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André Wolf considers mitigating climate change via trade policy

Strengthening the soul of the EU. Ursula von der Leyen discusses

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THE GLOBAL TRADE AND FINANCE PLATFORM

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Strengthening the soul of our union

In the face of complex challenges Ursula von der Leyen emphasises the Union's unity and how Europe can become a more formidable actor on the global stage

Many are the people who feel their lives have been on pause while the world has been on fast forward. The speed of events and the enormity of the challenges are sometimes difficult to grasp. This has also been a time of soul-searching. From people reassessing their own lives to wider debates on sharing vaccines and on shared values.

But as I look back on this past year, if I look at the state of the Union today, I see a strong soul in everything that we do. It was Robert Schuman who said: Europe needs a soul, an ideal, and the political will to serve this ideal.

Europe has brought those words to life in the last twelve months. In the biggest global health crisis for a century, we chose to go it together so that every part of Europe got the same access to a life-saving vaccine.

In the deepest global economic crisis for decades, we chose to go it together with NextGenerationEU. And in the gravest planetary crisis of all time, again we chose to go it together with the European Green Deal.

We did that together as Commission, as Parliament, as 27 member states. As one Europe. And we can be proud of it.

But corona times are not over. There is still much grief in our society as the pandemic lingers. There are hearts we can never mend, life stories we can never finish and time we can never give back to our young. We face new and enduring challenges in a world recovering – and fracturing – unevenly.

So there is no question: the next year will be yet another test of character. But I believe that it is when you are tested that your spirit – your soul - truly shines through.

As I look across our Union, I know that Europe will pass that test. And what gives me that confidence is the inspiration we can draw from Europe's young people. Because our youth put meaning into empathy and solidarity. They believe we have a responsibility towards the planet. And while they are anxious about the future, they are determined to make it better.

Our Union will be stronger if it is more like our next generation: reflective, determined and caring. Grounded in values and bold in action. This spirit will be more important than ever over the next twelve months. This is the message in the Letter of Intent I sent to President Sassoli and Prime Minister Janša to outline our priorities for the year ahead.

We have all benefited from the principles of our European social market economy – and we must make sure that the next generation can do so to build their future

A Europe united through adversity and recovery

A year is a long time in a pandemic. When I stood in front of you 12 months ago, I did not know when – or even if – we would have a safe and effective vaccine against COVID-19.

But today, and against all critics, Europe is among the world leaders. More than 70 per cent of adults in the EU are fully vaccinated. We were the only ones to share half of our vaccine production with the rest of the world.

We delivered more than 700 million doses to the European people, and we delivered more than another 700 million doses to the rest of the world, to more than 130 countries. We are the only region in the world to achieve that. A pandemic is a marathon, not a sprint.

We followed the science. We delivered to Europe. We delivered to the world. We did it the right way, because we did it the European way. And it worked! But while we have every reason to be confident, we have no reason to be complacent. Our first – and most urgent – priority is to speed up global vaccination.

With less than 1% of global doses administered in low-income countries, the scale of injustice and the level of urgency are obvious. This is one of the great geopolitical issues of our time. Team Europe is investing one billion euro to ramp up mRNA production capacity in Africa. We have already committed to share 250 million doses.

I can announce that the Commission will add a new donation of another 200 million doses by the middle of next year. This is an investment in solidarity – but also in global health.

The second priority is to continue our efforts here in Europe. We see worrisome divergences in vaccination rates in our Union. So we need to keep up the momentum.

And Europe is ready. We have 1.8 billion additional doses secured. This is enough for us and our neighbourhood when booster shots are needed. Let's do everything possible to ensure that this does not turn into a pandemic of the unvaccinated.

The final priority is to strengthen our pandemic preparedness. Last year, I said it was time to build a European Health Union. Today we are delivering. With our proposal we get the HERA authority up and running. This will be a huge asset to deal with future health threats earlier and better.

We have the innovation and scientific capacity, the private sector knowledge, we have competent national authorities. And now we need to bring all of that together, including massive funding.

So I am proposing a new health preparedness and resilience mission for the whole of the EU. And it should be backed up by Team Europe investment of €50 billion by 2027. To make sure that no virus will ever turn a local epidemic into a global pandemic. There is no better return on investment than that.

The work on the European Health Union is a big step forward. And I want to thank the European Parliament for your support. We have shown that when we act together, we are able to act fast.

Take the EU digital certificate. Today more than 400 million certificates have been generated across Europe. 42 countries in 4 continents are plugged in. We proposed it in March. You pushed it! Three months later it was up and running. Thanks to this joint effort, while the rest of the world talked about it, Europe just did it.

We did a lot of things right. We moved fast to create SURE. This supported over 31 million workers and 2.5 million companies across Europe. We learned the lessons from the past when we were too divided and too delayed.

And the difference is stark: last time it took 8 years for the Eurozone GDP to get back to pre-crisis levels. This time we expect 19 countries to be at pre-pandemic levels this year with the rest following next. Growth in the euro area outpaced both the US and China in the last quarter.

But this is only the beginning. And the lessons from the financial crisis should serve as a cautionary tale. At that time, Europe declared victory too soon and we paid the price for that. And we will not repeat the same mistake.

The good news is that with NextGenerationEU we will now invest in both short-term recovery and long-term prosperity. We will address structural issues in our economy: from labour market reforms in Spain, to pension reforms in Slovenia or tax reform in Austria.

In an unprecedented manner, we will invest in 5G and fibre. But equally important is the investment in digital skills. This task needs leaders' attention and a structured dialogue at top-level.

Our response provides a clear direction to markets and investors alike. But, as we look ahead, we also need to reflect on how the crisis has affected the shape of our economy – from increased debt, to uneven impact on different sectors, or new ways of working.

To do that, the Commission will relaunch the discussion on the Economic Governance Review in the coming weeks. The aim is to build a consensus on the way forward well in time for 2023.

We will soon celebrate 30 years of the Single Market. For 30 years it has been the great enabler of progress and prosperity in Europe. At the outset of the pandemic, we defended it against the pressures of erosion and fragmentation. For our recovery, the Single Market is the driver of good jobs and competitiveness.

That is particularly important in the digital single market. We have made ambitious proposals in the last year.

- To contain the gatekeeper power of major platforms;
- To underpin the democratic responsibility of those platforms;
- To foster innovation;
- To channel the power of artificial intelligence.

Digital is the make-or-break issue. And member states share that view. Digital spending in NextGenerationEU will even overshoot the 20% target. That reflects the importance of investing in our European tech sovereignty. We have to double down to shape our digital transformation according to our own rules and values.

Allow me to focus on semi-conductors, those tiny chips that make everything work: from smartphones and electric scooters to trains or entire smart factories. There is no digital without chips. And while we speak, whole production lines are already working at reduced speed - despite growing demand - because of a shortage of semi- conductors.

But while global demand has exploded, Europe's share across the entire value chain, from design to manufacturing capacity has shrunk. We depend on state-of-the-art chips manufactured in Asia. So this is not just a matter of our competitiveness. This is also a matter of tech sovereignty. So let's put all of our focus on it.

We will present a new European Chips Act. We need to link together our world-class research, design and testing capacities. We need to coordinate EU and national investment along the value chain.

The aim is to jointly create a state-of-the-art European chip ecosystem, including production. That ensures our security of supply and will develop new markets for ground- breaking European tech.

Yes, this is a daunting task. And I know that some claim it cannot be done. But they said the same thing about Galileo 20 years ago. And look what happened. We got our act together. Today European satellites provide the navigation system for more than 2 billion smartphones worldwide. We are world leaders. So let's be bold again, this time with semi-conductors.

The pandemic has left deep scars that have also left their mark on our social market economy. For nights on end, we all stood at our windows and doors to applaud critical workers. We felt how much we relied on all those women and men who work for lower wages, fewer protections and less security. The applause may have faded away but the strength of feeling cannot.

This is why the implementation of the European Pillar of Social Rights is so important – to ensure decent jobs, fairer working conditions, better healthcare and better balance in people's lives.

If the pandemic taught us one thing, it is that time is precious. And caring for someone you love is the most precious time of all. We will come forward with a new European Care Strategy to support men and women in finding the best care and the best life balance for them. But social fairness is not just a question of time. It is also a question of fair taxation.

In our social market economy, it is good for companies to make profits. And they make profits thanks to the quality of our infrastructure, social security and education systems. So the very least we can expect is that they pay their fair share.

This is why we will continue to crack down on tax avoidance and evasion. We will put forward a new initiative to address those hiding profits behind shell entities. And we will do everything in our power to seal the historic global deal on minimum taxation. Asking big companies to pay the right amount of tax is not only a question of public finances, but above all a question of basic fairness.

We have all benefited from the principles of our European social market economy – and we must make sure that the next generation can do so to build their future. This is our most educated, talented and motivated generation. And it has missed out on so much to keep others safe.

Being young is normally a time of discovery, of creating new experiences. A time to meet lifelong friends, to find your own path. And what did we ask this generation to do? To keep their social distance, to stay locked down and to do school from home. For more than a year.

This is why everything that we do – from the European Green Deal to NextGenerationEU – is about protecting their future. That is also why NextGenerationEU must be funded by the new own resources that we are working on.

But we must also caution against creating new divides. Because Europe needs all of its youth. We must step up our support to those who fall into the gaps – those not in any kind of employment, education or training.

For them, we will put in place a new programme, ALMA. ALMA will help these young Europeans to find temporary work experience in another member state. Because they too deserve an experience like Erasmus. To gain skills, to create bonds and help forge their own European identity.

But if we are to shape our Union in their mould, young people must be able to shape Europe's future. Our Union needs a soul and a vision they can connect to.

Or as Jacques Delors asked: *"How can we ever build Europe if young people do not see it as a collective project and a vision of their own future?"*

This is why we will propose to make 2022 the Year of European Youth. A year dedicated to empowering those who have dedicated so much to others. And it is why we will make sure that young people can help lead the debate in the Conference on the Future of Europe.

This is their future and this must be their Conference too. And as we said when we took office, the Commission will be ready to follow up on what is agreed by the Conference.

A Europe united in responsibility

This is a generation with a conscience. They are pushing us to go further and faster to tackle the climate crisis. And events of the summer only served to explain why. We saw floods in Belgium and Germany. And wildfires burning from the Greek islands to the hills in France.

And if we don't believe our own eyes, we only have to follow the science. The UN recently published the IPCC report, the Intergovernmental Panel on Climate Change. It is the authority on the science of climate change.

The report leaves no doubt. Climate change is man-made. But since it is man-made, we can do something about it. As I heard it said recently: It's warming. It's us. We're sure. It's bad. But we can fix it. And change is already happening.

More electric vehicles than diesel cars were registered in Germany in the first half of this year. Poland is now the EU's largest exporter of car batteries and electric buses. Or take the New European Bauhaus that led to an explosion of creativity of architects, designers, engineers across our Union. So clearly something is on the move. And this is what the European Green Deal is all about.

In my speech last year, I announced our target of at least 55% emission reduction by 2030. Since then we have together turned our climate goals into legal obligations. And we are the first major economy to present comprehensive legislation in order to get it done.

You have seen the complexity of the detail. But the goal is simple. We will put a price on pollution. We will clean the energy we use. We will have smarter cars and cleaner airplanes.

And we will make sure that higher climate ambition comes with more social ambition. This must be a fair green transition. This is why we proposed a new Social Climate Fund to tackle the energy poverty that already 34 million Europeans suffer from. I count on both Parliament and member states to keep the package and to keep the ambition together.

When it comes to climate change and the nature crisis, Europe can do a lot. And it will support others. I am proud to announce today that the EU will double its external funding for biodiversity, in particular for the most vulnerable countries.

But Europe cannot do it alone. The COP26 in Glasgow will be a moment of truth for the global community. Major economies – from the US to Japan – have set ambitions for climate neutrality in 2050 or shortly after. These need

now to be backed up by concrete plans in time for Glasgow. Because current commitments for 2030 will not keep global warming to 1.5°C within reach. Every country has a responsibility!

The goals that President Xi has set for China are encouraging. But we call for that same leadership on setting out how China will get there. The world would be relieved if they showed they could peak emissions by mid-decade - and move away from coal at home and abroad.

But while every country has a responsibility, major economies do have a special duty to the least developed and most vulnerable countries. Climate finance is essential for them - both for mitigation and adaptation.

In Mexico and in Paris, the world committed to provide 100 billion dollars a year until 2025. We deliver on our commitment. Team Europe contributes 25 billion dollars per year. But others still leave a gaping hole towards reaching the global target. Closing that gap will increase the chance of success at Glasgow.

My message today is that Europe is ready to do more. We will now propose an additional 4 billion euro for climate finance until 2027. But we expect the United States and our partners to step up too. Closing the climate finance gap together – the US and the EU – would be a strong signal for global climate leadership. It is time to deliver.

This climate and economic leadership is central to Europe's global and security objectives. It also reflects a wider shift in world affairs at a time of transition towards a new international order.

We are entering a new era of hyper-competitiveness. An era in which some stop at nothing to gain influence: from vaccine promises and high-interest loans, to missiles and misinformation. An era of regional rivalries and major powers refocusing their attention towards each other.

Recent events in Afghanistan are not the cause of this change – but they are a symptom of it. And first and foremost, I want to be clear. We stand by the Afghan people. The women and children, prosecutors, journalists and human rights defenders.

I think in particular of women judges who are now in hiding from the men they jailed. They have been put at risk for their contribution to justice and the rule of law. We must support them and we will coordinate all efforts with member states to bring them to safety.

And we must continue supporting all Afghans in the country and in neighbouring countries. We must do everything to avert the real risk of a major famine and humanitarian disaster. And we will do our part. We will increase again humanitarian aid for Afghanistan by €100 million. This will be part of a new, wider Afghan Support Package that we will present in the next weeks to combine all of our efforts.

Witnessing events unfold in Afghanistan was profoundly painful for all the families of fallen servicemen and servicewomen. We bow to the sacrifice of those soldiers, diplomats and aid workers who laid down their lives.

To make sure that their service will never be in vain, we have to reflect on how this mission could end so abruptly. There are deeply troubling questions that allies will have to tackle within NATO.

But there is simply no security and defence issue where less cooperation is the answer. We need to invest in our joint partnership and to draw on each side's unique strength.

This is why we are working with Secretary-General Jens Stoltenberg on a new EU-NATO Joint Declaration to be presented before the end of the year. But this is only one part of the equation.

Europe can – and clearly should – be able and willing to do more on its own. But if we are to do more, we first need to explain why. I see three broad categories.

First, we need to provide stability in our neighbourhood and across different regions. We are connected to the world by narrow straits, stormy seas and vast land borders. Because of that geography, Europe knows better than anyone that if you don't deal in time with the crisis abroad, the crisis comes to you.

Secondly, the nature of the threats we face is evolving rapidly: from hybrid or cyber- attacks to the growing arms race in space. Disruptive technology has been a great equaliser in the way power can be used today by rogue states or non-state groups.

You no longer need armies and missiles to cause mass damage. You can paralyse industrial plants, city administrations and hospitals – all you need is your laptop. You can disrupt entire elections with a smartphone and an internet connection.

The third reason is that the European Union is a unique security provider. There will be missions where NATO or the UN will not be present, but where the EU should be. On the ground, our soldiers work side-by-side with police officers, lawyers and doctors, with humanitarian workers and human rights defenders, with teachers and engineers.

We can combine military and civilian, along with diplomacy and development – and we have a long history in building and protecting peace. The good news is that over the past years, we have started to develop a European defence ecosystem.

But what we need is the European Defence Union. In the last weeks, there have been many discussions on expeditionary forces. On what type and how many we need: battlegroups or EU entry forces.

This is no doubt part of the debate – and I believe it will be part of the solution. But the more fundamental issue is why this has not worked in the past. You can have the most advanced forces in the world – but if you are never prepared to use them - of what use are they?

What has held us back until now is not just a shortfall of capacity – it is the lack of political will. And if we develop this political will, there is a lot that we can do at EU level. Allow me to give you three concrete examples.

First, we need to build the foundation for collective decision-making – this is what I call situational awareness. We fall short if member states active in the same region, do not share their information on the European level. It is vital that we improve intelligence cooperation.

But this is not just about intelligence in the narrow sense. It is about bringing together the knowledge from all services and all sources. From space to police trainers, from open source to development agencies. Their work gives us a unique scope and depth of knowledge. It is out there!

But we can only use that, to make informed decisions if we have the full picture. And this is currently not the case. We have the knowledge, but it is disjoined. Information is fragmented. This is why the EU could consider its own Joint Situational Awareness Centre to fuse all the different pieces of information. And to be better prepared, to be fully informed and to be able to decide.

Secondly, we need to improve interoperability. This is why we are already investing in common European platforms, from fighter jets, to drones and cyber. But we have to keep thinking of new ways to use all possible synergies. One example could be to consider waiving VAT when buying defence equipment developed and produced in Europe. This would not only increase our interoperability, but also decrease our dependencies of today.

Third, we cannot talk about defence without talking about cyber. If everything is connected, everything can be hacked. Given that resources are scarce, we have to bundle our forces. And we should not just be satisfied to address the cyber threat, but also strive to become a leader in cyber security.

It should be here in Europe where cyber defence tools are developed. This is why we need a European Cyber Defence Policy, including legislation on common standards under a new European Cyber Resilience Act. So, we can do a lot at EU level. But member states need to do more too. This starts with a common assessment of the threats we face and a common approach to dealing with them. The upcoming Strategic Compass is a key process of this discussion.

And we need to decide how we can use all of the possibilities that are already in the Treaty. This is why, under the French Presidency, President Macron and I will convene a Summit on European defence. It is time for Europe to step up to the next level.

In a more contested world, protecting your interests is not only about defending yourself. It is about forging strong and reliable partnerships. This is not a luxury – it is essential for our future stability, security and prosperity. This work starts by deepening our partnership with our closest allies. With the US we will develop our new agenda for global change – from the new Trade and Technology Council to health security and sustainability. The EU and the US will always be stronger – together.

The same is true of our neighbours in the Western Balkans. Before the end of the month, I will travel to the region to send a strong signal of our commitment to the accession process. We owe it to all those young people who believe in a European future.

This is why we are ramping up our support through our new investment and economic plan, worth around a third of the region's GDP. Because an investment in the future of the Western Balkans is an investment in the future of the EU.

And we will also continue investing in our partnerships across our neighbourhood – from stepping up our engagement in the Eastern Partnership to implementing the new Agenda for the Mediterranean and continuing to work on the different aspects of our relationship with Turkey.

If Europe is to become a more active global player, it also needs to focus on the next generation of partnerships. In this spirit, today's new EU - Indo-Pacific strategy is a milestone. It reflects the growing importance of the region to our prosperity and security. But also the fact that autocratic regimes use it to try to expand their influence.

Europe needs to be more present and more active in the region. So we will work together to deepen trade links, strengthen global supply chains and develop new investment projects on green and digital technologies. This is a template for how Europe can redesign its model to connect the world.

We are good at financing roads. But it does not make sense for Europe to build a perfect road between a Chinese-owned copper mine and a Chinese-owned harbour. We have to get smarter when it comes to these kinds of investments.

This is why we will soon present our new connectivity strategy called Global Gateway. We will build Global Gateway partnerships with countries around the world. We want investments in quality infrastructure, connecting goods, people and services around the world. We will take a values-based approach, offering transparency and good governance to our partners.

We want to create links and not dependencies! And we know how this can work. Since the summer, a new underwater fibre optic cable has connected Brazil to Portugal. We will invest with Africa to create a market for green hydrogen that connects the two shores of the Mediterranean.

We need a Team Europe approach to make Global Gateway happen. We will connect institutions and investment, banks and the business community. And we will make this a priority for regional summits – starting with the next EU-Africa Summit in February.

We want to turn Global Gateway into a trusted brand around the world. And let me be very clear: doing business around the world, global trade – all that is good and necessary. But this can never be done at the expense of people's dignity and freedom.

There are 25 million people out there, who are threatened or coerced into forced labour. We can never accept that they are forced to make products – and that these products then end up for sale in shops here in Europe.

So we will propose a ban on products in our market that have been made by forced labour. Human rights are not for sale – at any price.

A Europe united in freedom and diversity

And human beings are not bargaining chips. Look at what happened at our borders with Belarus. The regime in Minsk has instrumentalised human beings. They have put people on planes and literally pushed them towards Europe's borders. This can never be tolerated.

And the quick European reaction shows that. And rest assured, we will continue to stand together with Lithuania, Latvia and Poland. And, let's call it what it is: this is a hybrid attack to destabilise Europe.

These are not isolated events. We saw similar incidents at other borders. And we can expect to see it again. This is why, as part of our work on Schengen, we will set out new ways to respond to such aggression and ensure unity in protecting our external borders.

But as long as we do not find common ground on how to manage migration, our opponents will continue to target that. Meanwhile, human traffickers continue to exploit people through deadly routes across the Mediterranean. These events show us that every country has a stake in building a European migration system.

The New Pact on Migration and Asylum gives us everything we need to manage the different types of situations we face. All the elements are there. This is a balanced and humane system that works for all member states - in all circumstances.

We know that we can find common ground. But in the year since the Commission presented the Pact, progress has been painfully slow. I think, this is the moment now for a European migration management policy. So I urge you, in this House and in member states, to speed up the process.

This ultimately comes down to a question of trust. Trust between member states. Trust for Europeans that migration can be managed. Trust that Europe will always live up to its enduring duty to the most vulnerable and most in need.

There are many strongly held views on migration in Europe but I believe the common ground is not so far away. Because if you ask most Europeans, they would agree that we should act to curb irregular migration but also act to provide a refuge for those forced to flee.

They would agree that we should return those who have no right to stay. But that we should welcome those who come here legally and make such a vital contribution to our society and economy. And we should all agree that the topic of migration should never be used to divide. I am convinced that there is a way that Europe can build trust amongst us when it comes to migration.

Societies that build on democracy and common values stand on stable ground. They have trust in people. This is how new ideas are formed, how change happens, how injustices are overcome. Trust in these common values brought our founders together, after World War Two.

And it is these same values that united the freedom fighters who tore down the Iron Curtain over 30 years ago. They wanted democracy. They wanted the freedom to choose their government. They wanted the rule of law and for everyone to be equal before the law.

They wanted freedom of speech and independent media. To no longer be spied on by their governments. They wanted to combat corruption. And the freedom to be different from the majority. Or, as former Czech President Václav Havel put it, they wanted all those *"great European values."*

These values come from the cultural, religious and humanist heritage of Europe. They are part of our soul, part of what defines us today. These values are now enshrined in our European treaties. This is what we all signed up to when we became part of this Union as free and sovereign countries. We are determined to defend these values. And we will never waver in that determination.

Our values are guaranteed by our legal order and safeguarded by the judgments of the European Court of Justice. These judgments are binding. We make sure that they are respected. And we do so in every member state of our Union.

Because protecting the rule of law is not just a noble goal. Protecting the rule of law is also hard work and a constant struggle for improvement. Our Rule of Law reports are part of this process, with for example justice reforms in Malta or corruption inquiries in Slovakia. And from 2022, our Rule of Law reports will come with specific recommendations to member states.

Nevertheless, there are worrying developments in certain member states. Let me be clear: dialogue always comes first. But dialogue is not an end in itself, it should lead to results. This is why we take a dual approach of dialogue and decisive action. And this is what we will continue to do.

Because people must be able to rely on the right to an independent judiciary. The right to be treated equally before the law. Everywhere in Europe. Whether you belong to a majority or a minority.

The European budget is the future of our Union cast in figures. That is why it must be protected. We need to ensure that every euro and every cent is spent for its proper purpose and in line with rule of law principles.

Investments that enable our children to have a better future must not be allowed to seep away into dark channels. Corruption is not just taxpayer money stolen. It is investors scared off, big favours bought by big money and democracy undermined by the powerful. When it comes to protecting our budget, we will pursue every case, with everything in our power.

Defending our values is also defending freedom. Freedom to be who you are, freedom to say what's on your mind, freedom to love whoever you want.

But freedom also means freedom from fear. And during the pandemic, too many women were deprived of that freedom. It was an acutely terrifying time for those with nowhere to hide, nowhere to escape from their abusers. We need to shed light on this darkness, we need to show ways out of the pain. Their abusers must be brought to justice. And those women must have their freedom and their self-determination back.

This is why by the end of year, we will propose a law to combat violence against women – from prevention to protection and effective prosecution, online and offline. It is about defending the dignity of each individual. It is about justice. Because this is the soul of Europe. And we must make it even stronger.

Allow me to finish with one of the freedoms that gives voice to all other freedoms – media freedom. Journalists are being targeted simply for doing their job. Some have been threatened, some beaten and, tragically, some murdered. Right here, in our European Union.

Let me mention some of their names: Daphné Caruana Galizia. Ján Kuciak. Peter de Vries. The details of their stories may be different but what they have in common is that they all fought and died for our right to be informed.

Information is a public good. We must protect those who create transparency – the journalists. That is why today we have put forward a recommendation to give journalists better protection.

And we need to stop those who threaten media freedom. Media companies cannot be treated as just another business. Their independence is essential. Europe needs a law that safeguards this independence – and the Commission will deliver a Media Freedom Act in the next year. Defending media freedom means defending our democracy.

Conclusion

Strengthening Schuman's European ideal that I invoked earlier is a continuous work. And we should not hide away from our inconsistencies and imperfections. But imperfect as it might be, our Union is both beautifully unique and uniquely beautiful. It is a Union where we strengthen our individual liberty through the strength of our community.

A Union shaped as much by our shared history and values as by our different cultures and perspectives. A Union with a soul. Trying to find the right words to capture the essence of this feeling is not easy. But it is easier when you borrow them from someone who inspires you. And this is why I have invited a guest of honour to be with us today.

Many of you might know her – a gold medallist from Italy who captured my heart this summer. But what you might not know is that only in April, she was told her life was in peril. She went through surgery, she fought back, she recovered. And only 119 days after she left the hospital, she won Paralympic gold.

Beatrice Vio, Bebe, has overcome so much, so young. Her story is one of rising against all odds. Of succeeding thanks to talent, tenacity and unrelenting positivity. She is in the image of her generation: a leader and an advocate for the causes she believes in.

And she has managed to achieve all of that by living up to her belief that - if it seems impossible – then it can be done. Se sembra impossibile, allora si può fare.

This was the spirit of Europe's founders and this is the spirit of Europe's next generation. So let's be inspired by Bebe and by all the young people who change our perception of the possible.

Who show us that you can be what you want to be. And that you can achieve whatever you believe. This is the soul of Europe. This is the future of Europe. Let's make it stronger together.

Viva l'Europa. ■

Ursula von der Leyen is President of the European Commission

This article is based on the 2021 State of the Union Address, 15 September 2021

Climate change mitigation via trade policy

There is a need to limit greenhouse gas emissions. André Wolf considers the potential and challenges of environmental protection in trade agreements

With his announcement of a radical turnaround in climate policy, US President Joe Biden has already sent a clear signal shortly after taking office. His concept for achieving the long-term goal of a climate-neutral US economy envisages not only national measures but also a new form of climate diplomacy, which should explicitly include the inclusion of climate issues in international trade agreements.

In parallel, there have been calls in the European Union to flank its own intensified climate protection efforts in the future with trade policy measures, specifically a CO_2 border adjustment.

In order to be able to evaluate the chances of success of such a combination of trade and climate policy from an economic point of view, it is necessary to address the questions of which climate effects emanate from cross-border trade and how possible control instruments work.

From economic theory, no clear effect of trade liberalization on the global emission of greenhouse gases can be derived. Basically, three types of partially contradictory impact channels are distinguished: scale, composition and technology effects (Charnovitz, 2010).

The scale effect manifests itself in the short term in that additional sales potential abroad directly enables improved utilization of domestic production resources. In the medium term, additional growth potential results from increased capital accumulation and productivity gains, as has been widely documented empirically as an effect of trade openness (Wacziarg & Welch, 2008).

Such trade-induced economic growth, taken in isolation, would imply not only an increase in absolute emissions in goods production but also in international transport. However, the purely expansionary effect of trade can be

overridden by compositional and technological effects. One important question is how, in a specific case, trade opening affects the specialization of individual trading partners in more or less emission-intensive goods.

If national regulatory regimes differ in their stringency with regard to CO_2 emissions, it is likely that countries with dirtier technology will see their comparative cost advantage in more emission-intensive traded goods and, with improved export opportunities, will shift additional resources to their production.

As a consequence, comparative specialization can lead to a spatially disadvantageous distribution of international production of these goods in terms of climate policy, which is not compensated by a spatially reverse shift in the case of more climate-neutral products.

... the new US administration has the opportunity to put into practice its declared will to resume multilateral efforts

This would lead to an overall increase in transnational greenhouse gas emissions and at the same time to an increased shift to countries with underdeveloped abatement technology. Technology-related differences in emissions intensity between poorer and richer industrialized countries could thus be exacerbated in the course of an expansion of trade.

In such an environment, national climate policy threatens to fizzle out, since efforts to limit greenhouse gas emissions at the national level are not only counteracted to a certain extent by an outflow of emissions activity abroad (carbon leakage), but also weaken the competitive position of the country's own companies. This reduces the incentive to implement ambitious climate targets.

This has generated calls for trade policy corrective measures that extend the politically targeted internalization of climate externalities to imported goods. Customs policy offers itself as a direct control instrument.

The concept of a CO_2 border adjustment, which is currently planned at the EU level, provides for the customs clearance of imported goods depending on their CO_2 footprint. This is intended to guarantee that domestic companies burdened by emissions regulation measures do not experience a cost disadvantage compared to foreign exporters, while at the same time avoiding carbon leakage. The positive incentive effects of an emissions-based cost burden on investments in green technologies could thus ideally be transferred to foreign producers.

Economic research is divided in its assessment of the climate policy effectiveness of this instrument. Elliott *et al* (2013) conclude that the introduction of a CO_2 tariff significantly amplifies the global emissions effect of national climate policies in rich countries and does so more strongly the higher the CO_2 taxation for domestic firms in these countries.

In contrast, Larch & Wanner (2014) conclude that global CO_2 emissions would increase as a result of the tariff. The reason for this is the higher relative emission intensity of the import sectors in countries with higher emission taxation: the despecialization that sets in during the course of the tariff introduction thus exerts a detrimental influence on the global use of resources from a climate protection perspective.

On the other hand, the literature agrees that the introduction of such an instrument is accompanied by considerable global distributional effects, which are initially counterproductive from a development economic point of view: poorer countries are on average more affected, due to the higher CO2 intensity of their industrial exports.

The global costs of emissions avoidance thus decrease only to a limited extent, as they are to a large extent merely passed on to poorer countries (Böhringer *et al* 2018).

Moreover, there are question marks from both a legal and a practical point of view. Legally, compatibility with WTO statutes is at least not obvious. This applies in particular to the principle of equal treatment of foreign and domestic companies and the most favoured nation principle.

The concrete form of the agreement is likely to be decisive. For example, the tariff burden must not be based on the source of origin, but on concrete product characteristics, for which the same criteria should also be used for domestic and foreign companies (Moore, 2011).

