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Industry 5.0:

A Transformative Vision for Europe

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Industry 5.0:

A Transformative Vision for Europe

Governing Systemic Transformations towards a Sustainable Industry

ESIR Policy Brief No. 3

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Industry 5.0 - A Transformative Vision for Europe

1 Introduction

Europe faces a triple imperative to protect, prepare and transform[1] in its quest for building forward better after the deadliest pandemic of the past century and for building forward better to address the greatest challenge humanity has ever faced – climate change and biodiversity collapse. An enormous challenge: how to transform human life quickly enough to enable 8 billion people to live sustainably and peacefully within planetary boundaries?

While Europe cannot face this challenge alone, we believe it can lead the global community towards the deep systemic transformation that this and the next decades will inevitably require. We think that Europe will only be able to achieve this leadership if it will at once strengthen its internal cohesion and capacity to speak with one single voice; and promote a deep transformation of the economy at the global level by shifting beyond GDP determined growth and embracing an Industry 5.0 programme.

Building resilience within our existing economy and transforming to a new set of economic ecosystems that are more resilient to future shocks and stresses should be Europe's mission henceforth. Ensuring that European industrial development is oriented towards resilience whilst enabling and accelerating the transition to the age of sustainable wellbeing for all is an essential step for the future of the EU industrial strategy. An EU-wide industrial strategy focused on the constituent elements of Industry 5.0 would unleash Europe's industrial potential and reward resilient, sustainable, regenerative and circular economic business conduct rather than short term overproduction and consumption models determined by the current growth paradigm.

1.1 Europe must bounce forward better

PROTECTING and PREPARING Europe's economy and society by seeking to reconstitute the *status quo ante* is the wrong response to ensure medium- and long-term prosperity for several reasons. First, trying to return to the *status quo* means embracing paradigms in economic, social and environmental policy that were already showing substantial deficiencies and materially negative impact on critical dimensions of the economy (such as natural systems) before the pandemic and can partly be held responsible for the dramatic impact of COVID-19. Second, the COVID-19 crisis made clear that relying on and stimulating a growth-oriented paradigm, based on value-extracting, highly energy-intensive, massively wasteful and polluting materials and resource use, as well as a very short-term approach to capitalism, will not help the world achieve sustainable development in ways that respect planetary boundaries. On the contrary, current paradigms of value-extracting economic, social and industrial activity are root causes of global warming and the destruction of the natural environment, resources and systems that human welfare and life together with millions of other species depend on.

Therefore, the third imperative for Europe, therefore, is to radically TRANSFORM its economy, its ways of life and its relationship with the

[1] Protect, prepare and transform Europe - Publications Office of the EU (europa.eu)

environment. Transformation is urgent and will be needed at all levels of government, economy and society if Europe wants to build a path to prosperity in the medium and long term. The industry has a particular responsibility. For instance, models from the European Commission foresee a reduction of GHG emissions from industry between 18.2 to 25.1% over the next nine years[2] to achieve the objective of the climate law. Transformation means, first of all, mainstreaming resilience, sustainability, regenerative and circular economic principles in all its policies, and in the implementation of those policies, from Horizon Europe to the national plans for resilience and recovery.

The past few months have sent mixed signals in this respect: alongside resounding commitments to the twin transition, at the EU level, the stated ambition to focus on people, planet, and prosperity has met with significant resistance, leading to disappointing outcomes in key domains such as the taxonomy for sustainable investment, as well as the full re-orientation of the better regulation agenda towards a post-GDP paradigm. And a first analysis of the available National Resilience and Recovery Plans showed that the Member States have given priority to measures aimed at "protecting" current economic and social activities – thus protecting the vested interests of both – and thereby mitigating the short-term effects of the pandemic, rather than creating the preconditions for change[3].

1.2 Industry must become the engine of Europe's systemic transformation

In such a context – one that calls on all government and civil society elements to drive change – the role of industry is pivotal. Without a profound industrial transformation, it will be impossible for Europe to realise its ambition to become a more resilient, sustainable, circular and regenerative economy while preserving and nurturing its competitiveness at the international level.

In this policy brief, we argue that a new, much more ambitious and systemic vision is needed for Europe's industry compared to the one that is currently proposed by the EU updated industrial strategy. We argue that engagement with leading businesses and industrial actors, and support for industrial innovation that delivers scaled solutions that are more sustainable and circular economic, is essential to the EU vision of "competitive sustainability". Industry must become a protagonist: a driving force for systemic transformation and planetary regeneration. This will require a deep transformation of business models and a change in the mindset and the economic approaches in policy, finance investment and corporate governance. More specifically, it entails a fundamental redesign of value chains to embrace new technology possibilities, sustainability, the application of circular economic design principles and regenerative approaches. The redesign of value chains will deliver societal and planetary wellbeing, as well as the adoption of metrics and indicators that enable measurement of progress towards this vision; and a regulatory system that effectively guides accelerated compliance, adoption and best practice.

[2] See on page 52 under the following link: https://eur-lex.europa.eu/resource.html?uri=cellar:749e04bb-f8c5-11ea-991b-01aa75ed71a1.0001.02/DOC_1&format=PDF

[3] De Vet et al. (2021) observe that "most measures consisted of horizontal support instruments without predetermined focus"; they also mention the possible confusion generated by the multiplicity of targets given to national governments, including the twin transition, resilience, consistency with the country-specific recommendations, etc.; and the lack of meta-level coordination, especially for what concerns the need to reconcile national plans with the need to proactively shape inclusive, resilient, fair and sustainable industrial value chains (on which, see our dedicated chapter below).

We believe that industry should be regenerative and restorative by design and by action, "giving back" the resources used in the past, interdependent with the natural world, adaptive to change and based on core accountability for social justice. Hence, we propose a new and bold vision for Industry 5.0 to supersede Industry 4.0 and provide the directionality we need to drive scale innovation that delivers new forms of economic and social value that effectively balance people, planet and prosperity. We also believe that this transformation can only be achieved if it is embraced at all levels of government, from the national and local level to the EU, and that it needs to be promoted and used to align key policies in the international arena.

Below, we articulate this vision with respect to the main elements that can drive meaningful systemic transformation and how to measure progress at all levels of government.

1.3 Industry 4.0 is not the right framework to achieve Europe's 2030 goals

Over the past decade, Europe has gradually stepped up its commitment to industrial transformation mostly by working on the transition towards so-called industry 4.0, a paradigm that is essentially technological, centred around the emergence of cyber-physical objects, and offering a promise of enhanced efficiency through digital connectivity and artificial intelligence. However, the Industry 4.0 paradigm, as currently conceived, is not fit for purpose in a context of climate crisis and planetary emergency, nor does it address deep social tensions. On the contrary, it is structurally aligned with the optimisation of business models and economic thinking that are the root causes of the threats we now face. The current digital economy is a winner-takes-all model that creates technological monopoly and giant wealth inequality.

