Department for Business, Energy & Industrial Strategy

Pulp and Paper Sector

Joint Industry - Government

Industrial Decarbonisation and Energy Efficiency Roadmap Action Plan

October 2017

JOINT ACTIONS TO DELIVER THE 2050 DECARBONISATION ROADMAPS

Contents

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 cent[1] while growing the gross domestic product of the overall UK economy by 67%[2]. In parallel, the UK has been improving energy security, creating jobs and realising export opportunities as a result.

The Industrial Decarbonisation and Energy Efficiency Roadmaps project is a key collaboration between Government and industry to help industry decarbonise and improve its energy efficiency, whilst also improving 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 pulp and paper 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 Confederation of Paper Industries, the Paper Industry Technical Association and pulp and paper companies 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

[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

delivering clean economic growth, and that it maximises the economic benefits from the UK's transition to a low carbon economy.

Claire Perry
Minister of State for Climate Change and Industry

Industry Foreword

The manufacture of paper is predominatly based on cellulose fibres, principally derived from managed forests - a renewable, recyclable and sustainable resource, at the heart of a growing bio-fibre based and low carbon economy. Resource efficiency is key, both through the support of forest management and also by recycling paper back into new products. The sector continually invests in energy efficiency measures and contains a large number of on-site power generation sets, that together with demand-side management, already make a substantial contribution towards decarbonisation and balancing the national electrical grid. With the right policy framework this contribution could become even larger.

Papermakers (and indeed the wider paper value chain) welcome the Roadmap partnership with Government. Especially important is the opportunity to explore the existing potential for the sector to decarbonise production, and (critically) better identify and understand barriers hindering progress over the longer term; though of course short and medium term issues cannot be neglected by Government as we need a sector both profitable and dynamic ready to face the long-term challenges identified through the Roadmap.

UK papermakers have already acted to reduce carbon emissions. Between 1990 (the base year for the UK Climate Change Act) and 2016, emissions of fossil derived carbon dioxide (both direct and indirect) from UK papermaking fell from 6.6 million to 2.3 million tonnes – a total reduction of 64% (CPI, 2017). Allowing for changed production levels, this means that in 1990, each tonne of UK made paper resulted in 1.3 tonnes of fossil CO2 being released, while in 2016 this figure has been reduced to 0.6 tonnes – a reduction of more than half (CPI, 2017), delivered by a combination of new plant, investment in CHP, improvements in energy efficiency and fuel switching to lower carbon energy sources.

Sadly, the number of UK mills has halved since 2000, with UK sites facing competitiveness challenges, including relatively high industrial electricity prices. Welcome progress has been made by Government in beginning to address this issue for a sub-set of sites, but continued action is required on energy cost as a pre-requisite to secure investment on the scale required to deliver the 2050 targets; the alternative is further de-industrialisation.

Being based on a renewable resource, sustainability is the foundation of the paper sector. The quickly growing bioeconomy and the ‘Industry 4.0 revolution’ presents a major opportunity for the sector to grow and change, and indeed at European level there is alreay a target to increase sector added value by 50% while still meeting decarbonisation targets. However to be able to deliver the neccissary scale of finance to deliver both new investments and energy efficiency, companies need to generate

profits and be confident that profits will continue to allow investments to be paid off. In the current environment of regulatory uncertainty, high regulatory cost[3] and low profitability, strategic investments to deliver low carbon manufacturing must be linked to corporate responsibility; cost reduction; market evolution; and the cyclical replacement of equipment as part of long investment cycles.

The UK should be on the cusp of an industrial renaissance where the combination of Brexit and a renewed focus on industrial strategy creates the conditions for investment to flourish in the UK's foundation industries. But this will not happen by chance, and Government policy and the business strategies of companies with UK-based paper and pulp installations and other interests will need to dovetail closely to ensure that this opportunity is not missed. Government action will itself need to be coherent, to prevent the policies of other departments or local government frustrating the industrial strategy in implementation.

It follows that for industry to act, Government will need to act in collaboration with industry to make the UK an attractive place for low-carbon but energy intensive manufacturing to be located. Central to this aspiration is creating the the right investment climate to enable product innovation, research & development and the commercialisation of ideas here in the UK.

