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Engineering and Physical Sciences Research Council

Decarbonising the Ceramics Sector: Building an Evidence Base

Workshop Summary Report July 2026

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1. Executive Summary

IDRIC's first sector-specific workshop on the Ceramics sector was held online on 26th February 2026. This document is a summary of the discussions held at the workshop, including techno-economic barriers, opportunities, and policy recommendations for the sector in its transition to low-carbon technologies. Attendees included UK-wide industry stakeholders. The workshop output will inform a wider report and related research activity in IDRIC's policy work on hard-to-abate sectors. These activities are supported by EPSRC and DESNZ.

The Ceramics sector is currently facing a myriad of challenges that make its decarbonisation extremely difficult. For many ceramics manufacturers, concerns are existential in the increasingly competitive global environment. Such concerns often sit ahead of conversations about (or can undermine) investing in low-carbon technologies. Nevertheless, the sector has already invested considerably in upgrades to its processes and factories, as well as resources in analysing potential pathways for decarbonisation, including the development of a roadmap[1].

Alongside immediate commercial pressures, the sector also faces additional technical challenges that shape the realities of decarbonisation.

Ceramics manufacturing generates emissions not just from fuel combustion and electricity use, but also from the chemical decomposition of carbonates during firing (known as process emissions). These intrinsic emissions set the sector apart from many other energy-intensive industries and cannot be eliminated simply by fuel-switching. Credible decarbonisation policy for the Ceramics sector must recognise this dual challenge and ensure that policy frameworks address both combustion and process emissions.

Compounding these technical challenges, is the absence of and/or delays in providing enabling infrastructure as well as the lack of clear policy signals from government. With established factories dispersed across regions, often to be close to the source of their primary raw materials / skilled employees, relocating to hydrogen or carbon capture infrastructure is not feasible for most manufacturers, many of whom are also SMEs. Compared to other energy-intensive industries, ceramics is much more disparate, with a large number of comparably smaller-emitting sites, which influences the commercial viability of some decarbonisation technologies (in terms of their scale). This leaves companies navigating uncertainty without the foundational conditions required to plan or invest confidently.

These barriers further increase the wider risk of deindustrialisation. The UK has already lost segments of its ceramics industry, and others are heading in that direction, often without a clear public understanding of the economic and social consequences. Continued deindustrialisation threatens skilled employment and local economies. At the same time, high and volatile energy costs, policy instability, and a less competitive investment environment are pushing both domestic and international companies to consider shifting production outside of the UK. Even UK-headquartered firms operating globally are questioning if the UK remains a viable location for future manufacturing.

[1] Ceramics UK, Decarbonising UK Ceramic Manufacturing Roadmap: Interactive PDF (Stoke-on-Trent: Ceramics UK, 2024), https://static1.squarespace.com/static/6566f758dd1a4c385d6b7a86/t/65b8d0ce61458d1b000a5963/1706610905794/Roadmap+Interactive+PDF.pdf.)

The workshop also identified opportunities to support progress that has already been made. Participants highlighted the potential for closing the deployment gap by accelerating the roll-out of existing technologies through mechanisms such as Contracts for Difference (CfDs), targeted capex and opex support, and improved access to electricity cost-relief schemes where a number of factors have contributed to limited access for support from government. There was support for reinvesting UK Emissions Trading Scheme (ETS) revenues into industrial decarbonisation to help de-risk early adoption and maintain competitiveness.

The workshop also highlighted the need for continued Research and Innovation (R&I) to address the most complex aspects of ceramics decarbonisation, including high-temperature kiln operations, alternative materials, advanced kiln design and improved heat-recovery technologies and carbon capture technologies that would have to work with the very low 1.5 to 2.5% CO2 concentration levels in the exhaust gasses from ceramics production. Emerging tools such as digital twins offer promising opportunities to optimise and test processes and fuels to reduce investment risk and energy use. Significant untapped potential exists in terms of collaboration with universities and research bodies, which could accelerate investment and help reduce costs over time.

Against this backdrop, the workshop highlighted an urgent need for coherent policy, infrastructure planning, and recognition of the sector's unique challenges if the UK is to retain its ceramics industry and support its transition towards a lower carbon future whilst ensuring growth and competitiveness.

2. Technical Pathways

The following section on Technical Pathways outlines the main decarbonisation pathways available to the Ceramics sector, providing an overview of their current technical feasibility. Each section summarises the technical opportunities and limitations associated with energy efficiency, fuel switching to biogas, fuel switching to hydrogen, Carbon Capture Utilisation and Storage (CCUS), and electrification.

2.1. Energy efficiency

Energy efficiency improvements and use of waste heat recovery were identified as key opportunities for shorter-term emissions reductions, particularly in the drying process of ceramics production. These require comparatively little Research and Development (R&D) or testing.

