EDRC
Energy Demand Research Centre

Closing the Timing Gap: Securing the Future of UK Energy-Intensive Industries

October 2026

Dr Peace Adesina, School of Chemical and Process Engineering, University of Leeds

Prof Peter Taylor, School of Chemical and Process Engineering & School of Earth, Environment and Sustainability, University of Leeds

UK Research and Innovation
Economic and Social Research Council
Engineering and Physical Sciences Research Council

Contents

Executive Summary 3

Key Findings 4

Introduction 6

The timing mismatch between industrial decarbonisation investment and low-carbon infrastructure delivery 6

Greater co-ordination can help close the timing gap 19

Policy Recommendations 22

References 25

Executive Summary

UK energy-intensive industries are entering a critical period in which the timing of low-carbon infrastructure delivery is increasingly impacting industrial reinvestment decisions. Economically efficient industrial decarbonisation is constrained by long asset lifetimes and infrequent reinvestment cycles, with major capital decisions typically occurring every 25–50 years. Across sectors including steel, cement, lime, chemicals, glass, ceramics, pulp and paper, many core assets are approaching key reinvestment points in the 2020s. However, hydrogen and CO_2 transport and storage networks remain at an early stage of deployment, and substantial upgrades to electricity networks are required in many locations. Under current trajectories, much of this enabling infrastructure is unlikely to be operational before the early 2030s.

This temporal misalignment is increasing commercial uncertainty, incentivising firms to extend the life of existing fossil-fuel assets, defer investment, or reconsider the location of future production. The challenge is compounded by heterogeneous sectoral and geographical circumstances: industrial processes differ in asset lifetimes, operational flexibility and infrastructure needs, while cluster-led infrastructure sequencing does not necessarily align with site-level investment windows.

Dispersed industrial sites are particularly disadvantaged, facing delayed or uncertain access to hydrogen and carbon capture and storage (CCS) infrastructure. Persistently high UK industrial electricity prices and delays in grid connections further constrain near-term electrification uptake.

The core policy challenge for many industrial sectors lies as much in the timing, sequencing and coordination of enabling infrastructure delivery with industrial investment cycles as in the availability of decarbonisation options. Investment in traditional high-carbon production is increasingly difficult to reconcile with longer-term decarbonisation requirements, while low-carbon replacement investment faces additional costs, uncertainty and infrastructure dependencies.

Without clearer visibility over reinvestment timelines, faster infrastructure delivery, and mechanisms to reduce coordination and first-mover risk, there is the potential that industrial decarbonisation will be delayed, or that substantial manufacturing capacity will close, and the UK will lose opportunities to attract future low-carbon industrial projects.

Key Findings

1. **An investment–Infrastructure sequencing gap is reshaping industrial investment in uneven and potentially irreversible ways.** Across energy-intensive sectors, reinvestment decisions are increasingly taken amid uncertainty over future access to hydrogen, CCS and electricity networks. Where assets have long operating lifetimes and infrequent replacement cycles, the absence of supporting low-carbon infrastructure may encourage firms to extend the life of existing assets or adopt transitional solutions that are suboptimal in the long-term. This creates a risk of locking in higher emissions and constraining future decarbonisation pathways. In some cases, firms may choose to reduce or cease operations altogether.

2. **Industrial reinvestment cycles and decarbonisation pathways vary sharply across sectors and sites, weakening the effectiveness of cluster-led policy approaches.** Differences in asset lifetimes, operational flexibility (for example, changing processes, fuel use, production levels, or technology) and tolerance for infrastructure delivery risk mean that common infrastructure timelines can lead to divergent outcomes for investment and competitiveness. As a result, cluster-led sequencing aligns well with some sectors but fits others poorly.

3. **Geography is a key determinant of industrial decarbonisation and investment outcomes.** Place-based differences in infrastructure availability are creating uneven industrial decarbonisation and investment outcomes. Earlier access to hydrogen and CCS infrastructure within coastal clusters may provide some sites with greater flexibility to align reinvestment decisions with decarbonisation objectives. In contrast, inland and geographically dispersed sites may face delayed or uncertain infrastructure access, increasing the risk of higher-cost transition pathways, deferred investment, or missed decarbonisation opportunities. As a result, firms in the same sector may face very different investment opportunities depending on their geographical location.

4. **Electricity network constraints and high electricity costs continue to impede decarbonisation investment.** Long grid connection timelines and persistently higher UK electricity prices relative to European competitors constrain electrification as a viable short-term decarbonisation option for many firms.

5. **Cement, lime and ceramics face the highest infrastructure-investment misalignment risks**. This heightened risk arises from the combination of three characteristics: long-lived production assets with few major

reinvestment opportunities, geographically constrained sites linked to raw materials and established supply chains, and limited decarbonisation pathway flexibility. Cement and lime depend heavily on CCS to address process emissions, while technical and economic constraints on large-scale kiln electrification will increase the ceramics sector's reliance on low-carbon hydrogen. Similar risks are also present in **chemicals, refining** and **steel**, although these tend to be more site- and process-specific due to greater variation in decarbonisation pathways, infrastructure requirements and geographic concentration. Consequently, delays or uncertainty in infrastructure delivery can force firms to make major investment decisions before suitable low-carbon options are available, increasing the risk of emissions lock-in and missed decarbonisation opportunities.

6. **The central policy challenge is one of sequencing and coordination.** Delivering industrial decarbonisation requires better alignment between industrial policy, strategic energy planning and infrastructure delivery. Yet infrastructure and industrial investments are often planned by different actors operating on different timescales. Without better visibility of industrial demand, reinvestment windows and infrastructure dependencies, coordination failures can delay investment and undermine both competitiveness and decarbonisation objectives. Strengthened strategic and regional planning, informed by industry and regional stakeholders, could help align infrastructure delivery with industrial investment needs.

Introduction

Industry is central to the UK's growth mission.[1] The Modern Industrial Strategy identifies manufacturing and other growth-driving sectors as important sources of long-term investment, productivity and output growth, while seeking to strengthen high-potential clusters and strategic industrial sites.[2] Government has also signalled a renewed focus on industrial growth and reindustrialisation, seeking to attract investment, strengthen manufacturing and other strategic industries, and create high-quality industrial jobs across the UK.[3] Recent statements by the Burnham Government have emphasised its commitment to reindustrialisation, regional growth and competitiveness, highlighting the importance of lower energy costs, improved infrastructure and place-based industrial development to support manufacturing investment and growth.[4]

Energy-intensive industries (EIIs) are particularly important in this context. As foundational sectors that supply essential materials such as steel, cement, chemicals, glass, ceramics and refined products, they underpin wider manufacturing value chains while contributing significantly to regional economies and industrial employment. Delivering on these ambitions, however, requires detailed work to align investment timelines, key policy interventions and the role of public institutions, alongside consistent signals that these sectors have a long-term future in the UK. A key challenge is that industrial investment decisions are already being made today, while many of the low-carbon infrastructure networks needed to support decarbonisation will not be available until later in the decade. This creates a risk that investment, decarbonisation and industrial strategy objectives become misaligned.

