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Securing our future

Europe's 2040 climate target and path to climate neutrality by 2050 building a sustainable, just and prosperous society

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1 Contents

1 Contents 1
1 A Vision beyond 2030 2
2 Ambitious global climate action 4
3 The 2040 target and a pathway to climate neutrality 6
3.1 The target 6
3.2 Cost of inaction 8
4 Delivering the 2040 target 10
4.1 Implementing the 2030 policy framework 10
4.2 An economy that delivers for people 10
4.3 The EU's energy system 11
4.4 Industry decarbonisation deal 14
4.5 Decarbonising transport and improving mobility 19
4.6 Land, food and bioeconomy 20
4.7 Investing in our future 23
5 Conclusion and next steps 26
8 building blocks for achieving the 2040 target 27

1 A Vision beyond 2030

Climate change is intensifying and its real-life costs accelerating. A historically high acceleration in climate disruption in 2023, saw global warming reaching 1.48°C above pre-industrial level for the first time, and ocean temperatures and Antarctic Ocean ice loss breaking records by a wide margin. It is clearer than ever that achieving a stable climate and safeguarding a liveable planet for current and future generations means cutting global greenhouse gas (GHG) emissions sharply and rapidly and preparing for future impacts of climate change([1]). This pathway can and must go hand in hand with shaping a prosperous and fair society, and EU industry and agricultural sector that are agile and strong in a globally competitive and increasingly sustainable economy that delivers for all the people and in line with the 20 principles of the European Pillar of Social Rights and its Action Plan.

The outcome of COP28 in Dubai and the first global stocktake of climate action shows that the rest of the world is rapidly moving onto this pathway as well. The EU, having written climate neutrality by 2050 into law, has been leading in climate action, and will stay the course.

The vision of Europe at the end of the next decade is a comprehensive one: it should remain a prime destination for investment opportunities that bring stable, future-proof quality jobs, with a strong industrial ecosystem. Europe should lead in developing the clean technology markets of the future, where all major countries and businesses seek to avail themselves of the market opportunities. Becoming a continent with clean, low-carbon, affordable energy and sustainable food and materials, will make it resilient against future crises, such as those currently caused by disruptions in the supply of fossil fuels. By remaining a global leader and a trusted partner in climate action, Europe will simultaneously strengthen its open strategic autonomy and diversify its sustainable global value chains to be the master of its fate in a volatile world.

Well-designed climate action can deliver this vision for Europe and its citizens. The European Green Deal is the EU's long-term strategy for economic growth, investment and innovation. Its implementation will notably strengthen the EU's energy independence from fossil fuels. In 2022, the value of fossil fuel imports soared to EUR 640 billion (4.1% of GDP), because of Russia's war of aggression against Ukraine. In 2023, when prices came down substantially, net fossil fuel import costs accounted for about 2.4% of GDP ([2]).

Growing the economy on the basis of fossil fuels and resource wastage is not sustainable. The EU has shown that climate action and sustaining economic growth go hand in hand by decoupling growth from greenhouse gas emissions. According to provisional data, total net

([1]) IPCC. AR6 Synthesis Report: Climate Change 2023
([2]) Based on trade data for the first 10 months and projected GDP

GHG emissions were 32.5% lower in 2022 than in 1990([3]) while the economy has grown by 67% ([4]). The materials productivity has increased by 37.5% between 2000 and 2022 ([5]).

Record levels of renewable and low carbon technologies are now being deployed. The EU installed an unprecedented 17 GW of new wind energy and 56 GW of solar (DC) in 2023. In 2022, about 3 million units of heat pumps were sold.

The European Climate Law introduced an intermediate target to be proposed by the Commission at the latest six months after the global stocktake under the Paris Agreement. Hence, in line with the scientific advice by the European Scientific Advisory Board on Climate Change and based on a detailed Impact Assessment, this Communication presents a 90% net GHG emission reduction compared to 1990 levels as the recommended target for 2040 ("the 2040 target"). It would ensure that the corresponding overall greenhouse gas (GHG) emissions budget for the EU between now and 2050 is in line with the provisions of the European Climate Law and provides a credible pathway to a strong and sustainable society in Europe.

Achieving this target will require a number of enabling conditions, such as the full implementation of the agreed 2030 framework, ensuring the competitiveness of the European industry, a greater focus on a just transition that leaves no one behind, a level playing field with international partners, and a strategic dialogue on the post-2030 framework, including with industry and the agricultural sector.

The objective of this Communication is to launch the political debate and inform the preparation of the post-2030 framework. It does not propose new policy measures or set new sector-specific targets.

At this, stability and full implementation of the legislative framework in place for meeting the 2030 climate and energy targets is a precondition for the EU to stay on course to the 2040 target on the way to climate neutrality in 2050 and to reap the full potential of the transition. In fact, an extension of current policies towards 2040 would already lead to a -88% reduction by 2040. Frontloading the decarbonisation on our path to climate neutrality by 2050 will significantly reduce fossil fuel imports (by 80% in 2040) and hence provide greater protection against price shocks and create a lead market in clean technologies, strengthening the EU's open strategic autonomy and competitiveness. More focus is however needed on a framework that ensures that all citizens benefit from the climate transition, already now and into the next decades. For example, the European Green Deal must also be an industrial decarbonisation deal. Europe needs better integration of employment and skills as well as social and distributional aspects in climate action and an enabling framework for decarbonised industry in the pursuit of sustainable economic growth, as well as a global level playing field for green business to thrive. Europe will also need to plan the necessary energy

([3]) Climate Action Progress Report 2023.
([4]) Estimate from AMECO database (European Commission, DG ECFIN), real GDP.
([5]) Eurostat, Circular Economy Monitoring Framework.

and transport infrastructure. These aspects will be addressed in the upcoming reviews already foreseen in existing EU measures to ensure the successful achievement of our 2030 objectives.

Moreover, Europe will need to mobilise the right mix of private and public sector investment to make our economy both sustainable and competitive. In this area, a European approach on finance will be needed in the coming years, in close cooperation with Member States, to generate economies of scale and scope, while limiting fragmentation of efforts and deepening of regional imbalances.

Many investments to be undertaken to realise the 2030 climate and energy targets have impacts spanning decades. Defining a climate target for 2040 now will provide investment predictability. It will help EU decision makers, Member States and stakeholders to take the necessary decisions in this critical decade, so that these are compatible with the 2040 target and the climate neutrality objective, minimising the risks of lock-in to costly, sub-optimal paths and stranded assets.

The imperative that the transition has to be just is at the heart of the European Green Deal given the worries among some citizens and industrial actors about the risks and costs of the climate and energy transition. Climate action has to bring everybody along, paying particular attention to supporting those who face the greatest challenge. That is why this Communication is the start of a dialogue and an extensive outreach to citizens, businesses, social partners, NGOs, academia and other stakeholders on the right 2040 pathway to climate neutrality by 2050. Such dialogue with industry is already taking place through Clean Transition Dialogues organised with the key industrial sectors, and will be continued and expanded, including in a 2040 perspective. The Strategic Dialogue on the Future of Agriculture with farmers and other actors in the food chain on the future of agriculture has also been launched. Furthermore, a a structured and systematic dialogue with social partners should be strengthened to ensure their contribution, focusing on employment, including availability of jobs for displaced workers, mobility, job quality, investments in reskilling and upskilling. The Commission will present the stocktake of the Clean Transition Dialogues prior to the Special European Council meeting in April this year. These dialogues and outreach will allow the next Commission to table legislative proposals for the post-2030 policy framework that will be needed to deliver the 2040 target in a fair and cost-efficient manner.

2 Ambitious global climate action

The first global stocktake under the Paris Agreement found that parties are putting increasingly effective climate policies in place, but that urgent additional action is needed to put the world fully on track for achieving the goals of the Paris Agreement.

The parties at COP28 agreed that limiting global warming to 1.5°C requires deep, rapid and sustained reductions in global GHG emissions of 43% by 2030 and 60% by 2035 compared to 2019 levels and reaching net zero CO_2 emissions globally by 2050. The Global Stocktake highlighted that the fossil fuel era should draw to an end, recognising the need for all to transition away from fossil fuels. The agreement also calls on the parties to triple global

renewable energy capacity and double the rate of energy efficiency improvements by 2030, to accelerate efforts globally towards net zero emission energy systems, making use of zero- and low-carbon fuels well before or by around mid-century. While emphasising the importance of a just transition, it also calls to accelerate efforts to phase down unabated coal, emissions from road transport, tackle methane, and other non-CO_2 emissions this decade, and phase out as soon as possible inefficient fossil fuel subsidies that do not address energy poverty or vulnerable groups. This will require a shift in investment patterns across the globe to ensure finance flows are consistent with low emission and climate resilient development pathways.

