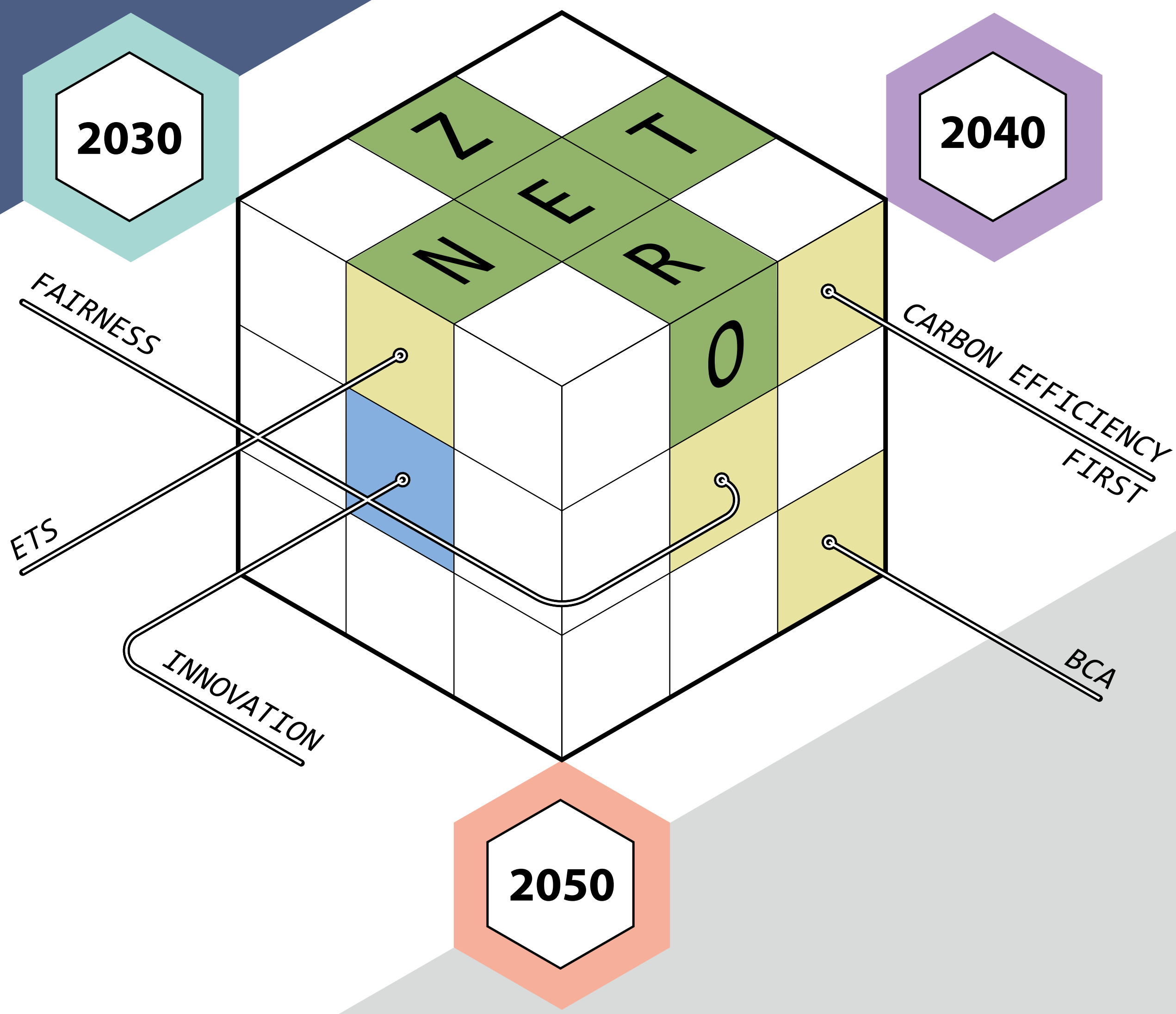
# RELAUNCHING A SUSTAINABLE INDUSTRIAL SECTOR

Europe's zero carbon moonshot




sandbag
smarter climate policy

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# Executive summary

A zero-carbon industrial sector by 2050 can play a vital role in Europe's economy, providing prosperity while safeguarding the health of the climate on which we all depend. It can also act as a model that industry in other jurisdictions can follow, leveraging the effect on global emissions reduction. By building the EU post-COVID19 recovery signals around the EU Green Deal and the new industrial strategy with the associated circular economy action plan, the EU can start boldly set out on a new path to become, indeed, the world's first net-zero emissions economy (if not continent).

This report has been informed by a call for evidence conducted by Sandbag between October 2019 – January 2020 and builds on Sandbag's previous work on industrial emissions policy. It follows on from Sandbag's report on *Barriers to Industrial Decarbonisation*, published in Spring 2018, which drew heavily on input from industrial stakeholders. The purpose of that report was to understand what policy gaps exist in decarbonising Europe's major industries. This report attempts to find policy solutions to bridge the gaps identified in the 2018 report and enable European industry to transition to net zero emissions.

The evidence collected for this report predates the economic disruption caused by the COVID-19 pandemic. It nonetheless represents a recent snapshot of industries' needs in reaching net zero which are unchanged. Indeed, the recovery plans currently under discussion among EU officials could help to accelerate the net zero transition in industrial sectors.

Long before the COVID-19 outbreak took hold, it had become apparent that progress towards reducing industrial emissions in Europe had largely stalled. In the five years up to the end of 2019 there has been no substantial reduction in emissions from European industrial sectors as a whole and in some sectors emissions have even risen during that period. If this trend is allowed to continue, the EU will fail to meet its goal of net zero emissions by 2050.

Moving away from the status quo requires a carefully orchestrated policy portfolio to kick-start what will be the most transformative process since the Industrial Revolution of the 19th Century.

Several step changes are needed in the pace of emissions reductions in industry. Following the EU Green Deal political agenda for the next 4 years of the European Commission and its March 2020 release of a New Industrial Strategy for the EU (NISE)[1], there is an opportunity to re-examine the relationship between industry and climate policy, between environmental and competitiveness, to address existing policy gaps and persistent barriers to decarbonisation, and ultimately, to create the right conditions for the net-zero industry of the future to flourish in Europe.

With the right set of policies, the prospects for Europe's much awaited "moon landing moment" can lead us to eliminating emissions from industry in Europe and the much desired first mover advantages that come with that. But continuous action is needed, starting now with the current policy and legislative programme. This report is an attempt to set out a range of policies that are needed to drive industrial decarbonisation up to 2030 and beyond, in order to support industrial actors on their shot for the moon.

While the moon metaphors build on the speech of Commission President Ursula von der Leyen in launching the EU Green Deal, it is also worth noting that at the time of launching this report, the United States had recently signed a presidential treaty encouraging moon explorations for raw minerals. The current geopolitical developments reflect that the EU and the world desperately need a more circular approach in how we use materials, in order to keep within planetary boundaries. The EU is best placed to lead the world towards sustainable manufacturing, environmentally fair trade and smart innovation, in order to create a carbon-efficiency first circular economy model.

1. European Commission. (2020). A New Industrial Strategy for Europe https://ec.europa.eu/info/sites/info/files/communication-eu-industrial-strategy-march-2020_en.pdf

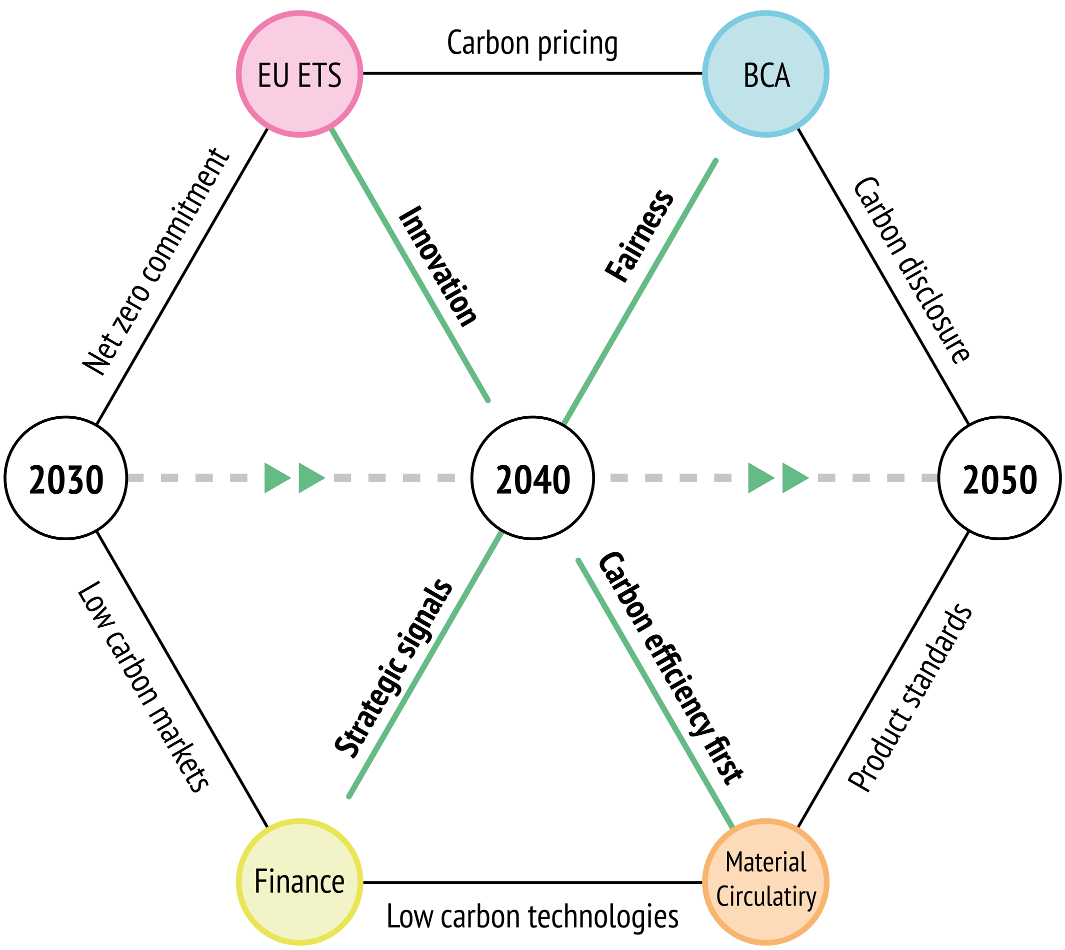
# Key findings and recommendations of this report

## The pillars of a net zero transition

The policies needed to meet the challenges of reaching net zero are grouped around four policy areas, or 'pillars', that support the priorities of the NISE. A comprehensive approach would look to coordinate efforts between each pillar, with a focus on the next decade as the time to anchor the transformative policy changes while achieving deep emission cuts already.

FIGURE 1

The four pillars of net zero European Industry



**Pillar 1: Strategic signals to set in motion unprecedented change by maximising emission reductions within each of the 3 decades ahead**

The unprecedented breadth and depth, scale and spin and nature and necessity of the transition implies clearer strategic signals and stronger incentives for the transformation pathway to net zero are needed, including reduction milestones to 2030, 2040, 2050, etc.

**Pillar 2: Ensuring fairness: fair competition from the environmental perspective**, fairness towards consumers with regards to the carbon embedded in products, fairness for European industry and a fair transition for jobs in the field

Creating a level playing field for industry producing zero carbon goods in a net-zero policy landscape is a must, so that European industry can flourish in an environmentally fair trade regime, which seeks to eliminate market distortions incurring inadequate carbon pricing around the world. The plan should secure a predictable transition for jobs in the field, by incorporating "phase-out and reskilling" plans for the highly emitting industrial sectors as they move towards new technologies requiring a different set of skills. Carbon pricing continues to be one policy option which can ensure both by generating the revenues required for the innovation and the reskilling processes embedded in this transformation.

**Pillar 3: Innovation at the heart of the transition.** This can be promoted by: Stimulating the development and/or deployment of zero carbon technologies, networks and processes with a firm anchor in the next decade looking out towards 2050 zero carbon horizons; and adopting policies which do not lead to technological lock-in or presuppose what innovations should occur. The policy environment should be one that encourages out-of-the-box solutions by providing a stable framework.

**Pillar 4: Promoting carbon efficiency first** in the circular economy, including a more circular approach to the manufacturing of intermediary products (steel, cement, chemicals, etc.). A greater focus on carbon and resource efficiency throughout the lifecycle of intermediary materials would better promote the kinds of innovation and approach to resource management that EU policymakers are now seeking.

# Summary of recommendations emerging from each pillar

## 1 Clear trajectories for emissions reductions are urgently needed to create a strong strategic signal to decarbonise

Clear strategic signals of the need to eliminate emissions over the next three decades are required, together with stronger incentives to invest in low-carbon technologies. Existing legislation, in particular the EUETS, must be aligned with a net zero trajectory since this remains the primary policy covering emissions from Europe's industries and provides both a trajectory and emissions cap, albeit at levels currently misaligned with the Paris Agreement.

- **A revised and more ambitious cap for the EU ETS, the main policy covering industry emissions, should be set as a matter of urgent priority. The pathway to 2050 should start from real emission levels as submitted to the UNFCCC in the context of the Paris Global stocktake.**
- **More rapid emissions reductions are needed by 2030 if the EU is to reach its long-term goal.** Delaying the strengthening of targets until Phase 5 of the EUETS, which begins after 2030, leaves too little time to decarbonise industry by 2050.
- **A new indicative 2040 inflexion point** should be established to provide further guidance to investors on the required decarbonisation pathway. A -80% target based on current emissions levels will stimulate deployment of new technologies well before 2050, and help to reduce costs which will be particularly important for eliminating the remaining 20% of emissions which will likely require the use of more expensive technologies.
- **A clear and binding commitment to a 2050 goal of net zero emissions should be set for sectors covered by the EU ETS.** The length of investment cycles in energy intensive industry implies a clear signal to investors of the need for near complete decarbonisation of production by 2050 is required now. European industries should not expect to continue to emit on the expectation of net zero being achieved by continuing emissions from industry and negative emissions in aggregate from other sectors.
- Incentives under the ETS for heavy industry decarbonisation need to be revised, as they currently follow an unsustainable trajectory misaligned with the goals of the Paris Agreement (as described in Chapter 4). An alternative to the current system is needed and it will require transitioning towards other forms of protection against the risk of carbon leakage.

- **A floor price for the EUETS should be introduced** to stabilise the EU ETS price against economic shocks of various kinds and provide a safety net on investments in low carbon technologies over the next decade. **This would be best achieved through an auction reserve price.**

## 2 Fairness starts with creating a level playing field for zero carbon products and continues with ensuring a fair transition of skills

European industry has long been concerned that the cost of measures to reduce emissions within Europe could simply lead to production and investment relocating outside Europe with no fall in global emissions (carbon leakage). There is no evidence of substantial leakage to date that can be attributed to the carbon price. However, the risk of leakage either in the context of a net zero policy framework needs to be taken seriously, especially as the approach and measures taken by other jurisdictions may are likely to be different from those of the EU. Hence, the carbon leakage discussion needs to fundamentally be reframed into a net-zero in Europe first debate, in view of the new paradigm created by the net zero commitment.

**The introduction of a carbon border adjustment to replace free allocation and create fair trading conditions making environmental concerns the new terrain for competitiveness is a key component of achieving net-zero industry in Europe.** The current mechanism for protecting industry through free allocation of allowances is not sustainable under a cap that aims for net-zero and has not proven to have environmental benefits. Alternative measures are therefore needed to prevent carbon leakage in future.

Furthermore, as our previous work has shown, the current benchmark system In the EU ETS also leads to a slowing of innovation, as it gives financial incentives for stakeholders to not lower emissions from the top 10% best performers included in the benchmark calculation.  This makes the need for reform of the current system even more urgent.

- **Border Carbon Adjustments (BCAs), should be introduced as quickly as feasible** to improve incentives for decarbonisation (no later than 2025).
- As part of the phase in of BCAs, **free allocation of allowances under the EUETS should be reduced accordingly**. This can be done by reducing benchmarks and/or applying a cross-sectoral correction factor. At present benchmarks decrease linearly from current levels at a rate in the range 0.2%p.a. to 1.6%p.a.  This implies a cumulative decrease of 6% to 48% by 2050.  This is clearly completely inconsistent with a net zero target.

- **A rate of reduction of at least 3.3% p.a. of today's emissions levels is needed under the EU ETS.**
- **Following the model of planned coal phase-outs, planned transformation must incorporate plans for ensuring a fair transition of skills for workers.**

## 3 Innovation at the heart of low carbon industrial strategy

Stimulating the development and deployment of zero carbon technologies, networks and processes needs mix of policies

The technological capability for partially or completely decarbonising many industrial processes already exists. However, in most cases, it is currently not economic to deploy these technologies. Moreover, for a small number of industrial sectors low carbon solutions have not yet been developed. **Securing the development and deployment of new technologies will need additional policies.** Stronger carbon pricing alone will not be enough, although it is a key mechanism within a wider system of policies.

Support for low carbon technologies will need to focus on those which **offer a pathway to zero emissions.** New technologies that incrementally reduce emissions may have some short-term value but will not be consistent with 2050 targets. The need as we move towards 2050 is for **technologies which are "no carbon not low carbon"**

A variety of approaches are available to bring new technologies online and get them to scale. These may be used in combination. Most have been implemented in one form or another for renewables, which have grown very rapidly over the last two decades.

