In partnership with:

INSPIRED ENERGY PLC

MAKE uk
The Manufacturers' Organisation

125 YEARS BACKING BRITAIN'S MAKERS

MANUFACTURING SECTOR NET ZERO ROADMAP

MakeUK.org

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EXECUTIVE SUMMARY

Make UK has committed to help its members in their transition to net zero and has developed a roadmap in partnership with experts from Inspired Energy. On its pathway to the net zero by 2050 goal, the manufacturing industry overwhelmingly supports the ambition to achieve a 67% reduction in Scope 1 and 2 emissions by 2035 (compared to a 2018 baseline and in line with a 78% reduction compared to 1990 emissions). This equates to an absolute emissions reduction of 48 million tonnes of CO_2e.

This roadmap was developed in consultation with Make UK's membership and the major manufacturing sub-sectors including food and drink, electronics, chemicals, paper, metal, and steel industries. All sub-sectors agree to support a net zero by 2050 ambition for UK manufacturing and several industry bodies and companies have already set their own decarbonisation pathways. Clearly manufacturers are stepping up to the plate and are now ready for the challenge.

Net zero, despite the challenge, presents one of the single biggest opportunities for the manufacturing sector as the industry is in a unique position to help the whole of the UK achieve its net zero ambitions. Manufacturing will be key to developing technologies, designing, and making the products and providing the services that will help the rest of the economy decarbonise. The progression to net zero presents many opportunities for the manufacturing industry, including:

- **Receiving new grants and funding for green investments**
- **Improving process and material efficiency and productivity through innovation and the adoption of Industrial Digital Technologies** (IDTs e.g. robots/automation, artificial intelligence, Internet of Things, additive manufacturing, virtual/augmented reality)
- **Maximising innovation for the development and manufacture new low-carbon products and provide services, which will create new revenues** in many sectors based on the wider economy enablers e.g. the continued manufacturing of wind turbines between 2020-2030, the development and manufacturing of electrical vehicles and batteries, the manufacturing of small modular and advanced nuclear reactors and the development of hydrogen infrastructure and products between 2030-2040, and the development of commercial CCUS equipment and infrastructure between 2040 and 2050
- **Attracting new talent and creative potential** to a greener industry enabled and enhanced by the introduction of industrial digital technologies

The roadmap commitments now indicate the manufacturing industry's readiness to work towards net zero. **There are however conditions required for the manufacturing sector to reach the net zero goal and fully realise the opportunities presented by the net zero ambition.** A deeply or fully decarbonised power supply, reliable, in sufficiency and at a reasonable cost is one of these conditions. This includes the development of a hydrogen network that reaches not only industrial clusters but also dispersed manufacturing sites. Specific government support is required in several areas to kickstart these processes and help manufacturers overcome their challenges, including:

- **Additional funding and an adapted fiscal and financial landscape to incentivise low carbon but higher cost processes** (such as fossil fuel replacement, raw material efficiency and electrification) - this must also include safeguarding lenders and businesses against the erosion of the value of green investments due to the obsolescence of disruptive but short-lived technologies, as these rapidly evolve.
- **Policy to prevent carbon leakage** (i.e., relocation of manufacturing companies to countries where production costs are not impacted by emission constraints or customers choosing lower cost products from countries with laxer emission constraints)
- **Rehauling the whole energy (and carbon) pricing system** to ensure a reliable supply of energy at a reasonable cost and switch from fossil fuels to electricity
- **Filling the skills gap to meet the demand for more qualified workers with green and digital skills** to implement the use of transformative technology and innovation in the workplace. Equipping today's leaders with effective sustainability skills and tomorrow's engineers and workers with the necessary skills and supporting digital tools will enable the sector to transition to and operate in a net zero world.

The UK manufacturing industry will without a doubt be a major contributor to the UK's journey to net zero. Being the UK's third most emitting sector and responsible for a sixth of the country's total emissions, a concerted effort to reduce manufacturing emissions will have an important impact on the country's overall emissions profile.

Working together will be an important part of overcoming the challenges facing manufacturing sector - whether by developing a circular economy, supporting their supply chain, or enabling their customers, collaboration will be key. **Make UK calls for its members to join in the collective effort of the manufacturing sector to take without delay the steps towards achieving the required greenhouse gas emission reduction goal and to understand and grasp the emerging opportunities.**

In doing so, Make UK commits to support its members in their journey by re-enforcing its existing net zero framework. This will include the continued refinement of the roadmap milestones, awareness-building and an adapted training programme, facilitated sharing of best practice amongst members, and collaboration with government and other stakeholders to create optimal conditions for businesses to transition to the low carbon economy.

"I am delighted to see that the manufacturing sector is ready to tackle its net zero goal. You will find a massively important consensus across all sub-sectors on the need for ambitious targets to be set now to ensure action is taken in the short term. These manufacturers want to start on this new journey with hope for the opportunities it can bring, as well as travelling with trepidation for the many challenges that we need to work together to solve. I wish us all good luck."

Professor Steve Evans, Institute for Manufacturing, University of Cambridge

1. NET ZERO COMMITMENTS

MANUFACTURING SECTOR KEY COMMITMENTS

2035

↓67%

Scope 1 and 2 emissions reduction vs 2018[1]

2050

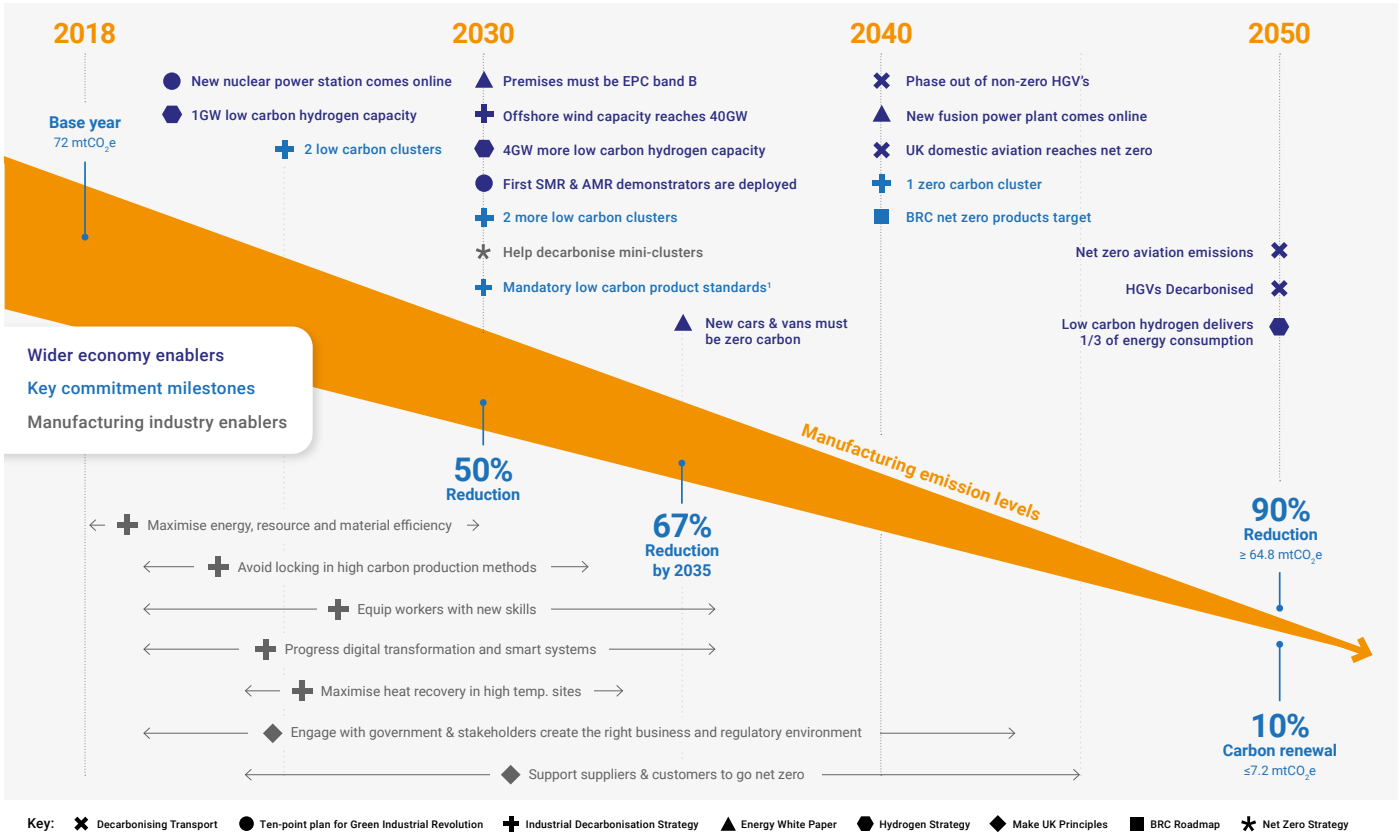
NET ZERO

Scope 1 and 2 emissions reduction of at least 90%

- Help establish 4 low carbon industrial clusters by 2030, 1 zero carbon cluster by 2040[2] and decarbonise the mini-clusters at dispersed sites
- Support our suppliers and customers to get to net zero, to reduce our Scope 3 emissions
- Offer net zero products[3]
- Utilise carbon removal[4] where needed, to achieve net zero by 2050
- Engage with Government and other stakeholders to create the optimal business and regulatory environment

[1]In line with absolute Scope 1 and 2 emissions reduction of 78% vs 1990
[2]As per the UK Industrial Decarbonisation Strategy
[3]Each sub-sector to decide to what extent it can offer Net Zero Products
[4]All carbon removal routes to be considered, including nature-based solutions, technology solutions and CCS

2. MANUFACTURING SECTOR NET ZERO ROADMAP



2.1. MAKE UK'S ROLE ON THE PATHWAY TO NET ZERO

MAKE UK IS HELPING PREPARE THE MANUFACTURING SECTOR TO OPERATE IN A NET ZERO ECONOMY

Make UK has produced this roadmap to:

- Give guidance to Make UK members on the strategic direction of the sector, how they can play their part, and show progress immediately.
- Inform the Government of the manufacturing industry collective position and its needs, and support delivery of the Industrial Decarbonisation Strategy.
- Provide information on the position of the sector to external stakeholders and to enable overall coordination where possible.

This is in keeping with and building on the *Make UK Net Zero Guiding Principles*, which are:

1.
Ambition, commitment, and action

We commit to an ambitious, rapid, and just transition to a net zero economy limiting warming to 1.5ºC while meeting the global goals.

We deliver action in the short-term, focusing on what is material.

2.
Science-based and transparent

We measure our impact and adjust our strategy to the latest science.

We adapt to a warming world, evaluating risks and growing resilience to protect our businesses.

We report on progress in a transparent, consistent, and accessible way.

3.
Innovation and systemic societal change

We move beyond business as usual. We innovate business models, product and service design and initiatives in our own facilities and across the value chain.

We advocate for a resilient, future-proof, clean, sustainable, and thriving UK manufacturing industry. We support policy aligned to Net Zero.

We support positive change in society. We design to benefit communities and nature. We promote fairness, solidarity / co-benefits

4.
Joining forces and collaboration

We collaborate across our own and other industry sectors, governmental and non-governmental organisations, joining forces, seeking coherence, sharing learning, and promoting best practices.

Make UK has been careful to ensure that its members are able to support the commitments presented and that notwithstanding the challenges, no one is left behind. This explains why this first roadmap is high level, providing an overall direction that all can recognise and rally around. It focuses on mitigation (e.g., carbon emission reduction) and further work will be undertaken at a later stage to further refine the milestones and extend considerations to adaptation.

THE MANUFACTURING INDUSTRY HAS A MAJOR ROLE TO PLAY ON THE UK'S JOURNEY TO NET ZERO

The UK was the first major economy to nationally commit to reach net zero (GHG) emissions within our boundaries, as well as for the UK's share of international aviation and shipping, by 2050. The pathway towards this has been set into law via the Climate Change Act of 2008, amended in 2019, through the 6th Carbon Budget and added to by a new law in 2021 (the Climate Change Act 2008 (Credit Limit) Order 2021). This has committed the country to reductions of 68% by 2030 and 78% by 2035, compared to 1990 (which equates to a 67% reduction compared to 2018 levels); and net zero by 2050.

According to the Climate Change Committee's 2021 Progress Report to Parliament, the manufacturing and construction industry is the third most polluting industry in the UK and was responsible for 13% and 18% of UK greenhouse gas emissions in 2019 and 2020 respectively. Although emissions from the manufacturing and construction industry have reduced by 17% over the last five years, the industry still produced 61 million tonnes of carbon dioxide equivalent (tCO_2e) in 2020. Hence there is a long way to get to net zero.