The results of COP28 set the minimum expectation for action from the entire global community and put others on the trajectory that the EU is already on. The EU will continue to contribute to building the means and momentum for increased global action and persuade and support other countries to follow suit.

Building on the success and potential of the Global Gateway, international cooperation will expand to new areas in line with the collective commitments of the Global Stocktake and new technological opportunities. Climate finance will remain at the heart of the EU's contribution to global climate action. The EU, together with its Member States and the European Investment Bank (EIB), is the biggest contributor of public climate finance to developing economies, with a contribution of €28.5 billion in 2022 and mobilising an additional €11.9 billion of private finance.

The EU and its Member States will further strengthen climate diplomacy in bilateral, plurilateral (G7, G20, OECD, Climate Club among others) and multilateral fora.

The Commission will set up a dedicated taskforce to offer its expertise and deploy staff to set up carbon markets, develop a global approach to carbon pricing[6], intensify its carbon market diplomacy around the world and amplify its efforts to replicate the success of the EU Emissions Trading System (ETS) by encouraging and supporting other jurisdictions to introduce or improve their own carbon pricing mechanisms.

The gradual implementation of the Carbon Border Adjustment Mechanism (CBAM), which entered into force, in its transitional phase, on 1 October 2023, also incentivises governments to use pricing measures to reduce emissions and for industries to reduce their GHG emissions, based on a methodology that has potential for international application.

In a volatile geopolitical environment, the EU will continue to develop stable partnerships with like-minded countries. The Green Alliances and Green Partnerships concluded with partners since 2021 will sustain the EU and partners' pathways to climate neutrality. It will broaden and deepen partnerships with reliable international suppliers, including neighbourhood countries, to ensure its long-term energy security and predictability of supply throughout the energy transition. This will help reduce external dependencies and costs while de-risking supply chains. It will also empower European businesses and society to benefit

(6) This work should take due account of the EU's push for global carbon pricing measures for international aviation and maritime transport, through ICAO and IMO respectively.

from the global transition and from the increasing demand for clean technologies, coupled with policy instruments to ensure the resilience of the EU net-zero technologies supply.

Trade agreements can help advance climate goals and achieve our targets while ensuring that the international trading system remains fair and non-discriminatory. Trade policy can drive innovation, promoting sustainable value chains and creating market access for clean technologies and products.

Reflecting the significant momentum in enlarging the EU, the Commission will support candidate and potential candidate countries in aligning with and adopting the EU's climate and energy acquis, including the European Climate Law. This includes implementation of the commitments made through the Energy Community to deliver 2030 climate and energy targets and climate neutrality by 2050 within a framework based on the Energy Union Governance Regulation. Commitment to and transition in line with the 2040 milestone will also be an important factor in the accession process of future EU Member States.

The 2040 target, once agreed, will be the basis of the EU's new Nationally Determined Contribution (NDC) under the Paris Agreement, to be communicated to the UNFCCC by 2025, ahead of COP30. A net greenhouse gas figure for the EU in 2035 will be derived once the 2040 target is agreed, for communication as part of the new NDC.

3 The 2040 target and a pathway to climate neutrality

3.1 The target

To put the EU on a firm path to climate neutrality, this Communication presents **a 90% net GHG emissions reduction compared to 1990 levels as the recommended target for 2040 ('the 2040 target').** To deliver a reduction of net GHG emissions of 90%, the analysis in the impact assessment shows that the level of remaining EU GHG emissions in 2040 should be less than 850 $MtCO_2$-eq ([7]) and carbon removals (from the atmosphere through land-based and industrial carbon removals) should reach up to 400 $MtCO_2$.

The proposed target is based on a thorough impact assessment ([8]) that looked in detail at the implications of three target options for 2040:

- Option 1, a reduction of up to 80% compared to 1990, consistent with a linear trajectory between 2030 and 2050 ([9]);
- Option 2, a reduction of 85-90%, compatible with the level of net GHG reduction that would be reached if the current policy framework were extended to 2040 and
- Option 3, a reduction of 90-95%.

([7]) Excluding emissions from the LULUCF sector.
([8]) The analysis is based on scenarios that reflect policies and measures until March 2023. Member States will submit their final National Energy and Climate Plans in 2024, which may include additional measures.
([9]) Consistent with the trajectory referred to in Article 8 of the European Climate law, a linear trajectory between the agreed 2030 target and climate neutrality in 2050, reaching around 78% in 2040.

There is a clear difference between the target options in terms of the importance of novel technologies. Option 3 is accompanied by faster investments for deployment of novel low carbon technologies such as hydrogen production by electrolysis, carbon capture and use and industrial carbon removals between 2031 and 2040 than in Option 2. Option 1 largely leaves the deployment of new technologies to 2041-2050, and therefore risks not reaching climate neutrality by 2050. Option 3 anticipates the large amount of carbon removals that is needed to reach climate neutrality by 2050 and to deliver net negative emissions beyond.

Option 3 leads to the lowest GHG budget for the EU, with net cumulative GHG emissions (the indicative GHG budget) of 16 $GtCO_2$-eq for 2030-2050. It is the only option that corresponds to the advice of the ESABCC ([10]), minimises the total GHG emissions we put into the atmosphere and is in line with the provisions of European Climate Law to present a GHG budget that does not put at risk the EU's commitments under the Paris Agreement. With the remaining global carbon budget ([11]) shrinking fast, it is essential that all parties minimise their own cumulative emissions. Setting the EU on this pathway as early as possible will make this transition cheaper and more predictable. The more climate action is delayed, the greater the human and economic costs and the greater the need to fund restoration and adaptation, drawing resources from the EU economy.

All options feature a shift in total costs from operational (linked to fossil fuel purchases) to capital costs. Investment needs for 2031-2050 are similar across options, with Option 3 requiring higher annual investment needs in 2031-2040 than Options 1 and 2, but then lower in 2041-2050. However, with the exception of energy-intensive industries, the differences between Options 2 and 3 in terms of resulting total energy system cost, GDP and competitiveness on global export shares remains limited. Option 3 sets a clear transition path away from fossil fuels as called for by COP28, providing the greatest benefits in terms of energy independence and enhanced protection against fossil fuel price shocks. It strengthens the EU's open strategic autonomy in the highly volatile international context where dependence on fossil fuel imports is a risk for the security of the EU and its economic stability.

The recommended target requires a rapid deployment of zero and low carbon technologies by 2040, creating a large domestic market for clean tech manufacturers, incentivising research and innovation and the creation of a strong European industrial basis, which will place the EU in a leading position in the global clean technology race rather than delaying action to the last decade to 2050. However, with more action in the decade 2031-2040, Option 3 also involves moderately higher needs for raw materials (and less in the following decade), and, if novel technologies are not deployed fast enough, a higher risk of potential environmental trade-offs notably in terms of land use and role of biomass in the energy system.

([10]) ESABCC (2023). Scientific advice for the determination of an EU-wide 2040 climate target and a greenhouse gas budget for 2030–2050. DOI: 10.2800/609405

([11]) For further details, see Annex 14 of the Impact Assessment.

A target of 90% will require greater focus and effort to ensure a just transition than for less ambitious target options, as the transition is somewhat accelerated. While the difference across options in costs for households is limited (notably thanks to higher energy efficiency in Option 3 that limits energy purchases), the post-2030 policy framework should include adequate policy measures to ensure affordable energy prices and access to decarbonised solutions. Redistributive measures will be essential to address social impacts so that no one is left behind.

How the target options compare

Investments and costs

All options require a similar level of investment over 2031-2050 and entail the redirection of resources that would otherwise, in the absence of action, also need to be invested in more carbon intensive technologies in order to provide for the economy's energy needs. Energy system investment needs amount to close to €660 billion (equivalent to 3.2% of GDP) per annum on average over the entire period (against €250 billion over 2011-2020, or 1.7% of GDP, a decade with relatively low investments in the energy system), and yearly spendings in transport([12]) to about €870 billion (equivalent to 4.2% of GDP, a similar proportion of GDP as in 2011-2020). Option 3 brings some energy system investments forward to the 2030s, with an average annual investment of €710 billion over 2031-2040.

The resulting energy system costs ([13]) are also similar across options, ranging from 12.4% (Option 1), 12.7% (Option 2) to 12.9% of GDP (Option 3) in 2031-2040, a moderate increase compared to the 11.9% of GDP spent in 2011-2020, and then fall to about 11.3% for 2041-2050. The cost of fossil fuel imports decreases significantly under Option 3, to less than 1.4% of GDP by 2040 and less than 0.6% in the last decade (against 2.3% over 2010-2021 and 4.1% in 2022 during the recent energy crisis), saving about €2.8 trillion over 2031-2050.