Whilst discussions often focus on decarbonising the firing process, one participant pointed out that stages such as product drying and spray drying for granulation, also consume significant energy. The drying process typically relies on mild heating, often already using electricity, and there is considerable scope to improve efficiency by revisiting both process design and associated emissions (albeit these may be small).

A significant portion of gas consumption also currently goes into dryers where large volumes of moisture are driven off. Much of the energy used in this stage is lost through exhaust streams, yet this moisture and heat could be recovered, improving both energy and resource efficiency.

Measures such as heat recovery can be implemented without fundamentally altering product performance. Beyond reducing energy usage, such measures can also lower water consumption. Interim improvements in drying efficiency can meaningfully reduce carbon emissions. Batch kilns were identified as a particularly high-potential area for heat recovery, with estimates suggesting that up to 90% of heat generated may be recoverable (where this is applicable).

Many companies have already implemented measures such as redirecting airflow and optimising heat-use in drying operations using heat recovered from furnaces. Many firms are actively pursuing these ‘low-hanging fruit’ opportunities, where proven technologies can be deployed with limited R&D requirements.

2.2. Fuel Switching to Biogas

Fuel switching to biogas offers an almost functionally identical alternative to natural gas and could potentially be delivered through the existing gas network with relatively minor process adjustments, if any.

Biogas could be particularly beneficial for transition phases, supported through contractual mechanisms without the need for physical delivery to the site as long as a corresponding amount of fuel is injected into the system as a whole. Blending levels could gradually increase from partial substitution to 100% biogas as network availability and production capacity develop.

A significant limiting factor is the availability of bio-fuels, which are often targeted towards 'prioritised' sectors / applications. Ceramic producers need long-term energy supply security in order to readily operate their long-term production processes.

2.3. Fuel Switch to Hydrogen

Fuel switching to hydrogen presents a potential option from the early 2030s onwards, when hydrogen infrastructure is expected to become more readily available at scale to support industrial fuel switching[2]. Fuel switching from natural gas to hydrogen means retention of gaseous fuel use, on which the majority of kilns rely as primary energy source. Hydrogen can be delivered through those parts of the existing gas Distribution networks and infrastructure where the old iron mains have already been replaced by modern polyethylene materials. This replacement programme is over 75% complete and due to reach 100% in the early 2030s.[3] It is worth noting that even the old iron mains networks carried town gas until it was progressively replaced by natural gas during the 1970s. Town gas contained up to 50% hydrogen (by volume). This is not a new or unknown procedure.

The Transmission network may require significant replacement due to the risk of potential embrittlement with the higher pressures and materials involved. In some cases, a duplicate network may be needed in the transition for any users unable to process a blended supply.

Switching to hydrogen is likely to require some more significant process changes, even though it still provides a flame-based heat source with some familiar process characteristics and benefits. Manufacturers would still need to adapt combustion systems and kiln designs according to the characteristics of hydrogen such as the higher flame temperature.

Hydrogen could initially be introduced through blending. However, it is worth noting that, for example, a 20% hydrogen blend (by volume) due to its lower energy density, would actually only deliver a 7% reduction in carbon emissions.

DESNZ Hydrogen for Heat programme[4] for domestic heat have shown that blends of 20% (by volume) can be used by all existing appliances without adverse effects on performance. They have also shown that, with appropriate adaptation, 100% hydrogen does not represent any greater overall safety risk to users than natural gas.

Similar studies would be valuable to establish the blends that can be used without adverse impact on performance or safety for industrial sectors.

Some kiln manufacturers are investing heavily in hydrogen-enabled furnace designs for products, but this technology is at a very early stage and far behind what is required for broader commercial deployment.

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[2] UK Department for Energy Security and Net Zero, Hydrogen Infrastructure Strategic Planning: Policy Statement (London: HM Government, 2025), https://www.gov.uk/government/publications/hydrogen-infrastructure-strategic-planning-policy-statement/hydrogen-infrastructure-strategic-planning-policy-statement-accessible-webpage.
[3] Institution of Gas Engineers and Managers (IGEM), "Investing in Mains Replacement Is Key to Meeting Our Safety and Environmental Goals: Here's Why" (Kegworth: IGEM, 2025) https://www.igem.org.uk/resource/investing-in-mains-replacement-is-key-to-meeting-our-safety-and-environmental-goals-here-s-why.html.
[4] DESNZ "Evaluation of Hy4Heat Final Report 2." 2023. https://assets.publishing.service.gov.uk/media/63fe1053d3bf7f25f76ffc8c/evaluation_of_hy4heat_final_report.pdf.

2.4. Carbon Capture Utilisation and Storage (CCUS) - Retaining Natural Gas

Retaining natural gas as the primary source of fuel (delivered through the current network) whilst implementing CCUS could potentially still offer a significant pathway to emissions reduction without changing fuel or the manufacturing process.

