EUROPEAN
COMMISSION

Brussels, 27.9.2021
SWD(2021) 277 final

COMMISSION STAFF WORKING DOCUMENT

For a resilient, innovative, sustainable and digital energy-intensive industries ecosystem: Scenarios for a transition pathway

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1. INTRODUCTION

On 10 March 2020, the Commission adopted a new Industrial Strategy to help Europe's industry lead the green and digital transformations and to drive Europe's global competitiveness and open strategic autonomy. Following the experience of the COVID-19 pandemic, the update of the EU Industrial Strategy[1] highlights the need to promote an inclusive recovery and further accelerate the green and digital transitions in line with the EU Green Deal[2] and Digital Decade[3] and increase resilience of EU industrial ecosystems. To do so, the Commission proposes a collaborative process with stakeholders – including Member States, industry, social partners, research and technology organisations, NGOs, citizens – to identify and co-design a possible path forward – a transition pathway – for industrial ecosystems, with priority given to the ecosystems that face the most important challenges and have been most heavily affected by the crisis. The transition pathway resulting from this process would identify the main objectives to be achieved and their timing during the transition period, the actions required to get there and the costs and challenges along the way.

This Staff Working Document serves as a starting point for the consultation and co-creation process with stakeholders. It builds on the ecosystem fiche included in the 2021 Annual Single Market Report[4] and is part of the engagement with stakeholders on the sectoral roadmaps towards climate neutrality set out in the Climate Law, as well as on the objectives set out in the European Green Deal and its main strategies for a more sustainable EU economy and society.

The transition pathway for the energy-intensive industries (EII) ecosystem can build on previous work done in the context of the "**Masterplan for a competitive transformation of EU energy-intensive industries enabling a climate-neutral, circular economy by 2050**" (see annex). The Masterplan, published in 2019, was the outcome of a year-long dialogue with stakeholders represented in the High-Level Group on Energy-Intensive Industries. It expressed the EIIs' commitment to climate neutrality by 2050 and set out concrete recommendations for actions by the EU, Member States and industry itself.

However, the focus of the transition pathway should be broader than the Masterplan's in two key dimensions: First, the EII ecosystem covers a broader range of sectors than are represented in the High-Level Group. These sectors have in common that they supply intermediate products to each other and to many downstream sectors of the economy, are closely integrated with energy providers as well as with the waste and recycling industries. Second, the transition pathway should focus not only on climate neutrality and circularity but also address the urgency to move towards a zero pollution and a toxic-free Europe, to stop biodiversity loss, as well as the digitalisation challenge and the need to strengthen the resilience of EU value chains.

The consultation process kicked off by this document invites Member States, social partners and all other stakeholders to contribute to a bottom-up assessment of scale, cost, long-term benefits and challenges and conditions of the required actions to accompany the twin transition of the industrial ecosystem.

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[1] COM(2021) 350 final
[2] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal
[3] Europe's Digital Decade: digital targets for 2030 | European Commission (europa.eu)
[4] SWD(2021) 351 final

1.1. The energy-intensive industries ecosystem in the EU

The energy-intensive industries (EII) ecosystem covers the chemicals, steel, pulp and paper, plastics, mining, extraction and quarrying, refineries, cement, wood, rubber, non-ferrous metals, ferro-alloys, industrial gases, glass and ceramics industries. The sectors included in the ecosystem are characterised by a high energy and carbon intensity and by being at the starting point of many value chains, providing raw, processed and intermediate materials rather than finished goods.

The industries of the EII ecosystem employ 7.8 million people in Europe and provide a value added of EUR 549 billion (4.55% of the EU total).[5] In 2019, they were responsible for 22% of total EU greenhouse gas emissions.[6]

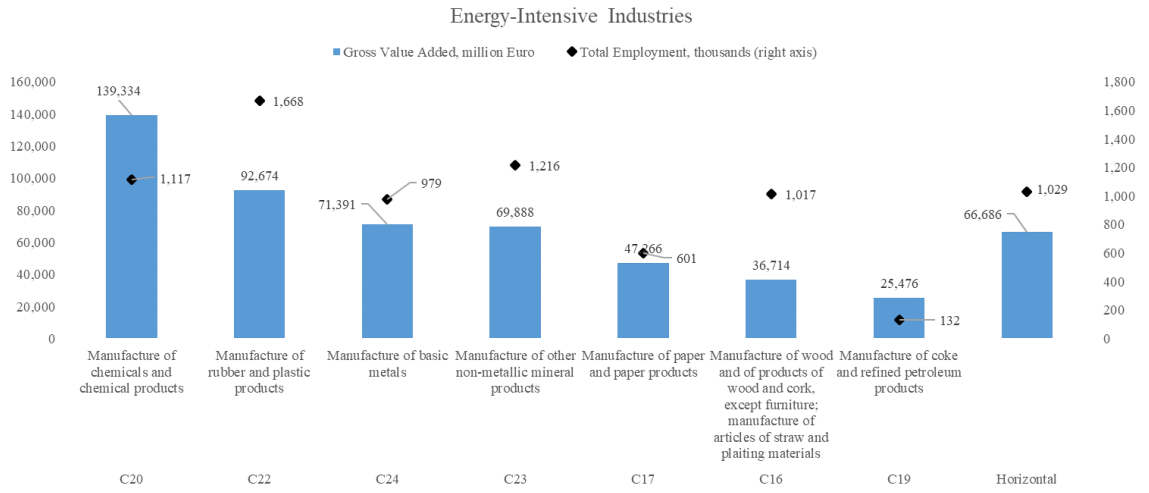

Figure: Value added and employment in the EII ecosystem[7]

The EIIs supply the basic materials used across our economy; they are strongly interlinked both with each other and with downstream sectors. They are also often closely connected or integrated with energy providers, as well as with the waste and recycling industries. Increased use of renewable energy and a strengthened circular economy will amplify these connections.

SMEs represent 99% of companies active in the EII ecosystem and account for 51% of employees working in this ecosystem. SMEs also represent 31% of the EII ecosystem turnover and 37% of value added. All parts of the ecosystem have a mix of large companies and SMEs. At one extreme, the refineries sector accounts for 40 large companies, at the other extreme, the manufacture of wood products has around 100,000 SMEs.[8]

[5] Eurostat [nama_10_a64] and [nama_10_a64_e]. Data from 2018 (or latest year available).
[6] Eurostat [env_ac_ainah_r2].
[7] Note: The horizontal bars refer to NACE codes; "Horizontal" refers to activities which contribute to all ecosystems, such as professional services and utilities; see Annex 4 of the Annual Single Market Report 2021. Source: Eurostat, National Accounts. Data from 2018 (or latest year available)
[8] Eurostat [sbs_sc_sca_r2]. Data from 2018 (or latest year available).

1.2. An ecosystem faced with multiple transition challenges

Even before the onset of the COVID-19 crisis, the EII ecosystem faced multiple, interrelated challenges. First and foremost, the challenge to decarbonise, in line with the EU's ambition to become climate neutral by 2050[9], while remaining competitive and continuing to provide the basic goods that downstream sectors and consumers require. Connected to this, an innovation and investment challenge, namely to develop and scale-up new, climate-neutral processes, become more digital and circular, and to adapt business models to changing customer needs, while providing high-quality employment. Finally, the challenge of performing this transition in a just and socially fair manner, and in a context of intense international competition and geopolitical development.

The green and digital transitions in the EIIs are characterised by high upfront investment costs that will lead to fuel and carbon savings on the long term and by a need to rethink business models: to become carbon-neutral, circular and environmentally sustainable, EIIs need to make changes to their long-established processes, make long-term investments in a challenging and fast-changing business environment and write off assets that are connected to fossil fuels. They also need to rethink the way in which they are implanted in surrounding communities, to allay public concerns related to possible conversion strategies but also to exploit potential synergies with broader transition processes, related to regional development schemes, reskilling initiatives and more.

To embrace digitalisation, they have to become more agile and innovative, build capacities in data collection, analysis and sharing, and protect themselves against the vulnerabilities (e.g. cybersecurity) that come with this transformation. To address the resistance to change by some, the implications and sharing of costs and benefits need to be discussed between the various stakeholders (companies, workers, consumers, investors, energy suppliers, society overall), shaping the transformation and its success factors.

COVID-19 added to this setting a more immediate threat, with border closures challenging supply chains and demand from downstream sectors dropping significantly. Annual production in the EU EIIs dropped significantly in 2020 (decrease ranging from around 22% for the steel sector, 10-16% for cement, 10-15% for flat glass and 1-11% for non-ferrous metals, amongst surveyed companies). This was largely driven by demand shocks in downstream industries, notably in automotive and construction, starting in March 2020.

In 2021, there is a strong, but uneven global recovery. As economic conditions ease, consumer spending is increasing and governments are rolling out their recovery packages, leading to a boom in certain sectors, such as building materials. As producers of many of these materials, companies in the EII ecosystem are benefiting from strong demand and increased prices for metals, minerals and timber. At the same time, processing sectors, which are also part of the EII ecosystem, are experiencing difficulties with securing their feedstock and energy supplies (see recent spikes in natural gas and electricity prices) at competitive prices. Shortages in other essential products, such as microchips, have at times led downstream sectors such as the automotive industry to halt production, thus in turn also decreasing their demand for EII products. To support the economic recovery, we need to preserve fair and undistorted trade within Europe and

[9] COM(2019) 640 final ('The European Green Deal'), Regulation (EU) 2021/1119 ('European Climate Law')

globally, but also work on building more resilient supply chains to be able to face such shocks.

2. VISION 2030/2050: A TRANSITION PATHWAY FOR THE EU ENERGY-INTENSIVE INDUSTRIES ECOSYSTEM

2.1. A resilient and competitive EU energy-intensive industries ecosystem

The importance of resilience and the need to ensure autonomy in key areas are important lessons that the EU and other global players have learned from the COVID-19 pandemic. While the EU benefits from being integrated in global value chains and from world markets being open – to ensure both security of supplies and sustained demand for our industrial output – excessive dependencies in strategic areas can lead to vulnerabilities, as shown notably at the beginning of the pandemic.

In the context of its "Update to the 2020 New Industrial Strategy", the European Commission published a Staff Working Document on strategic dependencies and capacities. In that document, it carried out a detailed quantitative analysis of foreign dependencies in the most sensitive ecosystems and a selected number of in-depth reviews of strategic dependencies. It also presented possible policy measures and tools to address them.[10] A bottom-up mapping of product dependencies included in the SWD identified 137 products in sensitive ecosystems for which the EU is highly dependent, of which 99 are linked to the energy-intensive industries ecosystem and 16 of these are critical raw materials.