The fundamental question, however, is first whether CO_2 emissions can be used as a characteristic for differential treatment. And if so, may such a differentiating characteristic be applied only to the comparison of different products or also to different production processes for one and the same product?

From a practical point of view, the question of a suitable assessment basis arises. Against the background of today's international value chains, the quantification and allocation of greenhouse gas emissions turns out to be extremely complex and thus a sure source of dispute.

This is especially true for the question of how to deal with emissions from the production of intermediate inputs. A common recommendation is therefore to initially limit tariff collection to a few energy-intensive sectors of primary industry, such as steel, cement or aluminium (Delbeke & Vis, 2020). But even then, it is still open to what the assessment is spatially oriented.

With regard to the climate policy steering effect, it would make most sense if the emissions occurring in production in the exporting country were used in the tariff assessment for the good crossing the border.

From the point of view of the importing country, however, this would require a high level of information on the energy intensity and energy mix of production in the country of origin, and also harbours potential for conflict with regard to the resulting tariff differences between trading partners.

Alternatively, the emissions intensity in the importing country or even a global average value could be used as a basis. Although this would solve the above-mentioned problems, it would not have the same steering effect in terms of costs.

And above all, from a dynamic point of view, this would not provide an incentive for exporting countries to invest in the adoption of more emission-neutral technologies. All these are reasons why, at the international level, the CO_2 tariff has not yet progressed beyond the conception phase (Mehling *et al* 2019).

Hence, it seems more promising to integrate climate policy goals into trade policy through bilateral and multilateral channels, for example as integral components or ancillary provisions of regional trade agreements.

A wide range of options are available for this. For example, it is possible to agree on the mutual dismantling of trade barriers on goods that play a major role in the transformation of the energy supply toward climate neutrality, such as wind turbines and solar cells.

In addition to tariff dismantling, this can also involve non-tariff barriers, for example in the form of harmonization or mutual recognition of test standards in approval procedures. However, agreements can also relate to more far-reaching aspects beyond trade policy.

Specific target agreements could be reached on increasing energy efficiency or the share of renewable energies in the participating economies.

Trade agreements could also be a suitable vehicle for committing partner countries to a roadmap for the orderly reduction of national subsidies on fossil resources that avoids distortions of competition.

Conversely, legal certainty for the transformation of energy supply could be increased via recognition of existing national support systems in the area of renewable energy sources.

Finally, another aspect that has often played an important role in recent rounds of negotiations is public procurement. Bilateral acceptance of environmental and climate protection standards as a criterion in public procurement could be a means of defusing the ongoing debates on non-discriminatory market access in terms of climate policy.

Historically, the North American Free Trade Agreement NAFTA is considered to be the first regional trade agreement with a concrete reference to environmental protection. In a side agreement, the establishment of a commission for cooperation on environmental protection issues was agreed and the contracting states were granted the right to take trade-restricting measures in connection with obligations under international environmental agreements.

In the EU's trade policy, environmental protection requirements are present, among other things, in the form of special incentive arrangements in the Generalized System of Preferences (GSP), which unilaterally grant trade preferences to developing countries.

In contrast, recent regional trade agreements have offered little innovation from a climate perspective. Although the idea of climate protection is always present in the language, there is a clear lack of binding regulations.

For example, neither the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) nor the EU-Canada Comprehensive Economic and Trade Agreement (CETA) contain binding agreements on tariff reductions on environmental goods, reduced subsidies for fossil technologies, or harmonization of environmental standards. Instead, the treaty texts are dominated by general declarations of intent on future climate policy cooperation and compliance with existing climate agreements.

Only the EU-Singapore FTA at least includes the issue of subsidy reduction as an explicit goal, although it also does not specify concrete steps to achieve the goal (Fisher *et al* 2019).

In the worst case, these agreements could even limit the future scope for national climate policy, as the now common regulations on investor protection in principle give foreign companies the opportunity to sue via an external dispute settlement mechanism against what they see as discriminatory tightening of environmental law.

The same may apply to future agreements on the protection of intellectual property rights for internationally traded goods if they are designed to undermine the transmission of green technologies.

From a global perspective, future regional trade agreements will be able to make an effective contribution to climate protection if they prove to be successful test laboratories for innovative climate protection efforts, without relying on compartmentalization in their structure. Only in this way is there potential for expanding new regulatory regimes to the multilateral level.

At the same time, transparency must be created as to which trade-related measures really serve climate goals and which are merely disguised protectionism. This is particularly important to prevent the existing rifts between rich and poor countries in trade policy from widening even further.

At the WTO level, this would require finally arriving at a generally binding definition of the term environmental goods and associated special regulations. In this respect, too, the new US administration has the opportunity to put into practice its declared will to resume multilateral efforts. ■

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Why technology shapes European power

Ulrike Franke and José Ignacio Torreblanca consider the role of technology in shaping international relations and argue that the EU needs to engage with the geopolitical implications of technology

Summary

- New technologies are a major redistributor of power among states and a significant force shaping international relations.

- The European Union has for too long seen technology primarily through an economic lens, disregarding its implications for its partnerships and for its own geopolitical influence.

- If the EU wants to be more than a mediator between the two real technological powers, the United States and China, it will need to change its mindset.

- For the EU and its partners, the vulnerabilities created by battles over technology divide into two types: new dependencies and openness to foreign interference.

- The EU and its member states need deeper engagement with the geopolitical implications and geopolitical power elements of technology.

- This engagement has an external element of reaching out to partners and an internal element of ensuring close cooperation between the EU and its member states.

Introduction

The European Union has unveiled the world's first plans to regulate artificial intelligence (AI). The publication of the rules is part of a frenzy of EU tech regulation and strategies: there is also the Digital Services Act, the Digital Markets Act, the Digital Decade, the Cybersecurity Strategy, the Data Strategy, and more.

Most importantly, the AI regulation follows the implementation of another major EU technology regulation that anyone who accesses the internet has encountered many times: the 2018 General Data Protection Regulation (GDPR). The EU is doubling down on its role as a regulatory superpower.

Technology regulation may sound like (and, to some extent, is) a boring topic that should chiefly concern legal experts. But technology has found its way onto geopolitical battlegrounds. Throughout history, technology has not only transformed economies and societies but also been a major redistributor of power among states and a significant force shaping and reshaping international relations.

New technologies can massively boost a country's economy and, therefore, global influence. They can enable capabilities that provide a country with military advantages or even dominance. And the values and standards that tech products embody are determined by whoever manufactures them.

But the EU, for all its pathbreaking work on regulation, does not appear to have fully recognised just how geopolitical technology can be – or how geopolitical the current generation of emerging, primarily digital, technologies has become. At the 2020 Munich Security Conference (the last one before the pandemic), it was painfully obvious that the EU was widely considered to be – at best – a mediator between the two real technological powers, the United States and China.

Since then, some things have changed. For one, technological competition between the US and China is increasingly fierce. The US has imposed export controls on semiconductors, aiming to cut off China's supply lines, and has pressed its allies worldwide to kick Chinese companies out of strategic markets, such as 5G.

A recent report by the US National Security Commission on Artificial Intelligence mentions China a whopping 699 times (Europe appears 93 times; Russia 64). Meanwhile, China's central government wants Chinese AI to be the world's undisputed leader by 2030. And Chinese President Xi Jinping is pressing for greater independence from global supply chains. A fight for technological spheres of influence is playing out before our eyes, and the rhetoric around it is getting more heated.

It is crucial for Europe to recognise and consider the international second- and third-order effects of any actions it takes in the technological space

In Europe, there has been some encouraging movement. The EU has begun to speak more forcefully about *"digital and technological sovereignty"*; the European Commission has laid out a strategic vision or *"digital compass"*; the European External Action Service has started regarding technology, connectivity, and data flows as a key dimension of the EU's external relations and partnership agreements; and a few member states' foreign ministries have begun producing strategies on the geopolitical dimension of technology.

More recently, the European Council has called for a *"geostrategic and global approach to connectivity."* And the US and the EU are looking into increased tech cooperation – most notably in the form of the Technology and Trade Council, which they announced at their June 2021 summit.

Nonetheless, Brussels and most member state capitals remain primarily focused on the economic, social, and labour implications of technology – almost as if they believe that, by ignoring tech geopolitics, they can escape it altogether.

But the technological is geopolitical. States might not need to care about who owns the technology in a market-orientated, rules-based world order governed by solid multilateral institutions that enforced international norms.

They could expect market forces and open and accessible global supply chains to take care of their technological needs, be it in the production of semiconductors or the construction of global networks to connect users to the internet.

Technological sovereignty becomes an existential question when the global market is hijacked by state actors, multipolarity and unilateralism replace multilateralism, and great powers turn interdependencies into vulnerabilities as they seek to set up spheres of influence.

European countries and their partners risk becoming playgrounds of technological competition between great powers, which attempt to coerce them into joining a bloc.

Countries could become economically dependent on others for key technologies, leaving them unable to influence standards in a way that corresponds with their values and even subject to direct foreign interference. Geopolitically speaking, technology is not neutral.

This is not just about Europe standing its ground – or choosing sides – in the Sino-American competition, which is what most European analyses now focus on. It goes beyond that. In fact, Europeans largely overlook two issues. Firstly, all EU action – and inaction – on tech has consequences that reach beyond the union. The EU has a long history of ignoring, and being surprised by, the external implications of its actions.

For instance, this was the case with the Common Agricultural Policy, which – despite being devised as a way to balance the Franco-German relationship – had huge global implications; the Ukraine Association Agreement, whose dramatic geopolitical consequences were not fully anticipated by EU policymakers; and, more recently, the GDPR, whose global impact was not foreseen by EU regulators.

Policymaking within the EU is so complicated and inward-looking that little time and space is left for anticipating the impact of EU regulations on external actors or, even more ambitiously, thinking strategically about which countries or regions may want to partner with the EU to pursue similar goals.

However, the sheer size of the EU's internal market means that external actors often have no option but to comply with EU rules even if they dislike them, see them as problematic and costly to implement, or had no role in their creation.

The EU rarely acknowledges ahead of time how its actions will affect non-EU states. When it does, this usually involves a positive reading of the *"Brussels effect"* – the idea that EU regulation, through the weight of the bloc's market, will automatically become a model for other powers.

European leaders often portray the Brussels effect as automatic, an almost magical occurrence rather than something that requires further thought. Generally, they pay little to no attention to second- and third-order effects on other players.

Secondly, the EU puts too little thought into the way in which its internal actions – or lack thereof – influence its geopolitical power, since this is a metric that rarely comes up in any European discussions. For others, AI means power: the US National Security Commission on Artificial Intelligence defines its own role as being to *"prescribe actions to ensure the United States wins the AI competition and sets the foundation to win the broader technology competition."* Russian President Vladimir Putin famously declared that whoever becomes the leader in AI *"will become the ruler of the world."*

But the EU, and most Europeans, do not think in these terms. This is partly due to issues of competency, but even more to the way the EU sees itself: despite much rhetoric on a *"geopolitical union"* – and the high representative for foreign affairs and security policy's insistence that the EU has to *"learn to use the language of power"* – Brussels remains largely uncomfortable with power politics.

The EU's ethos is that of a market-driven, technocratically led entity that, from the start, has left 'high politics' (security and defence) in the hands of member states. This means that the European Commission sees the world in terms not of power, coercion, or relative gain but as a game of market regulation.

Most member states are no different: on technology, few of them have picked up the geopolitical baton. It is possible to see this as one of the many civilisational advances of the EU – and these authors are not advocating that the EU take an adversarial, competitive stance – but the fact remains that, if Europe is not interested in geopolitics, geopolitics is interested in Europe.

The European Council on Foreign Relations is focusing on this external and geopolitical dimension of the development, adoption, and regulation of technology in Europe. In this dimension, it is important – and often necessary – for things to work at home: Europe needs to improve its connectivity; support its start-ups and established firms; invest in research, talent, and digital skills; strengthen its digital infrastructure; and more.

But, broadly speaking, the EU and European experts are paying enough attention to these issues. What they overlook are the geopolitical implications of technology, which are playing out on many battlegrounds and creating two main types of vulnerability.

Battlegrounds of vulnerability

Battles over technology are being fought in a growing number of arenas and are creating ever more vulnerabilities third countries can weaponise. The following assessment, therefore, only provides a snapshot of some of these battlefields, but it explains the origins of these vulnerabilities – which, generally, divide into two types: new dependencies and openness to foreign interference.

New dependencies

Countries around the world are pursuing AI, 5G, additive manufacturing, and other new technologies primarily because they promise to yield significant economic gains. Some of the ways in which governments try to support their domestic industries are already leading to concerns over protectionism and even techno-nationalism.

For example, on 5G, the effect of China's protected home market advantage is making Chinese telecoms giants almost unbeatable in third-country markets, creating an uneven playing field.

Geopolitically, these economic divergences are less important than the dependencies that result from particular states leading – or having monopolies – on some technologies. Such dominance can empower a state to give or withhold technologies from others, to pressure them to do its bidding, or to use these dependencies to force others to align or otherwise change its foreign policy.

Members of the EU need to be wary of technological dependence on non-EU providers, particularly non-democratic states – or else they will become digital colonies of others. If Europe loses ground on technologies, it could also lead to European partners finding themselves dependent on other actors, as others fill the gap left by Europeans.

Achieving technological sovereignty is, therefore, crucial for states that want to enjoy foreign policy autonomy. Two forms of critical infrastructure are of particular interest to the EU in this context: 5G and submarine cables.

5G independence

Europe's choice of vendors for the roll-out of 5G was at the centre of the first heavily and openly contested geopolitical struggle over a technological development since the end of the cold war. The US, under President Donald Trump, made the exclusion of Chinese suppliers from future European network infrastructure a test case for the transatlantic alliance. In many European capitals, Washington employed a 'with us or against us' logic that had a huge impact on an area previously deemed to be merely a commercial decision for European telecoms operators. The 5G debate thereby served as a geopolitical wake-up call for many EU member states in their thinking about technology.

Some, however, are still refusing to make hard choices on 5G, or are even continuing to play along with Chinese connectivity strategies and initiatives.

One odd feature of the debate is that, in fact, Europe is well placed on 5G – it has two companies that are global leaders in the area (to the extent that they are unrivalled even by US suppliers) and it could move to secure its 5G independence at a relatively low cost if it allocated additional resources to the task.

But, for Europeans, the debate demonstrated for the first time the importance of access to competitive tech players. And this remains an important topic for Europe, since the development of the telecoms industry is continuing with 6G.

Undersea cables

Submarine cables are essential to the functioning of all digital sectors. Ninety-seven per cent of internet traffic and $10 trillion in daily financial transactions pass through these cables.

Broadly speaking, the greater the number of undersea cables and the routes they provide, the swifter and stabler the internet access for the countries they connect – and, therefore, the lower the risk of interruptions that could lead to a digital network collapse.

In the last few years, Chinese and American companies such as Huawei, Amazon, Microsoft, Google, and Facebook have increased their presence in the market for undersea cables linking both European and non-European Mediterranean states to parts of the world such as Asia and Africa.

European companies have adapted to this situation by forming consortia to compete with American or Chinese international groups. The EU lacks an all-encompassing strategy for a sector in which individual governments are still the key players.

However, an initiative such as the BELLA submarine cable – which links Europe and Latin America, and will boost data-driven business, trade, education, and scientific research between the two regions – is a good example of how the EU can get it right by using its budget to support private-public cooperation in this key area.

If the EU fails to project its power in the Mediterranean, other global players will fill this space and create dependencies for Europe and its partners. These players will be able to penetrate the digital economy of Middle Eastern and African countries, to the detriment of European economic interests.

Furthermore, there are also security risks associated with undersea cables. Companies often potentially have access to the data transmitted by the cables they manage.

In this scenario, the physical protection of this type of infrastructure is likely to become increasingly difficult for the EU and for all organisations involved in the sector. Physical damage to this infrastructure could be catastrophic.

Setting standards

The process of setting technology standards is a subtle way to create dependencies. These standards, once set, can be difficult or costly to change. Unbeknown to most members of the public, there is a race on to set the standards on which digital infrastructure will run.

Initially, the US mostly set up and administered digital standards, either publicly or via private firms. After a while, and with the support of the EU, countries 'multilateralised' technical standards to include stakeholders and government actors from third countries. This has largely served European interests well. Now, as globalisation fragments and China and the US decouple, the battle over technical standards has become critical.

If the EU does not set its own standards, it will be forced to adopt standards made by others – who may not share its values. Governance of the internet, including technical governance, is becoming increasingly bifurcated; the danger is that countries will be forced to choose between adopting the standards of a US internet or a Chinese internet, and to thereby give up access to the other market.

Artificial intelligence is one area in which an important standard-setting process is currently taking place. The EU chose early on to prioritise trustworthy or ethical AI. An EU high-level expert group developed ethics guidelines for trustworthy AI in 2018, and has since made policy and investment recommendations for trustworthy AI.

The bloc's new AI regulation emphasises that it aims to become *"a global leader"* in the development of trustworthy and ethical AI, and concern about unethical AI is shared throughout the union.

If no ethical standards are established, AI-enabled systems could create or reinforce biases without allowing for any appeal or rectification. There might be no limitations on states' misuse of AI to, for example, control populations.

Individuals' lives could be destroyed or severely curtailed by opaque AI- enabled systems in areas such as the judicial system, law enforcement, or credit ratings. People would be unprotected from manipulation through AI-enabled disinformation.

While such developments might slightly hamper the adoption of AI, states would still likely use these systems extensively, creating an AI-enabled dystopia.

Alternatively, if the EU does not act, others will impose their AI standards. Many actors, including private firms, are already working on rules for ethical AI. Should they develop and promote these rules sufficiently, the EU would be reduced to following standards that it could not influence.

As such, there is a substantial upside for the EU if it gets trustworthy AI right. By ensuring that AI developed in the union is trustworthy, Europe can provide benefits to all users of AI-enabled systems.

Ensuring that all AI-enabled systems used in the EU are ethical is directly beneficial for Europeans, who can trust that their technologies will not be biased, illegal, or otherwise harmful.

This is likely to encourage and, therefore, increase AI adoption rates, which one can expect to have a positive economic impact. If the EU succeeds in encouraging others to adopt trustworthy AI standards, this would further widen the circle of beneficiaries.

Even better would be if the EU established itself as a leader in ethical AI, prompting others to follow its regulations. This would ensure that the ideals that Europeans value would be adequately reflected in AI systems.

Furthermore, the EU could gain a location advantage – meaning that, because of its leadership on ethical AI, *"AI made in Europe"* would be widely seen as following the highest standards, thereby becoming a sought-after commodity.

Another area of standard-setting is data privacy. Few topics are as important to the EU's self-image as the protection of individual privacy. The EU made history with its GDPR regulation – which has changed the way that millions, if not billions, of people engage with the internet.

But guaranteeing that everybody can be free in the digital realm is an ongoing effort. Privacy is under threat from state actors and private firms, which are fighting efforts to curb their access to private data.

If the EU fails to secure data privacy, its citizens will see their data flowing out of Europe, treated according to the lowest privacy standards available, and used to feed the AI industrial development and surveillance capacity of third countries and their companies. Europeans' fundamental rights would be damaged, and European firms would lose their competitive edge, market opportunities, and revenue.

Apps with lax data privacy standards developed by third countries – most often authoritarian states such as China – are already collecting enormous amounts of Europeans' data, which may be used for surveillance, coercion, and aggressive marketing techniques. The EU's failure to act would aggravate these problems.

The worst-case scenarios of digital surveillance and surveillance capitalism running wild are truly dystopian. People risk being tracked in every aspect of their lives and being influenced without realising it – be it in buying certain products or voting for certain political actors.

If the EU does not export these regulations and ensure that the global governance of data is regulated according to European-like standards, its citizens will not be fully protected.

At the same time, billions of people will lose their rights to privacy. Surveillance regimes would be strengthened, and democracies weakened. This could undermine and even destroy the democratic process and embolden authoritarian regimes.

Foreign interference

Technologies can create not only dependencies but also direct ways for states to interfere with others.

The EU will need to protect itself against such interference – but should also keep in mind that it may be able to utilise these tools itself.

Disinformation and securing democracy

Back in 2010, at the time of the Arab uprisings, the belief was that the internet would help democracy spread and consolidate across the globe. A decade later, Freedom House is reporting a sustained global decline in democracy, and the World Health Organization is using the word *"infodemic"* to characterise the influence of disinformation on the COVID-19 crisis.

Contrary to the expectation that the open, horizontal, and decentralised nature of the internet would help citizens connect with each other and push for democracy, authoritarian governments have successfully mastered digital technologies to enhance their power and control over their citizens, help other authoritarian or illiberal governments control and repress their citizens, and undermine democracies.

While citizens in established democracies have lost faith in democracy and supported populist or illiberal forces, authoritarian regimes have turned social media and digital technologies into effective tools of surveillance and social control, suppressing democratic opposition.

Social media companies' business model of advertising to captive audiences and harvesting user data has led to an economy of attention that prizes emotion, increases political polarisation, and erodes trust in institutions.

And, because of a lack of adequate regulation, these companies are vulnerable to foreign influence operations and electoral interference designed to fuel extremism, undermine citizens' trust in political institutions, and suppress criticism of authoritarian regimes.

However, the problems of disinformation and the use of emerging technologies for interference in the political process go beyond social networks. AI-enabled *"deepfakes"*, for example, have already been used to trick EU politicians, a tactic that one can expect to become an ever-greater problem.

Unless democracies curtail foreign influence operations and electoral interference, they risk decline as more and more voters lose trust in political institutions. Citizens might stop supporting democracy – at home and abroad – and human rights promotion policies, alliances of democracies, and rules- based multilateral solutions to world problems. All this could lead to a values-free EU foreign policy.

At the same time, authoritarian regimes could tighten their grip on their citizens by showing them that democracy is not a model they should aspire to. If democracy and liberal values lose their pre- eminence, this will undermine the liberal multilateral order – helping authoritarian regimes capture or weaken global governance institutions.

Much as authoritarian governments export AI surveillance technologies to like-minded partners and allies, the EU should, apart from protecting democracy at home, provide struggling democracies abroad with the technology to protect their public sphere and elections.

Military and defence

There have been moments in history when warfare changed because of the introduction and innovative use of new military technology. From the crossbow to gunpowder, tanks to nuclear weapons – when technologies are introduced and used in novel ways, they can have a fundamental impact on how wars are fought, militaries are organised, and strategies are developed.

New technologies, particularly AI, might initiate such a fundamental change. Artificial intelligence can enable new types of military systems in everything from logistics and sustainment to cyber operations and autonomous weapons.

The adoption of AI in the military realm could change the global balance of power, by giving new actors decisive military capabilities. Military AI is emerging as a new frontier for great power rivalry.

If Europe does not address the changes in warfare that AI is likely to bring about, it will become vulnerable to new forms of attack. In the worst-case scenario, Europe's defences could be fundamentally compromised (through, for example, the erosion of nuclear deterrence).

European countries' interoperability with the US, their most important NATO ally, would be weakened and their opponents militarily emboldened. Even if it avoids this scenario, Europe will be unable to shape the debate on the use and possible regulation of AI-enabled military systems if it avoids the issue.

In contrast, by engaging with the military applications of new technologies such as AI, the EU could strengthen its capabilities, thereby helping guarantee the safety and security of its citizens. Europe's military-industrial base could receive a boost through work on cutting-edge technology.

AI-enabled capabilities could become an important area of cooperation between European companies, thereby strengthening common European defence.

Working with allies to streamline the use of AI within NATO would not only guarantee a continuation of interoperability but could also improve interoperability between allied forces – through the use of AI-enabled command and control.

Finally, by engaging in the debate on the military applications of AI, Europe could help mitigate the most problematic uses of systems such as lethal autonomous weapons.

What Europe needs to do

ECFR has put forward recommendations on how to address all these sources of vulnerability, from 5G and undersea cables to military AI. The EU needs to improve its data sovereignty by adopting strict regulations on data privacy and ensuring that these are exported to countries and companies that access Europeans' data.

EU member states should create an ecosystem in which smaller 5G players that focus on software and virtualisation can scale up their operations and cooperate effectively with larger European and US companies.

The EU should heavily invest in exporting technologies and practices that protect democracy and help achieve technological sovereignty, and in learning from others' experiences in this realm.

But more important than these individual fixes is deeper engagement with the external implications and geopolitical power elements of technology. This engagement has an external element of reaching out to partners and an internal element of ensuring close cooperation between the EU and its member states.

Outreach to partners

The EU needs a global strategy for improving its partners' access to reliable and safe technology. Otherwise, the bloc will leave a space that others will fill. Democracies would be further weakened and impoverished. Autocracies would thrive. Europe would be wrong if it thought it could set out its own rules and standards and let the rest of the world adapt.

The Brussels effect, by which Europe silently exported its data privacy regulation to the rest of the world, will not easily repeat itself. GDPR happened when technology was still under the geopolitical radar. Now, technology has been (geo)politicised and both governments and industry actors know how closely intertwined power, technology, and regulation are.

Both China and the US are reaching out to third countries. The US has programmes such as The Clean Network, which aims to help its allies end their use of Chinese 5G. The Chinese Belt and Road Initiative includes a digital component. And Chinese firms, with governmental support, export facial recognition and surveillance techniques to autocracies around the world.

The challenge for the EU is in working with like-minded countries and multilateral bodies – such as the Organisation for Economic Co-operation and Development (OECD), but also regional arrangements such as those in Latin America, Africa, and the Indo-Pacific – to develop fair, open, and values-driven technological standards.

The EU should deploy the incentive of access to its digital market to strengthen its alliances. The bloc should use its financial institutions to incentivise EU firms to invest in countries that are seeking to adopt these critical technologies but, at the same time, want to reduce their technological dependence on China.

The EU should also consider establishing a comprehensive and compelling tech package that would allow it to become a geopolitical player in the area.

This 'tech compact' should include: upgrading existing or prospective trade agreements to grant improved access to the EU digital services market to countries that comply with EU standards in areas such as data flows, privacy, and AI; offering technical assistance to governments and parliaments wishing to align with the EU on regulatory issues; offering funding guarantees for connectivity investments; coordinating positions on technical standards in multilateral organisations; and offering cyber security and democracy-protection packages.

In contrast to other great powers, whose tech offers are often based on coercion and the exploitation of weakness, the EU should stand for a principled approach based on partnerships, mutual interests, consent, and solidarity.

Also, as it is already doing, the EU should continue scanning its internal market for vulnerabilities in critical technological sectors, identifying high-risk vendors, and ensuring reciprocity in market access to these technologies for countries that restrict or curtail digital trade.

It will not be sufficient for the EU to merely approve internal regulations in the expectation that others will accept them, such as in the case of the GDPR. For example, the bloc is already operating on bilateral agreements with like-minded countries such as Japan to implement data privacy clauses that ensure the free and safe flow of data. But this is not enough in itself.

The EU should aim higher – through multilateral institutions such as the OECD and the International Monetary Fund, or through groupings such as the G20 – to establish a global data privacy regime whose standards are valid for most democracies, if not for all countries (as those ruled by authoritarian regimes may opt out).

A key component of this is the transatlantic relationship. A major agreement on data privacy with the US would help break the current dynamic of regulatory fragmentation, helping both the country and the EU jointly take on China and other illiberal regimes.

The importance of cooperation between the EU and its member states

The European Commission and other Brussels institutions are positioning the EU as a powerful actor in the global debates about tech regulation. But not all member states appear to feel the same sense of urgency.

As of today, 21 member states have now published AI policy documents in which they identify areas of focus, develop recommendations, and decide funding priorities.

These strategies reveal that most EU member states primarily see AI through an economic lens. Almost all the strategies were written by or under the leadership of economics ministries (or variations thereof) or, less often, ministries of innovation.

With very few exceptions – such as France – most EU countries do not engage with the challenges posed by the way that the development and use of AI might affect the international balance of power. Even fewer discuss or even mention the impact of AI on defence.

If the EU moves forward on technology issues without the support of its member states, it risks losing credibility and the capability to influence others. Worse, it could leave empty spaces in Europe that external actors fill. But, if the EU and its member states work together closely on technology issues, the bloc will be strengthened – and will lead by showing that its rules and regulations, such as those on privacy or trustworthy AI, work at home. In this, the EU can benefit from member states' diplomatic reach in various regions.

It is crucial for Europe to recognise and consider the international second- and third-order effects of any actions it takes in the technological space. It needs to acknowledge that these actions have an impact on its geopolitical power.

They influence the EU's soft power as a role model, its positioning relative to other major players' plans, and its geopolitical room for manoeuvre. ■

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Public finances in the EU

COVID-19 has led to governments borrowing at unprecedented levels. Mehmet Burak Turgut discusses EU government finances as well as relevant policy priorities to ensure healthier public finances in the future

The COVID-19 pandemic, which broke out in March 2020 and continued through subsequent waves in fall 2020 and spring 2021, resulted in a fallout in the global economic activity and world output contraction by 3.3% during the last year, as shown by the recent IMF survey.

The losses in the output led to lower income and revenues of the taxpayers, which in turn diminished the tax revenue generating capacity of the governments. At the same time, the governments responded to the crisis with extensive fiscal support measures, amounting to more than USD13 billion globally[1]. These increasing expenditures paired with decreasing tax revenues pushed the governments to borrow at unprecedented levels, causing a huge spike in global public debt.

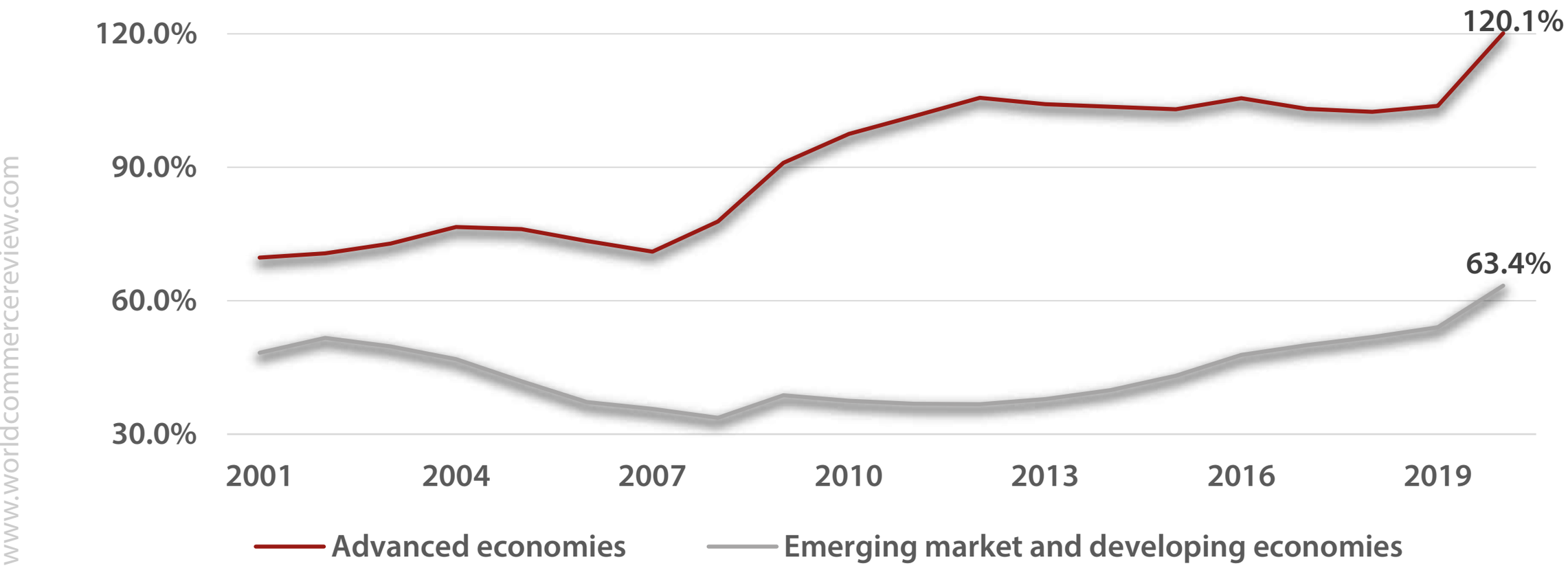
Figure 1 depicts the evolution of debt-to-GDP ratio over the last two decades for advanced (in red) and emerging market and developing (in grey) economies. The impact of the pandemic is visible for both groups – the debt-to-GDP ratio increased by 16.3 pp y/y for advanced economies and by 9.3 pp y/y for emerging market and developing economies, reaching, respectively, 120.1% and 63.4% in 2020.

