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Europe's Energy Transition:
A Common Challenge

REPORT SEPTEMBER 2021

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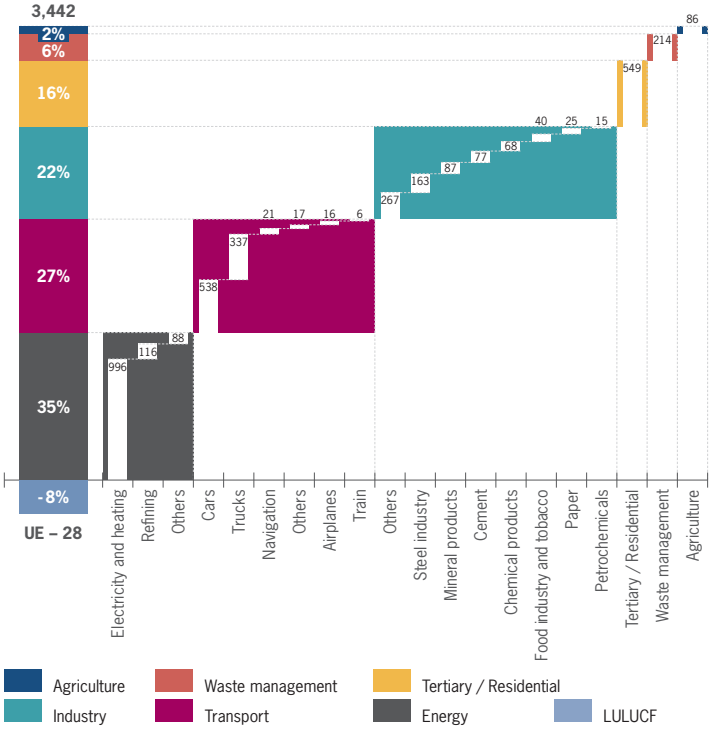
There is no desire more natural than the desire for knowledge

FOREWORD

The objective set by the European Union of achieving carbon neutrality by 2050 implies a radical transformation of our systems of energy production, transformation and consumption, notably the challenge of replacing hydrocarbons with decarbonised energy sources. In Europe, this transformation will involve a reduction in emissions of around 3.5 billion tonnes of CO_2 per year, which would require, amongst other things, the replacement of millions of thermal vehicles, the energy renovation of millions of buildings and the decarbonisation of heavy industrial processes. It is clear that Europe's energy transition must lead to profound changes in behaviour across entire sectors of society, with the goal of a massive and rapid reduction in the consumption of carbon-based goods. It will also require significant technological innovation and investment in R&D in order to decarbonise applications and sectors for which no satisfactory solutions yet exist.

Distribution of European CO_2 emissions by sector of activity

(2017 – billions of tons)



Note: this graph does not take into account anthropogenic GHG emissions other than CO_2. The latter represent between 20 and 25% of total emissions, and are highly concentrated in the agricultural sector, in such phenomena as methane emissions.

Source: AEE, Eurostat, Kearney

1 *Center for Climate and Energy Solutions.*

In Europe, electricity and heat generation and road transport (cars and trucks) account for more than half of CO_2 emissions. The decarbonisation of electricity production, the promotion of energy sobriety, and the electrification of transport will all play key roles, therefore, in the European energy transition.

Given the global nature of the climate challenge, it is appropriate that the definition of relevant regulations and the coordination of transition efforts within industry should be undertaken by the European Union. In order to accelerate the reductions initiated by the 2020 Climate and Energy Package, important decisions have now been taken by the European Union to reduce the emission levels within the sectors of electricity generation, construction, transport and industry. This has been done within the framework of the European Green Deal. This overarching objective was also reflected in the EU's budgetary response to the coronavirus crisis. On 11 December 2020, EU leaders agreed on a €1.8 trillion package to support and boost the European economy. Specifically, over the 2021-2027 period, the EU budget will amount to €1,074 billion, to which will be added €750 billion from the new European recovery instrument, known as the *Next Generation EU (NGEU)*. Of these funds, EU leaders have committed to devoting an envelope of €547 billion to the green transition. This represents around one fourth of the additional investments required to meet the objective of reducing emissions by 55% by 2030 – estimated by the European Commission to be more than €300 billion per year.[2] This public sector commitment would appear proportional to the significant transition effort which private sector businesses and consumers will have to undertake. With 90% of the NGEU funds going to finance Member States' national recovery plans, **it is now incumbent upon these states to submit plans that credibly integrate green transition imperatives, and on the European Commission to then ensure their effectiveness.**

All of this represents decisive progress, but these efforts must be complemented by private investment, an ambitious regulatory framework, and changes in European citizens' own behaviour and consumption habits. In addition,

2 Impact assessment on the new climate targets for 2030, European Commission.

the European energy transition still faces many political hurdles, notably the divergence of objectives and priorities between Member States. These differences, inherited from industrial choices and geographical specificities, are also the reflection of very heterogeneous economic and social situations. **Making the energy transition a success, i.e. ensuring the effectiveness of investments to reduce CO_2 emissions while guaranteeing the EU's energy security and controlling this transformation's economic and social impact, will depend on political and technological decisions, and on the coordination of investments at a European level.** In this respect, the conversion of the European electricity system represents a major element in this transformation, and will need to be carefully coordinated.

The funds of the **recovery plan undoubtedly offer an opportunity to accelerate the European energy transition.** Care must be taken, however, that the investments which are identified and approved are those which best serve the agreed climate objectives. While the reduction of CO_2 emissions is obviously an imperative, it must be remembered that energy security (accessibility in quantity and quality) and energy costs are indispensable conditions for the sustainability of European economies.

Seizing the opportunities of the energy transition

The energy transition represents a wealth of economic, geopolitical and social opportunities for the European Union. It offers the chance to develop new sectors of excellence, creating value and "green" jobs, particularly in the field of renewable energy, hydrogen and electric batteries. By reducing our dependence on fossil fuels, these new sectors could also increase our energy independence. Finally, it must be remembered that, in addition to helping preserve our ecosystem, the fight against global warming is a public health issue, in that the transition to less carbon-intensive energy sources will reduce air pollution and associated cardiovascular and respiratory risks.

Making informed technology choices

We believe that the debate on energy technologies should be dispassionate, and that our collective choices should be based on a systematic analysis of the scientific, technical and socio-economic aspects of the various options available. The merit of each climate action must be measured by its net societal benefit, taking into account its economic cost and its ecological benefit, estimated using a carbon price reflecting the EU's climate goals. Only these criteria can guarantee the development of safe, clean and affordable energy for European citizens. **The European Union must therefore provide itself with the means of effective coordination at Community level, based on informed technological and economic choices.**

Supporting the development of renewable energies without taking into account the adaptations required by their intermittency, exposes electricity networks to the risk of future malfunctions, and ultimately to electricity price inflation. Likewise, the wholesale promotion of hydrogen could lead to the development of costly and energy-inefficient solutions. To take another example: as has already been demonstrated by an IEA report in 2017, the ecological benefit (i.e. carbon balance) of electric cars is lower than expected, and can even be zero in countries with a high carbon electricity mix. In many countries, the development of electric vehicles must therefore be preceded by the decarbonisation of the electricity mix. Another example offered by certain experts is that the carbon footprint of photovoltaic panels can increase significantly if they are manufactured from a high carbon energy mix and transported over long distances before being installed.

So-called "green" solutions, then, must be regarded as heterogeneous, the implementation of which is not necessarily always advantageous at this point in time. Each solution must therefore be studied individually, taking into account its technological specificities and local constraints. A systematic life-cycle analysis of the solutions under consideration is essential to the success of the energy transition, with a comparison of the economic and social costs and benefits of each solution.

Addressing the lack of market economy mechanisms through an appropriate regulatory framework

The energy transition consists of substituting widely deployed, mature and, by definition, competitive technologies and industrial tools with so-called decarbonised solutions, which are often emerging and, in many cases, still non-competitive (e.g. green hydrogen, CCUS, bioenergy).

In the absence of a fair carbon price covering all emitting sectors (i.e. ETS market), there are insufficient economic incentives for their development and widespread deployment. In such a context, some socially desirable green technologies will not be implemented due to their lack of profitability as compared with fossil fuel-based solutions. This competitive disadvantage of green solutions can be corrected by incentive mechanisms established by public authorities: feed-in tariffs, subsidies, tax rebates, etc. The main flaw of such approaches is that they encourage indiscriminate development, i.e. without control of the expected result in terms of greenhouse gas emission reduction and energy cost control.

To ensure that EU funds are used appropriately and cost-effectively to reduce greenhouse gas emissions, **it is essential that an informed selection of investments be made and that the necessary means to do so be available. To this end, the EU should develop a carbon price tag, in order to be able to put a monetary value on emission reductions when evaluating potential climate actions. An appropriate regulatory framework should also be put in place to reduce our consumption of fossil fuels.**

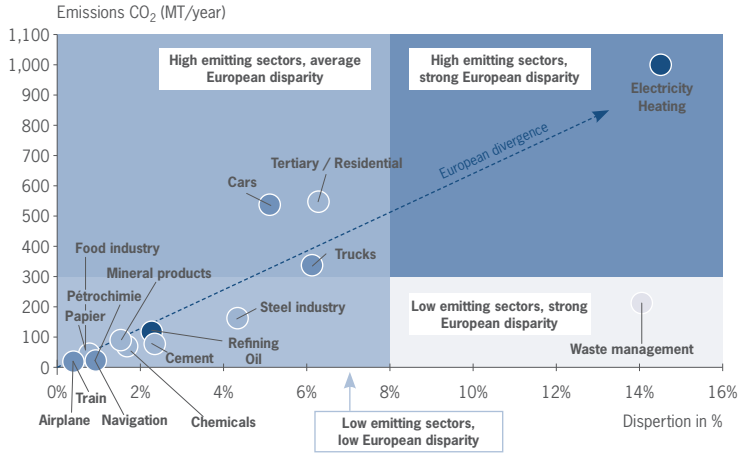
Taking national specificities into account

There is considerable heterogeneity in the origin of CO_2 emissions within the European Union. For example, the share of CO_2 emissions from electricity and heat generation varies greatly depending on the energy mix of each Member State. It represents more than 40% in countries which are heavily dependent on coal, but only 15% in France, thanks to its nuclear energy park.

The emissions arising from the road transportation sector, however, are relatively homogeneous across the EU.

Dispersion of CO_2 emissions in Europe

(2017 – UE 28)



Note: dispertion within EU countries, measured by the standard deviation of the relative weight of emissions from the sector in each country.

Source: AEE, Eurostat, Kearney

Extending carbon pricing and ensuring a socially just and acceptable energy transition

In the conclusions of the extraordinary European Council meeting of 17-21 July 2020 that led to the European Recovery Plan,[3] EU leaders asked the European Commission to propose a revision of the EU Emissions Trading Scheme (ETS), in order to consider its extension to other economic sectors. Ideally, this system would cover all European emissions, including the key sectors of transport and construction. This review is not only an opportunity to strengthen carbon pricing. It was carried out on 14 July 2021, when the Commission submitted a coherent set of proposals, including the creation of a permit market for these two sectors, as well as the introduction of a carbon pricing mechanism at the Union's borders with a view to re-establishing fair competition between European and foreign companies taking climate externality into account. Europe must also coordinate its strategic choices and control its investments. Last but not least, Europe will have to succeed in directing private investments towards the transition and in redistributing the revenues from carbon pricing to citizens, to ensure the social justice of the European energy transition and to allow citizens to contribute to the collective effort. The cost of the transition must be minimised, of course, but it must be kept in mind that the cost will necessarily be borne collectively. **Issues of financing, social justice and the sharing of the global effort must therefore be at the heart of climate policy.**

3 Extraordinary meeting of the European Council (17, 18, 19, 20 and 21 July 2020), p. 8: "In the same spirit, the Commission will present a proposal for a revised emissions trading scheme, possibly extended to aviation and maritime transport."

The choice made in this report is not to take a position on a European energy mix.

This report has chosen not to make recommendations on the composition of the future energy mix. This is a deliberate decision, particularly in view of the importance of renewable energies and nuclear power in the overall energy transition equation.

Indeed, the choice of the energy mix of each Member State depends strongly on the local economic and geographical conditions (e.g. sun, wind, topography, hydrography), and on the political and social acceptability of different energy technologies. Whether these solutions are based on nuclear, wind, solar, hydro or bioenergy, all face heterogeneous levels of acceptability, and which vary significantly between EU countries and indeed between regions. Within the European Union, the issue of the energy mix is therefore inherently divisive and has been deliberately side-lined. For the same reasons, this report does not discuss the levers of energy efficiency, another key subject in the discussions concerning reducing CO_2 emissions.

This report concentrates on developing points of convergence, in order to help accelerate the energy transition at the EU level. It therefore focuses on identifying European solutions to accelerate the exit from fossil fuels (coal, oil and gas). As underlined by the recent agreement to make the 27 EU countries carbon neutral by 2050, there is a European consensus on this issue.

In the search for a European consensus, we have adopted a principle of technological neutrality. **The tutelary value of carbon and its evolution over time (two major political decisions) must determine the pace of the transition away from each form of fossil energy.** This report therefore focuses on possible solutions to encourage the abandonment of CO_2 emitting energy sources, and leaves it to individual States to determine which technologies should make up their future energy mix. In this way, we maintain the flexibility needed to take Member States' and regions' specific national, economic, social and geographical characteristics into account.

The following boxes illustrate in a more concrete way the national specificities and the reasons why the sovereignty of Member States in regards to technological choices should be respected. Readers may also wish to refer to the various reports published by the Institut Montaigne that deal more specifically with the 2019-2023 Multiannual Energy Programme and the National Low Carbon Strategy in force in France.

Germany's climate goals

Germany has long produced most of its electricity from coal, a resource that it exploits locally, which is relatively cheap (excluding CO_2 taxation) and has enabled its long-term industrial development. Several German territories, especially in the east of the country, specialise in coal mines and power plants, which are the largest providers of employment in those areas. **Historically, Germany has therefore been dependent on this high carbon emission fossil energy** (820 gCO_2/kWh of electricity according to the IPCC, compared to 12 for wind or nuclear power, for example).

In the 1970s and 1980s, Germany also built nuclear power plants, which supplied up to 30% of German electricity in the 2000s. In 2010, Angela Merkel's government planned to develop this energy and to extend the existing reactors, but the situation changed after the Fukushima accident in 2011: the political establishment in Germany has since definitively turned away from nuclear power. Germany was very quick to shut down several reactors and embarked on a nuclear phase-out which is expected to be completed by 2022. At the same time, it has deployed major financial resources to promote renewable energies (wind and solar), which has enabled the development of their production at an unprecedented rate. **The phase-out of nuclear power and the development of renewable energies have been**

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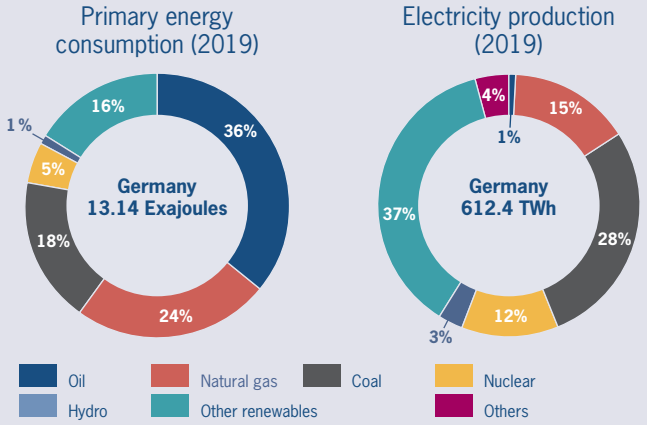
the two main pillars of the German energy transition, known as the "Energiewende".



The consequences of the Energiewende

By 2020, the share of renewables (also including hydro and biomass) in the electricity mix has exceeded 50%, with nuclear power decreasing to 12%, but fossil fuels continuing to produce more than a third of the country's electricity. Contrary to popular belief, Germany's nuclear phase-out is not being compensated for by an increased use of coal. The development of renewable energies having outpaced the decline in nuclear energy, this has instead led to a decline in coal production, with **the German government adding a target for phasing out coal by 2035 – 2038 to its "Energiewende".**

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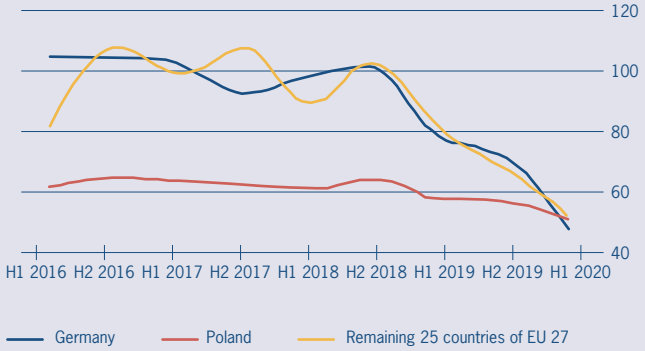
Germany's coal production has fallen faster than Poland's

(Coal-fired electricity genaration (terrawatt hoiurs - hard coal and lignite))



Source: Ember

Although this target remains in the distant future, **the challenge remains considerable for Germany,** as the move away from coal will have major social consequences, and could weaken the power grid if other measures are not taken. Electricity from solar and wind power is intermittent, varying according to the time of day for solar and according to the wind intensity for wind. These energies must therefore be complemented by guaranteed sources of electricity which can produce enough at any given time to compensate for their intermittency.

Gas-fired power plants (whose emissions are twice as low as coal but still very high, 490 gCO_2/kWh) have therefore been developed, as have biomass and energy storage which relies on pumping water

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(reversible hydroelectric dams). In addition, the plan to phase out coal by 2038 may soon become obsolete, given the rapid rise in the price of emission allowances on the ETS market, making natural gas more competitive than coal, which emits far more per kWh produced. Other methods of storage or demand flexibility may be implemented in the coming decades. In the long term, the move away from coal will lead to a significant reduction in CO_2 emissions, but the electricity mix will retain a significant proportion of natural gas, which will have to be replaced by biogas. Large amounts of storage will also be required, and this will need to be developed through processes which are very low-emission and price competitive. **There remain many challenges ahead, therefore, if the "Energiewende" is to go beyond the phase-out of nuclear power and make Germany's electricity production a low-carbon one.**

The "Climate Package", a restart of the energy and climate policy in Germany?

In the context of the limits faced by Germany's energy transition, the German government's "Climate Package" was presented on 20 September 2019. Beyond an upwardly revised greenhouse gas emissions reduction target (55% compared to 1990), **the main decision made was the introduction of carbon pricing for transport and buildings, in three phases.** The price initially set by the government (€10 per tonne in 2021) has been re-evaluated to €25 under pressure from the Green Party. This price will increase by €5 in 2022 and 2023, rising to €45 in 2024 and €55 in 2025. During the second phase, a carbon market will be introduced for these sectors, with a carbon price of between €55 and €65 per tonne, before being eventually integrated into the European Emissions Trading Scheme, which itself will be extended to all sectors of the economy.

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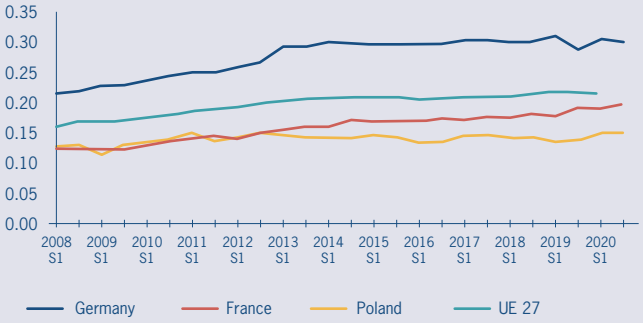
Faced with the risk of protest movements, the German authorities have emphasised the social justice aspects of the transition. The tax paid by electricity consumers to finance renewable energies and the contributions intended to finance the networks are set to decrease, with the shortfall being compensated for by the carbon tax. If the latter were to generate more revenue than expected, the difference would go to electricity consumers.

Electricity prices for the domestic consumer

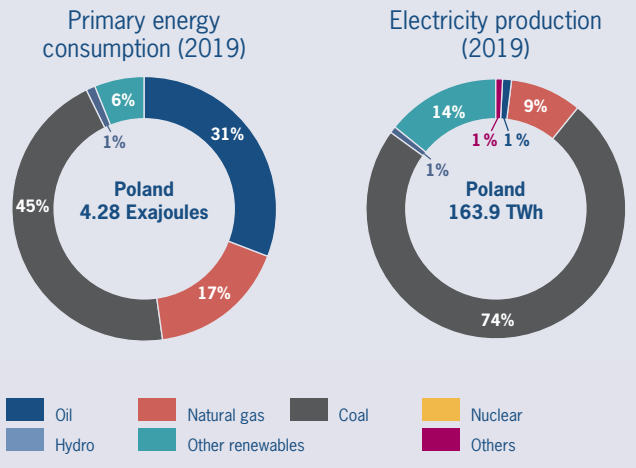
(in the 2500-5000 kWh range; all taxes and levies included)



Source: Eurostat

Transforming the Polish electricity mix

Poland, whose energy mix is still largely dominated by coal, is the only EU member country that has not committed to a "carbon neutral" target by 2050. According to a study by the Polish Economic Institute (PEI)[4] published on 19 August 2020, Warsaw could envisage reaching this target between 2056 and 2067. In particular, the Polish government aims to increase the share of renewable energy in the country's final energy consumption to between 21% and 23% by 2040 (and to 27% by 2030 for electricity production) and to increase the share of nuclear power in its energy mix.



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4 Time for decarbonisation, Polish Economic Institute (2020).

Coal at the heart of Poland's energy and electricity mix

In Poland, fossil fuels accounted for 93% of primary energy consumption in 2019 (44.6% for coal alone). The country of nearly 38 million people was the 11th highest coal consumer in the world in 2019. This fuel generates almost three quarters of Poland's electricity.

