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Decarbonization from the ground up: what Local Industrial Decarbonization Plans reveal about place-based approaches to decarbonizing industry in the UK

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ABSTRACT

Energy-intensive industrial sectors such as steel, chemicals and cement are among the highest sources of carbon emissions globally. Production facilities are often concentrated in distinct geographic locations, shaped by historical access to infrastructure, resources and skilled labour. Such spatial concentration poses a challenge for climate policy, requiring a balance between national and international decarbonization frameworks and context-specific, local interventions. This paper explores that dilemma through an analysis of the UK's Local Industrial Decarbonization Plans (LIDPs) competition (2023–2025), which supported 13 local industrial clusters in developing decarbonization plans. Drawing on stakeholder interviews and project documentation for 12 projects, the study identifies four sub-types of local cluster – bounded, regional, urban and sector-based – each presenting distinct opportunities and challenges. To interpret these findings, we propose a conceptual framework that situates industrial decarbonization at the intersection of Place, Sector and Intervention. Key challenges, such as infrastructure constraints, fragmented data, and difficulties in engagement, reflect misalignments across these domains. Our analysis suggests that while local decarbonization ambition is essential, it is insufficient by itself. National-level infrastructure investment, institutional support and coordinated data strategies remain critical enablers for local industrial decarbonization. Together, the findings underline the need for multi-scalar, integrated approaches to industrial decarbonization policy.

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Industrial decarbonization; industry; policy alignment; place

Key policy insights

- Place-based approaches for industrial decarbonization are important but fragile. Their success depends on strong local relationships and a shared sense of purpose. Long-term policy support will be critical to sustain and scale these collaborative efforts.
- Place-based approaches alone will not be sufficient for industrial decarbonization. Policy is also needed to create market demand and provide certainty around enabling infrastructures within a broader industrial strategy.
- Local industrial clusters are not uniform but may share characteristics that suggest common types. Identifying these patterns and tailoring policy accordingly could support more effective and targeted decarbonization strategies.

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1. Introduction

Energy-intensive industries are foundational to modern economies and will provide many of the materials required for low-carbon transition. However, industry is also the most CO_2 intensive end-use sector, accounting for almost half of total final consumption emissions globally in 2023 (IEA, 2024b). As countries transition to low-carbon economies, technological innovation and targeted policies will play key roles in addressing sector-specific challenges and enabling a just transition (Rissman et al., 2020). With the rise of low-carbon production methods, however, the optimal locations for heavy industries are likely to shift towards places with access to abundant renewable energy, essential for powering clean production processes, suitable geological sites for carbon capture and storage (CCS) and sufficient natural resources, such as physical space and water. This shift has been predicted to create a 'new geography of heavy industry' (Bataille et al., 2021, p. 2), favouring those areas rich in these resources (Gabrielli et al., 2023; While & Eadson, 2021) and with the infrastructures and institutional capacity to effectively engage with the low-carbon transition (Rattle & Taylor, 2023).

Industrial decarbonization must occur within short timeframes and under internationally agreed emissions limits, while simultaneously transforming multiple hard-to-abate sectors (Fankhauser et al., 2022). This makes it qualitatively different from previous industrial transitions. As the IPCC argues, industrial policy has historically been used to promote economic development and wealth creation, either by supporting emerging industries, protecting declining sectors, or managing industrial phase-outs and worker retraining (Bashmakov et al., 2022). More recently there has been increasing attention to 'green' industrial policy aimed at supporting low-carbon technologies and green growth (Busch et al., 2018; OECD Net Zero+, 2024). However, these approaches tend to focus on creating new clean technology markets rather than addressing the more fundamental changes required for present heavy industry to reach zero emissions (Bashmakov et al., 2022). The policy implications of this transformation remain relatively underexplored and represent 'a new governance challenge' (*ibid*. p. 1209) requiring active state coordination, long-term policy support, and public investment. Because industry is unevenly distributed across regions, a single national policy response is unlikely to be sufficient (IEA, 2025). Instead, spatially differentiated responses will be required, meaning place-based approaches to industrial decarbonization are likely to become increasingly important in the coming decades.

However, what a 'place-based' approach entails in practice is not always clear. Barca (2009) offers a three-part definition of a place-based policy: that economic outcomes are shaped by locally specific resources, institutions, knowledge and preferences; that development is influenced by connections between places; and that policy interventions should be tailored to the characteristics of given places. As such, place-based approaches can be distinguished from place-neutral approaches, which assume that market-led adjustments can improve economic outcomes if barriers to mobility, skills development and growth are removed (Barca et al., 2012).

Place-based policy has become increasingly embedded within contemporary climate governance (Government of South Africa, 2022; OECD, 2025) and industrial strategy (Bailey et al., 2026) in recent decades as a means of addressing regional disparities and supporting inclusive growth. In the UK however, and particularly England, which is characterized by a strong culture of centralism (Heseltine, 2012) and where the implementation of place-based initiatives has been marked by persistent policy and institutional churn since the 1980s (Pugh, 2024), questions persist over what policies labelled as 'place-based' offer in practice, beyond locally-led or area-based policy (Marsden et al., 2025). These tensions are especially apparent in industrial decarbonization policy, since energy intensive industry is often already highly spatially concentrated.

The UK was the first major economy to launch an Industrial Decarbonisation Strategy (IDS) in 2021 (HM Government, 2021). While this was not characterized as place-based, it was geographically targeted, focused on carbon-intensive coastal clusters, typically centred around steelworks or oil refineries. The spatial concentration of heavy industry in these areas enables economies of scale for decarbonization, making it more viable to develop shared infrastructures, such as hydrogen production facilities and CCS pipeline networks (Lazzeretti et al., 2013; World Economic Forum, 2022).

