July 2024

National Wealth Fund Taskforce

Interim Sector Analysis

Appendix to the Interim Report

Context

The Labour Party has proposed a £7.3bn public capital investment through a National Wealth Fund (NWF). There is an opportunity to design a first of kind public-private partnership, that deploys catalytic capital to crowd private investment into priority net zero sectors.

Five sectors have been identified by the Labour Party as the sectors that the NWF could support. These sectors include:

- Green Steel
- Green Hydrogen
- Industrial Decarbonisation
- Gigafactories (for the production of EV & grid-scale batteries); and
- Ports

As part of the National Wealth Fund Taskforce (Taskforce) analysis into these sectors has been undertaken to identify where there is a role for the NWF to deploy catalytic capital to help facilitate the growth of the sectors, support green job growth and enable sector wide decarbonisation.

Acknowledgements

The Green Finance Institute (GFI) would like to thank KPMG LLP (KPMG) for its assistance in compiling this report. KPMG accepts no responsibility or liability to any person other than the GFI in respect of its work. KPMG's role in relation to this report involved supporting the GFI with performing a factual analysis of the priority net zero sectors identified by the National Wealth Fund Task Force and high-level estimate of investment needed by 2030.

Sector issues & potential areas for intervention

Assessment of investment challenges in the five preliminary sectors identified by Labour has identified emerging areas the NWF could support alongside a robust and enabling policy environment. The sectors have distinct areas requiring support but strong linkages that have the potential to enable decarbonisation across transport, industry and electricity supply.

	Green Steel		Green Hydrogen		Industrial Decarbonisation		Gigafactories		Ports (& associated infrastructure)	
Contribution to a low carbon UK economy in 2030	*CO_2 (a)*	*Jobs(b)*	*CO_2 (a)*	*Jobs(b)*	*CO_2 (a)*	*Jobs(b)*	*CO_2 (a)*	*Jobs(b)*	*CO_2 (a)*	*Jobs(b)*
	~1%	~39k	~0.5%	30k	~5%	>2.6m(c)	~5%	19k	NA	30k
Sector issues	• Energy cost • Capital cost • Demand certainty • Recycling capabilities • Technology maturity • Enabling infrastructure		• Demand certainty • Delivery risk • Energy cost • Capital cost • Transport and storage infrastructure		• Access to renewable power • High capital cost • Long payback periods • Technology availability & maturity • Enabling infrastructure		• Supply chain • Demand certainty • Capital cost • Production cost and scalability		• Investment viability • Demand certainty • Pipeline visibility • Delivery risk • UK attractiveness	
NWF example products	• Equity; Debt; Price Assurance		• Equity; Debt; Guarantees		• Equity; Debt; Guarantees		• Equity; Debt; Guarantees		• Equity; Debt; Guarantees; Price Assurance	
Emerging areas intervention	• DRI-BOF production infrastructure • Conversion of BF-BOF facilities to clean technology • Recycling facilities & technology		• Transport & storage infrastructure • Domestic electrolyser production		• Access to renewable power • Onsite capital upgrades		• UK raw material supplies e.g., lithium • Large scale component & cell & pack manufacturing		• Quays, berths, channels, laydown & storage and assembly & loading facility upgrades • Portside real estate & low-carbon supply chains	
Key sector linkages	• **Green Hydrogen** production • **Industrial Decarbonisation** • **Port** Infrastructure enabling FLOW (e.g. substructure manufacturing)		• **Green Steel** (conversion of BF-BOF to H2-DRI) • **Industrial Decarbonisation** (H2 T&S infrastructure and capital upgrades for fuel switching) • **Port** enabling infrastructure for H2 transport and storage		• **Green Hydrogen** production, T&S • **Green Steel** for Steel sector decarbonisation (conversion of existing BF-BOF)		• **Industrial Decarbonisation**		• **Green Steel** end-use manufacturing for FLOW assets • **Green Hydrogen** transport & storage	

Notes: All information is Based on analysis of publicly available data as of June 2024; (a) Carbon abatement potential is an indicative percentage reduction in overall UK GHG emissions per annum by 2030 compared to 2023 UK total GHG emission; (b) Direct jobs supported by the sector in 2030; (c) Based on the number of direct jobs currently provided by industry in the UK (ONS, Annual Business Survey)

Estimated sector investment requirements

In the areas identified the NWF could play a role and considering current announcements, supplemental investment in the region of £35.9bn-£56.9bn may be required by 2030.

	Estimated investment need (to 2030)(a,b)		Announced / committed capital flows		Estimated supplemental investment need (to 2030)(c)	Preliminary NWF funding
Green Steel	EAF replacement	£2.5bn	PUBLIC £0.3bn	PRIVATE £0.8bn	£2.5 – 3.8bn	£2.5bn
	Scrap facilities	£1.2bn – £2.3bn				
	H2-DRI facilities(d)	£0 - £0.2bn				
	Total Green Steel	**£3.7bn - £5.0bn**				
Green Hydrogen	Elec. manufacturing	£0.1bn - £0.3bn	PUBLIC £1.9bn	PRIVATE £0.4bn	£11.8 – 20.0bn	£0.5bn
	Green H2 production	£12bn - £20bn				
	T&S Infrastructure	£2bn - £2bn				
	Total Green H2	**£14.1bn - £22.3bn**				
Industrial Decarbonisation	Cluster decarb.	£21.7bn - £38.2bn	PUBLIC £21.9bn	PRIVATE *Unknown*	Up to £16.2bn	£1.0bn
	Total Industrial(e)	**£21.7bn - £38.2bn**				
Gigafactories	Raw materials	£0 - £0.6bn	PUBLIC £0.5bn	PRIVATE £3.5bn	£4.1 – 10.6bn	£1.5bn
	Gigafactory facilities	£8.1bn				
	Recycling	£0 - £5.9bn				
	Total Gigafactories	**£8.1bn - £10.6bn**				
Ports	FLOW enabling	£3.5bn	PUBLIC £0.2bn	PRIVATE £2.0bn	£1.3 – 6.3bn	£1.8bn
	H2 & CCUS enabling	£0 - £5.0bn				
	Total Ports	**£3.5bn - £8.5bn**				

Notes: All information is based on analysis of publicly available data as of June 2024; (a) The figures contained herein are of a general nature and are not intended to address the circumstances of any particular individual or entity; (b) Estimated investment need is the capital costs required to develop and construct capacity / volume / and /or infrastructure to meet UK targets or ambitions for each sector; (c) Investment gap calculated as investment need to 2030 less announced public funding and committed private; (d) Excludes investment for green hydrogen production; (e) Industrial decarbonisation investment required includes investment in i) Green hydrogen production capacity, ii) Green hydrogen T&S infrastructure, iii) Green Steel EAF capacity, and iv) H2 & CCUS enabling port infrastructure

Analysis Deep-dive: Green Steel (1/3)

Sector definition

The production of steel through low carbon and sustainable methods by reducing emissions, replacing fossil fuel-based processes with low carbon sources of energy and chemical feedstocks, as well as minimising and recycling waste

Contribution to a low carbon UK economy

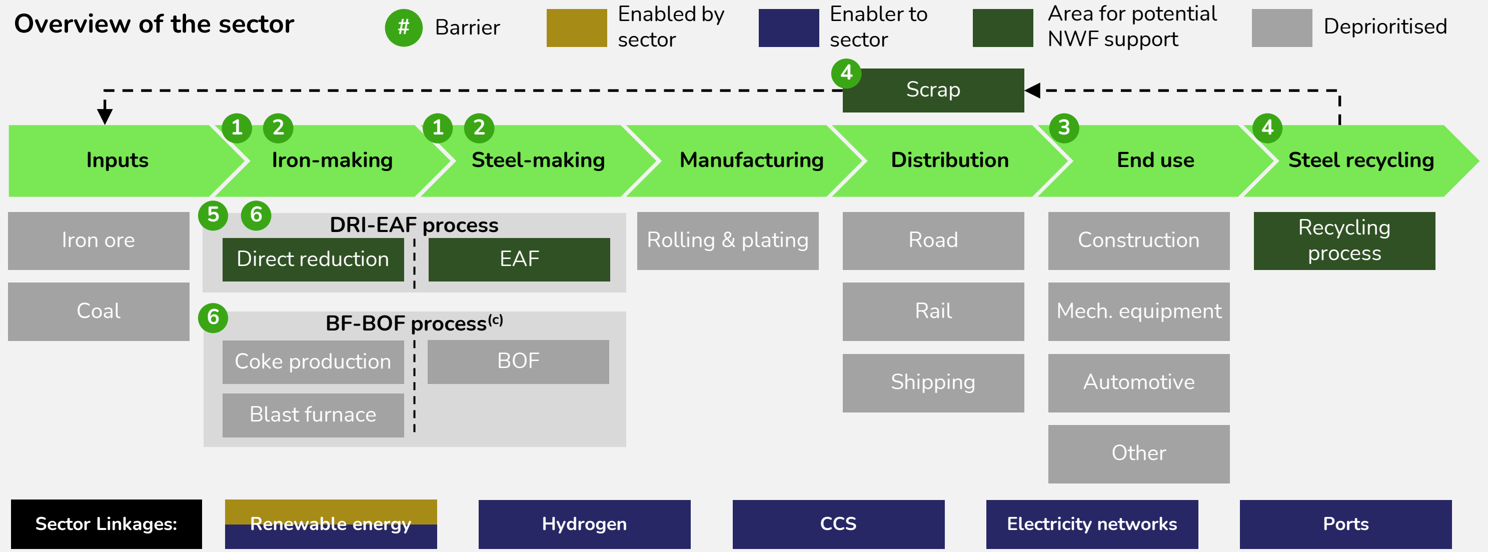
		2030
Emissions abatement potential	Mt CO_2 p.a. (% of UK 2023 emissions)[1]	~4.9 (1%)
Clean jobs	Direct	Limited market data
Annual GVA	£bn	

