E3G

BRIEFING PAPER February 2020

FOSTERING CLIMATE-NEUTRAL, ENERGY-INTENSIVE INDUSTRIES IN EUROPE:

A POLICY VISION FOR THE EU INDUSTRIAL STRATEGY

OLIVER SARTOR AND JOHANNA LEHNE

The EU has set the ambition for Europe to become the first climate-neutral continent by 2050. This will require a step-change in emissions reductions across the European economy, including in energy-intensive industries, such as steel, cement, aluminium, paper and chemicals. These sectors account for roughly 17% of EU emissions and have seen stagnating emissions reductions in recent years.

A vast number of policy options to decarbonise heavy industry have been put forward. This paper builds on these. It outlines the elements that a comprehensive policy package for decarbonising industry must contain and explores how policy needs will evolve at different stages of the transition to climate-neutrality. It proposes a set of policies for each stage, laying out an illustrative policy roadmap to 2030 and beyond.

In the lead up to the upcoming EU industrial strategy, this paper sets out key priorities to put energy-intensive industries on track for climate neutrality by 2050.

E3G

Box 1. Policy recommendations to foster CO_2-neutral energy-intensive industries in Europe

PRIORITIES	SPECIFIC POLICY RECOMMENDATIONS
Support first generation of commercial scale climate neutral production sites	• Offer Carbon Contracts for Difference to cover higher operational expenditure for breakthrough clean production technologies.
Identify and invest in priority infrastructure	• Require Transition System Operators and Member States to plan for and provide access to green hydrogen, carbon capture and storage and power infrastructure. • Mobilise EU and Member State funds to build priority cross-border projects under Projects of Common Interest.
Create lead markets and introduce demand-pull instruments	• Set green public procurement standards for governments, • Set green material purchase quotas to ensure a given % green cement, steel and basic chemicals on market by 2030
Identify a pathway to long-term carbon leakage solutions	•Signal pathways to CO_2-neutral product standards by 2035. •Explore border carbon adjustments for cement and steel as an interim measure.
Increase the circularity of energy-intensive basic materials	• Implement eco-design standards for carbon-intensive final products. • Strengthen end-of-life obligations on product disassembly, sorting and quality control.
Expand the climate neutral industry technology portfolio	• Make broadening and improving the portfolio of climate neutral basic materials production technologies a focus of Horizon Europe (2021-2027)
Establish governance tools to coordinate the industry transition	• Establish a Clean Economy Observatory to identify bottlenecks and advise the Commission. • Create a dedicated place for industry decarbonisation in the Energy Union Governance framework, within th National Energy and Climate Plans and regional investment plans.

E3G

CONTENTS

Context

The European Green Deal communication promised to "mobilise industry for a clean and circular economy" and called for "deeply transformative" policies to ensure this happens.[1] The Commission now needs to deliver on this promise. It is set to release its new industrial strategy on 10 March 2020. The strategy will establish the direction of travel for the EU economy. In addition to delivering climate goals, it will be expected to strengthen growth and competitiveness and navigate tricky trade relations with the US and China. While the strategy will go beyond heavy industry to also touch on digital and defence policy among other areas, it will, nonetheless, be highly influential in setting the parameters for the transition to a climate-neutral industrial sector by 2050. A successful industrial strategy could establish the policy framework required to make EU industry clean, productive, globally competitive and future-proof.

Energy-intensive industries (EIIs), such as steel, cement, aluminium, paper and bulk chemicals, will need to make a fundamental shift from the CO_2 intensive processes and products that are central to their business models today. So far progress has been slow. Industrial emissions reductions have stagnated since 2012[2] and breakthrough decarbonisation technologies remain trapped at the pilot stage. The large potential for material circularity[3] – using less of these materials by recycling and using them in different ways – remains underexploited. As low carbon investment accelerates in China, the risk of Europe losing its advantage in clean industry is becoming a more serious issue. With many industrial plants coming up for reinvestment and refurbishment in

[1] European Commission (2019), **The European Green Deal**

[2] Carbon Market Watch (2019), **Cracking Europe's Hardest Nut**

[3] Material Economics (2018), **The Circular Economy: A Powerful Force for Climate Mitigation**

the next 10 years, time is running out to ensure the right investments are made to forge a pathway towards climate-neutrality.

This is also a key issue for the just transition and for Europe's economic cohesion. Many heavy industry sectors are dealing with overcapacity in the global market. By supporting the world's first investments in the large-scale deployment of breakthrough, climate-neutral technologies, the EU will be able to create a long-term future for these sectors in Europe, securing jobs throughout the industrial value chain. By doing so in a way that benefits all regions, an EU industrial policy package can reduce the risk of fragmented national policies and start to bridge inequalities in the shift to a net zero carbon economy.

