Institute for Public Policy Research

IPPR North

FORGING THE FUTURE

A VISION FOR NORTHERN STEEL'S NET ZERO TRANSFORMATION

Jonathan Webb

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SUMMARY

The steel industry underpins the economies and identities of many towns and city regions across the North. Despite this, in the spring 2021 budget, the chancellor referred to steel as an industry of the past. This perception fails to realise the important role steel will play in both supporting the North's economy and the UK's wider transition to a low-carbon future. With the pursuit of the right technologies now and investment to create a competitive low-carbon steel industry, northern steel, as a foundational industry, can be central to the country's prosperity in the decades to come.

This great transformation can offer something more hopeful; a cleaner, greener future for the steel industry. In turn, this will support prosperous towns and communities, providing the prospect of a good life for the people who live there. If we are serious about levelling up, we must begin to recast steel as an industry of the future. With a proper decarbonisation plan, the North's steel industry can not only achieve net zero emissions; it can also transform its competitiveness to become a world leader in the low-carbon steel market.

None of this can be achieved without the right support or policy plans in place. There are major technological questions that need to be confronted, and policies to increase the demand for low-carbon northern steel need to be articulated.

With a vision in place for the transition to net zero northern steel, the government's levelling up agenda can be provided with fresh impetus. Alongside recent announcements on a northern economic campus and the UK infrastructure bank, decarbonising steel can help build the North's economy and raise prosperity. Getting the correct policies in place can empower the steel industry to drive forward decarbonisation.

KEY FINDINGS

The UK steel industry is of national strategic importance. It employs approximately 32,000 people directly, with a further 52,000 people employed in its supply chain. Its direct contribution to the UK economy is £2 billion a year. Future market opportunities worth over £3.8 billion a year could be available by 2030. Over one-third of the industry's jobs and a significant number of steel producers are based in the north of England. As a result, the North has a unique opportunity to lead the UK's production of zero carbon steel.

This report shows that there are clear opportunities from decarbonising the industry. A drive towards zero carbon steel would not just protect existing jobs; a modern and competitive industry would also attract new investment that can create new business opportunities, jobs, and wealth within the North.

To achieve this transformation, significant barriers need to be overcome. The negative perception of steel as a sunset industry persists and this has meant that there is a lack of forward planning for decarbonisation. To address this, we outline a comprehensive plan for decarbonising northern steel. In doing so, we propose a mix of resource efficiency, electrification, hydrogen, and carbon capture and storage technologies to decarbonise northern steel. We examine how this decarbonisation approach would play out across key industrial clusters located in Yorkshire and the Humber, as well as the North East.

We estimate the annual cost of decarbonising northern steel to be approximately £267 million by 2050. If pursued, our plan would result in a rapid drop in emissions from northern steel production by 2035, with the industry effectively reaching net zero by 2036. Alongside capital investment, we set out a package of key recommendations to help lay the foundations for a stronger, low-carbon, and productive industry. In doing so, we propose a better future for the industry alongside steel communities.

RECOMMENDATIONS

The four pillars of our vision for zero carbon steel in the North are as follows.

A new chapter for industrial decarbonisation strategy

Industrial decarbonisation strategy in the UK is too centralised and is not connected to a broader vision for how it will benefit regional economies. A new approach to developing industrial strategy for the steel industry should provide a national framework that facilitates input from regional and local leaders. The decarbonisation pathways for industrial clusters outlined in this report should be drawn upon to develop bespoke regional solutions that complement their wider plans for creating a low-carbon economy. Our plans would complement and provide region specific guidance for the UK government's Industrial Decarbonisation Strategy. As part of its strategy, the UK government should address the high energy costs the industry currently faces.

Investment in the industry is not currently significant enough to enable it to carry out the required retrofitting of plants and change of production methods needed to produce low-carbon steel. We anticipate that the annual cost of this transition will be approximately £267 million by 2050. To achieve net zero, the UK government must increase its investment in electrification, hydrogen, resource efficiency and CCS technologies. Over the first decade, the UK government will need to significantly invest in technological development and industry decarbonisation. From the 2030s, we anticipate its share of the investment will fall as private sector investment is crowded in to meet at least half of the costs by the mid-2030s.

Making the most of devolution

We have an emerging system of devolution in England. It has the potential to help drive innovation and investment in green steel, particularly in the North where 62 per cent of the population are covered by some form of devolution deal. We recommend that by drawing on the local knowledge, and partnerships of metro mayors and local authority leaders, the government can help fulfil net zero ambitions. For example, by helping to drive demand for green steel through progressive procurement and devolving allocations of research and development (R&D) expenditure, progress can be made on boosting regional productivity.

Ensuring a just transition to net zero

The decarbonisation of the North's steel industry can also deliver benefits for the workers of the region. This means that investment and capital support must be underpinned by support for training, retraining and skills. A jobs guarantee offered from industry and underwritten by government could provide workers with confidence that they have a future in the industry.

The low-carbon steel industry of the future must start training the workforce of tomorrow, today. Reviewing the capacity of (and improving investment in, if necessary) high-quality technical and vocational education will be crucial to create the skills pipeline that industry in the North will need.

A low-carbon steel market

The production of low-carbon steel is an opportunity to transform the fortunes of the UK's steel industry. The likely imposition of carbon border adjustment mechanisms by major economies in the years to come will fire the starting gun on the race to net zero steel. If the North's steel industry can get off the mark quickly, the rewards could be significant. The impetus for decarbonisation will soon be significant and it is pivotal that UK steel producers are supported in their efforts to decarbonise production.

Within the industry, there remains a sense that central government could do more to support UK steel, both in terms of providing loans and other financial support to help the industry decarbonise, as well as by creating demand for UK steel domestically and by identifying new export opportunities.

Ultimately, northern steel should strive to reverse its fortunes and compete on the global stage as a world leader in low-carbon steel production. This cannot happen if it lacks a well-paid, well-trained, and motivated work force. To this end, the UK government should consider the central importance of the North's steel industry in any future trade negotiations and ensure that new deals do not erode its historically good pay and working conditions.

INTRODUCTION

Northern steel has faced significant challenges in recent decades, first with de-industrialisation and more recently with attempts to devalue steel through the dumping of steel on the international market (Rhodes 2018). At the same time, the high cost of energy for the industry have made it increasingly difficult for it to compete with international and European competitors, who can buy energy at much lower prices (UK Steel 2018). A lack of long-term strategy from consecutive governments and a view that the industry has been stuck in a process of managed decline has reduced industry morale. Yet despite these challenges, The UK's steel industry remains a crucial foundational industry and today, UK-based manufacturers produce enough high-quality steel to meet most the UK's steel needs.

However, new opportunities now await the steel industry. The need to decarbonise our economy by 2050 will require a fundamental rethink of industry, but potentially, this transformation will provide an opportunity for northern steel to become a world leading, low-carbon industry. Not only will this transition to low-carbon production help preserve the many jobs that steel brings to the North, it will also create new demand for UK steel and allow the industry to grow and create new jobs.

The moment for change in both our perception of the industry and our need to decarbonise is now urgent. Other countries have already begun to decarbonise their steel industry. The faster the UK moves to transform the industry, the more likely it is to be a market leader. With the requirement to reduce carbon emissions now enshrined in law, the question is no longer a matter of if, but a question of how the industry can best decarbonise.

This report outlines a vision for decarbonising northern steel. To understand the challenges and opportunities facing the industry, three roundtables were held with key industry experts. Following this, a literature and policy review was conducted, as well as an analysis of the available data on steel industry in the north. The findings of this report are translated into key recommendations for achieving this vision for a transformed low-carbon steel sector in the north of England.

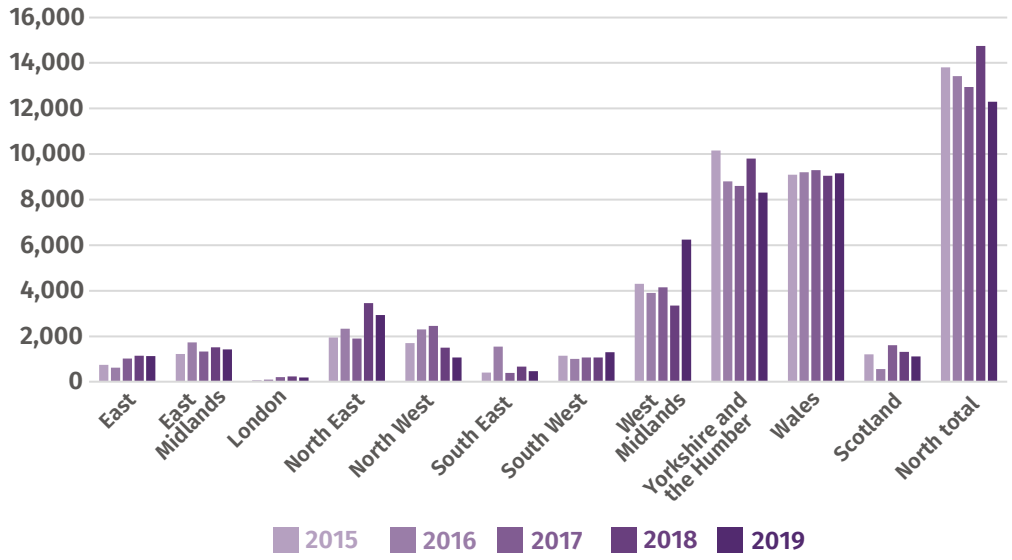
1.
NORTHERN STEEL MATTERS

The steel industry is a significant employer in the north of England. The industry has remained both a valuable economic asset (Rhodes 2018) and an important cultural institution (Nayak 2019) across the North's regions. However, it is important to recognise that the industry has also faced significant challenges since the 1980s, with the most recent crisis occurring as a result of foreign competitors, notably China, flooding the market with cheap discounted steel (Hudson 2017). Since its peak employment in 1971, the industry in the UK has seen a gradual decline in the total number of people it employs reduced from over 320,000 to approximately 32,000 by 2016 (Rhodes 2018). Alongside direct employment, the UK's steel industry employs approximately 52,000 people through its supply chains and contributes over £2 billion directly to the UK economy (UK Steel 2019). Future market opportunities worth over £3.8 billion a year could be available by 2030 (ibid).

