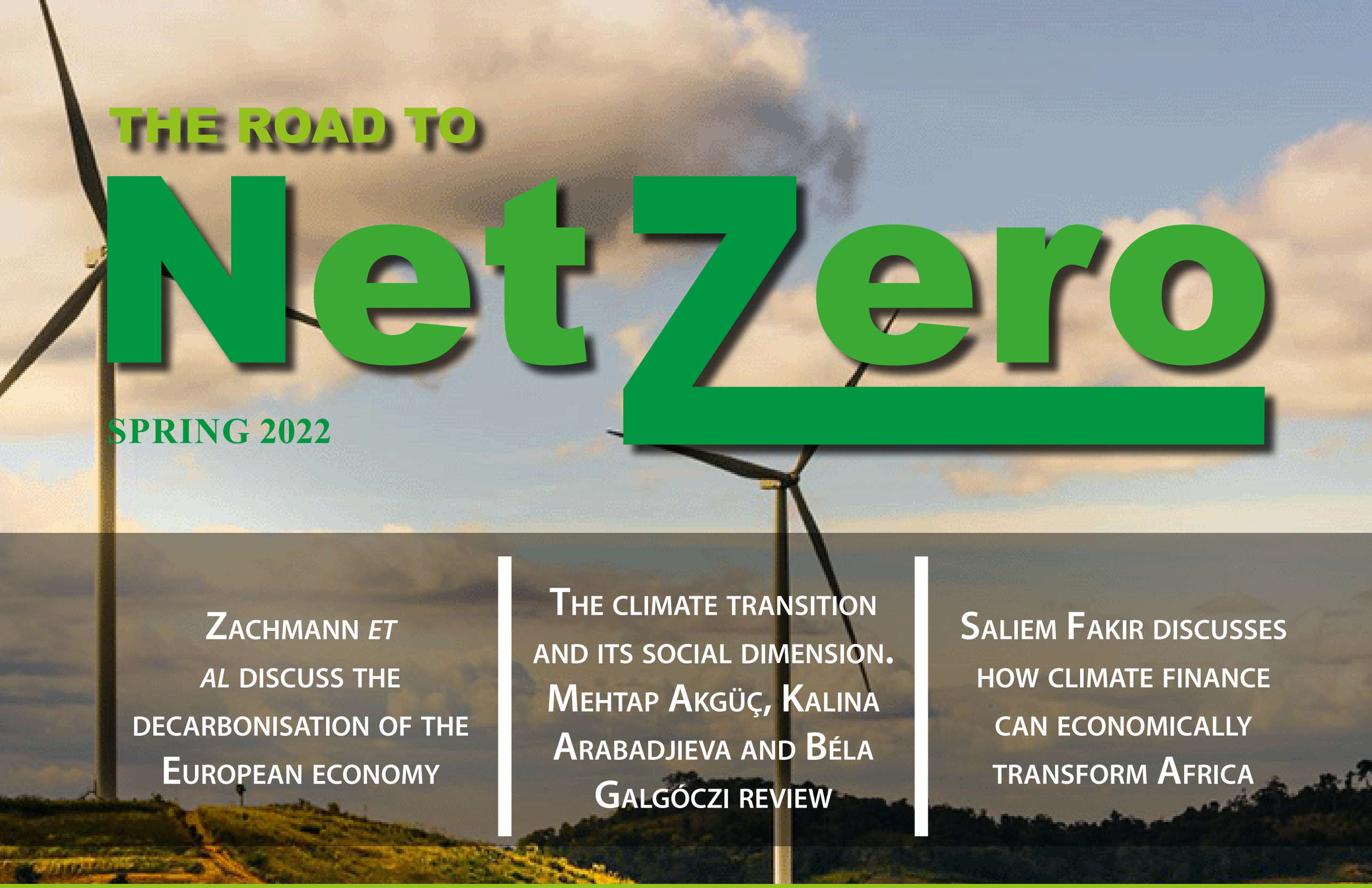

THE ROAD TO Net Zero

SPRING 2022

ZACHMANN *ET AL* DISCUSS THE DECARBONISATION OF THE EUROPEAN ECONOMY

THE CLIMATE TRANSITION AND ITS SOCIAL DIMENSION. MEHTAP AKGÜÇ, KALINA ARABADJIEVA AND BÉLA GALGÓCZI REVIEW

SALIEM FAKIR DISCUSSES HOW CLIMATE FINANCE CAN ECONOMICALLY TRANSFORM AFRICA

SUSTAINABLE DEVELOPMENT

Foreword

Welcome to the inaugural edition of The Road to Net Zero, a *World Commerce Review* supplement. This publication has been prepared in response to readership demand for an overview of the steps being taken in the transition to a cleaner and greener sustainable world.

All aspects of climate action are examined, with the most respected authors providing the reader with the most comprehensive information available. Our brief is to provide all the data necessary for the readership to make their own informed decisions. All editorials are independent, and content is unaffected by advertising or other commercial considerations. Authors are not endorsing any commercial or other content within the publication. ■

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Green investment and fiscal consolidation

Zsolt Darvas and Guntram Wolff consider options for increasing green investment needs when major fiscal consolidations are needed

The EU's ambitious emissions reduction targets will require a major increase in green investments. This column considers options for increasing public green investment when major consolidations are needed after the fiscal support provided during the pandemic.

The authors make the case for a green golden rule allowing green investment to be funded by deficits that would not count in the fiscal rules. Concerns about 'greenwashing' could be addressed through a narrow definition of green investments and strong institutional scrutiny, while countries with debt sustainability concerns could initially rely only on NGEU for their green investment.

Increasing green public investment while consolidating budget deficits will be a central challenge of this decade. The EU has set the ambitious goal of a 55% greenhouse gas emissions reduction by 2030 compared to 1990 and zero net emissions by 2050. This will require a major increase in green investments, of which is a sizeable part should be public investment. At the same time, major fiscal consolidations are needed after the extraordinary fiscal support during the COVID-19 crisis.

The consolidations will be framed by European fiscal rules. Past consolidation episodes resulted in major public investment cuts. How can the EU ensure that public investment will increase when fiscal consolidation is implemented?[1]

The fiscal rules debate

A buoyant academic and policy analysis literature has assessed the EU fiscal rules. We see a broad consensus on the fact that the current rules face technical problems (measurement of potential output and structural balances) and are not well implemented, but not on other questions, including on the role of judgement, country-specificity, and the degree of centralisation in fiscal surveillance (eg. Martin *et al* 2021).

A comprehensive and broad-based reform will hence take time and is unlikely to be completed by the reinstatement of fiscal rules in 2023, but the need to increase green public investment is imminent. In this column, we assess the scope for adapting the rules to make room for increased public green investment.

Green investment needs to meet EU targets

European Commission scenarios suggest an immediate expansion of annual investment in clean and efficient energy use and transport by about 2% of GDP in order to reach the EU's climate targets (European Commission 2020).

... economic and accounting logic suggests that net capital investments be funded by deficits, reflecting the long lifetime of green infrastructure

This estimate is in line with those of D'Aprile *et al* (2020) for the EU and the International Energy Agency (2020) for the world, among others. It does not include the cost of flanking social policies which cannot be regarded as green investment.

The share of the public and private sectors in green investment needs

Most of the new investment has to be private, but the public share will be significant. For overall climate-related investments in energy and transport, the 2019 National Energy and Climate Plans foresaw an average 28% public funding share in the EU (European Investment Bank 2020)[2].

If one assumes that the new additional green investments were in line with this 28% public share, an annual additional public investment of about 0.6% of EU GDP would result. This is a major fiscal effort that will need to be financed.

The share of public funding can be reduced by appropriate government regulation, taxation policy and, in particular, a higher carbon price. However, a drastic carbon price increase might not be socially sustainable and the European industry might not cope with that either. Moreover, some green investments cannot be done by the private sector because of market failures.

It is also crucial to remove distortions in the taxation and subsidisation of the energy system to incentivise more private investment. But the updated estimates[3] of Coady *et al* (2019) show that they amounted to a mere 0.15% of GDP in the EU in 2020. Eliminating explicit subsidies could cover about one-fourth of the new public investment need.

Lessons from the past

Public investment was a victim of fiscal consolidation in previous episodes (Figure 1). Gross public investment fell by 0.8 percentage points of GDP from 2009 to 2013 in the EU, and fell even further by 2016.

Even in the group of long-standing EU members that did not face market pressure, the real value of public investment was slightly lower in 2013 than in 2009, while overall primary expenditures increased by about 5% in this period.

There were only a few countries where public investment as a share of GDP remained unchanged or increased (Belgium, Denmark, Finland, Hungary, Sweden). In countries under market pressure, investment cut was more dramatic. Other more future-oriented spending items, such as research and development and education spending, were also cut.

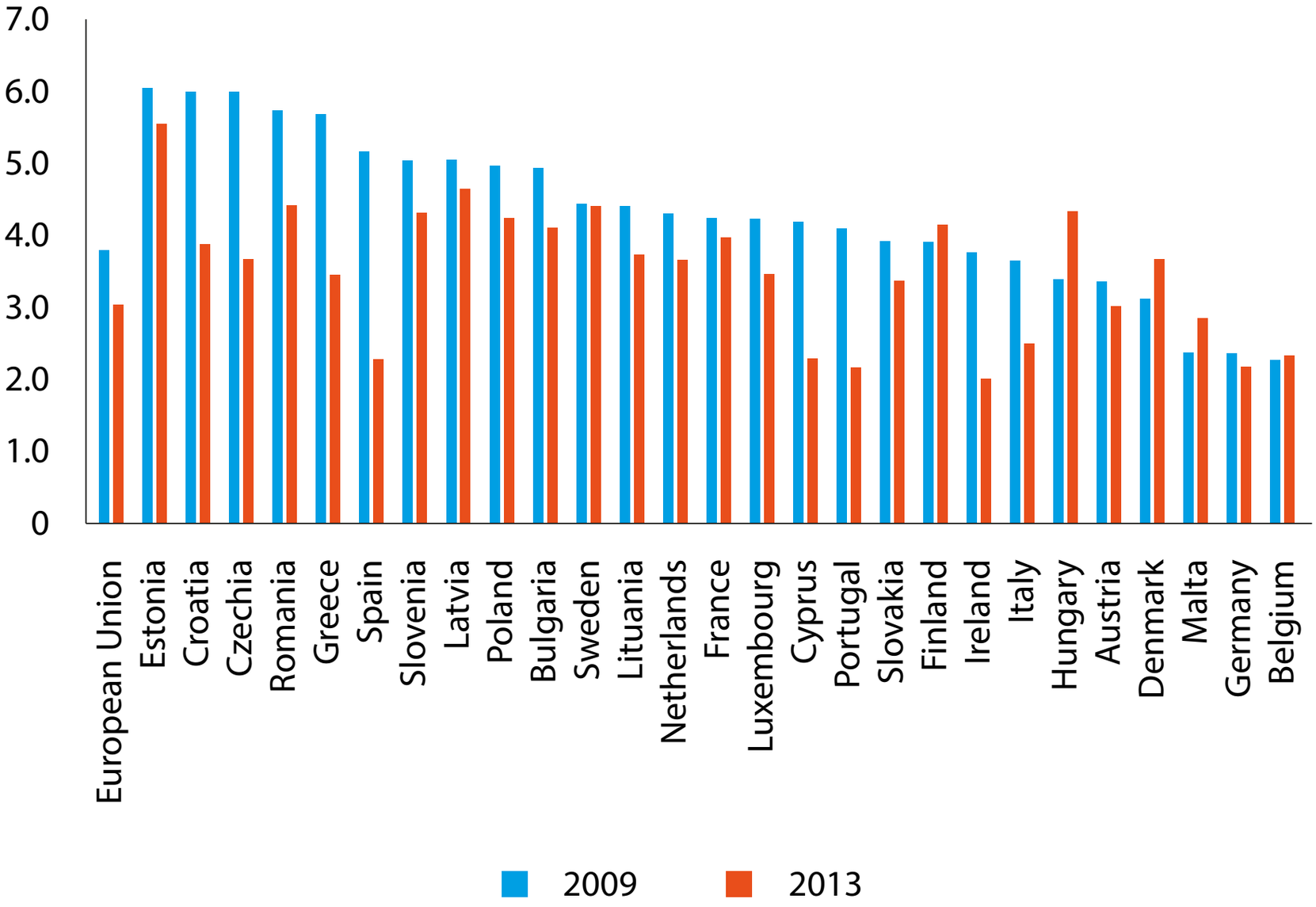
There are reasons why politicians prefer cutting investment over current spending. First, in ageing societies, the interests of future generations have less electoral support. Vote-maximising politicians are likely to decide against the future, as seen in previous fiscal consolidation episodes.

Second, fiscal rules disadvantage investments by treating them fully as current expenses, even though the benefits of investments accrue over long periods. This biases the political economy further against investment. Basic accounting logic would allow net investments to be funded by deficits as they increase the stock of assets (Blanchard and Giavazzi 2004).

Options for dealing with the trade-off between fiscal consolidation and increased green public investment

Fiscal consolidation will have to start when EU fiscal rules are reinstated from 2023. According to our simulations

Figure 1. Gross public investment, 2009 and 2013 (% GDP)



Source: November 2021 AMECO dataset.

(Darvas and Wolff 2021), the speed of consolidation can be moderate – half a percent per year – under a flexible interpretation of current EU fiscal rules.

This flexible interpretation would neglect the 1/20th debt reduction rule (a rule that de facto has not been implemented on account of other relevant factors such as the implementation of structural reforms).

However, to increase climate spending by 0.6% of GDP, governments would need to cut other spending by 1.1 percentage points, so that the 0.5% overall consolidation is achieved. Such deep cuts to non-climate spending simply will not happen given our political systems. Thus, policymakers will face a hard choice between scaling back climate ambitions, amending fiscal rules to make public climate investment possible, or designing a new redistributive EU climate fund to circumvent fiscal rules.

In our view, climate targets must prevail, for two main reasons. First, European backtracking on emission reduction targets might be followed by similar backtracking in non-EU countries, which would risk irreversible deterioration of the environment. Second, for most EU countries, there is negligible risk of fiscal unsustainability. For these countries, financing public climate investment by debt is sensible.

This leaves the EU with three options for fostering green public investment. One would be a general relaxation of EU fiscal rules. However, this would not provide incentives to increase public investment, and additional fiscal resources could well be used for recurrent consumptive spending given the political economy reality.

A second option would be to centrally fund all EU climate expenditure, possibly via EU borrowing. In our simulations (Darvas and Wolff 2021), we show that this is already the road undertaken for a number of southern and eastern EU countries via the Recovery and Resilience Facility (RFF) until 2024.

An advantage of continuing with this approach and widening it to all EU countries would be the approval of national green investment plans by the Commission and the Council. This could help ensure consistency with EU goals and prevent greenwashing. However, such a fund would need to have a much larger capacity than NextGenerationEU (NGEU) and would need to be in place for decades.

The treatment of the RRF in EU fiscal indicators and fiscal rules provides lessons on how a new EU climate fund would be treated. In line with the European System of Accounts and a Council legal option, in September 2021, Eurostat[4] concluded that national spending financed by RRF grants will not be included in national deficit and debt indicators, but spending financed by RRF loans will be (Darvas 2022).

The justification for excluding RRF grants is that EU borrowing to finance these grants should not be counted as member-state debt because *"there is no match between the grants received from the RRF by the individual member states and the amounts that potentially will have to be repaid by each individual member state, as the two elements are calculated on the basis of different criteria"* and *"there is great uncertainty on what amount each member state will be liable for"* (para. 38 of the Eurostat guidance).

Thus, EU debt used to finance the grants constitutes only *"a contingent liability for the Union budgetary planning"*, but not a national debt (para. 42). RRF grants do not matter for deficits either. RRF grants are thus exempt from EU fiscal rules.

It is different for spending financed by RRF loans. A country that borrowed from the EU is liable to repay the full amount of the loan (along with its interest) to the EU. Thus, spending financed by RRF loans is not exempt from fiscal rules.

An EU climate fund would be recorded the same way as the RRF. If it entailed major cross-country redistribution, its political feasibility looks difficult. Yet, without any re-distributive elements, spending by this fund would not alleviate the constraint coming from fiscal consolidation requirements.

The third option, which we favour, would be a green golden rule: allowing green investment to be funded by deficits that would not count in the fiscal rules. This would provide incentives to undertake them, because such investment would be excluded from the consolidation requirements.

The critical issue is the definition of green investment. A defining criterion of climate investment should be a direct reduction of harmful emissions. National fiscal councils and audit offices, the European Commission, the European Court of Auditors, and the Council should play a role in assessing compliance with the green golden rule.

A further advantage of a green golden rule is that it could be utilised by all EU countries. In contrast, a non-redistributive EU climate fund offering only loans might not incur significant demand, partly because some EU countries can borrow at a cheaper rate than the EU, and partly because demand for RRF loans was also moderate, suggesting that borrowing from the EU is not a popular action.

Contrary to public investment, where the positive growth effects are well established in the literature (eg. Tenhofen *et al* 2010), the impact of green investment on growth is uncertain as many green investments would only replace functioning 'brown' infrastructure.

A green golden rule can therefore be problematic in countries with debt sustainability problems. Such countries should, initially, rely only on NGEU for their green investment as they cannot ignore risks to budget constraints. Only after NGEU expires after 2026 will the question of a green golden rule become relevant for these countries.

Legal options

Ultimately, certain elements of the 2011 Six-Pack legislation[5] and the 2012 Treaty on Stability, Coordination and Governance (TSCG)[6] should be revised to include a green golden rule in the EU fiscal framework. This might take years. But until that is achieved, there are pragmatic options for fostering such a rule in the preventive arm of the SGP, though not in the corrective arm. This requires a revision of:

- the existing 'investment clause' to alter the adjustment path in the next years, and
- the medium-term objective (MTO) to change the long-run anchor for the structural balance.

A Council decision would be sufficient for these changes.

The current investment clause allows for temporary deviations from the MTO (or from the adjustment path towards it), amounting to at most 0.5% of GDP under rather strict conditions, such that a negative GDP growth or a level of GDP more than 1.5% below its potential.

When all conditions are met, only national co-financing of projects co-funded by the EU under certain EU funds can be considered. The temporary deviation must be corrected by the fourth year.

These conditions are not specified in any EU legislation, but are based on a Council decision, informed by a Commission proposal[7], a Council legal service option and an EFC compromise agreement[8]. Possible revisions of the investment clause could include the removal of the GDP condition, extending the scope to new green public investment, increasing the 0.5% maximum deviation, and allowing a longer time to correct the temporary deviation.

The determination of the MTO is codified in Article 2a of Regulation 1466/97[9], and public investment is explicitly mentioned as a consideration for the MTO.

We propose that a first calculation of the MTOs follows the procedure described in the latest (2017) version of the Code of Conduct of the Stability and Growth Pact[10], and then in a second step, these MTOs are lowered by the increase in the net green investment the country aims to implement.