The manufacturing sector has a major role to play both in decarbonising its own operations and in the wider decarbonising of the entire economy by designing and manufacturing the products and services that all others will need for the low-carbon economy to work:

UK Net Zero means limiting overall greenhouse gas (GHG) emissions to 100% below 1990 levels across the whole economy. Any remaining emissions which cannot be eliminated in the first place must be balanced by finding ways to absorb an equivalent amount (e.g., carbon removals) of greenhouse gases (GHG) from the atmosphere.

- The manufacturing industry will be vital to developing the low-carbon hydrogen infrastructure and equipment needed to help decarbonise buildings and transport emissions
- The development and manufacturing of new electric vehicles will be necessary to reach low-carbon transportation targets
- Manufacturing innovation in the carbon capture, utilisation and storage (CCUS) space will be pivotal to carbon removal of residual emissions from hard to decarbonise industries
- And the manufacturing of new wind and nuclear power machinery and equipment will be essential for achieving national low-carbon electricity targets

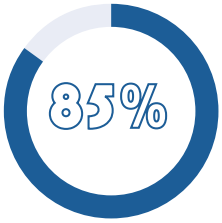
WHERE DO CURRENT MANUFACTURING EMISSIONS COME FROM?

Scope 1 emissions (directly generated by a manufacturing operations) are under the business's direct control so energy and process efficiency management are key to reducing them.

Scope 2 emissions (indirect, from purchased energy) will depend on the carbon intensity of the energy supplier, so mostly on the choice of supplier.

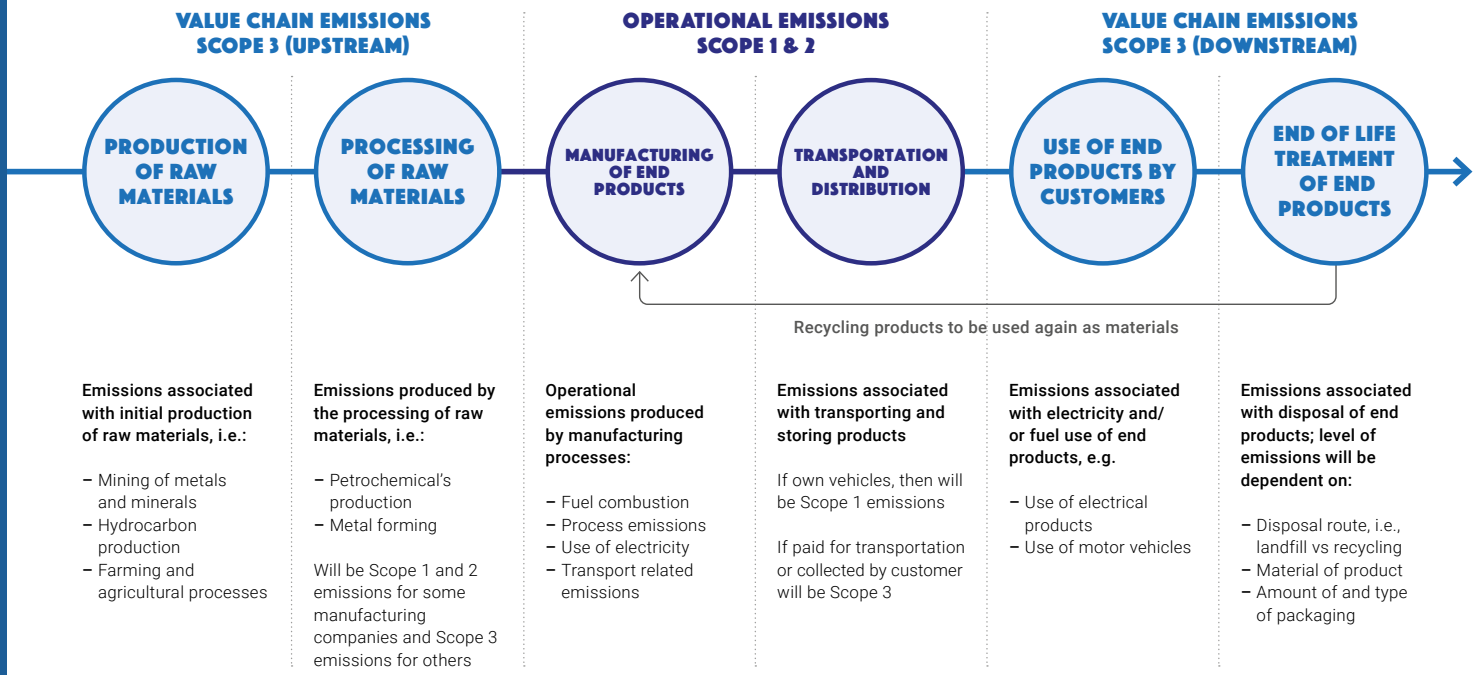
Scope 3 emissions (value chain): are likely to constitute the bulk of the emissions, and are not directly under the business's control, so more difficult to manage. They are however, influenced by supplier selection, supplier development, product design and marketing. The first step is to make an inventory of these emissions and deal with them at a later stage, although there are actions that can be taken immediately depending on the level of the organisation's commitment.

Approximately 90% of emissions from the manufacturing and construction industry come from manufacturing activity, with over 85% of these produced by fuel combustion (for high- and low-grade process heat, drying/separation, space heating and on-site electricity generation) and the remainder originating from process emissions (i.e., produced by chemical processes)[5]. The remaining 10% of emissions from the manufacturing and construction industry are produced by off-road mobile machinery (i.e., machinery used in construction, mining and transport infrastructure).



OF MANUFACTURING EMISSIONS ARE PRODUCED BY FUEL COMBUSTION

MANUFACTURING EMISSIONS



Emissions associated with initial production of raw materials, i.e.:

- Mining of metals and minerals
- Hydrocarbon production
- Farming and agricultural processes

Emissions produced by the processing of raw materials, i.e.:

- Petrochemical's production
- Metal forming

Will be Scope 1 and 2 emissions for some manufacturing companies and Scope 3 emissions for others

Operational emissions produced by manufacturing processes:

- Fuel combustion
- Process emissions
- Use of electricity
- Transport related emissions

Emissions associated with transporting and storing products

If own vehicles, then will be Scope 1 emissions

If paid for transportation or collected by customer will be Scope 3

Emissions associated with electricity and/ or fuel use of end products, e.g.

- Use of electrical products
- Use of motor vehicles

Emissions associated with disposal of end products; level of emissions will be dependent on:

- Disposal route, i.e., landfill vs recycling
- Material of product
- Amount of and type of packaging

Source: Inspired Energy, 2021

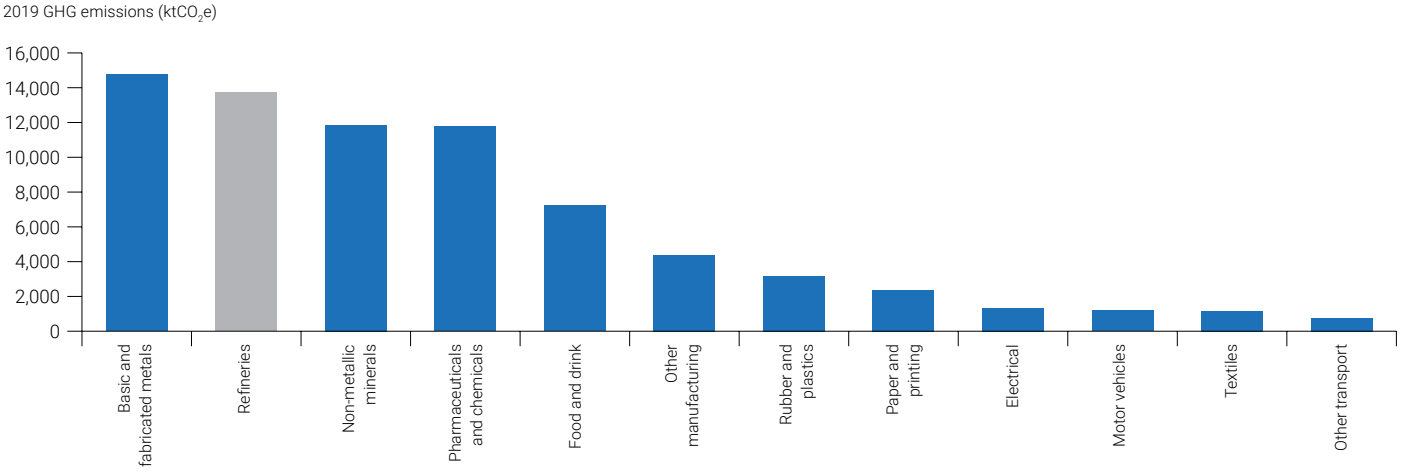
[5]CCC: https://www.theccc.org.uk/wp-content/uploads/2020/12/Sector-summary-Manufacturing-and-construction.pdf

Over two thirds of the UK's manufacturing direct (Scope 1) emissions come from three sub-sectors: basic and fabricated metals, non-metallic minerals (i.e. cement, ceramics, glass and lime) and pharmaceuticals and chemicals. These sectors involve fossil fuel intensive processes resulting in high emissions.

The manufacturing sector overall is composed of a wide range of sub-sectors of very different size and nature. The sector has over 80% of small and mid-size enterprises SMEs (mostly medium sized) which are either located in one of the seven major industrial clusters or dispersed. Some sectors are energy intensive (EIIs) and others less so, with each having their own challenges.

Just over half of manufacturing emissions come from clustered areas, such as industrial hubs along the UK's North Sea coast, Southampton or South Wales, while the remainder come from dispersed sites spread out across the country. Of the industrial clusters, Humberside is the largest, producing a third of all 'clustered sites' emissions and approximately 3% of the UK's total greenhouse gas emissions.

Industrial GHG emissions (scope1) by sub-sector SIC code (1990-2019)

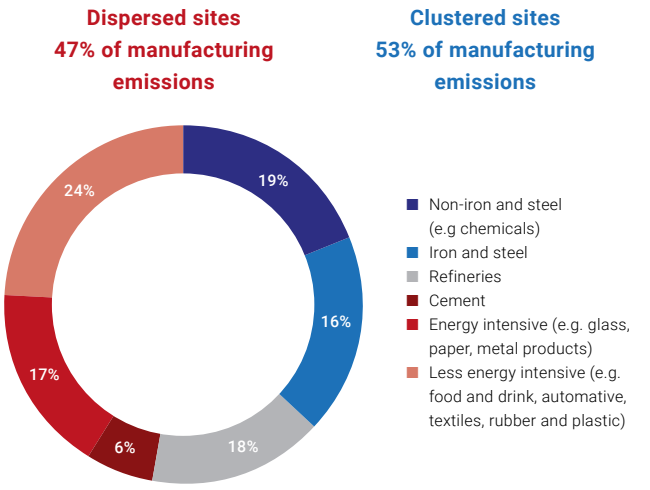


Emissions are reported on a source basis, meaning emissions are attributed to the sector that emits them directly (e.g. emissions produced by a power station are allocated to the power station are allocated to the power station as opposed to the end-users of the electricity it generates).

Source: BEIS, Industrial Strategy, 1990-2019 report

Dispersed sites produce just under half of all manufacturing emissions and tend to be made up of SMEs, which will face different decarbonisation challenges to the industrial clusters. Getting new infrastructure, i.e. hydrogen and CO2 networks, to the geographically disparate sites, will be a major challenge. As all manufacturers - regardless of size and location - are expected to decarbonise, additional support to ensure the transition to net zero is timely and cost efficient will be key for dispersed manufacturers.

Manufacturing emissions split by location, based on 2017 emissions



Manufacturing emissions (includes from refineries which are not part of Make UK membership) split by industry type and location, based on 2017 emissions

Source: Industrial Decarbonisation Strategy and Net Zero Industrial Pathways Model

2.2. MANUFACTURING SECTOR-SPECIFIC NET ZERO ROADMAPS

SEVERAL MANUFACTURING SUB-SECTORS HAVE ALREADY COMMITTED TO NET ZERO TARGETS

Over a dozen of the UK's manufacturing industry bodies have developed roadmaps demonstrating how their sector could reach net zero. Amongst these , some , such as the Food & Drink Federation (FDF) and the British Retail Consortium (BRC) have announced ambitions to achieve net zero before the national UK target date of 2050. Others focus on the steps and Government help that will be required to achieve net zero within their sector. A summary of existing sector-specific roadmaps is presented in Annex A.

