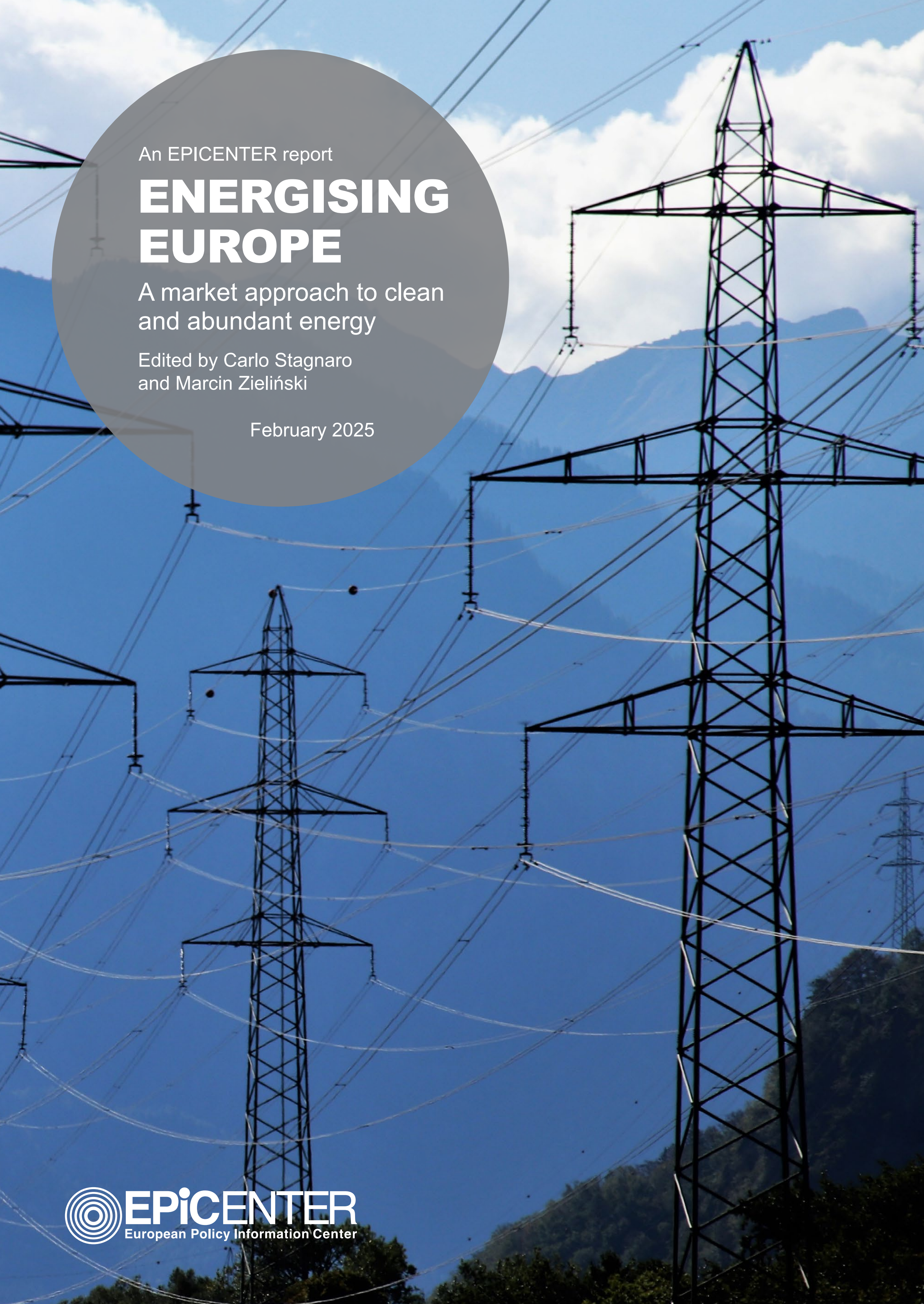

An EPICENTER report

ENERGISING EUROPE

A market approach to clean and abundant energy

Edited by Carlo Stagnaro
and Marcin Zieliński

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Contents

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Summary

The ideal climate policy

- A cost-effective green transition in the EU can be achieved by implementing a single emissions trading system (ETS).
- In the short term, the current ETS can be improved by removing national targets that require emissions reductions in certain sectors that will also be covered by ETS II, slated to come into effect in 2027.
- In the long term, a cost-effective climate policy can be achieved by merging ETS I and II into a single ETS, which will also cover emissions that are currently outside the scope of ETS I and II, e.g. emissions from agriculture.
- To promote a cost-effective ETS, negative emissions should be accounted for in the ETS (by granting allowances for certain technologies such as carbon capture, storage, and utilisation (CCSU)) to ensure that the cheapest emissions reductions are implemented.
- For a more cost-effective climate policy, we also need to eliminate sector-specific targets, such as banning new internal combustion engines (ICEs) by 2035 and increasing the share of renewable energy to at least 42.5–45 per cent by 2030. Sector-specific targets undermine the cost-effectiveness of the ETS and, therefore, increase the cost of climate change mitigation.
- Similarly, ‘double regulation’, or targeting emissions in a sector using more than one instrument (such as emissions requirements for carmakers), is not cost-effective and should be abandoned in favour of implementing the ETS as the sole EU instrument for tackling emissions.
- A comprehensive reform of the ETS can ensure that the EU climate policy is implemented cost-effectively.

Technology neutrality

- Climate policies should not pick technological winners and losers; they should incentivise sustainable technologies and put a price on negative externalities.
- Specific goals that target renewable energy and energy efficiency adoption should be removed because they may impose unnecessary costs.
- All clean technologies, including nuclear power, renewable energies, and CCSU, should be treated equally insofar as they contribute to reducing carbon emissions.
- Bureaucratic obstacles to installing renewable energy and nuclear power should be removed.
- EU energy taxation should be revised to reflect actual environmental damages. When ETS II is introduced, other energy taxes should be reduced accordingly.

Competition in energy markets

- The liberalisation of the electricity and gas markets, initiated in the 1990s, has been relatively successful even though significant progress is still possible.
- Moreover, some policies, such as renewable energy mandates and targets, may be inconsistent with the ideal of promoting competition in energy markets.
- While environmental targets should be realised through the appropriate pricing of carbon emissions and other negative externalities, competition in the electricity and natural gas markets must be encouraged to promote lower prices and innovation.
- Therefore, EU directives and regulations concerning the functioning of energy markets should focus on promoting competition and removing unnecessary regulations.
- It is necessary to phase out all price controls and price regulations, both in the wholesale and retail electricity and gas markets, as well as in the form of explicit support for renewable energy and other specific technologies.
- Moderate support schemes may be introduced to foster the development of renewable and nuclear energy, such as support to the conclusion of

power purchase agreements (PPAs), for example in the form of public guarantees.

- Permitting procedures should be revised to remove unnecessary obstacles to the development of clean energies.
- Faster development of cross-border infrastructures may improve the functioning of the market.

Exploitation of domestic gas resources

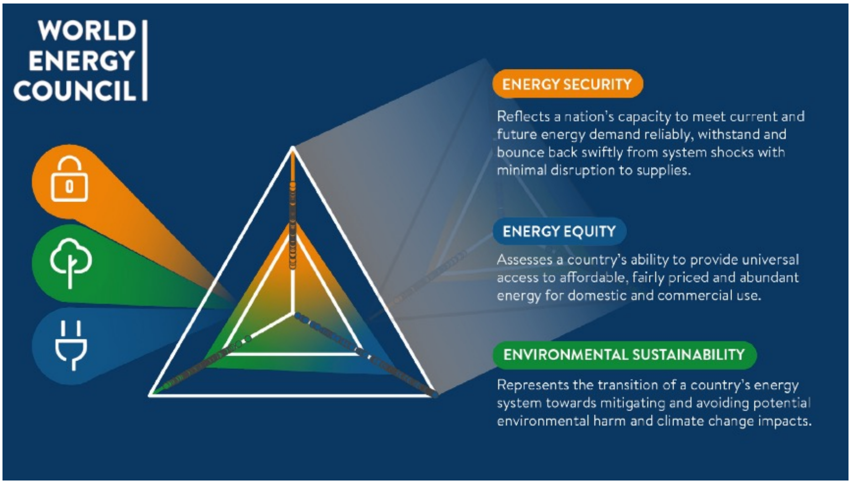
- It is preferable that the transition to a more carbon-neutral economy occurs while Europe primarily uses oil produced locally, by EU member, candidate, or associate states rather than that imported from hostile countries and unreliable autocracies. The Black Sea bedrock shares many geological similarities with the Caspian Sea, a region well known for its significant oil and gas reserves. Therefore, prospection should be continued, and commercial exploitation accelerated.
- Extending the existing network, at least to recently discovered gas reserves, is necessary. However, the benefits of new energy sources will extend beyond the countries situated around the Black Sea. Part of the gas production can be exported to other countries that still rely on gas from Russia (e.g. Austria and Hungary) or on coal, as Germany has since closing its nuclear plants.
- The benefits of existing pipeline networks can be significantly amplified by interconnecting them. The economic, social, and political benefits will outweigh the relatively small supplementary costs.

Introduction

The goals of any energy policy are often described with reference to the so-called 'energy trilemma': the idea that energy systems should balance the interests of energy security, competitive and equitable access, and sustainability, as illustrated by Figure 1. These dimensions may or may not be pursued simultaneously; in fact, suboptimal policies may result in the maximisation of only one aspect to the detriment of the other two. The 2022 EU energy crisis was, in part, a consequence of policies that treat the sustainability of energy systems as an independent and overarching goal. By designing climate policies that favour certain technologies over others, EU member states imposed unnecessary costs on their economies (Gugler, Haxhimusa and Liebensteiner 2021) – particularly on those at the bottom of the income distribution (Vona 2023). Besides, the emphasis on renewable energy also led to the underfunding and underdevelopment of other energy sources, both fossil (such as oil and gas) and non-fossil (such as nuclear). This contributed to exacerbating the vulnerability of Europe's energy systems. When Russia invaded Ukraine, Moscow leveraged this fragility and triggered an unprecedented escalation of natural gas and electricity prices in the EU, severely endangering European economies. Only extraordinary policies and weak demand due to mild winters could help the EU overcome the immediate impact of the crisis.[1]

1 'Europe's energy crisis: What factors drove the record fall in natural gas demand in 2022?', *International Energy Agency*, 14 March 2023 (https://www.iea.org/commentaries/europe-s-energy-crisis-what-factors-drove-the-record-fall-in-natural-gas-demand-in-2022).

