacity in 2030 by technology, NECP vs least-cost



Source: BloombergNEF, NECP

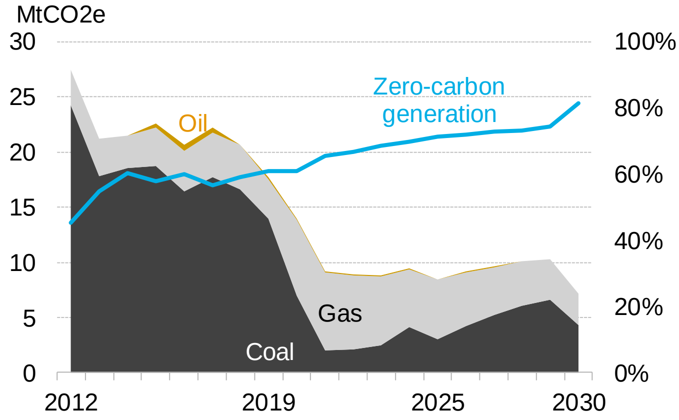
The 2021-30 investment total runs to around 12 billion euros, when including the new nuclear plant foreseen in the NECP (Figure 42). The nuclear investment of 4 billion euros represents almost a third of total new capacity spending, but with under 1GW it adds less than 10% of new capacity. New nuclear capacity might lead to increasing levels of renewables curtailment, as nuclear generation cannot easily turn off when intermittent renewables are generating. A planned addition of 1GW pumped hydro capacity, together with batteries in addition to the planned NECP build, could help balance renewables generation.

Figure 42: New investment in capacity



Source: BloombergNEF

Figure 43: Power sector emissions and zero-carbon generation share



Source: BloombergNEF

Nuclear generation could reach up to 24-25% from 17-18% of total generation after a new unit is commissioned in 2030. This nuclear investment could lead the zero-carbon share of generation to reach similar levels as in the least-cost scenario, but for a noticeably higher total upfront investment cost of 14 billion euros compared to 10 billion euros – as the NECP also envisions building new renewables capacity to meet 2030 targets. The running and decommissioning costs of nuclear power plants also far exceed those of solar and wind. The least-cost scenario also allows additional coal retirements, leading to a more significant drop in emissions, which fall 71% in the least-cost and 65% in the NECP scenario (Figure 43). The NECP scenario relies on nuclear power to achieve emissions reduction, but as nuclear plants can face delays, deployment of more renewables might be a faster way of decarbonizing Romania's grid.

Table 8: Comparison between least-cost and NECP scenario

	Least-cost	NECP
Total renewables build, 2020 to 2030	10GW	6GW
Investment in new renewables	5.7 billion euros	7.3
Share of renewables generation in 2030	63%	57%
Share of zero-carbon generation in 2030	80%	81%
Emissions reduction from 2018 to 2030 (share)	71%	65%

	Least-cost	NECP
Difference in annual emissions in 2018 vs 2030 (absolute)	-17MtCO2	-13MTCO2

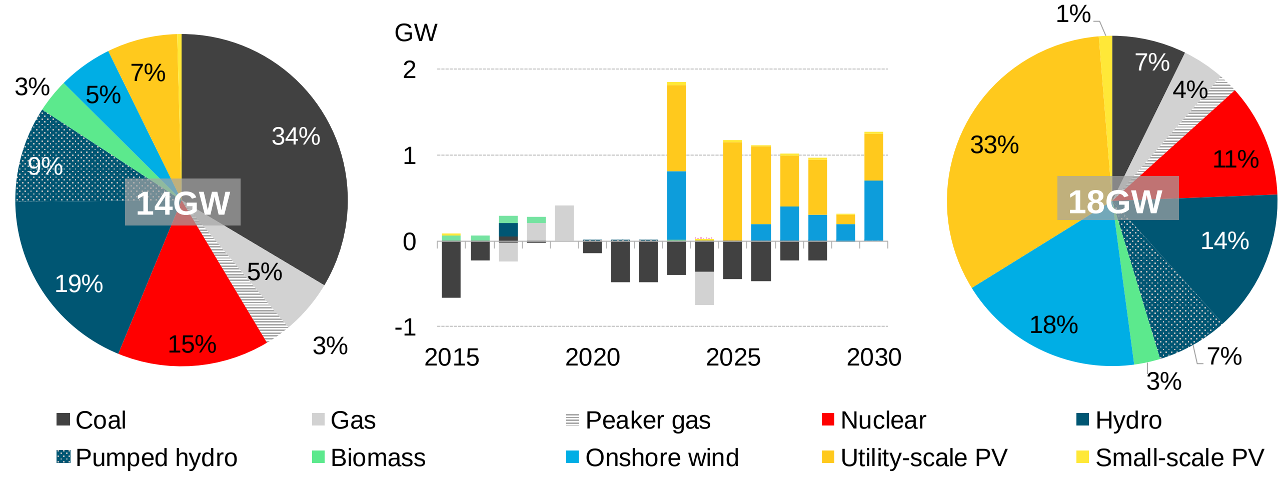
Source: BloombergNEF

4.4. Bulgaria

Least-cost

Bulgaria's least-cost scenario sees almost 8GW of new renewables installed over the next decade, while coal and lignite capacity drops by nearly three-quarters, leaving just 1.3GW online by 2030 (Figure 44). Roughly half of Bulgaria's current coal and lignite fleet is over 50 years old, and is near the end of its lifespan. Other units that have been operating for more than 40 years are pushed out by high carbon costs. One hard coal unit commissioned as late as 2011 is already benefiting from a lifetime derogation to comply with EU air pollution limits. Costly retrofits required by emission standards are not included in the least-cost scenario, but the total investment necessary for the remaining 1.3GW is significantly lower than the cost of retrofitting the entire existing coal fleet. The two remaining hard coal units can benefit from CHP derogations until 2023, but will need to be retrofitted after that, and the same applies for the four lignite units.