A **mix of policies needs to be introduced for industry**, potentially including the following:

- **Volume based approaches**

  Volume or market share obligations may guarantee a certain market share for low or zero carbon products. This may, for example, be imposed by a zero carbon product standard for part of the market. Another possible approach is a system of tradable zero carbon certificates.

- **Direct financial support**
  - » Tax incentives.
  - » Low cost finance.
  - » Direct subsidies

  Price based approaches such as guaranteed prices or contracts for difference are possilbe (see page 67). Contracts for difference may be applied to either carbon or product prices.

  Under the European Union Emissions Trading System (EUETS), the Innovation Fund is the primary policy instrument for reducing the costs and de-risking low carbon technologies, although it will not be enough on its own.

- **The EUETS Innovation Fund needs to be reformed to direct funds to supporting projects that can contribute to delivering net zero by 2050.**

- **Measures will also be needed to support the development of networks for low carbon hydrogen and transport of CO2 from CCS, as well as continuing development of electricity networks.** Among other things, low carbon hydrogen may be necessary for industrial processes which can't be electrified. However the balance between hydrogen and CCS in industry remains highly uncertain at present, and policy must be robust enough to incentivise both where they are appropriate, and accommodate the possibility that one or the other may predominate or both may have major roles to play.

## 4 Carbon Efficiency First and the circular economy

Any standards introduced to promote circularity should focus on emissions and follow the carbon efficiency principle (i.e. through "embodied carbon standards") but may explicitly or implicitly include other criteria such as including a certain percentage of recycled input.

To complement the Circular Economy Action Plan, launched earlier this year, **the EU should develop an action plan for promoting material circularity in industrial sectors that produce bulk commodities**, which reduces demand for primary raw materials, and therefore emissions. The following actions should be considered:

- Resource roadmaps that identify the opportunities to increase material circularity up to 2030 and beyond are recommended.

- **New ecodesign requirements** should be introduced urgently to promote efficient use of materials and reusability to 50% by 2030 already, particularly in the construction sector which accounts for at least one quarter of all waste produced in the EU.[2]
- To improve market transparency the Commission should work with stakeholders to develop robust **mandatory product carbon footprint labelling standards for high impact intermediary materials**, which would fall under the certification process for products sold in the EU. This can build on the measurement and reporting instruments that are required to implement Border Carbon Adjustments and product standards, using methodologies that have been tried and tested in existing voluntary environmental footprint disclosure schemes.
- **Include embedded carbon criteria in product standards for intermediary materials sold in the Single Market** to reduce the market for goods produced using the most carbon-intensive forms of production. Standards should be tightened over time to reach zero (or close to zero) by 2050. Product standards can form a valuable complement to BCAs. While BCAs provide a constant incentive to improve from present levels, performance standards that are gradually tightened over time can eliminate high carbon products completely, and can set a clear track over time towards levels of performance all producers must reach.
- To promote the use of sustainable construction products and reduce emissions from the built environment, a **zero carbon construction standard** should be introduced and become effective **before 2025**. These standards should account lifecycle emissions so that new buildings are fit for a carbon neutral world. A zero-carbon construction standard will also drive markets for low carbon materials and products.

These recommendations are summarised in the table overleaf.

2. https://ec.europa.eu/environment/waste/construction_demolition.htm

## Summary of net zero vision for industry

### An unprecedented transition: Clearer signals and stronger incentives for the path to net zero

- Revise both the 2030 and 2050 EU ETS trajectories (including benchmarks for free allocation)
- Free Allocation replaced gradually with more effective and environmentally fairer alternatives
- Establish and indicative 2040 emissions target (i.e. -80% by 2040)
- Introduce a carbon floor price for the EUETS (through an auction reserve price)

### Creating a fair framework for zero carbon manufacturing in the EU

- Introduce Border Carbon Adjustments (BCAs) for goods sold in the EU and phase out free allocation of allowances under the EUETS
- Alongside the introduction of BCAs free allocation of allowances should be phased down more rapidly than is currently planned by increasing the rate of reduction of benchmarks.
- Standards for carbon content should be established on the basis of carbon efficiency first, with requirements strengthened over time.
- Make disclosure of carbon footprint information mandatory for intermediary materials sold in Europe
- Introduce zero carbon construction standards for all new buildings

### Innovation at the heart of strategy: Stimulating the development and deployment of zero carbon technologies, networks and processes

- Use a combination of policies to deliver industrial decarbonisation that mimics successful policy approaches for decarbonising the electricity sector
- Direct financing for low carbon technologies (particularly the innovation fund) towards technologies, emphasising those that can contribute to delivering net zero emissions society by 2050
- Develop instruments designed to specifically support the development of low carbon networks, so that low carbon hydrogen production and CCS can be developed on an appropriate scale, along with continuing development of electricity networks.

### The circular economy: increasing carbon and resource efficiency

- Develop an EU action plan and strategy for promoting material circularity in high impact intermediary materials, based on the carbon efficiency first principle
- Introduce ecodesign requirements to promote efficient use of materials and reusability, particularly in the construction sector by 2025, 2030

# Contents

# Introduction

## 1.1 The challenge of net zero emissions for industry

The goal of reaching carbon neutrality by 2050, in line with the goals of the Paris Agreement, is now central to EU policy making following the launch of the EU Climate Law by the European Commission in March 2020. Achieving carbon neutrality by 2050 implies raising the level of EU climate ambition from the current target of an 80-95% reduction in greenhouse gas emissions in the industry sectors by 2050 (compared to 1990 levels) to completely eliminating net emissions, termed 'net zero'[3]. The move already has the support of the vast majority of Member States[4], the European Commission and the European Parliament.

In some sectors of the EU economy, the transition to net zero emissions is already underway. The expansion of renewable energy capacity over the last decade and the accelerating growth in electrification of surface transport provide glimpses of the sort of technological transformation that will underpin a carbon neutral economy. These developments also offer clues as to the policy portfolios that can lead to rapid cost reductions in low carbon technologies.

However, there has been little progress so far in reducing emissions from Europe's industrial sectors. Industrial emissions are substantial, accounting for approximately one seventh of the EU's total greenhouse gas emissions. The level of emissions from industrial sectors covered by the EU Emissions Trading System (EU ETS) has remained almost constant in recent years, falling just 0.55% between 2013 and 2019. By contrast, the 19.7% reduction in total ETS emissions that occurred over the same period was almost entirely due to a decline in coal use in the power sector[5].

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3. Net zero is usually interpreted as meaning that a small amount of unavoidable emissions, for example some emissions from agriculture are balanced by measures to absorb CO2, such as reforestation.

4. Bjerkem, J., et al. (2019). An Industry Action Plan for a more competitive, sustainable and strategic European Union. 21. https://www.epc.eu/en/Publications/An-Industry-Action-Plan-for-a-more-competitive-sustainable-and-strate~2c7ab8

5. See https://sandbag.be/index.php/2020/04/28/is-the-eu-ets-going-to-pass-the-novel-coronavirus-test/

For Europe to become a carbon neutral continent, all industries must play a role in serving a society that will increasingly demand low- and zero-carbon products. Nevertheless, completely decarbonising industry is challenging because there are high barriers to doing so. The EU's current approach to reducing industrial emissions has had weak results and a net zero policy framework is needed to help businesses navigate the risks involved.

A clear emissions trajectory is an important part of any future policy package since this will enable industry to plan for the future with greater certainty and help steer the development of new low carbon technologies, positioning European industry as a leader internationally.

The majority of direct emissions from industry in the EU are associated with the production of intermediary materials such as steel, cement, pulp and paper and chemicals sectors. Decarbonising these sectors would therefore not only eliminate the vast majority of industrial emissions but will also lead to the development of solutions that can be used to decarbonise other sectors at lower cost than would otherwise be the case. Coordination between sectors will be a crucial aspect of future policy direction, with industry being seen as a single unit composed of different parts moving in sync, rather than detached sectors and subsectors. Such an approach would enable different sectors and actors along each value chain to work together in developing and scaling cross-cutting innovations.

In this report discussion of sector specific issues focuses on four of the major energy and carbon-intensive industrial sectors covered by the EUETS which represent close to half of all industrial emissions (or 326.58 MtCO2 in 2019)[6]:

- Cement & Lime
- Iron & Steel
- Paper & Pulp
- Ceramics

6. Derived from Sandbag's calculations of ETS emissions and sectoral emissions data from EUTL.

## 1.2 An EU Green Deal for industry

The practical implications of reaching net zero emissions in industry are largely well understood and solutions to decarbonise industrial processes are either in development or already exist. However, there are significant challenges to deploying low carbon technologies and supporting infrastructure on a commercial scale which need to be addressed. The European Commission's long-term strategy to transform the greenhouse gas emitting economy, includes a suite of policy measures under the banner of a 'green deal for Europe'. These include a 'Climate Law', a new 'EU industrial strategy', and a 'Carbon Border Tax' among other policy measures. Taken together, the proposed measures imply a more proactive role for EU institutions in managing emissions reductions than has been the case to date.

EU policymakers have acknowledged that a more ambitious industrial strategy is needed to meet their objective of climate neutrality[7] and are currently seeking to identify potential policy solutions.

This report aims to contribute to this effort by identifying broad types of action that industries can take to reduce their emissions, and the policy instruments that will be needed to support these actions. It follows on from previous analysis by Sandbag on industrial emissions policy, in particular our 2018 report on Barriers to Industrial Decarbonisation.

The remainder of the report addresses the different facets of meeting a net zero target in industrial sectors, namely:

- what should net zero industrial strategy seek to do;
- the requirements for achieving net zero industry;
- the barriers that limit progress in reducing industrial emissions; and
- policies that can deliver net zero industry in Europe, with a focus on actions that can be taken up to 2030.

7. p.4 https://data.consilium.europa.eu/doc/document/ST-1-2019-INIT/en/pdf

## 1.3 Methodology

This report seeks to understand what policy measures are needed to reach the overall goal of net zero industry by 2050. It builds on Sandbag's extensive previous work on the EUETS and draws on insights from businesses in those sectors which face the complex task of making net zero a reality, as well as other studies.

In order to gain insight into how prepared Europe's carbon-intensive industries are to reach net zero as well as understand the barriers they face in doing so, Sandbag launched a call for evidence on November 11th 2019, entitled "How effectively is EU policy promoting decarbonisation of Europe's energy intensive industries?". The call remained open to submissions until January 10th, 2020. Sandbag also engaged organisations and individuals in sectors relevant to this report throughout the process of its development.

Responses to the call for evidence were received from stakeholders in the cement & lime, construction products, ceramics, chemicals, paper & pulp, and iron & steel sectors.

A link to the call for evidence questionnaire can be found here.

# Responses to Sandbag's call for evidence

This chapter summarises the responses received to Sandbag's call for evidence from a range of industries operating in the EU. We asked respondents to indicate which technologies they are relying on to decarbonise their business. In this chapter respondents are identified according to the sector(s) they operate in and these are indicated in brackets next to their respective feedback.

The table below provides an overview of the technological options being considered by the respondents' businesses.

TABLE 1

## Respondents' preferred methods for decarbonising

<table>
<tr><th></th><th>Energy use emissions</th><th>Process emissions</th></tr>
<tr><td>Lime<br>33% energy use emissions<br>67% process emissions</td><td>Low carbon fuels<br>CCS/U</td><td>CCS/U (≤100%)</td></tr>
<tr><td rowspan="2">Portland cement<br>40% energy use emissions<br>60% process emissions</td><td colspan="2">CCS (≤100%)<br>Increased use of recycled materials</td></tr>
<tr><td>Biofuels (≤100%)<br>Electrification (≤100%)<br>Energy efficiency</td><td></td></tr>
<tr><td>Silicon carbide (Ceramics)<br>0% energy use emissions<br>100% process emissions</td><td>[Indirect emissions from electricity sector]</td><td>CCS/U (≤80%)<br>Increased material substitution/ efficiency (≤8%)</td></tr>
<tr><td>Paper & pulp<br>100% energy use emissions<br>0% process emissions</td><td>Energy efficiency (≤10%)<br>Biomass / BECCS (≤90%)<br>On-site renewables<br>Hydrogen<br>Electrification<br>Solid biomass<br>CCS/U</td><td>N/A</td></tr>
<tr><td>Steel<br>33% energy use emissions<br>67% process emissions</td><td>Electrification (≤50%)<br>Hydrogen/wastes/biomass (≤50%)</td><td>CCU (≤50%)<br>Hydrogen or CCS (≤30%)<br>Biomass/plastic waste (≤20%)<br>Product substitution (≤100%)</td></tr>
</table>

| | Energy use emissions | Process emissions |
|---|---|---|
| **Iron ore pellets**<br>75% energy use emissions<br>14% process emissions<br>11% Others | Biofuels<br>Hydrogen<br>Electricity | Process innovation - replacing binders used for pelletising process (100%) |
| **Plant oil mill (rapeseed)** | [Indirect emissions from electricity sector]<br>Energy efficiency<br>Hydrogen | |

Note: each sector listed in this table represents one response. Numbers in brackets are indicate the emissions reduction technology of each pathway as indicated by the respondent.

Reported levels of ambition, activity and investment in developing low-carbon solutions vary greatly between different companies. Two respondents reported being engaged in R&D of low-carbon technologies with trade associations or universities (lime, silicon carbide) but also acknowledged a high degree of uncertainty in their capability for achieving net zero emissions.

Others are already close to carrying out commercial scale demonstration projects (steel, iron ore pellets) for technologies that can yield large reductions in both energy use and process emissions. These developments are being closely watched by other industries that have yet to find their own solutions for decarbonising.

Reliance on 'breakthrough technologies'[8] was a recurring theme in all responses bar that of a paper and pulp company. Indeed, even companies engaged in large scale technology demonstrations admit that wider deployment of these technologies is not economically feasible under prevailing market conditions. Nevertheless, several respondents made it clear that at present no alternative to CCS exists for decarbonising some industrial processes.

By-products from some industries can also be a useful resource in other processes. One example of this is the use of waste gases from steelmaking to create chemical feedstocks, a form of carbon capture and utilisation (CCU). A number of respondents highlighted similar plans (in less specific detail) to collaborate with other sectors on decarbonising their business. Synergies between sectors should be a primary area of focus for EU policy making with a view to accelerating the development of breakthrough technologies.

8. The term broadly refers to technologies which in theory can effect substantial emissions reductions but are still in the R&D phase of development

## 2.1 Drivers of decarbonisation

In some sectors carbon pricing is seen as the primary driver of decarbonisation. For example, the respondents from the lime and silicon carbide (ceramics) sectors cited carbon pricing as the primary driver of decarbonisation in their businesses.

The respondents that reported carbon pricing as their primary driver to decarbonise also indicated their future plans for decarbonisation were 'unclear' and that technologies required to achieve significant emissions reductions are underdeveloped, requiring further investment and sustainable business models. This was particularly the case for industries that emit a high proportion of process emissions.Eliminating process emissions requires very disruptive changes to manufacturing inputs and/or processes which in many cases will require industry-wide coordination and regulatory change.

Customer demand for green products, on the other hand, is considered the primary driver of emissions reductions for the paper and pulp manufacturer, and an iron ore pellet maker.

For a cement producer, both customer demand and carbon pricing play a significant role in driving emissions reductions. This has to be read in the context of creation of a market for non-conventional materials, through public procurement requests and campaigns to increase the demand for such products by boosting up their confidence in alternatives, etc.

A response from a major steel producer raised border carbon adjustments as being a key driver for further decarbonisation. Similar views were expressed with regards to future changes in state aid rules.

The divergence in answers is symptomatic of a widening *capability gap* centred around technological and economic feasibility of decarbonising industrial products and processes. New EU policies are needed precisely to bridge this gap.

## 2.2 What are industries doing in preparation Planning for net zero

Respondents were asked about their business' plans to reduce emissions up to 2030 and 2050.

All companies that reported plans to reduce emissions to net zero by 2050 consider those plans to be contingent, to a greater or lesser extent, on supportive

Member State, EU or global policies in the near-term. On a practical level that means ambitious reduction plans for 2030 being already in place. Business' uncertainty over their 2030 reduction obligations raises questions about the feasibility of reaching net zero by 2050. This is further described in subsequent sections.

A steelmaker, a cement producer and a construction products firm all reported having agreed internally on the ambition to reduce emissions to net zero by 2050. A representative from the latter organisation, which produces flat glass, plaster, insulation materials and ceramics, stated that their business already has the capability to fully decarbonise it's product portfolio and that it uses an internal carbon price as an element of this. Moreover, an iron ore pellet producer has plans to produce zero emissions iron ore pellets by 2045 so 2050 is not the only time horizon businesses are looking at.

However, a number of companies have not yet fully developed their 2030 ambitions. Moreover, there are notable differences in the short-term ambitions and amount of emissions reductions achieved to date by different companies.
A larger number of respondents have clear achievables in sight for 2030 than plans for net-zero by 2050, which is a reminder of the proximity of the 2030

TABLE 2

## Emissions reductions targets for different industries - achieved & planned

| **Sector** (emissions baseline used) | **CO2 reductions achieved to date** | **2030 target** | **2050 target** |
|---|---|---|---|
| **Lime** 2005 baseline | Unknown | Modest reduction [not-specified] | Unknown |
| **Portland cement** 2005 baseline | -10% | Some net-zero cement production by 2030 [non-specified] | Net zero (-100%) |
| **Silicon carbide (Ceramics)** 2000 baseline | Unknown | -8% | Unknown |
| **Paper & pulp** 2006 baseline | -48% | N/A | Net zero (-100%) |
| **Steel** 2007 baseline | -8% (2020 target) | [new target due in 2021] | Net zero (-100%) |
| **Iron ore pellets** 2005 baseline | +4% | -32% | Net zero (-100%) |

timeline. There is huge variation in the 2030 ambitions of companies that responded to Sandbag's call for evidence, indicating that some are not on track to reach net zero emissions by 2050. Of the respondents that have ambitions for 2050, most are confident technological solutions would be available but they require a market for zero carbon products or a carbon price that will help create a market for them. However, there are also those which have a company policy for net-zero but remain uncertain that such a goal is feasible, either economically or technologically.

