MOODY'S ANALYTICS

ANALYSIS
JULY 2023

European Transition: The Economic Impact of Net Zero

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Introduction

The EU aims to be the first region in the world to achieve net zero emissions by 2050. Doing so requires not only significant economic transformation in every country and sector of the EU but also significant commitment along the way. While economic theory suggests pricing emissions is a single and sufficient tool to drive the change from fossil fuel technologies to renewable alternatives, in practice, moving the supertanker that is the EU away from its current reliance on fossil fuels will require a variety of policies that reach into every sector of the economy. These policies will be felt in various parts of the economy: fossil fuel producing and using sectors, economic agents who must pay for the environmental impact of fossil fuels, government revenues, and industrial structure. To better understand the economic implications of the EU's climate policies, Moody's Analytics has started to explicitly model EU climate policies. In this paper, we discuss our findings based on an incorporation of key climate policy commitments into our baseline forecasts.

European Transition: The Economic Impact of Net Zero

BY DAWN HOLLAND AND GAURAV GANGULY

The EU aims to be the first region in the world to achieve net zero emissions by 2050. Doing so requires not only significant economic transformation in every country and sector of the EU but also significant commitment along the way. While economic theory suggests pricing emissions is a single and sufficient tool to drive the change from fossil fuel technologies to renewable alternatives, in practice, moving the supertanker that is the EU away from its current reliance on fossil fuels will require a variety of policies that reach into every sector of the economy. These policies will be felt in various parts of the economy: fossil fuel producing and using sectors, economic agents who must pay for the environmental impact of fossil fuels, government revenues, and industrial structure. To better understand the economic implications of the EU's climate policies, Moody's Analytics has started to explicitly model EU climate policies. In this paper, we discuss our findings based on an incorporation of key climate policy commitments into our baseline forecasts.

Part 1: European climate policy

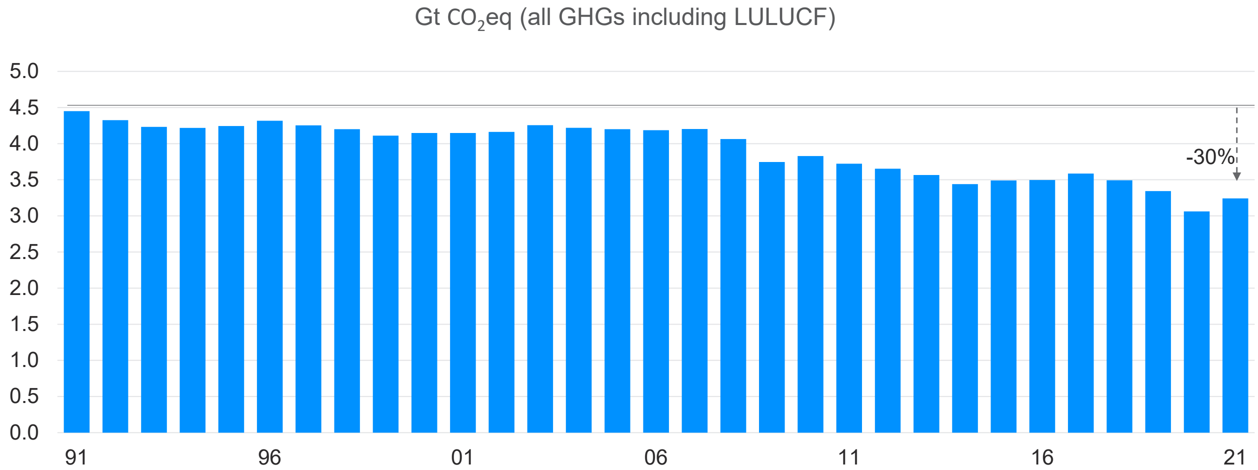
The EU is the third largest greenhouse gas, or GHG, emitter after China and the U.S. and accounts for approximately 7% of global emissions. For historical perspective, increases in energy efficiency and a move away from coal towards renewable energy in the last decade have meant that EU emissions have declined over time and as of 2021 were 30% below their 1990 level (see Chart 1).

Simple extrapolation of this trend would mean that by the early 2050s the EU's net emissions would be more than 1.8 GtCO2eq and a long way from its commitment to net zero. Simply maintaining the historical trend is insufficient for the EU to achieve its goal.

European Green Deal

The economics of transforming the energy system relies on the idea of a marginal abatement cost curve and a carbon price. The cost of removing a tonne of GHG emissions depends on the industry and the technology in question. Rank ordering these costs by industry and technology gives rise to the marginal abatement cost curve, which slopes upwards, usually nonlinearly, as eliminating GHG emissions in some sectors is far harder than in others. Though it is the same fossil fuels that enter each industry, the cost of removal depends on the technological alternative. For example, switching from coal-fired electricity plants to renewable energy is a far cheaper economic proposition per unit of GHGs abated compared with

Chart 1: EU Net Emissions



Sources: EEA, Moody's Analytics

the cost of switching from coal-based steel production to an alternative method based on electricity or renewable gases. Given the nonlinear nature of an abatement cost curve, it is generally accepted wisdom that a gradual transformation of the energy system is desirable for two reasons. First, a carbon price that starts low and gradually rises avoids a large negative shock to the economy where sectors with low costs of abatement are forced to pay a high price. The experience in 2022 serves as a useful reminder of why abrupt shocks to the energy system are not desirable. Second, sequencing is important as successive industries benefit from low and zero carbon solutions developed in other industries. For example, decarbonising electricity production lowers emissions associated with producing other goods and services. While this is the theory, in practice, the process is much more complex, especially in the EU given that it seeks to create policies that align 27 countries with different industrial structures, energy systems, regulatory environments, and diverse levels of economic development.

The European Green Deal introduced in 2019 laid out a package of initiatives for a new EU economy that met the EU's commitment to the Paris accord, improved biodiversity, and created a more circular and less resource-intensive economy. To achieve these objectives, the EGD also envisaged the need to foster greater technological innovation, provide the workforce with the skills needed to ensure a smooth transition, and last but not least ensure that economic inequality did not increase as a result of its various policies.

The EGD proposed legislation, subsequently passed into law, to achieve net zero by 2050 and to cut GHGs relative to 1990 levels by at least 55% by 2030.

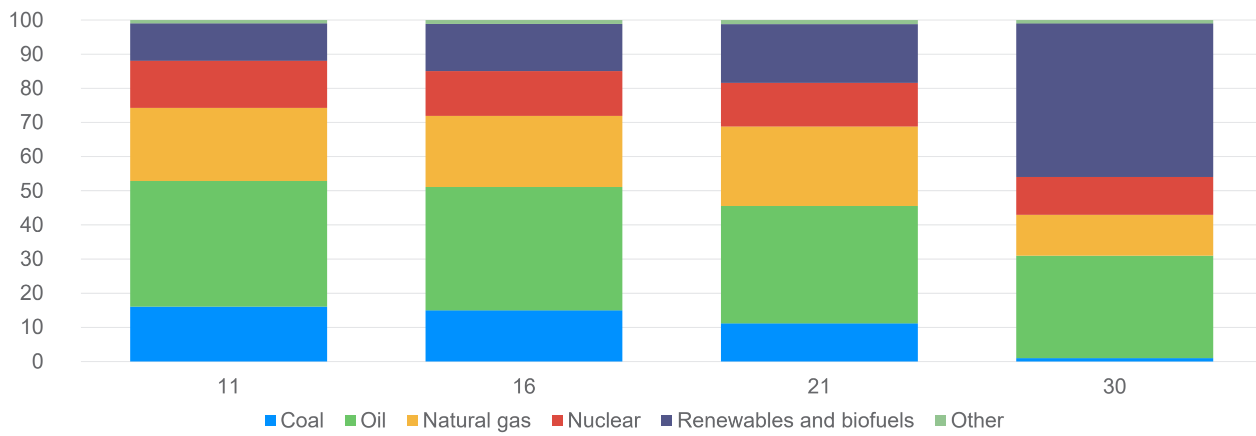
2030 targets: Fit for 55 and RePower EU

To meet its 2030 target, the EU subsequently brought in the Fit for 55 package. It is a sweeping set of measures that legislates quantity restrictions on GHG emissions in various sectors, introduces national level emissions targets, sets emission standards for road transport, determines energy performance of buildings, tackles the rollout of infrastructure for alternative fuels, and regulates the use of land and forestry as carbon sinks (land use, land use change, and forestry, or LULUCF).

