

Making the UK a world leader in the production of clean steel



Summary

Maintaining a domestic steel industry is strategically important for the UK. British steel underpins our essential sectors, from energy and transport to aerospace and construction. It is also a key industrial employer, benefiting towns across our industrial heartlands. But primary steelmaking in the UK is heavily polluting and incompatible with Britain's ambitious climate change goals.

The government has indicated that any long-term support for the steel sector is contingent on decarbonisation. It is here that hydrogen holds real promise: direct reduced iron (DRI) technology means that hydrogen can replace coal in primary steelmaking, producing steam instead of carbon dioxide. This hydrogen technology can be coupled with electric arc furnaces - currently used solely for recycling - to create a cutting edge, flexible, steel industry in the UK that can both make the most of valuable scrap metal resource we currently lose to exports and provide a full range of primary steel grades with near zero emissions.

To achieve this, the government should commit to a phased plan for the industry, bringing forward ambitious targets along with trials which could then lead to the commercialisation of this new technology. The timescales for this plan should be:

- **2021:** A commitment for ore-based steelmaking in the UK to be near zero emissions by 2035 and plan for the steel industry.
- **2021-22:** A pilot trialling hydrogen-based steelmaking in the UK.
- **Mid 2020s:** A clean steel hub and agreed delivery strategy for near zero steel.

The trial and hub could be delivered through a competitive tender administered by the government or through a private-public partnership, with large-scale private funding supported by funds from the government. The government has already earmarked £250 million to help the steel industry decarbonise through its Clean Steel Fund. A new at-scale DRI plant could cost around £500 million, but an initial, small-scale proof-of-concept pilot would cost vastly less than this.

If the government invests in clean steel it would see social and economic benefits including:

- **Make the UK a world-leader in clean steel:** Low carbon steel can revitalise UK industry, making UK produced steel globally competitive in a new net zero age.

- **Help level up Britain:** Low carbon steel can protect and upskill jobs in some of the UK's key industrial heartlands.

Background: the UK clean steel revolution

Maintaining a domestic steel industry is strategically important for the UK. British produced steel supplies the foundations for our essential industries, from energy and transport to aerospace and construction. For example, 96 per cent of Network Rail's rail tracks are made with primary steel from Scunthorpe,ⁱ 45 per cent of the steel required for production in Nissan's Sunderland plant is supplied by Port Talbotⁱⁱ and British Steel is providing bespoke steel sections for Hinkley Point C.ⁱⁱⁱ Recycled steel plays a key part in this too, with Liberty Speciality Steels creating bespoke alloys for the aerospace industry,^{iv} and Sheffield Forgemasters supplying steel for numerous submarine platforms and surface vessels including Britain's Trafalgar, Vanguard and Astute UK submarine programmes.^v

The UK's steel sector is also a key industrial employer, benefiting towns across our industrial heartlands. Around 600 businesses are involved in the sector,^{vi} and it provides more than 33,400 highly skilled jobs across Britain.^{vii} The industry also supports a further 40,000 in its supply chains,^{viii} with steel sector wages 46 per cent above regional averages.^{ix}

However, this is an industry that is struggling to survive. The steel industry's importance to the whole UK economy declined between 1990 and 2020, from 0.3 per cent of total output to less than 0.1 per cent, with output falling by 9 per cent in 2020 alone.^x The ongoing troubles at Liberty Steel, the latest in a long-line of industry fallouts and bailouts, are creating even greater uncertainty too.

Britain's steel industry is also highly polluting, making it incompatible with the UK's ambitious climate change targets. Primary steelmaking in Britain uses coal. It is one of the UK's largest single-point emitters of carbon dioxide with our two remaining virgin steel plants making up 15% of industrial emissions.^{xi} At home, the UK has already committed in law to reach net zero carbon emissions by 2050, and the Climate Change Committee has recommended UK steelmaking should reach near zero emissions by 2035,^{xii} a target which cannot be reached without significant industry realignment. Globally, this year marks the UK's Presidency of COP26 and the UK is a key steering member of the Clean Energy Ministerial. It is critical that it underpins its leadership ambitions on climate change with definitive steps towards achieving net zero across as many sectors as possible.

Against this backdrop, it is vital the government adopts an ambitious decarbonisation plan for the steel sector so that the industry is properly future-proofed. For a start, this means using and reusing steel as efficiently as we can, so we need less of it. It also means maximising the recycling of scrap steel through the UK's electric arc furnaces (EAFs) rather than exporting it as waste only to reimport the high value products other countries turn it into.^{xiii} EAF's are already an established

part of the UK's steelmaking infrastructure, and themselves are a good route to steel decarbonisation, as they are involved in the recycling of scrap steel and produce far fewer emissions than primary steelmaking, and these emissions can be reduced further as we decarbonise the grid. Further to this, they allow for batch production rather than providing a continuous output, offering considerable flexibility.^{xiv} The UK is in a strong global position for the availability of scrap steel and these actions alone could deliver a significant reduction in UK steel emissions, and ensure that the UK is able to maximise its export of high value products, where it is best placed to compete globally.

