



Department for
Business, Energy
& Industrial Strategy

UK **pia**

Oil Refining

Joint Industry - Government

Industrial Decarbonisation and Energy Efficiency Roadmap
Action Plan

October 2017



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. 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 gross domestic product of 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 oil refining 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 oil refining 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 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.

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>



Claire Perry

Claire Perry
Minister of State for Climate Change and Industry

UKPIA Foreword

The Oil Refining Sector Decarbonisation and Energy Efficiency Action Plan, marks an important step in defining the conditions necessary and steps required to realise the decarbonisation potential identified for the refining sector in the Phase I report, “Refining Sector Industrial Decarbonisation & Energy Efficiency Roadmaps to 2050” published in March 2015.

The downstream oil sector plays a vital role in the supply of petroleum products used as road transport, aviation, marine and heating fuels, for power generation and as feedstocks for the petrochemicals industry. Millions of consumers, along with thousands of businesses, hospitals, schools, the emergency services, maritime and aviation customers depend on these supplies for mobility, power and heating. The six UK refineries currently in operation supply product meeting some 85% of inland demand and continue to provide a secure, affordable and resilient supply of these products, securing a strong base for the UK economy and its future growth.

The International Energy Agency has forecast that EU demand for oil products will decline from around 33% of primary energy demand in 2014 to 25% by 2040 under its Current Policies Scenario³. The rate of decline will largely depend on the effectiveness of broader decarbonisation, energy efficiency policies and provision of alternative fuels and technologies, in particular, for heating, power generation and transport. As a consequence, the European refining sector will continue to face major challenges, with continuing over-capacity and the serious risk of further refinery closures. However, the role of the UK refining and downstream oil sector will remain critical in supporting an orderly transition to a low carbon economy.

The investment climate for the refining sector is therefore extremely uncertain. Refinery operators have a fiduciary duty to their shareholders to make a return on their investment, but must also maintain their assets and implement safety, environmental and other improvements to ensure regulatory compliance, their licence to operate and to maintain competitiveness in a challenging global market. Any such investments also compete against other investment opportunities available to the refinery operator or their shareholders, both within the UK and further afield as was clearly identified as a barrier to investment in decarbonisation in phase I of this project.

A strong and convincing economic case is therefore a pre-requisite for investment in decarbonisation and energy efficiency measures in the refining sector. Some of the measures identified in this document are aimed specifically at finding that convincing case, particularly for projects that extend beyond the border of individual refineries, for example clustering and carbon capture and storage. Industry investment can only occur if the right market conditions are established, but this will require an effective cross-

³ Three scenarios are identified under the IEA World Energy Outlook 2016, the Current Policies, New Policies and 450 Scenarios. Under the New Policies Scenario, EU demand is projected to fall to 23% of primary energy demand; under the 450 Scenario, this figure falls to 17%.

sector carbon reduction approach which evolves to provide a suitable incentive to GHG reductions. Such an approach will need to be established uniformly across all relevant competitors in both domestic and international markets and should not compromise security of supply and resilience, given the importance of the sector to the broader economy. The Government has a crucial role to play in development of the policy framework required to create these market conditions, both domestically and in its international diplomacy and actions on climate change.



A handwritten signature in blue ink, consisting of a stylized 'C' followed by a horizontal line.

Chris Hunt
Director General
UK Petroleum Industry Association

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 42%⁴ 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. These emissions savings 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.

They are also the ones subject to global competition from facilities not subject to the same levels of decarbonisation policy, thereby increasing the risk of carbon-leakage to other countries around the world.

The UK has six remaining major operational refineries: the Essar Stanlow Manufacturing Complex in Cheshire; the ExxonMobil Refinery at Fawley; the Petrolneos Grangemouth Refinery in Scotland; the Phillips 66 Humber and Total Lindsey Oil Refineries in Humberside; and the Valero refinery at Pembroke in Wales. The refineries have over

⁴ As footnote 1.

⁵ As footnote 2.

⁶ Statistics derived from ONS data on exports and workforce

3000 permanent staff excluding contractors, with around 8000 staff employed directly by these companies in the broader downstream oil supply chain, including the refineries. An additional 21000 or so are employed indirectly by maintenance contractors etc., suppliers, fuel distributors and hauliers, independent filling stations etc.⁷. This employment is focused mostly in areas of the UK which experience economic deprivation and which rely on manufacturing for skilled work.

The presence of a domestic refining base twinned with the UK's crude oil production gives the UK a relatively resilient position and assurance that we can source the fuels we need. High levels of supply resilience are vital to enable the continued availability of feedstocks for other sectors, such as the chemicals sector, which is particularly important to the UK economy, generating an annual turnover of around £32 billion and exports worth £26 billion⁸.