Industry 4.0 lacks key design and performance dimensions that will be indispensable to make systemic transformation possible and to ensure the necessary decoupling of resource and material use from negative environmental, climate and societal impacts. These dimensions include:

- regenerative features of industrial transformation, so as to both embrace the circular economy and positive restorative feedback loops not as an afterthought, but as a key pillar of the design of entire value chains;

- an inherently social dimension, demanding attention to the wellbeing of workers, the need for social inclusion and the adoption of technologies that do not substitute, but rather complement human capabilities whenever possible; and

- a mandatory environmental dimension, which leads to the promotion of transformation that eliminates the use of fossil fuels, promotes energy efficiency, draws on nature-based solutions, regenerates carbon sinks, restores biodiversity and crafts new ways of thriving in respectful interdependence with natural systems.

Without a green and social industrial strategy as a cornerstone of the Green Deal, the EU will not succeed in its journey towards a completely new economic

paradigm within one generation (becoming climate-neutral by 2050 or rather by 2030, as the latest scientific evidence suggests). The Green Deal will define and shape industrial policy making not only in the current mandate period of the Commission but also far thereafter and can only do so with a deep just transition policy in place. The proposed 1 trillion EUR, 10-year plan to put the EU on course to climate neutrality by 2050 could *de facto* become a better strategy for economic development in the EU, strengthening its position globally. However, this has to be complemented by a long-term industrial strategy that prepares industry for the digital and low-carbon economy and allows industry to remain competitive and just while decarbonising. It must direct industry towards the big societal challenges: a net-zero emissions economy, inclusive growth, health, social and regional cohesion, sustainable mobility and environmental regeneration.

2 A New Vision for Industry: towards Industry 5.0

The vision for 'Industry 5.0' we propose moves past a narrow and traditional focus on technology-or economic enabled growth of the existing extractive, production and consumption driven economic model to a more transformative view of growth that is focused on human progress and well-being based on reducing and shifting consumption to new forms of sustainable, circular and regenerative economic value creation and equitable prosperity. Rather than representing a technological leap forward, Industry 5.0 actually nests the Industry 4.0 approach in a broader context, providing regenerative purpose and directionality to the technological transformation of industrial production for people-planet-prosperity rather than simply value extraction to benefit shareholders.

An Industry 5.0 approach has very important consequences for the EU industrial strategy *writ large*. It requires new economic orientations to industry performance, new design for business models, value chains and supply chains, new purpose for digital transformation, new approaches to policymaking in partnership with business and industry, new capabilities and approaches to research and innovation as well as vertical and horizontal coherence by acting at all levels of government and through international standards. It addresses recent knowledge and learnings from the COVID pandemic and the fundamental need to build resilience across value chains and secure people's lives and livelihoods whilst living within planetary boundaries. It proposes a very different set of enabling approaches to Europe's so-called "twin transition", intending to connect digital transformation with sustainability and climate action. We explore this below.

Table 1 - **Differences between Industry 4.0 and Industry 5.0**

Industry 4.0	Industry 5.0
• Centred around enhanced efficiency through digital connectivity and artificial intelligence • Technology – centred around the emergence of cyber-physical objectives	• Ensures a framework for industry that combines competitiveness and sustainability, allowing industry to realise its potential as one of the pillars of transformation • Emphasises impact of alternative modes of (technology) governance

• Aligned with optimisation of business models within existing capital market dynamics and economic models – i.e. ultimately directed at minimisation of costs and maximisation of profit for shareholders • No focus on design and performance dimensions essential for systemic transformation and decoupling of resource and material use from negative environmental, climate and social impacts	for sustainability and resilience • Empowers workers through the use of digital devices, endorsing a human-centric approach to technology • Builds transition pathways towards environmentally sustainable uses of technology • Expands the remit of corporation's responsibility to their whole value chains • Introduces indicators that show, for each industrial ecosystem, the progress achieved on the path to well-being, resilience and overall sustainability.

In essence, Industry 5.0 is a transformative model that reflects the evolution of our thinking post COVID. It takes into consideration learnings from the pandemic and the need to design an industrial system that is inherently more resilient to future shocks and stresses and truly integrates European Green Deal social and environmental principles.

2.1 Responsible at the value chain/ecosystem level

Industry 5.0 means first and foremost a decisive move away from neo-liberal capitalism models with a focus on production for profit and "shareholder primacy", towards a more balanced view of value over time and a multi-valent understanding of capital – human and natural as well as financial. This change implies significantly more than due diligence for supply chains but an understanding of de-risking through resilience building. Building resilience throughout the value chain requires a people-planet-prosperity approach that focuses on short-term levers and long-term planning rather than short term profit seeking. A key learning from Covid-19 has been the importance of resilience building across the value chain to ensure delivery of products and services during crises. Companies stress testing and applying Environmental Social Governance (ESG) criteria have already shown greater resilience during the recent pandemic, therefore highlighting the potential role ESG can play in de risking.

Emphasis on returns to shareholders, cherished by the Chicago school of economics since the times of Milton Friedman, is today widely questioned around the world, even in the United States where it has dominated markets and market expectations. Even the increasingly popular notion of "stakeholder capitalism", while recognising corporate responsibility for ensuring that all relevant interests represented in the firm are catered for, is insufficient to enable a full transition to Industry 5.0.

Instead, a new European enterprise model should be based on the principles of fairness, resilience, sustainability, circular economics, and multi-valent forms of

capital – principles of new economic thinking and regenerative economics[4]. To succeed, this approach will need to be recognised, promoted and rewarded by financial markets and public procurement as the adopted model to ensure that all relevant interests, inside and outside the firm, present and future, are adequately pursued through business conduct and financial capital flows. Only in this way, industry can become the real engine of the 'twin transition'. Industry 5.0 needs to model and bring into being a post-capitalist world that ensures proper feedback loops between industrial transformation and a re-evaluation of capital, including natural and human capital flows.

The onset of climate change and the need for deep decarbonisation constitute an imperative for industry to transform core business models for the sake of survival and economic resilience. Only by excelling relative to international competitors on design principles for resiliency, renewal and regeneration of resources and circular economics (e.g. redundancy, decentralisation, modular production and distribution, circulation of materials as long as possible), will Europe's industry be able to reap the benefits of first mover advantage in managing the strategic risks of climate change, climate action (transition risk), environmental degradation and social and political instability. Deliberate, bold action to transform and renew business models would also allow Europe to exert greater global leadership on climate tipping points alongside social tipping points by demonstrating what is possible and would enhance the credibility of Europe's desire to adopt a Carbon Border Adjustment Mechanism, critical to keep level playing field for EU companies.

2.2 Regenerative, circular economic, by design

Regenerative, circular economy approaches provide a framework for systems solutions, and above all systemic transformation to enable sustainable core business activities and industry models. This is the core of an Industry 5.0 approach and brings together three key systems principles, each led by a focus on design.

The three principles can be summarised as:

- Design out waste and pollution.
- Keep products and materials in productive use and circulation.
- Regenerate natural systems and enhance carbon sinks.