The prevalence of coal in the energy mix has negative consequences for the health of its population. According to the WHO, Poland alone has 33 of the 50 most unhealthy cities in Europe, causing more than 40,000 premature deaths each year. This is due in particular to the 4 million homes heated by individual coal stoves, considered to be the source of smog, a brownish fog made up of fine noxious particles that covers a large part of the country every year. In addition, about 80% of Polish coal mines are unprofitable, according to a European Commission report, and many coal-fired power plants are inefficient, with output levels below 30%. The state is therefore obligated to intervene massively to support the sector. According to a study conducted by the International Monetary Fund (IMF), state subsidies for coal in Poland amount to more than 5% of national GDP. Already weakened by this situation, the Polish coal industry is in great difficulty due to the health crisis and the resulting sharp decline in demand. Coal prices have fallen, as have oil prices, forcing the PGG mining group, one of Europe's largest, to consider major restructuring.

New directions in Polish energy policy

The major features of the Polish energy policy are already known, and include an investment of €29 billion in offshore wind power. Indeed, the country appears to want to take a leading role in this sector. Warsaw signed a joint declaration with the seven other countries bordering the Baltic Sea to accelerate the construction of offshore farms in the area. Of the 23 gigawatts of offshore wind turbines currently installed

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along Europe's coasts, the Baltic Sea still has only 2.2 gigawatts, although, according to the most optimistic scenarios, it could host up to 93 GW by 2050. Poland appears to want to position itself as a champion of offshore wind development. It has announced a target of 28 GW by 2050, which is almost a third of all offshore capacity in the Baltic Sea. **The development of nuclear power is the second pillar of this plan.** According to the government, nuclear power will eventually account for 20% of the Polish energy mix. Piotr Naimski, government plenipotentiary for strategic energy infrastructure, says that Poland plans to produce 6 to 9 gigawatts from nuclear power, requiring the building of six new reactors in different regions of Poland. While the move away from coal is as much about economics as it is about ecology, the question of the conversion of Poland's coal-mining regions has other social ramifications.

The electricity mix in France

Nuclear power is the main energy source for the French electricity network. France currently has the second largest installed capacity in the world behind the United States, with 56 reactors in 18 plants in mainland France, all operated by the French energy company EDF (84% owned by the French state). Without entering into the debate on its overall environmental impact, we would like to point out that nuclear power generation has the advantage of having a minimal impact on the climate, as the fission of uranium atoms in reactors does not emit greenhouse gases, unlike the combustion of hydrocarbons or coal in thermal power plants, for example.

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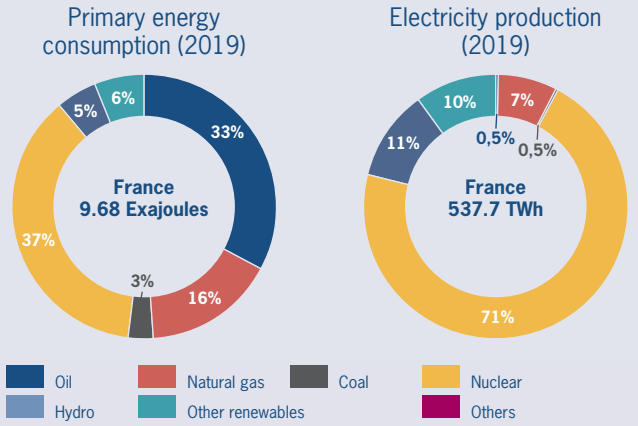

The French Nuclear Safety Authority (ASN) recently opened the way, in a generic approval, for extending the lifespan of reactors from 40 to 50 years. This applies in particular to the thirty-two 900 MWe reactors commissioned in the 1980s. Individual approvals for each reactor will then be required.

France has adopted into law the objective of reducing the share of nuclear power in the electricity mix to 50% by 2035 (initially 2025, but subsequently pushed back). The multi-annual energy programme (PPE) for the periods 2019-2023 and 2024-2028 provides for a schedule for the closing of 14 reactors by 2035 (including the two Fessenheim reactors already closed). The government has not yet fully defined the role of nuclear energy in the transition to carbon neutrality by 2050. A 100% renewable scenario is being studied, but maintaining the share of nuclear power at 50% of the electricity mix

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is also being considered and could ultimately prove to be a more realistic solution. In the absence of an economically viable solution for electricity storage, however, it will be crucial to maintain a significant share of electricity generation capacity which is controllable and decarbonised.

Contributors

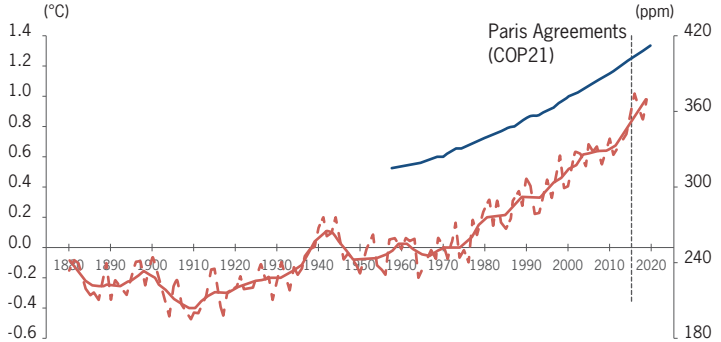
This report, prepared by the Institut Montaigne with the support of Kearney, proposes guidelines for accelerating and completing the European Green Deal in order to move towards a unified European strategy for energy transition, integrating the sometimes divergent interests of the Member States and supporting the effects of this transformation over time. It brings together the expertise of European think tanks specialised in the field of energy transition, in order to submit to the European Commission concrete proposals for the implementation of the Green Pact for Europe and the acceleration of the energy transition, based on a continental approach which is not merely a reflection of French positions. The choice to confront and bring together the perspectives of French, German and Polish experts thus represents an original approach, based not only on the complementarities but also on the divergences within the "Weimar Triangle".

SUMMARY

OVERVIEW OF THE EUROPEAN ENERGY TRANSITION: *THE EUROPEAN GREEN DEAL IN THE FACE OF THE CRISIS*

Five years after the signing of the Paris Agreement, the urgency of climate change requires the accelerated implementation of environmental and energy policies. This viewpoint is now shared within the European Union, by scientists, from the IPCC to the High Council for the Climate, by citizens, the Parliament, the Member States and the Commission. This European consensus has nonetheless yet to find expression in an action plan. Whereas the evolution of current emissions already guarantees a warming of +1.5°C by 2050, the objective set by the Paris Agreement to limit global warming to a level "significantly below 2°C" by the end of the century appears more ambitious than ever, and therefore requires strong and rapid action. These are essential given the scale of the environmental disasters which too great a rise in global temperatures will incur.

Increase in global annual mean temperature and atmospheric CO_2 concentration
(1850 – 2019)



Note: average temperatures based on land and sea data.

Source: https://data.giss.nasa.gov/gistemp/
https://climate.nasa.gov/vital-signs/carbon-dioxide/

Greenhouse gas emissions, including not just CO_2 but also gases such as methane and nitrogen oxides, must therefore be drastically reduced to meet the commitments of the Paris Agreement. More than 3% less per year for France, for example, whereas the current trajectory has been -1% per year on average over the last 20 years[5] (excluding imported emissions). Current emission trends are leading to an increase in average temperatures of 2.6-4.8°C by 2100,[6] and to greater temperature variability, favouring extreme weather events. Limiting this increase to 2°C would mean cutting our emissions by more than 60% by 2050. Limiting the increase to 1.5°C would require a

5 2019 Annual Report - Acting consistently with the ambitions, High Council on Climate (2019).
6 Fifth Assessment Report (AR5) on Climate Change, GIEC (2014).

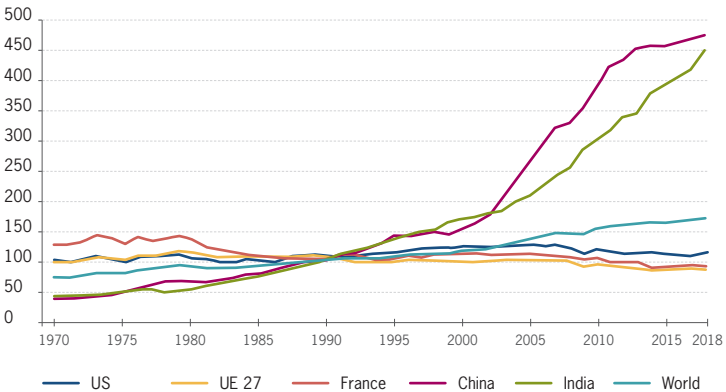
reduction in annual emissions of about 85%, thereby achieving carbon neutrality within 30 years.

Where does the European Union stand?

The dynamic set in motion by the European Union in terms of energy transition is undeniable, and the continent is now clearly distinguishing itself from the rest of the "major emitters". In 2017, the European Union emitted 4.3 Gt of greenhouse gases (calculated in CO_2 equivalent), which represents a 23.5% decrease compared to 1990. In the same year, China emitted 13.1 Gt CO_2eq (+402% since 1990) and the US 6.5 Gt CO_2eq (+1.3%).[7] Considering only CO_2 emissions, the dynamics are similar, with an increase of 63% globally between 1990 and 2017.[8]

Evolution of CO_2 emissions from 1970 to 2018 by region

(Base index 100 in 1990)



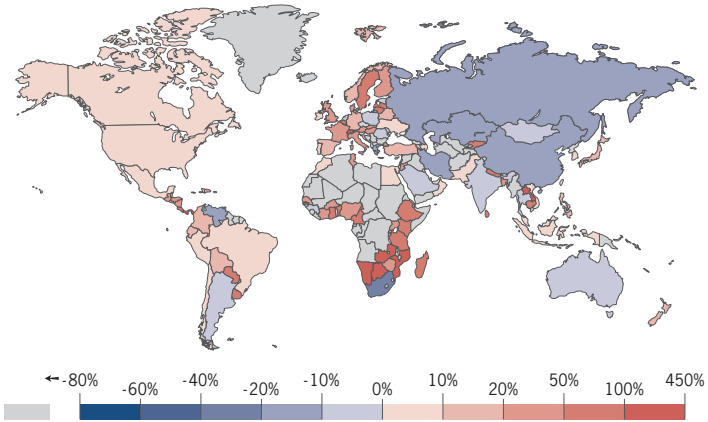
Source: EDGAR, 2019.

7 Greenhouse gas emissions by country, OECD.
8 Global Carbon Project, Le Quéré et al. (2018).

The stabilisation of emissions per capita at the global level also masks major disparities, with a notable drop in the United States and Europe, but a sharp increase in Asia (+270% in China and +160% in India), illustrating the economic catch-up that continues today. In 2017, each European emitted an average of 6.9 tonnes of CO_2 excluding imported emissions, which represents a decrease of 25% on 1990. Although this average is still much higher than the world average (4.9 tonnes per year per inhabitant, itself up 14% since 1990), this difference can easily be explained by early economic and industrial development and by the fact that several regions of the world are catching up. This level is also much lower than the averages for North America (15.7 tonnes for the United States and 16.8 tonnes for Canada), Russia (12.2 tonnes) or Japan (10.4 tonnes).

However, the EU's success is more mixed when emissions from the consumption of imported products is taken into account. The carbon footprint is then estimated to be 19% higher, at 8.2 tonnes of CO_2 per capita, illustrating the phenomenon of the "relocation" of our emissions to Asia that has increased over the past 15 years.

CO_2 emissions from international trade in 2016



Note: share of carbon dioxide (CO_2) emissions embedded in trade, measured as emissions exported or imported as the percentage of domestic production emissions. Positive value (red) represent net importers of CO_2 (i.e. "20%" would mean a country imported emissions equivalent to 20% of its domestic emissions). Negative values (blue) represent net exporters of CO_2.

Source: Peter et al. (2012 updated); Global Carbon Project (2018) OurWorldInData.org/co2-and-other-greenhouse-gas-emissions/

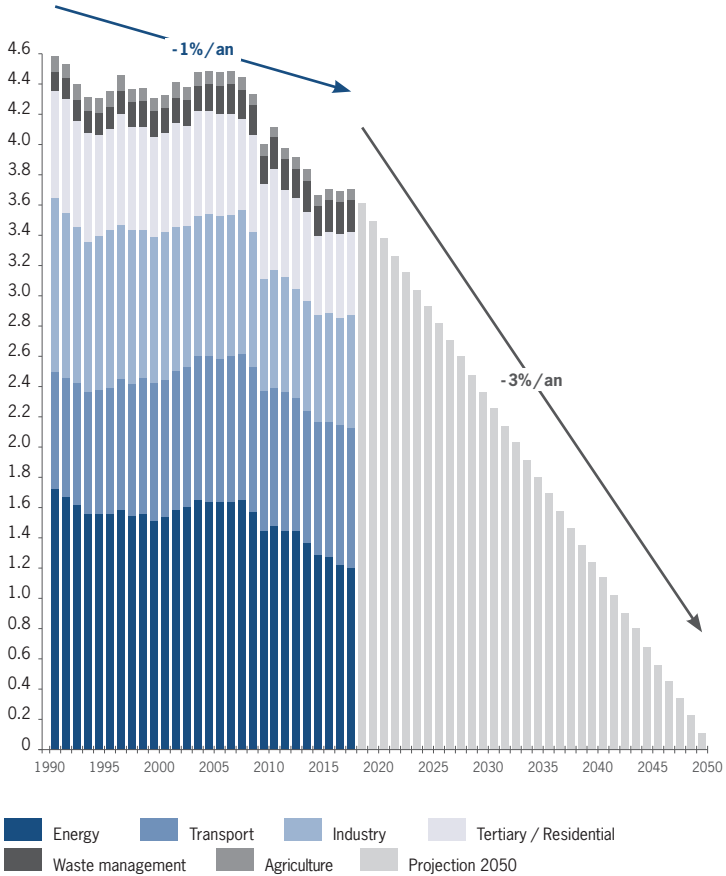
The European Green Deal, a new political project for the European Union

With a carbon footprint of 8.2 tonnes of CO_2 per capita, Europe is doing better than other major developed countries (USA, Canada, Japan) in terms of both level and trend, but is still far from reaching the target of one tonne of CO_2 per capita required to achieve carbon neutrality.[9] Since the 1990s, the European Union has become aware of the need to decarbonise the economy and has made strong commitments in this direction. The European Climate and Energy Framework for 2030 thus sets targets to meet the international commitments of the European Union and its Member States by reducing greenhouse gas emissions by at least 40% compared to 1990; by increasing the share of renewable energy in electricity generation to at least 32%; and by improving energy efficiency by at least 32.5%. Greenhouse gas emission reduction targets have recently been strengthened under the Green Deal for Europe, which has been at the heart of the new European Commission's climate action since December 2019. The target of a 40% reduction in emissions by 2030 was raised to at least 55% by the European Council in December 2020, with a view to achieving carbon neutrality by 2050. This new target requires a reduction in CO_2 emissions of more than 3% per year until 2050, compared to a reduction of only 1% per year since 1990.

9 According to the European Commission's Long-Term Strategy, which sets its carbon budget in 2050 to 500 $MtCO_2eq$, and according to the French National Low Carbon Strategy, which sets its limit to 80 $MtCO_2eq$, i.e. about one tonne of CO_2 equivalent per inhabitant.

Net CO_2 emissions of EU countries and projection of carbon neutrality scenario by 2050

($GtCO_2eq$, 1990 – 2050)



Source: Eurostat, Kearney.

In particular, the new energy efficiency targets are very ambitious compared to the previous trajectory. In 2017, for example, the European Union had reduced its energy consumption by only 14.7% compared to 1990. Achieving a 20% reduction by 2020 and 36% by 2030, as proposed by the Commission, therefore implies a significant acceleration in the reduction of internal consumption by moderating uses and developing a low energy economic model. Despite numerous forward-looking reports on the subject, there is still uncertainty as to how this target can be achieved.

To achieve this reduction in emissions in the coming years, the European Commission has launched a number of legislative initiatives under the Green Pact for Europe. Firstly, the new climate targets of a 55% reduction in GHG emissions by 2030 compared to 1990 will be applied to the reduction trajectory of the European carbon market cap (ETS), vehicle emission standards, and energy efficiency and renewable energy regulations. This heterogeneous approach, mixing price signals (ETS) and sectoral policies, will require a considerable cost-benefit analysis to ensure its overall coherence and to guarantee that the ecological objective is achieved at the lowest social cost.

The Green Pact for Europe also includes several sectoral strategies: the energy "renovation wave" in the building sector, the European offshore wind strategy, the sectoral integration strategy and the hydrogen strategy, as well as the 'greening' of investments in the trans-European energy networks. These plans are complemented by the new EU Industrial Strategy, the Action Plan for a Circular Economy, and the Strategic Action Plan on Batteries, as well as regulations on the same topic. With regard to transport, a new strategy for sustainable mobility has been presented, together with a revision of the alternative fuels infrastructure directive, along with other initiatives designed to massively develop the charging infrastructure for electric vehicles. In the fields of hydrogen and batteries, major projects of common European interest (PIIEC) benefiting from exemptions from the general State subventions regime have been launched to facilitate the emergence of "European champions" and to develop industrial sectors in these sustainable technologies.

The Green Pact for Europe promises to massively develop sustainable financing through the Investment Plan for a Sustainable Europe, which will devote €1,000 billion to the green transition. A significant part of the EU budget is dedicated to green investments, through grants from EU funding programmes, loans from the European Investment Bank and guarantees from the InvestEU programme. Given that the energy transition requires a shift from polluting sectors to sustainable ones (in particular the closure of coal-fired power plants), a €17.5 billion Just Transition Fund has been set up to support a socially equitable transition. In order to take into account imported emissions, to combat carbon leakage and environmental dumping, and to ensure fair competition between EU and non-EU producers, the European Union plans to introduce a carbon adjustment mechanism at the borders in 2021 which will allow it to impose a carbon price on certain imported products. The ETS market could be extended to new sectors such as maritime transport.

Finally, the Green Pact should be at the heart of European policies and in particular the European Semester, which evaluates the economic policies of the Member States. The "European taxonomy" of sustainable activities could also provide a first framework to structure and encourage the development of green finance. The directive on extra-financial reporting could provide more transparency on the climate actions of companies, making it easier for societal actors, including funds but also consumers and individual savers, to exert an influence.

The impact of the coronavirus crisis on the European energy transition

At the same time as the Green Deal and its many related projects were being launched by the European Commission, the Covid-19 crisis hit Europe hard and hobbled its economy. Current estimates point to a recession of 6.4% on average in the European Union in 2020.[10] Lockdown measures stemming from the health crisis led to a significant decrease in energy consumption. Oil and gas prices temporarily fell as a result of lower demand. European countries also saw a drop in electricity consumption of up to 25%,[11] thereby increasing the share of renewables in the electricity mix, due to the fact that they take priority in the electricity market.

10 Preliminary estimate for Q4 2020, Eurostat (2021).

The health crisis has offered a reminder of the importance of security of supply. Given that the energy sector is highly dependent on imports, due to the uneven distribution of reserves across the planet, it is necessary to reflect on the robustness of its various value chains, which will be profoundly modified by the transition to low-carbon technologies.[12] The European strategies for the creation of sectors of excellence, in the battery, hydrogen and renewable energy sectors, also benefit from attention now being given to the reindustrialisation of the European Union.

The coronavirus crisis could also be an opportunity to question our relationship with nature, and thereby increase awareness of the disasters the coming climate crisis could provoke if unchecked. The spread of the SARS-CoV-2 virus that caused Covid-19 most likely originated from the recombination of a bat and pangolin virus,[13] suggesting that the destruction of biodiversity and wildlife trafficking increases the risk of a pandemic. Deforestation and poaching also expose people to health crises by forcing animals and humans into close proximity. Once the current health crisis has passed, it is possible that food shortages, freshwater scarcity, heat waves, more frequent and intense natural disasters, and the associated increase in inequality and population movements caused by climate change will reveal that the coronavirus epidemic as merely one part of a much wider environmental crisis. On the other hand, the magnitude of the current crisis might be a unique opportunity to transform the current European economic model into one which is decarbonised, energy-efficient and socially equitable.

11 Covid-19 impact on electricity, Agence Internationale de l'Énergie (2020).
12 Coronavirus and energy, a sector facing its geographical concentrations, T. Metz, Le Grand Continent (2020).
13 Did pangolins spread the China coronavirus to people?, Nature (2020).

At the end of May 2020, the European Commission proposed an ambitious recovery plan to address the disastrous economic consequences of the coronavirus crisis. Following tough negotiations between Member States, a historic agreement was reached during the extraordinary European Council meeting of 17-21 July 2020 on this plan as well as on the new EU budget for the period 2021-2027, confirmed by the European Council of 10-11 December 2020. The European recovery plan, called Next Generation EU, is unprecedented in its scale (€750 billion) and in its method of financing, which is based on a common debt issued by the European Commission. It also intends to put the Green Pact for Europe at the centre of the European recovery strategy.

Compared to the 2018 discussions on the Multiannual Financial Framework (MFF) (where the Commission assumed a budget of €1,135 billion over seven years), the total amount has now increased significantly: €1,074 billion for the 2021-2027 budget, plus €750 billion for the recovery plan, of which €390 billion will be distributed directly to Member States in the form of subsidies. In particular, 30% of these funds (MFF and Recovery Plan) are expected to be dedicated to the pursuit of the EU's climate objectives.

Beyond this 30% of "green" investments, it is crucial that the remaining 70% does not harm the environment. The principle of "do no harm" should be applied. Though this principle has been presented as fundamental to the recovery plan, the devil is in the details. According to the Green Taxonomy Regulation, a given economic activity complies with the "do no harm" principle if, over its life cycle, it does not go against any of the following six environmental objectives: climate change mitigation and adaptation, water protection, development of a circular economy, pollution control and biodiversity conservation. However, to be effective this principle must be enforceable, by preventing states from reinitiating activities that cause pollution. However, if a Member State plans to give a strong boost to its fossil fuel industry, will the European institutions be able to react? Will they be able to counter the willingness of a heavily coal-dependent country to compensate for higher carbon prices by increasing government subsidies to coal mines?