Oil refining is the third highest emitting industrial sector in terms of direct and indirect emissions⁹. It employs specific processes (distillation, conversion, reforming, desulphurisation and hydrogen production) to convert crude oil into a combination of intermediate and end-products. The intermediate products are typically blended to produce the remaining end-products. The sector processed 67.07 million tonnes of crude oil in 2012 (Dukes, 2014), and contributed a direct value to the economy of £2.3 billion in 2013 (IHS Purvin and Gertz, 2013). In 2015, the sector emitted ~13 million tonnes of CO₂¹⁰, of which around 60% was derived from the combustion of hydrocarbons (mostly refinery fuel gas, which is a by-product of the refining process) in boilers and furnaces, with the balance being process emissions from hydrogen production, catalyst regeneration, and other refining processes. The 2050 Oil Refining Roadmap identifies the maximum technical decarbonisation potential as a reduction of 6 million tonnes of CO₂ emitted per year by 2050. This would correspond to a 64% reduction in emissions compared to 2012 levels.

The companies operating within the UK oil refining sector are predominantly owned by international businesses headquartered outside of the UK. Proposals for investment in UK refineries compete with others elsewhere and in other related sectors, for example, upstream oil and gas, petrochemicals and renewable energy. Within the UK also, energy efficiency and decarbonisation projects are in internal competition for capital with other investment projects that are more closely related to continued regulatory

⁷ See Review of the Refining and Fuel Import Sectors in the UK available at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/302172/Refining_and_fuel_imports_in_the_UK_FINAL_VERSION.pdf.

⁸ Source – ONS.

⁹ Industrial Decarbonisation & Energy Efficiency Roadmaps to 2050 – Oil Refining see https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/416671/Oil_Refining_Report.pdf.

¹⁰ See EU ETS EU Transactions Log (EUTL) available at <http://ec.europa.eu/environment/ets/>.

compliance (where the cost of upcoming regulatory measures is seen as a key challenge for refineries).

UK demand for petroleum products has declined over the last ten years, although some recovery was seen in 2015¹¹. UK refineries compete for supply with refineries in Europe and further afield. Between 2009 and 2015, three UK refineries closed - Teesside (Petroplus) in 2009; Coryton (Petroplus) in 2012; and Milford Haven (Murco) in 2014. There has also been a reduction of capacity through mothballing of primary distillation. The threat of further refinery closures remains, with the potential for increased imports to make up any shortfall developing in this event, which could result in further carbon leakage to refineries in other parts of the world and reduced security of supply, such security being pivotal to the UK economy.

¹¹ Digest of United Kingdom Energy Statistics (DUKES) Table 3.2 – see <https://www.gov.uk/government/statistics/petroleum-chapter-3-digest-of-united-kingdom-energy-statistics-dukes>.

Government's Current Work and Policy

Government's policy towards the downstream fuel sector, including oil refineries, is set out in the 2014 Review of the Refining and Fuel Import Sectors in the UK. The Review outlined that a mix of domestic refining and imports is good for the UK's economy and energy resilience, and for employment. While the Review acknowledged that government and industry must be prepared for further changes to the size and shape of the UK market, by working together we can ensure that the refining and import sectors work effectively and continue to deliver fuel resilience to the UK.

Since that publication, government and the sector have worked together to address regulatory burdens. The work of the Midstream Oil Sector Government and Industry Task Force (which ran from 2014-2016) ensured that refineries have a voluntary code to improve access to pipelines, and are eligible for compensation under the EII Compensation Package against indirect Renewable Obligation and Feed-in Tariff costs associated with electricity imports from the grid. This seeks to maintain competitiveness in comparison with other EU and extra-EU refinery suppliers. Additionally, the work of the Task Force has greatly improved understanding of the resilience of the fuel supply chain, with two studies delivered by government that looked at the ability of the UK to source the fuels it needs in the face of global 'Black Swan' disruptions against different refining capacity scenarios. It developed an in-depth model to look in detail at the ability of the UK market to respond to potential point failures with existing infrastructure.

Following the conclusion of that focussed initiative, work continues on a wide range of policy areas impacting on the future of the sector - including changes to transport fuels and current and future environmental legislation amongst others - with government and industry working closely to maintain a competitive environment for the sector, to continue to contribute to our economic prosperity while transitioning to a low carbon future.