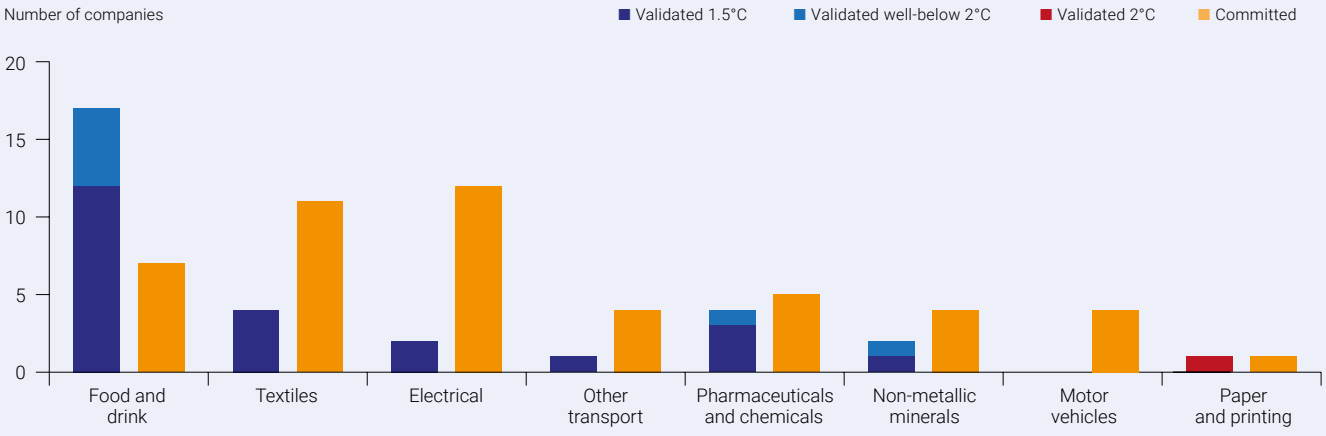
2.3. COMPANY SCIENCE-BASED TARGET COMMITMENTS

AS WELL AS SECTOR AMBITIONS, OVER 75 UK MANUFACTURING COMPANIES HAVE COMMITTED TO SETTING OR SUBMITTED SCIENCE-BASED TARGETS

To date, 2000 companies (from all sectors) have committed to setting science-based targets (SBT). A carbon emissions target is defined as science-based it if it in line with the scale of reductions required to keep global temperature increase below 2°C above pre-industrial temperatures.

These companies are therefore in the process of developing their target for validation, most of which are 1.5°C targets. Of the 75 manufacturing companies that are participating in the SBTi, companies from the food and drink sector have submitted the most targets to net (see chart below).

Manufacturing companies that have committed to set or have validated Science Based Targets



Manufacturing companies that have committed to set or have validated Science-Based Targets. 'Committed' companies are those who have committed to setting a SBT but are yet to submit it for validation by the Science-Based Target Initiative (SBTi). Validated target' means a target which has been officially validated against one of the SBTi's emissions reduction scenarios e.g. 2°C, well below 2°C or 1.5°C scenario.

Source: Science Based Targets Initiative. Correct as of October 2021.

3. NET ZERO TRANSITION AS AN OPPORTUNITY

3.1. OPPORTUNITIES CREATED BY THE MANUFACTURING INDUSTRY

THE MANUFACTURING INDUSTRY IS CONTRIBUTING ITS EXPERTISE TO HELP THE UK ACHIEVE NET ZERO

The manufacturing sector has a great history of being flexible and innovative to overcome challenges. The challenges of the net-zero transition and Covid-19 have increased the need for this sector's sustainability and resilience so that the country and the sector can prosper in a low carbon economy.

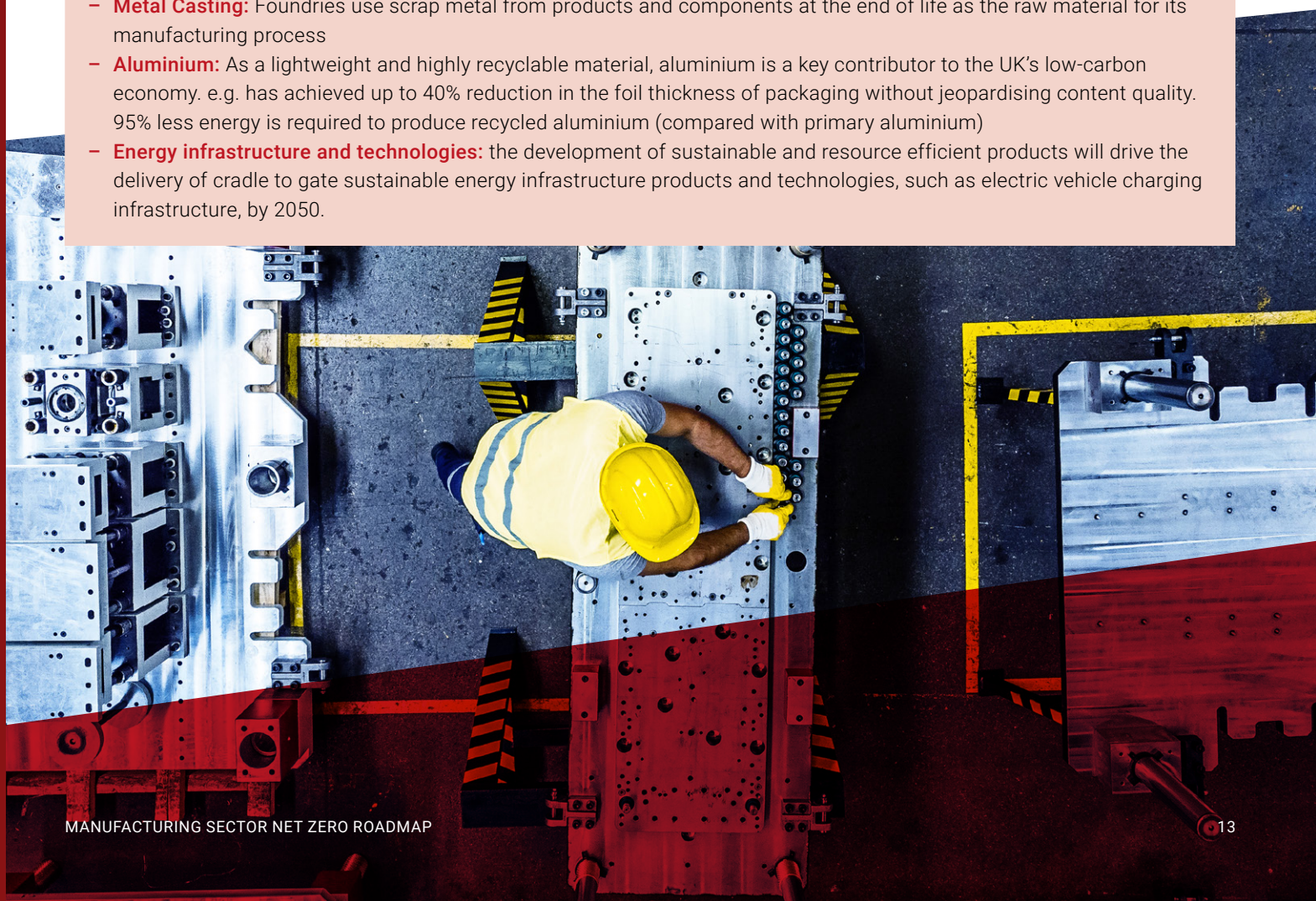
The manufacturing industry will play a major role in six decarbonisation areas that will be key to enabling the UK to achieve its 2050 net zero target: resource efficiency, transport, low-carbon energy, built environment, greening supply chains and product standards. Below are several examples of how manufacturing sub-sectors are already taking, or planning to take, action in these areas (see references at end of report for list of roadmaps and sustainability reports referenced in the six areas).

ENABLING LOW-CARBON ENERGY GENERATION

- **Chemicals:** Enabling larger rotor blades on wind turbines, more efficient solar panels and steam turbines for nuclear reactors (SMRs), developing Green and Blue Hydrogen with CCUS. Non - Ferrous Metals form the basis of complex chemicals that are essential to the technical implementation of sustainable technologies, such as Electric Vehicles and batteries.
- **Glass:** Flat glass is in solar technology and glass fibre plays key role in the construction of wind turbine blades. Improved glass fibre products are allowing manufacturers to construct longer, lighter, and more efficient rotor blades for larger wind turbines
- **Ceramics:** Produce refractory insulation used in renewable applications (wind turbines and solar) and nuclear applications
- **Metal casting:** Die casting components provide precision products needed for a wide range of renewable energy technologies
- **Electronics:** The data centre sector is a consistent and predictable energy user and could enable greater adoption of intermittent renewables and a more distributed grid
- **Aviation:** Ongoing R&D into alternative fuels and technologies for use in air travel, such as hybrid, electrification, battery design and sustainable aviation fuels (SAF)

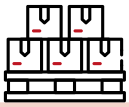
RESOURCE EFFICIENCY

- **Chemicals:** Lighter plastic parts will reduce a car's weight and better tyres improve energy efficiency
- **Food & Drink:** Food waste reduction and improved production, use, food security and disposal of food and drink packaging. Local production promotes fewer and friendlier food miles
- **Engineering:** Embedding low-carbon design and implementation at scale so products perform adequately by 2030. Increase materials reuse and retrofit of buildings
- **Paper and Pulp:** Raise awareness of state-of-the-art energy efficiency technology and invest in R&D to lower carbon emissions and improving energy efficiency
- **Digital technologies:** Implementing new digital technologies and techniques can increase sustainability and improve energy efficiencies within a manufacturing business. Specific types of technologies that can improve efficiency include; automation (robotics, cobotics), internet of things (IOT), virtual reality (VR) and augmented reality (AR), Additive Manufacturing (e.g. 3D printing) and Artificial Intelligence (AI)/machine learning are helping to make a difference in their businesses sustainability and energy/resource efficiencies.
- **Concrete and Cement:** Concrete is 100% recyclable and naturally absorbs atmospheric CO2 throughout its lifetime from carbonation. Carbonation increases when concrete is crushed for reuse at the end of its life and during any secondary use but can also be accelerated during concrete production
- **Ceramics:** Produce high temperature process insulation
- **Textiles:** Agree good practice design principles, including durability, recyclability, use of recycled content and minimising waste, to lower the impacts of products. Pilot reuse business models to decouple business growth from the use of virgin resources. Close the loop on materials to accelerate commercialisation of fibre-to-fibre recycling in the UK
- **Automotive:** Recommends battery recycling facilities to develop UK as a ULEV manufacturing location
- **Metal Casting:** Foundries use scrap metal from products and components at the end of life as the raw material for its manufacturing process
- **Aluminium:** As a lightweight and highly recyclable material, aluminium is a key contributor to the UK's low-carbon economy. e.g. has achieved up to 40% reduction in the foil thickness of packaging without jeopardising content quality. 95% less energy is required to produce recycled aluminium (compared with primary aluminium)
- **Energy infrastructure and technologies:** the development of sustainable and resource efficient products will drive the delivery of cradle to gate sustainable energy infrastructure products and technologies, such as electric vehicle charging infrastructure, by 2050.



BUILT ENVIRONMENT

- **UK Steel:** Reducing overspecification of steel will reduce embedded carbon. Steel can be lightweight and make quality building structures with smaller foundations.
- **Construction:** Switching to materials with lower embodied carbon footprints, such as timber which makes up a key part of modular constructions, will reduce the overall emissions associated with construction projects
- **Chemicals:** High rated energy efficient windows and doors are manufactured from PVC
- **Glass:** Flat glass - if all buildings in the UK updated glazing to (1.4 U value) by 2030, it would result in a 32% reduction in energy consumption from buildings.
- **Ceramics:** High thermal mass construction products e.g. bricks and electric storage heater components
- **Water:** Increase use of grey water and rainwater to decrease water demand and emissions
- **Aluminium:** Intelligent facades incorporating aluminium systems can decrease energy consumption in buildings by up to 50%
- **Concrete and cement:** Concrete's thermal performance properties help construct highly energy efficient buildings and infrastructure. Thermal mass is a property of concrete and masonry, where heat can be absorbed, stored and released slowly. Concrete buildings with high thermal mass generally have lower energy requirements and emissions from heating and cooling
- **Energy infrastructure and technologies:** development of higher efficiency heating and cooling systems and more efficient products for electrical supply to buildings



GREENING THE SUPPLY CHAIN

- **Food and Drink:** Work with agriculture industry to reduce emissions and improve food security
- **Engineering:** Include whole-life carbon assessment into public procurement. Improve whole-life carbon performance of products
- **Industrial Digital Technologies:** Technologies such as the Internet of Things and artificial intelligence (AI) among others are rapidly transforming manufacturing industry as part of the 4th Industrial Revolution. Supply chain issue management can help achieve operational excellence through digitisation and continuous process improvement
- **Paper and Pulp:** UK pulp and paper expertise to support UK bio-refining initiatives and to developing the bioeconomy
- **Water:** Work with farmers on spray chemicals and chemical alternatives improves water quality and limits treatment needs. Work with Local authorities to encourage water efficiency and grey and rainwater reuse through planning regulations
- **Automotive:** EV production will grow the domestic EV supply chain. Fuel cell capacity and supply chain needed to support cars, heavier vehicles, and rail units by 2030. Fleet renewal remains the quickest way to lower emissions and supports essential net zero technologies, like light weighting and advanced materials in the supply chain