While there has been a gradual decline in the number of people working directly in the steel industry since the 1980s, the steel industry in the North still directly employs a significant number of people, with approximately 12,000 people employed in steel production jobs as of 2019 (NOMIS 2020).

FIGURE 1.1: THE STEEL INDUSTRY CONTINUES TO BE A SIGNIFICANT EMPLOYER IN THE NORTH OF ENGLAND, PRIMARILY IN YORKSHIRE AND THE HUMBER

Employees in the UK steel industry by region



Source: NOMIS (2020) BRES survey data SIC codes 241, 242 and 243. These codes include primary and secondary production, including steel processing.

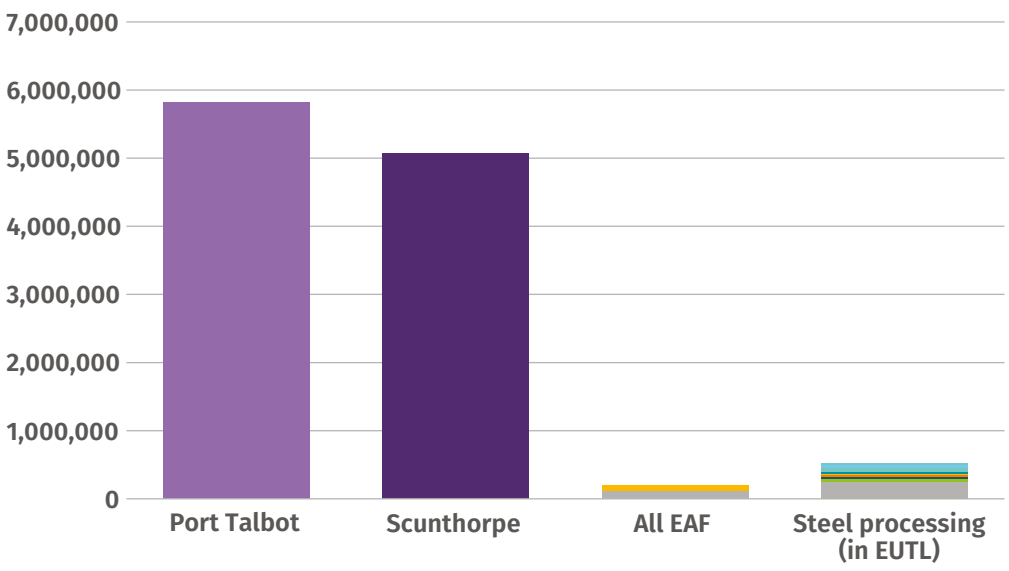
In the north of England, sites such as British Steel, Liberty Steel, and Sheffield Forgemasters are significant local employers in Scunthorpe, Rotherham, and Sheffield respectively. In Scunthorpe alone, the British Steel plant directly employs 3250 workers (Ember 2020). As a result, northern steel actively underpins much of the local economy in these areas.

THE NEED FOR AN INDUSTRY TRANSFORMATION

While the steel industry makes a clear contribution to North's economy, it faces significant challenges in terms of expanding its output, improving competitiveness and decarbonising its manufacturing processes. International markets are particularly competitive, and steelmakers are often operating along tight profit margins (BEIS 2020). Competitive industry is the sum of its parts. It needs to be underpinned by long-term strategy and vision, with significant investment in innovation and R&D. Successful industry should offer well-paid jobs, with clear opportunities for progression. Efforts should be made to ensure the domestic procurement of industry goods, while the quality of the final product and strategic trade policy create international demand and reduce export barriers. To date, the industry has been let down by a lack of long-term planning and industry investment. This is coupled with little attempt to create market opportunities for UK steel.

Steel remains a very carbon intensive industry and a significant amount of steel is still produced using carbon intensive blast furnaces (Ember 2020). The UK's two remaining blast furnace sites are located at Port Talbot in South Wales and Scunthorpe in North Lincolnshire. These contribute significantly to the industry's total emissions.

FIGURE 1.2: NOT ALL STEEL PLANTS CONTRIBUTE EQUALLY TO THE UK'S EMISSIONS – PORT TALBOT AND SCUNTHORPE ACCOUNT FOR MORE THAN 90 PER CENT OF UK STEEL EMISSIONS



Source: Ember (2020)

With the challenge of decarbonisation comes an opportunity to recast UK steel as a world leading supplier of high-quality steel. Ultimately, a more specialised industry that is less likely to attract high carbon taxes will give the UK industry a competitive advantage over other countries. At the same time, new methods can further increase the productivity of UK steel so that the UK's needs are met alongside strong export demand from foreign markets. The development of the industry in this way can bring significant benefits to the North, contributing to the creation of new low-carbon jobs and ensuring that steel remains a vibrant part of the North's cultural heritage. With the prospect of carbon pricing ramping up in the years to come, now is the time for the industry to be supported in its transition to net zero (Bloomberg 2021). Without this transition, it risks being diminished as a profitable and competitive industry.

ENSURING A JUST TRANSITION

Bringing about the decarbonisation of the steel industry is not just about creating a world leading, competitive industry. Ensuring its transition is important both for safeguarding existing jobs and creating new ones. The North is already leading the way in transforming the steel industry, with the £75 million Zero Carbon Humber bid a clear indication that the North's steel producing regions want to accelerate the drive to net zero (British Steel 2020).

The transition to a low-carbon economy will fundamentally change how work is carried out across industry sectors. Changes in manufacturing technique are likely to result in some jobs changing or moving elsewhere in the steel making process. A managed transition will be needed to ensure that people retain jobs where possible or find new jobs in the wider industry, and that the creation of a cutting-edge industry also provides new economic opportunities in specific areas like Teesside and South Yorkshire.

A just transition requires maintaining and improving working standards and wages; it cannot erode them. Across the North, current skills training falls behind other regions, with more people only being qualified up to NVQ level 1 or 2 (Johns et al 2020). Raising education and skills provision across the North will be vital for creating the workforce pipeline that future low-carbon industries like steel need.

Early evidence from IPPR's citizens juries suggests that a just transition is important to people in the north of England. Jurors from across Tees Valley and County Durham concluded that the response to the climate and nature emergency must be fair, with a priority placed on creating a national blueprint for low-carbon work. Under this national plan, local industrial strategy must be formulated that ensures the North benefits from future low-carbon jobs (IPPR 2021).

WHY A FUTURE FOR STEEL MATTERS FOR LEVELLING UP

The government's levelling up agenda represents an opportunity to ensure that manufacturing industries like steel can help support both decarbonisation and economic prosperity in the north of England. However, without a clear vision for the industry's future, there is a danger that the slow death of the industry could level down prosperity and opportunity in places like Scunthorpe, Hartlepool, and Rotherham.

One of the key barriers to progress is that the power to support the industry rests largely with central government. While a supportive national framework is important, currently, combined and local authorities have only limited powers and resources to intervene to support steel in their areas as table 1.1 illustrates.

TABLE 1.1: POWER TO SHAPE THE MAJOR POLICY DOMAINS TO DEVELOP INDUSTRY AND SUPPORT LEVELLING UP REST OVERWHELMINGLY WITH CENTRAL GOVERNMENT

Policy domain	Importance for industry	Role in levelling up	Central government powers	Role of combined and local authorities
Industrial policy	Determines where industry will be concentrated and how different businesses and industrial clusters will be integrated into the wider economy.	**Creating prosperity:** Supports foundational industry that contributes to regional GVA. Supports high skilled and well-paid jobs. Creates further employment in industry supply chains.	UK government determines industrial strategy and shapes decisions around funding for industry. Its prioritisation of industry can determine the willingness of businesses to perform R&D.	Local and combined authorities' involvement in local enterprise partnerships (LEPs). Economic development teams can provide supportive conditions for investment, including infrastructure support.
Adult education and skills	Securing workforce pipelines and meeting local labour market needs.	**Equal opportunity:** Ensures opportunity and access to good quality work in the labour market is widely available and distributed fairly across the country.	UK government determines education and skills budget and coordinates national qualifications framework. Pre-adult education and careers advice overseen by schools.	Devolution of adult skills underway in some combined authorities (Raikes 2019).
Stimulating market access and demand internationally, nationally, and locally.	Creating domestic demand for produced goods and ensuring export opportunities exist.	**Creating prosperity:** Brings value into the local economy by creating world leading business. Promotes wealth circulation and inclusive growth.	UK government produces procurement guidance and steers procurement for major infrastructure projects. Exit from the EU ensures that UK government is solely responsible for determining trade deals and creating export opportunities through Department for International Trade.	Combined and local authorities can use procurement policy to drive up standards and secure local economic/ social benefit. Planning authorities may be able to influence markets through specific low-carbon planning policies.
Steering investment	Vital for supporting R&D development of low-carbon technologies.	**Creating prosperity:** Government investment in industry can help leverage further private investment. Ensuring a fairer regional distribution of investment in industry development can boost economic growth, create jobs, and close regional divides.	R&D investment highly influenced by industrial strategy, which is formulated and implemented by UK government.	Local and combined authorities can use economic development and investment teams to develop business cases and attract private R&D investment, as well as working alongside LEPs to support business development.

Source: Author's analysis

The importance of foundation industries like steel has not always been understood. For example, there was no reference to steel in the government's 2016 Northern Powerhouse Strategy (HMT 2016). However, recent announcements from government including plans to create a new economic campus at Darlington potentially provide a fresh opportunity to refocus investment in the North and its industrial assets. The North's major industrial clusters currently generate approximately 18 $MtCO_2$ emissions per year as of 2017 (BEIS 2017). The shift to net zero must transform these clusters and in doing so, safeguard the long-term competitiveness of northern industry, including steel. Doing so is vital for supporting jobs and businesses in towns and cities across the North.