Decarbonisation in the Refining Sector

Energy consumption has always been a major cost element for refinery operators and currently accounts for around 60% of operating costs. The sector therefore has significant incentive to manage energy production and use efficiently and over the past 20 years or so, has improved its energy efficiency by around 10%¹². This has been achieved through investment in dedicated combined heat and power (CHP) plants, fuel switching from liquid fuels to refinery fuel gas/natural gas, process optimisation and early adoption of Energy Management Systems (EMS). In addition, UK refineries are subject to a carbon price through the European Emissions Trading System (EU ETS), and

¹² See CONCAWE Report 3/12 "EU refinery energy systems and efficiency" available at https://www.concawe.eu/uploads/Modules/Publications/rpt_12-03-2012-01520-01-e.pdf.

undertake Energy Saving Opportunities Scheme (ESOS) assessments to identify additional cost-effective energy saving measures.

While refineries in the UK have made investments to meet new fuel specifications and other regulatory requirements, such as compliance with the provisions of the EU Industrial Emissions Directive, in addition to the achievements referred to above, the work of the Task Force was also important to better understand the pressures the sector is facing in the UK and Europe as a region, and how the cumulative impact of competitiveness on the sector needs to be carefully considered.

Phase I of the Roadmaps programme showed that deep decarbonisation of EIs is achievable, however, there are significant barriers, including cost; economic, business and policy uncertainty; knowledge and skills; and access to finance. The Phase I pathways report identified eleven key barriers to investment for the oil refining sector, highlighting the lack of a compelling economic case for investment in key decarbonisation options, for example carbon capture utilisation and storage (CCUS). Government and industry will continue to work together to address these challenges to ensure that the UK has a successful and competitive oil refining sector. Opportunities around new technologies, including CCUS and potential clustering opportunities at current refinery locations, set out in this document, have the potential to contribute towards the decarbonisation of the sector to support its competitiveness and to ensure it is able to contribute to UK emissions reduction targets. Of key importance to this sector will be the long-term demand for hydrocarbon based fuels in transport which currently accounts for over 80% of final consumption for petroleum products. As identified in the Phase I pathways report, this will be influenced by many factors, domestic and global, including growth, technology progression and others. This has the potential to significantly impact on refinery economics with potential for transport fuel demand to drop while petrochemical demand may increase.

This present report sets out efforts being taken now and areas that could be developed that will better enable the UK to work towards the decarbonisation potential that Phase I helped us identify. There are items specific to refining, but also areas where opportunities for energy efficiency improvement and decarbonisation will require the involvement of other sectors, for example through clustering, waste heat recovery and carbon capture and storage/utilisation. There is therefore substantial scope to take steps in the short term that could enable all industrial sectors to make deeper emissions reductions over the longer term whilst staying competitive.

Government and the UK Petroleum Association (UKPIA) have collaborated on this document, which identifies voluntary actions and tasks that each party may undertake to enable deeper emissions reductions in the oil refining sector over the short and longer term while staying competitive. This assessment has been agreed by government and UKPIA, and focus on enhancing the broad conditions within which the decarbonisation pathways, identified in the Phase I Roadmaps report, can be delivered.

The parties support the actions attributed to them, but have not made a legally binding commitment to fulfil these actions. None of these actions/tasks are refinery or project specific, and do not therefore obligate individual companies to act. Both BEIS and UKPIA recognise that companies within the sector operate in an open competitive market subject to competition law, and that no actions identified in this report should compromise or undermine such competition or individual corporate behaviour, and that energy related site-based projects are only likely to be progressed where companies see a robust business case for so doing.

Nothing in this report shall undermine the corporate separateness of the commercial entities involved. All of the suggested actions in this report (including but not limited to any disclosure of information) will be developed in compliance with applicable law (including competition law). Individual companies are free to take other measures or to go beyond the measures described in this document. Where the actions contemplated in this document refer to the sharing of information, no commercially sensitive information will be exchanged.

2. Actions

2.1 Action 1: Provide strategy and leadership on decarbonisation and energy efficiency measures in the UK Oil Refining sector

- Building on existing work, including the 2015 Roadmaps Pathways Report, the Industrial Strategy consultation, and the forthcoming Clean Growth Strategy (CGS), as well as utilising the knowledge from the existing sector working group, a UKPIA Working Group will seek to further identify the ways in which the UK refining sector can decarbonise whilst remaining nationally and internationally competitive. This will help to address the barrier identified in Phase I of the Roadmaps programme relating to a lack of focus on decarbonisation from organisational management, and the issue of refineries considering that there is little economic case for investment in decarbonisation measures, and instead focusing more on short-term viability and regulatory compliance to ensure high levels of process safety and environmental protection.
- The objective of this action is to draft a strategy that sets out the sector's key challenges to achieving its decarbonisation objectives, for example addressing why investment in decarbonisation and energy efficiency projects may not be prioritised by refineries, and a shortage of key skilled staff. As part of this, the strategy will need to consider, amongst other things, the high rates of return required for energy efficiency and decarbonisation investments to be able to be justified to shareholders, and for those investments to compete for capital with other projects associated with, for example, regulatory compliance or cost-optimisation. Government will, via the CGS, be providing more clarity on our future plans which should make the economic case for decarbonisation stronger.
- This is a short-term action but its effects will be long term for the sector.
- This action links to all other actions in this document.
- Implementation of this action will result in a strategy that will deliver the framework for the potential transition to a low-carbon UK refinery sector. It is not possible to quantify the emissions reductions for this action.