Figure 44: Evolution of installed capacity from 2018 to 2030



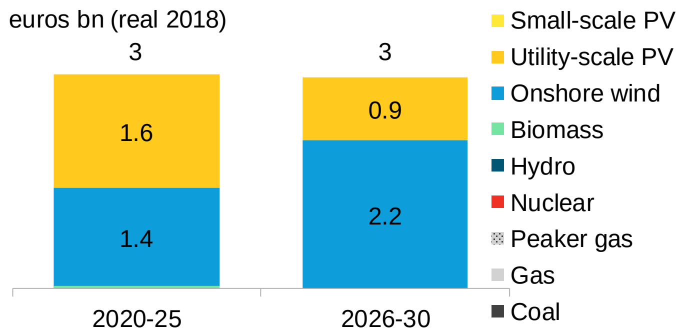
Source: BloombergNEF

The new renewables build over the next decade is dominated by PV, which jumps from 7% of the capacity mix in 2018 to just over a third by 2030 (Figure 44). A major spike in build in 2023 occurs in response to coal retirements and an absence of pipeline projects under development that could be expected to commission in the next two years. This is an issue that Bulgaria's government will need to anticipate in order to manage the replacement of retiring coal capacity. Onshore wind also sees steady growth, thanks to falling capital costs and high capacity factors in Bulgaria.

The share of combined-cycle gas in installed capacity decreases slightly, from 5% of the mix in 2018 to 4% by 2030, as some older units retire. The 7.7GW of new renewables capacity is enough to allow 3.2GW of coal and lignite retirements, without the need for additional gas or reliance on interconnectors.

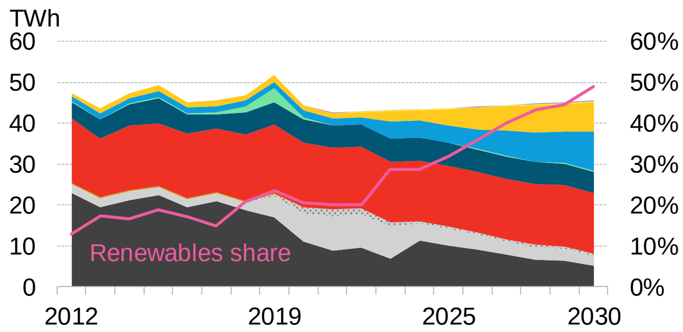
These renewables additions attract around 6 billion euros over the next decade, with a larger share going to onshore wind than solar, which has lower capital costs than wind (Figure 45). This investment allows Bulgaria to achieve 75% renewables in electricity generation by 2030, with wind and solar together making up 52% of the mix (Figure 46). Gas generation eats into the share of coal in the early 2020s, but recovers in the middle of the decade. By then, coal capacity has fallen enough that coal generation cannot fully displace gas, even though gas prices rise and carbon costs decrease after 2024.

Figure 45: New investment in capacity



Source: BloombergNEF

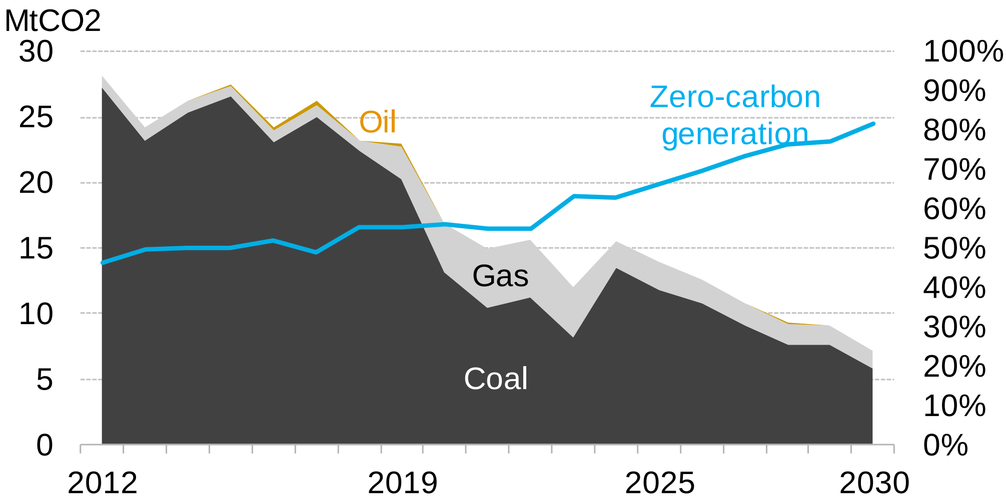
Figure 46: Generation mix and renewables share



Source: BloombergNEF

Bulgaria's nuclear fleet, alongside hydro, allows the country to reach 82% zero-carbon electricity generation in a least-cost scenario (Figure 47). Coal retirements and steady renewables build see power-sector emissions drop rapidly in the first part of the decade, with an overall 70% reduction from 2018 to 2030. Annual emissions in 2030 are 16MtCO2 below 2018 levels.