This supports the assertion made in the European Green Deal Communication that access to resources is a "strategic security question" for the EU, as well as a pre-requisite for accomplishing the green and digital transformation. A foresight report on "Critical Raw Materials in Strategic Sectors and Technologies"[11], published by the European Commission's Joint Research Centre in 2020, calculates that demand for rare earths could increase tenfold, and demand for lithium 60-fold over the next 30 years in a scenario consistent with climate neutrality and increased use of digital technologies. Increasing demand, limited substitution possibilities and high levels of supply concentration, in combination, create significant vulnerabilities in the field of critical raw materials. If not addressed, these vulnerabilities could reduce the competitiveness of European companies and hamper the EU's ability to deliver on its green and digital ambitions. Furthermore, a high supply concentration in countries with low standards of governance[12] not only poses a risk to security of supply, but may also exacerbate environmental and social problems, such as forced labour and child labour.

The Commission's Action Plan on Critical Raw Materials,[13] adopted in September 2020, aims to address these vulnerabilities through a combination of policies and action: by diversifying and strengthening global supply chains including by continuing to work with partners around the world, reducing excessive import dependence, enhancing circularity

[10] https://ec.europa.eu/info/sites/default/files/swd-strategic-dependencies-capacities_en.pdf
[11] https://ec.europa.eu/docsroom/documents/42881
[12] According to the Worldwide Governance Indicators (WGI), which assess (I) Voice and Accountability; (II) Political Stability and Absence of Violence; (III) Government Effectiveness; (IV) Regulatory Quality; (V) Rule of Law; and (VI) Control of Corruption.
[13] COM/2020/474 final

and resource efficiency, and, in strategic areas, by increasing supply capacity within the EU. In addition, the Circular Economy Action Plan[14] and the Zero-Pollution Action Plan[15] promote circular economy processes aiming to ensure that waste is prevented and the resources used are kept in the EU economy for as long as possible.

Beyond critical raw materials, other challenges to resilience in the energy-intensive industries ecosystem include various trade and competition distortions put in place by other global actors to increase the competitiveness of their domestic industries through subsidies and the build-up of overcapacities, or to gain an unfair advantage in downstream sectors through e.g. export restrictions of raw materials.

The EU is responding to such distortions through its trade policy, including through the use of its trade defence instruments. Alone the steel sector currently accounts for one third of all trade defence measures currently put in place by the EU. Additionally, the EU is active in various multilateral fora, such as the Global Forum on Steel Excess Capacities, and prioritises such distortions in bilateral trade negotiations to address the root causes of distortive state interventions. Moreover, the Commission has proposed a new Regulation to address potential distortive effects of foreign subsidies and ensure level playing field in the Single Market (currently under discussion by the co-legislators)[16].

Given the role of energy-intensive industries in providing inputs for critical infrastructures and security-relevant technology, foreign ownership or control of assets can in certain cases constitute a risk to security or public order beyond the Member State where the infrastructure or technology is located. For that reason, the EU has put in place a foreign direct investment (FDI) screening framework[17] which complements national mechanisms for the screening of FDI and allows the Commission to issue opinions related to specific FDI transactions, where the security or public order of more than one Member State or a project or programme of Union interest appears to be at risk.

Key questions for stakeholders

- What are the main challenges to ensure resilience in your specific industry or country? What are the key priority sectors, products and materials? Which steps are you and other actors taking to address them?
- What other issues in relation to resilience would you propose to be considered for this pathway?
- What additional or different output scenarios for 2030 and 2050 (cf. table below) would benefit the development of a resilient EII ecosystem?
- Can you provide any data or analysis on strategic foreign dependencies you face (of a given input or technology) to support the Commission's analytical work on strategic capacities and dependencies going forward? Can you provide evidence if you are stretched as a supplier of strategic inputs or technologies?

[14] COM/2020/98 final
[15] COM(2021) 400 final
[16] https://ec.europa.eu/competition/international/overview/proposal_for_regulation.pdf
[17] Regulation (EU) 2019/452

List of actions to increase resilience in the energy-intensive industries ecosystem

Issues*	Actions and possible division of roles	Possible output scenarios for 2030/2050
Insufficient investment into strategic raw materials extraction and processing facilities in Europe	**Commission:** Facilitate the work of the European Raw Materials Alliance, develop sustainable financing criteria for the mining, extractive and processing sectors in Delegated Acts on Taxonomy **Member States:** Enable the required investments through appropriate financial support, where required, and reduced administrative burden **Industry:** Develop and implement projects that can contribute towards the European Raw Materials Alliance's goals, proactively involving local communities	2030: Investment pipeline of the European Raw Materials Alliance completed
Highly concentrated supply structures for critical raw materials, insufficient respect of environmental and social standards	**Commission:** Negotiate strategic partnerships with resource-rich countries, reinforce use of trade policy tools to secure undistorted access to new markets with due regard for international environmental and social sustainability standards, support R&D&I into tracking and labelling of raw materials; boost social/environmental certification and design rules; improve the knowledge base **Member States:** Consider how to ensure sufficient own capacities in strategic sectors, support the Commission's raw materials diplomacy; improve the knowledge base **Industry:** Diversify sourcing at a company level, build relationships with multiple/alternative/back-up suppliers, promote and prioritise decent supply chains, strengthen foresight and risk management strategies more generally, including as regards environmental and social risks	A network of partner countries that can supply the required sustainable raw materials to Europe in line with international social and environmental standards, increased diversification and back-up capacities; reduced number of critical raw materials; identify avenues for substitution by advanced materials
Increasing demand for critical raw materials, insufficient use of secondary raw materials, insufficient recycling rates	**Commission and Member States:** Support research and innovation (R&I) into substitution of critical raw materials, material efficiency and circularity; improve recycling rates through better collection and recycling systems (including extended producer responsibility) and introduction of market based instruments; boost market for secondary raw materials via circular product design rules (e.g. requirements to enable high quality recycling of products/materials to feed supply; minimum recycled content requirements on certain products to feed demand); take measures to ensure that global markets are undistorted. **Industry:** Improve foresight and risk management on critical raw materials demand and possible supply gaps; increase the availability and use of secondary raw materials; adjust by substituting CRMs in key products and improving material efficiency; implement circularity by design and increase incorporation of recycled content in new products	EU industry has access to sufficient amounts of raw materials to satisfy its needs, recycling rates are substantially increased compared with today, particularly for critical raw materials; reduced number of critical raw materials; increase use of secondary raw materials vs virgin raw materials.

Foreign acquisition of key strategic assets	**Commission and MS:** Application of EU and national FDI screening and approval mechanisms **Industry:** Increased awareness of vulnerabilities arising from sales of key business areas or assets to foreign competitors; possible acquisition of strategic assets in third countries by European companies	Key strategic assets in the EII ecosystem are controlled in a way that does not constitute a risk to security or public order.

* This is a non-exhaustive list for the purposes of the consultation. The table is based on several consultation processes and positions provided by EII stakeholders. This is a European Commission staff working document. It does not constitute the official position of the Commission, nor does it prejudge any such position.

2.2. Greening of the energy-intensive industries ecosystem

As a major emitter of greenhouse gases (representing 22% of all EU GHG emissions in 2019), the EII ecosystem has a major role to play in climate mitigation. Between 1990 and 2015, the EIIs already reduced their emissions significantly, and, since 2014, with an average yearly rate of 15[18] mostly through energy efficiency measures and other incremental improvements; but to achieve climate neutrality by 2050, a fundamental shift to sustainability – including accelerated and deep decarbonisation and a generalised circular transition – is required. The modelling underlying the Commission's policy proposals for delivering the European Green Deal[19] calculates that industry's emissions of around 600 million tonnes CO_2-eq. in 2015[20] would have to decrease by around 23% by 2030. The in-depth analysis accompanying the EU Long-Term Strategy estimated that reductions of at least 95% by 2050 are in line with the economy-wide climate neutrality target now enshrined in the European Climate Law.

Beside the challenge of reducing its own greenhouse gas (GHG) emissions, the EII ecosystem also has a role to play as an enabler of decarbonisation in other ecosystems, considering the whole life cycle of products and services used. For example, the raw materials sector provides the critical raw materials required for solar panels and wind turbines used in the renewable energy ecosystem; or electric vehicle motors and batteries used in the mobility ecosystems; bio-based materials are offered for substitution of fossil-based ones e.g. in the textile and mobility ecosystems. The increased electrification of sectors will also boost demand for base metals, such as copper. The Renovation Wave[21] will require more and novel building materials with good insulation properties and a low environmental footprint. EIIs as major and growing electricity consumers can also play a role in integrating more renewable energy sources into the system by concluding renewable Power Purchase Agreements and providing demand-side flexibility. Industrial waste heat can become an important source to replace fossil fuels for low-temperature applications, such as building heating.

[18] EU Reference Scenario 2020 – ISBN 10.2833/35750
[19] SWD(2021) 601 final.
[20] The definition of "industry" in the PRIMES model is broader than the definition of the EII ecosystem (it includes chemicals, but also textiles, food&drink and others). Within these sectors, it includes process emissions, but not refineries and energy branch emissions.
[21] A Renovation Wave for Europe - greening our buildings, creating jobs, improving lives, COM(2020) 662

Finally, the EII ecosystem has other life-cycle environmental and social impacts: raw materials extraction has to become less invasive and address its impact on biodiversity and water resources, as well as address labour abuses, occupational health and safety challenges and potential impacts on public health and living conditions of affected communities. A strengthened market for secondary raw materials could play a key role in this. Process industries should work towards the European Green Deal's zero pollution ambition for a toxic-free environment, in particular to contribute to achieve the objectives of the Chemicals Strategy for Sustainability[22] to ensuring that all chemicals are used more safely and sustainably, to minimise and substitute as far as possible substances of concern, and to phase out the most harmful chemicals for non-essential societal use, in particular in consumer products. It should also contribute to the biodiversity objectives; the role of circular products and processes must be promoted, with important benefits from an environmental, autonomy and competitiveness perspective.

Given that investment cycles in EIIs often go over several decades, decisions have to be taken today to shift to low-carbon and circular production processes, make the accompanying investments, including for re-/upskilling of the workforce, and adapt business models. The costs for making these investments should be borne primarily by the industry itself, in line with the polluter pays principle, but supported by public regulation and investment. Depending on the industry, there are different mature technical options to move to net-zero emissions: more energy efficient, digitalized processes; direct use of renewable resources; electrification; the use of clean hydrogen, sustainable biomass and sustainable bioenergy as a renewable feedstock or energy source to replace fossil fuels; carbon capture, utilisation and storage; increased circularity to retain material value and reduce the need for primary raw materials extraction; etc. In many cases, these technological pathways are complementary and should be pursued in parallel.

Recent studies[23] show that production costs of low-carbon technologies are highly uncertain. While continued R&I plays a role in making them more competitive in the future, they are still more expensive than fossil fuel based production pathways. The renewable electricity price is a determining factor for technologies relying on direct electrification, but it is also the major cost component of green hydrogen production. The price of biomass is a determining input for a fuel switch route in the cement sector and new feedstock routes in the chemicals sector. The capital-intensive carbon capture technologies and the cost of carbon transport and storage determine the competitiveness of carbon capture and storage routes in all sectors. To avoid risks of technological lock-in and stranded technologies, thorough consideration of R&I results in Horizon Europe partnerships like Processes4Planet and Clean Steel partnerships, Clean Hydrogen alliance plays a crucial role in enabling efficient investment in future technologies.