This paper sets out key priorities to put energy-intensive industries on track for climate neutrality by 2050. Section 1 outlines policy needs during different phases of the climate-neutral industry transition. Section 2 highlights seven priorities for the coming decade and translates these into a set of 12 concrete policy proposals to be implemented as part of the new EU industrial strategy (see Box 1 above). This analysis builds on work from the High-Level Group on Energy-Intensive Industries and by various leading European research organisations. [4]

The paper focuses primarily on how to decarbonise production processes for energy-intensive materials. However, this is only one part of the challenge. Demand for these materials can be reduced by taking a new approach to design, using higher-quality materials, substituting these materials for others, improving material efficiency and increasing reuse and recycling. While we touch on some policies required for this shift, a more comprehensive look at demand-side options and how these could transform heavy industry sectors, bringing in new, more disruptive players, goes somewhat beyond the scope of this paper.

1. Transitioning to a climate neutral industry

Context

In contrast to large developing countries, the EU's capital stock is already built and, in many cases, experiencing overcapacity. The transition to a climate neutral industry in Europe will, therefore, require converting brownfield sites – land that has already been used for industrial purposes. Companies facing a tightening

[4] European Commission (2019), **Masterplan for a Competitive Transformation of EU Energy-intensive Industries**; Institute for European Studies (2019), **Industrial Transformation 2050** ; Agora-Energiewende (2019), **Climate-neutral Industry** ; Neuhoff et al. (2019), **Building Blocks Building Blocks for a Climate-Neutral European Industrial Sector**

E3G

emissions constraint will have to decide whether to close older sites when they are due for major refurbishment, or to invest heavily to make them climate neutral. This is a crucial moment to support companies to choose the latter option.

The policy framework emerging from the new industrial strategy must create an unequivocal business case for investing in genuinely climate neutral production. A focus on 'silver bullets', relying exclusively on R&D, border carbon adjustments, or carbon price floors, will not be sufficient. The strategy should draw on a coordinated mix of supply-push and demand-pull policies:

a) Policies that create a business case for investments in the first generation of climate-neutral production plants and for the roll out of the required infrastructure to operate these plants (e.g. clean electricity, green H_2, CCS).

b) Policies, including targets and governance frameworks, that enable the scale up of climate neutral production beyond the first generation of sites.

Figure 1 (below) outlines the four basic stages of the transition to a climate neutral industrial sector. It shows market penetration of the current portfolio of climate neutral technologies on the vertical axis and time on the horizontal axis.[5] Policy needs evolve over time, depending on where different sectors are along the trajectory.

Stage 1 – Research, development and demonstration

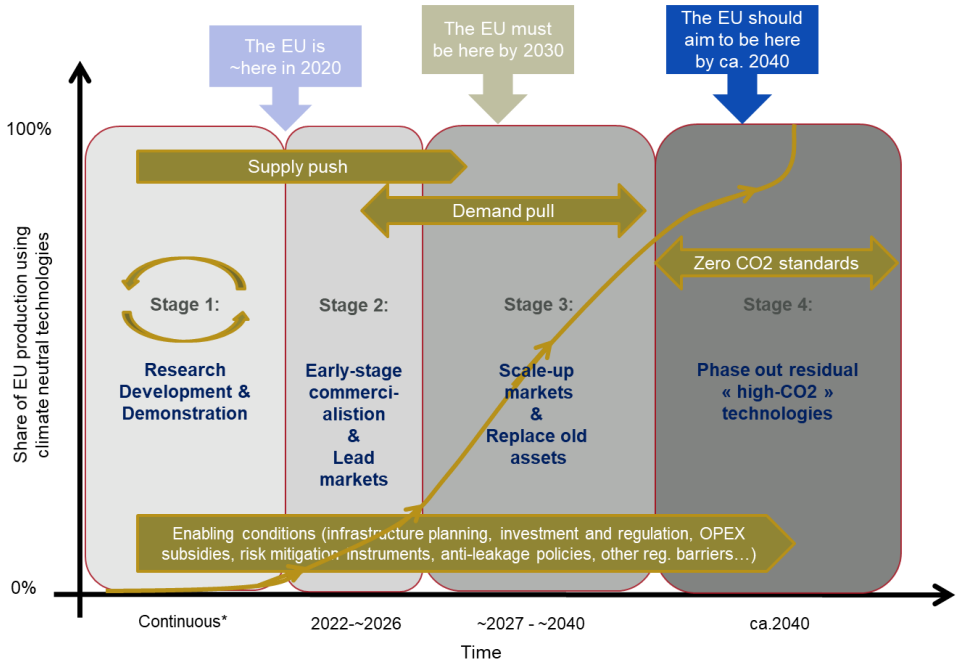
The objective in stage one is to push forward the development of climate-neutral technologies with the aim of bringing down their cost, addressing technological blind spots and broadening the portfolio of technologies.

There are a range of technologies that can be supported and taken forward as options for pursuing climate neutrality in industrial processes.[6] However, this **portfolio is currently still relatively expensive and narrow** and the range of decarbonisation options varies considerably by sector. It is, therefore, important that RD&D continues in parallel to later stages in the transition. New technologies are developed, and existing ones are refined, as others move on to commercialisation

[5] For our present purposes we abstract from the fact that different technologies may emerge at slightly different time horizons.