The scale of the change that needs to take place can be seen in the various sources of energy in use (see Chart 2). Economic activity in the EU, like anywhere else, is heavily dependent on fossil fuels. In 2021, 69% of the total energy supply of 1,462 million tonnes oil equivalent comprised fossil fuels, of which 34% was oil, 23% was natural gas, and 11% coal and other solid fossil fuels. Renewables and biofuels made up 17% of total energy supply.

Chart 2: EU Energy Supply by 2030

Share of primary energy consumption, %



Sources: Eurostat, Moody's Analytics

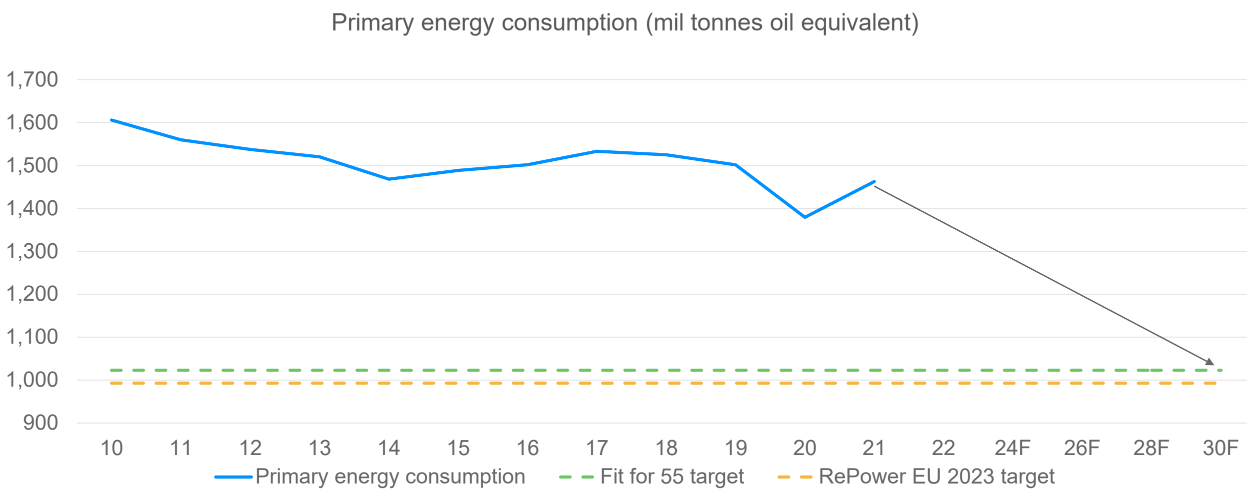
Oil makes up the biggest part of energy supply, and its share of energy supply declined 3% over the period 2011-2021. The contribution of natural gas, the second major fossil fuel, has increased by more than 2% over the same period, while that of coal has declined 5% with most of the gap picked up by an increase in renewables. Coal will continue to decline as the EU decarbonises and shuts down coal-fired power plants with renewables filling the gap.

The EU has split its 2030 target into two. The first, the Renewable Energy Directive, sets the renewable content of energy supply. The second, the Energy Efficiency Directive, determines the total quantity of energy needed. The former aims to change the energy supply mix and sets a target for renewable energy as a share of total energy supply, while the latter seeks to improve energy efficiency. These pieces of legislation also create a framework for attracting investment into renewables and energy efficiency and set targets to be achieved by 2030. Taken together, they result in lower overall energy consumption with higher renewable content. Both RED and EED targets to 2030 have been revised upwards since inception, every time increasing the ambition level. Prior to the Russian invasion of Ukraine, which led to a significant re-think of EU policy on energy security, the RED target to 2030 was 40% renewable energy content in primary energy consumption, while the EED target was for 1,023 Mtoe primary energy consumption, which represents a 30% decline compared with actual consumption in 2021. To meet these targets, coal will be almost phased out by 2030, while natural gas will decline to approximately 12%. Oil usage remains more resilient out to 2030 and will decline significantly only beyond 2030.

The Russian invasion of Ukraine raised the issue of gas security and highlighted the need for a more rapid, front-loaded transition. Accordingly, the RePower EU plan, introduced in May of last year, aims for progress in three areas to speed up energy independence. The first is supplier diversification, primarily by increasing liquefied natural gas and pipeline supplies. The second is greater coordination, monitoring and enforcement of standards for gas in storage across the EU and, potentially, also a more coordinated approach in gas procurement. The third is to increase the pace of climate mitigation, thereby lessening reliance both on fossil fuels and to eliminate Russia as a supplier.

To achieve the third objective, RePower EU proposed raising the RED target to 45% and the EED target to 993 Mtoe by 2030, which represents a 32% decrease in primary energy consumption—that is, adding an extra 2 percentage points to the existing target (see Chart 3).

Chart 3: Energy Targets Upgraded

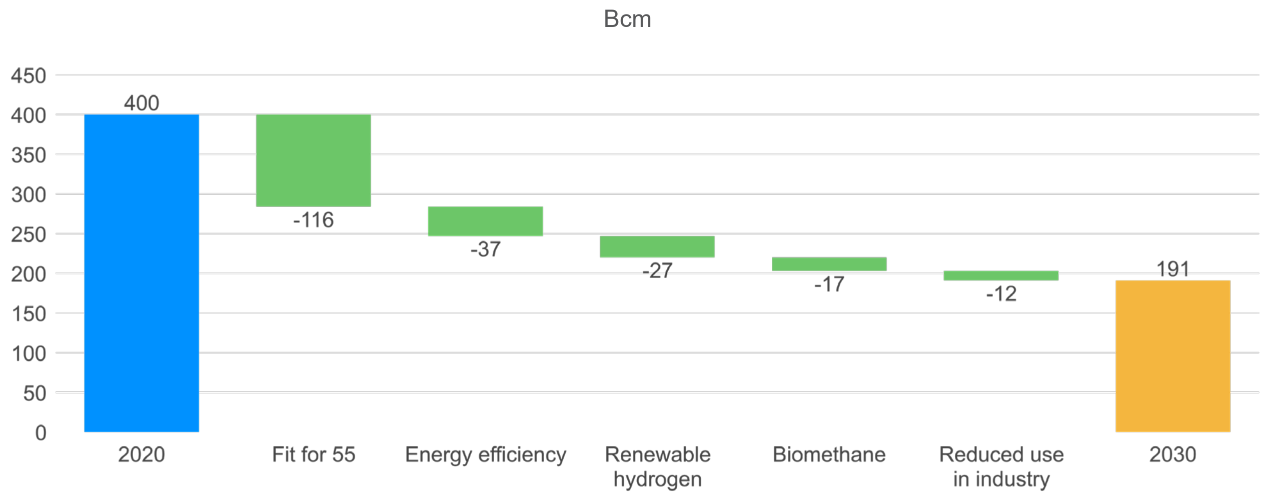


Source: Moody's Analytics

A variety of measures have been outlined to reduce gas consumption. Use of heat exchange pumps and tighter criteria around buildings and residential emissions will result in a drop in gas consumption of 3 billion cubic metres. This improvement in efficiency includes the 10-bcm savings that result from lower winter thermostat settings outlined under short-term measures. Renewable hydrogen and biomethane will account for a further 44-bcm drop in gas demand, while reduced gas use in industry will further reduce demand by 12 bcm. Successful implementation of these additional climate measures together with the Fit for 55 package could lead to a 190-bcm drop in gas consumption by 2030 (see Chart 4). Under the original RePower EU plan, all additional measures other than the renewable hydrogen target were to be implemented by 2027 with the implication that the EU intended to completely stop imports of Russian gas in the next five years. Events have overtaken the original plan, but the targets have by and large been adopted.

After deliberations at the EU level, the RePower EU plan targets have been modified and the RED has been upgraded to a 42.5% target plus an additional 2.5% voluntary uptake at the member state level. The EED has also been strengthened but for now, only at the EU level. These new targets are still in the process of being considered by member states, which in coming months will submit updated proposals.