A regenerative, circular economy offers more distributed, diverse and inclusive models for industry, based on the intensified use of renewable energy and circular value chains. Industry 5.0 needs to be given clear purpose in enabling the transition to: industry-relevant, intersectoral, regenerative, circular economic pathways. This means moving decisively beyond Industry 4.0 paradigms that encourage digitally-enabled extractive and consumptive economic activity, which results in nothing other than an acceleration of negative climate impacts and ecosystem loss.

[4] Ben Haggard, Regenerative Economics; Gunter Pauli and Politecnico di Torino – 3D business models.

BOX 1: The evolution of circular economic thinking

Concepts of circular economy have gained global prominence and have gone through a considerable evolution over the last two decades, and continue to attract a wide range of definitions and debate. To be effective as a framework to support and guide a structural transformation of economic thinking, business models, and design of industry and trade such as proposed by Industry 5.0, the circular economy needs to be applied as a regenerative economic model and a framework for development of system solutions that both protect and regenerate nature, as well as delivering benefits to many global challenges.

To this end, the circular economy framework directs attention at three principles: the elimination of waste and pollution, circulation of products and materials in order to keep them productively in use in the economy for as long as possible, and thirdly, the design of product and service systems to regenerate nature and natural capital. The circular economy should be used as a model that considers economic activity from a systems and business eco-systems perspective, and is based on increased use of renewable energy and materials, and is inherently more distributed, diverse, inclusive and resilient. As a solutions framework it can be applied and used to guide solution development at many levels, including product and product service, system design through to business ecosystem, value chain, and supply chain set-up and relationship transformation. As such, the circular economy provides a powerful framework for enabling delivery of the European Commission's Green Deal and for being at the core of an Industry 5.0 approach.

The nature of the transformation required to capture the full potential of Industry 5.0 is systemic. That is, it will require a business level transformation of product/service/system design, supply chain reconfiguration that moves beyond a singular focus on cost optimisation or linearity, towards business models and systems that are more restorative and regenerative by design. This shift can be achieved by adopting a process-oriented whole system approach that restores, renews and revitalises energy, materials and natural ecosystems. The process-oriented whole system approach requires building on economic models that enhance sharing, re-use, repair, re-manufacturing, re-sale and recycling for products based on technical/non-biological materials. Alongside, it is necessary to design for more biodiverse sourcing of ingredients and sourcing of ingredients grown using regenerative agricultural practices for food, and use of regenerative production approaches for bio-sourced materials, such as fiber crops and forestry. Additionally, the underpinning circular economy principles foster business operating models that utilise more localised material feedstock and new manufacturing and digital capabilities.

Importantly, much can be done by businesses acting together to mobilise and innovate circular economy solutions. For instance, many companies are now actively investing in new product service solutions, many of which represent a fundamental shift in approach, led by design, including rethinking material choices, sourcing, supply chain practices and relationships, product packaging, distribution, services models, digital channels and logistics relationships, and marketing and communication.

A systemic Industry 5.0 approach will also necessitate a realignment of policy, to support business innovation and transformation aligned with regenerative circular economy principles and to encourage all companies to orient away from linear, extractive, wasteful and polluting practices. Current policy and sector siloes will need to be broken down and red tape removed that prevents transformation. This shift in policy orientation needs to occur overall, but also at a multiple scales and sector-specific levels, taking into account the particular needs and barriers to transformation that currently exist within different sectors.

There are many examples of businesses redesigning and developing new value chain models to take into account the economic opportunities inherent in circular and regenerative business models. These examples also encompass new and more agile customer engagement, sales, leasing models, production and inventory methods possible as a result of new digital tools, which have lower carbon impact and which respond to the changing global trade context. Policy alignment to promote, optimise and enable these new business models will be required and incentives put in place to support the front-runners and to encourage laggards to follow leading practices.

2.3 Self-sustaining and adaptive, less fragile

The Covid-19 crisis – as most of the crises before – have exposed the limits of our ability to make predictions in the context of complex systems. The inextricable web of relations between the globalised economy and our interconnected society made the management of the socio-economic consequences of the pandemic a daunting task. Most importantly, we realised that we live in an economy that was not planned to face emergencies that were largely predictable (and indeed, predicted) such as the COVID-19 pandemic. The imperative to strengthen our preparedness and embark into a journey of systemic transformation is self-evident: we need to build businesses and industries that keep functioning in the face of unexpected challenges and increasingly major disruptions; a robust industrial system, which remains within the planetary boundaries, leaves no one behind and, better, actively contributes to wellbeing and planetary regeneration. Notably, the new industrial system will have to reflect the growing post-COVID shift in human consciousness that survival in the face of crisis and access to essential goods and services is more important than the ownership of most material goods, all of which are useless when confined to home living and virtual working.

By reducing Europe's dependence on imports of strategic raw materials and energy, a radically transformed, resource efficient Industry 5.0, powered by regenerative, circular thinking and design would deliver new forms of economic value and prosperity, greater European competitiveness and guarantee strategic independence, a vital necessity that the Covid-19 crisis emphasised. As demonstrated by recent studies, the global material budget will simply not

suffice to cover the competing needs for materials of highly industrialised and emerging nations. Thanks to decarbonisation, EU's energy import dependence would for instance be massively reduced, from 54% to 20% by 2050. The optimisation paradigm on which global value chains (GVCs) were built is efficient in the short run, but hides risks for future generations through complex interdependencies, often diluting corporate responsibility into a web of contractual provisions and questionable private certification schemes. Covid-19 revealed some of these fragilities due to the lack of diversification of supply sources. The recent gas and microchip crises are further examples of our propensity to foster industrial and resource dependencies rather than invest in new infrastructure and self-sustenance. The redundancy of supply links might not seem efficient but is the cornerstone of long-run resilience. We need to move-away from a sole focus on efficiency metrics and embrace more holistic approaches, redundancy and sovereignty wherever possible thus enhancing local ecosystems for production for local consumption.

2.4 Decentralised, to achieve resilience and sustainability

Decentralisation is a critical step in all industrial sectors, not only digital. The globalisation and centralisation of our current food systems expose many regions to sudden shortages and even famines if link get severely disrupted. We urgently need to map and reduce the gap between food production and food consumption of all EU regions. That requires redesigning EU policy such as the Common Agricultural Policy to focus on resilience and regenerative principles: currently, 80% of the CAP funds go to very large corporations, and the impact of these funds on the local economy is hard to gauge.

Shifting our agricultural policy to support a regenerative farm to fork system that promotes the design of food cultivation, products and services that use more diverse and re-generatively sourced seed and produce, as well as enhance local production for local consumption from rural communities, will build more resilient food corridors across the EU and between rural and urban communities. Such an approach will not only foster more optimised and circular food chains but will empower small holder farmers and rural communities by bringing them back into the fold of European society as an essential function within our economies.

Decentralization should not only be a core principle of the physical world, but also of the digital one. Although the Web 2.0 has given opportunity to technological platforms to capture value generated by content creators and users' data, Web 3.0 promises to build a new internet based on decentralization and user sovereignty, thus both mirroring and enabling the evolution of work and labour shifts.