A targeted strategy that focusses on building a low-carbon economy around existing industrial clusters could provide much needed substance to the rhetoric of levelling up. Securing the future of northern steel will also be vital in helping the North recover from the social and economic damage of Covid-19. Industrial areas with a history of heavy manufacturing have been hit hard by the pandemic. In these areas, many of which are in the north of England, the number of people receiving universal credit as an in-work top-up has doubled since the start of the pandemic (Beatty and Fothergill 2021). Many areas have also seen significant rises in unemployment, with 2020 unemployment levels at the highest they've been for 25 years (Johns et al 2020).

Ensuring the steel industry gets through the current economic challenge is not enough. We need to ensure the industry is resilient, and is able to achieve its potential as a vital part of the North's future low-carbon economy.

2.
A PLAN FOR DECARBONISING STEEL

In this chapter, we examine the pathways to decarbonise steel including costs, impacts, emissions, and potential implications for employment. Our analysis primarily draws on discussions that took place during three IPPR North roundtables on the topic of decarbonising steel, as well as the CCC's Net Zero Pathway for manufacturing and construction (CCC 2020a).

Current methods of steel production explained

The main steel production methods currently deployed in the UK are the blast furnace-basic oxygen furnace (BF-BOF) method of production and electric arc furnace production (EAF).

BF-BOF production uses oxygen to convert a charge of blast-furnace iron and scrap into steel. Carbon is necessary to separate iron from oxygen. This requires coal to be converted into coke as the primary reducing agent. The UK's two major steel plants – Port Talbot and Scunthorpe – use this method. While they produce the largest output of steel, they also produce the highest level of emissions.

EAF technology is already low-carbon. It uses high-current electric arcs to melt steel scrap and convert it into liquid steel. Because EAFs produce steel from high-quality steel scrap, they can achieve high levels of resource efficiency and re-use when compared to BF-BOF production. Because EAFs use a different production method and require different furnace inputs, retrofit is usually needed to convert BF-BOF plants to EAF production.

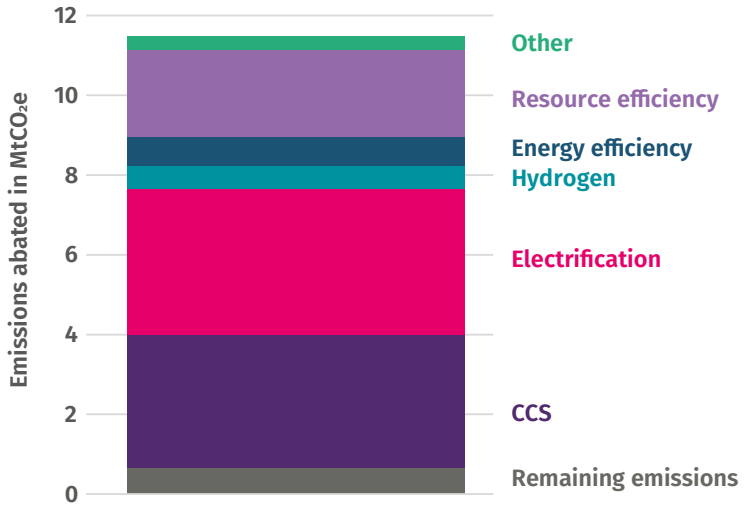
A SECTOR PATHWAY FOR DECARBONISATION

The CCC's sixth carbon budget provides a sector decarbonisation pathway for the manufacturing and construction industry, within which sits the steel industry (CCC 2020a).

The CCC sector pathway outline a major role for resource efficiency, electrification, hydrogen and carbon capture and storage (CCS). These key technologies are analysed in this chapter. The full mix of technologies and measures is detailed in figure 2.1.

FIGURE 2.1: A MIX OF DIFFERENT TECHNOLOGIES AND ACTIONS WILL BE NEEDED TO REDUCE EMISSIONS ACROSS DIFFERENT INDUSTRY SECTORS, INCLUDING IRON AND STEEL

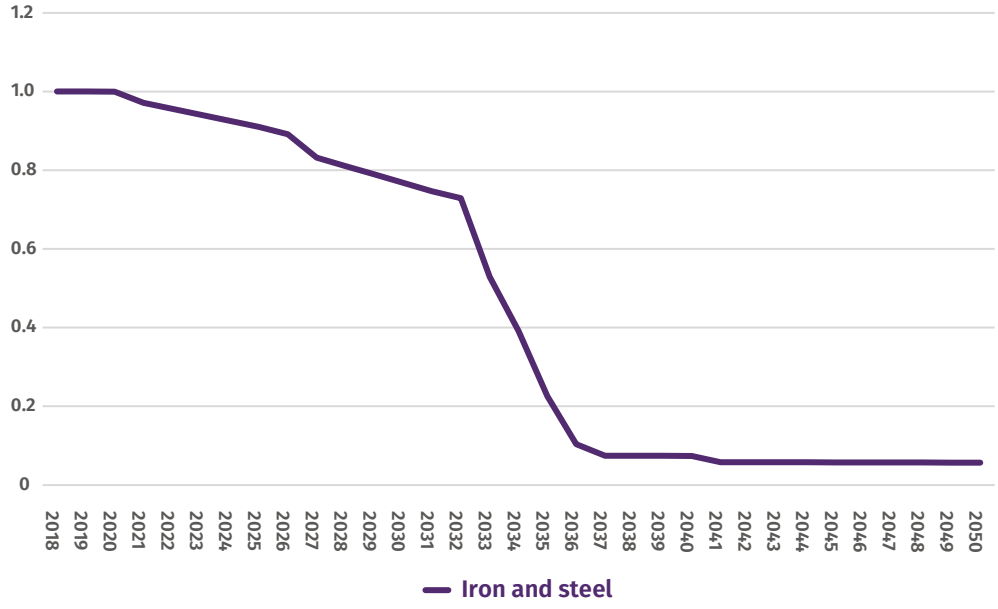
Abatement in $MtCO_2e$ unlocked by different abatement methods for iron and steel as proposed by the CCC



Source: CCC (2020b)

FIGURE 2.2: RAPID DEVELOPMENTS IN TECHNOLOGY COULD ALLOW THE UK'S STEEL INDUSTRY TO ABATE MOST EMISSIONS BY THE MID-2030S.

Abatement strategy applied to iron and steel subsector, with impact on annual emissions as proposed by the CCC (normalised to annual subsector baseline)



Source: CCC (2020b)

As figure 2.1 illustrates, the biggest gains in emissions reduction within the iron and steel industry will come from a combination of resource efficiency, electrification, CCS and hydrogen. A mix of technological solutions is required because no single solution offers a panacea; each technology comes with its own benefits and weaknesses. The following sections will look at each of these different options to understand how they might be applied to decarbonise northern steel.

TABLE 2.1: A MIX OF TECHNOLOGIES WILL BE NEEDED TO DECARBONISE THE NORTH'S STEEL SECTOR

The mix of technologies outlined in this chapter and their role in helping decarbonise the steel sector

Technology	Role in decarbonising steel
Resource efficiency	Allows steel producers to make more with less. Better use of resources and the use of recycled materials wherever possible minimises the need for producing primary materials through carbon intensive methods.
Electrification	Essential for expanding energy infrastructure to increase accessibility to electricity. This is needed for EAF production and for creating electrolysis to produce hydrogen. Electrification processes should also aim to expand the generation of energy from renewables and reduce energy costs to industry.
Hydrogen	Hydrogen has been identified as a replacement agent for BF-BOF steelmaking in bigger steel plants that may face significant costs and challenges in adapting to EAF production using scrap. The carbon emissions from hydrogen produced using natural gas will need to be captured. In the long run, the aim should be to produce as much hydrogen as possible through electrolysis. This avoids the need for natural gas and could be used to produce direct reduced iron that can be used in EAFs.
Carbon capture and storage (CCS)	CCS can be used to capture emissions from BF-BOF steel production. However, we anticipate (see next chapter) CCS' main use will be to capture the emissions from the production of hydrogen and to capture emissions from smaller processing sites.

Source: Author's analysis of CCC (2020a)

RESOURCE EFFICIENCY

Resource efficiency involves using resources more effectively and recycling materials where possible to reduce the primary production of materials through carbon intensive methods. Over the pasts several decades, the steel industry has significantly improved its resource efficiency (Carmona et al 2019). Because significant gains have already been made, the potential abatement of emissions from resource efficiency will likely be maximised by the late 2020s. Until then, efficiency gains are likely to come from greater use of scrap steel in steel production methods (ibid, CCC 2020b).

Other abatement solutions will have to play a key role in reducing emissions beyond the 2020s once resource efficiency has been maximised. This is largely recognised by the steel industry, with industry experts acknowledging that while improved efficiency has resulted in much of the gains to date, further decarbonisation will not be possible without the deployment of new technologies at scale.

ELECTRIFICATION

Electrification of the industry will come about primarily through the wider adoption of Electric Arc Furnaces (EAFs). In the North, EAFs are currently in use at Liberty Steel in Rotherham, Sheffield Forgemasters, and Outokumpu in Sheffield (Ember 2020). Internationally, other countries have also pursued EAF production, with approximately 60 per cent of US steel now produced through EAF methods (Seetharaman 2016). The CCC's pathway suggests electrification will deliver the largest reduction in emissions for the steel industry.

Stakeholders in the North are optimistic about the benefits that will come with the widespread adoption of EAFs as a low-carbon solution. Steel production in Sheffield and Rotherham provides a clear example for the industry of how the technology can be effectively deployed. However, there is also substantial concern about the current cost of energy for industry (see 'UK energy prices' box). Additional concerns have been expressed about the impact of EAF uptake on employment. Trade unions for example have suggested that the use of EAF technology at Port Talbot will require fewer workers, reduce output, and ultimately result in less direct employment at the steelworks (Pooler and Pickard 2020).

These concerns could be answered by ensuring that the transition is underscored by a commitment to ensuring that every carbon intensive job in the industry is replaced by at least one low-carbon job either directly in industry or in its wider supply chain. Ultimately, a more productive and competitive industry can allow the UK not just to meet its own domestic steel needs, it can also ensure that northern steel plants are able to compete internationally as pioneering suppliers of low-carbon steel. EAF technology can play a key role in achieving this.

