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Ceramic Sector

Joint Industry - Government

Industrial Decarbonisation and Energy Efficiency Roadmap
Action Plan

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JOINT ACTIONS TO DELIVER THE 2050 DECARBONISATION ROADMAPS

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Foreword from the Minister of State

With industry representing nearly a quarter of UK emissions, helping industrial sectors decarbonise and improve their energy efficiency is a crucial part of our Clean Growth Strategy for meeting the UK's legally binding Carbon Budgets. It will also be essential for achieving the Industrial Strategy's aims of reducing business energy costs, improving industrial productivity and competitiveness, and driving clean economic growth.

Globally, investment in clean technologies is rising while costs fall. Against this backdrop, few countries have been more successful than the UK in growing their economy while reducing emissions – cutting UK emissions by over 40 per cent¹ while growing the overall UK economy by 67 per cent². In parallel, the UK has been improving energy security, creating jobs and realising export opportunities from the new industries and companies that have been created.

The Industrial Decarbonisation and Energy Efficiency Roadmaps project is a key collaboration between Government and industry to help industry make the low carbon transition while also maintaining its competitiveness. The publication of this action plan is an important milestone for the project, as it identifies commitments from all parties to enable the Ceramic sector to decarbonise and improve its energy efficiency. These commitments build on the potential identified in [Phase 1](#) of the Industrial Roadmaps project, which provided an evidence base of the carbon savings industry could expect to make in different decarbonisation scenarios.

The actions in this plan would not have been possible without such strong and constructive input from the Ceramic sector so I would like to extend a huge thank you to them for helping us get this far. They are voluntary but provide an important framework for future decarbonisation and energy efficiency improvements, all the way up to 2050. They cover specific technological solutions such as industrial heat recovery and fuel switching, and also wider themes such as innovation, skills development and investment which are all key pillars of the Industrial Strategy.

The identification and publication of these actions is not the end of the Industrial Roadmaps project. All parties are committed to working together to implement this action plan, while also meeting future decarbonisation challenges and opportunities as the landscape evolves. So its publication is in many ways a starting point to build on for further collaborative working, as well as a key project milestone in its own right. By building on the

¹ Provisional 2016 emissions: BEIS provisional UK emissions statistics 1990-2016: <https://www.gov.uk/government/statistics/provisional-uk-greenhouse-gas-emissions-national-statistics-2016>

² Office for National Statistics, 2017, ABMI GDP series, 1990-2016: <https://www.ons.gov.uk/economy/grossdomesticproductgdp/timeseries/abmi/pgdp>

collaborative way of working that has been so effective so far, we will ensure this Action Plan makes a significant contribution to the Industrial Strategy's aim of delivering clean economic growth, and that it maximises the economic benefits from the UK's transition to a low carbon economy.



Claire Perry
Claire Perry
Minister of State for Climate Change and Industry

Industry Foreword

As we transition to a low-carbon economy, it is essential that we consider how we generate, distribute and use energy in our society. This is particularly important in energy-intensive industries, such as ceramics, given the scale of energy consumption and the associated carbon emissions. However, while increasing energy / carbon efficiency, it is essential that UK industry remains internationally competitive to continue delivering vital employment and economic benefits. We must avoid an outcome where UK jobs are exported and carbon is imported (with potentially increased global emissions); and instead develop fair and equitable UK policies that incentivise investment, innovation and emissions reduction, whilst enabling the long-term sustainability of the UK's ceramic industry.

Through a series of workshops and regular steering group meetings involving the British Ceramic Confederation (BCC), representatives from the various facets of the sector, the Department for Business, Energy and Industrial Strategy (BEIS), academia and other stakeholders, a series of joint actions have been collaboratively agreed.

The intention of the programme is for Government, the ceramic sector and other complementary organisations to implement the actions to deliver further improvements in decarbonisation and energy efficiency, whilst maintaining a strong on-going competitive position for the UK ceramic industry³. The Action Plan provides a focal point for this. The action plan will also provide links to other key government policy areas such as the emerging Industrial Strategy and the Clean Growth Strategy.

The principal benefits for the sector are working collaboratively with Government to deliver:

- A supportive, long-term policy framework that delivers an economic environment which allows the ceramic sector to invest, innovate, grow and flourish. Immediate priorities for the ceramic sector include: i) full carbon leakage mitigation for installations in the EU ETS or any UK equivalent and ii) a level playing field on electricity prices vs EU and international competitors.
- Finance and investment incentives (or other measures) to help tip the balance favourably and encourage investment in proven energy / carbon-efficient technologies.

³ The ceramic sector has allocated resource to the delivery of the Action Plan. Continued resource availability is, however, contingent on competing demands in relating areas, most notably: Brexit-related trade and energy / climate matters, as well as the development of an industrial strategy / sector deal.

- A targeted innovation and deployment programme for new innovative technologies in energy-intensive industries (including the ceramic sector).

These actions will be delivered through a combination of government support, commitment from industry (BCC and its members) and involvement of other complementary organisations (such as Innovate UK, the Knowledge Transfer Network and academia). The aim is to help companies in the sector make the most of existing resources, to de-risk investment in proven technologies and to bring forward innovation, whilst developing a supportive, long-term policy framework. This will allow the ceramic sector to survive and thrive as an integral part of a competitive, sustainable, low-carbon and resource-efficient economy.



Laura Cohen.

Chief Executive
British Ceramic Confederation
Dr Laura Cohen MBE CEng FIMMM

The parties named in this action plan support the actions attributed to them, but have not made a legally binding commitment to fulfil those actions.

1. Introduction and Policy Overview

In 2015 the world committed to the historic Paris Agreement which saw 195 countries commit to take action to reduce emissions. This Agreement included the goal of keeping the global mean temperature rise to well below two degrees, whilst pursuing efforts to limit temperatures rises to less than 1.5 degrees. Additionally, the Agreement enshrines a goal of net zero greenhouse gas emissions in the second half of this century. The UK is already playing its part in delivering the Paris Agreement through its domestic climate framework. This framework includes the UK Climate Change Act which sets a target to reduce greenhouse gas emissions by at least 80% by 2050, against 1990 levels. To do so, the UK needs to move to a more energy efficient, low-carbon economy whilst also ensuring a thriving and internationally competitive industrial sector.

As part of the UK's commitment to the Act the government is required to publish a plan which sets out how the UK will decarbonise its economy through the 2020s. For industrial sectors, this plan draws on the collaborative work of the 2050 Industrial Roadmaps project and these Action Plans. The UK has already successfully reduced its territorial emissions by 40%⁴ [1] since 1990 while growing the overall economy by over 67%⁵. Industrial carbon emissions including those from energy-intensive industries (EIIs) have halved since 1990, which has mainly been due to efficiency gains, fuel switching, a change to industrial structure of the UK and re-location of production overseas.

However, more will need to be done, and it is a shared challenge for Government and industry to realise not only these emissions savings but also the industrial opportunities of the transition to a clean economy. The emissions savings in the industrial sector will be predominately achieved by the eight industrial sectors that currently emit approximately two thirds of industrial carbon emissions: cement, ceramics, chemicals, food & drink, glass, iron & steel, oil refining, and pulp & paper. These sectors make a significant contribution to our economy, employing around 2% of the UK's workforce - often in regions of high relative deprivation - and making up approximately 18% of our exports⁶. With the right policies and business environment, these businesses can continue increasing their energy / carbon efficiency, whilst remaining internationally competitive and delivering vital employment and economic benefits to the UK.

The UK ceramic industry manufactures a diverse range of products including bricks, roof tiles, drainage pipes, wall tiles, tableware, giftware, sanitary ware, technical components and refractories, accounting for approx. £2 billion in annual sales including £0.5 billion in exports. 20,000 people are directly employed in the industry, across 160 sites located

⁴ As in footnote 1.

⁵ As in footnote 2.

⁶ Statistics derived from ONS data on exports and workforce

throughout the UK, with three quarters of companies being SMEs⁷. The sector has seen a recent increase in ceramic imports, most notably in bricks, clay roof tiles, tableware and refractories.

The sector is energy-intensive and consumes around 4.7 TWh of delivered energy per year, with gas accounting for 80 to 82% of the industry's overall energy mix⁸. Total emissions in 2012 were 1.2 million tonnes CO₂, with the Roadmaps pathways showing a maximum technical abatement potential of up to 0.7 million tonnes CO₂ by 2050 if cost considerations are not taken into account⁹. Most of this was through the electrification of heat and accompanying grid decarbonisation, although energy efficiency including heat recovery and the use of biofuels could also make significant contributions. This follows the separate 2050 Roadmap study undertaken by Cerame-Unie in 2012, which showed a similar technical reduction potential if cost and international competitiveness were not taken into account¹⁰.