TRANSPORT

- **Glass:** Continuous filament glass fibre products can reduce weight of vehicles which in turn reduces transport emissions
- **Ceramics:** Produce electric vehicle battery components
- **Automotive:** With appropriate production facilities and supply chains they could produce up to one million electric vehicles a year domestically
- **Metal Casting:** Casting's sector is key part of electric vehicles and rail transport supply chain
- **Aluminium:** Can provide alternatives to single-use plastics to supporting more sustainable transport. e.g., Aluminium-driven light weighting
- **Aerospace Manufacturing:** Supporting the UK supply chain to develop new hybrid-electric and electric technologies and sustainable aviation fuels (SAF)
- **Energy infrastructure and technologies:** Delivering electric vehicle charging infrastructure needed for national uptake of EVs and meeting of Government targets

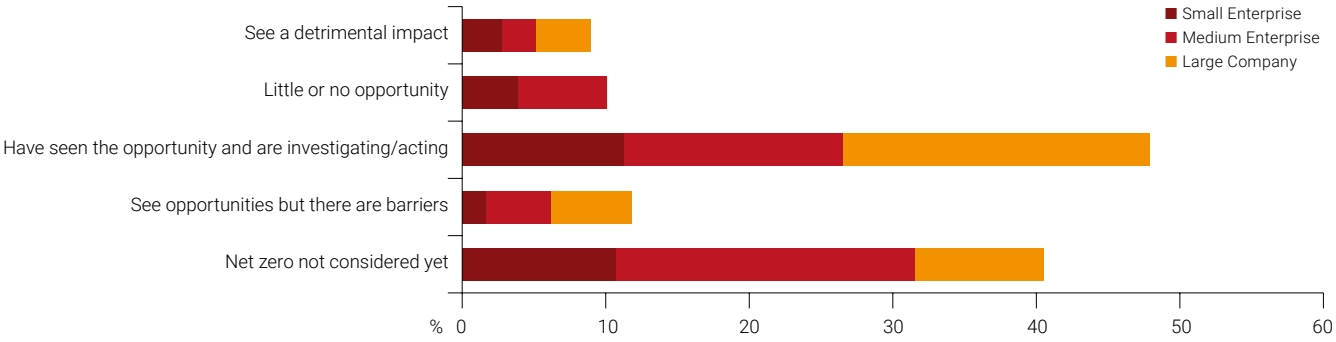
IMPROVING STANDARDS

- **Food & Drink:** Promote sustainability standards and initiatives in the sector
- **Engineering:** Design and performance will increase material efficiency, carbon performance of buildings and infrastructure, including reuse of materials and components
- **Concrete and cement:** Switching to sustainable cement, depending on technologies used to make it, can reduce carbon emissions by between 50 and 80%. Low carbon cements are already available and further increasing the use of waste, by-products and lower carbon constituents will reduce the emissions produced by the sector, this will require innovations in concrete mix design and revisions to product and building standards.
- **Water:** White good manufacturing: more water efficient, reduces treated water demand
- **Textiles:** Work to align with Textiles Exchange – Creating Material Change, UN SDGs, Sustainable Apparel Coalition and The Microfibre Consortium - Introduce voluntary standard and 'carbon-checker' labelling for the UK textiles manufacturing sector by 2025 to enable consumers to make an informed choice (supported by Make it British).
- **Energy infrastructure and technologies:** developing and promoting standards for improved efficiency and interoperability of products, and developing standard processes for assessing embedded carbon and material efficiency in product design

NEARLY HALF THE UK MANUFACTURERS SEE THE TRANSITION TO NET ZERO AS AN OPPORTUNITY

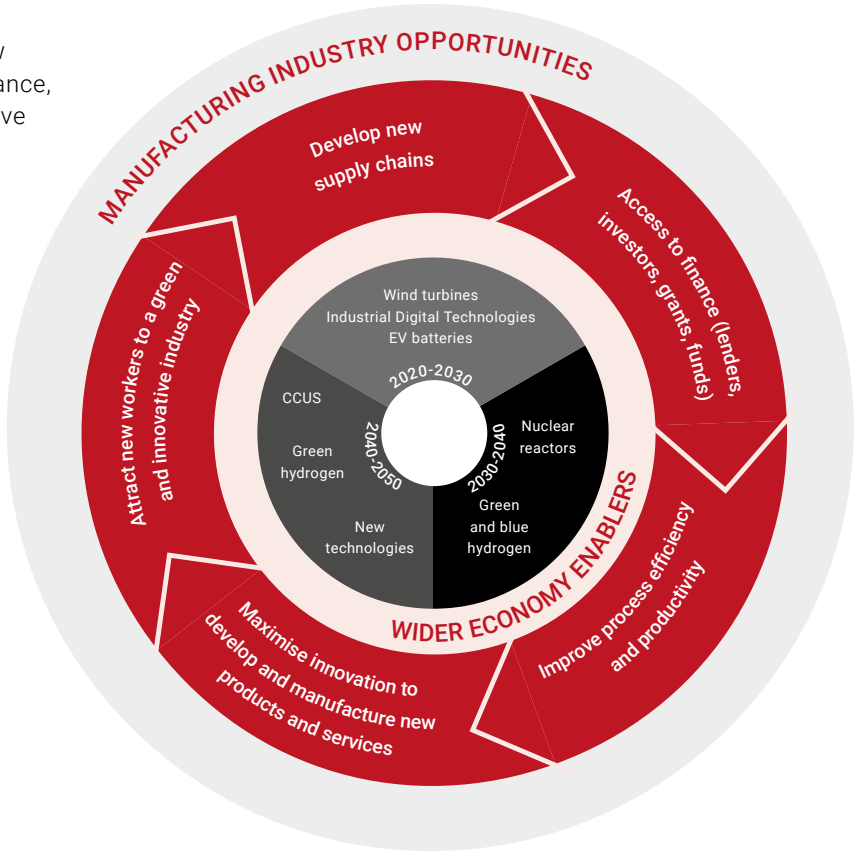
The manufacturing industry is one of the largest GHG emitters in the UK, therefore, manufacturers will be significantly impacted by changes in policy and consumer behaviours resulting from net zero targets. A survey carried out for the Towards a Net-Zero Carbon UK Manufacturing Sector report found that already at the end of 2019 nearly half of UK manufacturers see net zero as an opportunity- this proportion will have increased since.

Which of the following statements apply to the opportunities for your company from the transition to a net-zero carbon economy?



Source: Energy Survey, Make UK, 2019

When surveyed, Make UK members identified opportunities around consumer preferences, new product standards, access to lender/investor finance, attracting new workers to the industry and improve process efficiency and productivity.



GENERAL MANUFACTURING OPPORTUNITIES

Access to finance (grants/funds/lenders /investors)

Make UK recommends that the Government encourages and rewards investment in the green economy by making the grant schemes simpler, fewer, and more accessible to SMEs and by expanding fiscal incentives, e.g., tax allowances for investment that support the transition to a net zero economy. Other suggested recommendations to improve these incentives and make them more accessible to manufacturers include; extending the 130% investment super-deduction beyond 2023 to incentivise investment in digital and green technologies, extending/expanding the Climate Change Agreement (CCA) scheme, extending the 12-month tax relief for industrial building improvement to beyond 2024, and excluding energy saving methods (e.g. solar panels and ground source pumps) from the plant and machinery calculations for business rates. A roll out of 'Made Smarter' has been carried out to support SME's across the country to equip business with digital tools, innovation and skills and has helped build awareness of these options.

The Industrial Renewable Heat Incentive, which ended in 2021, could also be prolonged as our research showed it was little known amongst the SME community.

Examples of existing funding/grants:
- BEIS Industrial Energy Transformation Fund (IETF)
- BEIS Industrial Fuel Switching Competition
- Clean Heat Grant
- BEIS Industrial Energy Efficiency Accelerator
- BEIS CCUS Innovation 2.0 Competition
- Scotland's Net Zero Infrastructure (SNZI) programme
- There are multiple third-party finance options for renewables & further opportunities to develop generation on land proximate to company sites.

Improve process efficiency and productivity

Improving efficiency will reduce GHG emissions as well as cutting operational costs

Examples of measures to manage and reduce energy demand:
- Manufacturing equipment improve efficiency
- Manufacturing process improvement
- Building efficiency improvements to reduce consumption
- Sustainability measures to reduce waste
- Behaviour changes to reduce consumption
- Digitisation to monitor and control consumption

Maximise innovation to develop and manufacture new products and services

Taking advantage of changing consumer preference towards greener products will allow manufacturers to develop new types of green products, generating new revenue

Examples:
- **New products:** wind turbines, electric batteries, nuclear reactors, blue & green hydrogen, CCUS, new technologies, industrial digital technologies etc...
- **Innovation:** lightweight glass fibre reinforced plastic parts for vehicles, sustainable concrete
- **Digital technologies:** utilise new digital technologies and techniques such as automation, robotics and cobotics, IOT, VR, AR, AI and machine learning

Develop new supply chains

New products and markets will lead to new supply chains that will allow manufactures to expand and access new revenue. However, the development of new supply chains will require significant planning and support to see upscaling of new focus areas as well as a transition of the workforce from high carbon to low carbon sectors. Aside from new supply chains, certain existing supply chains will see a major uptake in demand and without proper planning there are major risks associated with the tight or lack of supply of materials, manufacturing capacity and people.

Examples:
- Bio refining supply chain
- CCUS supply chain
- Hydrogen supply chain
- EVs supply chain (including EV charging infrastructure)
- Closed loop textiles
- Circular steel supply chains
- Electricity network supply chains

Attract new workers to green and innovate industry

Increased social awareness of environmental issues means new graduates and other workers consider green credentials when deciding on where to work. Decarbonising manufacturing will bring new talent and skills to innovate industry.

Examples:
- Offshore Wind Industry Council (OWIC) predict an increase of jobs in the wind sector from 26,000 in 2021 to more than 69,800 by 2026
- Automotive sector deal 2018 aims to create a new National Retraining Scheme that supports people to re-skill, beginning with a £64m investment for digital and construction training
- Types of green jobs that will drive innovation include Biomimicry, Materials Innovation and product design, Green Chemistry, Lifecycle Management, Lean Manufacturing, Adaptive Leadership, Equity and Regenerative Capitalism

3.2. SECTOR SPECIFIC NET ZERO OPPORTUNITIES

AEROSPACE

Source: ADS & Regional Aerospace Alliances

Sector growth potential by developing new technological solutions such as sustainable aviation fuels (SAF), hybrid-electric, electric and hydrogen for alternative power generation (e.g. fuel cells, gas turbines), distribution & motors, and infrastructure.

AUTOMOTIVE

Source: SMMT

Major government focus on bringing zero emission vehicles to market - notably electric (including fuel cells). This includes end of sale dates: by 2030 no more traditional petrol and diesel cars, by 2035 all cars and vans must be zero emission at tailpipe. Heavy goods vehicles to be confirmed.

CHEMICALS

Source: CIA

96% of manufactured goods contain chemical sector content. An increase in manufactured goods, connected to the net zero goal, will provide growth opportunities for the UK chemical sector.

FOOD & DRINK

Source: FDF

Manufacturers can build on new growth opportunities in alternative proteins, alongside products with enhanced credentials around sustainability.

ELECTRICAL EQUIPMENT

Source: BEAMA

Market demand for net zero compliant technologies. Significant growth in related R&D, innovation, green jobs, and training in the industry. Real opportunity to re-shore some sectors that will be critical for net zero delivery - forming a key part of the UKs new green industrial revolution.

WATER

Source: Water UK Routemap

Access to Ofwat innovation fund where customer support is demonstrated. There is scope to build on existing work with stakeholders, such as the Woodland Trust, wildlife trust, RSPB, Regional NGOs, natural England and local communities in the development/restoration of sequestration sites.

STEEL

Source: UK Steel

The UK steel sector could become the first sector in the world to decarbonise. With a suitable and supportive market environment the UK steel sector can invest in net zero production, drastically reduce carbon emissions, and grow its steel production and export through increased demand. Vitally this would close the gap between current delivery and true demand of steel.

