E3G

REPORT JUNE 2024

GROWING CLEAN STEEL IN THE UK
PRIORITIES FOR THE NEXT GOVERNMENT

LAITH WHITWHAM

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E3G is an independent climate change think tank with a global outlook. We work on the frontier of the climate landscape, tackling the barriers and advancing the solutions to a safe climate. Our goal is to translate climate politics, economics and policies into action.

E3G builds broad-based coalitions to deliver a safe climate, working closely with like-minded partners in government, politics, civil society, science, the media, public interest foundations and elsewhere to leverage change.
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SUMMARY

The global steel industry is racing to establish clean steel supply. Without a plan, the UK may end up losing out on primary steel production – with consequences for jobs, the competitiveness of other sectors, and strategic national interests. Avoiding that scenario is within easy reach. A more supportive policy framework and public investment of just £2.1–3.5bn can put the UK on the path to a clean steel future that supports both the economy and people.

The current plan for UK steel will lead to further decline, but that doesn't have to be the case

UK steel demand is set to grow 26% by 2030.[1] As an extremely carbon-intensive material – production making up 2.4% of the UK's territorial emissions[2] – it is crucial that the UK decarbonise its steel supply to mitigate the impacts of climate change.

The government has agreed to provide £500m to Tata Steel to transition to an electric arc furnace (EAF) and is close to a similar deal with British Steel, who operate the UK's only other primary steel plant. This will reduce emissions by 75–85% at the two sites. Moreover, it will future-proof the sites, each of which currently loses £1m a day making highly carbon-intensive steel.[3]

However, this plan will also cut thousands of jobs and, without green iron supply, make the UK dependent on imports for primary steel. This may harm sectors that rely on domestic primary steel, such as automotive and offshore wind manufacturing – both priority growth sectors for the UK, and areas central to ambitions on energy security and net zero.[4] There is also a risk, though slight,

[1] Green Alliance (2023) **A Brighter Future for UK Steel**

[2] House of Commons Library (2023) **Contribution of the Steel Industry to the UK Economy**

[3] BBC (2024) **Union Votes for Strike Action over Tata Job Losses**

[4] Department for Business and Trade (2023) **Advanced Manufacturing Plan**

that imported steel is higher emissions than the primary steel produced in the UK, which would increase the UK's climate impact.
This doesn't have to be the case; a brighter future for UK steel is possible. If the UK invests in low-emissions primary steelmaking, with iron produced using low-carbon hydrogen, it can secure a higher number of jobs, establish a secure domestic supply of primary steel, mitigate supply chain dependencies, and support a wide range of strategic and economic priorities.

Additionally, as the world shifts to near-zero emissions steelmaking, green iron hubs are likely to emerge in countries with abundant renewables and iron ore resources. This presents an opportunity to import green iron to process into primary steel domestically, complimenting UK assets and increasing total capacity.

Other countries are already racing to establish clean steelmaking, investing billions in the sector. Comparisons with overseas projects show that the UK is missing an opportunity to secure primary steel production capacity. They also show that for a similar investment to the government's deal with Tata Steel, other countries are securing low-emissions primary steel and iron capacity, whereas Tata plan to produce secondary steel alone. This reflects the findings of E3G's Steel Policy Scorecard,[5] which reveals that the UK is falling behind other G7 countries when it comes to providing public investment and supportive policies to establish clean steel supply.

Low-emissions primary steel production would not come at a great cost

Public investment of just £2.1–£3.5bn in new assets can put the UK on the path to a secure supply of primary steel with low carbon emissions. This investment could cover a range of scenarios, from establishing a new green iron plant to supply UK EAFs, to converting Tata and British Steel's plants to integrated green iron and primary steel plants (H-DRI-EAF), or even establishing an entirely new integrated green iron and steel plant elsewhere – perhaps near UK hydrogen production.

A £2.1–3.5bn clean steel fund would leave fiscal headroom to support the ongoing costs of low-carbon hydrogen in a lower capex scenario (Scenario 1 or

[5] E3G (2024) **Raising ambition on steel decarbonisation: The 2023 E3G Steel Policy Scorecard**

2), until hydrogen comes down in price and/or green iron is available on the global market. Additional funding would likely be needed to support hydrogen costs in a higher capex scenario (Scenario 3).

Each scenario has a range of benefits and drawbacks; the UK must optimise investment to reflect the reality of domestic and international demand, and what the UK can produce competitively. But steelmaking does not exist in a vacuum: domestic steel demand and competitiveness would both benefit from a stronger manufacturing base and cheaper low-carbon hydrogen production in the UK – support in these areas would therefore deliver co-benefits to the steel sector.

The next government will have to balance these trade-offs while also making investment decisions that reflect the level of import dependency the UK is open to accommodating.

Growing clean steelmaking requires more than upfront investment support

On top of support for the upfront cost of new low-emissions steel plants, the government needs to act quickly to improve the overall investment environment for clean steelmaking. At present, high electricity prices and a lack of an overarching plan for the growth of UK manufacturing have created uncertainty for investors considering the UK. Weak demand signals additionally undermine the business case for new investment.

So regardless of whether the capital is available for new plants, the wider business environment impedes the long-term competitiveness of clean steel in the UK. A green industrial strategy is needed to create a plan to grow and decarbonise steel and wider manufacturing. This must be accompanied by measures to reduce electricity prices, stimulate the market for low-emissions steel, and increase the availability of crucial materials like scrap steel. In particular, the plan for growing UK steelmaking must look across the value chain and aim to achieve co-benefits, such as growth and new jobs across the primary steel value chain, stimulated by growing demand in sectors like automotive and offshore wind manufacturing.

Supporting the growth of clean steel in the UK would help to tackle regional inequality

The impact of concentrated job losses in communities like Port Talbot and Scunthorpe should not be underestimated, nor should the fate of these areas be resigned to the pursuit of global efficiencies the UK may not be able to secure. The poorly managed deindustrialisation of the 1980s created job losses in mining communities across northern England, many of which are still the most deprived areas in Britain today.

The steel sector provides good quality jobs that pay above the national average and supports the growth of vanguard industries of the future. Sustaining these jobs and creating a steel sector that doesn't just survive difficult circumstances, but delivers growth and prosperity over the long term, should be a priority for any government serious about tackling regional inequality.

Key policy recommendations

Put the UK on a pathway to clean steel

1. Implement an ambitious green industrial strategy. The strategy should include an explicit vision for the future of domestic steel production and how it will align with the UK's wider strategic and economic aims, from energy security to the growth of new cleantech sectors.
2. Establish a clean steel fund with £2.1bn–£3.5bn of funding, with the aim to establish up to 3.78 Mt of additional secondary steel capacity, 4.44 Mt of low-emissions primary steel capacity, and 5 Mt of domestic hydrogen direct reduced iron (DRI) capacity.
3. Establish strict conditions on labour standards and corporate responsibility in return for government funding for clean steel.
4. Ringfence funding from the clean steel fund for the development of new technologies for green iron and steel production.
5. Pursue international trade partnerships to kick-start green iron trade.

Grow demand for clean steel

6. Implement green public procurement criteria that limit the embodied carbon of steel procured for public projects.
7. Establish mandatory life-cycle emissions standards on certain goods sold in the UK, prioritising sectors with low exposure to material costs.

Bring down power prices

8. Increase network charge exemptions provided by the British Industry Supercharger to 90%.
9. Move network and policy costs from industrial electricity bills to general taxation.