The timing mismatch between industrial decarbonisation investment and low-carbon infrastructure delivery

The UK’s energy-intensive industries face a structural timing mismatch between their capital reinvestment cycles and the delivery of supporting low-carbon infrastructure, such as hydrogen, CCS and electricity networks. Many UK foundation-industry production sites were established or substantially expanded during successive waves of post-war industrial investment between 1950 and 1980.[5,6] Although individual equipment and safety-critical systems have subsequently been replaced, refurbished, rebuilt or upgraded, in many cases, major production systems have remained in operation across multiple investment cycles through successive refurbishment and reinvestment. Consequently, many sites are entering periods in which major refurbishment,

replacement, technological conversion and decarbonisation investment decisions are becoming increasingly relevant, contributing to a partial concentration of major investment decisions across the 2020s and into the early 2030s—particularly in capital-intensive sectors such as steel and cement.[5–11]

This is occurring while hydrogen and CCS networks, and electricity grid upgrades, are unlikely to be available at sufficient scale across industrial regions until the early to mid-2030s.[8,12–15] As a result, firms face constrained choices: extend the life of high-carbon assets through rebuilds or relines, delay investment at commercial risk, or adopt suboptimal transitional solutions—raising the risk of carbon lock-in and reduced competitiveness or site closure.

These challenges are intensified by the diversity of energy-intensive industrial (EII) sectors and processes. Asset lifetimes, energy requirements, and decarbonisation pathways differ significantly across steel, cement, lime, chemicals, refining, glass, ceramics, and pulp and paper.[15–18] As a result, reinvestment decisions are highly sector- and site-specific, and cluster-led policy frameworks often fail to align with these reinvestment windows as shown in **Table 1**. Some sectors face a small number of major investment windows over several decades, while others have more frequent opportunities to adopt low-carbon technologies.

In integrated steel, for example, blast furnaces typically operate for 15–25 years before requiring a major rebuild of their internal lining (known as a reline), while underlying assets may remain in service for at least 40-60 years.[19–21] However, these technical cycles are becoming less central in investment decisions, which are now increasingly driven by expectations of infrastructure availability.[15,22–24] The steel works at Port Talbot illustrate this dynamic. The blast furnaces approaching the end of their operating life required reinvestment by 2024 because of rising maintenance costs and operational instability. [25–27] At this point, the feasibility of alternative decarbonisation pathways was strongly influenced by infrastructure availability: A CCS-based pathway would have required a new CO_2 transport solution with shipping CO_2 to the North-West cluster identified as the predominant transport option under consideration. Conversion to hydrogen-based direct reduced iron (H_2-DRI) depended on low-carbon hydrogen and supporting infrastructure that was not expected to be available within the site's investment window.[28,29] Without this infrastructure, electric arc furnace (EAF) production was the only decarbonisation option deliverable within a reasonable timeframe, and only then because of a streamlined grid upgrade process.[30–32]

Table 1. Typology of energy-intensive industries based on asset characteristics, reinvestment dynamics, and policy requirements

EII Geographical Archetype	**Example EII sectors**	**Process Critical Asset**	**Typical Reinvestment cycle**	**Main Policy Challenge**
Concentrated	Integrated steel	Blast furnace (BF)	~40-60 years[28] Relines: 15 – 25 years	Few sites with very large individual capacities lead to large, infrequent reinvestment decisions in long-lived assets, so individual investment choices can shape the national sector trajectory for decades.
	Refining	Crude distillation unit (CDU)	20-30+ years[33]	
		Fluid catalytic crackers (FCC)	~20-30+ years	
		Hydrocrackers	~20 – 25 years[34]	
	Aluminium	Aluminium smelter	~20-40 years Pot relines: 5-7 years[35]	
Resource-anchored	Cement	Cement/clinker kiln	~25-40 years[28] to partial rebuild[36]	Assets are geographically constrained by local raw-material resources (site specific) and require decarbonisation infrastructure to be available when major reinvestment decisions are made, or firms will reinvest in existing fossil-based configurations.
	Lime	Lime kiln	~20- 30+ years	
Resource influenced, geographically distributed	Ceramics	Ceramic kiln	~40 years[37]	Many firms making numerous and independent investment decisions over time, requiring scalable, widely accessible decarbonisation support.
	Glass	Glass furnace	12-20 years[28] Container glass: 10-15 years[38] Flat glass: ~20 years to partial rebuild[38]	
	Pulp & paper	Pulp & paper mill	30-60 years[39]	
Network-integrated	Bulk Chemicals	Steam crackers (ethylene), reformers etc.	~20- 50 years[40]	Investment viability depends on timely access to infrastructure across the network/cluster.

Note: *Archetypes indicate whether production is concentrated in industrial clusters or dispersed across multiple locations, with implications for access to shared decarbonisation infrastructure.*

The Port Talbot case illustrates how infrastructure availability and timing can shape industrial technology choices. Where enabling infrastructure is not available when assets reach critical reinvestment points, the range of feasible decarbonisation pathways can be significantly narrowed.

In refining and bulk chemicals, decarbonisation depends less on the replacement of a single asset and more on the coordinated availability of hydrogen and CO_2 transport and storage infrastructure. Investment typically occurs through the ongoing modification, replacement and optimisation of interconnected process units rather than through wholesale plant replacement. As a result, these sites combine long-lived assets with incremental investment, so decisions occur across overlapping, time-critical reinvestment cycles. Confidence in infrastructure delivery is therefore central to investment behaviour. Where infrastructure deployment timelines fail to align with these cycles, low-carbon transition projects risk becoming commercially unviable as delays in hydrogen, CCS, or grid infrastructure do not merely postpone decarbonisation but can potentially alter investment trajectories in ways that are economically and institutionally difficult to reverse.[41]

The Stanlow refinery in the HyNet Cluster highlights some of these challenges. Essar Energy Transition (EET) reports that major projects at the refinery—including carbon capture and a second hydrogen plant—have been placed on standby due to uncertainty over CO_2 transport and storage availability.[41] It also reports that prolonged negotiations over government support have delayed the first hydrogen plant's FID, increasing development costs and potentially discouraging further investment.[41] This uncertainty may also affect the value of decarbonisation investments already made at the site. For example, Stanlow commissioned a hydrogen-ready furnace in 2025 as part of its wider transition strategy, but the asset's full emissions reduction potential depends on access to low-carbon hydrogen and associated infrastructure that remains under development.[42,43]

In the absence of timely CCS and hydrogen network deployment, the furnace is currently running on natural gas meaning that the refinery remains exposed to sustained carbon costs, which weakens the project's economics. As a result, infrastructure delays are not simply slowing deployment but also constraining the sequencing, scale and viability of Stanlow's overall transition strategy. [41,44]

More broadly, facilities in priority Track 1 and Track 2 industrial clusters face multi-year gaps between project selection, investment decisions and operation, causing infrastructure delivery to miss critical reinvestment points.[45–48]

Electricity networks can also be a limiting factor for industrial decarbonisation, but barriers are generally lower. Grid connection delays— often extending for a

decade or more into the 2030s—continue to limit electrification in steel, as illustrated by the case of Scunthorpe. Union debates in 2025 over electric arc furnace deployment highlighted electricity network capacity as a critical bottleneck.[49] Reforms introduced in 2025 under TMO4+ connections reform package shifted the system toward a 'first ready and needed, first connected' approach, improving queue management and prioritising shovel-ready projects aligned with national energy targets. However, queue reform does not itself deliver the physical network capacity required for new connections. Electricity demand is projected to grow substantially towards 2050, increasing the need for network investment and reinforcement.[50]

Connections reform also remains a work in progress: Ofgem's ongoing demand-connections reforms seek to improve the progression of viable projects, accelerate physical connections and develop arrangements for strategically important large demand users. The government has also recently announced the creation of Great British Grid, a new publicly owned body that will invest in electricity network infrastructure and work alongside existing network operators to accelerate grid upgrades, increase competition and support economic growth.[51] The announcement specifically identifies competitive tendering of transmission projects as a mechanism for accelerating investment, however, the extent to which it will also invest in distribution networks is currently unclear.[51] These developments are relevant to industrial electrification, where connection timing depends on both queue management and the delivery of required network infrastructure.[15,52–54]

Other energy-intensive sectors, such as ceramics, glass and chemicals, face similar problems in addition to internationally uncompetitive electricity prices compared to those in other European countries, risking constraints on investment in low-carbon industrial technologies.