Figure 47: Power sector emissions and zero-carbon generation share

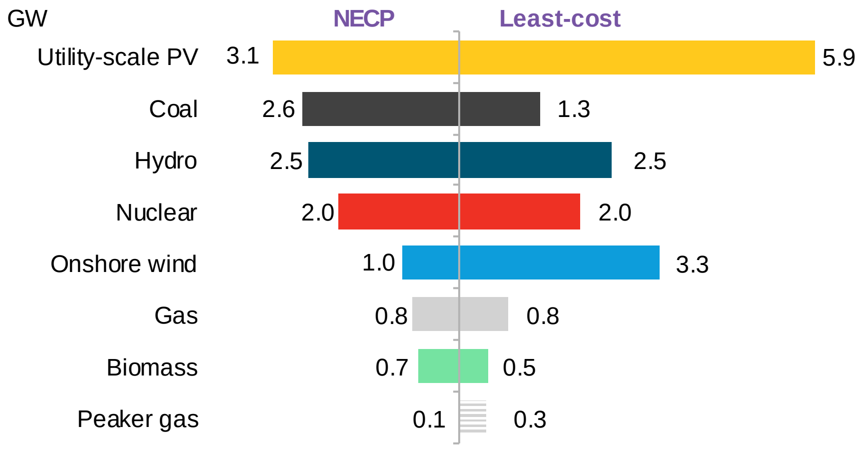


Source: BloombergNEF

NECP

Bulgaria's NECP sees the addition of less than 3GW of new renewables capacity over the next decade, including over 2GW of new solar (Figure 48). By 2030, Bulgaria would lean on a system with a total of 3GW of PV and 1GW of onshore wind, as well as 700MW of biomass. Limiting renewables build to the capacity targets laid out in the NECP requires a large part of the coal fleet to remain online to meet demand, with more than half of the current coal fleet still operating in 2030. Carbon prices and retrofits to meet emission standards will be a challenge for the economics of the remaining coal fleet and there is a high risk that these coal assets will be underutilized, creating financial stress for their owners.

Figure 48: Capacity in 2030 by technology, NECP vs least-cost



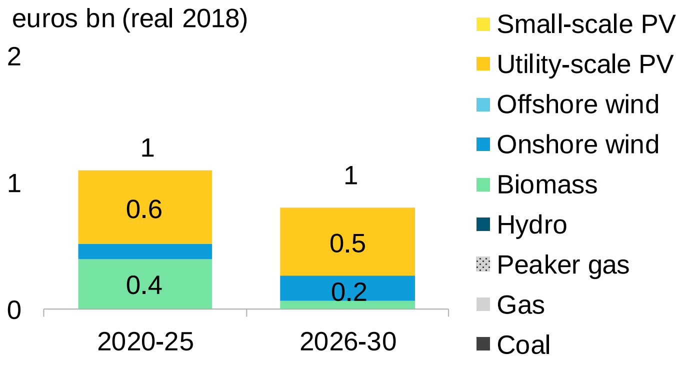
Source: BloombergNEF, NECP

New gas capacity is not added in the mix Bulgaria's NECP lays out. The NECP scenario's remaining coal capacity, plus new renewables and the existing nuclear fleet, mean it does not need to add new CCGTs as demand growth is muted due to Covid-19. A new gas pipeline from Greece to Bulgaria is currently being constructed, but will likely serve mainly as transit to the rest of Europe, rather than increasing the country's own gas consumption. Bulgaria's gas power strategy differs from its neighbor, as Romania has chosen to replace a larger part of its coal fleet with gas. However, new gas plants could risk becoming stranded assets and, as the least-cost scenario shows, no new gas capacity is necessary if higher amounts of renewables are built.

Despite recent discussions about adding a new 2GW nuclear plant near Belene, the NECP does not see Bulgaria's nuclear capacity increasing until after 2035. The Belene project was first launched in the 1970s, but gained new attention after 2017 when the government announced its intentions to find an investor. Potential investors signed a memorandum of understanding in June 2020, but due to the long construction time of nuclear plants, it is unlikely that new nuclear capacity would commission before 2030.

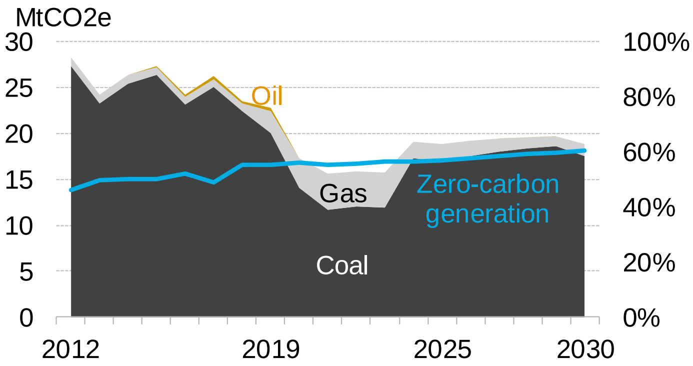
Instead, new investment laid out in the NECP until 2030 goes exclusively to renewables, which attract 2.2 billion euros over 2026-2030 (Figure 49). Bulgaria's plan to add 2.2GW of PV means the majority of investment goes to this technology. The paucity of investment in onshore wind is most notable in comparison to the least-cost scenario.