Energy costs are a major factor for the sector, accounting for as much as one third of production costs, thereby naturally driving efficiencies and improvements. The UK's heavy clay sector, for example, has recently invested in some of the most energy- and carbon-efficient manufacturing ceramic operations in the world. Long-term planning is essential, however, as ceramics is a capital-intensive sector with long-investment cycles; a production plant can typically last more than 40 years.

A large proportion of ceramic companies are part of the EU Emissions Trading Scheme (EU ETS) and fall within the Industrial Emissions Directive (IED) / Environmental Permitting Regulations (EPR). Beyond this, the principal policies and regulations that directly affect companies in the ceramic industry are the Climate Change Levy (CCL), Climate Change Agreements (CCA) and the Energy Saving Opportunity Scheme (ESOS). Some companies with wider corporate undertakings are also in the Carbon Reduction Commitment Energy Efficiency Scheme (CRC) and mandatory Greenhouse Gas (GHG) reporting. Further to this, ceramic companies are impacted by schemes related to electricity use: indirect EU ETS costs; Carbon Price Floor (CPF) / Carbon Price Support (CPS); Levy Control Framework (LCF); Renewables Obligation (RO); Feed-in Tariffs (FiTs); EMR (Electricity Market Reform) FiTs with Contracts for Difference (CfD) and EMR Capacity Market (CM) etc.

⁷ Source – British Ceramic Confederation

⁸ Source - British Ceramic Confederation 2012 CCA data

⁹ Industrial Decarbonisation & Energy Efficiency Roadmaps to 2050 – Cross-sector Summary – Ceramics sector -

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/416676/Ceramic_Report.pdf

¹⁰ Ceramic Industry Roadmap: Paving the way to 2050

<http://cerameunie.eu/topics/cerame-unie-sectors/cerame-unie/ceramic-industry-roadmap-paving-the-way-to-2050>

There is therefore substantial scope for collaboration between industry, government and others to take steps in the short term that could enable industry sectors to make deeper emissions reductions over the longer term while staying competitive. The first phase of the Industrial Decarbonisation and Energy Efficiency Roadmaps to 2050 show that deep decarbonisation of EILs is achievable, however, there are significant barriers, including cost competitiveness; economic, business and policy uncertainty; knowledge and skills; and access to finance.

Following publication of the Roadmaps, government and the British Ceramic Confederation (BCC) have now agreed this joint Action Plan that sets out voluntary commitments that each party will undertake to enable the ceramic sector to make deeper emissions reductions over the longer term while staying internationally competitive. This involves the following actions:

- Creation of a Decarbonisation Leadership Group to provide strategy and leadership for decarbonisation within the ceramic sector and to collaboratively develop a supportive, long-term policy framework for EILs.
- Increase the adoption of state-of-the-art technology and existing energy-efficiency practices through sharing knowledge and bolstering financial support
- Define innovation requirements for the sector and implement mechanisms for collaborative innovation including funding to stimulate technology development, demonstration and implementation
- Increase RD&I with potential applications in the ceramic sector and maximise its funding from both Government and the sector
- Develop and demonstrate advanced heat recovery technologies to increase the re-use of waste heat
- Increase the use of bioenergy in the sector
- Increase implementation of on-site renewables for self-generation of electricity requirements
- Collaborate with customers to create market pull for decarbonisation in the sector
- Develop a long-term engagement strategy with suppliers in the sector
- Increase skills and knowledge within the sector to enable an internationally competitive, energy / carbon-efficient future

The intention is that these actions will be delivered through a combination of government support, commitment from industry (BCC and its members) and involvement of other complementary organisations. The aim is to help companies in the sector make the most of existing resources, to de-risk investment in proven technologies and bring forward innovation, whilst working collaboratively to develop a supportive long-term policy framework. Delivery will be coordinated by a new ceramic sector “Decarbonisation Leadership Group”, involving representatives from individual organisations within the sector, the BCC and BEIS. Alongside this will be a Ceramic Technology Hub to facilitate knowledge sharing of existing technology and a Ceramic Innovation Platform to encourage innovation in the sector.

2. Actions

2.1 Action 1: Creation of a Decarbonisation Leadership Group to provide strategy and leadership for decarbonisation within the ceramics sector and to collaboratively develop a supportive, long-term policy framework for EIs

- Appointed senior representatives from the ceramics industry will provide leadership within the sector through the creation of a Decarbonisation Leadership Group which will push forward the activities laid out in the Action Plan. It will oversee activities to:
 - 1 Communicate an industry and government joint vision about the economic and environmental importance of transitioning the ceramic industry to a low-carbon and competitive future
 - 2 Lead sectoral engagement between the ceramics sector, government and other stakeholders to work collaboratively to develop a supportive, long-term policy framework that delivers an economic environment which allows the ceramic sector to invest, innovate, grow and flourish
 - 3 Oversee activities to increase the deployment / utilisation of proven energy / carbon-efficient technologies, including leading engagement to develop finance and investment incentives.
 - 4 Oversee and inspire innovation activities in the sector
 - 5 Improve skills development and knowledge within the sector
- The objective of this action is to provide a platform to drive energy and carbon reduction activities in the sector and encourage companies within the sector to participate in its initiatives and align their strategies with the overall sector vision. The ceramic sector is diverse and providing leadership should help to bring the sector together to implement these actions and achieve decarbonisation and longer-term competitiveness of the ceramics sector. The Decarbonisation Leadership Group will also spearhead engagement with Government and other stakeholders to develop a supportive long-term policy framework for EIs and will work with its respective subgroups to oversee activities related to increasing the deployment of proven technologies, encouraging innovation and on developing skills.
- Although this action will be started in the short-term (in 2017), it must continue throughout the period of this plan (through to the 2020's) to ensure that the priorities of decarbonisation, energy efficiency and competitiveness in the sector are all maintained.
- This action will be a priority undertaking as it underpins all the actions in the plan.
- As this is the most important enabler for all other actions in this plan, implementation will be the precursor for all subsequent decarbonisation actions. Its impact cannot be quantified in isolation, but it will be central to achieving the reductions identified in the rest of the plan.

Action 1 tasks

Task 1A: Create a Decarbonisation Leadership Group within the ceramic sector to drive energy and carbon reduction in the sector

This Leadership Group should consist of senior individuals within the sector and will provide strategy and leadership to drive energy and carbon reduction in the ceramic sector. The group will be responsible for liaising with BEIS, ceramic companies and other stakeholders (academia, trade unions, funding / innovation bodies, equipment suppliers, raw material suppliers etc.) and will oversee the five strands of work outlined above and described in later actions. Where appropriate, this could include working through existing governmental / cross-sector industry groups such as the EII Stakeholder Forum, Manufacturers Climate Change Group (MCCG), Energy-Intensive Users Group (EIUG) to maintain a cross-sectoral focus on 2050 Roadmaps / Action Plans.

Owners: BCC and its members to lead with support from BEIS and other stakeholders

Timing: 2017 onwards

Task 1B: Collaboratively develop a supportive, long-term policy framework for EII

Government, industry and other stakeholders should work collaboratively to establish a coherent, long-term policy framework that delivers an economic environment which allows the ceramic sector to invest, innovate, grow and flourish. The development of a supportive framework should be linked to other policies with which it dovetails (including energy, climate, environment, the Industrial Strategy as well as wider relevant policy) and build on evidence provided through the Roadmap Action Plan process. Immediate priorities for the ceramic sector include: i) full carbon leakage mitigation for installations in the EU ETS or any UK equivalent and ii) a level playing field on electricity prices vs EU and international competitors.

Owners: Decarbonisation Leadership Group with support of nominated industry representatives in partnership with BEIS

Timing: 2017 onwards

Task 1C: Assign a point of contact for the ceramics sector within BEIS to drive implementation of the action plan and to continue collaborative working dialogue between government and industry on decarbonisation, energy efficiency, industrial competitiveness and related matters

Owners: BEIS

Timing: 2017-2018

Task 1D: Ensure ongoing engagement between nominated government and ceramics sector representatives, to regularly track and report on action plan progress, including issues covered in the plan related to energy policy, decarbonisation, industrial competitiveness and related matters.