Fiscal surveillance should ensure that the extra fiscal space provided by a lowered MTO is solely used for net green investment. A limitation of the proposed MTO correction is that the floor of the MTO is minus 1% for euro-area and ERM2 members with public debt below 60%, and minus 0.5% when debt is over 60% of GDP.

Conclusions

Increasing green investments in periods of budget consolidation will prove politically close to impossible if these investments are undertaken by cutting current expenditures or raising taxes. It is also not recommended that long-term capital investments be funded from current revenues.

Instead, economic and accounting logic suggests that net capital investments be funded by deficits, reflecting the long lifetime of green infrastructure. A green golden rule would provide the right incentives for this. A major and justified worry is 'greenwashing', or the desire of governments to declare current spending as green capital investments.

This needs to be addressed through a narrow definition of green investments and strong institutional scrutiny. A second worry is that green investments have uncertain growth effects. In countries with debt sustainability concerns, such investments should therefore not be funded with national deficits.

And indeed, until 2026, it is the EU recovery fund that will provide for that funding. Until a green golden rule is agreed on and legally implemented, there is scope to allow for some of such investment to take place by using the existing flexibilities. ■

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Endnotes

1. This column was written before the outbreak of the war in Ukraine.

2. The EIB (2021) reported a 45% unweighted average public share in the EU. We calculate the weighted average at 28%. IRENA's (2021) 1.5°C scenario estimated a 22% public share at the global level in 2019, which would decline to 17% beyond 2030.

3. https://www.imf.org/en/Topics/climate-change/energy-subsidies

4. https://ec.europa.eu/eurostat/documents/10186/10693286/GFS-guidance-note-statistical-recording-recovery-resilience-facility.pdf

5. https://ec.europa.eu/info/business-economy-euro/economic-and-fiscal-policy-coordination/eu-economic-governance-monitoring-prevention-correction/stability-and-growth-pact/legal-basis-stability-and-growth-pact_en

6. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:42012A0302(01)

7. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52015DC0012&from=EN

8. http://data.consilium.europa.eu/doc/document/ST-14345-2015-INIT/en/pdf

9. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:01997R1466-20111213

10. http://data.consilium.europa.eu/doc/document/ST-9344-2017-INIT/en/pdf

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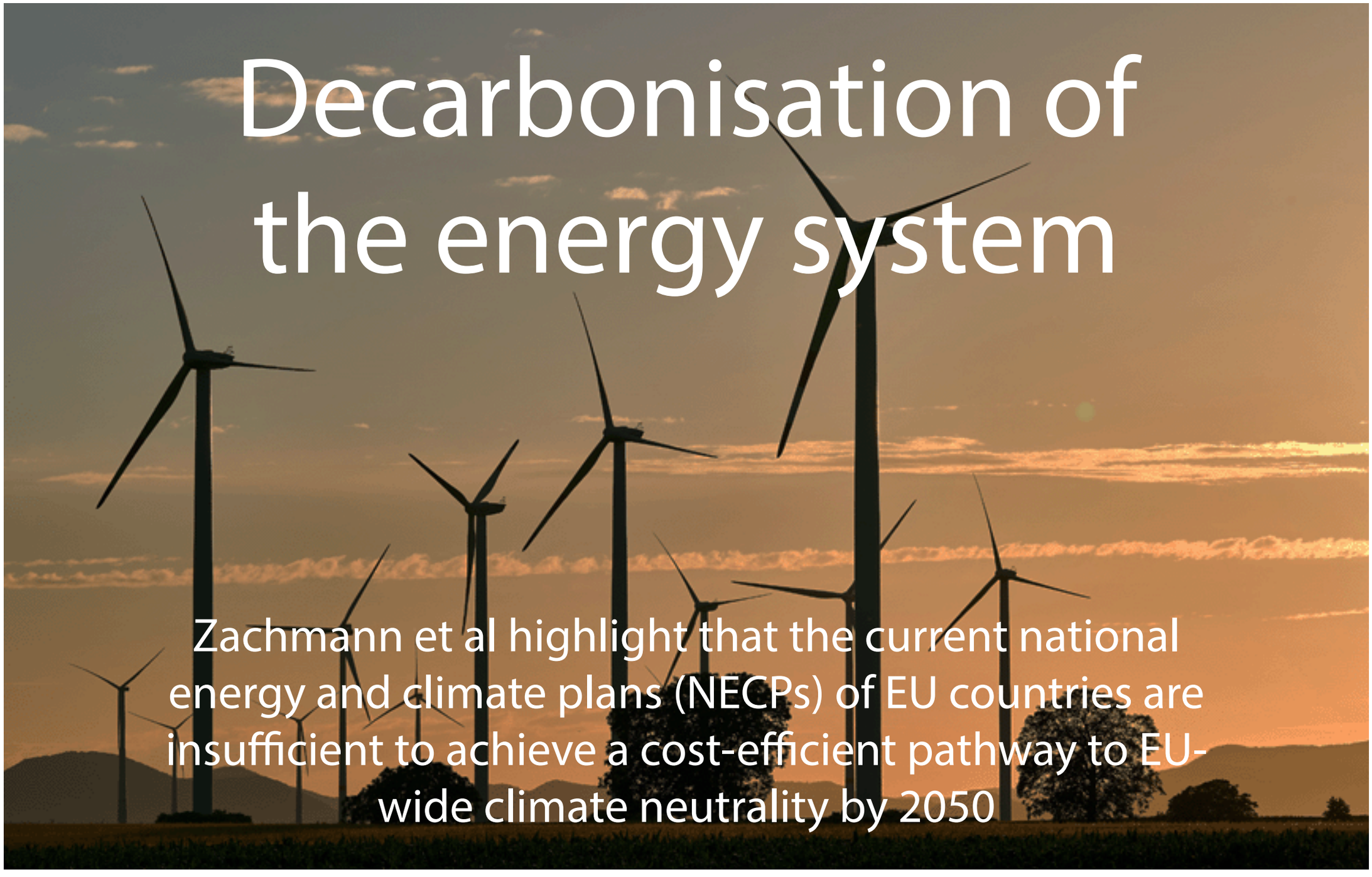
This column is a lead commentary in the VoxEU debate on euro area reform and was first published on VoxEU.org.

Decarbonisation of the energy system



Zachmann et al highlight that the current national energy and climate plans (NECPs) of EU countries are insufficient to achieve a cost-efficient pathway to EU-wide climate neutrality by 2050

Summary

Three quarters of the European Union's greenhouse gas emissions stem from burning coal, oil and natural gas to produce energy services, including heating for buildings, transportation and operation of machinery. The transition to climate neutrality means these services must be provided without associated emissions.

It is not possible today to determine tomorrow's optimal clean energy system, largely because the cost, limitations and capability developments of competing technologies cannot be predicted. Energy systems with widely diverging shares of 'green fuels', in the form of electricity, hydrogen and synthetic hydrocarbons, remain conceivable.

We find the overall cost of these systems to be of the same order of magnitude, but they involve larger investments at different stages of value chains. A large share of synthetic hydrocarbons would require more investment outside the EU, but less in domestic infrastructure and demand-side appliances, while electrification requires large investment in domestic infrastructure and appliances.

Current projections show an overall cost advantage for direct electrification, but projections will evolve and critical players may push hard for alternative fuels. Policy will thus play a major role in shaping this balance.

Political decisions should, first, push out carbon-emitting technology, primarily through carbon pricing. The more credible and predictable this strategy is over the coming decades, the smoother will be both divestment from brown technologies and investment in green technologies.

Second, policy needs to help ensure that enough climate-neutral alternatives are available in time. Clear public support should be given to three system decisions about which we are sufficiently confident: the massive roll-out of renewable electricity generation; the electrification of significant shares of final energy consumption; and rapid phase-out of coal from electricity generation.

For energy services where no dominant system has yet emerged, policy should forcefully explore different solutions by supporting technological and regulatory experimentation.

Given the size and urgency of the transition, the current knowledge infrastructure in Europe is insufficient. Data on the current and projected state of the energy system remains inconsistent, either published in different places or not at all. This impedes the societal discussion.

The transition to climate neutrality in Europe and elsewhere will be unnecessarily expensive without a knowledge infrastructure that allows society to learn which technologies, systems, and polices work best under which circumstances.

1 Introduction

For the European Union to become the first climate-neutral continent by 2050, the decarbonisation of the energy sector will be crucial. Production and use of energy accounts currently for more than three quarters of the EU's greenhouse gas emissions[1], and most of the EU energy system still relies on the combustion of oil, natural gas and coal.

Meanwhile, the potential to reduce demand for energy services is most likely limited and therefore most energy services currently based on fossil-fuels need to be replaced by climate-neutral alternatives. One of the open issues is the relative role of different non-fossil fuels[2] – primarily electricity, hydrogen and synthetic methane – in final energy use.

We present three extreme scenarios to highlight the consequences of different energy-policy choices: first, the full electrification of the economy; second, the widespread use of hydrogen; and third, widespread use of synthetic methane. In practice, a combination of the three scenarios is most likely to be implemented, and the three scenarios are not equally probable.

Irrespective of the choices made, we emphasise three main 'no-regret' policies that should in any case be implemented[3]: (a) rapid deployment of more renewable electricity generation, (b) electrification of significant shares of final energy uses (such as heating and transportation), and (c) the swift phase-out of coal.

Our analysis also highlights that the current national energy and climate plans (NECPs) of EU countries are insufficient to achieve a cost-efficient pathway to EU-wide climate neutrality by 2050. Consequently, a strong commitment framework is needed to ensure that NECPs are aligned with European targets.

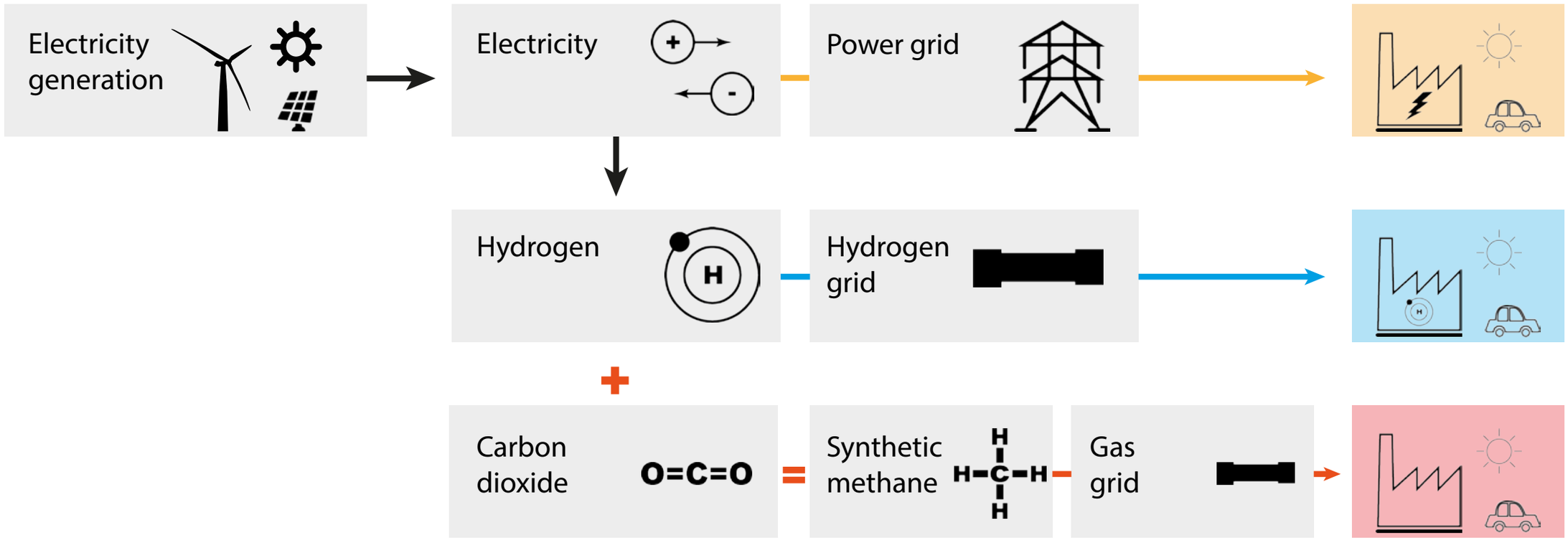
2 Different scenarios

How the European energy system will develop over the next decades is highly uncertain. In particular, the roles in the future energy mix of hydrogen (H_2), synthetic methane (CH_4) and their derivate products (such as ammonia) remain hard to predict. These fuels can be produced using renewable electricity (and/or biomass). On this basis, they are referred to as 'green'.

Hydrogen can be produced from electrolysis of water (Figure 1). Synthetic methane can then be produced via an additional electrochemical process known as the methanation of hydrogen. In this process, hydrogen and carbon dioxide are used as inputs (Götz *et al* 2016).

Political decisions, particularly on agreements with third countries for the future import of green fuels, act as commitment devices

Figure 1. Simplified overview of a low-carbon energy system



Source: Bruegel

If the inputs are 'clean' over their lifetime – for example, hydrogen obtained from electrolysis using renewable electricity, and CO_2 captured from the atmosphere – the final product is considered greenhouse-gas-neutral. The additional methanation process makes synthetic methane more electricity-intensive and expensive than hydrogen (Evangelopoulou *et al* 2019).

Alternatively, synthetic methane can be produced from biogenic sources, ie. by increasing the methane concentration in biogas to almost 100 percent, but the potential for biogas production in the EU is rather limited[4]. The resulting synthetic methane might replace fossil natural gas, which is also almost pure methane.

The main advantage of synthetic methane is that it can be fed into the existing natural gas transportation and storage infrastructure. Furthermore, it requires less investment on the demand side than hydrogen or direct electrification, since current natural gas heating systems or turbines could be fuelled with synthetic methane in the future.

However, beyond this initial capital stock advantage, synthetic methane appears significantly less attractive than hydrogen or direct electrification. There would be high investment costs for production facilities[5], and substantial amounts of electricity required to run them, because of the poor overall energy efficiency[6].

The energy efficiency of hydrogen produced from a unit input of renewable electricity is higher. However, hydrogen cannot be pumped through existing natural gas pipelines, which would need to be retrofitted to transport hydrogen safely.

Our three scenarios illustrate the uncertainty around the future energy system and find robust, no-regret developments that appear in all scenarios. We assume a plausible level of energy demand in 2050 and make

extreme assumptions about the contribution of each of the three fuels to meeting this demand. We distinguish: a) an 'all-electric world'; b) a hydrogen-dominated world in which hydrogen demand is so great that hydrogen imports are required; and c) a 'green gases' world, in which synthetic methane plays a major role as a replacement for natural gas.

All scenarios rely on extensive electrification of energy supply and demand, and a phase-out of coal and fossil natural gas.

We assess the future energy system in 2030 and 2050 according to these three scenarios. We assume the same useful energy demand in all scenarios, but this demand would be satisfied with different technologies and from different sources (Box 1).

In addition, the role of energy imports varies across the scenarios; domestic energy demand is met from a mix of domestic renewable energy generation and imported fuels. In the scenarios focussing on transition to hydrogen and synthetic methane, energy imports would meet a large share of demand. This implies less demand for electricity generation domestically which is off-shored via production of these fuels abroad (Figure 2).

More importantly, a major increase in renewable electricity generation in the EU is required to achieve the emissions reductions from the energy sector. Figure 2 shows that electricity generation levels must at least double by 2050 compared to today (with potential deployment abroad in the case of energy imports).

We assume that all of the growth will come from renewables, mostly wind and solar. Electricity generation in the EU from coal and natural gas will have to be phased out in line with international commitments such as the Glasgow Climate Pact[7].

Table 1. Scenario assumptions

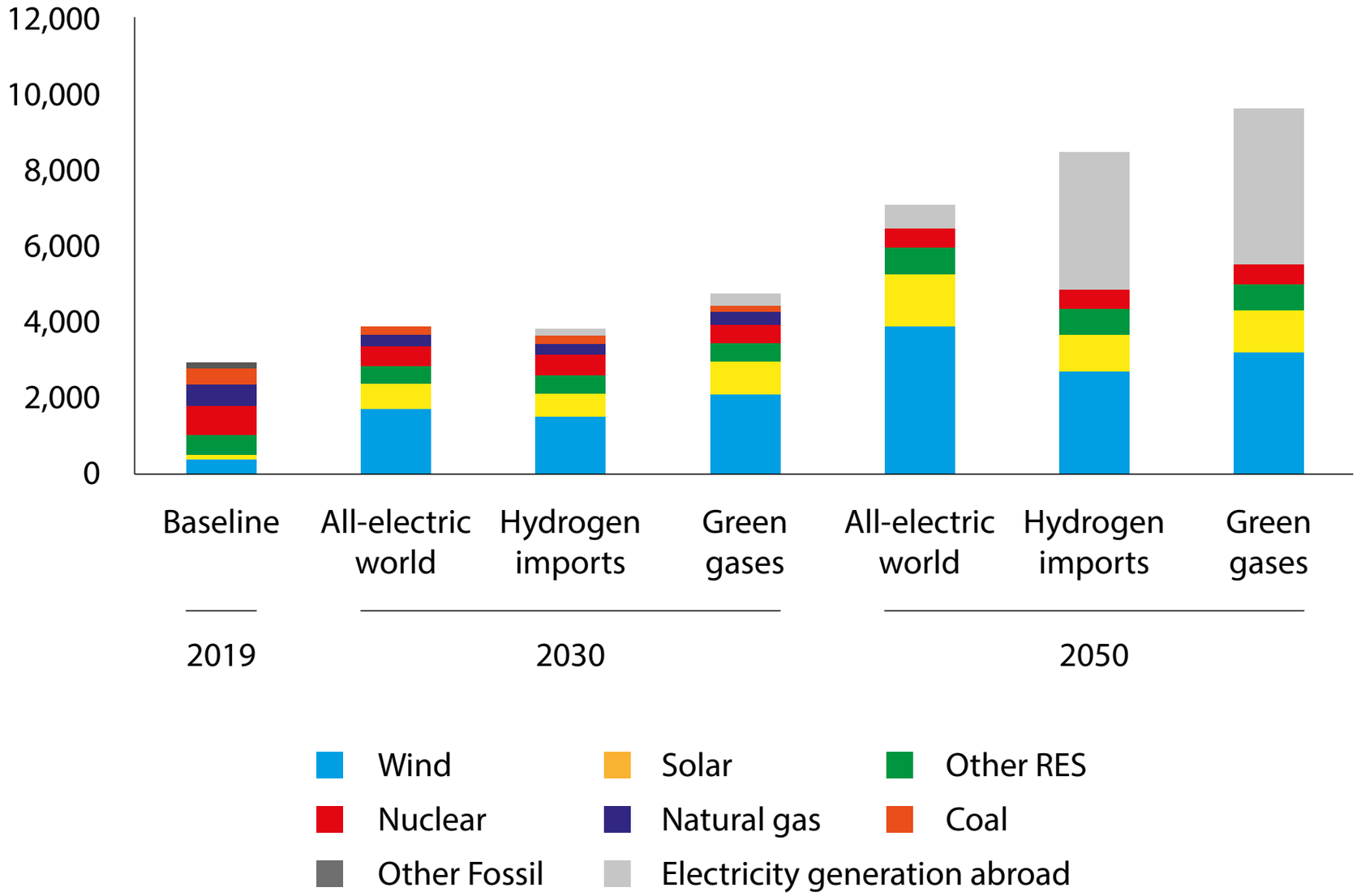
	Green gases	Hydrogen	Renewable electricity
All-electric world	Gas transmission and distribution infrastructure is largely decommissioned	Hydrogen clusters with very concentrated pipeline network; some hydrogen storage for electricity seasonal storage	Significant upgrading and expanding of European transmission and distribution grid
Hydrogen imports to fuel EU	Gas transmission and distribution infrastructure is largely repurposed (ie. green gas is consumed where it is produced)	Meshed European transmission infrastructure connected to import points and hydrogen distribution grids in repurposed methane pipelines, hydrogen fuelling station infrastructure	Electricity distribution only strengthened where no hydrogen is available; electricity transmission modestly strengthened
Green gases in old pipelines	Gas transmission and distribution infrastructure is largely maintained and used by green methane	Hydrogen clusters with very concentrated pipeline networks; some hydrogen storage for seasonal electricity storage	Electricity distribution only strengthened where no methane is available; electricity transmission modestly strengthened

Source: Bruegel

Box 1. Scenario analysis methodology

For each scenario, we calculated the required investments (2020-2030, 2030-2050) in the energy sector, ie. additional power generation capacities, investments in electrolyser and transmission grids, and investments in hydrogen grids – but not the cost of demand-side appliances. It is impossible to have a clear ordering of the cost of appliances that serve the same purposes but use different fuels. The corresponding energy system investment unit costs are taken from the ASSET project (Capros et al 2018). The investment volumes in the different scenarios are calculated based on the assumption that the amount of useful energy required in each sector is the same as that implied in the MIX-55 scenario results developed by E3Modelling (JRC, 2021). 'Useful' energy is the energy service finally made available to users (kilometres driven, square metres heated). As more efficient fuel systems (electricity) require less kWh of input to provide the same service (heating) than less efficient systems (hydrogen), a smaller system is required to provide the same service. For each major final use, we estimated for each fuel the required input. For each scenario, we estimated the share of each fuel in each use type. Based on this, we calculated required inputs of the different fuels for each sector and in total. This allowed us to calculate the necessary transmission and generation capacities. Ultimately, these capacities can be translated into investment figures.