Geography further complicates the picture. Steel, cement, and refining sites that are part of a coastal industrial cluster may gain earlier access to hydrogen and CO_2 transport. By contrast, dispersed, resource-anchored and resource-influenced inland sites, particularly ceramics and cement sites around Stoke-on-Trent and in the Peak District, face more complex, infrastructure-intensive and potentially slower decarbonisation pathways, often requiring extensive multi-county CO_2 pipeline and transport networks to connect to offshore storage facilities.[55,56]

Collectively, this analysis demonstrates that aligning industrial reinvestment cycles with enabling infrastructure delivery remains a significant but under-recognised challenge for industrial decarbonisation.

Electrification *is relatively location-flexible but constrained by grid capacity, connection availability and reinforcement timelines*

Hydrogen *availability is location-dependent and, in the near term, likely to be concentrated around industrial clusters: large-scale supply depends on the development of production, transport and storage infrastructure, with blue hydrogen particularly linked to CCUS-enabled clusters and green hydrogen also shaped by electricity availability and network capacity.*

CCS *is network-bound – access is largely concentrated in industrial clusters, but deployment also depends on a connected chain of capture, transport and permanent storage.*

These structural differences mean that timing risks vary sharply by site and pathway, shaping whether reinvestment windows are met or missed.

Figures 1a and 1b illustrate how typical industrial reinvestment windows align with the expected availability of key decarbonisation pathways, including electrification, hydrogen and CCS for EII sectors. When read left to right, the figures highlight potential timing mismatches between asset replacement decisions and access to the infrastructure required to support low-carbon manufacturing. The first red dashed vertical line, positioned at 2026, represents an illustrative EII firm facing a major reinvestment decision, such as replacing or refurbishing a production asset. The second green dashed vertical line, positioned at 2050, marks the UK net zero target year.

The 2026 decision point is intended as an example of a firm evaluating low-carbon investment options against expected infrastructure availability. Black blocks indicate illustrative major reinvestment windows and their typical frequency within each sector. Reinvestment timing varies across firms and facilities and may occur earlier or later than shown. Hatched bars show implementation lead times between an investment decision and operational deployment, while solid-coloured bars indicate the subsequent availability of the decarbonisation pathway.

Figure 1a. Indicative timelines for industrial reinvestment cycles and low-carbon infrastructure availability across UK energy-intensive industries, highlighting deployment pathways for biomass, BECCS, hydrogen, CCS, and electrification– Cement & Lime, Refining, Chemicals and Steel. Track 1 clusters have progressed to financial close for their core CO_2 transport and storage infrastructure, whereas Track 2 clusters remain in development, with final investment decisions still pending and delivery timelines less certain. Electrification is comparatively location-flexible in principle, but the timescale for large industrial connections remains strongly location- and load-dependent and therefore has a comparatively larger uncertainty: while some sites may connect within a few years, projects requiring substantial reinforcement can face multi-year lead times even as connections reform reduces queue-related delays.

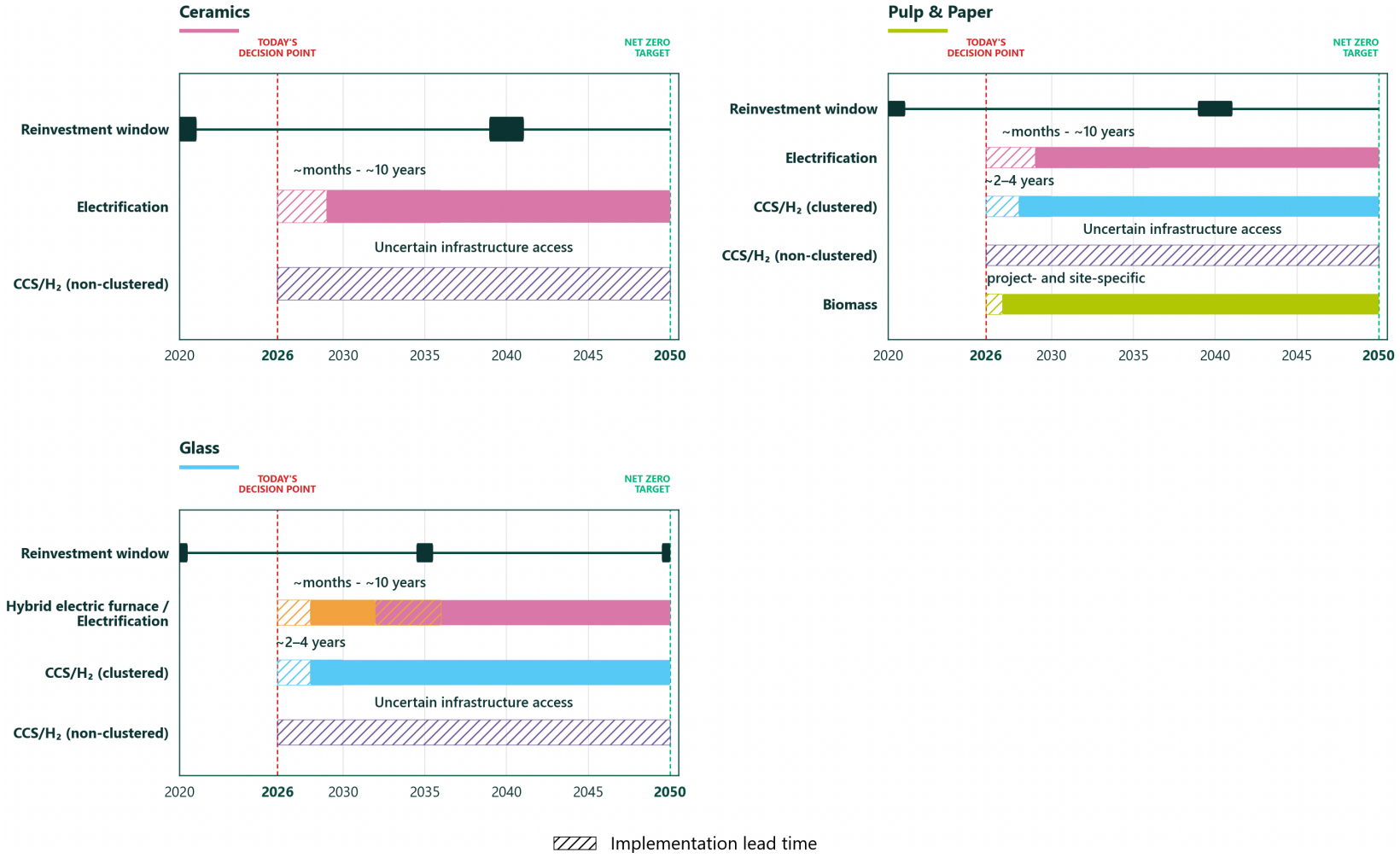


Figure 1b. Indicative timelines for industrial reinvestment cycles and low-carbon infrastructure availability across UK energy-intensive industries, highlighting deployment pathways for biomass, BECCS, hydrogen, CCS, and electrification– Ceramics, Pulp & Paper, Glass.