Action 1 tasks

Task 1A: Continue to use existing government–industry working groups and forums (for example the Energy Intensive Industry Stakeholder Forum) to meet on a regular basis to discuss decarbonisation and energy efficiency issues affecting the sector, so that these issues are kept at the forefront of government and industry agendas.

Owner: Group participants (including Government and industry members). Outputs of the group to be coordinated by the UKPIA Working Group

Timing: Ongoing

Task 1B: Building on the 2015 Roadmap Pathways document, the Industrial Strategy consultation and the forthcoming Clean Growth Strategy, and this current document, seek to further identify options for decarbonisation of the UK refining sector to support and complement the wider government policy framework for the sector, to better enable an orderly transition to a low-carbon future for the sector. These should be developed on the basis of a robust business or economic case, to justify the allocation of resources to implement the other tasks identified in this document.

Owner: UKPIA Working Group with support from BEIS, with contributions from industry

Timing: 2018-2019

2.2 Action 2: To increase the uptake of state-of-the-art technologies (SATs)

- This action aims to develop options to encourage increased uptake of state-of-the-art energy efficiency technologies in the oil refining sector. This will include the development of a robust reference list of energy efficiency and decarbonisation projects already deployed by industry.
- The objective of this action is to enable greater deployment of SATs which could be utilised by the sector. This should be done through raising awareness of the opportunities that currently exist, identification and implementation of energy efficiency improvement projects, and increased sharing of non-proprietary knowledge when projects have been successfully deployed. This action involves collaboration through existing government/industry forums (such as those mentioned in Action 1, task A above) and through an online portal, to ensure that there is an awareness of new and existing energy efficiency and decarbonisation technologies. Lessons could be learnt from previous collaborative projects in the sector, for example the Carbon Capture Project¹³.
- This is a short to medium term action, but the benefits will be long-term.
- This action links to Action 1 (strategy and leadership within the sector), and Action 3 (facilitating greater access to finance).
- The impact of this action will be a reduction in carbon emissions and improved energy efficiency of the sector through, for example, deployment of heat recovery technologies, and process unit design and utility system improvements. It is not possible to quantify the emissions reductions for this action.

¹³ See <http://www.co2captureproject.org>.

Action 2 tasks

Task 2A: UKPIA to encourage refinery operators to independently review the business/economic cases for implementing projects which utilise SAT, aligned with and building on the outcomes of their energy audits (for example ESOS) and external benchmarking studies.

Owner: UKPIA Working Group and refinery operators

Timing: 2017 onwards

Task 2B: UKPIA to encourage refinery operators to utilise existing industry forums and groups to cooperate, identify, and share SATs that have been deployed and that have delivered reduced carbon emissions and/or improved energy efficiency, thereby promoting awareness of successful technologies.

Owner: UKPIA Working Group and refinery operators

Timing: 2017 onwards

Task 2C: Launch a web portal that facilitates greater industry collaboration by enabling companies in the refining 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 refining sector to share information on research and development, best practice, knowledge sharing and access to funding opportunities. The website will be designed through close engagement with UKPIA and its member companies to help ensure it meets business requirements.

Task Owner: BEIS, with input from industry

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 non-proprietary information.

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

Owners: BEIS

Timing: Ongoing

Task 2F: 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

2.3 Action 3: Facilitate greater access to finance for energy efficiency and decarbonisation-related investments

- This action seeks to ensure that industry is aware of and knows how to access the full range of funding and finance sources that could be used to support R&D and mature energy efficiency and decarbonisation investments. These funding streams include public sector funding, current EU funding (if applicable), and third-party finance. In addition, this action also seeks to investigate the possibility of expanding the Energy Technologies List (ETL) to include additional decarbonisation and energy efficiency technologies applicable to the oil refining sector. Consequently, if they were included on the revised list, refineries investing in those technologies would be entitled to receive Enhanced Capital Allowances (ECAs). Refineries receiving ECAs would receive support to decarbonise - this will address the barrier identified in Phase I of the Roadmaps programme relating to long payback periods for advanced technologies.
- The objective of this action is to raise awareness of existing external financing available to the sector to deliver more sector investment in state-of-the-art and innovative energy efficiency and decarbonisation technologies. Any Government funding made available should not impact the competitive nature of the industry.
- This action is to be carried out in the short to medium term and links to longer term actions aimed at increasing the uptake of state-of-the-art energy efficiency and decarbonisation technologies in the sector.
- This action links to Action 2 (increasing the uptake of SAT).
- The impact of implementing this action will be to reduce energy consumption, thereby reducing relative carbon emissions and lowering energy costs, however the decarbonisation impact of this task cannot be quantified.