Figure 2. Electricity generation in 2019, 2030, and 2050 in TWh



Note: RES = renewable energy sources.
Source: Bruegel (see Zachmann et al 2021).

The greater role of electricity will be visible in the future through more direct use of electricity in final energy use ('electrification', eg. of transportation) and through the introduction of hydrogen and synthetic methane produced from electricity ('indirect electrification').

Figure 3 shows that direct electrification will play a major role in all scenarios because it is a low-cost way of decarbonising many energy demand areas.

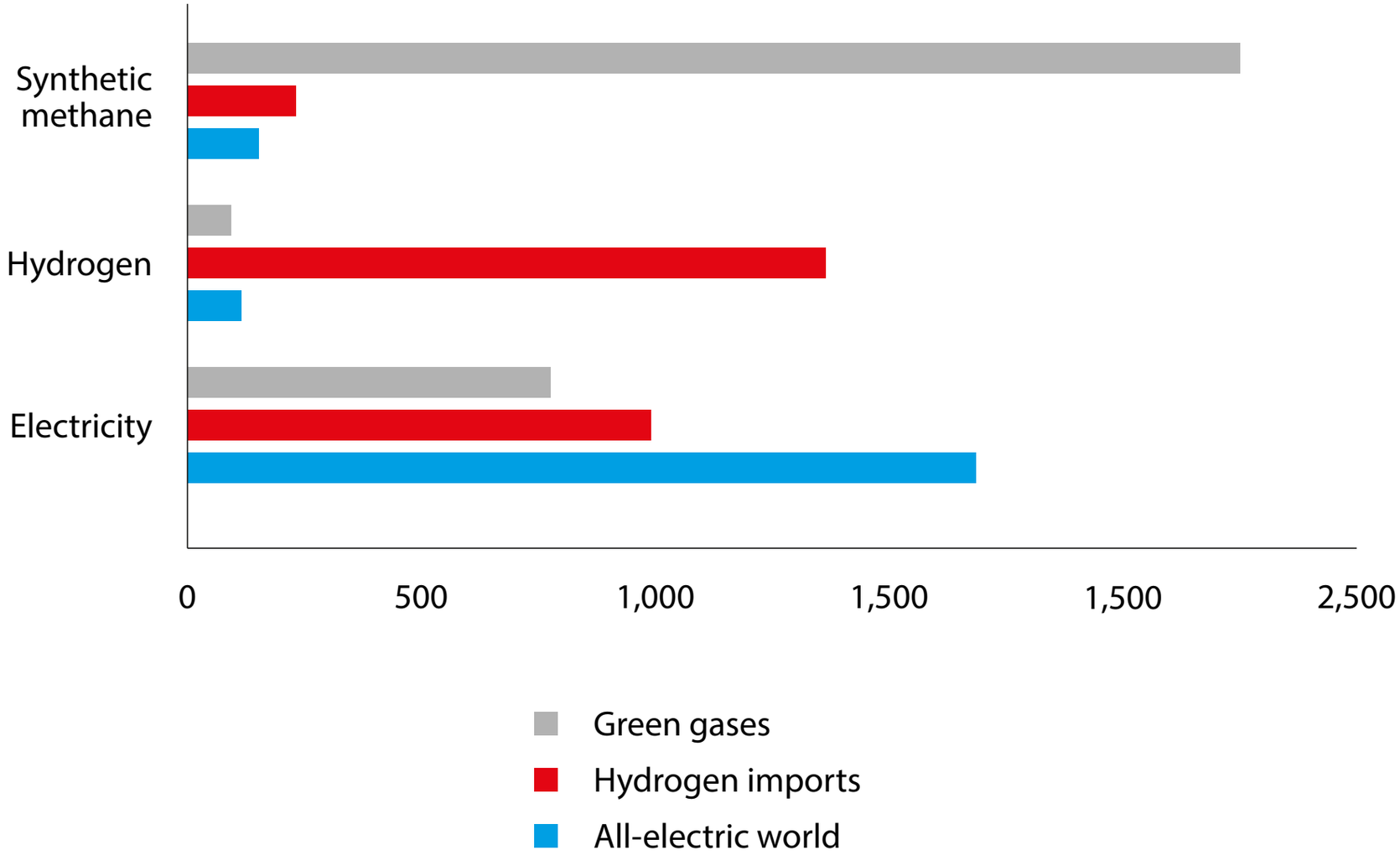
Due to their energy-inefficient production processes, hydrogen or synthetic methane will only become viable bulk-energy carriers if low-carbon electricity generation in Europe (or in the interconnected neighbourhood) turns out to be severely limited.

Even assuming learning and cost decreases, only small amounts of hydrogen and synthetic methane are no-regret decarbonisation solutions[8] for sectors where electrification is impossible or hard to achieve.

The scenario approach helps us to investigate the relative costs of each decarbonisation option. Clearly, there is too much uncertainty around key parameters (learning rates, future appliance costs, supply constraints, etc) to be able at this point to determine the optimal future energy system. However, some insights are gained from comparing the three scenarios.

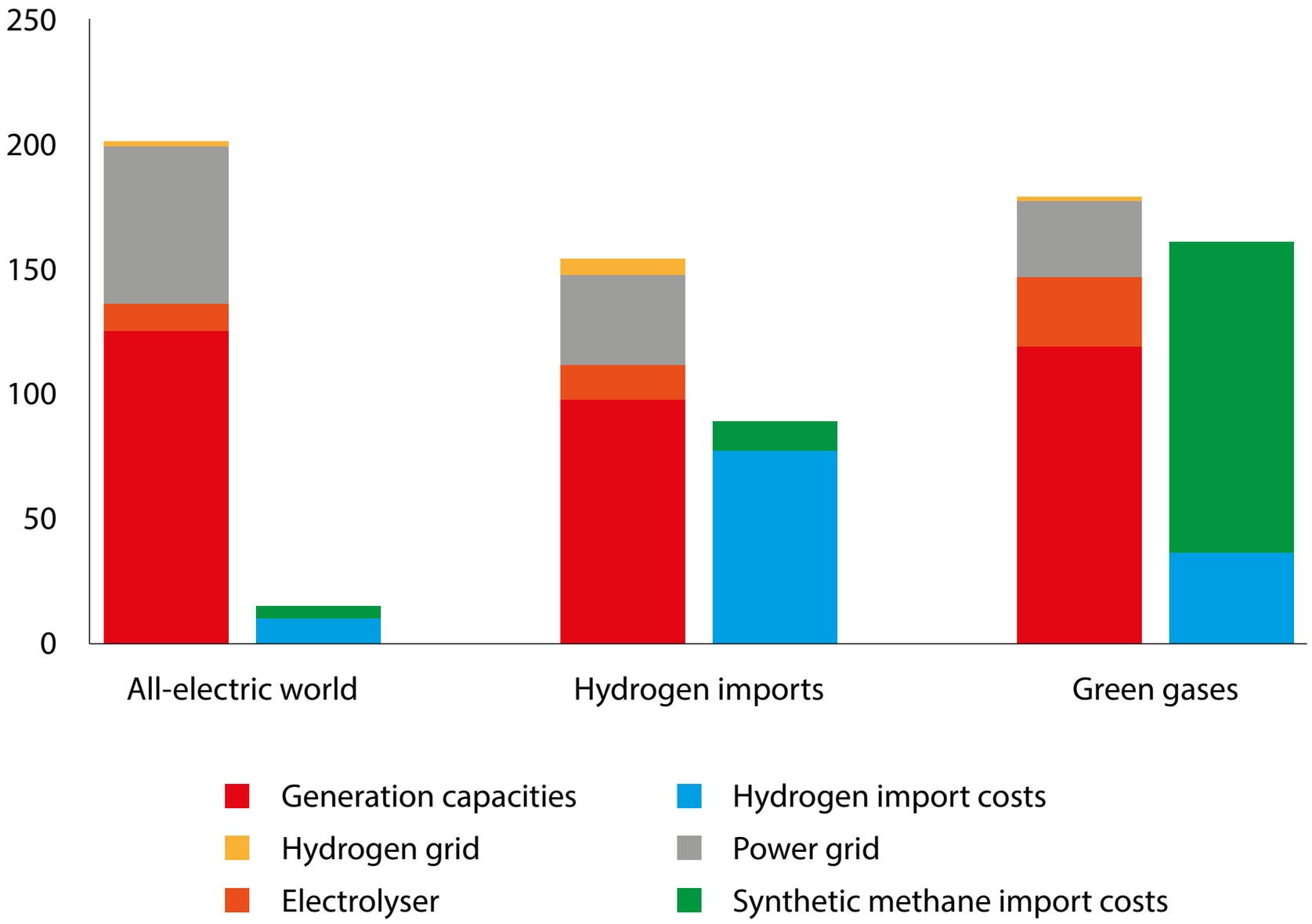
First, different scenarios have different investment needs (Figure 4). For example, the 'all-electric world' scenario with widespread electrification requires massive expansion of electricity grids, even more than in the other scenarios because of the interconnection of all possible demand areas.

Figure 3. Change in final energy consumption by fuel between 2020 and 2050 (TWh)



Source: Bruegel (see Zachmann et al 2021).

Figure 4. Annualised investment costs (left-hand bars) and fuel import costs (right-hand bars) in the three scenarios, 2021-2050, € billions



Note: In each case, the left bar indicates the average annual investment cost and the right bar the annual fuel import cost.
Source: Bruegel.

In contrast, a hydrogen-focused energy system will incur costs for the retrofitting of pipelines to enable hydrogen to be transported.

Second, all scenarios require significant investment in low-carbon power supply. Expansion costs for low-carbon electricity generation are more than half the domestic EU investment costs in all scenarios.

Third, the need for domestic generation investment would be even greater in the 'hydrogen imports' and 'green gases' scenarios, unless much of the electricity production is offshored and imported in the form of hydrogen and synthetic methane. This leads to high import costs (Figure 4).

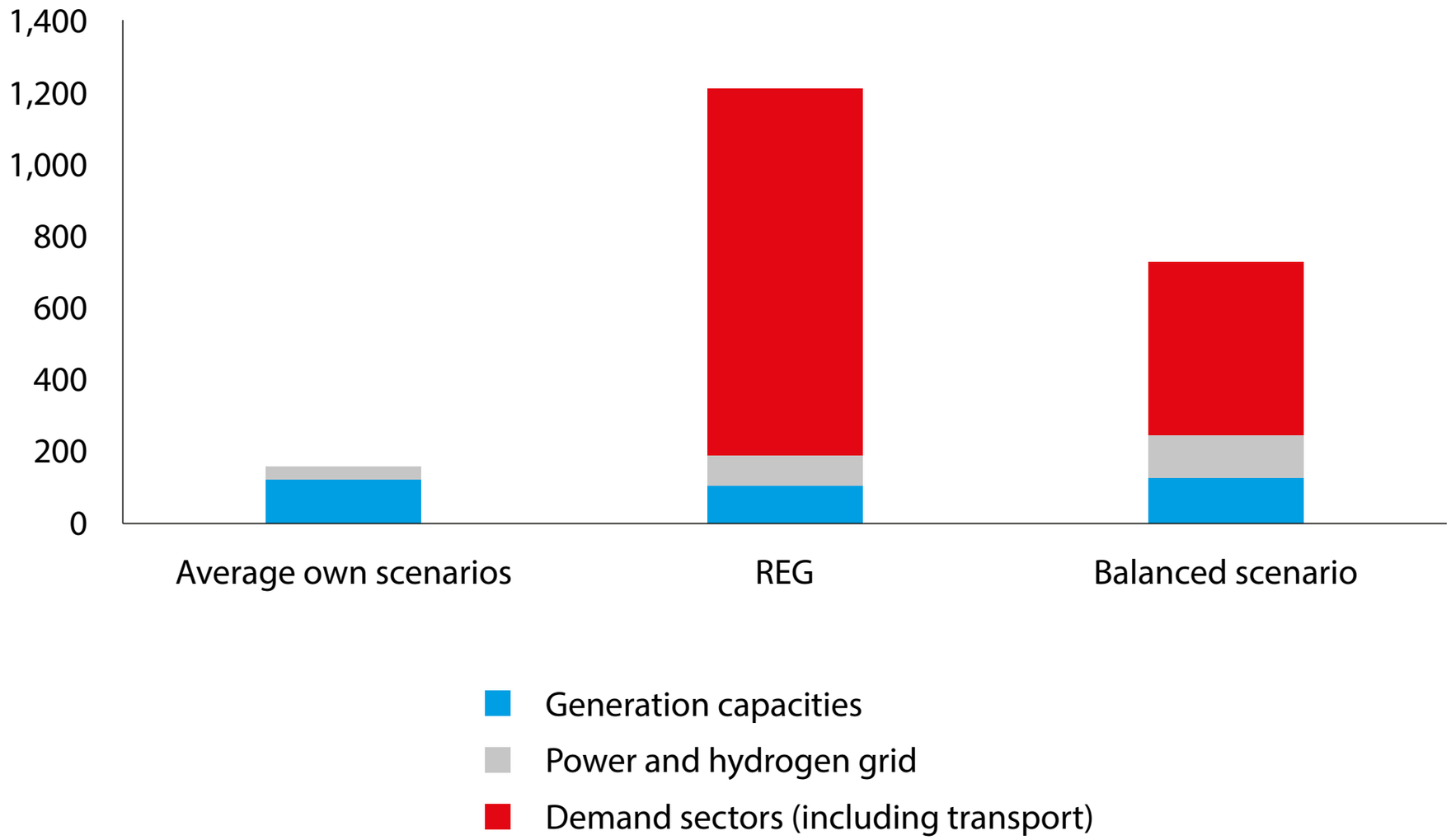
In sum, electrification is a no-regret option across all three scenarios. In addition, the scenario focusing on widespread electrification has the lowest cost of the three scenarios. From a cost perspective, hydrogen use is more likely than synthetic methane use. Hydrogen can plausibly be a complement to widespread electrification, with hydrogen helping to decarbonise demand areas where electrification is hard or costly (eg. aviation).

An energy system biased towards synthetic methane would be the costliest choice. The advantages of re-using existing natural gas infrastructure would not compensate for the high investment and operation costs of synthetic methane production facilities.

3 Encouraging the needed private investment

While our scenario analysis is focussed exclusively on the supply-side, previous modelling studies have shown that the vast majority of investment needs are on the demand side (Figure 5).

Figure 5. Required average annual investments (2031-2050)



Note: REG (regulatory-based) scenario comes from the European Commission (2020a); Balanced scenario is from Evangelopoulou et al (2019). All investments and costs are depicted in billions of 2020 €. Our scenarios do not consider demand-side investments.
Source: Bruegel.

Households must purchase clean vehicles and install clean heating systems, and firms must invest in clean production processes. Figure 5 shows that demand-side investment exceeds supply-side investment expenditures by a factor of at least five.

In order to provide the private sector with sufficient confidence to make these investments, policy must pursue two complementary tracks. First, credible signals should indicate that the energy use of fossil fuels and the investment in the appliances that consume them will be relentlessly regulated out of the market. Simultaneously, policy should demonstrate that alternative low-carbon fuels will be available and cost-effective.

These policy tracks complement one another. Without convincing signals that fossil fuels will not be available in the future, investors will not be motivated to invest capital in switching, preferring instead to wait and see[9]. But announcing only fossil fuel phase-outs without credible commitments as to what new energy systems will be made available also will not work.

Social and political constraints imply that governments will ultimately never follow through on fossil-fuel bans or high carbon prices if no alternatives are in place to provide essential services (ie. governments will not permit household fossil energy bills to grow too large without alternatives available[10]).

3.1 Ending the use of fossil fuels

In our discussion on ending the use of fossil fuels, we differentiate between 'neutral' (no-regret) choices and policies that favour one of the described scenarios.

Technologically-neutral policies can contribute to ending the use of fossil fuels. These are policies that keep all pathways open and do not favour any clean fuel.

They include for example: greenhouse gas pricing, which increases the costs of carbon-intensive production, but is neutral about its alternatives[11]; bans on/strict standards for internal combustion engine vehicles and gas boilers, which phase out the use of fossil fuels but do not prescribe specific alternatives; and mandates to stop fossil-fuel investment that would only be economically viable if there is still unabated combustion after 2045, which do not prescribe a specific replacement technology.

However, such technology-neutral policies are not necessarily sufficient to end the use of fossil fuels, as shown by coal. There exists no foreseeable future in which coal will play any (significant) role in the European energy system.