Figure 49: New investment in capacity



Source: BloombergNEF

Figure 50: Power sector emissions and zero-carbon generation share



Source: BloombergNEF

The NECP envisions a 30% share of renewables in final electricity consumption by 2030, but the generation modelled from the planned capacity shows that renewables generation might reach only 27%. With nuclear generation included, the share of zero-carbon generation reaches 60% by 2030, up from 55% in 2018 (Figure 50).

By 2030, power sector emissions are down 20% from 2018 levels. However, a less aggressive coal retirement schedule means that emissions rise again in the middle of the decade as coal generation responds to lower carbon prices. Less coal in the system would mean this spike is less acute and emission reductions early in the 2020s could be maintained through the end of the decade. Overall, the least-cost scenario sees a significantly steeper drop in emissions of 70%, compared with only 20% in the NECP scenario.

Table 9: Comparison between least-cost and NECP scenarios

	Least-cost	NECP
Total renewables build, 2020 to 2030	7.7GW	2.7GW
Investment in new renewables	6.2 billion euros	2.2 billion euros
Share of renewables generation in 2030	49%	27%
Share of zero-carbon generation in 2030	82%	60%
Emissions reduction from 2018 to 2030 (share)	70%	20%
Difference in annual emissions in 2018 vs 2030 (absolute)	16MtCO2	5MtCO2

Source: BloombergNEF

Section 5. Conclusion

Key messages

1 **Renewables are the cheapest source of new bulk electricity generation for Poland, Czechia, Romania and Bulgaria. New renewables are becoming competitive against the marginal cost of existing coal and gas power plants.**

BNEF's levelized cost of electricity analysis makes it clear that the most economic source for new bulk electricity generation in most markets is now wind or solar, rather than coal or gas – and Poland, Czechia, Romania and Bulgaria are no exception to this trend. Falling equipment costs for renewables have led to levelized costs dropping across the world, to the extent to which new renewables are also offering a competitive alternative to existing coal and gas assets (Figure 51).

Figure 51: Tipping point one, Poland

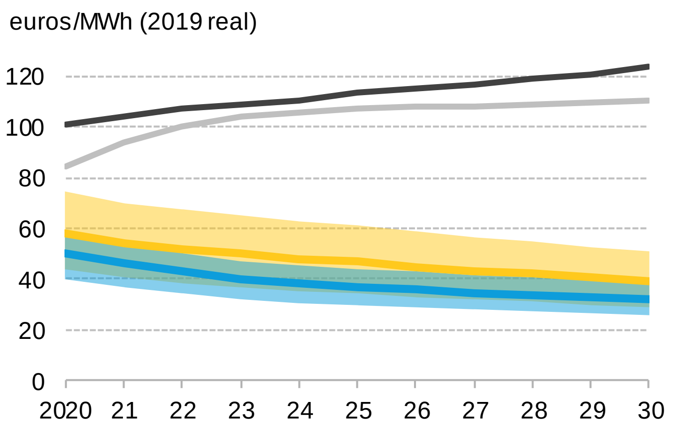
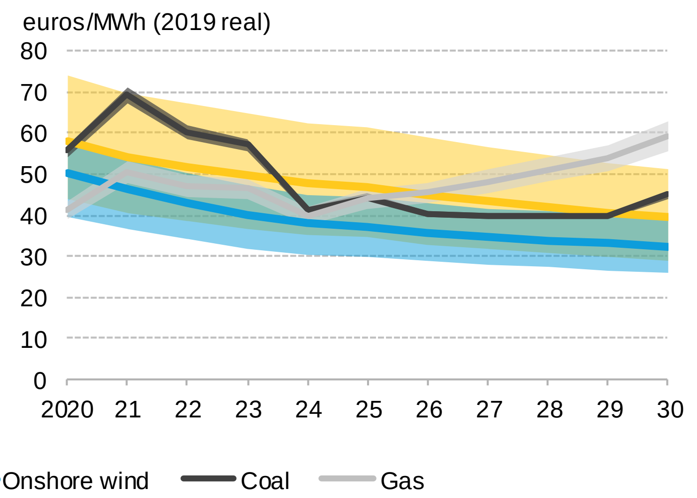