If the EII firm chooses to pursue a low-carbon pathway, the timeline illustrates the likely time required for the necessary infrastructure to become available and for the firm to connect to it. These timelines vary by technology and location. Electrification depends on the availability of grid capacity, the delivery of grid connections, and any required network reinforcements, which vary by region and site. Hydrogen and CCS depend on the rollout of transport, storage, and distribution infrastructure, with sites located in industrial clusters generally expected to gain access earlier than more dispersed locations.

Biomass fuel and biomass combined heat and power (CHP) are notable exceptions, as both are established technologies that can potentially be deployed through site-level investment without waiting for new hydrogen or CO_2 transport infrastructure. Their deployment may nevertheless be constrained by project lead times, sustainable biomass availability, permitting, capital requirements and site-specific considerations.

In the context of the reinvestment windows shown in the figures, steel, cement, lime, and ceramics sectors are characterised by long and infrequent reinvestment cycles for major assets such as blast furnaces, rotary kilns, lime kilns, and tunnel kilns, typically ranging from 20 to 60 years. Refineries, in contrast, undergo multiple and staggered investment cycles across interconnected process units, while retaining long-lived underlying infrastructure. However, major reinvestment decisions are generally less frequent than the furnace rebuilds characteristic of the glass sector, providing fewer recurring opportunities to align process-technology investment with new infrastructure.

For the Pembroke Refinery, access to South Wales Industrial Cluster (SWIC) CCS and hydrogen-pipeline infrastructure is assumed around 2031/ 2032, based on indicative SWIC deployment timelines by UKRI Industrial Decarbonisation Challenge (IDC) Deployment Projects.[57] Meanwhile, Fawley has proposed a 120 MW green hydrogen project targeting commissioning in 2029. However, in the case of both Pembroke and Fawley, delivery of the projects remains subject to project development and investment decisions.[58] By contrast, the Solent Cluster's proposed CO_2 pipeline projects are no longer being progressed, potentially delaying access to CCS infrastructure.[59]

The earliest Track-1 and Track-1 expansion clusters — including HyNet and the East Coast Cluster across Teesside and the Humber — are expected to become operational from 2028–2029.[57] Track-2 clusters are anticipated around 2030-2031[57], based on indicative deployment timelines. This creates an approximate 2 to 4-year gap between a major reinvestment decision made in 2026 and the initial availability of hydrogen and CCS infrastructure, while full network integration and wider industrial connectivity may take considerably longer.

For dispersed or inland sites, access to CCS and hydrogen infrastructure may occur on significantly longer and more uncertain timescales, owing to the need for additional transport, storage, and distribution infrastructure beyond that required in industrial clusters. Electrification offers a more location-flexible decarbonisation pathway; however, deployment remains constrained by grid reinforcement requirements and electricity connection timescales, which typically range from a few months to 10 years, depending on the magnitude of the new load.

For glass, although technologies such as hybrid electric furnaces and hybrid-fuel systems are already being demonstrated through programmes led by Glass Futures, widespread deployment is expected to take longer. Challenges remain regarding product quality, process stability, furnace refractory performance, and the availability of sufficient low-carbon electricity at industrial scale. [60–62]

Table 2 presents an indicative assessment of the risk of investment-infrastructure misalignment across energy-intensive industrial sectors. This assessment considers three principal factors: **site geography, dependence on low-carbon infrastructure,** and **asset lifetimes**. Sites located outside major industrial clusters may face delayed or uncertain access to hydrogen and CCS infrastructure, while long-lived assets provide relatively few opportunities to alter investment pathways.

For example, a cement kiln rebuilt in 2026 using conventional technology because low-carbon infrastructure is unavailable may have no further major replacement opportunity, or at most one, before **2050**. Although intermediate upgrades, relines and efficiency improvements may occur, these generally provide more limited opportunities for adopting alternative production technologies. In some sectors, however, relines and major rebuilds can provide the chance to reassess the underlying technology pathway, particularly where assets are older or approaching the end of their operational life.

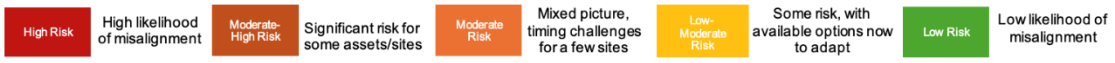
Table 2. Indicative sectoral risk of misalignment between industrial investment cycles and low-carbon infrastructure availability for different EIIs.

Sector	Relative Indicative Infrastructure-Investment Misalignment Risk	Rationale (based on site geography, infrastructure dependence, asset lifetime)	Approximate renewal opportunities between 2026 decision point and 2050
Cement & Lime	High Risk	• Long-lived kiln assets (25–40+ years), • Often dispersed sites with limited scope for relocation due to raw-material and production requirements. • Strong dependence on CO_2 transport and storage infrastructure, creating a risk of misalignment if infrastructure is unavailable when major kiln investments are made.	0-1 major reinvestment opportunity
Ceramics	High Risk	• Long-lived kiln and production assets (could exceed 40 years), with periodic rebuilds and upgrades, creating important but infrequent reinvestment decision points. • Production is geographically dispersed, with many sites located outside major industrial clusters. • Location constraints linked to established supply chains. • Electrification is only feasible for some smaller production lines • Large-scale electrification remains technically challenging for some processes, increasing potential reliance on future hydrogen supply to dispersed sites.	0 major reinvestment opportunity; 1-2 upgrade/rebuild opportunities

Chemicals	Moderate-High Risk	• Long-lived assets and diverse technology options make infrastructure timing highly site-specific. • Infrastructure dependence varies significantly across subsectors, processes and sites. • Some decarbonisation pathways require shared hydrogen and/or CO_2 infrastructure • Other pathways offer greater flexibility through electrification, efficiency improvements or feedstock substitution.	0-1 major reinvestment opportunity (highly process dependent)
Refining	Moderate-High Risk	• Complex networks of long-lived process units requiring ongoing reinvestment. • All UK refineries are located within industrial clusters. • Deep decarbonisation may depend on access to low-carbon hydrogen and CCS infrastructure, alongside electrification. • Potential timing mismatch between asset reinvestment cycles and infrastructure availability.	0-1 major reinvestment opportunity
Steel	Moderate Risk	• Long-lived blast-furnace assets (40-60 years), with relines (15-25 years) creating periodic opportunities to reassess technology choices. • Highly concentrated geography can support coordinated infrastructure deployment. • Transition to electric steelmaking creates substantial electricity network requirements.	0 major reinvestment opportunity; 1-2 relines

		• Scunthorpe is the UK's only remaining integrated steel works facing a strategic decision over the future of its blast-furnace assets. • Major decarbonisation decisions at Scunthorpe depend on timely availability of grid capacity and enabling infrastructure.	
Pulp & Paper	Low- Moderate Risk	• Long asset lifetimes (25-40 years), but multiple opportunities to decarbonise through different technology pathways. • Less dependent on any single shared infrastructure network. • Production is geographically distributed, with most UK paper mills located outside established industrial clusters. • Multiple decarbonisation options, including electrification, biomass, efficiency improvements and hydrogen. • Infrastructure risks remain site-specific, particularly electricity-network capacity and sustainable biomass availability.	0-1 major reinvestment opportunity
Glass	Low-Moderate Risk	• Frequent furnace rebuilds (10-20 years) create multiple opportunities to align investments with infrastructure deployment. • Production sites are geographically dispersed, both within and outside industrial clusters. • Electric and hybrid furnaces provide	1-2 (possibly 3) major reinvestment opportunities.

		alternatives to hydrogen and CCS pathways. • Risk varies between glass subsectors, with container glass having more mature electrification pathways (lower risk) than flat glass (comparatively higher risk) • High electrification could require significant grid upgrades and timely reinforcement at individual sites.	