Figure 1. Illustration of the energy trilemma



Source: World Energy Council (2024)

Some lessons were learnt from the 2022 energy crisis, as shown by the Draghi report, which calls for a more balanced approach to energy policy (Draghi 2024). This includes the introduction of specific measures to improve energy security and a more balanced approach to climate policy that accounts for the relatively low share of Europe in world carbon emissions. The other recommendations of the Draghi report are less convincing, partly because they were a response to the exceptional conditions that emerged during the crisis, and which have, to a large extent, been since overcome.

This chapter is organised as follows. Section 2 details how the EU climate policy should ideally be designed, considering other goals that are as important as sustainability – such as energy affordability and security. Section 3 translates these principles into policy proposals or reforms in an attempt to incorporate into Europe's energy policy the ideals of technology neutrality and free markets. Section 4 focuses on electricity markets and shows that liberalisation, which started in the 1990s, has been successful but is now in danger; we therefore argue that policies that further open up the market should be introduced. Finally, Section 5 examines the exploitation of domestic gas resources, with a case study on the Black Sea.

How should the ideal EU climate policy be designed?

by Otto Brøns-Petersen (CEPOS) & Line Andersen (CEPOS)

Ideal global climate policy

Greenhouse gas (GHG) emissions cause global temperatures to rise. This leads to weather and other environmental changes, which are associated with economic losses. As the damages associated with GHG emissions are global, the world collectively bears the burden of the emissions of any one emitter. Basic economic theory suggests that externalities are most efficiently addressed through pricing – for example, through a Pigouvian tax (Pigou 1920). The literature questions the feasibility of well-functioning Pigouvian taxes and suggests more nuanced policies instead (Coase 1960). For example, economists have proposed the creation of cap-and-trade schemes, under which allowances are exchanged in order to achieve a least-cost allocation of the emissions cuts. This is the case of the EU Emissions Trading System (EU ETS). Unlike a Pigouvian tax, the ETS sets a cap on emissions and leaves it to the market to find the cheapest way to cut emissions; the price of CO_2 allowances reflects the marginal cost of emissions abatement. In an ideal world, the price of ETS allowances under the optimal cap will be equivalent to the optimal carbon tax that leads to a reduction in CO_2 emissions to a level equal to the ETS cap.

GHG emissions should ideally be priced according to the global marginal damage. It is well established in the economic sciences that establishing a uniform price for GHG emissions would be the most cost-effective path to reducing emissions (Mankiw 2008; Tirole 2017).[2]

Putting a price on GHG emissions will ensure that the negative externalities of emissions are internalised within production costs and that production will only take place if the benefits exceed costs. An optimal climate policy would impose a global, uniform, and technology-neutral price, which would incentivise nations to achieve the cheapest emission reductions. Putting a price on GHG emissions will not only impact the price of the energy produced using fossil fuels, but also that of all products made using energy from fossil fuels or whose production processes release GHG emissions into the atmosphere (e.g. cement or steel). This move will ensure that emissions reductions are implemented more quickly in sectors where GHG emissions create the least value (e.g. in sectors with cheap green alternatives) and more slowly in sectors where GHG emissions create more value (e.g. in sectors where it is harder to transition to green technologies). Thus, the price solves an information problem for governments and consumers, who would otherwise be unaware of the true climate impact of their consumption choices. The price mechanism is the only way to handle complex economic processes (Hayek 1945) and avoid the political dangers of regulatory state and central planning.

At the same time, imposing a uniform price on GHG emissions would work as an indirect 'subsidy' for energy-saving initiatives, renewable energy, and research and development on green technologies. This is because the price on emissions will incentivise emitters to reduce their costs by using alternatives that emit less.

However, there is no global institution that can lead the negotiations among governments to introduce a uniform tax on GHG emissions. This raises the question of what the second-best alternatives are. The Tiebout mechanism suggests that political tasks should be solved at the level best equipped to handle them and in as decentralised a manner as possible (Tiebout 1956). As the climate crisis is a global phenomenon, policy action should be taken at a level that is as close to global as possible. In this instance, the EU is well-positioned to be a key player. This approach is

2 'Economists' statement on carbon dividends', *Wall Street Journal*, 16 January 2019 (https://www.wsj.com/articles/economists-statement-on-carbon-dividends-11547682910).

also reflected in the EU's participation in the Paris Agreement on behalf of its member states.[3] The EU does not have the ability to impose a European climate tax, but it can introduce an emissions trading system (ETS), which indirectly puts a price on emissions, and has the same desirable properties as a Pigouvian tax.

The current climate policy in the EU

In 2021, the EU set a climate target, 'Fit for 55', to reduce EU emissions to at least 55 per cent below its 1990 levels by 2030, and to achieve climate neutrality by 2050. In 2024, the European Commission also proposed a 2040 climate target to reduce emissions by 90 per cent relative to 1990.[4] To achieve these targets, the EU has adopted several provisions. The emissions covered by EU provisions can be divided into two classes: those covered by the ETS and those that member states are required to mitigate as per national targets (Effort Sharing Regulation and Regulation on Land Use, Land-Use Change, and Forestry (LULUCF)).

The EU often promotes cost-effective climate policies. In 2005, it introduced the world's first international ETS.[5] It was based on the 'cap and trade' principle, which puts a cap (that declines over time) on the GHG emissions that can be emitted by certain sectors in the EU. The cap is enforced using emissions allowances, where one allowance gives the right to emit one tonne of CO_2eq (i.e., carbon dioxide equivalent). This implies that the ETS is technology-neutral. The allowances are then sold in auctions and may be traded.[6] This means that the price of allowances (and thereby the price of GHG emissions) is determined by the EU carbon market.

ETS (I)[7] covers electricity and heat generation, energy-intensive industry, aviation within the European Economic Area (EEA), and maritime transport.

3 'Paris Agreement on climate change', *European Commission*, n.d. (https://www.consilium.europa.eu/en/policies/climate-change/paris-agreement/).
4 '2040 climate target', *European Commission*, n.d. (https://climate.ec.europa.eu/eu-action/climate-strategies-targets/2040-climate-target_en).
5 'Development of EU ETS (2005–2020)', *European Commission*, n.d. (https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/development-eu-ets-2005-2020_en).
6 'What is the EU ETS?', *European Commission*, n.d. (https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/what-eu-ets_en).
7 'Scope of the EU ETS', *European Commission*, n.d. (https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/scope-eu-ets_en).

In 2023, an additional ETS (II)[8] was introduced. ETS II will be fully operational in 2027. It covers buildings, road transport, and additional sectors. The Effort Sharing Regulation, initially adopted in 2018, requires member states to reduce their emissions from the following sectors by 2030: domestic transport (excluding aviation), buildings, agriculture, small industry, and waste. This means that emissions from the transportation and buildings sectors will be covered by both ETS II and the Effort Sharing Regulation in 2027–2030, when ETS II is scheduled to be fully operational. The LULUCF regulation requires member states to ensure that emissions from the land use and forestry sectors are compensated through the equivalent removal of CO_2 in 2021–2030.[9]

The revenue from the ETS primarily flows toward national budgets. However, member states are required to use it to support investments in renewable energy, energy-efficiency improvements, and low-carbon technologies.[10]

Fit for 55 significantly strengthens the ambitions of the EU's climate policy. Some calculations suggest that if the rest of the world limits its emissions to the same extent as indicated in the EU's plans, global, cumulative GHG emissions would be close to the level required to keep the global temperature rise below 1.5 °C (Hassler, Krusell, and Olovsson 2024).

The backbone of the EU climate policy is the ETS. However, the EU climate policy also incorporates sector-specific regulations outside of the ETS. These regulations will increase the cost of the green transition as they counteract the cost-effective properties of the ETS. Some sector-specific targets include a ban on new internal combustion engines (ICEs) by 2035. By 2035, CO_2 emissions from newly-registered cars and vans are required to be gradually reduced. Another sector-specific target aims to increase energy efficiency by having member states reduce their energy consumption by 2030.[11] In addition, the EU has a binding renewable energy target: renewable energy must make up at least 42.5 per cent – ideally 45 per

8 'ETS2: buildings, road transport and additional sectors', *European Commission*, n.d. (https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/ets2-buildings-road-transport-and-additional-sectors_en).

9 'Land use sector', *European Commission*, n.d. (https://climate.ec.europa.eu/eu-action/land-use-sector_en).

10 'What is the EU ETS?', *European Commission.*

11 'Energy efficiency directive', *European Commission*, n.d. (https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficiency-targets-directive-and-rules/energy-efficiency-directive_en).

cent – of the total energy use by 2030.[12] Additionally, suppliers of aircraft fuel are required to gradually increase the share of supply of sustainable aviation fuels (such as synthetic fuels or advanced biofuels).[13] These are only a few examples of extant sector-specific regulations.

The ideal EU climate policy

The foundation for an ideal EU climate policy is already in place in the form of the ETS. The ETS serves the same purpose as a Pigouvian tax, as it sets a price for emissions. This means that all externalities are internalised within production costs through the price on emissions. This allows market mechanisms to work efficiently and ensures that GHG emissions are mitigated in those sectors where mitigation is cheapest, ensuring a cost-effective climate policy in the EU.