## 2.3 Preconditions for decarbonising products and processes

Respondents were asked what prerequisites their business has for deploying low-carbon technologies (as described in the above section). Their answers can be grouped into five themes:

1. Financing the cost of low-carbon technologies;
2. Creating a level playing field;
3. Increased access to low-carbon infrastructure;
4. Markets for low-carbon goods
5. Placing a value on emissions reductions throughout the value chain.

### Financing

For some industries, the cost of producing low-carbon versions of core products incurs higher capital expenditure (CAPEX) and operating expenditure (OPEX). In view of this, respondents from the cement and steel sectors argue that long term EU or Member State support for the capital costs of low or zero-carbon production capacity is a requirement for producing low-carbon products. The same respondents also indicated that secure and low-cost energy supply would be necessary for enabling either CCS or process electrification.

### Level playing field

Equitable treatment, both internationally and within the Single Market, featured as the foremost concern among industries that responded to Sandbag's call for evidence. In spite of having limited exposure to carbon pricing, some in industry - even within the same value chain - view the ETS as a challenge to their competitiveness while others want to see carbon pricing strengthened or better aligned to best performing technologies. Many of these concerns have been debated since the earliest days of the ETS, although the responses given reflect a continued opposition to unilateral EU carbon pricing from a sizable constituency of European industry.

Several respondents (steel, ceramics, oil mill) made reference to the potential negative impact of carbon pricing on the competitiveness of their industry compared with non-EU counterparts.

Several respondents (lime, steel, pellets) also argued that exemptions from the ETS for small emitters (those below 20 MW or waste to energy plants, for example), and the application of different ETS benchmarks to industries that produce directly substitutable products, leads to market distortions and fails to promote the least emitting methods of production. In general, respondents consider the current carbon pricing regime to not be conducive to promoting low-carbon production.

### Access to low-carbon infrastructure

The availability of low-carbon electricity (for electrification), CO2 transport and storage infrastructure (for CCS), biomass, and low-carbon hydrogen - all at low cost - is a demand shared by the majority of industries that responded to Sandbag's call for evidence. Indeed, without access to suitable low-carbon infrastructure, many industries will fail to reach net zero emissions by 2050. The majority of industries that rely on low-carbon infrastructure to carry out full decarbonisation want suitable infrastructure to be made available by the EU and Member State governments at low-cost.

### Markets for low-carbon goods

Many respondents expressed concerns about the lack of demand for low-carbon goods which they argue limits their ability to recover additional costs associated with low-carbon production methods, since in most cases producing low-carbon goods incurs higher costs. According to one steelmaker, the price of low-carbon steel, relative to current production methods, will increase by 35% to 100%. However, another steelmaker expressed confidence that its customers would be willing to pay a premium for low-carbon steel.

### Placing a value on emissions reductions

Several respondents (steel, plant oil refiner) want to see a broader range of emissions reductions activities being credited or otherwise incentivised. They argue that emissions should be considered in the context of entire value chains (for example, using lifecycle carbon analysis) to incentivise the broadest range of low-carbon solutions. Reference was made in particular to emissions reductions that fall outside the scope of ETS benchmarks and are therefore not priced in. For the lime and silicon carbide sectors, this issue is of lesser importance since their products' lifecycle emissions are largely covered by the ETS.

## 2.4 What policy approaches are favoured by industry?

Our call for evidence tested attitudes of industrial stakeholders towards a variety of potential policy measures that could form part of a future net zero strategy. Most responses referred to the creation of new financial instruments designed to support both CAPEX and OPEX requirements for decarbonising industries. There were, however, also calls for regulatory changes that would not directly finance low-carbon technologies.

### Border carbon adjustments

Opinion on BCAs is divided. Several respondents to Sandbag's call for evidence expressed concern that a BCA might not mitigate competitive risks for EU industries that export outside the Single Market (lime, ceramics, paper & pulp), or were otherwise circumspect about a BCA. Others – including a steelmaker, cement company, and a plant oil producer – view a BCA favourably, seeing it as a safeguard for the competitiveness of EU businesses.

These contrasting assessments largely reflect uncertainty over the potential form of BCA and what that could mean for the treatment of carbon-intensive goods exported to non-EU markets, and the future of free allocation under the ETS. Some in industry have expressed hope that a future BCA could include a system for reimbursing direct and/or indirect carbon-costs for products exported outside of the Single Market. However, several observers regard this - and the continuation of free allocation to sectors covered by a BCA - as being incompatible with World Trade Organisation (WTO) rules. If this is the cae, implementing a BCA will require the removal of conflicting articles in the ETS Directive.

### Promoting consumption of low-carbon goods

There are a number of ways in which low-carbon goods can be made more attractive and available to consumers. The main challenges in doing so are related to cost or competitiveness, the availability of information about embodied carbon in products, and existing product requirements.

The relative cost of producing low-carbon goods is a significant barrier to promoting them. A common set of solutions that emerged from responses focussed on how additional costs are distributed - BCAs being just one of several potential means of addressing this issue. Several respondents proposed new forms of taxation or EU regulation in order to create a market for low-carbon goods or to enable carbon costs to be passed on to consumers. These include taxes on the carbon content of goods, carbon labelling requirements for products or quotas that require a minimum proportion of zero carbon material in goods.

Carbon consumption taxation was suggested by a representative of the lime sector as a possible alternative to a BCA. They argue that such a measure would remove competitiveness issues for EU businesses that export to other markets (assuming the tax would replace current carbon pricing). However, the current system in the EU prices pollution at production level, not at consumption.

Attitudes towards the greening product standards and disclosure of emissions performance through eco-labelling were overwhelmingly positive. Those in favour include a cement producer, a lime producer, a silicon carbide producer, a paper and pulp manufacturer, and two of Europe's largest iron & steel makers. However, some within that group consider green product standards to be of secondary importance to other measures, such as financing the development of low-carbon technologies.

One steelmaker proposed giving priority market access for products with high levels of recycled content by, for example, mandating minimum percentages of recycled carbon content in commodities such as ethanol which can be synthesised from CO or CO2.

A cement manufacturer and construction products company both argued that a robust public procurement framework is needed to stimulate consumption of products with a low-carbon footprint. The latter reported already being engaged in a number of product carbon disclosure initiatives and encouraged EU policymakers to incorporate these frameworks into relevant regulations.

Respondents from the cement and construction products sectors also promoted environmental product declarations as a means of providing consumers with better information about the carbon footprint of products they specify or purchase. To be effective, carbon footprint information would have to be presented in a format that is useful to those who make purchasing decisions.

### Investment in low-carbon production

Nearly all respondents considered that carbon pricing at current levels is not sufficient to justify investment in low-carbon technologies that have yet to be commercialised. There are, however, significant differences in technology cost associated with fully decarbonising industrial processes. A cement manufacturer argued that carbon price levels on the order of €100/tonne would be necessary to bring the costs of manufacturing cement products using CCS in line with unabated processes. Similarly, a construction products company reported using an internal carbon price of €100/tCO2 in order to evaluate investment decisions. However, another respondent with experience of working in the soda ash sector (a material used in the manufacture of glass) indicated that internal carbon pricing, while useful as a tool for guiding investment, is not a sufficient justification for investing in low-carbon technologies.

Two respondents from the steel and ceramics sectors called for greater access to EU funds to support innovation and the commercialisation of low-carbon technologies. One referred specifically to changes in State Aid rules that would allow the EU to support decarbonisation pathways that the respondent considers to be uneconomical at present.

A paper and pulp manufacturer proposed modifying the EU's Renewable Energy Directive (RED2) in order to steer the development of biomass use towards meeting emissions reduction goals in industrial sectors.

One steelmaker also called for the EU's Sustainable Finance taxonomy to be broadened to promote circular economy practices. The same respondent also promoted the idea of carbon contracts for difference for the purpose of de-risking investments in low-carbon materials production.

### Development of low-carbon infrastructure

Most respondents want to see enabling policies and public funding to support the development of low-carbon infrastructure. One respondent sought an EU-wide assessment of future energy requirements, while several more called for the creation of new EU frameworks to steer the development of low-carbon solutions in response to those requirements. However, a paper and pulp manufacturer registered disapproval for subsiding alternatives to carbon-intensive production processes.

### Integration of climate and materials policy

Several respondents (steel) argued that the circular economy initiative should be better linked to climate policy to avoid wastes being landfilled or incinerated. However, waste incineration is considered an important part of some industries' decarbonisation plans even though such processes contribute to climate change and prevent recycling. This was confirmed by speculation from a lime producer that burning fuel *generated from recycled material* would help to improve material circularity in their business.

## 2.5 Promoting material circularity

The term 'material circularity' describes an approach for preserving the value of materials at all stages of their life cycle. A 2019 report from Material Economics indicated that an economy with high levels of material circularity could more than halve the anticipated level of emissions in 2050. Promoting circular economy practices must therefore be an essential component of the Commission's strategy for achieving its dual objectives of net zero emissions and decoupling economic growth from resource use.

There are two primary obstacles standing in the way of achieving a circular economy: First, opportunities to recycle materials are not being exploited to their full potential. Often this is due to inadequate collection and sorting infrastructure, as well as the low value of recycled products relative to their production cost. Progress towards meeting bulk waste reduction targets, such as those set under the EU's Waste Framework Directive, obscures the failure to recycle large quantities of materials that are used in the construction sector in particular.

Second, materials continue to be produced which cannot be recycled using currently available techniques, contributing to waste streams for which downcycling, incineration and ultimately landfill are the only solutions to hand. While recycling processes are continuously evolving, leading to higher rates of material recovery, there is no guarantee that technologies will be developed in future to extract value from currently non-recyclable materials.

Among industrial sectors, the potential for material circularity varies enormously. This largely reflects differences in materials characteristics produced by different sectors which affects their recycling potential. However, other factors have an impact on recycling rates too.

Steel, aluminium and mineral wool are examples of products that can be recycled very many times without loss of quality. Every tonne of steel recycled reduces emissions by up to 90% compared to manufacturing steel from virgin ore. Similarly, for aluminium emissions savings of around 97% can be achieved through recycling. According to one steelmaker, 54% of all steel produced in Europe originates from scrap. The same respondent also indicated that demand for ferrous scrap currently exceeds its availability in Europe.

Other materials, however, deteriorate in quality each time they are recycled and consequently have finite potential for material recovery. For example, products made with wood fibres such as paper and card can typically be recycled up to seven times before the quality of fibres deteriorates rendering them unusable, according to one paper and pulp manufacturer. Widely used plastic polymers, on the other hand, may only be recyclable only up to two to three times using conventional techniques before it becomes necessary to reduce them to their constituent chemical building blocks using enhanced material recovery methods.

Moreover, there are those materials which are difficult or else impossible to recycle using existing techniques. These include many kinds of compound plastics as well as ceramics and cement which has been used in concrete, all of which are used on a large scale globally. Once used, these materials cannot be recycled back into their original product owing to the chemical or physical changes they undergo either during production or use phase. Often, they are downcycled: mixed plastics are converted into lower grade plastic, ceramics and cement into building aggregate or fill. Indeed, respondents to Sandbag's call for evidence from the lime and silicon carbide sectors reported limited potential for recycling or their products for the foreseeable future. Once cement producer reported that approximately 8% of their cement is recycled content but this could be increased to 20%.

Finally, material circularity need not be limited to recycling. Certain types of waste products from industrial processes can find application in other sectors. An example of this is waste gases from steelmaking which can be used as a feedstock for methanol production. Blast furnace slag from steelmaking is also commonly used as a substitute for clinker in cement. Whether or not these processes actually contribute to material circularity ultimately depends on the fate of the materials and whether they continue to retain their value thereafter. Indeed, a common misconception is that incinerating waste to produce energy or heat industrial processes contributes to material circularity. Incineration can only reduce the value of materials.

Nevertheless, recycling also carries with it a number of caveats:

**Emissions reductions are not guaranteed:** Creating products from recycled secondary raw materials does not automatically result in energy or greenhouse gas emissions savings compared to using virgin material. In many instances, the source of energy used to power a recycling process will have a greater impact on product lifecycle emissions than the recycling of the material. This dynamic is particularly evident in the paper industry where plants manufacturing virgin paper will typically use biomass (forest trimmings) to provide the energy needed for the process whereas paper recycling plants commonly use natural gas (since they may not be geographically close to sources of biomass), resulting in elevated emissions for recycled paper.

**Contamination**: The economics of material recovery are affected by the presence of contaminants. These include any extraneous elements that become entrained with the material at any point during life which cannot be easily separated later. Copper contamination is an issue that affects steel recycling and leads to reduced quality in secondary steels. Responding to Sandbag's call for evidence, one steelmaker commented that current regulations and waste targets do not set requirements for product design where the choice of materials can affect a product's recyclability.

# Why are Europe's industries not on target for net zero?

There are numerous political and economic factors that have resulted in a large segment of European industry failing to significantly reduce CO2 emissions in recent years. Underperformance of the EU ETS in non-power sectors has been a major contributor and is discussed in the next chapter. In this chapter we identify important barriers to decarbonisation, particularly around the introduction of new technologies and infrastructure, that also need to be addressed.

## 3.1 Lack of demand for low carbon goods

Many respondents expressed concerns about the lack of demand for low carbon goods which, they argue, limits their ability to recover additional costs associated with low carbon production methods, since in most cases producing low carbon goods incurs higher costs. According to one steelmaker, the price of low carbon steel, relative to current production methods, will increase by 35% to 100%. However, another steelmaker expressed confidence that its customers would be willing to pay a premium for low carbon steel.

## 3.2 Inadequate incentives for new technologies and processes

Reliance on 'breakthrough technologies'[5] was a recurring theme in most responses to our call for evidence. The deployment of breakthrough technologies is not only capital intensive, but also typically leads to higher operating costs, at least in the short term. Industries engaged in large scale technology demonstrations readily acknowledge that commercial deployment of these technologies is not viable under prevailing economic and policy conditions. Consequently, their plans to achieve net zero emissions by 2050 are contingent, to a greater or lesser extent, on supportive EU or global policy measures for developing and deploying new technologies.

Some industrial companies are in the process of developing technologies which have the potential to substantially or entirely reduce CO2 emissions from their operations, and which can be deployed by 2030. Companies producing steel and iron ore pellets who responded to Sandbag's call for evidence indicated they are close to carrying out commercial scale demonstration projects for low carbon technologies. These developments are being closely watched by other industries that have yet to find their own solutions for decarbonisation.

For other sectors, however, low carbon technologies are at a less mature stage of development and the potential for these technologies to reduce emissions is therefore less easily quantifiable. Respondents from the lime and silicon carbide (ceramics) sectors reported being engaged in R&D of low carbon technologies with trade associations or universities (lime, silicon carbide), but acknowledged that reaching net zero will be technically challenging for their sectors as process emissions make up the majority of their carbon footprint and relevant solutions, such as CCUS, are 'underdeveloped'.

EU policymakers have consistently adopted a technology neutral stance in pursuing decarbonisation. However, the desire to keep all decarbonisation options on the table does not in itself create the conditions necessary for a range of different technology options to come to market. Frameworks for commercialising low carbon technologies have been missing from successive EU industrial policy approaches.

In the electricity sector, rapid cost reductions in low carbon technologies have been achieved as a result of EU renewable targets, the availability of funding mechanisms, as well as Member State energy policies. Lessons from this experience should inform the approach taken to scaling up technologies for decarbonising industry.

Several respondents to Sandbag's call for evidence have indicated that both CAPEX and OPEX support for low carbon technologies is currently missing.

## 3.3 Lack of support for new low carbon infrastructure

Four technologies dominate the mix of low carbon solutions favoured by industry: CCS/U, electrification, and low carbon hydrogen, and biomass. The availability of infrastructure to support electrification, CO2 transport and storage (for CCS), biomass, and hydrogen - all at low cost - is a demand shared by nearly all industries that responded to Sandbag's call for evidence. Indeed, without access to suitable low carbon infrastructure, many will fail to achieve net zero emissions by 2050.

For hydrogen and CCS major new pipeline networks will be needed – to transport hydrogen and CO2 respectively. The development of such networks will require policy support, but no significant support is yet in place.

Full-chain CCS projects that link carbon capture to permanent sequestration have long lead times: the planning requirements are complex, construction may take five or more years[9], while testing of storage sites would likely take several years in addition before the site could become fully operational. For CCS to play a significant role in decarbonising industry before 2050, commercial scale projects will need to come online within the next decade. However, industries cannot invest in CCS without knowing they will have access to CO2 transportation networks or a market that is willing to pay for low carbon products.