This cluster-based approach shaped the early trajectory of UK industrial decarbonization policy. However, from 2023 onwards, policy attention began to extend to 'dispersed industrial sites': defined in the IDS as industrial facilities located more than 25 km from a recognized cluster. These sites lie beyond the reach of cluster-based shared infrastructure. They are also more heterogeneous in size, sector and emissions profile. While less emissions-intensive than clusters, dispersed sites are significantly more numerous, accounting for 45% of the UK's industrial emissions.

Within this context, the Local Industrial Decarbonisation Plan (LIDP) competition was launched in April 2023. Termed a 'place-based' initiative (Innovate UK, 2023), the programme aimed to support local industrial clusters in developing plans to guide industrial decarbonization (Innovation Funding Service, 2023). This paper provides a qualitative analysis of the programme, drawing on stakeholder interviews and project documentation. It reveals how place-based approaches can support local industrial decarbonization. However, it also highlights limitations of the approach as it was implemented, identifying where additional policy interventions are needed. These insights offer lessons for climate policy on the role of place-based strategies in advancing industrial decarbonization internationally.

The analysis is structured around three questions:

1. What are the characteristics of the projects that won funding under the LIDP competition?
2. What does the LIDP competition reveal about the effectiveness of place-based policy for industrial decarbonization planning?
3. How can lessons from the LIDP competition inform future policy for industrial decarbonization?

In addressing these questions, we make a dual contribution. Conceptually, we offer a heuristic framework to understand how place-based strategies intersect with sectoral and intervention-based policy approaches. This approach provides a means to better understand the different rationales of each, and to assess how these approaches can be better aligned to support decarbonization across diverse industrial geographies. Empirically, we analyse the development of 12 local industrial strategies, offering insights into how the spatial configuration of projects influenced outcomes. In doing so, we expand upon the prevailing cluster/dispersed site binary in UK policy, revealing a more nuanced geography of industrial decarbonization.

The remainder of the paper is structured as follows. Section 2 introduces industrial decarbonization as a challenge situated at the intersections of sector, intervention, and place-based policy. Section 3 provides our methodological approach. Section 4 addresses the first two research questions by examining the shared characteristics of projects funded through the competition and analysing how the projects evolved in different cluster sub-types. In Section 5, we address our third research question and draw lessons for future policy. Section 6 concludes by discussing limitations and offering recommendations for future research.

2. Industrial decarbonization policy and its intersections

Numerous studies have outlined the key policy interventions for industrial decarbonization at global and national levels (Åhman et al., 2017; Bataille et al., 2018; IEA, 2025; Nilsson et al., 2021; Rissman et al., 2020). We propose that industrial decarbonization sits at the intersection of three overlapping domains: the characteristics of the industrial sectors involved ('sector'), the decarbonization interventions employed, which may be technical (e.g. new technologies or infrastructure), or market-oriented (e.g. low-carbon product standards) ('intervention'), and the geographical, social, and economic settings in which these occur ('place'). Policy instruments operate within, and critically, across, the intersections of these domains. Figure 1 illustrates this relationship. The following sections characterize each domain before examining their intersections. We argue that successful industrial decarbonization depends on recognizing and addressing all six elements.

2.1. Approaches to industrial decarbonization

2.1.1. Sector-based

A distinguishing feature of energy-intensive industry is the diversity of processes it uses. The sector as a whole is considered hard-to-abate due to its high energy intensity, high capital costs, long investment cycles, lack of markets for low-carbon materials, low profit margins, trade exposure and the immaturity of many abatement options (Bataille, 2020). The steel, cement and chemicals sectors are particularly emissions intensive, accounting for 60% of industrial fossil fuel demand and approximately 70% of direct industrial CO_2 emissions (IEA, 2020).

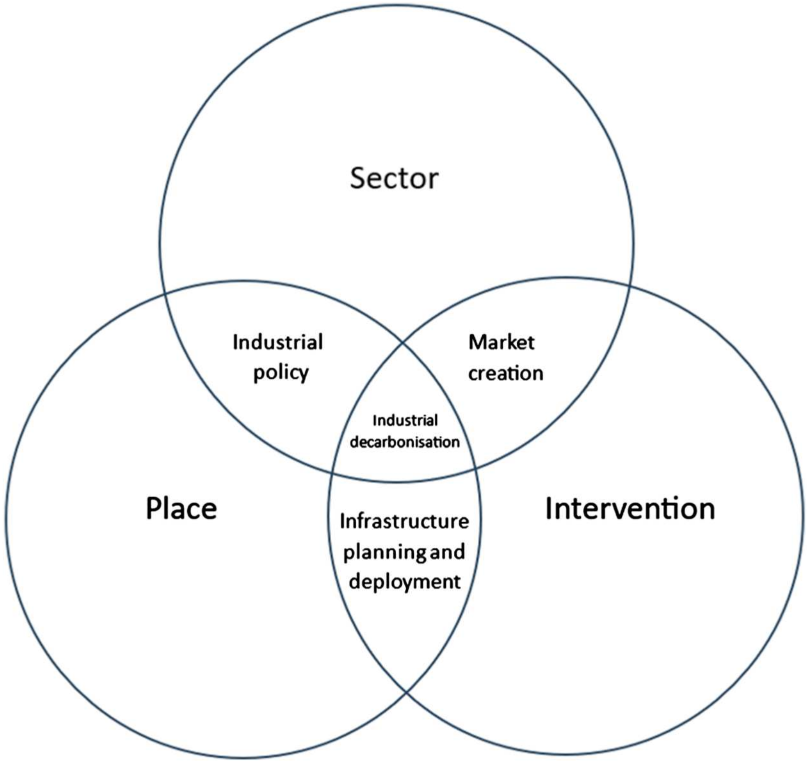

Figure 1. Approaches to industrial decarbonization.