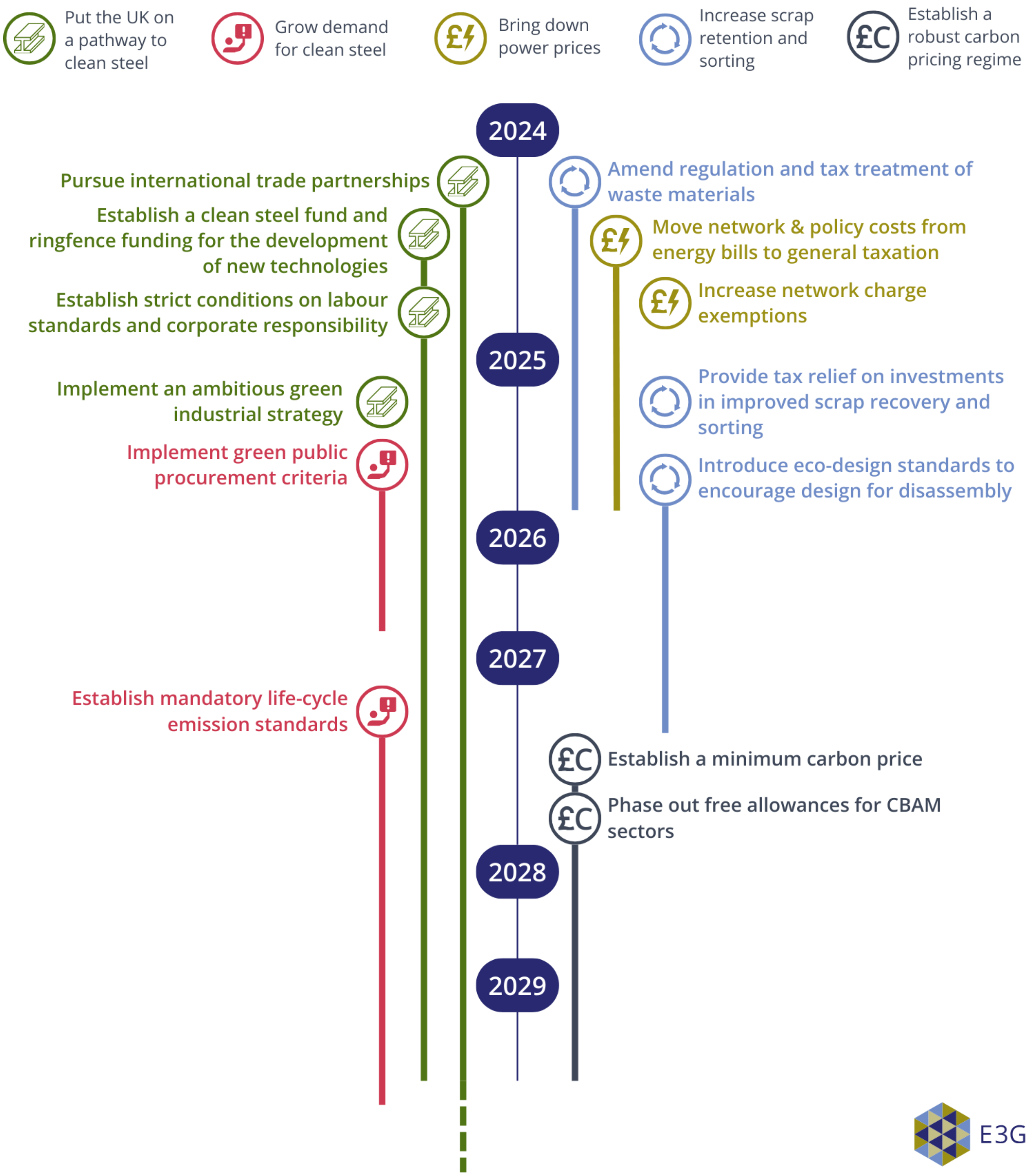
Increase scrap retention and sorting

10. Amend regulation and tax treatment of waste materials to remove financial incentives for the export of scrap steel.
11. Introduce eco-design standards to encourage design for disassembly.
12. Provide tax relief on investments in improved scrap recovery and sorting processes.

Establish a robust carbon pricing regime

13. Establish a minimum carbon price that rises over time to ensure the cost of UK ETS emissions allowances remains sufficiently high to incentivise investment in decarbonisation.
14. Phase out free allowances for CBAM sectors as a CBAM is implemented.

Timeline for growing clean steel in the UK



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PREFACE
HOW ARE IRON AND STEEL MADE?

Most of the world's steel is made via two methods: the blast furnace-basic oxygen furnace (BF-BOF) method, and the electric arc furnace (EAF) method.

Blast furnace-basic oxygen furnace (BF-BOF) steelmaking

This is an extremely carbon-intensive process known as "primary" or "virgin" steelmaking, which dominates production around the world.

In a blast furnace (BF), coking coal and limestone are used as reactants to remove the impurities in iron ore, leaving a purer form of hot, liquid iron. This is transported to a basic oxygen furnace (BOF), in which oxygen is blown through the molten mixture to remove carbon and other impurities, creating steel.

Electric arc furnace (EAF) steelmaking

This is the second most common method of producing steel and is far less carbon intensive than a BF-BOF, especially when powered by clean electricity.

In an EAF, electricity is used to create an extremely high-power "electric arc" between two electrodes over a solid metal mixture. This melts the metal, ready for refining, after which it is cast into shapes such as slabs and billets.

To produce secondary steel, recycled steel scrap is fed into the EAF for remelting and processing. To produce primary steel, metallic iron is fed into the EAF.

Ironmaking for EAF steelmaking

Iron used to produce primary steel in EAFs is made by reducing iron ore with a gas, such as hydrogen. This removes impurities, leaving a sponge-like pellet of direct reduced iron (DRI). This is compacted into hot briquetted iron (HBI) to enable safe transportation to other countries where it can be refined into steel.

The carbon intensity of this process largely depends on the reducing gas. Iron- and steelmakers are looking to replace fossil gas with low-carbon hydrogen.

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CHAPTER 1
AN OVERVIEW OF UK STEELMAKING

Steel in the UK: growing demand, declining production

Clean steelmaking is essential to mitigating climate change, and the UK is a valuable market for clean steel. Demand for steel in the UK is set to grow 26% by 2030, fueled by growing infrastructure needs for clean energy and transport networks.[6]

However, despite rising demand, UK steel production is at its lowest since the Great Depression,[7] now just one-fifth its historical peak.[8] Six UK steelmakers produce 5.9 Mt per year in total, of which 1.1 Mt comes from four secondary steel sites and 4.8 Mt from just two primary steel sites.[9] Steelmaking is responsible for 14% of the UK's industrial emissions and 2.4% of all territorial emissions.[10]

On the road away from a secure steel supply

A secure steel supply is essential. Steel is needed for strategic national interests, such as new housing, transport networks, and energy infrastructure. Steel is also needed for growth in sectors that look promising in the UK, such as zero-emissions vehicle production, heat pump manufacturing, and offshore wind.[11]

Historically, it has not been possible to produce all steel grades in an EAF due to issues with the quality of scrap steel supplies. However, by adding metallic iron to the EAF melt – to produce primary steel – this problem can be overcome. However, the UK is on course to eliminate iron production, leaving its EAFs to produce secondary steel from scrap. In 2023, the government agreed to grant

[6] Green Alliance (2023) **A Brighter Future for UK Steel**
[7] UK Steel (2023) **UK Steel Key Statistics Guide 2023**
[8] House of Commons Library (2021) **UK Steel Industry: Statistics and Policy**
[9] UK Steel (2023) **UK Steel Key Statistics Guide 2023**
[10] House of Commons Library (2023) **Contribution of the Steel Industry to the UK Economy**
[11] IPPR (2024) **Manufacturing Matters**

£500m to Tata Steel to support the transition of their Port Talbot plant to a 3 Mt electric arc furnace (EAF).[12] A similar deal has been proposed by the UK's only other primary steelmaker, British Steel – in this case converting its plant in Scunthorpe to two smaller EAFs, one in Scunthorpe and one in Teesside, but with the same level of investment.[13] This will reduce emissions at each site by 75–85%,[14] and end the £1m loss each site currently makes per day.[15] However, it will also lead to thousands of job losses.