Moreover, some level of EU or Member State involvement will be required to deliver the kinds of large-scale hydrogen and CO2 transport infrastructure or expansion of electricity grids envisaged in industry roadmaps since the costs, extensive risks and strategic planning involved cannot be managed by the private sector alone. Within the last two years, a number of CO2 and hydrogen transport and storage projects have sought funding for development either from the Connecting Europe Facility (as Projects of Common Interest)[10] or directly from Member States[11]. However, the prospect of those projects being developed remains uncertain. Without suitable frameworks or funding mechanisms for the expansion of low carbon infrastructure, it is also unclear how the EU will achieve its net zero ambition.

Sites suitable for geological storage of CO2 are, for the most part, concentrated in northern Europe and the prospects of CCS development elsewhere in Europe are less promising. Biomass too is not available in quantities large enough to satisfy demand in many parts of Europe and it is unclear to what extent the supply of sustainable biomass can be increased. Further analysis is needed to determine the extent to which both CCS and biomass can satisfy demand implied by industrial sectors' decarbonisation strategies up to 2050.

For CCS, economies of scale are also an important factor in reducing the costs of full-chain, making it better suited for use within industrial clusters, rather than for single installations. This also means the financing requirements for CCS are very high and cannot be supported at current carbon price levels. Dedicated incentives are therefore needed to enable the development of these projects.

9. Office of Carbon Capture and Storage. (2010). UK Carbon Capture and Storage (CCS) Commercial Scale Demonstration Programme. p5. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/47995/1075-uk-ccs-commercialscale-demonstration-programme-fu.pdf

10. European Commission. (2019). Candidate PCI projects in cross-border carbon dioxide (CO2) transport networks. https://ec.europa.eu/info/sites/info/files/detailed_information_regarding_the_candidate_projects_in_co2_network_0.pdf

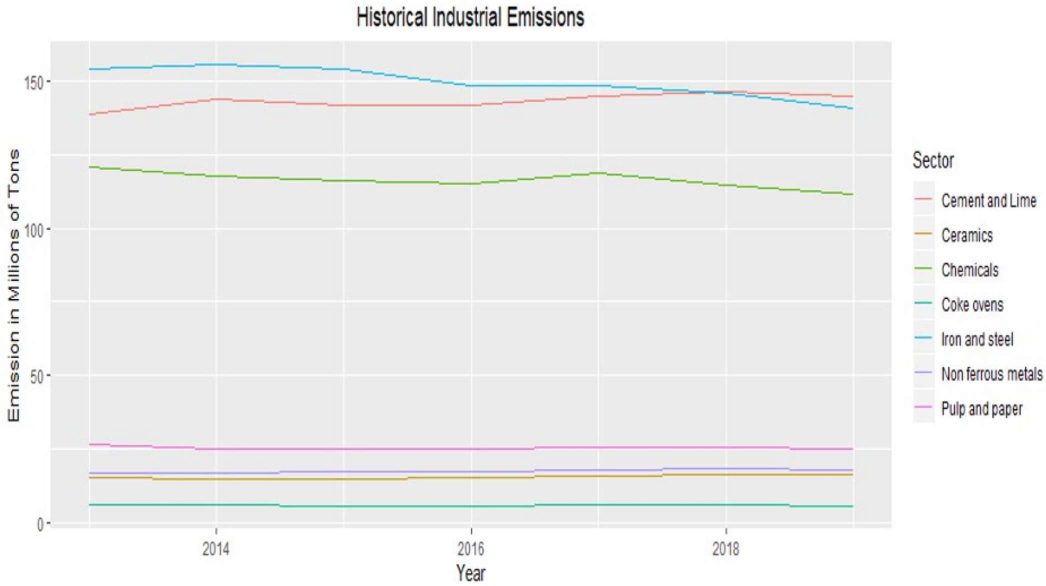
11. Simon, F. (2018). Meet Europe's two 'most exciting' CO2 capture and storage projects. *Euractiv*. https://www.euractiv.com/section/energy/news/meet-europes-two-most-exciting-co2-storage-projects/

# Making the EU ETS a key driver of industrial decarbonisation

European industry is currently far from being on a pathway towards net-zero emissions by 2050 Several reasons for this have already been offered by respondents to Sandbag's call for evidence. Indeed, while certain sectors, such as power, are moving towards a net-zero compatible trajectory by 2050, heavy industry in the EU shows few signs of decarbonising on a grand scale, despite these sectors having been covered by the EU's own Emission Trading System and therefore obliged in theory to steadily reduce their emissions in accordance with at least the cap of the scheme. When looking at the impact that the ETS has had on reducing emissions in the sectors covered by this report, we see that progress has largely stagnated.

FIGURE 2

## CO2 emissions from seven major European industries 2013 - 2019

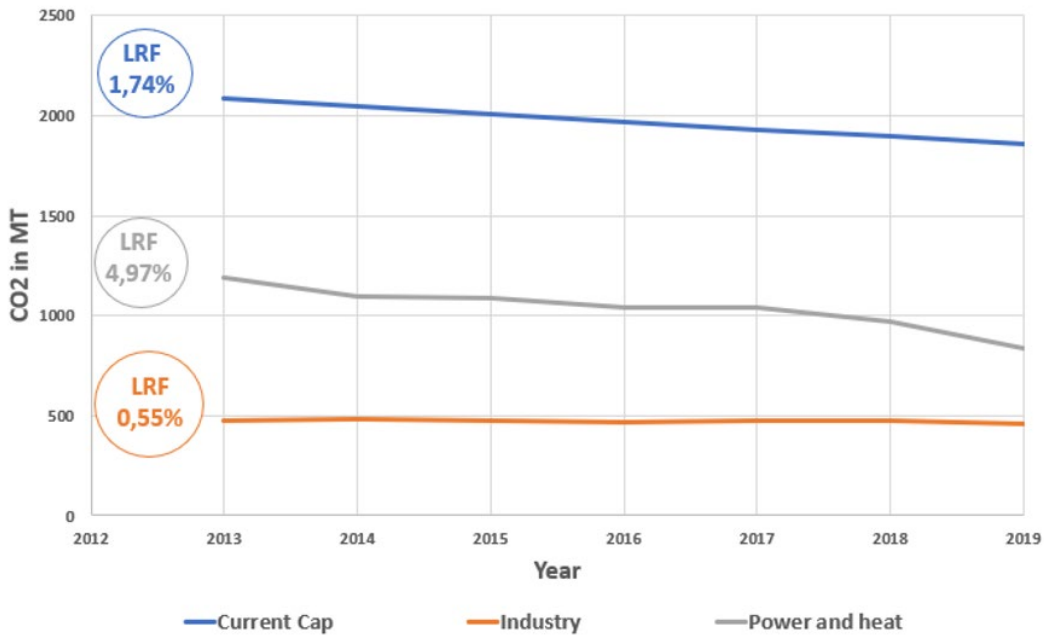



**Source**: EUTL

The EU ETS is defined by its trajectory or the cap it places on emissions. The slope of this cap is in fact the annual reduction rate implied for the sectors covered by the scheme. For Phase III, the cap of 2,084,301,856 Tons of CO2 and its slope have been set on parameters set on a level of ambition much lower than what was possible and emissions under the EU ETS have been persistently below the cap. The annual reduction rate, known as the linear reduction factor was set in line with the EU 2020 package, that is to say a 20% cut in greenhouse gas emissions from 1990 levels. However, industrial sectors have been decarbonising at a rate much slower than the cap and therefore annual reductions foreseen for this phase are certainly much lower than the ones of the power sector, the other big sector covered by the ETS. While in Phase III the linear reduction factor or the annual rate of cap decrease was set at 1.74%, power sector emissions have fallen at a much higher rate (4.97% - as shown in grey below), while industry has experienced  emissions reductions at a much slower rate than the cap (0.55% - as shown in orange below).

FIGURE 3

## The EU ETS' linear reduction factor for different sectors




**Source**: EUTL

When compared to the rate at which emissions in the power sector (also covered by the ETS) have decreased, it is quite clear that the EU ETS is failing to incentivise emissions reductions in industrial sectors, despite it having been highly successful in promoting reductions in the power sector. Previous reports by Sandbag have identified shortcomings in the design of the EU ETS that have allowed this situation to persist[12]. While there have been welcome reforms to the EU ETS in recent years, the scheme remains inconsistent with a trajectory to net zero emissions by 2050 and also perpetuates the conditions that have prevented industry lowering their emissions, in spite of proven options for decarbonising being available to most industrial sectors.

Our analysis has identified 3 main weaknesses of the EU ETS which have prevented it from working effectively in the direction of decarbonisation EU industry:

1. the inappropriateness of the cap;
2. the free allocation regime;
3. the lock-in of innovation through perverse incentives.

The lack of a stringent cap is a problem shared by both the power sector and industrial sectors. However, unlike industry, the power sector has - with a small number of exceptions - not been shielded from the carbon price by free allocation. This has enabled carbon pricing to incentivise the deployment of low- and zero-carbon technologies, reducing both emissions and the cost of technologies. Additional sectoral policies for the power sectors (i.e. renewables targets, feed-in tariffs, etc.) also helped, something which we recommend for industry sectors as well, especially now that the Market Stability Reserve, a reserve created specifically to absorb and eventually remove excess emission allowances from the EU ETS, cancellation would reduce allowances in response to additional reductions. This would seem to imply that a similar policy mix could be pursued for industry if similar levels of emissions reductions are to be realised.

## 4.1 Weaknesses of the EU ETS

### 4.1.1 Inadequate cap to signal the required emissions reductions.

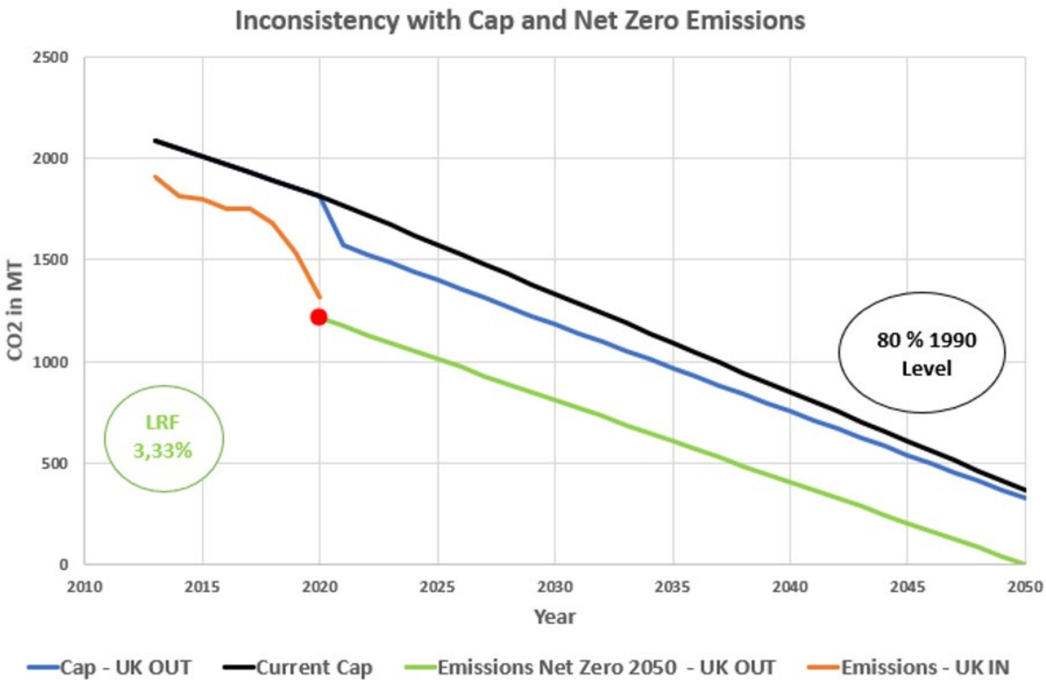
The EU ETS cap is inadequate in several respects. The cap is currently too loose, being above current emissions levels, which in turn has led to a surplus of allowances. This oversupply of EUAs has been further exacerbated by the ongoing COVID-19 crisis. Secondly, the 2030 ETS cap requires only a 43% reduction on

12. Sandbag. (2018). The Carbon Leakage Conundrum https://sandbag.be/index.php/project/carbon-leakage-conundrum/

2005 levels which is inconsistent with the rate of emissions reduction needed to reach net zero emissions by 2050. As the figure below shows, a net zero trajectory for the EU ETS (shown in green) tracks well below the EU's current emissions targets (shown in blue).

FIGURE 4

## The EU ETS cap and actual emissions levels in Europe




**Source**: EUTL

**The level of the Phase 4 cap needs to be reset** to reflect current emissions levels, with its future pathway determined by a long-term net zero target. The cap will further need to be addressed as a result of the departure of the United Kingdom from the EU, and therefore a realistic cap would be starting at real emissions levels of EU28-1 and aiming for net-zero by 2050.

The COVID-19 pandemic and related lockdowns created a sharp drop in economic activities and increased the surplus under the EU ETS even further[13]. While the scheme was able to bounce back and the price remained relatively stable, it is undeniable that the impact on the surplus in the ETS is not to be underestimated. To estimate the surplus of allowances in the ETS at the end of Phase 3, the

13. Further analysis of the impact of COVID-19 on the ETS can be found on Sandbag's blog.

one to be carried into Phase IV, we created 2 scenarios for the year 2020. This allowed us to understand how COVID-19 might affect the number of allowances in circulation. We used 2019 emissions as the latest reference point and applied the following assumptions for the industrial sectors:

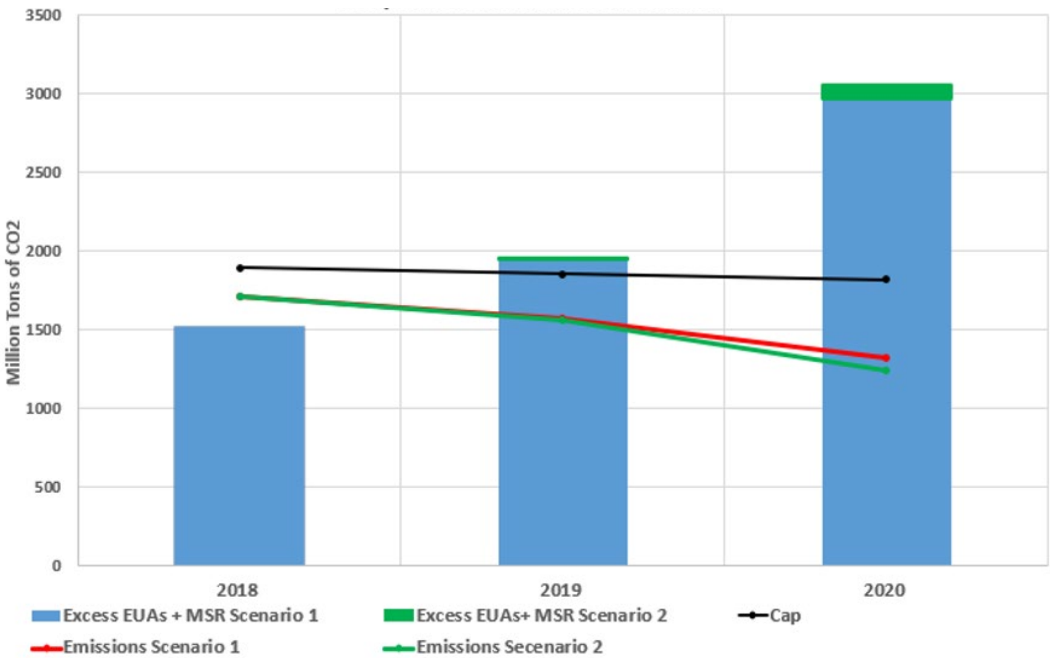
- a monthly emissions reduction of 30% due to partial or total shutdowns caused by the lockdown;
- recovery expected gradually within 6 months after the lockdown ends. Historically, this has been the observed catch up lag between financial markets and national economies – as happened during the 2009 H1N1 pandemic[14]

In terms of modelling the impact on the whole range of emissions under the EU ETS and under a given timeline, we created 2 scenarios to quantify the impact of COVID-19 on emissions:

I. Scenario 1: lockdown lifted across EU Member States starting with May 15th, 2020;
II. Scenario 2: lockdown lifted across EU Member States starting with May 15th 2020, but a second wave hits Europe September 15th, 2020 and lockdown is reinstated as of that date until the end of the year.

FIGURE 5

## Comparison of two recession scenarios




**Source**: EUTL and Sandbag's analysis

14. https://www.entrepreneur.com/slideshow/348392

As shown in Figure 5, above, in Scenario 1, 1253 MT of excess EUAs are present in 2019 and 1343 MT in 2020. Scenario 2, calculates an even steeper increase of excess EUAs, to 1428 MT in 2020.

An implication of this is that Phase IV of the EU ETS is due to start with an oversupply of 2 years' worth of emissions in the scheme. This is worrying as the excess allowances will exert downward pressure on the EU carbon price, making the EU ETS less effective in driving industrial decarbonisation.

## 4.2 Free Allocation and other market distortions vs. ensuring a fair playing field for European Industry has created technological lock-in

Equitable treatment of emissions, both internationally and within the Single Market, featured as a prominent concern among industries that responded to Sandbag's call for evidence. Several respondents (steel, ceramics, plant oil refiner) argue that carbon pricing has a negative impact on the competitiveness of their industry compared with non-EU counterparts. Conversely, others would like to see carbon pricing strengthened and better aligned to support best performing technologies. Evidently, there remains opposition to unilateral EU carbon pricing. However, a growing number of businesses in industrial sectors are calling for equalising measures to be introduced and these are detailed in Chapter 2.