We welcome the collaborative work with Government on this action plan. As we continue to work together, and from a wider perspective, we would welcome further Government action on a number of priorities to support the decarbonisation and energy efficiency opportunities identified by the 2050 Roadmaps. These issues need to be addressed if the opportunities are to be delivered.

These include:

- Additional support for energy efficiency to bring the best available technologies to all UK operations;
- Providing long-term regulatory stability against which investments can be made;
- Delivering secure energy supplies at competitive prices;
- Confirming that support schemes are long-term and cover all affected installations;
- Ensuring that any targets are realistic and achievable;
- Supporting the development of markets for lower carbon products;
- Better accounting for embedded carbon in imported goods when setting polices;
- Further developing training schemes to provide suitably skilled staff;
- Taking the concept of a circular economy to maximise resource efficiency;

[3] http://ec.europa.eu/growth/tools-databases/newsroom/cf/itemdetail.cfm?item_id=9000

- Reviewing the planning system to ensure investments in efficiency can be effectively delivered.

CPI & PITA October 2017

Barry Read
The Paper Industry Technical Association

Andrew Large
Confederation of Paper industries

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

This document describes priority agreed actions to be implemented by a range of stakeholders in the UK Pulp and Paper sector. The actions, which are intended to enable and deliver decarbonisation and energy efficiency in the UK while maintaining sector competitiveness, have been identified by stakeholders from industry, government and other parties. These include actors within the value chain, supply chain, institutions and academics. They focus on overcoming barriers and delivering the decarbonisation pathways identified in the previously published 2050 Industrial Roadmaps reports[4].

The parties to the agreement expect progress with addressing the identified issues to be monitored, and activities through the plan itself to be updated over time to reflect new developments and other changes.

This Action Plan is voluntary and jointly-owned between government and industry. Government Departments (led by BEIS) and the Paper & Pulp sector (led by CPI and PITA) will work together to oversee delivery of the Action Plan and future work, regularly updating on progress.

To achieve this, BEIS and the sector Trade Associations will set up a Roadmap Strategy Group to provide an ongoing forum to discuss and review the delivery of the tasks in this action plan.

The group will focus on:

- A review of Action Plan delivery, progress and reporting;
- A strategic overview of cross sectoral actions;
- Overseeing the development of future actions that can secure the objectives of the plan.

[4] https://www.gov.uk/government/publications/industrial-decarbonisation-and-energy-efficiency-roadmaps-to-2050

1. Introduction and Policy Overview

As set out in the Industrial Strategy Green Paper, recent UK energy policy has developed through the framework of a 'trilemma' – the need to simultaneously find policies that contribute to meeting climate change targets, guarantee security of energy supply and minimise energy costs. One of the three major challenges for energy policy (that the industrial strategy will address) is to ensure that the transition to low-carbon economy – and the securing of our energy supplies – must be done in a way to minimise the cost to business and domestic consumers.

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 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 UKs 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 reduced its territorial emissions by 42%[5] [1] since 1990 while growing the overall economy by over 67%[6]. 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 low carbon 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 exports[7]. Increasing productivity and driving growth across all sectors of the economy are key objectives of the UK industrial Strategy and

[5] Provisional 2016 emissions: BEIS provisional UK emissions statistics 1990-2016: https://www.gov.uk/government/statistics/provisional-uk-greenhouse-gas-emissions-national-statistics-2016

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

[7] Statistics derived from ONS data on exports and workforce

Government will work with any sector which can organise behind strong leadership to address shared challenges and opportunities

There is 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 showed that deep decarbonisation of EIIs is achievable. However, there are significant barriers, including cost; economic, business and policy uncertainty; knowledge and skills gaps; and access to finance. These issues are explored further through this paper[8].

Following publication of the sector technical Roadmap, Government, the Confederation of Paper Industries and the Paper Industry Technical Association have now agreed this Action Plan, setting out voluntary commitments that each party will undertake to enable the paper and pulp sector to make deeper emissions reductions over the longer-term while staying competitive. This involves the following actions:

- Facilitating greater access to finance for energy efficiency and decarbonisation-related investments;
- Identifying and implementing waste heat recovery projects;
- Raising awareness of state-of-the-art energy efficiency technology and improving related skills through training support;
- Encouraging greater use of sustainable biomass to deliver a lower carbon footprint within the sector;
- Identifying and delivering innovation, including demonstration projects;
- Increasing activity at the R&D stage relating to lowering carbon emissions and improving energy efficiency;
- Contributing UK pulp and paper expertise to bolster UK bio-refining initiatives and to developing the bio-economy.