This is a unique pathway among industrialised nations, who are mostly maintaining or increasing primary output alongside demand.[16] It follows the UK's steep trajectory of industrial decline, which has been quicker and more intense than in all other G7 countries.[17]

Without domestic primary steel, the UK will either need to adapt manufacturing processes to use secondary steel from its EAFs (which is not yet possible in all sectors without adding iron to the EAF melt[18]) or rely entirely on imports of iron, primary steel and/or finished goods made in other countries. There are pros and cons to this approach: on the one hand, other countries may be able to produce iron and primary steel more competitively, bringing down prices for consumers. On the other, the UK would be reliant on international supply chains for certain products, making it more vulnerable to shocks in global supply, or dependent on other nations for sensitive products – such as energy and defence components.

Dependence on international supply is already having negative effects: according to the Department for Energy Security and Net Zero (DESNZ), the lack of domestic capacity and a squeeze on the global supply of wind turbine

[12] DBT (2024) **Tata Steel / Port Talbot Steelworks Q&A**

[13] British Steel (2024) **British Steel's £1.25-billion decarbonisation plan given major boost as permission granted for Electric Arc Furnace in Scunthorpe**

[14] The transition at Port Talbot will reduce the site's emissions by 85% (Tata Steel (2024) Tata Steel announces next steps towards its ambitious transformation from blast furnaces to green steelmaking in the UK and initiates **statutory consultation**).

At British Steel, the transition will reduce the site's emissions by 75% (British Steel (2024) **British Steel's £1.25-billion decarbonisation plan given major boost as permission granted for Electric Arc Furnace in Scunthorpe**).

[15] BBC (2024) **Union Votes for Strike Action over Tata Job Losses**

[16] OECD (2024) **Steelmaking Capacity**

[17] IPPR (2024) **Manufacturing Matters – The Cornerstone of a Competitive Green Economy**

[18] UK Steel (2024) **Electric Arc Furnaces and Product Ranges**

components is already hampering the UK's ability to accelerate clean energy development.[19]

With UK primary steel production less carbon intensive than the global average,[20] there is also a risk, though slight, that **reliance on imported steel may also result in a net increase in emissions**. It would be preferable for the UK to produce clean steel here than rely on high-emissions steel from elsewhere.

An alternative vision for UK steel

A brighter future for UK steel is possible. To achieve it, the next government must take a holistic, ambitious approach to UK industry and manufacturing. This includes transforming current sites and delivering a just transition for workers while establishing policy and investment support to grow a secure supply of low-emissions primary steel.

Other countries are offering significant financial support that has unlocked investment in the first wave of clean steel projects from South Asia to North America. We can see from these projects that some countries are securing green iron and primary steel capacity for a similar level of investment to what the UK is putting into securing secondary steelmaking alone in Port Talbot (Table 1, Chapter 2).

Imported iron will likely play a role in UK steelmaking

Domestic primary steelmaking does not necessarily require domestic ironmaking. The UK could import hot briquetted iron (HBI), for processing into primary steel in an EAF. **Importing green iron could have a net benefit by harnessing the efficiency gains of producing iron in countries with iron ore supplies and abundant renewables** to produce hydrogen for direct reduced iron (H-DRI). Imported HBI could also be used in conjunction with domestically produced DRI to increase the steel capacity of the UK's steel plants.

However, there are currently no plans for the import of green iron, with the UK steel sector instead planning to move to secondary production only. There is also no industrial or trade policy setting out how the UK will ensure it has sufficient

[19] Department for Energy Security and Net Zero (2024) **UK Renewables Deployment Supply Chain Readiness Study**

[20] UK Steel (2022) **Net Zero Steel: A Vision for the Future of UK Steel Production**

iron and steel capacity, whether domestic or via trade partners. Moreover, there is also very little global DRI capacity, and almost no low-carbon hydrogen-DRI. It should be noted however, that the decision is not binary. **The UK has an opportunity to establish early H-DRI capacity and capture a share of the market, creating a valuable economic opportunity while mitigating supply chain dependency.** This could then be complimented by imported iron once it is available from the global market at the right price and volume.

This report sets out a framework for growing clean steel in the UK. Chapter 2 assesses the capital requirements of 3 scenarios for growing clean steelmaking in the UK – compared to a baseline scenario built on the government's current plan for UK steelmaking. Chapter 3 looks beyond funding, at the wider policies needed to improve the overall environment for competitive UK steelmaking in the long term.

CHAPTER 2
INVESTING IN CLEAN STEEL

Green iron and clean steelmaking capacity comes at a relatively low price

Other countries are establishing green iron **and** primary steel capacity for a similar level of total investment to what the UK is putting into establishing secondary steel in Port Talbot (see examples in Table 1).

According to data gathered by Global Energy Monitor,[21] as of April 2024 there are 12 active projects globally that aim to produce over 2 Mt of H-DRI. Total investment in these projects ranges from $1.2bn to $7bn, with a mean average of $2.6bn.[22]

The projects at the higher end of the investment range also include primary steelmaking facilities that use the DRI to make low-emissions primary steel, while cheaper projects either have lower steel capacity or focus solely on ironmaking. Table 1 highlights some of these projects from across the world.

Due to high upfront capital requirements, governments aiming to secure clean steel capacity are offering significant financial support to stimulate private investment. This is the context within which the UK must compete, with even the most laissez-faire economies shifting to a more interventionist approach.

However, support varies between countries and projects. The average subsidy intensity for green iron is £306 per tonne in Europe, versus £199 in the US;[23] public funding accounts for 58% of the financing for Salzgitter's Lower Saxony plant, versus 4% of H2 Green Steel's Boden plant. This reflects terms negotiated by industry, geographic differences (such as domestic resources), and the varied private finance leveraged by different companies.

[21] Global Energy Monitor (2024) **Global Steel Plant Tracker, April 2024 (V1) Release**

[22] Ibid.

[23] Public Citizen (2024) **Government Subsidies for the Green Steel Transition**. This may be higher following $6bn granted by the US DOE to projects including several iron steel initiatives: DOE (2024) **Industrial Demonstrations Program Selections for Award Negotiations: Iron and Steel**

Table 1: Examples of clean steel projects from across the world.

Company	Country	Capacity (Mt)		Investment ($bn)		
		DRI	Steel	Public	Private	Total
ArcelorMittal	Spain	2.3*	1.1*	0.5*	0.6*	1.1
H2GS	Sweden	2.1*	5*	0.3*	6.7*	7
Techint Group	Mexico	2.1†	2.6†	Not stated	2.2†	2.2
Salzgitter	Germany	2*	1.9*	1.1*	0.8*	1.9
Vulcan Green Steel	Oman	2.5†	5†	Not stated	3†	3

* Public Citizen (2024) **Government Subsidies for the Green Steel Transition**
† Global Energy Monitor (2024) **Global Steel Plant Tracker**

Three scenarios for growing clean steel in the UK

To get a sense of what the UK might need to invest to establish clean steelmaking, we present three investment scenarios, comparing them to the current plan to transition to 100% secondary steelmaking, which is used as the baseline scenario.