Trade in carbon-intensive materials presents enormous challenges for the effective implementation of climate policy in industrial sectors. Preventing carbon leakage has long been a preoccupation of EU policymakers responsible for developing emissions policy. Though there is little evidence that carbon leakage has occurred to any significant extent since the ETS was established[15], it remains an important risk in the context of the move to a net-zero emissions economy.

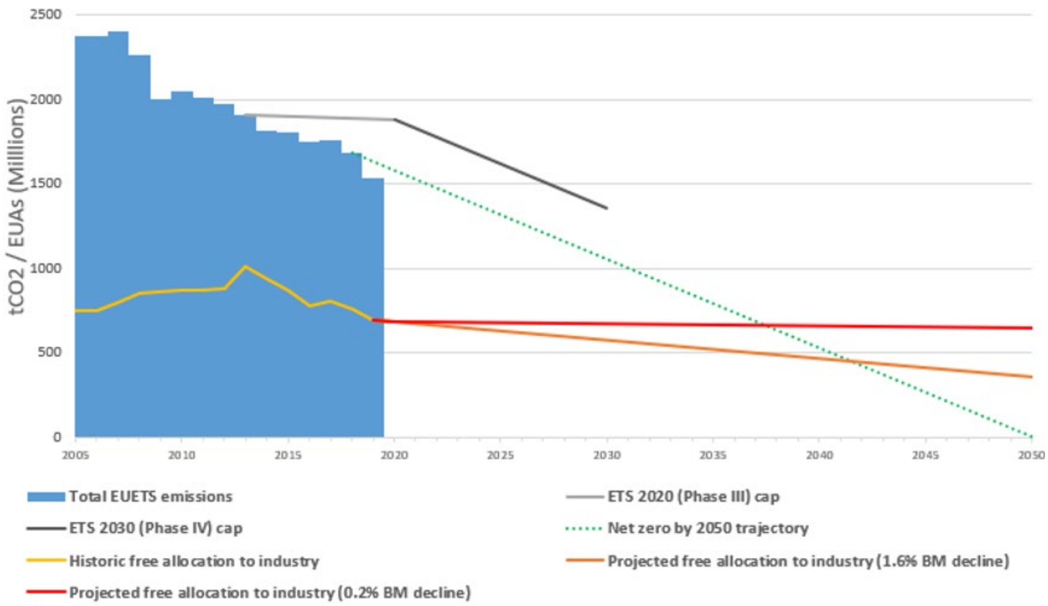
The EU has so far sought to reduce the possibility of carbon leakage through free allocation, which limits industrial sectors' exposure to carbon pricing. In doing so, it has also greatly diminished the incentive for industry to reduce emissions. However, free allocation will not provide indefinite protection to industry and puts manufacturers that produce low-carbon products through non-benchmarked processes at a competitive disadvantage.

15. Naegele, H., & Zaklan, A. (2019). Does the EU ETS cause carbon leakage in European manufacturing?. Journal of Environmental Economics and Management, 93, 125-147. https://www.sciencedirect.com/science/article/abs/pii/S0095069617306836

As Figure 6 shows, a net zero trajectory for the EU ETS tracks well below the EU's current emissions targets (shown in grey) while the proposed rate of reduction in free allocation to European industry reduces at an even slower rate than the targets. It decreases linearly from current levels at a rate in the range of 0.2%p.a. to 1.6%p.a. This implies a cumulative decrease of 6% to 48% by 2050 respectively. This is clearly completely inconsistent with a net zero target. As the EU seeks to raise its ambition on climate change the cap will be reduced, eventually to zero, and there will be no allowances to allocate free of charge.

FIGURE 6

## EU ETS emissions and caps




**Sources**: EUTL, EEA ETS Data Viewer

With both the 2030 and 2050 caps expected to be reset from their current levels, the pressure on free allocation will increase. The proposed benchmark trajectories create a misleading emissions trajectory for industry that allows industrial sectors to delay action to reduce emissions in the short term. This effectively is pushing the EU ETS industry against a clif which makes a long-term well managed transformation to net-zero industrial processes very unlikely to happen.

### Benchmarks that fail to deliver innovation

Free allocation to industry is determined by product benchmarks, which are detailed in the EU Commission's 2011 Benchmarking Decision, which includes 52 product benchmark definitions[16].

16. Two additional 'fallback' benchmarks are also used for calculating emissions based on heat and fuel.

A benchmark is the average of emissions per ton of product produced of the 10% most energy efficient EU installations for each type of product covered. This means that the most efficient installations have a free allocation that almost entirely covers their emissions, and in some cases exceeds their emissions. In these cases, the total carbon cost is close to zero, and it may even lead to a net profit, a situation which Sandbag has revealed in the past[17]. The Commission's approach to benchmarking has created several distortions:

- Low- or zero-carbon alternatives to benchmarked processes are often not treated under the same benchmark and therefore cannot benefit from receiving free allocation or the competitive advantage gained from having their processes included in the benchmark(s).
- A new process which reduces emissions may not fall under the existing benchmark, potentially leading to a loss of free allocation under a new benchmark.
- Materials producers whose emissions are covered by a benchmark may be deterred from reducing emissions because this may lead to a downward adjustment of the benchmark affecting other installations they operate which have yet to implement low-carbon processes.

The ETS product benchmarks for industrial sectors plot an even less ambitious emissions reduction trajectory than the unambitious cap, falling at 0.2% to 1.6% p.a., compared to a constant benchmark for the current cap.

Several respondents to Sandbag's call for evidence called for a range of emissions reductions activities beyond those recognised under the benchmarks to be credited or otherwise incentivised. Indeed, research published by Sandbag in 2018 has shown that installations which achieve emissions reductions using production methods that the Commission views as differing from the benchmark definitions can find they are excluded from the relevant benchmark (as is the case for steel producers that use pelletised iron ore, rather than sinter) or else unable to participate in the ETS altogether (which is the experience of cement manufacturers that produce non-Portland cements)[18]. In this way, the ETS benchmarking approach creates economic distortions that steer manufacturers towards incremental emissions reductions and inhibit the commercialisation of low carbon technologies in Europe.

To capture a wider range of opportunities to reduce emissions, the scope of the current benchmarks should be broadened, and **the rate of decrease of free allocation benchmarks needs to be much faster.**

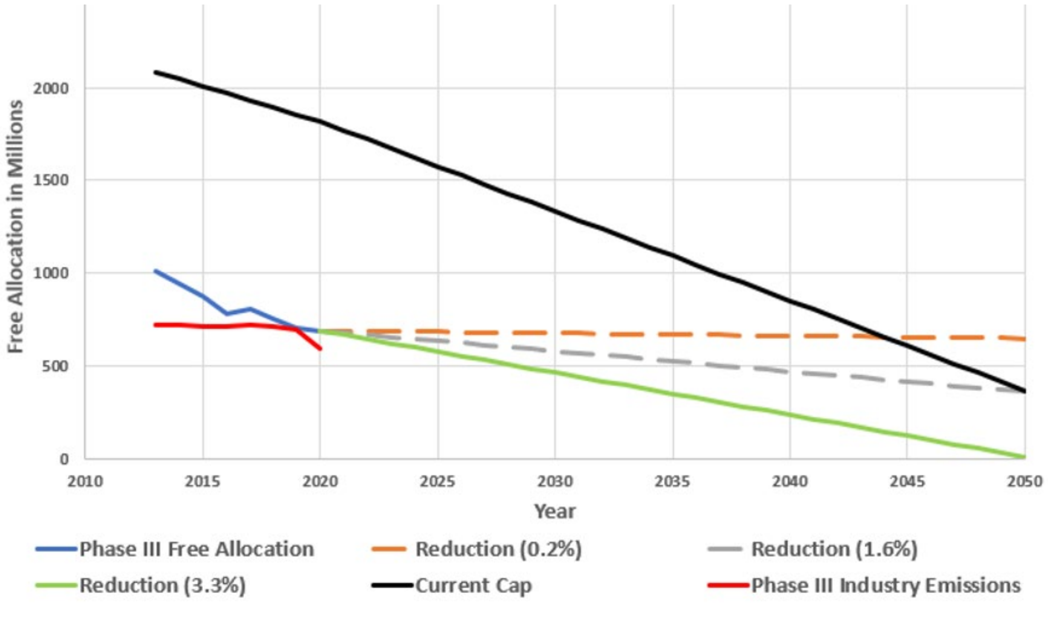
17. Sandbag. (2010). The Carbon Rich List. https://sandbag.be/index.php/project/carbon-fat-cats-company-analysis-of-the-eu-ets/

18. Lytton, W. (2019). Barriers to industrial decarbonisation. https://ember-climate.org/wp-content/uploads/2018/05/Sandbag_barriers-to-industrial-decarbonisation_Report_final_23May.pdf

For industry to reach net zero emissions by 2050, the rate of decrease needs to be at least 3.3%p.a. based on today's emission levels. This needs to be matched by a phase-in of Border Carbon Adjustments to balance the decreasing benchmark and mitigate the risk of carbon leakage.

FIGURE 7

## Free allocation projection with benchmark reduction




**Source**: EUTL

Fixing the faulty relationship between the benchmarks and free allocations would be time consuming and attempts to modify benchmarks have proven to be extremely fraught in the past. Finding an equitable way to move away from the system of free allocation as quickly as possible is needed. In that sense, the introduction of a BCA would enable the ETS to function more effectively.

Competitiveness issues also exist within the Single Market. As aforementioned, different ETS benchmarks continue to be applied to directly substitutable products under the ETS, contravening the text of the Directive. Several respondents (lime, steel, pellets) also cited the exemption of small emitters (installations below 20 MW or waste to energy plants, for example), from the ETS as leading to competitive distortions.

## 4.3 Inadequate carbon price signals

Partly as a result of the inadequate cap, EUA prices, although substantially higher than they were before the recent reforms were introduced, are too low[19]. Respondents to our call for evidence noted that the EU ETS fails to promote low carbon methods of production because the price is too low to incentivise many decarbonisation approaches and too unpredictable to form the basis of long-term low carbon investments. Several reported using internal carbon prices at much higher levels than current EUA prices to reorient their business practices in line with climate targets as well as to manage climate risks. Indeed, this has become increasingly common practice across a range of industries[20].

At the time of writing this report, ETS carbon prices stood well below the true cost of CO2 emissions or the levels needed to promote successful decarbonisation. (Estimated to be around 54.70USD/tCO2[21].)

## 4.4. Fixing the EU ETS: Creating clear signals for industry

To provide an appropriate signal to investors the EU ETS cap needs to decline at a rate consistent with the EU's overall emissions reductions goals. This implies:

**A revised 2030 cap**. This is required because more rapid emissions reductions are needed by 2030 if the EU is to reach its longer-term goals. Waiting for Phase 5, which runs through the 2030s is too late. We note that analysis by Sandbag[22] and and Cambridge Econometrics has shown that even a business-as-usual scenario will take emissions to well below the current cap, with a 50% reduction in overall EU emissions being expected in such a scenario compared with the current target of 40%.

**A new indicative 2040 target.** This would provide further guidance to investors on the required decarbonisation pathway. A target of -80% by 2040 is appropriate and would pave a steady path of decreasing emissions to 2050, avoiding a potential cliff-edge.

19. Edenhofer, O., C. Flachsland, C. Wolff, L. K. Schmid, A. Leipprand, N. Koch, U. Kornek, M. Pahle. (2017). Decarbonization and EU ETS Reform: Introducing a price floor to drive low-carbon investments. p.7 https://www.mcc-berlin.net/fileadmin/data/C18_MCC_Publications/Decarbonization_EU_ETS_Reform_Policy_Paper.pdf

20. CDP. (2017). Putting a price on carbon: Integrating climate risk into business planning. p.8 https://b8f65cb373b1b7b15feb-c70d8ead6ced550b4d987d7c03fcdd1d.ssl.cf3.rackcdn.com/cms/reports/documents/000/002/738/original/Putting-a-price-on-carbon-CDP-Report-2017.pdf?1507739326

21. Wang, P., Deng, X., Zhou, H., & Yu, S. (2019). Estimates of the social cost of carbon: A review based on meta-analysis. Journal of cleaner production, 209, 1494-1507. https://www.sciencedirect.com/science/article/pii/S0959652618334589?via%3Dihub

22. Sandbag. (2019). Halfway There: Existing policies put Europe on track for emission cuts of at least 50% by 2030 https://sandbag.be/index.php/project/halfway-there/

**A clear and binding commitment to a 2050 goal of net zero emissions for sectors covered by the EU ETS.** EU ETS sectors should not expect to continue to emit, with net zero achieved by negative emissions in aggregate from other sectors. Investment cycles in energy intensive sectors are often lengthy and a clear signal to manufacturing businesses is important so that planned investments in new capacity can deliver zero carbon production by 2050.

The above targets should be minimum commitments which can be ratcheted up, in line with the Paris Agreement.

### Strengthening the price of EU Allowances

As well as giving a clear long-term signal revising the 2030 cap would increase prices in the short term, thus strengthening incentives. However, there is more that can be done. At present annual emissions remain below the cap while the MSR does not absorb all excess allowances which are, by design, transferable from one year to the next, weakening the price. In 2019 emissions were 1532 million tonnes compared with a cap of 1854.7 million tonnes.

### Increasing the stability of carbon prices

Investments in zero carbon technology would be less risky, and therefore cheaper for companies to implement, with a more certain carbon price. This could be achieved by putting a floor on the price to act as a backstop for the value of investments in emissions reduction. This is probably best done by means of an auction reserve price.

It would be intended that the floor would never be binding, because the market would ensure an adequate price. However, if this failed, for example due to political uncertainties or economic shocks, investors would have the reassurance of the floor price. The introduction of such measures has been resisted in the past. However, the case for them now appears more clear-cut in the context of the need for investment to reach net zero emissions, therefore **a floor price for the EU ETS should be introduced as a safeguard on investments.**

# The EU’s Industrial Strategy and Circular Economy Action Plan - a new political context for industry

Achieving a net zero industry by 2050 requires a set of policies that satisfy the four major pillars of the net zero transition outlined earlier in this report. The New Industrial Strategy for Europe (NISE), released in March this year, and the Circular Economy Action Plan (CEAP) set out numerous ambitions and principles designed to address many of the core challenges of reaching a net zero industry. Several of these speak directly to the concerns raised by industry in our call for evidence and do in fact successfully bridge a gap that has long existed between the EU’s rhetoric on climate ambition and its policies governing industry and resource management. Nevertheless these strategies have yet to be implemented and, for the most part, they lack important detail on the specific measures that will be needed to reduce emissions and decouple economic growth from resource use.

This chapter explores the ways in which actions to achieve net zero can be embedded within the EU’s industry and resource policies.

## 5.1 General approaches to decarbonising industry

The pathways to reaching zero emissions have been studied extensively[23,24,25,26]. For the analysis in this section we have studied the published literature and will be building on the responses to a call for evidence Sandbag conducted for this report and outlined in the previous chapter. Here we assess the extent to which the key policy gaps are addressed by the NISE and what additional measures will be needed to turn the vision put forward by the European Commission into a policy portfolio apt for sustaining a “shot for the moon”.

23. See for example https://www.theccc.org.uk/publication/net-zero-the-uks-contribution-to-stopping-global-warming/

24. Material Economics. (2019). Industrial Transformation 2050: Pathways to Net-Zero Emissions from EU Heavy Industry. https://www.euractiv.com/wp-content/uploads/sites/2/2019/04/Exec-Sum-MATERIAL-ECONOMICS-INDUSTRIAL-TRANSFORMATION-2050.pdf

25. Wyns et. al., (2019), Industrial Transformation 2050 - Towards an Industrial Strategy for a Climate Neutral Europe, IES, IES. Available at ies.be https://www.ies.be/node/5074

26. EU Commission. (2018). A Clean Planet for all: A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52018DC0773

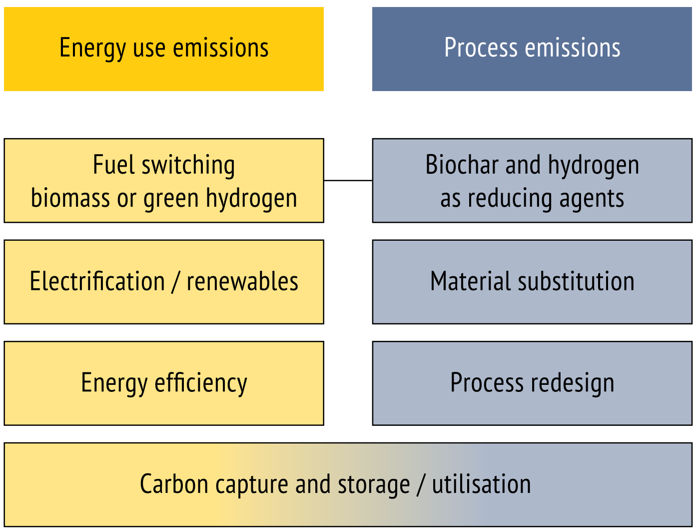
The main approaches to reducing emissions are similar across many industrial sectors. However, the balance and details of the approaches required differ. We have summarised three main types of change needed to eliminate emissions from industry include:

- Cutting emissions from energy inputs for industrial processes
- Cutting process emissions
- Making more efficient use of high impact intermediary products by applying the carbon efficiency first principal

These are summarised in the figure below.