Chart 4: Gas Reduction Under RePower EU

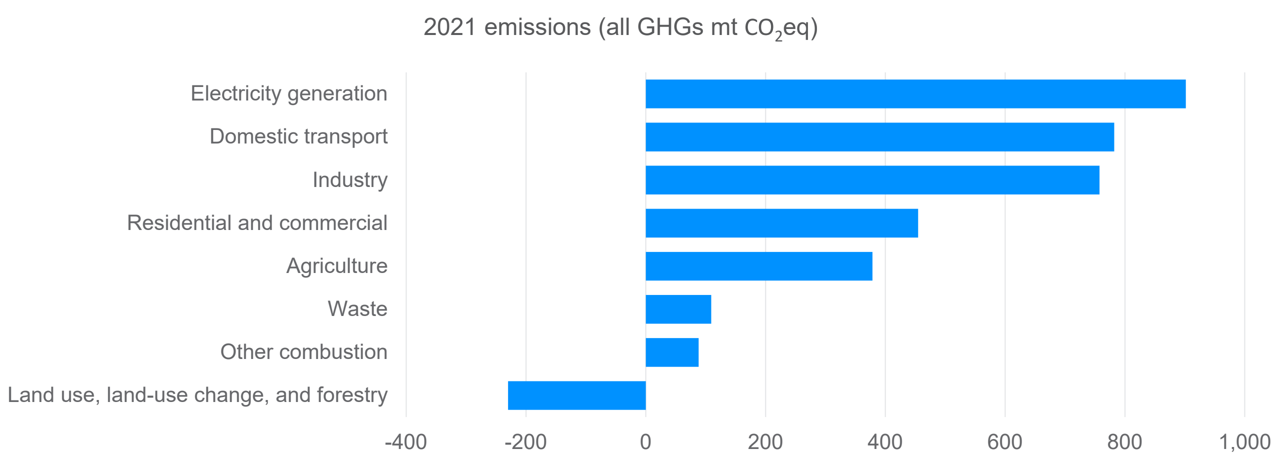


Sources: European Commission, Moody's Analytics

Emissions by sector

Breaking out the sectoral shares of emissions provides further insight into the scale of the problem, particularly in the context of the abatement cost curve and sequencing of actions (see Chart 5).

Chart 5: Emissions by Sector



Sources: EEA, Moody's Analytics

While emissions from electricity supply have been declining, as of 2021, approximately 28% of EU emissions come from electricity generation closely followed by domestic transport and industry. These three sectors together account for 75% of EU emissions and EU policy needs to tackle a number of different concerns to enable successful sectoral decarbonisation.

In terms of sequencing, lower costs and less time are needed to achieve a significant rate of decarbonisation in the power generation sector compared with road transport or energy-intensive industry. Mature technological alternatives for power generation exist with competitive costs vis-à-vis fossil fuels, though moving to a system with significant renewable content is challenging given the variable nature of renewable energy. In addition, there are also significant implementation challenges. Wind and solar energy are the key to decarbonising the energy system, but there are implementation challenges out to 2030. The onshore wind target of 510 gigawatts requires more than 30 GW of incremental capacity per year between now and 2030 to be achievable. The offshore wind targets of 60 GW by 2030 and 300 GW by 2050 are similarly challenging. Solar targets look more achievable with a 2030 goal of 750 GW likely to be surpassed given the current rate of progress. The Russian invasion of Ukraine has given the EU a reason to improve its progress, and several improvements in permitting procedures have been incorporated into the latest amendment to the RED.

Successful decarbonising of road transport depends on yet-to-come cost reductions for electric vehicles, the development of charging infrastructure, and even technologies such as green hydrogen that are still in the early stages of development. The main measure in the transport sector is the ban on the sale of internal combustion engines from 2035. EV sales have risen steadily in the EU to 22% of all new-car sales in 2022, albeit with significant variation across countries, while slow development of charging infrastructure is seen as a significant impediment to a more rapid uptake. The EU's newly formed hydrogen strategy as formulated in the RePower EU plan also envisages greater rollout of hydrogen filling stations to help with the decarbonisation of heavy goods vehicles.

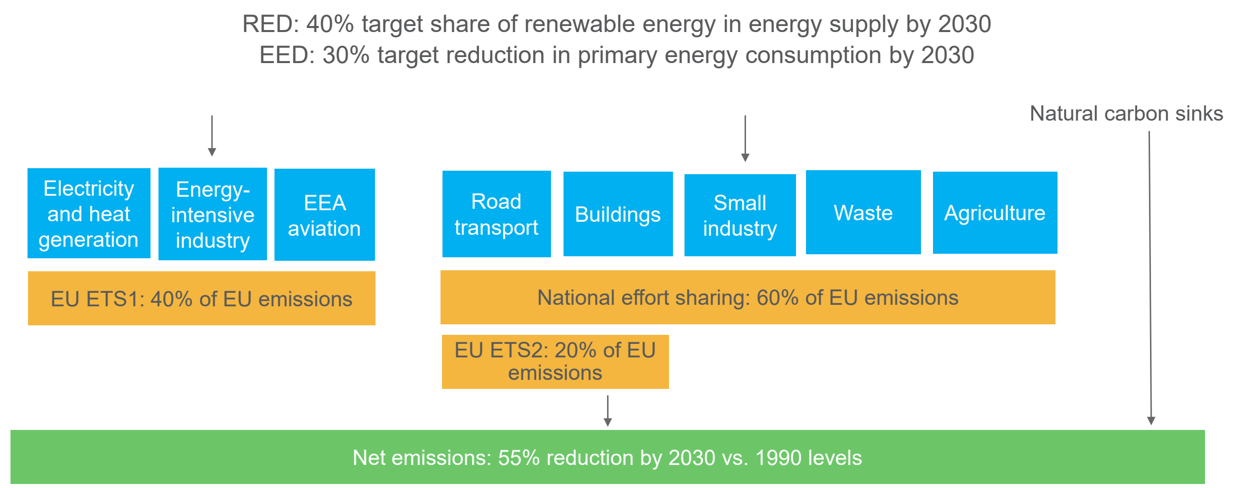
Energy-intensive industries such as steel and cement present some of the biggest cost challenges. In response to the Inflation Reduction Act in the U.S., the EU published its Green Industrial Plan in February 2023. It lays out various measures aimed at securing the EU's competitive advantage in industry. These measures range from simplifying permitting procedures in industry for low carbon manufacturing to ensuring resilient supply chains for technologies related to decarbonisation.

Finally, LULUCF will be a significant part of the solution since full decarbonisation is too costly to achieve. By 2030, LULUCF will absorb 301Mt CO_2 of emissions. If successfully implemented it is likely to push the Fit for 55 target, pre-RePower EU, up to 57%.

Emissions pricing

Capping emissions in the EU is being tackled through a range of channels (see Chart 6). In addition to the targets, the EU has a system of setting quantity restrictions on annual emissions known as the EU Emissions Trading Scheme. Qualifying firms under the scheme are entitled to allowances that cap the quantity of annual emissions, and those with excess requirements may buy allowances from those with surpluses. The ETS covers electricity generation, emission-intensive industry and aviation within the EU, and captures 40% of the emissions within the EU. The remaining 60% of EU emissions apply to all other industry sectors such as agriculture, households and waste, where rather than have a single-market mechanism, countries are expected to have individual plans for emission reduction. This country-specific approach, referred to as National Effort Sharing, caters both to country heterogeneity in industry and building stock as well as to differences in the level of economic development. Richer EU countries are expected to commit to more stringent reduction under NES than poorer EU countries.