The assessment also shows that progress, for example on the circular economy, can reduce investment needs in the energy system by about 7% over 2031-2050 (representing yearly savings of €45 billion) and spendings in transport by about 9% (€127 billion). This leads to lower energy system costs of 12.6% of GDP in 2031-2040 and 10.8% in 2041-2050, substantially lower than in 2011-2020.

Environment

All three target options offer significant co-benefits, including improvements in air quality, ecosystems, enhanced health, and reduced healthcare costs.

3.2 Cost of inaction

([12]) Investments in the transport sector reflect the expenditures on vehicles, rolling stock, aircraft and vessels plus recharging and refuelling infrastructure. They do not cover investments in infrastructure to support multimodal mobility and sustainable urban transport. In particular, the acquisition costs of private vehicles represent about 60% of the total.

([13]) The energy system cost is broader than the investments, and consists of the capital cost (annualised investment cost) and the energy expenditures for economic activities. See the impact assessment for more details.

The costs and human impacts of a changing climate are large and growing. Climate-related extreme events have risen between 1980 and 2022, causing 220 000 deaths and EUR 650 billion in economic losses over the period in the EU, of which about EUR 170 billion over the past 5 years only.([14]) As one of the consequences, in February 2024 it was decided to increase the EU's Solidarity and Emergency Aid Reserve by EUR 1.5 billion for the period 2024-2027 (i.e. on top of the EUR 1.2 billion per year under the original MFF). It is further estimated that 61 000 lives were lost to heat in 2022, a figure that was only superseded by the heatwaves of 2003, which caused 70 000 deaths ([15]). These numbers might increase rapidly, since the compound effects of climate change, land use and environmental degradation can also affect health in multiple ways creating new opportunities for transmission of viral infections among previously geographically isolated species of wildlife and the transition of diseases from wild animals to humans. In addition, climate change in combination with biodiversity loss is a significant driver of food insecurity. We now face increasing risks of reaching irreversible climate tipping points, with unknown and potentially catastrophic consequences for societies, ecosystems and economies.

Inaction would lead to far larger and growing costs in the coming decades. Although estimates of the costs of extreme weather events are uncertain, the impact assessment estimates conservatively, without taking account of possible tipping points, that such costs could lower GDP by about 7% by the end of the century. Over the period 2031-2050, the cumulative additional GDP cost of a pathway leading to worse global warming could amount to EUR 2.4 trillion in the EU, compared to the costs under a pathway compatible with the 1.5°C objective of the Paris Agreement. ([16])

While the challenges linked to the transition to climate neutrality should not be underestimated, the process itself will generate major new opportunities and secure a sustainable future for all. The impact assessment estimates that achieving the 90% target could reduce premature deaths due to air pollution from 466 000 per year in 2015 to 196 000 per year in 2040, with a related reduction in costs from about EUR 1 700 billion in 2015 to EUR 670 billion in 2040 ([17]).

Net imports of fossil fuels would be reduced while the economy will grow larger. The impact assessment estimates that the cost of stylised fossil fuel price shocks in terms of lost output and employment would be halved if they were to take place in a significantly decarbonised economy (as attained under the 2040 climate target).

([14]) European Environment Agency (2023). Economic losses from weather- and climate-related extremes in Europe.

([15]) Ballester, J., Quijal-Zamorano, M., Méndez Turrubiates, R.F. et al. Heat-related mortality in Europe during the summer of 2022. Nat Med 29, 1857–1866 (2023). https://doi.org/10.1038/s41591-023-02419-z, https://www.nature.com/articles/s41591-023-02419-z.

([16])Comparison between the impact of IPCC's Representative Concentration Pathway RCP7.0 "higher warming" pathway (with a "best estimate" warming of 2.1°C in the mid-term (2041-2060) and 3.6°C in the long-term (2081-2100)), and the 1.5°C compatible RCP1.9 pathway (with the "best estimate" temperatures of 1.6°C and 1.4°C).

([17]) Based on the value of statistical life (high valuation method). These estimates are indicative , derived from the methodology underpinning the Commission dedicated clean air analysis, such as in the 3rd Clean Air Outlook.

4 Delivering the 2040 target

Delivering the 2040 target will depend on the full implementation of the 2030 climate and energy framework and calls for the development of a post-2030 policy framework. This must be complemented with a broad enabling framework for the two equally important objectives of the European Green Deal, namely just transition and competitive sustainability. This double focus will trigger the necessary investment decisions and mobilise finance, roll-out innovative technologies and ensure that all EU citizens and economic sectors can benefit from the transition and access affordable solutions.

4.1 Implementing the 2030 policy framework

All efforts must be made to implement the 2030 energy and climate framework as the stepping stone to reaching the 2040 target and climate neutrality in 2050, in line with the European Climate Law. The on-going update of the National Energy and Climate Plans (NECPs) is a key element in monitoring the progress towards the 2030 climate and energy targets. The initial assessment of the draft NECPs ([18]) highlights the need for the increased level of ambition and improvements in the final submissions due from Member States by June 2024. The Commission calls on Member States to take decisive measures in effectively implementing the commonly agreed policies and legislation and is ready to work with Member States, sectors and social partners to facilitate the necessary actions. Tailor-made expertise through the Commission's Technical Support Instrument can help Member States undertake reforms supporting the implementation of the 2030 policy framework.

4.2 An economy that delivers for people

EU citizens are at the heart of the Green Deal. The most vulnerable people, such as those with lower income, persons with disabilities, marginalised communities and older people are much more exposed to climate hazards as they lack the means to protect themselves against such risks. This makes the EU's climate agenda even more important, alongside investment and support policies that generate social and economic benefits, which reduce poverty and inequalities. This includes investing in people through re-skilling and upskilling of the workforce, support for labour market transitions and targeted income support measures. Effective social dialogue as well as a strong involvement of stakeholders and citizens is key to anticipating and managing change alongside measures to help all to participate actively in the green transition through accessible and affordable environmentally friendly options.

A just and fair transition for people

The transition to climate neutrality is happening alongside the development of artificial intelligence, digitalisation, ageing and geopolitical insecurity amongst other trends. Together they will lead to changes in the way we produce and consume goods and services, with implications for households and workers.

([18]) COM(2023) 796 final

In terms of employment, the effects of the transition will vary by sector and by region, according to their dependence on specific activities. Fossil fuel-dependent sectors, such as transport and energy intensive industries will go through a fundamental transformation. It is also crucial to ensure that mobility options remain affordable and accessible for all, citizens and economic operators alike, and that rural and remote regions across the EU are better connected to further facilitate their development. Workers, communities and regions dependent on carbon-intensive activities will be the most affected, calling for continued just transition support as the transition takes shape, in tandem with closely coordinated and comprehensive Member State action and measures ([19]). The transition will bring new opportunities for business and job creation, for workers at all skill levels, but will benefit some regions more than others. EU cohesion policy, with its investments and specifically from the Just Transition Fund, an instrument dedicated to supporting the economic diversification and reconversion of impacted territories and communities, and national measures, will continue to play an essential role in supporting regions the most affected by the transition.

Carbon pricing, such as under the EU ETS, is reducing emissions while generating significant revenues for Member States to tackle climate change and increasingly to support industrial innovation and households for a fair transition. The ETS funded Social Climate Fund, including obligatory Member State contributions, will mobilise EUR 87 billion to support vulnerable households, transport users and micro-enterprises. On top of that, Member States are obliged to spend their overall national revenues from the ETS for climate and energy purposes, that include addressing the social impacts of the transition. Used effectively, these funds can support people through the transition and have a lasting impact on their quality of life. Support will continue to be necessary after 2030, including through Member State measures and a strengthened just transition policy framework.

4.3 The EU's energy system

Renewable, zero and low carbon energy solutions

All zero and low carbon energy solutions (including renewables, nuclear, energy efficiency, storage, CCS, CCU, carbon removals, geothermal and hydro-energy, and all other current and future net-zero energy technologies) are necessary to decarbonise the energy system by 2040. Solar and wind will make up the vast majority of renewable energy solutions. The Commission will pursue its policies to ensure a fast deployment of all renewable energy, as well as of zero and low carbon solutions, a further development of energy efficiency. It has established a number of initiatives to accelerate renewables deployment, create enabling conditions for EU renewable industry and boost their competitiveness, such as the EU Solar PV Alliance and the Wind Charter. Ambitious electrification is key and the Commission will continue to work with Member States to further develop smarter grids, system integration, demand flexibility and storage solutions. Accelerated permitting and cross-border cost

([19]) In line with and building on the Council Recommendation on "ensuring a fair transition towards climate neutrality" (C/2022/243).

sharing will speed up the development of offshore wind projects in line with the recent action plans on wind and grids.