UK Papermaking

UK papermaking acts as the foundation for a paper-based sector representing a collective turnover of £11.5 billion per annum and directly employing 56,000 people (ONS Annual Business Survey 2015, SIC code 17); an additional 232,000 jobs are supported through the wider supply chain. The paper-based industries are widely spread throughout the UK, but with concentrations in the North West & far South East of England, Wales and Scotland.

In 2016, the UK produced 3.7 million tonnes of paper and board, down from a peak of 6.6 million tonnes in 2000. Of this amount, 1 million tonnes were exported (at a value of

[8] https://www.gov.uk/government/publications/industrial-decarbonisation-and-energy-efficiency-roadmaps-to-2050

£1 billion), down from a peak of 1.8 million tonnes in 2000. Including imports, 11.5 million tonnes of paper and board were placed on the domestic market in 2016 (with imports valued at £6 billion), making the UK the largest net importer of paper and board in the world (CPI, 2017).

Papermaking has always been part of a circular economy, with recovered paper being made into new paper alongside that made from virgin fibres – in the UK around 73% of all fibre used to make paper is recovered from collected paper and card, with a number of sites also recovering energy from otherwise waste materials.

Of concern is that such has been the loss of UK reprocessing facilities, that more than half of the paper currently domestically collected for recycling is now being processed overseas, with UK jobs and wealth creation being exported alongside the recovered paper.

In any serious discussion about rebalancing the economy and improving the country's balance of trade, then the paper-based industries stand out as a sector to be supported, with huge potential for innovation and growth to provide good quality manufacturing jobs, many in disadvantaged areas supporting the 'country working for all' aspiration of the Prime Minister.

Not only would a growing UK industry displace imports and help address the balance of trade issue, but papermaking is well suited to on-site energy generation supporting the further deployment of more intermittent renewable electricity generation.

The Papermaking process

In the papermaking process, either paper for recycling or wood fibres (on occasion other types of fibres) serve as the raw material to the pulp production. The pulp is then processed, dewatered and dried into paper in the paper machine, after which the paper can be treated through various processes to produce a paper of the required quality. Pulp production can either be integrated with paper-making or carried out as a separate activity.

The paper machine, and in particular the drying process, accounts for about two thirds of all energy use in a typical UK pulp and paper mill, using mainly steam produced by natural gas or biomass. The combustion of fuels to produce electricity and/or steam that is used in the process, together with indirect emissions from purchased electricity make up the pulp and paper sector carbon footprint – unlike some other sectors, all emissions are from heat and power – there are no process emissions.

Industrial structure

The UK pulp and paper sector is dominated by multi-national organisations, with the ten largest sites representing more than 75% of capacity, and nine of them head-quartered outside the UK. Competition in the sector is strong, particularly in high volume paper grades where margins and profitability are generally low. With global competition and international ownership, UK mills must compete with sites in Europe and further afield, both on product marketing and also to secure strategic investments.

The use of CHP is widespread (with around 65% of production coming from sites with CHP) with the two large mills processing virgin timber both having biomass powered CHP. A number of other mills are already using or considering using various types of biomass as an alternative source of energy to gas.

Direct emissions originate largely from steam-producing boilers and gas turbines, and indirect emissions from grid supplied electricity. The paper machine –- and the drying process –- accounts for the great majority of all energy use in a typical UK pulp and paper mill. Direct fuel use in the sector is currently dominated by natural gas, but more than 25% of fuel used is biomass. The use of coal has effectively already been eliminated.

Operational background

Analysis at overall sector level is complex as different sub-sectors face very different operational pressures. Overall UK production of paper peaked at 6.6m tonnes in 2000 before declining to 3.9m tonnes in 2016; however the overall figure masks substantial differences between sub-sectors.