Action 3 tasks

Task 3A: Government to establish an industrial energy efficiency scheme to help large companies install measures to cut their energy use and their bills.

Owner: BEIS with input from industry.

Timing: 2017-2022

Task 3B: Improve the signposting to available sources of public funding and finance for state-of-the-art energy efficiency/carbon efficiency technologies. This would be in the form of an online portal (as discussed in Action 2 Task C above) signposting companies to funding and finance options available to them.

Owner: BEIS, with input from the UKPIA Working Group

Timing: 2017-2018

Task 3C: To explore the potential for additional technologies, such as burners, process control, industrial boilers, heat recovery etc. which could be included in the Energy Technology List (ETL) to encourage wider investment opportunities through Enhanced Capital Allowances. The Carbon Trust are already doing a study to assess the potential for adding technologies to the ETL.

Task Owner: BEIS

Timing: 2017 – 2020

Task 3D: 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 mature energy efficiency and decarbonisation investments, 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.

Task Owner: BEIS (UKPIA will lead on encouraging engagement from the refining sector including identifying participants / individual businesses for the group).

Timings: 2017-2019

2.4 Action 4: Identify potential clustering opportunities around existing UK refineries

- This action involves considering (based on publically available information) the potential the UK oil refinery locations have for becoming part of a wider industrial energy-led cluster so that by-products (for example heat or CO₂) can be used by third parties, and infrastructure networks (for example industrial heat recovery, industrial carbon capture usage/storage, and heat networks) can be shared by the cluster participants. This will address the barriers identified in Phase I of the Roadmaps programme relating to knowledge sharing and collaboration on decarbonisation projects.
- The objective of this action is both to develop a better understanding of clustering opportunities that could benefit the oil refining sector and other parts of UK industry, and to take steps to increase the creation of energy-led clusters in the UK.
- This action will be carried out in the short to medium term, with the aim of encouraging the clustering of all UK industries in the longer term.
- This action links to Action 6 (identifying opportunities for using industrial heat recovery).
- The impact of implementing this action will be a reduction in relative carbon emissions for the refinery and the customer who offtakes the heat and/or CO₂. However, as the clustering opportunities are yet to be identified, the decarbonisation impacts cannot at this stage be quantified.

Action 4 tasks

Task 4A: Government and Local Enterprise Partnerships (LEPs) to continue working with oil refineries, existing local industry and potential investors, to encourage new businesses/factories to cluster around the existing oil refinery sites to take advantage of existing or planned energy efficiency technologies including industrial heat recovery, and heat networks.

Task Owner: BEIS leading the project, and working with LEPs, refinery operators, industry, and other businesses who may be interested in cross-sector clustering.

Timing: 2017 onwards

2.5 Action 5: Ensure the oil refining sector has access to an appropriately skilled workforce

- This action aims to ensure that the oil refining sector has access to an appropriately skilled workforce, who are experienced in decarbonisation and energy efficiency technologies. This will address the barrier identified in Phase I of the Roadmaps programme relating to shortages of key skilled staff.
- The objective of this action is to identify and address any skills and knowledge gaps in the sector, so that the sector can access appropriately skilled personnel, including those with knowledge about decarbonisation and energy efficiency technologies.
- This action is short to medium term to ensure the sector has access to the required skills in the long term.
- This action links to Action 1 (strategy and leadership), Action 2 (increasing deployment of SAT), Action 3, (facilitating greater access to finance), and Action 4 (clustering).
- Implementation of this action will enable the sector to ensure it has the necessary skills to support the continued deployment of energy efficiency technologies; a quantitative assessment of the emissions reduction impact is not possible.

Action 5 tasks

Task 5A: On an ongoing basis, the UKPIA Working Group, in collaboration with industry, to identify and review the gaps in knowledge and skills that exist relating to energy efficiency and decarbonisation technologies and practices in the oil refining sector.

Task Owner: UKPIA Working Group to lead

Timing: 2017 onwards

Task 5B: Based on the outcome of Task A, the UKPIA Working Group to collaborate with industry to develop targeted oil refining sector apprenticeships around decarbonisation, energy management, energy efficiency and environmental matters, through BEIS's 'Trailblazer' programme.