Figure 52: Tipping point two, Poland



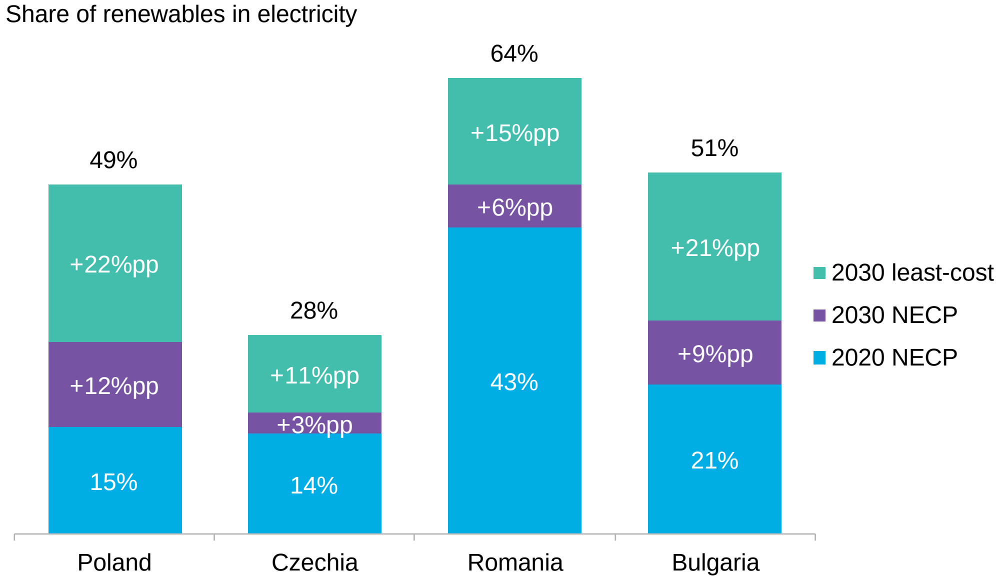
Source: BloombergNEF

Comparing the new build cost of renewables on an LCOE basis with the marginal costs of existing coal and gas assets in Poland, Czechia, Romania and Bulgaria, renewables are already outcompeting existing coal. Onshore wind is more competitive in Poland and Czechia, with utility-scale PV is the more economic option in Romania and Bulgaria. By the middle of the 2020s, new renewables also undercut existing gas in each of these four markets. The prospect of higher carbon prices that could result from upcoming increase in EU climate ambition would make renewables more competitive fast, and further incentivize coal-to-gas switching.

2 **More ambitious 2030 renewables targets are possible, as Poland, Czechia, Romania and Bulgaria. In our policy agnostic least-cost scenario, they already reach a 47% of renewables generation by 2030.**

In the least-cost scenarios, each country is able to meet and exceed its 2030 target for the share of renewables in power consumption. This is encouraging, as the 2030 targets laid out in each country's NECP will likely need to be revised if the EU is to meet more ambitious 2030 goals included in the Green Deal. The NECP process itself includes revisions foreseen every two years. Both financially and technically, Poland, Czechia, Romania and Bulgaria can make a step-change in their 2030 renewables goals.

Figure 53: Share of renewables generation in least-cost scenario and current 2030 targets



Source: BloombergNEF, NECP. Note: renewables share includes small scale hydro and biomass.

Czechia aims to achieve a 17% renewables share by 2030, but in the least-cost scenario, it reaches nearly 30%. Poland targets 27%, but could get as high as 49%, while Bulgaria aims for 30% though could actually exceed 50%. Romania's latest NECP targets 49%, but a least-cost scenario can bring the country to 64% renewables in electricity generation.

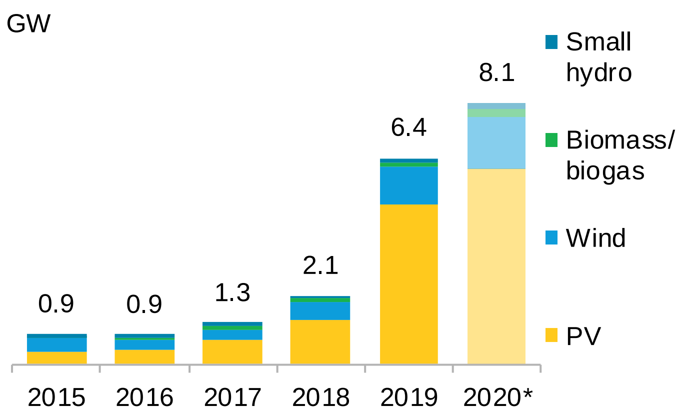
3 The scale of renewables deployment in the least-cost scenario is ambitious, but not unrealistic, at 53GW of new renewables added across the four markets combined over the next decade.

The least-cost scenario sees all countries adding high volumes of renewables in most years as uncompetitive and underutilized coal and lignite assets leave the system. The least-cost scenario sees a total of more than 50GW new renewables capacity added, including 25GW of wind and 29GW of solar. This would mark an immediate acceleration from current levels of deployment, for all countries except Poland, which has seen its renewables build pick up in the last two years. However, reasonable limits are in place in all cases, as no more than 1.5GW of one technology is added in a single year. Furthermore, the maximum amount of additions is within the range of what these markets have achieved collectively in the past. Combining the record solar and wind annual installations for Poland, Czechia, Romania and Bulgaria equals just over 5.5GW.

These kinds of volumes can be achieved, even in Czechia, Romania and Bulgaria, where renewables development has been muted in recent years. Another Eastern European country, Ukraine, managed to triple its renewables capacity additions within one year, installing nearly 4GW of new wind and solar capacity in 2019 thanks to an extremely generous tariff. (Figure 54).

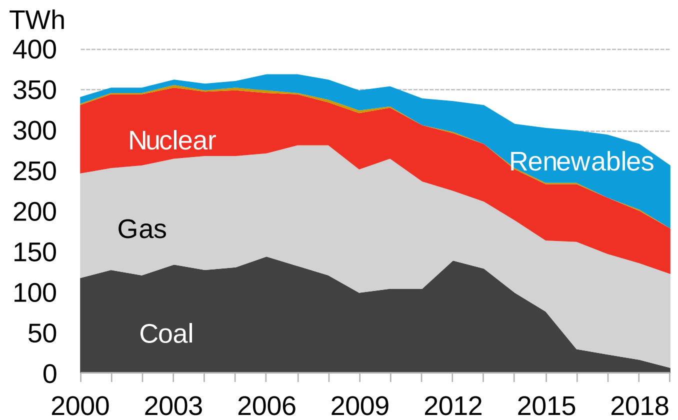
Poland has also managed to accelerate renewables investment and installations, adding nearly 1GW in 2019, and it is on track to add nearly 2GW in 2020.

Figure 54: Annual renewables additions, Ukraine



Source: BloombergNEF, NEURC. Note: 2020 estimate refers to projects under construction.