[6] Agora-Energiewende (2019), **Climate-neutral Industry**

Figure 1. Basic steps for getting to ~100% climate neutral production in EIIs in Europe



*Stage 1: RD&D continues beyond 2020, as technologies are iteratively improved and the technology base is expanded.

This approach is also consistent with the literature on industrial policy. 'Horizontal' industrial policy – supporting an industry to develop a range of competing solutions – is deemed to be more effective than 'vertical' industrial policy as it promotes competition on cost and performance. A broader portfolio of solutions will also reduce the risk of regulatory capture by companies promoting certain technologies.

Finally, given the speed of the transition required, attention may need to be paid to the **design of intellectual property policy** to supporting technology deployment and improvements beyond the first mover (e.g. limitations on IP exclusion periods).

Box 1. Key policies for Stage 1

- Early stage R&D funding programs building on public private partnerships (e.g. Horizon Europe, national RD&D programs)
- Funding a broad portfolio of pilots and demonstration projects (e.g. ETS Innovation Fund)
- Public procurement competitions to support innovative start-ups offering new solutions

- Mechanisms to limit intellect property exclusivity (e.g. favouring broad industrial consortia in funding decisions, limitations on exclusivity periods).

Stage 2 – Early stage commercialisation and creation of lead markets

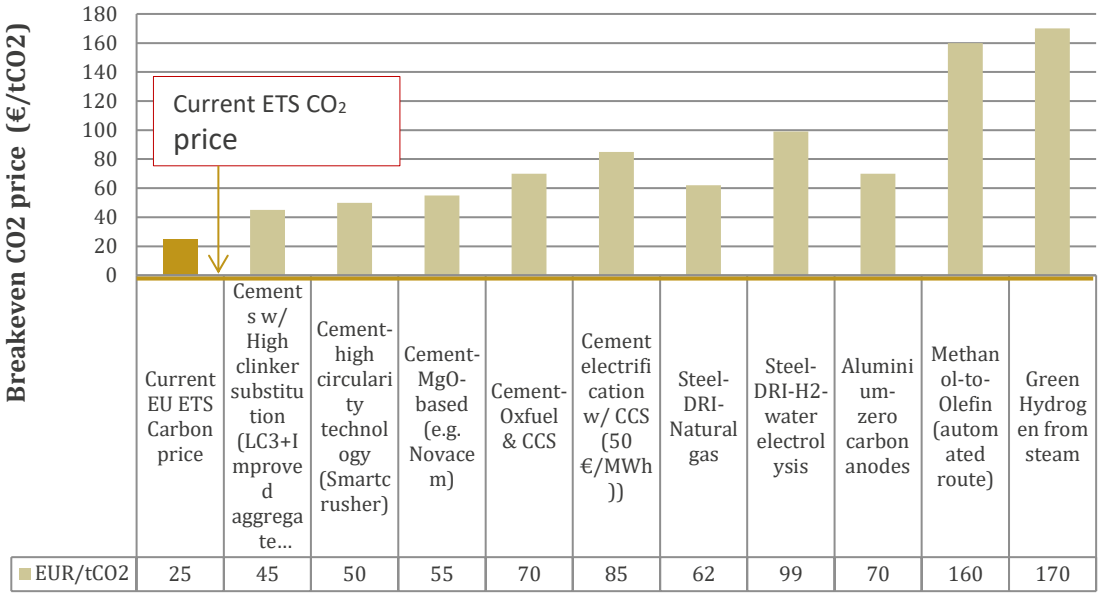
The main objective during stage 2 is to create a business case for climate-neutral technologies to enter the market and be deployed at commercial scale. Most EU heavy industry sectors currently find themselves at the very beginning of this stage. Europe is home to numerous EU and nationally-funded demonstration projects for low-carbon industrial breakthrough technologies. Despite the growing range of promising, tested technologies, companies are not investing in commercial scale sites to deploy them. Several challenges stand in the way of those investments.

Most technology options for decarbonising heavy industry in line with climate neutrality are significantly more expensive than conventional production processes and breakeven carbon prices are substantially higher than what is currently considered likely under the EU ETS (see Figure 2). Even with a high enough carbon price, investors will worry that the price could fall in future, rendering a once viable investment unprofitable. Some form of subsidy and/or CO_2 price risk mitigation instrument will, therefore, be required to cover higher operating and capital costs – such that climate-neutral technologies can compete with high-carbon ones.

In addition to the higher production costs, **investments in the first commercial production sites are characterised by unusually high levels of risk.** While a pilot project may cost in the order of €10-50 million, an equivalent commercial scale plant will often be in the order of several hundreds of millions to billions of euros.[7] By definition, first-of-a-kind technologies have not yet been tested at commercial scale, this creates very significant financial and business risks. Will the site be built on time? Will the technology work as expected at the new scale? Will consumers be willing to buy the resulting product? Consequently, investors in first-of-a-kind sites will often demand some form of public financial guarantee, to limit their investment exposure.