4. DECARBONISING THE MANUFACTURING SECTOR

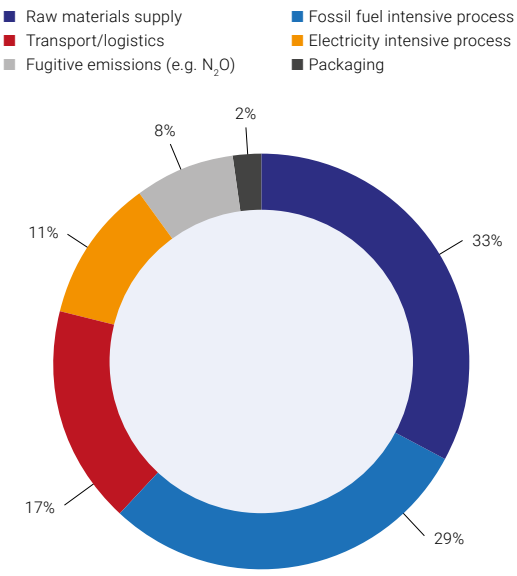
4.1. MANUFACTURING PROCESSES

ACHIEVING DECARBONISATION TARGETS WILL INVOLVE MAJOR CHANGES TO MANUFACTURING PROCESSES

Long established manufacturing businesses and processes were developed against a backdrop of abundant and low-cost fossil fuels, the use of which is embedded in many manufacturing workflows. Until now there had been no need to find alternatives nor to be particularly efficient, and so there were no real drivers to innovate process changes. This poses major challenges now as the industry needs to decarbonise. Changing existing processes and workflows can be costly and innovation will be required to develop new, low-carbon alternatives. Nevertheless, although upfront costs can be high, once changed processes are often more operationally cost efficient.

Make UK members identified decarbonising the supply of raw materials, decarbonising fossil fuel intensive processes and decarbonising transport and logistics as the hardest aspects of their operations to decarbonise. These challenges will impact all manufacturing sectors to varying degrees.

What aspects of your business are the hardest to decarbonise



Results of the Make UK consultation poll question 'What aspects of your business are the hardest to decarbonise'

Source: Make UK net zero roadmap consultation, 2021

DECARBONISING FOSSIL FUEL INTENSIVE PROCESSES WILL BE THE KEY CHALLENGE FOR THE MANUFACTURING INDUSTRY TO OVERCOME

Decarbonising fossil fuel intensive processes poses economic and logistical challenges for almost all manufacturing sectors. Many manufacturers use fossil fuels, mostly natural gas, in their processes, both to produce energy but also as a raw material. Additionally, chemicals, which are often fossil fuel based, are used across the manufacturing industry as a raw material. Changing processes that use fossil fuels as a raw material will be costly as equipment will need to be upgraded or retrofitted and alternative low-carbon fuels are often more expensive. Changing processes that use fossil fuels to generate energy or heat will also be expensive, as again alternative energy options, including electricity, are currently more expensive than traditional fossil fuels.

However, it has also been shown that 'tweaking processes' to improve them progressively over the years can lead to very significant carbon emission reductions for a lot less cost compared to introducing major process changes.

There are best in class companies within each sector who are demonstrating that it is possible to achieve these 'best days' (with the least carbon emissions). If these best practices were shared more widely amongst companies using similar processes, or equipment, the impact in carbon emission reduction could be very significant.[6] Something not to pass by!

[6]https://www.ifm.eng.cam.ac.uk/uploads/Resources/Next-Manufacturing-Revolution-full-report.pdf

Solution	Solution readiness	Affordability	Carbon offset potential
Fuel switching			
Electrification			
Hydrogen based gas system			
Carbon capture, utilization, and storage (CCUS)			
Bioenergy with carbon capture and storage (BECCS)			

Source: Inspired Energy, 2021

Key: Low  High 

Switching from fossil fuels to low-carbon alternatives, such as green hydrogen or bioenergy, to produce heat or power could significantly help manufacturers reduce emissions from energy intensive processes. Although some of these options are still in developmental stages, such as low-carbon hydrogen which requires significant innovation to provide supply in sufficient quantities and distribution outside industrial clusters, other options are more readily available.

As well as using fossil fuels in manufacturing processes, many manufacturers use natural gas for space heating. Switching to low-carbon heating alternatives is an issue across the economy, not just the manufacturing sector. Current alternatives such as biomass boilers, ground source heat pumps and air-to-water heat pumps are however not economically viable for manufacturers that need to heat large spaces. The transition to a hydrogen-based gas system will therefore provide a lower cost, lower carbon alternative to natural gas heating for manufacturers. However there needs to be significant investment in hydrogen production and transportation to allow hydrogen to be utilised by manufacturers across the country. The development of a hydrogen network will be a huge undertaking that the Government needs to be encouraging the work of. Thus far, several coalitions between energy companies and manufacturers have been progressing plans to develop hydrogen systems in industrial clusters, for example Zero Carbon Humber and Net Zero Teeside. The National Grid has also recently communicated plans regarding the building of a 'backbone' of hydrogen pipelines across the UK (Project Union), starting as early as 2026 and spanning the next 15 years. To allow manufactures at both industrial hubs and dispersed sites to adequately plan their decarbonisation route, further details, guarantees and progression of these hydrogen projects will be required.

Carbonation – the ability of concrete to absorb carbon dioxide during its use - is already being deployed across the concrete industry and is a key enabler for the cement industry to reach net negative emissions by 2050.

The Steel industry is considering numerous options to decarbonise its production, including applying CCS to integrated BOF (Basic Oxygen Furnace) production to capture the associated emissions, switching to electric arc furnaces to melt scrap steel into new steel, or novel technologies like hydrogen-based steel production, which replace coking coal with low-carbon hydrogen as the chemical reducing agent.

Generating electricity from low-carbon sources, such as renewables and nuclear, and electrifying heating and transportation would help reduce emissions. UK electricity prices have been substantially higher than in other comparable countries, making a switch to electricity very challenging commercially. This problem is exacerbated for sectors exposed to international trade (such as steel and other commodities) which have been suffering from a very uncompetitive price differential of electricity with their European counterparts. More recently gas prices have soared due to unprecedented demand, pulling up even more the electricity costs.

Carbon capture, utilisation and storge (CCUS) will be a key technology in completely decarbonising manufacturing processes where fossil fuels cannot be replaced. However, CCUS is still being developed and has yet to be rolled out commercially in the UK. Improvements in the efficiency of capture material and the development of a CO_2 transportation network, need to be achieved to allow the potential of this technology to be fully realized. Natural CO_2 sequestration processes, such as that that takes place in the natural carbonation of concrete, could be utilised sooner.

There are several key enablers that will incentivise and help the switching of high fossil fuel intensive processes:

- Government hydrogen capacity targets of 1GW by 2025 and 5GW by 2030 will encourage the development of hydrogen production and mean hydrogen becomes available as an alternative fuel
- Government targets around industrial clusters and the development of hydrogen infrastructure will help industrial areas access and use hydrogen
- Targets to decarbonise electricity production whilst maintaining and increasing capacity – in particular the target to reach 40GW offshore wind capacity by 2030 and new nuclear power plants – will increase the availability of low-carbon electricity
- The development and implementation of innovative CCUS technology – encouraged by BEIS funding research and development in this space – will enable wide scale deployment across industrial sites and so use with hard to decarbonise processes
- Government policy to incentivise electricity usage will be a key enabler to encourage fuel switching

Green hydrogen is made using water and electricity ideally generated from renewable energy. This process is called 'electrolysis.'

Blue hydrogen comes from natural gas with carbon capture and storage (CCS) to capture emissions produced during the process.

4.2. RAW MATERIAL SUPPLY

DECARBONISING RAW MATERIAL SUPPLY WILL INVOLVE MAJOR CHANGES TO SUPPLY CHAINS AND PROCESSES

Decarbonising raw material supply is a major challenge to the manufacturing industry as it requires decarbonisation across the entire value chain. It will involve industries outside of manufacturing, such as the mining and oil and gas industries, to decarbonise their processes to ensure any raw materials or purchased products have a low-carbon footprint. Additionally, in supply chains where there are going to be major increases in demand to meet the UK's 2050 Net Zero and sixth carbon budget,, e.g. supply chains associated with electricity networks and EV charging equipment, careful planning and sector support will be required to help these scale up. Moreover, planning for one sector (e.g. CCUS) should cover multiple sectors (e.g. hydrogen, and nuclear) as these may be competing for the same materials, equipment components and workforce resources.

Embodied carbon footprint is the total carbon footprint of a material/product and includes all emissions associated with its production, i.e., extraction of the raw material, refinement, processing, manufacturing and transportation.

Solution	Solution readiness	Affordability	Carbon offset potential
Circular economy			
Material substitution			
Supply chain collaboration			
Key: Low  High 	The preparedness of tier-1 suppliers to implement bespoke changes will vary significantly depending on their sector and the existing technological options/ funding available to them	The cost to implement technological solutions will vary dramatically depending on scale and the type of technology/solution implemented	Technologies/solutions will be capable of reducing CO2 emissions at dramatically different rates depending on their scale/effectiveness

Source: Inspired Energy, 2021

Circular economy involves the use of recycled raw, or even waste materials, rather than new, primary resources, which significantly reduces the embodied carbon of products, reduces waste and often reduces energy usage. Many industries are already encouraging a 'circular economy' in their processes which ensures materials are reused as far as possible. Already, 'urban mining' (e.g., extracting precious metals from recycled electronic equipment) and extracting metals and minerals from slag, significantly reduces the carbon footprint of raw materials. However, demand for these minerals currently outstrips existing stock, and so raw material producers will need to lessen their operational emissions to ensure a reduction in the carbon footprint of new raw materials.

The glass industry is already using recycled glass in operations. This reduces process CO_2 emissions by 200kg for every tonne of recycled glass used.

Changing the materials used in manufacturing processes from those with high-embodied carbon to low-embodied carbon would help significantly reduce emissions associated with manufacturing processes. For example, using wood in construction rather than metals, results in significantly lower embodied emissions. However, lower embodied emissions should be considered in conjunction with other factors

when choosing products, such as whole life performance, recyclability, cost. Creating new green supply chains and products is a key opportunity created by the net zero journey, both in terms of providing opportunities for new businesses but also to help existing manufacturing businesses decarbonise.

Working with suppliers to reduce the emissions associated with their processes will reduce the embodied carbon of raw materials significantly. Offering green products will also be beneficial to suppliers as it will allow them to supply existing customers while also benefiting from income from new green supply chains.

Insetting – investing in carbon reduction projects within a company's own supply chain

Manufacturing companies can work with suppliers to encourage uptake of innovative technology/infrastructure or implementation of emission reduction initiatives, such as procuring green electricity, this process is also known as insetting. This will serve to reduce the Scope 1 and 2[7] emissions of tier-1 suppliers, and reduce the emissions attributed to manufactures Scope 3 emissions[8] as a result of purchasing manufacturing materials/goods with lower embodied carbon.

Several important **enablers** will help decarbonise raw material supply:

- Government policy and funding to support smaller manufacturing companies to decarbonise products in a cost and time efficient way
- The introduction of low-carbon clauses in tenders will encourage suppliers to decarbonise their activities
- The introduction of low-carbon product standards – considered for introduction in 2030, with some pilots in 2025 – and the achievement of the British Retail Consortium's net zero products from 2040 target, will make it a requirement to only provide low-carbon products
- Funding and fiscal measures to support and encourage implementation of circular economies, such as the Low-carbon and Circular Economy Fund in Greater Birmingham & Solihull LEP, will help all manufacturers change processes to allow the use of recycled raw materials
- Support and funding for upstream technological innovation that will allow tier-1 suppliers to decarbonise operations

The food and drink industry are already collaborating with farmers to reduce the emissions of agricultural processes, through initiatives such as:

- Livestock production efficiency – increased efficiency through diet management/strategic feed selection will reduce methane emissions per unit of product
- Nitrogen efficiency – slow/controlled-release nitrogen products to optimize the amount being absorbed by plants and reduce the amount degrading to N_2O
- Precision agriculture – tailor production inputs to specific plots within a field – reduces input costs and increase yields

[7]Scope 1 emissions are direct emissions from owned or controlled sources. Scope 2 emissions are indirect emissions from the generation of purchased energy.
[8]Scope 3 emissions are indirect emissions related to value chain

4.3. TRANSPORT AND LOGISTICS

DECARBONISING TRANSPORT AND LOGISTICS WILL BE A LONG-TERM PROCESS AS NEW TECHNOLOGIES BECOME AVAILABLE

Transportation of goods and materials is often one of the top value chain emission sources as almost all freight options, regardless of transport type, still use fossil fuels as the main source of energy. Air freight is generally the highest emitting mode of transport on a unit basis, followed by road freight, rail freight and then sea freight. The key challenge around decarbonising manufacturing transportation is therefore the current lack of existing low-carbon transportation technologies. Although electric vehicles are now commonplace for personal transport, commercial electric trucks and other heavy-goods vehicles (HGVs) are not commercially available. Low-carbon flights are even further from being an option, and while there is a major push to develop low-carbon shipping options, shipping is still currently a fossil fuel intensive industry. Manufacturers are therefore limited, especially in the short-term, as to what low-carbon transportation options they can use.