Figure 55: Electricity generation, United Kingdom

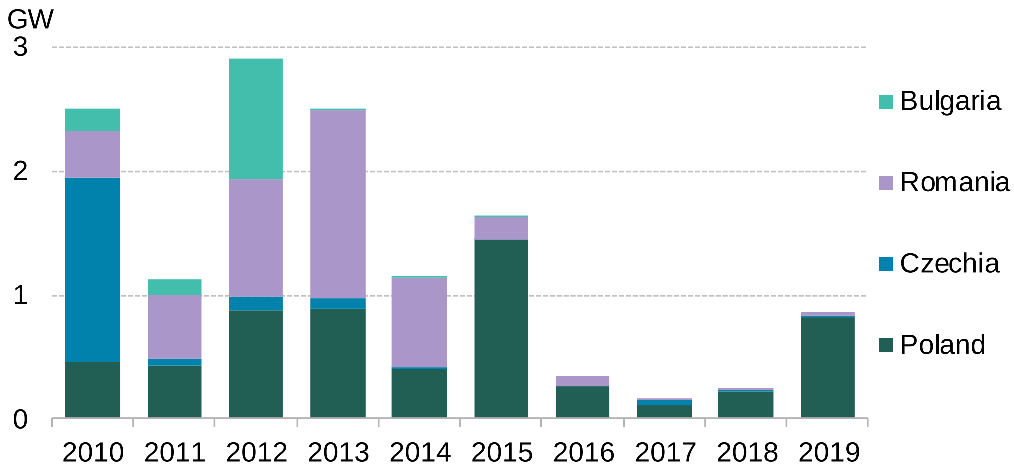


Source: BloombergNEF

The pace of reduction of coal generation is also not unprecedented. The UK reduced its share of coal in the power mix from more than 40% in 2012, to just 2% in 2019 (Figure 55). While our least-cost scenarios model each country as an island, and demonstrate that this kind of rapid coal phase-out is possible, the reality of increasing interconnection means that power systems have even more resources at their disposal to balance their grids. The prospect of green recovery policies enhancing incentives for the transition will also support this acceleration.

4 The acceleration of renewables investment will require enabling policies to be introduced where they are missing, and policy stability.

Figure 56: Annual renewables additions, Poland, Czechia, Romania, Bulgaria



Source: BloombergNEF

Clear and stable policy will be essential to bringing these renewables volumes online, and in translating targets into steady investment. Planning would need to begin immediately, along with the improvement of policies. Poland, Czechia and Romania have all cut renewables support retroactively in the past, which caused investments in the sector to fall (Figure 56). While Poland has used its auction program to generate renewed interest in renewables, Czechia, Romania and Bulgaria would all be starting from a standstill. Competitive auctions have become the mechanism of choice for procurement of large-scale renewables capacity, but Czechia, Romania and Bulgaria have yet to introduce such programs. They would need to do so rapidly to send signals to investors that the renewables sectors are open for business.

Table 10: Key policy mechanisms for renewables support

	Auctions	Feed-in tariff	Targets	Net-metering	Indirect subsidies
Poland	Yes	Yes	Yes	Yes	Yes
Czechia	No	No	Yes	No	Yes
Romania	No	No	Yes	Yes	No
Bulgaria	No	Yes	Yes	No	No

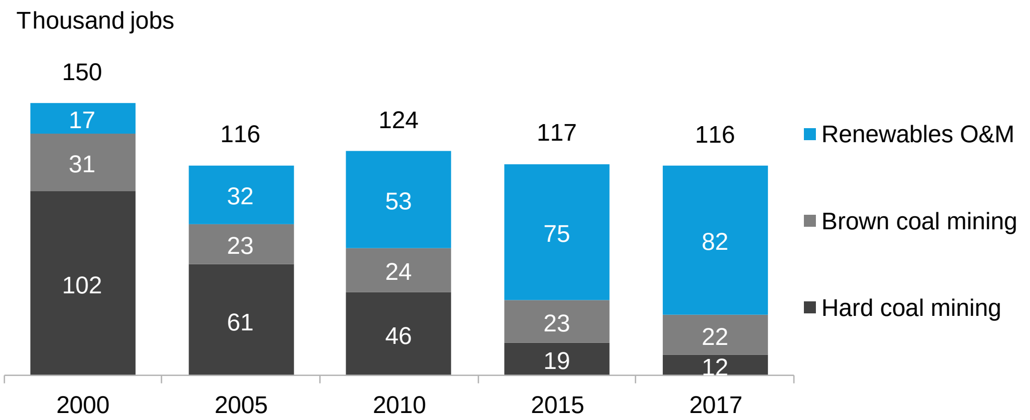
Source: BloombergNEF. Note: Indirect subsidies refer to tax incentives, investment grants, etc.

Policy making will also need to tackle the additional challenge of public acceptance of onshore wind. Poland still has the 2016 Distance Act in place which acts as an effective moratorium on new onshore wind build, and concerns about NIMBYism grow across Europe. Policy makers face a double challenge of ensuring that development occurs with appropriate due diligence, but without bogging down investor interest with excessive red tape.

5 Renewables represent a 45 billion-euro investment opportunity over the next decade, and could bring more than 45,000 associated jobs.