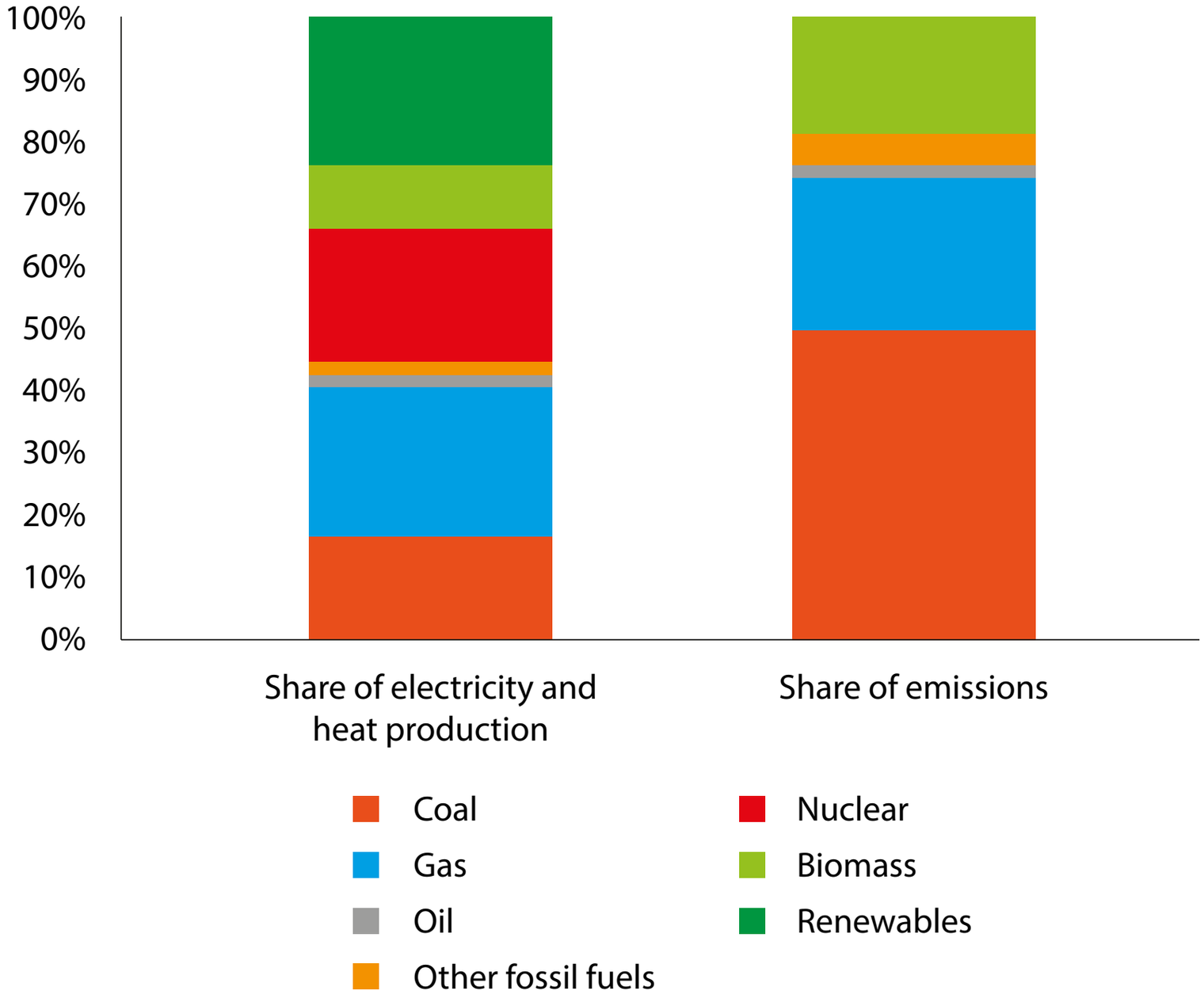
Especially in electricity and heat production, which presently uses almost half of hard coal[12] and almost all lignite in the EU, a coal phase-out must be achieved swiftly to not over-exploit Europe's carbon budget and to maintain international credibility.

Using coal to generate electricity and heat is highly emissions-intensive: coal provides only 17 percent of total electricity and heat production in the EU, but generates half of the greenhouse-gas emissions in this sector (Figure 6).

The importance of coal in electricity and heat production varies across the EU, with many countries – predominantly in North and West Europe – having no or almost no coal in their systems, and a few countries – in Central and East Europe – with very high shares (Figure 7).

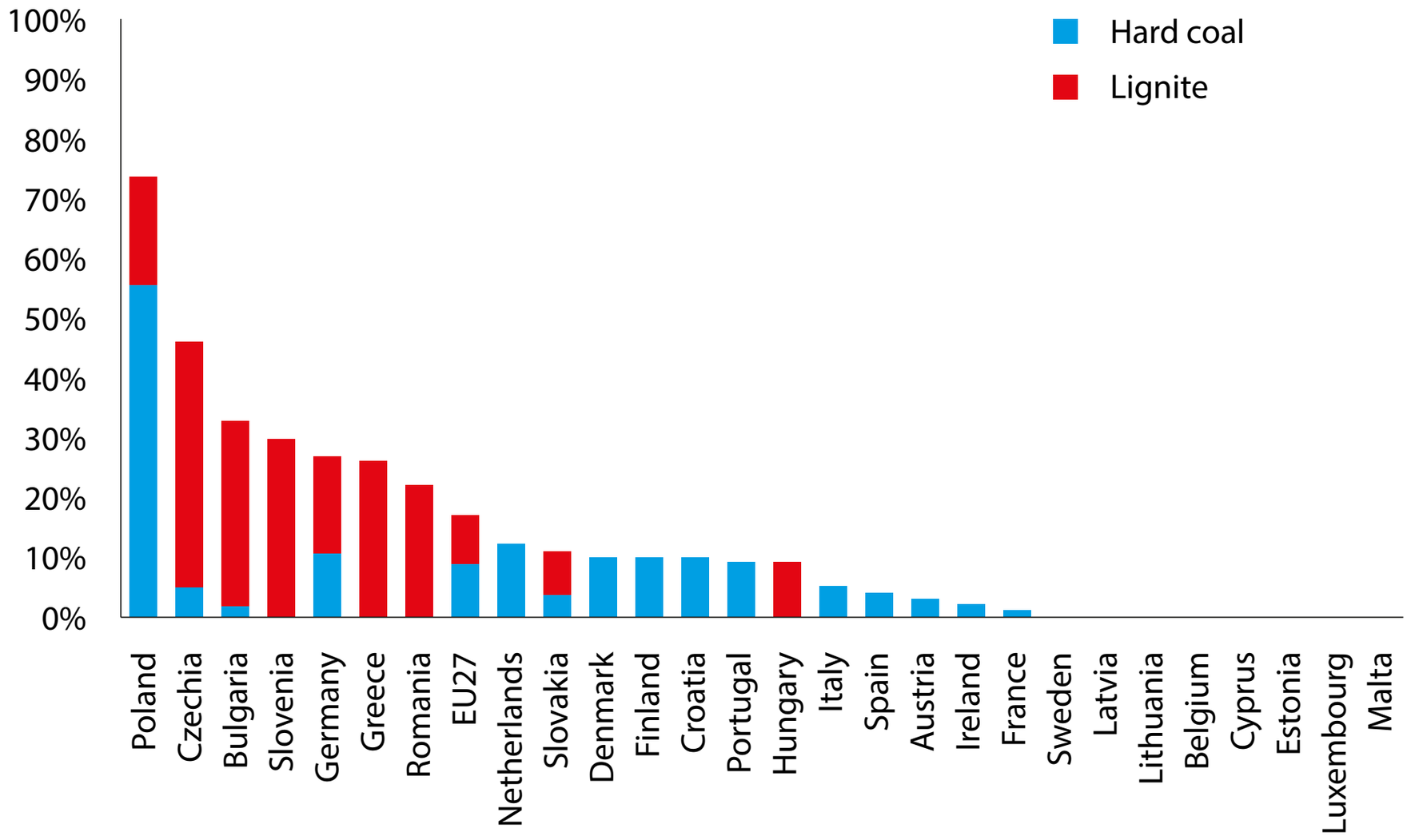
Seven EU countries (Poland, Czechia, Bulgaria, Slovenia, Germany, Greece and Romania) have coal shares above 20 percent. On the other hand, twelve EU countries have shares around 10 percent. Germany has the fifth largest share of coal, but due to its size has the second-largest coal-sector in the EU.

Figure 6. Share of coal in emissions and electricity and heat production (2019)



Source: Bruegel based on Eurostat (ngr_bal_peh) and EU CRF Tables reported to UNFCCC.

Figure 7. Share of coal in electricity and heat production in the EU (2019)



Source: Bruegel based on Eurostat (dataset ngr_bal_peh).

Because of an annual reduction factor, the annual issuance of emission allowances into the EU emissions trading system (ETS) will continue to decline, reaching zero in less than 30 years.

This provides a clear and powerful signal to national and regional administrations and companies that coal combustion will have to be phased-out.

Regarding the short-term operation of existing coal plants, increasing carbon prices affect the equilibrium[13] between coal, gas and electricity prices – incentivising a reduction in the operating hours of coal units.

In longer-term decision making, tightening emission budgets will not only prevent new-builds of coal assets but also encourage the early closure of existing ones.

However, if this process is left entirely to market forces and individual operators, the resulting closure schedule is likely to be inefficient. Political uncertainty over future policy direction, and notably the ability of large companies to influence this, implies that companies face some incentive to continue running coal plants at negative profit margins to avoid paying large decommissioning costs today.

In this case, a strict time schedule for phase-out is required to avoid the postponement of closure decisions. On the other hand, rapid and uncoordinated plant closures may threaten (regional) security of supply.

Therefore, a geographically determined phase-out schedule is crucial to manage the physical limitations of electricity grids as dispatchable generation drops offline. The need to manage the regional economic and social repercussions also calls for a planned phase-out.

Most EU countries already have national coal phase-out policies, usually with a phase-out schedule and a terminal date for coal-fired power plants.

Only a few EU countries in central and eastern Europe do not have an end date (including Bulgaria, Slovenia, and Croatia), or have a very late end date (such as Poland, 2049, and Germany, 2038)[14], for phasing out coal from electricity generation.

Finally, without a clear vision of publicly acceptable and competitive alternative power supplies, the phase-out plans are not credible. Here, public support for alternatives reduces the cost of the transition (eg. through accelerated learning) and also serves as a public commitment.

High carbon prices are thus an efficient driver of a coal phase-out, but can only be credible and hence successful if it is made sure realistic alternatives will be phased in at the same time.

3.2 Ensuring availability of low-carbon alternatives

Policy must focus not only on ending the use of fossil fuels, but also on providing credible low-carbon alternatives. To do so, certain actions are essential under all scenarios.

The first is to build out low-carbon electricity generation capacity. At least an additional 2,000 terawatt hours of domestic electricity generation in 2050 compared to 2019 is required in all scenarios, which is approximately a 70 percent increase.

Second, in certain areas, direct electrification appears likely to be the optimal solution, including for passenger vehicles[15], large shares of household heating[16] and low-temperature industrial heat[17].

Here, policymakers should be willing to do what is needed to provide the policy framework (infrastructure, regulation, support for research, development, demonstration and deployment) to enable the fast roll-out of decarbonised systems.

This does not imply that policy will blindly favour one system, but that the burden of proof will be on alternative technologies to provide not-yet-seen evidence of their superiority. Direct electrification will work for a substantial percentage of EU's decarbonisation needs and this should be swiftly exploited.

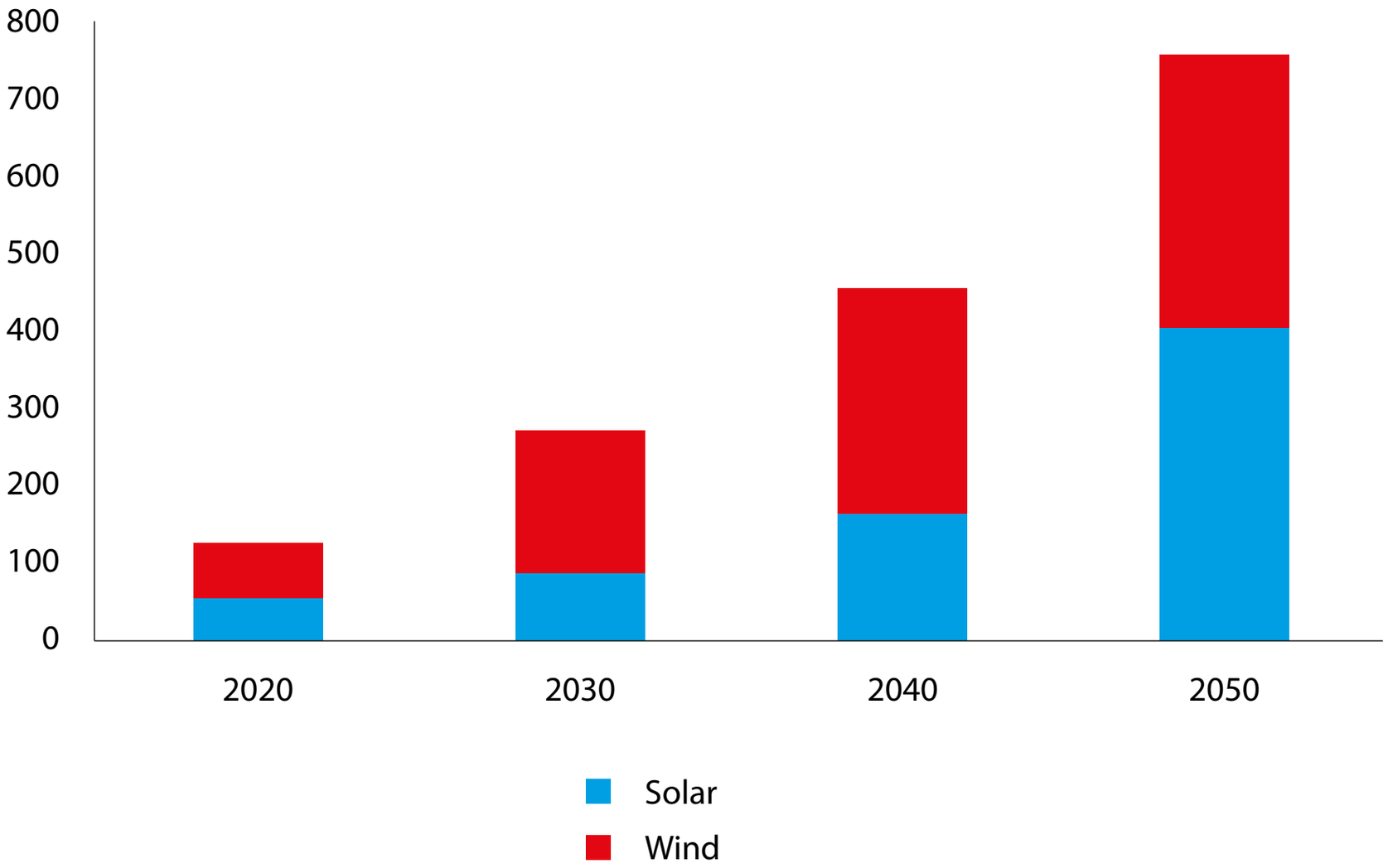
The coal phase-out is a prime example highlighting the need for significant deployment of new low-carbon electricity capacity. The deployment record in the past two decades indicates that renewable electricity is the cost-efficient option[18].

However, as wind and solar PV power plants have structurally lower full-load hours (hours in which the entire power capacity of a power plant is used), the overall capacity of the power plant fleet has to be substantially increased to provide the same amount of energy.

Among EU countries, the need to deploy renewable power plants in order to phase-out coal varies. Countries with a low share of coal in electricity and heat production will be able to replace coal with modest investments in additional renewable energy capacities.

Countries with high shares of coal (especially Poland, Czechia, Bulgaria and Slovenia) must invest aggressively in renewable energy capacities so they can phase-out coal in the next decade. Renewable capacities need to be multiplied by a factor of at least six by 2050 in the seven most coal-intensive EU countries (Figure 8).

Figure 8. Wind and PV power plant capacities needed for decarbonisation in the seven most coal-intensive EU countries (in GW)



Note: The data covers EU countries with significant shares of coal in electricity and heat production: Bulgaria, Czechia, Germany, Greece, Hungary, Poland, Romania and Slovenia.
Source: Zachmann et al (2021).

However, all EU countries need to increase renewable energy deployment rates substantially to achieve climate neutrality by 2050.

As the coal phase out progresses, gas-fired power plants could play an important transitional role. They have relatively low capital costs (about half that of coal plants) and can be dispatched more quickly than coal plants when needed to back-up fluctuating wind and solar PV power plants. They can thus support the system for the few days/weeks of the year when demand exceeds renewable energy production.

However, new gas power plants risk becoming stranded assets if they cannot be operated commercially under strict carbon-neutrality constraints.

Depending on the needs of the future power sector, three different types of gas fired power plant are conceivable: 1) plants with relatively low capital costs and low planned load factors, and which can be switched to carbon-neutral fuels such as synthetic methane or hydrogen; 2) plants designed to recover their fixed costs over a short period; 3) very efficient plants with higher load factors that can be commercially operated with carbon capture and storage.

Given the legacy power plant fleet and the decreasing cost of renewables, the first niche currently appears to be the largest. A predictable regulatory environment and a well-functioning electricity market is the best approach to identify efficient solutions.

Beyond these two uncontroversial solutions (direct electrification where appropriate and the massive deployment of renewable electricity generation), the most promising solutions for other energy uses (including significant industry applications, aviation or seasonal energy storage) are less clear.

Hence the approach should be two-pronged: to provide a European and national policy framework encouraging the rapid deployment of the uncontroversial solutions, and encouraging companies to explore in depth different solutions in the less-clear areas.

In the next decade, this two-pronged approach will be particularly important for industry and households (including transport). In these sectors, emissions reductions have so far been too slow; in order to meet 2030 targets, a step change is necessary.

The major focus on these areas in the European Commission's Fit for 55 policy push, and the spending plans of countries under Next Generation EU (Darvas *et al* 2021), reflect this. The policy challenge is to strike the right balance between allowing fair competition between low-carbon technologies while providing enough of a technologically-specific push for the required solutions to be deployed at scale in time.

For comparison, the 2005 launch of the EU ETS placed neutral pressures on the power sector to decarbonise, but was accompanied by the roll-out of massive support schemes for renewable power generation.

These policies favoured the development of those renewable technologies that were already mature enough to compete for subsidies, and were very successful in dramatically bringing down their costs.

Without this complementarity, the ETS would have led to a stronger temporary switch from coal to natural gas, while increasing prices and dependencies might have undermined the political sustainability of European carbon pricing.

In a similar vein, policies to end the use of fossil fuels in industry and households[19] must be accompanied by a second category of policies providing clear signals on the future availability of clean fuels. This requires governments to make credible commitments to facilitate the necessary infrastructure for new fuels (both physical and institutional), which will be laid out through a series of path-nudging choices over the coming years.