FIGURE 8

Summary of approaches to decarbonising industry as resulting from the call for evidence




Low-carbon technologies are often most effective when they exploit synergies between different industries. For example, CCS projects benefit from economies of scale and are typically more cost-effective if applied to several emitters that are in close proximity to each other and can share different expertise. These are sometimes referred to as ‘clusters’.

### 5.1.1 Reducing emissions from energy use

Energy use emissions can be eliminated through **switching fuels** from coal, oil and natural gas to zero-carbon-capable energy sources. **Electrification** powered by renewable electricity - mainly solar and wind - is likely to be a major contributor to this. Electrification has applications in many industries from steelmaking and cement manufacturing to paper making and the production of green hydrogen. It is among the measures being considered by industries that responded to our call for evidence. A key concern raised is the extent to which the current grid capacity can accommodate future demand for electrification of industrial processes in addition to already increasing demand for electricity to decarbonise other sectors, such as transport. To that end, the expansion of grid development is a priority for industries that expect to electrify their processes.

Of course, challenges exist in developing sufficient renewable energy capacity, etc. For example were the paper industry to electrify its entire fleet, the additional demand on the electricity grid across the EU would be equivalent to that of the UK's electricity consumption[27]. Electrification therefore raises questions around feasibility if applied at large scale to industrial sectors, an issue that a number of respondents to our call for evidence raised concerns about.

**Zero carbon fuels, such as solar fuels and green hydrogen** are likely to be key contributors to net zero industrial processes as a source of heat. Zero carbon hydrogen can be made through electrolysis of water using renewable electricity. However, at present electrolysis accounts for less than 0.1% of dedicated hydrogen production[28]. An alternative is to produce hydrogen from natural gas in reformers – which at present is the most common method of production – but using CCS to make the process low carbon[29]. The switch to hydrogen would require changes to burning equipment and the costs of doing so vary across different industries. Several respondents to Sandbag's call for evidence (construction products, steel, iron ore pellets) indicated that hydrogen either will or could form part of their decarbonisation strategy. Some expressed concerns about the cost of using hydrogen as an energy source. In most cases, respondents did not indicate how they intend to source hydrogen to meet their needs due to the uncertainties around its availability.

**CCS/U** is a form of carbon removal which involves a process of extracting carbon dioxide from industrial fuels or exhaust gases before they are combusted or vented to the atmosphere, and transporting the carbon dioxide to permanent geological storage, or else converting it into useful products. CCS is considered among industry to have limited application for mitigating energy use emissions at present, due to the high costs of developing and maintaining the additional infrastructure. In a number of sectors there is potential to convert carbon emissions into useful products using (CCU). However, the markets for CCU-derived products are generally quite small in comparison to the volumes of

27. Personal communication to authors.

28. IEA. (2019). The Future of Hydrogen: Seizing today's opportunities. https://www.iea.org/reports/the-future-of-hydrogen

29. At present Steam Methane Reformers (SMRs) are the main technology used. However if CCS is required Auto Thermal Reformers (ATR) may have advantages.

$CO_2$ that would need to be captured where CCS is deployed. Implementing CCS also requires infrastructure to be available near the site of production in order to transport $CO_2$ to offshore storage sites, something that exists in very few locations at present.

A further consideration for 2050 is that CCS does not capture all of the emissions from a process, so a small proportion escape to the atmosphere (typically around 5% even for a well-designed facility). Absorption of $CO_2$, for example by reforestation, or direct air capture would be necessary to balance this. This may limit the role of CCS, including in the production of low carbon hydrogen.

There is a need to ensure that, where CCS is necessary, the right infrastructure is developed on a timescale that allows it to be brought into service and contribute to delivering net zero by 2050. We have recommended that an independent advisory group be tasked with assessing the need for CCS in the EU in order that appropriate support can be provided to enable its development.

The balance between hydrogen development and CCS deployment as two possible routes is uncertain at present, and policy needs to recognise this uncertainty by keeping both options on the table.

**Sustainable biomass** and synthetic fuels may also play a significant role in some sectors. In particular biomass will continue to play a significant role in paper and pulp production. Many models of pathways to limit climate change include substantial use of biomass energy with CCS (BECCS), which can in principle reduce carbon in the atmosphere (negative emissions). However, looking into the scale of biomass required for the plans of energy companies which intend to use it, it is unclear whether Europe's forests will be able to cope with such demand. Hence, this solution has to be kept to a sustainable level in order to discourage massive scale investments planning around it, when it may not be able to deliver.

The CEAP refers to plans for the EU Commission to assess the feasibility of such labelling measures for packaging and plastics products but stops short of considering a similar measure for high impact intermediary products from industrial sectors. For industrial sectors, **energy efficiency needs to be reconceptualised as carbon efficiency first** to promote opportunities to reduce the emissions intensity of industrial processes that are not being captured by existing policies.

The ETS and Renewables Directive, for example, incentivise a limited range of carbon efficiency measures while the Ecodesign Directive covers only a small segment of products used in the economy. In many industries, energy efficiency levels are close to the limit of what is economically feasible with existing processes, and this cannot produce the large changes required to reach net zero emissions. A focus on carbon efficiency first through measures such as product carbon labelling could accelerate reductions in per product emissions.

### 5.1.2 Reducing process emissions

Several industries, including iron and steel, cement, glassmaking, and aluminium produce emissions as part of the chemistry of production processes. These emissions need to be eliminated to achieve net zero emissions. CCS, material substitution, process redesign, and hydrogen are the primary methods for achieving this.

Deploying **CCS** to mitigate process emissions has advantages over the use of CCS to remove energy-related emissions since process emissions tend to have much higher concentrations of CO2, making capture less expensive. Carbon capture technologies have tested and improved over recent decades but the lack of CO2 transport and storage infrastructure is a bottleneck for full chain CCS projects.

**Material substitution** involves replacing material inputs for industrial processes with alternatives that do not produce process emissions, or otherwise have lower embodied carbon. In some cases, material substitution also leads to changes in energy use emissions as the thermal inputs required for a given manufacturing process will vary according to the materials used. The NISE refers to boosting recycling and the use of secondary raw materials but provides very little detail on how this will happen.

A closely related approach to eliminating emissions is **process redesign**. For example, in aluminium there has been extensive research into the use of materials other than carbon for the electrodes used in the process, but many low-carbon alternatives are costly relative to conventional processes.

In addition, some industries - steelmaking and fertiliser production in particular - are able to make use of **hydrogen as a reducing agent**, in place of traditional reduction processes that use fossil fuels. The hydrogen used must be low carbon for the approach to be effective in eliminating emissions. The NISE refers to establishing industrial alliances as a means of risk sharing and financing the development of clean hydrogen infrastructure. However, given there remain substantial cost barriers, such alliances may not be enough.

### 5.1.3 Resource efficiency

**Material circularity** is an approach to manufacturing that conserves the value of materials throughout their lifecycle such that they can be continually reused or recycled. This reduces the amount of primary raw materials required for manufacturing and typically leads to significant reductions in both energy and process emissions. Another benefit of the circular economy is the reduction in ecological and environmental damage caused by large scale abstraction of resources. The CEAP raises the concept of "Safe Operating Spaces" where the use of natural resources is limited according to predetermined environmental thresholds.

The CEAP refers to the potential for including circular economy practices in Best Available Techniques reference documents as part of the upcoming review of the Industrial Emissions Directive. Certainly this could encourage EU industries to shift away from linear forms of production. Although, additional measures to increase the availability of secondary raw materials are equally necessary to make closed loop manufacturing a reality. Digital technologies that track resources as well as the expansion of waste handling infrastructure will play a central role in bringing this about.

For construction waste, rates of recycling vary enormously between EU Member States. In 2008, the EU set a target for 70% of construction and demolition waste to be recycled by 2020. However, if downcycling is excluded, no EU Member State has yet met that target[30].

The process of recycling in itself does not guarantee energy or greenhouse gas emissions savings compared to using virgin material. For many materials, the source of energy used to carry out recycling will have a more significant impact on product lifecycle emissions than the recycling of the material itself.

Material circularity need not be limited to recycling, however. There is potential for wider material circularity in a range of sectors. The responses to our call for evidence confirm that some types of waste products from industrial processes can find application in other sectors. For example, waste gases from steelmaking which can be used as a feedstock for methanol production. Blast furnace slag from steelmaking is also commonly used as a substitute for clinker in Portland cement. These two examples represent the sorts of ways in which sectors can reduce waste and emissions.

The extent to which the reuse of materials contributes to material circularity depends on whether the materials continue to retain their value with each

30. Gross, A. S. (2019). Concrete chokes our landfill sites – but where else can it go? *Guardian* https://www.theguardian.com/cities/2019/feb/26/concrete-chokes-our-landfill-sites-but-where-else-can-it-go

lifecycle. A common misconception is that incinerating waste to produce energy or downcycling mixed waste streams into lower-grade materials contributes to material circularity. Downcycling can be avoided if the value of recycled materials justifies the cost of recycling them. Here carbon pricing may play an indirect role in promoting recycling but landfill taxes, adopting waste hierarchy principles, and extended producer responsibility (EPR) provide more convincing incentives.

Many businesses that responded to Sandbag's call for evidence did not report material efficiency as being a prominent feature of their decarbonisation strategies. This may be for several reasons: some businesses have already achieved high rates of recycling, others produce materials which cannot easily be recycled, while others are not directly involved in recycling their products. However, it is apparent that closing the loop will require closer alignment of incentives to preserve the value of materials at various stages in the value chain.

#### 5.1.3.1 A past disconnect between climate policy and the circular economy initiative

The potential for emissions reductions from improved material circularity seems significant. A 2019 report from Material Economics indicated that an economy with high levels of material circularity[31] could more than halve the anticipated level of emissions in 2050. Even if this is a large over-estimate, the gains could still make a substantial contribution to meeting the overall emissions reduction goal. Promoting circular economy practices is therefore an important component of the Commission's strategy for achieving its dual objectives of net zero emissions and decoupling economic growth from resource use.

There are two primary obstacles that prevent a more circular economy: First, opportunities to recycle materials are not being exploited to their full potential. Often this is due to inadequate collection and sorting infrastructure, as well as the low economic value of recycled materials relative to the cost of recycling. Second, materials continue to be produced which cannot be recycled using currently available techniques, contributing to unrecoverable wastes for which downcycling, incineration and ultimately landfill are the only solutions available. While recycling processes are continuously evolving, leading to higher rates of material recovery, there is no guarantee that new techniques for recycling currently non-recyclable materials will be developed in future.

In this report's recommendations, we outline how extending the Circular Economy Action Plan to include high value intermediary products could reduce emissions by limiting resource consumption and preserving the value of materials.

31. The term 'material circularity' describes an approach for preserving the value of materials at all stages of their life cycle.

#### 5.1.3.2 Applying existing circular economy policies to high impact intermediary products

Adopting circular economy principles in product design will play an important role in boosting material recovery rates since the choice of materials used in products and the way they are bonded together affect their recyclability.

It was also argued (steel) that the circular economy initiative should be better linked to climate policy to avoid wastes being landfilled or incinerated. Waste incineration (commonly referred to as the 'co-processing of alternative fuels') is considered an important part of some industries' decarbonisation plans even though such processes often yield little or no saving in direct emissions. The use of alternative fuels does not promote material circularity and, in the context of net zero, is unsustainable and therefore unlikely to play a significant role in delivering net zero for industrial sectors.

The following sections describe measures that can be used to decarbonise the three focus sectors of this report.

## 5.2 Cement, lime & concrete

In 2018, European cement and lime production was responsible for 153MtCO2[32], the highest level of emissions from the sectors since 2011.

Typically, two thirds of direct emissions from an integrated cement or lime plant will come from the chemical process of converting limestone into lime while the remaining third are mostly attributable to fuel use. Below, we outline the four primary means through which these emissions can be reduced: material circularity, carbon capture and storage or utilisation (CCS/U), material substitution and fuel substitution.

### 5.2.1 Material circularity

In Europe and elsewhere, concrete rubble from demolition waste is typically downcycled into aggregate that is used as construction fill or simply used for landfill.

Although concrete is not well suited for disassembly or re-use over multiple lifecycles, both aggregate and cement components can be separated from end-of-life concrete using a variety of readily available techniques, often at lower cost compared to removing these materials from sites as wastes. One estimate suggests that unreacted cement recovered from concrete could be used

32. CO2 emissions data from EEA ETS Data Viewer.

to replace up to 80% of new cement in constructions, saving close to half the emissions per tonne of cement as well as reducing overall demand[33]. However, unreacted cement, represents only a small portion of the total amount of cement in poured concrete and recovery of the remaining portion incurs significant costs[34]. One cement producer reported that their current cement production typically includes 8% recycled material with potential to increase this to 20%.

Stronger incentives for reducing lifecycle emissions from concrete, which accounts for more than a quarter of all waste generated in the EU[35], would ensure that opportunities to reduce cement emissions are fully realised.

Recycling is referred to very little, if at all, in literature from the cement industry. This may be because cement recycling is most often carried out at the point of demolition and therefore beyond the normal scope of a cement producer's activities. Issues around the sustainable built environment will need to be dealt with as part of the CEAP and Level(s) frameworks.

### 5.2.2 Carbon capture and storage or utilisation for the cement sector

The technology can be applied to both process and combustion emissions from cement and lime plants and therefore holds potential to almost entirely decarbonise cement and lime manufacture, within certain geographies. It appears to have captured the interest of Europe's cement majors who have begun piloting carbon capture technologies for cement through projects such as the LEILAC demonstration plant, as well as in the development of CO2-enriched cements and precast concrete products. Norcem also recently completed a FEED study on the use of CCS for their cement plant in Brevik. Cembureau, the European cement trade association, has promoted CCS/U as a means of reducing the majority of cement-making emissions[36] though, as they point out, the commercial application of CCS is contingent on "co-financing", implying significant funding or other form of incentive.

Carbon capture technologies for cement are costly - estimated to be between €42 and €84/tCO2[37], depending on the capture process used. And while CCU

33. Material Economics. (2019). Industrial Transformation 2050 - Pathways to Net-Zero Emissions from EU Heavy Industry.. p.27 https://materialeconomics.com/publications/industrial-transformation-2050

34. Material District. (2018). NEW MACHINE CAN RECLAIM CEMENT FROM RECYCLED CONCRETE. https://materialdistrict.com/article/machine-reclaim-cement-recycled-concrete/

35. European Commission. *Waste* https://ec.europa.eu/environment/waste/construction_demolition.htm

36. CEMBUREAU. (2018). Building Carbon Neutrality in Europe. p.5 https://lowcarboneconomy.cembureau.eu/wp-content/uploads/2018/12/CEMBUREAU-BUILDING-CARBON-NEUTRALITY-IN-EUROPE_final.pdf

37. Gardarsdottir, S. O., De Lena, E., Romano, M., Roussanaly, S., Voldsund, M., Pérez-Calvo, J. F., ... & Gazzani, M. (2019). Comparison of technologies for CO2 capture from cement production—Part 2: Cost analysis. Energies, 12(3), 542.

techniques such as injecting CO2 into fresh concrete can offset the costs of carbon capture, the size of the market for CCU-derived products is small in comparison to the emissions from Europe's cement plants. Some, if not most of the captured CO2 will need to be stored permanently. However, as discussed in Chapter 3, the requirements for CCS infrastructure are complex and a high carbon price alone will not deliver CCS.

### 5.2.3 Material substitution

Portland cement clinker can be substituted in varying degrees with other less carbon-intensive materials such as pozzolans and calcined clays. (Ground blast furnace slag from steel mills may also be used as a clinker substitute but has a significant carbon footprint and is already widely used with limited availability of new sources.) The geographic distribution of clinker substitutes is a limiting factor in some geographies, albeit one that is far from being reached. Pozzolanic materials, for example, can be found in historically volcanic regions around the Mediterranean but are scarcer in northern Europe. Since cement production is largely localised to areas where it is used, different approaches are required subject to the regional availability of resources.

Blast furnace slag, a by-product of steelmaking, is used as a direct replacement for clinker in Portland cement. However, demand for blast furnace slag is high while its availability closely depends on volumes of pig iron production[38]. It is unclear to what extent the use of blast furnace slag can drive further reductions in cement emissions.

Substituting clinker for other low carbon alternatives can affect the characteristics and performance of a cement although, for many clinker substitutes, similar performance can be achieved. For some applications, a more radical extension of clinker substitution principle might involve entirely replacing Portland cement with low carbon precast materials or even wood.

### 5.2.4 Fuel substitution

Until recently, cement and lime plants typically burned coal or *petcoke* to produce the thermal input required for their processes. Increasingly, cement plants are burning municipal and industrial waste streams, commonly referred to as "alternative fuels". While burning alternative fuels helps to divert waste from landfill, it nevertheless emits large quantities of CO2 and has little impact on direct emissions from cement plants.

38. Department for Business, Energy & Industrial Strategy. FLY ASH AND BLAST FURNACE SLAG FOR CEMENT MANUFACTURING. p.19 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/660888/fly-ash-blast-furnace-slag-cement-manufacturing.pdf

Biomass is also used to provide heat for some cement plants although the extent to which it can replace coal or alternative fuels is unclear as sources of sustainable biomass are limited and competition for them is high.

Similarly, low carbon hydrogen may be used to provide some heat input for cement plans although, due to technical limitations, it cannot completely replace other heat sources and has not been tested in the cement manufacturing process[39].

Finally, the electrification of calciners has been touted as a way of reducing energy-related emissions though, according to one respondent, this technique has not been tested outside of laboratory conditions.