These sectors illustrate many of the challenges of industrial decarbonization. Traditional steel production relies on fossil fuels, particularly coking coal, which serves a dual purpose: providing the intense heat required for processing and acting as a reducing agent in the chemical reduction of iron ore (primarily iron oxide) by removing oxygen to produce iron. Similarly, the primary source of CO_2 emissions in cement production is at the kilning stage, from the combustion of fuel and the chemical decomposition of limestone into calcium oxide and CO_2 during calcination. Calcination accounts for about two-thirds of total emissions, meaning cement production cannot be decarbonized solely by decarbonizing the energy supply (Habert et al., 2020). In the chemicals sector, the hundreds of products and processes involved make standardizing decarbonization measures difficult (Saygin & Gielen, 2021). In addition, 50% of the sector's energy input is from fossil fuel-derived feedstocks rather than energy supply (Gabrielli et al., 2023).

Given the complexity of the issues involved, sector-specific roadmaps have emerged as key policy tools. Sweden is a leading example, having developed detailed roadmaps for its industrial sectors to guide their decarbonization efforts (IEA, 2024a). By outlining goals, pathways and actions, roadmaps are intended to coordinate policy, investment and innovation, reducing the risk of sectors becoming locked into high-emission trajectories (Gerres et al., 2019). However, the sector-specific approach has a tendency to treat sectors as isolated entities, overlooking the cross-sectoral potential of decarbonization interventions (Gerres et al., 2019). Consequently, roadmaps alone are unlikely to deliver the scale of change required for a full industrial transition.

2.1.2. Intervention-based

Technology options for decarbonizing industrial processes can be grouped into four categories (Gailani et al., 2024). Resource and energy efficiency strategies (REE) aim to reduce emissions by minimizing the use of raw materials through recycling, industrial symbiosis, the substitution of emissions-intensive inputs, and reducing the energy required for production. Fuel switching involves replacing fossil fuels used for high-temperature process heat with lower-carbon alternatives. These include hydrogen, biomass and low-carbon electricity. Process-specific modifications and novel low-carbon technologies can reduce consumption emissions, often in combination with fuel switching, depending on the specific industrial process. Finally, in the absence of other solutions, CCS targets residual emissions by capturing CO_2 from processes such as steel and cement production and storing it, typically in geological formations.

In practice, a mix of technological, financial and infrastructure interventions will be required (IEA, 2022). Planning and building the required transmission and storage systems for electricity, hydrogen and CO_2 will be capital-intensive and face significant demand uncertainty, creating risks that will deter private investors in the absence of national policy support. Government action will therefore be essential to support technology deployment and establish the broader conditions required for transition. This includes mobilizing finance and investment; developing markets for near-zero emissions materials, investing in critical infrastructure and improving material efficiency and circularity (Bataille, 2020). A robust regulatory framework will also be required to govern liability, ensure monitoring, and support integration across industrial systems (IEA, 2025). For industries with high process emissions, decarbonization will likely require the co-location of facilities for CCS and low-carbon hydrogen production, alongside high voltage electricity transmission (Schneider et al., 2020).

2.1.3. Place-based

The effectiveness of industrial decarbonization strategies is shaped by the geographical context of industrial sites. Studies from the US, UK and Europe (Herman & Sovacool, 2024; Janipour et al., 2022; Lai & Devine-Wright, 2024) have emphasized the importance of understanding local conditions and capabilities as integral to shaping effective industrial decarbonization. Crucially, place is not only important in shaping technical suitability for low-carbon infrastructures, but also in the role industry and employment play in shaping the social identity and political economy of local areas (Devine-Wright, 2022; Thomas et al., 2022).

The Netherlands and the United Kingdom were early adopters of place-based approaches to industrial decarbonization (Government of the Netherlands, 2019; HM Government, 2021). Policy efforts have focused on coastal industrial clusters, centred around the petrochemicals and steel sectors, due to their high carbon intensity and suitability for co-located infrastructure. However, industrial areas outside of these clusters have received less attention. These regions often host less carbon-intensive but regionally significant sectors such as glass, paper, and ceramics. A comprehensive industrial decarbonization strategy must extend beyond clusters, if it is to deliver an effective low-carbon transition (Rattle et al., 2023).

2.2. Policy for industrial decarbonization

2.2.1. Market creation (intervention and sector)

A key barrier to industrial decarbonization is the cost gap between established technologies and lower carbon alternatives (Heck et al., 2024). Bridging this gap will require policies that address both supply and demand for low-carbon materials, alongside systemic interventions to support these changes at both national and global scale (Otto & Oberthür, 2024). On the supply side, policy should enable innovation and technology development to make low-carbon production viable, for example, through R&D funding, pilot projects, and knowledge-sharing initiatives. On the demand side, creating markets for low-carbon products is essential. Tools such as Carbon Contracts for Difference and green procurement can help drive uptake and support scale-up. Transparent standards and labelling are also critical to verify emissions claims and build trust. At a systems level, carbon pricing, whether through direct mechanisms like taxes or cap-and-trade, or indirect tools such as tradeable standards, will remain central. In all cases, robust monitoring and reporting frameworks are vital to track progress and ensure accountability (IEA, 2025).

Figure 1 illustrates that market creation policies are generally designed to operate aspatially. That is, they function primarily along supply chains and through markets, rather than being tailored to the places in which industrial activities are embedded. This flexibility allows firms to align interventions with local business conditions (Stavins, 2003). However, it may also limit their effectiveness for industrial decarbonization, where outcomes will be shaped by available infrastructure, regional industrial configurations and place-specific spatial constraints. Industrial sectors are not distributed evenly across countries and regions, nor do they produce interchangeable goods (Rickard, 2020). Without attention to these conditions, a given market intervention may support decarbonization in one region while leaving others behind.