As the sustainable transformation unfolds, the development and deployment of new innovative techniques by energy-intensive industry sectors should increase synergies between decarbonisation, depollution and other environmental objectives. Recent work

[22] Chemicals Strategy for Sustainability. Towards a Toxic-Free Environment, COM(2020) 667.
[23] JRC (2020), *Decarbonisation of industrial heat: The iron and steel sector*; based on: International Energy Agency (2020), *Energy technology perspectives;*
Material Economics (2019), *Industrial transformation 2050 — pathways to net-zero emissions from EU heavy industry;*
Agora Energiewende and Wuppertal Institut (2019), *Klimaneutrale Industrie: Schlüsseltechnologien und Politikoptionen für Stahl, Chemie und Zement*.

and related studies[24] have made it increasingly clear that innovative and breakthrough decarbonisation techniques, i.e. precisely those that will be deployed by the energy intensive industry, will also lead to significant air pollution benefits.

In this context, sustainability and competitiveness of the EIIs should be seen as two mutually supportive objectives: while observing high environmental and social standards inevitably creates compliance costs, it also helps companies set themselves apart from competitors, innovate, increase productivity and conquer new markets. In the EII ecosystem, this is particularly true, as the green transition requires a fundamental rethinking of traditional production processes, the development of new business models (e.g. industrial symbiosis, reuse and recycling, producer ownership, energy system integration) and the creation of whole new value chains (e.g. clean hydrogen). As frontrunners in the application of innovative, low-carbon production pathways, European companies can benefit from first-mover advantages. Various policies and instruments have already been put in place (cf. chapters 3.1 and 3.2) to bridge the cost gap in the transition period.

European and other companies have already begun to embark on the transformation – through research and development, pilot plants, and in some cases demonstration at industrial scale; however, many new process technologies are either not yet sufficiently developed, lack a business case or require coordination and complementary public investments, such as into infrastructure. In many cases, low-carbon production processes may initially have higher operational costs than the conventional alternative,[25] which comes on top of the initial R&D and capital investment. More stringent carbon pricing, the availability of abundant, decarbonised electricity at affordable prices and measures to support the deployment of low-carbon commodities (e.g. via Carbon Contracts for Difference) should change the balance in favour of sustainable production processes.

R&I plays a crucial role in making low-carbon technologies more competitive and in assessing potential risks before technologies are rolled out. To maximise synergies between different R&I efforts and make them useful for industrial transitions, the European Research Area (ERA) common industrial technology roadmaps launched in 2020 in the New ERA Strategy[26] will align and link key partnerships under Horizon Europe with industrial ecosystems, including energy-intensive industries. They will provide comprehensive evidence on European R&I development for breakthrough low-carbon technologies and point to strengths and weaknesses in investment agendas and framework conditions at EU and national level.

The first roadmap on low-carbon industrial technologies for energy-intensive industries aims at enabling the transformation needed to reach net-zero emissions. A second roadmap on circular industrial technologies is being scoped to follow and support Zero Pollution Action Plan ambition, addressing the circularity of the production processes, in

[24] The study 'Wider environmental impacts of industry decarbonisation', 2021, Wood, commissioned by the DG Environment summarised existing studies: https://circabc.europa.eu/ui/group/06f33a94-9829-4eee-b187-21bb783a0fbf/library/39928fd6-dcea-4fbc-b798-70e816bdecb0?p=1&n=10&sort=modified_DESC

[25] For example, a study by Material Economics, estimates that the cost per tonne of steel produced with hydrogen direct reduction will be between 10 and 20% higher than with the conventional blast furnace process. This is driven by the cost of renewable electricity and hydrogen, which will be required in vast quantities. (Material Economics (2019): Industrial Transformation 2050). The same report ranges the investment needs from the steel industry from around €70bn to around €100bn.

[26] Communication A new ERA for Research and Innovation, COM/2020/628 final

terms of material use and circularity of emissions, and the waste streams generated by industries such as steel, chemicals or ceramics.

The recent IEA "Net Zero by 2050" flagship report[27] concluded that almost half of the cumulative CO_2 emissions reductions required to get us to climate neutrality by 2050 may come from technologies that are currently at the early development/demonstration phase and that would not become available at scale without further (and significant) research and development efforts. The IEA has also made a connection between the transition to a net-zero economy and the supply of critical raw materials in its report entitled "The Role of Critical Minerals in Clean Energy Transitions".[28]

Overall, the green transition will mean a shift in the EU's raw materials use: while fossil fuels will be phased out, demand for metals and minerals will increase.[29] The advantage of the latter class of raw materials is that they can be reused and recycled, meaning that over time the demand for extraction of primary raw materials will decrease. To this end, a focus on circularity and resource efficiency should permeate the value chains served by the EIIs – from design to consumption/use and to end-of-life management, including effective waste prevention, collection and recycling systems. Moving towards a fully circular economy will not only be essential in mitigating climate change and other environmental impacts of raw materials extraction, but also in reducing the EU's import dependence, satisfying the growing demand for raw materials and retaining material value.

The "Masterplan for a competitive transformation of EU energy-intensive industries enabling a climate-neutral, circular economy by 2050" looked in detail at the actions to be taken and the challenges to be addressed to enable this transition. The main priorities it identified – creation of markets for climate-neutral and circular products; financing for R&D, demonstration and commercial uptake; and access to low-carbon energy and feedstock at affordable prices – and the lists of concrete actions to be taken by different stakeholders, have already served as a guiding tool for policymaking and stakeholder coordination. A detailed overview of how the recommendations are being addressed is provided in Annex I.

Beside the general, ecosystem-wide vision provided by the Masterplan, it is essential for specific sectors and companies to plan ahead, define which technological pathways to embark on and outline concretely the milestones to be achieved. Many sectors have already developed mid-century roadmaps but few of them are in line with the EU's increased climate ambition for 2030. These should be followed up on, regularly updated and possibly expanded to include not only the technology and investment dimension but also the implications for jobs, skills and regions. There is also a number of relevant work streams such as the ERA common industrial technology roadmaps, and reports and studies on transition pathways that should to be taken into consideration, including by Finland[30], Agora Energiewende[31], McKinsey& Company[32], the EU Reference scenario[33]

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[27] https://www.iea.org/reports/net-zero-by-2050

[28] https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions

[29] Cf. International Resources Panel (2019): Global Resources Outlook 2019; JRC (2020): Critical materials for strategic technologies and sectors in the EU.

[30] https://julkaisut.valtioneuvosto.fi/handle/10024/162851

[31] https://www.agora-energiewende.de/en/publications/a-clean-industry-package-for-the-eu-impulse/ and https://www.agora-energiewende.de/en/publications/tomorrows-markets-today/

[32] https://www.mckinsey.com/business-functions/sustainability/our-insights/how-the-european-union-could-achieve-net-zero-emissions-at-net-zero-cost#

and the Impact Assessment accompanying the policy package released on July 2021[34]. The Energy and Industry Geography Lab, an online geospatial information hub, developed by the European Commission's Joint Research Centre that will be released around the end of the year, will also be a useful tool for large energy consumers and infrastructure planners.

Key questions for stakeholders

- Are the energy-intensive industries on the right track to achieve our targets (climate neutrality, biodiversity, circularity, zero pollution, social fairness)? In which areas are the action gaps between where we want to be and where we need to be greatest?
- What other issues or barriers in relation to the green transition would you propose to be considered for this pathway?
- What additional or different output scenarios for 2030 and 2050 (cf. table below) would benefit the development of a sustainable EII ecosystem?
- Are there specific targets already set in the roadmaps by the different EII sectors to define where the EII wants to be in 2030 in terms of transition toward climate neutrality and in terms of circularity?
- What actions are required to create lead markets for low carbon products?
- What additional initiatives could facilitate secondary raw material transfer from one industry sector to another or internally within a sector? What actions are needed to boost demand and secure supply? Is it possible to double the circular material use rate by 2030 in line with the Circular economy action plan?
- In addressing the challenges outlined here, how do you see the respective roles of the Commission, Member States, industry, social partners and other stakeholders? Do we need new or amended legislation, international agreements, new institutional structures, new standards, targeted funding, industry initiatives, targeted research and innovation, better communication or any other action towards a more innovative ecosystem?

[33] https://ec.europa.eu/energy/data-analysis/energy-modelling/eu-reference-scenario-2020_en
[34] SWD(2021) 601 final

List of actions to increase sustainability in the energy-intensive industries ecosystem

Issues*	Actions and possible division of roles	Possible output scenarios for 2030/2050
High investment cost to move from early phase to commercialisation, many low-carbon technologies are still under development	**Commission:** In compliance with competition and trade rules, continued support for R&D&I and for commercial demonstration of low-carbon technologies, with targeted instruments (such as the Innovation Fund or Horizon Europe aimed at bridging the "valley of death". Support for 1st-of-a-kind projects to address technological uncertainty of upscaling. Increased transparency in state of play in R&D&I development through ERA industrial technology roadmaps. **Industry:** Boost commercialisation of sustainable EII products, develop clear technological roadmaps highlighting investments needs, with measurable intermediate targets. When making investment decisions, build on synergies between different environmental objectives (such as GHG and air pollution) to optimise the cost-benefit ratio. **Member States:** Support R&D&I and commercial demonstration of low-carbon technologies, technology transfer and uptake.	Necessary investments have been made into the technologies that are necessary to bring EIIs on track to climate neutrality by 2050 Expected impacts of the Clean Steel and Processes4Planet partnerships (as examples of specific targets): • Developing, testing and scaling breakthrough technologies for clean steel production to contribute to the reduction in CO2 emissions target by 55% by 2030 and reach the EU targets of 95% CO2 reductions by 2050 • Achieving TRL 8 by 2030 in at least 12 technologies funded by the Partnership • Implementing by 2027 at least 2 demonstration projects leading to 50% CO2 emission reduction. • Putting in place more than 15 large scale demonstrators reaching TRL 9 towards 100% climate neutrality by 2030 across energy intensive industries • Launching 25 circularity hubs by energy intensive industries with regions in Europe by 2027 • Reuse/recycle of industrial waste water by 90%.
EIIs face long planning horizons and lead times for new sustainable, low-CO_2 installations	**Commission:** conduct foresight studies and set up mid- to long-term roadmaps that will inform investors about the future options and necessities, ensuring that investments will be future-proof and avoiding lock-in due to non-sustainable investments. **MS:** Review, accelerate and improve lengthy planning and permitting processes, in cooperation with industry.	Planning and permitting processes are accelerated and no longer perceived as an unjustified barrier to investments into decarbonisation of EIIs
Difficulty in mobilising and matching financing for sustainable, low-CO_2 projects	**Commission/MS:** Technical assistance in accessing funding opportunities. Work with MS to provide financial support to projects aiming at modernising and decarbonising EIIs. Fund the demonstration of low-carbon technologies through an expanded ETS Innovation Fund. **Industry**: Boost private funding of low-	By 2030: Investments into first of a kind industrial projects have been made By 2050: Massive deployment of sustainable, low-carbon production processes, fully replacing polluting processes