2.5 Digitalised with purpose, to live within planetary boundaries

Digital technologies become an ever more central part of the life of people both as citizens and as employees. They also have the potential to significantly improve the comparative advantages of European manufacturing and thereby protect or even re-shore industrial jobs. Europe's industry will be digitalised, or it will cease to exist.

Yet over the past decade, the ongoing concentration of economic power, the accumulation of value (and data) in the hands of a few (non-European) technology companies, and the mainstream transformation and rapid growth of online business models, have progressively led to unprecedented concerns in terms of economic, social and environmental sustainability. The centralisation and platformisation of digital business models has led many real economy companies in a situation of dependency, many workers in a situation of precarity, many citizens in a situation of private or public surveillance. It also led the internet to become the largest fossil-fuel-powered machine in the world, on track to generate 14% of global emissions by 2040. Furthermore, digital platforms based on monetising data, and business models fuelled by advertising revenue, are driving exponential consumption and demand for instantaneity, in turn accelerating a vast and wasteful global trade and logistics industry that is disastrous for emissions and for individual carbon footprints. As things stand, without clear redirection and orientation of the digital transformation to enable less wasteful, more energy efficient, more regenerative, distributed, diverse and inclusive – more humane, respectful of people's wellbeing and sense of self – reliance on the digital economy is a very shaky pillar of the "twin transition". Digitalisation must shift from an "internet of things" to "digital for people-planet-prosperity".

A regenerative vision for industry through an Industry 5.0 approach would offer the timely opportunity to include specific holistic sustainability and resilience targets within Europe's digital roadmap, so digitalisation becomes a lever for lowering the carbon and material footprint of Europe's economy and industry within it and shifts to a people and planet-centred approach. Digital technologies could be harnessed to deliver on climate commitments, bringing digital and green properly together. Artificial Intelligence (AI), for example, can and should be designed and deployed for sustainability rather than being independent or ignorant of it. Distributed ledger technologies, smart contracts and NFTs can be coded for radical transparency, shared ownership of the commons and automation on the principles of resilience, regeneration and sustainability.

Digital technologies have a huge role to play in enabling more sustainable and circular economic models, maximising efficiencies, providing greater transparency, new design tools, new forms of business models, new approaches to manufacturing, repair, upgrade, remanufacturing, re-use and re-sale, to name a few. Drawing on combinations of sensors, distributed ledger, smart contracts, multi-agent AI, automation and robotisation, nanotech and network computing, digital transformation could play a crucial role in offering better choices for citizens to consume and use resources in vastly more sustainable ways while at the same time participating in the creation of new and better forms of economic growth.

Designing technology infrastructure in a decentralised way geared towards people-planet-prosperity, for example, would also encourage redundancy and resilience, reducing the need for high emissions, costly and insecure information and data flows towards remote data centres. It would also take into consideration social needs and the well-needed human dimension of digitalisation and AI. Emphasis on edge/cloud solutions is much needed in this respect, but requires a fully functional data strategy, as well as innovation in the domain of satellite technology, semiconductors and "embedded AI". Building this brand-new infrastructure will require a proactive industrial policy, as well as

the ability to couple it with incentives to avoid that the digital transformation leaves many workers behind, and consumes too much energy both in rural and urban areas.

There is a need for an evidence-based debate on technological choices for industry 5.0 in light of differentiated impact on GHG emissions, materials circularity and other planetary boundaries as well as technology readiness levels and social tipping points. Clarity must also be achieved in terms of synergies and dilemmas around technologies targeting process emissions those addressing GHG emissions from combustion of fossil fuels[5]. Europe's industrial policy and 'twin transition' framework needs to ensure that Industry 5.0 is fundamentally and structurally different, not just a 'software update' of industry 4.0 but a truly innovative industrial revolution founded on human and planetary needs versus just innovation for profit.

2.6 Measuring what matters: regenerative metrics and regulatory frameworks

The new industrial strategy would need to be based on totally new targets and indicators for business performance and sustainability in business models rather than the rather "classical" headline indicators of competitiveness presented by the European Commission in July 2018 and enshrined in Industry 4.0, and only partly revised in May 2021.

Policy and measurement of economic activity need to place greater emphasis on the material/real economy over financial metrics and short term profiteering. For example, Industry 5.0 should orient towards the optimisation of more appropriate measures that reflect contemporary economic thinking, such as 'return on material assets' and material decoupling, 'return on invested energy', 'return on natural assets' and valuing human and natural capital. Moreover, in progressing towards Industry 5.0, the EU should take a proactive leading role in defining terms and measures that align with the vision as well as with other policy tools such as the new Taxonomy framework and Foresight Dashboard indicators.

Flattening emissions from the production of materials through resource efficiency and decoupling is becoming increasingly urgent. Globally, the production of materials increased as a share of GHG emissions from 15% in 1995 to 23% in 2015.[6] In the EU, switching to a genuine circular economy would also help reduce greenhouse gas emissions by 39%.[7] However, we have a very long way ahead of us: only 11.2% of materials used in EU-27 were circulated back into the economy in 2017.[8] In the context of Europe's triple imperative, it will be important for the revised industrial strategy and European enterprise model to set the right direction. This means for instance, building on

[5] Wider environmental impacts of industry decarbonisation. Wood, Deloitte, IEEP, 2021, service contract for DG environment.

[6] International Resource Panel, Resource Efficiency and Climate Change, (6th August 2020) https://www.resourcepanel.org/reports/resource-efficiency-and-climate-changehttps://www.euractiv.com/section/circular-economy/news/circular-economy-could-reduce-greenhouse-gas-emissions-by-39/.

[7] https://www.euractiv.com/section/circular-economy/news/circular-economy-could-reduce-greenhouse-gas-emissions-by-39/

[8] Eurostat. Circular Materials Use Rate (15th August 2020) https://ec.europa.eu/eurostat/databrowser/view/cei_srm030/default/table?Lang=enhttps://think2030.eu/publications/a-low-carbon-and-circular-industry-for-europe/

the "energy efficiency first" principles to a wider "resource efficiency first" principle.[9]

3 Governance to enable Industry 5.0: Key Actions

Ensuring that industry becomes a pillar and driver of sustainability, regeneration of nature and inclusion rather than constituting a threat puts radically new demands on government, public policy and the interaction between industry and the state. First, it requires new policies and policy instruments, new partnerships, and new objectives for policies affecting industry. Second, it requires a portfolio approach to research and innovation projects, combined with the willingness and a mandate to take informed risks. Third, it requires agility, in the form of resource fluidity (i.e. the ability to quickly allocate and reallocate budget and other resources), and in the form of an improved ability to respond quickly to changing circumstances. Finally, it requires an ability to link policy processes, policy areas and governance levels in a more efficient and user-friendly manner, with users here defined as industry, citizens, and other stakeholders. Thus, in a nutshell, industry 5.0 needs government 5.0.

3.1 A new role for Government: Industry 5.0 needs Government 5.0

Public sector decision-making and processes are out of sync with the speed, uncertainty and transformation imperative.