2.2.2. Infrastructure deployment (place and intervention)

Geographic context will be a critical factor in shaping the technical and economic feasibility of industrial decarbonization interventions. Coastal industrial clusters with access to geologies suitable for CCS and hydrogen storage, abundant offshore wind and links to global trade networks are well-positioned for the deployment of hydrogen and CCS infrastructure (Rattle & Taylor, 2023; Sovacool et al., 2022). However, investment in electricity networks is also vital to meet rising low-carbon energy demand. Regional variations in grid capacity and headroom may otherwise pose serious constraints, with electrification potential limited in grid-constrained areas (Gailani & Taylor, 2025).

Readiness for industrial decarbonization also varies according to local institutional capacity and human capital (Roelfes et al., 2018). Cluster organizations are crucial for securing government support, coordinating stakeholders and shaping shared infrastructure strategies (Rattle & Taylor, 2023). However, limited workforce readiness, weak political commitment and the absence of intermediary networks can impede progress (Roelfes et al., 2018; Stork & Schenkel, 2017). These disparities risk deepening regional inequalities, as more prepared areas attract greater public and private investment. Policies that overlook such spatial differences may leave some regions behind.

2.2.3. Industrial strategy (sector and place)

Industrial strategy sits at the intersection of sector and place, requiring deliberate choices about where to invest and which sectors to prioritize. Traditionally, its goal has been to promote economic growth by supporting strategically important sectors through tools such as tax incentives and targeted investment (Åhman et al., 2017). In the context of net zero, however, industrial strategy must also treat decarbonization as a core objective of industrial development (Nilsson et al., 2021).

While and Eadson (2021) argue that the state's role in this process is threefold. First, it must manage the uneven regional impacts associated with the expansion of renewable energy investment and the decline of fossil fuel production. Second, it must foster the development of new low-carbon growth sectors. Third, it must enable the competitive transformation of high-emission industries by ensuring access to affordable low-carbon energy and infrastructure and by facilitating technological upgrading. Regions reliant on energy-intensive industry are vulnerable to the economic restructuring the low-carbon transition will bring (Atkins, 2024; While & Eadson, 2021). Without targeted policy support, these areas face job losses, reduced tax revenues, skill mismatches, and deepening inequality. Failure to integrate industrial strategy and industrial decarbonization strategy, and to account for their spatial implications, risks deepening regional disparities and weakening the legitimacy of the overall transition.

3. Methodology

This paper draws on data collected between April 2023 and March 2025, covering the full duration of the LIDP competition. As the projects varied in the type and amount of information they made public, we adopted a *bricolage* approach to data collection (Denzin & Lincoln, 2013) drawing on multiple sources to accommodate variation across cases.

In total, we conducted 21 semi-structured online interviews (30–80 min) with 22 individuals involved in 12 of the 13 projects. Representatives from the remaining project did not respond to interview requests. Participants were identified through online searches, event attendance, and snowball sampling, and selected based on their project involvement. Interviews explored the nature of the places involved, the industrial profile of their areas, and the enablers and constraints shaping project development, alongside the scope and focus of the projects themselves. The aim was to gain a clearer understanding of the places engaged in the programme and to assess what the development of the plans revealed about the effectiveness and challenges of a place-based approach.

In addition, we attended 15 project events including workshops, conferences, and site visits. These did not generate primary observational data but facilitated the identification of interviewees and access to documents not otherwise made publicly available. Additional project documents were identified on project websites. Documents were analysed alongside interview transcripts to triangulate findings and contextualize interview accounts. In total, 25 public documents were analysed. Details of our sources are provided in Appendices 1 and 2.

Data were analysed through a multistage coding approach (Creswell & Creswell, 2017; Richards, 2014) using NVivo 12 Plus. Interview transcripts, reports and presentations were imported into NVivo and coded within a shared analytical framework. We began with topical coding to identify the common attributes of the winning projects. Coding was conducted first across data types within each project to enable comparison between sources, and then across the 12 projects to identify cross-case patterns. The findings are presented in Section 4.1.

As this process revealed considerable variation in the spatial configuration of the projects and the places involved, we undertook a second round of analytical coding to examine the implications of these differences more systematically. This resulted in a four-part typology of mini clusters.

- **Bounded clusters (n = 5):** located within defined industrial estates or ports, involving a small number of proximate businesses.
- **Regional clusters (n = 4):** covering broader areas without fixed boundaries (with Northern Ireland aligned to national borders).
- **Urban clusters (n = 2):** comprising multiple clusters within metropolitan areas.
- **Sector cluster (n = 1):** focused on aerospace and organized around supply-chain proximity.

Comparing projects between and across cluster types revealed systematic differences in the effectiveness of place-based approaches. The differences are presented in Section 4.2 and the implications of these differences are presented in Section 4.3.

Finally, we undertook an analytical synthesis drawing together findings from the earlier coding stages to derive broader lessons for the effectiveness of a place-based approach for industrial decarbonization. These are discussed in Section 5.

4. Results

4.1. Shared characteristics of winning projects

The winning projects were diverse in scale, sector, business size, and lead organization. Some included 'traditional' energy-intensive industries, like oil refineries and chemicals manufacturers, while others focused on less carbon intensive sectors, such as advanced manufacturing, life sciences and/or logistics. Most projects involved a mix of SMEs and larger firms across a broad range of sectors. Lead organizations ranged from local authorities to industry bodies and others. Eleven projects were in England, with one each in Northern Ireland and Wales. Further details are provided in Figure 2 and Appendix 3.

Despite this diversity, a key unifying factor was a history of prior collaboration among the main stakeholders. Consistent with previous studies of industrial cluster decarbonization (Geels et al., 2023; Gough & Mander, 2022; Sovacool et al., 2023) many interviewees identified these locally rooted, long-standing networks as a key factor in mobilizing to bid for LIDP funding. Across the cases, a common pattern emerged in which prior collaboration enabled engagement with local firms and, in turn, access to usable data. Where these links were weaker, projects subsequently struggled.