	CO_2 projects.	
New technologies currently face higher operational costs than conventional ones	**Commission/MS:** Implement instruments that address OPEX disparity, such as CCfDs, through funding possibilities in the Innovation Fund as well as through better accommodation of such schemes in the EU's State aid guidelines;[35] Develop the Green Claims Initiative and the Sustainable Products Initiative to boost demand for green products; support development of R&D&I in Horizon Europe partnerships with industry to make new technologies more cost-efficient **Industry:** Invest into R&D&I and commercialisation to drive down the costs of new technologies	Low-carbon and resource efficient processes are able to compete with conventional processes through a mix of public support instruments, increased product differentiation by consumers, economy of scale, and cost decreases in low-carbon technologies through a steep learning curve
Low CO2-technologies are dependent on the timely and coordinated deployment of external supporting infrastructure, e.g. renewable electricity, clean hydrogen, CCUS	**Commission/MS/Industry:** International coordination around electricity transmission, hydrogen and CO_2 infrastructure. Several initiatives already underway promoting coordination of RES and hydrogen (e.g. Clean Hydrogen Alliance, revision of the rules on Trans-European Networks for Energy). Infrastructure funding through the Connecting Europe Facility. Research funding on CCUS through Horizon Europe, **Industry:** Engage in cross-supply chain collaboration, e.g. around H2 production and storage. Actively engage with alliances and partnerships, develop mature roadmaps to specify full electricity, hydrogen, CCUS needs. Engage with the energy suppliers in flagship projects.	Industry has access to abundant, decarbonised electricity at affordable prices, is connected to the required electricity, hydrogen and CCS infrastructure; network operators systematically integrate changes in demand arising from decarbonisation needs into their network planning
Lack of established markets for sustainable, green products	**Commission/MS**: Leverage public procurement to create market for sustainable products, including CO2 reduction requirements and performance-based specifications in tenders; standardisation of low-carbon products; labelling of industrial products manufactured with renewable energy; set sustainability information requirements on relevant products; facilitate green public procurement procedures; promote a level-playing field on green claims made on products **Industry:** Develop green products buyer's clubs within their B2B value chain. Actively engage across the sector to develop sustainability certification	Consumers (final consumers, businesses, public authorities) of EII products demand sustainable, low-carbon and circular products; European producers are leaders in the emerging global markets for clean technology and low-carbon base materials

[35] Cf. https://ec.europa.eu/competition-policy/public-consultations/2021-ceeag_en

	schemes, creating a differentiating value added to their green products.	
EIIs face high trade exposure and uneven global competition	**Commission:** Use trade policy, including trade defence tools; promote green/low-carbon standards and labelling globally; promote decent supply chains.	GHG emissions incurred in the production of EII goods both within and outside the EU are priced at an equal level
Low incentive to retain material value, including by waste-prevention, reuse of products and materials and recycling of waste	**Commission:** Implement design requirements that include waste prevention, reuse, recyclability and repair criteria as well as minimum recycled content requirements where feasible, promote Extended Producer Responsibility where relevant, introduce the requirement to industrial operators to incorporate Resource Efficiency and Circular Economy and Plans and a Chemicals Management System as sections of their Environmental Management Systems (EMS); Promote industrial symbiosis for the circularity of energy and materials flows between industrial plants in the same industrial area and urban industrial symbiosis to ensure optimal re-use of waste (Process4Planet partnership under Horizon Europe) **Member States:** Use economic instruments and monitoring to incentivize reuse and recycling **Industry:** Integrate full lifecycle approach in design and manufacturing.	EIIs pursue circularity by design, significantly reduce waste generation, boost repair offers to consumers and achieve high recycling rates, especially for critical raw materials. Uptake of secondary raw materials in product design also boosted.
Lack of up-/reskilling support	**Commission/MS:** work with industry on skills partnerships under the Pact for Skills, implement the "Blueprint Alliances for Sectoral Cooperation on Skills" established under the Erasmus+, implement the upskilling programmes of the EIT KICs in their specific thematic areas; implement the Just Transition Mechanism. **Social partners/industry/trade unions:** Map-out and better anticipate skill requirements, including of new technologies and in major R&I projects, and actively engage in upskilling/reskilling of workforce, including through EU-level social dialogue.	Up/reskilling support for workers is a reality based on the implementations of roadmaps for upskilling/reskilling of workers jointly developed and implemented by social partners, industry and trade unions; skill requirements are assessed as integral part of R&I projects; relevant funding tools are used effectively to support reskilling/upskilling. Adult participation rates in training increase in line with the new headline target of the European Pillar of Social Rights Action Plan.
Transition in the EII ecosystem will require labour reallocation, between and within regions, potentially leading to problematic demographic shifts	**Commission/MS:** granular mapping of employment in the industries at NUTS 2 and 3 levels **Member States and social partners:** support restructuring and job-to-job transitions in a socially fair manner	Mapping of where jobs are being created, transformed and lost to better tailor support and cohesion policies, as well as the engagement and active involvement of affected citizens and communities in view of developing alternative regional development schemes
Lack of	**MS:** strengthen active labour market	Ensure just transitions in the context

anticipation and management of change can lead to unnecessary disruptive restructuring	policies and tools, including adequate social protection and revenue recycling, to ensure just transitions including for the workers and households most impacted **Social partners/industry/trade unions:** effective social dialogue at European, national, regional and company level to anticipate and manage change in the eco-system, promoting retraining, upskilling and job-to-job transitions and necessary accompanying policies	of rapid technological transformation

* This is a non-exhaustive list for the purposes of the consultation. The table is based on several consultation processes and positions provided by EII stakeholders. This is a European Commission staff working document. It does not constitute the official position of the Commission, nor does it prejudge any such position

2.3. Digitalisation of the energy-intensive industries ecosystem

The digital transformation offers many opportunities for companies in the EII ecosystem to improve their operations.

Logistics and process operation of EII can be optimised by connecting sensors and controls in real time with powerful Artificial Intelligence running. Human operators would be involved in decision making whenever needed through human machine interfaces based on augmented and virtual reality Optimisation involves balancing supply and demand and avoiding waste. It can take into account the needed stability for the power grid, and use less power if renewable energy sources supply is low, or vice versa.

Predictive maintenance, using digital technologies, will reduce the frequency of disruptions and the length of downtimes and make maintenance plannable.

More autonomous and dexterous robots could provide access to remote raw material deposits and improve occupational health and safety. The use of earth observation data already today allows for better raw materials exploration and monitoring of environmental and social impacts.

Industrial data spaces, allowing for easy, trustful and secure data sharing in and across sectors, can help optimise industrial processes and energy efficiency, as well as circularity of energy and materials flows between industrial plants in the same industrial area.

Digital technologies can also be very useful during the transition phase from the current industrial processes towards sustainable ones. Digital twins and other simulation technologies, supported by industrial data spaces, can help optimising the transition by easily exploring the various options, and helping to take policy decisions on the basis of scientific data. The "Destination Earth" initiative supported by the Digital Europe programme can significantly contribute to this objective.[36]

[36] https://digital-strategy.ec.europa.eu/en/policies/destination-earth

Additionally, digitalisation can change business models and the nature of competition:[37] Digital product passports could give consumers detailed information about the environmental characteristics of their product, sourcing of raw and other materials (incl. chemicals), and working conditions along the entire value chain. This would enable companies to differentiate themselves from competitors based on their environmental, social and governance credentials, or the environmental footprint and recycled content of their products, rather than purely the price. Such technologies could give downstream companies (which rely on the EII ecosystem for sourcing their inputs) a stake in ensuring compliance and improved performance along their entire value chain.

Finally, in order to make use of the full potential advantages of digital technologies, the entire value chain has to be digitalised, including the smaller vendors or service providers. This will require an effort to make digital technologies easily available for the SMEs in the value chain.

Given the severe consequences that cyber-attacks and IT system failures could have in the EII ecosystem,[38] particular attention should be paid to cybersecurity concerns. Digital technologies used in the EIIs should be extremely resilient to internal and external disruption, designed with stringent safety and security criteria; safeguards should be used when consumer-grade technologies, which are intrinsically less secure and reliable, interact with core EII system, which could happen e.g. in smart grid applications.

A series of legislative instruments, will contribute to facilitating digitalisation in the EII ecosystem. These include the forthcoming Sustainable Products Initiative, the forthcoming EU legislative proposal on Sustainable Corporate Governance, the Data Governance Act, the Data Act, and the Cybersecurity Strategy.

In terms of EU financial support, notably the Single Market, Digital Europe and Cohesion programmes, will promote the deployment and use of digital capabilities including industrial data spaces, computing power, open standards, testing and experimentation facilities.

The digital transformation of the EII ecosystem can help increase the resilience, sustainability and competitiveness of this ecosystem. The awareness of opportunities and understanding of challenges related to the digital transition is less advanced than on other dimensions. The purpose of this chapter is to kick-off a discussion on how the EII ecosystem could make greater use of digital applications, including in support of the transition to sustainability and social fairness. Given the early stage of the reflection, the list of applications and possible implications provided above only presents a first collection of ideas. Stakeholders, who know their business environment and the opportunities for innovation best, are invited to present their best practices, ideas and concerns, to complement this list and lay the groundwork for future reflection and, where necessary, action.

[37] For example, a recent report by McKinsey and Company highlights developments in the chemicals industry: https://www.mckinsey.com/industries/chemicals/our-insights/how-chemical-players-can-win-in-the-transition-to-digital-platforms

[38] EIIs generally operate large and powerful machines (mining equipment, sawmills, furnaces, etc.) that could pose a danger to workers and the environment if they malfunction; they are connected to critical infrastructure (electricity and gas grids, waterways) that could be compromised by cyber attacks on EIIs; finally, single plants are often responsible for a large share of the aggregate production, such that their sabotage could disrupt several downstream value chains.

Key questions for stakeholders

- Which digital technologies are the most relevant for the EII ecosystem or for your specific industry? Which ones are you already applying today and which will require more time, funding and coordination?
- What are the main barriers to uptake of digital technologies in the EII ecosystem?
- How can data collection, use and sharing (in and across sectors) be increased to improve resilience, sustainability and competitiveness of the EII ecosystem? What issues need to be tackled?
- What other issues related to the digital transition would you propose to be considered for this pathway?
- What additional or different output scenarios for 2030 or 2050 (cf. table below) would benefit the development of an innovative EII ecosystem?
- What are the implications of digital technologies for the EII ecosystem and for the main skill requirements and training needs in its sectors? How could they help increase innovation, resilience, competitiveness and sustainability? Do you see any risks in the use of digital technologies and how could these be addressed?
- Is policy intervention/coordination required to move forward on the use of digital technologies in EIIs ? If so, in which way and by which actors?
- In addressing the challenges outlined here, how do you see the respective roles of the Commission, Member States, industry, social partners and other stakeholders? Do we need new or amended legislation, international agreements, new institutional structures, new standards, targeted funding, industry initiatives, better communication or any other action towards a more innovative ecosystem?