Solution		Solution readiness	Affordability	Carbon offset potential
Electric vehicles				
Hydrogen vehicles				
eHighway/electric motorway				
Decentralised supply chains				
Net Zero Aviation	Hydrogen			
	Electric			

Source: Inspired Energy, 2021

Key: Low  High 

Electric trucks and lorries are still in the early development stages, although the phase out of non-zero carbon HGVs is targeted for 2040. Several companies are in the process of developing pilot and trial electric trucks, but size and range are still major hurdles to overcome before these vehicles can be used commercially.

Due to the weight and size of batteries needed to power HGVs, hydrogen is currently viewed as the likely alternative fuel for larger vehicles. Indeed, hydrogen is already being used commercially as a fuel for large vehicles such as buses. The continued development of hydrogen fueled engines,

LeylandTrucks have been conducting a recent project to test and log the performance of 20 DAF LF electric 19-tonne rigids to help support the UK Government's Department for Transport (DfT) efforts to encourage the use of electric vehicles in commercial transport. This project is part of the Government's £20 million zero emissions road freight trials and aims to help fleet operators understand the strengths, challenges and deployment options of electric trucks.

particularly for the likes of HGVs and lorries, will significantly help to decarbonise manufacturing transport emissions. The supply of low-carbon hydrogen throughout the country is a technical issue that needs to be solved to allow the wider roll-out of hydrogen powered vehicles.

Electric motorways are an alternative option which would allow vehicles to attach to overhead wires and run-on electricity, like rail and trams. The vehicles that use them would have batteries that charge while in motion so that when they detach from the wires they can continue their journey while producing zero emissions. An economical and technical feasibility study - led by the infrastructure solution company Costain - is being conducted as part of the DfT's zero emissions road freight fund with an aim to have an eMotorway in action by 2030.

Procuring raw materials, products and services from local sources is a non-technology option for reducing emissions from transport and logistics. Although unlikely to completely decarbonise transport and logistics, having a local supply chain would minimise the energy required for transporting materials, especially for international transportation. As well as reducing emissions, there are social and economic benefits of developing a local supply chain. It would provide more local jobs and have an indirect positive impact on the local economy.

Collaboration between different sectors and government will be key to decarbonising transport and logistics.

Joint investment creates more opportunities to quickly develop and trial new sustainable products through pooling resources, combining expertise and distributing financial risk. It also encourages sharing of best practice within and between industries to drive increased use of alternative, low carbon solutions.

To enable the decarbonisation of manufacturing transport and logistics, there are several key technology **enablers** that will require Government help to allow continued development:

- In line with Government targets to phase out fossil fuel powered vehicles (personal vehicles from 2035 and HGVs by 2040), the development of electric and/or hydrogen HGVs will be required – Government funding to encourage innovation and trials will be key to ensure commercial roll out of these vehicles
- To allow wide-scale, commercial roll out of hydrogen vehicles, Government policy to support the development of low-carbon hydrogen production and infrastructure will be needed
- Decarbonising electricity generation whilst maintaining and increasing capacity to meet demand is required to facilitate the transition to electric vehicles and eHighways

Tevva – a British zero-emissions truck manufacturer – have been developing an electric truck with a hydrogen powered range extended, which would allow drivers to travel 700km plus in one go. The range extender technology (REX), which uses a hydrogen fuel cell, is not expected to be available for commercial use until 2023.

Food and drink sector: the benefits of decentralising supply chains

- Current centralised resourcing systems result in materials being shipped or hauled significant distances from overseas tier-1 suppliers, resulting in significant emissions per kg of product transported
- Sourcing produce locally would reduce the need for additives (pretreatments, chemicals etc.) as food wouldn't need to be preserved for long-haul journeys – this would have the indirect benefits of reducing the lifecycle carbon footprint of products
- Sourcing materials locally would also mitigate against delays in deliveries due to logistical issues

The Jet Zero Council (JZC)

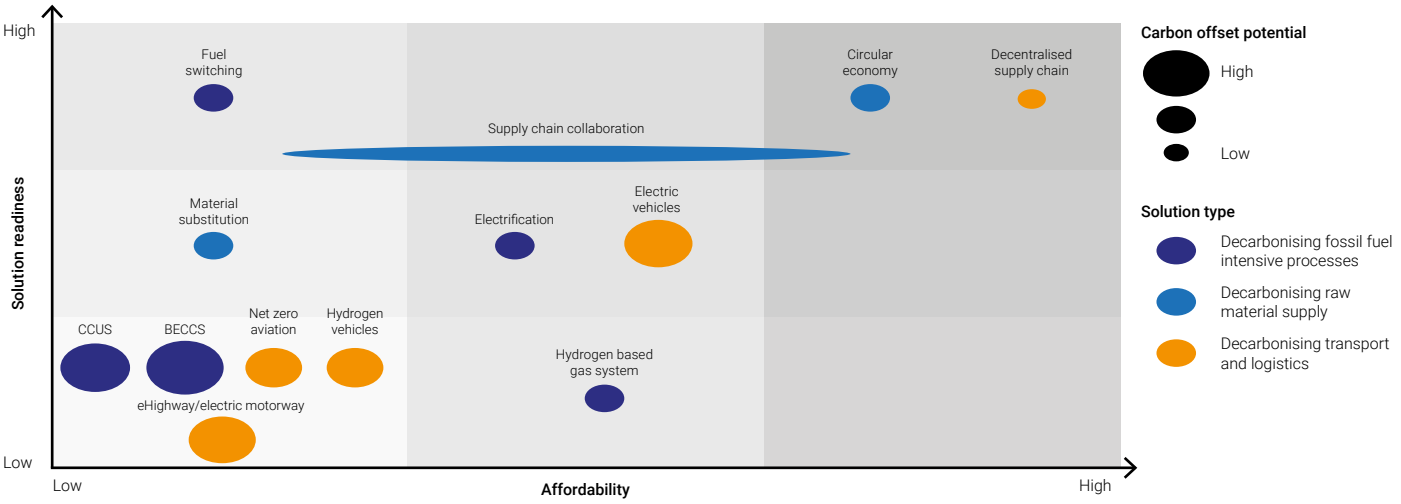
The aviation industry and Government set up the JZC partnership to deliver zero emission transatlantic flights within a generation. The JZC is primarily focusing on engine technology, supporting the development of electric and hydrogen flight, and how to accelerate the production of sustainable aviation fuels (SAF). SAFs are expected to play a major role in decarbonising aviation, particularly for long-haul flights where electrification is technically very challenging.

As outlined in the UK's Transport Decarbonisation Plan and in the Jet Zero Consultation, the UK Government is committed to achieving net zero aviation by 2050. However, despite the vast potential of SAF, its production and use is still very limited and it is very costly to produce. Other considerations in the development of SAFs are the availability and type of feedstock e.g. the use of only waste-derived biofuels or renewable fuels of non-biological origin (RFNBOs), and the development of SAF using nuclear energy or recycled carbon fuels (RCFs). Feedstock type has also been addressed by the Renewable Energy European Directive which asks that companies move away from producing biofuels that are based on food-based fuels and focus only on by-products of waste. In addition, where hydrogen is used as a process input, the mandate recommends that it must be from a low carbon source.

- To overcome SAF challenges, the UK Government introduced the Renewable Transport Fuel Obligation (RTFO). This is a programme to support commercialisation of the domestic SAF industry, to deliver carbon savings and maximise the industrial opportunities for the UK.

It has helped develop the first few volumes of SAF but to make this a reality for industry, a more comprehensive policy framework is needed to accelerate SAF deployment and truly capture the environmental benefits and green jobs the sector can deliver.

Readiness and affordability of solutions to help decarbonise the manufacturing sector



Source: Make UK net zero roadmap consultation, 2021

4.4. SECTOR SPECIFIC CHALLENGES

AEROSPACE

Source: ADS & Regional Aerospace Alliances

Aerospace supports a wide range of legacy products (some dating back to designs produced in 1950/1960s) which use 'legacy' processes and are uneconomic to re-design. New technologies that require global infrastructural changes may delay realisation of benefits.

CEMENT & CONCRETE

Source: MPA

High proportion of process emissions means CCUS required which needs carbon dioxide transport and storage infrastructure for dispersed sites (majority of sites). Also require access to waste biomass fuels and competitively priced energy.

CHEMICALS

Source: CIA

According to the CCC, industry decarbonisation under all their scenarios has an annual cost of ~ £5-10 billion. Some of this could be passed on to consumers, where industry is not exposed to international competition or where the incremental costs are small. However, trade-exposed industries will require a level playing field to ensure that emissions are reduced, not offshored.

ELECTRICAL EQUIPMENT

Source: BEAMA

Managing the required growth in supply chain demands to meet carbon budget 6 requires significant investment from the private sector (R&D, manufacturing capacity, training, recruitment). Better and more strategic supply chain planning is needed to avoid risks that may be associated with specific material shortages, supply of skills and people into the industry.

AUTOMOTIVE

Source: SMMT

On vehicle side: consumer demand and affordability. Commensurate levels of recharging infrastructure - notably publicly accessible chargers. Technology solutions still not set - notably on heavier goods vehicle side. Issues with supplies of materials to make EVs. Training on repair/ maintenance of new tech & recycling.

On manufacturing side: unclear which technology can replace gas and be affordable, secure supply, etc.

For both vehicles and manufacturing: security of supply, affordability and accessibility of necessary electrical or hydrogen supply.

FOOD & DRINK

Source: FDF

Currently there is no industry agreed approach to carbon labelling, despite many excellent initiatives in place across the sector. Due to the complexity of calculating supply chain emissions, comparing 'carbon labels' does not presently allow the consumer to fully assess green claims and compare like with like.

GLASS

Source: Glass Sector Net Zero Strategy

Energy costs account for around a third of overall manufacturing costs. The high cost of alternative fuels which are typically over 3 times that of natural gas, currently prohibit manufacturers from fuel switching. In addition, most sites would need to upgrade their connection for hydrogen and electricity.

CERAMICS

Source: BCC

Low carbon alternative to natural gas (hydrogen & biomass): technical viability, cost and competitiveness, existing kiln compatibility, safety concerns. In addition to roll-out timeline uncertainty, distribution infrastructure, fuel availability.

Electricity: UK industrial electricity costs are uncompetitive, making wider use for firing unviable.

Process Emissions: Carbon capture may not be widely possible, given such a large number of relatively-small sites, spread across the UK in locations away from industrial clusters. The sector's off-cluster dispersal / location will be a particular challenge.

OTHER MINERAL PRODUCTS

Source: MPA

Lime sites are mostly in dispersed rural locations and will require CCUS – same challenge as cement of getting CO_2 transport and storage infrastructure to these locations. Lime production also requires hydrogen or biomethane to be available in sufficient quantities and at a competitive price. Decarbonisation of non-road mobile machinery key across almost all mineral products, which will be challenging.

PAPER & PULP

Source: CPI

Need commercially viable replacement fuels for natural gas and better quality materials from recycling streams. Challenges around 'recycling from refuse' options that are more carbon intensive overall.

STEEL

Source: UK Steel

Electricity prices: Net Zero steel production will be significantly more electricity intensive than traditional methods. All the major technologies required will vastly increase a steel companies demand for electricity, but UK steelmakers are currently paying 61% more than their German competitors. Parity of electricity prices is essential to attracting investment from multinational companies.

Net Zero Steel Market: Producing steel with Net Zero emissions is significantly more expensive than traditional alternatives, and there is no method of receiving a return on the additional CAPEX and OPEX required. As the steel market is very trade-intensive, domestic production will be outcompeted without intervention to create a low-carbon steel market.

CAPEX challenges: The cost of new investments will be significant, so will need support for capex investment in new production facilities and energy efficiency.

WATER

Source: Water UK Routemap

Government funding for decarbonisation projects is focused on other sectors and additional funding for early investment in important enablers such as process emissions monitoring is not made available.

The sector does not identify enough suitable land for renewables/ significant site prospects are lost or delayed due to planning barriers.

Green Gas Support Scheme does not provide sufficient level of financial incentives/ excludes alternatives to grid injection, which disincentivises companies from investing in biomethane upgrade infrastructure. Therefore, there is not as large a shift to export biomethane.

Lack of availability of sufficient additional funding (outside the price control) stalls progress on early adoption and trialling of technologies which is critical to benefit realisation by 2030.