Significant additional infrastructure will also be required on site for capture, meaning a need for additional land around factories. CCUS is also dependent on the development of new infrastructure to transport and permanently store captured carbon emissions. In addition, emerging technologies such as Monolithic Metal Frameworks (for the CCUS process) are not currently viable to remove the low concentrations of carbon from the kiln exhaust gas. The availability and timing of such third-party infrastructure is a major barrier to the viability of CCUS as a route for ceramics decarbonisation.

2.5. Electrification

Securing Network Supplies

For the Ceramics sector, electrification is one of the most challenging pathways (particularly the larger sites) and for many would require significant changes to processes and operations. Electrification of processes, particularly kilns, requires far more power than many local grids can currently supply (or are currently being planned for) and so requires new or significantly reinforced electricity connections at distribution level, and sometimes the transition level. Most kilns are currently firing gas at a rate of 5 to 10 MW per hour. Whilst replacing this with electricity would be more energy efficient, this could require increases in power supplies to sites above 5 MWe. Currently, large heavy clay sites have a 1 to 2 MW electrical supply.

Further Roll-out of On-site Generation

On-site renewable power generation is already generated/ in use by many in the sector, with others procuring renewable energy either through REGOs or Power Purchase Agreements. The ability to generate electricity on-site to reduce reliance on the grid and remove a key constraint on electrification is being increasingly explored across the sector. A key consideration is the quantity of electricity required to operate kilns and run a manufacturing process as most sites would need a significant amount of electricity. This is compounded by the intermittency of renewables versus the need to provide a constant, and dependable (secure) baseload for processes.

Complex grid rules, permissions and administrative hurdles can make generating electricity on-site extremely difficult. With electrification, there is no equivalent to ‘blending’ or contractual mechanisms which allow for a gradual transition over time. This means whether they intend to import electricity or generate their own, many companies cannot electrify in reasonable or predictable timescales. With many connection delays stretching well into the 2030s, electrification is not currently perceived as a viable investment case.

Electrification - Kilns

There are a number of electrified kilns already in use in the sector, for smaller-scale, product-specific and R&D applications. However, for many products there is currently no commercially or technically viable electric kilns at sufficient scale to be used for mass production, such as brickworks, or others such as refractory manufacturers which rely on sintering at extremely high temperatures in large batch kilns. Even if electrified kilns eventually become technically possible, and viable (by operating costs) adopting them would require complete kiln replacement, which would be extremely costly and disruptive.

Kilns are one of the most challenging aspects of the ceramics production process to decarbonise due to the underlying chemistry and necessary process conditions. For a number of operations, the flame-based firing in a gas kiln is an integral part of the process to achieve specific product characteristics. Oxygen availability, flame characteristics, and the chemistry of combustion directly influence material transformation.

Company B suggested one possible development opportunity might be adapting certain processes to smaller electric kilns, enabling the firing of smaller parts in smaller batch sizes. Although nothing currently prevents this, it would have wider consequences and is product-dependant, not a widespread solution. This could support early adoption of lower-carbon technologies whilst allowing manufacturers to experiment with new production materials. However, some stakeholders highlighted that efficiency of large-scale production is intrinsically tied to continuously operating kilns, and so whilst smaller intermittent processes may offer some advantages, these may be outweighed by efficiency losses elsewhere (particularly as batch kilns involve a complete temperature cycle from ambient temp, to peak firing, back down to ambient). From this perspective, moving from large kilns to multiple smaller units may undermine production economics and other energy and environmental regulatory obligations for businesses

3. Economics of Technical Pathways

3.1. General investment issues

Decarbonisation across the sector, and across all pathways will require significant investment. Many decarbonisation pathways involve replacing assets with long life-cycles of up to 50 years.[5] Without amortising sunk investments and continuing to use these assets until their naturally life-expiry, there is a potential for significant financial loss. Even replacing life-expired assets is costly, especially where this is accompanied by a need to develop and invest in new/upgraded infrastructure and/or entirely new production technologies.

Firms face having to commit capital well before they have clarity about costs, performance, and long-term government policy or regulation. New and additional risks are attached not only to the development phase, but also to any follow-on investment and then to the level of ongoing costs and future revenue.

For most pathways, the projected paybacks are low (if even positive), highly uncertain, and/or may only be realised very late in the assets (long) life. Companies are therefore often faced with decisions about investments which do not generate commercial returns to meet environmental policy and reduce emissions, versus alternative more-attractive investment propositions overseas. When customers do not value such changes, they are not willing to cover the extra costs incurred and instead seek lower price alternatives elsewhere.

When these economic risks are paired with current high levels of policy and regulatory uncertainty, the overall investment environment becomes extremely challenging. The cost of finance - both equity and debt – rise accordingly. Investors simply seek alternative locations where there are more stable policy frameworks and shorter anticipated payback periods, or they simply do not invest.