In many countries, there is a significant discrepancy in the pace of change (and sense of urgency?) between, on the one hand, companies, industries and individuals, many of whom are acutely exposed to far-reaching disruption and rapid change, and, on the other hand, large parts of the public sector that for various reasons moves at a much slower speed. Tackling the increasingly urgent and existential challenges we face, and seizing the opportunities that arise in times of disruption, critically depend on a better alignment between the public and private sector. Achieving this result requires the following steps.

- Policy processes, including regulatory change, need to focus more on breaking path dependencies – in areas such as behaviour, regulations, incentive structures and policy design – that lock us into old patterns of consumption, production and organization. Policymaking needs greater awareness of how to achieve 'unlearning', address lock-ins and overcome inertia of patterns, policies and processes that prevent necessary and desirable change.

- Compliance processes need to happen in parallel rather than sequentially. Notably, there is a need for better governance of policy processes facing new, disruptive and system-changing actors and solutions. Currently, the achievement of systemic changes is hampered and discouraged by sequential policy processes (first you get a permit from one government

[9] https://think2030.eu/publications/a-low-carbon-and-circular-industry-for-europe/

agency, then you need approval from the next government agency, etc.) which are out of sync with the pace of change required to tackle climate change and handle technological changes and competitive pressures. Furthermore, new actors and solutions often have to navigate a multitude of government agencies with different expertise and responsibilities, without anyone in government assuming a responsibility that the overall processes are effective, synergistic and time appropriate.

- Public funding for research and innovation in service of creating new, sustainable economic models, new markets and industrial ecosystems' needs to break out of its safety net of seeking sector-based, individual, business case driven projects assessed on the basis of discrete and recognisable deliverables in order to create the conditions to fund portfolios of actions that are more effective in facilitating unexpected, intersectoral combinations and transformative options for large scale structural change.

- Public funding for research and innovation in service of creating new, sustainable economic models, new markets and industrial ecosystems needs to break out of its current risk aversion. Public funding of all types – grants, project finance, lending and investment – is conditioned to seek sector-based, individual, business-case-driven projects, assessed on the basis of discrete and recognisable deliverables, with the result that outcomes are more often than not siloed, substitutional and incremental. An overhaul of the structures and support mechanisms for public funding is needed in order to create the conditions to fund early and mid-stage portfolios of actions that are more effective in facilitating unexpected, intersectoral combinations and transformative options for large scale structural change.

The current era of uncertainty, instability and rapid change calls for a degree of resource fluidity, strategic agility and leadership in the public sector, that is at odds with the existing budget processes, incentive structures, competencies and institutional rigidities that characterize policymaking today.[10]

3.1.1 Policy coherence: walking the better regulation walk

A very important step would be to ensure that, when proposing new rules or evaluating old ones, institutions assess their coherence with an ambitious EU agenda for systemic transformation. Simply applying cost-benefit analysis to new rules, or exclusively focusing on reducing regulatory costs would not lead EU institutions to "walk the talk". The choice of the best course of action to address policy problems should be inspired by the need to achieve progress towards the objectives mentioned in Section 2 above. When a regulatory alternative reduces compliance costs but jeopardises systemic transformation, it should not be chosen as the best possible option. In this respect, the European Commission has already announced a gradual reorientation of the better regulation agenda towards the sustainable development goals:[11] however, so

[10] See e.g. Doz and Kosonen's (2014) "Governments for the Future: Building the Strategic and Agile State"

[11] See https://ec.europa.eu/info/law/law-making-process/planning-and-proposing-law/better-regulation-why-and-how/better-regulation-guidelines-and-toolbox_en and the new Communication on better regulation, "Joining Forces to make better laws", at https://ec.europa.eu/info/sites/default/files/better_regulation_joining_forces_to_make_better_laws_en_0.pdf

far this was only partly achieved, and took rather the form of an add-on to previous methods than a transformational practice that leads the EU to measure progress differently, and more meaningfully. If transformation is to be achieved, then decision-making tools have to coherently follow.

The same applies to new tools that are associated with better regulation, such as adaptive and experimental regulation, foresight and horizon scanning. Future-proofing public policy requires anticipatory governance and regulation (including regulatory sandboxes), foresight-based policymaking (with foresight or "futurescoping"[12] not only aimed at predicting technological development or trends through horizon scanning, but also to proactively "shape the future"[13]) and adaptive regulation.[14] The mainstreaming of these tools in the daily practice of the Commission is still in its infancy, and may require additional guidance and investment over the coming years. Moreover, to maximise impact, the development of transition pathways for industrial ecosystems announced with the update of the EU industrial strategy in May 2021 should be reconciled with the EU Industry 5.0 agenda, as well as with the use of horizon scanning techniques.[15]

Regulation must also create an enabling environment for meaningful innovation for sustainability by building on existing good practices. One example is the Best Available Techniques Reference documents (BREFs) as part of the forthcoming reform of the Industrial Emissions Directive, but also the emergence of markets for innovative products and processes through eco-design and green procurement. Innovation for sustainability must also be supported by rewarding frontrunners and discouraging laggards. For this, the full internalisation of the costs of externalities is paramount and can be operationalised through the phase of Fossil Fuel Subsidies, the reform the Energy Tax Directive and further tax reforms aligned with the polluter pays principle.

Considering the speed with which technologies and new business models transform entire industries, planning for structural disruption regularly and proactively is key. The establishment of a culture of social dialogue at all levels (company, sector, regional and national) becomes imperative to ensure smooth and just workforce transitions, to help those whose jobs are at a risk to move to another job of the same or even better quality and to support the regeneration of adversely affected regions, industrial zones, cities and communities at large.

The distributional impact of the twin transition will have a deep impact on our ways of living and will fail if due care is not invested in maintaining social cohesion. The gig and freelance economy, for example, needs to be regulated so that all workers have access to standard labour contracts. Compensation mechanisms need to be developed for those that are affected by an accumulation of increasing heating, housing and transportation costs. Energy poverty (11% of European citizens and projected to grow exponentially in the next decade) must be addressed by all means and basic needs such as

[12] See https://knowledge4policy.ec.europa.eu/foresight_en

[13] GCPSE Foresight_Summary.pdf

[14] Anticipatory Innovation Governance - Observatory of Public Sector Innovation Observatory of Public Sector Innovation (oecd-opsi.org); Anticipatory regulation | Nesta

[15] European Commission, Communication "Updating the 2020 New Industrial Strategy: Building a stronger Single Market for Europe's recovery", 5 May 2021, at https://ec.europa.eu/info/files/communication-updating-2020-new-industrial-strategy-building-stronger-single-market-europes-recovery_en.

affordable transport and housing must be guaranteed for all. Without social acceptance, the twin transition of our societies will fail. Trade unions must make sure that the green, regenerative economy is co-created and co-shaped by workers rather than handed down from above.

3.1.2 Harnessing the power of public private collaboration: shaping markets and tilting the playing field

Governments have to do more than just fixing different types of market failures (taking care of positive and negative externalities due to pricing failures). They will have to incentivise investments in low-carbon and smart technologies, support the creation of new and viable markets for regenerative, circular economic models and business activities, enable creation of new business ecosystems and value chains, enhance new partnerships domestically and internationally, shape the demand side though procurement policy, price mechanisms and a supportive regulatory framework and most importantly ensure a "just transition", as it will be social tipping points that will create economic collapse before environmental tipping points. Public authorities must steer investment-led economic development across many different sectors and instead of picking the winners, governments should rather support the "willing" and the "innovative", those companies willing to partner, transform and innovate towards the new green and social paradigm[16].