As we described earlier, emissions within the EU are covered by ETS I, ETS II, or national policies to mitigate them. This implies that the price on emissions is not uniform across sectors, which goes against the basic principle of a Pigouvian tax. To achieve a cost-effective climate policy in the EU, all emissions should be priced uniformly within a single ETS that covers all EU emissions. Herby (2023) shows that costs could be reduced by around 25 per cent if the sectors covered by ETS I and II were brought under a single ETS. From 2027, when ETS II takes effect, until 2030, the transportation and buildings sectors are covered by both ETS II and the Effort Sharing Regulation, which leads to inconsistent pricing on emissions. This problem of double regulation can be addressed by removing national policies affecting the sectors covered by ETS II.

Another area for improvement would be to include negative emissions in the ETS. For instance, carbon capture, storage, and utilisation (CCSU) initiatives should be granted new allowances. These allowances can then be sold in the market. This would create an incentive to capture, and thereby reduce, the amount of GHGs in the atmosphere, just as the price on emissions does. Including negative emissions in the ETS promotes cost-effectiveness, as it ensures that the cheapest emission reductions are implemented.

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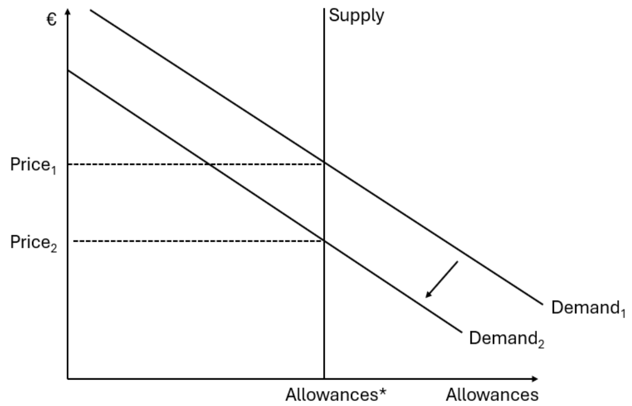
12 'Renewable energy targets', *European Commission*, n.d. (https://energy.ec.europa.eu/topics/renewable-energy/renewable-energy-directive-targets-and-rules/renewable-energy-targets_en).

13 'ReFuelEU Aviation', *European Commission*, n.d. (https://transport.ec.europa.eu/transport-modes/air/environment/refueleu-aviation_en).

Sector-specific targets are supposedly aimed at promoting faster emission reductions. However, this approach is not aligned with the idea of a single ETS. In an ETS, there is a supply of – and a cap on – allowances for GHG emissions, which companies must procure if they produce emissions as part of their production processes. This implicitly puts a price on GHG emissions. Figure 2 illustrates how the ETS works.

Figure 2. The number of allowances (emissions) are unaffected by shifts in demand[14]



Source: Authors' illustration

As Figure 2 shows, the number of allowances (and thus emissions) is fixed by the supply of allowances (the cap). Because the supply of allowances is fixed, a downward shift in demand reduces the price (from $Price_1$ to $Price_2$) on allowances in the carbon market without affecting the number of allowances, and thus, the total emissions permitted under the ETS. In a fully efficient ETS, there will be 100 per cent leakage, i.e., a reduction in emissions in one sector covered by the ETS will be offset by growing emissions in another sector covered by the ETS, leaving the total amount of emission unaffected.

Imposing sector-specific targets, such as a ban on new ICEs, will cause a downward shift in the demand for emissions allowances as car manufacturers will then only sell non-CO_2-emitting vehicles. As Figure 2

14 The figure is purely illustrative. There are exceptions to this mechanism, e.g. the market stability reserve.

illustrates, the number of allowances – and thereby emissions – will remain unaffected by the ban. If the ban is not effective, i.e., the carbon price rather than the ban drives the phasing out of new ICEs, the cost of the green transition will be unaffected. However, considering that the ban aims to speed up the phasing out of ICEs, it will likely come with a cost without a further decrease in GHG emissions. This will increase the total cost of the green transition.

The same mechanism applies to the remaining sectors that are covered by the ETS. Sector-specific targets are not technology-neutral, and so may hinder the identification of the cheapest emissions reductions under the ETS. The ideal EU climate policy would thus include the phase-out of sector-specific targets to ensure cost-effectiveness.

Due to the market stability reserve (MSR), the leakage rate is not always 100 per cent in ETS I. The MSR cancels allowances if there is a large surplus of allowances on the market; and it releases additional allowances if the total number of allowances falls below a certain threshold. This means that the leakage rate can be below 100 per cent, implying that emissions reductions within the ETS may have an ambiguous impact on global emissions – which may or may not be reduced. Beck, Kruse-Andersen, and Stewart (2023) and Silbye and Sørensen (2023) estimate that the surplus of allowances will be reduced to the point that the leakage rate will be close to 100 per cent from the beginning of the 2030s. Silbye and Sørensen (2023) predict that given current regulations, the leakage will be below 100 per cent up until 2032, whereafter it will be 100 per cent. The MSR creates uncertainty within the ETS because it makes it difficult to estimate present and future leakage rates. Cancelling allowances poses challenges for member states pursuing a more ambitious climate policy than EU climate targets, as cancelling them might lead to the release of additional allowances, making the national reductions irrelevant.

ETS II has a price stability mechanism[15] that will be activated if the carbon price exceeds €45, which will trigger the sale of a given number of additional allowances. Similarly, if the price of allowances increases too rapidly, additional allowances may be released from the reserve. The price stability mechanism acts as a soft price ceiling and, in this instance, the price on emissions can be understood as a tax, as the price rather than the amount of allowances is somewhat fixed. An ETS without price controls would be

15 'ETS2: buildings, road transport and additional sectors', *European Commission*.

more reliable in meeting quantitative targets. However, price controls can serve as insurance against uncertainty; besides, a price cap may be required to ensure the political feasibility of the scheme. If the EU's ambitious climate targets prove to be very difficult to meet, the carbon price increases above the value of externalities, and the EU is on track to meet the commitments of the Paris Agreement, a price control in the ETS can keep the carbon price below a certain threshold. However, if the price control is activated, then climate targets should be adjusted accordingly. This is because if reductions are to be achieved through measures other than the ETS, they are likely more costly, which would counteract the purpose of price control.

In the future, the revenue from the ETS should flow to each member state, but there is no need to earmark the revenue for promoting climate-friendly technologies. As we described previously, the price on emissions works as an indirect 'subsidy' – e.g. to green technologies – and public spending could raise the cost of the green transition. Earmarking revenue for specific green investments imposes non-uniform shadow prices on GHGs, which could counteract cost-effectiveness. If the revenue is to be earmarked, then the framework should be designed to ensure that shadow prices on GHGs are uniform. However, some of the ETS revenues (below a certain, reasonable threshold) might be used to partly finance EU-wide infrastructure deemed by the EU Commission as being of common interest. Broadly speaking, however, ETS revenues should be used to reduce other taxes in member states in order to contain the fiscal impact of climate policies.

Therefore, significant reform of the current climate policy is necessary. A short-term improvement would be to eliminate double regulation by removing sector-specific emissions reduction targets for sectors covered by ETS II. In the long term, all emissions within the EU should be uniformly priced – which is not the case today. To impose uniform pricing, ETS I and II should be combined into a single ETS that also covers sectors not yet included in either existing ETS. This single ETS should also incorporate negative emissions, which would promote cost-effectiveness. In addition, under a fully efficient ETS, sector-specific targets will not promote faster emission reductions, which is why these targets should be repealed under an ideal EU climate policy. Such a reform of the ETS would ensure that the EU climate policy cost-effectively achieves the set climate targets.

Technology neutrality in practice

by Diana Năsulea (IES), Christian Năsulea (IES), Cécile Philippe (IEM) & Carlo Stagnaro (IBL)

The framework we have presented in the previous sections has large, practical implications with regard to both the design of the ideal EU climate policy and the reform of current policies. As climate targets become more ambitious, making climate policies cost-effective is critical. The EU has made climate one of its key, long-term goals, under the assumption that, on the one hand, climate neutrality by 2050 is a feasible target and, on the other, the first movers will gain a competitive edge in the market. While there may be some merit to this belief, events have not played out as expected. The EU has over-achieved its climate targets so far and may be on track to meet its self-imposed 2030 goals, but other countries are not necessarily following – and President-elect Trump has already announced that the US will scale down its climate commitments[16]. To make things worse, Europe has not achieved technological leadership in clean technologies; key technologies, such as photovoltaic panels, electric vehicles (EVs), and long-term storage batteries, are either dominated by China or the US, or, in any case, remain outside European producers' dominance. Even wind turbines, which used to be an area of European specialisation, are now exposed to harsh competition from more efficient Chinese companies[17]. The EU still has visible leadership in clean internal combustion engines

16 'Trump would withdraw US from Paris climate treaty again, campaign says', *Politico*, 28 June 2024 (https://www.politico.com/news/2024/06/28/trump-paris-climate-treaty-withdrawal-again-00165903).

17 'China Threatens Europe's Windmills', *CEPA*, 17 October 2024 (https://cepa.org/article/china-threatens-europes-windmills/).

(ICEs), but it will ban the sale of new ICEs by 2035 unless this commitment is revised[18].

Ambitious climate targets, in combination with sectoral or sub-sectoral targets, may turn Europe's climate leadership into an economic nightmare. If the EU intends to remain at the forefront of decarbonisation while minimising the costs of the energy transition, it should move to a principled environmental policy, following the premise we have laid down. In practice, this means abandoning every policy that favours particular technologies while switching to pure carbon pricing via the ETS or carbon taxes. Under pure carbon pricing, emitters are charged according to the amount of emissions they produce regardless of their objectives, production processes, or choice of primary fuel. By the same token, emission cuts are rewarded according to the total amount of emissions reduced, regardless of how, why, or by whom this goal is achieved. As per the principle of technology neutrality, the policy is only aimed at cutting emissions, i.e., it is a purely environmental policy. While the principle of technology neutrality is embedded in Europe's climate policies (EC 2022), it is systematically violated both at the EU and member states levels. This results in unnecessary costs and, possibly, an implicit disincentive to invest and innovate in technologies that are not incentivised by policy.