Across pathways, the economics of decarbonisation are difficult on their own. When compounded by uncertainty around future government support and policy/regulatory frameworks, long-term investment decisions become extremely challenging. Increased costs, risk premiums and borrowing costs reduce or eliminate the business case for any major capital investment.

3.2. Economics of Energy Efficiency

Technologies required for improving drying efficiency and waste heat recovery are already available and have been successfully demonstrated. However, many companies lack the internal expertise, financial capital and capacity to pursue projects like waste heat recovery independently.

Several firms had previously included such projects in their carbon transition plan, supported by The Industrial Energy Transformation Fund (IETF). The availability of upfront capital made these

[5] Khalil, Ahmed M. E., Anne P. M. Velenturf, Masoud Ahmadinia, and Shaowei Zhang. 2023. "Context Analysis for Transformative Change in the Ceramic Industry" Sustainability 15, no. 16: 12230. https://doi.org/10.3390/su151612230

projects viable by helping with cashflow and reducing payback periods. However, where funding was not secured, most of these projects had to be removed from their transition plans.

The Government has announced that there will be no follow-on funding for IETF and has even abandoned the expected second call for Phase 3 funding. This means that many energy efficiency opportunities are no longer viable for progression by industry.

Such retrospective changes and discontinuities in the funding approach also significantly increase the policy and regulatory risk faced by companies. At best, this increases the cost of capital for any associated investment and, at worst, means the cancellation of wider investment plans further increasing the risk of closure of production facilities in the UK. The availability of UK grant schemes could incentivises site owners to invest in UK plants if matched funding is available.

3.3. Economics of Biogas

Biogas remains technically attractive as a near-term decarbonisation option, without needing significant changes to equipment, processes, and infrastructure. However, investment has not materialised due to significant limitations in its availability for use (to support continuous manufacturing operations) and current UK Emissions Trading Scheme (ETS) rules preventing biomethane being delivered through the gas network from being counted as zero-carbon. Only biomethane delivered exclusively to site qualifies for this rating, which is not achievable for most manufacturers. Biomethane injected into the grid can have a zero rating under the EU ETS, enabling use of biomethane on a much larger scale than in the UK[6]. Despite its technical feasibility, biogas has not progressed as a practical pathway under the existing policy conditions in the UK.

3.4. Economics of Hydrogen

Since even the relatively simple conversion to biogas is not currently economically attractive, the greater risks, costs and uncertainties associated with hydrogen further reduce the probability of switching to hydrogen, unless significant support is put in place.

Even where hydrogen-firing has been proven as technically viable, supporting infrastructure remains a key barrier to implementation. Currently, there is no hydrogen network to supply industry, and regulatory barriers prevent companies from developing their own hydrogen production facilities which could be injected into the grid. Without access to hydrogen infrastructure, and with many sites located outside of industrial clusters, companies face a technical dead-end in being able to use hydrogen from the grid or developing their own hydrogen production facilities.

Whilst hydrogen production may be technically possible in certain areas, the lack of a national hydrogen network prevents this happening. A credit-based system could allow industries to

[6] Environmental Protection Agency. 2025. “RED II Biomass Requirements for EU ETS Participants Feb 2025.” Www.epa.ie. 2025. https://www.epa.ie/publications/licensing--permitting/climate-change/red-ii-biomass-requirements-for-eu-ets-participants-feb-2025.php.

benefit from low-carbon hydrogen produced elsewhere. However, current regulations do not permit this.

Participants noted that progress is often slowed by institutional inertia and a fragmented policy environment. Economic constraints and decarbonisation objectives are not always aligned, particularly in cases where responsibilities are spread across various departments.

Participants described the common scenario they face - inhibited by inertia and fragmented policymaking. Treasury-driven economic constraints often conflict with decarbonisation objectives, leaving businesses caught between demands and financial barriers, both imposed by the same Government, albeit often from disparate departments, operating in isolation.

Participants suggest an alternative market-based approaches which may offer a more efficient route to decarbonisation than physically transporting hydrogen through the gas network. In principle, it should be possible to pay a producer to generate low-carbon hydrogen and receive the associated emissions credits, even if only a limited amount is physically injected into the network or reaches the site.

This is already tried and tested for renewable electricity credits. In such a system, all users connected to the grid would benefit from the carbon reduction, regardless of their proximity to the point of injection. However, any such mechanism must be cost-effective. If hydrogen or hydrogen-linked credits significantly increase fuel costs, manufacturers risk pricing themselves out of the market, especially when competing with imports from competing countries with lower energy prices.