Each scenario for growth requires a different amount of investment, results in different capacity, and comes with a range of benefits and drawbacks. The total capacity in each scenario includes 1.1 Mt of secondary steel currently made by the four existing EAF operators, which is assumed to be maintained. (This capacity could also increase with more support for current steelmakers, which is addressed in Chapter 3.) Where there is not enough domestic DRI capacity to exhaust the additional steelmaking capacity of certain scenarios, it is assumed that this steelmaking capacity will be used to make secondary steel from scrap.

Cost assumptions underpinning each scenario are based on the real costs of active international clean steel projects. However, the actual costs for a similar project in the UK may vary due to different economic circumstances and costs for construction in different geographies. The estimates are designed to provide a general illustration of the global average cost of different technologies and what the UK may have to spend to establish green iron and clean steel capacity (see the Annex for the methodology for estimating plant costs).

Table 3 summarises the plant costs and capacity assumptions used in the scenarios. Figure 1 (next page) summarises the developments each scenario would include, the investment required, and the iron- and steelmaking capacity it would deliver.

Table 3: Cost estimate for green iron and primary steel developments in the UK

Development	Investment		Capacity (Mt)		
	Total	Public	Secondary steel	DRI	Primary steel
Brownfield BF-BOF to EAF	£1.25bn ($1.57bn)	£0.5bn	3	—	—
Brownfield BF-BOF to H-DRI-EAF	£1.92bn ($2.41bn)	£0.77bn	—	2.5	2.22
Greenfield H-DRI-EAF	£3.5bn ($4.4bn)	£1.4bn	—	2.5	2.22
Greenfield H-DRI	£2.83bn ($3.55bn)	£1.13bn	—	2.5	—

Baseline scenario

The current plan to transition to 100% EAF steelmaking

As detailed above, the current plan is to transition the two BF-BOFs at Port Talbot and Scunthorpe to EAFs, with an additional EAF built in Teesside (as in Scenarios 2 and 3). These plants will make low-emissions secondary steel from scrap but could also produce low-emissions primary steel from imported green iron.

This scenario delivers 7.1 Mt of secondary steel production, but no iron or primary steel capacity. The investment is £1.25bn of which £0.5bn is public.

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Scenarios for clean steelmaking in the UK

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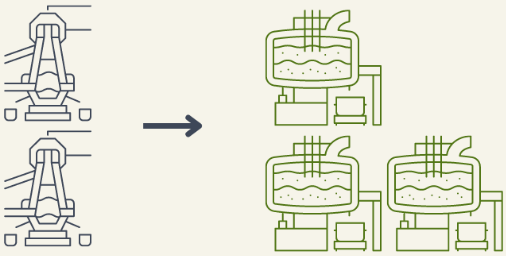
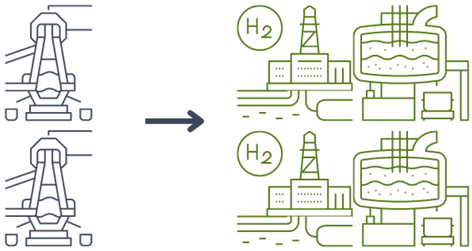
Baseline scenario: 100% EAF steelmaking



Conversion of 2 BF-BOFs to EAFs at Port Talbot and Scunthorpe, and another EAF at Teesside.
2 × £1.25bn (£0.5bn public)

Total investment	Total capacity		
£2.5bn	**7.1 Mt**	**0 Mt**	**0 Mt**
(£1bn public)	secondary steel	H-DRI	primary steel

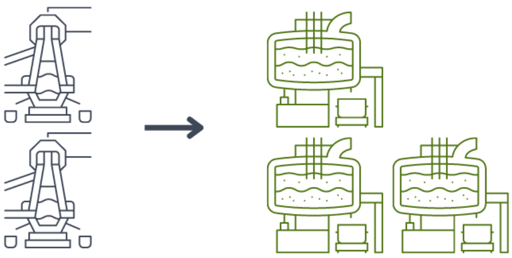
1 Brownfield conversion only



Conversion of 2 BF-BOFs to integrated H-DRI-EAFs at Port Talbot and Scunthorpe.
2 × £1.92bn (£0.77bn public)

Total investment	Total capacity		
£3.84bn	**1.1 Mt**	**5 Mt**	**4.44 Mt**
(£1.54bn public)	secondary steel	H-DRI	primary steel

2 Brownfield conversion & greenfield development – Option 1

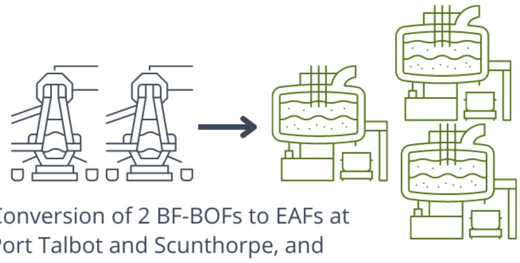


Conversion of 2 BF-BOFs to EAFs at Port Talbot and Scunthorpe, and another EAF at Teesside.
2 × £1.25bn (£0.5bn public)

New H-DRI plant in a favourable location.
£2.83bn (£1.13bn public)

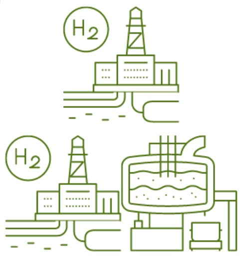
Total investment	Total capacity		
£5.33bn	**4.88 Mt**	**2.5 Mt**	**2.22 Mt**
(£2.13bn public)	secondary steel	H-DRI	primary steel

3 Brownfield conversion & greenfield development – Option 2



Conversion of 2 BF-BOFs to EAFs at Port Talbot and Scunthorpe, and another EAF at Teesside.
2 × £1.25bn (£0.5bn public)

New H-DRI and integrated H-DRI-EAF plants in favourable locations.
£2.83bn (£1.13bn public)
£3.5bn (£1.4bn public)



Total investment	Total capacity		
£8.83bn	**4.88 Mt**	**5 Mt**	**4.44 Mt**
(£3.53bn public)	secondary steel	H-DRI	primary steel

Figure 1: This report compares three possible growth scenarios for steelmaking in the UK with the baseline scenario of transitioning to 100% EAF steelmaking.

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Benefits

> Low upfront capital requirement and reduced costs from building on existing infrastructure.

> If the UK secured supplies of green iron from global producers, primary steelmaking would remain possible in the future.

> Some jobs would be kept in communities already reliant on steel.

Drawbacks

> Large overall job losses (more so than any scenario for growth).

> Significant dependence on imports: either of green iron to produce primary steel, or of primary steel and finished products to replace domestic production.

> Does not support sectors that need primary steel, which could negatively impact the UK's manufacturing capabilities and strategic interests.

Scenario 1: Brownfield conversion

Transition to low-emissions primary steel at Port Talbot and Scunthorpe

In this scenario, the two BF-BOFs in Port Talbot and Scunthorpe are transitioned to integrated H-DRI-EAFs that can make low-emissions primary steel. Unlike the baseline scenario, there is no EAF in Teesside, but the sites at Port Talbot and Scunthorpe can produce primary steel with hydrogen-based ironmaking capacity.