UK energy prices: A key barrier for decarbonising steel

Energy costs for industry are a key barrier to widespread electrification. This was repeatedly referenced in our roundtable discussions as the most significant barrier holding back both the widespread adoption of EAFs and limiting the current capacity of the industry to be cost-effective and competitive. In 2018/19, the average electricity price for UK steel producers reached £65 per megawatt hour (MWh), comparted to £43/MWh in Germany and £31/MWh in France (UK Steel 2018). This price disparity equates to £55 million per year when compared to Germany and increases operating costs, while ultimately reducing the industries competitive edge (ibid).

Reducing the cost of electricity for industry will require looking at the market factors that increase costs, such as demand and how much energy is imported from outside the UK, and increasing generation capacity. Over time, as the UK generates more of its energy requirements from renewables, industry costs are likely to decrease; the price of renewables has already fallen rapidly over the past decade and will continue to do so (Carbon Brief 2020). The UK is also home to expansive wind and solar resources, which will, in the long run, make electrification a viable and cost-effective route for decarbonisation (CCC 2020c). The increased need for electricity both in an industrial and domestic setting over the next decades will also require expanding grid capability (ibid). Consequently, electrification in the steel industry will need to be joined with efforts to expand the use of renewables and the energy grid's capability to meet increased demand.

HARNESSING THE POWER OF HYDROGEN

Developing the North's hydrogen economy is integral to decarbonise its transport, industry and to a lesser extent heat from buildings. As part of developing the hydrogen economy, the North needs to accelerate the roll out of necessary infrastructure such as distribution networks, while the use of hydrogen scales up alongside other decarbonisation technologies (CCC 2018). Furthermore, as grey hydrogen production requires natural gases, the development of green hydrogen from renewable energy sources will need to be accelerated to ensure that hydrogen remains a viable decarbonisation route (IEA 2019).[1]

Hydrogen is anticipated to be a relatively small part of the CCC's proposed abatement pathway for the steel industry. Hydrogen, unlike the use of EAFs, is not currently an onstream technology. In industry, its adoption will depend on the development of wider hydrogen infrastructure to reduce costs, with the relevant networks for supplying hydrogen technology being relatively underdeveloped (CCC 2020d).

Moving from blue hydrogen to green hydrogen production will require pursuing ambitious electrification plans (Baxter 2020). In Sweden, low energy prices and a surplus of hydropower have made hydrogen-based production a reality, but neither of these conditions are currently present in the UK. For this reason and following the CCC's pathways (CCC 2020d), hydrogen will initially need to be used in significant configuration with CCS technology to capture the emissions from production (blue hydrogen production). In the long term, hydrogen production will also benefit from electrification.

There is optimism within the industry that hydrogen can play a key role in decarbonising production. Hydrogen-based direct reduction of iron (DRI) could be used in EAF production (ibid, McKinsey 2020). Ambitious plans to create 'hydrogen economies' in areas such as Merseyside, Tees Valley, Leeds, and the Humber could rapidly bring hydrogen technologies onstream in the next few years, increasing its role in decarbonising steel production (CEN 2020).

CARBON CAPTURE AND STORAGE

Carbon capture and storage (CCS) involves capturing the carbon dioxide emissions from industrial processes and storing them deep underground in geological formations. CCS will be crucial for capturing industry emissions and the £1 billion committed for various CCS technologies (to be applied across all manufacturing industries) will be pivotal in scaling up the technology from 2025 (CCC 2020d). Local government and business leaders in the North had previously developed CCS plans for industry and the energy sector. However, the government scrapped its CCS competition scheme in 2015 (BBC 2017). As a result, significant efforts will need to be made to rebuild trust in future commitments to the use of CCS.

Our discussions with the steel sector revealed that CCS is perceived as advantageous. Unlike other technological solutions, it reduces the need to change existing industrial processes as carbon is captured from current modes of production. However, as with any technology it does not offer a panacea. Furthermore, as a technological solution, there are additional considerations attached to the widespread uptake of CCS by the steel industry.

Because CCS requires appropriate sites to store emitted carbon dioxide, storage sites would need to be located close to existing steel works to reduce transport need and be logistically viable. Earlier research has suggested that industry located near the North Sea, such as steel producers in the North

1 Hydrogen produced from natural gasses is often termed 'grey hydrogen'. The process of capturing the excess carbon from this process is referred to as blue hydrogen production. Green hydrogen production involves using electrolysis to break water into component elements of hydrogen and oxygen. Unlike grey or blue hydrogen production methods, it is not dependent on the use of natural gases.

East and Humber region, are most likely to benefit from the potential of CCS (ECC 2015). CCS will also be necessary if plans are made to expand the use of hydrogen production within the steel industry. Until green hydrogen can be produced, the emissions from grey hydrogen will need to be captured.

CCS is identified by the CCC as a key technology that will enable the industry to decarbonise and is viewed positively by stakeholders in the North (CCC 2020d). CCS is also a favoured technology in regional decarbonisation plans (such as Zero Carbon Humber) because it will be considerably cheaper than deploying some new technologies in heavy industry. The Humber and North East could benefit from CCS due to their proximity to possible storage locations in the North Sea. Overall, CCS effectiveness will be dependent on its coupling with other technologies and efforts to drive down demand for fossil fuels. We subsequently envisage a smaller role for it alongside hydrogen production in chapter 3.

A TIMELINE FOR DECARBONISATION

No single technological solution will be able to decarbonise the North's steel industry on its own. A blend of measures will be needed, and different technological pathways will need to be accelerated and deployed at different moments in time. The indicative timeline below summarises the appropriate moment for scaling up each technology.

Some technologies are ready now. For example, resource efficiency is already being deployed and can be scaled up. Similarly, electrification is 'tech ready' as electric arc furnaces are already in operation. In contrast, hydrogen and CCS solutions are still developing, albeit at a rapid pace. Investing in their development now and beginning the expansion of infrastructure upgrades to deliver hydrogen and transport captured carbon for storage will take considerably longer.

TABLE 2.2: A MIX OF TECHNOLOGIES WILL NEED TO BE DEPLOYED TO DECARBONISE THE STEEL INDUSTRY

Estimated timescales for technological solutions to be achieved and required policy levers

Timescales	Technology	Policy levers
2020–30	Resource efficiency	Use existing technologies and modern methods of working to improve resource efficiency and drive-up industry productivity.
2020–30	Electrification	- Begin expansion of energy generation from renewables. - Initiate policies to bring down energy costs for industry. - Expand capacity of the grid. - Provision of support to steelmakers to construct new electric arc furnaces where needed. - Devise circular economy plan for scrap steel.
2023–40	Hydrogen	- Scale up production of blue hydrogen. - Develop infrastructure in parallel with CCS solutions. - Develop hydrogen technology to reduce dependence on natural gasses and produce hydrogen primarily through electrolysis. - Provide means to deliver hydrogen in significant quantities to steelmaking industry for use in the DRI process.
2023–40	CCS	- Identify appropriate sites for CCS. - Development of hydrogen infrastructure in parallel. - Build infrastructure for transporting and disposing of captured carbon. - Ensure steel plants have the means to capture carbon effectively where necessary.

Source: Author's analysis

3.
A NEW ERA FOR THE STEEL INDUSTRY IN THE NORTH

This chapter outlines specific decarbonisation pathways for the major steel producing regions of the North. These proposed pathways draw heavily on the CCC's overall strategy for abatement, while also making specific place-based recommendations based on which technological solutions are likely to maximise emissions reductions and secure future jobs. We focus on the North's major steel producing clusters across South Yorkshire and Derbyshire, the Humber, North Yorkshire[2] and North Lincolnshire, and the North East.

A NEW ERA FOR NORTHERN STEEL

Our analysis sets out a vision for decarbonising the major steel-producing clusters in the north of England. By adopting this vision, the UK government can show its commitment to northern steel. Our vision shows that steel is not just an industry of the past; it remains integral to the UK's future.

Across the identified cluster, jobs will be secured both through the direct employment of existing and new workers in upgraded electric arc furnaces, as well as through the possible deployment of hydrogen and CCS technologies. Alongside these major technologies, all the analysed clusters will need to pursue greater resource efficiency.

While there are clear benefits to be gained from transitioning the industry, a 'one size fits all' approach will not work. The North's steel industry is diverse and different regions will require different solutions based on the configuration of their current steelmaking facilities and natural geography, and the development of their wider low-carbon economy.