The latest IPCC report highlights the need for policy to insist on the immediate rather than gradual phasing out of fossil fuels as a source of energy and disconnection of economic growth from CO2 emissions, leading to a steep reduction of the material and energy content of consumption pattern and production methods and an immediate incentivisation to further accelerate and scale alternative solutions. Strong policy signals supported by active and integrated innovation ecosystems would enable a well-managed transition to a regenerative, circular economic and climate-neutral economy that in turn offers the opportunity to reinvigorate Europe's industries and create new employment opportunities in sustainable value chains.

This requires a coherent approach between policies covering industrial installations (IED), assets (taxonomy), supply chains (due diligence), products (product policy), materials (CEAP), pricing (ETS, CBAM, environmental fiscal reform), sectors and systems (agriculture, energy, forestry, nutrition, mobility, healthcare and housing) and finally trade.

3.2 Corporate Governance 5.0

To set the course for systemic transformation, corporations need to change their mindset, and orient their action towards Industry 5.0 objectives. The consequences of such a transition are profound, and directly challenge the incentive scheme followed by most corporations today, focused on short term gains, as well as on shareholder primacy. The need to depart from the shareholder model of capitalism has been evoked even by past champions of this approach such as the American Business Roundtable, and was echoed by

[16] Fixing markets isn't enough. We have to actively shape and create them and tilt the playing field in the direction of the growth we want." Mariana Mazzucato & Rainer Kattel & Josh Ryan-Collins. "Challenge-Driven Innovation Policy: Towards a New Policy Toolkit", *Journal of Industry, Competition and Trade*, 26 December 2019 https://doi.org/10.1007/s10842-019-00329-w

the World Economic Forum and by U.S: President Joe Biden among others. At the same time, moving towards "stakeholder capitalism" is also unlikely to lead to an adequate consideration of the need for deep, systemic transformation.

As a result of the existing mismatch between corporate incentives and needed objectives, business leaders wishing to place their corporations on a transformative path are often criticised, when not ousted by their boards. This is why a new European Enterprise Model is needed, in which corporate progress and performance are measured coherently with the role businesses are expected to play in this ambitious, transformative plan. The current work of the European Commission on proposing a new framework for sustainable corporate governance appears to be timely and necessary, but its current legislative trajectory appears to be facing significant challenges. While an in-depth analysis of the current proposal would fall beyond the scope of this paper, it is important to highlight the importance of requiring that companies' board integrate sustainability aspects into the business strategy, and set measurable, specific, time-bound and science-based sustainability targets to measure progress along those objectives.

Alongside legal reform, strengthening the framework for corporate social responsibility will contribute to the implementation of the objectives of industrial policy. By Introducing legal frameworks, minimum standards and certification/labelling, non-financial reporting on sustainability, mandatory due diligence and business model or strategic innovation in order to make CSR an effective tool to ensure that companies do not only act in a maximising profit way but take proper account of social/ environmental/general interest concerns as part of their 'license to operate'. It should be the ambition of the European Pillar of Social Rights to guarantee that all workers have access to standard labour contracts with fair working conditions and to support all workers in their transition to the jobs and skills of a low-carbon economy.

3.2.1 The importance of social governance 5.0

Job creation is central to the New Social and Green Deal Contract, along with human rights, social protection, equality, and inclusion. A strong Europe wide employment market is also central to the region's recovery and to building, the resilience needed to future shocks and stresses.

Workers are calling on governments to come together with unions, employers and other key stakeholders to set ambitious job creation and retainership targets as a matter of urgency. To that end, a large portion of job creation and new skills development should happen through the catalysation of a net zero carbon, circular and regenerative job market. The European Commission's own ESDE report (2019) shows that not only do climate change policies boost the European job market but climate inaction would have significant socio-economic costs for Europe, particularly Southern Europe.

Industry 5.0 therefore requires social innovation to enhance prosperity and foster good quality jobs alongside measures to support education and skill training to enable workers to adapt to a shifting job market. This includes access to technology to avoid digital gaps in regions with less industrial development and the creation of employment and opportunity with a focus on

ensuring economic security and social justice at the same time. Equal access to education and healthcare as well as safeguarding social mobility are fundamental roles of governments (at least in Europe) and vital prerequisites for revolutionising industry and making it people- and planet-proof.

A major pillar of European social policy and Industry 5.0 must be the formalisation of at least 50% of informal jobs by 2030, thus enabling the successful implementation of the UN Sustainable Development Goal 8. The ILO debate on the Future of work shows that new forms of work need new rules to protect people from growing exploitation and inequalities, and to avoid a dual labor market. Industry 5.0 must be embedded with this spirit.

Weakened collective bargaining, through decentralisation and allowing companies to deviate from collective agreements, was a tactic used by governments in the last economic crisis to try to stimulate jobs by reducing so-called 'rigidities' in the labor market. The ILO debate on the Future of work and the ILO Recommendation 104 shows that new forms of work need new rules to protect people from growing exploitation and inequalities, and to avoid a dual labor market[17]. Industry 5.0 must be embedded with this spirit.

Another key element to stimulating decent jobs is well-targeted procurement strategies – which can explicitly encourage and support suppliers, manufacturers, and service providers who meet requirements for sustainability, resilience and regenerative principles, and create clear conditions on the quality of jobs that are offered including in the care sector industry. Procurement strategies can also include conditions for employing disadvantaged or underrepresented groups in the labour market. Such fair procurement strategies are especially important in supporting decent work in all sectors related to climate action and environmental protection, where procurement is widely used.

3.2.2 Research and innovation designed to drive systemic industrial transformation

Scientific, social and industry-led paradigm shifts have triggered profound changes in mindsets, skills and capabilities over multiple generations both as a necessary consequence of difference and as an enabling condition for structural changes to take hold and scale, establishing a new set of norms and expectations. The Industrial Revolution represented one such shift that transformed education, apprenticeships, research and innovation practices and the nature of work. Work on industry 4.0 has increasingly highlighted the existence of skills gaps, the need for re-skilling and up-skilling across the board, particularly in manufacturing and operations[18], widening intergenerational differences between those born digitally native and those not and a concentration of market power in the hands of developers able to code and recode.

[17] ILO Report of the "Global Commission on the future of work" chaired by Cyril Ramaphosa and Stefan Löfven. https://www.ilo.org/global/topics/future-of-work/WCMS_569528/lang--en/index.htm

[18] See for example McKinsey, August 7, 2020: https://www.mckinsey.com/business-functions/operations/our-insights/building-the-vital-skills-for-the-future-of-work-in-operations

The industrial transformation that Europe now needs to achieve sustainable living and the protection and regeneration of nature will require a comparable scale of change in ways of thinking and working, knowledge, core competencies, leadership and collaboration capabilities and above all, research and innovation practices. This is not optional: in the words of Sharan Burrow, General Secretary, ITUC, "there are no jobs on a dead planet", nor on a planet trapped in vicious cycles of pandemia, physical environmental catastrophes and consequent mental health crises.