Task Owner: UKPIA Working Group with input from industry, and collaborating with BEIS

Timing: 2017 onwards

2.6 Action 6: Identify and deliver industrial heat recovery projects that realise broader benefits for industrial sectors

- Industry and Government will identify and seek to deliver industrial heat recovery projects that realise benefits for manufacturing sites in England and Wales. Government will support this by introducing an Industrial Heat Recovery Scheme. This will provide financial support for feasibility studies, to identify opportunities for recoverable heat projects and assess their costs and benefits. It will also provide financial support for capital investment, to help make industrial heat recovery projects commercially viable.
- The objective of this action is to develop a pipeline of industrial heat recovery projects, some of which companies will be able to take forward themselves, and some of which may be eligible for capital support from government. The action will enable and encourage more industry investment in, and deployment of, recoverable heat technologies, in order to reduce primary energy demand and increase low carbon heat use. It will help to tackle financial barriers to uptake, and realise economic and commercial potential for recoverable heat in industry.
- This action links to the actions relating to finance and clustering. Implementation of this action will contribute to a potential for industrial heat recovery in the UK in the range of 5 TWh/yr to 28 TWh/yr, reducing primary energy demand¹⁴.

¹⁴ See DECC Sponsored study “The potential for recovering and using surplus heat from industry” available at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/294900/element_energy_et_al_potential_for_recovering_and_using_surplus_heat_from_industry.pdf.

Action 6 tasks

Task 6A: 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 onsite 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 6B: Work collaboratively with industry seeking to export waste heat to heat networks with a view to 1) quantifying the benefits of export 2) understanding the perceived risks associated with supply to a network 3) identifying technical and contractual solutions which mitigate these risks and 4) sharing examples of these solutions in practice.

Owners: BEIS with input from industry, Heat Trust, local authorities, and Scottish Government.

Timing: 2017-2018

Task 6C: Investigate further options for incentivising the use of industrial waste heat. The objective of this sub-task is to increase the evidence base and understanding of the costs and benefits of IHR, to enable further consideration of the technical and economic case for providing an incentive beyond the IHRS.

Owners: BEIS and the UKPIA Group working collaboratively

Timing: 2018 - 2021

2.7 Action 7: Facilitate the deployment of carbon capture, usage and storage (CCUS) in the Oil Refining Sector

- This action aims to facilitate the deployment of CCUS in the refining sector, including by undertaking studies on the potential of various technologies, and the potential of industrial clusters for deployment of CCUS. It also includes tasks on raising industry awareness of best practice and existing resources; and on public awareness and acceptance.
- A significant amount of relevant activity is already underway. For example, research into options for commercial models for large scale industrial CCS adoption, commissioned by Tees Valley Unlimited and funded by BEIS was published on 7th February¹⁵.
- The CCS Commercialisation Programme's Key Knowledge Deliverables have also provided government, industry and academia with valuable technical and commercial insight on how cost-effective CCS may be deployed in the future.
- The objective of the action is to help develop an understanding of what is required in order to deploy CCUS, and to support and create the conditions for their deployment. It will involve collaboration between central government, industry and local authorities, including through existing forums.
- The specific decarbonisation impact of this action is hard to quantify, but CCS has significant decarbonisation potential. Industrial CCS overall, if deployed in the maximum technology pathway developed in Phase 1 of the Roadmaps project could be the largest contributor to decarbonisation across the eight sectors, with a total emission reduction potential of 23 million tonnes of CO₂ per annum in 2050 (37% of the total combined reduction in the Max Tech pathway¹⁶).
- Carbon capture and utilisation (CCU) is an important option and offers economic opportunities but it is unlikely, on its own, to be sufficient, as not all CO₂ usage technologies lead to CO₂ savings and others are energy intensive. Importantly though, deploying CCU can reduce the costs of capture technology and can be tested at existing UK industrial sites. CCU can also lower the carbon footprint of products, and provides opportunities for industrial symbiosis with commensurate economic benefits.
- As well as the specific tasks set out in this action, HMG has set out details of its new approach to CCUS in the Clean Growth Strategy, which was published at the same time as this document. This approach is relevant to industrial sectors, and Government will work with the refining sector as part of the ongoing roadmaps process, to help them realise the opportunities that it presents for them.

¹⁵ [Link](#)

¹⁶ *Industrial Decarbonisation & Energy Efficiency Roadmaps 2050, Cross sector summary*, DECC BIS March 2015.

Action 7 tasks

Task 7A: Assess the potential of CO₂ utilisation in the UK through a study to identify the most promising applications of CCU and how CCU commercialisation can be facilitated.