First, access to energy will be determined increasingly by low-carbon sources of electricity and the fuels derived from this. Therefore, new infrastructure is essential to connect supply and demand of these energy vectors.

The signals sent by policymakers today regarding infrastructure roll-out provide a signal for private-sector investment (eg. greater electricity transmission capacity, roll-out of hydrogen transmission pipelines). We argue that bold decisions need to be taken today to stimulate a wave of new infrastructure investments.

This includes questions for policymakers outside the current comfort zone, such as: should competition concerns be temporarily ignored and should vertical integration of the generation, pipeline transportation and consumption of new green fuels be permitted, in order to allow nascent markets to grow quickly?

How can EU countries be made more cooperative and ambitious when constructing projects of common interest and transmitting clean fuels across borders? Beyond transmission-level infrastructure, there will also be a role for government support for/permitting of investments to reinforce distribution grids and final infrastructure, eg. charging for electric vehicles.

Second, energy markets are not self-organised institutions but are designed by policy. The current market design for electricity and natural gas reflects the ambition of gradually realising a European energy market by coupling

short-term markets – and expecting that these price signals will ultimately lead to coordination of energy-sector investments in different EU countries.

But so far, national instruments to support specific technologies (eg. solar in Germany; nuclear in France; gas in Italy) have superseded European market signals. The net zero transition will require a substantial rethink about how investments are coordinated to result in an energy mix that is relatively efficient.

Most attention should be given to getting right the electricity market design and sector rules, as electricity will in any scenario be the most important future clean-energy fuel. But rules for other fuels also require a rethink. For natural gas, the main question is how to manage the phase-down with as little disruption as possible (eg. no uncontrolled death spirals of decreasing use and higher per-unit infrastructure cost).

Meanwhile emerging fuels such as hydrogen, which has historically been treated as a chemical input product, will have to be re-considered as a fuel.

Finally, political decisions, particularly on country-level agreements with third countries for the future import of green fuels, act as commitment devices. Signing such agreements sends a message that a government believes in a particular green fuel and is prepared over the coming years to back it through the different stages of production (or import), transport and consumption.

For example, Germany has signed a number of bilateral deals to import green fuels[20]. The volume of agreements suggests that Germany intends to emphasise imports in its future fuel mix. Choices will have to be made on the extent of the value chain exported.

Importing green hydrogen implies off-shoring the stages of electricity generation and electrolysis, while importing green ammonia or synthetic hydrocarbons implies off-shoring another stage of the value chain. Fuels that are the subject of political agreements are therefore revealing of the political perspective on the future domestic energy infrastructure.

4 Enhancing the transition toolbox

As Europe decarbonises, lessons must be learned to provide guidance to the later stages of European decarbonisation and also to third-countries that want to follow Europe's path.

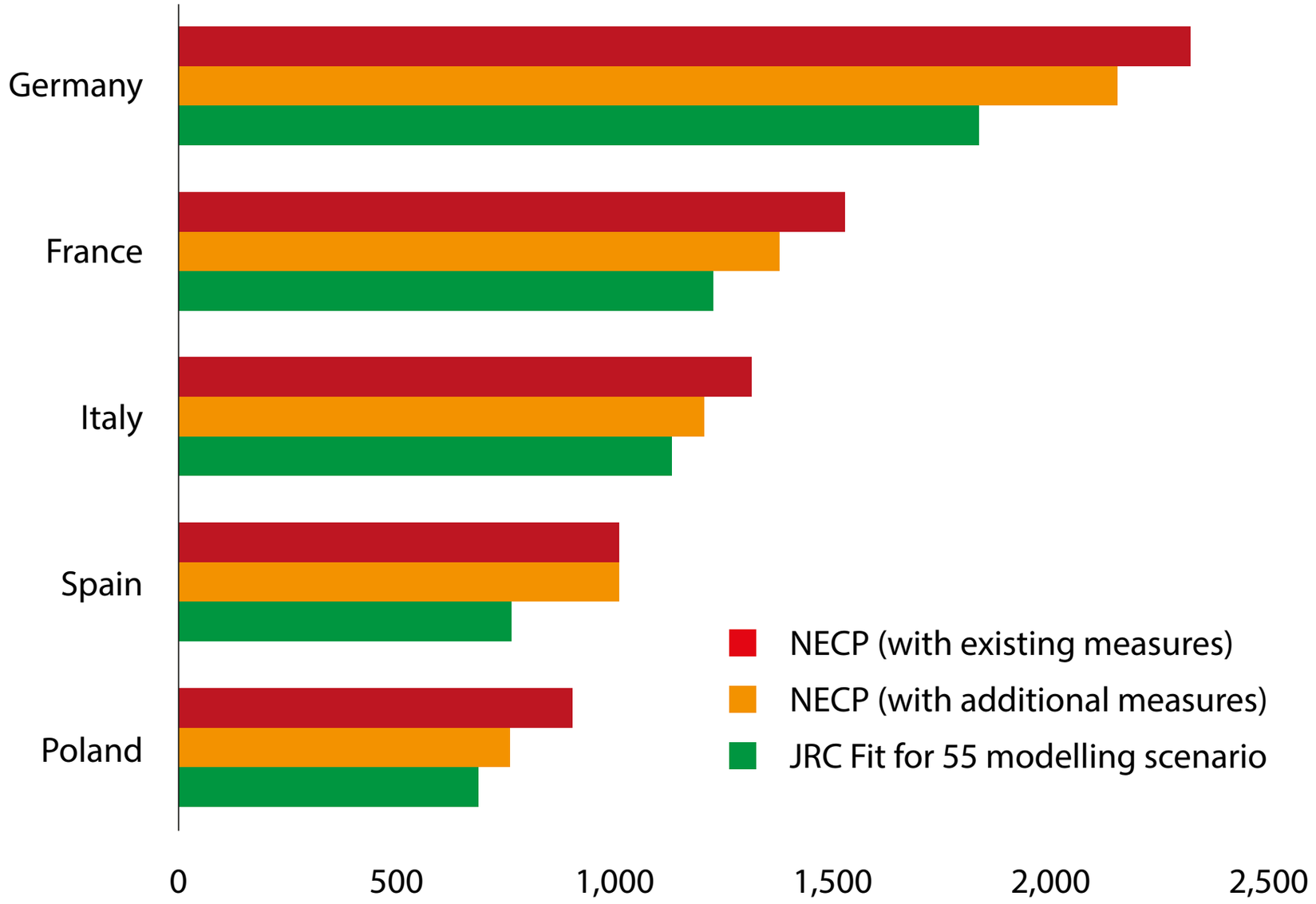
As a bloc of 27 countries with different geographies, economies and politics, there is likely to be significant divergence in the pathways EU countries follow to reach net zero. While coherence and collaboration in certain areas are important for efficient investments, in certain areas a diversity of approach should be celebrated.

The pursuing of different policies, and ultimately fuel mixes, by EU countries will provide important data on the pros and cons of respective pathways.

However, country-level plans must conform to minimum levels of ambition. So far, EU countries' national energy and climate plans (NECPs) are insufficient as net zero pathways. For example, Figure 9 shows that NECPs consistently miss required energy efficiency gains.

Member states that will fall short in terms of energy efficiency gains must demonstrate that they are able to make up for this shortcoming with alternative policy, eg. more rapid deployment of renewable capacity.

Figure 9. Final energy consumption projections in 2030 (TWh), selected countries



Source: Zachmann et al (2021).

Finally, efforts should be made at EU and member-state level to improve the collection and transparent communication of relevant data. Currently, NECPs are difficult to compare and not structured coherently.

The European Union should consider creating a European Energy Agency (similar to the United States Energy Information Administration), which would be responsible for detailed analyses of NECPs and all other aspects of the EU's low-carbon energy transition.

The policies implemented over the coming years will fundamentally reshape the lives of every European citizen. A transparent reference point for the often very technical issues will be essential to ensure high quality political discussions. ■

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Endnotes

1. See Eurostat, 'Greenhouse gas emissions by source sector' dataset, 'energy' value. Note this includes fuel combustion for power generation, transport and industrial applications. Measured in CO_2 equivalent.

2. For simplicity's sake, by 'fuel', we mean the three energy vectors of electricity, hydrogen and synthetic methane.

3. Full details can be found in Zachmann et al (2021).

4. The JRC (2018) estimated a "realistic biogas potential" of 18 billion cubic metres in Europe, corresponding to about 5 percent of current natural gas consumption; see Scarlat et al (2018).

5. Schiebahn et al (2015) explored the costs of synthetic methane production.

6. The efficiency of the process, from renewable electricity, via hydrogen and methanation, into the energy contained in methane is about 64 percent (Schaaf et al 2014).

7. See https://ukcop26.org/cop26-presidency-outcomes-the-climate-pact/

8. To be precise, the term 'defossilisation' should be used instead of decarbonisation when describing a system with synthetic methane. Indeed, methane is a carbon-containing energy carrier. CO_2 is emitted from its combustion and CH_4 is a greenhouse gas itself, which might leak during transportation.

9. The IEA highlights this challenge when contrasting the required reductions in oil and gas investments in a net zero scenario with the required increases in clean energy and infrastructure. While the world appears on track for the former, it is markedly missing the latter (IEA, 2021).

10. While current European government subsidies are in response to high gas prices, they indicate the measures governments are willing to take in the case of high energy prices (Sgaravatti et al 2021).

11. In the EU, emissions of carbon dioxide, hydrofluorocarbons and nitrous oxide from large point-emission sources are capped and priced under the EU emissions trading system. Methane, another potent greenhouse gas emitted from coal mines and oil and gas infrastructure, needs to be limited too; see European Commission (2020b).

12. Half of the hard coal used serves as an input to industrial processes, which will be difficult to abate; however, technological alternatives are being developed.

13. This equilibrium is complex and non-linear and affected by many exogenous factors including electricity demand development, global energy market developments and public decisions to support/close other electricity generation assets, such as nuclear and renewables.
14. The 2021-2025 German coalition agreement states that the coalition wants to "accelerate" the phase-out and complete it "ideally already by 2030" (Koalitionsvertrag 2021–2025).
15. The share of electric cars in new registrations already reached 10 percent for the EU, Iceland, Norway, and the UK in 2020, and is increasing quickly, see European Environment Agency, 'New registrations of electric vehicles in Europe', 18 November 2021. The share is also above 10 percent for the global market; see Nathanial Bullard, 'Electric Vehicles Are Going to Dent Oil Demand—Eventually', Bloomberg Green, 9 December 2021.
16. For example, Flis and Deutsch (2021) explored clearly the financial benefits of heat pumps at household level.
17. Madeddu et al (2020) found that 78 percent of existing industry energy demand is electrifiable with existing technologies, while 99 percent of the demand is electrifiable with the addition of technologies currently under development.
18. The Lazard Levelized Cost of Energy Report shows significant cost-advantages for new-build solar and wind (Lazard, 2021).
19. For example, strengthening the ETS price, roll-out of second ETS/national-level carbon pricing, combustion- engine vehicle bans.
20. The European Commission in December 2021 approved Germany's H2Global plan, which mobilises €900 million for investment in green hydrogen production in non-EU countries with the intention of importing into the EU.
See https://ec.europa.eu/commission/presscorner/detail/en/ip_21_7022

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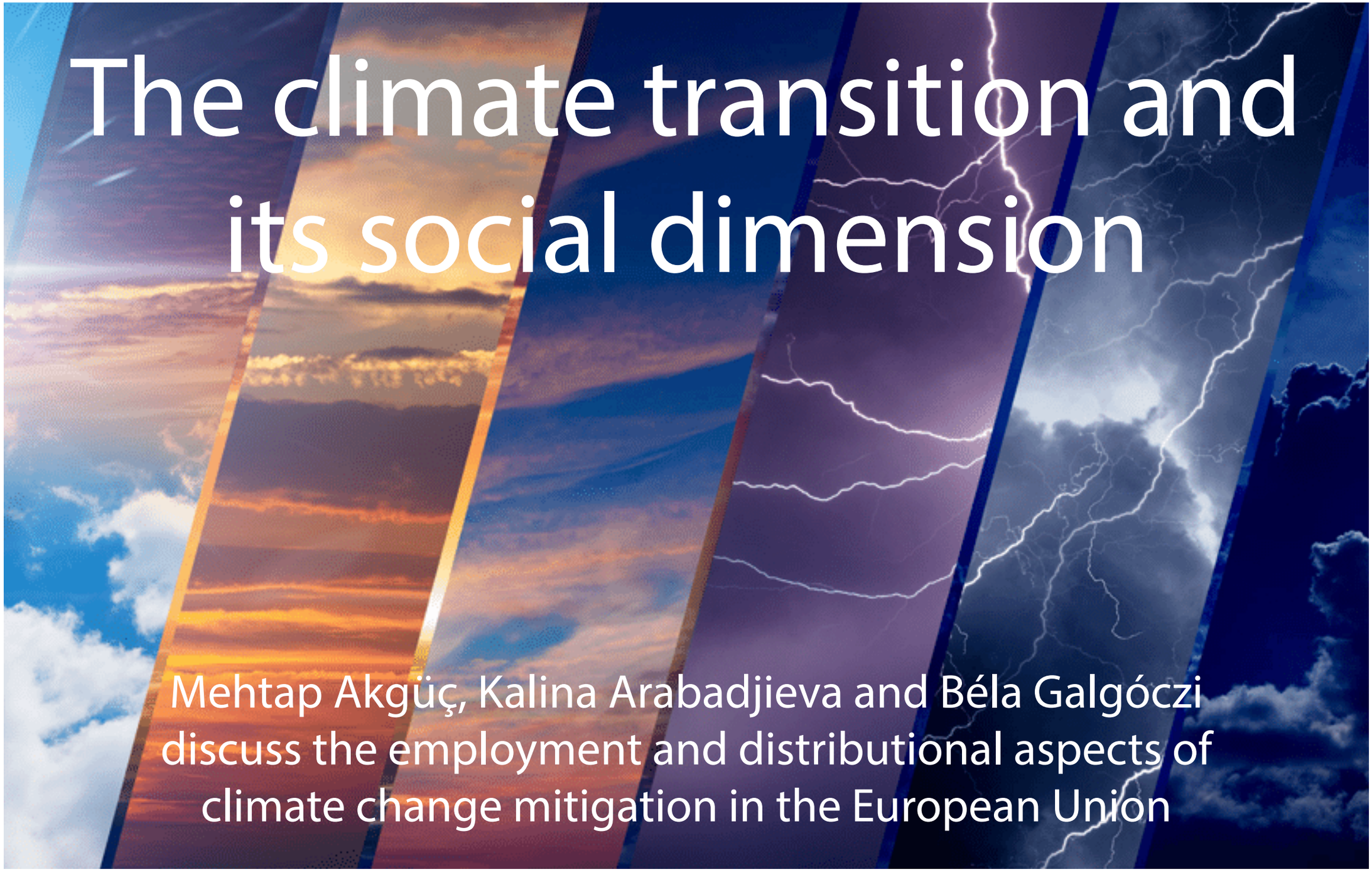

The climate transition and its social dimension

Mehtap Akgüç, Kalina Arabadjieva and Béla Galgóczi discuss the employment and distributional aspects of climate change mitigation in the European Union

The proposal by the European Commission for a Council Recommendation on the social and labour aspects of the climate transition, presented last December, is another welcome sign that employment and distributional aspects of climate change mitigation have been recognized at the highest policy level.

As well as the inclusion of the notion of just transition into the preamble of the 2015 Paris Agreement, and then in the Glasgow Climate Pact, this can be seen as a modest but important achievement of a several decades-long campaign for a just transition by the labour movement.

The announcement of the European Green Deal (EGD)[1] in 2019 had already included pledges to 'leave no-one behind.' The Just Transition Mechanism[2] and the proposed Social Climate Fund[3] are some of the main EU measures announced to date intended to mitigate the impact of the transition on the most affected regions, vulnerable individuals and businesses.

The expected Council recommendation, which is not legally binding, would provide guidance to member states on how to ensure that the green transition takes place in a just and fair way. This is a huge challenge that spans across many questions, such as the distributional effects of decarbonization policies, jobs losses and employment transitions, the protection of basic social rights and inclusion of citizens in decision-making, to name but a few.

By no means should this instrument be seen as a substitute for strengthening the social dimension of EU legislative and policy measures on climate change. Nor should it give reason to lower climate ambitions – a 'just transition' does not mean 'slow transition.'

A just transition for the EU can only be 'just' in a true sense if it goes with maximum climate ambition, particularly given Europe's historical debt to low carbon footprint developing countries. With this in mind, we outline some

of the key labour and social effects of the EU's Fit for 55 climate package[4] on the EU population and potential responses that the recommendation should consider.

Employment effects

Climate policies are having and will continue to have a major effect on the world of work. Millions of new jobs are being created in the transition to a net zero carbon economy, but a large number of jobs will also disappear. The majority of jobs will go through a fundamental transformation.

A just transition means that addressing both the employment and distributional effects of a transition to net zero should be an integral part of the package and not supplementary corrective measures

This unprecedented wave of restructuring will have unequal effects on many fronts, including skills, gender, age, economic activity and region. Sectoral differences are particularly high.

The energy and automotive sectors will be the ones most affected by the decarbonisation drive from climate and environmental regulations at European and national levels. While coal has no future and coal-dependent jobs will be gone, the automobile does have one, albeit in quite a different form from the one we know.

In the coal-based power sector the majority of currently existing jobs will disappear in a decade and the regional effects will be harsh[5], as over 90% of coal jobs are concentrated in ten NUTS 2 regions, four of them in Poland.

With a more than 5% share of total European employment, the automotive sector is a key employer. For the car industry, the demise of the combustion engine and the electrification of the powertrain will require the development of new competences, skills and forms of work organisation. These will have a substantial impact on the comparative advantages held by certain nations and manufacturers[6].

The renewable energy sector, construction and low-carbon infrastructure are expected to deliver most of the job creation[7]. However, transitional policies should consider the local dimensions of the transition - the places where jobs are lost and created are not necessarily the same and relocating labour is not straightforward.

Jobs and skills

Climate change policy will have a major impact on jobs, their skill contents and how they are performed.
The transition will come along with increasing demand for skills in the renewable and cleaner energy sector, energy and resource efficiency, digital competences, STEM knowledge to trigger innovation and breakthrough technology, greener construction methods, city planning and design, technical competences in adaptation, waste

management, maintenance and repair technologies to reduce resource exigency as well as boost circular economy practices, to name a few[8].

To match the rising demand in specific skills and competences for the green transition, training programs and education curricula need to be adapted to the needs of the labour market. Public sector and businesses could cooperate to adapt the training and education programs.

Training, reskilling and upskilling should be made available to the wider workforce and in a flexible format to the extent possible (eg. online or flexible hours) to ensure that nobody is left behind and attract new talents to green jobs, avoiding skill gaps.