During the same period, government expenditures increased, respectively, from 38.6% to 47.4% and from 31.0% to 34.0% of GDP with the government revenues halting at 35.0% and 26.0% for advanced and developing economies[2]. The higher borrowing needed to finance the increasing expenditures during the pandemic time thus fuelled the debt and elevated global government indebtedness to unprecedented levels.

The European Union perspective

The governments in the European Union swiftly responded to the COVID-19 pandemic with substantial fiscal measures. As of April 2021, the sum of the EU-wide announced support amounted to more than €4.6 billion[3],

Figure 1. The debt-to-GDP ratio in advanced and developing economies



Source: International Monetary Fund Fiscal Policy Responses to COVID-19, January 2021.

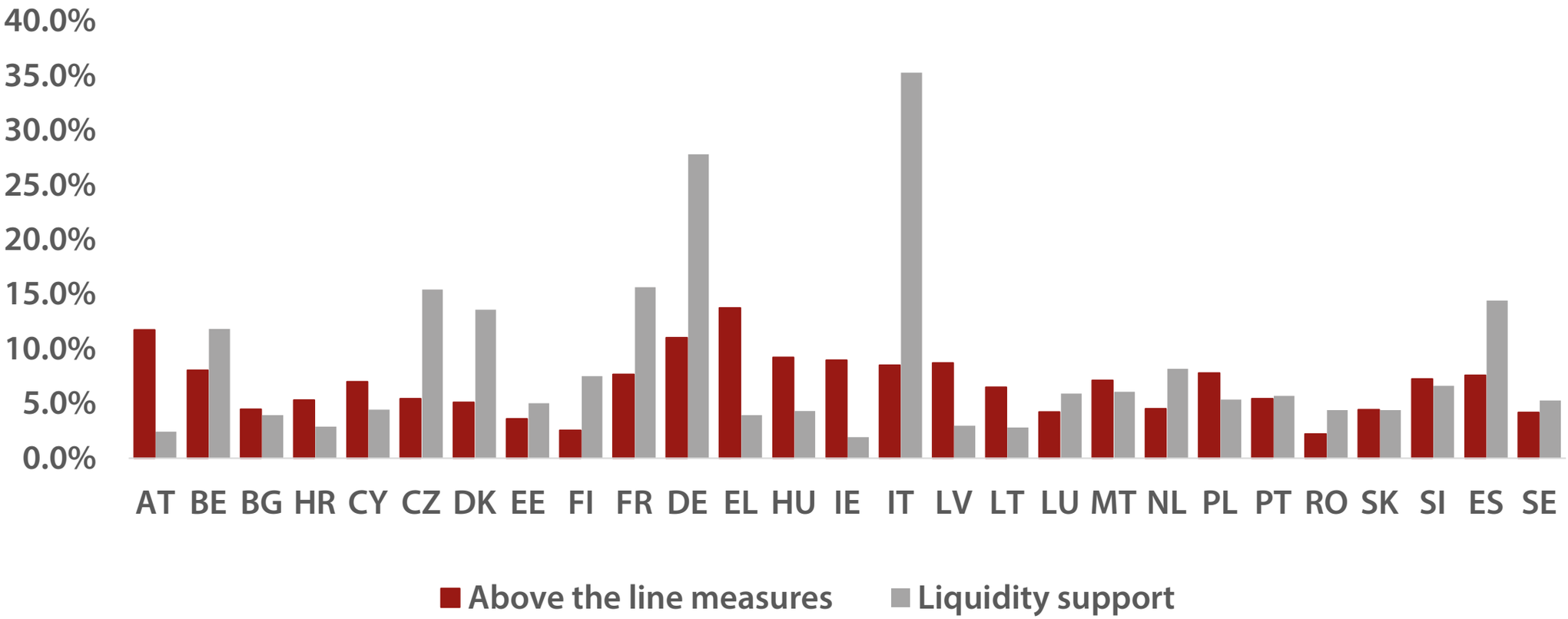
including €1.7 billion above-the-line measures such as additional spending or foregone revenues as well as liquidity measures mostly in the form of loan guarantees and asset purchases.

Figure 2 shows the distribution of these fiscal support measures throughout the EU member states (MS) as a percentage of GDP. The liquidity measures largely surpassed above-the-line measures in the four largest EU economies – Germany, France, Italy, and Spain – as well as Belgium and Czech Republic.

On the contrary, additional spending or foregone revenues highly exceeded liquidity measures in Austria, Greece, and Latvia. The allocation of fiscal support between the above-the-line and liquidity measures was balanced throughout the rest of the EU member states.

...the governments [in the European Union) responded to the crisis with extensive fiscal support measures

Figure 2. The fiscal support measures in the EU



Source: Author's own elaboration based on data available at Eurostat.

The scale of the national measures varied among the MS – from 8.2% in Croatia to 43.7% in Italy. Besides the individual country actions, the EU also introduced support measures from the Union's budget that made up approximately 10% of total EU GDP for year 2020[4].

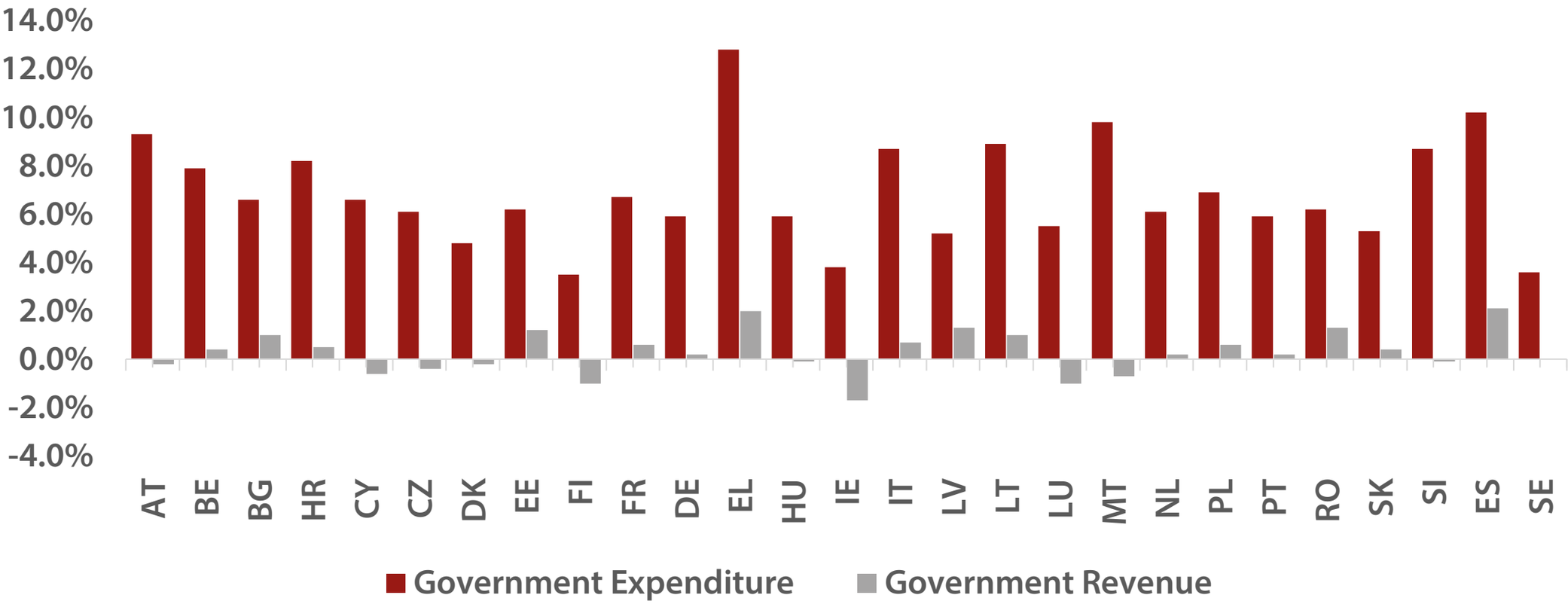
How have these fiscal support policies affected and will affect the finances of the governments in the EU? The majority of the liquidity support measures is in the form of guarantees and the impact of these contingent liabilities on public debt depends on the extent to which the guarantees will be activated.

Moreover, some parts of the above-the-line measures will be unfolded throughout 2021 and 2022 and may require additional amendments subject to the progress of economic recovery which means that their real impact on public debt is not yet certain.

Figure 3 shows the changes in the government expenditures and revenues of the EU member states measured as their share of GDP between 2019 and 2020. The government expenditure-to-GDP ratio increased in all MS in 2020 with y/y changes ranging between 3.5% (Finland) and 12.8% (Greece) throughout the EU. The automatic stabilizers and discretionary fiscal measures used to stabilize the economy in the wake of the pandemic are the main reasons behind the higher government expenditure-to-GDP ratio in the EU.

On the other hand, government revenue-to-GDP ratio did not experience substantial change in 2020 with y/y variations ranging between -1.7% (Ireland) and 2.0% (Greece). The main reason behind the relatively stable government revenue-to-GDP ratio during the pandemic was a proportional decrease in the levels of both components that resulted, respectively, from lower tax collection (fuelled by the marginal drop in consumption and introduction of tax relief measures) and a comparable fall-out in economic activity.

Figure 3. Change in the government spending and revenue in EU member states in 2020



Source: Author's own elaboration based on data available at Eurostat.

Figures 2 and 3 also showcase that not all of the announced fiscal support measures in the EU became government expenditure because only part of the liquidity support measures were realised in 2020[5]. As a result of the spike in expenditures paired with the slack in revenues, the EU governments needed to borrow funds to finance these expenditures which has driven up the public debt.

Figure 4 compares the public debt-to-GDP ratios of the EU member states in 2019 and 2020. The y/y change of the ratio varies between 2.1% (Ireland) and 25.1% (Greece) with the 13.2% y/y change for the EU-27 which raised average levels of public debt in the EU to 90.7% of GDP in 2020.

Even though spikes were observed between March and May 2020, the surge in indebtedness of the EU member states did not bring an increase in the sovereign debt risk premia which remained low in the major EU economies[6].

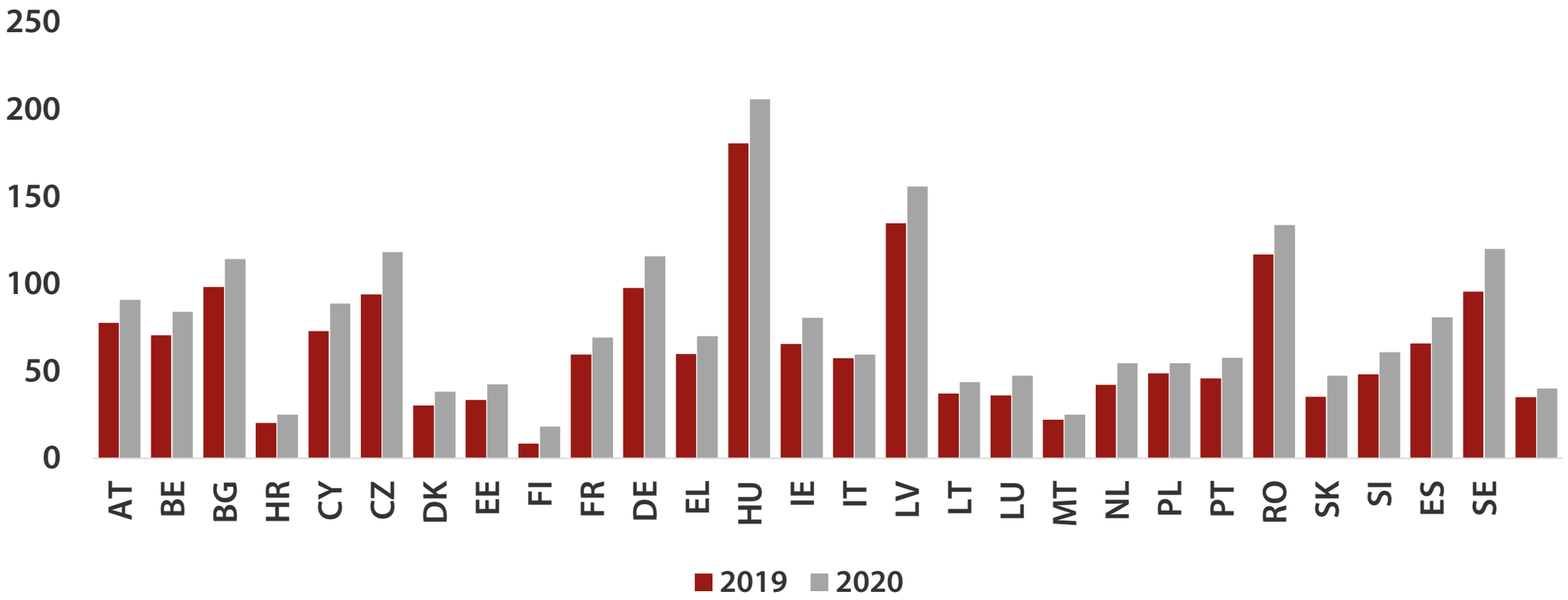
This is partly due to (i) low interest environment which kept the debt costs manageable and (ii) decisive actions of the EU and member states that repressed further collapse in economic activity. The rise of the public debt from the beginning of the pandemic has thus not exposed the EU economies to a higher sovereign debt risk so far.

Poland in the spotlight

The Polish Parliament introduced fiscal legislation packages titled 'Anti-Crisis Shields'[7] in March 2020 that, as of January 2021, have already amounted to PLN 312 billion[8] support in the form of additional spending, deferred revenues, loans and guarantees.

This drove the government expenditures from 41.7% of GDP to 48.7% of GDP between 2019 and 2020 whereas the government revenue remained at 41.7% of GDP[9]. These changes in the two main blocks of fiscal policy moved the deficit from -0.7% to -7.0% of GDP[10] between 2019 and 2020.

Figure 4. Public debt-to-GDP ratio in EU member states



Source: Author's own elaboration based on data available at Eurostat.

As a result, the debt-to-GDP ratio in Poland jumped by 11.9 pp y/y reaching 57.5% in 2020[11]. Despite such notable change in the debt-to-GDP ratio in 2020, it was still below the average EU change of 13.2 pp y/y[12].

The future

The current debt stock of governments is historically high and is approaching the post-World War II levels. Even such high level of debt, however, can be sustainable as long as the global trend on the sufficiently low interest rates continues.

Hence, what poses risks for the affordability of the public debt is a potential fast rise of the interest rates. Such a scenario would lead to large tax hikes and spending cuts that could curb the growth over the long term.

Other than that, there are still some risks present due to the elevated public debt, including:

- limited ability to implement counter-cyclical fiscal policy during economic crisis;
- decreased ability to respond to unexpected events, like wars, financial crises, and natural disasters which could result in larger negative effects on the economy and on people's wellbeing;
- private sector under-investment due to uncertainty about future taxes and crowding out of private debt.

Despite the presence of the aforementioned risks, the start of mass vaccination campaigns in all member states in 2021 has accelerated the return to a 'new normal' with the expected increase in economic activity.

While this will help to improve public finances, the recovered economy should, nonetheless, be supported with policy efforts for healthier public finances. These efforts can focus more on building resilient and inclusive economic structure to curb the rising inequality, boost productive capacity, and raise potential output.

For example, the Recovery and Resilience Facility of the Next Generation EU[13] plan allows countries to finance such policy efforts with non-repayable support which will make it possible to finance growth-enhancing public investment projects and cover costs of productivity-enhancing reforms without inducing higher levels of deficit and debt.

Besides, monetary policy can also play a role in strengthening these efforts. The ability of the central banks to maintain low interest rates despite rising inflation will allow to maintain price stability to serve the debt and prevent its further accumulation. ■

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Endnotes

1. https://www.imf.org/en/Publications/FM/Issues/2021/03/29/fiscal-monitor-april-2021#Chapter%201
2. https://www.imf.org/en/Publications/WEO/weo-database/2021/April/weo-report?a=1&c=110,200,&s=GGR_NGDP,GGX_NGDP,&sy=2019&ey=2020&ssm=0&scsm=1&scc=0&ssd=1&ssc=0&sic=0&sort=country&ds=.&br=1
3. https://www.imf.org/en/Topics/imf-and-covid19/Fiscal-Policies-Database-in-Response-to-COVID-19
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7. https://home.kpmg/xx/en/home/insights/2020/04/poland-government-and-institution-measures-in-response-to-covid.html
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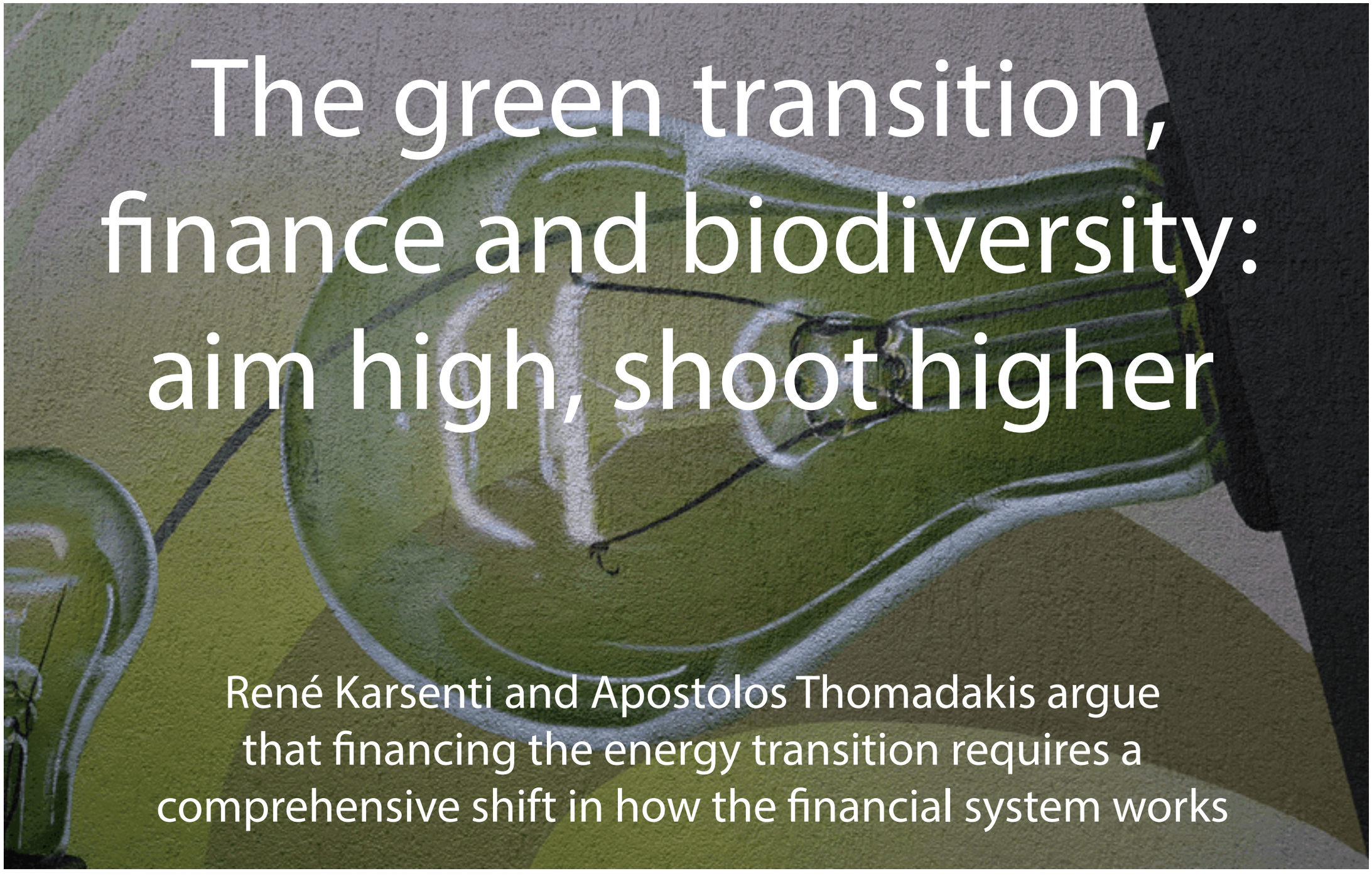
10. https://ec.europa.eu/eurostat/databrowser/view/gov_10a_main/default/table?lang=en
11. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Government_finance_statistics
12. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Government_finance_statistics
13. https://ec.europa.eu/info/sites/default/files/economy-finance/1_en_act_part1_v9.pdf

The green transition, finance and biodiversity: aim high, shoot higher



René Karsenti and Apostolos Thomadakis argue that financing the energy transition requires a comprehensive shift in how the financial system works

The urgency to succeed in financing the energy transition and reorienting private capital to sustainable investments requires a comprehensive shift in how the financial system works. The role of major market participants, investors, and policymakers in facilitating this shift is essential. To develop more green and sustainable economic growth, there is a need to:

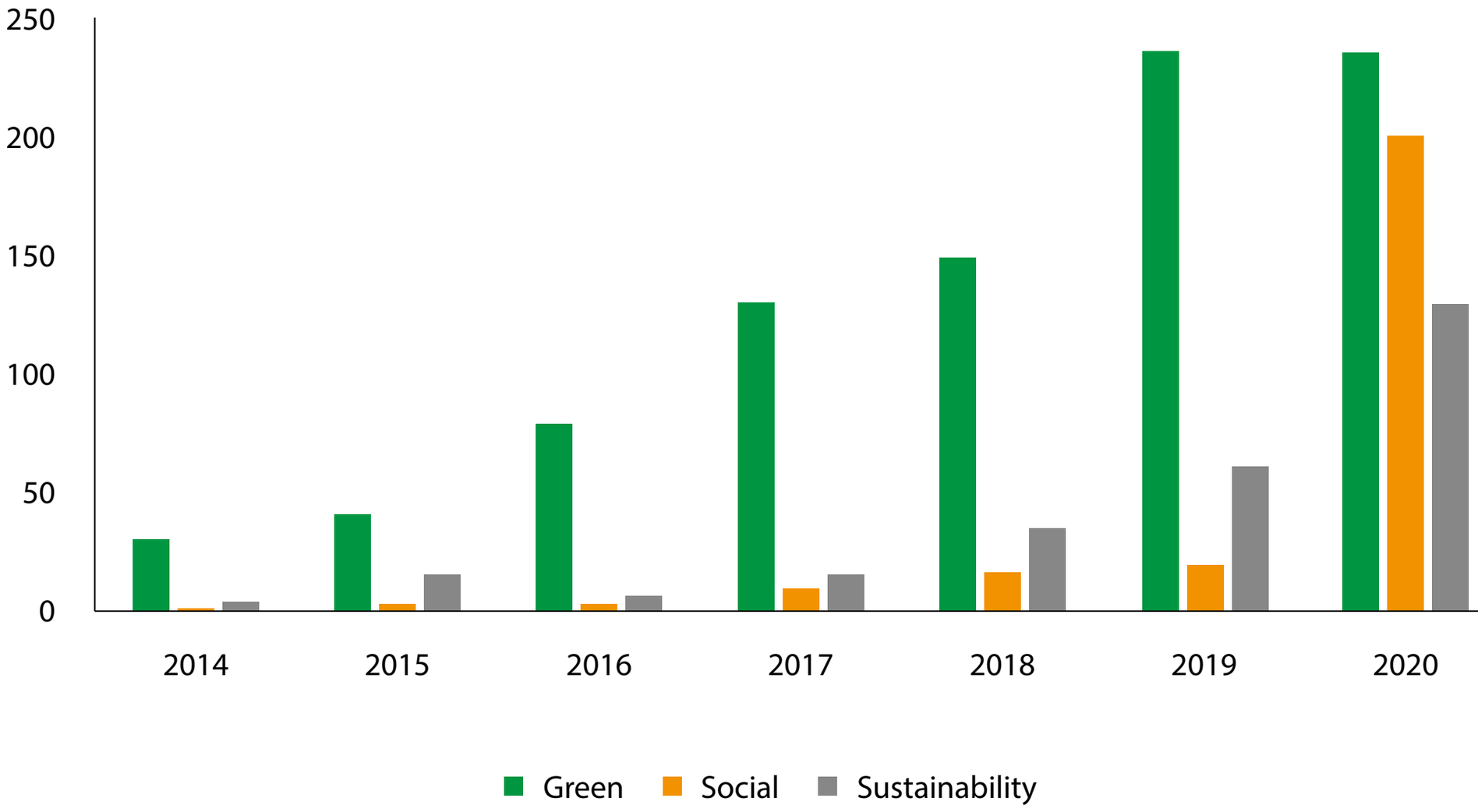
1. broaden access to the market through innovation and diversification;
2. further develop global standards and taxonomies;
3. enhance disclosure and reporting;
4. fully incorporate fintech and digitisation;
5. fully address biodiversity and nature-related risks

Beyond its quasi-moral obligation, mobilising finance for the energy transition is a historic opportunity, especially for the EU to act and lead as a true pioneer, that should not be missed.

Fifteen years ago, green, social and sustainability bonds (or sustainable bonds, collectively) were non-existent, while the green issuance volume was still a miniscule share of the bond market. Institutions such as the European Investment Bank (EIB), the World Bank Group (WBG), the International Capital Market Association (ICMA), and the International Finance Facility for Immunisation (IFFIm), have been trailblazers and put forward several significant initiatives.

As a result, building on such and other subsequent initiatives, the market has grown exponentially and moved from an aggregate issuance of €35 billion in 2014 to €568 billion in 2020 (see Figure 1). Today, the total value of outstanding sustainable bonds is at €1.6 trillion[1].

Figure 1. Global issuance of green, social and sustainability bonds (€ billion, 2014-2020)



Note: The process followed by the CBI to classify a green bond as eligible covers the following steps: i) identification of climate- themes and self-labelled debt; ii) screening sectors and green credentials to determine if the proceeds will finance eligible green expenses/assets/projects/activities; iii) evaluating the use of proceeds threshold. For more information on the Green Bond Database Screening Process, see here.
Source: Climate Bonds Initiative.

In the shadow of the pandemic

The COVID-19 pandemic has caused colossal damage since the beginning of 2020. It has been estimated that the cumulative cost to the global economy in 2020-21 would be over €10 trillion[2]. More importantly, it has pushed hundreds of millions of additional people into poverty across the world, while it has disrupted progress towards achieving the United Nations (UN) Sustainable Development Goals (SDGs)[3].

The decade ahead promises to be exciting, with new tools, participants, practices, and standards coming to the fore that will help us to navigate the climate transition

But, at the same time, it made clear the important role that capital markets play in intermediating capital to rebuild shattered economies. Indeed, the pandemic has served as an accelerant for growth in the sustainable bond markets. sustainable bond issuance totalled around €411 billion in the first half of 2021, nearly a 60% year-on-year growth from H1 2020[4].

In particular, social issues have gained momentum and emerged as a key instrument in financing a post-COVID 'sustainable recovery'. This segment represented 36% of the total sustainable bond issuance in 2020, up from 6% in 2019.

This is a remarkable development since the creation of the first IFFIm Vaccine Bond in 2006. Although many were concerned that the focus on social bonds would detract from progress in the green bond market, in fact the complete opposite has been the case.

Green and environmental considerations have been hard-wired into the countries' post-COVID programmes, both on the funding and disbursement side. What's also noticeable is that more than 95% of the sustainable bonds issued in 2020 reference ICMA's Green and Social Bond Principles[5].

Despite these positive developments, more needs to be done. Below we identify five key areas in which renewed focus should be given. For the remainder of this particular piece we will concentrate primarily on the fifth and final area.

- Broaden the market through innovation and the diversification of market participants and products in the green and sustainability space[6].

- Develop global standards further and ensure taxonomies are as harmonised as possible – in close consultations with market players – to avoid fragmentation.
- Enhance disclosure in reporting by issuers and investors, including on their climate transition strategy to generate even more confidence and robustness[7].
- Incorporate fintech and digitalisation as the main driving forces for the development of capital markets[8].
- Fully address biodiversity and nature-related risks, which has been identified as one of the top five risks in terms of likelihood and impact in the coming 10 years[9].

Assessing the risks

To effectively address biodiversity, it is important to first distinguish nature-related risks from climate change-specific risks, and then to find ways to properly measure them. Nature-related risks (encompassing biodiversity loss and ecosystem degradation) and climate-related risks, are both essential components for the accurate assessment of environmental risks.

Although they are highly interconnected, at the same time they are distinct from each other. Nature-related risks broadly refers to the risks to an organisation posed by the linkages between its activities and the natural world[10]. These can be shorter-term risks, as well as longer-term risks arising from its impact and dependency on nature.

On the other hand, climate change risks can be categorised into two broad categories, those risks related to the physical impacts of climate change (eg. acute risk, chronic risk), and risks related to the transition to a lower-carbon economy (eg. policy and legal risks, technological risks, market risks, reputational risk)[11].

However, some of these risks have been carried over into nature-related risks – namely physical (eg. the loss of mangrove swamps), transition (eg. the closure of soft drinks plants in India due to their impact on water

shortages), and litigation (eg. bond investors taking legal action against a Californian energy utility company for misrepresenting the risks of wildfires).

Moving into the measurement of such risks, Gross Domestic Product (GDP) has so far failed to clearly capture the depreciation of changes in biodiversity[12]. Nevertheless, according to the World Economic Forum (WEF), half of global GDP in 2019 was moderately or highly dependent on natural capital[13].

Although the depreciation and loss of natural capital has been a primary source of 'economic growth', it has not been taken into account in the calculations. Thus, there is need to capture the true value (or 'accounting prices')[14] of natural capital. This will allow for accurate measurements of the financial costs and risks and avoid further rapid destruction of our common biodiversity.