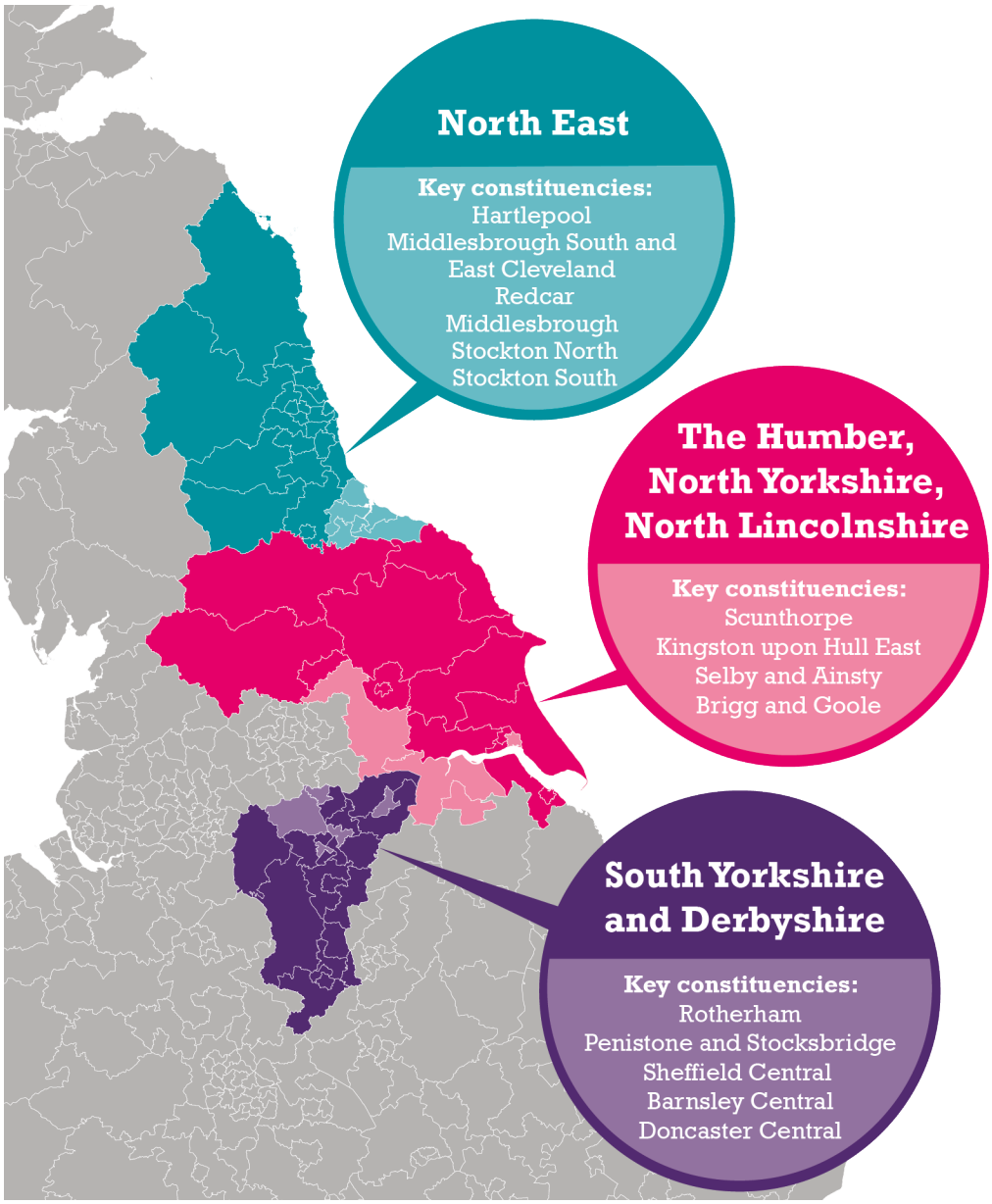
SOUTH YORKSHIRE AND DERBYSHIRE

Steel plants operated by Sheffield Forgemasters and Liberty Steel in Rotherham are already operating electric arc furnaces (EAFs) (Hall and Box 2018). A clear commitment exists to harnessing this technology, with Liberty Steel alone committing £60 million over the next few years to improve output from its Rotherham plant (PES 2020). To improve capacity in the South Yorkshire region, further investment will be needed. Any investment must also consider the strong likelihood that CCS will need to be applied to smaller processing facilities in the region, such as the Stocksbridge works (Element Energy 2020b).

With additional support through government backed loans to help further develop capacity, the major steelmaking plants in South Yorkshire and Derbyshire can lead the way in making the most of tech-ready solutions. The quicker they can improve their production capacity and ensure that their scrap steel needs are met, the more likely they are to make the most of domestic and international market opportunities. Further policy measures will be needed to help bring down the cost of energy for industry. Local industrial strategy will need to be developed to ensure that low-carbon steel is used in traditional and advanced manufacturing industry.

2 We use North Yorkshire County Council as the NUTS 3 region. Hartlepool, Stockton-on-Tees, South Teesside and Darlington are included in the North East cluster.

FIGURE 3.1: DECARBONISATION ACTIVITY SHOULD BE FOCUSSED ON STEEL PRODUCING INDUSTRIAL CLUSTERS IN SOUTH YORKSHIRE, DERBYSHIRE (PURPLE), THE HUMBER, NORTH YORKSHIRE, NORTH LINCOLNSHIRE (PINK) AND NORTH EAST (BLUE)



Source: Author's analysis

The development of the UK's hydrogen economy could also benefit steel producers in the region. Early trials suggest that direct reduced iron could also be used alongside scrap in EAFs (MP 2017). This would help overcome any potential difficulties in procuring the quantity of high-quality scrap needed for EAF production and would further increase regional output (McKinsey 2020).

Overall, because the region has already implemented EAF technology, the efforts of government and industry should focus on increasing production rates and creating demand for low-carbon steel produced in the region. This will require reducing the cost of energy for industry and pushing ahead with other electrification measures.

THE HUMBER, NORTH YORKSHIRE, AND NORTH LINCOLNSHIRE

The Zero Carbon Humber partnership is pursuing a roadmap for decarbonisation that emphasises the use of CCS and hydrogen (Zero Carbon Humber 2021). The proximity of this cluster to the North Sea, combined with the development of the wider hydrogen economy in the region, would allow steel producers to pursue a mix of CCS and hydrogen technologies. In terms of steel production, hydrogen-based production should be the ultimate goal, with CCS used to capture fossil fuels from the process of hydrogen production.

The British Steel plant in Scunthorpe is one of the UK's two remaining blast furnace sites, with the other being located at Port Talbot. Scunthorpe is significant both in terms of its production output and the fact it employs around 3,250 workers (Ember 2020). Its strategic location close to the North Sea means that with the right support and development of hydrogen infrastructure, the plant can shift to hydrogen-based production. CCS could also be used to capture emissions from steel processing at smaller sites where the use of hydrogen is not possible. In the long run, switching from basic oxygen steelmaking to the use of hydrogen will provide a much more sustainable and long-term solution for the Scunthorpe plant than a solution that focusses only on CCS. Its wider deployment will require rapidly accelerating the development of hydrogen technologies. The ultimate aim should be to develop the use of green hydrogen for use in steel production.

To develop this pathway, CCS and hydrogen technologies will need to be significantly scaled up in the years to come. Because these technologies are still developing, it is also important to acknowledge that this pathway is not as certain as one based on electrification. EAFs using scrap steel would represent an alternative pathway that uses a proven technology and is already effectively used by steelmakers in South Yorkshire. The main barriers to the deployment of EAFs include the costs of converting blast furnaces, potential shortfalls in the domestic and international scrap market and the risk to jobs posed by the more fundamental upheaval in production methods. For these reasons, we propose a hybrid solution that uses hydrogen in combination with EAF production.

Agile green steel: hybrid low-carbon production at Scunthorpe

The steel plant at Scunthorpe produces most of the North's steel industry emissions. The process of enabling low-carbon production in Scunthorpe would have three phases.

In line with previous plans mooted for the steelworks, EAF technology could be added to the site to create a hybrid setup (Metal Bulletin 2017). In the short-term, this would allow the plant to produce steel from scrap, while ongoing efforts are made to develop hydrogen technologies.

Towards the end of the 2020s, hydrogen technology is likely to be available. In the first instance, some blue hydrogen could be directly inputted into the blast furnaces. More significantly, hydrogen can be used as a reducing agent in the direct reduction of iron (DRI). Direct reduced iron could be melted in an EAF (McKinsey 2020). As blue hydrogen requires natural gas for production, some CCS technology will also need to be scaled up from the beginning of the 2030s to capture carbon from production. This phase would enable hydrogen to be used in tandem with blast furnace technology, while EAF production takes place in parallel.

By 2035, green hydrogen could be used widely in the plant. Green hydrogen is carbon free and can be used as the sole reducing agent in the direct reduction of iron (DRI). This direct reduced iron could be widely used with EAF technology to produce steel (Bellona 2021, McKinsey 2020).[3] Eventually, the blast furnaces could largely be replaced with EAFs and the steelworks could have a hybrid setup. It would focus on producing the majority of its steel through green hydrogen direct reduced iron and scrap steel in EAFs.

This strategy has significant advantages. First, it could almost entirely remove carbon emissions from steel-making processes by the mid-2030s. Second, it provides a low regret option. The use of direct reduced iron in EAFs would overcome any shortfalls that might exist in the scrap steel market, produce high quality steel and could sustain high levels of production. Third, while this route may have initial costs, the widescale use of green hydrogen would build demand for and leverage the North's future hydrogen economies.

To transform the Scunthorpe steelworks, further electrification in the form of EAFs and the development of hydrogen will be crucial. These requirements are reflected in the overall mix of technologies needed to decarbonise Northern steel and their corresponding costs are outlined in chapter 4.

Ultimately, different combinations of electrification, hydrogen and CCS could achieve similar decarbonisation results. Each combination has strengths and weaknesses. However, current plans for the region appear to favour a combination of hydrogen and CCS to decarbonise heavy industry. This is due to the likely supply of hydrogen close by and the development of CCS facilities in the North Sea that can make this pathway a cost-effective option (Zero Carbon Humber 2021, CCC 2020a). Our vision emphasises a mix of hydrogen and EAF production as the most effective route for decarbonising this cluster.

In summary, a combination of electrification and hydrogen, supported with the use of some CCS, could offer a sustainable long-term solution.

NORTH EAST

The North East represents the third most significant steel industry cluster and includes several notable processing plants in Middlesbrough and Hartlepool. With the closure of the British Steel plant in Redcar, no blast furnaces are operating in the region. However, plans have been mooted to restart production at Teesside, with the installation of new EAFs (Steel Orbis 2020). This proven low-carbon technology will increase demand for scrap in the short-term and will likely offer a significant production boost to the region.