Current market status

🟩⬜⬜⬜ Low maturity/ impact
🟩🟩🟩🟩 High maturity/ impact

Policy support	🟩⬜⬜⬜	*Indirect policy support is available but there is not yet a targeted green steel plan*
Economics	🟩⬜⬜⬜	*UK steel is facing an uncompetitive cost base when compared to international markets*[2]
Societal impact	🟩🟩🟩⬜	*In 2022 UK steel contributed £11.5bn of GVA, and has the potential to protect 39k direct jobs*[3,a]
Technology maturity	🟩🟩⬜⬜	*Hydrogen direct reduction technology is still in the development stage with a TRL of 6-8*[4]
Regulatory status	🟩⬜⬜⬜	*There is a lack of regulatory incentives which could encourage investment in green steel is (such as product standards or a UK CBAM)*[b]
Environmental impact	🟩🟩🟩⬜	*Steel contributes ~17% of the UK's industrial emissions, and over 2.4% of the UK's total emissions*[5]

Barriers to deployment



Overview of the sector

Barrier
🟨 Enabled by sector
🟦 Enabler to sector
🟩 Area for potential NWF support
⬜ Deprioritised

④ Scrap

Inputs: Iron ore; Coal
①② Iron-making
①② Steel-making
⑤⑥ DRI-EAF process: Direct reduction; EAF
⑥ BF-BOF process[c]: Coke production; Blast furnace; BOF
Manufacturing: Rolling & plating
Distribution: Road; Rail; Shipping
③ End use: Construction; Mech. equipment; Automotive; Other
④ Steel recycling: Recycling process

Sector Linkages: Renewable energy | Hydrogen | CCS | Electricity networks | Ports

① Energy costs

Industrial energy prices in UK are almost 20%[6] higher than the IEA median, making the UK a less attractive market for steel production

② Capital costs

Significant CAPEX requirements and thin (or negative) margins in the sector make financing new investments difficult

③ Demand Uncertainty

Green steel can cost on average 40% more that conventional steel[7] excluding carbon costs. The lack of a green steel market results in uncertain returns profile and long payback periods on green steel investments

④ Recycling capabilities

Productivity and product ranges for EAFs in the UK are limited by a lack of high-quality steel scrap as a recycling feedstock. The UK currently exports approximately 77% of its scrap steel[8]

⑤ Technology maturity

Hydrogen direct reduction of iron ore is still in the development phase (TRL 6-8)[4]. A commercial scale hydrogen plant is not expected until the mid-2030s, delaying investment in hydrogen-enabled ironmaking[9]

⑥ Enabling infrastructure

Lack of hydrogen transport and storage infrastructure & business models still pending finalisation is delaying investment timelines in low carbon technologies

Notes: (a) Includes direct, indirect, and induced GVA; (b) UK Carbon Border Adjustment Mechanism; (c) BF-BOF process included as the UK is still reliant on ironmaking via the integrated process for virgin steel

Sources: (1) Green alliance, A brighter future for UK steel, 2023; (2) Liberty Steel, UK steel sector – survival or renaissance?, 2023 (3) WPI Economics, Economic benefits of industrial decarbonisation, 2023; (4) Shahabuddin et al., Decarbonisation and hydrogen integration of steel industries: Recent development, challenges and technoeconomic analysis, 2023; (5) Aldersgate Group, Accelerating the Decarbonisation of Industrial clusters and dispersed sites, 2021; (6) DESNZ, International industrial energy prices, May 2024; (7) Bloomberg NEF, Green Steel Demand is Rising Faster Than Production Can Ramp Up, 2023; (8) UK Parliament, PostNote: Green Steel, 2022; (9) UK Steel, Net Zero Steel: A Vision for the Future of UK Steel Production, 2022

Analysis Deep-dive: Green Steel (2/3)

Addressing the sector barriers

Barriers	Drivers	Potential areas of focus for NWF
1. Energy cost	• Despite the British Industry Supercharger (Apr-24), high wholesale electricity costs and capacity charges make UK production more expensive than EU counterparts	• Limited role for NWF: support to be driven by policy reform (such as REMA) to deliver more competitive energy prices in the UK
2. Capital costs	• Switching from coal-based production to the electric process requires significant capital investment • Thin margins (or loss-making operations) make financing new investments difficult	• **Loan guarantees** for FOAK investments, focusing on dispersed sites with limited existing government support • **Debt** or **equity** investment in low carbon or efficiency measures
3. Demand uncertainty	• Green steel can cost on average 40% more than conventional steel due to higher costs of production(1) • Low carbon pricing and bearish UK ETS outlook as well as a lack of other complementary policies result in end users not being incentivised to procure green steel	• **Price assurance** mechanism such as a CfD to mitigate higher price challenges supported by policy through product standards, green public procurement, and implementing CBAM
4. Recycling capabilities	• Demand for reprocessing scrap steel to a high quality has been historically low in the UK, when combined with high costs this has resulted in under-investment • The Export Packaging Recovery Note (ePRN) currently offers price support to scrap exports. Recyclers are incentivised to export rather than investing in reprocessing equipment for the UK market	• **Debt** or **equity** investment in improved recycling technology • Policy measures to address current incentives for metal recyclers to export scrap (e.g. ePRN)
5. Technology maturity	• Hydrogen direct reduction of iron ore has a TRL of 6-8, and is yet to be demonstrated at scale(2) • There are currently no hydrogen-steel plants operating or under development in the UK(3)	• **Loan guarantees** to de-risk FOAK commercial-scale facilities when technical feasibility is further established • Partner with e.g. UKRI to facilitate grants for demonstrating low carbon DRI processes
6. Enabling infrastructure	• UK government is still finalising the CCS and hydrogen T&S business models for industrial clusters • There is currently no plan for supporting dispersed sites	• **Debt** or **equity** investment in supporting dispersed sites to access hydrogen or CCS infrastructure

Initial NWF Allocation[a]

£2.5bn

The type of NWF product that's needed:

🟩 EQUITY	🟩 DEBT	GUARANTEE	🟩 PRICE ASSURANCE	GRANT

Where should NWF investment be prioritised:

- DRI-BOF production infrastructure
- Conversion of BF-BOF facilities to clean technology
- Recycling facilities & technology

Wider development considerations

- Consider market regimes such as REMA, UK ETS and CBAM to ensure green steel can compete on price internationally and against carbon intensive steel
- Review existing mechanisms which incentivise the export of scrap, and product standards to incentivise demand
- A broader industrial strategy is required from government to drive investment and decarbonisation in steel

Notes: (a) Initial NWF allocation announced by Labour Party for the sector;