The least-cost scenarios see the addition of more than 50GW of new renewables in the next ten years, potentially creating a vibrant new sector for national economies. The total new capacity unlocks just under 54 billion euros of new investment opportunities, and also has the potential to act as a major driver for employment. In Germany, on average clean power operations and maintenance created 0.9 jobs per megawatt in 2017, against 0.7 for coal. These figures do not include renewables jobs in other parts of the value chain such as construction, which typically represents over a third of employment in solar and wind.

Figure 57: German coal mining jobs vs renewables operations and maintenance jobs



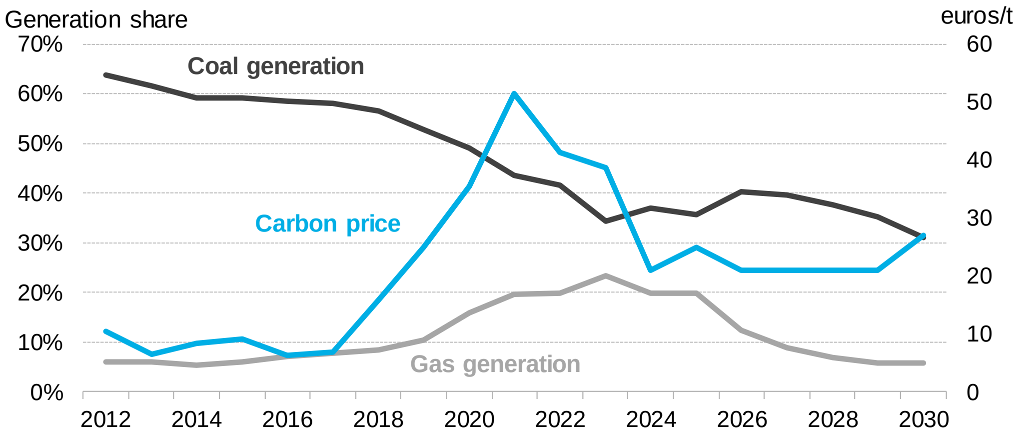
Source: BloombergNEF, BMWi. Note: Coal employment refers to mining. Renewables jobs only account for operations and maintenance.

Mitigating the impact of coal closures will also require a long-term strategy and planning. While the sector is already facing long-term decline, an acceleration of coal closures would have significant knock-on socio-economic effects. The capital set aside for the EU's Just Transition Mechanism, which includes 40 billion euros in direct, confirms that support has never been higher for regions and territories that are facing the challenges brought by a struggling coal industry.

6 Future EU ETS reform may be needed to prevent the risk of lower carbon prices encouraging a return of coal generation at the expense of gas in the second half of this decade.

The exposure of coal, lignite and, to a lesser extent, gas to carbon costs means that EUA prices over the next decade will play a defining role in the profitability and utilization of these assets. BNEF's current outlook for the carbon price says that they will rise above current levels until 2024, but decline again after that, because it does not preempt the results of climate ambition raising and upcoming EU ETS reforms. In the second half of the decade, without policy intervention, a plummeting carbon price creates a risk that coal power plants that are still online increase their generation. This risks crowding out the generation of recently built gas plants, as seen in Poland's least-cost scenario (Figure 58). Policy tightening in the coming years will be crucial to prevent putting at risk the progress member states are making on decarbonizing their power sector. In response to the uncertainty volatile carbon prices can have on emissions reduction in the power sector, the U.K. introduced a carbon price floor that helped coal asset owners better plan for their phase-out commitments.

Figure 58: Capacity factors for coal and gas, aggregated across Poland, Czechia, Romania and Bulgaria vs carbon price



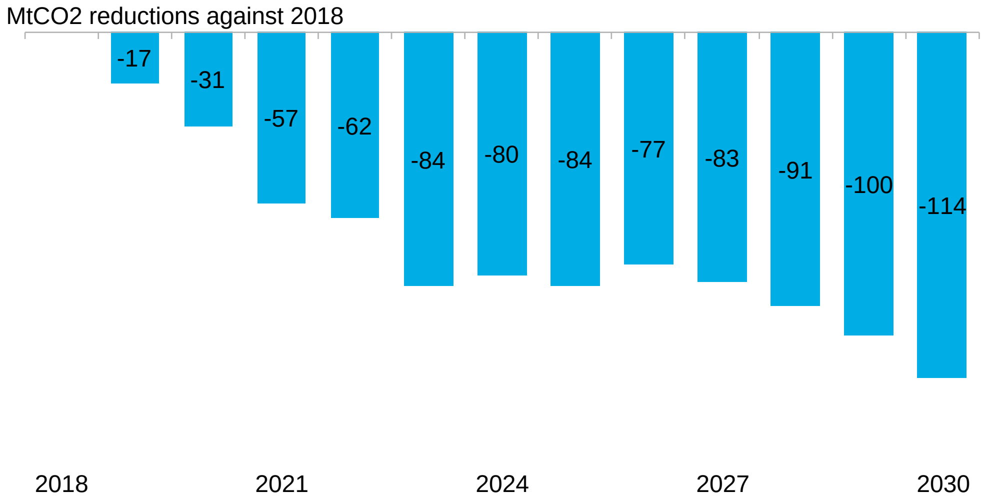
Source: BloombergNEF

Beyond the carbon price, stricter emissions limits may also result in a larger portion of the coal and lignite fleets retiring. The worsening economics of coal may see more plants shutting down rather than investing in upgrades and retrofits. With less coal, there is larger need for gas generation even as carbon prices fall. This can be seen in the case of Romania, where in the least-case scenario, gas continues to generate at high levels beyond 2025.