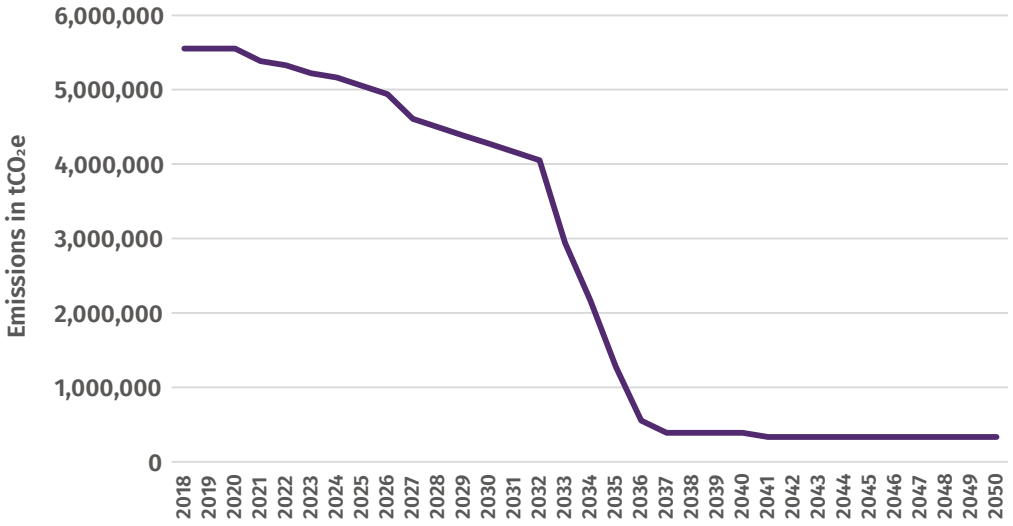
Because scrap can increasingly be used as part of the production process in blast furnace-basic oxygen furnaces (all be it at a rate of 15–20 per cent), it's also likely to find demand in the short-term, helping to drive up resource efficiency across the industry in other regions of the UK (IEA 2020, McKinsey 2020). For this reason, exploring how scrap can be generated in greater quantities will be vital for kickstarting steel production in the North East. Alongside this, exploring how residual emissions can be abated from the region's processing plants will likely require driving up resource efficiency, deploying CCS and accelerating the pace of electrification.

3 This technology is currently being tested in the HYBRIT steelworks in Sweden (HYBRIT 2021).

The North East can play a vital role the North's low-carbon future. To do so, plans to develop new EAFs on Teesside must be realised. In addition, the region's proximity to the North Sea means it can support other regions by producing hydrogen and providing CCS storage. Strong political support for low-carbon industry has been expressed from metro mayors in the Tees Valley and North of Tyne. A new Teesside Taskforce has also been established by the UK2070, which is examining a revitalisation of the steel industry in the area (UK2070 2020). In addition, the government's commitment to the economic campus in Darlington and the expansion of freeports in the region provides new momentum to think about how the North East can develop a low-carbon steel industry.

FIGURE 3.2: THE PROPOSED STRATEGIES DEPLOYED ACROSS THE IDENTIFIED CLUSTERS WOULD DELIVER SIGNIFICANT EMISSIONS REDUCTIONS BEFORE 2035, WITH THE BULK OF DECARBONISATION ACHIEVED BY 2036

Projected emissions from northern steel in tCO_2e under proposed abatement strategy



Source: IPPR analysis using existing emissions data from Ember (2020)

4. POLICIES TO SUPPORT DECARBONISING AND INDUSTRY GROWTH

This chapter outlines the policies needed to support investment in the industry, expand R&D, ensure the transition is just, and create future market opportunities. This mix of policy measures is needed to ensure the steel industry can decarbonise and increase demand for low-carbon steel produced in the North.

INVESTING TO DECARBONISE THE INDUSTRY: CORE COSTS

New funds such as the £170 million Industrial Decarbonisation Challenge Fund and the planned £250 million Clean Steel Fund will enable industrial clusters to accelerate their decarbonisation efforts (BEIS 2021b). These funds are part of the UK Government's Industrial Decarbonisation Strategy (HMG 2021). However, current funding will need to be significantly ramped up. In addition, the government's plans to increase R&D spend to 2.4 per cent of GDP by 2027 won't be realised without additional public R&D expenditure to crowd-in additional private investment (Parkes 2019).

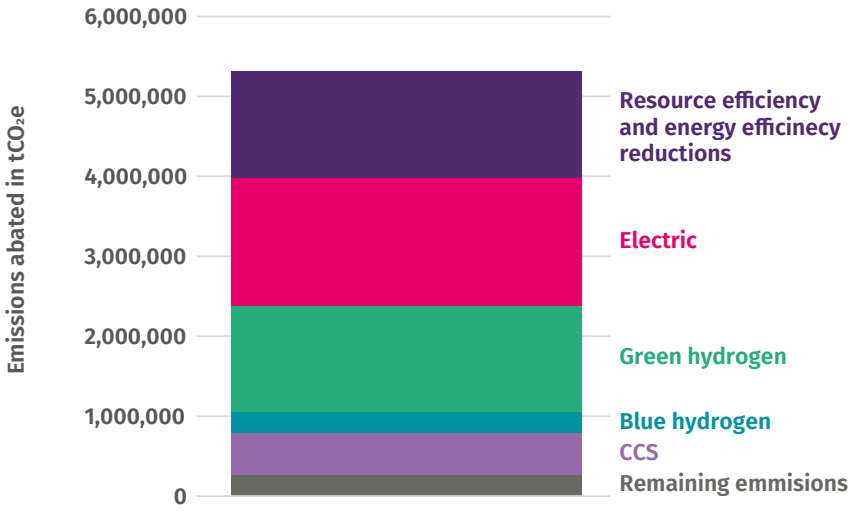
We estimate that the annual cost for cutting emissions to near zero in the North's steel industry would be approximately £267 million by 2050.[4] In practice, if these costs are spread over the lifetime of the investment, the annual cost will likely be lower earlier on as fewer emissions are abated. As more emissions are abated through the 2030s, the costs will be affected by increased abatement, carbon value trajectories, potential changes in low-carbon fuel costs and other technological developments. The cost in 2050 represents how much the annual cost will be in that year for applying our strategy and continuing abatement. In practice the speed of decarbonisation will be determined by industry action. Our analysis suggests that with the right action, decarbonisation could accelerate in the 2030s, abating most emissions by 2036 (see figure 3.2). We provide a 2050 cost in line with how others have presented an annualised cost (CCC 2019, 2020a; Element Energy 2020a).

Our estimates represent the annual cost in 2050 for decarbonising northern steel. Given that the Humber, North Yorkshire, and North Lincolnshire industrial cluster is currently the greatest source of emissions, funding will need to be targeted more acutely at this cluster in practice. The South Yorkshire and Derbyshire industrial cluster has already accelerated efforts to decarbonise and the concentration of processing facilities in the North East cluster means that these regions contribute significantly less by way of emissions. Subsequently, the cost of achieving net zero would be significantly lower in these areas (see figure 1.2).

4 To model these costs, we first retrieved the available emissions data for Northern steel (Ember 2020) and used this to establish baseline emissions in line with the CCC's approach (2020d, 2020e). This established a counterfactual scenario for 2050, where no action on climate has occurred. We used a best estimate of the abatement cost per ton of CO_2e using available data from Element Energy (2020a) and the CCC (2018, 2020e). These estimates and the cost assumptions made remain highly uncertain and subject to significant changes as technologies develop and policies change. Hydrogen costs are the most uncertain and estimated costs could change significantly. Our assumptions assume a much bigger role for green hydrogen in the North when compared to the CCC's pathway in figure 2.1. We include methane management and the capture of emissions from blue hydrogen production and use in our CCS estimates.

FIGURE 4.1: THE PROPOSED MIX OF TECHNOLOGIES APPLIED IN 2050 FOR ABATING EMISSIONS IN LINE WITH OUR VISION

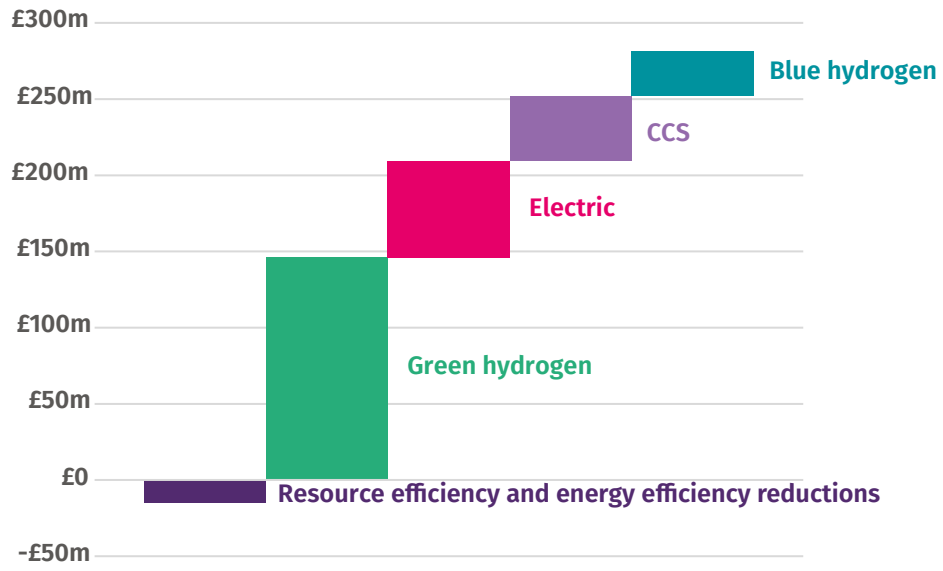
Technologies for abatement of emissions from Northern steel (tCO_2e)



Source: IPPR modelling using data from Element Energy (2020a) and CCC (2020a, 2020d, 2020e).

FIGURE 4.2: THE ANNUAL COST IN 2050 OF OUR VISION

Annualised cost in 2050 of approximately £267 million



Source: IPPR modelling using data from Element Energy (2020a) and CCC (2020a, 2020d, 2020e)

A major implication of the UK's decision to exit the European Union has been its divergence from EU state aid rules. There exists some scope within the current level playing field arrangements for state aid to be more significant and targeted within the current level playing field arrangements (Morris 2020). Efforts to support northern steel could build on existing plans such as the Clean Steel Fund and or constitute other support such as low interest loans for industry. The precise mix of government support to private investment is covered in the recommendations section of this report.

R&D TO ACCELERATE THE DEVELOPMENT OF LOW-CARBON INDUSTRIAL CLUSTERS

Ensuring that regional plans for decarbonising steel in the North can be delivered and that the identified technologies are developed at pace will require investing in R&D. It will also require boosting collaboration between industry and research institutions. This is already happening through the involvement of the University of Sheffield in the Zero Carbon Humber plan and the establishment of initiatives like the Net Zero North programme have facilitated collaboration between research and industry (N8 Research Partnership 2021). The steel industry can do more to build on these initiatives and create a thriving R&D environment for industry development in the North.