3.5. Economics of CCUS

Even if sufficient support was available for companies to invest in on-site carbon capture equipment, the economics heavily limit implementation. CCUS is fundamentally dependent on the development, availability and cost of third parties investing in, and operating the necessary transport and storage infrastructure. This is not currently accessible to the vast majority of organisations in the ceramics sector. The ongoing costs of transport and storage services remains a big unknown in the investment case. The viability of CCUS will be determined less by the technical readiness of ceramics producers, than by the pace, scale and costs of third-party investment in transport and storage facilities.

CCUS will not be a universal sector solution. Given the level of investment that would be needed, as well as associated logistical impacts, this would be on a very limited, site-specific basis, determined by scale and concentration of emissions (which has a significant impact on potential commercial viability). Indeed, CCUS costs at present are prohibitively expensive for companies to move this forward.

3.6. Economics of Electrification

Electrification represents not just significant technical challenges but also substantial economic barriers. High UK industrial electricity costs are already one of the most substantial

challenges for current electricity use, particularly compared to European competitors. The extra investment and adaptation costs make further electrification economically unviable.

Many investments require new or upgraded connections but, even very short connection distances can involve extremely high capital costs and long lead times. These cost differentials, combined with the risks and delays inherent, underline that electrification is currently one of the least economically viable pathways.

4. Competitiveness Environment

As previously indicated, UK ceramics manufacturers operate in an intensely competitive environment shaped by international pressures and shifting customer expectations. Companies face competition not just from international ceramics producers but also from competing, substitutable materials such as alternative construction products, cement/concrete, glass and steel. Many of these alternatives may have lower “headline” embodied carbon although they are of shorter lifespan, less durable, of higher maintenance requirements and with their whole-life carbon emissions often comparably higher. This places UK ceramics firms at a disadvantage, particularly as in general, short-term benefits are prioritised over long-term sustainability and durability.

Volatility in UK / global energy markets and supply-chains also pose a significant risk. For example, the surge in gas prices and other economic impacts in light of the war in Ukraine (and ongoing conflict in Iran) have directly / indirectly contributed to several plants being forced to mothball or shut down over recent years, either due to production cost increases or market downturns. This results in loss of local economic and employment benefits, as well as undermines UK supply chain resilience. This shows the vulnerability of energy-intensive industries to geopolitical events and shocks, highlighting the importance of stable, affordable energy supplies as part of any decarbonisation pathway. Bringing UK industrial energy prices closer to international benchmarks is seen as essential for enabling long-term planning, supporting decarbonisation technologies and ensuring the sector can compete on a level playing field.

As mentioned earlier, most international competitors also enjoy cheaper energy supplies, may have more access to government schemes and support (enabling them to decarbonise whilst maintaining competitive prices), and many producers, particularly from the non-EU, can face no environmental drivers to reduce emissions. These disparities create a challenging landscape for UK manufacturers seeking to invest in low-carbon technologies without eroding their market position.

There are other facets to which decision-making is made. UK ceramic goods are often recognised internationally for being of inherent high quality, and producers have been able to compete on this basis, rather than solely on price. However, this differs to the mass market where overseas producers have been seen to significantly undercut domestic production in the UK. Additionally, for certain products such as clay brick, imports may not be produced to withstand the UK’s varying weather conditions.

Development of a market for low-carbon products could play a role in helping resolve disparities; however for ceramics it would be fraught with implementation challenges and may not level the playing field.

Companies, such as Company A, have previously used low-carbon credentials as a selling point, but such efforts remain the exception rather than the norm, and companies also have to navigate the challenges of potentially making claims which could be classified as greenwashing[7].

Some companies are receiving questions from customers about their carbon footprint, sustainability, and lifecycles. However, these enquiries still rarely translate into a willingness to pay more for low-carbon products. Overall, customers still predominantly prioritise price and operational needs and such interest cannot yet be considered a genuine market driver.

5. Policy, Regulation and Governance

Effective decarbonisation requires a policy environment that is stable, joined up and predictable, particularly when businesses are faced with making decisions about assets with 15–50-year lifespans. The current landscape is comprised of a persistent lack of joined-up thinking across government, with limited drivers or ability to coordinate across departments and align multiple policy objectives.

This leads to contradictory signals, inconsistent incentives, and an environment that undermines long-term investment confidence. As mentioned previously, firms are expected to reduce emissions, yet receive little incentive, or in some cases, disincentives, to invest in the UK. For example, if a company invests in a highly efficient kiln, future policy changes such as an increase in gas levies could undermine this decision and erode investment instantly.

This is combined with extremely complex government initiatives designed to support decarbonisation. Participants noted that they had not seen a clear example of a government policy or scheme that has delivered meaningful benefits without resulting in higher costs and administrative burdens. This complexity deters participation and undermines the effectiveness of support mechanisms intended to accelerate decarbonisation.

Short-term political targets such as local authorities unilaterally adopting ambitious net-zero targets and dates without considering, or being aware of the unintended consequences and industrial realities that can further distort competition and markets and undermine long-term investment planning.