7 Following a least-cost pathway to develop the power sector in each of these four countries over the coming decade would deliver emissions reductions equivalent to 6% of the EU's target of a 55% cut by 2030.

In the least-cost scenario, major emission reductions are unlocked for each country. Together, this represents an almost 50% drop in absolute emissions from the 2018 total to 2030, as emissions in 2030 are 114MtCO2 lower than 2018 levels. As the EU's proposed 2030 emission reduction targets will require mitigation of 1.8Gt of CO2e across the bloc, the contribution of an accelerated energy transition in Poland, Czechia, Romania and Bulgaria would be significant. These four countries on their own can cut 6% of the CO2 that the EU will need to eliminate by 2030.

Figure 59: Annual power sector emissions reductions from 2018 levels delivered by Poland, Czechia, Romania and Bulgaria cumulatively



Source: BloombergNEF

The emissions drop is steepest from now until 2023, as coal-fired power plants are already feeling the combined pressure of higher carbon prices, low gas prices, and the end of derogation regimes. Lower demand so far in 2020 is giving a foretaste of this trend, as coal generation has dropped off more rapidly than gas in Poland, Czechia, Romania and Bulgaria.

Appendix A. Modelling inputs

A.1. Fuel prices

Table 11: Hard coal prices, euros/t (6000 kcal/kg)

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Poland	92.64	66.16	56.79	56.32	55.45	53.5	51.95	51	49.42	48.18	48.18	48.18	48.18
Czechia	92.64	66.16	56.79	56.32	55.45	53.5	51.95	51	49.42	48.18	48.18	48.18	48.18
Romania	92.64	66.16	56.79	56.32	55.45	53.5	51.95	51	49.42	48.18	48.18	48.18	48.18
Bulgaria	92.64	66.16	56.79	56.32	55.45	53.5	51.95	51	49.42	48.18	48.18	48.18	48.18

Source: BloombergNEF

Table 12: Lignite prices, euros/t (3000 kcal/kg)

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Poland,	38.53	38.53	38.53	38.53	38.53	38.53	38.53	38.53	38.53	38.53	38.53	38.53	38.53
Czechia	16.39	16.39	16.39	16.39	16.39	16.39	16.39	16.39	16.39	16.39	16.39	16.39	16.39
Romania	30.97	30.97	30.97	30.97	30.97	30.97	30.97	30.97	30.97	30.97	30.97	30.97	30.97
Bulgaria	16.34	16.34	16.34	16.34	16.34	16.34	16.34	16.34	16.34	16.34	16.34	16.34	16.34

Source: BloombergNEF

Table 13: Gas prices, euros/MMBtu

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Poland	6.9	4.31	3.16	3.54	3.6	3.63	3.64	4	4.36	4.72	5.08	5.44	5.8
Czechia	6.9	4.31	3.16	3.54	3.6	3.63	3.64	4	4.36	4.72	5.08	5.44	5.8
Romania	6.9	4.31	3.16	3.54	3.6	3.63	3.64	4	4.36	4.72	5.08	5.44	5.8
Bulgaria	6.9	4.31	3.16	3.54	3.6	3.63	3.64	4	4.36	4.72	5.08	5.44	5.8

Source: BloombergNEF

A.2. Demand

Table 14: Demand with BloombergNEF Covid-19 impact scenario 2, TWh

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Poland	169.6	165.1	159.9	151.3	153.1	154.8	156.3	157.5	158.3	158.8	158.9	158.7	158.1
Czechia	87.0	86.4	81.1	76.9	77	77.1	77.3	77.4	77.5	77.5	77.6	77.6	77.6
Romania	64.4	59	61.2	58.6	59.1	59.5	59.9	60.4	60.8	61.3	61.7	62.1	62.6
Bulgaria	44.9	46.5	45.5	44.4	42.5	42.7	42.9	43.1	43.3	43.5	43.7	43.9	44.2

Source: BloombergNEF

A.3. Renewables build pipeline

Table 15: Small-scale PV, MW

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Poland	190	640	710	790	880	611	498	552	574	596	619	641	663
Czechia	-	-	20	-	-	23	29	36	38	39	42	43	45
Romania	0	60	50	60	70	394	420	444	436	436	427	427	419
Bulgaria	-	-	-	-	-	30	23	21	20	20	21	21	22

Source: BloombergNEF

Table 16: Utility-scale PV, MW

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Poland	20	20	290	770	2000	500	0	0	0	0	0	0	0
Czechia	0	0	0	0	0	0	0	0	0	0	0	0	0
Romania	0	14	0	80	100	0	0	0	0	0	0	0	0
Bulgaria	0	0	0	0	0	0	0	0	0	0	0	0	0

Source: BloombergNEF

Table 17: Onshore wind, MW

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Poland	20	20	290	770	2000	500	0	0	0	0	0	0	0
Czechia	0	0	0	0	0	0	0	0	0	0	0	0	0
Romania	0	0	0	0	0	0	0	0	0	0	0	0	0
Bulgaria	0	0	0	0	0	0	0	0	0	0	0	0	0

Source: BloombergNEF

Table 18: Offshore wind, MW

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Poland	0	0	0	0	0	0	0	0	840	1050	600	500	500
Czechia	-	-	-	-	-	-	-	-	-	-	-	-	-
Romania	0	0	0	0	0	0	0	0	0	0	0	0	0
Bulgaria	0	0	0	0	0	0	0	0	0	0	0	0	0

Source: BloombergNEF

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