List of actions to increase digitalisation of the energy-intensive industries ecosystem

Issues*	Actions and possible division of roles	**Possible output scenarios for 2030/2050**
Further development of digital technologies that optimise EII processes	**Commission:** Provide opportunities in Horizon Europe for collaborative research to use novel ICT technologies in the EII sector. Promote data sharing among these companies to improve the entire value chain through the development of Data Spaces in Digital Europe Programme. **Industry:** explore cooperation opportunities in industrial clusters to enhance energy and material efficiency	EIIs make use of digital technologies and data to enhance the efficiency and sustainability of their operations
Slow take-up of digital technologies that would enhance sustainability	**Commission:** Support the development of green and energy data spaces to support energy efficiency measures, energy system integration, industrial symbiosis and the substantiation of green claims, implement the Sustainable Product Initiative incl. the digital product passport to increase sustainability, transparency and traceability of products **Industry:** Develop IT and monitoring systems to support the rollout of sustainability information on products	EIIs are able to substantiate green claims through improved data use and data sharing. Consumers can view reliable product sustainability information through digital product passports (incl. also on social aspects of sustainability)
Cybersecurity concerns	**Commission/MS:** Take action to address cybersecurity concerns specific to the EII (guidelines, legislation, cybersecurity capacity building, etc.) **Industry:** Invest into cybersecurity, run stress tests to identify vulnerabilities and address them	EIIs have addressed cybersecurity concerns through prevention or robust structures, and can on this basis make better use of digital technologies
Lack of digital skills among EII workers	**Commission/MS:** Support and invest into digital skills development, work with the industry and social partners to forge and implement skills partnerships under the Pact for Skills **Social partners/industry/trade unions:** Identify and anticipate skill requirements and training needs, develop roadmaps, curricula and tools for upskilling/reskilling workers in the EII ecosystem to use digital technologies, actively invest in digital skills, education and training	EIIs have adequate tools for skills anticipation and (re)training and a sufficiently trained workforce to make optimal use of digital technologies By 2030: Ensure that EIIs contribute effectively to the EU headline target for adult participation in training
Ensuring that digitalisation strengthens the resilience of industry and	**Social partners/industry/trade unions:** promote social dialogue to anticipate and manage changes as a result of digitalisation, building on the European cross-sectoral framework agreement on digitalisation[39]	Ensure just transitions, including in the context of greater digitalisation

[39] European Social Partners Autonomous Framework Agreement on Digitalisation, https://www.etuc.org/system/files/document/file2020-06/Final%2022%2006%2020_Agreement%20on%20Digitalisation%202020.pdf

jobs		
Lack of broadband infrastructure, esp. in rural areas	**Commission/MS:** Support roll out broadband infrastructure **Industry:** roll out broadband infrastructure	All EIIs, even in rural areas, have access to broadband infrastructure and face no technical limits to their application of digital technologies By 2030: Gigabit for everyone, 5G everywhere in Europe.[40] 5G massively implemented to support efficient use cases of verticals leading to energy savings
Need to support uptake of digital technologies and coordinate digitalisation across several dimensions	**Commission:** Digital Innovation Hubs provide digital innovation support, together with funding from Next Generation EU, Cohesion Policy Funds, Horizon Europe **Industry:** Include digitalisation in roadmaps, link to sustainability and engage across all dimensions, support digitalisation of all actors in the value chain, including SMEs	Digitalisation in EIIs is advanced, including in SMEs, and well coordinated, synergies between digitalisation and sustainability are made use of to the maximum extent

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[40] Digital Compass communication, COM(2021)118

3. SUPPORTING THE ECOSYSTEM TRANSITION AND LONG-TERM HORIZONTAL CHALLENGES

The energy-intensive industries ecosystem will need a supportive framework at European, national, regional and local levels, and a commitment from industrial and other relevant stakeholders in order to work towards a common vision. This includes an enabling regulatory framework, sufficient financing, access to energy and infrastructure, a strategy and comprehensive, effective policies for skills and just transition, and broad social support for the measures needed to address for the challenges and needs of the transformation. Additionally, continued dialogue and monitoring in social dialogue committees, stakeholder groups and international fora is needed, as well as a set of KPIs to monitor the achievement of objectives. These are all necessary enablers for the successful transition of the EII ecosystem.

3.1. Enabling regulatory framework

Given their large environmental impacts, activities in the EII ecosystem are subject to numerous regulations at both national and European level: EIIs must comply with EU environmental regulations, e.g. the Extractive Waste Directive, Waste Framework Directive, Industrial Emissions Directive and Environmental Impact Assessment Directive, and need permits at national, regional or local level before starting operations. Most sectors in the EII ecosystem have also, since 2005, been subject to carbon pricing through the EU Emissions Trading System (ETS). These regulations are thus crucial in defining the operating environment for EIIs.

In July 2021, the European Commission adopted the package to deliver the European Green Deal – a package of 13 legislative proposals jointly designed to deliver on the targets of the European Green Deal, namely to decrease GHG emissions by at least 55% (compared to 1990 levels) by 2030, and to achieve climate neutrality by 2050.[41] The aim of this package, which is now under negotiation between the European Parliament and the Council, is to provide an ambitious, balanced and stable regulatory framework for GHG emission reductions across the European economy while ensuring that the transition is just and socially fair.

Particularly relevant for the EII ecosystem within this package is the proposal to strengthen and extend the EU ETS, which includes a substantial increase in the size of the Innovation Fund. Furthermore, the proposed EU Carbon Border Adjustment Mechanism – covering the iron and steel, cement, fertiliser, aluminium and electricity sectors – would address carbon leakage and increase global ambition on climate change mitigation. Finally, the proposed amendment of the Renewable Energy Directive not only increases the renewable energy target to 40%, but it also puts in place a certification system for renewable hydrogen and mandates quotas for renewable hydrogen consumption in industry and transport.

There is also potential for other regulatory instruments to create markets for sustainable, circular and low-carbon products:–The development of green and low-carbon standards, certification and labelling obligations, the sustainable products initiative, sustainable corporate governance legislation, public procurement rules and guidelines and the green

[41] Communication on 'Fit for 55': delivering the EU's 2030 climate target on the way to climate neutrality, COM/2021/550 final

claims initiative will all work together to help consumers and supply chain actors differentiate between conventional and "clean" products based on their life cycle environmental and social performance.

The Technical Support Instrument can support Member State authorities in designing and implementing reforms that facilitate the transition of the EII ecosystem. Competition and trade policy can also contribute to the transition, by defining clearly the rules of cooperation between companies on R&D, allowing support to decarbonisation, preventing investments into potentially stranded assets, and promoting or agreeing on more stringent environmental and social standards to be applied by our trade partner countries.

Question for the stakeholders:

- What more or different would be needed in order to support the transition? Which elements are missing or do you find insufficient in the current regulatory framework?
- Which roles do the EU and the national level have in addressing this?
- How important is public procurement for your industry and how could green public procurement help create lead markets for sustainable, low-carbon and circular products?
- What other options, in addition to public procurement, could help the creation of these lead markets?
- Which economic and/or regulatory instruments could support the development of new business models and support the competitiveness of sustainable solutions?

3.2. Financing of projects and activities

The transition of the EII ecosystem will require significant upfront investments. While private investment will have to provide the bulk of these investments, public support has a role to play in addressing market failures, such as in R&D and in the provision of infrastructure, de-risking instruments for first of a kind investments.

The EU's sustainable finance taxonomy will be essential to direct private investment towards sustainable economic activities and improve financing conditions for investments into climate mitigation and other environmental objectives. The EU Taxonomy Climate Delegated Act[42], adopted on 4 June 2021, defines which economic activities can make a substantial contribution to climate change mitigation. It includes many EII activities, provided that installations achieve best performance levels in terms of greenhouse gas emissions, and thereby supports the necessary transition of the EII ecosystem. These criteria will be regularly reviewed and complemented by further Delegated Acts, in order to ensure they chart a credible pathway toward decarbonisation.

Under the InvestEU programme, which is designed to leverage private finance towards EU policy objectives, the decarbonisation of energy-intensive industries and the

[42] COMMISSION DELEGATED REGULATION (EU) …/... supplementing Regulation (EU) 2020/852 of the European Parliament and of the Council by establishing the technical screening criteria for determining the conditions under which an economic activity qualifies as contributing substantially to climate change mitigation or climate change adaptation and for determining whether that economic activity causes no significant harm to any of the other environmental objectives. C/2021/2800 final.

substantial reduction of emissions in such industries is an area eligible for financing and investment operations, in particular across three policy windows (i.e. Sustainable Infrastructure; SME; Research, Innovation and Digitisation) through equity-type and debt-type products. Thematic financial products targeting specific policy objectives, including modernisation and decarbonisation of energy-intensive industry are currently under negotiations with the implementing partners.

The EIB also has an essential role to play in providing funding to private projects that are essential to decarbonisation or otherwise strategically important, such as critical raw materials projects. As the EU's "climate bank", it pledged to increase its climate funding to 50% by 2025, i.e. to approximately EUR 30 billion annually. Investment pipelines currently being compiled by the European Clean Hydrogen Alliance, the European Raw Materials Alliance or relevant Horizon Europe partnerships, including the Knowledge and Innovation Communities of the European Institute of Innovation and Technology (EIT KICs)[43], can serve as orientation as to where such resources could be well spent, to support the emergence or strengthening of strategic value chains in Europe that are essential enablers of decarbonisation.

The Clean Technology Materials Task Force run by the European Raw Materials Alliance could also be helpful in identifying which type of projects could be covered under this mandate. This Clean Technologies Task Force would involve all relevant actors, including the Commission, the EIB, the EBRD, the European Battery Alliance (EBA) and industrial actors and it would contribute to building-up the investment chains (from exploration to post-closure) for priority projects related to critical raw materials. The European Commission can assist financially by covering risks via the sustainable infrastructure window of InvestEU.

As far as public funds are concerned, a range of funds is available at the EU level. In the period 2021-27, Horizon Europe will fund (complemented by private partners) four partnerships relevant to the EII ecosystem: First, the Processes4Planet partnership, which covers ten sectors related to process manufacturing, including all players in energy intensive industries (except glass)), with a combined public-private investment volume of EUR 2.6 billion; second, the Clean Steel partnership, with an investment volume of EUR 1,7 billion; third, the Clean Hydrogen partnership, with an investment volume of EUR 2 billion; and fourth, the Circular Bio-Based Europe partnership, with an investment volume of EUR 1 billion.

Hubs For Circularity (H4C) will be key instruments with a regional dimension to advance the R&I agenda of European industries towards the Green Deal's objectives and accelerate the industrial transition and contributing to fill the death valley gap between pilots and commercial size plants exploiting synergies between EU programmes and other funding/loan sources. The industry signalled to launch the process development for 25 Hubs for Circularity by 2027. Under the first Work Programme of Horizon Europe 2021/2022, the focus has been on launching numerous projects on electrification, hydrogen, conversion of CO2, waste reduction and new circular value chains.