While an optimal climate policy would eliminate regulations, obligations, or prohibitions, the EU and national laws are currently entrenched with sectoral or technological targets. Therefore, the following sections provide guidance on how the current system could be gradually reformed to nudge Europe's climate laws towards technological neutrality.

Renewable energies

Renewable energies are a critical pillar of the EU climate policy, particularly in (but not limited to) the power sector. These technologies have become increasingly competitive over time, with substantial cost reductions, as large as 90 per cent for photovoltaic panels, in the past ten years. Battery storage is following a similar cost reduction curve, laying the ground for further improvements. There is little doubt that renewable energy penetration will skyrocket in the foreseeable future under all energy scenarios (IEA

18 'EU ban on the sale of new petrol and diesel cars from 2035 explained', *European Parliament*, 3 November 2022 (https://www.europarl.europa.eu/topics/en/article/20221019STO44572/eu-ban-on-sale-of-new-petrol-and-diesel-cars-from-2035-explained).

2024). In the past, renewable energies were heavily subsidised to promote their development and uptake. EU member states collectively spent as much as €87 billion in 2022 on subsidising renewable technologies, with solar, wind, and biomasses being the largest recipients (EC 2023). Whatever the reasons for such significant spending in the past, recent technological progress has made such policies clearly unnecessary. Therefore, we argue, subsidies for renewables should be stopped. This not only applies to older subsidisation tools, such as feed-in tariffs and green certificates, but also to other support instruments, such as the so-called Contracts for Difference (CdFs), which we will deal with in the next section.

Monetary subsidies are the most visible way of supporting renewables well beyond their unquestioned merits. Today, however, renewables enjoy a special status in EU climate policy – they benefit not only from monetary subsidies from member states and the EU's own funds (such as the Next Generation EU programme). Indeed, under the Fit for 55 climate plan, member states are expected to increase the share of renewables in their energy consumption to 42.5–45 per cent by 2030 (up from 23 per cent in 2022). This specific target could cause renewables to displace other, more efficient technologies simply because of the regulatory push. Therefore, while an optimal climate policy would repeal any specific target (including that of renewables), the Fit for 55 Plan could be revised such that the 42.5–45 per cent target includes not only renewables but also every other low-carbon technology, such as (but not limited to) nuclear power, low-carbon hydrogen and other low-carbon gases, and perhaps thermal power plants whose emissions are abated through CCSU or other technologies.

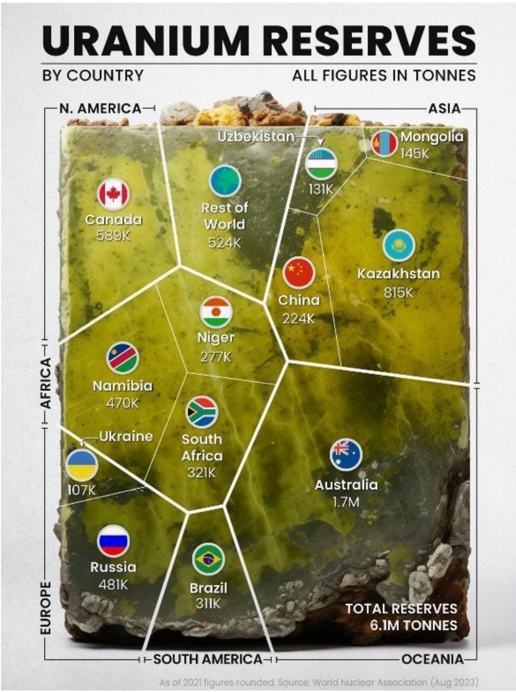
Nuclear power

Nuclear power is the largest low-carbon energy source in the European Union, accounting for 13 per cent of the EU's gross inland consumption and 25 per cent of gross electricity generation in 2021 (Dulian 2023). Nuclear power is not evenly distributed among member states; France is in the lead, producing more than half of all nuclear power in Europe. Other countries, including Finland, Slovakia, the Czech Republic, Sweden, and, outside the EU, the UK, have either historically relied on nuclear power or are in the process of increasing their fleet of nuclear generators. Still others, such as Poland and Italy, are considering starting nuclear generation.

Nuclear energy emits the least CO_2 per kWh produced. With 4 grams of CO_2eq emissions per kWh (linked to plant construction, maintenance and dismantling at end of life), it emits 3 to 4 times less than wind power and 8 to 11 times less than photovoltaic. The Institut économique Molinari calculated that the replacement of fossil fuels by nuclear power has made it possible in the previous 45 years to avoid the emission of around 25 times France's total CO_2eq emitted in 2022[19].

It comes with greater geostrategic independence of the electricity production from suppliers as well. Indeed, it avoids imports of fossil fuels and saves the use of critical metals. Unlike wind and solar power, nuclear power requires few critical metals per kWh produced. Moreover, uranium stock is are quite abundant and imports come from a variety of countries (Figure 3).

Figure 3. Global uranium reserves by country



Source: Visual Capitalist (2024)

19 'En 45 ans, le nucléaire en France a permis d'éviter environ 25 fois les émissions totales de CO2 de 2022', *Institut économique Molinari*, 20 December 2023 (https://www.institutmolinari.org/2023/12/20/en-45-ans-le-nucleaire-en-france-a-permis-deviter-environ-25-fois-les-emissions-totales-de-co2-de-2022/).

Nuclear energy has other advantages such as a small land footprint due to very high energy density: nuclear power requires just 0.03 hectares (ha) per megawatt (MW) installed. Photovoltaics require around 80 times as much land, and an onshore wind farm over 400 times as much. This saves on landscape, noise pollution and the depreciation of nearby habitats.

Public acceptance of nuclear energy has increased significantly in recent years in the EU, the US,[20] and worldwide.[21] This is a window of opportunity to develop new projects. However, there are still too many misconceptions about nuclear energy; a sustained and well-designed information campaign is the only way to counter them. Opposition to nuclear energy mainly stems from its operational safety risks, high material and financing costs, challenges associated with the supply of nuclear fuel, and difficulties associated with treating and storing nuclear waste. Small modular reactors (SMRs) answer these legitimate concerns in a more than satisfactory way.

Indeed, among recent technological developments, SMRs appear the most realistic and promising. According to the International Atomic Energy Agency (IAEA 2021), this technology offers flexibility (resulting from their small scale and modularity); relative efficiency (allowed by the standardisation of the reactors); higher safety (they operate at low pressure and shutdown automatically, without additional power); and cheaper maintenance (refuelling is required every three to seven years, compared to one or two years for large reactors). The previous European Parliament confirmed its interest in this technology (Dulian 2023), and there are indications that the 2024 European elections will not change this stance.

It is true that the cost of nuclear facilities has increased over time in the EU and in the United States but this is not static nor linear. As discussed by a recent paper (Epicenter, 2024), in the face of hostile public opinion, the cost of capital has increased under the effect of higher perceived political risk. The West has built less reactors “leading to a decline in the capacity of the nuclear industry to build and maintain new power plants and […] in the availability of specialised personnel.” Finally, “ever-stricter regulations that often apply to new and existing reactors have sent the cost of atomic energy upwards”.

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20 ‘Majority of Americans support more nuclear power in the country’, *Pew Research Center*, 5 August 2024 (https://www.pewresearch.org/short-reads/2024/08/05/majority-of-americans-support-more-nuclear-power-in-the-country/).

21 ‘Global survey finds high public support for nuclear’, *World Nuclear News*, 19 January 2024 (https://www.world-nuclear-news.org/Articles/Global-survey-finds-high-public-support-for-nuclea).

Financial costs are unavoidable because building a new nuclear plant takes time. Increasing interest rates and unforeseen delays can increase costs for investors up to the point that the project becomes economically unviable.

SMRs can decrease the size and concentration of these risks by reducing the total amount to be financed. Their modularity makes reaching a positive cashflow earlier in the process possible. The standardisation of reactors and other components can help accelerate the authorisation process and reduce regulatory uncertainty for all planned projects without any safety drawbacks.

Non-financial costs can be reduced using the same recipe applied successfully in all other industries: standardisation and mass production. Currently, every nuclear plant represents a project to be started from scratch, subject to overlapping and endless new regulations that are not always justified by legitimate safety concerns.

The standardisation allowed by modular reactors could accelerate this process and reduce the regulatory cost per unit of energy produced. The flexibility allowed by modularity will reduce revision stops during the life cycle of the project. Obviously, either for a company or for the electricity network, closing one of ten 100 MW reactors will have a lower impact than closing a 1,000 MW reactor.

On the other hand, it is technically possible to extend most of the current reactors to 60 years and some to 80 years. The oldest of them in France, for instance, have just passed 40 years of operation and are generally in good condition. What is more, they have been regularly refurbished, and their safety level has been improved every 10 years to take account of advances in knowledge and feedback from French and international experience. Contrary to popular belief, these reactors are even much safer than when they were new. Such extensions are not unheard of anywhere else in the world. Most American reactors using the same technology have had their operating licenses extended to 60 years, and some to 80 years. As these reactors are largely depreciated, they produce by far the cheapest decarbonized and controllable electricity on the market, even considering the aforementioned improvements.

Additionally, nuclear waste can be effectively managed. The two approaches to nuclear waste management are disposal and recycling. The disposal of nuclear waste is an emotional issue that triggers NIMBY-ism – or ‘not-in-my-backyard'-ism – which is very difficult to counter with rational arguments that the dangers of disposal are minimal compared to the daily risks faced (and ignored) by the population. In this case, along with sound scientific facts, innovative communication campaigns are necessary. Recycling used nuclear fuel is also a possibility, as the French experience and experiments demonstrate.