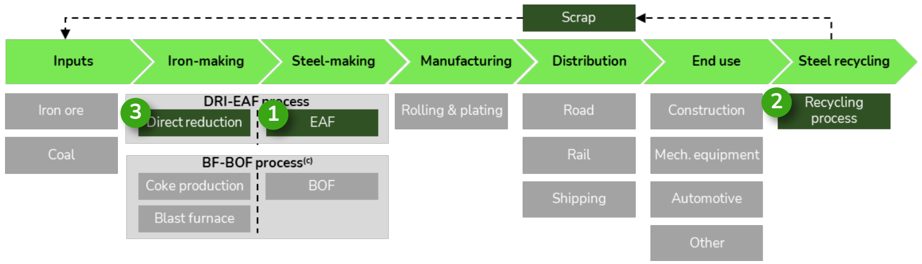
Sources: (1) Bloomberg NEF, Green Steel Demand is Rising Faster Than Production Can Ramp Up, 2023; (2) Shahabuddin et al., *Decarbonisation and hydrogen integration of steel industries: Recent development, challenges and technoeconomic analysis*, 2023; (3) UK Steel, Net Zero Steel: A Vision for the Future of UK Steel Production, 2022

Analysis Deep-dive: Green Steel (3/3)

Investment need analysis

Value chain overview

🟩 Area for potential NWF support



Estimated total investment need (to 2030)

£3.7 – 5.0bn

EAF replacement(2)	4.5 Mt
Scrap facilities(2,d)	4.2-6.1 Mt
H2-DRI facilities(e)	Up to 0.3 Mt

Announced / committed capital flows

£1.3bn

Public(1,b)	£0.5bn
Private(1,c)	£0.8bn

Supplemental investment need (to 2030)

£2.5 – 3.8bn

Preliminary NWF	£2.5bn

Investment requirement (to 2030)

Investment area		Definition	Low investment requirement	High investment requirement
①	EAF replacement	Cost to replace UK's exisitng BF-BOF production capabilities with scrap-based electric arc furnaces (EAFs)(a)	£2.5bn(1)	£2.5bn(1)
②	Scrap recycling upgrades	Cost to improve the UK's exisitng steel scrap recycling capabilties to meet the quality and volume requirements for secondary steel production	£1.2bn(d)	£2.3bn(d)
③	H2-DRI capacity	Cost of installing hydrogen-DRI capabilities	-	£0.2bn
Total investment need			**£3.7bn**	**£5.0bn**

Notes: Based on analysis of publicly available data as of June 2024 and estimated supplemental investment is based on the gap between estimated total investment and announced / committed capital flows. The Private capital flows are expected to be understated as it there will be a number of advanced projects that have yet to be announced but may well complete; (a) In line with industry announcements; (b) The Government has awarded a £500 million support package to Tata Steel for the development of a £1.25bn electric-arc furnace at Port Talbot; (c) Combined announced investment for electric arc furnaces by Tata and British steel; (d) Based on analysis of existing and future scrap requirements by 2030; (e) Based on analysis of potential H2-DRI capacity

Sources: (1) Combined announced investment for electric arc furnaces by Tata and British steel; (2) UK Steel, Steel scrap: A strategic raw material for net zero steel, 2023

Analysis Deep-dive: Green Hydrogen (1/3)

Sector definition

Production of hydrogen through electrolysis, and activities related to storage, transportation, distribution, and utilisation of hydrogen as an energy carrier or chemical feedstock and enabling supply chains

Contribution to a low carbon UK economy

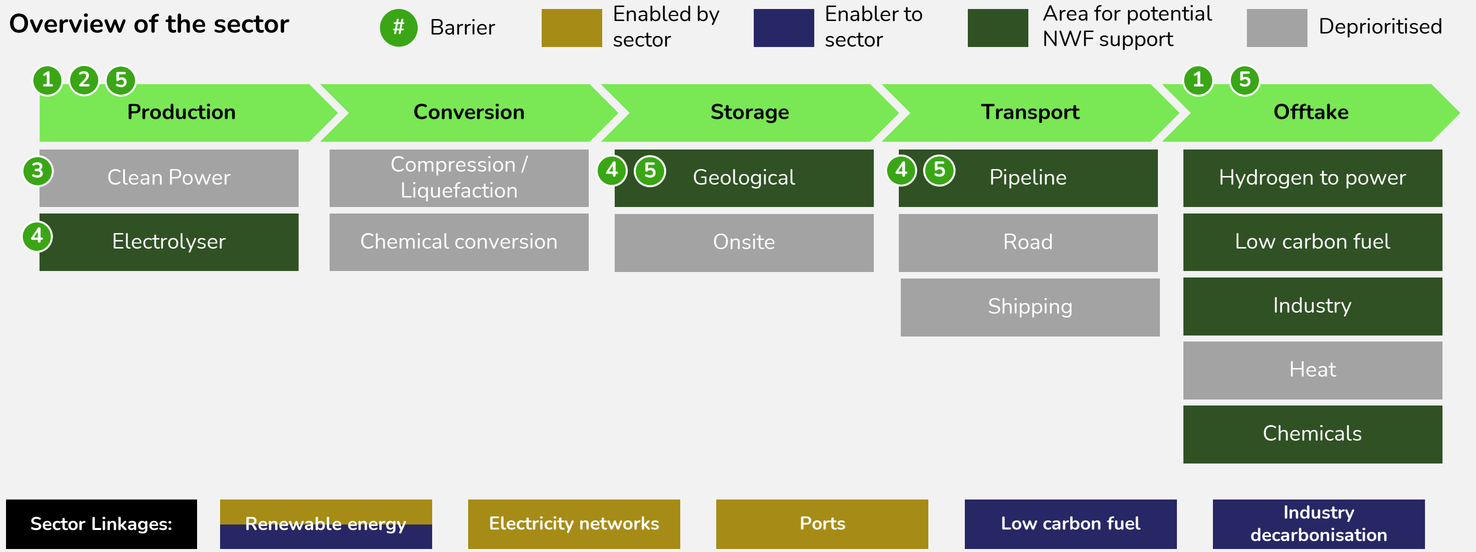
		2030
Emissions abatement potential	Mt CO_2 p.a. (% of UK 2023 emissions)(1)	~1.9 (0.5%)
Clean jobs	Direct(2)	~30k
Annual GVA	£bn(2,a)	7

Current market status

▮▯▯▯ Low maturity/ impact ▮▮▮▮ High maturity/ impact

Policy support	▮▮▯▯	*Production & offtake support through the Hydrogen Production Business Model with the Transport & Storage Business Model under development*
Economics	▮▮▯▯	*Industrial energy prices in UK are almost 20% higher than the IEA median(3)*
Societal impact	▮▮▯▯	*Industry is currently in nascent stage but has potential to add £7bn of GVA per year by 2030 and support 30k direct jobs(2)*
Technology maturity	▮▯▯▯	*Large-scale production is not established and end-use applications are still scaling*
Regulatory status	▮▮▯▯	*Regulations in place for permitting and approval, however these need streamlining; business models are in development*
Environmental impact	▮▮▯▯	*Existing hydrogen production (mostly SMR) is highly carbon intensive, Green hydrogen can abate this and enable wider decarbonisation across sectors(4)*

Barriers to deployment



Overview of the sector

Barrier · Enabled by sector · Enabler to sector · Area for potential NWF support · Deprioritised

Production ① ② ⑤
- ③ Clean Power
- ④ Electrolyser

Conversion
- Compression / Liquefaction
- Chemical conversion

Storage
- ④ ⑤ Geological
- Onsite

Transport
- ④ ⑤ Pipeline
- Road
- Shipping

Offtake ① ⑤
- Hydrogen to power
- Low carbon fuel
- Industry
- Heat
- Chemicals

Sector Linkages: Renewable energy · Electricity networks · Ports · Low carbon fuel · Industry decarbonisation

① Demand uncertainty

Reluctance of buyers to lock in long-term contracts at higher prices in hard-to-abate end use industrial applications is impacting how investable and bankable the projects are

② Delivery risk

Green hydrogen has not been delivered at scale, with supply constraints & project complexity creating a risk to the overall deliverability of projects

③ Energy cost

UK industrial electricity prices have historically been more than 20% higher than the IEA median, resulting in higher LCOH, disincentivising investment in UK green hydrogen production(3)

④ Capital costs

Capex costs account for a significant portion of hydrogen production. Pipeline & storage also require significant upfront investment due to project scale & complexity

⑤ Transport and storage infrastructure

Policy uncertainty on the role of hydrogen is delaying implementation of common infrastructure, inhibiting access to distribute hydrogen & increasing total costs

Notes: (a) Overall hydrogen sector contribution £7bn annual GVA in 2030, this includes £2.9bn in 2030 provided by low carbon electrolytic hydrogen production

Sources: (1) New Energy Outlook 2024, BNEF; (2) Economic Impact Assessment for the Hydrogen Sector to 2030, Hydrogen UK; (3) DESNZ, International industrial energy prices, May 2024; (4) Green hydrogen Organisation, Accessed May 2024; (5) Assessment of electrolysers: report, 2022, Scottish Government