[7] Bataille et al. (2017), **A review of technology and deep decarbonization pathway options for making energy-intensive industry production consistent with the Paris Agreement**

Figure 2. Breakeven CO_2 cost estimates for selected low-carbon EII technologies



Data Sources: Agora Energiewende (2019), Sartor and Bataille (2019), Material Economics (2019)
NB. Figures above represent lower bound estimates for several technology costs and typically assume 50€/MWh of electricity

A further challenge is the **availability of critical infrastructure**. Many climate neutral EII technologies depend on large amounts of decarbonised energy inputs (especially electricity or hydrogen) and, therefore, on the roll out of infrastructure to supply those inputs. Some sectors, for example cement, may require CCS transport and storage infrastructure. Policymakers will need to take strategic decisions about the ownership and regulation of this infrastructure and how to fund it. They will have to carefully balance different factors when deciding what to build and where. Priority projects could be identified on the basis that they:

- serve strategically important clusters of EII producers;
- facilitate the transition for climate neutral EII production sites looking to participate in early stage commercialisation of breakthrough technologies;
- are necessary to avoid high-carbon lock-in for sites facing major re-investment decisions during the coming decade;
- face relatively low barriers in terms of public acceptability.

Close coordination between public support policies for early stage production sites and infrastructure roll out and commissioning will be key. A dedicated governance framework and clear infrastructure and technology deployment targets would facilitate cooperation between public and private actors along the value chain.

The **absence of demand for climate-neutral basic materials and chemicals** presents another fundamental challenge. Policies need to be put in place to reassure companies that they will be able find a market for their climate-neutral products and thereby recover the costs of their investments. Stage 2, therefore, requires the development of lead markets for these products. Lead markets can help build familiarity among consumers with new climate neutral products. For instance, companies producing new cement and concrete chemistries may initially face challenges convincing their (often conservative) consumers, e.g. construction companies and developers, of the performance and value of their products.[8] Lead markets can help to grease the wheels of this learning process.

Most energy-intensive basic materials are internationally traded commodities. A final component of building the business case for the industrial transition will be to put in place a robust framework to protect against possible **carbon leakage**. Free allocation under the EU ETS will become unsustainable as the cap on the ETS declines in line with the EU's goal to achieve climate neutrality. International climate policies will take a long time to converge to comparable carbon prices. A bridging solution, but one which does not undermine carbon price signals, is a key condition for EU producers to make large scale investments in climate neutral production processes in Europe. Policies to begin a transition to border carbon adjustments (BCAs) or to climate neutral product standards, should therefore be implemented from the 2020s onwards (see discussion in stage 3).

The stage 2 policies discussed so far have focused primarily on how to decarbonise production processes for energy-intensive materials. This is only one part of the challenge. Demand for these materials can also be reduced by taking a new approach to design, using higher-quality materials, substituting these materials for others, improving the efficiency with which they are used and increasing the share that is reused and recycled. A final priority in stage 2 will, therefore, be to increase circularity in the production of basic materials and chemicals. Policies will be required to incentivise:

[8] Lehne and Preston (2018), **Making Concrete Change**

E3G

- **Circular design of products using energy intensive materials**, e.g. buildings, furniture, vehicles, electronic equipment, and a variety of plastic-intensive products. Design is critical to ensuring that the underlying raw materials of these products (e.g. steel and copper) can be re-separated with minimal contamination at end of life and re-used in high value ways to substitute primary materials.
- Better **end of life deconstruction, collection, materials sorting and quality control**. For instance, policies to prevent the shredding of vehicles, before specific contaminants are removed and to facilitate separate collection and sorting processes for key materials.
- **The uptake of breakthrough circular economy technologies.** These are technologies with the potential to increase circularity or resource efficiency in the use of basic materials (e.g. smart-crusher technologies for concrete, re-carbonation technologies, 3D metal printing technologies).

Many of the products using high levels of basic materials stay in use for a long time from electronic equipment (5-10 years), to vehicles (10-25 years), to buildings (30-100 years). If EIIs are to have high quality recycled material feedstocks, the groundwork must be prepared during the next 5-10 years. These measures are most relevant for the EU's new Circular Economy Action Plan.

Throughout stage 2, policymakers should try to implement policies that anticipate the requirements for stage 3. For example, lead markets, and the policies used to create them, can act as a steppingstone to scaling up demand for climate neutral basic materials. A labelling standard for 'green steel' established in stage 2 could help provide the technical basis for a 'green purchase quota' for steel implemented in stage 3. Similarly, policymakers in stage 2 will need to anticipate the transition to robust long-term anti-carbon leakage policies in stage 3.