This scenario delivers 5 Mt H-DRI and 4.44 Mt primary steel capacity in addition to 1.1 Mt secondary steel. The investment is £3.84bn of which £1.54bn is public.

Benefits

> This scenario retains a higher number of jobs than the baseline scenario, with jobs staying in communities already reliant on steel. Jobs would also be kept in the primary steel value chain.

> The additional investment enables domestic ironmaking and primary steelmaking, mitigating some dependency on international supplies of iron, steel, and finished products, and supporting manufacturing reliant on primary steel.

> As a brownfield conversion of existing sites, it reduces the cost of decarbonisation.

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Drawbacks

- Higher upfront capital costs than the baseline scenario.
- H-DRI production at Port Talbot and Scunthorpe may be less efficient than at a greenfield site near a UK hydrogen production location.
- Risk of producing more H-DRI than the UK needs, which could result in uncompetitive or stranded assets.
- H-DRI production would be owned by existing steelmakers, rather than a third party supplying all EAF operators. Scenario 2 has a more flexible range of assets, but at a higher overall cost.

Scenario 2: Brownfield conversion and greenfield development option 1

Transition to EAFs at Port Talbot, Scunthorpe, and Teesside, with an additional DRI plant at a new site

In this scenario, the two BF-BOFs at Port Talbot and Scunthorpe are transitioned to EAFs, with an additional EAF built in Teesside (as in the baseline scenario and Scenario 3). Additionally, a new H-DRI plant is built in a favourable third location – such as near one of the UK's hydrogen clusters – to supply iron to the EAFs for low-emissions primary steelmaking.

This scenario delivers 2.5 Mt H-DRI and 2.22 Mt primary steel capacity, in addition to 4.88 Mt secondary steel capacity. The investment is £5.33bn of which £2.13bn public.

Benefits

- Retains a higher number of jobs in communities already reliant on steel than the baseline scenario and creates new jobs in a new location. Jobs would also be supported across the primary steel value chain.
- Enables domestic iron and primary steelmaking. This mitigates some dependency on international supplies of iron, steel, and finished products and provides additional support to domestic manufacturing reliant on primary steel.
- The brownfield development of EAFs would capture the benefits of building on existing infrastructure, while the greenfield development of an H-DRI plant could capture the benefits of co-location with hydrogen producers. It would also provide a more optimised amount of iron for UK steelmaking.

E3G

Drawbacks

> Higher upfront capital requirement than the baseline scenario and Scenario 1.

> Could result in less iron and steel capacity for a higher cost than Scenario 1 (though perhaps more optimised/cost-effective over the long term).

> While it creates more jobs than the baseline scenario, it is not certain that it will replace all jobs lost in the transition from BF-BOFs. Moreover, some will not be based in areas currently dependent on steelmaking – as with all greenfield development.

Scenario 3: Brownfield conversion and greenfield development option 2

Transition to EAFs at Port Talbot, Scunthorpe, and Teesside, with an additional DRI plant and integrated H-DRI-EAF at new sites

In this scenario, the two BF-BOFs at Port Talbot and Scunthorpe are transitioned to EAFs, with an additional EAF built in Teesside (as in the baseline scenario and Scenario 2). In addition, an H-DRI plant **and** an H-DRI-EAF plant are built in two favourable locations to support domestic low-emissions primary steelmaking.

This scenario delivers 5 Mt H-DRI and 4.44 Mt primary steel capacity, in addition to 4.88 Mt secondary steel capacity. The investment is £8.83bn of which £3.53bn is public.

Benefits

> Of all the scenarios, this option retains and/or creates the highest number of jobs across the steel sector, including in two new locations. The H-DRI and H-DRI-EAF plants support new jobs in new locations, but also provide more capacity for the overall sector, enabling primary steel in existing steel communities, and supporting the primary steel value chain.

> Enables the highest level of domestic iron and primary steelmaking and has the highest mitigation of dependency on international supplies of iron, steel, and finished products. This provides additional support to domestic manufacturing reliant on primary steel.

> Builds on both existing infrastructure and the benefits of new sites.

Drawbacks

> Highest upfront capital costs.

> Highest risk of overcapacity next to what the UK may be able to produce or sell competitively.

> By far the largest energy requirement of all four scenarios.

> High demand for clean steel and low clean energy costs could justify this larger investment scenario. However, without favourable conditions, there is a risk the UK could end up with uncompetitive assets and stranded investment.

Implications of different pathways to clean steel

There is not one clear pathway for UK steelmaking. Each scenario delivers different benefits and carries different risks. For example, the baseline scenario is the cheapest option but would lack the primary steelmaking needed to protect more jobs, secure supply, and deliver greater economic benefits – particularly in other sectors reliant on primary steel. Conversely, converting an existing site to an H-DRI-EAF may be more cost-effective in the short term, but a more expensive H-DRI-EAF in a preferable location may capture efficiencies that save money over the long term.

It is likely that **the optimal combination of facilities depends heavily on domestic and international demand for clean steel** and what the UK can produce competitively. For example, a growing domestic zero-emissions vehicle sector would increase demand for clean steel.

In addition, the nature of international production across different product categories has a major impact on what the UK could (or should) look to produce domestically. For example, if the production of floating offshore wind components remains low, there is a clear case to invest in the range of facilities needed to produce these parts to meet the UK's targets for growing renewables (and potentially exporting to other nations doing the same).

If the UK can produce cheap low-carbon hydrogen – especially relative to the EU – this would justify more investment in H-DRI. In their assessment of the future hydrogen economy, PwC predict that the UK will produce **low-carbon** hydrogen at a lower cost than Germany, France, Sweden, Italy and Spain – the UK's key European steel competitors. With greater investment into the UK's hydrogen infrastructure, it is likely that UK steelmakers would lean more heavily towards the use of hydrogen in the ironmaking process.

Alternatively, government could attract new investment in H-DRI by creating a more attractive investment environment in which prospective steelmakers could make a faster, more substantial return.

Lastly, there is a strong need for the government to ensure good value for public money. The current plan for steel will result in 7.1 Mt of secondary steel for an investment of £2.5bn with £1bn from public funds. For an additional ~£0.54bn (Scenario 1), government could initiate £2.3bn of private funding and establish 5 Mt of DRI capacity, with 4.44 Mt of primary steel capacity. This is more in line with what other countries are doing and would enable the UK to produce iron and primary steel domestically.

Which pathway should the UK follow?

Ultimately the next government will have to balance the various trade-offs of different pathways to clean steelmaking, however it is clear that the current plan does not offer good value for money when compared to investments in other countries. It also introduces a high level of risk regarding increased exposure to global supply, which could undermine other economic sectors. It also results in extremely high job losses, which will damage the local economies and communities of Port Talbot and Scunthorpe.

By investing a relatively modest sum into growing the UK steel sector, the next government could prevent these negative impacts and secure a range of benefits. This includes protecting and securing a much larger number of jobs than the baseline scenario – including jobs not just in the steelmaking process, but across the value chain for primary steel. Establishing low-emissions primary steel capacity would also support supply chain security, benefitting the UK's resilience and sectors reliant on primary steel. Lastly, investing in the sector would offer the opportunity to capture an early market share in low-emissions primary steelmaking – which could lead to a valuable export opportunity in the future.