European coordination remains unclear, with possible pitfalls

Investments will have to be guided by the priorities identified in three European frameworks: the budgetary framework of the European Semester (a system for coordinating the economic and budgetary policies of the Member States) and the national recovery plans; the national energy-climate plans (climate trajectories drawn up by the Member States); and the equitable transition plans, which aim to provide social support for the energy transition in the European regions most affected by it, such as those heavily dependent on the coal industry. At the same time, the taxonomy on sustainable finance and the push for the use of internal carbon prices by industry and finance actors could encourage investments that reduce greenhouse gas emissions, illustrating a new strategy for sustainable finance.

As far as the recovery plans are concerned, Member States will have to submit them to the European Commission and the Commission will be responsible for evaluating them, based on multiple criteria.[14] If these criteria are not met, the Commission or a qualified majority in the Council may decide not to allocate a financial contribution for the recovery plan to the State concerned. However, these criteria are not only environmental in nature. Apart from the need to contribute to the green (and digital) transition, the evaluation will cover compliance with the structural reforms resulting from the recommendations of the European Semester, the impact of the recovery plan on growth and employment and the credibility of the plan's timetable and objectives. If a national recovery plan fulfils non- environmental criteria, it could therefore be validated despite insufficient environmental targets in relation to climate issues.[15] The "Do No Harm" criterion will have to be confirmed by a strict exclusion of investments in fossil fuels, to prevent an investment in green infrastructure and technologies simultaneous with the massively financing of fossil fuels.

14 Proposal for a regulation of the European Parliament and of the Council establishing a Recovery and Resilience Facility, European Commission (2020).

15 At this stage, the Commission states that each "national recovery and resilience plan" from Member States will have to contain 37% "climate-related expenditures" to be eligible for EU recovery plan funding.

The EU budget for the period 2021-2027 is nevertheless ambitious as regards investment in the energy transition, through the strengthening of existing programmes and initiatives and the creation of new programmes and financial instruments. The figures are higher and could accelerate the energy transition and the improvement economic resilience, but **it will be necessary to observe in detail how infrastructure spending is allocated, to ensure that it is in fact directed towards low-carbon technologies.**

Compared to the previous proposal under discussion in the Council, the Just Transition Fund will now receive a significant increase in its budget, rising from €7.5 billion to €17.5 billion – even though the Commission has since proposed to increase it further to €40 billion. This is an important, if perhaps still insufficient, first step in ensuring the social acceptability of the energy transition. This fund aims to support the ecological transition on a social level, focusing on employment and training in those regions most negatively impacted by the energy transition (in particular in Poland and Germany, due to the phasing out of coal). Like the border adjustment mechanism for carbon, it is a necessary complement to the European climate goals, which must be translated into a higher carbon value.

The European guarantee programme InvestEU, which was intended to replace the European Fund for Strategic Investment (EFSi) (a key element of the Juncker Plan after the euro crisis), is also being expanded, with €26.2 billion (in addition to the €31.6 billion initially proposed by the Commission). Its philosophy is the same as the Juncker Plan: the public funds mobilised serve as guarantees to attract and multiply public and private financing, relying on the leverage effect to generate hundreds of billions in investment. In this respect, the budget for infrastructure will be doubled, in particular to support the "wave of renovation" in the building sector, which is intended to be massive (doubling the rate of renovations). However, attention should be paid to where these infrastructure investments are going, as the EFSi has been criticised in the past for investing heavily in gas infrastructure.[16]

16 *Not worth celebrating yet?*, Bankwatch Network (2019).

To protect against such criticism, as well as to ensure an efficient allocation of these funds, it will be necessary to clarify how the climate objectives of public investments are evaluated.

In addition, half of the InvestEU budget will be dedicated to strategic value chains, with the aim of creating European industries in key sectors of the energy transition: renewable energies such as offshore wind, hydrogen and energy storage, notably through the Battery Alliance and the Clean Hydrogen Alliance, two projects bringing together companies from several European countries. The recharging infrastructure for electric cars could also be financed by these funds. Initially well under the amount proposed by the Commission (€80.9 billion proposed by the Council in July, compared to €94.4 billion by the Commission), the budget for the Horizon Europe research programme was increased to €95.5 billion in December following negotiations with the European Parliament. Although it falls short of the demands of the academic and research community,[17] and of the European Parliament's initial proposal of €120 billion, this budget will nonetheless be significant in accelerating research into low-carbon technologies. The European Energy Interconnection Facility, which finances the development of trans-European electricity and gas networks, will be reduced by €1.5 billion to €5.2 billion, a position shared by the Commission and the Council. It should be remembered that the goal of zero net emissions by 2050 is unattainable in Europe given the current state of science and technology. Green innovation is therefore vital. The reduction in marginal abatement costs that this will bring will benefit not only Europeans but the rest of the world. Green R&D subsidies are therefore a way of exporting our European ambitions to the entire planet.

To finance these new recovery and resilience projects, the Commission plans to borrow €750 billion on the financial markets. This loan will have to be repaid from 2028 onwards, and the Commission is leaving the door open as to how these amounts will be repaid. It foresees repayment along three possible lines: a gradual increase in all national contributions to the EU budget, a reduction

17 *Réaction du Conseil européen de la recherche à la proposition du Conseil européen* (2020).

in European expenditure, or the deployment of new resources of its own. The European institutions have agreed to introduce a tax on non-recycled plastic at the beginning of 2021, which would bring in €6 billion per year. Other new resources of its own are envisaged for the coming years. A border carbon adjustment mechanism to "charge" the ETS carbon price on imports from certain sectors could bring in €14 billion a year. The extension of the European carbon market to maritime transport, for example, could bring in €10 billion per year. However, in order to improve the social acceptability of our collective climate ambition,[18] it appears important to us that the revenues from carbon pricing be redistributed to households rather than to the repayment of the "Covid debt", which would therefore have to draw on other resources. Indeed, as we have seen in France with the Yellow Vests movement, the use of green taxation to top up the state budget leads to a rejection of this taxation.

Ambitious in its size and innovative force (common European debt and definition of new self-sourced resources), the environmental impact of the European budget remains uncertain. **In 2009, despite a stated desire to invest in clean energy, public money ultimately boosted the entire economy and increased emissions;** such mistakes may be made again. Thus far, the green conditions imposed on Member States regarding the use of the recovery plan funds remain weak, and will need to be audited and strengthened. From this perspective, **it will be crucial to coordinate the European recovery plan over time, to ensure a credible engagement towards vigorous carbon price growth on the continent. This issue is therefore of urgent importance.**

Given the scale of the public resources mobilised in the context of these recovery plans and the severe social crisis that is looming, it is more crucial than ever to ensure that every public euro spent generates the greatest possible social value. This value has many dimensions, from new income for households or companies, to the creation of new jobs and the reduction of social inequalities, and of course to the ecological and climate benefits. It is therefore crucial that the European Union strengthens its competence in assessing these various impacts. In order to aggregate these impacts and measure the societal value of these public actions, the EU also needs to have a debate on the tutelary values of these impacts, such as the social value of avoided carbon, or of job creation in times of massive unemployment. Giving value to what we collectively hold dear is a necessary condition for rationalising our collective choices.

18 Une partie importante des ajustements carbone aux frontières seront concrètement payées par les consommateurs européens à travers une hausse des prix des produits carbonés importés.

Towards a new climate software in Europe?

While the EU is the only region in the world to have achieved a significant reduction in CO_2 emissions since 1990, and is now outlining an ambitious strategy for the future with its Green Deal and post-Covid recovery plan, it still needs to accelerate its climate action. Member States must rapidly reduce their dependence on fossil fuels while developing low-carbon energies that will decarbonise their economies. The consensus on the objectives to be achieved masks divergent strategies, the diversity of energy mixes and the heterogeneous dynamics of the increases in renewable energy use within Member States.

The European energy policy is a key component in the EU's climate action, and pursues a large number of common objectives while leaving Member States considerable scope to determine the conditions for exploiting their resources, the choice between different energy sources, and the overall structure of their supply. **These disparities in national conditions and policies make it difficult to build a European consensus on the sectoral measures to be taken in the short and medium term, which are often defined on the basis of the lowest common denominator.** However, all emitting sectors are concerned: energy production accounted for 32% of CO_2 emissions in 2017, compared with 25% for transport, 20% for industry and 15% for the residential/tertiary sector.

Moreover, these disparities make it more difficult or even impossible to achieve the EU's 2030 targets. The stakes are high, however, and acceleration is necessary: on a continental scale, renewable energies represent only 14% of gross domestic consumption, a share which must be doubled within the next 10 years. If the Green Deal falls short of its target and does not make a comprehensive contribution to reinventing Europe's energy policies, the European Union is unlikely to achieve the climate goals it has set for itself. The EU's credible commitment to the energy transition, which is a prelude to and a condition for carbon neutrality, also presupposes that it makes overdue progress in a number of areas: energy efficiency, particularly in the building sector, the development of clean mobility and a reduction in the use of private cars and road freight, the development of energy storage, the strengthening of electricity and gas interconnections, and the definition of a uniform common price for carbon that is compatible with the stated climate ambition.

An essential social dimension

The definition of a European strategy to ensure that each of its objectives is achieved must take into account the growing need for social justice between citizens or between regions, this being an essential corollary to changing individual behaviour. Since low-income households spend a larger share of their income on energy consumption, any climate policy that leads to higher energy prices has a de facto regressive impact. This is true for carbon taxation as well as, for example, the substitution of more expensive renewable energies for fossil fuels in the electricity mix. It is therefore essential to accompany such taxation with an ambitious redistribution policy, such as the carbon dividend for households proposed by the Institut Montaigne in a recent note.[19] Such redistributive measures would at the same time reduce energy inequalities. The Just Transition Fund, which was set up particularly to support the phasing out of coal, meets this ambition, and its deployment will be accompanied by genuine social support on the ground, thanks specifically to a training policy for the affected workers. This fund could also serve as a model for supporting the energy transition necessary in other sectors, such as the aeronautics and automobile industries, whose production will have to fall if they are to achieve carbon neutrality without decarbonised alternatives being developed for this sector.

This report makes a number of recommendations that can contribute to a substantial acceleration of the energy transition, as is needed for the European Union to meet its climate objectives. This strategy is based on 4 main levers: (i) the strengthening of a long-term economic framework around carbon pricing; (ii) the consolidation of European coordination on energy transition issues; (iii) the introduction of a carbon traceability mechanism to measure carbon content and inform European consumers; and (iv) the support of European States' recovery plans with targeted regulations and investments, particularly in the areas of transport and hydrogen.

19 Carbon Dividend: Europe's Winning Card, Institut Montaigne, June 2020.

I

STRENGTHEN THE EU'S CO_2 EMISSIONS PRICING POLICY AND REDISTRIBUTE ITS REVENUES TO ENSURE SOCIAL EQUALITY

In 2019, the European Union continued to align its climate policy with the objectives of the Paris Agreement, with the presentation of its Green Deal, which sets as a priority the goal of achieving climate neutrality by 2050. This new ambition to move towards climate neutrality is based in particular on the greening of all economic assets and infrastructures. All Member States, all economic sectors, and all consumers and citizens will have to contribute to this effort. To achieve this, all European policies, programmes and economic instruments will have to be progressively aligned with the objective of climate neutrality, preferably at the lowest economic and social cost.

We must act on a broad front, but we must also act in the right order, set priorities, concentrate resources on useful actions, arbitrate between the rapid deployment of mature technologies and the anticipation of new solutions made possible by current innovations, and support industrial and social transitions. It is illusory to believe that such a project can be managed solely from above, as suggested by the European and national green recovery plans, or the "Climate and Resilience" law in France. A myriad of transformations in the daily lives of European citizens, in product choices, in modes of production and transport, as well as in the location of production and consumption, will have to be implemented simultaneously. **Only carbon pricing can effectively orchestrate this large-scale societal change.** In the current context of economic downturn caused by the Covid-19 health crisis, volatile oil prices and political uncertainties about the support for green policies integrated within this recovery, **this transition to a "climate neutral Europe" requires a growing and strengthened carbon pricing trajectory, adapted to the objectives to be achieved.** Beyond several isolated national attempts to introduce a carbon price complementary to that of the European ETS, this carbon pricing trajectory should be prioritised at a European level.

It is possible today to revive our economies while preventing economic actors from reinvesting in activities which will have to be subsequently rejected in the light of our climate objectives. To ensure this, it would be enough for the political institutions to announce a credible plan for a massive increase in the price of carbon, once our economy has emerged from the Covid-19-induced recession. The recent increase in the price of CO_2 emission allowances on the ETS market moves in this direction.

Strengthening the current European carbon pricing policy has a strong economic rationale: it demonstrates that the price signal is neither high nor predictable enough to reflect Europe's long-term climate goals, and therefore insufficiently informs the investment decisions of economic actors, concerning only a limited number of sectors and not taking imported emissions into account. Moreover, future revenues from a more ambitious carbon price will need to contribute to social justice, in order to reduce inequalities and ensure the acceptability of the policy. It is therefore urgent to strengthen the current European carbon pricing policy, in order to accelerate a fair transition to climate neutrality over the next decade.

1. Renew the European Union CO_2 Emissions Trading Scheme

Today in Europe, carbon pricing is done through the European Union CO_2 Emissions Trading Scheme – EU ETS. Created in 2005, it regulates CO_2 emissions from over 11,000 large European energy and industrial installations,

responsible for 40% of EU emissions, by setting an annual emissions cap that decreases each year (-1.74% per year from 2013 to 2020). Its target was to reduce CO_2 emissions by -21% in 2020 compared to 2005, and then by -43% in 2030, a target that will have to be increased to reach the new Green Deal objectives of -55% of emissions from all sectors in 2030.

This emissions cap is implemented through a quantity of emission allowances auctioned or granted free of charge to covered facilities. Over a given compliance period, these facilities must turn over to the European Commission the same quantity of emission allowances as there were verified emissions. These facilities can buy or sell allowances on the market, with each participant having an interest in reducing emissions, whose abatement cost is lower than the market price of the allowance. Therefore, with a current market price of around €50/tCO_2, the EU ETS is in the short term mainly aimed at encouraging the switch from coal fuels for electricity production; its price level, however, remains insufficient to bring about the profound transformation of decarbonising energy systems. In particular, it offers insufficient incentive to steelmakers to replace coal with hydrogen, or to electricity providers to invest massively in wind and solar power without a guaranteed price mechanism. If the ETS were extended to the transport and residential sectors, its current price would be insufficient to encourage individuals to replace combustion vehicles with electric vehicles, or to encourage many homeowners to invest in the thermal insulation of their homes.

Already in 2014, the EU ETS reached its 2020 reduction target of -21% compared to 2005 levels. CO_2 emissions from the energy and industrial sectors have fallen sharply as a result of the economic crisis, the development of renewables and improvements in energy efficiency, but the EU-ETS CO_2 price has had little influence. Despite reaching its target well in advance, the credibility of the EU ETS has been called into question. Indeed, from 2008 onwards, a structural imbalance was created between the supply of and demand for allowances, generating a significant surplus of unused allowances, reaching 1.7 billion in allowances in 2016, which was the equivalent of one year's worth of emissions. In this context, and without visibility on future climate constraints, the price of CO_2 has been fluctuating for a decade between 5 and 15 euros, a level far too low to encourage economic actors to reduce their GHG emissions over the longer term. This example shows the need for political willpower, regardless of whether climate policy is quantity-based (emission reductions) or price-based (carbon price). It is clear that the recession of the 2010s should have prompted the EU to reduce the supply of allowances to support the carbon price and accelerate the transition.

The European carbon market is incomplete

While the EU ETS has technically worked well since its implementation, providing a market price based on the balance between supply and demand, its main weakness has been its **inability to give a price signal to economic actors that reflects the long-term ambition towards a faster decarbonisation within the EU. Logically, the market has reached its short-term targets because these are set as inputs by the emissions cap.** Conversely, a carbon market cannot provide a stable, long-term price signal on the market[20] because of its variability and the effects of speculation. Because the number of quotas was too high after the 2008 crisis, the price was too low and unpredictable to provide economic actors with a long-term perspective. The high volatility observed on the EU ETS market and the absence of regulatory visibility over the time periods required for green investments create a fundamental uncertainty for actors implicated in the energy transition. This uncertainty seriously undermines the economic dynamism of the green transition sectors.

In 2017, the EU reformed the ETS to reduce the stock of unused allowances and increase the price above a certain threshold, using the Market Stability Reserve (MSR). This complex mechanism for removing some of the unused allowances from the market and placing them in a reserve, in order to reduce the number of allowances available and increase the price, has resulted in a relatively stable and increasing price over the last three years, and has proven to be effective in leading to a substitution of gas for coal, thereby confirming the importance of a high and stable price signal.

20 See the publications of Nicolas Bouleau.

Moreover, **the ETS market only covers 40% of emissions,** energy and industrial installations, **but does not cover the transport and residential sectors.** As the rest of the sectors are not taxed at European level, half of the Member States have introduced carbon taxes with different perimeters and prices. This additional carbon pricing is not harmonised at the European level, and is therefore unclear and unpredictable and does not allow for a significant impact on emission reductions. Moreover, the multiplicity of effective carbon prices, which are dependent on emission location, source and emitter identity, demonstrates the inefficiency of emission reduction efforts on the continent. Clearly, the same reduction in overall emissions in Europe could have been achieved at a lower cost to Europeans.

Finally, **the ETS market only takes into account emissions on European soil and does not take into account to emissions from imports.** By not setting a CO_2 price on imports, it thereby undermines market equity and competition between European and non-European products. The prospect of a sharply rising carbon price creates a risk of carbon leakage (transfer of emissions through the transfer of production sites). This phenomenon has yet to be observed to a large extent, because the price of carbon has thus far been low (less than €25 per tonne up to 2019), but it is likely to increase when the price of carbon rises significantly.[21]

While the 2017 reform improved the effectiveness of the EU ETS starting in 2019, it is nevertheless vital to continue its consolidation, in order to meet the challenges ahead: decarbonising and accelerating the transition to climate neutrality in the context of a severe economic downturn in 2020. This is why we propose the following measures.

21 *Taxe carbone aux frontières: le juste ajustement ?* A. Bustin, H. Sancho, J. Slawski, Le Grand Continent.

Proposals

1. Europe needs to introduce a carbon benchmark or reference value[22] by improving the market stability mechanism to achieve a carbon price floor.

Even in the absence of a green tax or quota market mechanism, it is essential to have a carbon reference value in order to prioritise the investments to be made to achieve climate neutrality. Reaching zero net emissions by 2050 is an extremely ambitious challenge. Indeed, action is needed on many fronts simultaneously and the costs and emission reduction potentials of many decarbonisation technologies are still largely unknown. In this context, cost-benefit analysis is essential to selecting the relevant actions, ensuring that the different levers are mutually reinforcing and determining the orders of priority. In particular, a robust cost-benefit analysis is particularly useful in comparing the impacts involved and identifying trade-offs. The setting of a reference price for carbon at European level, which should then be integrated into all impact studies, appears therefore crucial to achieving the targets set out in the Green Deal and to ensuring the coherence and alignment of the objectives of all European policies. The work of the Quinet Commission[23] carried out in France shows the feasibility of such an approach.

A floor or minimum carbon price should be introduced within the EU ETS to provide economic actors with a guarantee of minimum profitability on low-carbon choices and to avoid a counter-productive drop in the carbon price

22 A carbon benchmark value is a reference value that guides public action by allowing projects and public policies to be compared (cost per ton of CO_2 avoided) and price signal instruments (taxes, investment subsidies, standards, etc.) to be calibrated.

23 Published in February 2019, the Quinet report on "The value of climate action in France" recommends a value of €250/tonne of CO_2 in 2030 and by 2050 between €600 and €900 with an average value of €775 in order to achieve the goal of carbon neutrality. This carbon price should be compared to the socio-economic abatement cost of climate action per tonne of CO_2 avoided.

in times of economic crisis. This floor price could be set initially at a level that ensures the competitiveness of alternatives to coal, and then increased over time at a predetermined rate which could be revised periodically on predefined bases. So far, it has not yet been possible to establish a price floor mechanism, despite its usefulness and effectiveness in places where it has been implemented, such as in the Quebec-California ETS and in the UK, where the price floor for coal helped accelerate the rapid phase-out of this fossil fuel. It would be appropriate to include this measure in the European Commission's future proposals to strengthen the EU ETS, and to include it in the expected 2021 review of the Market Stability Reserve (MSR).[24]

2. Carbon pricing should be extended on a European scale to sectors other than those currently covered by the EU ETS.

The European Union must continue to adapt its EU ETS carbon market, beyond the first step taken in 2018, by integrating all economic sectors. In this context, in July 2019 the Council for Economic Analysis and the German Council of Economic Experts drew up a joint proposal: "A single carbon price for the single market"[25] argued that *"a single carbon price in the EU would be more effective in achieving the targets set in the Paris Agreement than a set of different national measures... It would also avoid carbon leakage and distortions of competition within the EU."* It further noted that *"the natural choice to implement this uniform price for CO_2 would be to extend the EU Emissions Trading Scheme (EU-ETS) to other sectors"*. The expansion of the sectors covered by the EU ETS is mentioned in the Green Deal and supported by Germany; the measure is intended to include other sectors. A first candidate could be the road transport sector, as is done in the ETS systems in Quebec and California, which includes fuel distributors. New Zealand's ETS covers the forestry sector, and eight other ETS include the construction sector.[26]

3. The EU will have to introduce a border carbon adjustment mechanism to set a CO_2 price on imports.

In order to allow EU targets to be raised without compromising the competitiveness of European industry and relocating our emissions, a carbon adjustment mechanism at the borders of the EU must be implemented to prevent carbon leakage that would result from the relocation of high emitting industries to countries with less ambitious climate policies, a movement that would be amplified by the increase in EU targets, and to extend carbon pricing to imports. France has been arguing in favour of such a mechanism, which consists of an obligation for importers of carbon-intensive goods to purchase CO_2 emission allowances from the EU ETS on the European market (EU-ETS), if the exporting country does not have equivalent CO_2 pricing. Such a measure would therefore not be protectionist, but rather an environmental "anti-dumping" policy. Each molecule of CO_2 needed for European consumption should be priced in the same way. This measure would also make it possible to project the European ambition to fight climate change to all the Union's economic partners. While in Europe it has not yet been possible to establish such a mechanism, something similar does exist, for example, in California for electricity imported from neighbouring states. It is of course crucial that this border adjustment mechanism be concomitant with the enlargement and elimination of exemptions and the distribution of free allowances within the Union. We cannot claim to be fighting unfair competition if Europe itself is not completely transparent about penalising its own issuers.