Box 2. Key policies for Stage 2

- Operating cost subsidies, such as carbon contracts for difference, to cover higher operating and capital costs for climate-neutral technologies
- Public equity co-financing and loan guarantees to mitigate capital risk for first generation sites
- Planning, public investment, removal of regulatory barriers and clarification of regulation for priority 'clean-industry' infrastructure

- Deployment targets to coordinate early-stage commercial scale breakthrough technology deployment and the roll out of infrastructure to support those technologies
- Policies to create lead markets (e.g. public procurement policies, green product labelling, private purchasing alliances for green products)
- Policies to transition to a robust, long term anti-carbon-leakage framework (e.g. explore BCAs, and product standards)
- Ecodesign policies for products using energy-intensive materials and policies to incentivise better collection, sorting and reuse of materials

Stage 3 – Scale up markets for climate neutral technologies and replace old assets

By the beginning of stage 3 it is assumed that, in each of the relevant EIIs, between ~20-30% of the EU market is supplied with climate-neutral products from new processes. However, assuming the policies proposed for stage 2 are adopted, this would mean that at this stage climate-neutral production would largely still be supported by the public sector. The objective in stage 3 is to shift to demand-pull policies to ensure that climate neutral technologies gradually replace the bulk of carbon-intensive technologies while shifting the cost burden off the public sector.

A crucial condition for scale up is a strong signal of growing demand for climate neutral products, increased production cost notwithstanding. Private sector **green product purchasing mandates** may be the most credible way to ensure demand at sufficient scale. These would mandate the private sector to pay for the higher cost of these materials or chemicals by effectively requiring them to meet a specific quota of their material purchases by buying climate-neutral materials.

To be effective a green product purchasing mandate will need a **clean production guarantee** so that goods can be tracked and counted towards a given consumer's quota (similar to a guarantee of origin for renewable energy). These, in turn, will require robust third-party verification systems, which would also need to be extended to importers. WTO compliance necessitates that equivalently low carbon products can enter and compete in the EU's market.

Policymakers will also need to **revise any regulatory barriers to consuming climate-neutral materials**. Building codes and construction product standards, for example, specify the type of cement that can be used for specific

applications. These standards tend to be prescriptive, requiring a specific chemistry, rather than performance based. In some countries CEM I, a very carbon-intensive form of cement clinker, is the only cement allowed in most concrete applications.[9]

Transition infrastructure (for clean electricity, green hydrogen and CCS) will need to be scaled up in line with the growing number of climate-neutral production sites. The mechanisms for coordinated infrastructure planning implemented in stage 2 will need to remain in place and by this stage policymakers will need to have clarified the rules for **how infrastructure assets and services will be governed and regulated**. Key questions include: Will green hydrogen production and supply be regulated as an extension of natural gas markets or of electricity markets? What will be the role of national and EU TSOs to support timely roll out and connection? How will competitive pricing for green fuels or CCS pipeline usage be assured while also ensuring that large investments in nearby industrial production sites can be undertaken at reasonable levels of risk? Should assets be publicly owned and licenced for private operators or should private ownership be allowed? What will be the role for long-term contracting to facilitate risky, site-specific investments?

As in stage 2, it will be important to protect against possible **carbon leakage** as climate neutral production is scaled up. In principle, producers selling products to purchasers under a green product purchasing mandate will face no risk of carbon leakage. However, these producers will only represent a small share of the market at the beginning of stage 3. Some form of protection may, therefore, be required – at least for the remaining share of the market using conventional technologies – until ~100% of the market can be covered by a climate neutral production standard. However, any protection measures must not undermine carbon price signals and the technological transformations required to enable emissions cuts.

In this context, it may be helpful to explore the use of **border carbon adjustments** (BCAs) as a possible measure for the cement and steel sectors, as signalled by the Commission in high-level statements in recent months.[10] However, beyond the many other difficulties to implementing BCAs,[11] they are not likely to be well adapted to all sectors (see Table 1). The aluminium sector,

[9] Lehne and Preston (2018), **Making Concrete Change**

[10] European Commission (2019), **The European Green Deal**

[11] Sandbag (2019), **The ABCs of BCAs**

E3G

for example, is likely to be easily 'gameable' through resource shuffling. Some chemical sectors may be difficult to protect due to complexities in their supply chains.

Table 1 Examples for a transition to anti-leakage protection for different EII product categories

Sectors considered appropriate for BCAs	Reason	Sectors considered appropriate for clean product standards	Reason
Cement and clinker	Limited trade beyond immediate EU neighbourhood, few exports.	Basic chemicals*	- Challenging MRV due to value chain complexity - High EU exports of downstream products
Steel	- Competes with cement for structural applications in buildings. - Limited exports of basic steel products from EU. - Homogeneous production process	Aluminium	- Challenging MRV due to indirect nature of emissions (electricity). - Possibility of resource shuffling to avoid BCA (e.g. sending only recycled or legacy hydro-based aluminium to EU)

*NB. This is a stylised representation. Some specific sub-categories of the 10 basic bulk chemicals may be better suited to moving to BCAs as well or directly to standards, depending on a more detailed assessment.
*MRV = measurement, reporting and verification

One option, therefore, is to pursue a long run transition towards **climate neutral product standards** that would apply both to imports and to domestic products. This would likely be WTO compatible if designed in the right way and pursued through international dialogue with trading partners. It will, however, take some time to arrive at a point where product standards can be set at a genuinely climate neutral level. Climate neutral product standards and green product purchasing mandates will have to be phased in to cover an ever-increasing share of consumption in the EU's internal market.