To better assess and understand opportunities, analysis is frequently delivered at sub-sector level, as in the first phase of the Roadmap process. While some part of the industry face declining markets (such as printing & writing) others benefit from sustained and increasing demand (such as hygiene (where substitution is difficult) and packaging (benefiting from major investment and a wave of innovation).

The forthcoming bioeconomy

Renewable resources are quickly replacing non-renewable ones in a number of industrial sectors, with an opportunity for the pulp and paper sector to continue to lead the way. Innovation is adding new functions and value to existing products, while the development of new bio-based products (ranging from new biocomposites to nanocellulose and a host of products based on the chemistry of forest fibres) is a major opportunity for the sector to grow is a sustainable way. However delivering such investment will not be easy and Government has a role to play in ensuring such investment comes to the UK.

Re-shoring the reprocessing of some of the paper currently exported for recycling, increasing the UK production of forest fibre, boosting the production of virgin paper, together with winning a share of the evolving bio-economy, represents an important opportunity to build a stronger manufacturing sector in the UK.

2. Actions

2.1 Action 1: Facilitate greater access to finance for energy efficiency and decarbonisation-related investments

- Industry and government will collaborate on tasks that bolster financial incentives and address barriers to increase investment in energy efficiency and decarbonisation-related projects.
- The objective of delivering investment for established technologies is to reduce carbon emissions and improve energy efficiency in manufacturing processes through delivering improvement projects.
- These short-term tasks include raising awareness of, and training in, investment options and business case development, and addressing the underwriting of specific project risks.
- The action, which is to be carried out in the short term (2017 – 2018), links in the longer term to those actions aimed at developing new or improved technologies given that once these are demonstrated, funding will be needed to deploy them as they become available.
- Implementation of this action will deliver reduced energy consumption per unit of product which will reduce relative carbon emissions and lower energy costs.

Action 1 Tasks

Task 1A: Raise awareness of plant managers, finance departments and other senior management regarding project finance options through conferences, training courses and qualifications backed up with up-to-date online information. Includes the set-up of training programmes to meet specific needs such as finance for energy efficiency technology – including general energy efficiency and Industrial Heat Recovery. Consider how the Energy Savings Opportunity Scheme (ESOS) can be used to identify suitable projects and to provide a basis for bankable finance.
Task Owner: CPI and PITA supported by BEIS
Timing: 2017 and ongoing

Task 1B: Launch and maintain a web portal that facilitates greater industry collaboration by enabling companies to share information on R&D, best practice, knowledge and access to funding and finance opportunities.
Task Owner: BEIS, with input from other Stakeholders
Timing: 2018

Task 1C: Government to establish an industrial energy efficiency scheme to help large companies install measures to cut their energy use and their bills.
Task Owner: BEIS
Timings: 2017-2022

Task 1D: 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 is already doing a study to assess the potential to improve the operation of the Enhanced Capital Allowance Scheme.
Task Owner: BEIS
Timings: 2017 – 2020

Task 1E: Industry to develop an engagement strategy with the finance sector and other funders to address barriers and opportunities to accessing external finance to support mature energy efficiency technologies and decarbonisation investments. There should also be a strategy for early engagement in potential funding opportunities to assess how the paper and pulp sector fits with funding calls.
Task Owner: CPI, with support from BEIS
Timings: 2017 – 2018

2.2 Action 2: To identify and implement industrial heat recovery projects that realise benefits for the sector

- Industry and Government will collaborate to identify and 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, arising from hundreds of source-sink-technology combinations from just 73 large industrial sites. Also primary energy demand will be reduced, leading to a reduction in fuel bills[9].