Owners: BEIS, BCC and the Decarbonisation Leadership Group

Timing: 2017 onwards

Task 1E : BEIS and the roadmap sectors to set up a Roadmap Strategy Group to provide an ongoing forum to discuss and review Action Plan delivery. This group would focus on:

- Review Action Plan delivery, progress and reporting.
- Strategic overview of cross sectoral actions – to cover CCS, Bioenergy, electrification of heat, the proposed Technology Forum, skills and financial support for energy efficiency and decarbonisation investment.
- Oversee development of future actions that can secure the objectives of the plans

Task Owner: BEIS and industry trade associations

Timing: 2017 - 2020

Task 1F: Ceramics Decarbonisation Leadership Group to consider what supplementary information could be reported on its consumption emissions.

- The Decarbonisation Leadership Group to explore what data and methodologies consistent with internationally recognised reporting practice could be used to undertake supplementary reporting of consumption emissions for the ceramics sector.
- Explore whether approaches such as whole life analysis can provide further detail of the role that products which are more energy intensive to produce, but which provide longer term carbon savings over their lifetime, can play in delivering decarbonisation benefits across the whole economy.

Task Owner: Ceramics Decarbonisation Leadership Group, with oversight from BEIS as appropriate

Timing: 2017-2018

Task 1G: DEFRA to work with the ceramics sector as part of a wider cross-sectoral approach to develop practical and achievable solutions to improving air quality, whilst meeting other priorities such as decarbonisation and maintaining competitiveness.

Develop collaborative dialogue between government, industry and other key stakeholders to establish whether a practical, achievable plan – similar to the approach used in the decarbonisation roadmaps project – is required.

Task Owner: DEFRA

Timing: 2017 - 2020

2.2 Action 2: To increase the adoption of state-of-the-art technology and existing energy efficiency practices through sharing knowledge and optimised financial support

- The objective of the action is to enable higher uptake of proven carbon reduction and energy efficiency technologies, by overcoming existing lack of awareness relating to technology and finance options and by considering additional financial incentives (where appropriate) to tip the balance in favour of investment.
- The ceramics sector, with support from government, will share knowledge on state-of-the-art technology, encouraging best practice in energy efficiency and disseminate information on the range of financial incentives and other instruments available. This will allow ceramics companies to have better knowledge of the existing technology options and financial incentives available, to help increase the deployment of existing carbon reduction and energy efficiency technologies. As part of this, additional finance or other measures to help unlock investment in proven technology will also be considered.
- This priority action, which should be started in the short term (2017-18), will generate activities throughout and beyond the period of this plan (through to the 2020s).
- This action is dependent on action 1 (Creation of a Decarbonisation Leadership Group) and links also to action 5 (Recovery and re-use of waste heat), action 7 (On-site renewables) and action 9 (Skills).
- The impact of increasing the adoption of state-of-the-art technology will be increased energy and/or carbon efficiency, reduced energy consumption and/or carbon emissions and lower overall costs. Reduced energy / carbon costs will improve competitiveness. Carbon reduction impact at site level could range from 2% to 30% (adoption of BAT kilns in the whitewares sector), depending on the technologies adopted¹¹.

¹¹ Industrial Decarbonisation & Energy Efficiency Roadmaps to 2050; Ceramics Sector Appendix C; Table 13

Action 2 tasks

Task 2A: Create a Ceramic Technology Hub under the Decarbonisation Leadership Group.

This Hub will be a representative sector group that is responsible for improving awareness of the range of proven energy / carbon efficient technologies and financial incentives / instruments available. The Hub will also have a role in working with Government to explore the case for additional financial incentives and support.

The Decarbonisation Leadership Group will define the Ceramic Technology Hub's terms of reference.

Owners: Decarbonisation Leadership Group, with involvement from BEIS

Timing: 2017-2018

Task 2B: Create a suite of case studies showing best practice for the sector on technologies already available (TRL 9) and those almost fully developed (TRL 8)

Priority technologies for the ceramic sector include: retrofit of updated burners and controls to improve combustion efficiency; fitting or updating heat recovery; retrofit of better refractories / insulation; Organic Rankine Cycle on heat recovery; raw materials formulation changes to bodies and coatings for lower temperature firing; better monitoring and control of firing process; microwave assisted drying; and process changes to reduce defects / waste / poor quality product. This list should also include general energy efficiency measures on sites such as heating, lighting or other electrical machinery (for example motors and compressors). The Ceramic Technology Hub will enlist the support of individual sector companies for this task.

Note: Consideration should be given by the Decarbonisation Leadership Group, the wider sector, the Ceramic Technology Hub and government on how to overcome the barrier that directly competing companies may be unwilling to share best practice in certain areas if it erodes their competitive advantage.

Owners: Ceramic Technology Hub

Timing: 2018 onwards

Task 2C: Launch a web portal that facilitates greater industry collaboration by enabling companies in the ceramics sector to share information on R&D, best practice, knowledge and access to funding opportunities.

BEIS will develop and launch a website that facilitates greater industry collaboration by enabling companies in the Ceramics sector to share information on best practice, knowledge sharing, access to finance, research and development and access to funding opportunities. The website will be designed through close engagement with the BCC and its member companies to help ensure it meets business requirements.

Task Owner: BEIS

Timing: 2018

Task 2D: Maintain a portal that enables industry to collaborate and share information

BEIS will maintain the website (task C) that facilitates greater industry collaboration through the sharing of information on research and development, best practice, knowledge sharing and access to funding opportunities, subject to its annual review (task E).

Owners: BEIS

Timing: Ongoing

Task 2E: Undertake annual reviews of the portal that enables industry to collaborate and share information

BEIS will be supported by industry to undertake annual reviews of the portal (task C) that facilitates industry collaboration through information sharing to ensure that it continues to be effective, utilised and aligned to business requirements.

Owners: BEIS

Timing: Ongoing

Task 2F: Explore the potential for additional technologies, such as burners, process control, industrial boilers, and heat recovery, which could be included in the Energy Technology List (ETL) to encourage wider investment opportunities through Enhanced Capital Allowances. The Carbon trust is already doing a study to assess the potential for adding technologies to the ETL.

Owners: BEIS, with support from BCC into Carbon Trust’s study.

Timing: 2017-2020

Task 2G: Government to establish an industrial energy efficiency scheme to help large companies install measures to cut their energy use and their bills.

Owner: BEIS

Timing: 2017-2022

Task 2H: Design and implement energy efficiency training programmes.

Supported by technical experts in ceramic companies and equipment suppliers, specific areas for improvement include burners, heat recovery, motors, drives, fans, improved process control, the use of sub-metering and process optimisation. Staff would develop operational excellence in energy management, with the use of ISO 50001 as a possible enabler.

This task could be joined up with other sectors who may share energy efficiency training resources and an accredited scheme could be considered.

Owners: Ceramic Technology Hub and the Ceramic Skills Group (see action 10 below)

Timing: 2019-2020

Task 2I: BEIS to organise a working group to facilitate dialogue between the finance sector and industry to explore how external finance could be used to support investment in mature energy efficiency and decarbonisation technologies , and to overcome the barriers to affordable external finance.

The working group will set out its own Terms of Reference, including how frequently it should meet. The BCC and the Decarbonisation Leadership Group will encourage engagement from the ceramics sector including identifying participants / individual businesses for the group

Owner: BEIS, BCC and the Decarbonisation Leadership Group.

Timings: 2017-2019

CASE STUDY – IBSTOCK CHESTERTON



Ibstock is the UK's largest brick manufacturer, with 19 brick sites, an annual production capacity of around 750 million bricks and around 1,500 UK employees. The company's brick, paver and thin brick products are used in four key end-markets: i) new-build housing; ii) housing repair, maintenance and improvement (RMI); iii) other new build; and iv) Infrastructure.

During 2012-13, the company invested £22 million on the complete redevelopment of its Chesterton brick facility. The new plant is equipped with the latest energy efficient drying and firing technology. This has resulted in carbon emissions per brick reducing by over 50% compared with product from the factories that it replaces. The combination of fuel-efficient firing and low process emissions from local, Etruria Marl clay mean the site is a benchmark performer in terms of carbon dioxide emissions. The investment also safeguards jobs at the site for the next 25 to 30 years.

The company is currently completing a £55 million investment in a state-of-the-art extension to its plant in Ibstock, Leicestershire.

Please see the Case Studies section for full details.