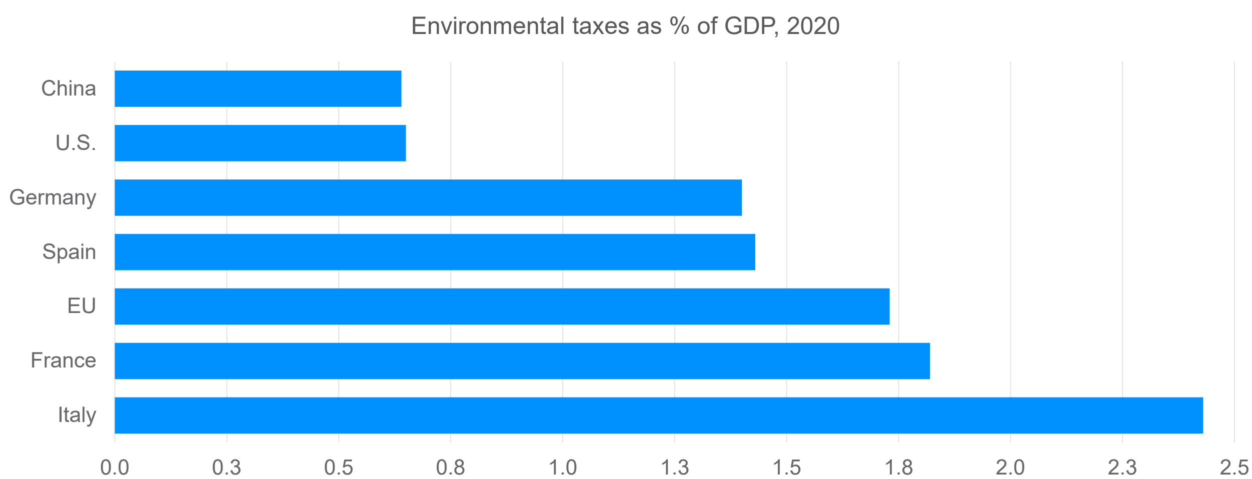
Chart 6: Capping Emissions



Sources: European Commission, Moody's Analytics

The EU ETS is the principal pricing mechanism under the Fit for 55 program. The ETS has come under fire for being too lax, but ambition levels have been revised following the Russian invasion of Ukraine last year. The number of emissions allowances given out every year and the fact that these allowances are only gradually removed from the market have been key criticisms of the ETS, but following reform in 2022 and adoption at the EU level in the first half of 2023, the cap is set to be reduced faster. Between 2024 and 2030, ETS allowances will drop at between 4.3% and 4.4% each year. Far fewer allowances on the market will have a meaningful impact on the ETS price. Energy-intensive industries will gradually lose their free allowances, and these will disappear completely by 2034. Finally, shipping emissions will be added to the existing ETS from 2024 and a new ETS covering buildings and transport will start to function from 2026.

Chart 7: High Environmental Taxes in the EU



Sources: Eurostat, OECD, Moody's Analytics

The ETS is not the only way in which the EU and member states collect revenue from fossil fuels. Admittedly the large array of taxes that have been in place for years were not designed with emissions reduction in mind, but they do serve as additional mechanisms for emissions reduction and imply that emissions pricing instruments attach to a higher price of fossil fuels than in other countries. The EU-weighted tax share of the end consumer price of road fuel is 52% for petrol and 47% for diesel and is among the highest in the world. All told, environmental tax revenues accounted for 1.8% of GDP in the EU in 2020 (see Chart 7).

Taking all taxes into consideration, the EU ETS does not currently add significantly to the overall end-user cost of fossil fuels, but as transition progresses, so will the impact of the ETS.

Part 2: Results

To understand the full implications of EU climate policy and transparently articulate our views on climate transition risk in our baseline forecast and other scenarios, a set of new climate policy levers have been introduced into the Moody's Analytics Global Macroeconomic Model. The new policy levers are directly linked to the real-world policy instruments that form the foundation of EU climate policy, as discussed in the previous section. These include the emissions targets associated with the EU Emissions Trading Scheme, a target for the renewable share of energy associated with the Renewable Energy Directive, and an energy-efficiency target associated with the Energy Efficiency Directive. We have also done some careful work on modelling a genuine net effective carbon tax rate at the national level, so that it more closely reflects the effective tax paid on the carbon that is emitted during the combustion of fossil fuels, including factoring out subsidies on carbon-emitting activities.

These developments allow us to go beyond the standard approach used in all other major macroeconomic models that include climate policy channels that tend to condense all climate policy instruments into a single hypothetical "carbon price". Treating all policies as a tax may overestimate the potential for raising fiscal revenue or the direct impact of climate policy on prices. The delineation between policy instruments that we have developed allows a more accurate assessment of the impact of climate policy choices on the composition of the energy system as well as on key macro variables such as inflation, fiscal revenue, and sector-level production.

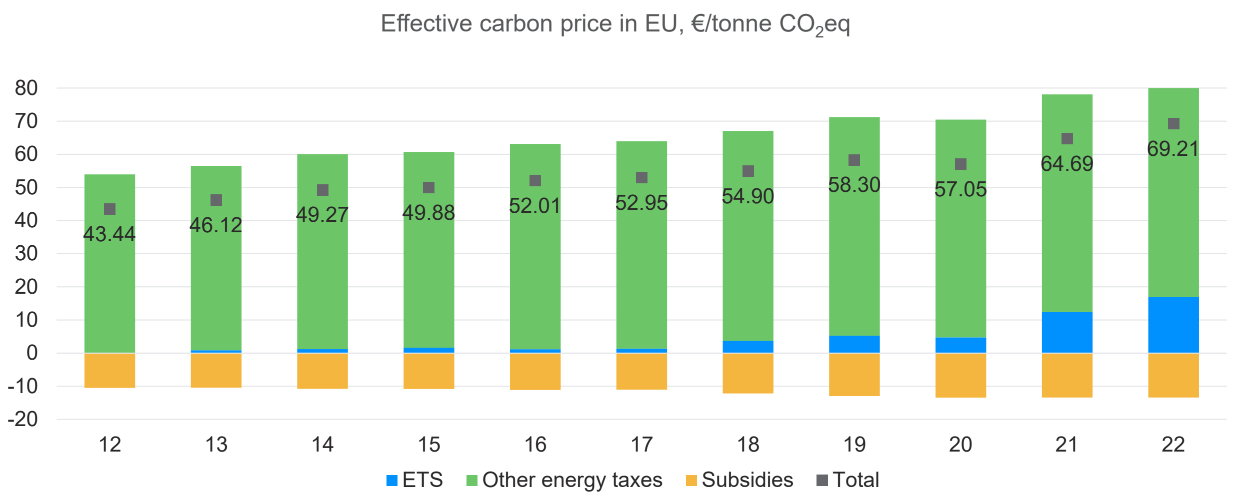
The effective carbon price in Europe

When asked about the level of the carbon price in Europe, many people will point to the observable price of emissions allowances that are traded under the EU Emissions Trading Scheme. But the ETS price can be a misleading guide to the actual effective tax that is attributable to the combustion of fossil fuels. First, the ETS system currently covers only about 40% of EU GHG emissions. Second, more than 40% of emissions allowances are still given away for free, so their initial price is effectively zero. In other words, the ETS price that we observe is applied to less than one-quarter of EU emissions. But there are also a range of other taxes in place in all EU member states that effectively do the job of a carbon price. Some are explicitly labelled a carbon tax—the first was introduced by Finland in 1990. Other taxes add to the costs of burning fossil fuels and releasing carbon emissions such as taxes on transport fuels.

At the same time, there are a range of subsidies in place that are designed to shield certain groups from high energy costs. These subsidies have the unintended consequence of encouraging the use of fossil fuels. This can be thought of as a "negative" carbon tax, reducing the total price paid for emitting a tonne of CO_2.

We have developed a new methodology to estimate historical carbon tax rates. Fossil fuel support payments[1] are subtracted from total government energy-related environmental revenues[2], and this is then divided by total emissions to calculate the net effective carbon tax per tonne of CO_2. We can also decompose energy-related environmental revenues into the share attributed to the EU ETS, which in fact accounts for only a small fraction of net revenue collected. After factoring out the share of emissions that are not covered by the ETS and the share of ETS allowances that are allocated for free[3], we estimate that less than 25% of this effective price in 2022 is directly attributable to costs associated with the EU Emissions Trading System (see Chart 8).

Chart 8: Decomposition of Net Effective Carbon Price in the EU



Sources: Eurostat, OECD, International Carbon Action Partnership, Moody's Analytics

Prices differ by country, depending on domestic tax policies (see Chart 9). While energy-related taxes are higher in Italy and France than they are in the Netherlands, the Netherlands has very few energy subsidies in place. Meanwhile, Ireland has relatively low levels of energy taxation, and high levels of subsidies, and pays less than one-third of the EU average price for carbon.