The EU Commission tasked its Joint Research Center (JRC) with verifying whether nuclear power does more harm than good to human health and the environment, taking into account both its desirable outcomes (the provision of decarbonised energy and the absence of other pollutants, such as particulate matters, or SOx) as well as its undesirable ones (such as the risk of radioactive fallouts and the production of radioactive waste). The JRC concluded that there is 'no science-based evidence that nuclear energy does more harm to human health or to the environment than other electricity production technologies already included in the EU taxonomy as activities supporting climate change mitigation' (Abousahl et al. 2021). Therefore, nuclear power was included in the EU taxonomy of sustainable activities, provided that a number of stringent criteria concerning the management of nuclear facilities and installations are met.[22]

At France's initiative, the European Nuclear Alliance has been set up in February 2023 to bring together countries in favor of nuclear power[23]. It includes Belgium, Bulgaria, Croatia, Czech Republic, Estonia, Finland, France, Hungary, the Netherlands, Poland, Romania, Slovakia, Slovenia and Sweden. These 14 countries (out of 27 member states) are now in the majority with Italy having an observer status.

While progress has been made, in particular for the development of new nuclear plants, existing plants remain subject to different regulations. To benefit from Contracts for Difference (CfDs) (as other renewable energies do)[24], authorization is required from the Directorate-General for Competition.

22 Commission Delegated Regulation (EU) 2022/1214 of 9 March 2022 amending Delegated Regulation (EU) 2021/2139 as regards economic activities in certain energy sectors and Delegated Regulation (EU) 2021/2178 as regards specific public disclosures for those economic activities.

23 'Declaration of the EU Nuclear Alliance, meeting of March 4th, 2024', *Ministère de l'Économie, des Finances et de l'Industrie* (https://presse.economie.gouv.fr/declaration-of-the-eu-nuclear-alliance-meeting-of-march-4th-2024/).

24 'Reform of electricity market design: Council reaches agreement', *Consilium*, 17 October 2023, (https://www.consilium.europa.eu/en/press/press-releases/2023/10/17/reform-of-electricity-market-design-council-reaches-agreement/).

However, such authorization can come with costly regulatory requirements, such as mandating the separation of business activities into different segments or even dismantling of operations.

Energy efficiency

As with renewable energies, the EU has introduced a specific target for energy efficiency: final energy consumption should be reduced to 11.7 per cent below the baseline by 2030. In order to achieve this target, several obligations have been introduced – for example, energy efficiency measures need to be introduced in public buildings, residential buildings, and industrial facilities.

In most scenarios, energy efficiency is a necessary component of a decarbonisation strategy. However, its precise contribution to the optimal decarbonisation strategy is far from obvious, and it should not have a preferred status over other technologies. Some member states have introduced generous subsidies for energy efficiency interventions in buildings that often overcompensate for investments that were, at least in part, already likely to be made. Moreover, there is evidence that subsidised investments in energy efficiency seldom deliver the desired results, as, more often than not, the costs significantly exceed the benefits (Fowlie, Greenstone, and Wolfram 2018).

Moreover, energy efficiency delivers a socially relevant benefit only insofar as it is instrumental in reducing carbon and other emissions. This means that the environmental rationale of energy efficiency is contingent on our energy system running on fossil fuels. While that is definitely true today, it will be less and less true as time passes: technological progress and policy-induced changes will make our energy systems less and less carbon-intensive. If one takes at face value the EU’s own goals, by 2030, a large share of Europe’s total energy supply will come from renewables and low-carbon fuels. It follows that the social benefits from making buildings more energy efficient will decrease over time: if a household reduces its energy consumption, but most or all of its energy comes from low-carbon sources, then the environmental (external) benefit will become negligible, while the private (internal) benefit of saving money on energy bills may remain substantial. The case for subsidising energy efficiency will become less and less compelling as the EU climate policy gradually achieves its goals.

Consequently, energy efficiency goals should be eliminated altogether post-2030 or should at least be made non-binding.

Carbon capture, storage, and utilisation

Carbon capture consists of technologies aimed at capturing carbon emissions produced by activities such as electricity generation from fossil fuels or other industrial processes such as steel and cement manufacturing (considered ‘hard to abate’ because no low-carbon technology is readily available on a large scale in these sectors). Once captured, carbon may be either stored in geological deposits or utilised as an input in other processes (for example, as a material in construction or in the production of synthetic methane). The jury is still out regarding the cost-effectiveness of CCSU and its feasibility on a large scale, even though there is a general consensus that it is, today, the only possible option to decarbonise some hard-to-abate industries (Borchardt 2023). The EU has included CCSU in the taxonomy[25] as an instrument to reach the required emissions threshold in some industrial activities. The Net Zero Industry Act even includes an EU-wide target to capture CO_2, with the legally binding objective of reaching an annual injection capacity of at least 50 million tonnes of CO_2 by 2030.[26]

Therefore, there is consensus that CCSU is a relevant component of the EU decarbonisation strategy. However, there is less agreement concerning the magnitude of its contribution as well as on the policies that may – or should – be implemented to promote CCSU. These range from recognising its role in some industries to making it mandatory in other cases. This is deeply inconsistent, both internally and with the rest of the climate framework. CCSU should be treated like other low-carbon technologies; in particular, since it helps prevent carbon emissions from certain industrial

25 Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088, OJ L 198/13; Commission Delegated Regulation (EU) 2021/2139 of 4 June 2021 supplementing Regulation (EU) 2020/852 of the European Parliament and of the Council by establishing the technical screening criteria for determining the conditions under which an economic activity qualifies as contributing substantially to climate change mitigation or climate change adaptation and for determining whether that economic activity causes no significant harm to any of the other environmental objectives.

26 Regulation (EU) 2024/1735 of the European Parliament and of the Council of 13 June 2024 on establishing a framework of measures for strengthening Europe’s net-zero technology manufacturing ecosystem and amending Regulation (EU) 2018/1724.

activities, CCSU should be fully integrated in the ETS, as we described in Section 2. Whenever emissions are sequestered by a CCSU facility, a negative emissions allowance should be generated to offset emissions by the same emitters or to be sold to third parties.

Energy taxation

Energy taxes play a major role in the EU; their combined revenue amounted to as high as 1.5 per cent of Europe's GDP in 2022, mostly from fuel taxes. Energy taxes have a long history and serve several purposes, including that of raising revenues. One of their goals, as described in Section 2, is to internalise the external costs of economic activities, with particular regard to environmental externalities. From this perspective, the current design of energy taxation in the EU lacks rationality and consistency.

First, energy taxes vary considerably by country – total revenues range from 0.8 per cent of the GDP in Sweden to 4.5 per cent of the GDP in Bulgaria. Second, the minimum tax rates for each fuel are set at the EU level even though most member states adopt higher rates – sometimes substantially higher – than the minimum.[27] However, there seems to be no discernible environmental rationale for the tax rate set for each fuel. A study by Booth and Stagnaro (2022) shows that, based on 2018 data, all energy sources are both taxed and subsidised. Combining the energy taxes and subsidies, they show that, on average, the implicit cost of a tonne of carbon ranged from less than €10 if emitted by burning coal in a power plant to more than €90 if emitted by a petrol-fuelled car.

During the 2019–2024 term, the European Commission tried to propose a reform of the Energy Taxation Directive. The reform promoted the idea that there should be consistency in how energy sources are taxed. In particular, the Commission suggested that taxes should refer to the energy content of fuels (i.e., euro per Joule) rather than volumetric indicators (such as euro per cubic metre of gas or euro per ton of coal and oil products).[28] However, the initiative eventually failed. The attempt to revise energy taxation should be revived, but two substantial changes should be introduced:

27 'Excise Duties on Energy', *European Commission*, n.d. (https://taxation-customs.ec.europa.eu/taxation/excise-duties/excise-duties-energy_en).

28 'EU Green Deal – Revision of the Energy Taxation Directive', *European Commission*, n.d. (https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12227-EU-Green-Deal-Revision-of-the-Energy-Taxation-Directive_en).

1) Instead of linking taxation to the energy content of various fuels, taxes should be defined according to their pollution intensity (with reference to both carbon and other pollutants). This would help make energy taxation a consistent component of the EU environmental policy.

2) Sectors included in the ETS (see the discussion in Section 2) should be excluded from energy taxes to prevent consumers from paying twice for the same externalities.

The latter point is especially relevant in road fuel taxation. To promote e-mobility, several member states undertax or even exempt electric chargers from taxation. This is both inconsistent and unsustainable – inconsistent because it does not reflect the actual carbon footprint from the share of electricity generated from fossil fuels, and unsustainable because energy taxes serve to balance public budgets. Shielding some consumers from energy taxes would shift a large share of the burden to those who continue to use fossil fuel-powered cars and happen to have lower incomes. As the share of electric vehicles becomes substantial in Europe, energy tax reforms should deal with the issue of how to replace the missing revenue (or, preferably, how to cut public spending accordingly).

Finally, while electric chargers may be undertaxed compared to other energy sources, electricity is also overtaxed (at least in some member states) because many green subsidies are financed through electricity levies. This is inconsistent with the broader design of the EU environmental policy, too; green levies should be incorporated under general taxation when and to the extent to which this is possible. Revenues from the ETS might serve to replace the financing of green subsidies.

Competition in energy markets

by Radovan Durana (INESS), Carlo Stagnaro (IBL) & William Wang (Fundalib)

One goal of the reforms proposed in the previous sections is reconciling the EU climate policy with the functioning of its energy markets, particularly that of electricity and natural gas. In fact, Europe pioneered the liberalisation of energy markets in the 1990s, following the success of the UK and Norway (Helm 2003). Over time, the EU has passed several packages of directives and regulations that have induced member states to abandon the previous model of operating vertically-integrated, state-owned energy monopolies and instead to develop a new market design based on the regulation of natural monopolies (such as networks) and competition in wholesale and retail markets. These reforms have been largely successful, even if they were sometimes implemented unevenly across the member states. More importantly, however, market functioning was hindered by conflicting environmental regulations, such as rules that gave renewable energies undue priority over other electricity generators or which subsidised the generation of green electricity, displacing the price discovery mechanism of liberalised markets (Stagnaro 2015; EPICENTER 2024).