To understand what level of investment is appropriate, the next government must establish a comprehensive plan to:

1. Ensure the UK can either produce, or secure through international supply chains, the steel it needs for its strategic aims on energy security, decarbonisation, defence, transport, and housing.
2. Deliver for the UK's wider economic ambitions, capabilities, and strengths, guided by demand and the opportunity to capture market share in growing sectors. This should be used to create jobs across the UK's industrial and manufacturing value chains.

Recommendations

1. **Implement an ambitious green industrial strategy**. The strategy should include an explicit vision for the future of domestic steel production and how it will align with the UK's wider strategic and economic aims, from energy security to the growth of new cleantech sectors. This should include: planning reforms and a blueprint for critical infrastructure to speed up investment in new plants; energy market reform to provide access to affordable clean power; and a national skills strategy to ensure the UK workforce has the skills to operate a thriving clean steel sector.
2. **Establish a clean steel fund with £2.1bn–£3.5bn of funding**, with the aim to establish up to 3.78 Mt of additional secondary steel capacity, 4.44 Mt of low-carbon primary steel capacity, and 2.5–5 Mt of domestic hydrogen DRI capacity. The fund should aim to stimulate £3.2bn–£5.5bn of private investment, based on a maximum 40% subsidy intensity. With low-carbon hydrogen representing 21% of clean steel production costs,[24] it is likely that clean primary steel projects may need some support for their ongoing energy costs on top of the support given to cover upfront capital expenditure. A fund of this size would be able to support some of these costs if supporting less capital investment (as seen in Scenario 2), but additional funding may be needed to support ongoing costs in a high capex scenario (Scenario 3). It is likely that support for ongoing costs may be necessary until hydrogen prices comes down. Separate mechanisms will be needed to tackle electricity prices for electro-intensive industries on an ongoing basis, or to structurally lower electricity prices for the long term.

[24] Energy Transitions Commission (2023) **Unlocking the First Wave of Breakthrough Steel Investments in the United Kingdom**

3. **Establish strict conditions on labour standards and corporate responsibility** in return for government funding for clean steel. Funding for clean steel should be deployed competitively, with strict conditionality that prohibits companies from retaining funds if they abandon projects or continue to use polluting fuels (such as fossil gas instead of low-carbon hydrogen) beyond an agreed transition date. Minimum requirements on labour standards and collective bargaining processes should be established to ensure fair compensation and safe working conditions for workers. E3G recommends positively weighting commitments on labour standards in the same way that lower costs are rewarded.

4. **Ringfence funding from the clean steel fund for the development of new technologies for green iron and steel production.** While most clean steel projects are using H-DRI, HBI, and EAFs, new technologies could reduce the heat and energy required for steelmaking or reduce the new infrastructure and capital needed. Possibilities include pilot schemes for molten-oxide electrolysis and alternative fuels. The UK should build on its world-leading research institutions (such as the Programme of Research and Innovation for the UK Steel and Metals sector, PRISM, and the SUSTAIN Future Manufacturing Research Hub) to establish the next generation of clean steel technologies. By following the Glass Futures model of industry, government, and local authority collaboration, the UK could establish first-of-a-kind projects, and export new technologies to other countries – speeding up global steel decarbonisation.

5. **Pursue international trade partnerships to kick-start green iron trade.** The shift to clean steelmaking is likely to create a greater role for green iron production in countries with abundant, low-cost renewable electricity and access to iron ore resources – such as Brazil, Australia, and South Africa. The UK should develop partnerships with these production hubs to enable access to cheaper, green iron, but also to accelerate the growth of global green iron production. Such partnerships could relieve pressure on domestic renewable electricity supply, reducing prices and overall decarbonisation costs.

CHAPTER 3
BEYOND THE FUNDING

In addition to financial support, the overall investment environment is critical to the success of clean steel projects and will heavily affect the route the UK takes to reducing the emissions from its steel consumption. This includes the demand for clean steel, the cost of electricity (and hydrogen, as discussed above), a supportive carbon pricing regime, and the availability of materials like scrap steel.

E3G's Steel Policy Scorecard highlights how the UK is lagging behind other nations when it comes to establishing the policies needed to support the growth of clean steelmaking.[25]

This chapter addresses each of these policy needs, providing recommendations to stimulate the growth of clean steelmaking in the UK. Just like public funding support, each of these factors is crucial, but none can deliver the transformation needed alone.

Growing demand for clean steel

To justify investment, businesses require clear demand. For example, if the UK were to pursue a high growth scenario (such as Scenario 3) with significant investment in green iron and steelmaking, the private sector would be looking for clear, long-term demand for green iron and steel to ensure their investment does not go into stranded assets. However, high-emissions steel currently dominates the market, undermining the confidence needed to pursue projects with such large upfront costs.

By establishing a long-term policy framework to stimulate early demand, government can use its role as regulator and consumer to improve the business case for clean steel and harness a valuable early share of the growing clean steel market. The UK government spent over £600m on steel in 2023 – equivalent to 25% of the economic contribution of steel produced in the UK. This purchasing

[25] E3G (2024) **Raising ambition on steel decarbonisation: The 2023 E3G Steel Policy Scorecard**

power could be used to create direct demand for clean steel by specifying clean steel for public projects.

In addition to procuring cleaner steel itself, government can set emissions standards in other industries to increase private procurement of clean steel. Some automakers are already signing private supply agreements for future clean steel to reduce the life-cycle emissions of their products. For example, Mercedes-Benz have an order for 50 kt of clean steel per year from H2 Green Steel, once in operation.[26] If all automakers were subject to life-cycle emissions standards for their vehicles (going beyond tailpipe emissions), there would be an industry-wide pull for clean steel supply. This could be replicated in other sectors that consume large quantities of steel, such as the construction industry.

Recommendations

6. **Implement green public procurement criteria that limit the embodied carbon of steel procured for public projects.** By setting a maximum level on the life-cycle emissions of the steel it buys, the government can directly improve the business case for domestic clean steel production. If accompanied by strong support for the decarbonisation of UK steelmaking, this could directly benefit domestic producers and the wider UK economy without the need for more contentious local content requirements.
7. **Establish mandatory life-cycle emissions standards on certain goods sold in the UK, prioritising sectors with low exposure to material costs.** By placing a maximum threshold on the life-cycle emissions of certain products – from steel itself as an intermediate product to finished goods such as cars and buildings – the government can create a demand pull from sectors required to reduce their emissions. To reduce the impact on consumers, government should start with sectors that have low exposure to increases in material costs, such as automotive production and the construction sector.

[26] Mercedes-Benz (2023) **Mercedes-Benz and H2 Green Steel Secure Supply Deal**

Bringing down power prices to improve the competitiveness of green iron and steel production

Green iron and steel production are electro-intensive processes, with EAFs and low-carbon hydrogen production both requiring large amounts of clean power. In both the baseline scenario and the three scenarios for growth, the UK's steel assets will draw a significant amount of power from the grid to power EAFs and DRI plants. In the three scenarios for growth, steelmakers will be even more exposed to electricity prices via their hydrogen costs, which includes the electricity used to power a hydrogen electrolyser.

However, industrial electricity prices are currently so high that some steelmakers are already reducing their output and, in some cases, shutting down sites entirely.[27] This has been a driver of the UK's diminishing steel capacity, which stands at less than half the potential output of existing assets.

Action to structurally lower electricity prices in the long term is therefore crucial. This will require market reform to reduce wholesale prices, as well as acceleration of the Connections Action Plan and Transmission Acceleration Plan to connect new steelmakers. However, with prices already so severe, inaction could decimate the existing sector. Near-term action is essential.