However, there remains a case for UK production of primary steel too. Some experts believe that the amount of steel available for recycling could triple by 2050 but others are more conservative.^{xv} In 2018 only 20 per cent of global steel production was from scrap steel, and the International Energy Agency thinks that even at higher recycling rates, scrap availability will put an upper limit on the potential for recycled production globally.^{xvi} There are also some limits at the moment on the grades of steel that can be made in an EAF due to the build up of some contaminating elements.

It is here that hydrogen-based steelmaking shows real promise. Direct reduced iron (DRI) technology means that hydrogen can replace coal as the reduction agent in steelmaking, producing steam instead of carbon dioxide. The precursor iron manufactured through DRI, known as sponge iron, can be made into steel in an EAF. The hydrogen DRI approach enables EAFs to continue to play a role in scrap recycling alongside a new role in primary steelmaking, offering the advantages of batch production alongside those of a broader range of potential products.

But the global race for clean steel has already begun and the UK is falling behind. In Europe, there are 23 planned or live hydrogen-based steelmaking trials, pilots and full-scale projects.^{xvii}

If British steelmaking isn't rapidly adapted, jobs, green innovation and our regional economies that depend on steel will suffer, and we will become reliant on foreign imports for our strategic sectors. But if we act now we can help support a thriving UK steel sector, making sure steel continues to be manufactured in the UK in the decades to come and boosting our industrial heartlands.

Below, we set what we are proposing, how this can be delivered, and how it will meet the UK's broader objectives.

A plan to decarbonise steel

The government should commit to achieving near zero emission steel production in the UK by 2035, and to measures to ensure more efficient use of steel. This should be accompanied by support for the trial and commercialisation of hydrogen-produced steel, developing the

groundwork to produce near zero steel coupled with electric arc furnaces, and recognising this as a promising route to wider decarbonisation and modernisation of this and other sectors.

- **2021: A new commitment and plan for the steel industry.** By COP26, the government should have set out its commitment to achieve near zero emissions steel production by 2035 and begun detailed negotiations with the sector and other stakeholders on a delivery timeline and supporting policies. It should also be taking concrete steps to improve the resource efficiency of steel use in the UK, and bringing forward a wider policy framework to support the steel industry transition towards net zero.
- **2021-22: A pilot trialling hydrogen-based steelmaking in the UK.** With plans to trial hydrogen reduction progressing rapidly in other countries, the government should not wait to have a full decarbonisation plan in place before kickstarting a UK pilot. The main aim of the trial would be to test production with existing electric arc furnace technology, create initial capability, develop world-leading expertise, and create a new anchor market for hydrogen. This should be in a strategically important location in the UK and could then be ramped up.
- **Mid 2020s: A clean steel hub and agreed delivery strategy for near zero steel.** The long-term vision for the government should be to build a clean steel hub in the UK that can provide low carbon, hydrogen reduced iron around the country as needed. Ideally this would be powered exclusively with renewable (green) hydrogen but fossil (blue) hydrogen could be used as an interim solution. The hub could be built in a strategic part of the country, maximising local resources, existing and any new electric arc furnaces, and steelmaking expertise. With at least some clean primary steel production secured, plans could be finalised on managing an equitable transition to low carbon production at other UK steelmaking sites. An agreed delivery strategy for net zero steel should make use of recycled steelmaking in the UK and press for more efficient use of steel in the longer term.

How will it be delivered and how much will it cost?

The government has indicated that any long-term support for the steel sector is contingent on decarbonisation, and in the Industrial Decarbonisation Strategy released earlier this year it pledged to consider the implications of the Climate Change Committee's recommendation for near zero emission ore based steelmaking by 2035.^{xviii} However, progress on the delivery of steel decarbonisation remains slow and strategies are vague on the next steps.

More widely, the Industrial Decarbonisation Strategy set out a promising range of offers that could make the policy landscape more favourable for clean steel, including continued funding for industrial decarbonisation, revisions to emissions trading, plans to help create a market for clean steel through product labelling and public procurement, and a commitment to look at the

competitiveness of industrial electricity prices. But no new funding was provided, nor clarity on what support would be available for switching fuels to hydrogen.^{xix}

Not explicitly mentioned in the strategy, but also worth exploring is the option of new border carbon adjustments to level the playing field between imported, polluting products, and cleaner, domestically produced steel.