A key step to making the EU energy policy more effective is restoring the functioning of energy markets. In part, this could be achieved by implementing the reforms described previously, as they would direct the EU energy policy towards a more neutral approach toward identifying the optimal energy mix. However, other reforms are needed in the electricity and gas markets to return Europe to the path of making its energy markets more competitive and open to innovation.

Phasing out of price regulation

The most important reform that should be implemented in the electricity and natural gas markets is the removal of price regulations at the retail level. Under EU norms, since 2007, all power and gas consumers have had the right to choose their energy supplier. Price regulation should be applied only in specific cases, such as to protect vulnerable customers, or under exceptional circumstances, such as during the 2022 crisis. Yet, many EU member states implement various forms of price regulation, either for subgroups of consumers, or for all small customers, even if they are free to choose non-regulated offers. Moreover, there is considerable arbitrariness in defining which customers are 'vulnerable' – so this norm may well result in undue regulation.

Many EU countries introduced extraordinary measures in 2021–2022 to shield consumers from exceptionally high prices[29]. Not all of these 'temporary' measures have been phased out. According to ACER (2023), some form of price regulation for either electricity or gas (or both) is still present in Bulgaria, Cyprus, Spain, France, Greece, Hungary, Italy, Lithuania, Malta, Netherlands, Poland, Portugal, and Slovakia. Almost none of these countries has committed to phasing out price regulations.

Many such measures have been introduced in the name of consumer protection. However, a large body of evidence shows that excessive protection eventually results in more harm than good (Robinson 2015). Price regulation has several unintended consequences that are particularly harmful in the context of the energy transition. First, it may induce customers not to switch to cheaper or more attractive offers; second, regulated prices may serve as a price target for competitors, thereby facilitating collusion; third, and most importantly, a key feature of competitive electricity and gas markets is that they foster commercial innovation. To attract new customers, competitors may develop more sophisticated offers that allow consumers to become more active participants in energy markets – for example, by providing flexible services (i.e., by enabling them to shift electricity loads from high-price, emission-intensive times to low-price, less carbon-intensive moments) or by offering 100 per cent green energy (or carbon offsets if this is not possible) (Littlechild 2021; Stagnaro 2023).

29 'National fiscal policy responses to the energy crisis', *Bruegel*, 26 June 2023 (https://www.bruegel.org/dataset/national-policies-shield-consumers-rising-energy-prices).

EU law mandates that price regulations should be phased out, but this provision has been loosely implemented. The Commission should require member states to remove any remaining form of price regulation. The definition of vulnerable customers and the types of interventions permitted should be more clearly defined at the EU level to prevent member states from circumventing retail competition by employing loose criteria. Moreover, the electricity market design reform introduces several new obligations for energy retailers, such as obligations to offer both fixed-price and variable-price offers or introducing burdensome constraints on the hedging strategies of energy traders and suppliers hedging regulations.[30] These obligations are often excessive and may lower competition. Thus, they should be carefully reviewed.

Competition in electricity markets

Wholesale power markets aim to guarantee that, at any given moment, the required amounts of energy are generated at the lowest possible cost. They achieve this by creating competitive markets where generators submit a bid for the quantity of energy they are able to generate and the minimum price at which they can generate it. Bids are ordered according to the marginal costs of generators and selected. This allows to build a generation schedule for each hour of the day in 'day-ahead' markets (so called because negotiations stop on the day before the physical delivery of the contracted energy). The market-clearing price, also known as the system marginal price, is paid to all the generators that have been selected, regardless of their marginal costs. As the time of delivery approaches, schedules are adjusted to take into account potential changes in the supply or demand sides of the market.

This mechanism is well known and widely adopted (Wolak 2021). More recently, it has come under scrutiny in the EU for two reasons. First, the quantity of subsidised renewable capacity has skyrocketed since the 2010s. Subsidised generators may be able to offer lower prices because they are paid a subsidy on top of the market price. This increases the generators' incentive to invest in subsidised capacity and results in lower wholesale prices (all other factors remaining constant), at least in the hours during which non-programmable renewables inject energy into the system. For any given level of demand, this means that unsubsidised

30 'Electricity market reform', *Consilium*, n.d. (https://www.consilium.europa.eu/en/policies/electricity-market-reform/).

generators are driven out of the market because of falling volumes and margins. However, since these facilities are still necessary for the provision of energy when renewables are not available, a situation may arise where market prices are not high enough to pay for their fixed costs. For this reason, several member states have introduced capacity remuneration mechanisms (CRMs), which transfer financial resources to these generators to overcome the ‘missing money problem’ (EC 2016). CRMs should be carefully designed to prevent them from becoming a market-distorting rather than a market-enhancing mechanism. They must be technology-neutral, as the EU state aid guidelines recommend (EC 2022).

Second, some argue that the increase in the share of energy sources with low or zero marginal costs, such as wind and photovoltaic power, makes the system marginally price unsustainable, as it would grant undue rents to generators with low marginal costs. This view is loosely embraced by the Draghi report (Draghi 2024), although the report does not lead it to its extreme consequences. However, granting economic rents to infra-marginal generators (i.e. generators whose marginal generation costs are below the market price at any given point in time) is not a bug of this system but a feature, insofar as these rents are necessary to cover the high fixed costs of low-marginal-cost generators. Instead, the bug is that the growth of these facilities has been driven by subsidies – and not economic merits –. More recently, the subsidies have become unsustainable, making high retail prices (burdened by green levies, which accounted for about 10 per cent of the average EU bill in 2022) the cost for relatively low wholesale power prices. Therefore, some have proposed shifting the cost of subsidies to general taxation because it reflects the cost of policy goals, not that of generating electricity (Lo Schiavo and Stagnaro 2025). It is also of relevance that support mechanisms have changed; instead of awarding monetary subsidies, such as feed-in tariffs, member states – under the auspices of the European Commission – have shifted towards a new form of support, i.e., Contracts for Difference (CfDs).

According to the Commission,

> A two-way contract for difference is a contract signed between an electricity generator and a public entity, typically the State, which sets a strike price, usually by a competitive tender. The generator sells the electricity in the market but then settles with the public entity the difference between the market price and the strike price. It thus allows the generator to receive a stable revenue for the

> electricity it produces, while at the same time it provides a revenue limitation for generators when market prices are high. In a two-way CfD, if the market price is below the strike price, the generator receives the difference; if the market price is above the strike price, the generator pays back the difference.[31]

Unlike feed-in tariffs and other subsidies, CfDs (if well designed, and if the selection process of the sellers is competitive) entail less costs. However, they are not free of distortions; for example, they may result in lower overall costs than other subsidies, but they substantially shift risk from investors to the state or the community. Moreover, if they are only available for some technologies, they might result in over-investment in these technologies and under-investment in others. By shielding the beneficiaries from short-term variations in wholesale prices, they could interfere with market signals, hence supporting excessive investments in places where all or most energy is already produced by low-carbon generators. And, finally, if the capacity supported by CfDs becomes substantial, the price of CfDs will squeeze the market price of energy (Khodadadi and Poudineh 2024).

Thus, while CfDs may entail lower social costs than feed-in tariffs, they still endanger the functioning of markets. Their main goal is to support the creation of renewable capacity, whereas the goal of the EU environmental policy is the reduction of carbon emissions. Support instruments for specific technologies should be removed, and the decarbonisation effort should be supported by adequate carbon pricing, particularly in the power sector, where the price formation mechanism can, and does, capture the cost of CO_2 allowances.

Competition in the gas market

Natural gas markets were successfully liberalised in the 2000s, with the partial exception of retail markets (see the previous section). However, while at that time, there was a widespread belief that natural gas demand would grow in the foreseeable future (IEA 2011), it is now clear that gas demand is on the decline due to increasing energy efficiency, electrification, growth of renewable energies, and a decline in energy-intensive industries

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31 'Questions and answers on the revision of the EU's internal electricity market design', *European Commission*, 14 March 20 (https://ec.europa.eu/commission/presscorner/detail/en/qanda_23_1593).

in Europe. Still, natural gas remains, and is likely to remain, a fundamental component of the EU's energy mix.

Reforms that could change the functioning of gas markets fall mostly under two types of interventions. First, natural gas is imported via pipelines and ships and is traded in several trading hubs in Europe. In 2022, there was a heated discussion on whether these hubs misprice gas; the Draghi report, for example, endorses this point of view (Draghi 2024). However, there is no evidence that Europe's major trading hubs, particularly, the well-known Title Transfer Facility (TTF), misprice gas or exhibit any illicit conduct. In fact, independent analyses both before (Heather 2020) and after (Heather 2024) the 2022 crisis, when prices skyrocketed because of supply constraints and the war in Ukraine, show that TTF and other hubs play a key role in driving market operations and capture actual demand and supply conditions, thereby allowing markets to adjust to ground-level realities. Therefore, proposals to regulate Europe's gas hubs should be resisted, especially given that even the extraordinary regulations in 2022 likely resulted in extra costs instead of the resolution of alleged malfunctioning of markets (Goodel et al. 2024). By the same token, other transitional measures that were introduced in 2022 – such as obligations to fill storage facilities by at least 90 per cent by November 2025 (De Giorgio 2023) and joint gas procurement – should be phased out. Either they did not work even during the emergency, or they are no longer necessary. Second, natural gas markets may be improved by removing unnecessary constraints on natural gas extraction.

Power purchase agreements (PPAs) and supporting the development of renewable energy

PPAs are emerging as a powerful tool in advancing the EU's renewable energy goals. They are long-term contracts between energy producers and consumers; they offer price stability and risk mitigation and promote private investment in renewable energy infrastructure. In this policy paper, which draws on country-specific data, we recommend that the European Commission promote wider adoption of PPAs to accelerate the EU's transition to a carbon-neutral economy by 2050.

PPAs offer several critical benefits that make them an effective strategy to realise the EU's decarbonisation goals:

- **Price stability.** PPAs lock in long-term energy prices, shielding consumers from volatile market rates. For example, the average industrial electricity price in Germany is €0.18 per kWh, which fluctuates with market conditions. By adopting PPAs, industries in Germany can secure rates of around €45–55 per MWh, which are lower and more predictable than current market prices (IEA 2024).