Box 3. Key policies for stage 3

- Significant expansion of demand-pull instruments (e.g. climate neutral product purchasing mandates or quotas)
- Enhance regulatory, national planning and financing frameworks for transition infrastructure

- Continue and enlarge scope of transition to long-term carbon leakage solutions (e.g. explore BCAs and roll out climate neutral product standards)
- Removal of product-specific barriers to market scale up (e.g. revisit cement/building codes)
- Signal future sunset clauses/product standards (once market penetration of climate neutral technology reaches high levels)

Stage 4 – Phase out remaining non-climate neutral industrial production

By the beginning of stage 4, it is assumed that market penetration levels of low carbon production have reached roughly 60-70% and the portfolio of climate-neutral technologies is well proven. The objective in stage 4 is to phase out any remaining technologies that are not compatible with climate neutrality. This category may include different types of plants including, for example, plants that were upgraded with intermediate decarbonisation technologies (e.g. steel plants using natural gas and direct reduced iron rather than green hydrogen) and now require a further step to become climate neutral.

The simplest solution would be to implement **sunset policies.** These would establish dates by which all production sites have to be brought in line with the same climate-neutral technology standards and set out the regulatory steps to phase out polluting technologies. This could be done by raising green product purchasing mandates to close to 100% of the market or by **sunsetting production from technologies** by shifting the whole market onto **standards** that exclude the use of technologies that are no longer considered consistent with climate neutrality.

In either case, one small challenge may be the question of what do about sites that produce goods for export. These sites could be negatively affected if they continue to compete with foreign producers with fewer climate policy constraints for their goods. In such cases, the EU would have two options: provide export rebates, or coordinate the phase in of zero carbon technologies with foreign trading partners. In any event, the latter is likely to be necessary as the EU seeks to set internal market standards that close off its market to non-climate neutral imports.

Thus, the “end game” for transitioning to climate neutral production would likely require coordination at the international level. The EU would therefore be wise to take a leading position itself prior to this point, so as to be able to shape

E3G

international policies in a way that fit the needs of the domestic transition, while adequately protecting the markets of its producers.

Box 4. Key policies for stage 4

- Sunset policies for production assets that are non-climate neutral
- Close markets to EII products that are not climate neutral (e.g. via climate neutral product standards applied both to imports and domestic production)

2. Policy recommendations for the EU industrial strategy

The EU currently finds itself at the beginning of stage 2: early stage commercialisation and the creation of lead markets. In this section we look at how policy priorities for stage 2 could potentially be addressed as part of the new EU industrial strategy and the policy framework that follows from it.

Priority 1: Support the first generation of commercial climate-neutral production sites

1. **Fund Carbon Contracts for Difference (CCfDs) to create a business case for breakthrough technologies:** As part of the planned ETS reform in 2021, the EU should earmark a share of auction revenues to fund CCfDs for first-of-a-kind commercial-scale climate-neutral industrial production sites. Investors in these sites would receive the difference between an agreed 'strike price' for CO_2 and the actual ETS price where the latter is lower than the agreed price, multiplied by the emissions saved from their project compared to existing technologies.[12] The EU would define the technology benchmarks that projects must beat to be considered 'climate neutrality compatible.' CCfDs would address the higher operating cost of breakthrough technologies, but may not cover all the cost increases or address all the risks associated with these projects. It may, therefore, make sense to allow companies to combine CCfDs with other risk capital financing (e.g. through InvestEU guarantees, the ETS Innovation Fund, and national support funding).

[12] Sartor and Bataille (2019), **Decarbonising basic materials in Europe**; Richstein (2017), **Project-Based Carbon Contracts** ; Agora-Energiewende (2019), **Climate-neutral Industry**

E3G

Priority 2: Identify and invest in priority infrastructure

2. **Require TSOs and Member States to plan and provide access to green hydrogen, CCS and power infrastructure:** Significant new infrastructure will be required to support the roll out of climate neutral production sites. The responsibility for planning for this infrastructure will need to be clearly allocated. In some areas, like electrification, existing TSOs may be required to account for industrial decarbonisation in their planning and ensure timely access. In other cases, e.g. for CCS or hydrogen, or for specific ports or industrial clusters, responsibilities may ultimately need to be allocated to different actors, in which case the state may be the best initial point of responsibility. This should be clarified in legislation.

3. **Mobilise EU and MS funds to build priority cross-border projects:** There will be numerous cross border projects (transmission wires, storage sites, hydrogen pipelines) of common EU interest for the industrial transition. EU infrastructure planning bodies will need to identify, plan and prioritise projects. As many of these new types of infrastructures go beyond the experience of ENTSO-E and ENTSOG or compete with their offer, a different actor may be better placed to identify and triage system needs. Priority projects will need access to relevant EU or national funding and dialogue to remove regulatory barriers, accelerate administrative approval and elaborate missing regulation for relevant infrastructure (e.g. for CCS). Coordination of these efforts across different initiatives, DGs and Member States will be crucial (see point on governance below).