## 5.3 Iron & steel

Europe's iron and steel sector (including coke production) emitted 149MtCO2 in 2018. Process emissions from iron reduction and smelting account for two thirds of the total CO2 footprint of steel while the remaining third relates to the fuels used to heat furnaces.

Companies in the sector appear to be engaged in developing technologies to eliminate emissions from their processes. Two respondents to Sandbag's call for evidence reported ambitions to reduce emissions to net zero by 2050 with one intending to produce zero emissions iron ore pellets by 2045.

The three primary means of decarbonising steel production are through increased material circularity, hydrogen-based steelmaking with electric arc furnaces (DRI-EAF process), and CCS/U.

### 5.3.1 Material circularity

Steel can be recycled many times without loss of quality and each tonne of steel that is recycled reduces emissions by up to 90% compared to steel produced from virgin ore[40]. The rate of steel recycling across Europe is already high: according to one steelmaker who responded to Sandbag's call for evidence, 54% of all steel produced in Europe originates from scrap. However, demand for ferrous scrap currently exceeds its availability in Europe.

39. CEMBUREAU. (Date unknown). Towards zero carbon fuels for cement manufacture. https://cembureau.eu/media/1840/16272-narrative-towards-zero-carbon-fuels-for-cement-manufacture_view-cement-sector.pdf

40.Material Economics. (2019). Industrial Transformation 2050 - Pathways to Net-Zero Emissions from EU Heavy Industry., p.26. 90% emissions reduction assumes production of steel using largely decarbonised electricity.

The economics of steel recycling are also affected by the presence of contaminants which cannot easily be separated. Copper contamination is an issue that affects steel recycling and, if not carefully managed, can lead to a reduction in steel quality. The principal causes of contamination are product design and waste management practices that result in the mixing of copper and steel. Coordination between circular economy and ecodesign policies can help limit copper contamination.

### 5.3.2 Hydrogen-Direct Reduced Iron

Direct Reduced Iron (DRI) is an established iron production process that uses natural gas or coke as a reducing agent. Replacing these fossil inputs with zero carbon hydrogen can eliminate CO2 emissions from the DRI production.

Although this process has not yet been tested at a commercial scale, respondents to Sandbag's call for evidence from the iron and steel processors indicated that hydrogen-based steel production is their preferred route for decarbonisation. The first pilot H-DRI project (HYBRIT, in Sweden) is scheduled to start operating in 2026, and a demonstration plant will follow by 2036.

The source of hydrogen used for H-DRI has implications for the embodied emissions of the steel produced. Most hydrogen produced today is from steam methane reforming (SMR), a process that uses fossil natural gas and generates carbon dioxide emissions as a by-product.

To make zero carbon steel zero carbon hydrogen, produced via electrolysis of water or by adding CCS to the reformer, is needed. However, at present electrolytic hydrogen is considerably more expensive to produce than that obtained through the SMR process. This is due to the combination of the high cost of electrolysers and electricity.

According to the IEA, the cost of electrolysers' will drop significantly as early as 2022-23 due to increased large scale production to satisfy demand[41]. According to an industry source, hydrogen from electrolysis could be competitive with SMR hydrogen by 2030 (assuming no price on carbon) in countries where renewables are cheap and abundant.

Other factors such as the level of carbon pricing and the evolution of free allocation, which are discussed in Chapter 4, will also have an impact on the economics of using hydrogen.

41. International Energy Agency (IEA). (2019). The Future of Hydrogen: Seizing today's opportunities . https://www.iea.org/reports/the-future-of-hydrogen

In the final stage of zero carbon steelmaking, hot metal from the DRI process is melted in electric arc furnace (EAF), a process which consumes large amounts of electricity, typically 425-475kWh per tonne of steel produced[42]. EAFs have minimal direct emissions but may lead to indirect emissions depending on the source of the electricity used. Process electrification therefore cannot be assumed to have zero emissions.

### 5.3.3 CCU/S

Waste gas from steelmaking contains a high proportion of carbon monoxide which can be synthesised into chemical feedstocks, thereby recycling carbon into higher value products. A consortium of companies at ArcelorMittal's steel mill in Ghent have developed a process for converting waste gas into ethanol. The net emissions reduction achieved through this process will depend on how the ethanol is subsequently used.

CCU technologies in the steel sector are also limited to processing waste gas which represents a small fraction of overall steelmaking emissions. CCS, on the other hand, provides a means of reducing the bulk of emissions from conventional blast furnace-basic oxygen furnace steelmaking. Yet, in spite of more than a decade of research into the application of CCS to the steelmaking - including through the ULCOS programme - no European project has yet come to fruition. Currently, the only commercial scale use of CCS in steelmaking is the Abu Dhabi CCS Project which uses the captured CO2 for enhanced oil recovery[43].

## 5.4 Paper & pulp

The paper and pulp sector emitted 27MtCO2 in 2018[44] and is the fourth largest industrial energy consumer in Europe[45]. Unlike many other industrial sectors, emissions from pulp and paper production have fallen in the last five years. In 2018, they were 26% below 2005 levels. Nevertheless, the industry faces significant challenges in reducing its emissions to net zero. A paper and pulp business that responded to Sandbag's call for evidence reported having a target to achieve net zero (scope 1) emissions by 2050 *if technically and economically feasible*.

42. HeatTreat Technologies. *Electric Arc Furnace: Energy Consumption* (accessed 26 May 2020). http://heattreatconsortium.com/metals-advisor/electric-arc-furnace/electric-arc-furnace-energy-consumption/

43. MIT. *ESI CCS Project Fact Sheet*: Carbon Dioxide Capture and Storage Project* (accessed 26 May 2020). https://sequestration.mit.edu/tools/projects/esi_ccs.html

44. Combined paper, pulp and cardboard CO2 emissions data from European Envrionment Agency ETS Data Viewer.

45. CEPI. (2018). The challenge: decarbonising whilst being recycling pioneer. http://www.cepi.org/system/files/public/documents/publications/CEPI%20policy%20briefing%20-%20Challenges%20in%20decarbonising%20whilst%20being%20recycling%20pioneer%20-%20final.pdf

Emissions from paper and pulp production are almost entirely energy related, resulting from the combustion of fuels used to generate heat. Technological options for decarbonising the sector include on-site renewable energy sources, fuel switching, and BECCS.

### 5.4.1 Material circularity

Material circularity plays an important role in the European paper industry which at present has a 72.5% recycling rate[46]. However, in contrast to many other sectors, paper recycling may lead to higher emissions relative to the manufacture of paper from virgin fibres. This is because installations producing virgin paper are often situated close to sources of biomass, while often this is not the case for paper recycling plants. The potential for material circularity to play a role in further reducing emissions from the sector is therefore limited.

### 5.4.2 BECCS

The use of bio-energy CCS would enable the paper sector to become a carbon negative industry, and to potentially provide emissions removal services to other industries that are unable to reach net zero. To date, no CCS projects have been attempted in the sector. The costs of doing so are expected to be higher than in other sectors due to the relatively small scale of emissions produced from a single paper and pulp plant[47]. For this reason, CCS is not considered a viable solution for the sector.

### 5.4.3 On-site renewables

Bioenergy from waste streams is an important source of energy for heating in the sector. According to one respondent, the availability of biomass is critical to decarbonising the sector and could reduce 90% of energy-related emissions across their business. Biomass is already readily available to many virgin paper and pulp installations since these are typically situated near to the source of timber used. However, this is not always the case.

Since the temperature requirements for heat in paper production are much lower (up to 180°C) than in other industrial processes, renewable energy sources can be a viable alternative to commonly used thermal inputs such as biomass (58%) and natural gas (32%)[48]. Ground source heat pumps have already been successfully trialled at some plants although the use of electricity incurs significantly higher

46. *Ibid*. p.1

47. VTT Technical Research Centre of Finland. (2015). CCS and Pulp and Paper Industry. p.10 https://ieaghg.org/docs/General_Docs/Lisbon%20presentations%20for%20website/11%20-%20A.%20Arasto%20(VTT).pdf

48. Mico, L. ((2019). Renewable Heating in the Pulp and Paper Industry. http://solarheateurope.eu/2019/02/11/renewable-heating-in-the-pulp-and-paper-industry/

costs[49]. The cost of electricity is clearly seen as an issue for the sector: one respondent suggested that affordable green electricity will be critical to their plans for decarbonising, echoing sentiments found in paper and pulp industry literature.

### 5.4.4 Fuel switching

Replacing natural gas for heating with electricity, decarbonised gas or zero carbon hydrogen also provide possible routes to eliminating energy emissions. However, according to the CEPI, the European paper industry association, replacing the natural gas currently used in paper production with electricity would increase the industry's electricity consumption by 250%[50] and lead to a more than doubling of energy costs at present.

The availability of decarbonised gas or hydrogen is heavily dependent on developments outside the paper and pulp sector. Estimates of the extent to which these solutions could decarbonise the sector are not available.

49. CEPI. (2018). The challenge: decarbonising whilst being recycling pioneer. http://www.cepi.org/system/files/public/documents/publications/CEPI%20policy%20briefing%20-%20Challenges%20in%20decarbonising%20whilst%20being%20recycling%20pioneer%20-%20final.pdf

50. *Ibid*. p.6

# How can EU industry be set on a pathway to net zero?

This chapter outlines policies needed to overcome the barriers to decarbonisation identified in previous sections of this report.

The policies needed to meet the challenges of reaching net zero are grouped around four pillars that correspond to the priorities of the NISE.

**Pillar 1: Making an unprecedented change through clear strategic signals targeting action to reduce emissions in the short, medium and long-term.** The unprecedented breadth and depth, scale and spin and nature and necessity of the transitions requires clearer strategic signals and stronger incentives for the transformation pathway to net zero are needed, including reduction milestones to 2030, 2040, 2050, etc.

**Pillar 2: Ensuring fair competition** Creating a level playing field for industry producing zero carbon goods, so that European industry can flourish with free and fair trade and absence of market distortions.

**Pillar 3: Innovation at the heart of the transition.** Stimulating the development and / or deployment of zero carbon technologies, networks and processes

**Pillar 4: The circular economy**. Promoting carbon efficiency first in the circular economy, including a more circular approach to manufacturing.

## 6.1 — Pillar 1: Clearer signals and stronger incentives for the path to net zero

This pillar is required because, as the NISE notes, the required transition is unprecedented in its breadth and depth, scale and speed, nature and necessity. It also notes that it takes a generation to transform an industrial sector and the value chains it forms part of, and the next five years will be decisive in setting the conditions for the transition[51].
This means that the EU's industrial strategy must provide clear signals for

51. European Commission. (2020). A New Industrial Strategy for Europe. pp.2,4 https://ec.europa.eu/info/sites/info/files/communication-eu-industrial-strategy-march-2020_en.pdf

businesses to start delivering net zero now, and not delay action until nearer to 2050. Businesses that manufacture bulk commodities in particular tend to have long investment cycles lasting several decades. Consequently, many are already planning investments in new or upgraded production capacity that will remain operational towards 2050 and even beyond. These will need to be zero-emissions capable so as not to become stranded assets.

Further reforms of the EUETS will be the main way of providing such signals. The EUETS will continue to play an important role over the next few decades as emissions reduce to net zero and be a critical component of policy. It provides an aggregate cap enforced by legally binding requirements to surrender EUAs for any emissions. As such it ensures that total emissions in the covered sectors remain below set limits. Furthermore, the EU ETS also offers a clear way of defining net zero emissions, because the types of any offsets or negative emissions allowed to balance the small residual emissions in 2050 can be defined by rules in the EU ETS Directive (see Chapter 4).

## 6.2 — Pillar 2: Creating a level playing field for zero carbon products

The NISE notes the importance of a level playing field and fair competition[52]. European industry is rightly concerned that the cost of measures to reduce emissions within Europe, including the required strengthening of the cap under the EU ETS, could simply lead to production and investment relocating outside Europe with no fall in global emissions (referred to as carbon leakage). While there is no evidence of substantial leakage to date the risk remains, especially as the cap tightens.

Measures are needed to prevent carbon leakage in future. Until now the main mechanism used to avoid carbon leakage has been free allocation of allowances. However, this is not sustainable as the number of free allowances available for allocation decreases, eventually to near zero. Either benchmarks for industries will need to reduce much faster than they do now, or a cross-sector correction factor (CSCF) will need to be applied. The present levels of protection from free allocation will thus not be sustainable.

We have identified two policy levers that can support the creation of a level playing field: Border Carbon Adjustments and carbon footprint performance standards. Both require extensive data on emissions - data which, in turn can be made use of in other policy context.
Border adjustments and performance standards both seek to reduce emissions

52. European Commission. (2020). A New Industrial Strategy for Europe. p.3 https://ec.europa.eu/commission/presscorner/detail/en/fs_20_425

by providing signals to both production within the EU and imports. They share similar requirements for measurement and tracking and verification of emissions for imports. However, they differ in the type of incentive they create. Performance standards provide a single threshold, with goods are either compliant or not. They eliminate some production from the market entirely, effectively imposing an infinite carbon price above a certain threshold. However, there is no incentive to reduce emissions further below the threshold once the standard has been met. In contrast carbon pricing, including through border adjustments, has a more continuous character providing stronger incentives the more emissions are reduced.

Each approach can have value, depending on circumstances. In the context of emissions intensive industry, performance standards seem best suited to ruling out high carbon production from outdated and ineffective technologies once new technologies have become available. For example, it might be useful to set a performance standard which can be met only by those using new processes, or with CCS. Higher carbon products prevailing in the market at present would be ruled out.

Performance standards can be tightened over time. By 2050 it may be appropriate to set standards to close to zero.

### 6.2.1 Border Carbon Adjustments BCAs

Border Carbon Adjustments (BCAs) can protect industrial sectors from unfair competition while safely exposing them to carbon pricing[53]. Sandbag has recently analysed this approach, and provided its assessment to the Commission via a consultation response, hence we do not consider them here in detail. However, we note that they are consistent with the NISE, which note the need to uphold, update and upgrade the world's trading system, and notes that a BCA eregime will be proposed in 2021.

#### EU ETS benchmarks should encompass best available technologies

BCAs should be introduced as quickly as possible, with free allocation of allowances phased out. BCAs have the potential to largely eliminate the distortions caused by free allocation set out in Section 3.

One way of doing this is to adjust ETS benchmarks. As a minimum, the ETS product benchmarks, which continue to be used as reference points for best performing technologies, currently ignore lowest-carbon methods of material production in carbon-intensive sectors such as cement and steel manufacturing. The scope of activities covered by the benchmarks should encompass the full

53. Sandbag. (2019). The A-B-C of BCAs. https://sandbag.be/index.php/project/the-abc-of-bcas/

range of relevant substitutes, consistent with the legal definitions given. The same approach should be used to establish reference technologies against which proposals to the Innovation Fund will be measured.

Modified benchmarks are in any case desirable and changes should be implemented to address the problems with incentives identified in Section 3. This remains the case irrespective of whether BCAs are being introduced.

### 6.2.2 Product standards (Embodied carbon standards)

Including embodied carbon criteria in product standards would bar access to the Single Market for products made using higher emissions manufacturing processes. This can be justified on the basis that greenhouse gas emissions, which contribute to climate change, constitute both a public safety issue and an environmental hazard.

There are precedents for developing product standards and legislation that limits certain practices, inputs or by-products from goods or manufacturing process in order to reduce harmful effects, even where those restrictions provide no immediate benefit to producers or consumers of the products concerned. These include the banning of products containing ozone-depleting substances (1987 Montreal Protocol), Euro standards that restrict the sale of new vehicles that exceed emissions limits (since 2009), and the restriction of hazardous substances in electrical equipment (2003 RoHS Directive 2002/95/EC). Notably, the latter endorses the "precautionary principle" in "the prohibition of other hazardous substances and their substitution by more environmentally friendly alternatives". A similar approach could feasibly be taken to reducing levels of embodied carbon.

The relevance of embodied carbon standards to a net zero strategy hinges on the level at which they are set and how that evolves over time. As CEPS point out in their 2019 paper[54], commercially available low carbon technologies would be required as reference points for embodied carbon standards. This is problematic for sectors that lack commercially available technologies that can significantly reduce emissions. For them, an embodied carbon standard would serve little purpose. And even where low carbon technologies are available to industry, using the least carbon-intensive production routes as benchmarks for embodied carbon standards might have the effect of severely reducing competition in product categories affected by the standard.

Embodied carbon standards would raise similar challenges for monitoring compliance as BCAs. However in some respects they may be more

54. Dröge, S. et al. (2019). How EU trade policy can enhance climate action: Options to boost low-carbon investment and avoid trade leakage. 7.

straightforward, for example because, unlike BCAs, there is no need to adjust for carbon pricing in exporting jurisdictions.

### 6.2.3 BCAs and product standards

Border Carbon Adjustments and product standards are sometimes characterised as alternative policies to incentivise emissions reductions in industry, with a choice of one or the other policy required. However, in practice they are different tools having different effects. Consequently, product standards and BCAs can be introduced together, and indeed can complement each other as part of a wider policy package.

BCAs provide a continuous (linear) incentive to reduce emissions, with higher costs the higher the emissions embodied in imports. The greater the reduction in emissions that is achieved, the greater the reductions and costs.

In contrast product standards have a yes/no character. Products are compliant or not. As such they can eliminate carbon-intensive products completely, and can set a clear track over time for levels of performance all producers must reach if future standards are modified. However, they do not incentivise reductions beyond the standard.