2.3 Action 3: To define innovation requirements for the sector and implement mechanisms for collaborative innovation, including funding to stimulate technology development, demonstration and implementation

- Industry, with support from government (including through appropriate innovation bodies), should set up mechanisms to work together within the ceramic sector and between other industrial sectors to identify innovation requirements and to stimulate both early-stage validation of new technologies (TRL 4-6) and demonstration projects (TRL 6-8).
- Transparent collaboration will enable companies within the sector to overcome the risk of investing in innovation and to move energy / carbon reduction technologies along the innovation process. This should result in more market-ready technology options for the sector, which should increase uptake, reducing carbon emissions as well as energy costs.
- This action, which should be started in the short term (2017), will generate a series of projects that will run through the medium-long term (2018 through to the 2020's).
- This priority action is dependent on action 1 (Creation of a Decarbonisation Leadership Group) and action 4 (Increase R&D). It also links to action 5 (Recovery and re-use of waste heat) and action 6 (Bioenergy).
- The impact of this action will be increased energy and carbon efficiency, reduced energy consumption, reduced carbon emissions and lower overall energy costs. Carbon reduction impact at site level could range from 5% to 80% (electrification of kilns) in some ceramic sub-sectors, depending on the technologies developed. The competitive impact of innovation would be in the reduction of energy / carbon costs and also in helping the UK ceramics sector to establish itself at the leading edge of innovation, attracting research into the sector and increasing the pool of skills and experience)¹².

¹² Industrial Decarbonisation & Energy Efficiency Roadmaps to 2050; Ceramics Sector Appendix C; Table 13

Action 3 tasks

Task 3A: Create a Ceramic Innovation Platform under the Decarbonisation Leadership Group

This Innovation Platform will be a representative sector group that is responsible for supporting innovation in the ceramic sector. The Decarbonisation Leadership Group will identify who would be best placed to create the unit and implement its actions. The Decarbonisation Leadership Group will define the Ceramic Innovation Platform’s terms of reference. The BCC will seek representation from sector companies and from government and funding / innovation bodies.

Owners: Ceramics Decarbonisation Leadership Group, BCC to support with input from sector companies and from government and funding / innovation bodies as appropriate

Timing: 2017-2018

Task 3B: Create Innovation Networks

These Innovation Networks could be created by, for example, holding a brokering event for suppliers, manufacturers and research organisations. Ways of using existing groups (wherever possible) should be identified, to avoid duplication of activity.

Owners: Ceramic Innovation Platform, with assistance from the wider sector, BCC, BEIS and Knowledge Transfer Network as appropriate

Timing: 2018

Task 3C: Create a summary document with defined objectives / requirements for innovation in the sector, related to identified technologies and short-term and longer-term priorities

Initial priorities (1-3 years) for early-stage technologies (TRL 3-6) identified include: develop improved refractories for kiln walls, floors, ceiling and for ceramics and other heat-intensive processes (such as steel, glass and cement); electric field assisted sintering techniques (Spark Plasma Sintering (SPS), Field Assisted Sintering Technique (FAST), Field Enhanced Sintering (FES)); and develop heat-pump technology to reclaim latent heat and liquid water from drying process.

Longer-term priorities (4-5 years) for early-stage technologies (TRL 3-6) include: very low- or zero-energy (but durable) coatings; Carbon Capture and Storage (CCS) or Carbon Capture and Utilisation (CCU) for large ceramics sites; and alternatives for yellow firing (potentially using colorants).

Initial priorities (1-3 years) for technologies ready for demonstration/pilot projects (TRL 6-8) identified include: redevelop design of seal between kiln and kiln car; develop low-cost, durable heat exchanger for low-grade exhaust heat; materials development to reduce number/temperature of firings; low air movement kiln; increased product packing density via redesigned kiln cars/refractories; and low-carbon biogas / syngas fuels for high-temperature heat applications (see also action 7).

Longer-term priorities (4-5 years) for technologies ready for demonstration/pilot projects (TRL 6-8) include: electrification of tunnel kilns; clay / raw material precalcination; microwave-assisted firing; vacuum / airless drying; dry-state body preparation; oxyfuel firing of ceramics and low-carbon hydrogen fuel for high-temperature heat applications.

A summary document should be produced, listing short-term and longer-term priorities for each of the identified early-stage and later-stage technologies, with clear objectives for innovation against each technology. Setting objectives could also include selection and assessment of relevant technologies already implemented in other industries that could be applied to ceramics.

Owners: Ceramic Innovation Platform

Timing: 2018-2019

Task 3D: Create joint research or demonstration projects via joint industry projects
It should be considered whether these projects should be externally managed and / or evaluated. This would be based on the outcome of task C. The Ceramic Innovation Platform will actively seek participants for priority projects identified in task C.

Owners: Ceramic Innovation Platform with support from ceramic sector companies

Timing: 2018-2020

Task 3E: Mobilise ceramics company directors and technical experts in the UK and Europe to encourage kiln manufacturers to participate in collaborative innovation

This collaborative innovation should specifically focus on:

- i) Sharing innovation ideas and expertise
- ii) Further developing innovations in their equipment (including collaboration involving ceramic manufacturing companies with UK sites)
- iii) Enabling technical people to engage in discussions, demonstrations and proposals
- iv) Participating in joint industry demonstration projects as referred to in task D

Owners: Ceramics Decarbonisation Leadership Group or Ceramic Innovation Platform to lead with support from ceramics sector companies

Timing: 2018-2019

Task 3F: Engage early with funders to ensure that targeted funding calls meet the needs of the ceramic sector.

The ceramic sector should for example engage with Innovate UK to input its requirements to shape funding opportunities in heat-intensive sectors and to better understand funding opportunities and how the ceramics sector fits within such funding calls.

Owners: Ceramic Innovation Platform

Timing: 2018 onwards

Task 3G: Explore the possibility of establishing an industry trial site for kilns to demonstrate innovations.

This trial site would address the problem that installation of trial technologies requires plant shutdown which disrupts production. Potential sites could include Lucideon / AMRICC (in Stoke-on-Trent), and consideration will also be given to synergies with other sectors (such as the glass sector). The Ceramic Innovation Platform will seek support from ceramic sector companies.

Owners: Ceramic Innovation Platform

Timing: 2018-2020

CASE STUDY - DUDSON / ENDEKA



In 2011, Dudson Ltd implemented a temperature reduction program on the glaze firing of its flatware products (plates, saucers etc.) by the introduction of Endeka's ThermECO glaze materials. Using this innovative glaze system, reductions in the firing temperature of up to 50°C have been achieved, resulting in carbon emission reductions of up to 25% per piece.

Since 2004, Endeka Ceramics Ltd had been developing its ThermECO range of products, which utilise raw material formulation changes to deliver lower temperature firing processes in the ceramic tableware, giftware and sanitaryware sectors. Their objective is to improve the energy efficiency of ceramic manufacturing, to deliver both cost and carbon emission reductions.

In addition to improved energy / carbon efficiency, Dudson's requirements of the new glaze were that any temperature reduction would not adversely affect the glaze colour or the stability of any additional decoration applied onto it; nor impinge on the highly-demanding food service performance requirements demanded by the hospitality sector (something which is a challenge, even for products made using conventional materials).

The success of this project was the result of close collaboration between Dudson and Endeka. The combination of materials performance, process optimisation and a coherent environmental message has resulted in strong customer demand for a product that has a lower cost of production coupled with lower carbon emissions.

Please see the Case Studies section for full details.

2.4 Action 4: To increase Research, Development and Innovation (RD&I) with potential applications in the ceramics sector and maximise its funding from both Government and the Sector

- The objective of this action is to stimulate RD&I to generate projects that can potentially feed the pipeline of breakthrough innovations in the sector.
- Funding from Government and industry needs to be maximised in order to develop technological solutions for further improving the energy / carbon-efficiency of industrial processes.
- Industry will create networks between the ceramic sector and UK / EU / international research base (such as universities and other research bodies) to match the ceramics sector RD&I needs with expertise and increase the pool of research projects and skills likely to be relevant to the sector.
- This priority action should be implemented in the short-medium term (2018-2020), and will lead to longer-term innovation actions (during the 2020's).
- This action is a precursor to some of the tasks within action 3 (Innovation) and links to action 10 (Skills).
- The impact of this action will be improved energy/carbon efficiency and lower energy/carbon costs. Carbon reduction impact cannot be quantified as this action should stimulate completely new areas of technology development.

Action 4 tasks

Task 4A: Maximise RD&I funding open to EIs.

Support energy efficiency and carbon reduction innovation in energy-intensive industries through provision of funding streams across funding bodies, for example Innovate UK, BEIS Science and Innovation Programme, Research Councils, and EU funding.

Owners: BEIS and Innovate UK

Timing: 2017 onwards

Task 4B: BEIS to run an Industrial Energy Efficiency Accelerator (IEEA) programme

BEIS to run an Industrial Energy Efficiency Accelerator (IEEA) programme which is open to EIs and worth £9.2m over four years. The accelerator will reduce energy costs for industry by funding the demonstration of close-to-market energy efficiency innovations and their wider roll out across the sector, while leveraging private sector investment.