Recommendations

8. **Increase network charge exemptions provided by the British Industry Supercharger to 90%.** The network charge exemptions of up to 60% offered by the British Industry Supercharger save some electro-intensive industrial businesses £14/MWh.[28] This should be extended to up to 90% to make H-DRI-EAF more competitive and mirror the 90% exemptions in Germany and the Netherlands.
9. **Move network and policy costs from industrial electricity bills to general taxation.** 22% of electricity bills are made up of "environmental and social levies", compared to just 2% of gas bills.[29] To increase the competitiveness of H_2 and EAF production, government should recover these levy costs through progressive taxation.

[27] Reuters (2023) **Liberty Steel Suspends Some UK Plants Due to Power Prices**

[28] Department for Business and Trade (2023) **Government Response: Network Charging Compensation Scheme**

[29] Business Energy and Industrial Strategy Committee (2022) **Decarbonising Heat in Homes**

Increasing scrap retention and sorting to meet the UK's plans for EAF steelmaking

While this report has largely focused on primary steelmaking, secondary steelmaking – using scrap steel as a feedstock – is a crucial part of the UK's existing and future steel sector and should be maximised. Not only does the UK have a high level of scrap, it has a mature renewables sector, meaning it can power EAFs more cleanly than other countries with more carbon-intensive grids. In addition, the use of EAFs mitigates expensive, energy intensive processes and mining practices, and increases circularity.

In the UK's current plan for steelmaking (the baseline scenario), 100% of production will take place in EAFs using scrap steel. Across all the three scenarios for growth, there are at least four EAF operators producing 1.1 Mt of secondary steel from scrap per year. Globally, demand for scrap is expected to increase threefold by 2050.[30]

However, while the UK recovers a significant amount of scrap – around 11 Mt per year – it exports 80% of it.[31] This is because exporting waste is cheaper than sorting it domestically, and due to a stronger business case/demand from the international steel market.[32]

In addition, some scrap steel cannot be used for certain products due to contaminants in the waste stream (resulting in blemishes and/or issues with material purity). Investment is needed in new sorting processes that can remove these impurities to expand the scope of products that can be made from secondary steel.

To fully utilise the UK's scrap steel supply, measures are needed to increase the recovery and retention of scrap and to improve the quality of what is recovered. This means increasing the recovery rate of scrap steel from waste streams, increasing the purity of that scrap steel through better sorting, and increasing the range of products EAFs can make.

[30] UK Steel (2023) **Steel Scrap: A Strategic Raw Material for Net Zero Steel**

[31] Ibid.

[32] Ibid.

Recommendations

10. **Amend regulation and tax treatment of waste materials to remove financial incentives for the export of scrap steel.** Packaging waste Export Recovery Notes (PERNs) offering payments for the export of scrap to be recycled abroad should be removed or reduced. This payment creates an incentive to export waste due to the higher cost of quality specifications and the disposal of contaminated waste in the UK. Reducing VAT and/or business rates levied on sales of scrap steel would also make it more economical to sell to the domestic rather than export market.

11. **Introduce eco-design standards to encourage design for disassembly.** Current designs of car components, for example, make it time-consuming and expensive for vehicle dismantlers to fully extract copper. As a result, some copper is mixed and melted with recovered steel, reducing the quality of the eventual downcycled steel. Design standards that encourage a focus on recovery and disassembly would increase the share of high-quality scrap recovered and recycled.

12. **Provide tax relief on investments in improved scrap recovery and sorting processes.** To produce more steel grades, investment is needed in better sorting processes that can remove more impurities. By extending full expensing to investment in scrap sorting technologies, the government can incentivise investment in technologies that will improve scrap supply streams and create new jobs in the process through the use of new, additional processes in the metals sorting sector. Dedicated R&D funding to improve scrap sorting and separation techniques would also help to reduce waste by increasing the amount of scrap steel that can be used in an EAF.

Establishing a robust carbon pricing regime

The UK Emissions Trading Scheme (ETS) is crucial to decarbonising steel. By placing a price on the CO_2e they emit, steelmakers are incentivised to decarbonise to mitigate that cost. As we near 2050, the cost of emissions must become sufficiently high to make polluting impracticable.

However, in the UK (and previously EU) ETS, prices have historically been low, and in the UK have dipped substantially in recent months. Moreover, the UK steel industry receives the majority of its allowances for free. This damages the incentive to decarbonise. It also weakens the investment case for clean technologies and fuels like hydrogen and electrification, which become more

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cost-effective as the cost of emitting increases. For example, some of the capital costs of building a new, cleaner plant could be "recovered" through the mitigation of carbon costs associated with more polluting production processes. Over time, this would make the use of clean power and hydrogen more cost-effective than if carbon prices remained low.

In addition to a rising carbon price on domestic production, a carbon price at the border is needed to ensure domestic producers making efforts to decarbonise are not undermined by high-carbon imports that have not faced a carbon price. With plans for a UK Carbon Border Adjustment Mechanism (CBAM) in motion, it is crucial that the government establish a plan for the withdrawal of free allowances to prevent "double protection" against imports. With some businesses receiving the majority (and sometimes all) of their allowances for free,[33] a clearer plan for the phase-out of free allowances will also ensure that carbon prices are applied more directly across the economy, while giving industry clarity on the nature of their future carbon costs.

Recommendations

13. **Establish a minimum carbon price that rises over time to ensure the cost of UK ETS emissions allowances remains sufficiently high to incentivise investment in decarbonisation.** This could be delivered by an auction reserve price (ARP) like that already used in the UK ETS, but at a higher level than in recent years (with the previous ARP unable to protect the efficacy of the scheme against sustained price falls). This should be established at a level that encourages investment in decarbonisation technologies, especially in the medium term until the cost of these technologies reduces.

14. **Phase out free allowances for CBAM sectors as a CBAM is implemented.** With a CBAM set to be in operation from 2027, free allowances should be reduced to prevent double protection of CBAM sectors. The UK ETS Authority should reduce free allowances in accordance with the level at which a CBAM is applied to imports, with full phase-out of free allowances by 2030 at the latest.

[33] UK government (2023) **UK Emissions Trading Scheme: Free Allocation Review**

ANNEX
METHODOLOGY FOR ESTIMATING PLANT COSTS

The data used to estimate plant costs was supplied by Global Energy Monitor.[34]

There are 36 active projects that plan to produce green iron. Only 22 of these publicly state an iron capacity figure. Of these, 19 also state the size of investment. These 19 projects form the sample used for this report (see Table 2, next page). We acknowledge that, without the data for the other 17 projects, this is an incomplete picture.

Estimating the cost of a greenfield DRI plant (2.5 Mt DRI)

Among the 19 projects with investment and iron capacity data, the mean average investment is $1.7bn, for a mean average capacity of 1.56 Mt DRI. This equals $1.09bn per 1 Mt of DRI.

10 of these projects are greenfield developments with a mean average investment of $1.76bn for 1.24 Mt DRI. This equals $1.42bn per 1 Mt of DRI.

Applying this average to a greenfield DRI plant with 2.5 Mt of DRI capacity gives an investment requirement of $3.55bn. A 2.5 Mt DRI plant (the modal average capacity of the major DRI projects) would enable 2.22 Mt of steel production at a rate of 1.125 Mt DRI to 1 Mt steel (see below for more information on the DRI to steel ratio).

For the purposes of this report, **a 2.5 Mt greenfield DRI plant requires £2.83bn of investment, of which £1.13bn comes from public funding** (see below for more information on currency conversion and subsidy intensity).