Gathering baseline energy use data was one of the main aims of the LIDP competition and an essential first step to inform the subsequent modelling work where alternative emissions pathways could be mapped. Established networks were important not only in facilitating rapid access to businesses – essential given the twelve-month funding window – but also in providing a foundation of trust. Trust was a crucial prerequisite for businesses to be prepared to overcome their confidentiality concerns and share energy consumption data with the projects.

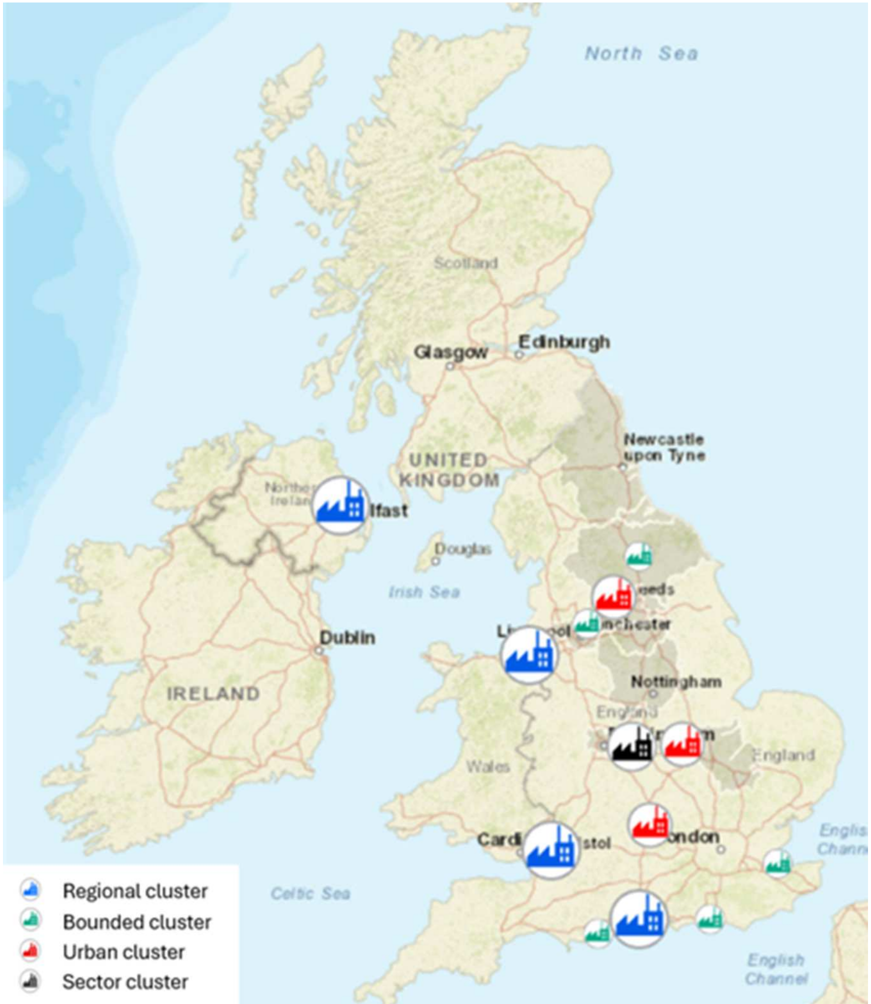

Figure 2. LIDP projects by location and category.

In contrast, when it came to engaging with businesses not already linked into existing networks, obtaining buy-in proved difficult. A consultant working on an urban cluster elaborated as follows:

> With some of the other sites, it has just come down to, 'Do we have a warm contact there or not?' If we don't, it's just been – a lot of people have been, 'We don't have the time of day to engage with this project, we're not interested at this point', so that's been a bit tricky.

A lack of accessible, reliable datasets on industrial energy use has been identified as a systemic barrier to effective decision-making on industrial decarbonization (Norman et al., 2020). This issue emerged as a common challenge, mentioned by interviewees from all 12 projects. As a project manager from a bounded cluster summarized:

> Everyone had the same issue about collecting data. So, whether you are a Port Authority or whether you're a Local Authority, or whether you're the Northern Ireland Assembly, everyone had exactly the same [challenge] … And nobody- There was no magic bullet.

While low engagement and response rates posed challenges for data collection, the underlying issues ran deeper. Participating businesses reported numerous difficulties in accessing essential data. These included challenges locating meters in rented properties, limited granularity (e.g. annual rather than daily or hourly data), and internal data gaps. Concerns about data privacy and commercial sensitivity further discouraged data sharing. Technical barriers, such as outdated systems and a lack of monitoring equipment, also limited the availability of high-quality data. Even when data was shared, inconsistent formats often required extensive cleaning before it could be used for modelling or analysis.

In the absence of comprehensive local datasets to inform baseline emissions studies, most LIDPs relied on surveys, open data (where available), and proxies to estimate emissions. The sector-based cluster offered one alternative approach. Although aerospace tier ones and Original Equipment Manufacturers do not require emissions data from suppliers, project members noted that international standardization could change this, potentially making data collection a mandatory part of future supply chain reporting.

4.2. How cluster configuration shaped coordination and delivery

This section compares how place-based approaches operated across different spatial configurations, showing how cluster configuration shaped both opportunities for coordination and constraints on delivery.

4.2.1. Bounded clusters: local allows action

Although the funding call was designed to be flexible, in recognition of the diversity of dispersed industry, there was an initial expectation that LIDP projects would focus on areas of proximate industry. Guidance defined local clusters as 'groups of closely located emitting industrial sites and other stakeholders', (Innovate UK, 2023, p. 8). Five of the winning projects followed this pattern, forming 'bounded clusters' of ports or established industrial estates.