5. BUILDING RESILIENCE

THE MANUFACTURING INDUSTRY MUST FOCUS ON BUILDING RESILIENCE IN RESPONSE TO THE CHALLENGES PRESENTED BY BOTH CLIMATE CHANGE AND TRANSITIONING TO NET ZERO

Our aptitude to manage an evolving risk landscape depends on our ability to both predict and adapt to identified and unexpected challenges. Predicting new challenges is of course often difficult but the importance of having industry ready and fully equipped to react is vital.

Digitisation and New Technologies	Manufacturers regard the acceleration of digitisation and the adoption of new technologies as priorities in ensuring future growth and resilience. Investing in technology and further digitisation has provided numerous benefits for the manufacturing sector, from increasing productivity to improving the standardisation of output and reducing waste. In research undertaken by Make UK, 'reduced costs and improved productivity' were seen as the overwhelming benefit (cited by 91% of respondents).
Managing Climate Risk	Managing the impact of climate change is a key priority in creating a resilient British industrial sector. Mandatory climate-related reporting (Task Force on Climate-Related Financial Disclosures) for large listed and non-listed businesses has been introduced and will be extended to cover most businesses by the mid-2020s. Securing investment money will depend more and more on the ability of manufacturing businesses to reassure investors and lenders that they have duly and realistically considered climatic risks.
Adapting to Climate Change	Manufacturers are increasingly investing in research to understand the factors that impact on their resilience, but Government support is vital. Extreme weather events can create cascading risks that spread globally across sectors and countries. The current model of conventional risk governance which focuses on single events and single sectors does not account for these types of risks. Adaptation actions include increased global capacity building for climate resilience including supply chains, health systems and early warning systems and identifying financial risks to businesses through setting international standards for eligibility of green projects and transparent reporting. Make UK and its members are ready to work with policy makers to deepen understanding of manufacturing resilience and plans to mitigate risk from future crises.

5.1. REDUCING EMISSIONS FROM MANUFACTURING

THE MANUFACTURING INDUSTRY SUPPORTS NET ZERO BY 2050 AND 67% REDUCTION BY 2035 TARGETS

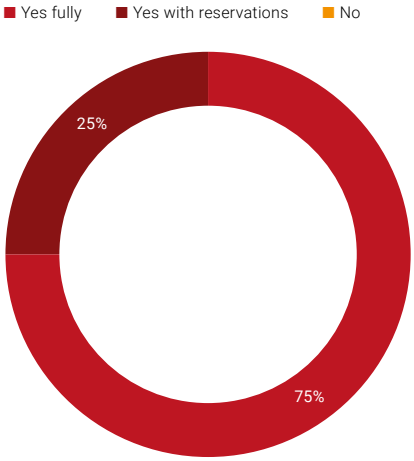
Consultation with Make UK members indicated general, strong support for setting the net zero by 2050 and 67% reduction by 2035 targets, with the right help and business environment. Several of the reservations came from sectors (such as the paper, steel, and chemical sectors) in which achieving both the short and long-term targets will be impossible without government support and new infrastructure.

Make UK is encouraging UK manufacturers to align with these targets, for example through:

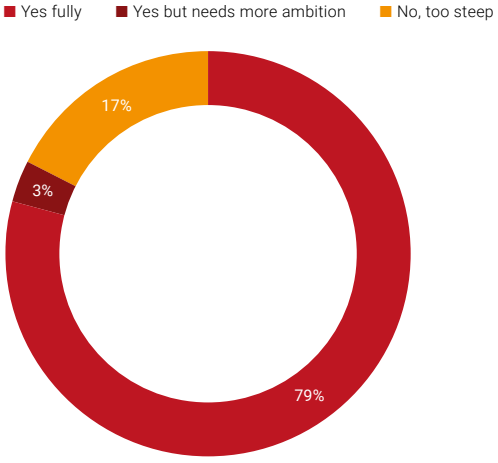
- Setting Science Based Targets, or equivalent, for Scope 1 & 2 emissions
- Conducting climate risk assessments in line with forthcoming TCFD-aligned reporting legislation

Through the Industrial Decarbonisation Strategy, the Government is exploring additional product-level data transparency requirements, as well as low-carbon labelling and standards, that aim to increase consumer demand for green products. These proposals will need to be discussed with members; especially as further details emerge from the government. UK manufacturers need to be making changes now to prevent investment in long-term energy intensive equipment and processes. To achieve net zero manufacturing companies must focus on reducing their individual Scope 1, 2 and 3 emissions.

Do you support Net Zero by 2050 target for UK manufacturing?



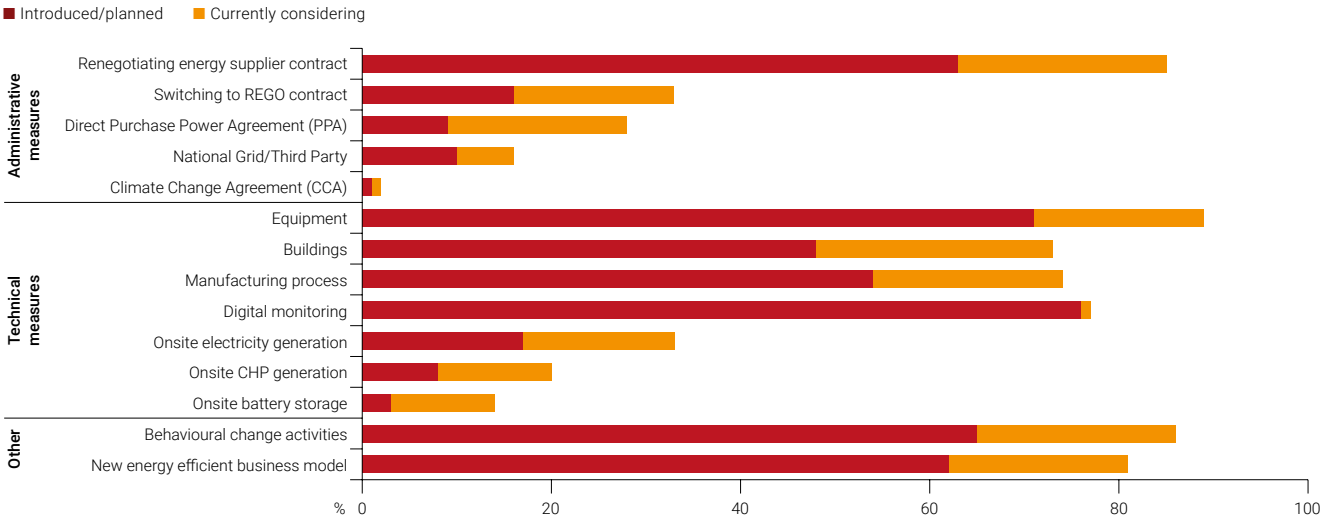
Do you support a 67% reduction by 2035 in absolute terms? (vs. 2018)



Results of the Make UK consultation poll questions around specific emission reduction targets (August 2021)

Source: Make UK net zero roadmap consultation, 2021

Range of options to reduce scope 1 and 2 emissions



Source: Make UK survey 2021

MANY MANUFACTURERS ARE TAKING OR CONSIDERING A RANGE OF ACTIONS TO REDUCE THEIR SCOPE 1 AND 2 CARBON EMISSIONS

When surveyed end of 2019 for the Make UK and E-ON's '*Towards a Net Zero Carbon UK Manufacturing Sector report*' on steps taken to action Scope 1 and 2 emissions, almost 63% of UK manufacturers had taken administrative measures, 40% had invested in technical measures, and another 20% are currently considering investment in these areas. All manufacturing companies need to decide on the range of carbon reduction actions most suitable for their operations and implement them.

These further proposed commitments are based on market trends and legislation where relevant but need to be further tested through consultation of Make UK's membership:

- All businesses are advised to **aim to to have their net zero roadmaps/strategies in place by early 2023 and ready to take the first meaningful steps** thereafter (conditional to government laying out the necessary policies, and providing the right level of support)
- All businesses should have therefore **measured their carbon emission baseline by the end of 2022, and installed half-hour (or less) electricity metering (or equivalent energy monitoring systems)** on the top 3 lines of production and/or most energy-consuming points.
- **By 2025, manufacturers of products with in-use emissions could commit to only produce some categories of low-carbon products** such as vehicles, machinery, heating systems and industrial plant, in line with a net zero future.

TO ACHIEVE NET ZERO, MANUFACTURERS NEED TO INFLUENCE THEIR SCOPE 3 SUPPLY CHAIN EMISSIONS

To target Scope 3 emissions, the following commitments are also proposed to be taken forward in the next step and tested against the Make UK membership in consultation:

- **All manufacturers to start screening and identifying their Scope 3 emissions** (at least the ones in the UK)
- All manufacturers to **engage with their value chain to gauge the willingness and potential** of their suppliers and customers to reduce their own Scope 1 and 2 emissions (at least the ones in the UK)
- All Manufacturers over the threshold for **Streamlined Energy and Carbon Reporting (SECR)** to:
  - Require their own direct suppliers to report their Scope 1 and 2 carbon footprints by 2023
  - Have measured their Scope 3 Inventory by 2024 (at least the ones in the UK)

We recognise that there will likely need to be different commitments for influencing UK and overseas suppliers. As proposed above, the suggested approach is that UK manufacturing commits to requiring their direct suppliers to baseline their own full carbon footprints, make this data available, and produce products compatible with a net zero future. This approach can also be taken to overseas suppliers, though for suppliers in countries with a different net zero pathway the requirements will need to be phased differently.

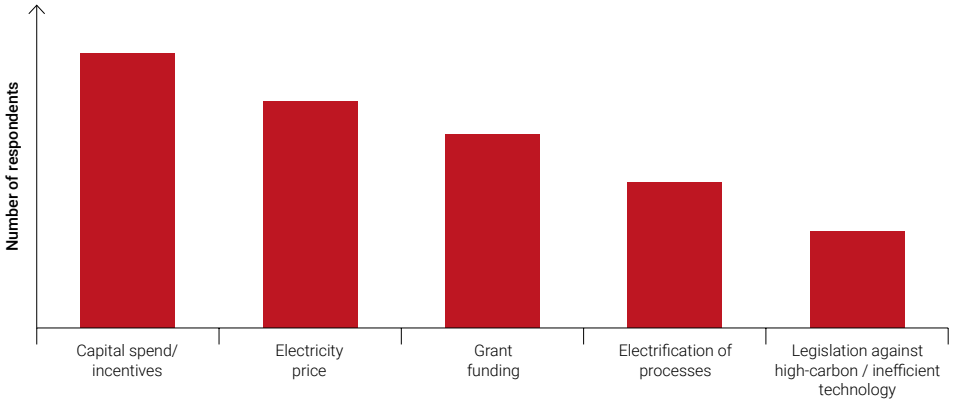
5.2. ACCESS TO FUNDING AND SKILLS

EASILY ACCESSIBLE FUNDING AND SUPPORT WITH DEVELOPING THE RIGHT SKILLS WILL BE KEY TO THE MANUFACTURING INDUSTRY ACHIEVING NET ZERO

Make UK members identified funding as key for overcoming decarbonisation challenges and highlighted the need for specific support around capital spend incentives, subsidies for the cost of electricity and grant funding. There are currently a wide range of low-carbon funding schemes however these are not available to all manufacturers as are often geographically focused. Funding opportunities that are available nationally and that mirror investment cycles to provide long-term investment security will help action decarbonisation risks and challenges.

Despite the available funding, access to schemes remains an issue and SMEs in particular have trouble knowing where to look for funds, and when they find them, understanding their eligibility for the funding, and with the applications themselves. A clearer and streamlined funding landscape is therefore needed to ensure funding is accessible to all manufacturers.

What are your priorities for financial and policy support?



Support with capex and support with running plant once electrified

Grant funding really important for early adopters to prove they work to others

Source: Make UK net zero roadmap consultation, 2021

The manufacturing sector also sees the need to develop the right skills within the industry to achieve net zero, in particular through the 'greening' of existing jobs, creation of new green jobs and educating employees across manufacturing businesses.

Make UK's own research[9] tells us that the three technical skills that will be in most demand are:

- Resource efficiency, e.g. carbon accounting, lean manufacturing
- Low-carbon economy, e.g. nuclear and renewable energy generation, carbon emission minimisation
- Development of new or amended products, e.g. design and production of electric vehicles

The average skill level of a net zero job is 26% higher than the current occupations across industry in the UK, so the quality of the training needs to be higher. The acquisition of in-depth skills would enable companies to accelerate the deployment of clean technologies, increase productivity and resource efficiency. In parallel, improving sustainability skills amongst leadership will help with educating manufacturing workforces about small changes that will help reduce emissions – this could include improving staff awareness of energy efficiency, improved waste management and more carbon-conscious business travel and commuting.