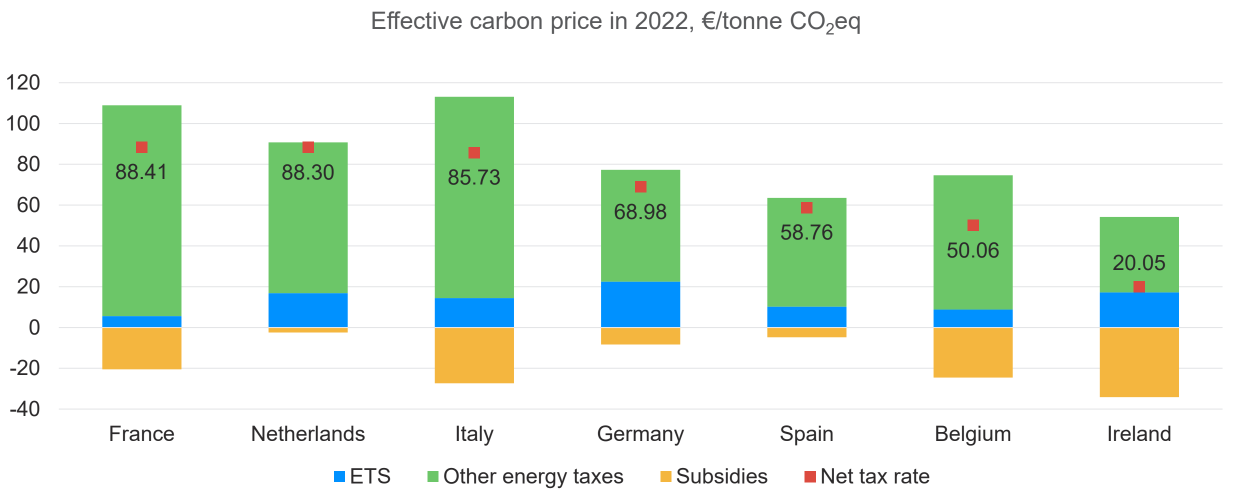
Having established a set of historical estimates for carbon prices in the EU, the challenge is to construct a trajectory for carbon prices that is consistent with the required abatement of emissions (pushing prices up), targeted energy-efficiency gains (reducing the need for price rises), targets for the renewable share of energy (reducing demand for fossil fuels and the need for price rises), the withdrawal of energy subsidies (pushing prices up, but maybe holding ETS prices down), introduction of the ETS extension to shipping, buildings and transport (increasing the contribution of ETS prices to the effective carbon price), and a gradual removal of free allocations of emissions allowances (holding the ETS price down). Table 1 details the various channels at play.

1 OECD's Inventory of Support Measures for fossil fuels.

2 Eurostat's environmental tax revenues [ENV_AC_TAX]

3 Calibrated from European Union Emissions Trading System data from the EU Transaction Log (EUTL), available at: https://www.eea.europa.eu/data-and-maps/data/european-union-emissions-trading-scheme-17

Chart 9: Some EU Countries Pay More Than Others to Emit Carbon



Sources: Eurostat, OECD, International Carbon Action Partnership, Moody's Analytics

Table 1: Upward and Downward Pressures on Carbon Price

	Impact on headline ETS price	Impact on effective ETS price	Impact on effective carbon price
Incremental emissions abatement	↑	↑	↑
Energy efficiency gains	↓	↓	↓
Increase in renewable capacity	↓	↓	↓
Withdrawal of energy subsidies	↓	↓	↑
Extension of ETS	→	↑	↑
Withdrawal of free allocations	↓	↓	↑

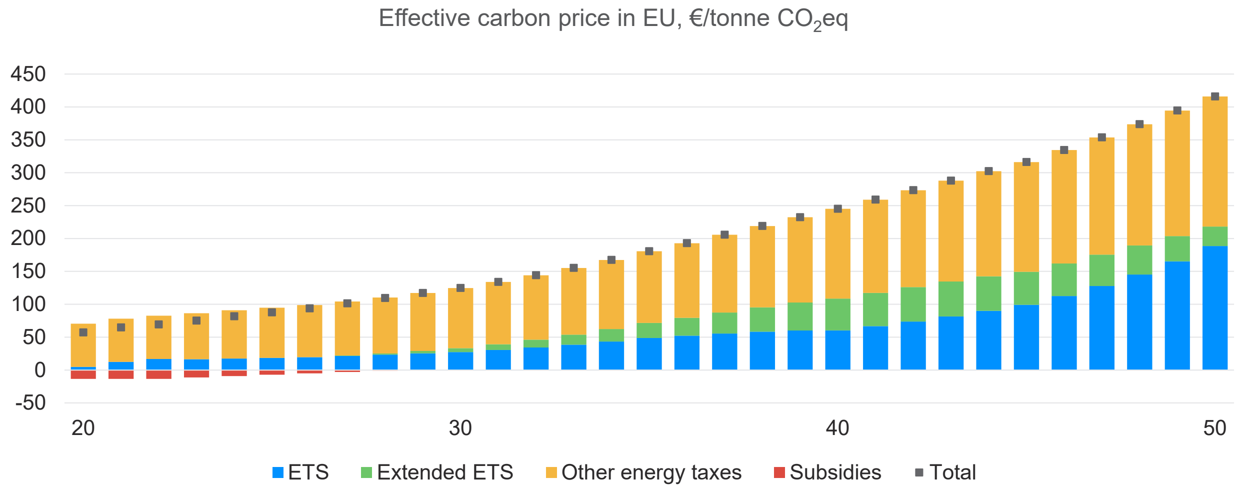
Source: Moody's Analytics

Modelling the interactions between these competing forces allows us to produce a forecast for the net effective carbon tax in the EU (see Chart 10). By 2050, the ETS systems jointly are expected to account for over half of the effective carbon price, compared with just 25% today. The extended ETS applied to buildings and transport sectors will account for a smaller and smaller share, as some of the industrial emissions under the primary ETS sectors will be particularly difficult to abate.

Transmission of a carbon tax

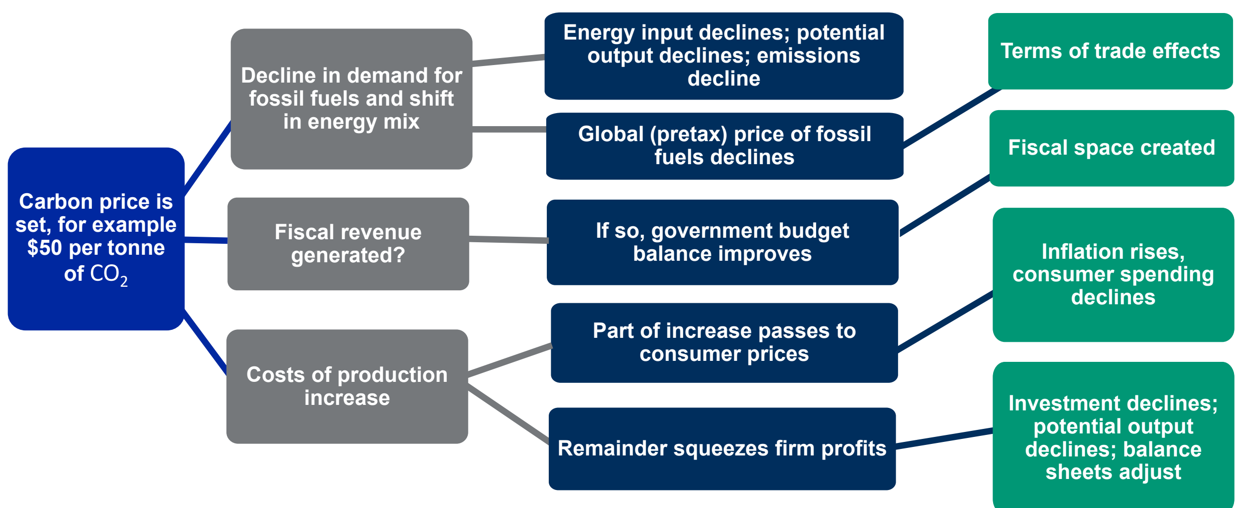
The transmission of a carbon tax through the energy sector and macroeconomy propagates through several channels (see Chart 11). When a tax on carbon is set, this first increases the costs of production. This passes to higher consumer prices and squeezes firm profits. A carbon price increases the costs of burning fossil fuels, encouraging a shift in the composition of energy towards lower-carbon and no-carbon energy sources. Globally, as demand for fossil fuels declines, this will put downward pressure on the global pretax price of fossil fuels. Fossil fuel importers benefit from the lower import price, which partially offsets higher