24 It will be remembered that the mechanism was implemented in January 2019 to take into account surpluses in the original ETS mechanism and adjust the quotas. An increase in the charge, and then a cancellation of quotas under the MSR could support the price above a certain threshold.

25 A single carbon price for the single market Council for Economic Analysis – German Council of Economic Experts (2019).

26 Emissions Trading Worldwide, International Carbon Action Partnership (2020).

This measure is included in the Green Deal, and the European Commission is expected to submit a proposal in June 2021. Such a measure presents significant logistical, legal and political challenges, but it has been shown that an implementation on several key sectors (steel, cement, electricity) is feasible, before possibly being expanded into other sectors at a later date, when accurate carbon traceability has been put in place (see *Part 3*). Care will need to be taken to ensure that the mechanism is compatible with WTO regulations. It would also be an interesting alternative to the allocation of free quotas to industrial sectors, which is scheduled to end by 2030.

2. Create a European Central Climate Bank (ECCB)

In order to address the need for an increasing and predictable price signal over the long term while adapting to the European political reality, we propose to replace the various carbon pricing schemes with a Central Climate Bank, which would be charged with setting an increasing and predictable CO_2 price that would allow the European Union to reach its carbon neutrality target by 2050.

This would render credible and coordinated the price trajectory by 2050, and would give the necessary visibility to energy transition actors. Credibility and visibility are issues that Europe has already encountered in the fight against inflation in the 1980s, where monetary policy and the objective of price stability was known to conflict with other objectives. The solution found was to increase the independence of the institutions with the power to issue money. Thus, the European Central Bank, created at the time of the changeover to the euro, is today an independent institution that has inherited a primary mandate of price stability. It is one of the Union's greatest successes to date. Building on this success, we propose to create a Central Climate Bank (CCB) with a mandate to increase the price of CO_2 in Europe by 4% per year. All European emissions (positive and negative) would be covered, not just those of the EU ETS sectors. Emission allowances would be purchased from the CCB by any importer or extractor of carbon in the EU, which would then replace the previously proposed border carbon adjustment. Unlike the current operation of the ECB, whose price

stability mandate is set out in the European treaties but whose numerical target was specified by its Governing Council in 1998,[27] the price target would be revised every 5 years by the BCC bodies on the recommendation of the **European Energy Transition Agency** (see *infra*), depending on whether or not the climate objectives are met and on the progress of scientific research on climate.

CCB revenues would either be fully redistributed to countries in proportion to their historical carbon consumption; or redistributed according to a key combining carbon consumption per country and a criterion allowing the compensation of those who will be most affected by a high carbon price due to, for example, their existing electricity mix, such as Poland, which is currently highly dependent on coal. The aim would be to put a redistributive policy in place within and between states which would compensate for inequalities, help the poorest households in their energy transition, and increase cohesion between European states. The Proposal C, presented below, addresses this objective.

In order to ensure that it functions properly and has the necessary information at its disposal, the Central Climate Bank will have to rely on the **European Energy Transition Agency**, whose role will be to inform investment decisions, redistribute financial resources and analyse the projected technological solutions, as well as to advise on their sequencing and implementation.

3. Redistribution of carbon pricing revenues to the lowest income sectors

It has been shown previously that a stable and rising carbon price is needed to significantly reduce emissions. This carbon pricing will have a regressive social impact and will weigh more heavily on low-income households than on the rest of the population; this will be even more so in regions most dependent on fossil fuels. For example, if we tax the entire carbon footprint of a French person at €50 per tonne of CO_2, it is clear that the tax is much

27 Avec un objectif d'inflation annuel proche mais inférieur à 2%.

higher proportionally for the poorest population, especially the poorest 10%, compared to the wealthiest. **The richest 10% of the French population would be significantly less taxed than the ninth decile even though they emit 26% more greenhouse gases.**

Therefore, whether through a refusal of the carbon tax (such as occurred in France in 2019), or opposition to a high price on the carbon market or set by the Central Carbon Bank, **some Europeans will not accept any forced energy transition which does not work against regressive social impact through a redistributive policy.** Any alternative strategy to carbon pricing which nonetheless leads to higher energy prices (such as feed-in tariffs in the solar sector) also creates a problem of wealth redistribution, to which should be added the issue of a lack of tax revenue that could be used to compensate lower income households. We therefore propose the following measures.

Proposals

1. Establish a carbon dividend to be redistributed to households.

The new revenues arising from the higher carbon market price and the carbon adjustment at borders should be redistributed to households in the form of a carbon dividend, as proposed by the Institut Montaigne in June 2020.[28] In order to maximise the social acceptability of carbon pricing and to improve social justice within the European Union, we propose to redistribute income in full to households, leaving the choice of the type of redistribution (flat rate, income-based or household energy constraints) to Member States, in order to comply with the subsidiarity principle.

However, we suggest the following mechanism for redistributing carbon pricing revenues, in three components:

1. A carbon dividend base for the majority of households, except for the wealthiest 20%;
2. A component inversely proportional to income, in order to favour the most modest households;
3. A component based on the energy constraints of households, which would increase the carbon dividend of those households for whom a daily commute by car is necessary, or who have poorly insulated housing or oil heating.

Finally, a share of the carbon dividend will be dedicated to redistributing proceeds between countries, taking into account their specificities as to income per capita and the share of domestic fossil resources in the national energy mix.

2. The Just Transition Fund will have to be re-evaluated at the halfway point of the Multiannual Financial Framework, to set a more ambitious budget of €40 billion.

The Multiannual Financial Framework 2021-2027 has allocated a budget of €17.5 billion for a socially-just transition, which marks an important first step in addressing the social impact of energy transition. However, this budget is likely to be insufficient to support the transition of employment in sectors destined to reduce their activity. Revaluing the fund to €40 billion halfway through the multiannual financial framework would allow the targeting of coal-related deindustrialisation as a first phase; in a second phase, it would also help the transition of numerous sectors and industries, for example the automotive and aeronautical industries, or the cement, steel and chemical industries. As the transition of employment in these sectors will accelerate in the coming years, an increase to this fund should be considered in order to adapt to the necessary support that will require. The strengthening of this fund should be conditional on a global agreement on commitments to increase the carbon price in the Union in the medium term. This increase in the Just Transition Fund should be negotiated at EU level in exchange for higher carbon price targets for the next three decades.

28 Carbon Dividend: Europe's Winning Card, Institut Montaigne, June 2020.

3. The European Union will have to provide strong incentives to Member States to use cohesion and regional funds and to provide social support for these jobs, which are destined to decline or even disappear.

Ensuring the fairness of the energy transition means addressing social and employment issues at a local level. Coal-fired power plants will close by 2035-2040, and there will be a significant decline in parts of the aviation sector, and in the number of cars sold. These sectors will see their needs in terms of labour and skills change accordingly, as with the transformation of the automotive sector towards electric mobility. European regions and territories will have to set up fair transition plans to provide social support for employment areas. They will also need to plan for the development of green industries with potential as regards regional development and relevant worker training.

4. The European Union will have to make it possible to receive financial aid, particularly for the lowest income households, in order to support the necessary behavioural changes.

In the areas of building renovation and insulation, the installation of heat pumps, the purchase of a light vehicles and/or electric cars, the purchase of electric bikes, and support for the consumption of agro-ecological foodstuffs, the transition will not be possible without purchase incentives to facilitate changes in consumption behaviour. To overcome the complexity and multiplication of this type of aid, the EU could harmonise these subsidies at European level and unify the different systems. By targeting the lowest income households, these subsidies will complement the carbon dividend proposed above by allowing these families to pay lower prices for low-carbon technologies.

II

STRENGTHEN COORDINATION ON ENERGY TRANSITION ISSUES AND BUILD SUPPORT WITHIN THE EUROPEAN UNION

In the field of energy policies, there is a divergence between the EU and the Member States. The main disagreement concerns the social aspects of this energy transition. Because of the heterogeneity of socio-economic situations within the European Union, the fight against global warming remains a major global concern. However, while this fight is a common concern, it is prioritised differently by each Member State, making it difficult to reach a consensus on the measures to be adopted.

1. Create an independent European Energy Transition Agency (EETA) with broader powers

The fight against climate change is now an accepted fact. Yet few people know or understand the costs and benefits of each climate action. The strategy of "whatever it takes" cannot be implemented here, as it would lead to exorbitantly high costs and, consequently, to social dissatisfaction. It is therefore essential that these debates be informed through the creation of a mechanism to produce clear and credible information for citizens and for public and private decision makers. This must be done at the highest level, to build credibility and to benefit from economies of scale.

The flurry of innovation in the field of energy transition is sometimes lacking in sound and systematic scientific foundation, and in concrete quantitative facts that take European specificities into account. In many cases, often due to a lack of hindsight or information, the real cost of planned solutions is imprecise, and its carbon benefit roughly or even erroneously assessed. Not all renewable solutions are good or equivalent to one other.

Today, there are two EU agencies (bodies governed by public law, each with its own legal personality, and separate from the Institutions) competent in the field of energy and environment.

- The **Agency for the Cooperation of Energy Regulators** (ACER) created in 2011 (established by the regulation n°713/2009), based in Ljubljana (Slovenia). Its mission is to ensure the smooth functioning of the European gas and electricity market, by dealing with energy issues of European or cross-border importance and by coordinating the national energy regulatory agencies. It complements and coordinates the work of the national regulatory authorities; (2) assists in setting the rules governing European networks; (3) makes, under certain circumstances, binding individual decisions on the terms and conditions applied to access and operational security of cross-border infrastructure; (4) advises the European institutions on electricity and natural gas matters; (5) monitors the internal electricity and natural gas markets and develops analyses; (6) monitors the wholesale energy markets in order to detect and prevent market abuse, in close cooperation with the national regulatory authorities (responsibility exercised since 2012, under Regulation (EU) No 1227/2011 on the integrity and transparency of the wholesale energy market – REMIT).
- The **European Environment Agency** (EEA). Created in 1994 (established by a 1990 regulation), based in Copenhagen, Denmark. Its mission is to preserve and monitor Europe's environment and to provide adequate, targeted, relevant and reliable information to decision-makers and the general public. To this end, it (1) collects and makes available environmental information from Member States' reporting offices for the European territory/makes available a wide range of information and assessments; (2) publishes every 5 years a report on the state of the environment in Europe and its future outlook; (3) coordinates the European Environment Information and Observation Network. Its role is to study the policies implemented and their effectiveness.

These agencies already play an advisory role to the European institutions. We propose to **strengthen the staff and the role of the European Environment Agency, renamed "European Energy Transition Agency"** to provide it with a real capacity to analyse and evaluate the public policies deployed in the European Union to fight against global warming. As such, the agency would:

- Consider the introduction of carbon values to be compatible with the climate target set by the EU political institutions, as achieved by the Quinet-2 Commission in France, for example;
- Advise, guarantee and provide cost/benefit analyses based on these values, prioritise and closely monitor investments related to the ecological transition;
- Analyse recovery plans in the light of the objective of accelerating the energy transition, draw up recommendations, conduct experience analyses and transfer knowledge from country to country;
- Act as the guarantor of the taxonomy and as the central European information centre and focal point, providing access to information and recommendations on investment policies.

The new resources of this agency would make it possible, in particular, to carry out cost-benefit analyses likely to inform the European Commission's teams in the regulatory trade-offs which they are confronted with, on the one hand, and to facilitate the evaluation of national recovery plans, on the other, by setting as an objective the greening of the energy mix of the various European States. It could also contribute to the analysis of green investments by relevant European financial actors, most notably the European Investment Bank.

The European Energy Transition Agency should provide the information necessary to rationalise the debate and investment choices for the public and private sectors.

The EU countries have demonstrated a common desire to fight climate change: all states have jointly signed the Paris Agreement. But many differences of opinion remain as to how to achieve this. Some of these differences are based on the lack of any sound rationale behind the solutions proposed, itself often linked to the absence of credible information based on economic and technological performance criteria.

In this respect, the European Energy Transition Agency's tasks would include:
- Defining performance criteria, both ecological and economic, which would take into account local, geographical, political and social characteristics
- Developing and publishing information (criteria) necessary for the sound analysis of investment choices concerning energy technologies and solutions. This would include the creation and development of databases on technologies and solutions, providing clear evidence of their techno-economic, energy and environmental performance, including an estimate of the cost per tonne of CO_2 avoided (CO_2 abatement cost) of different climate actions;
- Estimating the carbon price compatible with the emission reduction objectives decided by the Union, as well as its evolution over time, taking into account the prospects for technological progress in the various sectors;
- Developing a climate reference framework (taxonomy) to inform the investment choices of public and private actors;
- Providing a study and advisory capacity for Member States and European bodies;
- Defining investment priorities and fund allocation rules for the Central Climate Bank and the European Investment Bank (for investments related to energy transition).

The European Energy Transition Agency would monitor, anticipate and advise the Commission on energy transition, acting as the architect of an integrated European vision.

An integrated vision of Europe's energy transition is needed to optimise investment in the transformation of Europe's energy systems. The Agency would become the architect of an integrated European vision, monitoring

the transformation of energy systems, conducting impact studies on energy costs, energy security and the social impact of these transformations.

As a result, the Agency would play a key role in analysing the recovery plans submitted by the Member States, and in measuring the environmental cost-benefit impacts on behalf of the Commission.

The agency must also **maintain a forward-looking vision of the transition.** Monitoring the transition and providing feedback are essential elements for the continuous improvement of the transformation, beyond the European coordination role of the energy transition.

These prospective studies would make it possible to anticipate the investments needed to optimise the European electricity network, such as:
- Interconnection projects between European states to ensure the optimisation of the electricity mix;
- Adding flexibility to electricity demand;
- Electricity storage needs (batteries, hydrogen, hydraulic).

This agency would also help to prevent policies being implemented monolithically across Europe, as a given policy may be relevant for one state but not for another. This would apply, for example, to the electric vehicle, which must be developed and supported in areas where the electricity mix is decarbonised. In this capacity, the Agency would centralize the studies necessary for the Commission's decision-making as regards the planning, authorisation and construction of European energy infrastructure. Finally, this agency would not be tasked with drawing up decarbonisation master plans by sector and by country. It should be seen as a tool for climate decision-making in the public and private sectors, as well as for consumers and citizens.

2. Shift the paradigm of the European energy transition

A paradigm shift around the European energy transition would allow social policies to be linked to the fight against global warming. A "Green New Deal" with at its heart an ambitious policy of economic redistribution and support for employment will have to engage citizens in a new vision of society.

Beyond the costs of abandoning relatively cheap fossil fuels, the energy transition will bring economic, geopolitical and social opportunities for all Member States:

- It offers the opportunity to create new economic and technological competitiveness clusters, supporting the start-up of new sectors of excellence (renewable energies, hydrogen, batteries, etc.) that lead to value creation and "green" jobs. The creation of these new growth relays should make it possible to anticipate the slowdown in traditional sectors and respond to a need to modernise European infrastructures.
- These new sectors also ensure the security of energy supply, by reducing dependence on fossil fuels, which are gradually being replaced by low-carbon energy sources.
- The energy transition also tackles the problem of fuel poverty, which affects 50 million Europeans, by encouraging the thermal renovation of homes.
- Finally, the transition to less carbon-intensive energy sources reduces air pollution, with its associated cardiovascular and respiratory risks, and thereby reduces the associated costs to the health system. Air pollution causes more than 400,000 premature deaths per year according to the European Environment Agency.

It would now appear necessary to reintegrate these challenges into the discourse on energy transition, and to propose a new paradigm for energy policies that includes these added benefits of the transition. Refocusing the discourse concerning energy transition on economic opportunities, energy security and public health would make the fight against global warming more socially acceptable.

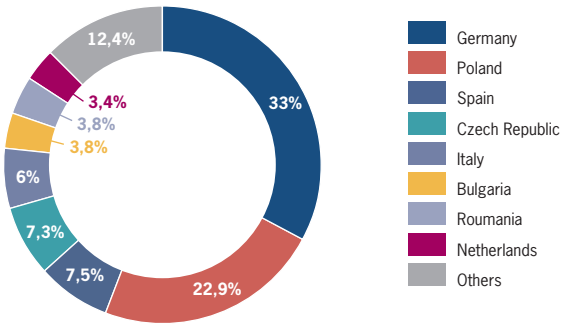
3. Plan the closure of European coal mines and power stations by supporting the conversion of the affected areas and employment basins

Existing power generation facilities are often highly carbon-intensive, particularly in Eastern Europe. Some of them are also new and could continue to operate for several decades. These countries will be the first to be hit by the necessary increase in the price of carbon. The decommissioning of coal-fired power plants is also the most effective measure to rapidly reduce CO_2 emissions on the continent. The ETS credit system should in theory allow these assets to be 'retired' from the electricity generation network, but this will come at a price:

- a massive devaluation of the capital tied up in these assets;
- a loss of economic and social value (excluding climate damage) for the stakeholders (employees, territories);
- a sharp increase in the price of electricity over a sufficiently long period of time to justify shifting the sunk capital to other energy sources (renewable or nuclear).

The acceptability of such a policy requires that those hardest hit economically, including mine and coal plant workers, be compensated. Given that an exit from coal use must therefore be prepared, and that the number of assets in question are known and relatively limited, compensation should be considered for those actors directly affected by this transition. The European Union (EU-27) still has 216 active coal-fired power plants (lignite and hard coal) in 18 Member States. Germany and Poland alone account for 55.8% of deployed capacity in operation (measured in MW), followed by Spain (7.5%), the Czech Republic (7.3%) and Italy (6.0%).

Distribution of installed capacity (lignite and hard coal) in the European Union

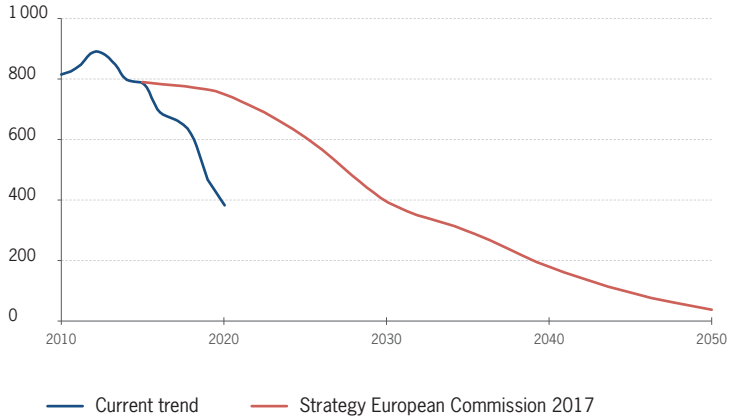


Source: Working Group, European Coal Plant Database.

The average age of the plants in operation is relatively high, though this can vary substantially from one Member State to another. The trends are generally regional, with a high proportion of older plants in Eastern Europe (e.g. capacity-weighted average age of 54 years in Slovakia, 51 years in Hungary, 48 years in the Czech Republic) and younger plants in Western Europe (8 years in the Netherlands, 31 years in Italy, 33 years in Portugal and 37 years in Germany)[29]. Moreover, four power plants are currently under construction (including two in Poland, with production planned to start in 2022 and 2023) and six are on stand-by (including five in Germany), even as the gradual rise in the price of carbon necessary to effectively combat climate change should make coal non-competitive.

29 *European Coal Plant Database*, Beyond Coal (2020).

Evolution of EU coal-fired power generation compared to the European Commission's scenario in 2017



Source: Power Barometer 2020, Eurelectric.

The continued operation of coal-fired power plants being incompatible with stated decarbonisation objectives, we propose to plan for an accelerated exit from coal in the EU-27 by rendering the transition socially equitable, by converting and training the employment areas hardest hit by the exit from coal. This early exit would be based on the following proposals.

Proposals

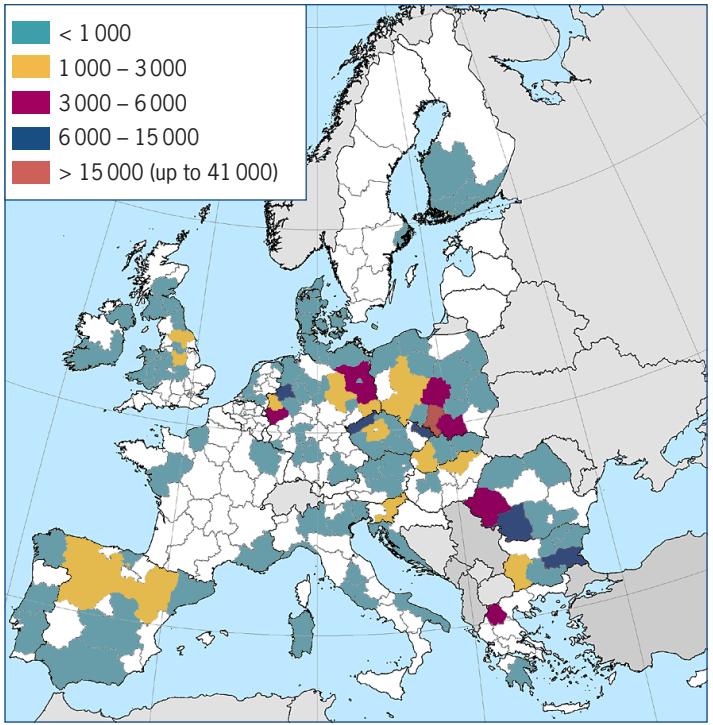
1. Make the transition socially equitable by mobilising European funds to support a social policy of conversion and re-training for coal-mining employment areas.