Developing comprehensive risk measures beyond the impact on GDP, are critical for market participants in their investment decisions. Banks and investors may be adversely affected by climate change risks, for example by holding the sovereign bonds of countries that are highly dependent on the over-exploitation of natural resources. In a case like this, the risk is under-priced by the market and needs to be clearly assessed and reported.

There is also need for a new set of international impact-weighted accounting standards, similar to the introduction of the international accounting standards after the 1929 Great Depression.

In essence, a standardised tool to measure the net impact that companies have on both the environment and people. More generally, although metrics that incorporate nature loss into risk models already exist[15], there is no single and widely accepted method for measuring biodiversity foot printing. Risks are far from negligible.

A 2018 assessment exercise found that 13 of the 18 sectors in the FTSE 100 (at that time having a total of approximately €1.4 trillion in net market capitalisation) have a high dependence on natural capital (including assets such as forests, water, fish stocks, minerals, biodiversity and land)[16].

This poses significant challenges to achieving the sustainable development objectives and poverty reduction.

Global commons – a radical proposition?

The long-term objective is to bring aggregate demand in line with aggregate supply; meaning that global demand must equal the biosphere's ability to meet the supply on a sustainable basis. This so-called 'impact equation' illustrates how the biosphere can heal itself over a set period[17].

But the current rate of depletion, driven by activity to create physical and human capital, threatens our fundamental life support system – the natural environment.

Perhaps a more visionary – and at the same time controversial – proposal for preserving natural capital, calls for the creation of a global Commons Fund (Dasgupta, 2021)[18]. Such an initiative would require an international organisation to monitor and manage forms of natural capital as global public goods.

This would be similar to the way the World Bank advances the cause of global economic development, and to the International Monetary Fund (IMF) when it comes to the rescue during instances of financial instability.

Global commons are like the Seven Seas – no one pays for their use as long as access to them is free. Such a rather controversial proposal might essentially entail the introduction of a new form of rent, to be collected through a

global organisation. The money raised would pay the compensation required to prevent further deterioration of the natural world.

However, this should not be perceived as an additional taxation to financial preservation, but instead as a way in which the global commons could (themselves) generate the funds needed to restore natural capital (ie. the air, water and land).

Conclusions

In 2015 Mark Carney – at that time Governor of the Bank of England – warned about "*the tragedy of the horizon*" and highlighted the important role of finance in accelerating short- and long-term climate change[19].

Progress in green and sustainable finance has been impressive since then, while the COVID-19 pandemic has proven its importance going forward.

The decade ahead promises to be exciting, with new tools, participants, practices, and standards coming to the fore that will help us to navigate the climate transition. The future of finance should be green and sustainable.

But to achieve this, it needs to be mindful of its environmental and social impacts, invest in the future, and also protect the ecosystem, and save lives. Let's not miss the opportunity to make a real and lasting impact. ■

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Director General of the European Investment Bank (EIB) and former Chairman of the European Capital Markets Institute (ECMI) Board, and Apostolos Thomadakis is a Researcher at ECMI and CEPS

Endnotes

1. Based on data from the Environmental Finance Bond Database, accessed on September 9, 2021.

2. See IMF (2020), "World Economic Outlook Update: A Crisis Like No Other, An Uncertain Recovery", June, International Monetary Fund.

3. Latest estimates put the number of newly poor people as a consequence of COVID-19 in 2020 to rise to between 119 and 124 million. See WB (2021), "Global Economic Prospects", June, World Bank.

4. See the Climate Bonds Initiative's Sustainable Debt Market Summary for H1 2021.

5. See Green Bond Principles (GBP) and Social Bond Principles (SBP).

6. The last few months have proved to be a period of remarkable innovation, with the launch of the ICMA's Sustainability-Linked Bond Principles last June and the Climate Transition Finance Handbook in December.

7. There is a need for a new set of international Impact-weighted accounting standards, similar to the introduction of the international accounting standards after the 1929 Great Depression. This would be a standardised tool to measure the net impact that companies have on the environment and on the people.

8. A striking commonality between FinTech and sustainability is the need for common standards and harmonisation. FinTech could be used to develop common platforms, particularly in the sustainable finance sector for oversight, to facilitate comparability, and provide dynamic insights into environmental, social and governance (ESG) performance and reporting. For data providers, regular and more frequent ESG reporting is paramount to harness analytics and create greater transparency.

9. See WEF (2020), "The Global Risks Report", 15 January, Word Economic Forum. Moreover, it has also been advocated by market participants and investors through the United Nations' Principles for Responsible Investment (PRI), as well

as the international alliance Act4Nature, while it is one of the six environmental objectives under the EU Taxonomy which is central to the EU's Biodiversity Strategy 2030. Other important initiatives towards this direction include: the Natural Capital Financial Facility (NCFF), a partnership between the EIB and the European Commission which has already resulted in the EIB issuing a Sustainability Awareness Bond with a biodiversity theme in early January, the Taskforce on Nature-related Financial Disclosures (TNFD), the Finance for Biodiversity (F4B) which proposes a dedicated international Nature and Climate Sovereign Bond Facility, the Biodiversity Finance Initiative (BIOFIN), and the Sustainable Blue Economy Initiative. More recently, it was released in the UK as part of the Dasgupta Review on the Economics of Biodiversity, commissioned in 2019 by HM Treasury.

10. See the TNFD (2021), "Nature in Scope: A Summary of the Proposed Scope, Governance, Work Plan, Communication and Resourcing Plan of the TNFD", June, Taskforce on Nature-related Financial Disclosures.

11. See TCFD (2017), "Recommendation of the Task Force on Climate-related Financial Disclosures", June, Task Force on Climate-related Financial Disclosures.

12. See Dasgupta (2021), "Economics of Biodiversity: The Dasgupta Review", February, HM Treasury.

13. See WFE (2020), "Nature Risk Rising: Why the Crisis Engulfing Nature Matters for Business and the Economy", January, World Economic Forum.

14. A capital good's accounting price refers to the contribution an additional unit of it would make to the flow of social benefits.

15. Such as the Exploring Natural Capital Opportunities, Risks and Exposures (ENCORE) tool, developed by the Natural Capital Finance Alliance (NCFA), or the Integrated Biodiversity Assessment Tool (IBAT).

16. This is based on NCFA's ENCORE database.

17. See footnote 11.

18. Such a proposal might be carried by the UK to the 26th United Nations Climate Change Conference of the Parties (COP26) taking place later in November, and promoted more widely.

19. See "Breaking the Tragedy of the Horizon – Climate Change and Financial Stability", speech on 29 September 2015.

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Can climate change be tackled without ditching economic growth?

Klaas Lenaerts, Simone Tagliapietra and Guntram B Wolff explore whether decarbonisation and economic growth are compatible to reach net zero by 2050

Higher levels of economic activity tend to go hand-in-hand with additional energy use and consumption of natural resources. As fossil fuels still account for 80 percent of the global energy mix, energy consumption remains closely related to greenhouse gas emissions and hence to climate forcing.

This paper explores whether decarbonisation and economic growth are compatible or whether the world economy needs to grow less to be able to reduce greenhouse gas emissions fast enough to reach net zero in 2050. The literature provides profoundly different answers to this question, with scholars positioning along a spectrum that extends from the most optimist version of 'green growth' theories to sceptical 'degrowth' theories.

While globally, CO_2 emissions per unit of GDP are declining, the decoupling rate from 1995 to 2018 was only -1.8 percent annually. To achieve net zero by 2050, the rate would have to accelerate to -8.7 percent, assuming population and GDP growth projections as given, or by a factor of almost five.

To keep GDP growth and population at their projections and thus reject the proposition of degrowth, decoupling would have to accelerate massively. Two avenues are crucial: reducing the energy intensity of production and/or the emissions intensity of energy.

The huge fall in the price of renewable energy provides hope that decoupling can accelerate. Decoupling rates have accelerated in the last decade and decoupling is substantially faster in the European Union. In the EU, we estimate that decoupling only has to accelerate by a factor of 2.5.

We do not think degrowth propositions advanced in the literature will be pursued and therefore focus on the main challenges that must be tackled to achieve decoupling. Unprecedented efforts are required to achieve green growth. But hoping for humanity to sacrifice growth appears unrealistic.

1 Introduction

Climate change is one of the most pressing issues of our time. The science is clear: human activities have already caused approximately 1°C of global warming and at current rates will likely cause 1.5°C of global warming above pre-industrial levels between 2030 and 2050 (IPCC, 2018).

With the Paris Agreement, governments have committed to limiting the temperature increase to well below 2°C above pre-industrial levels and to pursuing efforts to limit it to 1.5°C (UNFCCC, 2015). Keeping global warming below this limit will require global greenhouse gas (GHG) emissions to quickly decline by at least 45 percent from 2010 levels by 2030, and to reach net-zero by 2050, with negative emissions thereafter (IPCC, 2018).

Economic growth has historically been the main driver of rising environmental damage and GHG emissions. To achieve such deep emission cuts, the world would have to either decouple global GHG emissions from gross domestic product (GDP) or face deep cuts to GDP.

The numbers we present in sections 2 and 3 are sobering: current projections of global population size and GDP per capita imply that the world must reduce the rate of CO_2 emissions per unit of real GDP by around 9 percent per year on average to reach the climate targets described above. Between 1990 and 2016, global emissions per unit of real GDP decreased only by 1.8 percent per year.

Confronted with these facts, scholars disagree about whether humanity can afford continued economic growth. The so-called 'green growth' literature is optimistic that suitable policies and technology will reduce emissions to sustainable levels while allowing for continued or even boosted economic growth.

This thinking is shared by several governments and institutions. For instance, the European Commission defines its European Green Deal as 'Europe's new growth strategy'. Degrowth scholars on the other hand dismiss this and argue that the global economy must be scaled down, and that systemic change and redistribution is necessary to accomplish this and address the *"fairy tales of eternal economic growth"*, as campaigner Greta Thunberg told world leaders in 2019[1].

On some level, this academic debate on extreme positions is largely theoretical. Developing countries will want to grow and will implement policies to that effect. The idea of deeper cuts to GDP in rich countries is also theoretical: economic growth is of central importance for welfare and issues such as debt sustainability, pensions and social security.

A shrinking or 'degrowing' economy could potentially also exacerbate the distributional implications of decarbonisation that will arise regardless (see for example Markkanen and Anger-Kraavi, 2019).

Yet, the sharp contrast in the theoretical positions of scholars is a way to conceptualise the magnitude of the challenge. Striving for green growth is an imperative, but no one can be certain ex ante that such a path is possible. What is certain is that it cannot happen without some key prerequisites.

It will require massive investment in existing green technologies and in the advancement of new breakthrough technologies, including for negative emissions. It will also require changed behaviour from everyone, and our economies will have to be adapted to deal with the consequences of climate change that can no longer be avoided.

The paper is structured as follows. Section 2 presents the numbers that make clear how significant the problem of decoupling is. Section 3 reviews the literature on degrowth and explains why degrowth proposals are not viable.

Section 4 summarises the literature on green growth. Section 5 discusses essential steps for the realisation of green growth. Section 6 concludes with recommendations for policymakers.

2 The challenge of decoupling: the hard numbers

Pursuing deep decarbonisation will be challenging. Annual global GHG emissions keep rising and show no sign of peaking. In 2019, they were 62 percent higher than in 1990, the year of the first Intergovernmental Panel on Climate Change report, and 4 percent higher than in 2015 when the Paris Agreement was signed (Friedlingstein **et al** 2020).

Even unprecedented circumstances such as the massive restrictions introduced to contain COVID-19 led only to a 6 percent drop in emissions in 2020, from which a quick rebound to pre-pandemic levels promptly followed (IEA, 2021a).

Historically, economic growth – by which we mean real GDP growth – has long been associated with increasing GHG emissions. Empirically, the causal chain is straightforward: higher levels of economic activity tend to go hand in hand with additional energy use and consumption of natural resources.

Fossil fuels still account for 80 percent of the global energy mix (IEA, 2020), and so energy consumption is closely related to GHG emissions and hence to climate forcing. Expansion of industrial processes, livestock rearing and other agriculture adds to emissions, while deforestation reduces carbon sinks.

A far-reaching transformation of the global economy is needed to reduce emissions. As 73 percent of global GHG emissions come from energy production (mostly as CO_2), most reductions will need to happen in that area[2]. An interesting way to look at this is by formulating the problem as a simple identity, as done by Kaya and Yokoburi (1998) on the basis of Holdren and Ehrlich (1974):

$$GHG\ emissions = population * \frac{GDP}{population} * \frac{energy\ demand}{GDP} * \frac{GHG\ emissions}{energy\ demand}$$

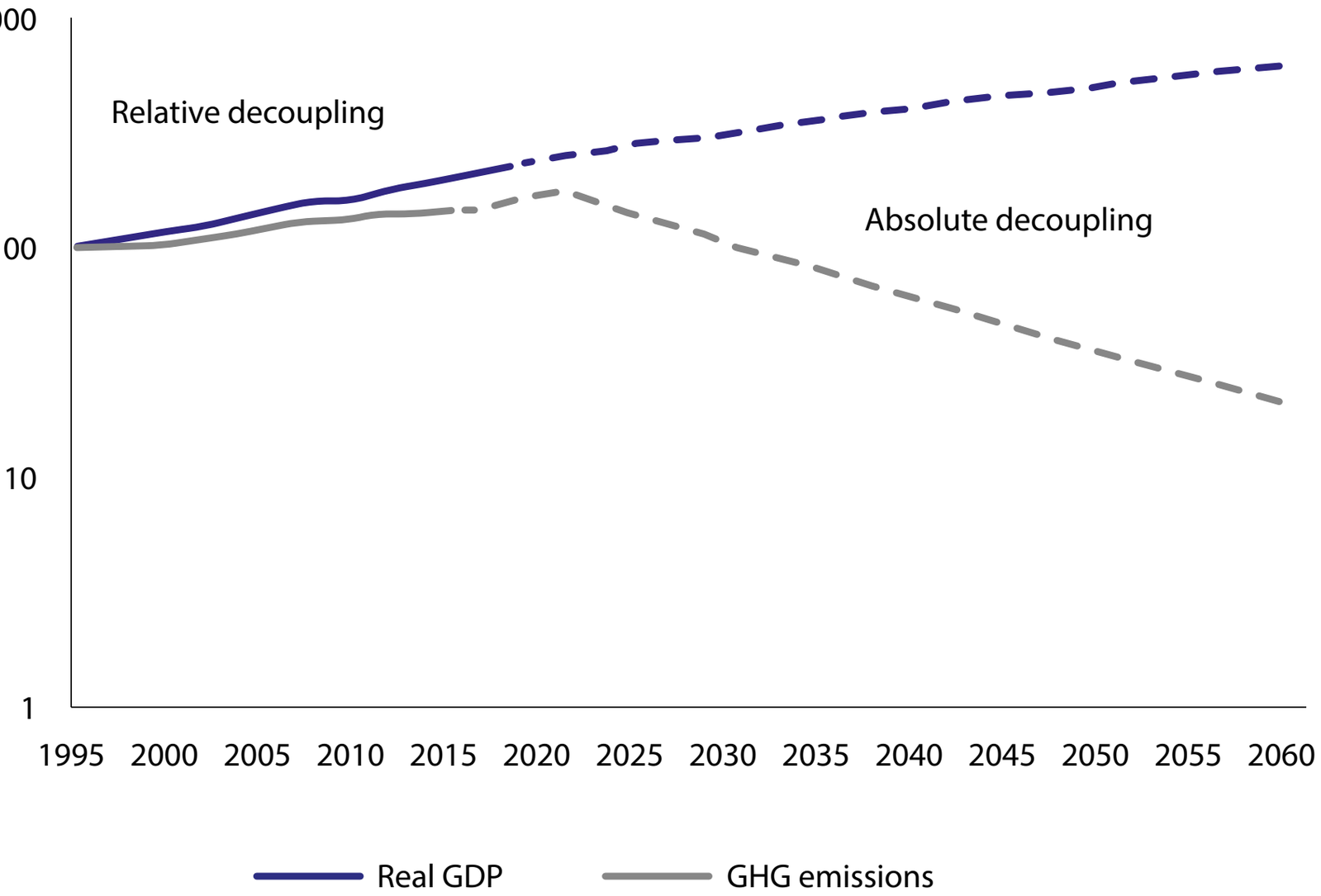
This identity permits GHG emissions (from energy production) to be decomposed into a product of the world's population size, GDP per capita, the energy intensity of GDP and the GHG emissions intensity of energy production[3].

Limiting population growth is one way to limit GHG emissions growth, but the debate on this topic goes far beyond the scope of our paper. We instead consider population growth as a given and base our analysis on OECD demographic forecasts. Cutting emissions would therefore need to happen by lowering some or all of the other factors.

Since lowering the second factor (GDP per capita) implies compromising economic and social welfare, the core question is whether the third and fourth factors (energy and emissions intensity) can decline at a sufficient speed to allow the first and the second to remain on their current paths.

This would imply an absolute decoupling of economic growth and GHG emissions (ie. a situation in which GHG emissions go down while real GDP continues to grow, see Figure 1) through a 'dematerialisation' of the economy (eg. through a shift from manufacturing to services), altered consumption behaviour, more efficient technology and the decarbonisation of the energy sector.

Figure 1. Global real GDP (2010 prices, PPP) and total GHG emissions



Note: 1995 =100. Logarithmic scale. Full lines are historical data, dots are OECD projections, dashes are a stylised representation of absolute decoupling.
Source: Bruegel, based on OECD, Economic Outlook No 103 – Long term baseline projections, accessed in July 2021 and on UNEP, World Environment Situation Room, accessed in July 2021.

Globally, there is no sign of absolute decoupling, but only of relative decoupling (ie. a situation in which total GHG emissions grow less than proportionately to real GDP).

Explained in terms of the Kaya identity, while energy related GHG emissions per unit of GDP are falling (the third and fourth factors combined), the fall is slower than the increase in real GDP (the first and second factors) so that overall emissions continue to rise.

In order to avoid global warming in excess of 1.5°C above pre-industrial levels, global GHG emissions must be rapidly reduced. Doing this without losses in economic prosperity will not be easy...

Figure 2 shows that in the last 100 years, annual CO_2 emissions from energy production have risen tenfold[4], even though emissions per unit of GDP have been slashed by almost two thirds (1.8 percent per year on average since 1990). This is simply because the global economy has grown at a much faster pace (2.8 percent per year on average since 1990).

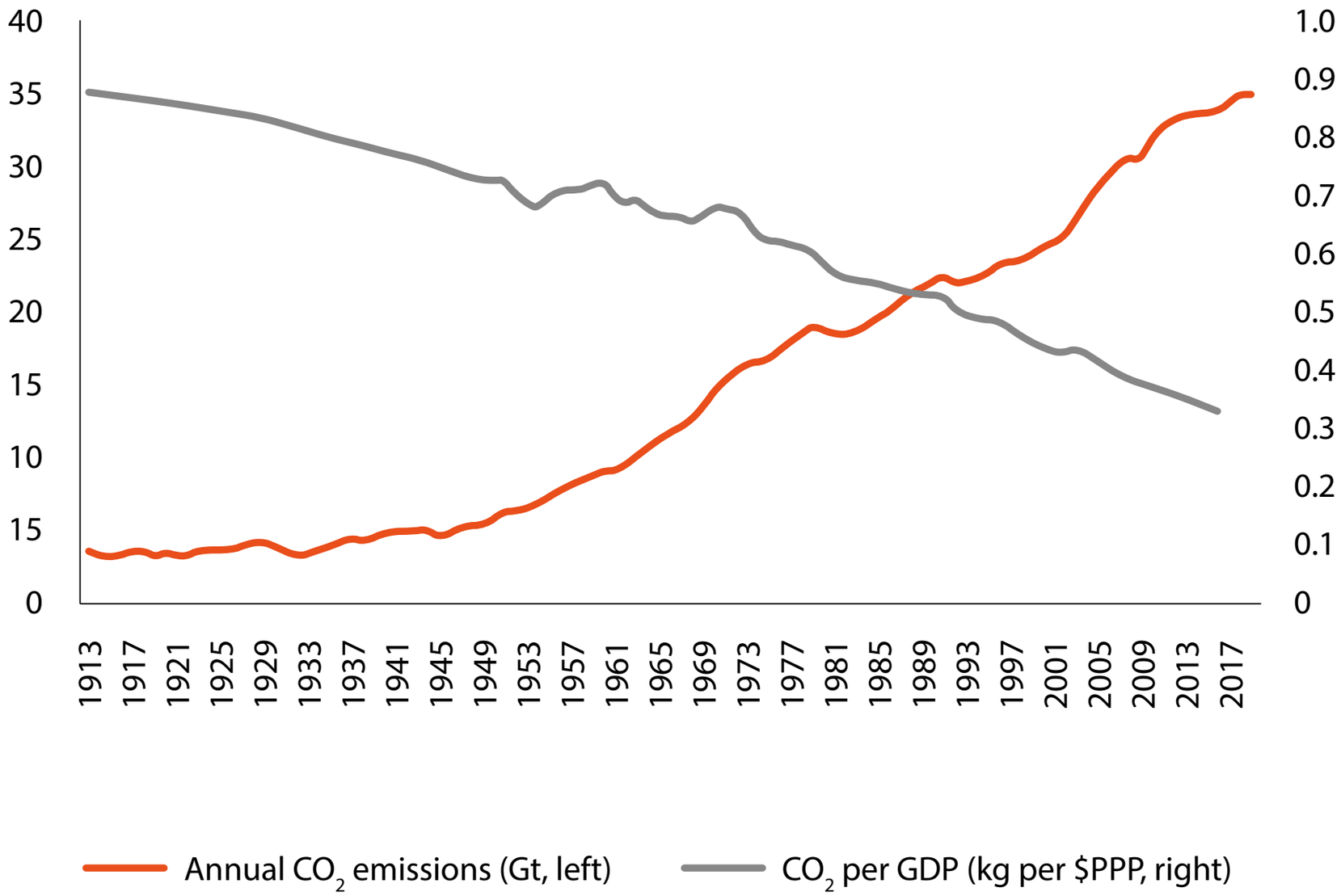
Thus, progress on decoupling GDP growth from CO_2 emissions has been achieved, but the continued expansion of the global economy has proven too fast to stop annual emissions from increasing, let alone to allow them to decrease, as is clear from Figure 2. A rough calculation (disregarding interactions between the factors of the Kaya identity) makes clear how far the world is still falling short:

- Gross emissions of CO_2 stood at around 35 billion Gt in 2018 (Our World in Data, OWID). This needs to decrease to approximately 5 Gt in 2050 according to a technologically conservative emissions pathway[5] of the IPCC (2018), or by 86 percent.

- The global population is projected to increase from 7.63 billion in 2018 to 9.77 billion people in 2050 (x1.28), and global real GDP per capita (2010 prices) is projected to increase from $19,896 to $41,099 or by 107 percent (OECD).

- CO_2 emissions per unit of GDP therefore have to decline by around 95 percent or approximately 9 percent per year on average from 2019 until 2050. Between 1990 and 2016, the world only achieved an average so-called 'decoupling rate' of 1.8 percent per year (based on OWID)[6]. Put differently, the average speed of decoupling during the next three decades will have to be almost five times greater. The later this acceleration happens, the greater it will have to be.

Figure 2. Global annual CO_2 emissions from burning of fossil fuels for energy production (in gigatonnes) and CO_2 emissions per unit of GDP (in kg per $PPP)



Source: Our World in Data (OWID) CO_2 Data Explorer (based on Global Carbon Project; BP; Maddison; UNWPP), accessed in July 2021; see https://ourworldindata.org/co2-emissions

Decoupling trends are not even fast enough in developed economies. Since 1990 the European Union's (EU) gross CO_2 emissions have decreased by 25 percent (OWID), while real GDP grew by 62 percent (European Commission, 2020a).

CO_2 emissions in the United States also started to decline more recently. This suggests that absolute decoupling is possible. But it is happening too slowly to match the globally required decoupling rate: the average EU decoupling rate was 3.4 percent per year between 1990 and 2016, while in the US it was 2.2 percent (OWID).

However, this is not the whole story. Developed economies such as the EU and the US import a lot of goods that are produced elsewhere, and thus GHG emissions attributable to consumption are somewhat higher than territorial emissions.

Fortunately, these broader emissions are also declining for the EU (Friedlingstein *et al* 2020). Once consumption-based territorial emissions are taken into account, the average decoupling rate for the EU is 2.3 percent per year since 1990 and 2.0 percent per year for the US (based on Friedlingstein *et al* 2020 and World Bank data), both lower than the rates based on territorial emissions.

3 Degrowth

Guided by past experience, the basic premise of degrowth theorists is that the world will not be able to sufficiently reduce GHG emissions while GDP grows.

In particular, they point to the fact that some of the technologies playing a relevant role in IPCC simulations, such as carbon capture and storage (CCS) applied to fossil power plants, or bioenergy with carbon capture and storage

(BECCS), do not yet exist and should not be relied on; their economic viability is unproven and they could even create new environmental problems (Keysser and Lenzen, 2021).

Such pessimistic views about our planet's capacity to sustain economic growth are not new. They have been around in some form at least since the *Essay on the Principle of Population* by Thomas Malthus (1789). He postulated that famines and economic collapse were inevitable unless birth rates decreased, based on the belief that population growth is exponential and growth of food production merely linear.

This argument was echoed throughout the twentieth century in environmentally inspired works by, for example, Osborn (1948) and Vogt (1948) and, most notably, in *The Population Bomb* by Paul Ehrlich (1968). Meadows *et al* (1972) predicted in *The Limits to Growth* (hereafter: LTG) that global population and economic activity would peak in the early twenty-first century, and advocated an economic and demographic 'equilibrium state' to avoid an uncontrolled collapse when humanity's need for resources finally exceeds the earth's capacity.

These authors all proved to be too pessimistic (at least so far) because they failed to predict the significant advances in agricultural yields, technological innovation and substitution, and declines in population growth rates.

Advances in resource efficiency have often been driven by market forces, such as for oil in the 1970s, when scarcity drove up prices, creating incentives for innovation.

However, technological progress is highly unpredictable, and since the atmosphere as a deposit for CO_2 is a rival but non-excludable good, purely market-driven innovation and substitution will not solve the problem of climate change (Eastin *et al* 2010).

Like LTG, modern degrowth theories subscribe to the idea that humanity must achieve a lower economic 'steady state' to avoid environmental catastrophe. The term 'degrowth' was probably first used in the writings of French philosopher André Gorz in 1972, and in the work of economist Georgescu-Roegen (1971, 1979), who wrote that economic activity in the long run is limited to a level supported by solar flows due to the laws of thermodynamics.

The term was popularised in the 1990s and 2000s by Serge Latouche (for example Latouche, 2009) who criticised economic development as a goal. In the early 2000s 'degrowth' was used as a slogan by social and environmental activists in France, Italy and Spain.

Finally, it emerged as an international research area in 2008 at the first Degrowth Conference in Paris (Demaria *et al* 2013; Kallis *et al* 2018), with many publications being produced, particularly in the first half of the 2010s, in the context of the global financial crisis and the sovereign debt crisis in Europe.

Authors including Giorgos Kallis (eg. Kallis, 2011), Jason Hickel (eg. Hickel, 2020), Tim Jackson (eg. Jackson, 2009) and Kate Raworth (eg. Raworth, 2017) are today at the forefront. Several variations of degrowth are advocated under different names, including 'wellbeing economics', 'steady-state economics', 'post-growth economics' and 'doughnut economics'.

There is no exact definition of what 'degrowth' stands for. Authors are not always clear on exactly what should 'degrow'. There are at least five different interpretations: degrowth of GDP, consumption, worktime, the economy's physical size, or 'radical' degrowth, referring to a wholesale transformation of the economic system (van den Bergh, 2011).

It is perhaps better to say that degrowth covers all these interpretations. Material and energy consumption and the economy's physical size need to degrow, out of a concern for resource depletion and more recently climate change.

Worktime degrowth is one tool to do so, GDP degrowth is an inevitable consequence (not an aim per se), and radical degrowth a necessary condition to make a post-growth economy socially sustainable (Kallis, 2011).

In terms of GDP and GHG emissions, degrowth scholars do not see a credible scenario in which the rate of decoupling of GDP and GHG emissions could be sufficiently high to avoid dangerous climate change (Jackson, 2009), and as such they arrive at the conclusion that global GDP must inevitably decline.

Realising the negative social consequences commonly associated with recessions, degrowth scholars set out to define a path to actively 'guide' GDP downward, rather than to passively let the world slip into a depression. Demaria *et al* (2013, p.209) therefore defined degrowth as a call for *"a democratically led redistributive downscaling of production and consumption in industrialised countries as a means to achieve environmental sustainability, social justice and well-being."*

As the definition suggests, the degrowth literature is not limited to the economy-environment nexus, but is also concerned with (international) redistribution, political participation, social fairness and 'beyond GDP' conceptions of welfare.

Antal and van den Bergh (2016) gathered a few economic arguments directed against the prospect of decoupling through green policies. The most common argument is the existence of a rebound effect from investment in efficiency and clean energy.

This means that as societies invest to reduce emissions, the increased income or savings resulting from those investments will at least partially offset the intended beneficial effects through increased consumption of non-renewable energy elsewhere. In addition, there is a risk that more stringent policies could see lower compliance because of what the authors call an 'environmental Laffer curve', with economic actors preferring to cheat rather than to respect regulations as the expected cost is lower.

A final objection is the possibility of burden-shifting: while not an issue for climate change, other environmental risks could be exacerbated indirectly by emission reduction efforts, for example soil pollution from mining for minerals.

Degrowth proponents advance a myriad of policies as part of a systemic change to make sure that the challenge of economic downscaling necessitated by ecological boundaries does not cause widespread human suffering. We will only touch on them superficially.

Perhaps the most important and common proposal is to limit the supply of production factors, most notably labour. Reductions in working hours are seen as a way to reduce consumption while increasing social welfare through more free time and achieving high levels of employment.

The latter must also be supported by shifting employment towards labour-intensive sectors and steering innovation to increase resource productivity rather than labour productivity, using green taxes and 'cap-and-share' schemes (Kallis, 2011; Kallis *et al* 2018).

Another element is to reduce aggregate investment by firms to net zero, which does not exclude that some (clean) sectors grow at the expense of other (dirty) sectors (Kallis *et al* 2018).

Other ideas found in the literature are the re-localisation of economies to shorten the distance between consumers and producers, and encouragement of the sharing economy (Paech, 2012), as well as new forms of (regional) money and limitations to property rights (Kallis *et al* 2012; van Griethuysen, 2012).

Some advocate for zero interest rates to avoid the growth imperative created by having to pay back interest (Binswanger, 2013), caps on savings to reduce wealth inequality and doing away with the logic of accumulation by firms and owners of capital. The aim is to arrive at a steady state in which the whole economy is consumed, which would end growth (Loehr, 2012).

Importantly, many of the proposed policies are considered by authors themselves to be incompatible with capitalism and unlikely to be implemented by liberal representative democracies.