Further, under the first Work Programme of Horizon Europe 2021-2022, a set of raw materials-related research and innovation actions will be funded with a budget of almost 300 million EUR. They will focus on exploration, mining, processing, refining, recycling and substitution, as well as developing skills, promoting responsible mining practices,

[43] EIT InnoEnergy, EIT Raw Materials or EIT Climate-KIC.

fostering international cooperation with resource-rich countries, mapping secondary sources in the EU and identifying investment needs. Funding is also available through Cluster 6 of Horizon Europe in the area of bio-based innovation systems. EUR 154 million are available for the first two years of HE programme[44]. In addition, a pilot scheme will explore the feasibility of "transition super-labs" in particularly difficult transition settings, including towns or regions dependent on fossil-fuel extraction or related industries. Furthermore, a number of Horizon Europe 2021-2022 actions focusing on technological development and deployment of Carbon Capture Use and Storage (CCUS) have also been launched: they aim at reducing the cost of CCUS technologies, demonstrate integrated-chain CCUS from relevant industrial sources and identification of relevant CCUS infrastructure needs.

The EU Innovation Fund supports low-carbon innovation in energy intensive industries. The Fund supports both the decarbonisation of industrial processes and substitute products which deliver low-carbon alternatives to the carbon-intensive ones. The support also includes carbon capture, use and storage in the sectors covered by Annex 1 to the EU ETS Directive, innovative renewable energy technologies and energy storage. In its current form and depending on the price of allowances, it would provide around EUR 25 billion over the period 2021-2030 (based on a carbon price of EUR 50/tCO2); the proposal for a revised ETS Directive would double the resources available for the Innovation Fund, and extend its scope to allow for instruments based on competitive tendering such as Carbon Contracts for Difference. There is scope for synergies between Horizon Europe partnerships and activities under the Innovation Fund, notably to bring research results closer to economic viability through 'high TRL' large scale demonstration in the Innovation Fund, to accelerate the green transformation of industries to meet the new 2030 targets set under the newly proposed ETS Directive (under the package to deliver the European Green Deal).

Other relevant EU funds for the EII ecosystem's green transition and for its resilience and competitiveness are the ETS Modernisation Fund, the Just Transition Fund, the European Regional Development Fund, the Cohesion Fund, the European Social Fund Plus, the Connecting Europe Facility, the Social Climate Fund and the LIFE programme. The national Recovery and Resilience Plans (RRPs) funded by the Recovery and Resilience Facility of the Next Generation EU have to allocate at minimum 37% of their funds to projects contributing to climate action i.e. to measures contributing to climate mitigation or adaptation. The 19 RRPs assessed and approved by the Commission at this stage include substantial investments into the decarbonisation of industry, including EIIs, such as in the areas of hydrogen, circularity and bioeconomy. On the digital side, the Digital Europe Programme will support the setup of the European Data Spaces and fund the design and delivery of specialised programmes in key capacity areas like data and AI, cybersecurity, quantum and HPC and support the reskilling and upskilling of workers through short-term courses in advanced digital skills. It will also support a network of European Digital Innovation Hubs. Further, the national Recovery and Resilience Plans funded by the Next Generation EU recovery package have to allocate at least 20% of their funds to measures contributing to the digital transition or challenges resulting from it (promotion of digital skills, digital infrastructures, digital-related R&D, development and deployment of advanced digital technologies, cybersecurity, etc.).

[44] Specifically, 94 M EUR on Circular Bioeconomy sectors, 39 M EUR on Zero pollution and 21 M EUR on Governance aspects of bio-based innovation.

There is also a variety of national and regional funds available in these areas. In the area of hydrogen, the European Commission has provided a "Hydrogen Public Funding Compass" to give stakeholders a practical overview and direct them to the funding sources appropriate to their thematic focus and project maturity. This approach could be replicated for other areas.

Finally, the State aid framework with its full set of available tools has an important role to play in accelerating the transition. The Climate, Energy and Environmental State Aid Guidelines, as well as other relevant State aid guidelines, are being reviewed, with a view to enabling support in new areas (e.g. circularity and biodiversity) and through new instruments (e.g. Carbon Contracts for Difference), as well as ensuring coherence with the relevant EU legislation and phasing out fossil fuel subsidies. Other relevant State aid rules, such as the General Block Exemption Regulation and the Regional Aid Guidelines, have also recently been reviewed on the basis of input from stakeholders. Important Projects of Common European Interest (IPCEIs) such as on batteries, as well as on hydrogen as currently being considered by Member States are relevant for this ecosystem, and Member States may propose other IPCEIs, including for low-carbon industry.

Question for the stakeholders:

- How can private investment in the EII ecosystem be better geared towards the necessary green and digital transitions?
- Can the framework conditions for private investments in these sectors be improved?
- Where do you see gaps in the current funding landscape which put at a disadvantage the EII ecosystem?
- Is there any incoherence between different funding streams which affects the transition in the EII ecosystem, and how could this be addressed?
- What is the role for the public and the private sector, and for the EU, national and regional level in providing funding in support of the transition in the EII ecosystem?

3.3. Infrastructure and energy needs

The green transition will require a fundamental change in how EIIs are supplied with energy. Whereas fossil fuels still make up the main energy source consumed by EIIs today, this will have to change rapidly over the next decades. Renewable electricity, clean hydrogen and biomass will be the main energy carriers of the future.

To accomplish the transition objectives while remaining competitive on global markets, EIIs will require access to decarbonised energy carriers at affordable prices. Given that wind and solar are already today the cheapest sources for new investments in power supply in many parts of Europe, accelerating their deployment and removing any unjustified barriers (such as unjustified administrative delays in permitting processes or prohibitive spatial planning rules) is imperative. Also existing decarbonised electricity sources, such as nuclear energy, may contribute to reducing GHG and replacing fossil fuels. A performant electric grid, with increased cross-border capacities, and a supportive market structure, incentivising energy storage and demand-side management that can accommodate the fluctuating generation profile of renewables, will be essential to increase the penetration of renewable energy sources in the electricity sector. The Trans-European Networks for Energy (TEN-E) is a policy that is focused on linking the energy

infrastructure of EU countries to develop better connected energy networks and is currently being revised.

Beside direct electrification, the direct use of renewable heat sources, clean hydrogen and carbon capture, utilisation and storage (CCUS) will play a major role in decarbonising the EII sector. Therefore, the creation of a European clean hydrogen value chain is a strategic priority of the EU, as outlined in the EU's Hydrogen Strategy of July 2020. This strategy sets ambitious targets for the deployment of electrolysers and the production of renewable hydrogen. It also outlines a vision for the gradual expansion of hydrogen transmission, distribution and storage infrastructure, as well as the uptake of hydrogen applications, with industry and transport being identified as the lead sectors. The availability of decarbonised electricity at affordable prices will be a major determinant of the speed and scale of hydrogen adoption, as well as of the transition overall. EU policies and developments should also consider how to best promote an international market for hydrogen technologies and hydrogen.

Further, in combination with bioenergy and direct air capture, CCUS could even allow for net-negative emissions. Also here, a dedicated infrastructure for transporting CO2, possibly within industrial clusters in a form of industrial symbiosis, but also towards remote storage sites, will be required.

EIIs will also need access to upgraded digital infrastructure, such as 5/6G networks, earth observation data and cloud-edge computing. New tools for developing Digital Twins of the EII ecosystem will be required, including location based intelligence and logistics. Simulation techniques including complexity approaches should interact with all EU Data Spaces and support upcoming distributed ledger solutions. Specifically, digital twins of the production and logistics processes can significantly help in optimising the energy consumption in real time, adapting it to the needs. To this end, it is important that even the smaller SMEs in the value chain have access to the digital technologies required.

One of the key recommendations of the Masterplan was to carry out a mapping of energy and non-energy infrastructure and supply, to help companies select their locations based on available infrastructure and renewable energy potential, and to help network operators identify future demand centres and necessary grid reinforcements. This recommendation has been followed up on by the European Commission's Joint Research Centre in the form of the Energy and Industry Geography Lab, a geospatial data management, visualisation and analysis tool that will become publicly available as of Q4 2021.

Question for the stakeholders:

- Where do you see shortcomings in the current infrastructure that would have to be addressed in order to support the transition of EIIs?
- Do you see any risk of stranded assets and misguided investments and how could this be prevented (e.g. through mid- to long-term roadmaps that inform investment decisions)?
- Are energy providers and network operators in your view aware of increased decarbonised energy and infrastructure needs? If not, how could this disconnect be addressed?
- In your view, are the technologies required for a resilient, green and digital EII ecosystem already available or do they yet have to be developed? Is the challenge essentially about commercial viability and scale-up or also about early-stage disruptive technologies? What is feasible and what depends on some hypothetical

disruptive technology?

- In your view, is there sufficient emphasis on the social and demographic impacts resulting from the transformation of the EIIs, including by engaging and actively involving affected citizens and communities in addition to the social partners?

3.4. Skills, training and just transition

Critical to supporting the ecosystem transition will be ensuring that the workforce will have the right skills to support it and that structural changes are collectively anticipated and managed. This is necessary to achieve a just and successful transition. Talented, well-educated and inventive workers and entrepreneurs are an essential force for innovation and competitiveness. The transition will require a major and sustained reallocation of labour across sectors, occupations and regions as well as significant investment in re- and up-skilling, retention of existing workers and attracting new workers. The nature and scale of these challenges varies among the different sectors of the ecosystem.

For example, the implementation of industrial symbiosis often requires adding resource or intermediate waste processing (for instance recycling of blast-furnace slag or steel dross) or treatment steps, which require more workforce, leading to an increase in overall employment. Furthermore, the cooperation between sectors can change the nature of existing jobs, which become more complex, involve more cooperation and co-creation. Therefore, new job opportunities can be expected in design, innovation and product development, disassembling, remanufacturing, repair, administrative handling of new service contracts, resource scouting and information management. In addition to enhanced digital skills, this requires new skills and key competences at all levels.

The Commission has financed a number of pan-European skills initiatives to support Member States and industrial actors in reskilling and upskilling. Two "Blueprint Alliances for Sectoral Cooperation on Skills", established under the Erasmus+ programme, aim at creating new strategic approaches and novel forms of cooperation between key stakeholders for skills development solutions in energy-intensive industries[45]. The "Pact for Skills" [46], announced in the European Skills Agenda adopted in July 2020[47], aims to further address skills gaps throughout industrial eco-systems by mobilising companies, workers, national, regional and local authorities, social partners, industry organisations, vocational education and training providers, chambers of commerce and employment services to invest in upskilling and reskilling actions. By joining forces and encouraging concrete commitments to invest in training for people of working age, the Pact can help address the industry's skills challenges. In the latest Framework Programme for Research and Innovation, skills and training provisions are also mainstreamed to the extent possible.[48] Furthermore, the EIT KICs[49] tailor and

[45] Blueprint Alliance "European Steel Skills Agenda" (ESSA): https://www.estep.eu/essa;
Blueprint "Skills Alliance for Industrial Symbiosis – For a Sustainable Process Industry" (SPIRE-SAIS): https://www.spire2030.eu/sais

[46] https://ec.europa.eu/social/main.jsp?catId=1517&langId=en and

[47] https://ec.europa.eu/social/main.jsp?catId=1223&langId=en (COM/2020/274 final)

[48] See, for instance, the work programme of cluster 4 "Digital, Industry and Space": https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/wp-call/2021-2022/wp-7-digital-industry-and-space_horizon-2021-2022_en.pdf ; and cluster 5 "Climate Energy and Mobility"

deliver challenge driven learning, education, training and upskilling programmes based on the real-world needs to increase the availability of a skilled workforce and ensure success in developing, building and operating industrial projects including across the energy intensive industry value chains.