The end of the coal industry will lead to the loss of 450,000 direct jobs in Europe,[30] particularly in Germany and Poland, but also in the Czech Republic, Romania and Bulgaria. It is therefore crucial to anticipate and plan for the transition of employment in coal-mining regions, which are already affected by high unemployment (29% unemployment in the mining region of Western Macedonia in Greece, and a youth unemployment rate of 39% in Silesia in Poland).[31] The economic conversion of these regions is made more difficult by the high average age of workers, the low diversification of local economic activities and the economic dependence of the relevant states on the coal sector.

30 EU coal regions: opportunities and challenges ahead, Alves Dias, P. et al., Joint Research Center, European Commission (2018).

31 A just energy transition or just a transition?, *Journal Général de l'Europe* (2019).

Potential job losses in the coal sector by 2030



Source: EU coal regions: opportunities and challenges ahead, Alves Dias, P. et al., Joint Research Center, Commission Européenne (2018).

This will require increased cooperation between companies, regulators, investors, employee representatives and local communities, in order to identify new sustainable industries for development. This cooperation has been tested in several European regions via the Platform for Coal Regions in Transition

piloted by the European Commission, and should be strongly reinforced within the European Agency for Energy Transition by linking it to the just territorial transition plans and to the European financing of the Just Transition Fund. Such cooperation would make it possible to anticipate and plan the exit from coal at the German-Polish level, for example, in order to deal with employment issues in cross-border regions.

The Agency will have to define the employment areas affected by the closure of coal-related installations (which may be cross-border) and support them in their sustainable economic development projects, allowing itself to provide direct support to employees directly and indirectly affected. This support would be achieved through regional "just transition" plans that enable local support for the retraining of thousands of employees in new sustainable sectors in line with European industrial priorities: development of low-carbon electricity production and electricity networks, hydrogen, batteries, etc. **The more planning and organisation that goes into the social transition, the less difficult it will be, allowing for a better orientation of young workers towards alternative jobs, a natural retirement of older employees, and the development of retraining and job transfer programmes adapted to mid-career workers.**[32]

More broadly, the energy transition will lead to numerous job losses in all activities dependant on fossil fuels, i.e. a large proportion of industrial activities. These losses may be offset by jobs in alternative low-emission technologies, but this transition is uncertain, and will have a very significant social impact. This is why the Parisot report on the programming of jobs and skills[33] calls for the creation of a social pact for the energy transition. It is necessary to transversally assess the opportunities and risks, sector by sector, region by region, and branch by branch. The transition will be socially acceptable if it is anticipated and planned, and if accompanied by strong social support programmes the end of coal will set an example for other sectors destined to decline or be profoundly transformed.

The budget of the Just Transition Fund will need to be revised at the mid-point of the multiannual financial framework, in 2024, to increase it to €40bn in order to strengthen support for coal workers and extend the fund's scope to other sectors that will be profoundly transformed by the energy transition.

2. Compensate, where necessary and within a predetermined framework, the operators of coal-fired power plants to accelerate their closure.

To accelerate and plan the exit from fossil fuels, the suggestion has been made in scientific publications[34] that operators' extraction and combustion activities be bought out. Under the logic of planned carbon pricing, fossil fuel operators would bear the responsibility for their long-term investments. For example, investing today in natural gas transmission capacity or in electricity generation based on this resource implies a risk that these real assets will become unprofitable in 10 to 20 years. Member States would not, of course, come to the rescue of these companies in this case. A specific problem arises for coal, given the urgency of excluding this highly polluting resource. If it proves difficult to end the use of coal through a clear and concerted increase in the price of carbon within a timeframe compatible with the emission reduction imperatives, the idea of compensating their owners by buying back these coal assets at the European level could be considered. This compensation would be carried out in accordance with the procedures specified by the European Energy Transition Agency, integrating future carbon and coal price trajectories, subsidies and support for other sources of energy production, the

32 *Implementing coal transitions - Insights from case studies of major coal-consuming economies*, O. Sartor, IDDRI (2018).

33 *Plan de programmation des emplois et des compétences – Mission de préparation,* L. Parisot (2019).

34 Buy Coal! A Case for Supply-Side Environmental Policy, B. Harstad, Journal of political economy (2012).

evolution of the European mix, the possible conversion of industrial facilities, accompanying measures, etc. Certain conditions, such as those relating to local employment, the regional economy or energy conversion, could also be imposed.

At present, the main owners of coal-fired power plants operating in the European Union are European electricity suppliers, which are often wholly or partly owned by the community through state or local government ownership. These owners could respond to calls for tender for early closure of coal-fired power plants launched by the European Energy Transition Agency. The Market Stability Reserve (MSR) would be adjusted when a plant closes to automatically remove the number of allowances used by the plant on average over the previous ten years, in order to correct the market for withdrawn capacity and stabilise the ETS market price. For those plants not participating in these tenders, the EU would plan for their decommissioning by limiting their operating time from 2025 onwards, in order to ensure that the plants are closed within the next ten years. Such a target would be made public, to provide a framework for possible negotiations on compensation.

III

ESTABLISH A CARBON TRACEABILITY SYSTEM TO INFORM CONSUMERS, EVALUATE COMPANIES, AND FACILITATE THE IMPLEMENTATION OF AN AMBITIOUS CARBON ADJUSTMENT SCHEME BETWEEN BORDERS

In the absence of carbon pricing commensurate with our responsibilities to future generations, many are calling for a sense of individual and institutional responsibility on the part of emitters and their clients. Besides the financial incentives controlled by the carbon price, cognitive science teaches us that many consumers and producers are motivated by intrinsic elements (self-image and self-esteem, social pressure, etc.) to do good, even if this incurs a personal cost. Some consumers may wish to buy an electric car despite its current drawbacks and high cost. Some investors may invest in SRI funds even if their risk/return ratio is less favourable on a purely financial level. Companies which are partially freed from the competitive pressure of cost-cutting are already agreeing to decarbonise their production facilities despite the additional costs. But how can these intrinsic motivations be boosted when the actors only have very vague information as to the ecological benefits of their sacrifices?

With few exceptions, details of the carbon impact of consumer products remain abstract or approximate. While it is certain that global warming has deep systemic causes over which individual behaviour has little control, acting on an individual level can nonetheless help reduce greenhouse gas emissions. For example, estimates suggest that individual behaviour has the potential to reduce an individual's carbon footprint by up to 25%.[35] Combined with a logic of collective demand, individual responsibility is therefore part of the solution to the climate challenge. For this, the carbon impact of consumer products must be made explicit and become a purchasing criterion for consumers.

Integrating the carbon criterion into purchasing decisions requires access to reliable and simple information regarding the carbon impact of particular production or consumer goods. However, no satisfactory system currently exists to compare the carbon footprint of production and consumer goods. Such systems have many shortcomings: multiple and non-comparable methodologies, unclear taxonomy, lack of official benchmarks, non-certified information, etc. With a few exceptions, the carbon impact is rarely integrated into decisions made by consumers. Only a few sectors, mainly energy and transport, have tools and information about their carbon emissions. There exists, therefore, the technical challenge of providing a unified methodology and a certified carbon accounting system at a European level, which would allow for true carbon traceability of production and consumer goods.

In addition, solving the challenge of implementing such a system **(Scopes 1, 2 and 3)** would provide stakeholders with credible information on the emissions related to companies' activities, thus providing a key indicator of their extra-financial performance. Finally, this carbon accounting system would apply to imported products, making it possible to export European regulations to third-party countries; for a growing number of products, this would allow the calculation of a carbon adjustment which is both accurate and in accordance with WTO rules at European borders. **Carbon traceability is a prerequisite for establishing true carbon adjustment at borders.**

35 Calculation made at the French level in the report: *Faire sa part?, Carbone 4* (2019).

Citizens are ready to change their consumption habits

According to the "Post-Covid survey by BETC" conducted in May 2020, the crisis has led more citizens to call for profound changes in environmental policy. According to the GreenFlex-ADEME 2019 Barometer of Responsible Consumption[36] published in May 2020 (carried out before the crisis), 60% of the French population already considers that climate action is urgent, and has expressed a desire to take part in the collective effort, in particular by limiting the environmental impact of their consumption.

Because they can encourage consumers to adopt more environmentally-friendly behaviour, information tools (labels, environmental displays, environmental claims, etc.) are of increasing interest to public decision-makers in charge of environmental issues, over and above purely economic instruments (price signals) or regulations (standards).

Environmental labelling in its infancy

Among the information tools available, labelling systems are developing in France and in Europe. The energy label has been compulsory on household appliances since 1992 and the energy-CO_2 label on vehicles was made compulsory in 2003. The energy performance evaluations on homes and buildings came into force in 2006. Finally, the environmental label on tyres has been displayed since 2012.

The Economic, Social and Environmental Council (ESEC) recommended in its March 2019 opinion[37] supporting a new dynamic on this topic and to take proactive political decisions during the implementation of the circular economy roadmap. Its recommendations are aimed at harmonising French and European systems and moving towards the generalisation of environmental

36 Barometer of Responsible Consumption, GreenFlex-ADEME (2019).
37 *L'affichage environnemental, levier pour la mise en œuvre de l'économie circulaire, Avis du CESE – Éditions des journaux officiels* (2019).

labelling. The ESEC also recommends that a single, mandatory scheme including environmental labelling be defined for all companies using environmental labelling, in order to make the information more accessible to consumers.

These recommendations can be found in the proposals of the Citizens' Climate Convention, which recommends introducing a "carbon score" for all products and services, an obligation of annual CO_2 reporting extended to Scope 3 for all organisations, and the display of emission information in places of consumption and in advertising.

The main shortcoming of the existing schemes is undoubtedly that the labelling typically indicates the emissions arising from the use of the products, but not those emitted by their production. However, in some cases (such as solar panels), the carbon content associated with the products' fabrication is far greater than the emissions associated with their use. **It is therefore necessary to take into account the carbon content resulting from the products' fabrication and, where appropriate, their transport from the country of export to the country of import and consumption.**

Pitfalls and difficulties in broadening the use of environmental labelling

Although environmental labelling is popular with the public, its implementation remains a real challenge. According to an analysis by the Commissariat Général au Développement Durable published in April 2019, the path to environmental labelling is fraught with pitfalls threatening its applicability (acceptance by manufacturers, feasibility for public authorities) and effectiveness (choice of environmental information that will guide the behaviour of manufacturers upstream and purchasers downstream, and determination of the right level of information for specific use).

While relatively "easy" to implement for certain products, because of their homogeneous "recipe" (e.g. cement), environmental labelling is a methodological headache for most other everyday consumer products.

It also requires a very thorough analysis of the life cycle of products and their qualities, to allow product comparison on the basis of the same "use value unit". The method developed by ADEME for calculating the indicators to be used for the environmental labelling of textiles–a sector that is ahead in this area –does not, for example, take into account the criterion of the product's lifespan, which is essential in calculating its environmental footprint.

In addition, the reliability and traceability of the data used for environmental labelling is essential for it to be an effective environmental measure in a competitive economic environment. For example, a vehicle is made up of thousands of components, manufactured by various subcontractors around the world. Each of them could claim to use green electricity specifically in order to power the production plant in question. The carbon content of a product is therefore highly dependent on where it is produced, i.e. the energy mix used for its production, which itself varies considerably between countries and regions.

Until the eventual advent of a technology guaranteeing total traceability at negligible environmental cost,[38] **it is necessary to propose a mechanism that favours the highest level of environmental performance. For each indicator in the label, an average figure would be used by default. A manufacturer wishing to claim an improved environmental footprint would then have to prove, through data from a traced and audited process, the improved performance of its product compared to the benchmark.**

Such a development would make it possible to support and strengthen a genuine economy of production and improve the reliability of environmental data. Reliable data that can be easily mobilised and that is broadly available is essential at all levels to support the strategy to combat global warming, regardless of which strategy is finally adopted: public policies, carbon taxes,

38 For example, initiatives implementing blockchain are currently being deployed in certain sectors or industries (e.g. the pharmaceutical industry).

environmental labelling, individual carbon counters, citizen involvement, etc. All actions need precise, quantified information to guide strategies, anchor commitment and verify the effectiveness of the measures adopted.

1. Develop European carbon accounting to determine the carbon content of goods produced and consumed in the EU

This recommendation includes the definition and implementation of a life cycle assessment of carbon content for consumer and producer goods. It is based on two simple principles:

- Human-induced CO_2 emissions can be linked to production or consumption goods. Conversely, each economic activity can be characterised by a level of CO_2 emissions;
- A precise analysis of CO_2 emissions is necessary to identify priority areas for action and to develop the necessary measures for their reduction.

For each production or consumption good, its carbon footprint should be defined by a life cycle analysis, i.e. the sum of the CO_2 emissions emitted at each stage of its value chain: manufacturing, transport, marketing, consumption and end of life.

This proposal aims to develop an information system concerning the carbon footprint of production and consumer goods. The establishment of a carbon traceability system should contribute to the reduction of carbon emissions by directing buyers' choices towards less carbon-intensive solutions. This system makes it possible to integrate the carbon dimension into the operational and investment choices of companies.

This proposal would be part of the process of revising the European framework to support sustainable investment (cf. the revision of the European taxonomy planned for late 2020 and 2021) and constitute one of the methodological pillars of climate policy.

This recommendation aims to develop European accounting for the measurement of the carbon content of consumer goods and products, which includes:

- developing and harmonising carbon emission assessments for production and consumer goods;
- accurately mapping the transfers of carbon flows: from the consumption of fossil fuels and throughout the production, distribution and marketing chain, to the final use of these goods and services ("well-to-wheel" analysis);
- making it possible to take the carbon content of imported products into account, to estimate the CO_2 emissions generated by Europe outside its borders, and to integrate the carbon intensity of the production site and of transport-related emissions.

2. Impose carbon labelling on goods consumed in the EU

Once carbon accounting has been established, certified labelling should be made compulsory to enable informed consumer choices:

- Inform and raise awareness among consumers about the CO_2 emissions associated with the consumption of goods. For example, the carbon content of a car should be reported; that is, the amount of carbon emitted in its manufacture, transport to the point of sale and use for an average mileage. In the same way, the carbon footprint of a full tank of gas should be indicated on the receipt;
- Enable and encourage the various economic actors to integrate the carbon dimension into their operational and investment choices, in particular via the selection of production goods, but also to reduce the carbon footprint associated with their products.

Furthermore, by requiring the publication of the carbon footprint of a company's activities, stakeholders are provided with a clear extra-financial evaluation criterion that assesses the company's sustainability. It is therefore a reliable indicator for evaluating the impact of the company over time.

3. Gradually extend carbon adjustment at EU borders to new sectors and to more complex products, through carbon accounting

The European Union's CO_2 emissions are largely the result of its imports, i.e. emissions arising from the foreign fabrication of products and consumer goods that are then imported into Europe. This trend has also been increasing sharply over the last fifteen years. That is why we propose to introduce a border carbon adjustment that would make import-related emissions pay for themselves at the ETS carbon market price.

Initially, to ensure the feasibility of the mechanism, it is important to limit it to high emitting sectors whose carbon footprint is easily quantifiable: steel, cement, electricity. In the longer term, however, once ambitious, reliable and homogeneous carbon accounting is in place, it will be possible to extend the carbon accounting obligation to imports, and to include new sectors in the carbon adjustment at borders (aluminium, chemicals, textiles, even manufactured goods).

IV

USE THE EUROPEAN RECOVERY PLANS AS AN OPPORTUNITY TO ACCELERATE THE DECARBONISATION OF THE EUROPEAN ECONOMY THROUGH TARGETED REFORMS AND INVESTMENTS

On 27 May 2021, Poland and Austria approved the €750 billion European Recovery Plan (including €47.5 billion for the REACT-EU programme), allowing the European Commission to begin raising funds on the capital markets. The European Commission has two months to examine and approve the national recovery plans. The first payments from the recovery fund to the European states could be made in the coming weeks, probably as early as July, and continue until 2023, depending on the investments made by the Member States. The overall vision of this broad scale European transformation will only become concrete once the national plans have been analysed and validated by the European Commission. The European strategy is to first agree on the financing and then select the priority areas to be transformed–a bottom-up approach to creating recovery plans, rather than a top-down one.

The European states are seeking to take advantage of this financial windfall to boost their economies. But are we sure that the investments chosen will

best serve the climate objective of the energy transition? The absence of an integrated (top-down) European plan, favouring a systematic and prioritised cost-benefit analysis of investment options, casts doubt on the choices that will ultimately be endorsed by the allocation of funds.

As the contents of the German, French and Polish recovery plans show, investment priorities diverge in several sectors. This is particularly the case in the transport and building sectors, or in the technological choices for hydrogen (a major focus of the German recovery plan). While the divergence on buildings can easily be explained by the strong geographical specificities (climate, architecture, urban planning), the European approach nevertheless overlooks the possible synergies in the development of cross-border transport infrastructures, and lacks a genuine European strategy for the development of the hydrogen economy. Analysis of the recovery plans therefore leads us to make a number of recommendations regarding transport and hydrogen, as to how their i.e., full potential might be realised on a European scale.

1. NextGenerationEU: the European architecture for recovery

The €750 billion NGEU instrument has several components. The main component (90% of the total envelope) is the "Recovery and Resilience Facility" (RRF) which allows for the financing of national–i.e. specific to each Member State–recovery plans consisting of reform commitments and investment projects in line with the recommendations emanating from the European Semester, as well as a number of other criteria, such as a minimum share allocated to the green (37%) and digital (20%) transition. Other elements of the NGEU include a €10 billion increase in the budget for the "Just Transition Fund".

Breakdown of the NGEU programme

	Price of 2018	
Facilities for resilience recovery	672,5	90%
of which loans	360,0	
of which transfers / grants	312,5	
REACT-EU	47,5	6%
Horizon Europe	5,0	1%
InvestEU	5,6	1%
Rural development	7,5	1%
Just Transition Fund	10,0	1%
RescEU	1,9	0%
Total	**750,0**	
of which loans	360,0	48%
of which transfers / grants	390,0	52%

A pre-allocation of the RRF by Member States of 70% of its total transfer envelope (70% × €312.5bn, i.e. almost €220bn) has been defined, using a distribution key incorporating GDP, population and the pre-crisis unemployment rate as variables. In accordance with Regulation 2021/241 establishing the RRF, the remaining 30% of the transfer envelope will be determined by a distribution key integrating the impact of the crisis, as determined by the contraction of real GDP in 2020 and the recovery in 2021.

For some Member States, such as Croatia, Greece and Bulgaria, the amounts due through the RRF represent several points of GDP (4.1%, 3.4% and 3.3% respectively over the period 2021-22). The RRF should therefore have a real macroeconomic impact for these countries. However, the latter will be much more modest for countries such as Germany and France: by way of illustration, the RRF allocation planned for France will only cover 40% of the €100bn recovery plan announced by the government last August.

In addition, the Regulation establishing the RRF requires that a minimum of 37% of expenditures under each national plan should be allocated for the financing of green transition projects according to an identification methodology developed by the European Commission.[39] The table below presents an estimate of the minimum amounts per country that will be allocated to the green transition in terms of GDP over the periods 2021-2022 and 2021-2025.[40] These vary significantly from country to country. While not insignificant, they may seem insufficient in the face of the climate imperative. It is therefore now up to Member States to propose ambitious plans that go beyond the 37% minimum threshold.

Minimum amounts of the Recovery and Resilience Facility allocated to the green transition

(excluding loans)

	Minimum amount from RRF for the climate (€ bn)	Min. Weather % GDP 2021-22	Min. Weather % GDP 2021-25
Greece	6,6	1,8%	0,7%
Portugal	5,1	1,2%	0,4%
Slovakia	2,3	1,2%	0,4%
Latvia	0,7	1,1%	0,4%
Spain	25,7	1,1%	0,4%
Bulgaria	2,3	0,9%	0,3%
Cyprus	0,4	0,8%	0,3%
Lithuania	0,8	0,8%	0,3%
Italia	25,5	0,7%	0,3%
Slovenia	0,7	0,7%	0,2%
Estonia	0,4	0,6%	0,2%
Malta	0,1	0,4%	0,2%
France	14,6	0,3%	0,1%
Belgium	2,2	0,2%	0,1%
Roumania	5,3	0,2%	0,1%
Austria	1,3	0,2%	0,1%
Finland	0,8	0,2%	0,1%
Netherlands	2,2	0,1%	0,1%
Germany	9,5	0,1%	0,1%
Ireland	0,4	0,0%	0,1%
Luxembourg	0,0	0,1%	0,0%

Source: Authors' calculations. The calculation is based on the table of maximum financial contributions per Member State in the Annex to Regulation 2021/241 establishing the RRF. The allocation of the non-predetermined 30% of the RRF is based on the Commission's autumn 2020 growth forecast. The minimum climate amounts are compared to GDP in 2021-2022 and 2021-2025 and are expressed as % GDP in the last two columns of the table.

39 In line with the strategy developed in the framework of the European Green Deal, the European Commission will assess the investments presented in the framework of the national recovery and resilience plans on the basis of the EU taxonomy rules on sustainable finance, making the issues around this taxonomy (and the positioning of the different energy sources) all the more important.

40 The GNP estimates are taken from the IMF's "World Economic Outlook" database.

The recovery plans drafted by the Member States to access the RRF funds will then be examined by the European Commission, which will propose the final plans to the Council for approval after negotiations with the Member States. Disbursement of funds by the European Commission will take place as the reform and investment projects in the plans are implemented, following the achievement of pre-defined targets or milestones.