Chart 10: Moody's Analytics Forecast for Effective Carbon Price



Sources: Eurostat, OECD, International Carbon Action Partnership, Moody's Analytics

Chart 11: Transmission of a Carbon Price



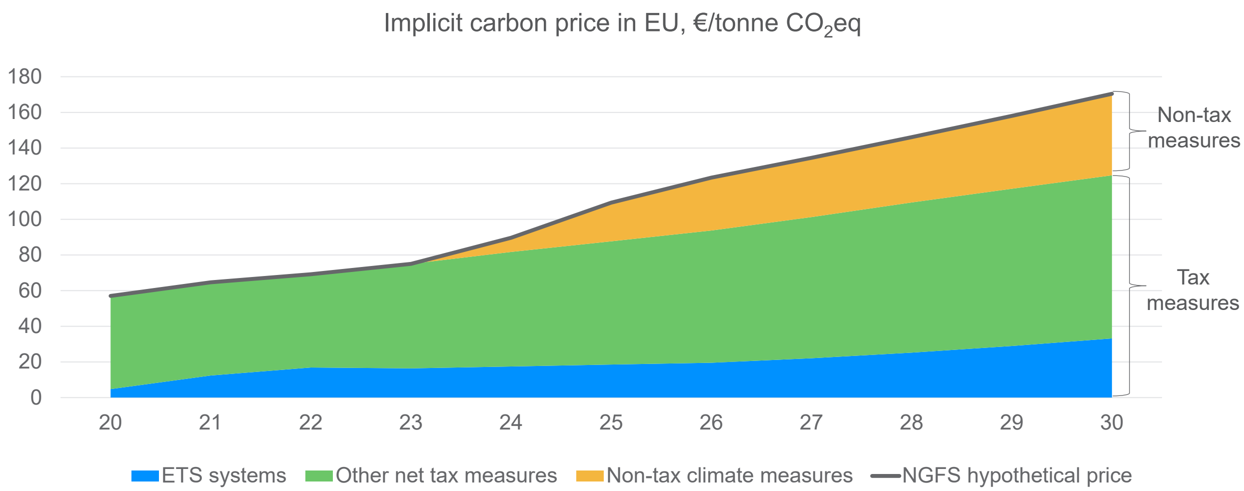
Source: Moody's Analytics

after-tax prices. But fossil fuel exporters lose out on export revenue. A carbon tax may also generate fiscal revenue, creating fiscal space that can be channelled back into the economy to offset some of the costs of transition on heavily impacted households and firms. And the combination of all these factors impacts the level of GDP. The net impact on GDP passes to different industrial sectors, according to their energy intensity and sensitivity to fossil fuel consumption.

Macroeconomic models that include climate policy channels tend to condense all climate policy instruments into a single hypothetical "carbon price" that propagates through the model as described above. This is also the approach taken in the Network for Greening the Financial System climate scenarios, where the stated carbon price is intended to be indicative of the degree of climate policy effort, rather than necessarily an explicit price on carbon itself.

Our modelling efforts allow a decomposition of this hypothetical carbon price into the part that can be directly attributed to tax measures and the part that is representative of non-tax climate policy measures (see Chart 12). This may include regulations such as the ban on sales on fossil fuel-driven vehicles after 2035, regulation related to energy-efficiency standards, or government investment in the expansion of renewable capacity or other technologies. By 2030, based on our understanding of EU climate policy, we estimate that the share of climate policy effort attributable to non-tax measures underpinning the NGFS indicates a carbon price for Europe at just over 25%. By 2050, this share is set to rise substantially, settling at close to 50% by 2100.

Chart 12: Decomposing the NGFS Hypothetical Carbon Price



Sources: NGFS, Eurostat, OECD, International Carbon Action Partnership, Moody's Analytics

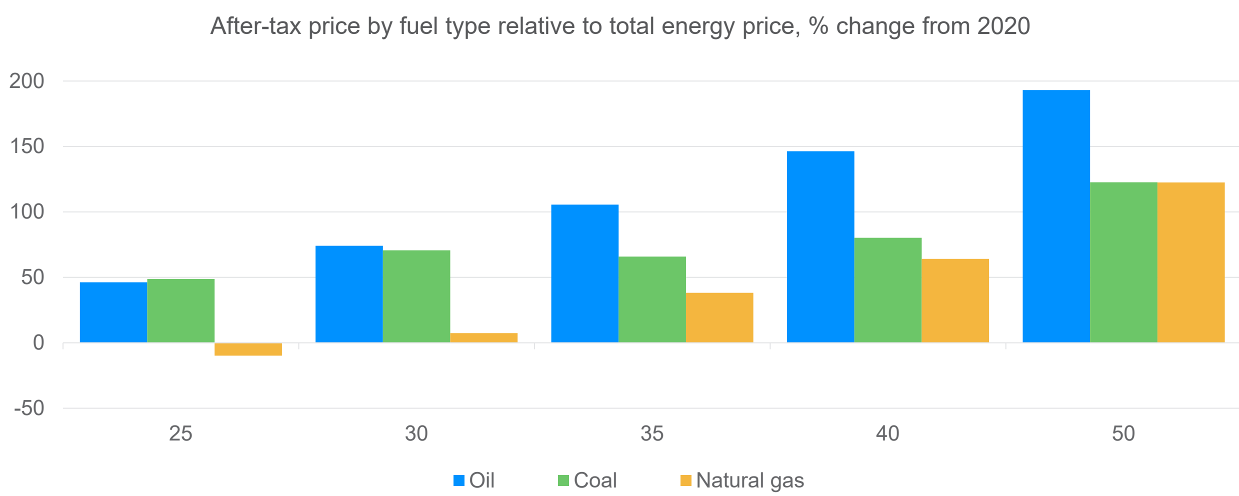
Modelling the price of fossil fuels

Climate policy measures impact the price of fossil fuels from two distinct channels in the Moody's Global Macroeconomic Model. The first is the tax channel, as described above, and the second is via regulation and other non-tax measures enacted to achieve the energy efficiency commitments laid out in the EU's Energy Efficiency Directive. We delve deeper into the tax channels to distinguish between fossil fuels that are primarily subject to the ETS price (coal); fuels that are primarily subject to the forthcoming Extended ETS and other environmental taxes (oil); and fuels that fall under both the current ETS system and the forthcoming extended ETS (natural gas). These distinctions mean that a more rapid withdrawal of emissions allowances under the current ETS system will drive up the after-tax price of coal and natural gas but have limited impact on the price of oil, whereas a more rapid withdrawal of allowances under the extended ETS system will impact the prices of oil and natural gas but have limited impact on the price of coal.

Targets for energy efficiency that underpin the Energy Efficiency Directive impact the price of all energy sources. If the target is growing more rapidly than "trend" efficiency gains (based on an historical average), this pushes energy prices higher to constrain energy consumption.

The composition of energy consumption depends on relative prices rather than absolute prices, as we allow a degree of technology switching that favours the lower-cost fuels. As policy efforts intensify, the relative prices of oil and gas will rise 70% by 2030, given their high carbon content (see Chart 13). After 2030, coal consumption will be largely phased out, but the relative price of oil will continue to rise at a rapid pace as efforts intensify to decarbonise the transport sector. Natural gas prices will also start to rise as hitting net zero targets will require the majority of all fossil fuels to be eliminated from the energy system.