[34] Global Energy Monitor (April 2024 (v1 release)) **Global steel plant tracker**. This data is freely available under the Creative Commons Attribution 4.0 International Public License

Table 2: The 19 projects used to estimate plant costs for the scenarios presented in this report.

Project name	Project type	Iron capacity (Mt per annum)	Steel capacity (Mt per annum)	Investment size ($bn)
HBIS Naiman	Greenfield	1.00	2.00	0.68
H2 Green Steel (H2GS) Iberia	Greenfield	2.00	3.75	2.6
H2 Green Steel (H2GS) Boden	Greenfield	2.10	5.00	7.08
Ternium Nuevo Leon DRI	Brownfield	2.10	2.60	2.2
Gijón DRI and EAF	Brownfield	2.30	1.10	1.65
ArcelorMittal Dofasco DRI	Brownfield	2.50	2.40	1.42
Pure Steel+	Brownfield	2.50	4.70	3.8
Vulcan Green Steel	Greenfield	2.50	5.00	3
µDRAL	Greenfield	0.00091	Not applicable	0.016
Christmas Creek Green Iron Pilot	Greenfield	0.0015	Not stated	0.050
HyIron - Oshivela	Greenfield	0.015	Not applicable	0.032
ZESTY pre-FEED / FEED Study	Greenfield	0.03	Not applicable	0.00061
Hamburg H2	Brownfield	0.10	Not stated	0.122
H2V CAP	Brownfield	0.30	Not stated	0.0036
GravitHy	Greenfield	2.00	Not applicable	2.31
H-DRI Dunkirk	Brownfield	2.50	Not stated	1.93
ArcelorMittal Belgium DRI	Brownfield	2.50	Not stated	1.24
tkH2Steel	Brownfield	2.50	Not stated	2.24
HYBRIT	Greenfield	2.70	Not stated	1.85

It should be noted that this figure comes from projects that also involve steel production. However, steel capacity figures are unavailable for most of these projects, and where they are available, they vary significantly. In reality, the cost of a greenfield H-DRI plant is therefore likely to be less than the estimated figure provided if the plant is dedicated entirely to iron production.

In our scenarios, we do not specify where the iron is used. It would likely be sold on the open market to all UK steelmakers; in reality some could even be shipped abroad, however our scenarios assume that all iron capacity is used domestically. This also reflects that some green iron would likely be imported, and could enable further expansion of primary steel capacity.

Estimating the cost of H-DRI-EAF plants (2.5 Mt DRI, 2.22 Mt steel)

There are eight projects with iron, steel and investment capacity data: four greenfield developments and four brownfield conversions. These projects are used to provide cost estimates for H-DRI-EAF plants.

Greenfield development

The four greenfield developments (H-DRI-EAF) have a mean average investment of $3.34bn for 1.9 Mt DRI and 3.94 Mt steel. This is $1.76 per 1 Mt DRI and therefore $4.4bn for a 2.5 Mt project with 2.22 Mt of steel capacity (using the below DRI to steel ratio).

For the purposes of this report, **a greenfield H-DRI-EAF plant with 2.5 Mt DRI capacity and 2.22 Mt steel capacity requires £3.5bn of investment, of which £1.4bn comes from public funding.**

Brownfield conversion

The four brownfield conversions have a mean average investment of $2.27bn for 2.35 Mt DRI and 2.7 Mt of steel. This is $0.97bn per 1 Mt DRI and therefore $2.41bn for a 2.5 Mt project with 2.22 Mt of steel capacity.

For the purposes of this report, **a brownfield H-DRI-EAF plant with 2.5 Mt DRI capacity and 2.22 Mt steel capacity requires £1.92bn of investment, of which £0.77bn comes from public funding.**

Adjusting for steel capacity

These figures show that the average level of steel production across all active projects is higher than the capacity enabled by their planned DRI production. This suggests that these projects plan to purchase additional iron from elsewhere to produce more steel. As the level of imports is impossible to quantify (and will always vary across plants and businesses), this report calculates steel capacity based on a plant's DRI capacity (at a ratio of 1.125 Mt of DRI to 1 Mt of steel). However, we acknowledge that with additional iron purchases, this steel capacity could increase.

Estimating the cost of brownfield conversion of a BF-BOF site to an EAF (3 Mt)

The existing deal between the UK government and Tata Steel, and the proposed, similar deal with British Steel, establish a precedent for a government deal with the steel industry for an investment in the brownfield conversion of a BF-BOF site to EAF technology.

For the purposes of this report, **a brownfield conversion from BF-BOF to EAF with 3 Mt of secondary steel capacity requires £1.25bn of investment, of which £0.5bn comes from public funding.**

Subsidy intensity

The subsidy intensity across all three scenarios has been set at 40% of the total investment required. This is based on the existing deal between the UK government and Tata Steel for the transition of its Port Talbot plant, where £0.5bn of support is provided towards the total estimated cost of £1.25bn. British Steel have proposed a similar deal, calling for the same level of subsidy intensity.

E3G does not endorse a specific level of subsidy intensity. However, the existing deals provide a useful working precedent given the limited information on the subsidy intensity required to attract investment in clean steel in the UK.

As noted in this report, other countries have secured investment in clean steel projects with far less public investment. Other policy support mechanisms can also provide a powerful incentive for companies to invest in lieu of direct financial support.

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Green iron to primary steel ratio

Across the three scenarios, it is assumed that 100% of the DRI produced in the UK will be used by domestic steelmakers for low-emissions primary steel production. Using the International Energy Agency's conversion figures,[35] 1.125 Mt of DRI leads to 1 Mt of steel production (this is in the middle of the IEA's range of 1.05-1.2 DRI per 1 Mt steel).

Where EAF capacity is higher than the low-emissions primary steel production enabled by a given amount of iron capacity, it is assumed that the remainder of this capacity is used to produce secondary steel. For example, in Scenario 2:

> The UK has one iron plant, producing 2.5 Mt of H-DRI.

> This enables 2.22 Mt of primary steel production.

> With three new EAFs at Port Talbot, Scunthorpe, and Teesside (with a combined capacity of 6 Mt), and the existing four steel EAF sites being maintained (with a combined capacity of 1.1 Mt), in this scenario the UK has 7.1 Mt of EAF capacity.

> Therefore, with 2.22 Mt of primary steel using the 2.5 Mt of DRI, there is an assumed 4.88 Mt of secondary steel production across these sites.

It is important to note that these assumptions rely on the retention of scrap steel. It would also be possible for these sites to import green iron to increase the production of primary steel instead of secondary steel with scrap.

Currency conversion

As of the end of April 2024 (when this data set was last updated) the Bank of England exchange rate was GBP 1 to USD 1.2566. These figures have been used to convert USD investment figures to GBP.

[35] IEA (2020) **Iron and Steel Technology Roadmap: Towards More Sustainable Steelmaking**

Final cost estimates

Table 4 summarises the cost estimates used in the report.

Table 4: Cost estimate for green iron and primary steel developments in the UK

Development	Investment (£bn)		Capacity (Mt)		
	Total	Public	Secondary steel	DRI	Primary steel
Brownfield BF-BOF to EAF	1.25	0.5	3	—	—
Brownfield BF-BOF to H-DRI-EAF	1.92	0.77	—	2.5	2.22
Greenfield H-DRI-EAF	3.5	1.4	—	2.5	2.22
Greenfield H-DRI	2.83	1.13	—	2.5	—