The Communication on Industrial Carbon Management sets out a roadmap to deploy the necessary CCS and CCU technologies for hard-to-abate sectors, stressing the need for a regulatory framework in areas such as injection and transport of CO2, as a precondition to create a single market for CO2. The Commission is also launching an Industrial Alliance to facilitate stakeholder's cooperation at EU level and to accelerate the deployment of Small Modular Reactors (SMRs) and ensure a strong EU supply chain, including a skilled workforce. This will leverage EU's manufacturing and innovation capacities to accelerate the deployment of first SMR projects in the EU by early 2030 under the highest standards of nuclear safety, environmental sustainability, and industrial competitiveness.

Affordability of energy prices is crucial to ensure that the benefits of decarbonisation are brought to the whole economy. Fossil fuel prices are volatile and set by global markets. Generation costs of renewable electricity have consistently been lower than those generated by fossil-fuels for more than a decade. The progressive substitution of fossil-fuel generation by renewables, complemented by efficient uptake of clean flexibility sources such as nuclear, and supported by a full implementation of an updated electricity market design, the further integration of cross-border EU (and extra-EU) power systems, and efficient uptake of clean flexibility sources may contribute to the lowering of wholesale electricity prices. Once fossil fuels are permanently displaced of the power mix over the next two decades and necessary investments are made on grids, storages and batteries, power prices might start to significantly decrease in the EU. Investments are necessary to avoid bottlenecks in the electrification of the economy. It is critical to ensure proper financing tools to avoid the required investments to increase final prices for consumers and industry. In the meantime, promoting and expanding the use of PPA's will help to stabilise prices and shield companies from high and volatile prices caused by fossil fuels.

Complementary social and industrial policies will be needed to ensure a smooth transition from current energy price levels to affordable clean energy. EU and Member States can protect lower-income and middle-income households from steep increases in energy prices. Tailor-made support will be needed for energy-intensive industries to bridge the transition period when they face the dual challenge of investing in clean production methods when available, and coping with high energy prices. As a start, the Innovation Fund matches innovation support with such solutions in the form of carbon contracts for difference. The transition will bring new challenges, such as land and water use. Win-win solutions (solar rooftops, agri-PV, biogas and biomethane from organic waste and residues) have to be prioritised, engaging citizens in the decisions.

Energy efficiency and buildings

The 'Energy Efficiency First principle' remains a central policy principle, and the impact of the 2030 energy efficiency target extends up to 2040. This will leverage private financing across all sectors and can unlock a European marketplace for energy efficiency investments. Circular business models reduce energy and resource consumption. The public sector, at all levels, should lead by example, including through green public procurement that considers sustainability criteria, and provide a blueprint to facilitate the transition.

The EU building stock accounts for 42% of final energy consumption, more than half of natural gas gross inland consumption and about 35% of energy related greenhouse gas emissions. Around 80% of energy consumption in buildings stems from heating and cooling needs. Carbon pricing for all fuels, foreseen as of 2027, will create a level-playing field for electricity, and generate revenues including for the Social Climate Fund that could be used for investments and the financing of structural reforms. An updated energy tax design can further accelerate the green electrification of the building stock and the energy system.

Electrification, grids and infrastructure, system integration, storage, digitalisation and flexibility

Electrification with a fully decarbonised power system by 2040 is the main driver of the energy transition. The share of electricity in the final energy consumption will double from 25% today to about 50% in 2040. The impact assessment shows that renewable energy in majority ([20]), complemented by nuclear energy ([21]), will generate over 90% of the electricity consumption in the EU in 2040 ([22]).

Today, the average yearly gain from the integrated electricity market for European consumers is about EUR 34 billion per year ([23]). Higher renewable shares and electrification will require substantial investments in the expansion of the EU's power grids at distribution and transmission level, as well as in upgrading to smarter and more flexible grids. New interconnectors expanded distribution grids, energy storage facilities, dispatchable energy supply, flexibility market solutions, and sector coupling will be needed to ensure flexibility and security of supply. The recent EU Grid Action Plan is a first step and its swift implementation should remain a priority for the Commission, Member States and industry in view of delivering on the 2030 and 2040 targets. This experience could lead to a comprehensive masterplan for accelerating the development of European integrated energy infrastructure. Security and resilience of critical energy infrastructure is a key priority to for a secure and stable energy supply.

Consumers should be empowered to adapt their consumption to market conditions. The digitalisation of the energy system, including AI, is key for more flexible energy sources ([24]).

With all these workstreams in mind, avoiding excessive high network tariffs for end users due to the pay-back of upfront grid investment and electrification will be a key regulatory objective at the EU and national level.

Fossil fuels

([20]) Including bioenergy conversion technologies (e.g. biogas), coupled with a sustainable biomass supply.
([21]) The analysis is based on scenarios that reflect policies and measures until March 2023. Member States will submit their final National Energy and Climate Plans in 2024, which may include additional measures, notably reflecting most recent announcements by some Member States to increase the deployment of nuclear energy.
([22]) The remaining 10% are compensated by negative emissions or supplied with low carbon solutions including use of carbon capture and storage.
([23]) ACER (2022). Final Assessment of the EU Wholesale Electricity Market Design.
([24]) Commission Action Plan for the Digitalisation of the Energy System.

In 2040, the consumption of fossil fuels for energy would reduce by approximately 80% compared to 2021. Coal will be phased out, while oil in transport (road, maritime and aviation) would represent about 60% of the remaining energy uses of fossil fuels. The remaining use of natural gas would be divided between industry, buildings, and the power system. In line with the international commitment to transition away from fossil fuels, policies should ensure that any remaining fossil fuel combustion will be coupled as soon as possible with carbon capture (utilisation) and storage. The gas market structure will change significantly, with an increasing role for low-carbon and renewable liquid fuels and gases. Gas infrastructure will need to adapt to the decentralized production, and a significant share of the oil and gas network may gradually be repurposed for e-fuels, advanced biofuels and renewable and low carbon hydrogen. Non-energy uses, such as feedstock for manufacturing, would account for about a third of the remaining fossil fuel consumption. Inefficient fossil fuel subsidies which do not address energy poverty or just transition should have been phased out by then.

4.4 Industry decarbonisation deal

To make the European Green Deal succeed in the next decade, a firmer and renewed European agenda for sustainable industry and competitiveness must complement it now and in the coming years. This enabling framework for industry decarbonisation will build on the Green Deal Industrial Plan ([25]). Creating the right framework conditions for all sectors in the economy (including access to finance, skills, affordable energy) is a precondition for the successful transition. At the same time, there are economic sectors which, given upfront investment for clean technologies and a challenging market environment, merit special attention to adapt their production processes in order to implement the Green Deal framework. The same goes for SMEs, who will need dedicated support to access finance for sustainable investments and to navigate the relevant EU regulations.

Success in the transformation will allow the EU to maintain its industrial strength in sectors like wind power, hydropower, and electrolysers, where it already has a trade surplus, and continue to increase domestic manufacturing capacity in growing sectors like batteries, electric vehicles, heat pumps, solar PV, CCU/CCS, technology for sustainable biogas and biomethane, and circular economy. The development of strong green and circular industries, both domestically and in like-minded partners, will strengthen the EU's competitive sustainability, multiply business opportunities for companies, generate economies of scale, as well as benefit more widely to the European economy, generating highly skilled jobs to help and ensure that the climate transition is socially just and inclusive.

Global competition for zero and low emission technologies will be intense. Large recourse to public subsidies and policy initiatives from our main competitors are distorting fair and free trade. Net-zero technologies are the focus of strong geostrategic interests and a global technological race. In China, long term planning, the vertical integration of entire sectors, and public subsidies have driven down costs, leading to China's dominance in many cleantech

([25]) COM(2023) 62

supply chains, from raw materials to components and end products. In the US, the US Inflation Reduction Act provides fiscal incentives for investment and production in cleantech manufacturing. Europe is taking action to secure its own leadership role in this race, playing to its core strengths and ensuring win-win partnerships with like-minded partners. . It will continue to apply its trade defence instruments to protect the industry from unfair trade imports and, as a result, ensure resilient supply chains.Europe's strength lies, amongst others, in its stability, its predictable policies and long history of bringing high quality and innovative industrial solutions to markets.

An enabling framework for investment and competitiveness in Europe….

Securing a conducive regulatory and financing environment will attract investment and production to Europe. The Critical Raw Materials Act, the Ecodesign for Sustainable Products Regulation and the Net Zero Industry Act are key instruments to deliver an open strategic autonomy, including by scaling up domestic production, setting up key partnerships with like-minded partners, applying circular economy approaches along the value chain, diversification, strategic projects and easier permitting across technologies and infrastructure. The Net Zero Industry Act is a concrete step in creating an industrial business case for the European transition to carbon neutrality. It addresses the right topics by substantially accelerating permitting, focusing R&D investments, and access to existing EU funding schemes.