- **Risk mitigation for both parties.** PPAs provide financial security for energy producers and consumers. For industrial consumers, PPAs offer a stable supply source, while producers benefit from predictable revenue streams. Spain's regulatory environment, including Royal Decree 244/2019[32], has enabled the emergence of PPAs that simplify energy sourcing for companies and offer reduced regulatory and financial risks.
- **Investment in renewable infrastructure.** PPAs drive private investments in renewable infrastructure, reducing the need for public subsidies. For instance, Portugal's solar energy PPA, priced at around €42 per MWh, has attracted private investors. This will help Portugal achieve its National Energy and Climate Plan target of increasing renewable energy share to 49 per cent by 2030.
- **Support for small and medium enterprises (SMEs).** PPAs can be structured to allow SMEs to participate in renewable energy markets, particularly through demand aggregation mechanisms. In Hungary, where credit constraints limit SMEs' participation in PPAs, an EU guarantee scheme could enhance accessibility, helping smaller businesses secure affordable renewable energy and stabilise costs.

To scale successful PPA models across the EU, the European Commission should develop a harmonised PPA framework that incorporates EU-level guarantee schemes for SMEs, incentives for renewable infrastructure investments, and streamlined guidelines to encourage member state adoption. PPAs offer the EU a practical solution to meet its renewable energy targets, stabilise costs, and reduce fossil fuel dependency. By enhancing market accessibility and promoting price stability, PPAs support the EU Green Deal and have the potential to position the EU as a global leader in the transition to sustainable energy.

32 Real Decreto 244/2019, de 5 de abril, por el que se regulan las condiciones administrativas, técnicas y económicas del autoconsumo de energía eléctrica.

Cross-border infrastructures

Electrification of industrial production and household consumption is critical for decarbonisation and reducing CO_2 emissions. However, the large-scale decentralisation of electricity generation, together with the need to meet the expected increase in electricity consumption, requires the urgent development of electricity networks. In the case of Europe, this means significantly higher investments, as the transmission and distribution networks built in the second half of the last century require massive renewal. The unpreparedness of the grid infrastructure is holding back electrification, measured as the share of electricity in the final energy consumption of the economy. The electrification rate is stagnant at 23 per cent in the EU[33]; in comparison, China has increased the electrification of its economy by 7 percentage points since 2015 to 28 per cent in 2022 according to International Energy Agency data. To meet its emissions targets, Europe needs to reach a 31–35 per cent electrification rate by 2030.

Eurelectric estimates that grid development and renewal in the EU and Norway will require an investment of €67 billion per year[34]. Although transmission network capacity in Europe increased by 12 per cent in the decade 2011–2021, grid development has lagged behind other development areas. According to an International Energy Agency study, investment in transmission networks alone is expected to reach $29 billion per year, as compared to $17 billion in 2022 – 60 per cent of the estimated need (IEA 2023).

The key question is: what is holding back investment in this area? It is necessary to raccurately forecast the trends in electricity consumption. In the period 2021–2023, electricity consumption fell by 7.5 per cent. Despite the growing share of electric vehicles and investments in heat pumps, European electricity consumption was in 2023 lower than in 2019. This is primarily due to a sharp decline in industrial electricity consumption. Only the electrification of essential sectors, such as steel production, will increase real electricity consumption; the current decline in production is due to high electricity prices, which are not set to reduce in the foreseeable future. Conversely, increasing the energy independence of households, by

33 ‘Saving Europe’s industry requires greater electrification’, *Eurelectric*, 3 October 2024 (https://www.eurelectric.org/news/saving-europes-industry-requires-greater-electrification/).

34 ‘Double investments in power distribution or lose Europe’s race to net-zero’, *Eurelectric*, 22 May 2024 (https://www.eurelectric.org/news/grid_investments_for_netzero/).

encouraging the use of photovoltaic panels and batteries, supporting corporate customers in transitioning to off-grid solar island systems, and increasing efficiency will reduce the demand for transmitted electricity.

Thus, planning for adequate transmission grid capacity is a complex task that involves more than simple projections of future consumption. The structure and flexibility of the network are more important than the volume of electricity to be transmitted, as they will allow not only the connection of millions of small sources but also the short-term transmission of large volumes of electricity over long distances.

Regulatory policy will have a significant impact on future investments in transmission networks. The construction of new networks is time-consuming and costly due to permitting procedures. It is not surprising, therefore, that the Draghi report also requests for temporary and local exemptions to environmental legislation to speed up permitting procedures (Draghi 2024). Another significant proposal is the introduction of a special 28th regime to permit interstate interconnections.

National energy security policies hamper the effective development of transmission networks. Despite efforts to develop a pan-European transmission network, networks are being built primarily to meet the energy self-sufficiency requirements of member states. The construction of interconnections between countries is hampered by individual national interests and differences in the organisation of electricity markets (for example, Sweden refusing to build a new interconnection with Germany[35]). The development of transmission networks is thus suboptimal and leads to higher prices for their use.

The renewal and development of transmission networks is taking place not only in the EU, but also in Asia and Africa. High global demand is leading to shortages in or an increase in the prices of the necessary components, including base metals (such as copper and aluminum) and transformers.

All of these factors influence the rising unit cost of investments and thus the rising costs of transmission and distribution infrastructure. According to the Eurelectric and EY Grids for Speed analysis, investments should

35 'Swedish government says no to new power cable to Germany', *Reuters*, 14 June 2024 (https://www.reuters.com/business/energy/swedish-government-says-no-new-power-cable-germany-2024-06-14/).

be anticipatory; ones that currently exceed the existing transmission demand are considered more efficient (Eurelectric and EY 2024). The final question is still who will pay for them.

A potential answer is that savings from fossil fuel consumption will offset the cost. However, despite the decline in the consumption of natural gas and oil, the rise in unit prices has increased the EU's expenditure on oil and gas compared to before the energy crisis. Although further savings in consumption will undoubtedly occur, these 'spare' resources will not be available for at least another decade.

Today, investments in the repair, operation, and construction of new infrastructure are mainly financed through charges included in electricity prices. However, high prices significantly reduce the competitiveness of European producers. At the same time, they lead to a scarcity of resources, as politicians fear the opposition of households to rising energy prices. It is, therefore, desirable that part of the investment be financed by general tax revenues and revenues from the sale of CO_2 permits.

The development of electricity grids should not be seen as an unavoidable cost but as an opportunity. The digitalisation of the grid will enable more efficient grid management and new business opportunities. This may lead to a decrease in the risk premium of investments. For this to happen, states must move away from existing price regulations and, at the same time, privatise distribution networks.

Black Sea offshore gas and oil

by Radu Nechita (IES), Diana Năsulea (IES) & Christian Năsulea (IES)

The Draghi report mentions the EU's relative lack of natural resources (energy and critical materials) as one of its weaknesses, which it must address in the near future. At the same time, natural gas is considered the second-best solution for energy production, as it is environmentally preferable to coal. The economic and political drawbacks of natural gas are well known; prospection and transportation are costly, and natural gas creates a logn-term dependence on governments hostile to EU's core values. In all scenarios, including the International Energy Agency ambitious Net Zero Roadmap (IEA 2024), the EU will keep using gas in the foreseeable future, though in lower quantities than it does today. Even the taxonomy of sustainable investments recognises that, under some limitations, the use of gas to generate electricity can be deemed to be aligned with the EU's climate targets.

In this context, it would be inconsistent and counterproductive to avoid using natural gas resources available in the EU. The natural gas (and oil) from the Black Sea offshore fields is an underused, available resource.

Proven reserves and the potential of undiscovered reserves

Black Sea oil and gas reserves present significant advantages due to the promising nature of both existing reserves and those yet to be discovered. Initial explorations, particularly in Romanian and Turkish waters, have revealed substantial deposits, with fields such as Neptun Deep and Sakarya showing high potential for production.

Adjacent to the Turkish Sakarya field, Neptun Deep, in the Romanian sector of the Black Sea, and the Midia field (in exploitation since 2022) hold great potential for the EU, as does the Khan Asparuh Bulgarian field, as these fields lie within the territories of EU member states (Scutaru 2024). In the long term, the EU can also consider reserves in the exclusive economic zones (EEZs) of Georgia and Ukraine, but this depends on the conclusion of the Russian invasion of Ukraine and on the future geopolitical orientation of Georgia after the recent elections.

These reserves not only provide a solid foundation to begin immediate extraction but also encourage further investment and exploration in neighbouring regions of the Black Sea, where hydrocarbon deposits may be similarly abundant.

Moreover, geological surveys and prospects suggest that the Black Sea basin may hold even more untapped resources in deeper and less explored areas. Advances in technology – such as deep-sea drilling and enhanced seismic imaging – have increased the accuracy of prospection initiatives, providing optimism that additional reserves exist beyond those that are currently known. This untapped potential for undiscovered resources makes the Black Sea an attractive energy frontier, offering long-term benefits not only for national economies but also for regional energy security.

The total amount of the proven reserves is an order of magnitude lower than the reserves of the major players (such as Russia and Qatar). However, the potential production would be sufficient to satisfy about one decade of consumption in the region, although some countries likely have geopolitical hesitations because of their dependency on Russian supplies. By developing these reserves, Black Sea countries can capitalise on a unique opportunity to reduce their energy imports, improve Europe's energy security, stimulate domestic energy sectors, and potentially become net exporters of natural gas and oil. The strategic location of the Black Sea also supports advantageous export routes to European markets, enhancing the geopolitical value of these reserves.

Exclusive economic zones of EU member states

One of the primary advantages of the Black Sea oil and gas reserves is their location within the EEZs of either EU member states, such as Romania and, potentially, Bulgaria, or associated states, such as Turkey, Ukraine, and, potentially, Georgia.