Kallis *et al* (2018) therefore argued that in the absence of democratic degrowth policies a period of involuntary economic stagnation caused by climate change might usher in an authoritarian version of capitalism, unless more democratic alternatives are put forward.

Finally, it should be noted that degrowth proponents devote relatively little attention to limiting population growth, which would theoretically offer another – though contentious – way to reconcile GDP per capita growth and emission reductions.

Where it is discussed, most authors view it as undesirable, especially when non-voluntary, and point out that the large and growing populations of the Global South put relatively little stress on the environment (Cosme *et al* 2017).

On the whole the proponents of degrowth do point out the size and magnitude of the challenge confronting the world. However, we do not see any likelihood that either advanced or developing economies would accept and implement the radical propositions embedded in the degrowth literature.

We also do not think that it is in any way possible to manage degrowth without massive negative welfare effects. Overall this therefore points to green growth and the need to confront its current limitations.

4 Green growth

The calculations in section 2 illustrate the scale of the challenge. However, it is also important to note that the low decoupling rate up to now has occurred in a context in which there hasn't been a significant climate effort globally, and developed economies have put in place only modest policies. This pattern need not continue, and there are signs that it might not.

The EU has already managed to cut its territorial emissions of CO_2. This is of course partly due to lower population and GDP per capita growth than the global average. But data also shows that the decoupling rate (decline in CO_2/GDP) between 1990 and 2016 stood at -3.4 percent per year in the EU (based on OWID), more than the global average of -1.8 percent.

However, this is not at the required -9.4 percent for the EU's net-zero goal. When we break CO_2/GDP down into its two components from the Kaya identity, energy demand/real GDP and CO_2/energy demand, we see that the higher decoupling rate is mostly due to a decline in the latter: the energy sector has been decarbonised more in the EU than elsewhere.

Tables 1A and 1B show broadly similar evolutions for energy demand/real GDP globally and in the EU (the EU does slightly better), but while the carbon intensity of energy has remained largely stable worldwide, in the EU it has decreased by a yearly average of 0.7 percent since 1995.

Table 1A. Factors of the Kaya identity and CO_2/GDP, average yearly rates of change (%) at global level in historical reference periods and net-zero emission scenario

WORLD	Historical 1995-2018	Net zero scenario 2019-2050	Historical 2005-2018	Net zero scenario 2019-2050
CO_2	1.9	-5.9	1.6	-5.9
Population	1.2	0.8	1.2	0.8
Real GDP per capita	2.6	2.3	2.6	2.3
Energy demand/real GDP	-1.7	-1.7	-1.8	-1.8
CO_2/energy demand	0.0	-7.2	0.0	-7.0
CO_2/real GDP	-1.8	-8.7	-2.1	-8.7

Table 1B. Factors of the Kaya identity and CO_2/GDP, average yearly rates of change (%) at EU27 level in historical reference periods and net zero emission scenario

EU27	Historical 1995-2018	Net zero scenario 2019-2050	Historical 2005-2018	Net zero scenario 2019-2050
CO_2	-0.8	-8.1	-1.6	-8.1
Population	0.2	0.0	0.2	0.0
Real GDP per capita	1.2	1.4	0.8	1.4
Energy demand/real GDP	-1.8	-1.8	-2.1	-2.1
CO_2/energy demand	-0.7	-7.7	0.7	-7.4
CO_2/real GDP	-3.3	-9.4	-3.7	-9.4

Note: targeted gross CO_2 levels in 2050 are based on the LED/P1 pathway of the IPCC (2018) for the global estimates and on the 1.5 LIFE pathway of European Commission (2018) for EU27 estimates. Both pathways rely little on negative emission technologies. Our net zero scenario uses forecasted population and GDP per capita data by the OECD (EU GDPpc approximated by euro area data) and assumes (arbitrarily) that energy demand/real GDP will continue to decline at the same yearly rate as its average in the relevant reference period (1995-2018 or 2005-2018). Note that due to the different sources of the historical data, rates in the historical columns do not add up entirely as can be expected mathematically. We nevertheless made efforts to make the historical data as consistent as possible. Numbers should be interpreted as rough estimations.
Source: Bruegel, based on OWID for CO_2 emissions and CO_2/GDP, OECD (2018) for GDP per capita data, OECD (2021a) for population, OECD (2021b) for energy demand/real GDP, and IEA (2020b) for CO_2/energy demand.

A decline in energy demand/real GDP can be driven by improvements in energy efficiency from using better technologies for production, transport, isolation etc; by behavioural change towards less energy-intensive consumption (eg. increased use of public transport, a larger sharing economy and more re-use of durable goods); and by a changing economic structure towards a more 'immaterial' service-oriented economy.

A decline in CO_2/energy demand is mostly driven by the shift from fossil fuels to renewable energy sources. Changing behaviour also plays a role (choosing to travel by rail rather than by air for example).

So far, energy demand/real GDP has declined more since 1995 than CO_2/energy demand. Perhaps this is somewhat surprising as in the long run it seems more likely that energy would be almost completely decarbonised than that the global economy would be completely 'de-energised': goods still need to be produced somewhere and transport, heating and lighting will remain necessary.

In practice, both factors will have to decline simultaneously to sufficiently reduce gross CO_2 emissions. This is also visible in Tables 1A and 1B, which show that if energy demand/real GDP continues to decline at its current rate, a very steep drop in CO_2/energy demand will be necessary for both the world and the EU.

If energy demand/real GDP is also addressed more strongly, the 'burden' can be spread over both factors of the Kaya identity (see for example the different rates depending on which reference period is used for energy demand/real GDP).

The data presented here suggest that an absolute decoupling of CO_2 and GDP is possible, but that it is currently still too slow to reach net zero. Note that while the required decoupling rate is higher for the EU than for the world, the

EU is closer to its goal: while the overall decoupling rate must increase around five-fold for the whole world, the EU itself only needs less than a three-fold acceleration.

The historical decoupling rate against which to compare also increases if one takes a more recent reference period, as is visible in the table. Speeding-up will still take tremendous effort: if the energy intensity of GDP decreases at the same speed as in the last few decades, even the EU would need to speed up its decarbonisation of energy by a factor of around 11 to reach its required decoupling rate.

The drastic decline in prices of renewable energy technologies suggests that such an accelerated decarbonisation of energy may be feasible. Figure 3 shows that over the last decade, the cost of generating electricity with solar panels has decreased by 85 percent, while the cost of doing so with wind turbines has decreased by 68 percent.

The costs of energy from solar and wind have become lower than fossil fuel alternatives even without subsidies. Firms and governments all over the world would therefore have economic incentives to make the necessary investments to save money and at the same time reduce their emissions.

Investment decisions are of course not based solely on market prices but also on government policies and strategies. Money is still being invested in fossil fuels, but volumes are declining. Meanwhile global investments in renewable energy generation have been on the rise uninterruptedly since 2017, even during the pandemic in 2020.

Moreover, it takes time before lower costs are translated into larger investments, and other key investments must be made before renewable energy can be used at a massive scale, notably in energy storage capacity and more reliable distribution and transmission.

As investments in battery storage are surging while costs are declining and investments in grids are set to recover in 2021, we can expect that the upward trend in renewable energy investment will continue for the foreseeable future (IEA, 2021d).

Already in the earlier literature rejecting degrowth pessimism, the central role of technology was highlighted. Stiglitz (1974) and Kamien and Schwartz (1978) did not yet address GHG emissions, but rather whether continued consumption growth is possible in a world with exhaustible resources.

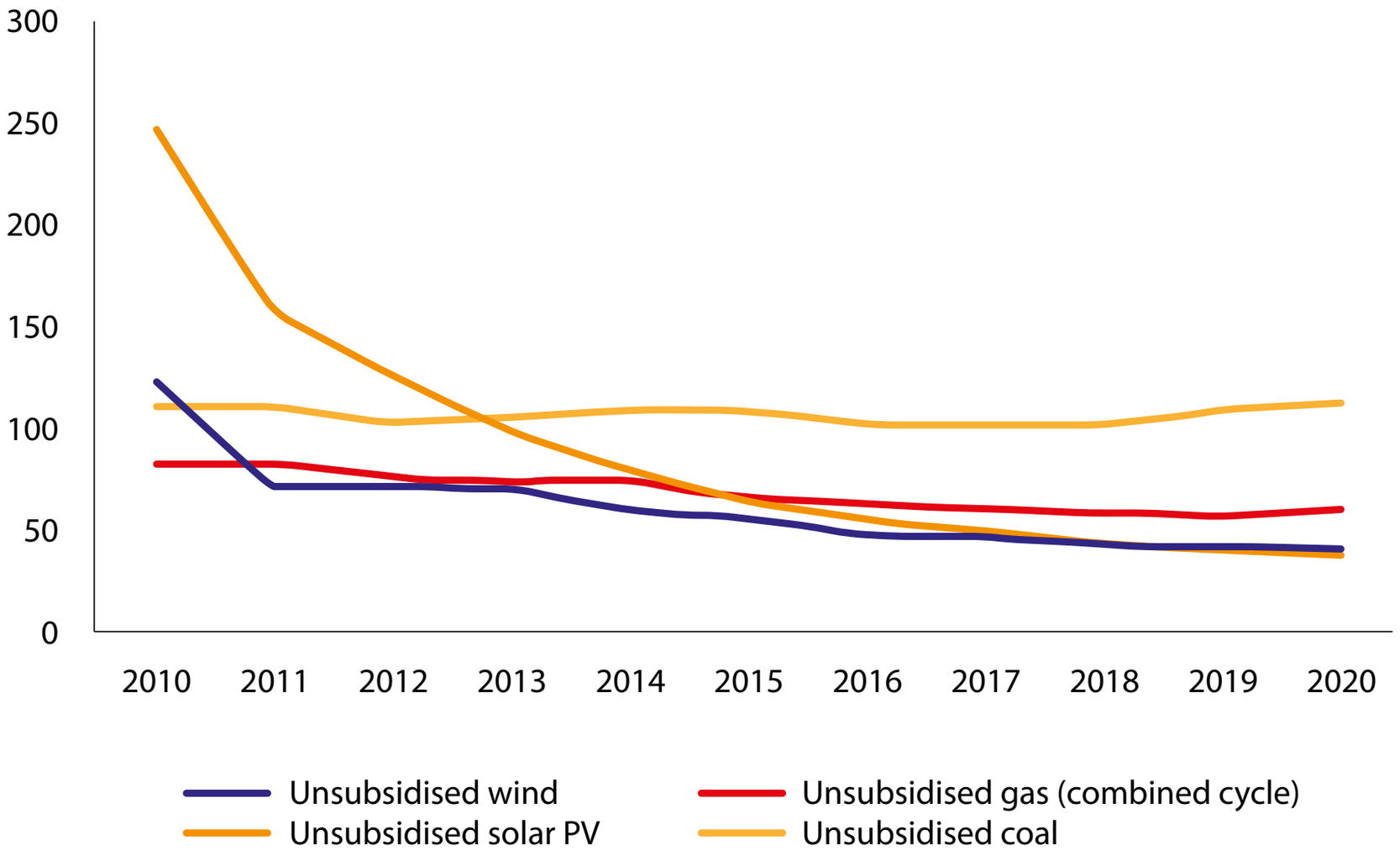
They found that technology-driven efficiency gains allow the limits set by nature to be pushed forward so that continued expansion is possible. Later papers, including Weitzman (1999), Acemoglu *et al* (2012) and Aghion *et al* (2016), discussed endogenous and directed technical change with more optimistic outlooks.

The 1987 Brundtland report *Our Common Future* is seen as a milestone for green growth with its definition[7] of 'sustainable development' (Jacob, 2012)[8]. The term 'green growth' only gained popularity in the wake of the global financial crisis of 2008 as an idea for short-term stimulus that incorporated environmental objectives (eg. OECD, 2009), and was adopted as a policy objective by international organisations in the subsequent years (Jacob, 2012).

Today it underpins the United Nations' Sustainable Development Goals[9], and to varying degrees different Green (New) Deal proposals (eg. European Commission, 2019; US House of Representatives, 2019).

No single definition has been developed of what is meant by 'green growth'. For example, the World Bank (2012), OECD (2011) and UNEP (2011) each define green objectives differently (Hickel and Kallis, 2020).

Figure 3. Levelised cost of energy (LCOE) from selected fossil fuels and renewable energy sources, in USD/MWh



Source: Lazard (2020).

Jacobs (2012) wrote that green GDP growth is understood as either: (1) higher growth than in a scenario without strong environmental or climate policies, both in the short and long run (dubbed the 'strong' version of green growth), or (2) lower in the short run and higher in the long run (the 'standard' version)[10].

Whatever the exact interpretation of green growth, publications from international organisations or governments predict both environmental benefits in the form of avoided climate damages and economic benefits resulting from increased investment and innovation[11].

This 'double dividend' forms the heart of the green-growth argument. The green-growth narrative rests on four pillars:

(1) subsidies for innovation and investments in renewable energy and energy efficiency that boost GDP;

(2) carbon pricing to further stimulate efficiency gains and renewables, and to avoid rebound effects, combined with recycling of tax revenues to cut corporate or labour taxes and boost employment;

(3) assumptions about innovation and negative emission technologies to accelerate the decoupling process; and

(4) compensation schemes for the poorest households, displaced workers or disadvantaged regions to make the transition politically feasible (see for example Table 2).

Table 2. Different green growth scenarios, showing targeted emission reductions, estimated GDP impact, key policies, and adversely affected groups (if no compensation)

	IMF (2020)	European Commission (2020b)[12]	IEA (2021b)
Emission reductions	Reduce gross global emissions by 80% by 2050	Reduce net EU emissions by 55% by 2030	Reduce global net CO_2 emissions to zero by 2050
GDP impact	Standard version: baseline GDP +0.7% first 15 years, -1% in 2050, +13% in 2100	Standard version: baseline GDP -0.27%/+0.50% by 2030	Strong version: baseline GDP +4% in 2030
Key policies	• green investment push • carbon pricing • compensatory transfers supportive macro policies	• green investment push • carbon pricing • tax recycling	• green investment push • carbon pricing
Adversely affected groups	• Low-income households, due to electricity prices and job status • Fossil fuel exporters	• Fossil fuel industry • Low-income households	• Fossil fuel exporters • Fossil fuel industry

Source: Bruegel.

Inclusion of such social elements puts current proposals a step beyond earlier incarnations of Green New Deals (Mastini *et al* 2021). In its most extreme form, green growth is believed to come as a result of free markets and does not even require public intervention other than carbon pricing (Gueret *et al* (2019) refer to this as 'green capitalism').

Overall, however, the empirical evidence for a double dividend looks mixed. In fact, some of the reports by official institutions state that a double dividend can be achieved only if very specific assumptions are made, while in many scenarios, strong climate action could at least in the short-term lower GDP growth.

5 Techno-optimism: important caveats

The numbers we have given show that the world needs to decouple gross GHG emissions and GDP growth much faster than currently. In the following, we set out the key actions necessary to achieve such a faster decoupling[13].

5.1 Need for massive investment in deployment of existing green technologies

To decouple GHG emissions and GDP growth, a huge expansion in green investment and a big shift in investment are needed. For instance, the IEA's (2021b) net-zero pathway estimates that global energy capital investments must increase from a current yearly average of about $2 trillion to $5 trillion (2019 prices) by 2030, after which they must stay at almost the same level until 2050.

As a fraction of global GDP, this would be an increase from 2.5 percent today to 4.5 percent in 2030, followed by a gradual decline back to 2.5 percent. Encouragingly, most of the technologies to be invested in up to 2030 (for 85 percent of emission reductions; see IEA, 2021b) are readily available.

Beyond 2030, that will be much less the case: only 54 percent of emission reductions will be accomplished with current technologies. Most of the investments up to 2050 (about 65 percent) would be directed to generating low-

carbon electricity, upgrading the electricity system for distribution and storage and electrifying new sectors of the economy (CO_2/energy demand), while a smaller though still significant share (about 15 percent) would be spent on efficiency improvements (energy demand/real GDP).

Governments will have to foot part of the bill, especially for large infrastructure projects or technologies still under development (IEA, 2021b). But the private sector will need to cover most of the investments.

It is therefore important that governments use policies to create incentives and facilitate investments, for example through carbon pricing, 'green' financial regulations and supervisory practises, or cooperation with the private sector through public financial institutions such as the European Investment Bank.

Clear and credible policy commitments also help by reducing the uncertainty that can keep firms from investing (Dechezlepretre *et al* 2021).

5.2 Need for breakthrough green technologies for decarbonisation

Most emission reduction scenarios that predict continued economic growth rely to varying degrees on the use of technologies that are not yet available. This is frequently used by degrowth proponents as an argument to question the feasibility of green growth.

The IEA net-zero pathway (2021b), for instance, relies to a great extent on future innovation: 15 percent of the emissions reductions by 2030 and 46 percent of the reductions between 2030 and 2050 are to be achieved with technologies that are currently in a demonstration or prototype phase, such as CCS, green hydrogen and advanced batteries.

The breakthroughs achieved in the current decade will therefore be crucial. Unfortunately, none of the technologies needed beyond 2030 are currently on track to being deployed in time (IEA, 2021c), as the road from concept to commercialisation is typically long and winding.

To accelerate the development of these innovative technologies, governments and the private sector both need to substantially increase their research and innovation funding. Fostering green innovation and bringing green technologies from the laboratory to the market requires government action, for example via pricing of emissions.

Public-private partnerships schemes, adequate risk-taking by public institutions and green industrial policy can further deliver breakthrough innovation (Tagliapietra and Veugelers, 2020). But, of course, there cannot be a guarantee that such breakthrough technologies will materialise in time.

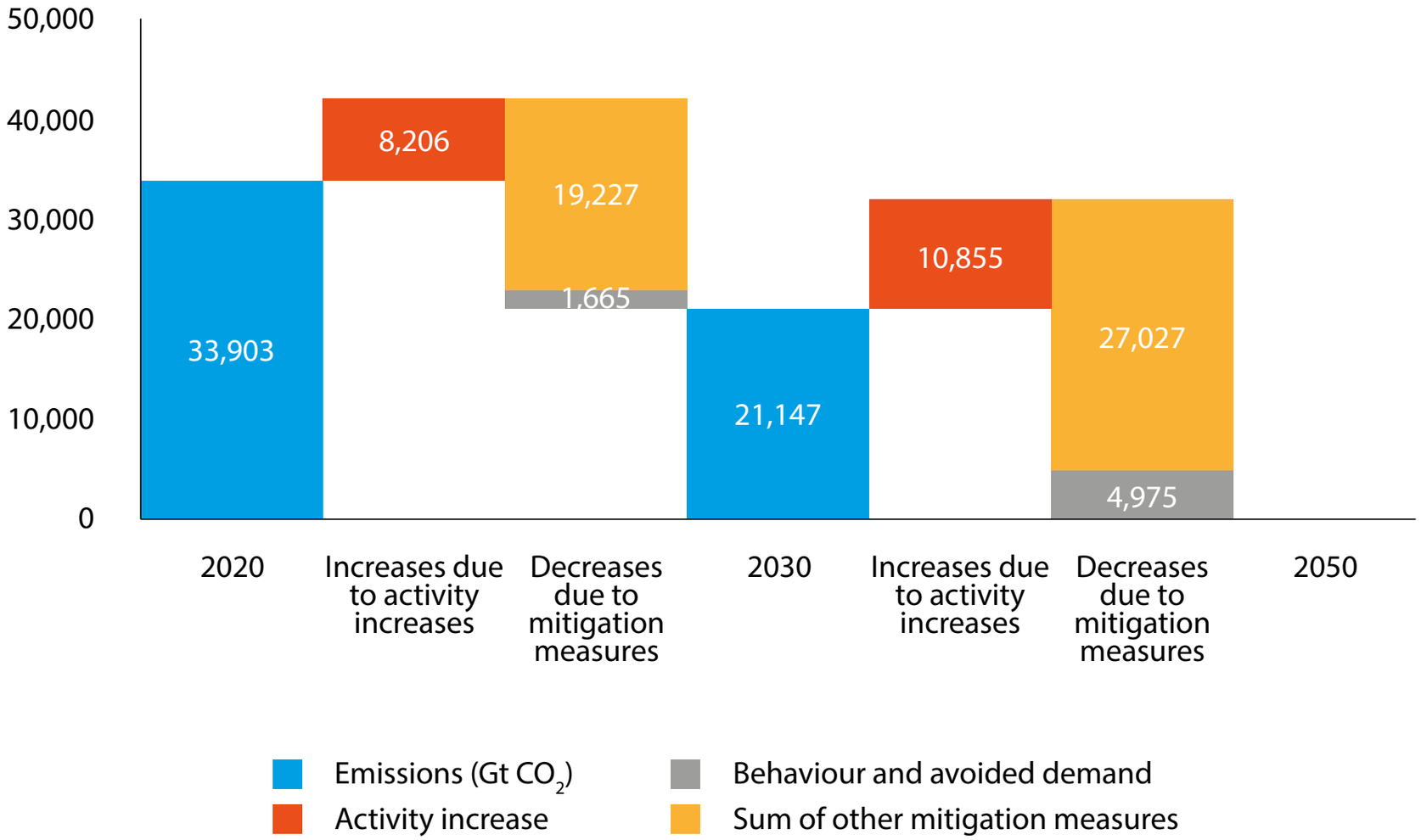
5.3 Need to foster behavioural change

In theory, emissions from energy production could be sufficiently reduced solely on the back of technology. However, we noted that both declines in energy demand/real GDP and CO_2/energy demand also depend on behavioural changes.

In practice, these will be needed to swiftly and affordably reduce emissions from sources that are more difficult to decarbonise, such as air travel. For instance, in the IEA (2021b) net-zero roadmap, behavioural change accounts for 12.5 percent of global CO_2 reductions between today and 2050 (Figure 4).

Behavioural change can also reduce the cost of the green transition. To appreciate this point, it is useful to compare the EU investment requirements to reach net zero by 2050 estimated by the European Commission under two

Figure 4. Impact of behavioural change in the IEA net-zero roadmap, emission reductions and increases from now to 2050 (megatonnes of CO_2)



Source: International Energy Agency (2021b).

different scenarios: one relying only on technology (1.5 TECH), and one relying on both technology and behavioural changes (1.5 LIFE).

Between 2031 and 2050, the 1.5 TECH scenario requires additional average annual investment of €289.5 billion compared to the baseline, while the 1.5 LIFE scenario requires only €175.7 billion (European Commission, 2018).

Furthermore, the energy sector is responsible for 73 percent of global GHG emissions[14]. This implies that even cutting energy-related emissions to zero would not be sufficient to achieve climate neutrality by mid-century, since the remaining emissions would still exceed the amounts permissible to limit global warming to 1.5°C (UNEP, 2020a).

Other sectors that primarily emit gasses including methane (CH_4) and nitrous oxide (N_2O) for other reasons than energy therefore also have an indispensable role to play in emission reductions. For much of these emissions however, particularly from agriculture and land use, which account for 18.4 percent of the total, technology is not likely to have much impact.

We have not made much progress in decoupling GHG emission from food production (1.0 percent per year since 1990, according to FAO data). As Turner (2020) put it, the technology 'cow' has indeed barely changed over the last millennia.

GHG emissions per kilo of meat from cattle have declined by a mere 0.4 percent per year on average since 1990. They account for 37 percent for all emissions from food production documented by the FAO[15] (FAOSTAT, 2021). A change in diet and the way we use land for producing other goods might thus become necessary.

Bearing this in mind, it is important to consider degrowthers' warnings of rebound effects. If policies to reduce emissions through investments in renewables and efficiency gains achieve positive income effects or too optimistic perceptions, a narrow focus on certain sectors could leave room for harmful effects from increased emissions elsewhere. This could offset at least part of the progress made in emission reductions from energy[16].

5.4 Need to develop and scale-up negative emission technologies

All IPCC emission pathways, including the one on which we based our calculations in sections 2 and 3, consider net CO_2 emissions, with reductions from agriculture, forests and other land use.

Reforestation, afforestation, habitat and soil management can be used to remove CO_2 from the atmosphere, provided that increased efforts are made in these areas. This is why gross emissions can remain small but positive in a net-zero situation.

Unlike the conservative pathway we used, most of the IPCC pathways (IPCC, 2018) also rely significantly on human-made negative emission technologies. They allow for greater remaining CO_2 emissions from activities that are hard to decarbonise when reaching climate neutrality by mid-century and beyond, as these are offset by more carbon removal.

This in turn means that the high required decoupling rate of around 9 percent becomes somewhat lower, which would make a difference in the feasibility of net-zero by mid-century.

This is controversial among climate scientists, however. Negative emission technologies are currently under development or in early small-scale implementation and are not on track to being ready in time (IEA, 2021c).

Furthermore, many scientists are sceptical about the feasibility and viability of certain technologies and are even worried that they may create numerous other serious environmental problems because of potentially high input requirements.

Governments should encourage the development of both natural and technological solutions but should be keenly aware that negative emission technologies cannot be a substitute for actual, immediate emission abatement.

5.5 Need to adapt our economies to unavoidable climate change

Global efforts to reduce GHG emissions are aimed at limiting global warming to 1.5°C, thus minimising dangerous climate change.

Unfortunately, with average temperatures already more than 1.0°C above pre-industrial levels (IPCC, 2018) climate change is already upon us. Natural disasters, most of which could be linked to climate change, reportedly caused $210 billion of damages worldwide in 2020[17] (Munich Re, 2021).

Structural change such as desertification and shifting seasonal patterns are already visible. Occasional and structural damages are bound to get worse and more frequent as temperatures rise to 1.5°C or 2°C in a mitigated scenario, let alone if we do nothing. For regions closer to the equator, climate change may become a matter of life and death, and political and other spillovers are to be expected.

It is therefore imperative that in parallel to mitigation efforts, investment in climate adaptation should accelerate. Coastal areas, often densely populated, will have to improve their flood defences, while many regions, in particular urban areas, simultaneously will have to save potable water for dry spells.

Buildings and cities need to be adapted to cope with sometimes much higher temperatures, while forests must be managed to minimise fire hazard. Rural areas will need to change their sources of income if certain crops become difficult to cultivate and tourist destinations lose their appeal.

Like mitigation, climate adaptation measures are good investments. For instance, in a scenario with 3°C of global warming or more, the PESETA IV study by the European Commission (2020c) estimated that installing reservoirs to reduce flood risks in Europe will save €40 billion per year by 2100, for a yearly investment of only €3.3 billion up to then.

Annual damages of up to €220 billion by 2100 can be avoided if we start investing less than €2 billion in the protection of our coastlines. The analysis suggests that such investments will still be worthwhile in a scenario with only 2°C of global warming.

It is important to realise the sizable returns to adaptation, as annual adaptation costs in the developing world alone are estimated to be between $140 billion and $300 billion in 2030, while those of developed countries are even higher (UNEP, 2020b).

6 Conclusions

In order to avoid global warming in excess of 1.5°C above pre-industrial levels, global GHG emissions must be rapidly reduced. Doing this without losses in economic prosperity will not be easy: so far, decoupling GHG emissions from GDP growth has been slow or absent.

This is seen as justification for degrowth scholars to propose a radical overhaul of our economic system. Yet this approach seems unrealistic. Asking for lower growth, let alone negative growth, would mean that large parts of the world could not develop, or only at the expense of even harsher degrowth in developed countries.

Low-income countries will obviously not follow this advice and the notion of redistributing income from rich to poor countries is also unrealistic.

The real question therefore becomes whether decarbonisation efforts can be accelerated. While global emissions have not declined, GHG emissions from developed economies such as the EU have, despite continued economic growth.

The data also shows that the speed of decoupling of emissions and growth has accelerated in the world. The efforts to reduce the carbon intensity of energy in many economies have contributed to a steep decline in the prices of renewable energy technology, which has improved the economic case for rapid decarbonisation worldwide.

Belief that further innovation and investment will enable the world to successfully reach climate neutrality by 2050 without reducing welfare underlies the green-growth narrative advocated by most governments and international organisations.

The direction and pace of technological progress are impossible to predict. Neither the degrowth hypothesis as the only approach to achieve climate neutrality by 2050, nor the green-growth hypothesis can therefore be credibly excluded ex ante. However, as we argued in the previous section, there are important actions governments can take to enhance the likelihood that green growth is achieved.

Ultimately, if stringent emission targets are taken as a given, the choice to pursue green growth, degrowth or something in between is a choice about how much one is willing to trust in technology and how much one wants to hedge against the adverse effects of declining GDP.

Both rely on untested ideas. The only certainty is that we should firmly commit to sticking to stringent targets no matter which path is chosen, and policy should evolve accordingly.

As the *Stern Review* (2007) put it, in the long run the benefits of strong climate action will outweigh the costs of climate action. ■

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Endnotes

1. See for example https://www.theguardian.com/environment/video/2019/sep/23/greta-thunberg-to-world-leaders-how-dare-you-you-have-stolen-my-dreams-and-my-childhood-video, accessed 15 July 2021.

2. The remaining emissions arise from agriculture (11.2 percent), land use (7.2 percent), industrial processes (5.2 percent) and waste (3.2 percent) (see https://www.climatewatchdata.org/ghg-emissions). While this paper focusses mostly on GHG emissions from energy, the more difficult part of emissions reduction and sustainability in general may in fact be making the necessary changes in how we use natural resources to feed and dress ourselves. More on this in section 5.

3. Energy production is what causes emissions, but the variable that must be impacted by policy is energy demand. We assume production is equal to demand and use IEA data on total primary energy supply to represent both. For IEA definitions see https://www.iea.org/commentaries/understanding-and-using-the-energy-balance

4. From here on we switch from showing data on total GHG emissions to data on CO_2 emissions for reasons of data availability and comparability to theoretical emission pathways. Since we focus on emissions mitigation in the energy sector, this is not an oversimplification: CO_2 represented 91 percent of global GHG emissions from energy in 2018 (CH4: 8.6

percent and N_2O: 0.8 percent), and the energy sector accounts for 93 percent of global CO_2 emissions (industry: 4.1 percent and LULUCF: 3.3 percent) (see https://www.climatewatchdata.org/ghg-emissions). LULUCF = land use, land-use change and forestry.

5. Loosely based on the LED/P1 pathway of the IPCC (2018), which uses neither carbon capture and storage technology (CCS) nor bioenergy with CCS (BECCS), technologies that are currently under development and that degrowth scholars deem unfit for climate change mitigation.

6. Decoupling is slowest in developing and emerging countries, where the carbon intensity of GDP is mostly higher than in Europe today. Between 1990 and 2016 the average yearly decoupling rate in India was -2.4 percent, in Africa -2.1 percent, in China -1.8 percent and in South America -1.1 (based on OWID data). It is important to note here that most of these countries had vastly lower levels of carbon intensity of GDP than developed countries throughout most of the previous century and have contributed much less to the current stock of CO_2 in the atmosphere. Nevertheless, as these economies increase their shares of world GDP, faster decoupling will become increasingly important. It is not for this paper to review the vast discussion on international climate justice and the degree to which different parts of the world, because they have increased the global stock of CO_2 in the atmosphere, should decouple more quickly.