Industrial policy should strengthen those sectors that are needed for the green transition, but may be challenged by this transition as they are harder to decarbonise, and hence fail without targeted and conditioned attention and support. Examples could include industrial alliances and symbiotic industrial clusters, like hydrogen valleys ([26]), within the EU and its neighbourhood. Such clusters help suppliers of clean technologies to scale up their operations, and improve their commercial viability by supplying several industrial off-takers within a cluster, while manufacturing industry could decarbonise their operations more effectively and at a lower cost by securing access to clean technologies and sharing costs. Particular attention should be paid to the creation of lead markets for clean technologies and products in Europe, embracing, among others, circularity, and sustainably sourced bio-based products.

Furthermore, bridging instruments are required to support industries before they become commercially viable. This requires a comprehensive reflection on all elements leading to private investments: from taxation to access to finance, from skills to regulatory burdens and energy costs for the day-to-day business activities. In this context, far more and continued attention is needed for a simplified regulatory environment for business and a fresh impetus in a strong Single Market that removes undue national regulatory barriers, especially for key technologies. This allows businesses to ramp up standard solutions across Europe, thus boosting their economic attractiveness for investors and is a crucial element for the future success of the EU agenda.

([26]) https://s3platform.jrc.ec.europa.eu/hydrogen-valleys

Particular attention should also be paid to the role of SMEs. They are drivers of the transition, vital in a number of supply chains and very often also impacted at large by changes in the policy and regulatory framework. Given their more limited size, and by extension resources, they may need additional support to adapt for instance their production processes in order to implement the Green Deal framework.

Public investment must be well-targeted, with the right mix and pooling of large-scale grants, loans, equity, guarantees, advisory and other public support, which is accessible in the quickest and simplest manner. The Recovery and Resilience Facility (RRF), the instrument at the heart of NextGenerationEU will continue to contribute to the green transition. The Innovation Fund, estimated to amount to EUR 40 billion by 2030, can play a big role, including through EU-wide competitive bidding instruments and 'auctions-as-a-service' jointly with Member States. The InvestEU budgetary guarantee is expected to mobilise more than 110 billion of green investment building on Union budgetary alongside EIB Group and other implementing partners' resources.

With due attention for decarbonised and competitive manufacturing industry

Electrification, adapted production processes, low carbon fuels and a full deployment of capture for process emissions will allow manufacturing industry to significantly reduce CO_2 emissions by 2040. The EU ETS with its common carbon price, provides a market-based tool to innovate with long-term predictability for Europe's main emitters. For some industries, this implies investing in a profound transformation of the production process ([27]). Carbon capture, use and storage is a solution in hard-to-abate sectors in the absence of other solutions.

Energy costs are key for the competitiveness of industry and in particular European Energy Intensive Industries ([28]) and merit particular attention with dedicated policies to allow early movers to clean energy to benefit from a smooth transition in energy prices. As a start, the adopted Electricity Market Design Reform makes energy bills of companies more independent from the short-term market price of electricity. Further expansion of the principle of competitive sustainability by rewarding European companies investing in low carbon technologies, including through public procurement processes or through targeted reforms in electricity grid access regulations, will be key both to create a thriving domestic manufacturing base and achieve climate ambition.

… built on a more circular economy and sustainable bioeconomy

([27]) This includes electrification and switching to alternative fuels (e.g. renewable and low carbon hydrogen, e-fuels or bioenergy), symbiotic industrial clusters, innovation in low carbon processes, energy and resource efficiency, material replacement and circular business models.

([28]) According to the International Energy Agency, the strong fossil fuel dependence of the EU exposes European EIIs to higher share of energy expenditures in total cost of production than competitors in the US or China. In the aftermath of the 2021-2022 energy shock due to the EU's dependence on fossil fuel imports, recent data suggests that part of the reduction in natural gas consumptions has been driven by a decrease in industrial output, in particular by energy intensive industries.

The Impact Assessment shows that up until 2040, the circular economy will become increasingly important to achieve both climate ambition and a new prosperity model for Europe. It is key to wed action against climate change and excessive resources use with new economic opportunities and greater EU autonomy. This makes implementation of the Circular Economy Action Plan a must and calls for a renewed partnership with industry for a circular economy agenda going forward.

A renewed agenda for the circular economy has clear benefits. Through repairing, refurbishing, reusing and recycling existing products and thereby extending their functional lifetime, resources are used more efficiently in production. Primary raw materials can be substituted with secondary raw materials that are less carbon-intensive. Fossil based materials can also be replaced by sustainably sourced biobased renewable materials, or other environmentally friendly innovative materials. This is in particular the case in sectors like construction, chemicals or textiles. Investments into material innovation need to be strengthened including up-skilling in the bioeconomic sector.

A stronger circular economy offers innovative business models that meet evolving consumer preferences and seize digital solutions. For example, circular business models like product-as-a-service, circular product design ensuring longer lifetime, reuse and repair, shared economy or on-demand production can reduce economic cost of energy and material use and make waste via a loop back into the economy a resource with economic value. Circular business can create significant greenhouse gas emissions reductions in hard-to-abate sectors. Examples include the built environment through better management of construction and demolition waste, heavy industry through material management solutions, clustering of resource-intensive complementary industrial activities, transport through shared mobility and reverse logistics, and the food sector. In 2021 there were 4.3 million jobs in the economic sectors directly linked to the circular economy, an increase of 11% compared with 2015([29]). Reducing materials input through re-use and recycling has the potential to boost growth and create a significant number of jobs in the EU, with upgraded knowledge and skills.

By reducing dependence on imports of critical raw materials, and reducing the environmental pressure and risks associated with natural resource extraction and consumption, circularity can boost the EU's security and open strategic autonomy.

With a growing need for industrial carbon management and carbon removals

Industrial decarbonisation will also have to address "process emissions" not related to fuel combustion. For these, carbon capture can be a solution.

The 2040 target entails an earlier deployment of carbon capture ([30]). Part of it will allow to generate industrial carbon removals which would complement land-based removals

([29]) Eurostat (2023) EU circular economy monitoring framework. May 2023. Direct jobs. These figures do not include jobs in the circular economy when it is integrated in other sectors.
([30]) "Carbon capture" includes carbon captured from industrial processes, power and heat production, biogas upgrade and direct air capture.

sequestering carbon in biomass and soils to contribute to the 90% reductions of net GHG emissions.

This will require a large portfolio of options such as BioCCS ([31]), DACCS (Direct Air Capture with Carbon Storage) and possibly other novel approaches. Carbon Capture, Utilisation and Storage (CCUS) technologies enable the decarbonisation of industrial sectors without alternative decarbonisation solutions by storing carbon permanently underground or in products, and by replacing the fossil carbon currently used as feedstock in various industries with non-fossil carbon. Likewise, the development of CO_2 value-chains through carbon capture and use (CCU), nature-friendly biobased materials, mechanical and chemical recycling can all boost the development of non-fossil feedstock to substitute fossil fuels in carbon-based products. Carbon capture will also remain important to reach net-zero by 2050 and absolute negative emissions thereafter. This calls, amongst others, for a continuous assessment how best to provide incentives for industrial carbon removals in existing EU legislation or through new instruments, be it the ETS Directive up for review in 2026 or dedicated instruments. To reap the economic opportunities of these technologies, it remains key to develop full economic value chains for them. That is why the Commission is presenting alongside this Communication a dedicated Industrial Carbon Management Communication with a strategy for the policy framework, more innovation and investments to unlock this potential. More public investment will be required to scale up research and innovation for this nascent industry. Industrial carbon removals do not replace, but complement, natural carbon removals, which remain essential to reach the climate target.

On a global level playing field

The transition will only be successful if Europe remains a sovereign and resilient economy that diversifies its sources of supply and that is resilient to supply disruptions, price volatility and other shocks. As the EU reduces its dependence on imported fossil fuels, strategic decisions have to be made not to create new vulnerabilities through its imports of net-zero technologies or low-emission energy commodities.

Alongside the efforts to create value chains for key technologies on our own continent, the EU must strategically approach global markets, to ensure access to strategic commodities including critical raw materials at affordable prices. The EU should also leverage its greatest strength, the Single Market, through joint purchase instruments and by allowing industrial actors to engage in various cooperation models to jointly negotiate better conditions, including prices from global producers with important safeguards for encouraging the transfer of benefits to end users and the involvement of smaller companies. In parallel, the EU should ensure global cooperation and trade to support sustainability. The EU should foster the development of international standards on the global stage, building on EU standards as a source of best practices.

([31]) Carbon capture and storage of biogenic CO_2 emissions originated from the combustion of biomass to produce energy (BECCS) or from the processing of biomass in industrial applications.

As the EU is leading in decarbonising its industry, additional measures are needed to ensure competitiveness of European exports on global markets. A true level playing field for businesses in Europe and globally is created when other countries adopt carbon pricing of their own, which would also contribute to an increase of global climate ambition.