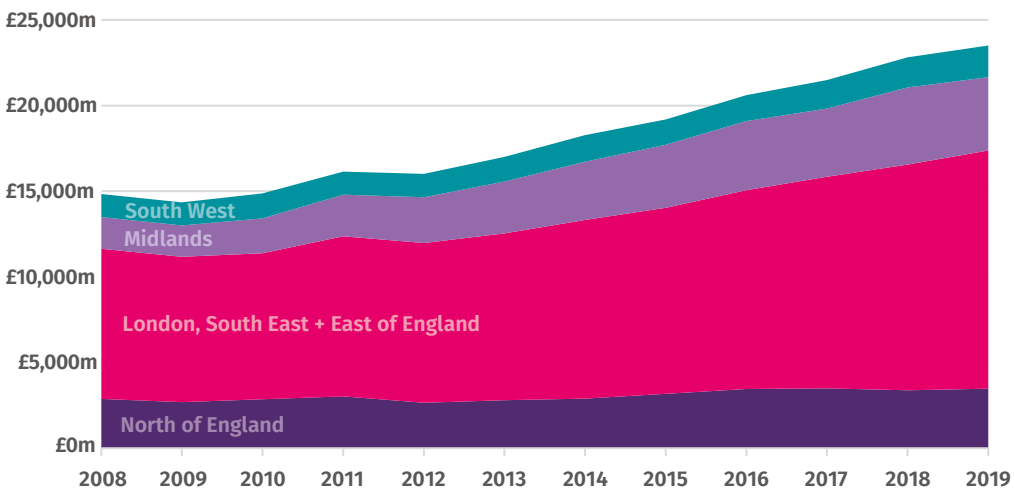
Factoring in the government's own investment in R&D, absolute levels of R&D spend are too low outside the South East and an additional £1.6 billion would be needed to boost it in line with per capita spending in London (Forth and Jones 2020). Overall, investment in R&D in the North lags behind other regions – both from business and from government. This has a significant opportunity cost for the North with knock on impacts for economic productivity. Previous IPPR research has shown that unlike many other advanced economies and our EU competitors, the UK government provides a lower level of support by way of R&D and investment (Lawrence and Stirling 2016, Parkes 2019). However, there are also differences in R&D spend between different industries, in addition to these regional divides in total R&D spend (Thomas and Nanda 2020).

Over £37 billion was invested in UK R&D in 2018 (ONS 2020a). The vast majority of R&D spend takes the form of business investment in R&D, with the remainder coming from government, not-for-profit and higher education investment. As of 2019, the total R&D performed by business stood at approximately £26 billion, with the total performed in England worth approximately £23 billion (ONS 2020b).[5] Of this, £80 million was invested across the UK in R&D performed by businesses specialising in the manufacture of basic metals (ibid). This investment pales in comparison to other major industries, such as the £2.5 billion in R&D performed by the motor vehicles sector (ibid). With much of the steel industry concentrated in the north of England, this underinvestment and nonperformance in R&D not only holds back the steel industry; it contributes to broader regional inequalities in R&D. IPPR North's analysis shows that as of 2019, 70 per cent of business R&D performed occurred outside of northern regions and remains highly concentrated in the Greater South East (ONS 2020b).

5 Total R&D figures up to 2019 were not available for all the R&D sectors in the UK at the time of report publication. For this reason, only R&D performed by business is shown.

FIGURE 4.3: INVESTMENT IN R&D IS CONCENTRATED OUTSIDE OF THE NORTH AND LARGELY IN LONDON, THE SOUTH EAST, AND THE EAST OF ENGLAND

R&D performed by business (£ million)



Source: IPPR analysis of ONS (2020b)

A JUST TRANSITION FUND

Previous IPPR research has outlined that to decarbonise the economy of the North and its traditional industrial base, significant support will be needed to help workers through the transition (Emden and Murphy 2019). A just transition fund for the North will need to provide wage-subsidies to transitioning workers, boost inward investment, and improve links between industry, academia, and technical colleges to enable appropriate recruitment, upskilling, and retraining (ibid). Devolution deals have already devolved the adult education budget across combined authorities. A North-wide just transition fund could be coordinated by existing bodies like the NP11 in partnership with devolved leaders.

Steel represents a significant part of the industry picture in the North, but the case for a just transition made here could also apply across other industries. Not only does the North have significant industrial assets that will need to be decarbonised; high levels of deprivation and previous scarring from deindustrialisation have created justifiable concern about the low-carbon transition (Robbins et al 2019). Table 4.1 shows that across UK regions, the number of workers who need support to develop the skills they need to participate in a future low-carbon economy is roughly equal to those who already have the required skills.

TABLE 4.1. REGIONS IN THE NORTH WILL HAVE A SIGNIFICANT NUMBER OF JOBS THAT NEED TO BE SUPPORTED IN THE LOW-CARBON TRANSITION

Estimated regional breakdown of transition exposure for employment in the UK

Region	Transition 'reskill' – workers who could participate in a low-carbon economy but need reskilling to do so (%)	Transition aligned – workers ready to take advantage of low-carbon transition job opportunities (%)	Percentage of transition jobs	Total jobs
North East	10.0	10.5	20.5	**1,059,975**
North West	10.7	10.8	21.5	**3,277,080**
Yorkshire and the Humber	10.9	11.3	22.2	**2,367,010**
East Midlands	11.2	11.9	23.1	**2,071,855**
West Midlands	11.1	11.4	22.5	**2,561,240**
East of England	10.9	10.7	21.6	**2,735,385**
London	10.1	8.9	19.0	**5,135,750**
South East	10.4	10.0	20.4	**4,080,100**
South West	10.0	10.1	20.1	**2,409,955**
Wales	9.6	10.3	19.9	**1,230,460**
Scotland	10.4	10.1	20.5	**2,440,150**
Northern Ireland	9.4	10.3	19.8	**669,692**
Total jobs	**3,151,058**	**3,113,078**	**6,264,136**	**30,038,652**

Source: Robbins et al (2019)

The Trade Union Congress (TUC) has outlined its plans for a just transition, which includes access to funding for workers to improve skills and maintain a guarantee that new jobs will be good jobs (Page 2019). Just as the divergence from EU rules opens opportunities for state aid investment, it also brings with it a risk that new jobs are created on worse terms (Morris 2020). This should be avoided to ensure that the steel industry remains a place where high-skilled and high-quality jobs are offered to northern workers with wider multiplier benefits for local economies.

CREATING A MARKET FOR LOW-CARBON STEEL

Creating demand for low-carbon steel will require the UK government to take several proactive steps to incentivise the production and use of low-carbon steel, create trade opportunities, and reduce tariffs.

A key policy lever for incentivising the production of and use of low-carbon steel is the use of carbon pricing. The imposition of tax on goods that are produced in a carbon intensive manner or that contribute to carbon emissions can help lower emissions. Previously, UK steel producers received free allocations within the EU Emissions Trading Scheme (ETS). These allocations will be phased out in the new UK ETS in line with the EU. However, the current Brexit arrangements also represent a significant watering down of the previous level playing field arrangements between the UK and EU (Morris 2020). This gives the UK government some capacity to diverge from the EU's emission trading scheme (ETS). Divergence from this could erode environmental standards but similarly, if the UK government raises its ambition, it would allow a more ambitious set of carbon pricing measures (Vivid Economics 2019a).

UK Carbon pricing could act as a starting gun for the steel industry to accelerate its transition. However, the timing of its introduction needs to be carefully considered. Increasing it before new EAF or hydrogen-based infrastructure is built could scupper the industry and result in carbon leakage as cheaper low-carbon steel is procured from elsewhere. Supporting capital investment into industry and reducing electricity prices must happen before the imposition of steep carbon pricing (Lord 2021).

With the introduction of an ambitious carbon border adjustment mechanism coming into play via the European Green Deal, one of the UK's major export markets will demand low-carbon steel (European Commission 2021). If other major export markets in North America introduce a similar carbon pricing policy, the UK's major markets will demand low-carbon steel. This will effectively create a premium for low-carbon steel in the decades to come and it is imperative the UK is able to benefit from this new market by decarbonising its steel production as soon as possible.

ENSURING THAT FUTURE NEGOTIATIONS PLACE A PREMIUM ON LOW-CARBON STEEL

Export tariffs effecting the UK as part of its agreement with EU have the potential to negatively impact UK steel production, with concerns already being raised about the 25 per cent tariffs UK steel will face on every tonne above the agreed quota (BBC 2021). The EU accounts for over 50 per cent of UK steel exports and with new quotas, it is likely that steel producers will need to find other international markets for UK steel (Rhodes 2018). Potential new trading arrangements such as the comprehensive and progressive Transpacific partnership (CPTPP) have also been mooted as an opportunity for creating new export markets. However, concerns have been expressed by the trade union movement that the CPTPP would allow China to export cheap steel by stealth through Vietnam and that the CPTPP would erode labour unions (TUC 2018).

Ultimately, the UK government will need to ensure that new trade partnerships maximise demand for British steel, while using carbon pricing to prevent producers being undercut by cheap carbon intensive steel.

FREEPORTS AND INWARD INVESTMENT

Alongside the potential of new trading partnerships, other initiatives such as the development of freeport zones have been announced to support the North's steel industry. Freeports are proposed to attract inward investment reducing tariffs and duties, streamlining customs and reducing operating costs (Walker 2020). In Teesside alone, it has been argued that freeport policies could create £2 billion of additional GVA and 32,000 jobs (Vivid Economics 2019b).

However, recent evidence suggests that the 8 freeports announced in the Spring 2021 budget will simply displace economic activity and jobs across the region, instead of creating new opportunities (Barnard 2021). Freeports will only add value if they form part of a coherent and long-term industrial strategy that prioritises decarbonisation and economic integration, as opposed to economic disintegration.

DEVELOPING DOMESTIC DEMAND THROUGH LOCAL PROCUREMENT

There are also significant policies that could be deployed to stimulate domestic demand for northern steel. Currently, there is a UK government commitment to procure UK steel wherever possible, and this is audited in a steel procurement pipeline (BEIS 2020). However, more localised forms of incentivising the procurement of northern steel are underutilised. Combined and local authorities in the North can use public procurement to encourage the sourcing of local goods and services to retain wealth and prosperity within the local economy (Raikes 2020).