Working time and work conditions will also be impacted by climate change and environmental degradation. For example, extreme and frequent heatwaves will necessitate reorganization of working time in key sectors or equipment of air conditioners will be needed to provide appropriate health and care services in regions experiencing adverse climate effects[9].

Distributional effects

Effective climate policies can only be based on a comprehensive policy framework that include regulation, standards, taxes and market mechanisms in a balanced manner. While market mechanisms – such as the EU's Emissions Trading Scheme[10] - that set price signals to market actors are one important element of this in changing investment and behavioural patterns, they can only have the desired effects in well-functioning markets, but current energy markets are far from that.

Moreover, the signals themselves have significant regressive distributional effects, disproportionally affecting low-income households, for whom fuel and transport consumption make up a higher share of their income[11].

Poorer households also have less capacity to change, as while low-carbon products (electric vehicles, rooftop solar panels, and so on) may have low operating costs, they tend to have high, upfront capital costs – presenting a hurdle for households with little access to cheap capital.

Certain vulnerable groups are likely to be affected more than others during the transition. For example, climate change induces gendered effects as men are disproportionately employed in polluting sectors.

This can imply mitigating effects for women: while it can result in overall poverty for the household as men lose jobs, it might also encourage women to enter into the labour force for paid employment – yet with concerns about job quality – to support household income.

However, there is also wide evidence pointing to disproportionate vulnerabilities – such as having fewer resources at disposal, reduced access to education as well as being frequently excluded from information and decision-making processes – faced by women during green transition[12]. Just transition must mean also empowering women and addressing these structural inequalities.

Another group experiencing vulnerabilities is migrants. For one, most of the foreign-born workers are employed in relatively low-paying and polluting sectors and have no or only limited access to training to upskill towards transition to low-carbon economy[13].

The other aspect relates to the future – both internal and international – migratory movements towards Europe as a result of climate emergency. Both of these aspects point to the importance of targeted social and labour market policies to manage flows, ensure successful socioeconomic integration and just transition for everyone including migrants. This would contribute to global climate justice as the ones most adversely impacted by climate change are not the main contributors to it.

Fundamental rights

The environmental, social and economic effects of climate change and related mitigation policies threaten the enjoyment of fundamental human rights[14]. These include basic social and economic rights, widely recognised in international and European human rights instruments and national constitutions[15]. They constitute entitlements to basic conditions for a decent human life, without which it is impossible to speak of a 'just' transition.

Both the distributional and employment consequences of climate change policies could affect various basic rights such as the right to work, the right to just working conditions, the rights to an adequate standard of living and to protection from poverty and social exclusion.

As the burdens of the transition fall disproportionately on those who are already most vulnerable, disparate impacts of policies along the axes of gender, ethnicity, migrant status, disability or other protected status could impinge on the right to equality and non-discrimination.

Threats to fundamental rights in global supply chains arise in the context of delivering the resources and technology necessary for decarbonisation[16].

At the same time, fundamental rights can provide a normative framework for the basic elements – *necessary but not sufficient* – of just transition policy. Aside from the rights mentioned above, ensuring respect for rights to vocational training, fair remuneration, social security, equal opportunities, and collective bargaining – and others – could constitute the foundations of a strategy to address the impacts of the green transition on workers and citizens more broadly.

Discussion of fundamental rights is, however, largely absent from the European Green Deal and Fit for 55 package. Reference is made to the European Pillar of Social Rights[17], a list of 20 principles without binding legal effect. There is no mention of the EU's own Charter of Fundamental Rights[18], nor other international legal norms.

The Recommendation could be an opportunity to strengthen the link between the just transition agenda and long-standing frameworks for the protection of fundamental labour and social rights, such as the European Social Charter or the core Conventions of the International Labour Organization.

Citizen participation

Climate protest movements such as Fridays for Future, as well as the tens of thousands of people who took to the streets during COP26 make clear that citizens want to have their voices heard when it comes to climate change.

A key challenge for a procedurally fair green transition is to ensure that the public, and especially the most affected communities and citizens, have an opportunity to participate in decision-making.

Participation is a means to empowering and fostering cooperation with affected communities and contributing to better outcomes and increased democratic legitimacy. In the labour context, this means meaningful participation by workers and social dialogue.

Climate citizen assemblies, convened in France, the UK and some other European countries over the last years are gaining popularity as a forum for public debate on climate change. The on-going Conference on the Future of Europe includes a panel on climate change, too.

But simply providing a forum is not enough – decision-makers also have to listen. Transparency, information and capacity-building are crucial to meaningful involvement, as are active steps to include marginalised groups and to ensure diversity across factors such as gender, ethnicity, age, socio-economic status or geographic location.

The way forward

Getting climate change under control is in the interest of humanity, the unprecedented restructuring process economies need to go through in a few decades to reach net zero emissions is policy-driven. These policies will have differential effects on people with different socio-economic characteristics, and policymakers have a dedicated responsibility to address these.

A just transition means that addressing both the employment and distributional effects of a transition to net zero should be an integral part of the package and not supplementary corrective measures.

The EGD has recognised this, but in practice social and employment policy initiatives have remained fragmented and additional. This shortcoming has become very clear with the announcement of the Fit for 55 package in July 2021.

Europe now has a Just Transition Fund with limited resources, dedicated mostly to helping coal regions manage the social and employment effects of coal phase-out. This is very important but reaches a small fraction of people affected by decarbonisation.

The newly announced Social Climate Fund has a very specific target, namely to fend off the detrimental distributional effects of a new emissions trading system for buildings and transport, but even for that it may not be enough[19]. Sectors that are highly affected, the automotive sector and energy intensive industries do not have dedicated instruments and a fund.

European-level labour market and social policy initiatives should provide guidance to member states to manage change, and the proposed Council Recommendation is one way of doing so. In this context, 'leaving no-one behind' should be more than a slogan and translate into concrete measures.

Contrary to the declarations, just transition policies are not yet an integral part of the European Green Deal agenda and of the more concrete Fit for 55 policy package. A comprehensive just transition policy framework should include the following elements:

1. Support for workers in the transition to new jobs with measures targeted to specific sectors (automobile, energy intensive industries, etc.) tailored to national and regional specifics.

2. Deal with the distributional effects of climate policies with targeted measures against energy and transport poverty, supporting and facilitating the affordability and accessibility of low carbon technologies to lower income households (retrofitting of buildings, access to renewable energy, vehicle fleet change, developing public transport).

3. Regional development initiatives to help carbon intensive regions towards a sustainable low-carbon economy.

4. Promote social dialogue and stakeholder involvement at all levels (EU, national, regional and plant level) in managing change towards a zero-carbon economy, including meaningful involvement by citizens.

5. Make sure that newly created green jobs are also good jobs in terms of contract type, social security, wages and working conditions in line with the ILO decent work agenda.

Today a large part of the workforce is in fear of change, a concern that is justified in a labour market environment characterised by increasing precariousness. As long as 'change' remains fearful, the biggest transformation since the industrial revolution ahead of us cannot succeed.

Inclusive and comprehensive social and economic policies are therefore essential to securing social justice, resilience and sustainability. ■

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Climate finance and development

Climate finance is treated as a form of aid support. Saliem Fakir argues that a shift is needed to investment support that would economically transform Africa

Climate finance is largely viewed as a form of finance that is locked in narrow negotiations at the UNFCC Paris process and climate talks revolving around the $100 billion/annum target. This target is still to be met but it is also clear it will be a trickle compared to the needs for energy transitions and global resilience investments that need to be put in place.

Also, it has largely been treated as a form of aid support, particularly for adaptation work in Africa, rather investment support needed for economic transformation on the continent.

Climate finance needs to be linked to the development pathways that Africa needs for the next two decades; particularly around sustaining reasonable and balanced economic growth – meeting the need for increasing national income and income for households.

Such economic growth should unlock potential in other low carbon economic sectors such as in renewables, electric vehicles and batteries amongst other things. In the long run this should reduce dependency on the export of raw commodities and helps to diversify African economies through a structured process of industrialization and for that matter exports of high value agricultural products and services. It ought to also reduce imports of fossil fuels.

The work of the African Climate Foundation as a philanthropic foundation is to identify a pipeline of initiatives, which we refer to as country platforms to support energy and resilience transitions.

One example of this is the Just Energy Transition Transaction (JETT) for South Africa that has secured a pledge for $8.5 billion worth of climate finance from bilateral and multilateral sources of funding (largely public funding).

The $8.5 billion package is currently being negotiated between the South African government and international partners who have committed to ensuring that this deal will support various infrastructure financing needs for South Africa's energy transition.

The deal is meant to provide blended finance options and facilities that catalyses on a much larger scale South Africa's transition to clean energy and a managed phase out of coal.

South Africa needs much more than $8.5 billion for the transition but the idea would be that additional domestic public and private finance would be mobilized on the back of international climate finance.

Climate finance needs to be linked to the development pathways that Africa needs for the next two decades; particularly around sustaining reasonable and balanced economic growth

The deal is meant to steer support for scaling in three areas:

- Scaling of renewables, linked to the repurposing of coal plants and doubling the current provisions within the Integrated Resource Plan (IRP).

- Supporting the scaling of electric vehicles in South Africa

- Building a stronger green hydrogen economy, which South Africa has potential to exploit.

This deal that South Africa and its partners announced in Glasgow is a unique type of climate finance package, which is tied to South Africa's nationally determined contributions.

It is a way in which advanced economies, in accordance with Article 9 of the Paris agreement, have the historical responsibility to assist developing countries in their transitions.

The deal is aimed at reducing the country's dependency on coal and de-risk South Africa's economy from the problem of having coal stranded assets that could pose systemic risk to financial sector, but also the electricity utility Eskom and the South African economy.

Crucial matters that need still be resolved is unpacking what the pipeline of projects look like – how much of public finance is needed and the cost of that public finance.

It is also recognised that the $8.5 billion is insufficient where $30 – $35 billion is needed and a large part of that will have to be financed from other sources.

More importantly, the financing package needs to reduce debt, not increase it, and it must also support the 'just' dimensions of the transition.

The JETT sets a framework of how to use climate finance across the African continent. There is a growing interest beyond South Africa to do a South African-type deal. This is also the case for other emerging economies like Indonesia, Vietnam and the Philippines where there is dependency oil, gas and coal to generate electricity.

This model of country platforms, like the one for South Africa, is a recipe that sets a useful framework for designing catalytic financing initiatives in other parts of the world.

It is an interesting model to turn climate finance as an instrument for strengthening investments in energy transitions on the continent and crowding in other sources of finance. ■

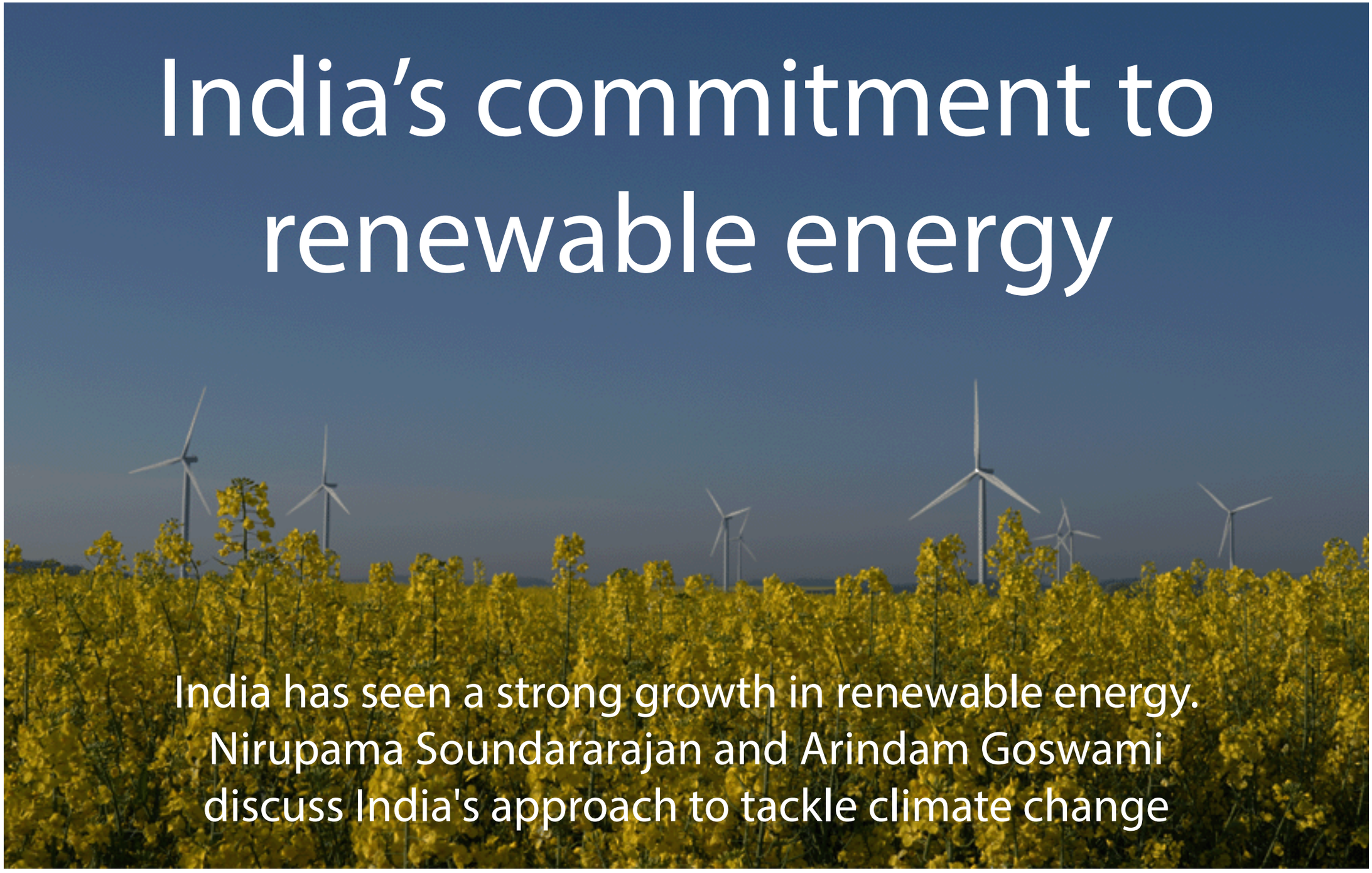
Saliem Fakir is Executive Director of the African Climate Foundation

ABOUT THE ACF

The African Climate Foundation is a new philanthropic re-granter on the African continent. Its primary aim is to support the achievement of climate and development nexus outcomes.

The key is to understand climate risks as well as opportunities and use philanthropic support to drive new investment pathways that climate-proof African economies and increase investments in new infrastructure as well as protection of climate vulnerable sectors important for jobs and exports.

India's commitment to renewable energy



India has seen a strong growth in renewable energy. Nirupama Soundararajan and Arindam Goswami discuss India's approach to tackle climate change

India has been committed towards alternative energy sources since early 2000. In 2002, renewable energy constituted a mere 3.2 per cent of total energy generation in India. However, by 2016 India's focus on renewables paid off and the share of renewables to total energy increased to 42.6 GW from a mere 3.4 GW[1].

The strong growth in share of renewable energy (RE) is testament to India's continued commitment to the cause. India set an ambitious target of reaching 175 GW of renewable energy generation by 2022 in the 2015 Paris climate summit. Towards this end, India has introduced various policy measures.

India has initiated a two-pronged approach to tackle climate change issues. First is the National Action Plan on Climate Change (NAPCC) adopted on June 30, 2008, comprising of eight National Missions focussing on domestic issues and encompasses action plans in relation to different sectors interrelated to energy, industry, agriculture, water, forests, urban spaces, and the environment which are in line with the UN's Sustainable Development Goals (SDGs).

The National Missions are on Solar Energy, Enhancing Energy Efficiency, creating a Sustainable Urban Habitat, Conserving Water, Sustaining the fragile Himalayan Eco-system, creating a Green India through expanded forests, making Agriculture Sustainable and creating a Strategic Knowledge Platform for serving all the National Missions[2].

The second is India's Intended Nationally Determined Commitments (INDC) submitted to the UNFCCC on October 2 2015, which centres around sustainable lifestyle, cleaner economic development, reducing emission intensity of gross domestic product (GDP), increasing the share of non-fossil fuel-based electricity, enhancing carbon sink (forests), mobilising finance, and technology transfer and capacity building[3].

As per India's Ministry of New and Renewable Energy's 2020-21 Annual Report[4], as of January 2021, India's installed RE capacity was at 92.54 GW, 24.53 per cent of total installed energy capacity. While India may miss her target for 2022 by an acceptable margin, her commitment towards RE remains ambitious and unshaken.

Indian Prime Minister Narendra Modi's five core commitments, dubbed as the *Panchamrit,* or five nectar elements to deal with the global climate change crisis, at the recently concluded 26th session of the Conference of the Parties (COP26) of the United Nations Climate Change Conference (UNFCC) garnered tremendous appreciation from the UNFCC members and from global media alike.

... one of the focus areas for the Government of India is to meet its COP26 objectives by reducing its dependence on fossil fuel, that is predominantly imported, and increase the uptake of non-carbon emitting fuel

The five core commitments as promised by PM Modi include taking India's non-fossil energy capacity to 500 GW by 2030, meeting 50 per cent of India's energy requirements from renewable energy by 2030, reduction of the total projected carbon emissions by one billion tonnes from 2020 until 2030 by India, reduction of the carbon intensity of the Indian economy by less than 45 per cent, and become a net zero carbon emitting economy by 2070[5].

As part of India's focus on RE, there has been an explicit thrust on electric vehicles (EVs), given the increase in vehicular numbers and congestion. India has a target of reaching 30 per cent share of EV by 2030[6].

While this is in line with India's declared agenda for 2030 in COP26, this alone will not help. While EV will go a long way in reducing carbon emissions from vehicles, the incremental electricity load that will be required to run these vehicles would still predominantly be met through burning of fossil fuels.

A case study for New Delhi indicates that the incremental consumption of electricity could range between 755.4 MU to 1,762.6 MU assuming all households in Delhi own some form EV. Delhi's monthly electricity generation as of 2019 was only 523.3 MU[7].

The incremental electricity required for 30 per cent share of EV pan India is predictably immense, and since India is yet to put in place a suitable action plan to meet this electricity through renewables, it is imperative that alternative fuel sources are also considered to meet India's 2030 targets.

We know that one of the focus areas for the Government of India is to meet its COP26 objectives by reducing its dependence on fossil fuel, that is predominantly imported, and increase the uptake of non-carbon emitting fuel. Hence the increasing focus on biofuels (Table 1).

Table 1. India's energy consumption mix

	Coal	Natural gas	Nuclear	Hydro	Wind, solar etc.	Biofuels and waste	Oil
2000	6,109,527	965,850	184,391	268,062	7,547	5,266,901	4,688,625
2010	11,682,321	2,277,696	286,543	449,717	83,449	6,349,398	6,785,545
2019	17,494,965	2,323,196	506,972	620,637	48,0115	7,998,012	9,859,175

Note: All units in Terajoule.
Source: https://www.iea.org/

The National Policy on Biofuels (NPB) 2018 iterates India's commitment to reducing fossil fuel use by concurrently increasing biofuel production and use. At present the Government of India has mandated the sale of ethanol blended petrol across the country except in the Union Territories of Andaman and Nicobar Islands and Lakshadweep.