Notes: *Renewal estimates are indicative and based on typical asset lifetimes and major renewal cycles reported in the literature. Actual site-specific investment opportunities will depend on asset age, maintenance schedules, production strategy and refurbishment requirements. Risk is not determined solely by renewal frequency but by geography, infrastructure dependence and availability. Ratings are not intended as forecasts of individual company outcomes.*

Greater co-ordination can help close the timing gap

The timing mismatch between industrial reinvestment cycles and low-carbon infrastructure delivery is not a temporary coordination problem that will be resolved through natural market adjustments or incremental policy change. It reflects structural features of the current delivery system that inhibit concurrent, co-ordinated, time-critical investment across different actors. Under existing arrangements, hydrogen production, CO_2 transport and storage, electricity network reinforcement, and industrial capital investment are planned, regulated, and financed largely in isolation.[63–65] Each is governed by distinct incentives, risks, and approval processes within their own mandate, encouraging sequential rather than integrated and coordinated decision-making.

This sequential logic creates a persistent coordination failure. Infrastructure developers typically require credible long-term demand before committing capital, while industrial firms seek assurance that enabling infrastructure will be operational, reliable, and deliver competitively priced services within asset-specific investment windows. This challenge is not limited to new infrastructure. Electricity network operators face similar constraints in

expanding the existing network. However, plans for the next regulatory period for distribution networks, RIIO-ED3 (2028 to 2033)[66], set out a more proactive and strategically planned approach to network investment than the current RIIO-ED2 (2023 to 2028), with its "build and flex" framework enabling strategically justified upfront investment where future need is sufficiently evidenced, while retaining flexibility where the scale, timing and location of demand remain uncertain. Nevertheless, distribution network investment will remain subject to demonstrating need, cost-effectiveness and consumer value.[66–68] Individually, delaying investment until uncertainty is resolved may be rational. Collectively, however, such behaviour may contribute to coordination failures, increasing the risk that enabling infrastructure is delivered too late to support time-critical industrial reinvestment opportunities.

As a result, first-mover risk remains a significant barrier to major capital commitments. Early industrial adopters face uncertainty over the timing, cost, and availability of enabling infrastructure, while infrastructure providers risk underutilised or stranded assets if industrial demand does not materialise at sufficient scale. Existing UK risk-sharing frameworks have focused primarily on improving project bankability through contract-for-difference (CfD) style revenue support mechanisms that reduce price uncertainty and stabilise revenues for industrial CCS and hydrogen production. [69,70] While the CCS framework incorporates mechanisms to mitigate certain coordination risks within the transport and storage value chain, including underutilisation, stranded asset and cross-chain risks,[71–73] broader system-level challenges associated with demand creation, infrastructure timing, cross-sector integration, investment sequencing and long-term industrial competitiveness remain only partially addressed.

For industrial electrification, risk sharing arrangements remain comparatively less developed, with current approaches focused on grant funding, innovation support, and network investment frameworks, rather than dedicated long-term revenue stabilisation models.[74–76] For hydrogen, CCS, and electrification pathways to translate into industrial investment, infrastructure must also be perceived as investable. This requires credible delivery timelines aligning with industrial investment cycles, predictable cost exposure, and a more balanced allocation of risk between early adopters, infrastructure providers, and government.

In the absence of these conditions, the option value of waiting or closing the site altogether can dominate investment decisions. Firms defer or downscale commitments to avoid premature lock-in or asset stranding, leading to fragmented delivery, repeated postponement of final investment decisions (FIDs), and missed reinvestment windows. These outcomes arise not from a lack of technology or ambition, but from misaligned risk, timing, and responsibility across actors with different planning horizons.

Fragmented decision-making, therefore, leads to sequential investment; sequential investment raises first-mover risk; and elevated risk delays final decisions, meaning infrastructure may arrive too late to influence large, irreversible capital renewal decisions.

Addressing this challenge requires a shift in how investment decisions are sequenced, governed, and supported. Rather than relying on reactive delivery once demand is fully proven, policy should enable anticipatory investment[50] where timing is critical, aligning infrastructure delivery with industrial asset renewal cycles. The new planning functions of the National Energy Systems Operator (NESO) could play a vital role in this regard if both the Strategic Spatial Energy Plan (SSEP)[77,78] and the Regional Energy Strategic Plans (RESP)[79] take a truly whole-system approach to the spatial planning and sequencing of electricity, hydrogen and CO_2 infrastructure needed to support industrial decarbonisation.

However, better planning is not all that is needed. This should be complemented by giving greater attention to how risk is allocated across value chains, alongside the governance frameworks that align expectations on timing, scale, and risk across industry, infrastructure providers, regulators, and government. Commercial viability is integral to this alignment. Measures that narrow the UK–EU electricity price gap, stabilise hydrogen and CO_2 transport costs, or offer targeted time-limited risk-sharing mechanisms for strategically important assets can play a decisive enabling role by reducing first-mover exposure and ensuring that co-ordinated infrastructure plans translate into investable industrial decisions.

The persistence of the timing gap therefore reflects not a lack of ambition, but a delivery system struggling to align multiple time-sensitive investments under conditions of technological, infrastructural, and market uncertainty, a challenge increasingly observed internationally, including in Germany and the European Union.[80–86]

Policy Recommendations

1. Visibility, Coordination & Strategic Planning: Ensure strategic energy planning systematically incorporates industrial investment needs and reinvestment timelines

Government should ensure that NESO has a clear responsibility, supported by appropriate capability and resources, to incorporate industrial decarbonisation and growth objectives into its whole-system energy planning. As the SSEP and RESPs are developed and refined, NESO should assess the location, timing and infrastructure requirements of existing and prospective industrial investment.

RESPs should provide a structured mechanism through which industrial businesses and regional stakeholders can communicate their decarbonisation, growth and infrastructure needs. The proposed RESP industry working groups may form part of the solution. Whatever the specific arrangement, engagement between industry, government, regulators, network companies, local and combined authorities, and regional economic bodies should be embedded from the outset and supported by sufficient technical, commercial and investment expertise to ensure that industrial needs inform regional planning and network investment decisions.

In compliance with competition law and with appropriate safeguards for commercially sensitive information, government and NESO should explore a structured process through which industrial firms can communicate anticipated reinvestment windows, future energy demand and critical infrastructure dependencies early enough to support timely infrastructure planning and investment decisions.[87] This information should inform regional and national energy planning, helping to identify where electricity network capacity and low-carbon infrastructure need to be available to support time-critical industrial investment. NESO should demonstrate how this evidence informs strategic and regional planning decisions.

Together, these measures would improve visibility of future industrial demand, identify time-critical investment opportunities and strengthen the evidence base for strategic energy planning.