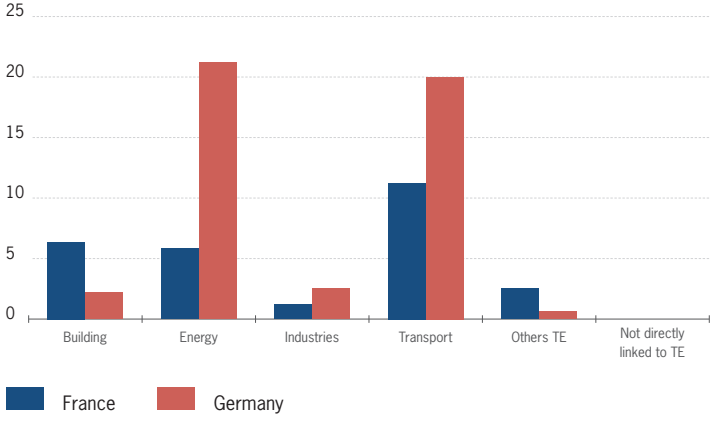
Note that the Regulation establishing the RRF requires, inter alia, that each investment and reform project proposed in the recovery plans must comply with the "Do No Significant Harm" principle within the meaning of Article 17 of the Green Taxonomy Regulation. In concrete terms, this means that no investment or reform funded by the RRF budget should have, in theory, a negative impact on the six EU environmental objectives as defined by the Green Taxonomy.[41] The Commission is responsible for assessing compliance with this requirement through its review of the recovery plans.

With this European framework in place, we will now look at the main elements of the green transition that have already been included in the recovery plans announced by Germany, France and Poland.

41 These are: climate change mitigation, adaptation to climate change, sustainable use and protection of aquatic and marine resources, transition to a circular economy, pollution prevention and reduction and, finally, protection and restoration of biodiversity and ecosystems.

2. Comparison of the energy and climate components of the German, French and Polish recovery plans

Recovery plan efforts related to energy transition in Germany and France



Note: not including investments not directly linked to energy or recovery plans, such as: € 63bn VAT in Germany, or hydrogen plan investments for France.

Source: Bundesministerium der Finanzen (2020): Corona-Folgen bekämpfen, Wohlstand sichern, Zukunftsfähigkeit stärken. Ergebnis Koalitionsausschuss, 3 juin 2020.

a) Germany

• The German recovery plan in response to the health crisis

As early as June 2020, the German federal government was the first in the European Union to present a comprehensive recovery programme. The total

budget amounted to a little over €130 billion, which is equivalent to 3.9% of the country's GDP in 2020 (Destatis, 2021).[42] The stimulus package comes in addition to the immediate liquidity measures and guarantees that were made available at the start of the first containment in March 2020. For example, the economic stabilisation fund (Wirtschaftsstabilisierungsfonds), which began operation in March 2020, includes a guarantee framework of €400 billion, recapitalisation measures of €100 billion and an additional €100 billion credit line from the state-owned credit institution for reconstruction (Kreditanstalt für den Wiederbaufbau, KfW). This fund provides liquidity to large companies in all sectors. Overall, the immediate budgetary response in Germany was substantial, taking into account the liquidity and guarantee measures and the stimulus package.[43]

The German recovery programme is based on three pillars:[44] (i) The recovery plan includes immediate measures such as VAT reductions; (ii) It includes targets related to European and international policies (e.g. expansion of humanitarian aid); and (iii) The 'investments for the future' include spending that puts a particular focus on digitalisation and investment in climate technologies. These pillars cover a variety of measures in different areas of the economy. Following the classification scheme developed by the Green Recovery Tracker,[45] tax measures can be grouped into six broad categories: 1) agriculture, land use and forestry, 2) buildings, 3) energy, 4) industry, 5) mobility and 6) other. Figure on page 85 gives an overview of the extent of support for each category.

• VAT and other

The largest amount is in the 'Other' category, with an overall amount of €63 billion. Measures such as additional bonuses for families, support for municipalities, and a new "programme for the future of hospitals" fall into this particular category. The most important element of the 'Other' category is the concentration of public investment, amounting to €10 billion. These investments focus on the digitalisation of administrative and security projects, as well as on new defence projects which have a high added value for Germany. Most of the measures in this category are unlikely to have a significant effect on the climate; the impact of other measures, such as the additional investment in 5G networks worth €5 billion, cannot be assessed. Only €650 million of investments will have a positive or very positive climate impact (e.g. support for research projects on climate protection).[46]

The most important measure in the overall fiscal stimulus package is the temporary reduction in VAT from 19% to 16%, which represents €20 billion. While reducing VAT may be an appropriate tool to stimulate consumption and thus boost economic activity, it also reinforces current fossil fuel dependent consumption patterns. From a climate perspective, the VAT reduction is not expected to have a positive impact, and could even be counter-productive for the environment.

• Buildings

A €2.25 billion share of the recovery plan has been reserved for the building sector. Two billion of this has been allocated to the CO_2 renovation programme for buildings, bringing the financial envelope of the programme to €2.5 billion per year for the period 2020-2021. The increase in the support programme also includes the energy renovation of municipal buildings and support for climate adaptation measures in social facilities. The remaining €250 million will be invested in sports infrastructure and in support for municipalities under the national climate initiative.

Additional financial support in the building sector is needed to achieve the national sectoral climate targets. Although emissions decreased by 2.8%

42 German GDP in 2020 was €3,332 billion at current prices. Source: Destatis (2021): National accounts, domestic product.
43 Anderson, J. et al. (2020): The fiscal response to the economic fallout from the coronavirus. Bruegel datasets.
44 Bundesministerium der Finanzen (2020): Corona-Folgen bekämpfen, Wohlstand sichern, Zukunftsfähigkeit stärken. Ergebnis Koalitionsausschuss 3. Juni 2020.
45 Reitzenstein, A. et al. (2021). Green Recovery Tracker Report: Germany. Green Recovery Tracker.
46 Reitzenstein, A. et al. (2021). Green Recovery Tracker Report: Germany. Green Recovery Tracker.

between 2019 and 2020, the building sector is the only one that exceeds the sectoral emission budget set in the National Climate Act.[47] For this reason, further investments in energy efficiency measures in buildings are an important step towards reaching climate neutrality in this sector. However, the stimulus programme could have benefited from additional investments, for example in heat pumps to support the later stages of the thermal transition, as advocated in the guidance notes before the implementation of the stimulus programme.[48] Heat pumps have a particularly low cost per tCO_2 avoided, if this energy source replaces oil-fired boilers.

• Energy

€20.7 billion is being invested in the energy sector. About half of this amount (€11 billion) is earmarked for the reduction of the surcharge on renewable energy (EEG-Umlage). Due to the drop in economic activity during the lockdown periods, the wholesale price of electricity fell significantly in 2020. In order to compensate renewable energy producers with the predefined subsidies, the EEG surcharge and thus the electricity prices for households and non-exempt industry would have increased in 2021. With the support of the government, the surcharge will decrease in 2021 to 6.5 ct/kWh from 6.8 ct/kWh in 2020. Without this subsidy, the surcharge would have been 9.65 ct/kWh. This measure helps avoid an additional burden on the disposable income of households. The same applies to companies: State intervention helps avoid additional financial burdens, providing essential support for many companies. At the same time, slightly lower electricity prices, and thus their increased competitiveness, strengthen the incentives to invest in clean and electricity-based technologies, such as sector coupling technologies or electric vehicles.

In addition, the government is investing €300 million in the expansion of support schemes for the energy transition. It focuses on identifying projects in areas with significant potential for transformative change: digitalisation and sector coupling.

47 *Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit (2021): Infografiken zur Klimabilanz.*

48 Agora Energiewende, Agora Verkehrswende (2020): Dual Benefit Stimulus for Germany – A Proposal for a Targeted 100 Billion Euro Growth and Investment Initiative.

• Industry

According to the Green Recovery Tracker, the federal government is planning to invest around €2.5 billion in the industrial sector. However, the exact amount depends on the definition of these measures. It could also be concluded that the overall amount of investment in the industry is much higher, as the National Hydrogen Strategy alone represents an investment volume of €9 billion.

The goal of the National Hydrogen Strategy is to install hydrogen production plants with a total capacity of 5 GW, including the necessary offshore and onshore power generation, by 2030. The aim is to double this capacity by 2035, or at the latest by 2040. The national hydrogen strategy focuses on industrial production processes. The strategy supports new plants through investment grants. In addition, it supports the higher operating costs arising from carbon-neutral technologies through contracts for difference (CFD). The aim of the recovery plan is to exempt the production of green hydrogen from the EEG surcharge. However, at the same time, the overall EEG surcharge should not increase. With the adapted EEG law of 2021, the production of green hydrogen is fully exempted from the EEG surcharge.

In addition to the rapid implementation of the legal framework, the recovery programme also foresees the rapid expansion of the hydrogen refuelling infrastructure to support the use of hydrogen for heavy road transport vehicles. Moreover, the government supports the direct use of green hydrogen in aircraft engines as well as the development of "hybrid-electric flight" concepts, which contain a combination of hydrogen, fuel cells and battery technology. The financial envelope for these measures represents a total of €7 billion.

A further €2 billion is earmarked for international green hydrogen partnerships with countries where hydrogen production is profitable thanks to their geographical location. In these countries, the German government plans to support hydrogen production plants based on "made in Germany" technologies. Thanks to these partnerships, the foreseeable demand for hydrogen in Germany should be met in the future.

49 Ministère fédéral de l'économie et de l'énergie (2020): *EEG surcharge will fall in 2021.*

Focusing on a national hydrogen strategy as part of the recovery programme is a good first step in the climate neutral transformation of Germany's energy-intensive industry. The industrial sector is responsible for 23% of the country's greenhouse gas emissions (187 t CO_2eq in 2019), making it the second largest emitting sector after energy and before transport.[50] At the same time, this energy-intensive industry employs about 280,000 people.[51] Therefore, supporting industry in order to help it become climate neutral is not only necessary from a climate point of view, but can also secure a significant number of (often well paid) jobs. The stimulus package investments can play a key role in initiating this transition. However, additional public investment will be needed in the near future to further support industrial transformation.

• Mobility

The German stimulus programme foresees €20 billion in investments in the mobility sector, which is one of the main drivers of the national economy. However, rather surprisingly, and in contrast to the last stimulus package, which was launched after the financial crisis, a general car scrappage premium is not part of the health crisis stimulus package. Instead, an 'innovation premium' supports the replacement of the car fleet with electric vehicles. The financial envelope for this premium is €2.2 billion. It is the second most important in the 'mobility' category.

The most important, with an overall investment volume of €5 billion, is the support of the state-owned railway company Deutsche Bahn. This investment increases Deutsche Bahn's equity capital, also taking into account the drop in ticket revenue due to the health crisis. This €5 billion comes in addition to their own increased funds, which were already allocated in 2019, in the National Climate Action Programme 2030 ("Klimaschutzprogramm 2030"), at a rate of €1 billion per year.[52]

50 German Environmental Agency (2021): Indicator: Greenhouse gas emissions.
51 Agora Energiewende und Wuppertal Institut (2019): Klimaneutrale Industrie: Schlüsseltechnologien und Politikoptionen für Stahl, Chemie und Zement. Berlin, November 2019.
52 German Federal Ministry of Transport and Digital Infrastructure (2020): Federal Government and DB boost railways with additional 11 billion euros to proactively reduce the climate footprint of transport.

Another €2.5 billion of the stimulus package is earmarked for finance investments in public transportation programmes, which are managed by German municipalities, and many of which are under extreme financial pressure. Through this investment, the German government is trying to compensate for the loss of ticket revenue due to the health crisis. The stimulus package provides investment of €2.5 billion to strengthen the e-mobility infrastructure, R&D and battery manufacturing, and to expand the charging infrastructure for electric vehicles.

As shown in figure on page 85, after the energy sector, the mobility sector now receives the second largest amount of financial support from the stimulus package. This emphasises in particular the greening of the mobility sector, as emissions from the transport sector have increased over the last decade.[53] At the same time, the mobility sector, with its powerful and massive automotive industry, is an important employer in the country. The transformation of this sector towards climate neutrality is essential in ensuring the future viability of the German economy.

• Agriculture

A little under €1 billion is being invested in the sectors of agriculture, land use and forestry, including €630 million for sustainable forestry. In recent years, German forests have suffered severe damage due to prolonged periods of drought. At the same time, the price of wood has fallen, partly because of the health crisis. This is why the federal government is investing in sustainable forest management, including support for the digitalisation of forestry and investment in modern machinery. Another €300 million will be invested in supporting the renovation of stables to improve animal welfare.

• Conclusion

Overall, the German government reacted quickly and comprehensively in the first months of the pandemic. While some large companies not known for their environmental efforts were supported with immediate liquidity measures, the

53 Umweltbundesamt (2020): Emissionsquellen.

government's stimulus package also focused on important future themes such as digitalisation, mobility and the greening of the global economy. In particular, the share of investments dedicated to the climate amounts to 21% of the total programme. Compared to the previous recovery programme which followed the financial crisis, where the green share was around 13%, this represents a significant increase. In absolute terms, the difference is even greater: while in the last recovery programme green investments amounted to around €10 billion, the Covid-19 crisis recovery programme is investing around €30 billion in environmental measures.

It is difficult to assess the extent to which these measures meet the real objective of climate neutrality. However, the programme includes important measures aimed at ensuring the national economy can face future challenges. The National Hydrogen Strategy establishes a solid basis for further technological development within these energy-intensive industries. Combined with German subsidies for battery R&D, the efforts in this field represent a strongly diversified policy towards resolving this key issue of energy storage for the power, transport and building sectors. In addition, the recovery plan emphasises sustainability in the mobility sector, and implements important incentives for the further development of the energy transition in Germany. Nevertheless, the recovery programme could have benefited from a clear long-term vision for an inclusive and sustainable economy, with measures linked to long-term objectives and conditions.

With Germany developing a carbon pricing scheme that combines a high ETS price with a carbon tax for non-covered sectors, this set of sectoral policies appears to contain a balanced portfolio of decarbonisation initiatives. A cost-benefit analysis of these targeted policies and their interaction with the ETS market (trickle down effects) remains to be carried out. Finally, the overall effectiveness of this strategy is questionable, as the German electricity mix is still heavily dependent on coal.

Following a censure of its climate law by the Constitutional Court, Germany has significantly raised its climate targets by aiming for a 65% reduction in its greenhouse gas emissions by 2030 compared to 1990, instead of the 55% reduction set only two years previously. The affirmation of this new ambition must be followed rapidly by investments and regulations in all sectors, in order to amplify the dynamics of the recovery plan. The parliamentary elections in September 2021 will play a major role in this respect, as the German Greens are expected to come out on top, according to estimates, or at least be part of a coalition with the centre-right CDU. The announced arrival of the Greens in the federal coalition would not change the current market economy philosophy, but could herald stronger regulations and above all massive investments financed by debt,[54] in contrast to the zero-deficit rule ("Schwarze Null") that was the norm before the pandemic.

b) France

In order to address the economic consequences of the Covid-19 pandemic and to support the recovery, France launched a €100 billion recovery plan in September 2020, called France Relance. Almost 30% of this sum, i.e. nearly €30 billion, or about 1.5 points of GDP, will be devoted to the ecological transition, in order to make it a core principle of the post-crisis economy.

This ambition has two main objectives:

- Decarbonise the French economy by achieving a 40% reduction in carbon emissions by 2030 (compared to their 1990 level);
- Support "green" innovation (energy, hydrogen, recycling, etc.) and put the fight against climate change at the heart of emerging sectors.

Broadly speaking, the French recovery plan is based on three main axes. In addition to ecology, there is also a focus on the competitiveness of the French economy and on cohesion. It should be noted here that all the measures

54 The Economic Policy of the German Greens, Alexandre Robinet-Borgomano, Institut Montaigne.

presented, including those that do not belong to the ecological axis, must respect the transversal objectives of combating climate change and decarbonising the French economy.

It is therefore a question, by means of these investments aimed at supporting the economic recovery, of contributing to the ecological conversion of the French economy. The measures presented within the ecology axis are structured around 9 key issues:

1. Energy renovation (€6.7bn, including €200 million for VSEs/SMEs);
2. Decarbonisation of industry (€1.2bn);
3. Infrastructure and green mobility (€8.58bn);
4. Green technologies (€8.2bn);
5. Maritime (€0.25bn);
6. Financing the energy and ecological transition of businesses (€2.5bn).
7. Agricultural transition (€1.2bn; including €200 million for the wood industry);
8. Biodiversity and the fight against artificialisation (€1.25bn);
9. Circular economy and short circuits (€0.5bn);

Among the measures presented, the first seven provide direct support for the energy transition, representing an overall investment effort of €28.6 billion (not including support for the Hydrogen Plan outside the recovery plan) (figure on page 85).

The main elements of the various measures deployed under France Relance are presented below.

• Energy renovation

The challenges of energy renovation are varied and are related to climate imperatives (improved energy efficiency to fight against CO_2 emissions), environmental imperatives (decreased use of resources and land artificialisation), economic imperatives (creation of jobs that cannot be relocated), social imperatives (renovation of thermal leakage and savings on energy bills) and health imperatives (improved sanitation).

Within the French economy, the building sector remains a major emitter of greenhouse gases (representing almost 25% of French direct greenhouse gas emissions in 2019). Faced with this situation, the recovery plan provides for four main measures, for a total of €6.7 billion:

- Energy renovation of private buildings (€2 billion to strengthen the energy renovation of households, over 2021 and 2022);
- Energy renovation of public buildings (€4 billion invested by the State, including €300 million delegated to the Regions, over 2021);
- Energy renovation and major rehabilitation of social housing (€500 million for the years 2021 and 2022, with a target of 10,000 renovated homes);
- Ecological transition and energy renovation of VSEs/SMEs, in order to help the ecological transition of VSEs/SMEs, particularly in the tourism and agriculture sectors (€200 million).

• Decarbonisation of industry

Industrial activities contribute significantly to France's direct greenhouse gas emissions, accounting for almost 20% of these emissions. The decarbonisation of industry is therefore an important part of the fight against global warming and the achievement of the objectives set by the French government.

The France Relance plan thus includes an important measure to support the decarbonisation of French industry. €1.2 billion will be invested over the period 2020-2022 in order to:

- Improve the energy efficiency of industry;
- Improve manufacturing processes (particularly through electrification);
- Decarbonise heat production.

• Green infrastructure and mobility

The transport sector remains the largest emitter of greenhouse gases and contributor to global warming in France, as well as the largest contributor to air pollution. Respecting France's commitments to combat global warming therefore requires support for the development of more environmentally friendly infrastructure and means of transport. The recovery plan therefore contains six measures focusing on these issues, for a total of €8.58 billion:

- Day-to-day mobility: developing a bicycle plan and public transport projects (€1.2 billion invested between 2020 and 2022);
- The implementation of a support plan for the railway sector (€4.7 billion between 2020 and 2022);
- Acceleration of transport infrastructure works (e.g. charging stations on national roads and motorways, promotion and acceleration of modal shifts from car to public/shared transport, development of the river network and rail links) (€550 million, between 2020 and 2022);
- The greening of the State's vehicle fleet: the recovery plan will support the replacement of thermal vehicles belonging to the State with less polluting electric vehicles (€180 million in 2021);
- Support for the purchase of clean vehicles as part of the automobile plan, in particular through bonuses, the conversion premium for light and heavy vehicles, and the deployment of charging stations (€1.9 billion between 2020 and 2022);
- Improving the resilience of electricity networks and energy transition in rural areas, to promote the electrification of rural activities and avoid reinforcements while strengthening resilience at the local level, through renewable energies or the development of storage capacities (€50 million over 2021 and 2022).

• Low greenhouse gas emitting technologies

In order to support the ecological transition, the recovery plan provides strong support for the development of future technologies, which should promote human and economic activities while minimising the carbon footprint. The recovery plan includes four key measures, based on different sectors, for a total investment of €8.2 billion:

- The development of a green hydrogen industry in France: the recovery plan strongly supports the development of a French hydrogen industry, with the goal of positioning France at the forefront of renewable and low carbon hydrogen production technologies. This includes support for the entire ecosystem and support for the industrialisation of the sector (€2 billion included in the recovery plan for the period 2020-2021; with an overall investment for the hydrogen strategy of €3.4 billion by 2023 and up to €7.2 billion by 2030);
- Support for innovation in the ecological transition, through an increase in the fourth investment programme for the future, PIA 4 (€3.4 billion to finance priority investment strategies for the ecological transition, over the period 2020 and 2021);
- Support for the nuclear sector: the aim here is to maintain the skills of the nuclear sector and to support the competitiveness and expertise of the French nuclear industry, to assure that its production of low-carbon electricity can continue in complete safety. This measure will also finance innovation in nuclear waste management and the accelerated dismantling operations for decommissioned facilities (€200 million over the period 2020-2022);
- Support plans for the aeronautics and automotive sectors: these two sectors contribute to global warming, and have been severely weakened by the Covid-19 crisis. In order to support their adaptation and transition, the recovery plan provides support for investments which should increase both competitiveness and innovation that will facilitate environmental transformation (€2.6 billion over the period 2020-2022).

• Maritime

The recovery plan identifies two main measures concerning the maritime sector, designed to develop French sovereignty in this area, and to support its economic competitiveness, for a total of €250 million:

- Strengthening the fisheries and aquaculture sectors to improve France's resilience and sovereignty: the recovery plan aims to support the development of sustainable fisheries and aquaculture sectors in order to limit the ecological footprint of these activities (€50 million over 2020-2022)
- Greening of ports: in addition to representing a major economic challenge, ports are also the site of activities that contribute to global warming. The recovery plan thus aims to strengthen the competitiveness of ports and the French maritime economy, for example by financing the development of port infrastructures, while promoting the ecological transition of these activities (€200 million over 2020 - 2022).