Owners: BEIS

Timing: 2017-2021

Task 4C: Map existing UK research expertise and areas of strength in relation to the ceramic sector with relevance to energy efficiency and decarbonisation

Ceramic Innovation Platform should investigate opportunities with existing service providers such as Innovate UK / KTN and other bodies that could implement this task.

Owners: Ceramic Innovation Platform

Timing: 2018-2019

Task 4D: Increase the likelihood of early-stage research projects (low TRL) being relevant to industry through the creation of networks to enable early interaction between research institutions, funding organisations and industry

This task could include stating relevant research needs for the ceramic sector over different timeframes to help attract research students to the sector. This would cover both academic research (final year Bachelors projects, Masters projects, PhDs, engineering doctorates, sandwich courses, postdoctoral research etc.) and applied industrial collaboration not linked to academic education. This provides an opportunity to explore discrete projects, free up time for key staff, provide students with practical placements and facilitate closer links between the sector and the research base. This could also help attract more high calibre entrants into the ceramic industry.

Owners: Ceramic Innovation Platform supported by BEIS, research organisations and ceramics companies

Timing: 2018 onwards

Task 4E: Create mechanisms to signpost existing funding sourcing in order to increase access to available RD&I / innovation finance by creating mechanisms to signpost existing funding sources.

The Ceramic Innovation platform will signpost existing support for applications, working with innovation bodies such as Innovate UK to raise awareness of the services that they offer. Open communication channels with funding providers should be established to work together to reduce the complexity of the application process. Ceramic Innovation Platform should engage with existing providers such as Innovate UK / KTN on implementation of this task.

Owners: Ceramic Innovation Platform

Timing: 2018-20

2.5 Action 5: To develop and demonstrate advanced heat recovery technologies to increase the re-use of waste heat in the ceramic sector

- The ceramic sector, with support from government, will engage in creating projects to develop and demonstrate new solutions and share best practice for the recovery and re-use of waste heat.
- The objective of the action is to increase the re-use of waste heat and reduce the ceramic sector's energy costs through collaboration to overcome technical challenges and de-risk investment in heat recovery projects for individual companies within the sector.
- This action should be implemented in the short-medium term (2017-2018), with initial focus on existing technologies and enabling actions to develop new solutions.
- This action, which combines both the sharing of best practice and the development of new solutions, is dependent on action 2 (Adoption of state-of-the-art technology) and action 3 (Innovation).
- The impact of this action will be reduced energy consumption / carbon emissions and lower energy / carbon costs. The carbon reduction impact at site level could range from 7.5% to 20%¹³, depending on the ceramic sub-sector and technologies developed.

¹³ Industrial Decarbonisation & Energy Efficiency Roadmaps to 2050; Ceramics Sector Appendix C; Table 13

Action 5 tasks

Task 5A: Introduce Industrial Heat Recovery Scheme (IHRS) to de-risk capital investment in industrial heat recovery technologies:

Government to introduce a financial support programme, providing:

- (i) match-funding support for on-site feasibility studies to increase knowledge and understanding of, and identify opportunities for, installation of industrial heat recovery technologies. This will help develop a pipeline of projects, some of which companies can take forward themselves, and some which may be eligible for capital support.
- (ii) capital support for industrial heat recovery investments, which have the potential to result in significant energy and carbon savings but which are not commercially viable by themselves.

Task Owner: BEIS, with input from industry

Timing: 2017 - 2021

Task 5B: Industry to create an innovation project to develop a durable, cost-effective heat exchanger for low-grade kiln exhaust heat.

This would be a specific task following from task A and some of the innovation activities in action 3 (Innovation). The Ceramic Innovation Platform will seek support from ceramics sector companies.

Owners: Ceramic Innovation Platform, with support from ceramics sector companies

Timing: 2018

Task 5C: Industry to engage with waste heat recovery solution providers to develop a roadmap for overcoming specific issues in the ceramics sector relating to waste heat.

This roadmap should cover maximising heat recovery from cooling air on continuous kilns (after first optimising the kiln), heat transfer media (ducted hot air, steam and oil), application of heat recovery onto batch kilns (where the amount of available heat varies continuously), use of Organic Rankine Cycles, recovery of waste heat on the dryer exhaust and developing heat recovery technology on the kiln exhaust.

Owners: Ceramic Innovation Platform

Timing: 2018-2019

Task 5D: Industry to share industrial heat recovery and re-use case studies and existing information and to develop an industrial heat recovery and re-use guide for the ceramics sector

This task should make use of the information-sharing mechanisms developed in action 1 (Leadership). The guide should include a link to a business case, differentiation between continuous and batch operations as well as the age and type of kiln and the products produced. The Ceramic Technology Hub should seek support from ceramics sector companies; some have already volunteered to contribute to this task.

Owners: Ceramic Technology Hub

Timing: 2018 – 2019

Task 5E: Explore the potential of providing industrial waste heat to heat networks.

This task could provide a revenue stream for ceramics companies where there is recoverable heat not being utilised and where there is potential for a new or existing network to become a customer for that heat. Initial discussions should focus on a possible extension to Stoke-on-Trent City Council’s District Heating Network (DHN), including back-up heat supply options needed by the end-user to accommodate periods of factory inactivity, such as maintenance or holiday shutdowns. The BEIS Heat Network Delivery Unit can advise on technical and commercial issues around heat supply to networks.

Owners: Ceramic Technology Hub with support of BCC, ceramics sector companies and BEIS where appropriate

Timing: 2018-2019

2.6 Action 6: To increase the use of bioenergy in the sector

- Industry, working closely with government and other sectors, including through the proposed cross-sector group on bioenergy, will investigate the potential for use of bioenergy and its by-products in the ceramic sector through information-gathering and initial demonstration projects to understand the possibilities of supply, and how increased bioenergy in the sector can add value and be part of the UK bioenergy strategy, taking into account feedstock availability, cost, supply security and sustainability issues such as air quality.
- The objective of this action is to clarify the potential for supply and use of bioenergy in the sector, overcoming the uncertainty about limits to availability and evaluate solutions to technical barriers. This should lead to increased adoption of bioenergy options within ceramic companies.
- Initial studies will be carried out in the short term (2017-18), with an ambition to have an initial demonstration project underway in the medium term (2019-20) to increase adoption in the longer term.
- This action is dependent on action 2 (Adoption of state-of-the-art technologies), action 3 (Innovation), and is linked to action 7 (On-site renewables).
- The size of the potential carbon reduction has not been fully quantified, however, within the heavy clay sub-sector, on-site gasification of biomass to syngas could have a potential impact of up to 29%¹⁴ reduction.

¹⁴ Industrial Decarbonisation & Energy Efficiency Roadmaps to 2050; Ceramics Sector Appendix C; Table 13

Action 6 tasks

Task 6A: Government to provide further clarity on the role that it expects biomass to play in the UK's future, both economically and in terms of decarbonisation.

Government should communicate the outputs from analytical work assessing the role biomass could play in the UK's future decarbonisation and economy. It is expected that this will cover a range of policy areas including the Bio-economy Strategy, use of bioenergy in industry and government's approach to long-term carbon budgets. This will provide a clearer idea to industry of the current and future policy landscape for bioenergy.

Owners: BEIS

Timing: 2017-2018

Task 6B: Review biomass availability, security of supply and costs using government's Bioenergy Resource Model.

This task will help develop a clearer understanding of how much biomass/biogenic waste is likely to be available in the future and the competing demands on it, its costs, supply security and its environmental sustainability including air quality. This understanding should then be used to form a shared view on its best uses, to maximise the economic and decarbonisation benefits. This will be achieved through a working group, which government will start.

This task should include information-gathering to identify potential future bioenergy requirements for the sector, and consideration of whether any additional information would be helpful. The BCC will seek support from ceramics sector companies.

Owners: BEIS and BCC, with support from ceramics sector companies

Timing: 2018

Task 6C: Prioritise the use of available biomass, and potential re-use of by-products within the ceramics industry, including which fuels / feedstocks, by-products, technologies and processes are of most interest to the ceramics sector.

This task should follow on from task 6B, the review of biomass availability. The ceramic sector would like to prioritise the use of scarce biomass for “best uses”, such as by-products to displace raw materials; or high-energy heat, in particular to co-fire alongside natural gas in dryers and kilns (rather than being used to generate electricity). Government should consider the sector’s proposals and evidence as appropriate, in the light of cross-sector demands for biomass. BCC will seek input from ceramics sector companies.

Owners: BCC, with support from BEIS and ceramics sector companies

Timing: 2018-2019

Task 6D: Carry out a feasibility study for unproven bioenergy technologies to identify potential demonstration projects.