Analysis Deep-dive: Green Hydrogen (2/3)

Addressing the sector barriers

Barriers	Drivers	Potential areas of focus for NWF
1. Demand uncertainty	• Long payback period for investment and transition of existing demand sites due to low carbon prices(1) • Lack of enabling infrastructure has inhibited uptake of demand side technologies • Reliance on single offtake with a limited market for uncontracted offtake creating volume risk	• **Debt or equity** to facilitate end users to switch to hydrogen, such as those industries not covered under Industrial energy transformation fund • **Price guarantees** to facilitate current hydrogen use cases e.g., chemicals, to switch from grey to green hydrogen
2. Delivery risk	• Concerns over availability of electrolysers • Availability of skilled & experienced contractors, owners & operators • Insurability of projects(2)	• **Guarantees or insurance** for **hydrogen production projects** to mitigate financial risks for private investors
3. Energy cost	• UK industrial electricity prices have historically been more than 20% higher than the International energy alliance median(3) and contribute a significant portion of total green hydrogen cost	• Limited Role for NWF: Considered an area for policy intervention through energy market reform
4. Capital cost	• Average cost of a European electrolyser is currently around £1,500-2400/kWH_2(4) with scale estimated to reduce costs by upwards of 50%(5)	• **Debt or equity** to facilitate expansion of domestic manufacturing capacity to facilitate increased scale and lower domestic prices • **Guarantees** to support early investment in transport and storage infrastructure
5. Transport and Storage Infrastructure	• UK government is still finalising the CCS and hydrogen T&S business models	• **Debt or equity** to support early stage investment in transport infrastructure as part of industrial clusters • **Guarantees** to support early investment in transport and storage infrastructure

Initial NWF Allocation(a)

£0.5bn

The type of NWF product that's needed:

[✓ EQUITY] [✓ DEBT] [✓ GUARANTEE] PRICE ASSURANCE GRANT

Where should NWF investment be prioritised:

- Transport & storage infrastructure
- Domestic electrolyser production
- Investment to support industrial conversion demand side/offtake

Wider development considerations

- Development of demand side business models to facilitate uptake of hydrogen for power, SAF and other derivatives
- UK ETS reforms, through carbon price guarantee to improve the business case of low carbon investment
- Electricity market reform to reduce grid constraints and lower electricity prices (as part of REMA)
- Outcomes of Hydrogen to power consultation
- Policy impact assessment to understand where additional policy is required to support sector development

Notes: (a) Initial NWF allocation announced by Labour Party for the sector; (b) Includes wider funding available for low carbon solutions, and other forms of hydrogen

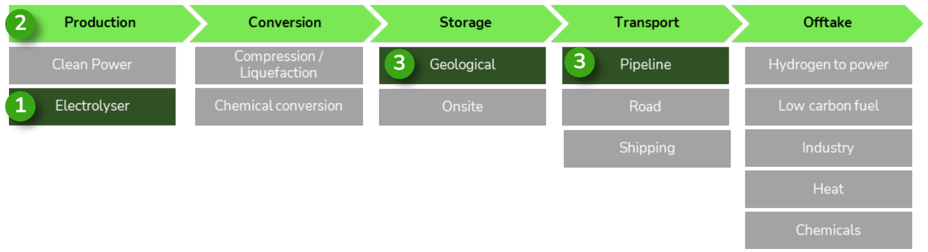
Sources: (1) UK carbon price falls to record low, Feb 2024, Financial Times; (2) The hydrogen investment challenge: Incorporating learnings and overcoming barriers, May 2024, Baringa; (3) DESNZ, International industrial energy prices, May 2024; (4) BNEF; (5) ITM Power, Project Bauen, 2021

Analysis Deep-dive: Green Hydrogen (3/3)

Investment need analysis

Value chain overview

🟩 Area for potential NWF support



Estimated total investment need (to 2030)

£14.1 – 22.3bn

Manufacturing(1)	2.5-5 GW/year
H2 Production(2,3)	6-10 GW
Transport & storage	Limited data

Announced / committed capital flows

£2.3bn

Public(1,a)	£1.9bn
Private(1)	£0.4bn

Estimated supplemental investment need (to 2030)

£11.8 – 20.0bn

Preliminary NWF	£0.5bn

Investment requirement (to 2030)

Investment area		Definition	Low investment requirement	High investment requirement
1	Electrolyser manufacturing	Development and construction capex for electrolyser manufacturing facilities	£0.1bn	£0.3bn
2	Green H_2 Production	Development and construction capex for electrolytic hydrogen production plants (i.e. Electrolyser + BOP)	£12bn	£20bn
3	Transport and Storage Infrastructure	Development and construction capex for hydrogen T&S infrastucture (e.g. pipelines, storage sites)(2)	£2bn(2)	£2bn(2)
Total investment need			**£14.1bn**	**£22.3bn**

Notes: Based on analysis of publicly available data as of June 2024 and estimated supplemental investment is based on the gap between estimated total investment and announced / committed capital flows. The Private capital flows are expected to be understated as it there will be a number of advanced projects that have yet to be announced but may well complete; (a) Includes wider funding available for low carbon solutions, and other forms of hydrogen

Sources: (1) Based on analysis of publicly available data as of June 2024; (2) Hydrogen net zero investment roadmap: leading the way to net zero, Feb 2024, Gov.UK; (3) Make Britain a clean energy superpower, Labour.org

Analysis Deep-dive: Industrial Decarbonisation (1/3)

Sector definition

The enablement of the decarbonisation of the UK's clustered and dispersed industrial sectors, through renewable and low carbon solutions including CCS, fuel switching, electrification, efficiency measures, and the associated supply chains

Contribution to a low carbon UK economy

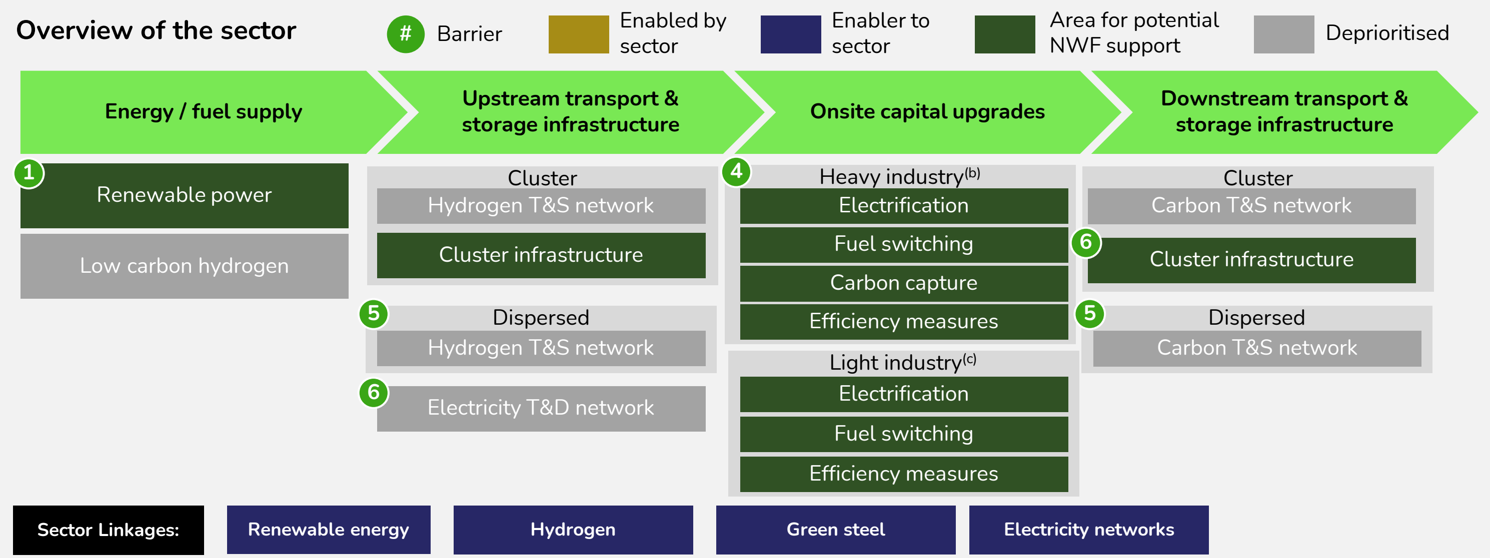
		2030
Emissions abatement potential	Mt CO_2 p.a. (% of UK 2023 emissions)(1)	~21 (5%)
Clean jobs	Direct(2,a)	50k
Annual GVA	£bn	Limited data