2. Sequencing Infrastructure Delivery and Industrial Reinvestment: Align infrastructure delivery and industrial support frameworks with sector-specific reinvestment windows

Government, led by the Departments for Energy Security and Net Zero and for Business and Trade, should strengthen coordination between industrial policy, strategic energy planning and infrastructure delivery to ensure that hydrogen, CCS and electricity-network infrastructure become available within industrial reinvestment windows. Working with NESO, Ofgem and network companies, infrastructure investment and industrial support frameworks should be aligned with expected industrial investment cycles to reduce the risk of missed decarbonisation opportunities.

Ofgem should consider how regulatory arrangements can support the timely translation of strategic and regional energy plans into proportionate network investment. Improved coordination would provide greater visibility of the sequencing, regional availability and delivery timelines of hydrogen, CCS and electricity-network infrastructure relative to industrial reinvestment needs.

Industrial support frameworks should reflect differences in asset lifecycles, infrastructure readiness and site characteristics, including the needs of inland and geographically dispersed sites with limited access to shared hydrogen and CCS infrastructure. Particular attention should be given to the cement, lime and ceramics sectors, where long-lived kiln assets, relatively constrained decarbonisation pathways and limited flexibility over plant location create heightened risks of infrastructure-investment misalignment. Government, NESO and infrastructure developers should therefore identify time-critical reinvestment windows and provide greater certainty regarding infrastructure delivery.

Regional and local growth strategies should inform these decisions by identifying industrial investment opportunities, infrastructure dependencies and priority sites. Where hydrogen or CCS infrastructure is unlikely to be available within relevant reinvestment windows, government and network planners should assess opportunities to enable viable electrification pathways through timely grid connections and network reinforcement. This needs to be accompanied by affordable industrial electricity prices, helping narrow the gap with prices in key European competitor countries.

Together, these measures would strengthen the translation of strategic energy planning into timely infrastructure delivery, ensuring that hydrogen, CCS and electricity-network investments are aligned with industrial reinvestment cycles and reducing the risk that viable decarbonisation opportunities are missed because enabling infrastructure is not available when investment decisions are made.

3. Commercial viability and Investment De-risking: Support the development of coordinated industrial ecosystems and shared infrastructure where market failures and first-mover risks constrain investment.

Government should improve long-term policy certainty and visibility regarding industrial decarbonisation support mechanisms, including measures that strengthen demand-side certainty. Relevant infrastructure developers also need to be transparent regarding likely trajectories for hydrogen costs, CO_2 transport and storage charges, and other key operating costs affecting industrial investment decisions.

Government could also take a more strategic approach to developing industrial ecosystems, supporting the co-location of complementary projects to improve infrastructure utilisation, create economies of scale and strengthen the business case for shared infrastructure. For example, the co-location of sustainable aviation fuel production within an industrial cluster could strengthen demand for hydrogen and carbon capture services, improving the investment case for associated infrastructure. Such approaches can help address coordination failures where infrastructure developers, industrial firms and other market participants, acting independently, are unable to capture the full value of their investments.

Greater predictability over future operating costs and support arrangements would help infrastructure availability translate into investable projects and reduce first-mover risk. However, where commercially viable projects continue to face demand uncertainty, coordination barriers or financing constraints, public finance institutions could help mobilise private investment and support strategically important industrial decarbonisation infrastructure. The National Wealth Fund, building on investments such as Peak Cluster, could play one such role through a range of financing instruments, subject to its investment mandate. [88] Such interventions would be most effective when they complement, rather than substitute for, government responsibility for strategic coordination and industrial policy, and are linked to credible utilisation pathways and demonstrable economic or decarbonisation benefits.

Together, these measures would help address coordination failures, reduce investment risk, improve confidence in future operating conditions and support the development of commercially viable industrial decarbonisation projects and shared infrastructure.

References

1. Department for Business & Trade. Invest 2035: the UK's modern industrial strategy. https://www.gov.uk/government/consultations/invest-2035-the-uks-modern-industrial-strategy/invest-2035-the-uks-modern-industrial-strategy (2026).
2. HM Government. The UK's Modern Industrial Strategy. (2025).
3. Scotland Office, Department for Business and Trade, Department for Energy Security and Net Zero & HM Treasury and The Rt Hon Rachel Reeves MP. Powering Britain's Future. https://www.gov.uk/government/news/powering-britains-future (2025).
4. MTA. Direction of Government – Report on the Prime Minister's speech in the Commons. https://www.mta.org.uk/resources/direction-of-government-report-on-the-prime-ministers-speech-in-the-commons-1st-september-2026/ (2026).
5. UK Parliament - Hansard. Industrial Investment. https://hansard.parliament.uk/Commons/1978-12-07/debates/2016c313-b4a1-432a-b825-f489f893b219/IndustrialInvestment (1978).
6. UK Parliament - Hansard. Investment (Manufacturing Industry). https://hansard.parliament.uk/commons/1978-06-23/debates/2c0af485-5ac9-48d2-bb4e-a6eed0916086/Investment(ManufacturingIndustry) (1978).
7. Ruparel, R. et al. Uplift in Demand, Shortfall in Supply: Can the UK Deliver on Its Infrastructure Investment Ambitions? BCG **27**, 2025 (2025).
8. Department of Energy Security and Net Zero & Department of Business, Energy and Industrial Strategy. Industrial decarbonisation strategy. (2021).
9. Edwards, P. Breedon Group's Hope Cement plant. Global Cement https://www.globalcement.com/magazine/articles/1069-breedon-group-s-hope-cement-plant (2018).
10. Ceramics UK. Decarbonising UK Ceramic Manufacturing Roadmap - Technical Appendix. https://www.ceramics-uk.org/knowledge-1/decarbonisation-roadmap-appendix (2026).
11. Kemsley Mill. Kemsley Mill – DS Smith. https://www.dssmith.com/globalassets/paper/pdfs/mill-sheets-pdf/dss_kemsley_mill.pdf.
12. Department of Energy Security and Net Zero. UK hydrogen strategy (accessible HTML version). https://www.gov.uk/government/publications/uk-hydrogen-strategy/uk-hydrogen-strategy-accessible-html-version (2024).
13. Department for Energy Security & Net Zero. Carbon Capture, Usage and Storage: a vision to establish a competitive market.

https://www.gov.uk/government/publications/carbon-capture-usage-and-storage-a-vision-to-establish-a-competitive-market/carbon-capture-usage-and-storage-a-vision-to-establish-a-competitive-market?trk=public_post_comment-text (2023).

14. Department of Energy Security and Net Zero. Hydrogen transport and storage networks pathway. https://www.gov.uk/government/publications/hydrogen-transport-and-storage-networks-pathway/hydrogen-transport-and-storage-networks-pathway (2023).

15. Gailani, A. & Taylor, P. Assessing electricity network capacity requirements for industrial decarbonisation in Great Britain. Energy Policy **201**, (2025).

16. Material Economics. Industrial Transformation 2050 Pathways to Net-Zero Emissions from EU Heavy Industry. (2019).

17. OECD. Low and zero emissions in the steel and cement industries. Barriers, technologies and policies. www.oecd.org/greengrowth (2020).

18. Verdolini, E. et al. Industrial Deep Decarbonization: Modeling Approaches and Data Challenges. (2023).

19. Åhman, M., Nykvist, B., Morales, E. T. & Algers, J. Building a stronger steel transition: Global cooperation and procurement in construction. One Earth **6**, 1421–1424 (2023).