This task should use the output of task 6C to identify potential barriers and enablers; identify suitable pilot sites; link in with cross-sector research and other potential pilots; initially inform policy enablers / requirements; draw on best practice; site map options, including the mapping of sites located near waste processing facilities or sites with biomass waste (such as food plants and refuse sites) to investigate options for gasification and anaerobic digestion. And it should draw on resources set out in action 2 (Adoption of state-of-the-art technology) to identify possible sources of funding. Priority technologies identified include on-site gasification to syngas or bio-synthetic natural gas (bio-SNG) at scale, anaerobic digestion to biogas and hydrogen. The Ceramic Innovation Platform will seek participation from ceramics sector companies.

Owners: Ceramic Innovation Platform, with support from ceramics sector companies and BEIS

Timing: 2019-2020

Task 6E: Invest in a pilot (demonstration) project.

To invest in a pilot project, those locations should be targeted where bioenergy is a low-risk option for decarbonisation, and where a secure supply of competitively-priced, sustainable feedstock is available, possibly by generating a map of potential sites. Opportunities to work together with other local energy users and/or with research projects should be identified, together with finance options.

Owners: Ceramic Innovation Platform with support from ceramics sector companies

Timing: 2020

Task 6F: Scale up proposals and plans.

This task should review the pilot and identify the learning. It should identify “routes to scale” for application of the technology, together with more specific policy insights and requests, which should then be passed to government. Sources of innovation funding / finance should be identified, to take forward a commercial-scale demonstration project.

Owners: Ceramic Innovation Platform with support from ceramics sector companies

Timing: 2020 onwards

Task 6G: Encourage ongoing support and adoption of bioenergy technologies through knowledge-sharing.

The Ceramic Technology Hub will share knowledge and raise awareness of the opportunities for investment in bioenergy technologies, especially with important stakeholders. Advice on technology options and benefits (including case studies) should be signposted, along with incentives such as the Renewable Heat Incentive. The broader context of this task is that there may need to be some overall infrastructure decisions made (national / local / site level), depending on which technologies are prioritised, and this could include looking at options for easing planning process for on-site renewables, working with the Department for Communities and Local Government (DCLG) / planning authorities.

Owners: Ceramic Technology Hub

Timing: 2020 onwards

2.7 Action 7: To increase the implementation of on-site renewables for self-generation of electricity requirements

- The ceramic sector with support from government and appropriate guidance / support bodies will collate and share available information on intermittent renewable electricity generation on the network, electricity storage, embedded renewable generation and demand side response, together with their feasibility for the ceramic sector.
- The aim is to increase the deployment of on-site renewables, electricity storage and demand side response through overcoming barriers such as planning issues and the lack of information available on the options for ceramics sites.
- This action should be implemented in the medium term (2018-2019) to achieve longer-term implementation of renewable generation (from 2020).
- This action is dependent on action 2 (Adoption of state-of-the-art technologies), action 3 (Innovation) and also links to action 7 (Bioenergy).
- The impact of this action will be an increase in use of low-carbon electricity and lower carbon emissions. The size of the carbon reduction cannot currently be quantified.

Action 7 tasks

Task 7A: Develop and disseminate an options guide to provide guidance to companies exploring on-site options for renewables.

This task could include: signposted funding sources; latest technology options, benefits and suitability, including battery storage, PV, wind, electricity generation from biogas (see action 6 (Bioenergy)); enable mapping of other potential local collaborators to share investment and risk (such as the 2 degrees manufacturing mapping tool); provide an Return On Investment (ROI) calculator to assess the payback of given technologies. The guide could also explore the use of remote renewable energy generation. The Ceramic Technology Hub, BCC and BEIS will investigate opportunities to work with the Carbon Trust and KTN on development and eventual dissemination of the guide.

Owners: Ceramic Technology Hub

Timing: 2018-2019

Task 7B: Site feasibility assessments by individual companies, using the task 7A guide to identify options for on-site renewable energy generation.

This task should also explore clustering options with other local energy users (to address lack of space issues), use local consultants to conduct a detailed assessment, and assess the possibility of also combining with energy storage and demand-side management. The Ceramic Technology Hub, with the BCC, will seek participation from ceramics sector companies.

Owners: The Ceramic Technology Hub with input from ceramics sector companies

Timing: 2019 onwards

Task 7C: Engage collaboratively with finance providers and policy makers to overcome identified barriers to investment.

Investors should be asked (directly or via government) to highlight and further develop low-carbon energy finance products, possibly through a round-table discussion with companies, investors and government to develop / pilot appropriate funding products. BCC should present evidence to government to support enabling policies if required.

Owners: BCC, with the support of the Ceramic Technology Hub and ceramics sector companies

Timing: 2018-2019

2.8 Action 8: Collaboration with customers to create market pull for decarbonisation in the sector

- The ceramic sector will work together with customers (including consumers, distributors, building merchants, procurement departments and architects) and government to stimulate the market demand for low-carbon ceramic products.
- The objective is to improve dialogue and raise awareness of the benefits (and potentially reduce the relative cost) of low-carbon products. It is also to create more market pull for lower carbon products and products that yield in-service energy / carbon savings. Evidence from the sector suggests that customers currently buy mainly on price so may benefit from information and encouragement to move to low-carbon options.
- The tasks within this action are mainly medium to long-term actions (2018 to 2019 onwards).
- This action is not dependent on other actions within the plan, but is complemented by action 9 (Skills) which targets suppliers (rather than customers).
- The impact of this action cannot be quantified at this stage. Creating consumer demand for lower-carbon products will help to support the business case for decarbonisation investment decisions.

Action 8 tasks

Task 8A: Government departments / Crown Commercial Service to ensure that all major projects above £10m use the Growth Balanced Scorecard, which allows more straightforward matters such as cost to be balanced against more complex issues such as social and wider economic considerations. This type of approach will help to achieve Government's key objectives, like sustainable economic growth. Government departments / Crown Commercial Service are encouraged to adopt the approach for other procurements below the £10 million Growth Balanced Scorecard threshold.

The Growth Balanced Scorecard enables the taking account of economic, social or environmental considerations in procurement design, technical specifications, award criteria and contract performance conditions linked to the subject matter of the contract, including sustainability and whole life costing of materials.

Task Owner: Government departments

Timing: 2017 – 2020

Task 8B: Identify areas where changes to the Building Regulations could increase the energy efficiency of buildings and/or reduce carbon emissions whilst also stimulating demand for clay construction products

This task would cover evaluating potential changes to the Building Regulations in order to improve the energy efficiency and reduce carbon emissions from buildings during the use phase (e.g. for heating and cooling purposes). The sector should engage with the appropriate government departments (e.g. DCLG), house builders and architects. BCC will seek support from ceramics sector companies in the heavy clay sub-sector for this task.

Owners: British Ceramic Confederation, with support of heavy clay ceramic sector companies

Timing: 2018-2019

2.9 Action 9: Develop a long-term engagement strategy with suppliers in the sector

- The ceramic sector will develop a long-term engagement strategy with equipment and raw materials suppliers to find common objectives to solve innovation problems.
- The objective is to integrate suppliers into innovation projects and overall strategy to decarbonise the entire value chain. Feedback from industry suggests kiln suppliers may have other priorities, in particular with demand from developing markets. The aim is to re-align these priorities with those of the UK/EU ceramic sector.
- Many of these actions will take place over the medium-to-long term (2018 to 2019 onwards).
- This action is dependent on action 3 (Innovation) and action 8 (Customers)
- The impact of this action cannot be quantified at this stage, but a more collaborative approach with suppliers would accelerate the innovation process and potentially lower the cost of innovation through leveraging resources and skills along the supply chain as effectively as possible.

Action 9 tasks

Task 9A: Develop a long-term engagement strategy with suppliers, building on the task defined in action 3 E above, to begin engagement at company director level.

The Decarbonisation Leadership Group will seek support and participation from ceramic sector companies.

Owners: Ceramics Decarbonisation Leadership Group, with support from ceramics sector companies

Timing: 2018-2019

Task 9B: Explore opportunities for cross-sector supplier engagement to set common standards on carbon reduction.

The Ceramics Decarbonisation Leadership Group should enable supplier collaboration within the ceramics sector, but also with other sectors using similar suppliers around common projects or requesting similar performance standards. It should cluster requests for groups of suppliers, and use value-chain “hot-spot” analysis to focus on high-carbon parts of the value chain.

Owners: Ceramics Decarbonisation Leadership Group

Timing: 2019-2020

Task 9C: Develop lifecycle accounting methodology to support exchange of information along the supply chain, to help provide clarity of information to enable increased demand for low-carbon ceramics products.