Current market status

▮▯▯▯ Low maturity/ impact ▮▮▮▮ High maturity/ impact

Policy support	▮▮▮▯	*Over £20bn has been announced to support the development of CCS in industrial clusters. Limited support for dispersed sites*
Economics	▮▮▯▯	*High energy costs and low carbon prices can make onsite capital upgrades uneconomical*
Societal impact	▮▮▮▯	*Currently contributes £152bn total GVA and supports a workforce of 1.4m, and could support over 50,000 additional green jobs in CCS by 2030* (2,3)
Technology maturity	▮▮▯▯	*Hydrogen and electrification fuel switching technologies for high temperature applications are still in development (TRL 3-6)*
Regulatory status	▮▮▮▯	*Strong regulatory support through hydrogen and CCS business models. Limited regulatory support for dispersed sites*
Environmental impact	▮▮▮▯	*Industry contributes >14% to total UK emissions*(4)

Barriers to deployment



Overview of the sector

Barrier 🟨 Enabled by sector 🟦 Enabler to sector 🟩 Area for potential NWF support ⬜ Deprioritised

Energy / fuel supply
① Renewable power
Low carbon hydrogen

Upstream transport & storage infrastructure
Cluster
Hydrogen T&S network
Cluster infrastructure
⑤ Dispersed
Hydrogen T&S network
⑥ Electricity T&D network

Onsite capital upgrades
④ Heavy industry[b]
Electrification
Fuel switching
Carbon capture
Efficiency measures
Light industry[c]
Electrification
Fuel switching
Efficiency measures

Downstream transport & storage infrastructure
Cluster
Carbon T&S network
⑥ Cluster infrastructure
⑤ Dispersed
Carbon T&S network

Sector Linkages: Renewable energy | Hydrogen | Green steel | Electricity networks

① Access to renewable power

High cost of onsite generation and challenges in securing PPA contracts can limit access to renewable power

② High capital cost

Significant CAPEX requirements of low carbon technologies, instalment costs, and converting existing processes make investment challenging

③ Investment viability

High costs and unfavourable market conditions (high energy costs, low carbon price as well as a lack of revenue drivers) result in long payback periods that are unattractive to investors

④ Technology availability and maturity

Hydrogen and electrification fuel switching technologies for high temperature applications are still in development (TRL 3-6)

⑤ Enabling infrastructure

Cost, scale and timeline to deploy dispersed hydrogen and CCS infrastructure is impacting the ability to decarbonise dispersed sites and expansion of existing clusters minimises the ability for relocation

⑥ Electricity network capacity

Grid connection costs and long delays of up to 12 years are preventing industrial users from investing in capital upgrades(5)

Notes: (a) Only considers potential green jobs in CCS by 2030, in addition to existing workforce; (b) High temperature / hard to decarbonise sectors and applications including iron & steel, cement, glass, and chemicals for which low carbon technology is not yet commercially available; (c) Low temperature applications or industries for which low carbon technology is commercially available

Sources: (1) UK government, Reducing emissions across the economy, 2022; (2) Aldersgate Group, *Accelerating the Decarbonisation of Industrial clusters and dispersed sites*, 2021; (3) WPI Economics, *Economic benefits of industrial decarbonisation*, 2023; (4) DESNZ, 2022 UK Greenhouse Gas Emissions – Final Figures, 2024; (5) IDRIC, Briefing note: Grid constraints and industrial decarbonisation, 2023

Analysis Deep-dive: Industrial Decarbonisation (2/3)

Addressing the sector barriers

Barriers	Drivers	Potential areas of focus for NWF
1. Access to renewable power	• Lenders to renewable projects typically require offtakers to have a strong investment grade credit ratings • Onsite generation requires a significant capital investment	• **Letters of credit (guarantee)** to companies with low/no credit rating to support PPA contracting (e.g. French Public investment bank) • **Debt** or **loan guarantees** for private renewable generation
2. High capital cost	• New equipment, supplementary equipment, and scrapping fossil fuel equipment can involve high costs • Some companies have limited access to capital	• **Debt** or **equity** in onsite capital upgrades (including potentially incentivising co-location of complementary industries, e.g. steel) • **Loan guarantees** for new technology investments
3. Investment viability	• Low or volatile carbon prices, alongside high energy costs can extend payback periods and increase the risk of investment - making financing more expensive and difficult to access	• UK ETS **carbon price guarantee** (e.g. carbon CfD) to improve the business case of low carbon investment and reduce payback period
4. Technology availability & maturity	• High temperature applications (>1,000 C) particularly for heavy industry are difficult to decarbonise with either electrification or hydrogen fuel switching • Technologies for these processes are still in the R&D phase (TRL 3-6)	• **Equity** support (venture capital) for developing technologies (e.g. gasification, pyrolysis etc.) • Partner with innovation hubs (e.g. UKRI) to facilitate grants for new technology deployment
5. Enabling infrastructure	• There is currently no plan for supporting CCS and hydrogen T&S in dispersed sites • Planning constraints restrict expansion of existing clusters to facilitate relocation	• **Debt or equity** to potentially support development of enabling infrastructure for dispersed sites (e.g. private hydrogen network, road transport, rail etc.)
6. Electricity network capacity	• Connection upgrades often have high costs for industrial users • Long planning timelines, and inefficient management of grid connection queues are contributing to long connection upgrade delays	• **Debt** support grid connection financing • **Debt or equity financing** for energy management solutions (e.g. storage, energy management systems)

Initial NWF Allocation[a]

£1.0bn

The type of NWF product that's needed:

EQUITY	DEBT	GUARANTEE	PRICE ASSURANCE	GRANT

Where should NWF investment be prioritised:

- Access to renewable power
- Onsite capital upgrades

Wider development considerations

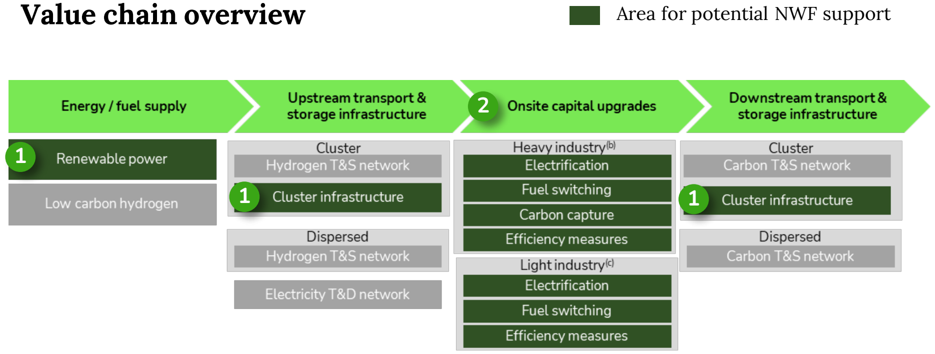
- Review existing market regimes such as REMA, UK ETS and CBAM to lower energy costs and increase carbon price to improve the business case for investment in capital upgrades
- Green public procurement standards to create demand certainty for low carbon products
- Regulation and development of voluntary carbon markets to facilitate additional revenue streams to promote viability of projects
- Frameworks & supporting policy to facilitate the development of green jobs & skills

Notes: (a) Initial NWF allocation announced by Labour Party for the sector; (b) Key funding opportunities available to industrial clusters and dispersed emitters
Sources: (1) UKRI, Enabling Net Zero: A Plan for UK Industrial Cluster Decarbonisation, 2023

Analysis Deep-dive: Industrial Decarbonisation (3/3)

Investment need analysis

Value chain overview



Estimated total investment need (to 2030)

£21.7 – 38.2bn

CCUS clusters[a]	5

Announced / committed capital flows

>£21.9bn

Public[b]	£21.9bn
Private	Limited Data

Estimated supplemental investment need (to 2030)

Up to £16.2bn

Preliminary NWF	£1.0bn

Investment requirement (to 2030)

Investment area		Definition	Low investment requirement	High investment requirement
①	Cluster decarbonisation	Invesment in CCUS, hydrogen, onsite capital upgrades, energy efficiency and renewable deployment for the four main industrial clusters linked to the UK Track 1&2 CCUS cluster sequencing and the Solent cluster(1,2,3,4,,5,a)	£21.7bn	£38.2bn
②	Dispersed and non-priotity cluster decarbonisation	Investment in enery efficiency and electrification measures for remaining industrial operations in the UK	*Not quantified due to lack of data*	
Total investment need			**£21.7bn**	**£38.2bn**