In terms of funding, the government has announced £250 million for the Clean Steel Fund, but it is not yet clear what technologies and projects will receive money and allocations will not take place for another two years by which point the UK will be even further behind competitors.

Our proposal could be delivered through a competitive tender administered by the government and with private funding backing initial public funds. Experts such as the Metals Processing Institute (MPI) estimate that a new at scale DRI plant could cost around £500 million,^{xx} but an initial, small-scale proof of concept pilot would cost vastly less than this. To put this into context, the Government provided £233 million to support the redevelopment of SSI's Redcar steelworks following its closure in 2015,^{xxi} with some estimates putting the true cost of the clean up at £1 billion - a process which Port Talbot and Scunthorpe will also have to undergo if they close.^{xxii}

The initial pilot trialling clean steel could be funded in partnership with any number of interested businesses, possibly including the Jingye Group, the owners of the Scunthorpe steelworks plant, or Tata Steel, the owners of Port Talbot.

Crucially, existing government commitments could kick-start funding. The government has already set aside £250 million in the Clean Steel Fund and may also be able to make use of a series of other funds (see annex). Given the lack of consensus on the Clean Steel Fund's best use and developments since the previous consultation, it could use at least some of this money for the purpose.

What this means for the UK

If the government invests in low-carbon steel manufacturing and uses, we will see social, economic and cultural benefits. As noted above, the two key objectives that can be met are:

- **Innovation and jobs: low carbon steel will revive UK industry and create jobs.**

Investing in low carbon manufacture and use of steel can help revitalise the UK's strategically important steel industry, not just making UK steelmaking fit for the 21st century but also giving the sector a global competitive edge. Few other industries have made as big a mark on world history as UK steel, and Britain should capitalise on its expertise in high specification steels and green industrial technology to advance both its exports as markets for low carbon steel emerge and expertise in this area.

- **Help level up.**

Investing in low carbon steel can help protect and upskill existing jobs in steelmaking areas, helping to level up our industrial heartlands. Measures to encourage efficient use and reuse of steel will also create new areas of expertise for UK workers, generating new jobs and improving productivity. Average wages in the steel sector are 28 percent higher than the national average and a massive 46 above some regional averages.^{xxiii} These places have a rich industrial history but their high skilled jobs are in need of future-proofing.

Annex

Policy	Detail/ relevance to steel	Timelines	Potential to support hydrogen steelmaking
Clean Steel Fund	<ul style="list-style-type: none"> - £250 million fund to facilitate the decarbonisation of steel. - It has three priority areas: switching to lower carbon fuels, carbon capture, usage and storage (CCUS), and energy and material efficiency. 	<ul style="list-style-type: none"> - The fund will be allocated in 2023. 	<ul style="list-style-type: none"> - It is not yet clear what technologies and projects will receive money. - Allocations will not take place for another two years.
CCS Infrastructure Fund	<ul style="list-style-type: none"> - £1 billion fund to support the deployment of four CCS sites across the UK. - CCS is an alternative route for decarbonising steel and can be used to generate blue hydrogen. 	<ul style="list-style-type: none"> - First announced in the 2020 Budget. - First two sites to be deployed by the mid-2020s and second two by 2030. - First two sites should be announced by October 2021. 	<ul style="list-style-type: none"> - CCS can be used to make blue hydrogen, which would benefit hydrogen-based steelmaking but this is higher carbon than green hydrogen, and so should not become a long term solution. - These funds cannot be used to fund a hydrogen DRI trial.
Net Zero Hydrogen Fund	<ul style="list-style-type: none"> - £240 million fund to scale up hydrogen production in the UK. - This will increase hydrogen capacity, which will be beneficial for hydrogen steelmaking in the longer-term. 	<ul style="list-style-type: none"> - Announced in the Ten Point Plan for a Green Industrial Revolution. - Unclear yet how it will be allocated. - More information should come with the Hydrogen Strategy. 	<ul style="list-style-type: none"> - This is unlikely to provide funds for hydrogen use.