Ceramics Decarbonisation Leadership Group should work with appropriate organisations to develop lifecycle accounting methodology, with accompanying tools the sector can easily use. It should apply lifecycle analysis to the ceramic industry to highlight opportunities / benefits, and improve knowledge to enable comparison of different construction options and allocate values to these.

Owners: Ceramics Decarbonisation Leadership Group with support from academia and BEIS

Timing: 2019-2020

2.10 Action 10: To increase skills and knowledge within the sector to enable a low-carbon internationally competitive future for the ceramics industry

- The ceramic sector should work with government, academia, appropriate skills bodies, Professional Bodies and others to increase the quality and take up of training and development, which directly supports the uptake of energy efficiency and decarbonisation technologies within the ceramic sector.
- The objective of this action is to increase decarbonisation and energy efficiency relevant knowledge and skills within the sector's existing and future workforce to ensure that the uptake of new approaches and technologies are fully supported. This will help increase skills and capabilities in the ceramics industry as it transitions to a low-carbon competitive future.
- This action will start in the medium term, and will run from 2018 to 2021.
- This action is linked to action 1 (Leadership).
- Increase in skills and knowledge will lead to greater efficiencies and improvements in ways of working.

Task 10A: Create a Ceramic Skills Group.

This Skills Group should be created under the Ceramics Decarbonisation Leadership Group and should be responsible for coordination of decarbonisation and energy efficiency skill activities with relevant stakeholders (companies, academia, education / skills bodies and government) and working with existing industry groups (where appropriate).

Owners: Ceramics Decarbonisation Leadership Group

Timing: 2018

Task 10B: Conduct a skills audit to map out the ceramic sector’s decarbonisation and energy efficiency learning needs and explore how these can be addressed.

A skills audit could identify the training needs in industry, focussing in particular on energy / carbon efficiency. These needs should then be matched with available courses, so that additional measures can be recommended as required. The Ceramic Skills Group will work with ceramics sector companies on this task.

Owners: Ceramic Skills Group, with support from training providers and ceramics sector companies

Timing: 2018-2019

Task 10C: Improve training options to increase skills within the ceramics sector.

This task can be carried out through engagement with colleges, universities and training bodies to develop further Continuing Professional Development (CPD) courses, short courses and part-time degrees for ongoing training and development of those working in the sector. It should be ensured that energy efficiency and decarbonisation are embedded in training courses, and that skills needs for future technologies that enable decarbonisation are addressed.

Owners: Ceramics Skills Group with support from training providers and professional bodies

Timing: 2019-2020

Task 10D: Investigate benefits of replicating or expanding existing models (such as Applied Materials Research, Innovation and Commercialisation Company (AMRICC)) for the ceramics sector. This task will help learning and development within industry.

Owners: Ceramic Skills Group

Timing: 2020 onwards

Task 10E: Develop a recruitment and retention strategy for STEM candidates within the ceramics and other EII sectors.

The Ceramic Skills Group should perform a gap analysis, initially within the ceramic sector but possibly working with other sectors, to understand existing initiatives in this area and identify gaps where progress is needed. Solutions could include: raising awareness and increasing attractiveness of career prospects within the sector; engaging with education establishments on industry placements for STEM students and teachers; help create energy-specific apprenticeships; and promote ongoing training and development within ceramic sector companies to increase skills that help enable a low-carbon competitive future for ceramics in the UK.

Owners: Ceramics Skills Group with support from local education authorities, employers and professional bodies

Timing: 2020

3. CASE STUDIES

Project	Dudson and Endeka materials development to reduce glaze firing temperature for a range of tableware for the hotel and catering industry.
<p>Relevant Action(s) No.</p>	<p>Action 2B, “Create a suite of case studies showing best practice for the sector on technologies already available (TRL 9) and those almost fully developed (TRL 8), including:...raw materials formulation changes for more efficient firing...”</p> <p>Action 3C “Create a summary document with defined objectives / requirements for innovation in the sector, related to identified technologies and short-term and longer-term priorities. Initial priorities (1-3 years) for technologies ready for demonstration/pilot projects (TRL 6-8) identified include: ... materials development to reduce temperature of firings...”</p> <p>Action 8 “Collaboration with customers to create consumer demand for decarbonisation in the sector”. <i>(Although not the original objective of this project, it ultimately demonstrated that market pull can be created with the right environmental message).</i></p> <p>Action 9 “Develop a long-term engagement strategy with suppliers in the sector”. <i>(This project describes collaboration between a materials supplier and a ceramics manufacturer).</i></p>
<p>Description</p>	<p>Summary: In 2011, Dudson implemented a temperature reduction program on the glaze firing of its flatware products. This was enabled by the use of glaze materials using Endeka’s ThermECO technology. The products are fired at a lower temperature and achieve up to a 25% reduction in carbon emissions and substantive energy savings compared to the production of an equivalent product using standard glaze materials.</p> <p>Detail Dudson is a manufacturer of ceramic tableware for the hospitality industry. It is a family-owned company based in Staffordshire that has been trading since 1800. The company has been at the forefront of initiatives within the ceramics sector to reduce environmental impact and energy intensity. The company invested in the recycling of waste materials as early as the 1960s. In more recent years, the company has made substantial investments in technical innovations to improve energy / carbon efficiency, for example, utilising fast-fire rather than conventional kilns as much as possible.</p>

Endeka Ceramics is a leading global supplier of raw materials and intermediate products to the ceramic industries, with production facilities in Spain, Italy, Portugal, Malaysia, Brazil, India and the UK. With more than 100 years of experience in striving for excellence through constant innovation and continuous evolution, Endeka prides itself in being at the forefront of ceramic materials innovation. Endeka Ceramics UK is the corporate 'Centre of Excellence' for the development and manufacture of products used in the tableware industry.

In 2004, Endeka embarked on a major research & development programme to improve the energy-efficiency of ceramics manufacture. Their approach was to develop formulations that could be fired by their customers at significantly lower temperatures in order to reduce both energy bills and CO₂ emissions. After overcoming significant Materials Science challenges, the first generation of ThermECO technologies was born.

ThermECO Calculator

	Conventional	ThermECO
Firing temperature (°C)	1210	1120
Annual energy use (kWhr)		
Annual CO ₂ e emissions (tonnes)		
Annual energy bill (£)		
Savings		
Equivalent to driving		
Equivalent to lighting a 60W bulb		

Endeka actively promoted this product and produced a ThermECO calculator on their website to help customers calculate potential savings and to enable them to balance more expensive materials against those savings (see image). The predicted savings generated by the calculator typically range from 9% up to 50% depending on the scenario. Endeka needed to demonstrate a sizeable net benefit of using ThermECO in order to

stimulate potential customer interest.

In 2011, following on-going collaboration between Dudson and Endeka, ThermECO glaze was introduced at Dudson on its flatware products (plates, saucers etc.) This enabled the temperature of the glaze firing process to be reduced by up to 50°C.

In addition, Dudson's also required the new glaze and its lower firing temperature to not affect the glaze colour or any decoration applied onto it; nor impinge on the highly-demanding food service performance requirements of the hospitality trade, namely: durability and the ability to withstand the use of aggressive detergents.

Meanwhile, Dudson's customers were looking to show their boards that they were sourcing environmentally friendlier products. Although not an initial objective of the project, this turned out to be a bonus.



<p>Opportunities</p>	<p>Developing and implementing raw material formulation changes at other sites in the ceramic sector in order to reduce product firing temperatures, without compromising durability or other technical performance requirements.</p> <p>There was no government support for this project. The collaboration has been jointly funded by both companies. Prior to the work with Dudson, Endeka had applied for, and had been awarded, a grant from the Carbon Trust. However, they turned it down as they would have had to give away their IP in return for the grant.</p>
<p>Outcome and benefits</p>	<ul style="list-style-type: none"> • Carbon emissions reduced by 25% per piece versus standardly-glazed products (resulting in a total CO₂ emission reduction of 17 tonnes per year on flatware products). • Temperature reduction helped to improve yield of first quality product by reducing some of the shape distortion associated with glaze firing.