Priority 3: Create lead markets and introduce scalable demand-pull instruments

4. **Revise public procurement standards for basic materials**: Reform the EU's set of declining standards for the average embedded CO_2 of basic materials used in building and construction projects in European and national public works. They would decline in a stepwise manner from 2025, to 2030, to 2035, helping to create lead markets and uptake for green basic materials. These would also promote consumer awareness of and familiarity with these products.

5. **Introduce green product purchasing mandates for large private sector consumers of EII materials:** The EU should introduce climate neutral purchasing mandates or quotas for sectors consuming significant amounts of

basic materials or chemicals, e.g. construction, automotive manufacturing, machinery parts, plastic goods and selected final users of CO_2-intensive chemicals. The system would take effect from 2026, with the purchasing mandate or share of green purchases in total consumption rising every five years. A de minimis rule could be applied to exempt small companies. The quota could be met through either purchasing very low-carbon primary products or 'circular' products. A list of climate neutral product definitions would be established by the Commission for the relevant sectors. To allow time for climate neutral and circular production capacities to grow, the system could initially set standards at a low level with obligations focused mainly on the public sector (see point 4) and without requiring all of the quota to be met through absolutely *zero* carbon production. However, a credible pathway would be established to ramp up the obligations over time, in line with breakthrough technology deployment expectations.

Priority 4: Explore different measures for long-term carbon leakage protection

6. **Explore the use of Border Carbon Adjustments in the cement and steel sectors:** The Commission has signalled its intention to explore the use of BCAs for cement and steel. BCAs could be implemented through reforms to anti-leakage provisions of the EU ETS Directive, as part of the scheduled revision in 2021/22, accompanying the cap revision. If the EU, ultimately, chooses to pursue BCAs, it will need a strong diplomatic strategy, consulting extensively with major trading partners prior to implementation.

7. **In parallel, prepare the groundwork for climate neutral product standards as a long-term solution (e.g. from 2035 onwards):** BCAs are not likely to be well adapted to all sectors, nor will they be technically or politically easy to implement. A more promising option may, therefore, be to signal an intention to shift to climate neutral product standards, which would apply both to imports and to domestic products. This would likely be WTO compatible if designed in the right way and pursued through international dialogue with trading partners. It would be difficult to set such standards today given how far we still are from large-scale climate-neutral production. However, these standards could already be sign-posted today for a later date, e.g. from 2035, at which point meeting them will be more feasible. Signalling the intention to meet these standards will already affect investment decisions today. An alternative pathway would be to gradually

scale up green product purchasing mandates until they apply to 100% of the market (including imports).

Priority 5: Increase the 'circularity' of energy-intensive basic materials

8. **Set eco-design standards for products using energy-intensive materials:** These would apply to products using the bulk of energy intensive materials, including buildings, furniture, automotive vehicles, electronic equipment, and plastic products. These would aim to reduce the risk of material contamination during fabrication, use and end of life stages of the product lifecycle. Where strict design rules cannot be applied immediately, an eco-labelling scheme could be created as a bridge solution to help create lead markets for circular product design. In such cases, the circular eco-label might also be applied where a producer can demonstrate better than average performance in terms of end of life recycling or emissions avoidance practices.

9. **Strengthen end-of-life product treatment, sorting, and quality control obligations:** The EU should explore options to more tightly regulate end-of-life product management. This would enable a higher rate of closed loop recycling of much higher quality materials in EII sectors. For instance, stronger rules and/or disincentives on building demolition or car shredding practices could be adopted. Furthermore, rules requiring more precise materials flow management by material quality or alloy type (rather than simply by broad material type) could facilitate high value recycling of EII materials. Regulations to tackle these policy gaps could be adopted as part of the EU's new Circular Economy Action Plan.

Priority 6: Expand and improve the EII breakthrough technology portfolio

10. **Establish improving the portfolio of climate neutral basic materials production technologies as a key focus area for Horizon Europe (2021-2027**): Grants could be awarded on the basis that projects specifically focused on broadening and improving the existing portfolio of technologies. This could include reducing costs, deepening emissions reductions, improving applicability to different geographical contexts, developing innovation clusters and piloting technologies at a pre-commercial stage.

E3G

Priority 7: Establish governance tools to coordinate the transition

11. **Establish an independent Clean Economy Observatory** to advise the Commission on priority infrastructure, decarbonisation and technology deployment targets, and to monitor progress and ensure policy coherence. The observatory would ensure a shared evidence base for taking policy decisions on industry decarbonisation and highlight knowledge gaps and uncertainties. It would interface with industry and Member States on a regular basis to guarantee policy continuity in achieving targets.

12. **Connect Energy Union Governance to industrial transition goals:** Member States would be mandated to develop plans for decarbonising heavy industry as part of the NECP planning and reporting framework, under the Energy Union Governance Regulation. These plans should give an overview of the state of play of the industry transition and next steps, including targets for industry, and the policies, measures and financing to deliver them. The NECPs would be a good vehicle for encouraging proper coordination and planning between the energy system and heavy industry transitions.[13] Finally, the Commission should produce an annual report for the European Parliament on progress made in the transition to a net-zero carbon, competitive industry as part of the State of the Energy Union.