On 7 June 2021, the Commission hosted a High-Level Roundtable on Skills for the Energy-Intensive Industries, to discuss challenges facing the EII ecosystem in terms of upskilling and reskilling of the workforce and identify where support is needed. Following this roundtable, the Commission is also working with industry to forge skills partnerships under the Pact for Skills. These efforts contribute to implementing the first principle of the European Pillar of Social Rights, which states that "everyone has the right to quality and inclusive education, training and life-long learning"[50], and to achieving the target set in the European Pillar of Social Rights Action Plan and endorsed by European leaders in Porto that, by 2030, 60% of adults should participate in training[51].

The transition to a climate-neutral economy will have repercussions on the sectoral composition of GDP, and, hence, particular economic and employment impact on regions with a high share of jobs in carbon-intensive industries. Jobs are likely to shift within the eco-system and geographically across Europe. Further work is needed to map the employment dimension of the transition, with more granular analysis needed to better identify and quantify labour related challenges, notably in terms of:

- Differentiation along the value chains (upstream and downstream, direct and indirect jobs)
- Geographical mapping at least at NUTS 2 and, where feasible, at NUTS 3 level[52]
- Description of skills availability and future skills needs in sectors and regions
- Socio-demographic description (age, gender, etc.) of the workforce in sectors and regions

The Just Transition Mechanism seeks to leave no one behind in the context of the European Green Deal. It will mobilise between EUR 65 and 75 billion in the next decade, of which EUR 17.5 billion will come directly from the EU budget in form of the Just Transition Fund.

These funds can be invested into economic diversification and reconversion, upskilling and reskilling of workers, deployment of new technologies and overall support for the decarbonisation of the industry. They are available to specific, most affected regions in each Member State, which will be agreed with the Commission in the context of territorial just transition plans. To receive the full allocation of the Just Transition Fund, Member States need to commit to the 2050 climate neutrality goal. In the case of JTF investments directed at ETS installations, the achievement of deep emission reductions going substantially below the relevant benchmarks established for free allocation under

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https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/wp-call/2021-2022/wp-8-climate-energy-and-mobility_horizon-2021-2022_en.pdf

[49] https://eit.europa.eu/our-activities/education

[50] Interinstitutional Proclamation on the European Pillar of Social Rights, C 428/10

[51] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the European Pillar of Social Rights Action Plan, COM(2021) 102 final

[52] A useful first step was done in this recently published study: European Emissions Trading System (ETS) – Calculations on the regional employment impact of ETS installations - Regional Policy - European Commission (europa.eu)

the ETS Directive need to be demonstrated. In addition, such investments should be necessary for the protection of a significant number of jobs in a given territory.

As part of the Just Transition Platform, working groups are being set up to develop and exchange practical solutions ensure that the decarbonisation of carbon-intensive industries happens in a fair way, leaving no one behind, in particular for the steel, cement and chemicals industry, and to enhance stakeholder engagement.

Besides its impacts on employment and wages, the EII ecosystem's transition may as well have impacts on households' disposable income, also for persons not working in EII, including through direct or indirect impacts on household expenditures for energy, mobility and housing. These price impacts may vary along the income distribution, being more significant for some persons or households than others, and being likely to be regressive overall. To ensure that the transition is as socially fair and inclusive as possible, it is important to assess these distributional impacts and minimise them through the design of transition-related and mitigation measures, as well as mitigation measures, which would seek to minimise them, thereby contributing to ensure that the transition is socially fair and inclusive.[53]

Distributional impact assessment (DIA[54]) – which importance is stressed in the recently adopted European Pillar of Social Rights Action Plan – is an appropriate tool to do so and should be therefore considered for the EII ecosystem's transition pathway. On top on distributional impacts on disposable income, consideration should also be given to distributional impacts that the EII ecosystem's transition may have on energy poverty and access to (some) essential services (e.g. energy and transport). As well, in complement to DIA, collecting stakeholders' views, on what could be distributional impacts of the EII ecosystem's transition and relevant measures to mitigate them, would be useful.

Just transition of the energy-intensive industries ecosystem also has a global component. The EU will continue to promote decent work and social inclusion worldwide, by cooperating with partner countries, in particular within the International Labour Organization (ILO) and through its trade and development policies, sustainable procurement and finance, and corporate transparency and sustainable corporate governance. In line with the call in the Council Conclusions on Human Rights and Decent Work in Global Supply Chains and following the European Pillar of Social Rights Action Plan, the Commission will address the social dimension of international action including by adopting a Communication on Decent Work Worldwide.

Question for the stakeholders:

- In your view, what are the main social and just transition challenge connected to the EII ecosystem's transition, and how do you see their scale?

[53] Such measures will be presented in particular in the forthcoming Commission proposal for a Council Recommendation on the social and labour aspects of a just transition towards climate neutrality, as announced in the "Fit for 55" package adopted on 14 July 2021. The Recommendation will provide guidance to MS on how to ensure comprehensive and effective approaches to just transition at national level, in order to help realise the employment potential of the transition, mitigate adverse effects, maximise social co-benefits and garner social acceptance and public support for the transition.

[54] Distributional Impact assessment (DIA) can be referred to as an analysis, usually quantitative in nature, which assesses the distributional effects of policy measures across the population, i.e. which assesses how these measures may impact differently various groups in the population.

- Do you have precise projections of the employment and reskilling needs for your sector and what actions are you taking?
- Does the just transition agenda put sufficient emphasis on the needs of affected citizens, including workers but also their families and especially young people, as well as the communities, and regions they live in? If not, how could these be addressed?
- To what extent do you think will up/re-skilling be achieved in your industry and in your region?
- In your view, what will be the distributional impacts of the EII ecosystem's transition – across the whole population (not only for persons working in EII) – on disposable income, energy poverty or access to some essential services? What could be relevant measures to address and mitigate these distributional impacts?
- Which roles can the Commission, Member States, social partners, industry, trade unions and other stakeholders play to master the transition in a just and socially fair way?

3.5. Awareness raising and communication

A major precondition for realising the necessary actions is understanding and support from the broader population, including the communities where initiatives are planned that would help this ecosystem to become green, digital and resilient. A key challenge is the fact that benefits from e.g. a secure raw materials supply are widely spread across Europe, while the potential downsides of the involved industrial operations are felt locally.

To accomplish the transition, both industry and policymakers need to get better at communicating the real benefits, but also seriously addressing concerns and being transparent on impacts and projects. It is essential that social partners and local stakeholders be involved early on and be given a stake in the project (e.g. through long-term, safe and well-paid job opportunities for locals, or through investment into local infrastructure, both physical and social). Social support is critical for effective policy implementation, which has to be inclusive at local level. Public awareness on the relevance of EIIs for the climate challenge should ground the communication path.

More generally, there is a need to communicate about the link between the green and digital transition and raw materials, and about the social and environmental standards that need to apply in Europe. Better communication and increased transparency regarding the real environmental impact of products, across their life-cycle, will also be central. Also required is continued discussion and research in academia, civil society and public institutions, to sharpen our understanding of trade-offs and highlight potential risks and bottlenecks early on.

Question for the stakeholders:

- Where do you see the main challenges in terms of communication and transparency?
- What are the main target audiences? Which actors can help to achieve a more inclusive and fact-based debate?
- Which specific actions could the Commission, Member States, the industry, social partners and other stakeholders take?
- Would you have any examples or good practice tools to share?

3.6. Thematic stakeholder meetings and governance

The Commission services will ensure that the co-creation process for the EII transition pathway will continue through structural interaction with Member States, social partners and other stakeholders. The Commission services will organise dedicated expert group meetings in the autumn to work on the resilience, sustainability and digitalisation dimensions. It will gather contributions and compile a final document on the EII ecosystem's transition pathway in December 2021/January 2022.

All stakeholders will be invited to provide their comments and inputs through the public consultation linked on this staff working document, as well as through established stakeholder fora. The Industrial Forum will provide input on horizontal aspects. The Commission will also take into account inputs from the European Raw Materials Alliance and the European Clean Hydrogen Alliance, the relevant EU Sectoral Social Dialogue Committees (steel, paper, chemicals, and extractive industries) and reflect targets set by the Horizon Europe Partnerships on Processes4Planet, Clean Steel, Circular Bio-Based Europe and Clean Hydrogen and consider outcomes of stakeholder consultations held in preparation of the ERA industrial technology roadmaps for R&I.

In the international context, the transition pathways work should take account e.g. of the Clean Energy Ministerial, Mission Innovation, the Trilateral EU-US-Japan Conference on Critical Materials, the Intergovernmental Forum on Mining, Minerals, Metals, as well as G7 action on decarbonising industry and addressing supply chain/critical mineral dependencies and market failures and the UN International Resources Panel.

Question for the stakeholders:

- Where do you see need for additional consultation or cooperation on the EII transition pathway, besides what is foreseen within the established stakeholder groups and partnerships described above?
- On which areas should international cooperation focus?

3.7. Key performance indicators

To monitor progress of the EII ecosystem towards the goal of becoming resilient, sustainable and more digital, the following key performance indicators are relevant. These partially overlap with the key performance indicators (KPIs) identified in the 2021 Annual Single Market Report that are monitored on annual basis, as well as with the Raw Materials Scoreboard, circular economy and sustainability indicators identified in the Circular Economy Action Plan and Chemicals Strategy for Sustainability, and the UN Sustainable Development Goals:

- Value added
- Number of jobs in EII sectors, by skill level
- Number of materials on the EU's triannual critical raw materials list
- Circular material use rate

- Recycling rates for key raw materials (critical and non-critical[55])
- Recycled content (availability of supply and level of demand)
- Emissions of GHGs and other harmful substances[56]
- Carbon intensity (GHG emissions/value added)
- Share of renewable energy in the EII ecosystem (also by energy carrier: electricity, hydrogen, biomass)
- Tonnes of captured, used and stored CO2
- TRL reached in key green and digital technologies
- Innovation performance in the EII ecosystem
- Annual adult participation rates in training in EII sectors
- Share of workers with basic digital skills
- Share of SMEs that reach at least a basic level of digital intensity
- Investments into R&D in the EII ecosystem
- Investments into decarbonisation in the EII ecosystem
- Investments into digitalisation in the EII ecosystem
- Increase (%) of data collection and use in the EII ecosystem
- Number of data sharing arrangements in and across the EII ecosystem

These KPIs should also be aligned with KPIs developed under Horizon Europe Partnerships and respectively taken into account when monitoring the success of such partnerships.