<p>UKRI Industrial Challenge Fund</p>	<ul style="list-style-type: none"> - A competition fund allocating money to projects tackling society’s ‘grand challenges’. - As part of this, the Industrial Decarbonisation Challenge Fund has allocated £171 million to scale up and provide research funding to the UK’s six industrial cluster plans. - These projects will scale up overall hydrogen and CCS/CCUS capacity, which is welcome for (both green and blue powered) hydrogen steelmaking. 	<ul style="list-style-type: none"> - Scoping funds were awarded to winning projects in 2021 to develop their plans. 	<ul style="list-style-type: none"> - Funding not focused on specific hydrogen uses.
<p>Industrial Energy Transformation Fund (IETF)/ Scottish IETF</p>	<ul style="list-style-type: none"> - A competition fund allocating money to incentivise investment in efficiency in existing sectors and in step change technologies. - £315 million in total funding is available (with £32 million more in Scotland). - £16.5 million funding has been made available for the winners of the first round of Phase one. - Winners for this include Celsa Manufacturing to install new technologies that improve energy efficiencies in the process to melt scrap metal and produce steel. - Up to £40 million of funding will be made available for winning projects in the second round of Phase one, that support energy efficiency and decarbonisation studies. 	<ul style="list-style-type: none"> - Funding pots will be available until 2024. - Winners of the first round of the Phase one competition were announced on 24 May, including for the Energy Efficiency Deployment competition and the Studies competition. - From 8 March to 14 July 2021, the second round of Phase one opened for projects that support energy efficiency and decarbonisation studies. - Phase two will open later in 2021 and expand the scope to include deployment of decarbonisation technologies. 	<ul style="list-style-type: none"> - A trial for hydrogen-based steelmaking will cost more than the individual funding streams on offer.
<p>Net Zero Innovation Portfolio</p>	<ul style="list-style-type: none"> - £1 billion competition fund to develop low-carbon technologies and systems. - Competitions will launch for projects in a number of areas, 	<ul style="list-style-type: none"> - Announced in the Ten Point Plan for a Green Industrial Revolution. - Competitions will launch throughout 2021 for the different subjects. 	<ul style="list-style-type: none"> - Industry could benefit from funds available for hydrogen or industrial switching projects, but the UK steel industry needs the

	<p>including hydrogen and industrial fuel switching.</p> <ul style="list-style-type: none"> - Competitions include the Carbon Capture, Usage and Storage (CCUS) Innovation 2.0 Competition, the Low Carbon Hydrogen Supply 2 Competition and the Direct Air Capture & Greenhouse Gas Removal competition (all announced on 24 May). 		<p>Government to commit to a direction with a plan alongside funding.</p>
<p>Industrial CCUS/Hydrogen Business Models</p>	<ul style="list-style-type: none"> - Outlines for the industrial carbon capture business model show that it is designed to incentivise the deployment of carbon capture technology for industrial users who often have no viable alternatives to achieve deep decarbonisation. - A hydrogen business model has not yet been published and may focus on producers not consumers. 	<ul style="list-style-type: none"> - Government set out its minded-to position for an industrial carbon capture business model in December 2020, and shared updates in May. - Further updates are expected on this and the other models this summer. 	<ul style="list-style-type: none"> - The total spending envelope hasn't been defined and detailed rules are still being worked up. - The hydrogen business model may focus on support for hydrogen production, not its use.
<p>National Infrastructure Bank</p>	<ul style="list-style-type: none"> - The bank will offer finance for projects across the UK in clean energy, transport, digital, water and waste, and more. - The bank will have £22 billion of financial capacity to deliver on its objectives, consisting of £12 billion of equity and debt capital and the ability to issue £10 billion of guarantees. 	<ul style="list-style-type: none"> - Announced in November 2020 Spending Review. 	<ul style="list-style-type: none"> - Industry could benefit from the financial assistance on offer, but the UK steel industry will need a clear plan to apply to the bank.

For more information, contact
Roz Bulleid, deputy policy director
rbulleid@green-alliance.org.uk

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- ^{iv} Liberty Steel, 'Aerospace Bar', no date.
- ^v Sheffield Forgemasters, 'Complex Casting and Forging Solutions for the most Demanding Engineering Applications', no date.
- ^{vi} Common Wealth, 'A test of mettle: Securing a future for a green UK steel industry', February 2021.
- ^{vii} House Commons, UK steel industry: statistics and policy', 2021.
- ^{viii} Department for Business, Energy and Industrial Strategy, 'Clean Steel Fund: Call for evidence', 2019.
- ^{ix} Make UK, 'A new deal for steel', December 2019.
- ^x House Commons, UK steel industry: statistics and policy', 2021.
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- ^{xii} Climate Change Committee, 'Sixth Carbon Budget', 09/12/2020.
- ^{xiii} Green Alliance, Completing the Circle, 2018
- ^{xiv} MPI, 'Decarbonisation of the steel industry', March 2021.
- ^{xv} UK FIRES, Absolute Zero, 2019
- ^{xvi} International Energy Agency, 'Iron and steel', June 2020.
- ^{xvii} ECIU, 'Stuck on the starting line: How the UK is falling behind Europe in the race to clean steel', May 2021.
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- ^{xxi} Department for Business, Energy and Industrial Strategy, 'Former SSI steelworks site to be redeveloped under full local control', 08/10/2020.
- ^{xxii} The Financial Times, 'MPs press government on clean-up of Teesside steel plant', 04/02/2016.
- ^{xxiii} Make UK, 'A new deal for steel', December 2019.