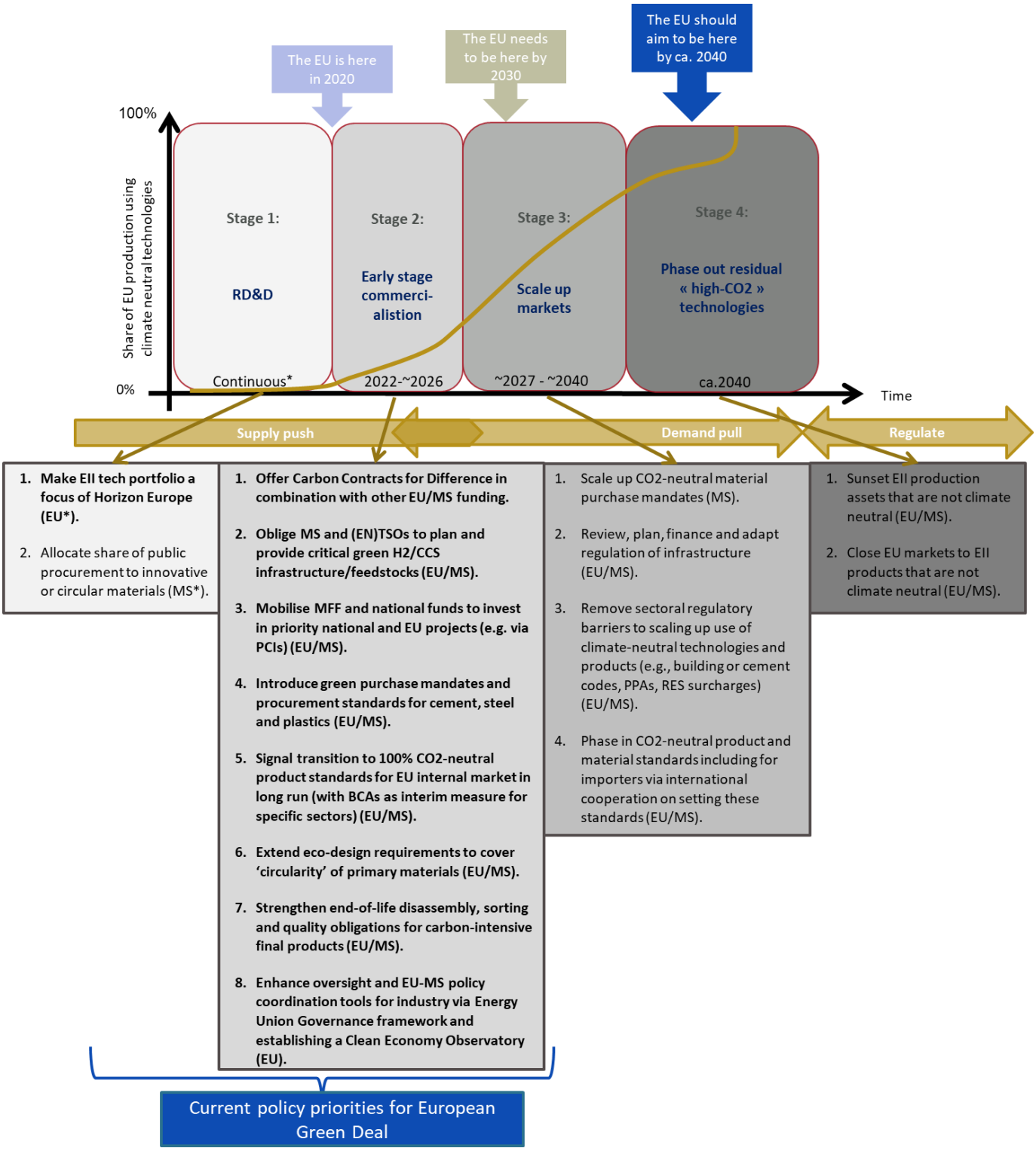
Conclusion

The European Green Deal communication called for 'deeply transformative' policies to put the European economy on track to achieve climate neutrality by 2050. For EII sectors, policies can only be deeply transformative if they create the conditions for massive private sector investment in climate neutral technologies. This paper maps out the kinds of policies most suited to creating those conditions. Based on this we have proposed a package of 12 essential policies to kick-start the transition to a climate-neutral heavy industry in Europe.

An important insight from this analysis is that it is only with a mutually supportive, coordinated and strategically coherent **package of policies** that the EU's industrial strategy can work. We need a smart combination of public sector push and market pull policies at different points in the transition.

[13] Currently there is no dedicated placeholder for "industry" in the NECP template, although there are place holders for "energy decarbonisation", for "finance and investment", for "innovation" and for "2050 strategies." Barring a revision of the Regulation governing the templates, it would thus be up to the Commission to encourage Member States to reveal harmonised and relevant information to industry in these other placeholders in the planning and reporting framework.

Figure 3. Summary of specific policies needed at each stage of the transition to climate neutral EIIs in Europe



*"EU" or "MS" refers to required level of policy development. Note however that Member States may nonetheless be responsible for implementation.