Green Public Procurement is a developing policy within the EU (Pouikli 2021). Taking this policy from a supranational to local level would allow local authorities to use the powers they have and ensure that planned infrastructure projects commit to using low-carbon steel. Infrastructure investment proposals should ensure that large value contracts submitted for infrastructure works are committed to procuring green steel wherever possible. The growing number of councils that have declared a climate emergency suggests a willingness from local leaders to play a more pro-active role in tackling the climate crisis. Creating demand for low-carbon goods is a key tool they have at their disposal to achieve this.

CONCLUSION

Decarbonising the steel industry is just as much about increasing the industry's competitiveness as it is about investing in the right technologies to reduce emissions. While the industry faces barriers to its competitiveness, none of these are insurmountable. However, overcoming them will require action from central government, both to invest in developing the technologies the industry needs and for creating domestic demand and export opportunities for the steel industry.

5.
A NET ZERO VISION FOR NORTHERN STEEL

To support the development of a net zero steel industry for the North, we have developed a series of key recommendations which we believe could help to unite UK government, metro mayors, steel producers, unions, and local authorities in a shared mission to develop the low-carbon steel industry of the future. Our vision offers strategic direction, a plan for investment, policies to secure a just transition and recommendations for creating market demand. This vision is underscored by a commitment to making the most of devolution.

The UK's current green growth plans could go further to harness the potential of the industry to decarbonise at pace. This includes long-term planning for industrial decarbonisation, a financial commitment to support the process and a political acknowledgement from central government as well as metro mayors, that steel still matters.

The costs outlined in this report suggest the annual cost for decarbonising northern steel will reach £267 million by 2050. This is significantly greater than the proposed total support currently on offer for helping the industry decarbonise under the UK government's Industrial Decarbonisation Strategy. This includes both the £250 million Clean Steel Fund, £240 million Net Zero Hydrogen fund, £170 million Industrial Decarbonisation Challenge Fund and various CCS funds.

STRATEGIC DIRECTION AND INVESTING IN NORTHERN STEEL

The time for supporting industry is now. With record low borrowing rates available to central government, investment made today can support future industry productivity and job creation in the decades to come.

Recommendation 1: Develop the Industrial Decarbonisation Strategy and ensure that it increases regional productivity

The UK is one of the most regionally unequal countries in the OECD (Johns et al 2020). levelling up the economy to support jobs and industry in the North is a key priority for the UK government. We recommend that the UK government develop its long-term plan for decarbonising the industry and ensure it doesn't just deliver investment in key technologies – it must also consider how industry decarbonisation can promote regional growth. The specific industrial cluster pathways outlined in this report align closely with the UK Government's 'EAF and DRI' option for iron and steel (HMG 2021). Our plan offers specific regional pathways, which could sit under the government's strategy. As part of this strategy, steel sector stakeholders in each of the clusters we identify should work with government to help deliver ambitious industry decarbonisation. Greater efforts to develop a place-based approach to decarbonising industry will also require devolving new powers and competencies (see recommendations 3 and 4).

As part of its decarbonisation strategy, we recommend the UK government addresses the comparatively high energy costs the UK steel industry currently

faces. Doing so will increase the viability of low-carbon technologies and boost industry competitiveness.

Recommendation 2: Target future government investment in northern steel to drive excellence in zero carbon and leverage new private sector investment

The UK government should carefully target future investment in northern steel so as to address market failure and incentivise innovation. This should include investment in EAFs, hydrogen technologies, green hydrogen for DRI, CCS, resource efficiency and other decarbonisation investments in the North. In particular, we see untapped potential in developing green hydrogen production across the North. The total annual cost will reach £267 million by 2050. We anticipate that initially, more government support in the form of technological investment and low interest loans to industry will be needed to support decarbonisation. However, by the 2030s, we expect that efforts to crowd in private investment will result in businesses providing at least 50 per cent of this annual cost by the mid-2030s before meeting the majority of the costs thereafter. The precise mix of support from government could include a combination of long-term industry loans and green bonds via the UK's new infrastructure bank based in Leeds.

A strong industry will strengthen the UK's economy and create further demand across various supply chains. This will create further jobs at a time when the UK both needs to meet its net zero obligations and recover effectively from the economic consequences of the Covid-19 pandemic.

MAKING THE MOST OF NORTHERN DEVOLUTION

We should use the levers of devolution to help maximise the potential of zero carbon steel in the North. Devolution to metro mayors provides a new opportunity to develop an industrial strategy for decarbonisation at a more granular level, building on the work already done to develop local industrial strategies. Prosperous industry combined with investment in the existing devolution frameworks can help develop industrial clusters that drive the UK's 'green industrial revolution'. This can help the UK government deliver on its new industrial strategy (HMT 2021).

As has already begun to happen in some areas of the North, metro mayors can use their convening power to bring key partners from the industry and trade unions together and to broker new opportunities for job creation and inward investment. Along with local authority chief executives in key steel production areas in the North, they should be key partners in the government's efforts to support a strong, zero carbon future for northern steel.

Recommendation 3: Combined and local authorities should use their buying power to drive demand for green steel

Combined and local authorities should examine how they can use their buying power to prioritise green steel from the UK. Progressive procurement strategies have been deployed in many areas of public expenditure including job creation, skills, and training. Equally, they could be used to prioritise green steel in new infrastructure development, town centre regeneration strategies, planning policy and local transport schemes. For example, many authorities will be applying to the new levelling up fund for capital schemes including transport, in order to support the regeneration of their area. Where appropriate, this could be an opportunity to encourage the use of green, UK steel, thereby helping to build confidence and market demand.

The government's decision to establish the new economic campus in Darlington is an important opportunity to raise the profile of industry in the North, including steel, and should be used to its full advantage, both as a vote of confidence in the northern steel industry and as a means to leverage future investment in strategic sectors like steel.

Recommendation 4: Devolve R&D spending to accelerate technological uptake

The development of low-carbon industrial clusters will require developing industry through enhanced R&D spend. At the moment, decisions on where money is spent and how it is invested are too often driven by central government decision-making, which results in the North losing out when it comes to investment. R&D budgets should be fully devolved to combined authorities who can properly invest in their local industrial strategies in partnership with local enterprise partnerships. This would accelerate the development of emerging technologies, such as green hydrogen.

A JUST TRANSITION

The transition must be just. Without proper investment to ensure that new workers can be trained or existing workers re-trained, the steel industry of the future will not have the workforce it needs.

Recommendation 5: A future jobs guarantee

A jobs guarantee should accompany plans to decarbonise steel to ensure communities in the North feel the economic benefits and new opportunities of the steel industry in the years to come.

Recommendation 6: A just transition fund

Previous IPPR research has emphasised the need for a just transition fund (Emden and Murphy 2019). The need for this fund is more pressing than ever. By putting in place a just transition fund, the UK government will not only secure future jobs; it will also address the anxieties businesses and trade unions have. This will create trust in the transition by dispelling the idea that decarbonisation will come at the expense of jobs.

Recommendation 7: Ensure that skills supply keeps pace with emerging demand

Ensuring current workers can obtain the new skills they might need to work in low-carbon industries like steel, will require retraining and upskilling for existing workers. Any future expansion of the low-carbon steel industry in the North will require a clear pathway for recruitment into well-paid and skilled jobs.

UK government investment in further education in the North will be crucial, as will supporting the steel industry to undertake ambitious retraining and recruitment programmes. Doing both these things is vital to create the skilled jobs that the low-carbon steel industry needs. Alongside this, UK government must encourage cross departmental collaboration on shared priorities such as decarbonisation, for example, between the Department of Education and BEIS so that skills provision better matches future industry need.

Local enterprise partnerships and combined/local authorities may be able to play a key coordinating role through local skills advisory panels or boards. These groups help to oversee projects to address skills gaps in the area covered by the local strategic partnership or combined authority area, as well as linking skills development to employment needs. In addition, many LEPs have specific task groups dedicated to particular sectors, like the green

economy. These groups can raise awareness to maximise the benefits of zero carbon steel.

CREATING DEMAND FOR LOW-CARBON NORTHERN STEEL

Industry buy-in for the transition can be significantly improved by creating a market for northern steel both domestically and internationally. Decarbonising northern steel is not just an opportunity to tackle the climate crisis and for the UK to fulfil its commitments under the Paris Agreement; it can also help relaunch the industry as a world leading producer of low-carbon steel. The introduction of new carbon adjustment mechanisms can also play a long-term role in ensuring key industries are incentivised to procure green steel.

Recommendation 8: Intensify carbon pricing policies once technologies are onstream to create a premium for low-carbon steel

Carbon pricing mechanisms can create demand for low-carbon steel and disincentivise the future use of carbon-intensive steel. However, the introduction of these measures must be timed correctly. It must accelerate uptake of low-carbon technologies but also not stifle industry further given current concerns around competitiveness. To this end, the introduction of carbon pricing should be coupled with the planned investment we outline in recommendation 2. A framework should be developed that gives steel producers rebates for accelerating their progress to low-carbon production, and allows exemptions to be made where it is clear that steel producers have committed to decarbonising their production methods within a reasonable timeframe.

Recommendation 9: A more stringent commitment to source British steel

The government should work with partners to explore how nationally important infrastructure schemes such as HS2, Northern Powerhouse Rail, and Cross Rail can prioritise the use of green, UK-made steel. The current framework for procuring UK steel first is not comprehensive enough, with steel often imported from elsewhere. The UK government has an opportunity to support UK-made green steel, thereby supporting industry jobs and businesses as well as creating new markets for green steel both in the UK and internationally. For example, this could form part of the Department for International Trade's 'Great' initiative, which encourages UK producers to export.

Recommendation 10: Ensuring that future trade agreements protect industry and promote sustainability

Britain's exit from the UK will result in new trade agreements being struck by the UK government. To prevent the import of cheaply produced and carbon intensive steel, the UK government should ensure that principles of job protection and environmental sustainability underpin trade negotiations. This means working with other nations to create demand for low-carbon steel while working to identify future export opportunities for low-carbon steel in the future.

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