Question for the stakeholders:

- Which KPIs should be used to assess the progress towards our transition objectives from each of the Commission, Member States, the industry, social partners and other stakeholders?
- What are the data sources?

[55] Including biomass, to be able to track biomass feedstock circularity.

[56] Emissions of GHG and other pollutants should be accounted in a life cycle perspective and applying robust and shared methods, as for example in line with the Green Claims Initiative and the EU Environmental Footprint methods (Commission Recommendation (2013/179/EU).

4. CONCLUSIONS AND INVITATION TO STAKEHOLDERS

In the context of the recovery from the COVID-19 crisis, this Staff Working Document lists initiatives, instruments and measures contributing to a sustainable, digital and resilient EII ecosystem. This transformation can only be reached if the different sectors of the ecosystem and their diverse actors work together and, more generally, if there is broad public support to the transition. All stakeholders, large and small, public and private, including the social partners are invited to work together and propose concrete actions, commitments and investments that will complement policy actions designed by the Commission and could be implemented at the sectoral, national and regional level, or even across borders, contributing towards a common vision of a resilient and sustainable energy intensive industries ecosystem in a 2050 climate neutral economy. It is particularly important to consider contributions with a 2030 perspective in mind. Social partners and other stakeholders are also invited to provide an assessment of scale, cost, long-term benefits and conditions of the required actions to accompany the twin transition of the EII ecosystem. Key issues and questions have been presented in this document under different sections. Concrete responses, proposals and commitments from EII stakeholders will be welcome by Monday, 22 November 2021 through online consultation.

Our shared ambition should be to help the EU EII ecosystem embrace the green and digital transformation and strengthen resilience to foster growth, jobs and competitiveness. This cannot be achieved by the Commission, Member States, , social partners and other stakeholders acting on their own.

Key for the recovery and transformation is collaboration and a forward-looking responsible and transparent attitude. All together, we need to think and plan ahead and be as ambitious as needed in the achievement of resilience, sustainability and digitalisation of the energy-intensive industries ecosystem, while ensuring we leave no one behind. We have the momentum of the recovery, the financial support, the need for change driven by citizens and by industry, the awareness and commitment of Member States and social partners, and the availability of EU funds with the NextGenerationEU recovery plan.

ANNEX I: KEY RECOMMENDATIONS OF THE MASTERPLAN AND FOLLOW-UP

Creation of markets for climate-neutral, circular economy products:

- **Fostering demand for and competitiveness of climate neutral, circular economy solutions through demand-side measures;**

In March 2020, European Commission updated the 2015 Circular Economy Action Plan and put in place follow-up actions to foster the circular economy potential; Industrial strategy (March 2020) and its update (May 2021) stressed the importance of the creation of markets for climate-neutral and circular products.

- **Investigating and developing alternative or complementary options for carbon pricing mechanisms considering their impact on emissions, markets and investments, both at EU and international level;**

In July 2021, the Commission published its policy proposal to deliver the Green Deal, aiming at achieving the 55% reduction of GHG emission by 2030 and setting the path to climate neutrality by 2050. Carbon Border Adjustment Mechanism will protect against the risk of carbon leakage, while strengthening of the current EU ETS and a new ETS for road transport and buildings will address carbon pricing.

- **Empowering customers and consumers in transition to climate-neutrality**.

The planned Sustainable Products Initiative (SPI) will shape the future internal market for a large number of products. Although it will focus primarily on setting supply-side requirements (such as product design requirements), it is expected to have a positive impact on demand and represent an important step in creating the conditions for industries and markets to step up the uptake of sustainable and circular products (for example, by requiring more sustainability-related information on products to be made available, possibly via a digital product passport). The intention for the SPI legislative proposal is to widen the scope of the Ecodesign Directive beyond energy-related products to make it applicable to the broadest possible range of products and make it deliver on circularity. As announced in the 2020 Circular Economy Action Plan, the ambition is to cover not only consumer products but also intermediary products like steel and chemicals, thereby encompassing business to business transactions, including raw materials and intermediate products like cement, steel, and chemical. Further initiatives are being developed to empower consumers in the green transition and on green claims, and more generally on sustainable consumption (social sustainability, social taxonomy and sustainable finance, etc.).

Developing climate-neutral solutions and financing their uptake:

- **Developing industrial demonstrators of key breakthrough technologies by 2030;**

The EU Innovation Fund supports both the decarbonisation of industrial processes and substitute products which deliver low-carbon alternatives. In its current form, it would provide around EUR 25 billion over the period 2021-2030 (based on a carbon price of EUR 50/tCO2); the proposal for a revised ETS Directive would double the resources available for the Innovation Fund, and extend its scope to allow for instruments based on competitive tendering such as Carbon Contracts for Difference.

The Horizon Europe Processes4Planet partnership will aim to deliver on three general objectives: (1) developing and fostering the deployment of climate neutral solutions, by way of integrating renewable energy and reducing emissions through CO/CO2 capture and use; (2) developing and deploying industrial solutions aimed at closing the energy and feedstock loops by fostering circularity and overhaul the use of waste; and (3) fostering the achievement of a global leadership in climate neutral and circular industry solutions, by moving towards commercially viable climate neutral and circular industry solutions, and by fostering new skills and jobs and reducing barriers for market uptake. The Horizon Europe Clean Steel partnership launched at the same time in June 2021 will supplement efforts in the steel sector.

- **Establishing major R&D&I programmes across all technological readiness levels (TRL), with a focus on bringing solutions closer to the market[57], and achieving better integration with national programmes, supported by State aid rules;**

The Horizon Europe Processes4Planet partnership was launched in June 2021 and it aims at developing disruptive solutions for circularity and climate neutrality, with a strong focus on the global competitiveness of the EU process industry. The lead entity from the private side is A. SPIRE, representing the ten sectors of the European process industry: cement, ceramics, chemicals, engineering, non-ferrous metals, pulp & paper, minerals, refining, steel and water. The 1.3 billion EUR has been allocated for the Processes4Planet partnership by the European Commission. Processes4Planet will also be designed to have an Impact Panel: an investors' roundtable for building peer relationships and identifying areas of follow-up financing and investment collaborations.

The Clean Steel partnership, digital partnerships under Horizon Europe as well as some other partnerships, in particular EIT InnoEnergy, EIT Raw Materials, EIT Digital or EIT Climate-KIC, will be relevant for the dual transition of the EII ecosystem.

"InnovFin – EU Finance for Innovators" is a joint initiative launched by the European Investment Bank Group in cooperation with the European Commission under Horizon 2020. InnovFin aims to facilitate and accelerate access to finance for innovative businesses and other innovative entities in Europe.

In September 2019, the European Commission launched the EIC Accelerator as a pilot in the perspective of Horizon Europe. It is the European Innovation Council‘s flagship programme for SMEs. It is a funding instrument for SMEs and start-ups that develop breakthrough innovation projects with high growth potential.

In October 2020, the Commission published the results of the State aid fitness check, which included evaluations of the General Block Exemption Regulation, the Guidelines on regional State aid, the Communication on important projects of common European interest (IPCEI), the Guidelines on State aid for environmental protection and energy and several other State aid rules relevant to the green transition of the EII ecosystem. These guidelines are currently under revision, on the basis of stakeholder consultations, and all new rules relevant to the Green Deal will be published before the end of 2021.

[57] Without crowding out private investments or distorting competition.

- **Facilitating access to private capital at affordable cost, including through de-risking instruments.**

Public funding has a role to play during the transition as it can leverage private investments. The State aid framework is being updated and it will be crucial to accelerate the transition. Since publication of the Masterplan in late 2019, Important Projects of Common European Interests (IPCEIs) on batteries, hydrogen proved to be relevant for this ecosystem. A range of EU funds are relevant - the EU Innovation Fund, the ETS Modernisation Fund, the European Regional Development Fund, the Cohesion Fund, the European Social Fund Plus, the Connecting Europe Facility and the LIFE programme, InvestEU, the national Recovery and Resilience Plans funded by the Next Generation EU recovery package since the funds allocated to the national Recovery and Resilience Plans must at least for 37% support the climate change objectives.

In June 2021, the Commission adopted the EU Taxonomy Climate Delegated Act and work is ongoing on preparation of the second delegated act that will cover environmental objectives. The EU's sustainable finance taxonomy will be essential to direct private investment towards sustainable economic activities.

In June 2020, the Commission launched the Just Transition Platform, which aims to assist EU countries and regions to unlock the support available through the Just Transition Mechanism. This platform will provide a single access point for support and knowledge related to the just transition. All the relevant knowledge and information that authorities and beneficiaries need will be shared on the platform, including funding opportunities, relevant regulatory updates or sector specific initiatives.

Access to resources and deployment:

- **Ensuring access and availability of decarbonised energy at globally competitive prices;**

The renewable energy share is growing in the EU and already reached 19.3% in 2019 (Eurostat). The proposed new target set in the proposed amendment of the Renewable Energy Directive will rise to 40% by 2030.

According to the International Renewable Energy Agency (IRENA), in 2019, the energy produced from renewable sources was comparable in price to that of fossil fuels and the cost of clean energy sources is falling year-on-year and will continue to do so as infrastructure develops.

- **Ensuring access to alternative feedstock sources, by promoting use of renewable and (carbon-based) recyclables beyond energy production;**

The EU's hydrogen strategy (July 2020) is as a key element of our approach to providing renewable feedstock to industry. The European Clean Hydrogen Alliance (launched July 2020) is working on a pipeline of projects for development and large-scale deployment of a hydrogen-based economy.

- **Mapping of energy and non-energy infrastructure and supply, underpinned by technologies for industrial transformation in support of climate-neutral industry**

As a result of the recommendation in the Masterplan, a public launch of the Energy and Industry Geography Lab is expected by the end of the year. It was highlighted as a key action in the update to the New Industrial Strategy. The user-friendly online tool brings together a wealth of energy-related data in an easy-to-use, map-based interface.

The "Masterplan for a competitive transformation of EU energy-intensive industries enabling a climate-neutral, circular economy by 2050" also argued for the need to create the industrial transition observatory.

The New Industrial Strategy for Europe announced setting up the Industrial Forum as a new, inclusive and open mechanism for co-designing solutions with stakeholders, supporting the Commission in its systematic analysis of the ecosystems and in assessing the risks and needs of industry as it embarks on the twin, green and digital, transition and the strengthening of its resilience. The Industrial Forum shall also contribute to the coordination of recovery efforts, as a forum for Member States and industry to exchange best practices aiming at the transformation of industrial ecosystems. The Industrial Forum held its first meeting in February 2021 and will build on, contribute to and complement the work carried out by the COMPET Council and the High-Level Group for Competitiveness. It will offer a sounding board for stakeholders and showcase the state of the European competitiveness – and the progress towards industrial transformation, bringing together the views of industrial stakeholders, public authorities, civil society organisations and investors.