9 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 2 Tasks

Task 2A: 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 2B: Improve knowledge sharing and exchange of best practice in IHR. Government, industry, academia and others will look to improve knowledge sharing and exchange of best practice in the field of IHR.
Task Owner: BEIS
Timing: 2017 and ongoing

Task 2C: Subject to funding, commission a study to evaluate waste heat recovery and use in other countries applicable to the pulp and paper industry; this to include identifying challenges and barriers to UK implementation. The project should include the sharing of case studies from industry and the development of a guide on industrial heat recovery for the pulp and paper sector. Key factors to consider include the business case and the different sources and grades of heat specific to pulp and paper sector processes.
Task Owner: PITA supported by BEIS
Timing: 2017 – 2018

Task 2D: Support companies to apply for funding through the Industrial Heat Recovery Scheme that will be launched in 2017 by sharing information and identifying consultants who have delivered pinch analyses in the paper and pulp industry before. If the pinch analysis study gets funded, the results should be presented in CPI and/or PITA meetings, including the process of getting funding and the study itself.
Task Owner: CPI and PITA
Timing: 2017 – 2018

2.3 Action 3: Raise awareness of state-of-the-art energy efficiency technology and improve related skills through training support

- Raise awareness of state-of-the-art energy efficiency technology and improve related skills through training support.
- The objective of the action is to enable greater deployment of established or near commercial energy efficient technology, so improving the sector's productivity and competitiveness through energy cost reduction, as well as lowering carbon emissions.
- The tasks that make up this action are short term and link to action 1 on facilitating greater access to finance.
- Implementation of this action will result in UK paper mills and their suppliers working more effectively together to understand how state-of-the-art technology can work in different settings within the sector – leading to increased energy efficiency in UK paper and pulp mills.

Action 3 Tasks

Task 3A: Subject to funding, establish a programme to further increase awareness of energy efficiency by creating a new role of an Energy Technology/Techniques Expert to keep up with the latest sector developments in industrial energy efficiency and disseminate best practice for maintenance, behaviour and overall technical competence. This delivered by a series of events and related information sharing and forums to brief on the latest technologies and products. Include major OEMs in the initiative by achieving support from paper and pulp company executives.
Task Owner: PITA with support from BEIS
Timing: 2017 - 2020

Task 3B: Provide a competition policy briefing note clarifying what information can be shared to improve energy efficiency and reduce greenhouse gas emissions under competition law.
Task Owner: BEIS
Timings: 2017-2018

Task 3C: Maintain and support the PITA Energy Optimisation course. Specific areas for improvement include motors, drives, fans and improved process control and the use of sub-metering and process optimisation. Staff would develop operational excellence in energy management, with the use of ISO50001 as a possible enabler. This could be joined up with other sectors who may share energy efficiency training resources.
Task Owner: PITA with support from CPI
Timing: 2018 and ongoing

2.4 Action 4: Encourage greater use of sustainable biomass to deliver a lower carbon footprint

- Develop a clearer understanding of how much biomass/biogenic waste is likely to be available in the future, and the competing demands on its use. This work will help with the development of a shared view on its optimum use and provide industry with a better picture of the future supply and demand of different types of biomass and biogenic waste, its likely costs and its sustainability benefits. Such improved understanding will reduce barriers to investments in biomass related projects. However, the scope for Government actually direct the use of such resources is limited, (both domestically and internationally) and so its actual use will be intrinsically linked to project economics.
- This action links to action 7 on biorefining in the longer term.
- Implementation of this action will result in lower carbon emissions from using competitive, sustainable and secure biomass supplies.

Action 4 Tasks

Task 4A: 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. Government will also consider the waste hierarchy, that supports the promotion of high quality recycling to provide clean resource streams for papermaking (and other reprocessing industries) before the balance is used for energy generation.
Task Owner: BEIS
Timing: 2017 - 2018

Task 4B: Government and industry to set up a cross-sector group to develop a collective view of the best uses of biomass and bioenergy across industry in an international context. This group will use existing analytical tools to identify the likely future supply and demand of different bioresources, their costs and their environmental sustainability – e.g.: BEIS's Bioenergy Resource Model and UK land use assessments. The group will be informed by evidence of the role bioenergy could play in the UK's future decarbonisation objectives, and by the emerging findings from the Government's Bioeconomy Strategy regarding the role of bioenergy in the UK's wider bioeconomy.
Task Owner: BEIS, with industry input
Timing: 2017 - 2019

Task 4C: The cross-sector group to develop a collective view on the best uses of bioenergy, including which technologies, processes and stages of the supply chain are of interest. This 'best use' will need to consider sustainability, economic value and technological feasibility, as well as how best to support appropriate use.
Task Owner: BEIS, with industry input
Timing: 2017 - 2019