The global nature of the ceramics industry means that the UK is often at a disadvantage and overlooked for investment due to high energy and climate costs and ambition as well as overzealous business regulatory burdens. Imports from countries with lower energy prices and stronger government support – mainly China, Spain, Belgium, Italy, and India[8] - have a clear

[7] https://www.gov.uk/government/collections/how-to-make-environmental-claims-about-products-and-services

[8] "The Observatory of Economic Complexity." 2026. The Observatory of Economic Complexity. 2026. https://oec.world/en/profile/bilateral-product/ceramic-products/reporter/gbr.

competitive advantage. These conditions make it easier for firms to experiment, build in-house laboratories and scale new technologies.

Businesses need stable, long-term schemes and forward-looking frameworks so manufacturers can invest confidently in technologies and infrastructure required for a low-carbon future.

5.1. Short-term Carbon Metrics and Regulation

UK manufacturers remain constrained by regulatory frameworks that undervalue durable, low-maintenance materials and create uncertainty for long-term investment. In the construction sector, clients and local authorities increasingly ask for Life Cycle Assessments (LCA) or verified Environmental Product Declarations (EPDs), yet the use of LCA and EPD information often fails to accurately reflect the true performance of ceramics products over their full lifetime. Building Lifecycle Assessments (which EPDs are used towards) typically assess environmental impacts over a 60-year period, despite products such as clay bricks being designed to last at least 150 years. This means that longer-life products can appear less-favourable in a shorter-term perspective, versus alternative product choices of a shorter lifespan, lesser durable, higher maintenance requirements Producing verified product-specific EPDs is resource-intensive and expensive, therefore extremely challenging for SMEs, and companies with extensive product ranges.

The emphasis on achieving the lowest possible embodied-carbon at the point of production encourages a short-term thinking in policy and market attitudes. The cheapest materials are often prioritised as well as the desire to advertise the lowest 'headline carbon' figure to sell products, even if this undermines long-term durability and sustainability. This issue is reinforced by market pressures that reward short-term cost savings over long-term environmental benefit.

Companies are actively exploring product adaptation, such as brick slips and thin bricks, to reduce material use, energy use and associated emissions whilst still offering the merits and aesthetics of the product. Such innovative products may offer sustainability benefits yet there needs to be greater market "pull" and demand for companies to justify further significant investments in bespoke manufacturing facilities. They may also fall outside existing research that feeds into traditional standards / specifications. These challenges relate not only to formal, published standards but also to informal industry norms and expectations, which can limit the adoption of new or more sustainable product designs.

Updating international carbon-accounting and reporting to reflect overall consumption e.g. domestic markets (or UK Government reporting more-transparently on this) would help illustrate how, in the UK, the impact of how domestic ceramics production is being undermined by increasing imported goods. The current reliance on production-based (territorial) emissions reporting does not capture the carbon embodied in imported products. The UK should place greater importance on consumption-based emissions reporting or consider both production and consumption-based emissions for a more accurate picture of the carbon associated with products in the UK market. Any work to revise or update standards should also ensure that the benefits of low-carbon products are fully recognised.

*Government **could support and accelerate existing innovation** by incentivising product research to **enable updates to standards for low-carbon products**. This would a**ccelerate the development of***

alternative product formats and ensure a level playing field for durable, low-carbon products to compete *within existing regulatory and market frameworks.*

5.2. Funding Barriers and the Deployment Gap

Participants highlighted that a lack of funding remains a major barrier to both innovation and deployment. Successful decarbonisation requires a balanced approach with funding to deploy existing technologies that can deliver immediate savings, alongside long-term R&D support to develop solutions for processes where no viable alternatives may currently exist.

Even when technologies are mature, companies often lack the capital to deploy them. Waste heat recovery was cited as a clear example – although the technology is proven and offers significant energy savings, many companies cannot proceed without government support. As described earlier, several companies had planned waste heat recovery projects in their carbon transition plan on the assumption that IETF support would be available. Participants described the demise of this scheme as a "cliff-edge" in the current funding and investment landscape.

Operational costs present a compounding challenge, as even when a low-carbon technology reduces overall energy consumption, it may rely on moving away from natural gas to more expensive electricity or alternative fuels. Without ongoing support and incentives for operational costs, companies risk undermining their competitiveness. Participants repeatedly emphasised that customers are generally unwilling to pay a premium for low-carbon products especially where lower cost imports already set tight price constraints, where embodied carbon is either unregulated or lacks credibility and transparency . This makes it very difficult to justify investments that increase operating costs and product price, even if overall emissions are reduced.