4.5 Decarbonising transport and improving mobility

In the transport sector, the implementation of the "Fit for 55" measures, combining technological solutions and carbon pricing, as well as an efficient and interconnected multimodal transport system, for both passengers and freight, will allow emissions to decrease by close to 80% in 2040 relative to 2015.

Decarbonising transport in a manner that continues to ensure affordability and accessibility will require significant investments both in new assets (zero and low emission vehicles, aircraft, vessels, rail equipment) and infrastructure for refuelling and recharging. At the same time, the renewable and low-carbon fuel costs should not be underestimated, and remain a key factor for the competitiveness of transport operators, in particular in the maritime and aviation sectors. Ensuring that a sufficient feedstock of sustainable alternative fuels is made available through dedicated measures, including regulatory where necessary, is key to reach the set ambition in a cost-effective way. As for other sectors, the associated investment needs in transport merit a discussion with Member States, the European Investment Bank and financial institutions how innovative EU finance tools can de-risk make-or-break strategic investments in a technology neutral manner for the European economy.

Projected emissions vary greatly across transport modes. Reductions of CO_2 emissions from road transport will accelerate over time and will come with significantly improved air quality in cities through the deployment of zero emission vehicles driven by the CO_2 standards, more than quadrupling the electrification of the sector over 2031-2040. The shares of battery-electric and other zero-emission vehicles are projected to rise to over 60% for cars, over 40% for vans and close to 40% for heavy-duty vehicles ([32]) by 2040. This transformation is a fully-fledged industrial policy opportunity for a sector vital for the EU economy, through investments in infrastructure and the full integration of the sector in the electricity grid, the development of critical raw materials supply chains and the development of a skilled workforce. Beyond CO_2 standards, carbon pricing and updated fuel policies will enable the decarbonisation of the stock of existing vehicles already on the roads that constitute the legacy fleet.

Maritime and air transport emissions will be reduced through the combined effects of "Fit for 55" measures. This includes the achievement of the targets set out in FuelEU Maritime ([33]) and ReFuelEU aviation([34]), spurring the deployment of renewable and low carbon fuels and of zero-emission aircraft and vessels. Through the ETS, the EU is the first jurisdiction to put

([32]) including trucks, buses and coaches.
([33]) Regulation (EU) 2023/1805 of the European Parliament and of the Council of 13 September 2023 on the use of renewable and low-carbon fuels in maritime transport, and amending Directive 2009/16/EC
([34]) Regulation (EU) 2023/2405 of the European Parliament and of the Council of 18 October 2023 on ensuring a level playing field for sustainable air transport (ReFuelEU Aviation)

an explicit carbon price on emissions from these sectors. This will stimulate and generate revenues for speeding up the large-scale uptake of zero-emission technologies, renewable and low carbon fuels and energy efficiency solutions in aviation and shipping. For instance, the Commission will organise calls for proposals with dedicated topics for the maritime sector under the Innovation Fund, as already announced.

As agreed in 2023, in 2026, the Commission will assess an extension of the carbon pricing for the aviation and maritime sectors ([35]). Addressing barriers to the deployment of alternative low- and zero-emissions fuels (including e-fuels and advanced biofuels) in aviation and maritime and giving them priority access to these fuels over sectors that have access to other decarbonisation solutions, such as direct electrification, will enable these sectors to contribute to the EU's climate objectives and to the global climate agenda ([36]). In doing so, the full climate impacts of aviation should be duly considered, in line with the latest scientific findings, and a system for airlines to monitor, report and verify non-CO_2 emissions and climate effects of aviation will be put in place.

Significant investments will be required in the energy system to replace fossil fuels with renewable and low-carbon fuels necessary to power the transport sector. Ensuring that a sufficient feedstock of sustainable alternative fuels is made available through dedicated measures is key to reaching the set ambition.

Higher use of rail thanks to increased use of railway infrastructure capacity, and an efficient and interconnected multimodal transport system for both passengers and freight supported by the multimodal Trans-European Transport Network, can therefore be significant contributors to reducing overall emissions. Deployment of different models based on mobility as a service, multimodality, digital solutions and optimised green logistics (e.g. for freight) will modernise and decarbonise the transport sector. Promoting sustainable and affordable urban mobility, including through adequate urban planning, will be important to enable more public transport, active mobility (i.e., walking and cycling) for short distance trips, with benefits for both the climate and people's health.

4.6 Land, food and bioeconomy

Ensuring climate-neutral food production and strengthening the bioeconomy sectors

Ensuring sufficient, affordable, quality food production in Europe is of strategic importance. At the same time, European farmers and foresters offer multiple vital services for the EU society, environment and economy. They ensure the production of primary food and bio-based materials, are at the core of the bioeconomy and the food system's value chains and have a vital role in ensuring food security. As managers of the land, they are also essential to ensure ecosystem services such as biodiversity protection and restoration, carbon removals or adaptation to climate change.

([35]) E.g. to cover excluded business aviation and vessels below 5000 GT.

([36]) Including to the meet the IMO Strategy on Reduction of GHG Emissions (net zero GHG by or around, i.e. close to 2050, with indicative checkpoints of at least 70% striving for 80% compared to 2008 by 2040).

Like all other sectors, agricultural activities play an important role in achieving the EU's 2040 climate ambition, while contributing to EU food sovereignty. The right policies, like boosting the availability of low-carbon alternatives ([37]) and circular applications, such as renure ([38]), with the right support to address trade-offs and decrease costs, show the potential to contribute to solutions. This is why the Commission chose to set up a Strategic Dialogue on the future of EU agriculture in order to, among other things, jointly shape the transition, and has committed to intensifying dialogue also with forest owners and other forest stakeholders. This dialogue will address issues such as viable livelihoods, reducing burdens and ensuring competitive and sustainable food production in the future. Given that it is among the most efficient global producers of food in terms of greenhouse gas (GHG) emissions, the EU should also work to prevent unfair competition and to ensure a level playing field with non-EU producers, in particular through trade agreements.

Bio-based materials that are sustainably sourced can not only store carbon over long periods (e.g., if wood is used as a construction material) but also replace fossil-based materials, and in this way the land sectors contribute to the decarbonisation of other sectors. More resource-efficient and biodiversity-friendly management of the land sector will also increase its resilience to the impacts of climate change, improve soil fertility and protect and restore nature, bringing win-win solutions for food security and the productivity of land. Also for the fisheries and aquaculture sector, in February 2023 the Commission has proposed measures to become climate neutral by 2050, by improving fuel efficiency and switching to renewable, low-carbon power sources ([39]).

This being said, policies addressing the food sector in a holistic way are more efficient than looking at the farming and fisheries sectors in isolation, because many decisions with a large mitigation potential are taken outside the farm gate: the chemical composition of fertilisers, the circular use of food waste (crop residues, manure, fisheries by-product), the reduction of food waste at the manufacture and retail stages, the choice of ingredients for manufactured food products, and consumers' dietary choices. A whole-of-food-sector approach is also the best way to give farmers perspective to solid and fair earnings from their produce.

The food industry plays an important role in driving producers' and consumers' decisions. It should receive the right incentives to procure more sustainable food ingredients and contribute to a food environment that makes healthier diets an accessible and affordable choice for consumers ([40]). The Common Agricultural Policy provides essential tools to support the transition of the farming sector towards new sustainable practices and business models. In particular, diverse and family-owned farms and those who combine crop and animal production are the backbone of EU farming and should be accompanied in the

([37]) Mitigation technologies such as selective breeding, optimised feed efficiency and improved manure management can reduce methane emissions from livestock. Precision farming and enhanced fertiliser efficiency can reduce nitrous oxide emissions.
([38]) REcovered Nitrogen from manure
([39]) The common fisheries policy today and tomorrow: a Fisheries and Oceans Pact towards sustainable, science-based, innovative and inclusive fisheries management - European Commission (europa.eu)
([40]) COM(2020) 381 final

transition to a climate-neutral land sector, taking into account its social, environmental and economic dimension.

In addition, it is crucial to create further business opportunities for a sustainable agrifood value chain and leverage private funds in synergy with public funding. This could be done with new market-based mechanisms to boost sustainable food, as this could result both in a better food price to reflect sustainability as well as a fair reward for farmers and new source of funding for investments. Only firm coordination with all industrial actors in the entire food value chain and focus on fair trading practices across that chain can unlock the right incentives for sustainable farming practices, ensure a decent and sustainable income for farmers and generate revenues to support the transition. and.

Thanks to advancements in digital monitoring technologies and advisory services, farmers and foresters will be able to quantify their GHG balance using reliable and harmonised certification methodologies ([41]). Approaches such as carbon farming enable certified climate action to be appropriately rewarded through result-based contracts with other actors in the value chain or through public support. Precision farming is one of the important tools to build on these achievements, allowing farmers to make better use of their soil and other natural assets, to the benefit of climate and environment.