Notes: Based on analysis of publicly available data as of June 2024 and estimated supplemental investment is based on the gap between estimated total investment and announced / committed capital flows. The Private capital flows are expected to be understated as it there will be a number of advanced projects that have yet to be announced but may well complete; (a) Based on analysis of publicly available information including the Humber, Net Zero North West (NZNW), Scottish Net Zero Roadmap (SNZR), and Tees Valley Net Zero, and Solent clusters based on their accelerated deployment before 2030, and availability of model-based economic plans for each; (b) Key funding opportunities available to industrial clusters and dispersed emitters

Sources: (1) NZNW, Net Zero North West: Investment case – Final Report, 2023; (2) Element Energy, Humber Industrial Cluster Plan: Net Zero emissions pathways in the Humber, 2022; (3) SNZR, A Net Zero Roadmap for Scottish Industry, 2023; (4) TVCA, Industrial decarbonisation cluster plan economic impact analysis – economic scenarios, 2023; (5) Solent Cluster, Socioeconomic report, 2023

Analysis Deep-dive: Gigafactories (1/3)

Sector definition

Large-scale manufacturing facilities for batteries for Electric Vehicles (EVs) and grid scale storage including the associated supply chain for upstream processing, usage and end of life applications

Contribution to a low carbon UK economy

		2030
Emissions abatement potential	Mt CO_2 p.a. (% of UK 2023 emissions)(1,2,a)	~21 (5%)
Clean jobs	Direct)(2,b)	~19k
Annual GVA	£mn(4,c)	750

Current market status

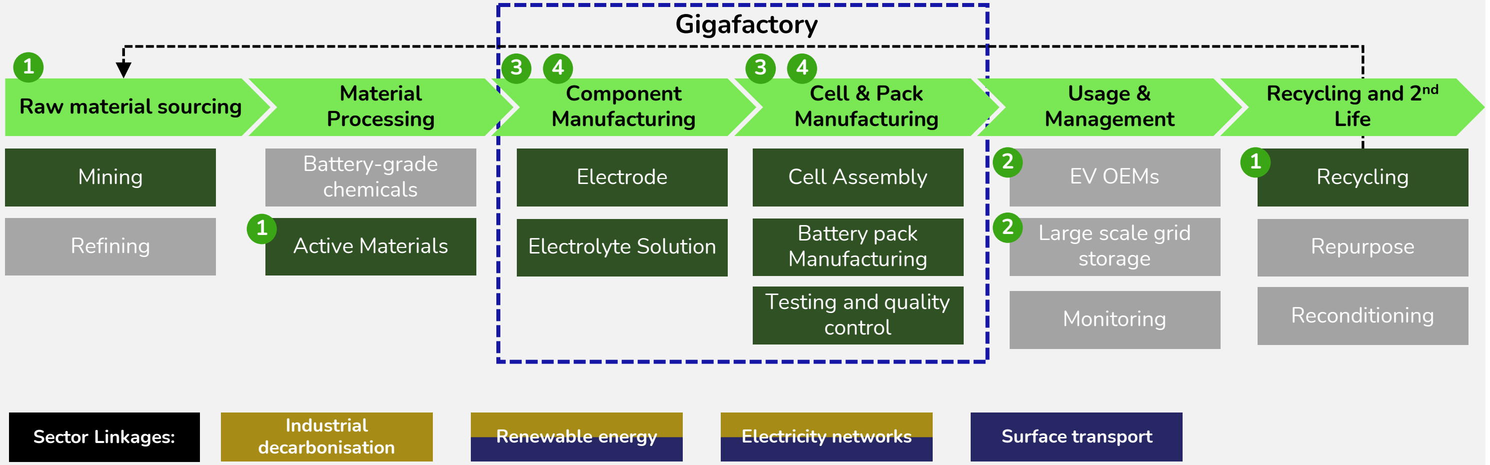
🟩⬜⬜⬜ Low maturity/ impact 🟩🟩🟩🟩 High maturity/ impact

Policy support	🟩🟩⬜⬜	*More than £2.0bn funding support is available via the Automotive Transformation Fund as well as demand-side measures including ICE ban*
Economics	🟩🟩⬜⬜	*High labour and energy cost adversely impact the competitiveness of UK manufactured batteries(2)*
Societal impact	🟩🟩⬜⬜	*Battery value chain currently contributes 13k direct jobs (2024). Has potential to protect 150k more jobs in wider EV manufacturing sector(2)*
Technology maturity	🟩🟩⬜⬜	*Multiple new battery technologies/chemistries are in development phase*
Regulatory status	🟩🟩🟩⬜	*ZEV mandate: All new cars and vans sold by 2035 to be zero-emission(3)*
Environmental impact	🟩🟩🟩⬜	*18% of UK's total emissions is attributed to domestic transport using ICE cars and vans(1)*

Barriers to deployment

Overview of the sector

● # Barrier 🟨 Enabled by sector 🟦 Enabler to sector 🟩 Area for potential NWF support ⬜ Deprioritised



Gigafactory

- ① Raw material sourcing
  - Mining
  - Refining
- Material Processing
  - Battery-grade chemicals
  - ① Active Materials
- ③ ④ Component Manufacturing
  - Electrode
  - Electrolyte Solution
- ③ ④ Cell & Pack Manufacturing
  - Cell Assembly
  - Battery pack Manufacturing
  - Testing and quality control
- Usage & Management
  - ② EV OEMs
  - ② Large scale grid storage
  - Monitoring
- Recycling and 2nd Life
  - ① Recycling
  - Repurpose
  - Reconditioning

Sector Linkages: Industrial decarbonisation | Renewable energy | Electricity networks | Surface transport

① Supply Chain

UK currently lacks a robust domestic supply chain for critical raw materials, and upstream inputs to battery manufacturing leading to potential supply risks and increased import costs

② Market Demand

Demand from larger players in the UK automotive manufacturing base is mostly spoken for which limits the total demand potential for batteries in the UK

③ Capital Cost

High upfront capital requirement with lack of long term offtake contracts (driven by uncertain demand) to provide bankable revenues impedes projects from securing financing

④ Production cost & Scalability

Batteries manufactured in the UK have a higher cost to produce, making investment in UK manufacturing uncompetitive compared to China and Europe

Notes: (a) Estimated based on emissions reduction from ~1.5 million EVs, equivalent to ~100 GWh capacity gigafactory; (b) 19k jobs supported directly through battery manufacturing and 37k jobs in the battery supply chain in the UK by 2030; (c) Scaled to project 100Gwh/year capacity in 2030 based on West midland's 60GWh/year gigafactory potential of add £450m of GVA to the UK economy

Sources: (1) Life cycle emissions for EU electric cars are three times lower than for petrol cars, Dec-23, The Guardian; (2) Annual Gigafactory study 2022, Faraday report; (3) Powering up the UK battery industry,2023, Green alliance; (4) Written evidence from West Midlands Gigafactory, Feb 2023, BEIS Committee

Analysis Deep-dive: Gigafactories (2/3)

Addressing the sector barriers

Barriers	Drivers	Potential areas of focus for NWF
1. Supply Chain	- Lack of local mining facilities and reliance upon imports for key raw materials such as Ni and Li(1) - Lack of battery recycling projects which could re-utilise critical raw materials already present in the UK	- **Debt or equity** to setup battery **recycling units** to facilitate reuse of key raw materials - **Equity** to support to expansion of **lithium mining / alternative materials** opportunity within UK - **Debt or equity** in **active material** production units
2. Market Demand	- Limited EV manufacturing base with battery demand from EV manufacturers currently at ~20GWh/yr(1), the bulk of this demand comes from JLR and Nissan, and is already spoken for by existing/proposed gigafactories - UK producers are not competitive in global markets due to additional export costs, this limits opportunity to scale existing facilities	- **Loans or guarantees** to attract large **automotive OEMs** to setup and expand EV manufacturing facilities in the UK through - **Debt or equity** to support deployment of **large scale grid storage** infrastructure
3. Capital Cost	- Gigafactories require significant capex and have a long payback period driven by long construction time (up to 5 years)(2) - Price fluctuations of raw materials can significantly impact the battery manufacturers' returns and payback period	- **Debt or guarantees** designed to take first loss providing additional cushion to private investors in **gigafactories**
4. Production cost and Scalability	- Gigafactories are energy intensive units and UK industrial electricity prices have historically been more than 20% higher than the IEA median(3) making cost of production in the UK uncompetitive - Scalability is a challenge for battery manufacturing in the UK due to fragmented offtake demand profile. This limits manufacturers to gain economies of scale	- **Revenue guarantees** for **battery manufacturers** to support capacity expansion - **Equity or debt investment** in co-located / private wire renewables to support reduction in cost and carbon intensity