Task Owner: BEIS

Timing: 2017-2018

Task 7B: Build understanding of the potential for deploying CCUS at industrial clusters by commissioning reports on the level of development at existing clusters, including opportunities for making further progress, and on the options for deploying CCUS at industrial sites that are isolated from carbon transport and storage infrastructure.

Task Owner: BEIS

Timing: 2018

Task 7C: Undertake activity to raise public awareness of the relevance of CCUS for industrial decarbonisation, for example in areas close to industrial clusters.

This should be done as part of BAU engagement activity. Detailed and bespoke public engagement on CCUS would ultimately be taken forward as part of any specific CCUS project.

Task Owner: UKPIA with input from member companies, cluster organisations and local authorities.

Timing: 2017 - 2018

3. Case Studies

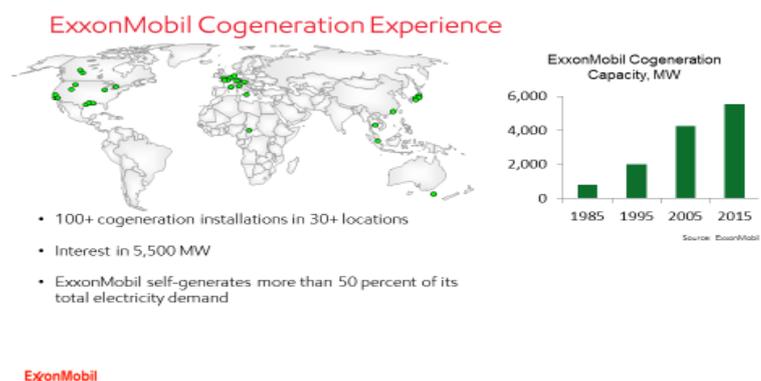
Project	ExxonMobil Fawley Refinery and Petrochemicals Site – Energy Efficiency and Combined Heat and Power
<p>Description</p>	<p>ExxonMobil is the world’s largest refiner, with interests in more than 20 refineries across Europe, North America and the Asia-Pacific region. ExxonMobil’s Fawley Refinery is the UK’s largest integrated oil refinery and chemical plant converting crude oil into transport fuels, lubricants and petrochemical products. The refinery can process more than 270,000 barrels of crude oil a day, providing ~20% of UK refinery capacity and can produce approximately 800,000 tonnes of petrochemicals per year. We operate around 700 kilometres of pipeline, the largest privately-owned underground oil pipeline distribution network in the UK; some 85% of refinery products are transported by pipeline from Fawley to distribution terminals at Hythe, Avonmouth, Birmingham, West London and Purfleet. Pipelines also link to Heathrow and Gatwick airports. We market Esso and Mobil-branded products and serve some 800,000 retail customers a day through a network of over 1,000 Esso branded service stations in the U.K with our site numbers continuing to grow. We also supply aviation fuel at Heathrow and Gatwick airports.</p>  <p>The European refining sector has experienced a tough operational climate, due to high energy costs and a structural imbalance¹⁷. EU and UK refineries, established 30-50 years ago, continue to compete with new, sophisticated refineries in locations such as the Middle East and Asia-Pacific that are not subject to the same policy environment. In the UK, refining (and associated</p>

¹⁷ If all UK refinery production were to be used in the UK market, imports to meet demand would amount to 50% of diesel fuel and 60% of jet fuel. On the other hand, surplus gasoline is exported

chemicals manufacturing) is under pressure to reduce emissions and hence energy consumption from both the manufacturing process and products at a time when regulation and consumer demand is placing greater expectations on the product mix (advanced fuel specifications - particularly low sulphur concentration and increasing biofuel content) and shifting demand from gasoline to diesel/jet. Non-discretionary expenditure on safety/environmental regulatory compliance continues to grow. The cumulative UK¹⁸ and EU¹⁹ regulatory burden reduces the competitiveness and profitability of the UK refining sector. In parallel, the rapid emergence of the US shale gas industry and ‘tight oil’ phenomenon has largely foreclosed the US gasoline shortage – the traditional home for UK surplus product.

Globally, energy consumed in our operations generates more than 80 percent of our direct greenhouse gas emissions and is one of our largest operating costs. As such, energy efficiency presents a tremendous opportunity to decrease costs, improve competitiveness and reduce emissions. The site’s single largest operating expense is the fuel and electricity required to operate the refining process (approximately 40% of the site’s operating expenses); the site consumes approximately 1700 MW of fuel.