Finally, as fossil-based carbon is phased out of the EU economy, farmers, foresters and fishermen will have new business opportunities to deliver biomass and bio-based materials in a sustainable manner for different uses in the bioeconomy, including in industry, construction, chemicals, energy or mobility. The enhanced use of biomass residues and waste, advanced biofuels, BECCS technologies, and biobased products should be accompanied with clear rules that promote sustainability and consider the impacts on the size of the natural carbon sink in the LULUCF sector.

Healthy ecosystems, sustainable land use, nature & biodiversity

A 2040 target and clear pathway from 2030 to 2050 should exploit and encourage synergies between climate neutrality, biodiversity and other environmental objectives.

Cutting GHG emissions and increasing carbon removals can improve resilience and biodiversity, whilst healthy nature and biodiversity are essential for climate change mitigation and resilience. Fire-prone areas are expected to expand across Europe due to climate change, threatening carbon sinks and biodiversity. Water ecosystems are highly vulnerable to climate change. High ozone levels, and air pollution damage forests, ecosystems and crops, reducing the potential for carbon removals and adaptation.

Given the intensifying competition for land and water, policies can be designed to ensure the sustainable, water efficient production and consumption of food, materials and bioenergy.

([41]) COM(2021) 800 final. The Communication on Sustainable Carbon Cycles announced an objective that, by 2028, every land manager should have access to verified emission and removal data to enable a wide uptake of carbon farming. In 2022, the Commission adopted a proposal for a Regulation establishing a Union certification framework for carbon removal, which is currently in co-legislation procedure.

Bioenergy should go in priority to sectors where the potential for electrification is limited, such as air or maritime transport.

4.7 Investing in our future

A comprehensive investment agenda

In a context of very intense global competition for attracting investment the EU needs a significant policy and financial initiative to attract and mobilise private investment within its borders and an enabling environment for the private sector to invest outside EU borders.

The EU has a strong basis to build on. The EU sustainable finance framework has already helped to enhance the transparency of corporates' business decisions and to increase the contribution of the financial sector to the transition. This framework will continue to be finetuned and developed for the needs of more actors, including those at earlier stages of the transition, in order to maximise its impact. However, the transition will not be achieved through predictability and regulation alone; Europe must become more attractive for private investment. For one, the EU Capital Markets Union must be deepened to unleash the EUR 470 billion in potential of annual private funding for companies at all stages of their development, including venture capital targeted at meeting the EU sustainability objectives and sustainable long-term investments for the climate transition ([42]).

Scaling up the impact calls for a reinforced, strategic capacity to identify and facilitate new investment opportunities and projects in sectors with the most impacts. The Commission, Member States and industry must jointly work towards creating a business case for the new business models in key sectors of the economy needed for the transition and notably in clean tech and decarbonised energy intensive industries and agriculture. Efforts on a simplified regulatory environment and a strong Single Market for businesses help in this regard.

Public sector support and direct investment should be strategically deployed, also by frontloading and maximising existing resources with large-scale pooling of funding, making it accessible in the fastest and simplest way possible and facilitating synergies between different instruments. Coordination between EU and Member State-level actions is crucial to maximise the impact of financing initiatives, with EU-level actions providing a framework to optimise policies and mobilise financial resources, while Member States tailor initiatives to specific regional and national needs in compliance with the State Aid framework. The proposed Strategic Technologies for Europe Platform (STEP), for instance, aims to improve coordination of funding to further leverage strategic investments into clean tech and bio tech.

From a public sector perspective, diversifying the financial landscape by using innovative financial instruments and targeted grants is crucial to attract private capital and to meet the investment targets. There is a clear need for a more efficient and tailored use of public

([42]) A recent think tank report suggested that companies in the EU could raise an additional EUR 470 billion in funding every year from the capital markets. See A renewed vision for EU capital markets (New Financial), January 2024.

financial resources, and the use of financial products and blending of financial sources to catalyse and de-risk private investments.

Grants should only be strategically deployed to support early-stage low carbon projects such as renewable energy, in the industrial sector, and other projects, where projects lack comfmercial viability, private investment is still nascent and difficult to market investments. For mature projects with proven revenue streams, market-oriented financial instruments, such as debt and equity finance, can play a pivotal role. These instruments can also be used for high risk first-of-a-kind or breakthrough projects in the form of impact finance or venture debt. The role of the EIB Group and other international and public financial institutions is critical to mobilise private investments, especially to de-risk projects, such as critical raw materials, and unlock the investments in infrastructure, provide longer tenors and larger tickets, as well as providing the signalling effect to other market participations.

Overall, a European approach on finance will be needed in the coming years, in close coordination with Member States, the European Investment Bank and the financial institutions to ensure a level playing field across the Single Market. Given the challenges for accelerating the deployment of net-zero technologies, intervention at the level of the Union helps coordinate responses accross Member States.

The recent European Investment Bank's counter-guarantee of EUR 5 billion for wind energy projects, for example, is expected to generate EUR 80 billion in investment. This shows the merit of a discussion with Member States how such innovative EU finance tools can de-risk make-or-break strategic investments in a technology-neutral manner into our economy.

Building on the experience the Commission gained with InvestEU, the use of financial instruments should be simplified further to make them more attractive to investors and project developers, including by tailoring instruments to specific investment types, providing clear terms, streamlining application processes, and developing user-friendly platforms, guidance and reducing administrative burdens. Further simplification throughout EU Programs and EU Financial Regulation is needed to offer true one-stop shops for finance and funding opportunities, which allows for pooling of resources, accelerated and easy access to finance, eventually combined with grants, limiting the number of forms to access support. These measures are necessary to ensure a level playing field for access to finance, which is particularly relevant for financial intermediaries and smaller businesses with limited organisational capacity.

It is important that sufficient fiscal space is preserved in Member States for investment, within the frame of medium- to long-term debt sustainability. The Innovation Fund as well as the national revenues under the EU ETS provide Member States with an important amount of funds that can be used for future-proof investments. This should be complemented by structural reforms to accelerate the transition towards climate neutrality. Similarly, the EU budget should be geared towards promoting, enabling and encouraging investment resulting in a lower level of emissions, while continuing, to implement, where applicable, the "do no significant harm" criteria, as already agreed by co-legislators for the next MFF. It should be reinforced to deliver higher quality investments and in this context the Commission urges swift progress on the proposed ETS own resource.

The 2040 target should also guide the financial sector and supervisory authorities when assessing the climate transition risks of investments, leading to favourable conditions when risks are minimised and adequate risk mitigation measures when they are not.

Research, innovation and skills

Technologies to be deployed to meet the EU's 2040 target include some that are market-ready, such as solar power, as well as a number that still need to be improved and scaled up.

It is therefore paramount to keep investing in the research and demonstration of innovative net-zero technologies, coordinating the EU and national R&I efforts, and strengthening efforts to bring innovations to the market and to scale them up. World-leading research on zero and low-carbon industrial technologies is being carried out at EU, national and regional levels across the EU, with the Horizon 2020 and Horizon Europe programmes funding cutting-edge R&I, including via partnerships with industry and Member States to help move low-carbon technologies for energy-intensive industries from basic research to deployment ([43]). Horizon Europe alone will allocate over EUR 30 billion (at least 35% of its budget) to climate action.

Revenues from carbon pricing are a clear source of financing for the deployment of innovative low carbon technologies and solutions. Since its creation in 2005, the ETS has generated more than EUR 180 billion, the largest share of which goes to Member States. Member States should be incentivised to invest these revenues into structural forward-looking reforms that significantly accelerate the manufacturing of innovative clean tech equipment and demonstrate and support the early deployment of industrial near zero solutions.

At EU level, the EU ETS Innovation Fund provides a strategic tool to support and scale up innovation in net-zero technologies towards full technological and commercial maturity. It is becoming a key instrument to deploy the EU green deal industrial strategy. In its first three rounds, the Innovation Fund allocated EUR 6.5 billion to around 100 pilot projects and demonstration plants for innovative low-carbon technologies. The amount and sectoral distribution of applications to the Innovation Fund show strong engagement of industrial actors in this transformation and a promising and abundant project pipeline. The heavy over-subscription of all large-scale calls for proposals calls for increasing available funding. For example, in the first two rounds of applications projects applied for EUR 33.8 billion of funding, for a total budget of EUR 1.1 billion. EU industry clearly has the know-how but also a challenge to invest in the new industrial revolution, for which the Innovation Fund can be an EU-based, single-market-aligned driver for cost efficient investments. The Commission will therefore seek to maximise the budget under the Innovation Fund until 2028 by frontloading the commitment of available funds. The Commission will also strengthen the synergies with other instruments and develop the Innovation Fund as a platform, through auctions to help Member States select and support the most promising projects with national funds in a cost-effective way. Innovative approaches, such as 'auctions-as-a-service' are a

([43]) European Commission (2023) Scaling up innovative technologies for climate neutrality

promising way to select the most competitive and environmentally effective projects across the Single Market, without competition distortions and in respect of the State aid rules.