Task 4D: Work with the relevant agencies to prepare a study addressing how UK reforestation can; increase the biomass resource; serve as a carbon sink; and reduce flooding risk.
Task Owner: BEIS with support from other forest sector Stakeholders
Timing: 2017 – 2018

2.5 Action 5: identify and deliver innovation including demonstration projects

- CPI to support the deployment of innovative decarbonisation and energy efficiency technology, with the objective being to deliver successful demonstration projects and enable scale up to lower carbon emissions and improved competitiveness.
- This action links to the research and development of energy efficiency, electrification and decarbonisation technologies (see action 6 below) and also the biorefining action (action 7).
- Implementation of this action will result in lower carbon emissions from using innovative technology. It could also give the UK a leading or competitive position through experience of the demonstration of emerging technologies.

Action 5 Tasks

Task 5A: PITA and CPI to work with KTN, Universities, Innovate UK, the Confederation of European Paper Industries (CEPI) and member companies as well as interested companies from other sectors to better understand the following issues: • Identification of innovative technologies being demonstrated or in need of demonstration • Monitor and support the continuing work being done on selected Two Teams[10] projects (at European level) to ensure that UK industry is aware of this work and promote opportunities to participate in future funded research, development and demonstration • Periodically monitor Engineering and Physical Sciences Research Council or publicly-funded R&D projects that need to move to demonstration; • Organise network events between paper and pulp companies, equipment suppliers and research institutions • Organise visits to European mills that have adopted key technologies. Technologies could include advanced waste heat recovery, Two Teams project concepts, and other potential technologies
Task Owner: CPI, working with PITA and other Stakeholders
Timing: 2017 and ongoing

Task 5B: Support energy efficiency and carbon reduction innovation in energy intensive industries through provision of funding streams across funding bodies, for example Innovate UK, BEIS and the Research Councils.
Task Owner: BEIS
Timing: 2017 and ongoing

Task 5C: Support and seek out partners for innovation projects to submit bids to access the above funding streams.
Task Owner: CPI
Timing: 2017 and ongoing

[10] http://www.cepi.org/node/16891

Task 5D: BEIS to run a cross-sector Industrial Energy Efficiency Accelerator (IEEA) programme, open to EIIs 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.
Task Owner: BEIS
Timing: 2017 – 2021

Task 5E: Facilitate joint industrial research or demonstration projects and consider whether these should be externally managed and/or evaluated.
Task Owner: PITA and CPI supported by individual companies
Timing: 2018 – 2020

Task 5F: Mobilise OEMs at senior level to: • share innovation ideas and expertise; • further develop innovations in their equipment (including collaboration with paper-making companies); • enable technical staff to engage in discussions, demonstrations and proposals.
Task Owner: PITA, supported by CPI
Timing: 2017 and ongoing

Task 5G: Build a framework for how intellectual property rights could be owned and exploited, built on the same principles that CEPI developed for the Two Team project.
Task Owner: CPI, supported by Industry
Timing: 2018 – 2019

Task 5H: CPI to actively disseminate information from CEPI and encourage their members to take an active role in any future innovation-type activity.
Task Owner: CPI, supported by Industry
Timing: 2017 and ongoing

Task 5I: Appraise the economics and feasibility of electric boilers, heat pumps and infrared heating and other electrification options to understand to what extent electrification can be used and what is already adopted.
Task Owner: CPI and PITA, supported by Government
Timing: 2020

2.6 Action 6: Increase activity at R & D stage relating to lowering carbon emissions and improving energy efficiency

- This action includes promotion of the UK as a place to conduct R&D and identification of the paper and pulp sector's 'R&D needs' to enable increased collaboration between the sector and research institutions on energy efficiency, decarbonisation and production processes.
- The objective of the action is to increase both (i) material-related R&D activity and applications in the pulp and paper sector and (ii) knowledge of the sector's innovation needs within the R& D community.
- This action is short term, but aiming to stimulate long term R&D activities and long term demonstration projects (see action 5 above). There are also links to action 7 (biorefining) and action 8 (value chain collaboration).