• Financing the energy and ecological transition of businesses

Finally, Bpifrance will mobilise nearly €2.5 billion in direct financing over the duration of the recovery plan, to support and finance the energy and ecological transition of businesses.

Bpifrance has therefore structured a "climate plan" based on:
- Support for the emergence and growth of "greentechs", i.e. the development of solutions (mainly technological) that make it possible to combat global warming and pollution (water, air, soil), and that contribute to the preservation of natural resources;
- Financing for the renewable energy sector;
- Financing and supporting companies in their ecological transition.

Over the duration of the recovery plan, Bpifrance will grant a total of €2.5 billion in direct financing (in debt: green loans and "energy saving loans"; and in equity) dedicated to the ecological transition.

• Agricultural transition

Environmental and climatic issues have a strong impact on agriculture (e.g. through issues related to maintaining biodiversity, resource management and conservation, soil quality, adaptation to climate change). Despite the contribution of its various activities to climate change, agriculture must therefore face its responsibilities in that regard head on.

Through five key measures, the recovery plan has therefore committed €1.2 billion to support and accompany the agricultural transition:
- Accelerating the agro-ecological transition: the recovery plan will support the environmental and societal performance of agriculture, while promoting local industries and the development of local food chains (€400 million over 2021 and 2022);
- Modernisation, health safety and animal welfare: the goal is to support livestock farming while avoiding health and environmental risks, through support for the entire sector, from farms to slaughterhouses (€250 million in 2021 and 2022);

- The national strategy on plant proteins: the recovery plan provides for investment to support the development of a plant protein industry in France, which will both contribute to France's food sovereignty and limit its need for raw materials produced in other countries and whose transport emits greenhouse gases (€100 million over 2021 and 2022);
- Renewal and development of agricultural equipment: the modernisation of farmers' equipment will be supported by the recovery plan, in order to improve its environmental performance (€250 million over 2021 and 2022);
- Support for the adaptation of the forestry sector: the forestry sector offsets about 20% of French CO_2 emissions and therefore plays a major role in climate change mitigation. The role of this sector could nevertheless be increased to meet the current challenges. In addition, forests are strongly affected by global warming. The recovery plan therefore aims to encourage investment to strengthen, improve and adapt it to climate change while continuing its development (€200 million over 2021 – 2022).

• Biodiversity and the fight against artificialisation

In order to contribute to the preservation of biodiversity and to the protection of territories, particularly those already in distress, the recovery plan outlines five measures relating to these issues, for a total of €1.25 billion:
- Biodiversity in the territories, risk prevention and strengthening resilience: The aim is to support and strengthen the structuring of economic sectors contributing to the local economy and the preservation of different ecosystems, particularly through ecological restoration operations or the development of adapted infrastructures, or through investments promoting the resilience of ecological and coastal areas (€250 million over 2021 and 2022, including €135 million for ecological restoration, €60 million for protected areas, €40 million for coastal protection and €15 million for strengthening dams);
- The development of a fund for recycling brownfield sites and artificial land: a €300 million fund will be deployed to finance operations to recycle urban and industrial brownfields, as well as to support the revitalisation of town centres and the relocation of activities (€300 million over 2021 and 2022);
- Aid for densification: aid will be granted to support municipalities in their public space densification projects (€350 million over 2021 and 2022);

- Seismic risk prevention in the West Indies: the recovery plan will help finance the seismic reinforcement of the most sensitive buildings in the West Indies, while also taking into account the increasing frequency of climatic events (€50 million, work to be started in 2021);
- Securing drinking water, sanitation and rainwater management infrastructures: the modernisation of drinking water networks, sanitation networks and wastewater treatment plants will be financed in order to strengthen local infrastructures (€300 million over 2021-2023).

• Circular economy and short circuits

By contributing to the development of the circular economy and short circuits, the recovery plan intends to promote limiting the use of resources and raw materials (linked for example to transport and production) as well as the reduction of greenhouse gas emissions arising from these activities.

This objective is supported by two key measures, for a total of €500 million:

- Investment in re-use and recycling: this involves in particular investing in activities and channels that enable local re-use, the reduction of plastic use and/or its recycling (additional €226 million from ADEME's "Circular Economy" fund over 2020, 2021 and 2022);
- Modernisation of sorting, recycling and waste recovery centres: the recovery plan will support the sorting and recycling sector, as well as waste recovery models and infrastructures (additional €274 million from ADEME's "Circular Economy" fund in 2020, 2021 and 2022).

• Conclusion

The French recovery programme is dedicating a large proportion of its investments to its climate objectives. A precise evaluation of these different measures and their contribution to the stated objective has yet to be carried out. The multiplication of measures also contributes to a fragmentation of investments, which may limit their effectiveness, at a time when significant amounts must be rapidly mobilised to support and accelerate the French energy transition. However, some measures could have a significant ripple effect on the private sector, leading to the sourcing of further investment to supplement the authorities' efforts. Finally, the link between the recovery programme and broader strategies (such as the hydrogen strategy) makes it possible to situate these issues within a timeframe wider than that of the recovery alone (2020-2022), and to support a longer-term roadmap.

But as with the German plan, the overall plan remains difficult to discern. It is true that the fight against climate change requires influencing many levers simultaneously, and combining a myriad of sectoral policies with carbon pricing instruments (tax and ETS). That said, policies such as those instituted in the "Climate and Resilience" law should be evaluated in greater detail, by measuring a cost per tCO_2 avoided wherever possible. This would allow for a better calibration of budgetary envelopes, leading to a better societal and environmental impact. This work still has to be done.

c) Poland

• Introduction, reminder of objectives

The Polish draft recovery and resilience plan was published on 26 February and is currently undergoing public consultation[55] Climate policy is one of the priorities of the plan, along with economic recovery, territorial cohesion and social inclusion. Elements related to climate and energy policy, such as reducing the energy intensity of production or reducing dependence on fossil fuels, are recognised as structural challenges for long-term development. The strategy acknowledges the negative effect on public health of air pollution from fossil fuels. Due to the Covid-19 pandemic in 2020, Poland had one of the highest levels of excess mortality in Europe; according to the paper, this may in part have been caused by an increased vulnerability to respiratory diseases due to air pollution.

55 Krajowy Plan Odbudowy i Zwiększania Odporności.

The Polish Recovery Plan refers to several other strategic documents developed by the country in recent years. Concerning the energy sector and climate policy as a whole, the most ambitious project is the "Polish Energy Policy 2040 (PEP2040)",[56] which proposes the strategy for partial decarbonisation of the energy sector which was adopted by the government at the beginning of February 2021. Among other things, the document contains, plans to build 6-9 GW of nuclear power capacity by 2040, as well as offshore wind power capacity of 11 GW. However, some of the assumptions of PEP2040 are already outdated. The strategy's main EUA price growth scenario does not take into account the higher EU emission reduction target (55%) adopted in December last year. It is also likely that the strategy underestimates the growth rate of solar energy, predicting only 5-7 GW of capacity in 2030, when in fact solar capacity has already reached 4 GW and continues to grow rapidly.[57]

In its current form, the draft plan only covers the subsidies section of the NGEU, which amounts to €23.85 billion. It is not yet clear whether loans will be included in the final version of the document. According to the RRF regulation, investments in the transition to a green economy must constitute at least 37% of the recovery and resilience plan expenditure. The Polish recovery plan classifies 37.7% of expenditure as contributing to this objective, but it now seems unlikely that this will hold up to scrutiny by the European Commission. For example, the €164 million that the Polish government intends to use to support unmanned air mobility has been classified as contributing 100% to climate objectives. In other areas, such as investments in hydrogen or intermodal mobility, the description of planned investments and reforms does not provide sufficient information to determine whether or not they will contribute to climate objectives. According to an assessment by E3G and Wise-Europa, only 18% of the expenditure described in the plan is likely to contribute to the climate objectives.

56 Polityka Energetyczna Polski do 2040 r.
57 Transformacja energetyczna w Polsce, edycja 2021, M. Jędra, Forum Energii.

While the EU's climate neutrality objective is mentioned as one of the Recovery Plan's general objectives, it is rarely mentioned in the specific provisions – in fact, only two areas explicitly refer to it: support for hydrogen, and the 'greening' of small and medium-sized cities. References to planned emission reductions are also absent in the milestones and targets, making it impossible to assess the real impact of planned investments and reforms on GHG emissions.

• Thermal renovation of buildings

Thermal renovation is a major component of the investments foreseen in the recovery and resilience plan. The Polish government intends to spend more than €3.2 billion improving the energy efficiency of residential buildings, and installing new, more efficient heating systems. In addition, €194 million will be spent on the thermal renovation of schools, and €67 million will be used to improve the energy efficiency of libraries and cultural centres. Concerning thermal renovation, a small portion of the funds have also been allocated to the greening of small and medium-sized cities, but this is included with several other objectives, such as cycling and pedestrian infrastructure, and parks, suggesting that the €460 million devoted to this area may not have a significant impact.

While the planned investment in the thermal renovation of buildings is significant, the potential emission reduction is impossible to assess at this stage. The recovery plan does not mention the depth of thermal renovation and does not contain qualitative targets in this respect.

• Decarbonisation of industry

Investments in the decarbonisation of industry are spread across different parts of the recovery and resilience plan. Among investments destined to encourage innovation, green technologies are mentioned, but are not the main objective of these axes. For example, the plan intends to invest €450 million in subsidies in innovative digital solutions for large companies. These solutions include those that aim to reduce both the consumption of natural resources and greenhouse gas emissions. However, this part was not qualified by the authors as contributing to climate objectives, which may suggest that only a

small portion of these funds will support green investments. A smaller sum, €162 million, will be devoted to promoting environmental technologies and innovations, including the circular economy. This section is only partially dedicated to climate objectives.

Two sections of the plan are designed to create new industries to support Poland's ecological transition. In the framework of the Polish initiative to support offshore energy production, €437 million will be spent on the production and maintenance of offshore wind farms, as part of the Polish offshore initiative. An even larger sum (€1.16 billion) will support industrial solutions for zero emission mobility. The range of possible projects is wide, from biofuel infrastructure to solar panels. Once again, the criteria for fund allocation are unclear, and it is impossible to predict the impact on emission reductions.

• Bonus for the purchase of zero emission public vehicles

The only green asset mentioned in the plan is zero-emission public transport. More than €1 billion will be used to support the purchase of zero-emission buses for municipalities, as well as to create appropriate infrastructure (e.g. charging points). However, there is no provision to support the purchase of individual electric vehicles, nor are there any measures to promote sustainable consumption in other areas. €398 million will be used to modernise rolling stock, but these investments are not classified as contributing to the climate target; it remains unclear, for example, whether these funds will be used for electric or zero-emission locomotives.

• Transformation of the agricultural sector

The agricultural sector is under-represented in the recovery and resilience plan, particularly as to investments in the sector's environmental transition. The government intends to spend €500 million to shorten supply chains in the food sector by building and improving distribution centres, investing in the circular economy and upgrading equipment. However, this sector has not been classified as contributing to climate objectives. The recovery plan also includes support for animal feed production, which could be contrary to the "Do No Significant Harm" rule. Support to the tune of €97 million for research and development in the food sector is also foreseen, but again this part has not been classified as contributing to climate objectives. It is therefore unlikely that priority will be given to identifying green solutions for agriculture.

• Hydrogen

Support for the development of hydrogen technologies has been increased to €797 million in the recovery and resilience plan. The money will fund projects at all stages of the hydrogen value chain, from production, infrastructure and distribution to use in transport, industry and power generation. The plan does not specify what type of hydrogen will be used, i.e. whether it will be produced from renewable energy sources (green hydrogen) or from fossil fuels (brown, grey or blue hydrogen). Despite an absence of specific technological details, the plan classifies hydrogen investments as contributing 100% to climate targets – something which could be challenged by the European Commission during its review.

• Modalities of action

In areas related to climate policy, the recovery and resilience plan uses incentives exclusively, both financial (subsidies) and regulatory (better regulation, administrative support). Targets and milestones do not provide a framework to verify actual emission reductions or energy efficiency gains achieved through investment. Instead, the document uses simple and straightforward measures that do not create an additional workload for beneficiaries. For example, the milestones for thermal retrofitting of residential buildings include the total number of buildings retrofitted, but not the efficiency gains, emission reductions, or local air quality improvements. Another popular measure is the adoption of a specific piece of legislation or a strategic document, for example the hydrogen strategy.

• Conclusion

Poland's recovery and resilience plan, in its draft version, misses the mark when it comes to supporting the environmental transition.[58] Without significant

58 Green Recovery Tracker Analysis: Poland, Z. Wetman´ska, F. Hellman (2021), E3G.

revisions, it is unlikely to be accepted by the European Commission, as the climate credentials of much of the funding listed as 'contributing to climate objectives' are unverifiable. In addition, many investments do not comply with the "Do No Significant Harm" rule, such as, for example investments in animal feed, road infrastructure or even hydrogen. At the same time, some areas of the plan could have a positive impact on emission reduction targets if particular measures regarding climate conditionality were included. For example, the plan provides support (€200 million) for much-needed urban and regional planning reform. With certain provisions concerning the prevention of urban sprawl, the promotion of public transport or the improvement of biodiversity, this part of the plan could easily be considered "green". Funds for innovation and research and development could also be directed towards zero-emission technologies. Many of the shortcomings of the proposed plan are due to the underlying strategic documents, such as the Polish Energy Policy 2040. Meeting the EU's 2030 climate targets will be a challenge for Poland, and the Recovery and Resilience Plan, in its current form, will not make that task much easier.

d) Summary

While the national recovery plans highlight the differences between the three Member States, both in terms of their current state of affairs and energy transition goals, they also highlight common challenges and shared trajectories that could greatly contribute to the acceleration of the European energy transition. This is particularly the case in the two main areas of the development of hydrogen technology and the decarbonisation of the transport sector. While these two objectives are widely shared, the commitments of the different governments underline different ambitions. For example, while Poland currently seems to be focusing on a limited part of the car fleet, Germany and France have adopted a broader and more ambitious vision, which is not only to green the fleet but also to strongly support the rail sector. Similarly, all three states have decided to support the development of hydrogen technology, sometimes as part of a wider hydrogen strategy, with longer-term investments (this is particularly the case in Germany and France). However, these strategies remain

national in scope and could lead to duplication of investments, divergence of future industrial standards, or the underdevelopment of European synergies in this sector.

While the national recovery programmes highlight the ambitions of the different Member States and the convergences which exist, they also demonstrate that complementary actions remain necessary to properly accelerate the European energy transition, particularly in key areas such as transport. There remains a considerable effort to be made to evaluate the socio-economic and environmental costs and benefits of this proliferation of climate actions; this is probably best done at the European level, as recommended earlier in this report.

3 Accelerate the decarbonisation through targeted investments in transport sector

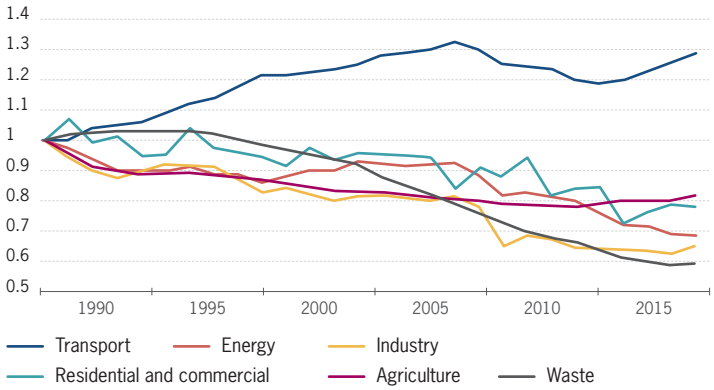
In order to propose pan-European projects consistent with the recovery plans and which would contribute to the green transition, we have focused on complementary measures that would promote the decarbonisation of the transport sector: transport accounts for a quarter of current European greenhouse gas emissions. It is also the only sector whose emissions have increased (by about 30%) since 1990. We therefore believe it urgent to accelerate the European coordination of transport policies, and to take advantage of the money available through the RRF to make large-scale investments in this area.

a) What is the current situation?

Road transport accounts for almost three quarters of transport sector emissions. Aviation accounts for 13% of these emissions, with a strong growth trajectory (pre-crisis). Finally, rail transport accounts for only 0.5% of emissions.

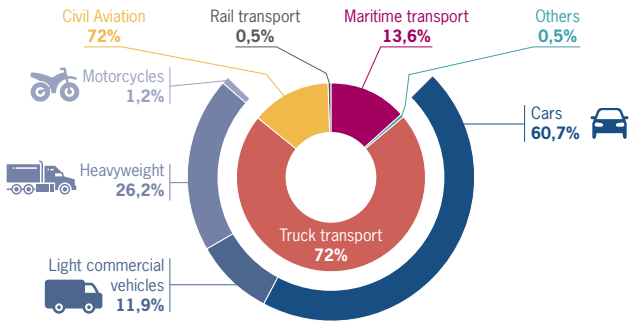
GHG emission trends by sector in the EU since 1990

(base 100 = 1990)



Source: European Environment Agency, 2019.

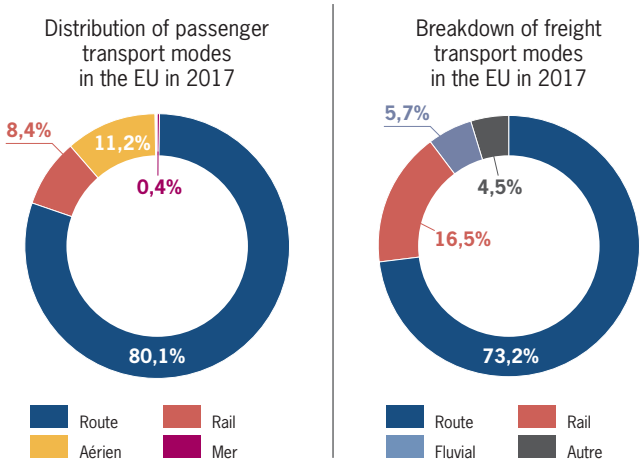
Distribution of transport emissions in the EU in 2016



Source: European Environment Agency.

The modal share of rail (the proportion of trips in passenger-km made or goods in ton-km transported by rail compared to other modes of transport) is very low and even declining for freight. From 13.6% in 1995, it was only 11.3% in 2017. For passenger transport, the modal share of rail has remained stable since 1995 at around 8%. Overall, the most notable development is the rise of air, which has seen its modal share double since 1995.

Distribution of rail transport modes by use in 2017

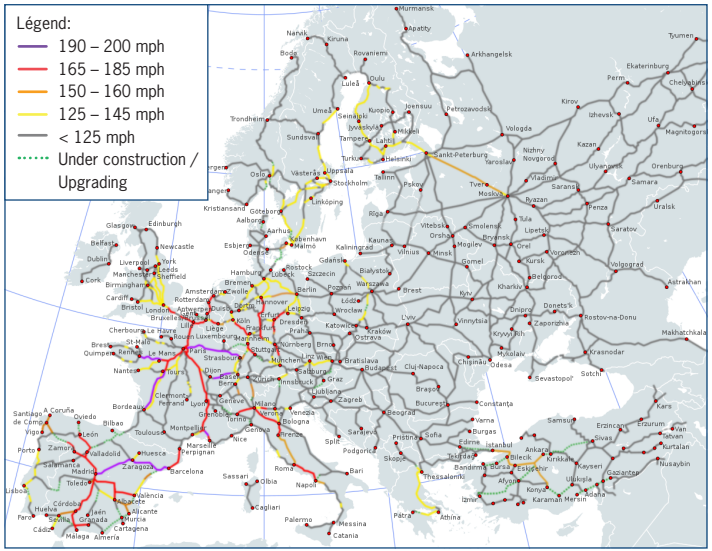


Note: these figures contain only intra-EU transport and therefore exclude aviation and maritime transport with non-EU states.

Source: Statistical pocketbook 2019: EU transport in figures, Eurostat.

We note that the density and quality of the high-speed network is extremely variable within Europe. Lines capable of travelling at more than 250 km/h are mainly concentrated in Western Europe (France, Italy, Spain), while in the East networks rarely allow for speeds above 200 km/h. While it takes 3 hours and 50 minutes to travel from Paris to Frankfurt by train, it takes 5 hours and 50 minutes to travel the same distance from Berlin to Warsaw.

High-speed train lines in Europe in 2019

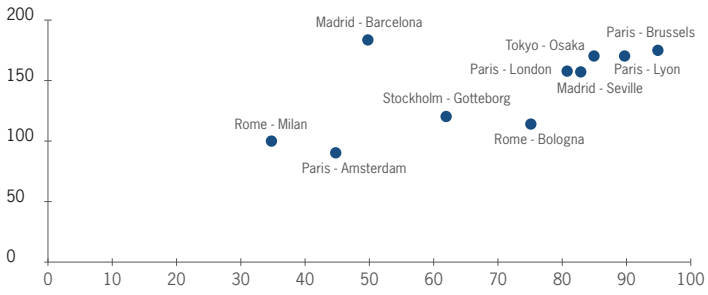


Source: TEN-T, UIC, Railways.

Low-cost aviation has democratised the use of aircraft, even for short distances. Air travel benefits from a favourable tax system that does not take its negative externalities into account, making it in many cases cheaper than its train equivalent. This is the case for trips within the same country and for trips between relatively close European cities that could be reached in less than four hours by train (e.g. Berlin-Warsaw). For such trips, the central location of train stations within cities, as well as the lack of waiting time before boarding, can make train travel competitive. Where the train option is competitive, the closure of short air routes which there are no longer attractive could be envisaged, as France has done on routes where a fast train alternative exists. A positive correlation between train market share and train speed can be seen here (Figures on page 115).