Chart 13: Relative Prices of Oil and Coal Will Rise Steeply



Source: Moody's Analytics

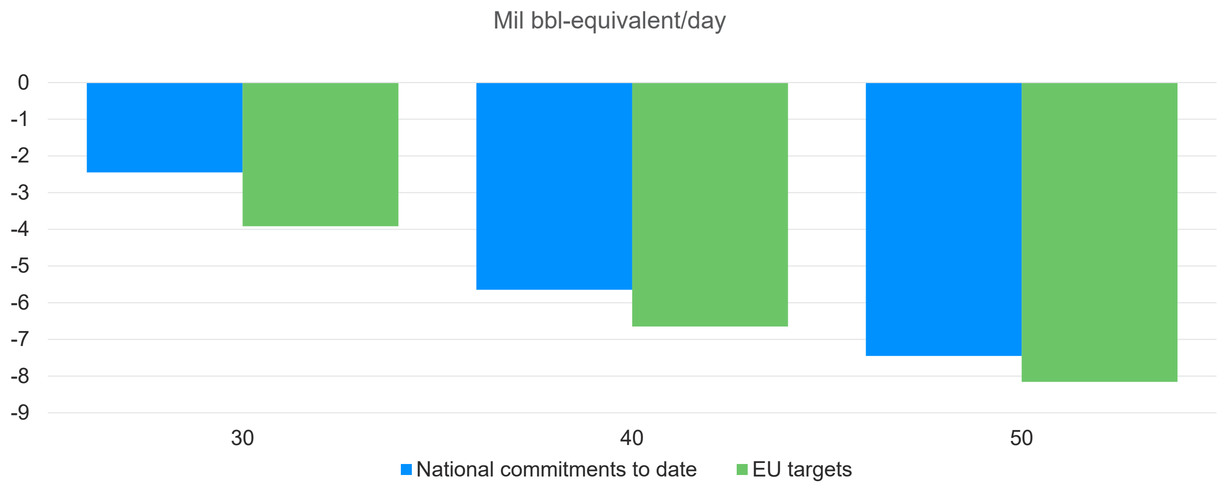
Fossil fuel consumption displaced

EU climate policy on its own is, of course, not sufficient to hit global climate targets. But it will make a substantial dent in global demand for fossil fuels and resonate through global energy markets. Tax and non-tax climate policy measures will drive a steady decline in energy consumption in the EU over the next decade to hit energy-efficiency targets (see Chart 3). At the same time, shifting relative prices and non-tax regulation will drive an even greater share of fossil fuels from the energy consumption mix (see Chart 2).

What does this mean in terms of global demand for fossil fuels? We distinguish between commitments agreed upon at the EU level, and country-level commitments to date, which are updated with a lag. To calibrate the impact of EU climate policy on global demand for fossil fuels, we compare our July 2023 baseline projections for fossil fuel demand in the EU to our December 2022 baseline forecasts, which were made prior to the introduction of any EU climate policy assumptions into the Moody's Analytics baseline.

By 2030, global oil demand is expected to decline by between 2 million and 4 million barrels per day as a result of EU climate policy, equivalent to around 4% of total global demand (see Chart 14). By 2050, EU policy on its own will withdraw demand for about 8 million bpd compared with a "no climate policy" baseline. If other parts of the world make similar progress in electrification and the switch to electric vehicles, global demand for oil could fall far more significantly, weighing heavily on global commodity prices and export revenue in oil-exporting countries.

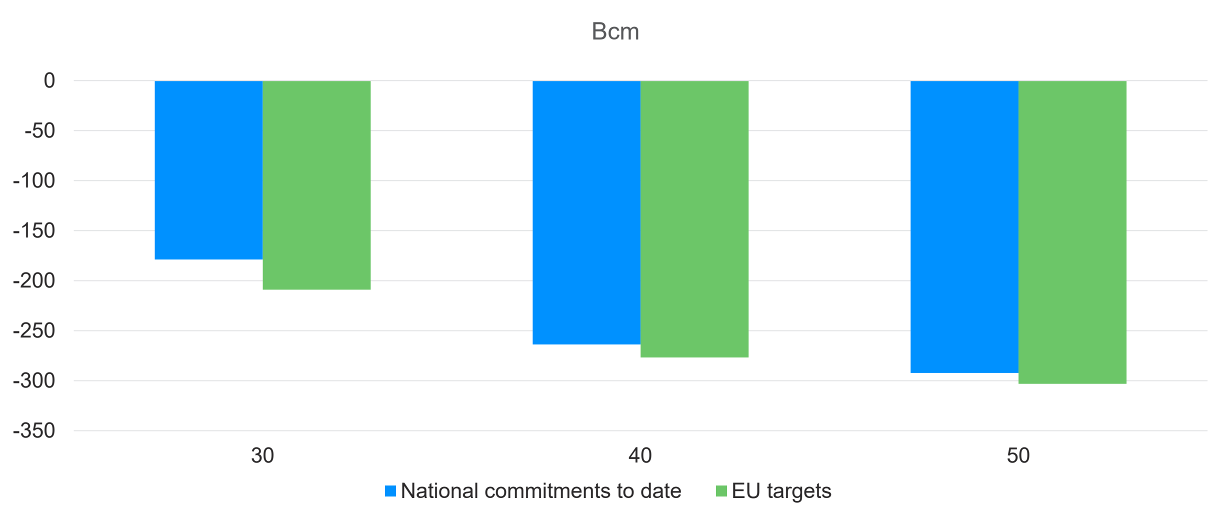
Chart 14: Decline in Global Oil Demand From EU Climate Policy



Source: Moody's Analytics

Global demand for natural gas will also be heavily impacted by EU climate policy, especially as RePower EU has accelerated the EU's ambition to reduce reliance on imported natural gas from Russia. By 2030, EU policy will reduce global demand for natural gas by about 200 bcm (see Chart 15).

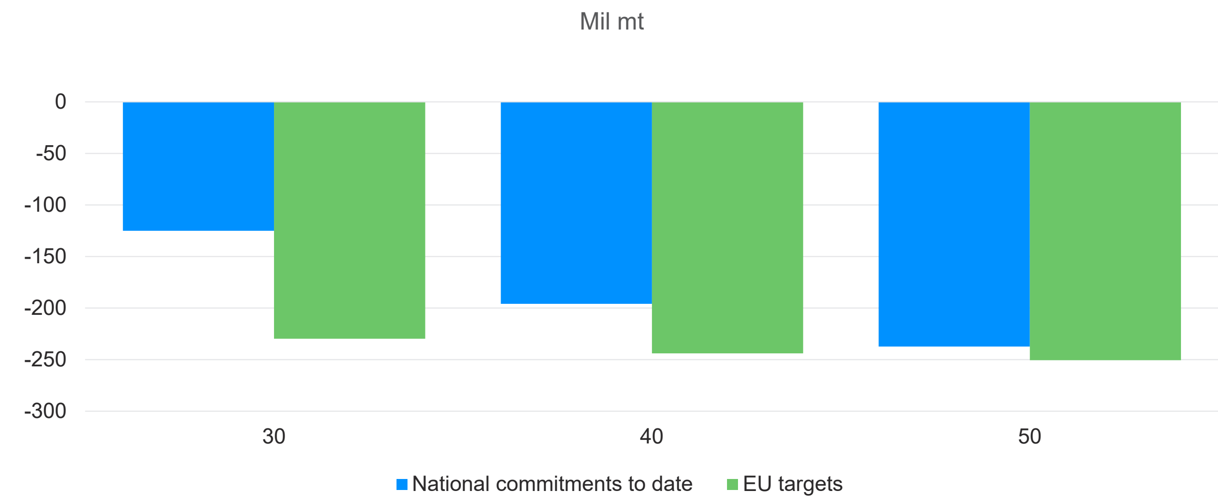
Chart 15: Decline in Global Natural Gas Demand From EU Climate Policy



Source: Moody's Analytics

The EU aims to phase out coal-fired electricity generation by 2030, although some countries have not yet adopted this in national legislation. EU climate policy will withdraw demand for 125 million to 230 million metric tonnes of coal by 2030, and close to 250 million metric tonnes by 2050 compared with a baseline where rising demand for electricity continues to be partly powered by coal (see Chart 16).