20. Copley, J. Green Vulcans? The political economy of steel decarbonisation. New Political Economy **29**, 972–985 (2024).

21. Algers, J., Åhman, M. & Nilsson, L. J. Paris Compatible Steel Capacity: Contraction and Replacement for zero Emissions. (2023).

22. Neuwirth, M., Fleiter, T. & Hofmann, R. Modelling the transformation of energy-intensive industries based on site-specific investment decisions. Scientific Reports 2024 14:1 **14**, 30552- (2024).

23. Geels, F. W., Sovacool, B. K. & Iskandarova, M. The socio-technical dynamics of net-zero industrial megaprojects: Outside-in and inside-out analyses of the Humber industrial cluster. Energy Res. Soc. Sci. **98**, 103003 (2023).

24. Sovacool, B. K. et al. Reconfiguring European industry for net-zero: a qualitative review of hydrogen and carbon capture utilization and storage benefits and implementation challenges. Energy Environ. Sci **17**, 3523 (2023).

25. Tata Steel UK. Closure of Blast Furnace 4 but green steel project will ensure next generation of steelmaking. https://www.tatasteeluk.com/corporate/news/closure-of-blast-furnace-4-but-green-steel-project-will-ensure-next-generation-of-steelmaking (2024).

26. Tata Steel UK. Tata Steel signs £500 million Grant Funding Agreement with UK Government for £1.25 billion green steel project in Port Talbot.

https://www.tatasteel.com/newsroom/press-releases/india/2024/tata-steel-signs-500-million-grant-funding-agreement-with-uk-government-for-125-billion-green-steel-project-in-port-talbot/ (2024).

27. Tata Steel. Following 7 months of formal and informal national level discussions with the UK trade unions, Tata Steel will proceed with its £1.25 Billion investment to build a state-of-the-art Electric Arc Furnace in Port Talbot and commence closure of the existing …. https://www.tatasteel.com/media/newsroom/press-releases/india/2024/following-7-months-of-formal-and-informal-national-level-discussions-with-the-uk-trade-unions/ (2024).

28. HM Government. Industrial Decarbonisation Strategy. (2021).

29. Neath Port Talbot Council. Section A-Matters for Decision. https://democracy.npt.gov.uk/documents/s104594/Section%20A-%20P2024-0711%20TATA%20Electric%20Arc%20Furnace.pdf (2024).

30. National Grid. National Grid shares plans for vital network upgrades in Port Talbot to support green steel transition. https://www.nationalgrid.com/media-centre/press-releases/National-Grid-shares-plans-for-vital-network-upgrades-in-Port-Talbot (2025).

31. OREACO. Margam Metamorphosis Melds Modernity & Megawatt Might. https://www.oreaco.com/news-1/margam-metamorphosis-melds-modernity-%26-megawatt-might (2025).

32. Tata Steel UK. Green Steel Future. Tata Steel – FAQ - Steel sovereignty https://www.tatasteeluk.com/green-steel-future (2025).

33. SULZER. Sulzer GTC helps Croatian refinery to restore its CDU operations | Sulzer. https://www.sulzer.com/en/shared/news/200623-sulzer-gtc-helps-croatian-refinery-to-restore-its-cdu-operations (2020).

34. García-Maza, S. & González-Delgado, Á. D. Technical–Economic Assessment and FP2O Technical–Economic Resilience Analysis of the Gas Oil Hydrocracking Process at Large Scale. Sci 2025, Vol. 7, Page 17 **7**, 17 (2025).

35. Nunez, P. Developing Guidance to Support Sustainable Spent Pot Lining (SPL) Management Across the Aluminium Industry. The Journal of The Minerals, Metals & Materials Society (TMS) **72**, (2020).

36. DNV-GL & WSP – Parsons Brinckerhoff. Cement Report. https://assets.publishing.service.gov.uk/media/5a8046d5e5274a2e8ab4f37d/Cement_Report.pdf (2015).

37. Department of Energy and Climate Change, Department for Business, Innovation. and Skills, WSP – Parsons Brinckerhoff & DNV-GL. Industrial Decarbonisation & Energy Efficiency Roadmaps to 2050–Ceramic Sector. (2015).

38. DNV-GL & WSP – Parsons Brinckerhoff. Glass_Report. https://assets.publishing.service.gov.uk/media/5a7f5b35ed915d74e33f5ed6/Glass_Report.pdf (2015).

39. DNV-GL & WSP – Parsons Brinckerhoff. Pulp_and_Paper_Report. https://assets.publishing.service.gov.uk/media/5a80864aed915d74e622ef4c/Pulp_and_Paper_Report.pdf (2015).

40. DNV-GL & WSP – Parsons Brinckerhoff. Chemicals_Report. https://assets.publishing.service.gov.uk/media/5a748ea240f0b616bcb17717/Chemicals_Report.pdf (2015).

41. UK Parliament. Written evidence submitted by Essar Energy Transition (MAN0060) . https://committees.parliament.uk/writtenevidence/161611/pdf/ (2026).

42. Essar. Essar Energy Transition's Hydrogen-Ready Furnace now Powering EET Fuels' Stanlow Site. https://www.essar.com/inthenews/essar-energy-transitions-hydrogen-ready-furnace-now-powering-eet-fuels-stanlow-site/ (2025).

43. Essar. Essar To Build UK'S First Refinery-based Hydrogen Furnace in £45 Million Investment. https://www.essar.com/inthenews/essar-to-build-uks-first-refinery-based-hydrogen-furnace-in-45-million-investment/ (2022).

44. Department of Business, Energy and Industrial Strategy. Cluster Sequencing for Carbon Capture Usage and Storage Deployment: Phase-2 –Background and Guidance for Submissions. (2021).

45. The Scottish Parliament. Net Zero, Energy and Transport Committee Session 6. (2025).

46. Department of Energy Security and Net Zero. CCUS Cluster Sequencing Track-2: Market update December 2023. https://www.gov.uk/government/publications/cluster-sequencing-for-carbon-capture-usage-and-storage-ccus-track-2/ccus-cluster-sequencing-track-2-market-update-december-2023 (2023).

47. CCSA. CCUS Delivery Plan Update 2025. https://cms.ccsassociation.org/wp-content/uploads/2026/01/CCSA-CCUS-Delivery-Plan-Update-2025.pdf?ver=1770388519 (2025).

48. Imperial College London. 2025 Spending Review: UK CCUS Status and Future Challenges. https://www.imperial.ac.uk/a-z-research/towards-net-zero/energy-transition-commentaries/commentaries/2025-spending-review-uk-ccus-status-and-future-challenges/ (2025).

49. Trades Union Congress. Industrial decarbonisation strategy – union priorities. https://www.tuc.org.uk/research-analysis/reports/industrial-decarbonisation-strategy-union-priorities (2025).

50. Gailani, A., Barker, B., Hicks, M.-L. & Taylor, P. Electrifying Industry and Distribution Networks. (2025).

51. Department for Energy Security and Net Zero & Great British Energy. Press Release: Great British Grid to speed up connections and cut bills. https://www.gov.uk/government/news/great-british-grid-to-speed-up-connections-and-cut-bills (2026).

52. Department for Energy Security and Net Zero, Ofgem, National Energy System Operator & The Rt Hon Ed Miliband MP. Clean energy projects prioritised for grid connections. https://www.gov.uk/government/news/clean-energy-projects-prioritised-for-grid-connections (2025).