7. "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development 1987, p. 41).

8. It lay at the basis of global ecological policy thinking of the next few years, such as at the Earth Summit and in the Rio Declaration in 1992, which explicitly called for economic growth to address environmental problems.

9. The SDGs indeed also include 'Decent Work and Economic Growth' as SDG8.

10. Adding to the confusion is lack of clarity about the baseline against which growth is usually compared: is it a trajectory based on historical average growth rates or a no-action scenario that includes serious damage from climate change in the long run? This is not trivial, as in comparison to an economy wrecked by runaway climate change, an economy that avoids global warming by growing more slowly or even by shrinking could be on a higher growth path, but this is generally not a scenario considered as 'green growth'.

11. The environmental benefits are sometimes augmented by more short-term co-benefits, mostly through improved health; see Karlsson et al (2020) for an overview.
12. Includes JRC-GEM-E3, E3ME and E-QUEST model estimates.
13. Because of the nature of renewable energy, global supply chains, and the consequences of climate change, as well as the benefits to be had from cooperation in R&D, each of these points should be addressed with international cooperation in mind (see for example Leonard et al 2021).
14. See Climate Watch for historical GHG emissions.
15. See FAOSTAT, Agri-Environmental Indicators, accessed on 20 July 2021.
16. In the absence of a limit or prices on emissions, there can also be rebound effects within the energy sector, for example when people start using more energy because it is becoming cheaper or greener. This means increases in energy demand/real GDP offset decreases in CO_2/energy demand.
17. See 'Record hurricane season and major wildfires – The natural disaster figures for 2020', Munich RE, accessed 24 February 2021.

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Hydrogen development strategies: a global perspective

The EU, UK, US, China and Japan all expect hydrogen to play a significant role in the decarbonisation of their economies. Alicia García Herrero, Simone Tagliapietra and Victor Vorsatz appraise their approaches

Nearly all global decarbonisation scenarios agree that the future is electric. There are two basic reasons why electrification is the primary and most cost-effective pathway to decarbonisation. First, after decades of subsidy-driven technological innovation, solar and wind have now become the cheapest electricity generation sources in most of the world.

Second, rapid technological advances enabling cheaper batteries, heat pumps, electric motors and similar technologies are now allowing electricity to enter sectors traditionally dominated by fossil fuels such as transport, heating and industry.

As global energy systems become electrified, the key challenge for system operators will be to keep up with electricity demand in real time to avoid blackouts. But as the share of solar and wind power increases, matching becomes more challenging: how do you meet electricity demand when the sun isn't shining or without wind?

One of the two main reasons hydrogen is now 'in vogue' is that, as a chemical energy carrier, it meets the storage and flexibility needs of a renewable energy. Also, hydrogen can be used to decarbonise hard-to-abate sectors, such as heavy industry, trucking, aviation or shipping.

Hydrogen appears to be the perfect complement to renewables in the path to decarbonisation, but only if produced via electrolysis based on electricity from renewables themselves.

Since 1975, global hydrogen demand has grown more than threefold, reaching 70 million tonnes per year in 2018. It is currently used as a feedstock in either oil refining or ammonia production. On the supply side, hydrogen is currently almost entirely supplied from fossil fuels, which makes it an emitter of 830 million tonnes of carbon dioxide per year, equivalent to the combined CO_2 emissions of Indonesia and the United Kingdom.

However, renewable hydrogen is now looking increasingly viable thanks to reductions in the cost of wind and solar technology usage. While the production costs of fossil-based hydrogen are currently estimated at €0.8-2.7 per kilogram, renewable hydrogen can already be produced at €2.5-6.3 per kilogram with further cost reductions projected. Given this, countries around the world are gearing up to develop a renewable hydrogen strategy.

Below, we provide a first comparison of the plans in the European Union, the United Kingdom, the United States, China and Japan to draw some initial perspectives on the current status of hydrogen development strategies globally.

Hydrogen appears to be the perfect complement to renewables in the path to decarbonisation, but only if produced via electrolysis based on electricity from renewables themselves

European Union

The EU expects hydrogen to play a significant role in delivering the deep emissions reductions required between 2030 and 2050 to achieve climate neutrality, and for this reason is predominantly focusing on the development of renewable hydrogen.

However, the EU also envisages a temporary use of other forms of low-carbon hydrogen to decarbonise existing fossil-based hydrogen production. Overall, the EU foresees a gradual trajectory for hydrogen deployment in Europe with three different phases (Table 1).

Table 1. The EU's hydrogen strategy

Period		Installed renewable hydrogen electrolysers (gigawatt)	Renewable hydrogen production (million tonnes)	Main sectorial target
Phase 1	2020-2024	6	1	Decarbonise existing hydrogen production in industry
Phase 2	2025-2030	40	10 (1% of EU final energy demand*)	Take-up in new end-use applications
Phase 3	2031-2050	Large-scale	Large-scale (10% of EU final energy demand*)	Reach all hard-to-abate sectors

**Note: this is the role of hydrogen in EU final energy demand envisaged in different EU long-term energy and climate scenarios. See European Commission (2020), p 56*
Source: Bruegel on European Commission (2020)

The EU strategy envisages two main lead markets for hydrogen: industrial applications and mobility. An immediate industrial application would target the reduction and the replacement of the current fossil-based hydrogen in refineries and in the production of ammonia, as well as the partial replacement of fossil fuels in steel making.

In the longer run, a greater utilisation of hydrogen would fully decarbonise the European steel making process. In transport, hydrogen is promising where electrification is more difficult. In the short run, it can be used in city buses, specific parts of the rail network where electrification is not feasible, or in heavy-duty road vehicles.

The EU sees a role for hydrogen in the decarbonisation of the aviation and maritime sectors. Here, a role may exist for hydrogen via fuel cells, but also in the production of synthetic kerosene and ammonia.

The EU strategic vision is additional to national hydrogen strategies and investments. A number of EU countries – Germany, France, Italy and Spain – adopted a hydrogen strategy in 2020

They also committed around €11.5 billion to hydrogen from 2021 to 2026 in the framework of Next Generation EU, with €3 billion of spending planned in Germany, €3 billion in Italy, €2 billion in France, €1.5 billion in Spain and around €1 billion each in Poland and Romania.

Furthermore, an EU Important Project of Common European Interest (IPCEI) on hydrogen was also launched in 2020 to help accelerate the creation of a European hydrogen value chain. The level of ambition of national strategies varies but is clearly high in some cases (Table 2).

Table 2. EU main national hydrogen strategies: targets and pledged funding

Period		Installed renewable hydrogen electrolysers (gigawatt)	Renewable hydrogen production (million tonnes)	Main sectorial target
Phase 1	2020-2024	6	1	Decarbonise existing hydrogen production in industry
Phase 2	2025-2030	40	10 (1% of EU final energy demand*)	Take-up in new end-use applications
Phase 3	2031-2050	Large-scale	Large-scale (10% of EU final energy demand*)	Reach all hard-to-abate sectors

Source: Bruegel on national hydrogen strategies

Germany aims to build up 5 GW of electrolyser capacity by 2030, contributing to the national energy consumption goal of 90-110 TWh by then. This is around 4% of the final energy consumption of Germany under the JRC 'Fit for 55' energy scenario. To achieve this, Germany has made €9 billion available through its national hydrogen strategy.

France's plans are even more ambitious with a target for electrolyser capacity of 6.5 GW by 2030 and with €7 billion of public funding up to 2030 to promote hydrogen applications in industry and transport.

Italy has also adopted a national hydrogen strategy, primarily targeting 5 GW of electrolyser capacity by 2030 – or 2% of final energy demand, to be scaled-up to 20% of final energy demand by 2050.

Lastly, Spain is aiming for 4 GW of electrolyser capacity, to be reached with €9 billion of public and private investment by 2030.

United Kingdom

The UK unveiled its strategy to develop what the government defines as a *"world-leading hydrogen economy"* in August 2021, which identifies hydrogen as a key ingredient for its energy transition, especially in electricity, industry and parts of the transport sector.

On the supply side, the main target is to develop 5 GW of low-carbon hydrogen production capacity by 2030 (similar to Germany and Italy), leading to 20-35% of the country's energy consumption being hydrogen-based by 2050.

On the demand side, the target is to let hydrogen play an important role in decarbonising those sectors that currently use hydrogen based on unabated fossil fuels, such as the chemical industry and oil refineries, as well as residential heating, electricity and certain transport segments.

It is interesting to note the high expectations the UK has on the role of hydrogen in the residential heating sector. It expects around 1 TWh of domestic heating demand to come from hydrogen by 2030, which would allow 67,000 homes to switch from natural gas to hydrogen each year.

The strategy then aspires to rapidly scale up to 45 TWh by 2035, to cover 10% of domestic heating demand with hydrogen by 2035.

On transport, it is important to mention that the strategy does not envisage using hydrogen in cars, but only those segments that will be more difficult to electrify, such as shipping, aviation, trucks, buses and trains.

The strategy estimates the UK-wide hydrogen economy to be worth £900 million and create over 9,000 jobs by 2030, potentially rising to 100,000 jobs and £13 billion by 2050.

United States

In contrast to the EU, the US will only start to develop a national clean hydrogen strategy after the passage of the bipartisan Infrastructure Investments and Jobs Act.

So far, the *Hydrogen Program Plan* and the *Hydrogen Strategy* by the Department of Energy (DoE) have offered a strategic framework to turn hydrogen into an *"affordable, widely available and reliable"* technology and *"an integral part of multiple sectors of the economy across the country."*

To fulfil its strategic vision, the US focuses on both fossil fuel-based and renewables-based hydrogen production. Hence, the US plans to utilise carbon capture and storage (CCS) to reduce emissions while still relying on production from natural gas.

The Infrastructure Investments and Jobs Act foresees the creation of at least four *"regional clean hydrogen hubs"* producing and using the fuel for manufacturing, heating and transportation. At least two would be in US regions *"with the greatest natural gas resources,"* according to the bill. One hub would produce from fossil fuels, one would use renewable power, and another nuclear power.

Coal is also listed a potential source. No target to increase the production of renewables-based hydrogen has been included in the bill. Furthermore, the legislation uses a highly debated definition of clean hydrogen, according to which a kilogram of hydrogen produced with CO_2 emissions of up to two kilograms is defined as 'clean'.

Similar to the EU, the US envisages the continued and increased use of hydrogen in oil refining in the short term. Additionally, the US aims to employ hydrogen as a portable power storage option.

In the medium term, hydrogen is to be applied to distributed stationary power generation, in fuel cells for medium- and heavy-duty vehicles and in the production of synthetic fuels. At the same time, hydrogen will substitute fossil fuels in industrial processes, for example in the production of steel and cement.

In the long term, hydrogen is expected to be integrated into energy systems, providing mid- to long-term storage, stabilisation services and the coproduction of hydrogen for end-uses other than electricity.

The US notably aims to utilise research and development investments to overcome technical barriers and validate hydrogen prototype applications by providing grants to research and development and demonstration projects.

While public hydrogen investments by the DoE were limited to about $150 million per year in 2017, the Infrastructure Investments and Jobs Act introduces future investments of up to $9 billion from 2022 to 2026. Hence, US investments are similar to the ones in the Next Generation EU programme.

Out of the $9 billion, $8 billion will go to the development of the regional hydrogen hubs using the fuel for manufacturing, heating and transportation. The additional billion will be assigned to research and development and demonstration projects for electrolysers.

If the US can keep up with its ambitions, the DoE estimates a four- to six-fold increase in hydrogen consumption by 2050. This increase would translate into hydrogen potentially accounting for up to 14% of US total energy demand by 2050.

China

China currently is the world's largest hydrogen producer but not of green hydrogen, as most is based on coal. In addition to more common uses of hydrogen such as feedstock for oil refining or ammonia production, the country also has targets for hydrogen applications in the transport sector.

As part of the recently released 14th Five-Year-Plan, hydrogen has been identified as a prioritised emerging industry in China, with an aim to increase the share of renewables-based hydrogen to 50% of total hydrogen production by 2030.

This represents a significant commitment, considering the country's current reliance on coal for hydrogen production. CCS technologies are also envisioned to play an important role in the decarbonisation of hydrogen production, similar to the approach followed by the US.

Future applications of hydrogen are expected to be specified in a national hydrogen development strategy, still to be published. At the provincial level, Shandong, for example, is aiming to develop industrial hydrogen clusters, in which the different application opportunities of hydrogen are intertwined. Pilot programmes to produce steel using renewables-based hydrogen have also been launched.

Moreover, the provincial plans include accelerated hydrogen refuelling station construction and continued fuel cell vehicle subsidies. Additionally, market observers expect current subsidies and investment programmes

in the transport sector to be extended to hydrogen delivery and storage infrastructure as well as to CCS and electrolysis technology. However, the extent of these investments also remains unclear until the national hydrogen development strategy has been outlined.

Japan

Japan adopted its *Basic Hydrogen Strategy* in 2017. This strategy envisions using hydrogen in both households and in industrial applications. Moreover, hydrogen is integrated into 10 of the 14 priority technology areas in the Japanese *Green Growth Strategy* published in 2020. Japan's hydrogen strategy is part of the country's desire to become independent of imported fossil fuels.

Japan aims to increase its hydrogen consumption twenty-fold till 2030, from around 300,000 tons currently, to 6 million tons. This rapid expansion reflects a rise in the share of hydrogen in current primary energy consumption from 0.2% to about 4.5%.

The increased demand is supposed to be covered by 300,000 tons of domestically-produced renewable hydrogen in 2030 and 5-10 million tons in 2050. The remaining demand will be met by imports of natural gas-based and renewables-based hydrogen.

While the share of renewables-based hydrogen in the imports is so far not subject to a quantitative target, domestic production is aimed to be 100% renewable-based by 2030.

Similar to China, Japan has been pursuing the application of hydrogen in the transport sector since the 2000s. By 2030, Japan aims to have 800,000 fuel cell vehicles, representing about 1% of currently registered vehicles.

Interestingly, Japan also foresees the use of hydrogen in the residential sector. By 2030, 5.3 million fuel cell units are expected to supply local power and heat households and power the industrial sector.

To achieve this wide-ranging application of hydrogen in the economy, Japan pursues quantitative targets for cost reductions and power efficiency increases, with significant research and development programmes being linked to these milestones.

Supported by significant public investments, Japan is working on the development of hydrogen infrastructure in the country, accompanied by relevant regulatory reforms, subsidies as well as the establishment of an international hydrogen supply chain, currently being envisioned in two demonstration projects in Australia and Brunei.

Conclusions

The EU, the UK and Japan currently have the most detailed hydrogen strategies, while, despite starting early, China's national strategy remains undefined and unfocused on renewable hydrogen. The US, however, is in the process of formulating its strategy which will be published soon.

When looking at planned investments, Japan, the US, and the EU all project similar levels of per capita public investment. In terms of future applications, all countries aim to deploy hydrogen in industry. The UK focus on residential heating is peculiar compared with other strategies.

All players envision a gradual transition to low-carbon hydrogen, be it by focussing on renewable hydrogen, in the EU and the UK, or CCS technologies, most notably in the US. Japan takes on a special role as it plans an international hydrogen supply chain given the country's limited domestic resources.

All in all, and notwithstanding these differences, it is clear that all players want hydrogen a significant role in the decarbonisation of their economies. ■

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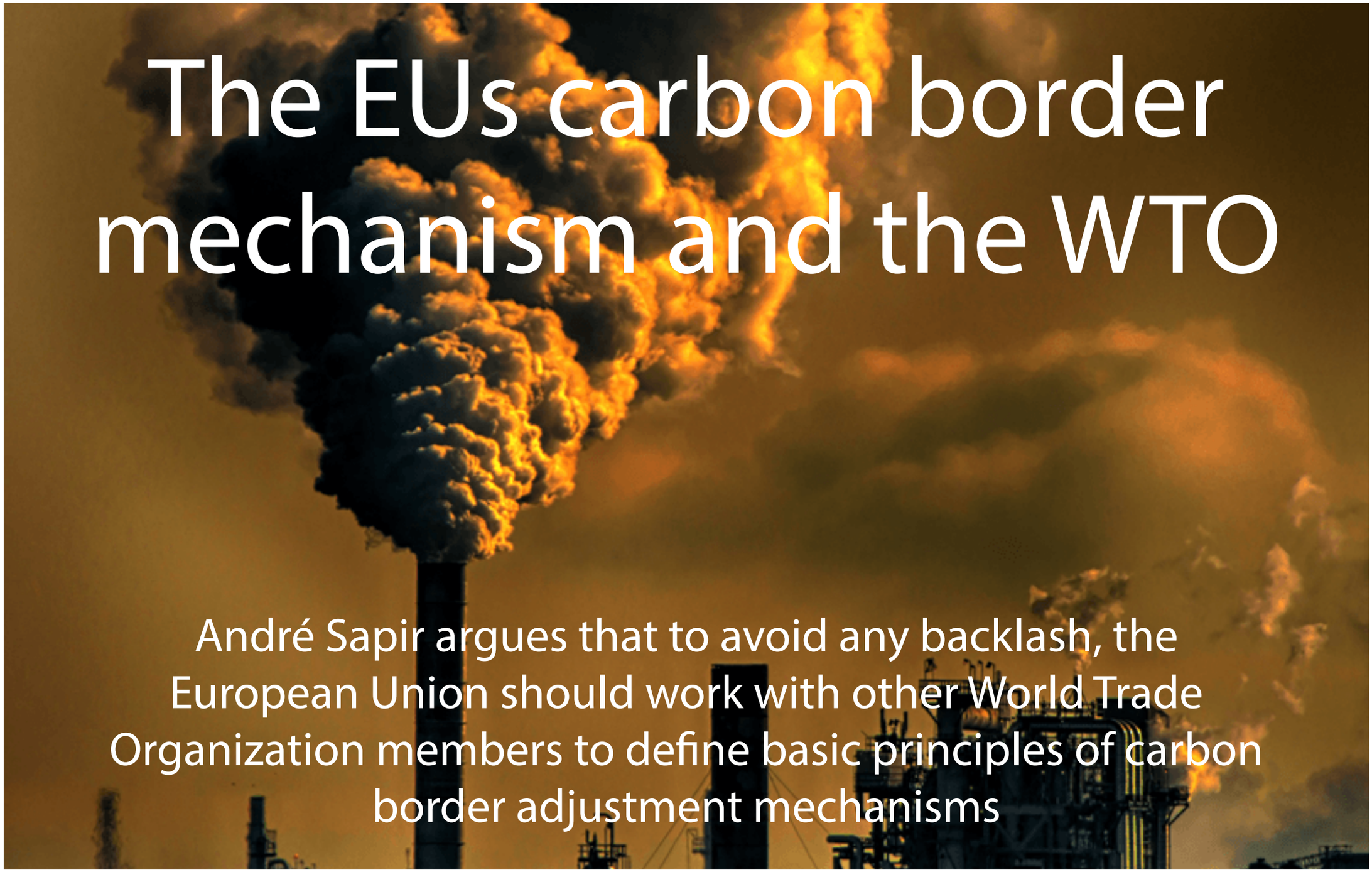


The EUs carbon border mechanism and the WTO

André Sapir argues that to avoid any backlash, the European Union should work with other World Trade Organization members to define basic principles of carbon border adjustment mechanisms

According to the World Bank's Carbon Pricing Dashboard, as of April 2021, 45 countries had in place national or supra-national carbon pricing schemes, in the form of either an emission trading system (ETS) or a carbon tax. Although existing schemes still only cover 18.8% of global greenhouse gas emissions, the international appetite for carbon pricing is clearly on the rise.

Ten of the G20 countries already implement such schemes and, at their 9-10 July meeting in Venice, G20 finance ministers adopted a communiqué encouraging, for the first time and *"if appropriate, the use of carbon pricing mechanisms."*

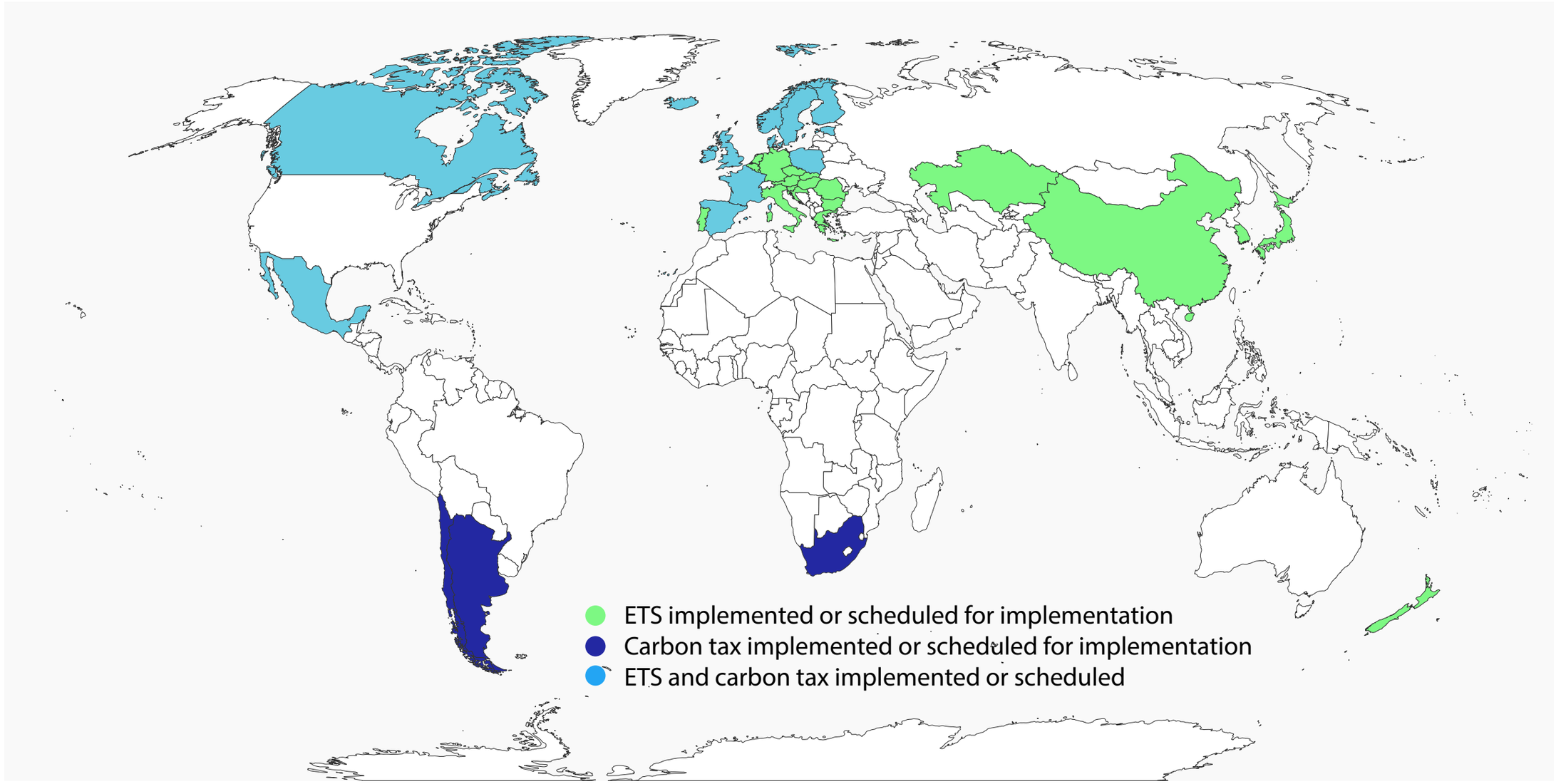
In the map, countries/jurisdictions with an ETS are shown in green, those with a carbon tax are shown in blue, and those with both an ETS and a carbon tax are shown in cyan shading.

The European Union's ETS, originally set up in 2005, operates in the 30 European Economic Area (EEA) countries – the 27 EU countries plus Iceland, Liechtenstein and Norway – some of which also apply national carbon taxes. According to the World Bank, the EU ETS currently covers 3.2% of global emissions.

So far, carbon pricing schemes only cover carbon emissions produced within the jurisdictions that operate these schemes. For instance, the EU ETS only applies to carbon emissions from production in the 30 EEA states, and Japan's carbon tax only applies to carbon emissions from production in Japan.

The fact that carbon pricing schemes are implemented only in a limited number of countries, and with different levels of carbon prices between these countries, has long raised the fear of carbon leakage, namely the possible transfer of carbon-intensive activities away from countries with high carbon prices that would not only be detrimental to economic activity in these countries but could also increase global emissions.

Figure 1. Summary map of regional, national and subnational carbon pricing initiatives



To avoid carbon leakage and level the playing field, it has long been argued that countries need to extend their carbon pricing schemes to emissions by producers located outside their borders but exported into the jurisdictions that operate such schemes.

To this day, however, no national or supra-national jurisdiction has implemented a carbon border adjustment mechanism (CBAM), which would make up for the difference between its domestic carbon price and the carbon price in countries with a lower (or no) carbon price.

The EU should be congratulated for having put forward a comprehensive response to tackling its own carbon emissions. It has done a service to the world by experimenting with policies that have not been tried elsewhere before, including a CBAM that complements its ETS

If adopted by the European Council and the European Parliament, the EU CBAM proposed in July by the European Commission would, therefore, be a first worldwide.

There are two main reasons why, prior to the proposed EU CBAM, no jurisdiction has introduced legislation to extend its domestic carbon pricing scheme to emissions produced outside its own territory.

First, the effective price of carbon emissions applied to tradeable products has so far been generally very low under most existing carbon pricing schemes.

For instance, under the EU ETS, the effective carbon price paid by producers of manufactured products covered by the ETS (such as cement, chemicals or iron and steel) was essentially zero, since they received free allocations of emission permits.

It was neither necessary nor possible, therefore, to impose a CBAM on similar products imported into the EU since, by definition, a CBAM is an adjustment meant to equalise the price of carbon between domestic products and imports.

The second reason is that a CBAM may not be compatible with the rules of the World Trade Organization (WTO), and even if it is, it may not be politically acceptable to foreign trading partners, who could retaliate.

This is what happened in 2012, when the EU decided to introduce a CBAM for the aviation sector, triggering a political backlash from powerful foreign countries (including Brazil, China, India, Japan, Korea, Mexico, Nigeria, Russia and the United States) that led to de facto withdrawal of the measure by the EU.

So how does the proposed EU CBAM score on these two issues and what are the chances that it will actually see the light of day?

The EU CBAM will only apply initially to a limited number of carbon-intensive products: cement, iron and steel, aluminium, fertilisers and electricity. For these products, free ETS allowances for EU producers will be reduced by 10% each year from 2025, resulting in their complete phase out by 2035, while the CBAM on imports will be gradually phased in at the same rhythm so it will only apply to the proportion of emissions that do not enjoy free allowances.

The CBAM will apply to imports at the price of carbon determined by the EU ETS system through auctions, which is expected to rise over time as free allowances, initially only in the five sectors listed above and later also in other import-competing sectors already subject to the EU ETS (including ceramics, glass, paper and other chemicals), are phased out.

Given that the EU carbon price is currently already above €50 per tonne of CO_2, it can probably be safely assumed that the effective price of carbon paid by EU producers in import-competing sectors subject to EU ETS will gradually rise to at least €50 by 2035, which is likely to generate carbon leakage in these countries and, therefore, justify the introduction of the CBAM.

Having established that the phase out of free ETS allowances will substantially increase the price of carbon faced by import-competing carbon-intensive producers in the EU, and therefore that the parallel phasing in of the CBAM is justified to avoid carbon leakage, we can now turn to the second issue and examine whether the proposed EU CBAM risks creating legal and political conflicts with third countries, and potential retaliatory measures.

Legal scholars agree (see here and here) that WTO rules in principle allow WTO members to adjust their ETS systems for imports as the EU CBAM proposes to do. Whether or not the EU CBAM complies with WTO rules is therefore down to its actual implementation and in particular whether it meets a double non-discrimination test: non-discrimination between domestic and foreign suppliers, and non-discrimination between foreign suppliers.

The EU CBAM purports to treat EU and foreign suppliers equally since they would both be paying the same price for their embedded carbon emissions for products sold in the EU – by purchasing ETS allowances for the former and CBAM certificates for the latter.

Foreign suppliers would be entitled to claim a reduction against the CBAM for any carbon price paid in the country of production (which is not rebated or in other way compensated for upon export).

Hence, suppliers from countries with carbon pricing schemes would be able to handle the CBAM administrative costs relatively painlessly. The situation would be different for suppliers from countries that implement carbon reduction policies through means other than carbon pricing.

Whether this would be regarded by some of these countries as discrimination in terms of WTO law remains to be seen. One accusation of discrimination that cannot be levelled against the Commission proposal is that it will exempt certain countries from the CBAM. Except for Iceland, Liechtenstein and Norway, which belong to the EU ETS, and Switzerland, which has an ETS linked to the EU ETS, the EU CBAM will apply to all countries.

With respect to Switzerland, the explanatory memorandum accompanying the Commission CBAM proposal (pp 26-27) states that exemptions *"could be granted to countries who have in place a carbon pricing system that imposes a*

carbon price at least equivalent to the price resulting from the EU ETS on products subject to the CBAM. In practice… such an approach may be considered for countries with an ETS linked to the EU ETS (eg. Switzerland)."

However, this statement raises a question about the meaning of 'equivalence' envisaged by the Commission. Switzerland's carbon pricing scheme is equivalent to the EU's scheme is two ways: like the EU, Switzerland has an ETS, and its ETS is linked to the EU ETS.

Hence there is equivalence in systems and in carbon prices. But what about a country that also has an ETS, which is not linked to the EU ETS but nonetheless imposes a carbon price which is the same or even higher than the EU ETS, or another country that uses a carbon tax instead of an ETS, which also imposes a carbon price equal to or higher than the EU ETS?

The flipside of non-discrimination between third countries (with the exception of Iceland, Liechtenstein, Norway and Switzerland) is that developing, and even least-developed countries will be subject to the same EU CBAM as more advanced countries, despite the principle of common but differentiated responsibilities enshrined in the Paris Agreement.

One way to reconcile the EU's obligation under both the WTO and the Paris Agreement would be to seek a WTO waiver permitting the exemption of developing or least-developed from the EU CBAM, or similar CBAMs that may follow the EU CBAM.

Both sets of issues – potential discrimination between countries with and without carbon pricing schemes, and lack of differentiation in favour of lower-income countries – should be addressed at the multilateral level in the WTO, with the EU seeking to establish with other WTO members a memorandum of understanding on carbon

border adjustment mechanisms that would define some basic principles. This would certainly help deflect not only potential legal challenges but also a political backlash against the EU CBAM.

The EU should be congratulated for having put forward a comprehensive response to tackling its own carbon emissions. It has done a service to the world by experimenting with policies that have not been tried elsewhere before, including a CBAM that complements its ETS.