New net-zero business opportunities lead to job creation and demand for new skills. Demand for additional skilled workers will come with investment made ahead of 2030 to meet the 2040 target, in net-zero technologies, in building renovations, innovative materials, and in servicing of net zero equipment. The skill sets of workers in declining fossil fuel or emission-intensive activities cannot always be easily transferred to new activities. An ambitious training and re-skilling development agenda coordinated at EU and Member State level should be developed to address the needs for new skills and jobs, building on the Skills agenda, European Year of Skills and existing EU initiatives. It should ensure new and improved job opportunities for those currently employed in sectors that are phasing out, and that the transition is not hampered by skills mismatches and shortages.

The further digitalisation of the economy will provide tools for example to manage the energy system integration and to contribute to a sustainable management of our land ([44]).

5 Conclusion and next steps

Securing the prosperity and well-being of current and future generations requires the EU to continue its transformation to climate neutrality and a sustainable, competitive economy resilient to climate hazards, geo-political risks and free of critical dependencies.

Key conclusions and policy insights for the transition can be drawn from the Commission's analysis (Annex to this Communication) to inform a broad debate on the action needed within the EU and in cooperation with our partners worldwide.

This Communication paves the way for a political debate and choices by European citizens and governments on the way forward. This will inform the next Commission making the legislative proposal to include the 2040 target in the European Climate Law and designing an appropriate post-2030 policy framework. The work done from 2024-2029 will shape Europe's path to 2040 and onwards to 2050. The policy framework will need to ensure a balanced and cost-effective contribution of all sectors to greenhouse gas emission reductions and carbon removals.

At the same time, to achieve the necessary greenhouse gas emission reductions and carbon removals, enabling conditions need to be in place. These include the full implementation of the 2030 framework; ensuring competitiveness of the European industry and agriculture; measures for ensuring a just transition; a global level playing field; and a strategic dialogue with stakeholders on the post-2030 framework, among others with a view to enabling the agricultural sector to maintain its role as guarantor of food security while decarbonising.

([44]) Such as "Destination Earth", a European Commission flagship initiative for a sustainable future.

Setting the EU's 2040 target will demonstrate the EU's determination to stay at the forefront of the global momentum of expanding cleantech manufacturing and harnessing the opportunities for economic growth and job creation. It will send a clear signal to the rest of the world that Europe remains fully committed to the Paris Agreement and to multilateral action providing the example and the means for others to act.

ANNEX

8 building blocks for achieving the 2040 target

1. **A resilient and decarbonised energy system for our buildings, transport and industry.**
   - All zero and low carbon energy solutions will be necessary (renewables, nuclear, energy efficiency, more sustainable bioenergy, storage, CCU, carbon removals, and all other current and future net-zero energy technologies).
   - The transition away from fossil fuels will increase the EU's independence and open strategic autonomy and reduce the risk of price shocks. Solid fossil fuels should be phased out. In line with REPowerEU, gas and oil use should decrease over time in a way that guarantees the EU's security of supply. A renewable and low carbon hydrogen supply chain should contribute to seasonal storage and hard to decarbonise sectors.
   - Electrification will be at the heart of the transition, through the deployment of recharging infrastructure, heat pumps and building insulation. The electricity sector should come close to full decarbonisation in the second half of the 2030s, with increased flexibility through smart grids, energy storage, demand response and low carbon dispatchable power energy storage. This will require an important reskilling effort in the manufacturing and servicing sectors.
   - The 2040 climate target will require substantial expansion and upgrades of the EU's power grids and storages. Changes in the energy mix will require significant investments over the coming 10-15 years and hinge on the ability to establish the right regulatory framework, integrated infrastructure planning, competitive manufacturing and incentives for resilient supply chains.

2. **An industrial revolution with competitiveness based on research and innovation, circularity, resource efficiency, industrial decarbonisation and clean tech manufacturing at its core.**
   - Need for a comprehensive investment agenda to attract private capital and ensure the EU remains an attractive destination for investment for research, innovation, deployment of new technologies, circular solutions and infrastructure. There is also a need for a smart and frontloaded use of public support for this transition, coupled with de-risking of private investment at scale.
   - As the Green Deal must also be an industrial decarbonisation deal, an enabling framework for decarbonised industry should complement a strengthened EU industrial policy with resilient value chains, notably for primary and secondary critical raw materials, and increased domestic manufacturing capacity in strategic sectors and principle of competitive sustainability fully incorporated in public procurement. This would require well-resourced funding mechanisms at EU level and the creation of lead markets, including through public procurement rules, market-based incentives, standards and labels to steer consumption towards sustainable, near-zero carbon materials and goods.
   - This will also require a more strategic approach to securing strategic commodities on the global market through joint purchase mechanisms, as well as measures addressing competitiveness of European exports on global markets.

- Along targeted investment support, carbon pricing will remain a principal driver for change. The current Emission Trading Systems will need to be supplemented with the efficient use of energy taxation and the phase out of fossil fuel subsidies which do not address energy poverty or just transition.

3. **Infrastructure to deliver and to transport and store hydrogen and CO_2.**

- Targeted public intervention can act as a catalyst to accelerate investment, including at European level. Particular attention should be paid to the development of a smart integrated energy infrastructure at the distribution level, including for the recharging and refuelling of vehicles, and for industrial clusters, including to supply hydrogen and low-carbon feedstock to substitute fossil-based input.
- Urban and city planning will allow citizens and business to decarbonise their environment, be it via recharging infrastructure or district heating.

4. **Enhanced emissions reductions in agriculture.**

- Agriculture plays a vital role in ensuring food security. Like other sectors, agriculture alsohas a role to play in the green transition. With effective policies that reward good practices there is room to decrease emissions from the sector faster while enhancing carbon removals in the land sector, in soils and forests. The agri-food value chain should be involved in order to create synergies and exploit the maximum mitigation potential.
- Clear policies and incentives should be put in place to realise the innovation potential in the food system and the bioeconomy at large as well as to deliver healthy and sustainable food to EU citizens.

5. **Climate policy as an investment policy**.

- An additional 1.5% of GDP compared to the 2011-2020 decade should be invested annually in the transition – moving resources away from less sustainable uses like fossil fuel subsidies. A strong mobilisation of the private sector will be pre-requisite to make this possible. The private sector will deliver most of these investments if the policy framework incentivises low carbon investment and discourages carbon intensive investment, provided there is a strong business case for these investments.
- Dedicated policies are needed to promote the EU as a leading destination for sustainable investments. This requires a comprehensive reflection on all elements: from taxation to access to finance, from skills to regulatory burdens, and from a deepening of the Single Market to energy costs. This is a crucial element for the future success of the EU agenda and should be coordinated with EU Member States.
- The transition also requires smart use of public support and financial schemes to leverage private investment at scale. Public support at scale in the sectors faced with high business risks and for households, where equity is a concern, will be essential. This will require a more active engagement and less risk-aversion from institutional financial actors and notably the EIB. At the same time, public support remains crucial, and the effective use of adequate resources, including through EU funding , should form part of a reflection, to make zero and low carbon industrial projects commercially viable.

6. **Fairness, solidarity and social policies at the core of the transition.**

- A climate neutral, inclusive and resilient economy will ensure the long-term prosperity and well-being of EU citizens. However, public policy and funds, as well as social dialogue, will have to tackle challenges for certain groups and regions, supporting decarbonisation investments by households.
- Addressing social concerns will require a clear policy focus on fairness, solidarity and social policies that not only alleviate the direct impact of carbon pricing where needed, but also

allow low-income households to make the effective transition towards no carbon emissions.

7. **EU climate diplomacy and partnerships to encourage global decarbonisation.**
   - The EU should continue to lead by example and provide a wide-ranging contribution to achieving the Paris Agreement goals and broaden and deepen its international partnerships.
   - It should deploy an active global carbon pricing diplomacy in synergy with other EU climate policy instruments such as CBAM.

8. **Risk management and resilience**.
   - The EU's natural resources are crucial to fully provide their ecosystem services, in particular in terms of controlling climate change and enhancing carbon sequestration.
   - The implementation of the Kunming-Montreal Global Biodiversity Framework and of the EU Biodiversity Strategy will be key to achieve the EU's climate objectives, including the 2040 target.
   - Climate change will nevertheless impact our societies for years to come, so we must prepare and adapt in parallel. Stepping up risk prevention and preparedness measures and implementing policies like water-efficiency or nature-based solutions in a coordinated manner will improve the resilience of the whole of our economy and reduce the costs.