ExxonMobil has operated a Global Energy Management System (GEMS) since 2000 across all its refining and petrochemical operations. GEMS requires sites to identify and implement energy saving opportunities. As a result of this, over the last decade, Fawley has improved its energy efficiency by over 20% by monitoring energy efficiency, maintaining efficiency-critical equipment, optimising existing process equipment and investing in equipment improvements. These activities can range from no or low-cost operations to large, capital intensive investments. The site’s most recent multi-million



¹⁸ This includes costs associated with items around process safety/bunding (i.e. post-Buncefield), the UK Compulsory Stock Obligation (CSO), and the UK Site Rateable Value.

¹⁹ Including emissions based regulation such as the EU Emissions Trading System (EU ETS) and the Industrial Emissions Directive (IED), as well as legislation concerning fuel specifications such as the Renewable Energy Directive (RED) and the EU Fuels Quality Directive (FQD).

pound project utilises waste heat from a furnace stack to improve the efficiency of the refinery’s steam system while smaller investments have upgraded furnace instrumentation and control systems to improve combustion efficiency.

Pre Cogen					Current				
Steam	Max	Total	Typical	Total	Max	Total	Typical	Total	Units
SP4 Boilers	2 x 500	1000	2 x 350	700	2 x 450	900	2 x 135	270	Te/hr
SP2 Boilers	5 x 60	300	5 x 0	0	N/A		N/A		Te/hr
Unit 3 Boiler	200	200	160	160	180	180	120	120	Te/hr
Cogen Boiler	N/A		N/A		230	230	150	150	Te/hr
		1500		860		1310		540	Te/hr

NB. SP2 Boilers were typically only used when either SP4 Unit 1 or 2 was shutdown

Pre Cogen					Current				
Generation	Max	Total	Typical	Total	Max	Total	Typical	Total	Units
STG Generation	67	67	67	67	60	60	40	40	MW
Unit 3 Generation	42	42	40	40	42	42	38	36	MW
Cogen Generation	N/A		N/A		140	140	135	135	MW
		109		107		242		211	MW

Occasionally in the early to mid 2000s, after NETA was introduced, there were periods of low Electricity Market Prices that made the running of the large Cogen uneconomic in Power Sales terms. However, from an Energy Efficiency point of view as well as an overall OPEX perspective, baseloading our Large Cogen and Unit 3 CHP units to offset Power imports and to satisfy our site Steam demand has always been, and continues to be, beneficial.

Another way we are improving our energy efficiency is through the expanded use of cogeneration, also known as combined heat and power (CHP). Cogeneration captures heat generated from the production of electricity for use in production, refining and chemical processing operations. ExxonMobil has long been committed to cogeneration and has interests in over 5,500 MW of CHP capacity in over 100 installations internationally. Due to its inherent energy efficiency, the use of cogeneration also leads to reduced GHG emissions; our global cogeneration facilities alone enable the avoidance of approximately 7 million metric tons per year of GHG emissions. This chart shows our international use of CHP plants.

At Fawley we have two combined heat and power plants, one operating since the mid 1980’s and the other since 1999, which supply the site’s electricity and steam needs and enables the refinery to export efficiently generated power to the grid. This second plant was commissioned by Fawley from National Power who also operated it until the facility was bought by us from RWE Npower in 2010, a decision which reflected the refinery’s primary need for constant steam supply (vs. commercial electricity supply) from the unit. The chart opposite provides a comparison of site steam and power production pre- and post- the use of CHP on site; due to on-site energy efficiency measures utilising the GEMS process the demand for steam has reduced significantly.

Overall, the refinery’s approach to project investment and selection is rigorous and methodical. It is recognised that there are important differences between a typical margin improvement-type project (such as a unit debottlenecking exercise) and an energy efficiency investment. Energy efficiency measures are often physically distributed across all operating units, are complex in engineering terms and higher in cost with lower project returns. Nevertheless, energy efficiency projects are progressed on the basis that they must be economically attractive and contribute to the

minimisation of operating costs. Equally, we have recognised that direct CHP unit ownership and operation enabled us to prioritise its constant operation to deliver reliable steam supply, versus a more commercially-driven approach to electricity generation with more variable operations. Overall, Fawley management recognise energy efficiency as a strategic goal and that improvement activities must be spread across all aspects of the refinery's operations; safety, environmental performance, margin improvement and energy management. We value the real energy efficiency contribution that embedded CHP capacity can provide and urge government to maintain a stable and supportive policy environment.

4. Glossary

Term	Definition
Task	An activity that will be delivered through a series of separate tasks
Sub-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 (e.g. increased energy efficiency in xx 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 (e.g. better awareness amongst industry managers of opportunities etc.) – an Emphasis on the overall action delivery or result – e.g. delivers Carbon capture 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