Bounded clusters offered a finite and countable number of potential participants, making it easier, in theory, to identify key stakeholders and develop what Shoreham Port referred to as 'the cluster mindset'. (Shoreham Port Industrial Cluster, 2025, p. 5). The Kemsley cluster in North Kent was particularly compact, made up of five large industrial emitters on an industrial estate, all of whom were already working together on circular economy initiatives.

The other four bounded clusters had larger stakeholder networks, but all were anchored by pre-existing governance structures that facilitated engagement. At both Poole Harbour and Shoreham Port, the Port Authorities acted as landlords, providing a central point of coordination and institutional stability. Stakehill Industrial Estate operated as a Business Improvement District, providing a platform for collective action. Dalton Industrial Estate had no overarching governance body, but businesses on the estate had a history of collaboration with the District Council, including a jointly funded infrastructure project to resolve flood-related access issues.

However, the localized scope of bounded clusters also introduced delivery challenges. Grid constraints are a well-documented risk to industrial electrification in Great Britain, with upgrades typically taking around five years to resolve (DESNZ, 2024). Four of the five bounded clusters – Dalton, Poole, Shoreham and Stakehill – reported possible grid constraints as a barrier to their electrification plans (Atom Valley, 2025; Poole Harbour Commissioners, 2025; Shoreham Port Industrial Cluster, 2025; WSP, 2025). In addition, the smaller stakeholder pool limited the scale of possible carbon reductions when compared to national and regional scale clusters. Participating organizations also varied significantly in their decarbonization maturity, requiring project plans to accommodate a broad range of readiness and capacity (Poole Harbour Commissioners, 2025; Shoreham Port Industrial Cluster, 2025). Such disparities risked hindering coordinated action. Finally, in a bounded cluster with a finite number of stakeholders, progress depended on securing buy-in from most, if not all, key actors. Without this, projects risked stalling, and with such a limited pool of participants, it was difficult to rebuild momentum or widen participation later (Niddrie-Webb et al., 2024).

4.2.2. Urban clusters: making geographic sense of the city

Two projects focused on urban clusters. Oxford's industrial landscape is shaped by its university connections, with advanced engineering and life sciences start-ups alongside the BMW Mini plant, which accounts for over half of the city's industrial emissions (Zero Carbon Oxford, 2024). Bradford has a more traditional manufacturing base incorporating a wide variety of industrial sectors. It ranks as the UK's fourth-largest city for manufacturing employment, with industry providing 12% of all jobs (Bradford Manufacturing Futures, 2024). Unlike Oxford, emissions are not concentrated in a single main emitter, but in numerous medium-sized businesses dispersed across the city region.

Although Oxford and Bradford differ in their industrial profiles, both responded to the challenges of urban industrial decarbonization by identifying and working with smaller sub-clusters. As one consultant put it, 'we're trying to designate clusters to make geographic sense of the city'. However, coordinating across multiple sub-clusters with distinct identities, infrastructure needs and levels of engagement introduced additional layers of complexity, particularly in an urban context where space was limited, and numerous landlords were involved. In both cases, the LIDP aimed to act as a single voice for a diverse industrial base. Engagement efforts focused on delivering energy audits at the site level.

However, while audits generated useful insights for individual businesses, the challenge was scaling these efforts into a unified cluster-level strategy capable of addressing systemic decarbonization challenges. As one project representative reflected, 'There's almost sub-clusters, and we have been thinking about how we talk about those. Can we talk about them as one group or are they completely different? I don't think we've solved that entirely yet'. Nonetheless, both projects were supported by a strong civic identity, clear strategic vision and well-established networks. This enabled them to strengthen connections and improve communication across previously disconnected industrial actors, laying the groundwork for more coordinated, place-based approaches in the future.

4.2.3. Regional clusters: resilience through scale

Four projects – the Solent, West of England Industrial Cluster (WEIC), North East Wales Industrial Decarbonisation (NEWID), and Decarbonising the Midlands Aerospace Cluster (DMAC) – were regional in scope, while a fifth, Industrial Decarbonisation Northern Ireland (ID-NI), operated nationally. Like urban clusters, these projects often developed sub-clusters to structure their approach. ID-NI identified nine potential clusters across Northern Ireland (Invest Northern Ireland, 2025) while WEIC adopted a 'hub and spoke' model centred on Portbury, Avonmouth and Severnside, and extending to 14 manufacturing sites across the South West (West of England Industrial Cluster, 2025). NEWID focused on two industrial hubs: Deeside and Wrexham (North East Wales Industrial Decarbonisation, 2025).

In contrast, the Solent did not adopt sub-clusters, likely because its emissions are highly concentrated. Four major emitters – including ExxonMobil's Fawley complex, the UK's largest integrated refinery and chemical facility – account for 98% of the region's industrial emissions (The Solent Cluster, 2025). Similarly, DMAC did not require sub-clusters since it was organized around a supply chain rather than geography.

A key strength of the regional approach was its resilience through scale. With a larger and more diverse group of participants, the impact of disengagement by any single actor was reduced. Unlike bounded clusters, which had to accommodate a small pool of stakeholders at varying stages of decarbonization maturity, regional clusters could focus engagement on the most advanced participants. They also encompassed more large-scale emitters and a broader industrial base than bounded or urban clusters, increasing the potential for emissions reduction, although this also introduced greater reliance on factors beyond the projects' direct control.

Notably, the WEIC, NEWID and Solent clusters incorporated plans for CCS to decarbonize. However, such ambitions were dependent on the viability of infrastructure projects external to the LIDPs. As the NEWID cluster plan acknowledged, 'NEWID cluster is reliant on projects developing in the North West of England, such as the HyNet CCS and hydrogen projects planned and underway', (North East Wales Industrial Decarbonisation, 2025, p. 7). Similarly, in the Solent cluster plan, CCS was identified as the most effective single lever for reducing regional industrial emissions. However, a proposal by ExxonMobil to develop large-scale CCS infrastructure was suspended by the company in autumn 2024. As a result, 'the future development of CCS in the region is currently uncertain', (The Solent Cluster, 2025, p. 27).