3.2.3 Transition pathways and strategic innovation for industry-led transformation

Industry 5.0 must create an enabling framework for rapid development and deployment of innovation within industry and resilience building within value chains, including increased R&D funding for industrial low-carbon, regenerative circular economic solutions, but also changes to regulatory frameworks covering Eco-design and BREFs (Best Available Technique Reference Documents)[19]. This represents a significant opportunity for European competitiveness. If Europe's triple imperative to protect, prepare and above all transform is taken seriously by Europe's leading businesses, industry would in turn activate the power of European research and innovation to provide a world class mechanism for accelerated learning, business model transformation and new opportunities for investment and scaling.

Strategic, systemic approaches to innovation should be deployed at the heart of Industry 5.0 to enable learning and to support deliberately adopted transformation of existing businesses, small and large, as well design of new industrial ecosystems and value chains, adopting principles of regeneration, circularity and resilience wherever possible. Likewise, applying these principles would encourage the European industry to make more of Europe's strength in small and medium enterprises (SMEs) and industrial clusters, which contain multiple pieces of the transformative puzzle we need to put together. At the same time, these principles represent the means to more multi-nodal, decentralised and localised industrial ecosystems able to share common principles and at the same time provide greater supply chain resiliency.

European research and innovation policy would need to change in turn, however, to encourage more flexible, genuinely experimental and risk-embracing approaches to innovation development and deployment in partnership with industry, less bureaucracy for SMEs seeking access R&D support and greater incentives for cross-pollination across research and innovation stages and across sectors. Above all, achieving the promise of Industry 5.0 to enable people, planet and prosperity to come together, would require industrial R&D policy and programming to enshrine principles of co-creation and mutualism with key stakeholders starting with the most marginalised and least influential.

3.2.4 Skills and mindsets for complex adaptive businesses

In a rapidly changing global context, COVID-19 has spurred innovation and entrepreneurship in the US and China whereas in Europe the rate of 'churn' and

[19] https://ec.europa.eu/environment/ecoap/about-eco-innovation/policies-matters/quiet-process-eco-innovation-industrial-emissions-directive_en

disruption (in a positive sense) is lagging behind. Europe continues to focus on protecting and not nearly as much on encouraging and enabling transformation. In principle, the underlying strength of Europe's values-based investment in basic well-being and social protection in most member states should provide a more robust basis from which to encourage and support speed, risk-taking and experimentation in the private sector and in government and academia. Industry 5.0 implies mind-sets, skills and capabilities, from entry level employees to boards of directors, trained to understand complexity, think in systems, using complexity friendly tools and methodologies, design principles, experiential learning, action and reflection cycles and iterations[20]. Curiosity, adaptability, empathy and responsibility for interdependence and for long-term outcomes will need to become foundational objectives for qualification and for employment.

In this sense, Industry 5.0 would present significant challenges and demand for new contemporary learning and education approaches that can scale and meet the needs of new entrants and re-skilling of the incumbent workforce; as well as a rapid reset of curricula and core tenets of business and economics for new generations of students. Transformation of vocational educational institutions and business schools in particular is particularly pressing and would require a comprehensive overhaul of existing academic programmes to focus on the development of future business and policy leaders with a solid understanding of complex systems and decision-making.

Meeting this need constitutes a significant opportunity for Europe, and in particular for European universities. Partnering with an industry-led vanguard focused on circularity, resilience and regeneration could provide the conditions for European universities to shorten the time to distribution and dissemination of new knowledge (e.g. academic research); as well as to reform education (undergraduate, graduate and lifelong learning) and promote strategic innovation portfolios. A deepening of public private partnerships designed to accelerate industrial transformation and collaboration along sustainability lines could stimulate European universities to become better hotbeds of innovation, not just through commercialisation of research (tech transfer and licensing offices) but also through renewal of education (content/form/reach), through co-creation and new forms of interaction with SMEs, industrial clusters and society, and by being 'living labs' (e.g. testing and procuring new solutions)[21].

Designing for effective regeneration, circularity, and resilience in sustainable business models and value chains will require intersectoral crossovers, cross-pollination and new collaborative industrial ecosystems to make the most of the rich properties of nature-based materials, integrated multi-disciplinary teams to achieve multi-dimensional business models, creating multiple forms of value. As a specific complement to the systems thinking and complexity skills mentioned above, Industry 5.0 will need to attract and invest in building mind-sets, skills and capabilities capable of sustaining long-term partnerships and radical cross-boundary collaborations and governance, including co-creation across disciplines. These skills are not currently core to curricula in secondary and tertiary education and usually come as a result of later stage maturity and

[20] See David Snowden on the domains of obvious, complicated, and complexity: Snowden, D and Rancati, A; "Managing complexity (and chaos) in times of crisis. A field guide for decision makers inspired by the Cynefin framework", https://publications.jrc.ec.europa.eu/repository/handle/JRC123629

[21] Sylvia Schwaag et al, *Renewal of Higher Education: Academic Leadership in Times of Transformation* (wordpress.com)

lifelong learning. They will need to be developed from an early age, again requiring an overhaul of the structures and embodied practices of educational and training institutions. They will also need to be taught as a priority to decision makers, boards of directors and middle managers throughout European businesses and in the public sector to enable one of the most critical intersectoral crossovers: that between the public and private sectors, between industry and public administration in managing the commons and for the common good.

3.3 Vertical and horizontal coherence, at all levels of government and through international standards

To be effective, the ambition level for transition to Industry 5.0 would need to be aligned to the scale of challenges facing Europe and the world, and at the same time target national and international policies, as well as critical subnational actors like cities, regional bodies and local communities where consumer behaviour and public sentiment catalyses demand.

3.3.1 Pan-European and International scale

Industry 5.0 represents an opportunity for Europe to reframe the quality of its leadership in the world through international cooperation, openness (while at the same time strengthening strategic autonomy in a way which is aligned with SDGs) and leadership in setting standards and norms for new manufacturing, sustainability, ethics and a digital economy/society. To give an example: less than 1% of textiles are currently collected and returned to the value chain post use in Europe, and the trends are worsening not improving. Setting an ambition level within an Industry 5.0 context at the sector level focused on regenerative, circular economy principles and material flows/use, aligned with the vision, would send a strong signal to the actors in the economy that policy is re-aligning to a new economic paradigm. Setting an EU target of say 50% of textiles materials flows returning to the value chain by 2030 would be appropriate and focus R&D on high potential high impact and scalable new technologies, encourage the alignment of value chain actors and the creation of captive demand, alignment of capital and scale infrastructure investment. However, this would need to be accompanied with a proper trade and development policy fostering cooperation, secondary market and circular economy infrastructure in third countries to ensure a fair and just transition.