The Government of India formally initiated the ethanol blending petrol (EBP) programme way back in 2003 when it considered supplying of 5 per cent ethanol blended petrol in nine states and four union territories (UT) in the country.

By 2008, blending of 5 percent ethanol with petrol was mandated in twenty states and four UTs with the further option of increasing the blend up to 10 percent of ethanol. The formulation of the National Policy on Biofuels in 2009 allowed ethanol to be procured from non-food feed stock like molasses, celluloses and lignocelluloses material including petrochemical route.

In 2013, oil manufacturing companies (OMCs) were directed to sell ethanol blended petrol with percentage of ethanol up to 10 per cent as per the Bureau of Indian Standard's (BIS) specifications to achieve 5 per cent ethanol blending across India.

The same year a decision was taken by the Cabinet Committee on Economic Affairs (CCEA) to procure ethanol only domestically and only from molasses and disallowed the usage of sugarcane and sugarcane juice as raw material. This had a negative impact on the supplies of ethanol.

Since 2014, the Government initiated reforms to boost indigenous production of ethanol. Some of these reforms over the years include reintroduction of administered price mechanism, opening of alternate route for ethanol production, amendment to Industries (Development & Regulation) Act, 1951 which legislates exclusive control of denatured ethanol by the central government, and reduction in Goods & Service Tax (GST) on ethanol meant for EBP Programme from 18 per cent to 5 per cent.

Notification of National Policy on Biofuels in 2018, which aims at mainstreaming of biofuel generated from non-food feedstock through next generation technology, explains the pledge towards climate change mitigation while enhancing energy security. The National Policy on Biofuels in 2018 aims to reach 20 per cent ethanol blending in petrol by 2030[8], which has subsequently been advanced to 2025.

Table 2. Annual world fuel ethanol production (million gallons)

Region	2016	2017	2018	2019	2020	2021	% of World production
United States	15,413	15,936	16,091	15,778	13,941	15,000	55%
Brazil	6,870	6,760	8,080	8,790	8,080	7,500	27%
European Union	1,240	1,320	1,360	1,380	1,260	1,300	5%
China	730	850	810	1,010	930	860	3%
India	270	210	420	470	510	820	3%
Canada	450	460	460	500	430	440	2%
Thailand	330	380	390	430	390	390	1%
Argentina	240	290	290	290	210	260	1%
Rest of World	627	664	729	682	659	740	3%
Total	**26,170**	**26,870**	**28,630**	**29,330**	**26,410**	**27,310**	

Source: https://ethanolrfa.org/markets-and-statistics/annual-ethanol-production

Recently, an expert committee formed under the NITI Aayog submitted its report titled *Roadmap for Ethanol Blending in India 2020-25* in July 2021 appraising the work undertaken by the Government in regard to the EBP. The Committee highlighted few of the steps which have worked for furthering EBP in India such as:

- Approval of the interest subvention for augmenting and enhancing ethanol production capacity by the Union Cabinet in December 2020

- Setting of standards for E5 (Ethanol 5 per cent, Petrol 95 per cent), E10 and E20 blends of EBP by the BIS

- Notification for adoption of E20 fuel as automotive fuel and issuance of mass emission standards for it by Ministry of Road Transport & Highways (MoRT&H) on 8th March 2021

- Notification for safety standards for ethanol blended fuels on the basis of Automotive Industry Standard (AIS 171) laying down safety requirements for type approval of pure ethanol, flex-fuel and ethanol-gasoline blended vehicles in India by MoRT&H on 25th May 2021

- Approval for BS-VI Emission norms for E20 Vehicles since 1st April 2020

The Committee pointed out that as a result of such efforts, the ethanol blending rose from 1.53 per cent during Ethanol Supply Year (ESY) 2013-14 to 7.93 per cent in ESY 2020-21. The Committee has further estimated that based on the expected growth in vehicle population of India, the ethanol demand till 2025 for achieving the goal of E20 will be 1,016 crore litres (10.16 billion litres) and has provided its recommendations based on the same.

To increase the ethanol production capacity, the Committee has recommended that the production of ethanol in India be raised to 760 crore litres (7.6 billion litres) from the existing 426 crore litres (4.26 litres) generated through molasses and 740 crore litres (7.4 billion litres) from the existing 258 crore litres (2.58 billion litres) generated through grain-based distilleries.

This, the Committee predicted will require 60 lakh MT of sugar and 165 lakh MT of grains per annum in ESY 2025. The Committee called for use of technology for production of 'advanced biofuels' from non-food feedstock.

On ethanol blending, the Committee recommends that pan-India availability of E10 fuel by April 2022 should be notified at the earliest and launch of E20 by April 2023, while additionally notifying all public and private sector OMCs to mandatorily join the programme.

The Committee also suggests formulation of specifications for intermediate blends such as E12 and E15. Literacy programme for consumers has also been suggested. Dispensing mechanism for various blends such as E10, E20 and E100 for two wheelers at retail outlets with lesser space requirements and logistical options for supplying ethanol all over the country have been suggested to augment infrastructure of OMCs.

Measures to expedite environmental clearances for producing ethanol, setting up a single window clearance for new projects for ethanol productions, and allowing unrestricted movement of denatured ethanol have been suggested to push the regulatory clearances for ethanol producing units.

Production of higher ethanol compatible vehicles, incentives for ethanol blended petrol vehicles, pricing policies of ethanol blended gasoline, and ways to encourage use of water saving crops to produce ethanol have been some of the other recommendations.

However, it is important to put things into perspective in terms of production and in terms of impact. First, we know that 10 million litres of blended fuel is supposed to reduce 20,000 tonnes of carbon emission[9].

As per India's COP26 targets, India plans to reduce carbon emissions by one gigatonne or 1 billion tonnes[10]. A basic calculation therefore suggests that if India manages to meet the ethanol demand target of 10.16 billion litres by 2025, this would result in a reduction of 0.10 billion tonnes of carbon emissions, which can barely be considered even as dent even these figures were to be extrapolated for 2030.

Clearly India needs to step up the targets of EBP. Hence purely from an impact point of view, the current EBP targets are a far cry from India's larger 2030 objective of reducing carbon emissions.

Second, it is apparent from Table 3 that the quantity supplied has almost always been less than the quantity tendered/contracted, and the quantity allocated. While phenomena like droughts, and issues like storage capacity can be listed as causes for some part of the difference in quantities, they do not explain the large discrepancy and inconsistency in supply figures.

Inconsistency in supply of ethanol will lead to uncertainty with regard to meeting blending targets, whether in 2022 or 2030. Part of the problem may also be that the primary feedstock for ethanol in India currently are molasses and the move to explore other sources of feedstock have been once recent. This has also been a common criticism of the ethanol blending programme[11].

Alternative feedstocks for ethanol would be those from second generation (2G) pathways, such as biomass and agricultural waste with high cellulosic and lignocellulosic content that can be converted to ethanol using 2G technologies.

Table 3. Ethanol supply, procurement, and blending (figures in billion litres)

Year	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Tendered	1.03	1.15	1.28	2.66	2.80	3.13
Quantity allocated	0.32	0.704	0.865	1.305	0.807	1.6104
Quantity supplied	0.154	0.38	0.674	1.114	0.665	1.505
Blending % (OMCs)	0.67	1.53	2.33	3.51	2.07	4.22

Source: 'Note on Biofuels', Ministry of Petroleum and Natural Gas, 2019. http://petroleum.nic.in/sites/default/files/biofuels.pdf

These are precisely the feedstocks that the NPB seeks to tap into, as the NPB notes *"studies undertaken in India have indicated a surplus biomass availability to the tune of 120-160 MMT annually, which, if converted, has the potential to yield 3000 crore litres (30 billion litres) of ethanol annually*[12]*."* This is the path the government should opt for.

Third, in 2021 India's domestic ethanol production was 820 million gallons or 3.1 billion litres[13]. In the same year, India's total imports for ethanol was 750 million litres[14]. Around 25 per cent of domestic production, is being met through imports.

Ironically, India's largest import partner is China. This does not behove India. India clearly has the capability to use domestic feedstock to meet the demand for ethanol. It makes even less sense to import from China given India's own tumultuous relationship with the country.

India's ethanol programme is crucial to India's growth and self-reliance. The ongoing Ukraine-Russia standoff has already resulted in spiralling oil prices upwards. Even if India does consider procuring excess oil from Russia, it would come at the cost of jeopardising relations with other important trading partners including America and United Kingdom.

India has always had the intention of reducing her dependence on crude oil, first for economic reasons (as a way to control the current account deficit), then for environmental reasons, and now more than ever for geopolitical reasons. ■

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Trade and the most vulnerable

Ngozi Okonjo-Iweala outlines her views on how climate priorities can be addressed through trade actions which prioritise the specific challenges faced by least developed countries

Some of the biggest threats to our economies and our societies come from environmental degradation – from climate change to biodiversity loss and the natural hazards that result. The climate crisis demands a multi-faceted response. At the heart of this response is our need to reduce poverty and enhance living standards while strengthening environmental sustainability.

We must also drive positive environmental change into our recovery from the pandemic by building greener, more socially inclusive economies, and investing in the systems needed to identify and contain future disease outbreaks – such as early warning systems.

Recent crises have demonstrated that like in the 'butterfly effect' – small, imperceptible changes in part of the planet can have a profound impact on the lives and livelihoods of people everywhere on this planet.

In reflecting on the climate crisis and the global response to the pandemic, it is clear to me that trade is part of the solution to the challenges we face, far more than it is part of the problem.

There are, inevitably, some downsides associated with trade: moving goods from one place to other has generally involved carbon emissions. But let's not forget that trade also makes production more efficient, and this can reduce emissions.

Trade and open global markets have also helped lift over a billion people out of poverty in recent decades. But many poor people in rich countries, as well as poor countries, have not shared fully in the gains.

The answer to these problems does not lie in a rejection or reduction of trade. A new joint policy note produced by the WTO and the World Bank makes clear that trade will be critical in driving the post-pandemic recovery.

A better answer to the real problems we see lies in better trade – a fairer and more equitable globalisation, one that brings marginalized people and countries into the economic mainstream, while helping us decouple human well-being from environmental impact.

Developing countries, and Least Developed Countries in particular, often have insufficient capacity to manage the risks and adapt to the environmental fallouts they are already experiencing. International mitigation policies and other measures to combat climate change could, if not careful calibrated with the needs and capacities of developing countries in mind, also impair the trade competitiveness of some developing countries.

But I know that such policies are not incompatible with the growth and development needs of developing countries including Small Island Developing States and LDCs.

Effective carbon pricing is increasingly considered a key market mechanism to support low carbon just transition

In this regard, there are a number of ways in which trade can contribute to curbing climate change, while ensuring a just transition for those countries that did the least to contribute to the problem.

Climate change is already affecting trade and the economy: from changing rainfall patterns to extreme weather events leading to disruptions in supply chains. UNEP estimates annual adaptation costs in developing countries to reach $140-300 billion by 2030 and $280-500 billion by 2050. The increasing frequency of natural disasters also threatens to further weaken the ability of SIDS to trade competitively.

A WTO information brief on trade resilience in the face of natural disasters, published just before COP26 last year, confirms that natural disasters have a more severe long-term impact on small economies. This occurs as immediate impacts on such countries are disproportionally large and volatility of economic activities is higher.

Developing countries, and particularly LDCs, face the challenge to enhance the climate-resilience of their trade-related infrastructure, improve digital connectivity and strengthen their policy frameworks as part of their efforts to mitigate the impact of natural disasters and adapt to climate change.

In our publication with the Global Centre for Adaptation we highlighted that trade is a mechanism for adaptation and resilience in the face of crop failure and natural disasters. Affected countries can bring in food and supplies necessary for reconstruction while domestic production remains impaired, allowing the economy to recover more quickly.

One set of models published in Nature Climate Change estimates that climate change is on track to push 55 million people into undernourishment by 2050 because of localised impacts on food production.

It found that greater trade integration could cut that number by as much as 64%, or 35 million people. Meanwhile, reducing trade in agricultural products would substantially increase the number of people likely to go hungry in the decades ahead.

On the mitigation side, developing countries must seek to use trade in support of their climate transition goals and build a diversified low-carbon economy. International competition and the emergence of a globally integrated solar photovoltaic (PV) supply chain has helped make solar the cheapest source of electricity generation in many parts of the world.

Wind energy has benefited from similar trends. Trade and competition can play a similar role in lowering costs for future technologies such as advanced batteries and hydrogen electrolysers.

Climate-related trade policies must be framed with a just transition in mind, with transition times for developing countries to find carbon alternatives, but also the financing for them to leapfrog the dirty infrastructure stage and directly build sustainable alternatives.

There is an important link here with aid for trade: trade-related development assistance to build energy, transport, and telecommunications infrastructure totalled $25 billion in 2019. Going forward, aid for trade should seek to build climate-resilient infrastructure and foster climate-proof supply chains.

Climate finance is indeed essential for allowing transition to a low-carbon economy for developing countries. For the poorest and most vulnerable countries, LDCs and SIDS, finance for adaptation represents more than 40%, almost double the share for all developing countries.

We need to demand optimized responses to the needs of developing and least developed countries. That is why the failure to mobile the 100 billion dollars a year of climate finance promised to developing countries is demotivating.

The Aid for Trade Initiative has an important role to play by mobilizing funding for critical supply-side infrastructure necessary for green transformation in developing countries and supporting the private sector to adapt to climate change.

Between 2013 and 2018, over $65 billion of Aid for Trade was provided to projects with a climate objective, including renewable power generation, distribution, and energy conservation, as well as climate-friendly and climate-resilient infrastructure.

For instance, a project in Nigeria made possible through development assistance has installed solar lamps, solar panels and cook stoves that emit less carbon dioxide to the benefit of residents and small enterprises in remote communities.

However, aid for trade needs to be better targeted to address development concerns in line with LDCs' nationally determined contributions. As I said earlier, the climate finance target as laid out in the COP16 accord has so far fallen short of the commitment to mobilize $100 billion per year by 2020.

This commitment was reaffirmed last November at COP26. We must also encourage the private sector to participate in the investments necessary to address the climate crisis. For example, in 2019 private climate finance alone mobilised $14 billion, representing close to 18% of total climate finance.

We therefore need to work together to explore the opportunities through aid for trade and other innovative financing mechanisms to address climate change issues in LDCs and explore opportunities for mutual leveraging of resources.

Beyond aid for trade, new international frameworks are necessary to ensure that countries at all levels of development take progressive steps towards enhanced environmental sustainability through trade. Therefore, support is needed for LDCs to assist them in participating in some on the ongoing discussions taking place at the intersection of trade and the environment.

For example, WTO members are currently discussing several issues, such as the facilitation of trade in environmental goods and services, the transition to a circular economy, plastics pollution, sustainable supply chains, and environmentally harmful subsidies, including those related to fossil fuels.

However, given the limited participation of LDCs, technical support must be made available to support the participation of LDCs in these discussions.

Indeed, lowering trade barriers to environmental goods and services would reduce the cost of renewable energy and lower the capital costs of building climate-resilient infrastructure. It will also result in economic diversification and job creation, particularly in services.

Services jobs related to renewables are often supplied locally and carried out by women. A growing number of jobs, especially in Africa, are being created in off-grid decentralized renewables, which also boosts employment in other sectors such as agro-processing, health care, communications, and local commerce.

WTO has a lot to contribute to this respect. Environmental goods and services are a focus of the Trade and Environmental Sustainability Structured Discussions (TESSD), an initiative that brings together 71 WTO members, amongst which many developing countries. Participants have defined a road map for work in 2022, and set up exchanges with business, civil society, and academic experts.

The Informal Dialogue on Plastics Pollution and Environmentally Sustainable Plastics Trade (IDP) is another initiative seeking to foster coordinated action to address the environmental, health and economic costs of plastics pollution.

The Informal Dialogue has gathered the support and participation of developed, developing and LDC members alike, with a particular attention to SIDS and has stressed the need to strengthen technical assistance for vulnerable economies.

In closing it is important I address efforts underway to institute carbon taxation schemes. Effective carbon pricing is increasingly considered a key market mechanism to support low carbon just transition. And the LDCs must be part of the discussion.

International cooperation can help ensure that efforts to put a price on carbon do not lead to avoidable business costs and trade frictions or place disproportionate burdens on poor countries. Fragmentation raises compliance costs and uncertainty for the private sector – and weighs heaviest on small businesses.

In addition, some developed countries are considering 'border tax adjustment measures' intended to equalize carbon costs across foreign and domestic producers.

However, many developing countries fear such measures could in practice be misused as a pretext for protectionism against their exports. This could weaken global cooperation on climate change when we need to strengthen it.

In my view, the optimal solution would be a shared global carbon price approach aligned with the Paris Agreement and its principles, though politically we are not there yet.