The yes/no nature of product standards means that they do not adequately address the problems of competitiveness and carbon leakage if free allocation of allowances is reduced. For example, suppose EU production has emissions in the range 1.7 to 1.9 tonnes per tonne of product, and imports have embodied emissions in the range 1.7 to 2.1. A product standard at 1.9 would eliminate some carbon-intensive imports. However the remainder, with emissions at similar levels to EU production, would meet the standard and pay no carbon price, while EU producers continue to be subject to the EU ETS. This would clearly risk carbon leakage. In contrast, BCAs solve this problem by imposing a price on imports for every tonne of embodied emissions.

Product standards nevertheless have a role to play in eliminating very carbon-intensive production and in mandating a pathway to net-zero, so helping to drive the development and deployment of new technologies. A mixture of BCAs and produce standards can thus address leakage issues and provide continuing price incentives to reduce emissions, while helping mandate a route towards zero.

### Taxes and standards as complements in transport

Combining carbon pricing with product standards has precedent. In the automotive sector fuel is heavily taxed (and thus so are emissions), providing a strong price incentive towards more efficient vehicles. At the same time tightening average efficiency standards gives impetus to long term technological development. While the analogy with decarbonising industry is not exact – for example because end consumers pay the tax in the transport sector – it does illustrate how pricing and product standards can work together.

## 6.2.4 Carbon footprint labelling

Equalising measures on carbon pricing and introducing product standards can help in creating a level playing field for traded commodities. Both of these require standards for disclosure of the carbon footprint of materials. Once this footprint has been assessed it can be spread more widely, including other products and a wider scope of emissions, and communicated in the form of labelling.

At present, the EU and Member States have incomplete visibility over the carbon footprint of materials that are produced or sold in their respective jurisdictions. Data that is collected on industrial emissions pertains largely to production emissions under ETS reporting mechanisms. However, to better understand the performance of policies designed to reduce emissions and measure progress towards achieving targets, the scope of data collection will need to be broadened to encompass the entire lifecycle carbon footprint of materials. This will make it possible to target policy interventions more effectively.

The development of carbon footprint labelling standards for bulk commodities would also provide a means of collecting much needed data on the carbon content of products sold in Europe. This exercise would prove useful irrespective of the effect that labelling itself may have on carbon consumption since the data collected would provide a useful metric for measuring the impact of EU emissions policy.

The "greening" of product standards and disclosure of emissions performance through eco-labelling enjoys widespread support from industry. Among businesses that responded to Sandbag's call for evidence, attitudes towards the greening product standards and disclosure of emissions performance through eco-labelling were overwhelmingly positive. Those in favour include a cement manufacturer, a lime producer, a silicon carbide producer, a paper and pulp manufacturer, two construction product manufacturers, and two of Europe's largest iron & steel makers. Mandatory energy performance labelling for consumer electrical goods sold in the EU serves as a useful analogy for carbon footprint labelling of industrial products and materials. The concept is, as mentioned above, popular across many industries who have acknowledged demand for verifiable low carbon products from their customers.

One steelmaker proposed giving priority market access for products with high levels of recycled content by, for example, mandating minimum percentages of recycled carbon content in certain commodities. However, this approach might not be well suited to other sectors, particularly where the benefits of recycling are more nuanced.

European standards are maintained by recognised European Standardisation Organisations (ESOs) which are independent from EU governance institutions but are required to update standards in accordance with relevant EU laws. It is therefore possible to establish new requirements for the disclosure of a product's carbon footprint and/or setting carbon footprint criteria in product standards through EU legislation.

The Commission should work with stakeholders to develop robust mandatory product carbon footprint labelling standards for industrial materials and products which would fall under the certification process for products sold in the EU. Crucially, the process of measuring the carbon footprint of products will provide valuable (and hitherto unavailable) data on downstream emissions which can then be used to measure the effectiveness of policies designed to reduce carbon consumption.

Providing open access to high quality granular data on carbon flows will be an important aspect of any such system. Businesses, financial institutions, academic organisations, think tanks and other interested parties with capacity to analyse this data have a role to play in making sense of emissions data and finding ways to improve the performance of emissions policy. While relevant authorities would also be able to compare submitted product performance information with actual monitoring data.

### 6.2.5 Develop zero carbon construction standards

The NISE notes that creating a more sustainable built environment will be essential to Europe's transition towards carbon neutrality[55]. To promote the use of sustainable construction products and reduce emissions from the built environment, **zero carbon construction standards** should be introduced and become effective before 2030. Since most constructions built today will have an expected lifetime beyond 2050, these requirements should include both fabrication and use emissions so that new buildings are fit for a carbon neutral world. A zero-carbon construction standard will also drive markets for low carbon materials and products.

55. European Commission. (2020). A New Industrial Strategy for Europe. p.7 https://ec.europa.eu/info/sites/info/files/communication-eu-industrial-strategy-march-2020_en.pdf

In the short term, requirements could be established for minimum recycled content in construction materials to reduce emissions from primary material production and construction waste. These requirements should increase over time in line with the EU's waste reduction targets.

### 6.2.6 Trade & international cooperation on climate change

The EU also has opportunities to advance the net zero agenda through international cooperation on climate policy objectives and in trade talks. Much can be achieved in pursuit of these goals, even taking account of recent global trade tensions and a deterioration in multilateral cooperation at national government levels. Many cities, states, regional governments and businesses remain committed to implementing measures to reduce emissions. Groups such as *The United States Climate Alliance, We Are Still In coalition*, and *We Mean Business* wield significant political and economic clout and are natural allies for the EU in building wider consensus around net zero.

However, the EU must be prepared to deliver on a net zero target with or without international cooperation.

## 6.3 — Pillar 3: Innovation at the heart of the transition

The NISE notes that Europe needs novel industrial processes and more clean technologies to reduce costs and improve market readiness. Indeed, Europe's industry must become an accelerator and enabler of change and innovation and that the industrial strategy is an industrial innovation strategy at heart, requiring innovation to be embedded in policy making. It advocates a range of players working together to create lead markets in clear technologies[56].

### 6.3.1 Supporting the development and deployment of new technologies

Low carbon technologies and new approaches to manufacturing will underpin the transition to net zero industry. For example, in the NISE the Commission notes it will support clean breakthrough technologies leading to a zero carbon steel making process[57].

56. *Ibid.* pp.3,4,7,10
57. *Ibid.* p.7

Many industries already have the technological capability for completely decarbonising their processes. However, the current policy environment is not conducive to the deployment of low carbon solutions for industry on a commercial scale where they can have a significant impact on emissions. Moreover, for a small number of industrial sectors, low carbon solutions have not yet been developed. Technological innovation is therefore necessary for providing the means of decarbonising industry, but so too are markets for low carbon technologies and products in order to make those solutions scalable and reduce the costs of decarbonising.

Under a net zero target, new rules will also be needed to govern EU and Member State funding for low carbon technologies to ensure they are directed to projects and technologies which can play a role in delivering net zero. The inclusion of net zero criteria will avoid finances being diverted to projects that are fundamentally incompatible with a net zero economy, examples being waste-to-energy plants and the production of CCU fuels.

As noted elsewhere in this report, new technologies need to be introduced throughout energy intensive sectors to achieve net zero emissions. These will likely include some mix of:

- New production processes.
- Low carbon hydrogen and electricity, and perhaps sustainable biomass and synthetic fuels made from captured CO2.
- Use of CCS/U.

Support for low carbon technologies will need to focus on those which offer a pathway to zero emissions. New technologies that incrementally reduce emissions may have some short-term value but will not be consistent with 2050 targets. The need in the context of the 2050 target is for technologies which are "no carbon not low carbon". A variety of approaches are available to bring new technologies online and get them to scale. These may be used in combination. They may each raise **issues around State Aid**. Revised state aid rules for priority areas, including energy and environmental aid, due in place in 2021[58] may have an important role to play here.

Most have been implemented in one form or another for renewables. In many cases support for low carbon technologies will be implemented by **reverse auctions** or similar procurement processes to ensure value for money and put downward pressure on costs. This approach is among the reasons costs for renewable electricity (wind and solar) have fallen so much in recent years.

58. *Ibid*. p.6

Examples of possible approaches are:

### Price based approaches

**Guaranteed prices for low carbon product.** A guaranteed price may be paid for each unit of low carbon product. In the electricity sector this has typically been implemented in the form of a Feed In Tariff (FIT).

**Contracts for differences (CfDs).** These typically guarantee a project will benefit from a defined carbon price by giving a payment depending on the difference between the defined price and a market price for carbon. For example, to be economically viable a CCS project may require a carbon price of €100/tCO2 of emissions avoided. A payment may be established for the difference between €100/tCO2 and the price of EUAs, so if the EUA price is €40/tCO2 a payment of €60/ tCO2 is made. There are many variants of this approach. For example, contracts for difference may be on **product prices instead of carbon prices**.

### Volume based approaches

**Volume or market share obligations.** These guarantee a certain market share for low or zero carbon products. This may be imposed by a **zero carbon product standard** for part of the market. Another approach is **Tradable zero carbon certificates**. Producing a tonne of low carbon product generates a certificate, which can be traded. Buyers must surrender a certain number of certificates when buying products, for example buying certificates covering 10% of their purchase.

### Direct financial support

**Tax incentives.** These reduce taxes for low carbon production, therefore increasing profitability of investment.

**Low cost finance.** Low cost finance, such as loans on favourable terms, may help encourage investment in low carbon production by reducing financing costs.

**Subsidies.** There may be direct financial payment to fund research, or the capital and/or operating costs of projects during the early deployment of technologies.

It is beyond the scope of this report to define the optimal policy package. However Sandbag expects to return to this issue in future work. However, any package will raise important issues of IP, and who will benefit from these policies.

As the NISE notes[59], IP is important to the EU's competitiveness and it will be important that expenditure on support for low carbon innovation secures full value for EU industry by safeguarding IP.

Such measures will be needed at least while new technologies are in their early stages and some form of support may be necessary for an extended time where the zero-carbon technologies are more expensive than high carbon options. For example, when CCS is used to decarbonise a process this will inevitably add to total costs, even as a mature technology, because there will always be costs to capture and transport and storage. There may be some opportunities for use of captured CO2, but it is unlikely that this will make the CCU chain profitable except in a few exceptional circumstances.

Long term support need not always be in the form of continuing subsidy. It may for example, be in the form of performance standards, border adjustment measures to protect industry from unfair competition, mandated markets for zero carbon products, a continuing tightening of the cap under the EU ETS, or some combination of these.

Creating new low-carbon networks poses particular challenges because of the economies of scale required, their strategic importance, and their extent across Europe. The NISE suggests Important Projects of Common European Interest (IPCEIs) as a promising route[60] and this approach certainly warrants further development since such large scale low-carbon projects often require cooperation across borders.

Some respondents to Sandbag's call for evidence also called for the EU's Sustainable Finance taxonomy to be broadened to promote circular economy practices. Those who require this form of support have also promoted the idea of carbon contracts for difference[61] for the purpose of de-risking investments in low carbon materials production.

### 6.3.2 Including net zero criteria in EU ETS Innovation Funding

Within the EU ETS the Innovation Fund will be the primary policy instrument for reducing the costs and de-risking low carbon technologies. The Fund will be financed from the auctioning of 450 million allowances from 2020 to 2030. At EUA prices of €20/tonne this would provide around €900 million p.a. Support is available for innovative low carbon technologies and processes in energy

59. *Ibid*. p.5

60. *Ibid*. p.12

61. A thorough discussion of carbon contracts for difference can be found in Climate Strategies' paper *Building Blocks for a Climate Neutral European Industrial Sector*. https://climatestrategies.org/publication/buildingblocks/

intensive industries, including products substituting carbon intensive ones. The Fund seeks to learn lessons from the previous NER300 by applying different ranking criteria to projects. However its effectiveness is yet to be demonstrated.

The Innovation Fund should be directed to supporting technologies that can contribute to delivering net zero by 2050. For projects that apply for Innovation Fund grants, the Commission has proposed an assessment methodology that compares the project's expected emissions performance with the relevant ETS benchmark. However, this method could lead emissions reduction projects being funded over the next decade that will become stranded assets thirty years from now. To reduce that risk, project developers should be required to demonstrate the compatibility of their project with a net zero economy to qualify for funding.

Furthermore, CCS and energy storage technologies cannot readily be assessed against existing ETS benchmarks because they will likely service a variety of different sectors to which a range of benchmarks will apply. As a result they risk being disqualified for failing to meet Innovation Fund award criteria. This is concerning given that CCS is widely regarded to have an essential role in the portfolio of low carbon technologies needed to meet net zero. The Innovation Fund selection criteria do not seem well-suited to supporting large-scale and long-term low-carbon network projects such as CCS where the benefits in emissions reductions might typically be realised many years after the project commences. Therefore additional support mechanisms that are appropriate to financing low carbon infrastructure may be needed to bring them into fruition.

The ETS Directive states that all revenues should be used to tackle climate change[62]. Reports by national governments indicate that around 80% is spent in practice although it is not clear how much of this is additional to what would otherwise have been spent in the absence of the EU ETS.

### 6.3.3 Establish network infrastructure taskforce to support low carbon hydrogen, CCS and electrification

New infrastructure will be required to enable industrial sectors to decarbonise: electrification of industrial processes will increase demand for low carbon electricity and require reinforcement of electricity grids. Similarly, the development of CCS will require new infrastructure to transport and store CO2. Assessments of the degree to which new infrastructure is required vary considerably, making it difficult to create the right conditions to support the development of low carbon infrastructure.

62. European Commission. (2003). Establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC. https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:02003L0087-20180408&qid=1590439100501&from=EN

To determine the appropriate level of support needed for each type of low carbon infrastructure, we propose that a task force is established for the purpose of investigating and mapping out infrastructure requirements from both sectoral and geographic perspectives. This exercise will reveal the extent to which new infrastructure is required and define appropriate institutional arrangements and economic incentives to bring this infrastructure online.

There will be a need to recognise the fundamental uncertainties involved, and retain the appropriate optionality. For example, there is, as noted, uncertainty about the balance of hydrogen production between electrolysis using renewables and natural gas reforming with CCS.

## 6.4 — Pillar 4: Realising the benefits of the circular economy

As the NISE notes, resource efficiency and the circular economy can both help the transition to net zero and secure the supply of clean and affordable energy and raw materials. Indeed the European Green Deal sets the objective of creating new markets for climate neutral and circular products[63]. The EU's Circular Economy Action Plan (CEAP)[64] notes the essential contribution of the circular economy to achieving climate neutrality by 2050 and decoupling economic growth from resource use, while ensuring the long-term competitiveness of the EU and leaving no one behind.

However, while the CEAP is the principal policy driver of resource efficiency, it includes measures that are predominantly relevant to consumer products and waste streams. Circular economy objectives for commodity materials are not covered by the Commission's Circular Economy Action Plan, and there is no explicit mention of emissions intensive or energy intensive industry.

Pursuing a net zero economy will involve reducing disposal of materials since nearly all forms of waste contribute to the release of greenhouse gases both directly, from landfill or waste incineration emissions, and indirectly, by creating additional demand for virgin materials to replace feedstocks lost in waste streams. One recent study estimated that a 56% reduction in emissions from the EU Commission's 2050 baseline scenario could in principle be achieved through

63. European Commission. (2020). A New Industrial Strategy for Europe. pp.3,7 https://ec.europa.eu/info/sites/info/files/communication-eu-industrial-strategy-march-2020_en.pdf

64. European Commission. (2020). Circular Economy Action Plan: For a cleaner and more competitive Europe. https://ec.europa.eu/environment/circular-economy/pdf/new_circular_economy_action_plan.pdf

circular economy approaches[65]. An updated EU Waste Framework Directive will have a crucial role in realising those opportunities.

For industrial sectors, the EU's focus on pricing carbon emissions at source overlooks the significant role of carbon consumption. Even as European industries decarbonise in the coming years, Europe's consumption of materials, particularly those imported from parts of the world with less stringent emissions policy, will continue contributing to climate change. Just as the polluter pays principle is designed to reduce direct emissions, similar measures should be considered at other points in the value chain to limit carbon consumption and drive demand for low carbon products.

To complement the forthcoming industrial strategy, **the EU should develop an action plan for promoting material circularity in industrial sectors**. This should include sectoral roadmaps that identify the opportunities to increase material circularity up to 2030 and beyond. In addition, new ecodesign requirements should be introduced for products containing industrial products to promote efficient use of materials and reusability, particularly in the construction sector. The plan should also target a reduction in the use of hard-to-recycle materials since these are a major source of waste and will have a much more limited role in a net zero economy than at present.

Banning materials that are difficult to recycle may not be an appropriate solution if alternatives are not immediately available. Raising landfill taxes while also increasing penalties for illegal dumping will create stronger incentives for innovation in new recyclable materials which can replace those that cannot be reused[66].

Moreover, the EU's Waste Framework Directive should enable companies that have the technology to convert waste streams into useful resources to do so as long as stringent safety requirements are met.

65. Material Economics. (2019). Industrial Transformation 2050: Pathways to Net-Zero Emissions from EU Heavy Industry. https://www.euractiv.com/wp-content/uploads/sites/2/2019/04/Exec-Sum-MATERIAL-ECONOMICS-INDUSTRIAL-TRANSFORMATION-2050.pdf

66. The introduction of specific taxation measures is not within the remit of the EU and it would therefore be up to Member States to set taxes for single-use materials.

sandbag

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