In addition, larger regional projects carried the risk of a diluted focus, particularly when multiple objectives or geographies were combined. In WEIC, for example, integrating a localized port-focused cluster with a region-wide carbon capture and transport plan was identified as creating tensions between the project's aims and delivery mechanisms. However, this challenge was successfully mitigated in Northern Ireland. Here the project benefited from a clear alignment of political, energy, and economic bodies operating within a single national boundary. This coherence supported a joined-up approach, underpinned by strong and early stakeholder engagement. As one project representative noted, ‘We reached out to the councils in the first instance, to make sure that all 11 councils were bought into this, because we didn’t see any point in trying to do this on an ad hoc basis. If it wasn’t going to be Northern Ireland-wide, we didn’t see the point’.

4.3. The effectiveness of place-based policy for industrial decarbonization

The LIDP competition highlighted both the promise and complexity of place-based industrial decarbonization. From the outset, it was clear that the winning projects were not a homogeneous group and that their decarbonization pathways would be far from uniform. While some clusters were spatially compact, others extended across regions with little physical proximity between sites. Many included a mix of energy-intensive sectors alongside a range of lighter industries not seen in previous cluster decarbonization initiatives, including logistics, life sciences and advanced manufacturing. This broader industrial base enabled wider participation and created opportunities for cross-sector learning. However, it also introduced coordination challenges – particularly where clusters lacked a shared identity. The widespread adoption of sub-clusters by regional and urban projects, as smaller, more manageable units within a larger geography, can be seen both as a pragmatic response to this complexity and as a tacit endorsement of the value of a local cluster approach.

The competition also exposed disparities in local capacity. Beyond spatial configuration, effectiveness also depended on the capacity to coordinate actors within these arrangements. Regardless of scale, projects led by trusted, neutral conveners achieved more consistent engagement and progress. These actors played a crucial role in engaging stakeholders, managing competing interests, and maintaining momentum. While effective coordination did not always require local leadership, geographical proximity often made collaboration easier. As one consultant observed:

> The good ones are where it’s collegiate. It’s neighbours working together and communicating well, and the project management is neutral and helping that coordination function. The less good ones are where that doesn’t happen – where individual firms do their own thing without understanding the wider agenda. That’s where I think having a geographic concentration helps – because you live with your neighbour.

Overall, the findings indicate that place-based policy was most effective where spatial configuration and coordinating capacity aligned. Proximity, or the presence of clear sub-structures, facilitated collaboration. However, sustained progress will depend on trusted convening institutions capable of managing competing interests and maintaining momentum.

5. Discussion: lessons for future industrial decarbonization policy

The LIDP projects demonstrated the importance of locally specific networks, institutional relationships and industrial configurations in shaping decarbonization pathways, reflecting key elements of Barca’s (2009) formulation of place-based policy and illustrating what such approaches offer in the context of local industrial decarbonization. However, the findings also suggest that place-based approaches alone were insufficient, since some of the conditions necessary for transition, particularly infrastructure provision and data availability, remained dependent on national policy and investment frameworks, elements that are more place-neutral (Barca et al., 2012) in nature. Figure 1 offers a way to conceptualize why these issues were difficult to resolve.

We locate infrastructure at the Place-Intervention intersection of the Venn diagram, reflecting how local decarbonization ambitions depend on national planning, investment, and delivery. The Solent, NEWID and WEIC built their strategies around expected access to CCS infrastructure. However, delivery of these technologies was outside their control, contingent on national policy, regulatory approvals, and external corporate timelines. Similar issues applied to electricity infrastructure. Grid constraints were a common barrier, limiting routes to electrification and the installation of new generation capacity. These constraints stemmed from national-level planning delays, lengthy connection queues, and uncertainty over future grid expansion, all outside the remit of local actors.

The risks associated with dependence on national infrastructure are also evident in the ongoing uncertainty surrounding the funding timescales for future (track-2) CCS clusters (Scottish Government, 2025). Regional actors may mobilize partnerships, develop plans and build strategic alignment, yet remain unable to progress without national commitment to infrastructure delivery. This uncertainty may also deter private investors, who are less likely to commit capital in the absence of clear policy signals (National Audit Office, 2024). In this context, place-based initiatives may function less as implementation mechanisms and more as 'holding structures' that sustain alignment during periods of policy uncertainty. However, without strong local leadership and ongoing funding sources such arrangements are unlikely to persist indefinitely.

The issue of data access represents a broader systemic constraint, which we locate at the Sector-Intervention intersection of Figure 1. Even in well-networked clusters, efforts to gather energy-use data were hindered by inconsistent formats, limited availability and commercial sensitivities. For many businesses, particularly SMEs, there was little incentive to collect or share data. This connects to the market creation challenges discussed in Section 2.2.1. Reliable, standardized data is essential for building credible industrial decarbonization plans at the local level, but without clear policy signals or market incentives, many businesses lack the motivation to invest in the necessary systems. As a result, many clusters relied on extrapolation to establish baselines and model decarbonization pathways.

These underlying data limitations were compounded by the design of the LIDP competition itself, which was intended to be flexible to accommodate the diversity of dispersed industrial sites (Innovate UK, 2023). However, this flexibility also resulted in varied outputs and forms of evidence across projects, with implications for the subsequent transparency and comparability of the plans. Because pathway modelling depended on firm-level energy and process data that was often commercially non-disclosable, the assumptions underpinning locally generated pathways were difficult to assess. In the absence of standardized outputs, the programme lacked a clear basis for comparative evaluation. These limitations reflect the trade-offs inherent in a place-based approach to industrial decarbonization. The flexibility afforded to projects enabled responses to be tailored to diverse local industrial contexts, but the lack of a mechanism to allow comparability between projects potentially limited the extent to which the LIDPs could support wider policy learning.