3.3.2 International rule making and standards setting

Global leadership would be further reinforced by leveraging the institutions and precedents for global financial rule making used in the wake of the credit crisis. Europe could set up an 'Industry Stability Board' analogous to the Financial Stability Board, recognizing the scale of systemic, strategic risks facing businesses and industries in Europe and globally from multiple connected shocks and stresses as well transition costs.

This would imply identifying industry and businesses globally and locally that are deemed 'too systemically important to fail' whereby failure = failure to transform in a fair and just manner while meeting the objectives of the Green Deal. These businesses would be required to demonstrate evidence of change to meet a set of de-carbonisation requirements, resiliency measures, circular economy principles, regenerative practices and stakeholder requirements (people-planet-sustainable prosperity) in order to continue to have access to credit, regulatory approvals and licenses to operate. Europe should also use FTA negotiations to collaborate with partners on ways to ratchet sustainability standards for industry, internalising eco-design standards or its forthcoming product policy and ensuring decent work and social criteria.

3.3.3. Regional focus

Innovation policy by definition targets more technologically advanced regions, those at the cutting edge of technological progress. Industry 5.0, because of its core principles of inclusivity and resiliency, implies strengthening innovation systems in regions in the periphery or those that are facing structural changes deserves special policy attention e.g. by taking into account the different levels of technological development when developing research and innovation programmes.[22]

The regional dimension deserves much more attention in the design of industrial policy. Industrial and technological progress has strong agglomeration effects and industry (especially in new emerging value chains) tend to concentrate in the more innovative, leading regions. Economic disparities across regions are persistent and deepening in Europe, leading to virtuous circles in the core regions and vicious circles in the periphery. Moreover, the climate transition will have a significant impact on carbon-dependent and less developed regions. All this is leading to a growing number of 'left-behind' and 'de-industrialised' regions in the EU (not only regions formerly dependent on coal).

To deal with the decline of regions, Industry 5.0 offers an opportunity to strengthen European resilience and security through regional redevelopment plans that localise transformation strategies and combine economic revitalisation programmes with social support and active labour market policies. Deliberate support and incentives for new business development and capability building to implement structural reforms at regional level would improve the quality of institutions, modernise industrial infrastructure, upgrade the skill structure and enable the development of policies that allow moves to higher

[22] See also the work by the European Commission on smart specialization for sustainability and transformation: Smart Specialisation Strategies for Sustainability (S4) - Smart Specialisation Platform (europa.eu) and Place-based innovation for sustainability - Smart Specialisation Platform (europa.eu)

value added activities. These plans have to be supported by smart specialisation strategies, which are a regional and innovation-oriented form of industrial policy with a view to unlock latent comparative advantages of a region. Support must be provided in the form of capacity building to ensure the effective uptake of available funding mechanisms as well as to formulate a tailor-made approach for each region. Finally, the deployment of a circular economy with its decentralised value chains offers opportunities for creating local jobs.

4 Our Call to Action: ESIR Industry 5.0 Action Plan

The triple Imperative and the role of industry

what	who
Deep transformation of business models where sustainability is a natural component and driver of international competitiveness	Industry, government, financial sector / investors, civil society, NGOs
Full re-orientation of the Better Regulation agenda towards a post-GDP paradigm	Government (EU Commission and MS)
Changes in the mind-set and economic approaches to policy, finance investment and corporate governance	Industry, financial sector / investors, government, civil society / NGOs
Fundamental redesign of value chains to embrace new technological possibilities and sustainability, as well as circular economic and societal well-being	Industry
Adoption of metrics and indicators that allow for the measurement of progress towards the vision	Industry, Government, Investors, NGOs
A regulatory system that effectively guides accelerated compliance, adoption and best practice	Government

New Economic Orientation and New Approaches to Industry Performance

what	who
Greater emphasis in policy and measurement of economic activity on the material/real economy over financial metrics to optimise 'return on material assets', return on invested energy', 'return on natural assets' and 'value of human capital'	Industry, Government, Financial sector, civil society and NGOs
Transitioning from a narrow "energy efficiency first" principle to a wider	Industry, Investors

"resource efficiency first" principle.	
A system of due diligence for all value chains that bring their products into the EU Single Market	Government, Industry
Reduced labour taxation (particularly for lower income workers), internalising pollution costs through environmental fiscal reform, considering the role of higher corporate and digital taxation; and discussing the application of a universal basic dividend or income logic	Government
A regulatory system that effectively guides accelerated compliance, adoption and best practice	Government

New Design for Business Models, Value Chains and Supply Chains

what	who
Redesign EU policies such as the Common Agricultural policy on the basis of resiliency principles (p. 8)	Government
Design reshoring of economic activities in such a way that it will reduce the overall carbon and material footprint of the supply chain. (p. 9)	Industry

New Purpose for Digital Transformation, Achieve Life within Planetary Boundaries

what	who
Harness digital technologies to deliver on climate commitments, bringing digital and green properly together	Industry, Financial sector

New Approaches to Policy-Making

what	who
Make a green and social industrial strategy the cornerstone of the Green Deal to address the challenges of the twin green and digital transitions. The Green Deal has to be complemented by a long-term industrial strategy that prepares	Government in interaction with stakeholders

industry for the digital and low-carbon economy and allows it to remain competitive and just while decarbonising.	
Put in place a coherent approach between policies covering industrial installations (IED), assets (taxonomy) supply chains (due diligence) products (product policy), materials (CEAP), pricing (ETS, CBAM, environmental fiscal reform), sectors and systems (agriculture, energy, forestry, nutrition, mobility, healthcare and housing and trade	Government
Create a 'one-stop shop' for companies to interact with the public sector on industrial transformation (streamline and expedite processes, facilitate interaction with different agencies and public sectors)	Government in consultation with stakeholders
Rethink the role of the public sector in enabling the transition to Industry 5.0 (objectives, instruments, policy coherence, partnerships, interactions)	Government in consultation with stakeholders

New Capabilities and Approaches to Research and Innovation

what	Who
Change regulatory frameworks covering Eco-design and BREFs (Best Available Technique Documents)	Government in interaction with stakeholders
Increase R&D funding for industrial low-carbon circular and regenerative economy solutions	Government in consultation with stakeholders
Change European research and innovation policies: - encourage more flexible, genuinely experimental and risk-embracing approaches to innovation development and deployment in partnership with industry - reduce bureaucracy for SMEs seeking access to R&D support - greater incentives for cross-pollination across research and innovation stages and across sectors	Government in consultation with stakeholders

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Europe faces a triple imperative to protect, prepare and transform in its quest for building forward better after the deadliest pandemic of the past century and for building forward better to address the greatest challenge humanity has ever faced – climate change and biodiversity collapse. An enormous challenge: how to transform human life quickly enough to enable 8 billion people to live sustainably and peacefully within planetary boundaries? While Europe cannot face this challenge alone, we believe it can lead the global community towards the deep systemic transformation that this and next decades will inevitably require. We think that Europe will only be able to achieve this leadership if it will at once strengthen its internal cohesion and capacity to speak with one single voice; and promote a deep transformation of the economy at the global level.

Research and Innovation policy

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