Chart 16: Decline in Global Coal Demand From EU Climate Policy



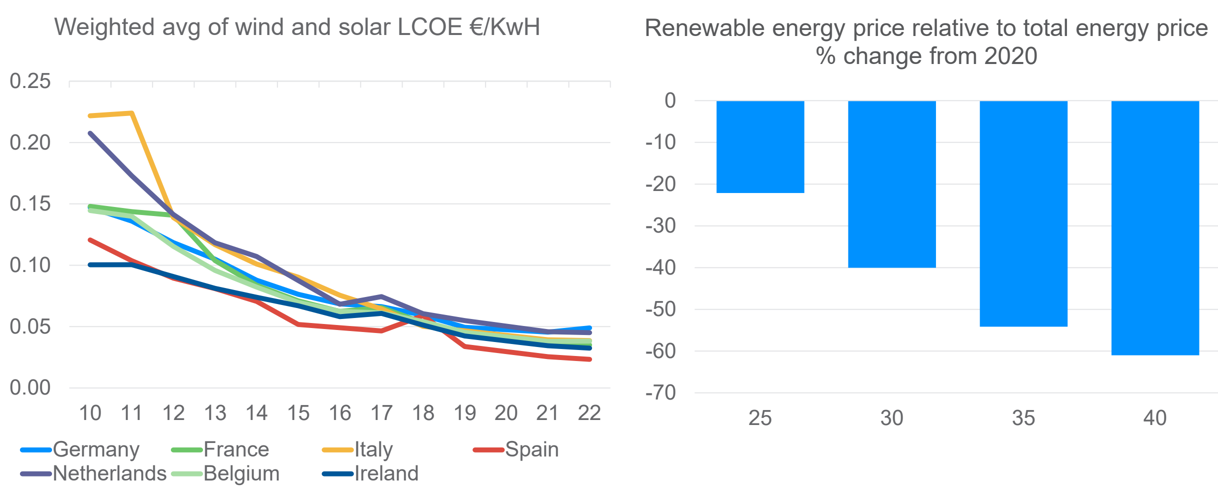
Source: Moody's Analytics

Renewable energy expansion

The counterpart to the phase-out of fossil fuel demand is a rapid ramp-up in renewable energy capacity. The EU's ambitious targets for the share of renewables in total energy will be met by a combination of organic price developments, taxes and restrictions on fossil fuels, and other country-specific policy measures such as subsidies and government investment that support the expansion of renewable capacity.

The levelized cost of renewable electricity has declined steadily over the last decade, reflecting both technological advances and economies of scale from the expansion of capacity. The average cost of wind and solar has dropped 60% to 75% in the last decade (see Chart 17). Over the same period, the renewable share of energy supply increased from 12% to 18%.

Chart 17: Price of Renewables Will Continue to Decline Relative to Fossil Fuels



Sources: International Renewable Energy Agency, Moody's Analytics

Moody's Analytics forecasts for the levelized costs of renewable electricity suggest that there is still scope for renewable prices to decline in absolute terms. More importantly, as the after-tax price of fossil fuels surges, the relative cost of renewable energy will plummet, encouraging the rapid shift towards renewables that is needed. By 2040, we expect the cost of renewable energy to decline by more than 60% compared with a total energy price that weights the prices of coal, oil, natural gas and renewables according to their share in the energy mix.

Conclusions

Implementing the transition to net zero in the EU is a significant challenge that requires an unprecedented rate of change. To put this in context, the EU has achieved an almost 30% reduction in GHG emissions since 1991, but to meet its targets it needs to achieve almost the same again by the end of the decade. In numbers, net emissions of all GHGs, which stood at 4.45 GtCO2eq in 1991 and 3.24 GtCO2eq in 2021, will need to decline to between 1.75 and 2 GtCO2eq by 2030 alone if the EU is to stay on target. The pace of transformation required has no historical precedent.

To achieve its objectives, the EU has implemented a range of policies. Two short-term targets stand out. The first is the target for the share of renewable energy that prior to the Russian invasion of Ukraine was set to rise to 40% by 2030. The second is the extent of efficiency gains, which should lead to a 30% reduction in primary energy consumption out to 2030. Both targets have been revised upwards by the EU following the Russian invasion of Ukraine and await adoption at the national level. If the increases are accepted by member states, then the target for renewable energy rises by 2.5 percentage points with the potential for another 2.5 ppt on a voluntary basis, while the target for energy efficiency rises by an extra 2 ppt.

These are ambitious targets and require significant coordination and additional policies. Permitting procedures will be simplified to reduce the lead time to installing renewable capacity, a necessary step in achieving the large capacity increase necessary to achieve the renewable target by 2030. A key mechanism to achieve transformation is the EU ETS, which has long been criticised for having too many free allowances that keep the price of traded emissions too low. Once again, the events of last year have precipitated action and the EU proposes to tighten allowances at a faster rate and to extend the ETS scheme to cover transport and buildings. Other measures in the pipeline include a potential carbon border tax. In response to the Inflation Reduction Act in the U.S., the EU is also considering a range of subsidies to offer industries.

If transition is successfully implemented, fossil fuel consumption will decline dramatically. Coal demand will be hit hardest by 2030 with a decline of 230 Mmt relative to a "no climate policy" baseline and a modest further decline thereafter. Demand for natural gas will also fall steeply by 2030 and we expect a decline of just over 200 bcm relative to the no policy baseline. The demand for gas will continue to fall beyond 2030. Oil consumption will fall slowly. Nonetheless, we expect a reduction of 3 million barrels per day by 2030, which will increase to approximately 8 million bpd by 2050.

The observed carbon price will rise out to 2050. By 2030, the average effective carbon price will exceed €100/tonne CO_2 in the EU as a whole, while France, Italy and the Netherlands will pay a considerably higher rate. Post-2030, as the distribution of free allocations of emissions allowances under the ETS scheme is gradually withdrawn, carbon prices will ramp up at a faster pace, hitting more than €400/tonne CO_2 by 2050.

Nonetheless, we do not expect the transition to generate significant inflation pressures. One point to note is that not only does the cost of renewable electricity decline relative to the cost of fossil electricity as carbon prices increase, but it is also expected to decline in absolute terms with the increase in installed capacity and as technological gains are made.

Scenario applications and further research

The addition of EU climate policies to our model allows us to construct a range of new policy-relevant scenarios and to apply the model to a range of "what-if" questions. A few examples of our new scenario capabilities are below:

- » Assessing the impact of changes in the renewable energy and energy-efficiency targets on the speed of transition.
- » Projecting the impact of changes to the ETS scheme such as a rollback of the proposal to extend ETS to buildings and transport.
- » Examining trade-offs that arise from the introduction of different price and quality restrictions such as reducing ETS allowances as planned but failing to introduce a carbon border tax.
- » Designing broader trade war scenarios where countries resort to carbon restrictions using tariff and non-tariff measures.
- » Assessing the temperature impact of the EU's transition plans.

The insights presented in this paper are the result of significant improvements to our model and represent the first step in a continuing journey to capture transition in the EU. In future research, we will address the investment needs of these climate policies and the split between public and private financing. We will also broaden the analysis to examine some of the macroeconomic and sectoral impacts of transition on output, employment and prices.

Transition will lead to unprecedented structural change that creates challenges for forecasts and scenarios, but the impact of transition on the economy can no longer be seen as a hypothetical "what-if". Climate scenarios with theoretical carbon prices that are calibrated to different socio-economic paradigms are useful in capturing different ways in which transition might progress over the longer term, but they do not follow real world policy closely enough, nor do they capture the resulting changes to the economy with sufficient granularity. On the other hand, short-term forecasts and analysis based purely on historical trends and the current configuration of the energy system also fail to capture the economic implications of a world that is moving away from fossil fuels. Filling this gap requires us to acknowledge that climate transition is ongoing, and that economic models, forecasts and analyses have to keep up. Nowhere is this more relevant than in the EU.

About the Authors

Dawn Holland is a director of economic research at Moody's Analytics, where she focuses on European economies and climate modelling. Her background is in macroeconomic modelling and forecasting, with a focus on fiscal policy and modelling interactions between the macroeconomy, poverty, inequality and the environment. She previously served as chief of global economic monitoring for the United Nations Department of Economic and Social Affairs in New York and headed the macromodelling work of the National Institute of Economic and Social Research in London. Dawn holds an MSc in economics from the London School of Economics and a BA in Soviet and East European studies from Tufts University.

Gaurav Ganguly is the chief economist for Europe and the Middle East and the head of the Climate Scenario Group at Moody's Analytics. Gaurav's prior experience is in banking and insurance, where he worked as an international economist specializing in a number of countries across Asia and Europe. He has worked on the financial aspects of climate change and was a visiting research fellow at the Grantham Institute for Climate Change at Imperial College in London. He has taught at a number of universities in the U.K. and obtained his MPhil and his DPhil in economics from the University of Oxford.

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