But the EU needs to collaborate with other jurisdictions to ensure its CBAM is embedded into a multilateral framework comprising both the Paris and WTO agreements, without which the pursuit of global carbon neutrality would ultimately be in vain. ■

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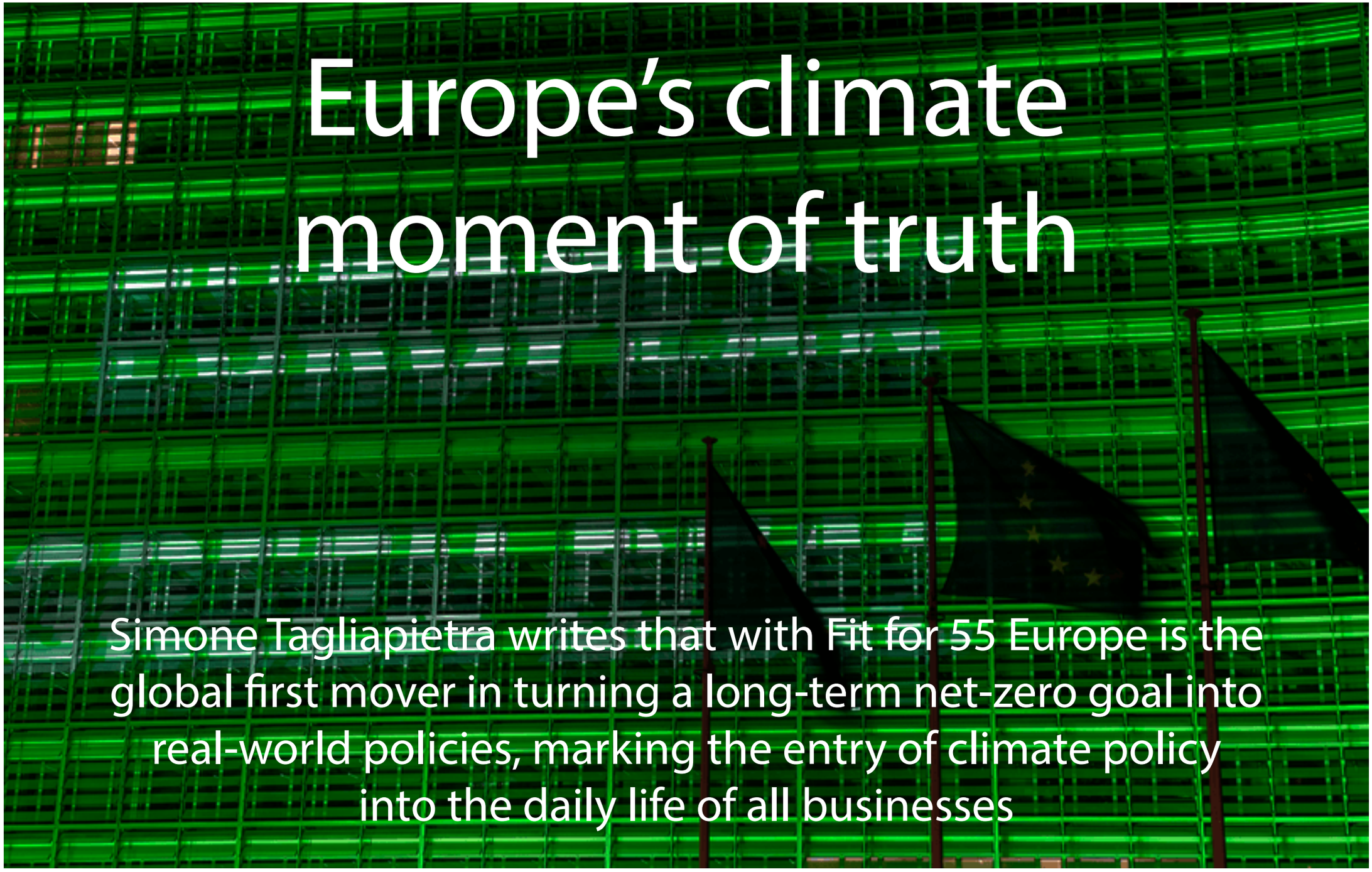
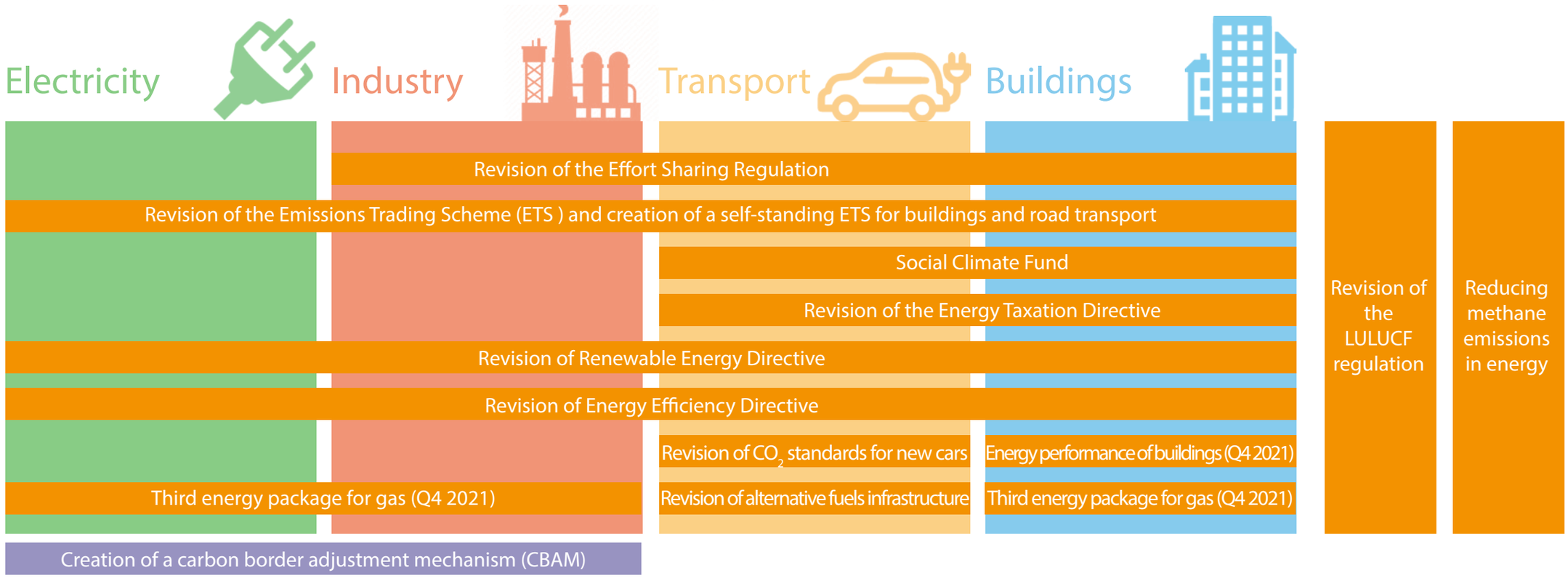
Europe's climate moment of truth



Simone Tagliapietra writes that with Fit for 55 Europe is the global first mover in turning a long-term net-zero goal into real-world policies, marking the entry of climate policy into the daily life of all businesses

The European Commission's long-awaited 'Fit for 55' package, intended to facilitate a European Union greenhouse gas emissions cut of 55% by 2030 compared to 1990, has as its core mission to turn the 2020s into a transformative decade for climate action. If agreed and implemented, the Fit for 55 proposals (Figure 1) would both deepen and broaden the decarbonisation of Europe's economy to achieve climate neutrality by 2050. Without the package, under current EU climate legislation, Europe will only achieve a 60% emissions reduction by 2050.

Figure 1. A scheme of the 'Fit for 55' jumbo package



Source: Bruegel

Fit for 55: a transformative package

The broad package containing hundreds of pages of legislative proposals, includes the creation of a new EU emissions trading system (ETS) for buildings and road transport, a profound restructuring of energy taxation in Europe, increased renewable energy and energy efficiency targets, the introduction of a carbon border adjustment mechanism and revised CO_2 emissions standards for new cars (see Annex).

Looking at the wide variety of 13 proposals, it is first interesting to note how certain items represent an evolution of current EU climate policymaking. It should be stressed that, while not innovative, this upgrade of existing instruments would deliver the majority of emission reductions by 2030 (Table 1).

Table 1. Evolution of EU climate targets

	2020	2030 framework (2014)	2030 framework (Fit for 55)
Emissions reduction target (Compared to 1990)	20%	40%	At least 55%
Renewable energy target(In total energy consumption)	20%	At least 32%	40% [Proposed]
Energy efficiency target(Compared to baseline scenario)	20%	At least 32.5%	36% [Proposed]

Source: Bruegel based on European Commission.

This is the case with the toughening of renewable energy and energy efficiency targets, and with the more rapid tightening of the ETS cap (ie. the linear reduction factor – already made steeper when the EU jumped from the 2020 to the 2030 climate target).

Transport and buildings get the climate policy spotlight

The package also contains major new components, not least emissions trading for buildings and transport. There is a clear reason for action in this area: so far, EU climate policy has predominantly focused on the decarbonisation of the electricity and industrial sectors, notably through the ETS and binding targets for renewable energy and energy efficiency.

With the Fit for 55 package, the EU is the first large economy in the world to start translating the goal of climate neutrality into real-world policies

Consequently, emissions from the electricity sector have fallen fast, and emissions from the industrial sector have also decreased, though to a lesser extent. However, emissions from the building sector have not decreased significantly, while transport sector emissions have even increased steadily (Figure 2).

The Fit for 55 package thus aims to bring transport and building into the EU decarbonisation process. As the two sectors respectively account for 22% and 35% of EU emissions, their decarbonisation is essential for the EU to reach its climate targets. It is also very important to foster their decarbonisation in this decade, to avoid an unrealistically fast decarbonisation requirement between 2030 and 2050.

The Fit for 55 package envisages decarbonisation in these sectors taking place within a framework involving a mix of policy instruments, primarily carbon pricing, energy taxation and environmental standards.

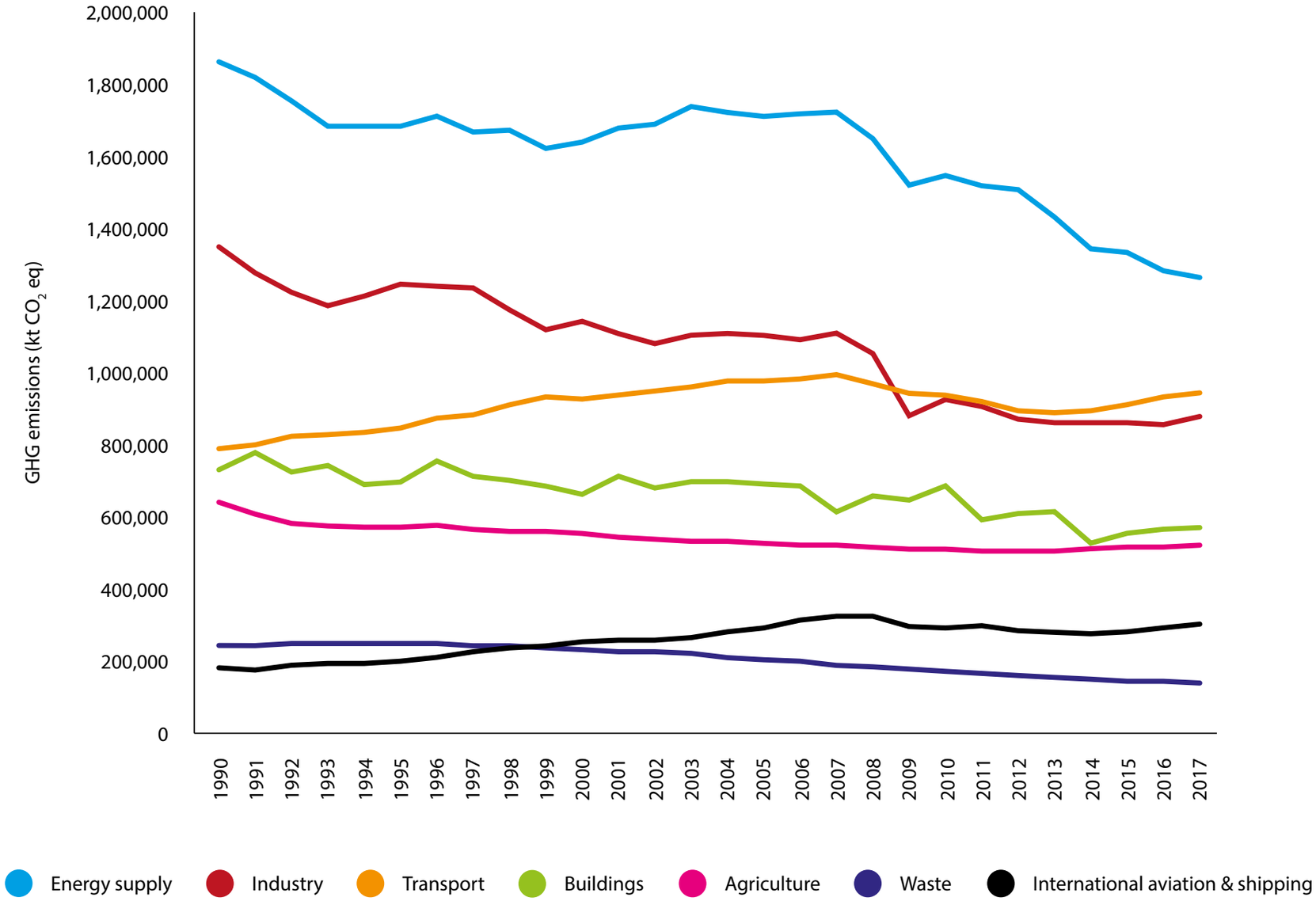
As decarbonisation goes economy-wide, social fairness will be crucial

Under the Fit for 55 proposals, a stand-alone ETS for buildings and road transport would enter into operation in 2026.

For reasons of technical feasibility and administrative efficiency, the impact of the scheme on citizens would be only indirect, as regulation would be binding on those further up the supply chain. But whether directly or indirectly, the system will ultimately impact citizens through higher transportation fuel prices and heating bills.

This transmission of decarbonisation costs to families and small and medium-sized businesses is politically delicate, and will most likely be at the heart of fierce negotiations over the next two years between the European Parliament and EU countries, which must jointly approve the plans.

Figure 2. Greenhouse gas emissions by sector



Note that buildings refers to residential and commercial as defined by the EEA. This does not include public electricity and heat production, unlike other estimates.
Source: Bruegel on data from European Environment Agency, available at: https://www.eea.europa.eu/data-and-maps/daviz/ghg-emissions-by-aggregated-sector-5#tab-dashboard-02

For instance, Pascal Canfin, who chairs the powerful European Parliament Committee on Environment, Public Health and Food Safety, has called the idea of establishing an ETS for buildings and road transport *"politically suicidal"*, and has claimed it risks triggering social unrest across Europe, similar to the yellow vests (gilets jaunes) movement in France.

In its proposal, the European Commission recognises the inevitable social impacts of the measures, and for this reason suggests channelling 25 percent of the revenues from the new ETS into a Social Climate Fund aimed at supporting building renovations and the uptake of clean cars by vulnerable families and small businesses, and to provide temporary lump-sum payments to vulnerable households to compensate for the increase in road transport and heating fuel prices.

Like the just transition fund or Next Generation EU, it suggests that EU countries design their own climate action social plans and then ask for financial support from the fund, which shall be conditional upon achieving pre-defined targets.

However, this might still be insufficient to shield the most vulnerable from the impacts of the measure. Some political groups in the European Parliament and some EU countries are likely to argue that a mix of stronger incentives for buildings renovation and electric vehicle deployment, and stronger environmental standards for buildings and cars, will do a better job.

And of course, some EU countries might claim that revenues from the new ETS for buildings and road transport should be entirely used at the national level, without having to go through an EU-wide Social Climate Fund.

A matter of sovereignty: the difficult question of energy taxation

The current EU Energy Taxation Directive – designed in 2003 – incentivises fossil fuel usage, rather than cleaner alternatives. Because of the political sensitivity of this framework, and the requirement that EU countries agree unanimously on tax measures, previous reform attempts have consistently failed.

With Fit for 55, the Commission proposes an overhaul of the framework based on the general principle that taxation of energy products and electricity should be based on both their energy content and environmental performance, and that different minimum levels of taxation should be allowed for motor fuels, heating fuels and electricity in order to promote greener choices.

In particular, an EU-wide minimum tax rate would be applied to polluting aviation fuels – except cargo-only flights, 'pleasure flights' and 'business aviation' – as well as to polluting boat and ship fuel, including fishing vessels. These minimum tax rates would be introduced over 10 years, starting in 2023.

The package also contemplates the possibility of tax exemptions for renewable electricity, renewable hydrogen and advanced biofuels and biogases, again with a view to promoting greener energy sources.

This proposal will be highly contentious, notably as some countries will likely consider the measure as an encroachment on their sovereignty, as they have in the past.

Farewell to combustion-engine cars

On the reduction of CO_2 emissions from new cars and new light commercial vehicles, the package contains a significant goal: vehicle CO_2 emissions should be cut by 55% by 2030 and by 100% by 2035 – with the important caveat that if manufacturers struggle to meet it, the goal can be postponed to 2040.

If met, the 2035 target is thus equivalent to a ban on the sales of new internal combustion engine cars in 14 years.

The logic of the measure is to give manufacturers sufficient time to properly plan (or accelerate) the conversion of their fleets to electricity, while ensuring the full decarbonisation of road transport by 2050.

As the average lifespan of a car is around 15 years, the full conversion of the European car parc will take place between 2035 and 2050 – a timeframe in which electric cars will become affordable for all.

While almost politically inconceivable until recently, this proposal is likely to be approved without major turbulence. Yes, certain EU countries and political groups in the European Parliament would like to see a faster transition, while others would like to see slower change.

But this could ultimately be acceptable to all, taking into account the industrial strategies of several European carmakers, which are already planning to bid farewell to traditional cars by 2030.

A carbon border adjustment to prevent carbon leakage from Europe

On top of all these important proposals is the controversial carbon border adjustment mechanism (CBAM). Already widely debated in Europe and globally, this measure is intended to ensure a level playing field for EU business, which could be put at a competitive disadvantage as Europe deepens its decarbonisation while others do not keep pace.

CBAM is about charging the carbon content of imports, to a level equal to domestic carbon pricing. The proposal envisages that the system initially targets a select number of carbon intensive goods including cement, iron and steel, aluminium, fertilizers and electricity.

EU importers of these goods will be required to buy CBAM certificates, the price of which shall mirror that of the ETS, and surrender them to a newly established CBAM Authority. For goods subject to ETS free allocation, CBAM price to be paid upon imports shall be reduced by a corresponding amount to ensure equal treatment.

Furthermore, for goods subject to a carbon price in their country of origin, a corresponding rebate will be applied, again to ensure equal treatment. CBAM shall be applied to goods imported from extra-EU countries, but some countries shall be exempted: Iceland, Liechtenstein, Norway and Switzerland.

The package proposes to assign the revenues generated by CBAM to the EU budget. A measure that no other economy has so far taken, the CBAM shall be gradually introduced from 2023, with a three-year transitional period to ensure the least possible impact on trade flows.

Starting the mechanism with a limited number of carbon-intensive goods will help to facilitate the system set-up. However, since a transitional period is envisaged to last until 2026, and since CBAM is envisaged to initially target only a limited set of goods, the system might just turn out to be too little too late.

This is one of the major issues that will likely characterise the EU institutional negotiations to finalise the measure over the next two years. Others will include, for instance, whether or not to: exempt least developed countries or use revenues for climate-related purposes only.

Given the global repercussions of the measure, the negotiations will certainly be followed with great attention in global capitals, starting with Beijing and Washington.

Conclusions

With the Fit for 55 package, the EU is the first large economy in the world to start translating the goal of climate neutrality into real-world policies.

In some areas, such as the CO_2 standards for cars and the reform of EU energy taxation, the challenge will be to emerge from political negotiations without any significant watering-down of the proposals. For other items, including the ETS reform and the CBAM proposal, significant enhancements could and should be made to make them stronger and more impactful.

The principle of climate justice should guide the negotiations over the next two years. Fit for 55 pushes EU decarbonization into higher gear, marking the visible entry of climate policy into the daily life of all European citizens and companies, and also starting to impact global trade partners.

Ensuring that the transition is socially fair, both domestically and internationally, is the most important element to make it successful in the long-run. ■

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The author is grateful to Maria Demertzis, Guntram B Wolff and Georg Zachmann for their comments on previous drafts.
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Annex: the main Fit for 55 measures

Proposed revision of existing legislation	
	Sectoral coverage • Expansion (from electricity and heat, energy-intensive industries and domestic aviation) to maritime transport. Reduction of the emissions cap • Increase in the linear reduction factor from the current 2.2% per year to 4.2% per year between 2021-2030, and one-off downward adjustment of the cap in 2023 to reduce it to be in line with the new level of annual reduction having been applicable from 2021. • Revenue utilisation to address distributional issues • Increased contribution to Innovation Fund and Modernisation Fund. • Member states must use all ETS revenues for climate-related purposes, including support to low-income households' buildings renovation.

EU emissions trading system	Free allowances • To be gradually reduced to zero by 2035. • Not provided to sectors covered by CBAM. • Made conditional on decarbonisation efforts in order to incentivise the uptake of low-carbon technologies. • Rules amended to support decarbonisation of energy-intensive industries. Introduction of a separate, self-standing, emissions trading system for buildings and road transport • Issuance of allowances and compliance obligations to start in 2026. • System will regulate fuel suppliers rather than households and car drivers. • It will become operational as of 2025, with a cap on emissions set from 2026. • The cap will be reduced annually to yield emissions reductions of 43% in 2030 compared to 2005. • Mitigation measures foreseen in order to address potential risk of excessive price volatility.

	• Revenues from the auctioning of allowances to be partially channelled into the Innovation Fund and the Climate Action Social Facility, and partially used by member states to invest in buildings and transport decarbonisation – with a focus on low-income households.
Climate Action Social Facility	• Aim: supporting building renovations and clean cars uptake by vulnerable families and small businesses, as well as at providing temporary sump-sum payments to vulnerable households to compensate for the increase in road transport and heating fuel prices. • Funding source: EU budget, using 25 percent of the expected revenues from the new ETS for buildings and transport. • Between 2025-2032 it will provide €72.2 billion of funding. • Spending should be front-loaded to precede and accompany a smooth introduction of the new ETS. • With a proposal to draw on matching member state funding, the Fund would mobilise €144.4 billion for a socially fair transition. Member states should use their auction revenues from the emissions trading for building and road transport fuels to finance parts of their national contributions to the Fund.

	• Functioning: resembling initiatives such as the Just Transition Fund or NextGenerationEU, it is proposed that member states design their own Climate Action Social Plans and then ask financial support from the facility, which shall be conditional upon achieving the promised milestones and targets.
Effort Sharing Regulation	• Revision of the binding annual emissions reduction targets in non-ETS sectors for each EU country for the period 2021–2030, always according to GDP per capita and always adjusting to reflect cost-effectiveness.
Energy Tax Directive	General principles • Starting in 2023, new structure for minimum tax rates based on the energy content of fuels and environmental performance. • Allow for different minimum levels of taxation to be set out for motor fuels, heating fuels and electricity. • Removal of incentives for fossil fuels. • Member states can exempt vulnerable households from taxation on heating fuels and electricity. Taxing aviation fuel and waterborne navigation fuel • Impose an EU-wide minimum tax rate for polluting aviation fuels, except cargo-only flights, 'pleasure flights' and 'business aviation'.

	• Impose an EU-wide minimum tax rate for polluting waterborne navigation fuel, including fishing. • These minimum tax rates start at zero in 2023 and increase gradually over a 10-year period. Tax exemptions for renewables and green hydrogen • Possibility for tax exemptions for renewable electricity, renewable hydrogen and advanced biofuels/biogases.
Renewable Energy Directive	• Increase in the EU binding renewable energy target for 2030 from "at least 32%" to 40%.
Energy Efficiency Directive	• Increase in the EU energy efficiency target for 2030 from "at least 32.5% compared to projections of the expected energy use in 2030" to 36%.
Regulation on the inclusion of GHG emissions and removals from land use, land use change and forestry (LULUCF)	• Turn the current requirement to ensure that CO_2 sinks do not shrink this decade into an EU target to expand the EU's sink to absorb 310 million CO_2e per year by 2030. A target to be met by giving each member state a legally binding goal. • Require better protections for forests and wildlands. • Starting in 2031, account for agricultural emissions of gases, including methane, in the EU net carbon sink tally.

	• Establish a system of carbon removal certificates that farmers and foresters could sell to polluters needing to balance their emissions, creating a financial incentive to store carbon.
Directive on deployment of alternative fuels infrastructure	• Requires member states to expand charging capacity in line with zero-emission car sales, and to install charging and fuelling points at regular intervals on major highways: every 60 kilometres for electric charging and every 150 kilometres for hydrogen refuelling. • Requires that aircraft and ships have access to clean electricity supply in major ports and airports.
Regulation setting CO_2 emission performance standards for new passenger cars and for new light commercial vehicles	• Reduction of CO_2 emissions from new cars of 55% by 2030 and of 100% by 2035 – with the caveat that if manufacturers struggle to meet it, the target can be postponed to 2040.
Energy performance of Buildings Directive	* To be announced in Q4-2021
Third Energy Package for gas	* To be announced in Q4-2021

Proposed introduction of new legislation	
Carbon Border Adjustment Mechanism	Objectives • Prevent carbon leakage, incentivise third countries to decarbonize and generate EU own resources. Key elements of design • Mirror EU carbon pricing through new mechanism for imports into EU. • Comply with WTO. • Complement EU ETS measures and focus on carbon intensive sectors. Concept • EU businesses pay a carbon border adjustment for imports of certain goods, equal to the price they would have to pay if the goods had been produced under the ETS rules. • Any carbon price paid in a third country can be fully deducted for the EU importer. • CBAM charge will be adjusted to reflect the level of ETS free allowances allocated to a certain sector. • Gradual phase-in starting in 2023, with a 3-year transitional period to ensure the least burden possible on trade flows.

Sectorial coverage

- Initially applied to a selected number of carbon intensive goods including cement, iron and steel, aluminium, fertilizers and electricity.
- To be extended to other sectors later on.

Procedures

- Certified importers of selected goods will have to buy CBAM certificates, the price of which mirrors the EU ETS.
- Emissions embedded in goods to be calculated based on information to be provided by the importer and verified by an accredited third party.
- Each year, certified importers will have to provide a CBAM declaration and surrender a corresponding number of CBAM certificates.
- Failure to do so will result in a penalty amounting to three times the average price of CBAM certificates.

Revenues

- CBAM revenues to be assigned to the EU budget.

A new asset class

Alexander Lehmann says the proposed EU green bond standard will be less prone to ‘greenwashing’, and the widest possible set of issuers and jurisdictions should be encouraged to use the standard

The European Commission's proposal for a European Union green bond standard, published 6 July, comes at a time when issuance of green bonds is booming, with the bulk being issued and traded within the EU. Demand for such assets by investors is similarly strong, though increasingly there are concerns about 'greenwashing' – exaggerated claims by issuers about the environmental quality of the underlying projects financed by the bonds. Dubious practices by some issuers could undermine the entire market.

The EU green bond standard may not become effective for some time but nevertheless the Commission's proposal could do much to direct investors into higher-quality bonds and projects. If used widely, a new asset class in global capital markets could emerge.

Containing greenwashing

A green bond is a traditional bond where the proceeds from issuance are used for a project that meets certain pre-established environmental criteria.

In the case of default, the investor typically has recourse to the issuer's entire balance sheet, as structures based only on the underlying green project or its revenues are rare.

To the end investor, the additional value from holding the green asset derives from this enhanced transparency and association with the green project financed by the bond (even though refinancing is common).

However, definitions of what activities are sustainable are often fuzzy or conflict across jurisdictions. Reporting on the use of proceeds, let alone a project's impact, is often lax. The problems with issuer disclosure and communicating information on the use of proceeds to investors are more pronounced in emerging markets, exactly where the bulk of low-carbon investment will be needed over the coming years.

The EU green bond standard would address these inherent problems with a rigorous regime of transparency and supervision. Only projects that are in line with the EU taxonomy of sustainable activities would be eligible for funding, and issuers would need to provide additional information at the time of issuance, and subsequently through regular reporting on the use of proceeds and its impact.

The new EU standard will put green bond markets on a sounder footing, though implementation should mobilise additional issuers and facilitate cross-border funding in capital markets

Crucially, only external reviewers supervised by the European Securities and Markets Authority (ESMA) will be allowed to sign off on an EU green bond.

Green bonds will be a crucial part of financing the low-carbon transition, given their typical long durations and end-loaded repayment structures, which fit well with large infrastructure projects. Use of the EU green bond label will be voluntary, so the extent to which investors use it and mobilise capital for the low-carbon transition should be one measure of its success.

But the standard will also define a framework for green assets in the capital markets. As such, it should foster scale and liquidity of the asset class, so that investors can discern a yield curve specific to green debt instruments.

Green bond funds and the securitisation of green bank loans could mobilise additional funds, but will depend on there being a uniform standard across different issuers and jurisdictions.

A global blueprint?

Given these wider objectives, there are two possible fates for the EU green bond standard. It may come to define a widely recognised quality benchmark that is replicated in other markets. This kind of 'Brussels effect' in global capital markets has, for instance, been observed for the EU format for retail investment funds (UCITS), which are now widely used outside the EU, including in emerging markets.

Alternatively, the EU's 'gold standard' ambition may remain out of reach for most issuers. Compliance with the technical standards in the EU taxonomy in particular could become a problem. Issuers will weigh the costs and complications of additional disclosure and of going through an ESMA-approved and supervised external reviewers against the benefits of accessing a wider investor base.

Alternative private green bond standards and certification processes may well continue to proliferate. Several EU capital market products have already been shunned by market participants in this way, as for instance has been the case with European long-term investment funds, first designed in 2015, but barely used since then.

Implementing the standard

To simultaneously define a high-quality bond standard while creating scale and liquidity in capital markets, pragmatic implementation by the EU supervisor, and full support from public sector issuers in the EU, will be crucial. Three measures in particular could define success.

First, the EU itself and other EU supranational and sovereign issuers will likely be the largest single class of green bond issuers over the coming years. Green bond issuance by the European Commission under the Next Generation EU (NGEU) programme may amount to €250 billion over the next three years, roughly equal to total global issuance of green bonds in 2020.

To date, issuance by ten EU sovereigns amounted to over €80 billion, and is set to increase rapidly given strong investor demand and the presumed benefits to funding costs in sovereign debt markets. To ensure credibility, the EU and other public sector issuers now need to adopt the EU green bond standard in their own capital market activities.

At the national level, we have already shown that the problems in classifying public expenditures under the EU taxonomy can be overcome (France has already done so). Some EU states have shown how a clear green bond framework can define credible forward-looking commitments on the use of bond proceeds in the national budgetary process.

But under the proposed, regulation green bond issuance by EU countries would be subject to a weaker standard than issuance by the private sector, as reviews by government auditors will not be subject to ESMA supervision. Government agencies would in effect determine what could become a key non-financial attribute of sovereign debt.