Action 6 Tasks

Task 6A: Map existing UK research expertise and areas of strength related to energy efficiency and decarbonisation that may be applicable to the pulp and paper sector.
Task Owner: KTN supported by PITA and CPI
Timing: 2017 - 2018

Task 6B: Promote UK industry as a place to conduct R&D by publishing relevant R&D needs over different timeframes and searching for partners to work on them.
Task Owner: PITA
Timing: 2017 and ongoing

Task 6C: Identify areas of research needs of the pulp and paper industry and promote these to universities by issuing challenge-led calls for innovation that could be worked on by Masters and PhD students.
Task Owner: PITA
Timing: 2017 and ongoing

Task 6D: Identify how the pulp and paper industry can access R&D funding from the new National Productivity Investment Fund.
Task Owner: BEIS
Timing: 2017-2018

2.7 Action 7: Contribute UK pulp and paper expertise to bolster UK biorefining initiatives and to develop the bio-economy.

- This action aims to create a joined-up UK biorefining roadmap, includes assessment of existing research projects to develop a framework for the development of the bio-economy and what this means for the UK pulp and paper sector and biorefining.
- The objective of the action is to evaluate the potential for economic value as a result of biorefining activities and the 'bio-economy'.
- This action is short term – with the aim at stimulating longer term biorefining activities for example through long term demonstration projects (see action 5 above).
- This action also links to action 4 (bioenergy), action 5 (demonstration projects) and action 6 (increased R&D).
- Implementation of this action will result in a framework to deliver enhanced development of the UK bio-economy and specifically the UK pulp and paper sector's role – with a focus on biorefining.

Action 7 Tasks

Task 7A: Assess biorefining initiatives in other countries or sectors and consider their applicability to the UK, similar to the Bio-Based Industries Public-Private Partnership from the European Commission.
Task Owner: PITA supported by CPI, KTN, Centre for Process Innovation[11]
Timing: 2017 – 2020

Task 7B: Work with relevant sectors and stakeholders to establish a UK biorefining roadmap (to complement existing activities). In addition to pulp and paper, sectors with a potential interest are chemicals, food and drink, waste management and agriculture. The UK roadmap would need to quantitatively estimate potential added value to each of the key stakeholder groups, and if considered of value, define the key actions for specific actors.
Task Owner: BEIS
Timing: 2017 – 2020

[11] Note that the Centre for Process Innovation is not to be confused with the Confederation of Paper Industries (CPI) – although they have the same acronym. In this plan – Centre for Process Innovation is always written in full.

2.8 Action 8: Value Chain Collaboration in the UK pulp and paper sector

- This action concerns value chain collaboration to identify and deliver improvements with regards to feedstock (both recycled and virgin), production and products. Specific tasks cover improved collaboration within sub-sectors, better separation to improve recovered fibre feedstock and material efficiency
- The objective of the action is to reduce carbon emissions from the UK sector while maintaining or increasing value through value chain collaboration. For example, the low quality of paper collected for recycling results in higher energy and processing costs for mills due to screening, sorting and processing out of contaminate materials. Accordingly this action includes a task to improve the quality of recovered fibre feedstock and reduce these costs
- The initial tasks are short term, but they may lead to longer term actions and projects.
- This action links to action 3 (as value chain collaboration may deliver improved energy efficiency)
- Implementation of this action will enable stakeholders to investigate opportunities within value chains, lower specific energy (due to improved recovered fibre feedstock) and lower emissions through material efficiency

Action 8 Tasks

Task 8A: Define and deliver an initiative to stimulate collaboration of the UK pulp and paper value chains.
Task Owner: CPI and PITA linked to the Industrial Strategy
Timing: 2017 – 2018

Task 8B: Promote better recycling processes to collect high quality recycled paper.
Task Owner: PITA, CPI supported by WRAP and other Stakeholders
Timing: 2017 and ongoing

2.9 Action 9: Provide leadership and strategy in the UK pulp and paper sector

- Develop a UK pulp and paper sector strategy to include long term objectives, energy efficiency, GHG emissions reductions and five year plans based on the other actions in this plan and taking into account company business strategies. The strategy should retain existing strengths and build future opportunities and growth.
- The objective is to deliver a sustainable and competitive pulp and paper sector to overcome short term challenges and ensure long-term success.
- This action begins in 2017 with agreement of the strategy and extends to the long term through regular review and monitoring of the five-year plans.
- This action links to all other actions.
- Implementation of this action will result in a framework to deliver enhanced development of the UK pulp and paper sector in the context of decarbonisation and competitiveness.