53. Department of Business & Trade. The UK steel strategy (web version). https://www.gov.uk/government/publications/steel-strategy/the-uk-steel-strategy-web-version (2026).

54. Ofgem. Connect update: demand connections reform. https://www.ofgem.gov.uk/policy/connect-update-demand-connections-reform (2026).

55. Peak Cluster Limited. Peak Cluster project guide - Our phase 1 consultation: www.peakcluster.co.uk. (2026).

56. GMB, Trades Union Congress & Green Alliance. Save British Ceramics - Policy priorities to rebuild a modern low carbon industry. (2025).

57. UKRI. Enabling net zero: progress on deploying CCS to decarbonise UK industrial clusters. (2024).

58. Hynamics. The Fawley Green Hydrogen Project. https://www.hynamics.com/en/our-projects/fawley-green-hydrogen (2026).

59. Emily Ford. CO_2 pipeline plan axed by ExxonMobil. BBC News https://www.bbc.co.uk/news/articles/c4glw4dyw8no (2024).

60. Ireson, R. Decarbonising glass production. Institute of Materials, Minerals & Mining https://www.iom3.org/resource/decarbonising-glass-production.html (2024).

61. Fuller, A., García, P. G., Hulme, R. & Ireson, R. Alternative Fuel Switching Technologies for the Glass Sector: Phase 3. (2022).

62. Buckland, Z. Successful alternative fuel trials for industrial glass. Institute of Materials, Minerals & Mining https://www.iom3.org/resource/successful-alternative-fuel-trials-for-industrial-glass.html (2026).

63. Majumder-Russell, D. & Kenber, N. Hydrogen law, regulations & strategy in the United Kingdom. CMS https://cms.law/en/int/expert-guides/cms-expert-guide-to-hydrogen/united-kingdom (2024).

64. Pencheva, P., Prokudina, A. & Reed, J. UK Hydrogen Ecosystem: A Pathway to 2050. https://www.ucl.ac.uk/steapp/ (2025) doi:10.17605/OSF.IO/WYK3A.

65. Department for Energy Security & Net Zero. Future Network Strategy for CO_2 Transport and Storage – Call for Evidence on CCUS Future Network Strategy. (2025).

66. Ofgem. Press Release: Ofgem sets rules for 2028 to 2033 grid investment to meet growing electricity demand. Ofgem https://www.ofgem.gov.uk/press-release/ofgem-sets-rules-2028-2033-grid-investment-meet-growing-electricity-demand (2026).

67. Ofgem. ED3 Framework Consultation. www.ofgem.gov.uk. (2024).

68. Ofgem. Decision: ED3 Framework Decision. www.ofgem.gov.uk. (2025).

69. Department for Energy Security and Net Zero & Department of Business, Energy and Industrial Strategy. Carbon capture, usage and storage (CCUS): business models. https://www.gov.uk/government/publications/carbon-capture-usage-and-storage-ccus-business-models (2026).

70. Department for Energy Security and Net Zero. Hydrogen production business model. https://www.gov.uk/government/publications/hydrogen-production-business-model (2025).

71. Department of Energy Security and Net Zero & Department of Business, Energy and Industrial Strategy. Carbon capture, usage and storage (CCUS): business models. https://www.gov.uk/government/publications/carbon-capture-usage-and-storage-ccus-business-models (2026).

72. Lockwood, T. Risk Allocation and Regulation for CO_2 Infrastructure - A UK Case Study. Clean Air Task Force https://www.catf.us/resource/risk-allocation-regulation-co2-infrastructure/ (2024).

73. Department for Energy Security and Net Zero. Hydrogen Allocation Rounds. https://www.gov.uk/government/collections/hydrogen-allocation-rounds (2025).

74. Department for Energy Security and Net Zero. Future of the Industrial Energy Transformation Fund – Summary of Responses to the Consultation and the Government's Response. https://assets.publishing.service.gov.uk/media/655cb2f7d03a8d000d07fdd0/future-of-the-ietf-government-response.pdf (2023).

75. Department for Energy Security and Net Zero & Department of Business, Energy and Industrial Strategy. Industrial Energy Transformation Fund. https://www.gov.uk/government/collections/industrial-energy-transformation-fund (2026).

76. Beth Barker & Marie-Laure Hicks. Next Steps for UK Industrial Decarbonisation Policy in 2025. Aldersgate Group (2025).

77. Department for Energy Security & Net Zero. Strategic Spatial Energy Plan Commission to the National Energy System Operator. https://assets.publishing.service.gov.uk/media/67168359d100972c0f4c9b41/strategic-spatial-energy-plan-ssep-neso-commission.pdf (2024).

78. National Energy System Operator (NESO). Strategic Spatial Energy Plan Methodology appendices. https://www.neso.energy/document/360506/download (2025).

79. National Energy System Operator (NESO). Regional Energy Strategic Planning (RESP). https://www.neso.energy/what-we-do/strategic-planning/regional-energy-strategic-planning-resp (2025).

80. Poudineh, R. & Apostolopoulou, D. The complex challenge of coordination in liberalised and carbon-constrained energy systems. The Oxford Institute for Energy Studies, Oxford (2025).

81. Geerinck, J., Brijs, T., Brussels, P. & Sudmeijer, B. Mind the Queue: Connection Reform for the Electricity Grid. BCG (2025).

82. Acer – European Union Agency for the Cooperation of Energy Regulators. European hydrogen markets – 2025 Monitoring Report. www.acer.europa.eu (2025).

83. Odenweller, A. & Ueckerdt, F. The green hydrogen ambition and implementation gap. Nature Energy 2025 10:1 **10**, 110–123 (2025).

84. Bundesrechnungshof. Implementation of the Federal Government's Hydrogen Strategy At a Glance – Special Report. (2025).

85. Reuters. Europe's hydrogen infrastructure faces 2-3 year delay, Enagas CEO says. https://www.reuters.com/sustainability/boards-policy-regulation/europes-hydrogen-infrastructure-faces-2-3-year-delay-enagas-ceo-says-2025-07-22/ (2025).

86. Waliszewska, A. Industrial Electrification in the EU-Blocked by the Grid? – Options for member states to unlock grid access for industrial consumers. E3G BRIEFINGS (2026).

87. HM Government & Competition and Markets Authority. Competition law: guide for public authorities. https://www.gov.uk/government/publications/competition-law-guide-for-public-authorities/competition-law-guide-for-public-authorities (2026).

88. National Wealth Fund. National Wealth Fund invests in Peak Cluster to secure a resilient future for cement and lime manufacturing in the UK. National Wealth Fund https://www.nationalwealthfund.org.uk/news-and-publications/news/national-wealth-fund-invests-in-peak-cluster-to-secure-a-resilient-future-for-cement-and-lime-manufacturing-in-the-uk/ (2025).

About EDRC

The Energy Demand Research Centre (EDRC) undertakes research for an affordable and secure low energy future. Our interdisciplinary research programme identifies evidence-based energy demand reductions for a sustainable and more equitable future. We work closely with partners from policy, industry, civil society and academia.

Grant number

EP/Y010078/1

DOI

10.48785/100/522

How the report should be referenced

Peace Adesina, Peter Taylor (2026), Closing the Timing Gap: Securing the Future of UK Energy-Intensive Industries, Energy Demand Research Centre.

hello@edrc.ac.uk

www.edrc.ac.uk

Bluesky

LinkedIn