Initial NWF Allocation(a)

£1.5bn

The type of NWF product that's needed:

[✓ EQUITY] [✓ DEBT] [✓ GUARANTEE] PRICE ASSURANCE GRANT

Where should NWF investment be prioritised:

- UK raw material supplies e.g. lithium, sodium, graphite
- Large scale component & cell & pack manufacturing
- Battery recycling capacity

Wider development considerations

- Electricity market reform to reduce grid constraints and lower electricity prices (as part of REMA)
- Potential for tax subsidies and trade policy reforms to enable access to global EV markets and facilitate raw material supply
- Consider further policies to encourage existing OEMs to electrify fleets manufactured in the UK, as well as attracting global OEMs set up EV manufacturing in the UK
- Consider implementation of product standards and minimum recycled content requirements similar to future EU policy(4)

Notes: (a) Initial NWF allocation announced by Labour Party for the sector

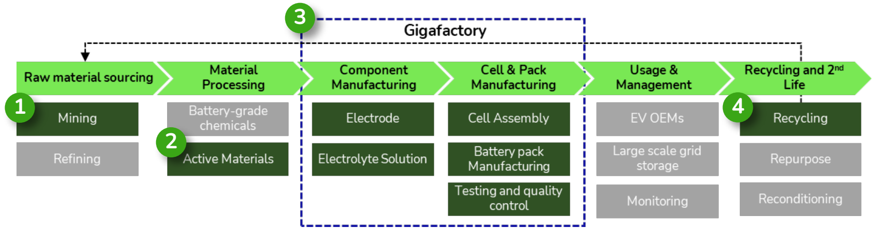
Sources: (1) Faraday Report – Annual Gigafactory study 2022, The Faraday Institution; (2) UK Battery Strategy, 2023, DBT; (3) DESNZ, International industrial energy prices, May 2024; (4) Environment and Climate Change Committee, EV strategy: rapid recharge needed, 2024

Analysis Deep-dive: Gigafactories (3/3)

Investment need analysis

Value chain overview

🟩 Area for potential NWF support



Estimated total investment need (to 2030)

£8.1 – 14.6bn

Lithium mining(1)	15ktpa
Active materials	Not quantified
Additional gigafactories(b)	84.2 GWh
Recycling capacity(3,a)	150 kt/year

Announced / committed capital flows

£4bn

Public(4,5)	£0.5bn
Private(4,5)	£3.5bn

Estimated supplemental investment need (to 2030)

£4.1 – 10.6bn

Preliminary NWF	£1.5bn

Investment requirement (to 2030)

Investment area		Definition	Low investment requirement	High investment requirement
①	Raw material sourcing	Lithium mining	-	£0.6bn
②	Active Materials	Processing of refining chemicals and raw materials into active materials for electrodes	-	*Not quantified due to lack of data*
③	Gigafactory facilities	Battery cell and pack manufacturing and assembly (including 100 GWh gigafactoies target, less existing Envision factory and proposed expansion)	£8.1bn(b)	£8.1bn(b)
④	Recycling	Recycling end of life batteries into black mass which are then reprocessed into Active Materials	-	£5.9bn
Total investment need			**£8.1bn**	**£14.6bn**

Notes: Based on analysis of publicly available data as of June 2024 and estimated supplemental investment is based on the gap between estimated total investment and announced / committed capital flows. The Private capital flows are expected to be understated as it there will be a number of advanced projects that have yet to be announced but may well complete; (a) No estimates available for 2030, 2035 used as a proxy; (b) based on analysis of UK gigafactory capacity ambition less capacity in construction

Sources: (1) UK Battery Strategy, 2023, DBT; (2) The 2035 UK Battery Recycling Industry Vision, 2023, Innovate UK; (3) The 2035 UK Battery Recycling Industry Vision, 2023, Innovate UK; (4) Tata Group to set up a battery gigafactory in the UK, Accessed Jun 2024, Tata Steel Europe; (5) UK government pays £500mn in subsidies for Tata battery plant, Accessed Jun 2024, Financial Times

Analysis Deep-dive: Ports (1/3)

Sector definition

Large scale infrastructure at ports which enable renewable power and low carbon technologies and associated supply chains, including portside manufacturing, assembly O&M as well as other enabling services

Contribution to a low carbon UK economy

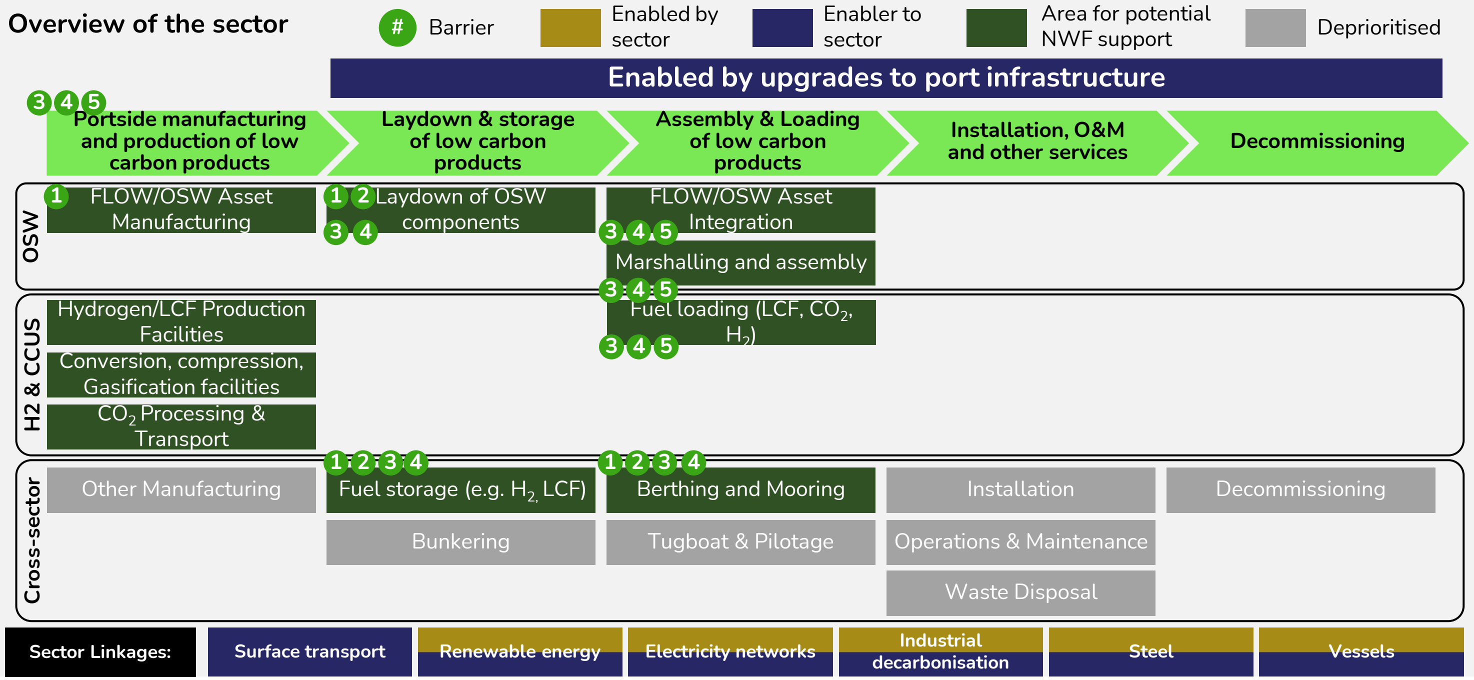
		2030
Emissions abatement potential	Mt CO_2 p.a. (% of UK 2023 emissions)(1)	NA Enabler to sectors
Clean jobs	Direct	30k(1,b)
Annual GVA	£bn	20.7(c)

Current market status

▮▯▯▯ Low maturity/ impact ▮▮▮▮ High maturity/ impact

Policy support	▮▮▯▯	*HMG Freeport Delivery Roadmap(2) - OSW, CCS and H2 identified as areas of focus, but limited detail provided. £160m provided via FLOWMIS*
Economics	▮▮▯▯	*EU ports deemed more competitive than UK counterparts, driven by ownership structures and operating costs(3)*
Societal impact	▮▮▮▯	*Current GVA contribution of £10.8bn and circa 127,000 jobs to the UK economy(1)*
Technology maturity	▮▮▮▯	*Ports technology not a concern, however expansion is dependent on nascent tech like FLOW, H2 and CCUS*
Regulatory status	▮▮▯▯	*Regulations focus on the low carbon technologies present at ports (i.e. CfDs, LCHA, CCUS T&S and H_2 Business models)*
Environmental impact	▮▮▮▯	*Opportunity to enable significant GHG emissions reductions across a range of sectors*