Closing the deployment gap through targeted funding would ***unlock immediate emissions reductions and adoption of proven technologies****. Continuing schemes such as the IETF and providing structured support for operational costs is an opportunity to* ***stabilise investment conditions.***

5.3. Capital Support for Decarbonisation Investment

A combination of upfront capital support and mechanisms that reflect any higher operating costs as well as reward verified carbon reductions is essential to unlocking investment in decarbonisation technologies, accelerating the rollout of proven technologies and strengthening the business case for decarbonisation. Companies are reluctant to commit to investments when they are unable to accurately gauge how energy prices, carbon costs, or regulatory environments will look. Without this confidence in the medium-term landscape, firms will not invest in low-carbon technologies.

Capital support to shorten payback periods would make investments more viable. This kind of support is critical not only for deploying established technologies, but also for encouraging broader decarbonisation. Carbon auction mechanisms should reward companies for the emissions they avoid by installing more efficient equipment. In such systems, the carbon

savings generated by new technologies have tangible financial value, providing an ongoing incentive beyond initial investment.

Strengthening capital support mechanisms would ***provide a mechanism to continue decarbonisation projects that may have previously stalled****. Targeted capital grants and carbon-reward mechanisms would* ***reduce risk by creating a more predictable investment environment for long-lived assets*** *such as kilns.*

5.4. 'Contracts for Outcomes' and other Output-Based Incentives

Participants saw output-based mechanisms as a powerful tool for accelerating decarbonisation, providing both certainty and reward for genuine emissions reduction through a contract rather than policy or regulatory schemes, especially where these incentivise inputs rather than outputs. Contract mechanisms could be used to provide a guaranteed reward for achieving measurable carbon reductions. Such a direct contractual link between performance and financial return, ensures companies are compensated for the emissions they avoid.

As with the Contracts for Difference (CfD) approach in the power generation sector, such an approach could offer a major advantage in terms of investment. It could create a more predictable revenue stream over the lifespan of a project and significantly reduce the policy and regulatory risks that commercial organisations are unable to assess or manage effectively. With more predictable income tied to verifiable carbon savings, companies can more reliably and cheaply raise capital against future returns. This contractual stability would be key for long-lived assets such as kilns where investment decisions must be made with confidence in long-term policy environment.

A contractual approach had been taken to manage international price disparity. In this a CfD mechanism was applied which used the French/German competitors' energy costs as the reference price.

Developing output-based contracts are a key opportunity to provide the Ceramics sector with ***long-term policy certainty, reward genuine emissions reductions, and level the playing field with international competitors****. Such mechanisms could* ***de-risk investment and transform the investment landscape****.*

5.5. Eligibility for Government support on energy costs

The UK Ceramics sector faces significant barriers in accessing government cost support schemes due to a number of contributory factors, largely around the accuracy / non-reflectiveness of data in eligibility assessments:

<u>Quality of Government data</u>

Eligibility for schemes such as the EII Supercharger Scheme and Energy-intensive Industries Compensation Scheme is determined using sector-level trade intensity and electro-intensity tests - both of which rely on Government datasets that are inherently linked to businesses at Companies House. Periodic surveys by the Office for National Statistics map business data by their Standard Industrial Classification codes (to describe business activities) which companies

self-select but with no checks / verification of their appropriateness. Ultimately, far more companies are using the SIC code associated with manufacturing of ceramics, compared to the number of businesses that are UK-based ceramics manufacturers; which inflates these datasets and therefore, they are non-reflective of the structure and performance of the UK Ceramics sector.

For example, SIC 23320 is the code used for Manufacture of Baked Clay Construction products. This is supposed to capture and reflect the companies in the UK that manufacture baked clay construction products such as clay bricks, clay roof tiles and clay drainage pipes. However the vast majority of the companies registered under SIC 23320 are using this code inappropriately; particularly linked to product sales (merchants, importers and distributors) and downstream use (brick-layers / builders), and with many other unrelated businesses. This greatly distorts the data as only 10% of registered companies are genuine manufacture baked clay construction products.

This inflates Government data in areas such as sector turnover figures and gross value added (GVA), which impacts (lowers) the apparent energy intensity of the sector.

The use of GVA in eligibility assessments

The inclusion of staff costs in GVA calculations, which are higher in labour-intensive companies like in the ceramics sector, distorts the electro-intensity tests that sectors / businesses have to pass to qualify for support.

Standardisation of Reference Prices for energy

'Average' industrial reference prices are used in tests, although smaller electricity consumers (like ceramic producers) pay more than this. This downplays their apparent electro-intensity.

Ceramics UK recommends that government undertakes a holistic review into the standard eligibility mechanisms it uses in the majority of energy support schemes for industry. Without such action, future policy reform risk continuing to misrepresent the sector, undermining competitiveness and a pathway to electrification.