For EU member states such as Romania and Bulgaria, the Black Sea reserves represent a critical opportunity to enhance the EU's energy security by decreasing reliance on external suppliers, especially Russia. The EU's push for diversified and sustainable energy sources aligns with the development of these reserves, which can potentially reduce the EU's vulnerability to external supply shocks and political tensions that can impact gas and oil imports. Accessing energy resources within the EU's own territory further supports the EU's broader goals of economic sovereignty, energy independence, and strategic autonomy.

For EU-associated states, such as Turkey and Ukraine, the Black Sea reserves provide a similarly crucial advantage. Turkey, already a pivotal player in the energy transit landscape, can solidify its role as both producer and transit hub for Black Sea gas, strengthening its bargaining position in regional energy politics. Turkey's Sakarya gas field exemplifies this potential, as its development will support Turkey's ambitions to meet a larger share of its domestic energy demand, reducing the country's reliance on imports and stabilising energy prices for its economy.

Ukraine, though still gfipped by geopolitical tensions, views its Black Sea reserves as a strategic asset for rebuilding energy independence and stabilising its economy. Similarly, Georgia's potential reserves could offer future economic benefits and strengthen its integration with European energy markets. Both Ukraine and Georgia's interest in developing Black Sea resources also aligns with the EU's energy diversification efforts, as it can bolster their partnerships with the EU.

Commercial exploitation: already under way

Commercial exploitation of Black Sea oil and gas has already commenced in Turkey's economic zone, with the commencement of production in the Sakarya gas field marking a significant milestone for the region. Turkey's exploration and early extraction efforts mark it as a pioneer in Black Sea extraction, with the Sakarya field estimated to contain significant reserves that can supply Turkey's domestic market for years to come. By tapping into its offshore reserves, Turkey is on track to reduce its dependence on imported energy, improve its energy–trade balance, and strengthen its strategic autonomy. Turkey's early start in extraction has allowed it to develop a robust infrastructure network for future Black Sea projects. Its technical capability, regulatory alignment, and cross-sector cooperation offer lessons that other Black Sea nations can learn from as they approach commercial production.

The reserves in Turkish economic zones – discovered in 2020 and already in exploitation since April 2023 – are estimated at 710 billion cubic metre (bcm). Their daily production reached 2.7 million cubic metre (mcm) in the beginning of 2024; they have a daily target of 10 mcm by the first quarter of 2025 and 40 mcm for the medium term. This would cover the needs of 15 million households.[36]

Romania, following Turkey's lead, is also preparing to initiate commercial exploitation of its Black Sea gas reserves, with production scheduled to start in 2027 from fields such as the Neptun Deep. Once production begins, Romania's Black Sea gas is expected to provide a steady domestic supply that could significantly enhance the country's energy independence and security. Furthermore, Romania could potentially export surplus gas to neighbouring EU countries, contributing to the EU's overall energy security goals and diversification efforts. The delay in the commencement of commercial extraction in Romania (compared to Turkey's) can be attributed to regulatory adjustments and the need to finalise infrastructure and investment plans to ensure the long-term viability of the project.

Together, Turkey and Romania's efforts to bring Black Sea gas to the market underscore the region's potential as an emerging energy hub, with each country strategically timed to contribute to a more stable and diversified regional energy supply. As Turkey's production continues and Romania's ramps up, both countries will play a vital role in shaping the Black Sea's future as a source of secure, local energy. This staggered approach to commercial exploitation may also encourage new investments, partnerships, and infrastructure developments across the Black Sea, bolstering the area's potential to become a cornerstone in European and regional energy strategies.

Functional pipeline network

A significant advantage of developing oil and gas capacity in the Black Sea region is the presence of an established pipeline network in countries such as Turkey, Romania, and Bulgaria. This infrastructure is well-positioned to transport extracted hydrocarbons from offshore fields to domestic markets and beyond with only minor upgrades, extensions, or interconnections. Using these existing pipelines would reduce the need for significant initial investments, allowing resources to be redirected

36 'Daily output from Türkiye's Black Sea reserve reaches 2.7 mcm', *Daily Sabah*, 29 January 2024 (https://www.dailysabah.com/business/energy/daily-output-from-turkiyes-black-sea-reserve-reaches-27-mcm).

towards enhancing production capacity and optimising supply chains rather than building entirely new infrastructure. As the REPowerEU plan acknowledges, building new pipelines and deepening connections in existing ones is critical to diversifying gas supplies.[37]

In Turkey, for instance, the current pipeline infrastructure features a comprehensive energy transit network that connects with the European and Middle Eastern markets. By implementing only minor upgrades to this system, Turkey can efficiently transport gas from its Sakarya field to industrial centres and major urban areas, ultimately feeding into Europe's larger energy network. Similarly, Romania's network connects to EU-standard pipelines, which creates potential for seamless distribution within the EU. The Transgaz network, for example, is already capable of iinvolving Bulgaria and Hungary, ensuring that Romanian Black Sea gas can be quickly integrated into the wider European market with minimal modifications.

This advantage not only reduces logistical challenges but also enhances regional energy security by facilitating swift distribution across borders. Bulgaria, with its strategic position as a transit country, has invested in interconnections that allow gas to flow both north, to Romania, and west, towards Serbia. These interconnections provide multiple export and import options, making the entire system more resilient to supply disruptions. Romania took a step in the right direction by investing, with EU support, in a new connection with the Moldovan network. The Iași-Chișinău pipeline allows the Republic of Moldova to import gas from Romania and other countries, which can help enhance its resilience given that it is otherwise extremely vulnerable to Russian pressures (Scutaru 2024).

Furthermore, the minor upgrades required – such as adding compressor stations, linking new Black Sea extraction points to the existing grid, and potentially building short extensions – are relatively low cost and can be completed more quickly than constructing large-scale pipelines. This operational readiness translates to faster time-to-market for Black Sea gas, enabling Romania, Turkey, and neighbouring countries to capitalise on these resources without significant delays.

37 'REPowerEU: A plan to rapidly reduce dependence on Russian fossil fuels and fast forward the green transition', *European Commission*, 18 May 2022 (https://ec.europa.eu/commission/presscorner/detail/en/ip_22_3131).

Black Sea particularities

The unique structure of the Black Sea – due to its stratified water layers – presents distinct advantages for offshore oil and gas extraction. The Black Sea's water is divided into layers – particularly in terms of oxygen content – that remain largely separate. While the upper 100 metres of water support a variety of marine life due to its high oxygen content, the deeper layers are anoxic, or oxygen-depleted, creating an environment that supports virtually no life below this depth. This unusual layering can help minimise the ecological footprint of offshore drilling, as there is significantly less marine biodiversity at greater depths here than in other oceanic regions.

Due to this layered structure, the risk of environmental disruption that could harm marine species and habitats is lower in the Back Sea, allowing for safer, more contained extraction practices. In contrast, oil and gas extraction in other regions – where ecosystems may extend to much greater depths – often requires extra precautions and more stringent environmental safeguards to protect marine biodiversity throughout the water column.

Additionally, the anoxic nature of the Black Sea's deeper layers also means that organic material decomposes very slowly, if at all, at these depths. This unique quality has led to the preservation of ancient shipwrecks and other archaeological artefacts on the seabed. This aspect may also help prevent the dispersion of pollutants resulting from deep-sea drilling activities. In practical terms, if any accidental spill or leakage were to occur at greater depths, the natural lack of circulation between layers might help contain contaminants, reducing the risk of widespread environmental impact.

For operators, this stratification implies that deep-sea drilling in the Black Sea can be executed with a slightly less complex set of ecological safeguards than those required in other marine environments, translating into reduced costs and fewer operational hurdles. For instance, the absence of marine life in the deeper layers may lessen the need for protective measures typically implemented to shield fragile, deep-water ecosystems.

Conclusion

The European Union's energy and climate policy has been increasingly driven by climate goals, that have taken over other equally important goals, such as competitiveness and energy security. Moreover, ambitious climate goals have been underpinned by a growing amount of regulations, that created pervasive administrative costs and added several layers of additional targets, related to the specific technologies to implement in order to cut emissions, such as binding targets for renewable energy and energy efficiency as well as an unequal treatment of low-carbon technologies.

While the abatement of CO_2 emissions reflects the social and political preferences of Europeans, other policies that pick winners and losers increase the overall costs of climate policies and undermines its legitimacy, as its impacts are being felt by the people, particularly those in the lower end of the income distribution. Climate goals can and should be pursued in a more cost-effective way, by relying on market forces rather than on political decisions. This can be done by relying more on the main pillar of Europe's climate policies, i.e. the EU ETS. Carbon pricing is by far the most cost-effective tool to incentivize emissions cuts.

For carbon pricing to work at its best, all low-carbon technologies should be treated equally, reflecting the environmental benefits they produce: hence nuclear power and carbon capture and sequestration should be treated as favorably as renewable energy sources. By the same token, all carbon emissions should be priced equally, regardless of their source. To do so, a comprehensive reform of energy taxation should be undertaken.

Markets should also be leveraged for their potential to engage consumers as well as suppliers. The process of liberalizing electricity and gas markets was started in the 1990s but then it was jeopardized by industrial policies that altered capital allocation, such as technology-based subsidies to renewable energies and pervasive regulations of end prices. The liberalization process should be re-started, with the aim of creating a competitive internal market and removing all price controls still embedded in the system. Cross-border infrastructures should be built in order to expand the physical dimension of the market and facilitate cross-border exchanges.

Despite all the efforts, the EU will still require fossil fuels even in a net-zero scenario, as the International Energy Agency reports consistently show. Therefore, domestic resources should be exploited, not just because this may contribute to Europe’s energy security, but also for the sake of environment. Oil and gas production in Europe is usually performed under higher environmental standards than in other parts of the world; on top moving large quantities of fossil fuels over long distances requires the consumption of fossil fuels too, hence contributing to CO_2 emissions. For any given level of demand for fossil fuels in the EU, domestic resources may be part of a strategy to increase competitiveness, security, and sustainability at the same time.

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