Modal share of rail versus air as a function of average speed

(2008)



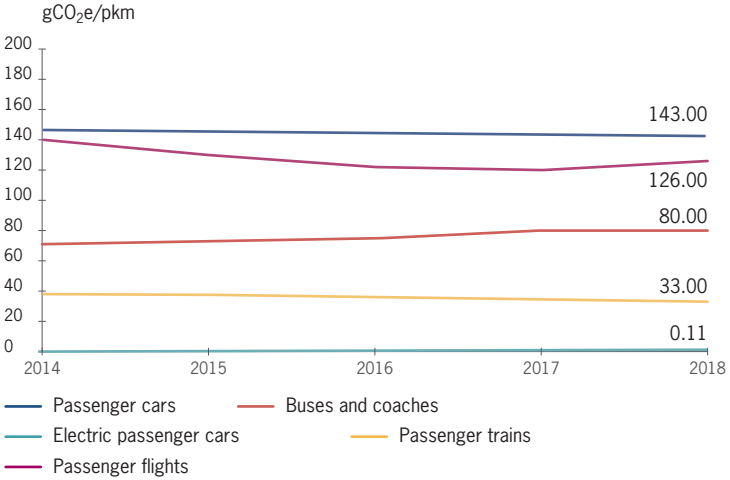
Source: The economic effects of high-speed rail investment, Ginés de Rus, OECD/ITF Joint Transport Research Centre Discussion Paper, No. 2008-16.

b) What solutions to decarbonize European transport?

A cost-benefit analysis of transport options must be developed on a case-by-case basis, region by region, to determine the best solutions within the European Union.

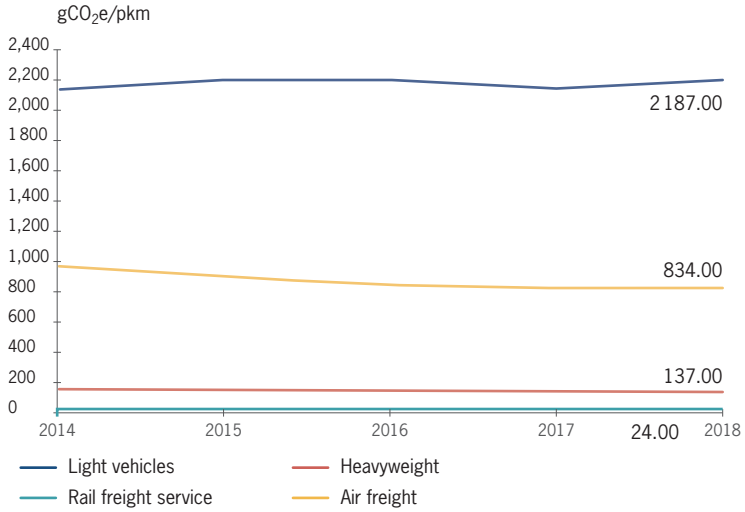
Average greenhouse gas (GHG) emissions from European transport

Average GHG emissions by motorized passenger transport mode, EU-27, 2014-2018
(well-to-wheel emissions)



Note: all values presented here are "well to wheel". This means that emissions from the production and distribution of fuels and those from their use are counted. A complete analysis, ie over the entire life cycle is hampered by a lack of data at European level.

Average GHG emissions by motorized mode of freight transport, EU-27, 2014-2018
(well-to-wheel cycle)



Note: all values presented here are "well to wheel". This means that emissions from the production and distribution of fuels and those from their use are counted. A complete analysis, ie over the entire life cycle is hampered by a lack of data at European level.

Source: Fraunhofer ISI and CE Delft 2020; European Environment Agency 2021, Rail and waterborne best for low-carbon motorised transport (March 2021).

A recent study by the European Environment Agency shows that, on average, trains are the least carbon-intensive means of transport in Europe, for both freight and passenger transport. However, these average values actually conceal fairly large geographical disparities for rail transport, as well as for the

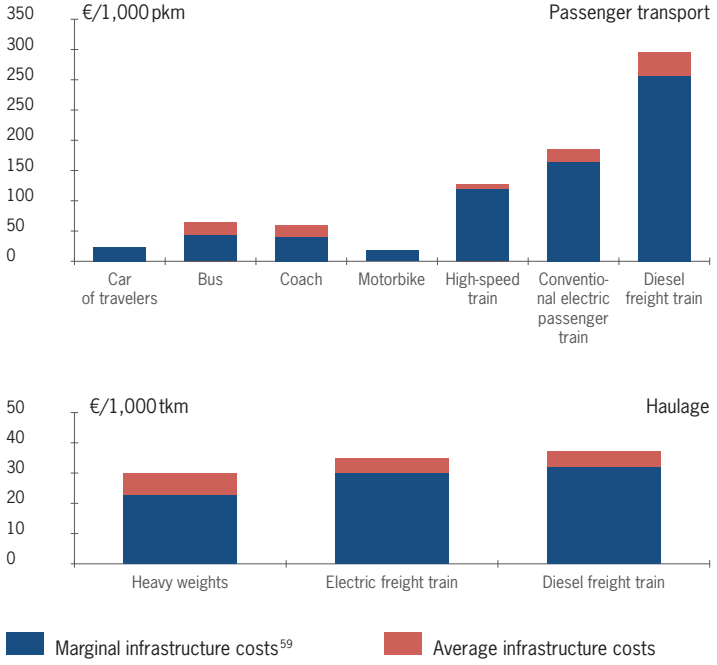
use of electric vehicles and all other electric applications that are powered by national electricity grids. Indeed, the carbon intensities of national electricity grids vary by a factor of one hundred within the European Union and reflect a very high degree of heterogeneity in the European electricity mix: in 2018, this carbon intensity was 8.8 gCO_2/kWh in Sweden and 873 gCO_2/kWh in Estonia. Thus, the potential for reducing CO_2 emissions from the electrification of transport (rail, electric vehicles) depends strongly on the carbon intensity of the electricity used. While the carbon emission reduction of such electrification seems obvious for low carbon intensities, it appears that the reduction potential enters a grey area for carbon intensities above 500 gCO_2/kWh.

In addition, the costs of infrastructure construction and maintenance strongly influence the attractiveness of the different transport solutions. Infrastructure investments for road, rail and waterway transport in the EU28 amounted to €267 billion for the year 2016. The study shows that the average cost per passenger/kilometer for passenger transport and the average cost per ton/kilometer for freight transport are very heterogeneous between the different modes of transport.

Costs are higher for rail than for road transport. This is partly due to the high fixed costs (e.g. construction costs) of rail infrastructure compared to road infrastructure, as well as the high impact of train occupancy, especially for diesel trains.

Divergences also appear within road transport. Average infrastructure costs are higher for buses and coaches, which can be explained by the relatively large share of variable (weight-dependent) infrastructure costs. For aviation, no EU28 average infrastructure costs are estimated in this study at the European level. However, evaluations of 33 selected airports show that infrastructure costs range from €3 to €41 per 1,000 passenger kilometers (with an average (unweighted) value for the selected airports of about €18 per 1,000 passenger kilometers); thus, the same order of magnitude as for road passenger transport.

Average costs of transport infrastructure invested in Europe in 2016



Source: European Commission, Overview of transport infrastructure expenditures and cost (2019).

On the basis of these results, the cost-benefit advantage of rail transport modes, especially with regard to the price per ton of CO_2 avoided, does not seem so obvious. The train shows the highest transport infrastructure costs,

59 *Green Recovery Tracker Analysis: Poland*, Z. Wetmańska, F. Hellman (2021), E3G.

and therefore questions the cost-benefit advantage of this mode of transport compared to other decarbonation solutions, in particular decarbonated road transport (electric or hydrogen vehicles). Case-by-case analyses, according to local needs and configurations, must be scrupulously developed, and not systematically oriented towards one or another of the transport solutions established on too general criteria. In this respect, the European Energy Transition Agency could develop detailed analyses of the transport decarbonization solutions best suited to local conditions.

The development of high-speed rail and night trains

The development of high-speed rail within the European Union is an interesting prospect for the Member States in the dual perspective of recovery and green transition; however, it should be accompanied by a detailed cost-benefit analysis on a case-by-case basis, in particular to identify the solutions that promote the lowest cost of reducing CO_2 emissions. The RIF's resources allow it to consider the development of several large-scale projects in the short term.

For example, the OFCE and the Vienna Institute for International Economic Studies have suggested a project for a network of ultra-fast trains linking all the major European cities as a way of reviving the economy. The German government also proposed in September 2020 to relaunch a Trans Europ Express 2.0 rail network that would connect major European cities, thus giving a boost to the railways during its presidency of the European Union.

In addition, the night train could be given a new lease of life in Europe if its competitiveness and service quality are improved.

Map of night trains in Europe, 2020

Source: Licenced by Eric Rosén under the Creative Commons Attribution-ShareAlike 4.0 International (CC BY-SA 4.0).

If high-speed rail were to become widespread in the European Union, it would seem appropriate to develop night trains for longer journeys between European countries, following the example of the Brussels-Vienna line which was

relaunched at the beginning of 2020. Moreover, the option of night trains could be appropriate for regions not accessible by high-speed trains. A new start for night trains over longer distances would require significant investment and interoperability between the rail networks of the Member States, which must be achieved by systematising standards at the European level.

Electrification of train lines

Another prospect for green investment in transportation is the **electrification of medium-sized train lines that still run on diesel.**

While 80% of train journeys are made on electrified track, only 54% of European tracks are electrified. This ratio is even lower than 40% in some Member States, such as the Czech Republic, Hungary and Romania.[60] In the European Union, massive electrification of the network could reduce emissions from the rail sector by up to 40%,[61] provided a sufficiently decarbonised electricity mix is used.

Priority should be given to the electrification of diesel rail lines with sufficient traffic density to justify the expense. This seems particularly applicable to several Eastern European lines. Where electrification is not economically justified, as on some small lines in Member States whose most heavily used lines have already been electrified, diesel trains could be replaced by trains using less carbon-intensive technologies such as hydrogen.

Finally, in the same spirit of accelerating the decarbonisation of transport, European recovery funds could be used to finance the **development of rail freight and low-carbon lorries** (recharging infrastructure for electric, biogas or hydrogen lorries, for example).

Rail freight will not be developed unless its competitiveness and the quality (or reliability) of its service are improved. In order to remove those obstacles

60 Rail transport and environment: Facts and figures, CER et UIC (2015).
61 EU transport GHG: routes to 2050? – Technical options to reduce GHG for non-road transport modes, Tom Hazeldine et al. (2009).

slowing the development of rail freight, it seems necessary that a genuine preparatory coordination effort be made at the European level. In the framework of their national recovery plans, Member States could jointly set realistic targets for the development of rail freight activity in Europe.

The decarbonisation of transport must ultimately involve reducing the carbon intensity of heavy goods vehicles, through the use of low-carbon technologies at the lowest possible cost according to the cost-benefit assessments discussed above (electric, hydrogen or bio-GNV-based lorries). Adequate charging infrastructure will need to be developed and implemented. Given the huge size of the investments needed, the European recovery plan funds could provide an important impetus. Consideration could also be given to introducing a time-limited direct purchase subsidy for electric-battery or hydrogen-powered trucks, as the German Ministry of Transport has done, and as proposed by Transport & Environment.[62]

In parallel with investments in low-carbon technologies, the EU will need to put in place the right regulatory framework to enable businesses and citizens to take part in the energy transition. In line with the 2030 climate targets, emission standards for cars will have to be revised to -55%, determined in something closer to real-world conditions, and the advantages given to heavy vehicles must be removed, so that only a single CO_2 emission standard will remain in place. Ambitious action will also be needed in the updating of heavy goods vehicle standards and in the reform of the Eurovignette. In order to encourage citizens to choose low-carbon technologies, work will have to be done on the role of advertisements of the most polluting technologies, which could be regulated.

62 Financing electric trucks and charging infrastructures, Transport & Environment (2020).

4. Promote coordinated development and cross-border projects in the hydrogen sector

The development of hydrogen technology holds great promise for the green transition, which in fact Member States such as Germany and France have given a central place in their recovery plans. In order to facilitate the emergence of a European sector of excellence, however, it is essential that national recovery plans be coordinated at the European level, and that cross-border initiatives be promoted. The aim should be to avoid a multiplication of redundant initiatives that would hinder the proper allocation of capital while slowing down the development of the sector.

Enormous decarbonisation potential

Let us start by briefly explaining the potential of hydrogen. It could play a key role in the decarbonisation of many sectors, which account for almost two-thirds of anthropogenic greenhouse gas emissions. While significant progress has been made in reducing the emissions intensity of the power generation sector, hydrogen solutions appear to be particularly well suited to sectors that are more difficult to decarbonise, such as certain means of transport and heavy industries like steel, chemicals and refining. In the longer term, hydrogen could also make it possible to develop synthetic fuels, which would be particularly useful for decarbonising the aviation sector, for which no satisfactory solution has yet been found. While many hydrogen-based solutions already exist in laboratories or in pilot projects, the main challenge in the perspective of constituting a real sector for the green transition is to develop competitive, large-scale solutions, while guaranteeing a minimal carbon footprint.

A strong European commitment to renewable and low-carbon hydrogen

Recent European announcements aim to place hydrogen at the heart of the upcoming energy transition. Germany is budgeting €7 billion to support this industry and is targeting 5 GW of installed capacity to produce hydrogen from renewables by 2030. France is preparing a similar plan of €7.2 billion to be deployed by 2030. The European Union has set a target of 6 GW by 2024 and 40 GW by 2030. The installed electrolysis capacities should therefore be multiplied by 40 (from 1 GW to 40 GW) and thus make it possible, by 2030, to produce 10 million tonnes of renewable hydrogen per year, i.e. about 10% of the current world production of hydrogen (118 Mt in 2018, for the most part produced from hydrocarbons and whose emissions amounted to 830 Mt CO_2, i.e. more than 2% of world emissions). Member States have therefore collectively agreed to massively support the production of renewable (green) and low-carbon (blue) hydrogen, i.e. from the electrolysis of water fuelled by green electricity or produced from hydrocarbons combined with technologies to capture and store the emitted CO_2.

In addition, a *European Clean Hydrogen Alliance* was established in July 2020 to strengthen global leadership in this domain and support the EU's commitment to achieve carbon neutrality by 2050. The Alliance aims at an "ambitious deployment of hydrogen technologies by 2030, bringing together renewable and low-carbon hydrogen production." Participation in the Alliance is open to the private and public sectors, i.e. industry, national and local public authorities, civil society and other stakeholders. It will contribute to the elaboration of the investment plan, in particular for the development of the European hydrogen infrastructure ("The alliance will support the increased production and demand of renewable and low-carbon hydrogen, coordinate actions and provide a forum for civil society"). Another important aspect is the special status given to European hydrogen projects – Important Projects of Common European Interest (IPCEI) – which means that governments will be able to support them with specific state aid provisions.

A necessary cost/benefit assessment integrating the environmental impact of projects

While the combustion of hydrogen does not emit CO_2, its production must meet strict criteria that must be monitored to ensure that the projects envisaged are truly carbon neutral, and are both technically and economically relevant. In this

respect, we believe that only an independent entity could credibly represent the interests of all stakeholders. This task could be entrusted to the European Energy Transition Agency.

We therefore recommend a rigorous and continuous assessment of the actual carbon content of the hydrogen solutions being developed.

Arbitrating hydrogen solutions with alternative solutions

Bioenergy, electric batteries powered by renewable electricity, or CO_2 capture and storage solutions may in some cases be alternatives to hydrogen, and may be potentially more competitive, having a more favourable energy balance and a lower carbon footprint. For example, short-term electricity storage with batteries is much more energy efficient and less expensive than hydrogen production and storage solutions. However, the cost of green hydrogen is still three to ten times higher than that of brown hydrogen, while the cost of blue hydrogen is on average twice that of brown hydrogen. The potential for reducing this cost differential should be considered in the economic analysis of investments proposed. The constitution of the green hydrogen price also illustrates the complexity of this analysis. Indeed, the cost of electricity constitutes about 60% of the cost of a kilogram of hydrogen, and inflation of the latter would have a severely penalizing effect on this sector. The sustainability of the green hydrogen sector, therefore, depends on the control or anticipation of the evolution of electricity costs.

Coordinating the expansion of the European hydrogen industry

In order to facilitate the emergence of a European industry of excellence, collaboration between Member States and the coordination of support programmes is crucial. The aim must be to avoid the multiplication of redundant initiatives by coordinating not only R&D efforts towards non-mature solutions, but also projects aimed at industrialising technologically mature solutions. In this respect, the European Commission has a key role to play in its assessment of national recovery plans ("recovery and resilience plans"). These must reflect **a coherent overall logic based on the comparative advantages of each Member State.**

We also propose the creation of a **European mechanism for monitoring hydrogen supply and demand.** The successful development of the hydrogen economy depends on the balance between the evolution of supply and demand, bearing in mind that none of the required infrastructures are yet developed, and that no significant, specific demand currently exists for renewable or low-carbon hydrogen. Managing this supply-demand balance requires the monitoring and anticipation of production and consumption, as well as the coordinated development of the infrastructure necessary for the physical flow and storage of hydrogen production.

Further efforts are needed to enable the commercial transport and storage of hydrogen, in order to reduce costs and to ensure safety at all stages of the process. Forward-looking policies should therefore cover the entire supply chain. This would also help to solve issues of competitiveness, as reducing the cost of all items along the supply chain would avoid distortions in competition.

Coordinating an integrated policy response through a European hydrogen plan

Mastering the development of hydrogen inevitably involves centralising relevant information and carrying out prospective studies on the evolution of markets and infrastructures. This role could naturally fall to the European Energy Transition Agency, whose objective must be to enable the rapid development of hydrogen infrastructures, in line with its ecosystem of applications and end users.

Member States could also **agree on a European "pricing" of hydrogen that incorporates its carbon content.** The European Union will have to put in place incentive mechanisms for the production and use of green and blue (rather than brown) hydrogen. This policy would involve the introduction of a specific pricing or emissions credit system to compensate for the additional

economic cost of solutions that generate a carbon benefit. Its methodologies should reflect both direct emissions (Scope 1, e.g. CO_2 emissions from reforming) and indirect emissions from the energy sector (Scope 2, e.g. CO_2 emissions from electricity generation based on electrolysis). Several options could be considered, such as:

- Feed-in tariffs for green hydrogen (i.e. price premiums for green hydrogen similar to the feed-in tariffs for renewable energy);
- Government subsidies covering the price difference between conventional fuels and green/blue hydrogen; or
- Tax allowances for types of hydrogen whose emissions remain below a certain level (e.g. 2 kg $CO_2$2/kgH2); or
- Carbon credits (linked to the ETS market price).

All of these options will require a commitment from governments not to change regulations at a later stage, in order to ensure investor confidence.

Given the many technological innovations being developed around hydrogen, it is likely that this sector will benefit from many technological and industrial advances over the next few years. These will reduce production costs and improve the energy efficiency of solutions. **It is therefore essential that the European Union actively support not only research projects, but also investment in pilot projects and industrialisation phases** to maintain its technological advantage and the competitiveness of its solutions in the emerging international market.

CONCLUSION

BY CHRISTIAN GOLLIER

If nothing is done, climate change will probably sweep away our civilisation within the next two centuries. This collapse and its immeasurable consequences must be prevented. The sacrifices to be made to achieve this are significant, but far less than the consequences of inaction. It is still necessary to identify the best actions to be taken and the economic and financial mechanisms to set them in motion very quickly.

The energy transition will have impacts on most aspects of our lives, from our consumption patterns to our means of travel to our holiday destinations. As renewable energies are still much more expensive to produce than Saudi oil and Russian gas, it will also have a negative impact on our purchasing power, at least in the short term. It is therefore crucial to put in place policies that allow us to achieve our climate objectives and that are the least detrimental to the purchasing power of our fellow citizens. Carbon pricing is essential to achieve this, either directly through taxation, or by evaluating each climate action by comparing the value of the carbon avoided with the economic and social cost of that action.

Such carbon pricing already exists in Europe through the EU ETS. But this market has until recently been dysfunctional, resulting in a carbon price that is far too low for the climate damage caused. In addition, the very high volatility of the carbon price in this market does not provide the economic environment and long-term visibility necessary to reassure green entrepreneurs, thereby delaying the necessary private investments. In this report, we support recommendations to replace the current quantity-only target with a mixed target that includes a credible long-term carbon price target, either through a price floor mechanism or the creation of an independent central bank for carbon. A significant increase in the price of carbon, consistent with

the Union's ambitious climate objectives, will have adverse consequences in terms of social inequalities, but the existence of tax revenues and an ambitious redistributive policy will make it possible to counteract these effects, while compensating those hardest hit by the transition, notably in the coal regions.

A price signal will not be enough, not least because there currently exists no social and political acceptance of a carbon price which would be compatible with European ambitions in this area. This will also require states to engage in targeted emission reduction policies supported by favourable cost-benefit assessments. This report offers a number of examples of such social value-creating policies, notably in the transport and energy sectors. Citizens should occupy a central place in all of these discussions. Through their consumption choices, they will participate in the transition. It is therefore crucial that they are well informed about the carbon content of each product and service. The report also makes a number of recommendations in this key area.

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THERE IS NO DESIRE MORE NATURAL THAN THE DESIRE FOR KNOWLEDGE

Europe's Energy Transition: A Common Challenge

While the European Union has been announcing a major plan to support the Green Deal energy transition, Institut Montaigne wanted to make a contribution to this major debate for the future of our society. The approach this work was deliberately European, focusing in particular on France, Germany and Poland, underlining the heterogeneity of situations within the European Union. This report, which is the result of numerous exchanges with different interlocutors (academia, politics, industry, civil society), examines the means and tools implemented to achieve the carbon neutrality objective that the 27 European States wish to attain by 2050. The reduction of European CO_2 emissions must accelerate significantly to reach the ambitious targets that Europe has set for itself, implying a radical transformation of energy production, transformation and consumption systems as well as an almost total eradication of the use of hydrocarbons in Europe. And this within the next 30 years. This decarbonization strategy also implies a profound transformation of skills and behaviors, as well as the development of numerous technological innovations, in order to decarbonize those sectors for which there are no solutions yet.

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