Issuance by the Commission under the NGEU programme began in June. Ultimately, the EU as the largest issuer of green bonds will need to account to bond investors for spending of the proceeds in EU countries.

It is in the interest of both the EU and member states that their own green bond issuance complies with the same high standards as corporate issuers. There should not be a separate green bond type for public sector issuers.

Second, EU regulators should define straightforward ways through which taxonomies in other jurisdictions can be mapped into alignment under the EU taxonomy. Many of such classification systems are in use globally, and EU coordination with the key jurisdictions should make different systems compatible (as suggested by Fabio Panetta).

The United Kingdom and the United States are likely to develop taxonomies which are more principles-based. Discussions between the EU and the Chinese authorities within the International Platform on Sustainable Finance suggests the two classification systems are not fundamentally at odds. Ultimately, issuers from non-EU markets should be able to access EU capital markets. EU bond investors may want to document a coherent standard aligned with the EU taxonomy in their global portfolios.

Finally, ESMA, as the EU's capital market supervisor, will need quickly to build up the skills and capacity for its new role as supervisor of green-bond reviewers. The criteria proposed by the European Commission are sensible, as they will put in place a minimum standard for qualifications, transparency and limitation of conflicts of interest.

ESMA should as much as possible enable entities outside the EU to issue on the basis of the EU standard. This should especially reflect the requirements in emerging markets, where corporate disclosure and reporting standards are still weak.

The financing requirements of the EU Green deal are substantial and will primarily rest with the private sector. The new EU standard will put green bond markets on a sounder footing, though implementation should mobilise additional issuers and facilitate cross-border funding in capital markets, which are quickly embracing sustainability. ■

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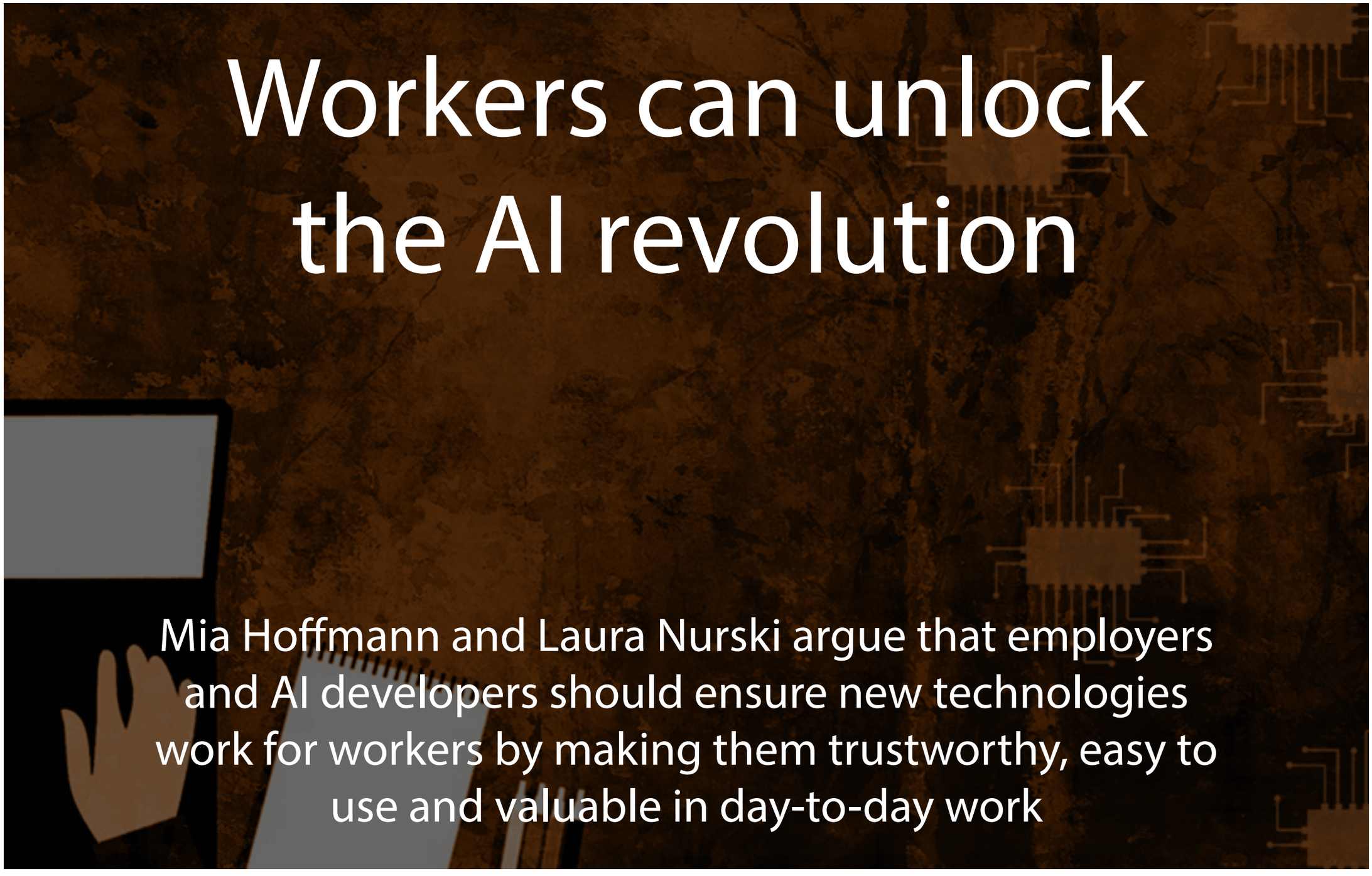
Workers can unlock the AI revolution



Mia Hoffmann and Laura Nurski argue that employers and AI developers should ensure new technologies work for workers by making them trustworthy, easy to use and valuable in day-to-day work

Artificial intelligence has the potential to boost firm-level labour productivity by three to four per cent, and therefore significantly impact economic growth in Europe. However, only four in ten European businesses have so far adopted an AI technology, most commonly in areas such as fraud detection or warehouse management.

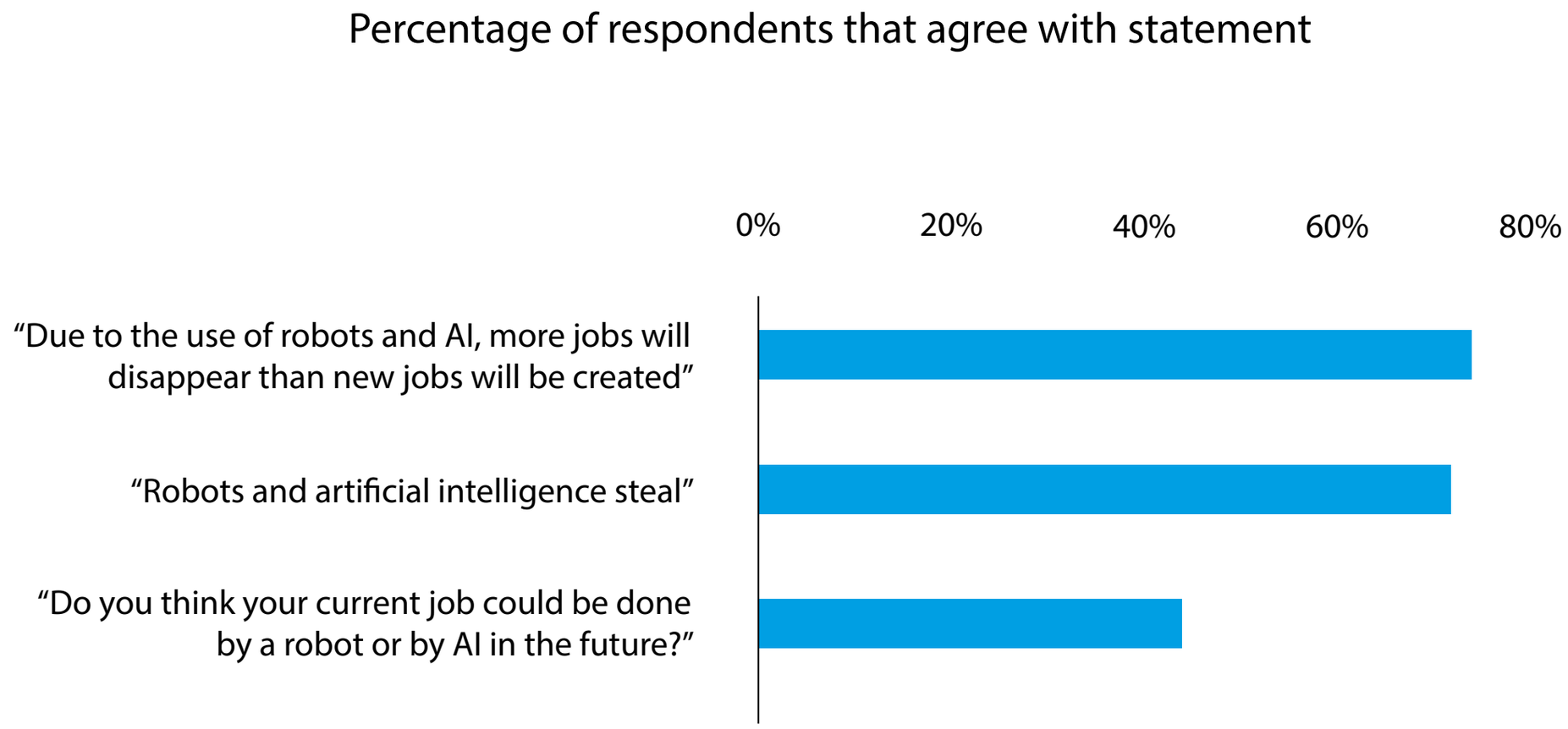
One reason why AI take-up in European firms might be slower than it could be is hesitance among workers to accept AI and other smart technologies at work. The underutilisation of technology by employees is considered a crucial factor in explaining the 'productivity paradox', or the phenomenon of productivity stagnation despite hugely increased technology uptake, because simply providing a new technology does not necessarily lead to its adoption by workers.

The percentage of Europeans comfortable with having a robot assist them at work decreased from 47% in 2014 to 35% in 2017, a statistic that seems partly driven by employment concerns: 74% of Europeans expect that AI will destroy more jobs than it creates, and 44% of workers think their current job could at least partly be done by a robot or AI (Figure 1).

This worry is greatest among low-skilled manual workers and white-collar workers, confirming research that people in professions at risk of automation are more fearful about the future.

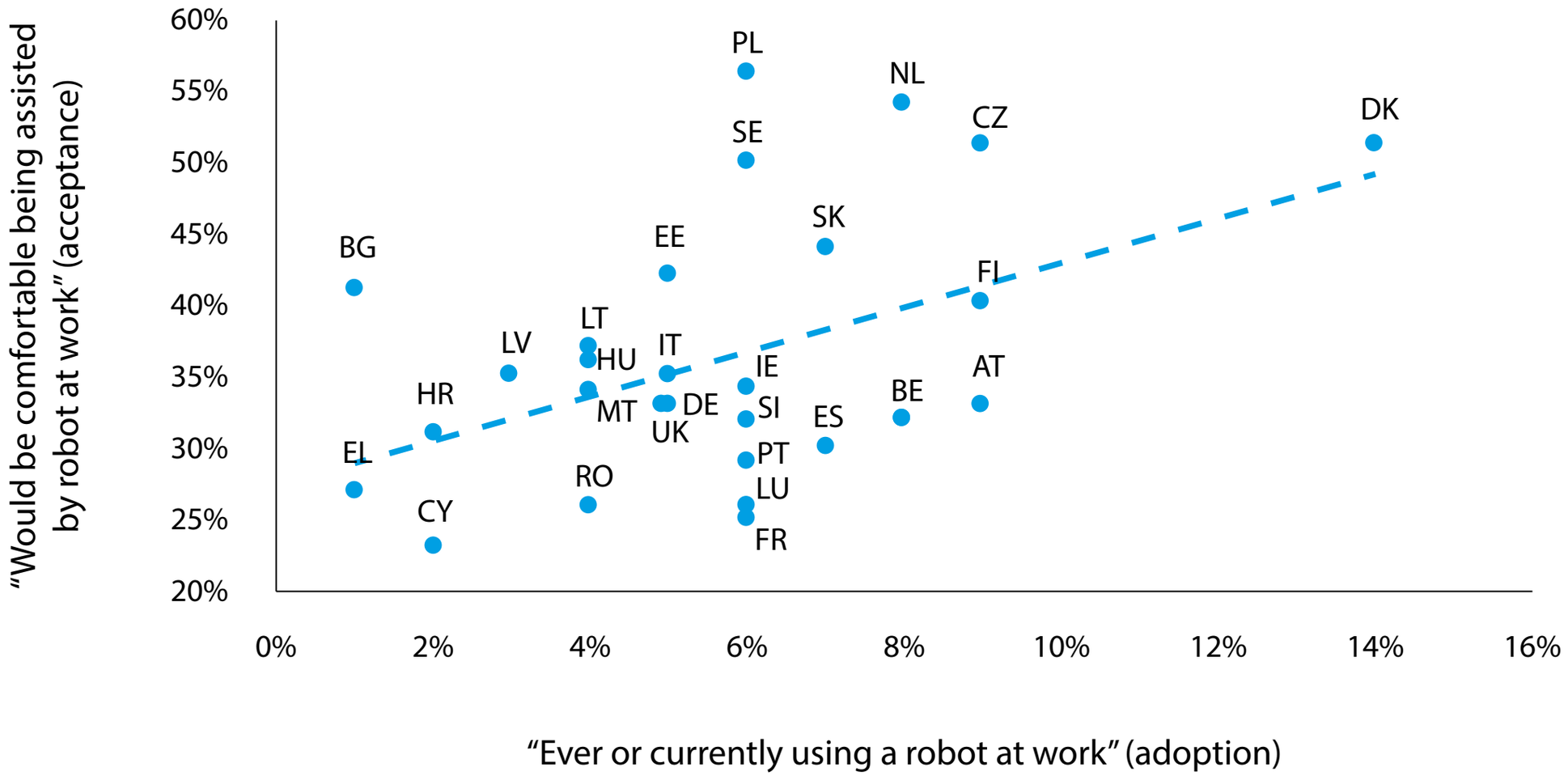
European data linking firm-level AI adoption and worker-level AI acceptance is scarce, but Eurobarometer provides some evidence about worker acceptance and adoption of new technologies at work. Workers in countries with greater acceptance of robots at work also report greater exposure to the adoption of workplace robots (Figure 2).

Figure 1. Europeans worry about the employment impact of AI and robots



Source: European Commission (2017) Special Eurobarometer 460.

Figure 2. Worker acceptance and firm adoption of robots at work are intricately linked



Source: European Commission (2017) Special Eurobarometer 460 – dataset volume A.

Causality probably runs both ways (as exposure to robots also increases acceptance through learning effects over time), but this data indicates that worker acceptance and adoption by firms of new technologies are intricately linked (with a correlation of 0.47).

To make the most of AI, both employers and workers need to be able to see its potential. The literature on technology acceptance in the workplace can guide policymakers and businesses to help workers accept AI and other smart technologies in the workplace.

To increase worker trust in AI systems, the regulation of AI itself and a focus on increasing worker data literacy are both essential to make sure they are ready to accept, adopt and allow AI to reach its full economic potential

Accepting technology at work: what do I have to gain and how much will it cost me?

A worker's decision on whether and how to use a new technology depends on two factors: the technology's perceived usefulness and its perceived ease of use. Perceived usefulness is defined as *"the degree to which a person believes that using a particular system would enhance his or her job performance"* and perceived ease-of-use is defined as *"the degree to which a person believes that using a particular system would be free from effort."*

If a worker believes the technology offers a lot for little effort, they will be more inclined to use it. Early studies showed that usefulness is a stronger predictor of uptake than ease-of-use: *"Users are often willing to cope with some difficulty of use in a system that provides critically needed functionality."* However, no amount of ease-of-use can compensate for a useless system.

Workers judge the first factor, perceived usefulness, by comparing the system's capabilities to their duties in the workplace. A worker values a technology more when it is relevant for their tasks, produces quality outputs and its results can be easily demonstrated.

Social processes also influence the perceived usefulness. If the technology appears to enhance one's status or if co-workers or supervisors expect a person to use the new technology, the worker's perception of the system's usefulness will increase.

The second factor, perceived ease-of-use, depends on the worker's pre-conceived beliefs about a technology, and the adjustments to those beliefs over time as a result of gaining direct experience with the system. A worker anchors their beliefs based on their computer literacy, existing organisational support resources, intrinsic motivation to use computers and any computer anxiety.

Once the worker experiences the actual technology, they adjust their beliefs based on the actual enjoyment of using the technology (aside from any performance consequences) and its objective usability (the actual level, rather than perception, of effort required to complete specific tasks).

The importance of organisational support for technology uptake increases over time, as more of the available support infrastructure gets used and assistance for concrete, on-the-job use becomes more relevant. Gender, age, experience and willingness to use have moderating effects on the above-mentioned factors.

Accepting robots and AI in the workplace

Algorithms in the workplace are not new. They have been used for optimisation (such as scheduling and inventory management) and prediction (such as demand forecasting, credit-risk analysis and personalised marketing) for several decades. The main differences between these old-school algorithms and current AI applications at work are: *who* is interacting with the algorithm, and *how* and *when*.

In the past, algorithms were mostly handled by statisticians or computer engineers in back-office departments. The outputs of algorithms had an impact on front-line workers (for example, by determining their monthly schedule), but those workers were usually unaware of the system's existence.

Now, many AI applications involve front-line workers interacting daily with algorithms on computers, smartphones and wearable devices. Also, in the past, algorithms acted over longer periods: scheduling and forecasting was done in advance and provided some form of stability for workers.

Now, fast and accessible algorithms can make minute-to-minute adjustments and react to the workers' environment in real time (for example Uber's surge pricing algorithm).

Research on the acceptance of robots and AI is still in its infancy and is characterised by small-sample studies. Workers' perspectives are underrepresented. A few critical factors emerge nonetheless.

For one, workers have been found to avoid using AI systems that are burdensome, for example, by increasing workloads or by sending excessive amounts of recommendations and alerts.

Similarly, the impenetrable nature of algorithms can be a barrier to adoption by workers. In the healthcare sector, not understanding why an AI's recommendation differs from one's own assessment prevents integration of its use into daily routines. The inability to judge the correctness of the system's decision leads to mistrust and reduces its perceived usefulness.

Obscure accountability for medical decisions makes workers uncomfortable about relying on a system with low levels of transparency. This accountability issue is just as important when workers themselves are data sources, for example, with algorithmic management.

In this case, the scepticism caused by the system's lack of transparency is reinforced by privacy concerns and doubts about data security, which can make workers less willing to adopt the technology.

When robots are involved, additional concerns about physical wellbeing arise. In workspaces with active human-robot collaboration, as in manufacturing, even minor robot malfunctions can lead to severe human injuries.

Therefore, safety considerations are crucial determinants of industrial workers' attitudes towards robotics in their workplace.

Individual job security concerns and overall adverse labour market effects are important factors in people's attitude towards robots at work. At the same time, workers base their attitudes on the robots' impact on their day-to-day jobs.

For example, human-robot interaction may replace human-human interaction, reducing communication and collaboration between co-workers. Or workers may need to reallocate time from job-specific tasks to monitoring the robot at work, leading to deskilling and depreciation of operational knowledge.

How to increase technology acceptance

Employers can ensure technologies work for workers, not against them, by making them easier to use and making them more useful in employees' day-to-day work. Interventions to increase user acceptance can occur before and after implementing a new technology.

Pre-implementation interventions focus on enabling accurate perceptions of usefulness and ease of use by providing a realistic preview of the system. This involves identifying and communicating specific use cases, such as operational problems or business opportunities that can be addressed by AI.

It also includes explaining the specific choice of technology with a transparent assessment of its benefits over other technical solutions. Enhancing the interpretability of models, for example by visualising which data influences the model's output, can reduce user uncertainty and increase trust.

In addition to management buy-in and high software engineering standards, two further factors increase technology acceptance pre-implementation: user participation and incentive alignment.

User participation, or involvement in the design, development and implementation of the system, helps users form judgments about the system's eventual relevance to their jobs, the output quality and demonstrability of results.

This can be achieved through hands-on activities including system evaluation and customisation, prototype testing and business process change initiatives.

In the specific case of AI, workers from different backgrounds could be involved in establishing anti-discrimination protocols that ensure the system has no underlying bias.

Incentive alignment ensures that the effective use of the system, as envisioned by the employer, aligns with workers' own interests and incentives. These incentives should be regarded more broadly than just monetary rewards, but extend to the fit between a technology and a worker's job requirements and value system.

For example, if using the technology does not benefit a worker or her direct co-workers but instead benefits members from other work units, the user will perceive a lack of incentive alignment that may lead to low use of the system.

Post-implementation interventions, in turn, focus on supporting the transition and adaptation to the new system. Training is the most critical intervention for greater user acceptance and system success. To reduce the perceived impenetrability of AI systems, organisations should invest in the data literacy of their workers.

Firms can further support workers by providing the necessary infrastructure for using the technology, creating dedicated helpdesks and providing business process experts.

Finally, worker's peers can provide support as well: they can assist with formal or informal training and can help with direct modification of the system or work processes.

Employers can step in to ease worker worries about AI's specific employment effects. While replacing workers is not the main objective of most AI adopting businesses, employers can focus more on augmenting workers' value through enhanced insights or learning. When job losses are unavoidable, employers can invest in retraining their workers for other opportunities within the firm.

Policy interventions to address concerns over loss of employment can include: creating safety nets with reskilling and transitioning programmes, individual learning accounts, unemployment benefits and universal basic income.

To increase worker trust in AI systems, the regulation of AI itself and a focus on increasing worker data literacy are both essential to make sure they are ready to accept, adopt and allow AI to reach its full economic potential. ■

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SPACs in the gap

Rebecca Christie considers special-purpose acquisition vehicles, and believes they could fill a gap in European equity markets and lure risk-averse investors off the sidelines

European equity markets lag behind their American counterparts and draw relatively limited interest from insurance companies and pension funds. Getting this capital off the sidelines and into growing companies is one of the main goals of the European Union's capital markets union project. To move forward, the EU will need to consider innovating, not just expanding, its equity offerings.

Special purpose acquisition companies, or SPACs, might be part of the solution. These companies are publicly traded pools of cash that seek to merge with a promising non-public company within a set timeframe.

The system works like this: a sponsor or group of sponsors, often a brand-name fund manager, takes this 'cash box' public with a promise to find a company to merge with, within two years. The sponsor keeps a 20% stake. Investors buy shares in this cash box that come with warrants for future shares. Then the pool of money merges with an existing company, likely as a minority shareholder, and that merged company takes over the SPAC's spot on the stock exchange and continues to trade.

Often the enterprise gets at least one more round of funding known as a private infusion of public equity (PIPE) around the time the merger takes place.

For growing, non-public companies these vehicles offer an alternative to pursuing an initial public offering (IPO), which can be complicated and costly, or working with private-equity investors who may demand substantial control in exchange for a cash infusion.

Because the SPACs have to find a company to merge with or refund all of the initial investments, the target firms may find they can get a more attractive deal than via other routes. Founders also may be more comfortable with the size of the stake they have to give up in the merger.

This potential to help companies find funding that will help them scale up is a big reason to consider a growing role for SPACs in EU market offerings.

New in Europe

SPACs are fairly new to European markets, in contrast to their recent rise in the surging US equity environment. In the US, they are viewed as expensive, lightly regulated, and currently deeply trendy – the focus of extensive international media coverage and renewed scrutiny from the US Securities and Exchange Commission.

...the question should not be whether SPACs are the ideal way forward for European equity markets but rather whether the costs and risks of this vehicle are worth it

Critics have painted them as poor bets. However, the same lottery-ticket characteristics that justify those criticisms also show the potential for SPACs to draw new money into the markets and to provide a new path for growing companies seeking funding. In Europe, where bank loans make up the lion's share of corporate financing, that makes these vehicles worth a look.

European policymakers therefore should look for ways to support the industry and channel its energies constructively. By adding investor protections and focusing on ways to align longer-term incentives of founders, investors and start-up firms, the EU may be able to channel SPACs' strengths while limiting their weaknesses.

Not cheap

The SPAC process is not cheap. The SPAC process tends to leech value out of the company, while enriching sponsors and some of the early shareholders. In a November 2020 study of 47 US SPACs that completed mergers between January 2019 and June 2020, SPAC shares worth $10 at initial sale held only $6.67 of value at the median by the time the merger took place.

In an April update, the median value fell to $6.40. The mean was $5.10, meaning that almost half the value of the initial share was diluted because of distributions to the sponsor, the warrant holders and underwriting costs. Share prices also usually fell after the merger. Shareholders thus bear the brunt of the costs and the dilutive effects.

There does seem to be a difference between 'high-quality' sponsors, who are former senior executives at Fortune 500 companies or are themselves a fund with $1 billion under management, and other sponsors, according to the research.

Yet the better performance of the quality sponsors is driven primarily by extreme winners, so the median performance is still bad. To get a sense of how uneven the returns are, consider the case of billionaire SPAC investor Chamath Palihapitiya.

According to the *New Yorker*, *"…if an everyday investor had bought one share of stock in each of his SPACs on the first day the stock traded, three of those investments would have lost money. The entire bundle would today be worth thirty-one per cent more than the investor had initially paid. A comparable investment in the S&P 500 over the same period would have returned similar profits, but would have involved much less volatility and risk."*

SPAC sponsors – and importantly, SPAC target companies – do not face the same risks. The sponsors themselves tend to do well regardless. Meanwhile the target companies often can negotiate for more cash and to remain in majority control of the post-merger company.

The study of 47 US SPACs found that on average, 70% of the merged company stayed with the target, leaving the combined SPAC holders with about 30% of the new entity. Because the SPAC usually has to liquidate if it cannot find a merger partner on time, the target companies may able to ask a higher price in a crowded market.

At a crossroads

Post-Brexit, the EU is at a crossroads in terms of what it wants its markets to look like. Historically, investors on the continent have been loath to take risks in their investments, and regulations shield them further.

But the global financial crisis and subsequent pandemic recession have changed the scene. Bank deposits and sovereign bond investments yield little or nothing, or sometimes lose money because of negative interest rates.

Meanwhile long-term capital is sitting on the sidelines. EIOPA, the EU insurance regulator, in December recommended loosening the framework for allowing insurers to invest in equity and long-term illiquid assets, and similar efforts are underway in the EU's next round of capital markets union planning. Now the challenge will be to convince investors that because they can invest in equity, they might actually want to.

Why would investors want to invest in a company when they don't know what it is going to do? First, these vehicles might represent a bet or a diversification from investors looking for a new asset class or to increase their general equity market exposure.

Second, the pre-merger investors get warrants that have often proved a way to lock in returns, although that is getting harder now that markets have learned how better to price them.

Third, well-heeled investors may relish the chance to invest alongside high-profile money managers, regional or sectoral specialists, and even non-financial celebrities. That last may seem far-fetched, but in an era when investors also are flocking to volatile crypto-assets and non-fungible token digital art, SPACs would seem to offer at least as logical a proposition for return.

When considering the potential role of SPACs in European markets, it's worth noting the differences with US markets. For one thing, SPACs in the EU are much less established: in the US, there were 248 SPAC IPOs in 2020, and 298 in the first quarter of 2021, according to market data presented at the ECGI event.

In Europe, the comparable numbers were 4 and 7, and the vehicles themselves tend to be smaller. In the US, SPACs can reach up to $1 billion in size. In the EU, funds are generally in the $300 million to $500 million range, and there can be restrictions on selling and redeeming.

For example, in some jurisdictions investors cannot redeem their shares unless they reject the proposed business combination. The UK, a popular locale for SPAC listings, has additional barriers such as a requirement that share trading be suspended when mergers are announced, which limits how investors can sell or redeem their holdings.

A review of the SPAC rules was included in the March 2021 *UK Listings Review* chaired by former EU financial services commissioner Jonathan Hill.

Fragmented rules

There is no EU regime for SPACs, which instead are subject to a melange of national rules, tax considerations and listing rules. SPAC IPO listings in Europe have primarily been in the UK, the Netherlands, Italy and Sweden.

Factors in deciding where to list include regulation, company law flexibility, taxes, governance, the likely country of the SPAC's target and the degree of investor familiarity with the process. The companies are more likely to be incorporated in tax-friendly jurisdictions like the British Virgin Islands, Luxembourg or the Netherlands, as well as in the UK and Italy.

Requirements for specifying a target industry sector vary, as do prospectus rules, although the general feeling is that SPACs are not subject to the Alternative Investment Fund Managers Directive (2011/61/EU).

The law firm found that it is possible to get pretty close to the US structures, although the presence of negative yields on cash holdings means that either investors or sponsors need to provide extra capital to keep the funding pool stable.

Another transatlantic difference is the prevalence and desirability of going public, either through an IPO or a direct listing. Where US commentators sometimes worry that the market for public offerings is becoming overheated, in Europe policy makers have emphasised the lack of market options for smaller companies, who also have a harder time getting bank loans than bigger firms.

In 2020, the High Level Forum on Capital Markets Union found that small and medium-sized enterprises (SMEs) are particular wary of equity markets, noting in its top findings that *"public listing is too burdensome and costly, especially for SMEs and the funding ecosystem for IPOs in the EU is underdeveloped."*

Overall, EU listed companies have been getting larger and older, as the public corporation has declined in prominence. A 2020 study for the European Commission by the Oxera consulting firm found the number of listings in the pre-Brexit EU 28 had declined substantially over the previous decade.

Meanwhile investors cite difficulty navigating prudential requirements and the maze of specialised investment vehicles meant to help smaller companies find funding.

Sponsors' responsibilities

One way to make SPACs a sturdier part of the EU market would be to require SPAC sponsors to take on more skin in the game, over a longer-term horizon. For example, in April, the SPAC Pegasus Europe raised €500 million in its April IPO and is looking to merge with a growth-oriented company in the financial services industry, according to its public profile.

A pre-listing announcement for Pegasus said the four co-sponsors would invest in a minimum of 10% of the initial offering and commit to enter into a substantial forward purchase agreement. This could be one model for aligning

incentives of sponsors, investors and the target firm over time. Because of the fragmented nature of European markets, the extra costs of joining forces with a fund sponsor might not seem so daunting, especially given the fees and hassle of other investment options.

To be sure, there will be ongoing questions of corporate control, particularly if institutional investors want to take a more active oversight role, and the market will continue to favour professional investors with better information.

However, expanding equity markets promises to boost the economy for governments, firms and households. The European Central Bank has further found that economies that have a funding structure more focused on equity than bank credit or other forms of debt have reduced their carbon footprints more than other countries in recent decades. SPACS can be one element of expanding EU options.

As regulators consider what to do with this format, the question should not be whether SPACs are the ideal way forward for European equity markets but rather whether the costs and risks of this vehicle are worth it if they can attract investment and growing companies that might otherwise not be in the markets at all. ■

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