Industrial decarbonization is an emerging policy area, with governments and public agencies still developing the institutional capacities required to coordinate complex transition programmes (McLaren & Kattel, 2025). In future, more consistent reporting frameworks and clearer requirements for data disclosure could address some of the issues identified in this research. However, the ability of public agencies to evaluate programmes will remain constrained by the extent to which firms are willing, or can be required, to share commercially sensitive operational data. As a result, some degree of variation is likely to be inevitable in place-based industrial decarbonization plans.

Since the launch of the LIDP competition in April 2023, the UK has experienced a change of government and a growing policy emphasis on industrial electrification (Climate Change Committee, 2025). At the same time, energy price crises have left UK industry facing the highest electricity prices in the G7, hindering the scale-up of low-carbon technologies (CBI and Energy UK, 2026). As a result, the future of place-based approaches to decarbonizing dispersed industry is unclear. No further national funding has been made available to the 13 clusters to support the implementation of their plans, nor for the development of new local clusters. Instead, policy has focused on mitigating industrial electricity costs through sectoral support mechanisms, such as the British Industrial Competitiveness Scheme and the British Industry Supercharger, both of which are place-neutral (Barca et al., 2012) in approach. While these measures are a response to immediate economic and political pressures, this change in policy focus arguably reflects the broader ambivalence that has historically characterized the implementation of place-based policy in the UK (Pugh, 2024).

As argued throughout this paper, industrial decarbonization will require a combination of sectoral, intervention-based and place-based approaches, each with its own strengths and weaknesses. At different moments, some approaches may prove more effective or politically viable than others. The key challenge for policymakers lies in providing businesses with certainty about the direction of travel, while recognizing the potential negative consequences associated with any given approach. In the UK context, this will require a clear signal in the forthcoming updated Industrial Decarbonisation Strategy on whether place-based approaches to dispersed industrial decarbonization will continue and, if so, how they will be supported beyond the planning stage. Equally, if the move towards sectoral support for industrial electrification continues, policymakers must seek to mitigate the risks for places and industrial communities that lack priority sectors or infrastructures needed to support large-scale electrification, including the potential for disinvestment and site closures. Failing to address these uneven regional impacts could undermine political support for industrial decarbonization.

6. Conclusions

In this paper, we explored the development of place-based approaches to industrial decarbonization in the UK, in the context of local industrial clusters. Conceptually, we proposed that industrial decarbonization should be understood as a strategy that balances the interrelated domains of sector, intervention and place. Our analysis identified key interfaces between these domains that shaped the character and feasibility of transition pathways. While these dynamics will play out differently across different national contexts, they suggest the need for an additional layer of coordination, planning, and delivery between the domains that current approaches do not yet offer.

Several features unique to the UK context have influenced the direction of its strategy and may limit the transferability of our empirical findings. These include longstanding challenges in implementing place-based policy, as well as geographical and industrial advantages for cluster-based decarbonization, including significant offshore CCS potential, a mature oil and gas sector, a high concentration of coastal industry, and strong access to offshore wind resources.

In addition, the relatively small policy arena limited the pool of potential participants. The study draws on interviews with, and documents authored by, actors directly involved in the LIDP programme. Perspectives from non-participating or unsuccessful stakeholders are therefore not represented. As many interviewees were project stakeholders, their accounts may reflect institutional positioning. The findings should thus be interpreted as analytically grounded insights into how the programme was understood by those operating within it, rather than as an external evaluation of its performance.

While this paper is UK-focused, the implications extend to other industrialized nations. Since 2020, there has been growing global interest in geographically clustering industrial facilities as a means of advancing the energy transition (Dhondt et al., 2025; Lai et al., 2025; World Economic Forum, 2025). While the implementation of these initiatives reflects national policy styles and regime characteristics, which change over time (Iskandarova et al., 2026), our findings confirm the importance of place-based approaches in aggregating actors, building shared visions and translating national policy into locally grounded strategies. Their effectiveness, however, is reliant on national infrastructure provision and the availability of robust data: conditions that typically lie outside local actors' direct control. These underlying dependencies are likely to remain consistent across countries and will require ongoing government support. The framework we propose provides a means to understand the interplay of factors that must be aligned for effective industrial decarbonization across diverse settings.

Globally, over 70% of industrial energy demand is concentrated in emerging markets and developing economies (IEA, 2024b). Decarbonization trajectories here will be shaped by local constraints, institutional capacities and policy priorities. Future research should examine how these strategies develop, and the forms that local industrial clusters take in these contexts. Comparative studies could assess which aspects of the UK experience are transferable, and which are context specific. Longitudinal work could provide insight into how local strategies evolve over time in response to changing technologies, infrastructure and market conditions.

Further investigation is also needed into how governance structures and power dynamics influence whose interests are prioritized in industrial decarbonization as projects move from planning to implementation. Understanding how decisions are made, by whom, and with what consequences will be critical to grasping the political dimensions of industrial transition. Finally, future research should consider how industrial decarbonization intersects with other systems such as transport, housing and skills development. Industry is only one element of place; effective decarbonization will depend on a whole system approach. Addressing these questions will be vital for shaping effective place-based industrial decarbonization policy across global settings.

Author contributions

CRediT: **Imogen Rattle:** Conceptualization, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing; **Peter G. Taylor:** Funding acquisition, Resources, Supervision, Writing – review & editing.

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Ethical approval

This study was approved by the Faculty Research Ethics Committee for Business, Environment, Social Sciences of The University of Leeds, UK. Reference No: BESS + FREC 1189.

Written informed consent was obtained from all participants prior to interview.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author, IR. The data are not publicly available due to containing information that could compromise the privacy of research participants.

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