Barriers to deployment



Overview of the sector

Barrier · 🟨 Enabled by sector · 🟦 Enabler to sector · 🟩 Area for potential NWF support · ⬜ Deprioritised

Enabled by upgrades to port infrastructure

③④⑤ Portside manufacturing and production of low carbon products → Laydown & storage of low carbon products → Assembly & Loading of low carbon products → Installation, O&M and other services → Decommissioning

OSW:
- ① FLOW/OSW Asset Manufacturing
- ①② Laydown of OSW components ③④
- FLOW/OSW Asset Integration ③④⑤
- Marshalling and assembly ③④⑤

H2 & CCUS:
- Hydrogen/LCF Production Facilities
- Conversion, compression, Gasification facilities
- CO_2 Processing & Transport
- Fuel loading (LCF, CO_2, H_2) ③④⑤

Cross-sector:
- Other Manufacturing
- ①②③④ Fuel storage (e.g. H_2, LCF)
- Bunkering
- ①②③④ Berthing and Mooring
- Tugboat & Pilotage
- Installation
- Operations & Maintenance
- Waste Disposal
- Decommissioning

Sector Linkages: Surface transport · Renewable energy · Electricity networks · Industrial decarbonisation · Steel · Vessels

① Investment Viability

Development requires significant capital expenditure (£50-500m CAPEX per project), while customers face cost pressures, limiting ports' ability to pass on costs

② Demand Certainty

Investors typically require certainty about port utilisation and revenue streams early in the development process

③ Pipeline Visibility

Uncertainty over the short-and medium-term pipeline of project construction, lead times for planning approvals as well as other marine related consent processes

④ Delivery risk

Uncertainty and lack of standardisation in delivery of port infrastructure required is a challenge. This inhibits commitment for both investors and developers

⑤ UK attractiveness

UK ports are typically privately owned with shorter investment horizons leading to higher development costs than competing ports, e.g. in the EU

Notes: Based on analysis of publicly available data as of June 2024; (a) Based on enablement of only 5GW of FLOW by 2030; b) relates only to jobs created by enabling FLOW; c) Extrapolated from UKIB report (£3.45bn of investment need with £2.87 of GVA per £ invested, added to existing £10.8bn of GVA in 2022

Sources: (1) UKIB - Port infrastructure - for floating offshore wind – 2023; (2) DLUHC - Freeports delivery roadmap; (3) Floating Offshore Wind Centre of Excellence: Port And Manufacturing Infrastructure Investment Models; (4) Floating Offshore Wind Taskforce – Industry Roadmap 2040

Analysis Deep-dive: Ports (2/3)

Addressing the sector barriers

Barriers	Drivers	Potential areas of focus for NWF
1. Investment viability	- High Capital Costs (e.g. a floating offshore wind (FLOW) integration port can cost up to £400m in CAPEX + DEVEX)(1,2) - Offshore wind developers focused on cost savings to achieve competitive contracts for difference (CfD) bids - Disparity in access to capital when comparing large privately owned ports against smaller trust ports	- **Debt financing for larger ports:** in strategically located ports to de-risk development on a no-regrets basis until bankable revenues can be secured - **Equity financing** for smaller ports with a longer term investment horizon - **Loan guarantees:** to address counterparty creditworthiness
2. Demand uncertainty (Revenue risk)	- Requirement for upfront revenue certainty to unlock financing for development - OSW developers contract when they have CfDs, which is too late for infrastructure development - Competition between suitable UK and EU ports	- **Loan / revenue guarantees:** Lenders require contracts to commit funding. In the absence of this certainty, another party would need to underwrite the risk of portside development
3. Pipeline visibility	- Lack of strategy on which locations should be developed compounded by competition with EU ports - Low visibility for project pipeline post 2030 OSW targets	- **Equity or debt for adjacencies:** Strategic investments in FLOW, CCS, H_2 projects beyond 2030 to support pipeline
4. Delivery risk	- Planning, consents and delivery timeline for port infrastructure and low carbon portside manufacturing facilities is uncertain - This discourages developers to enter into partnerships with ports as delays can cause adverse impacts to deployment	- Limited role for NWF but policy reform could facilitate development
5. UK attractiveness	- Many UK ports are privately owned, shorter investment horizons result in high development costs as well as operating costs - These costs reduce UK competitiveness against EU ports as they are passed on to low carbon project developers	- **Equity or debt:** Financing (per barrier 1 above) to reduce cost of capital

Initial NWF Allocation(a)

£1.8bn

The type of NWF product that's needed:

🟩 EQUITY	🟩 DEBT	🟩 GUARANTEE	🟩 PRICE ASSURANCE	GRANT

Where should NWF investment be prioritised:

- Quays, berths, channels, laydown & storage and assembly & loading facility upgrades
- Portside real estate & low-carbon supply chains

Wider development considerations

- Focus on development of "Strategic Ports" so these can be developed on a no-regrets basis and assess expansion of reach and scope of Freeports
- Incentives for UK ports and wider maritime industry to decarbonise will increase competitiveness with increasingly decarb focused customers
- Consider governance/ownership structures in some ports that may act as barrier to investment
- Frameworks & supporting policy to facilitate the development of green jobs & skills
- Outcomes of the review of the Ports National Policy statement should be completed & implemented(3)

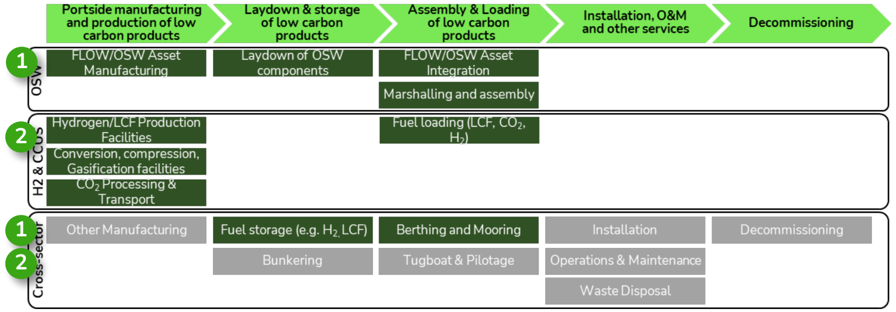
Notes: (a) Initial NWF allocation announced by Labour Party for the sector
Sources: (1) Floating Offshore Wind Centre of Excellence: Port And Manufacturing Infrastructure Investment Models; (2) Floating Offshore Wind Taskforce – Industry Roadmap 2040; (3) Department for Transport, Review of the national policy statement for ports, March 2023

Analysis Deep-dive: Ports (3/3)

Investment need analysis

Value chain overview

🟩 Area for potential NWF support



Estimated total investment need (to 2030)

£3.5 – 8.5bn

FLOW infrastructure(1)	5GW
H2/CCUS clusters(a)	Up to 5

Announced / committed capital flows

£2.2bn

Public(1)	£0.2bn
Private(3)	£2.0bn

Estimated supplemental investment need (to 2030)

£1.3 – 6.3bn

Preliminary NWF	£1.8bn

Investment requirement (to 2030)

Investment area		Definition	Low investment requirement	High investment requirement
1	FLOW	Development and construction capex for enabling port infrastructure (e.g. Portside manufacturing, laydown facilities & loading upgrades) to support throughput of FLOW technology	£3.5bn(2)	£3.5bn(2)
2	Hydrogen & CCUS	Development and construction capex for enabling port infrastructure (e.g. storage, loading upgrades) to support throughput of hydrogen and CCUS	-	£5.0bn
Total investment need			**£3.5bn**	**£8.5bn**

Notes: Based on analysis of publicly available data as of June 2024 and estimated supplemental investment is based on the gap between estimated total investment and announced / committed capital flows. The Private capital flows are expected to be understated as it there will be a number of advanced projects that have yet to be announced but may well complete; (a) Based on analysis of publicly available information including the Humber, Net Zero North West (NZNW), Scottish Net Zero Roadmap (SNZR), and Tees Valley Net Zero, and Solent clusters based on their accelerated deployment before 2030

Sources: (1) FLOWMIS grant funding; (2) UKIB, Port infrastructure for floating offshore wind, 2023; (3) Associated British Ports, Ready for tomorrow: ABP Sustainability Strategy, 2023