Reviewing the UK Government's approach to eligibility for support on energy costs is a key opportunity to ***ensure the sector has access to cost-relief schemes****. This may help firms to more-realistically* ***plan for electrification as a pathway*** *and* ***improve competitiveness by reducing costs.***

6. International Policy

6.1 Carbon Border Adjustment Mechanism (CBAM)

Carbon leakage remains a major strategic risk for the ceramics sector. Participants stress that unless a CBAM is designed with clear, credible and enforceable rules for assessing the carbon content of imported goods, it could undermine competitiveness rather than level the playing field.

The key concern is that the CBAM could become a vehicle for reducing or removing free ETS allowance, leaving domestic manufacturers exposed to the full cost of their carbon emissions, whilst still competing with imports whose carbon footprints are very difficult to measure. There are various practical challenges of calculating the embodied carbon in imported products, where no transparent measurement mechanisms currently exist. Without this data, UK manufacturers are at a disadvantage.

6. 2 Reinvesting UK ETS Revenues to Support Decarbonisation

Participants questioned if the substantial revenues collected through the UK ETS can be more directly reinvested into industrial decarbonisation, noting that despite operators contributing significant sums of money into the system, there is little transparency about where this money ultimately ends up. Recycling UK ETS revenues back into the industry through funding grants, capital support, or innovation funding, would provide a logical and impactful way to accelerate decarbonisation across the Ceramics sector.

This offers a key chance to create a stable, long-term funding stream for industrial decarbonisation and accelerate emissions reductions across the sector.

7. Research and Innovation

Although several proven technologies exist for the decarbonisation of ceramics products, R&D is still required to address the more complicated aspects of decarbonisation for the sector. The majority of ceramics production remains dependent on the use of gas for firing, with no feasible low-carbon alternatives. For these areas, particularly high-temperature and larger-scale kiln operations, substantial R&D is still required to develop solutions viable on a commercial scale. Academic collaboration could help to address other key technical challenges for the sector including developing product adaptation, alternative materials, developing kiln design, and advancing heat recovery technologies.

There is a need in the sector for strengthened collaboration with academia, greater awareness and engagement from industry, combined with a more targeted, sustained commitment from academic institutions to support ceramics innovation, where it is needed (as identified in the Ceramics UK sector Roadmap). Part of the challenge lies within academia itself, which has not always focused on ceramics-specific industrial needs. Much of the R&D that has been progressed in the past, or is currently being progressed, has not necessarily been targeted in the areas that would deliver significant, tangible emissions reduction and is of limited relevance to larger-scale standard ceramics production. Instead, R&D has often focused on product improvements aimed at downstream performance characteristics, niche areas and advanced product groups (such as the Centre for Advanced Structural Ceramics at Imperial College[9]) whereas R&D into energy and emissions reduction are relatively limited.

Stakeholders emphasised that, in terms of decarbonisation, academia must be better aligned with industry needs for effective collaboration. Comparable long-term research investment has not been sustained in the Ceramics sector the way it has been for other energy-intensive industries. The Ceramics sector has largely been an outlier, as other energy-intensive industries such as steel and cement, have been highly successful in leveraging academic expertise and securing large-scale research funding. It is worth noting that larger sectors such as steel and cement naturally attract more funding, given their higher emissions and the presence of fewer but much larger companies with greater capacity for resources and engagement. This also influences the level of funding committed to ceramics research where emissions sources are more complex, overall volumes are smaller, and the importance and benefits of the product in its demanding applications and uses (rather than production) have driven research. Some stakeholders also noted that these challenges may not be unique to the UK.

A considerable amount of R&D is already taking place in the sector, often funded and progressed directly by firms themselves due to the administrative burdens and complexities of government funding processes, particularly for SMEs. Ceramic manufacturers often deliver wider sustainability benefits through the performance of their products. For example, refractories that reduce energy use across heat-intensive industrial processes, including power generation. These contributions are often not reflected in how sustainability impacts are assessed and discussed.

[9] Imperial College London, “Centre for Advanced Structural Ceramics” (London: Imperial College London, n.d.) https://www.imperial.ac.uk/structural-ceramics/.

One suggested area is the development of digital twins for the ceramics manufacturing process. This type of digital modelling would allow manufacturers to test concepts virtually, such as substituting methane with hydrogen or comparing the thermal characteristics of electricity compared to combustion flames. A tool such as this would enable companies to explore process changes, assess and optimise designs before committing to major capital investment. Some manufacturers have already developed a full digital twin or a roller kiln, allowing them to modify and test a range of parameters virtually. The workshop highlighted strong industry interest in expanding these capabilities, but doing so requires sustained investment, collaboration and support.

There is significant potential for R&D through partnership with universities and research bodies. While funding routes such as EPSRC programmes, Innovate UK, and Knowledge Transfer Partnerships (KTPs) offer substantial opportunities, uptake across the ceramics sector has been shaped by more practical barriers associated with accessing these schemes.

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