Action 9 Tasks

Task 9A: Establish a UK sector strategy to include long term objectives based on the other actions in this plan
Task Owner: CPI
Timing: 2017 - 2018

Task 9B: Encourage UK pulp and paper companies to publish their business strategy informed by UK sector strategy
Task Owner: CPI
Timing: 2017 and ongoing

2.10 Action 10: Embedded renewable generation, demand side management and energy storage in the pulp and paper sector

- Identify and deliver opportunities to use energy storage and demand side management in combination with increased renewable deployment – either embedded on-site, via private wire or via the network.
- The objective of the action is to integrate the emerging opportunities of energy storage, addressing intermittent renewable generation on the network, and supporting embedded renewable generation and demand side response to simultaneously lower carbon emissions and energy costs.
- This action begins with short term tasks but extends to long term opportunities.
- Implementation of this action could result in a multitude of benefits including lower carbon emissions due to increased use of renewables, lower energy costs and better matching of supply and demand and boosting the productivity of the energy network.

Action 10 Tasks

Task 10A: Explore which areas might benefit from electricity demand flexibility and how Government can support the transitions to a more flexible electricity system focussing on whether there is a rationale for regulatory involvement to support larger industrial and commercials consumers to provide demand-side response and clarifying the role of aggregators and their relationship with other electricity industry parties.
Task Owner: Ofgem
Timing: 2017

2.11 Action 11: Consider the case for further investment in CHP in the sector

- Identify initiatives which would make investment in gas or biomass Combined Heat & Power (CHP) more attractive for sector operators.
- Most of the larger paper mills already have CHP but there is potential to expand coverage to medium-sized and smaller mills – and to ensure that life-expired CHP at larger mills is replaced with new CHP and not with boilers. These CHP could be gas turbine, gas engine or biomass – their relative carbon footprint will be assessed against grid decarbonisation predictions and economic considerations.
- The actual deployment of CHP has always fallen significantly below Government estimates. This work will aim to understand the reasons for this disparity.
- This action is about short term tasks as utilising natural gas fuel will not necessarily offer significant enough carbon savings post-2035 even if consumed in CHP plant.

Action 11 Tasks

Task 11A: Revisit the 2014 internal DECC study on deployment of CHP and update with latest energy and economic estimates, including for biomass, based on the DECC research. Factors affecting the uptake of gas CHP and Tackling Non-Financial Barriers to Gas CHP
Task Owner: BEIS
Timing: 2017-2018

3. Glossary

	Definition
Action	An activity that will be delivered through a series of separate tasks. Short-term to 2020 – long-term post 2020.
BEIS	Department for Business, Energy & Industrial Strategy.
Barrier	A factor that needs to be overcome for an action to be achieved.
Biorefinery	A facility that integrates biomass conversion processes and equipment that can produce fuels, power, heat, and value-added chemicals from biomass.
CPI	Confederation of Paper Industries. See paper.org.uk
Dependency	How one action might influence another action, for example a shorter-term action may be linked to longer term actions or ambitions.
Impact	A qualitative or quantitative description of the impact on carbon, financial or competitiveness as a result of successfully implementing the action.
Objective	The impact on strategic outcome of the action (e.g. increased energy efficiency in a sector).
OEM	Original Equipment Manufacturer.
Output	Result achieved by the action being undertaken (e.g. better awareness amongst industry managers of opportunities).
Pinch analysis	A methodology for minimising energy consumption of processes by calculating thermodynamically feasible energy targets (or minimum energy consumption) and achieving them by optimising heat recovery systems, energy supply methods and process operating conditions.
PITA	Paper Industry Technical Association. See http://www.pita.org.uk//
Resources	Staff or funding required to deliver a specific task.
Task	A specific piece of work to deliver an action.
Value chain collaboration	Working closely with value chain partners and other key stakeholders to develop optimal solutions across the value chain.
Two Teams project	CEPI project to identify breakthrough technology concepts that would give the paper and pulp industry the required dynamic for a successful future in Europe.