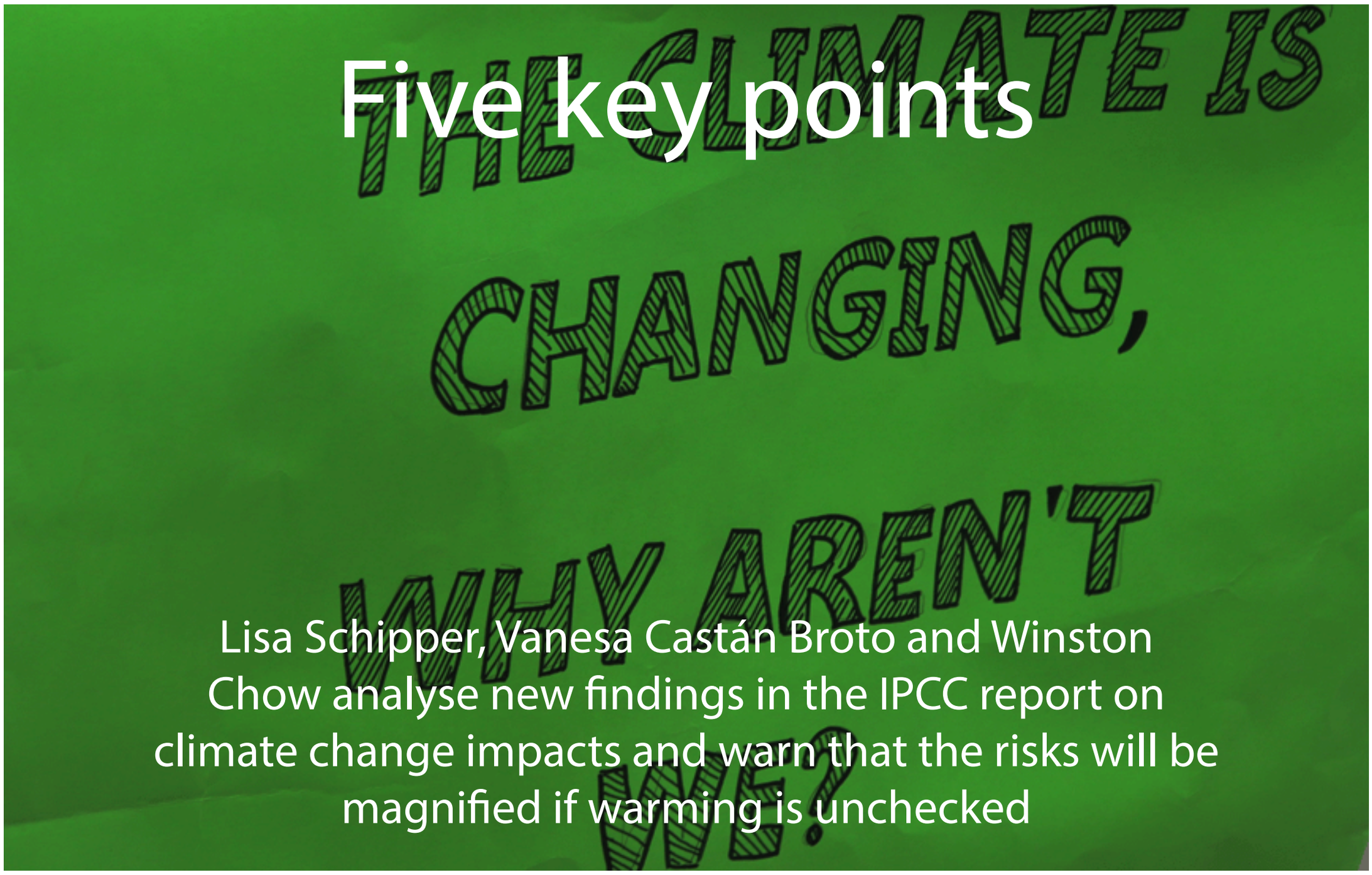
In the meantime, we must work closely with other international organisations, such as the IMF, the World Bank, the OECD, and others, and work on common approaches to carbon pricing, ensuring that measures are not adopted in a discriminatory manner and that the needs of developing countries and LDCs are addressed to enable a just transition.

Ultimately, this discussion is about people and planet. It is about ensuring that environmental sustainability is integrated into how we trade and what we trade. I must thank the leadership of the Climate Vulnerability Forum for the continued interest in advocating for strengthening the multilateral response to climate change.

In sum, LDCs are in need of support for a green transition and the WTO can play a key role in that regard. LDCs should not be left behind. ■

Ngozi Okonjo-Iweala is Director-General of the World Trade Organization

Five key points



Lisa Schipper, Vanesa Castán Broto and Winston Chow analyse new findings in the IPCC report on climate change impacts and warn that the risks will be magnified if warming is unchecked

The latest report from the UN's Intergovernmental Panel on Climate Change (IPCC) looks at the impacts, adaptation and vulnerabilities associated with the climate crisis, and we are three of the 270 scientists and researchers who wrote it.

The document reports stark new findings on the way current global warming of 1.1°C is impacting natural and human systems, and on how our ability to respond will be increasingly limited with every additional increment of warming.

Here are five key points in the new report:

1. Risks will be magnified if warming is unchecked

Since the previous IPCC report on impacts and adaptation back in 2014, heatwaves, droughts, wildfires and other extremes have increased in frequency and intensity far beyond natural variability. These hazards have substantially damaged ecosystems across the globe, and in some cases led to irreversible losses such as species extinction.

Humans are also hit too, through heightened food and water insecurities, greater incidences of food-, water- and vector-borne diseases, and worse physical and mental health.

If global warming is left unchecked, these climate hazards will unavoidably increase. Every increment of global temperature rise magnifies the resulting loss and damage.

2. Adaptation is hitting limits

The report says that much of the world's current climate adaptation measures are not necessarily effective. In fact, there are both 'hard' and 'soft' limits. In natural systems, the hard limits mean that no amount of human intervention

(beside reducing greenhouse gas emissions) can make a difference. For example, warm water coral reefs may completely disappear if ocean temperatures continue increasing – you can't simply 'adapt' to that.

In human systems, soft limits include obstacles like insufficient finance and poor planning, which could be addressed through more inclusive governance. However, there are also hard limits such as limited water in small islands, as rising seas and extreme weather can mean sea water contaminates fresh water. And once we lose an island to sea-level rise, no amount of adaptation will bring that island back.

... the report charts paths for climate-resilient development that policymakers can apply, all of which reduce climate risks while improving lives, especially among those most vulnerable to global warming

The IPCC also finds that adaptation cannot prevent all losses and damages, which are unequally distributed around the world.

3. 'Maladaptation' can make things worse

The IPCC cites evidence of adaptation actions that further deepen existing social inequities and lead to adverse outcomes – what's known as 'maladaptation'.

One example would be when a sea wall is built to protect a settlement from sea-level rise and instead prevents rainwater from draining, leading to the emergence of flooding as a new hazard. Unfortunately, there is ample evidence of maladaptation and it especially affects marginalised and vulnerable people.

For this latest report, the IPCC also made a conscious effort to bring in philosophers, anthropologists and other authors from many different disciplines which may not be seen as traditional areas of climate change research. This meant drawing on more qualitative social sciences and providing a richer picture of topics like vulnerability and climate justice.

Unlike any other IPCC report before it, this one attempted to involve indigenous knowledge. However there are strict rules in the IPCC about what sort of knowledge can be included, with anything not peer-reviewed seen as secondary or questionable by member countries.

While this new report is an inclusive step, there is still significant work needed to ensure that knowledge such as indigenous oral history has a place in IPCC assessments.

4. Cities are a challenge – and an opportunity

Among the figures reported, more than one billion people in low-lying settlements face hazards such as sea-level rise, subsiding coasts, or flooding at high tides, while 350 million urban residents live with the threat of water scarcity. Climate change impacts such as extreme temperatures also worsen ongoing problems in cities, such as air pollution.

Yet cities are also sites of opportunity, and the IPCC report maps a wide range of options for urban adaptation. These include physical barriers to stop floods and rising seas, or more nature-based solutions such as planting trees upstream to slow excess river flows and shade homes in heatwaves, or restoring mangroves that protect communities from coastal flooding.

The report also cites social policy measures such as cash transfers to provide safety nets, insurance and other types of livelihood support.

5. The window of opportunity is closing, rapidly

The new report emphasises the need to couple adaptation measures with greenhouse gas emission reductions to enable 'climate resilient development'.

This will require adequate financing, inclusive governance, transparency in decision making, and the participation of a wide range of people and groups.

Yet, the world is on a path to exceed 1.5°C warming within the next decade. Current development policies which accelerate greenhouse gas emissions actually increase climate maladaptation risks and widen social inequalities.

To urgently shift our collective course from 1.5°C of warming and beyond, the report charts paths for climate-resilient development that policymakers can apply, all of which reduce climate risks while improving lives, especially among those most vulnerable to global warming. Time, however, is running short. ■

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A European climate fund or a green golden rule

Zsolt Darvas argues that spending and borrowing via a non-redistributive EU climate fund or under a green golden rule would be treated the same in the EU's fiscal framework

There is a growing recognition that substantial public investment will be needed to meet the European Union's climate targets. However, it will be impossible to increase green public investment while consolidating budget deficits when EU fiscal rules are reintroduced from 2023.

In a paper for the informal meeting of EU finance ministers in September 2021, Guntram Wolff and I proposed a green golden rule to exclude any increase in net green public investment from the fiscal indicators used to measure compliance with fiscal rules.

Others, like Luis Garicano, have proposed a new European climate investment fund (akin to the loan component of the Recovery and Resilience Facility, RRF) to provide loans to finance climate change mitigation and adaptation until 2050, which would not involve direct redistribution across EU countries.

In fact, the two proposals would be equivalent in terms of project selection, implementation and treatment in fiscal indicators and fiscal rules, providing that the green golden rule is well designed to avoid 'greenwashing' and the climate investment fund does not involve redistribution.

Green golden rule

A main criticism of the green golden rule proposal is that it might lead to 'greenwashing': governments might try to reclassify spending as 'green' to exempt it from fiscal rules. But such misbehaviour would be a characteristic of an uncontrolled version of the rule that nobody proposes. To avoid greenwashing, we propose that:

1. The Council of the EU should define a specific list of climate investments eligible for the green golden rule;

2. Each country should integrate a climate public investment plan into its annual Stability/Convergence

Programme, specifying the items planned to be excluded from fiscal rules indicators according to the green golden rule;

3. The Commission would assess the plans and identify what spending can be excluded from fiscal rules, before making recommendations to the Council;

A non-redistributive EU climate fund and a well-designed green golden rule would be equivalent in terms of project selection and implementation procedures. The treatment of related spending and consequent borrowing in national fiscal indicators and in the EU's fiscal framework would be the same

4. The Council would approve (or reject) the Commission's recommendations;

5. National fiscal councils and audit offices, the European Commission, the European Court of Auditors and possibly other institutions would assess compliance with the green golden rule.

While there are some pragmatic options to mimic a green golden rule in the current EU fiscal framework, such as amending the so-called 'investment clause' and adjusting the medium-term objective for the structural balance, ultimately, elements of the 2011 Six-Pack legislation and the 2012 Treaty on Stability, Coordination and Governance (TSCG) should be revised to include a green golden rule.

An EU climate fund without direct redistribution

An EU climate fund would disburse cash to EU countries for green projects. If the fund is similar to the RRF, implementation would be practically identical to our green golden rule: the Council sets priorities, EU countries submit plans, the Commission assesses those plans, the Council approves (or rejects) them and various bodies oversee their execution.

If the fund does not involve direct redistribution, then spending and financing would count in national budget deficit and debt statistics and would thus be subject to fiscal constraints from 2023. A special decision could be made to exempt the deficits and debt related to projects financed by the fund, but this decision, and the associated legislative changes, would be the same at that needed for the green golden rule.

In explaining this I start by clarifying what no direct redistribution across EU countries means. There are two main options for this.

- The fund is financed by annual contributions without EU borrowing (like the regular EU budget): countries get back from the fund the exact amount they pay in. For example, in 2025, Germany borrows €10 billion on capital markets, pays €10 billion into the fund, receives €10 billion from the fund and spends this money on green projects.

- The fund borrows on capital markets, lends to EU countries, and later they repay the loan to the EU, which is used by the EU to repay borrowing from the market (as with RRF loans).

Because the first option appears somewhat odd, existing proposals focus on the second option. Nevertheless, both options result in the same treatment of the resulting climate spending in deficit and debt indicators and for the purposes of the fiscal rules. Another possible way of funding would be to collect new own resources for the climate fund (we'll return to this issue at the end).

Recall how spending financed by the RRF is treated for statistical purposes: in line with the European System of Accounts and a Council legal option, in September 2021, Eurostat concluded that national spending financed by RRF grants will not be included in national deficit and debt indicators, but spending financed by RRF loans will.

The justification for excluding RRF grants is that EU borrowing to finance these grants should not be counted as member-state debt because *"there is no match between the grants received from the RRF by the individual member states and the amounts that potentially will have to be repaid by each individual member state, as the two elements are calculated on the basis of different criteria"* and *"there is great uncertainty on what amount each member state will be liable for"* (paragraph 38 of the Eurostat guidance).

Thus, since there is redistribution (*"different criteria"*) and it is impossible to calculate the expected value of national liability to the repayment of EU debt in 2028-2058 (*"uncertainty"* – see my Policy Contribution on this issue), EU debt used to finance the grants constitutes only *"a contingent liability for the Union budgetary planning"*, but not a national debt (paragraph 42).

The national budget deficit is defined as the net borrowing of the government and thus spending from RRF grants does not matter for deficits: countries record a revenue (payment received from RRF) and an expenditure (national expenditure financed by the RRF), which is called *"the principle of the EU flows neutrality on the general government net lending/net borrowing"* in the statistical jargon (paragraph 28).

Thus, by blurring the liability that EU countries have for repaying the EU debt, the financing of RRF grants does not appear in national debt and deficit statistics and is thus exempt from EU fiscal rules.

This is different for spending financed by RRF loans: Eurostat concluded that these loans should be recorded as national debt and thus expenditure financed by that debt increases national budget deficits (paragraphs 43-45 of the Eurostat guidance). So, spending financed by RRF loans is not exempt from fiscal rules.

An EU climate fund would be recorded in the same way as the RRF.

The 2015 treatment of national contributions to the European Fund for Strategic Investments (EFSI) would not apply to an EU climate fund. In 2015, the Commission noted that *"Two aspects need to be distinguished here: i) whether these contributions are recorded statistically as deficit and/or debt, in line with the established definitions of the European System of Account (ESA); and ii) the way in which the Commission will take account of such contributions in its assessment of compliance with the Pact."*

How contributions are recorded is left to the independent Eurostat, though the Commission suggested that if a country borrows to fund the contribution, this will increase government debt. This in turn increases the budget deficit.

For the compliance assessment, the Commission decided that the initial contributions to EFSI are one-off measures, and thus they will not be accounted for in the structural balance (because, by definition, the structural balance does not include exceptional one-off measures).

The Commission also noted that an excessive deficit procedure would not be launched if non-compliance with the 3% deficit criterion results only from EFSI contributions, if the excess over the 3% reference value is small and is expected to be temporary, in line with Treaty provisions.

A similar conclusion was reached for non-respect of the debt criterion. The regular national co-financing of projects also co-financed by EFSI is to be included in the structural balance, but such national co-financing could be considered for the so-called 'investment clause', which allows temporary deviations from the medium-term objective for the structural balance, or from the adjustment path toward it, for a temporary period under rather strict conditions (see our assessment of the investment clause in section 3.2.2. here).

A European climate fund would be in place for decades and therefore national contributions to it cannot be considered as exceptional one-off measures. In the same vein, breaching the 3% deficit threshold would not be temporary if it lasts for decades. The investment clause could potentially be considered for expenditures financed by the EU climate fund, but in its 2015 approved form, the investment clause is based on very strict conditions that probably no country would meet after 2023.

Furthermore, the allowed maximum initial 0.5% of GDP temporary deviation, which should be corrected in four years, would be too tiny to make a difference. The investment clause could theoretically be revised by a Commission Communication, yet the Commission already struggled to find a legal base for this narrow investment clause in 2015.

Exempting green public spending from the structural balance for decades might not be possible under the current legal framework. Yet if a creative legal interpretation can be found, it could apply to spending via both an EU climate fund and a green golden rule.

Thus, our proposed green golden rule and an EU climate investment fund without direct redistribution would be equivalent in terms of project selection and implementation, and in terms of treatment in fiscal indicators and in the fiscal framework.

EU borrowing would make a difference

As with RRF loans, EU countries jointly guarantee the repayment of EU debt so the EU can borrow at a lower interest rate than more than half of its member states.

Since the EU lends to its members at its actual borrowing cost, some could cut interest payments by borrowing from the EU instead of borrowing from the market. By underwriting EU borrowing, more creditworthy EU countries implicitly subsidise those countries that borrow from the EU, by running the risk of that they default on their liability to the EU.

This risk is probably not high, not least because no EU country has ever defaulted on an EU liability and the share of EU climate fund related debt would be small compared with total national debt. But nevertheless there is a risk.

An EU climate fund offering only loans might not incur significant demand. First, some EU countries can borrow at a cheaper rate than the EU, so borrowing from the EU would lead to a financial loss. Second, demand for RRF loans was moderate: only seven countries decided to borrow from the RRF, and of these seven, only three borrowed the full available amounts. The other four only borrowed about one-third or less than what was available.

In contrast, a green golden rule could be utilised by all EU countries.

But an EU climate fund could result in positive reputational effects (demonstrating the EU's determination to act together) and beneficial financial market development resulting from more EU debt (see a nice assessment here), which would not be the case with a green golden rule.

An EU climate fund with direct redistribution

Direct redistribution via an EU climate fund would lead to different statistical treatment, especially if the fund is financed by long-term borrowing.

Like RRF grants, the different criteria used for allocating the cross-country grants from the fund and cross-country contributions to the fund, and the uncertainty about how much each country should pay into the fund in the future, would likely lead to the conclusion that expenditures financed by the fund would not constitute national deficit and debt.

Is there a rationale for redistribution? And would there be political will for that? The answer to the first question is not clear-cut. The climate is global and the marginal benefit of additional climate spending by a net-payer country could be higher in low-income countries outside of the EU than in another EU country.

On the other hand, fostering the achievement of EU climate goals, which could also strengthen EU climate leadership, and making fiscally weaker EU countries more fiscally sustainable would be positives for the EU. Highly-indebted EU countries might not be able to finance the necessary public climate investment. Furthermore, climate is a systemic risk that has asymmetric effects on EU countries.

The second question is political, and I do not wish to speculate on it.

Nevertheless, if the goals are to limit redistribution, exclude climate spending from fiscal rules and avoid changing fiscal-rule legislation, a trick would be to design a climate fund so it involves only 'little' redistribution.

For example, the criteria for allocating the grants from the fund would primarily depend on GNI, but would include other indicators as well. The future repayment of the resulting EU debt would depend only on GNI.

Thus, there would not be a direct match between the grants received from the climate fund by individual countries and the amounts that potentially will have to be repaid by each individual member state, so Eurostat might conclude that the consequent EU borrowing should not be counted in national debts and deficits.

An EU climate fund financed by new own resources

I make two observations for this option. First, it is already hard to find new own resources for the regular EU budget and Next Generation EU.

Second, a new own resource for the EU budget implies that the same revenue does not accrue to national budgets, thus increasing national budget deficits.

For example, if the revenues from the European Commission's plan to redirect to the EU some of the reallocated taxes from the world's largest companies and some of the revenues from the EU emissions trading system, then member states will not receive these tax revenues. Thus, national budget deficits are going to be larger, all else being equal.

The only exceptions are resources countries cannot levy, like the proposed carbon border adjustment, but it's unlikely that such a source would provide a sizeable contribution to an EU climate fund.

Summary

A non-redistributive EU climate fund and a well-designed green golden rule would be equivalent in terms of project selection and implementation procedures. The treatment of related spending and consequent borrowing in national fiscal indicators and in the EU's fiscal framework would be the same.

New regulations would be needed to set up both the climate fund and the green golden rule. Special legislation would be needed to exempt the subsequent climate expenditures from EU fiscal rules in both cases.

The main difference would be that an EU climate fund financed by EU borrowing would create an indirect subsidy going from more creditworthy to less creditworthy countries in the form of reduced interest costs, due to the joint guarantee of EU borrowing.

A new climate fund and EU borrowing might bring positive reputational effects and benefits for financial market development. The demand for loans from an EU climate fund could be low, while a green golden rule could be applied by all EU countries.

A climate fund financed by EU borrowing with redistributive effects across countries would likely result in the exclusion of the fund's activities from national fiscal indicators and EU fiscal rules. ■

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