	<p>Possible next step for Dudson is to implement temperature reductions on its hollowware range of products (bowls, cups, soup tureens etc.) This is currently being evaluated by both parties.</p> <p>If a further step change reduction in the glaze firing temperature could be achieved this could initiate temperature reductions in the preceding first (i.e. biscuit) firing.</p>
<p>Lessons Learnt</p>	<p>Better control of production parameters were required:</p> <ul style="list-style-type: none"> • Glaze rheology (i.e. glaze flow characteristics). • Application parameters. • Temperature distribution within kiln firing control. <p>The objectives of both Endeka and Dudson were aligned in this project; by working collaboratively, they were both able to achieve success.</p>
<p>Cost of implementation</p>	<p>Endeka funded the development and Dudson incurred the costs of implementation and testing. The project took about 6 months.</p>
<p>Year</p>	<p>2011 after several years of development by Endeka.</p>
<p>Contact</p>	<p>Phil Edworthy, Technical Manager, Dudson Ltd; email: Phil.Edworthy@Dudson.com</p> <p>Dr Robert Schaffer, Head of Research and Development, Endeka Ceramics Ltd, rob.schaffer@endekaceramics.com</p>

Project	£22 million investment by Ibstock Brick in the complete redevelopment of its Chesterton brick factory.
Relevant Action(s) No.	<p>Action 2B “Create a suite of case studies showing best practice for the sector on technologies already available (TRL 9) and those almost fully developed (TRL 8)...”</p> <p>Action 2G “Government to explore the case for additional financial support to help make energy efficiency and decarbonisation investments more commercially viable, for the ceramic sector, as well as other heat-intensive industries...”</p>
Description	<p>Summary: Ibstock is the UK’s largest brick manufacturer, with 19 brick sites, an annual production capacity of around 750 million bricks and around 1,500 UK employees. The company’s Chesterton factory has recently undergone a £22 million investment making it one of the most energy/carbon-efficient factories of its type in the world. Carbon emissions per brick have been reduced by over 50% compared with the factories that it replaces.</p> <p>Detail Ibstock plc are a major manufacturer of clay and concrete building products, with operations in the UK and US. Ibstock is the UK’s largest brick producer, offering a wide range of clay facing bricks and other clay based construction products that are manufactured at its 19 factories across the UK, which employ ~ 1,500 people. The company takes a proactive approach to energy management, as a commercial imperative to competitiveness, because energy and climate related costs are a significant part of total production costs. Across the EU/UK brick and roof tile sector energy costs typically represent 30-35% of total production costs.</p> <p>In 2011, during the recession and in anticipation of the return to growth, Ibstock decided to make a £22 million investment in the redevelopment of its Chesterton facility in Staffordshire - a factory which was coming to the end of its operational life and becoming uneconomic. The transformation now means the site utilises state-of-the-art, energy-efficient production technology; the production capacity of the site has been boosted from 50 to 80 million bricks per year and ~ 80 jobs have been safeguarded for the next 25 to 30 years. The site now also uses advanced robots to replace repetitive manual jobs, which in-turn have been supplanted by highly skilled engineering and production roles, many of which are filled through Ibstock’s successful apprenticeship scheme.</p>

The site redevelopment retains the footprint of the original 1960s factory, however all existing plant was removed, the whole factory floor replaced and the factory was reroofed to optimise the use of natural daylight and minimise the need for low energy lighting.

The design of the plant includes the latest brick production, drying and firing technology. The heat demand for the continuous dryer (which dries the extruded, wirecut bricks at around 100 °C for approx. 24 hours) is met exclusively by heat recovered from the kiln. The new tunnel kiln (which fires the bricks at temperatures up to 1100 °C during a 3 day process) is highly energy efficient and consumes less than 60% of the fuel energy per brick compared to the unit it replaced. Extensive use is made of heat recovered from the kiln, including: i) pre-heating the bricks during the earlier stages of firing, ii) heat recovery to the dryer and iii) pre-heating burner combustion air (rather than using ambient temperature air). The kiln also utilises an advanced monitoring, control and tracking system to ensure the time / temperature profile is correct at each stage.

In the brick industry, on-site carbon dioxide emissions are derived from two sources: i) the fuel used to fire the product and ii) process emissions that originate from the decomposition of carbonates and oxidation of organic content in the raw materials. The Chesterton factory uses Etruria Marl clay from the company's nearby Knutton quarry. This clay is highly prized by brickmakers on account of it exhibiting the lowest level of process emissions of UK brick clays. The combination of energy-efficient firing and the use of low process emission clay, means the site is a benchmark performer in terms of carbon dioxide emissions. The use of locally-available clay also avoids long-distance transportation of the raw materials to the site and the associated CO₂ emissions. In total, the significant investment in new plant and equipment made by Ibstock has reduced carbon dioxide emissions per brick by over 50% compared with the product from the factories it replaces.

This approach to minimising the environmental footprint of the factory has also been applied to set world-class standards in water conservation, noise reduction and transport efficiency measures.



However, the company is not resting on its laurels. It is currently nearing the end of a £55 million extension to its stock brick factory at Ibstock, Leicestershire. Again, this plant will utilise state-of-the-art production technology and set new standards for energy efficiency, water and waste recovery when it becomes operational later in 2017.

Opportunities

Significant energy / carbon savings could be obtained at other ceramic production sites through significant capital investment in state-of-the-art, energy / carbon-efficient production technology.

<p>Outcome and benefits</p>	<ul style="list-style-type: none"> • Investment in the latest energy efficient drying and firing technology has reduced CO₂ emissions per brick by over 50% compared with the previous factories. • Investment will safeguard jobs at Chesterton for the next 25 to 30 years. • Production capacity upped from 50 to 80 million bricks per year. • Upskilling of the workforce. • Reduced environmental factory footprint through energy conservation, water conservation as well as noise reduction and transport efficiency measures.
<p>Lessons Learnt</p>	<ul style="list-style-type: none"> • Significant capital investment can yield significant improvements in energy / carbon efficiency. • Energy efficiency savings alone may not be sufficient to justify an investment case in today's challenging economic climate. The benefits of such efficiency savings can only be realised when coupled with wider business objectives, e.g. extended plant life, labour savings (robotics), waste reduction and reduced CO₂ emission costs.
<p>Cost of implementation</p>	<p>£22 million privately-funded investment.</p>
<p>Year</p>	<p>Final investment decision made in Nov 2011. Old Chesterton factory made its last brick in Aug 2012. After a rapid demolition and site clearance, the new equipment was installed and commissioned with the first bricks produced in Jun 2013.</p>
<p>Contact</p>	<p>Mr Michael McGowan Quality, Environmental and Energy Manager m.mcgowan@ibstock.co.uk</p>

4. GLOSSARY

	Definition
Action	An activity that will be delivered through a series of separate tasks
Task	A specific piece of work to deliver an action
Impact	A qualitative or quantitative description of the impact on carbon, financial or competitiveness as a result of successfully implementing the action
Dependency	How one action might influence another action, for example a shorter-term action may be linked to longer-term actions or ambitions.
Resources	Staff or funding required to deliver a specific task
Objective	The impact on strategic outcome of the action (such as increased energy efficiency in sector, or the objective is to decarbonise and do this using CCS technology and a transport and storage network)
Output	(Tangible) result achieved by the action being undertaken (such as better awareness amongst industry managers of opportunities) with an emphasis on the overall action delivery or result (such as delivers CC network so that industry can use it to capture and store carbon)
Short-Term Action	Action that will be undertaken between 2017 and 2020
Longer-Term Action	Action that will take place beyond 2020
Barrier	A factor that needs to be overcome for an action to be achieved

5. ACRONYMS

	Definition
AMRICC	Applied Materials Research, Innovation and Commercialisation Company
BCC	British Ceramic Confederation
BEIS	Department for Business, Energy and Industrial Strategy
CCA	Climate Change Agreements
CCL	Climate Change Levy
CfD	Contracts for Difference
CM	Capacity Market
CPF	Carbon Price Floor
CPS	Carbon Price Support
CRC	Carbon Reduction Commitment
DCLG	Department for Communities and Local Government
DHN	District Heat Network
ECA	Enhanced Capital Allowance
EII	Energy-Intensive Industry
EIUG	Energy-Intensive Users Group
EMR	Electricity Market Reform
EPR	Environmental Permitting Regulations
ESOS	Energy Saving Opportunity Scheme
ETL	Energy Technology Product List
EU ETS	European Union Emissions Trading System
FiT	Feed-in Tariff
HNDU	Heat Networks Delivery Unit

	Definition
HNIP	Heat Networks Investment Project
IED	Industrial Emissions Directive
IEEA	Industrial Energy Efficiency Accelerator
IS	Innovation Strategy
KTN	Knowledge Transfer Network
LCF	Levy Control Framework
MCCG	Manufacturers Climate Change Group
PV	Photovoltaic
RD&I	Research, Development and Innovation
RHI	Renewable Heat Incentive
RO	Renewables Obligation
ROI	Return on Investment
STEM	Science, Technology, Engineering and Mathematics
TRL	Technology Readiness Level