The government, training providers and manufacturers need to make a collaborative effort to address the green skills gap. As education and skills policies will be crucial for long-term economic growth, Make UK are recommending Government to:

- Implement a green skills tax credit to encourage manufacturers to prioritise the acquisition of green skills in the race to reach net-zero
- Prioritise rapidly increasing provision of training at Level 4 and 5 to meet the green skills demand
- Encourage the Institute for Apprenticeships and Technical Education (IfATE) and Skills Productivity Board to work in partnership with the National Manufacturing Skills Taskforce
- Introduce a Help to Grow Green program for managers and leaders to support training in sustainability

[9] 'Unlocking the skills for a digital and green future', Make UK in partnership with Sage, October 2021

6. POLICY RECOMMENDATIONS FOR GOVERNMENT

6.1. MANUFACTURING INDUSTRY-WIDE RECOMMENDATIONS FOR GOVERNMENT

The manufacturing sector is ready to commit and take action to achieve its net zero goals. However, businesses will need a policy framework that will enable them to access the opportunities, funding and skills, and to operate in a smooth business environment.

Over the next decade, the manufacturing sector will need help from the Government, as recommended by the Climate Change Committee, to overcome the barriers that currently prevent it from investing in and transitioning to low-carbon activities.

A combination of policy and funding changes are required:

Access to funding	A streamlined and more easily accessible (non-competition) funding landscape would enable as many SMEs as possible to embark on their journey to net zero. Expansion of the scope of funds to include the upgrade of standard equipment such as pumps and compressors to modern energy-efficient versions, and the installation of energy information management systems or building management systems would help control energy use. Funding cycles should mirror investment cycles: The financial support that is available to manufacturers must match the needs of the sector including being longer-term. Manufacturers have long investment cycles when it comes to plant and machinery or investing in digital and green technologies. The sector should be consulted early on to ensure any financial instruments meet their needs. A centralised official point of reference for information in net zero (e.g., a net zero official government website) including where to find the little-known funding and tax credit opportunities that can apply to manufacturers in their net zero efforts e.g., to understand whether they qualify and help them with their applications.
Fuel switching	To encourage manufacturers to start fuel switching, the correct policy framework needs to be established. Manufacturers must be able to have confidence in a reliable alternative low-carbon energy supply at a reasonable cost. This could be in the form of subsidies on the use of green electricity or gas instead of more carbon intensive energy options. Putting the price of electricity at a par with or lower than gas prices in the UK, and of both gas and electricity at a par with their cost in other European countries is seen as essential.
Carbon pricing	The use of carbon pricing is required to provide certainly around the UK's net zero ambition and to send a clear market signal, thus helping manufacturers secure investment in low-carbon activities.

Carbon leakage and carbon taxation	A key concern for manufacturers is the potential for carbon leakage, as their goods and services increase in cost due to investment in low-carbon alternatives. The government needs to put a plan in place to mitigate the risks of carbon leakage. Make UK continues to support the UK ETS free allocation of carbon allowances as the best mechanism to tackle carbon leakage. However, with the net zero goal and carbon budgets this mechanism will eventually be phased out. The UK Government is currently exploring its options around carbon pricing, and is looking to update its UK-ETS scheme, the structure of its compensation scheme and the more rapid phase out of its free allowances, especially for sectors considered to be less impacted (e.g. not so exposed to international trade and carbon leakage or who have the ability to fuel switch with ease). The COP26 developments on a harmonised carbon price as a potential tool to address climate change is a significant step towards promoting the idea and coordinating carbon emission reduction.
Negative emissions technology market	The Government also needs to trigger the development of a market for negative emission technologies. This will provide manufacturers with long term security when starting to develop and manufacture these technologies and unlock UK's potential to export the knowledge.
EU Carbon Border Adjustment Mechanism (CBAM)	Make UK supports a CBAM in principle, in the absence of a truly global agreement on carbon price, recognising however the complexity for composite manufactured products (e.g. machines and their components). For now however, the scope of the EU-CBAM, which the UK might have to mirror, is mainly on primary raw materials. Government needs to work with the manufacturing industry to help understand what a UK CBAM would look like, how feasible it would be for manufactured products and what impact it would have on their business.
Funding CCUS & Low-carbon technologies	Funding to support the development and use of CCUS, low-carbon hydrogen and nuclear power, particularly for the SMEs outside the major industrial clusters will be key to allow manufacturers to develop and invest in these key low-carbon technologies. Currently there is no overall coordinated approach which will be essential to prevent competition for and double-counting of the same resources (raw materials, components and workforce) between these technologies.
A Green Skills Tax Credit	To ensure manufacturers have the right skills for the net zero challenge, the government should introduce incentives such as a Green Skills Tax Credit which encourages high emitting companies to invest in 'green collar' jobs. It's crucial that the Government, education and training providers, and manufacturers make a collaborative effort to address the green skills gap we face. To take advantage of this opportunity, we must prioritise education and skills policies crucial for our long-term economic growth. Therefore, we are recommending Government to: – Implement a green skills tax credit to encourage manufacturers to prioritise the acquisition of green skills in the race to reach net-zero. – Prioritise rapidly increasing provision of training at Level 4 and 5 to meet the green skills demand. – Encourage the Institute for Apprenticeships and Technical Education (IfATE) and Skills Productivity Board to work in partnership with the National Manufacturing Skills Taskforce. – Introduce a Help to Grow Green program for managers and leaders to support training in sustainability
Enabling a Competitive Market Environment	A major challenge for manufacturing will be ensuring regulation enables a competitive market environment for companies investing in decarbonisation, without having negative impacts on those sectors that will decarbonise slower. This can be done through standardised reporting processes (e.g. scope 3 embedded carbon in products). This is likely to be done on a sector by sector approach. Extending the scope of mandatory reporting to companies of every size, would encourage them to monitor their carbon emissions and would accelerate the understanding of their value chain. To minimise the administrative burden for the smaller players, less stringent criteria (e.g., only measuring, and self-certification with no or simplified reporting) could be applied. SMEs would benefit from aligning their reporting to the TCFD climate-related disclosure requirements (which are already mandatory in the UK for listed large companies and will be for non-listed large ones and LLPs from 1 April 2022)- and which are planned to be extended to SMEs by the mid-2020s.

6.2. SECTOR-SPECIFIC RECOMMENDATIONS FOR GOVERNMENT

ALUMINIUM

Source: ALFED Sustainability Roadmap

Develop policies and programmes that support the transformation of end-of-life aluminium into semi-fabricated and finished products in the UK

Develop the financial support and tax breaks needed to enable investment in low-carbon, energy- and water-efficient, UK-based manufacturing facilities.

Develop a national reuse, remanufacturing and recycling strategy to reduce aluminium scrap exports and boost domestic use of recycled aluminium.

STEEL

Source: UK Steel

- A Carbon Border Adjustment Mechanism (CBAM) or Product Standards will need to be implemented to ensure that low-carbon steel is not outcompeted by imported, lower-cost, high-emission steel.
- Support for R&D into new product routes, new technologies, and energy efficiency
- Support for decarbonising of industrial heat and support for low-carbon hydrogen.
- Policies to support improved scrap utilisation and quality will be essential to support a switch to Electric Arc Furnaces and reduce emissions in integrated sites.
- Policies to support CCUS and hydrogen-based steel production

ELECTRICAL EQUIPMENT

Source: BEAMA

Market certainty is needed through a detailed roadmap and delivery plan; supply chain strategy for the delivery of Net Zero electrical infrastructure; ensure building regulation mechanisms are updated; better enforcement of existing regulations and standards (this includes safety); broaden scope of compliance in the Future Homes Standard.

Lack of relevant skills is currently the number one barrier in the electrical sector and a limiting factor for the growth needed.

WATER

Source: Water UK Routemap

- Consider implementing a mandatory water labelling UK-wide scheme to help accelerate demand management options.
- Promote a policy framework for the price of carbon.
- Consider level of incentives and conditions to support the acceleration of biomethane supply in all forms and not just through grid injection.
- Consider additional funding available to the water sector to help accelerate the deployment of the largest decarbonisation opportunities associated with process emissions and bioresources

CERAMICS

Source: BCC

- Continued funding support to install renewable energy/ heat recovery technologies.
- Technical assistance / upskilling
- Further Research & Development (R&D) is needed for future technologies, followed by roll-out of measures - both require funding support
- UK consumers need more transparency about the UK's total carbon footprint and the carbon impacts of imported products in order for them to make informed choices.

GLASS

Source: Glass Sector Net Zero Strategy

The industry needs to be supported with clear policy direction to protect and help the industry continue manufacturing beyond 2050. The government must continue to support and protect industries from the risk of carbon leakage to ensure foundation industries remain in the UK. Government support for upgrading site connections and policies on electricity pricing for large industrial users enable the sector to gradually transition from natural gas to electricity.

AEROSPACE

Source: ADS & Regional Aerospace Alliances

Investment is required to support SMEs with understanding their carbon footprint. To date, little funding has been available to SMEs, and regionally managed expertise and funding for all parts of the industry is essential; there are proven models for this delivery in aerospace, e.g. via regional aerospace alliances.

PAPER & PULP

Source: CPI

A just phase out of natural gas that ensures paper mills can continue to access commercially viable sources of energy. Separate collections of recovered fibre from households to improve quality. Support for recycling as an equal partner in the circular bioeconomy alongside re-use.

CEMENT & CONCRETE

Source: MPA

5 key recommendations are:

- New domestic measures must eliminate the threat of carbon leakage and protect UK manufacturing jobs
- The UK must adopt new carbon accounting measures to take full responsibility for its emissions
- Government sector- specific funding for UK energy intensive industries to accelerate net zero innovation
- Whole life carbon assessment incorporated into Government policy to cut carbon and deliver improved social outcomes.
- Government must use its procurement powers to drive adoption of new low-carbon technologies to help build back better.

CHEMICALS

Source: CIA

The Climate Change Committee (CCC) Net Zero report outlines a number of policy asks of government to support the decarbonisation of hard-to-abate industry sectors. E.g., the free allocation of allowances within the UK ETS and compensation for costs resulting from UK climate policies. Alternatively it could involve taxpayer funding, new schemes such as border tariff adjustments/ product and building standards to drive demand for low-carbon goods. In addition, the UK governments new Chemical Strategy, in development, outlining the approach for managing chemicals regulations following the UK's departure from the EU needs to fit in with new policy aspirations of net zero.

AUTOMOTIVE

Source: SMMT

Commensurate targets on infrastructure providers, in line with ZEV mandate/EoS targets. Fiscal support to help encourage consumer uptake of vehicles. Infrastructure supply to be secure, robust, affordable and zero emissions. Support on developing new technologies to help manufacturing decarbonisation, e.g. hydrogen boilers, vehicle paint shops, etc. - better fiscal support than IETF currently offers.

TEXTILES

Source: Textiles 2030 Roadmap

Government planning for financial and regulatory policies, such as Extended Producer Responsibility and corporate reporting. Use evidence & insights from signatories to build new policies and funding mechanisms for textiles.

FOOD & DRINK

Source: FDF

After establishing an industry agreed framework on data and emission factors, the government needs to support the creation of an aligned industry methodology for product labelling systems to communicate carbon footprints. The successor scheme to the CCA for the manufacturing sector should also include carbon reduction.

7. WHAT NEXT FOR THE MANUFACTURING INDUSTRY?

Make UK is keen for all its members, industry bodies and companies alike to develop their own roadmaps to net zero without delay. Make UK plans to develop a more practical manufacturing 'Guide to Net Zero' which will help its members navigate the process of developing their own net zero targets and roadmaps.

Manufacturers:

- Direct emissions: the first step is to measure/estimate their Scope 1 and 2 carbon footprint, so that they can then identify and quantify the sources of emissions and set up a strategy to tackle them.
- Value chain emissions: Scope 3 inventory which will help identify where in their value chain emission reduction efforts should be focussed.

Make UK will also be conducting periodic reviews of the manufacturing industry's progress towards its net zero ambitions. These reviews will highlight decarbonisation 'success stories' as well as provide updates on progress in combating the net zero challenges identified in this report. Make UK encourages collaboration between its members and across the manufacturing sector. It will continue to support initiatives that help facilitate progress towards net zero, for example **the Inspired Energy 'My Net Zero Toolkit' which helps manufacturers track and disclose their emissions and establish a plan to reduce them.** Through Make UK's collaboration with their trusted partners Inspired Energy, ABGI, and others as relevant members can obtain help and guidance regarding environmental and ESG reporting, for example SECR, ESOS, CDP and TCFD, as well as identification of and applications for environmental funding, grants and exemption schemes.

Make UK's Health and Safety Services also provide **training designed to equip all levels of the workforce with the knowledge and skills to help our members achieve their environmental and sustainability goals.** Our IEMA accredited courses will help to implement your Net Zero strategy and factor in the Environment Act 2021.

The course	Who is it for?	How does it help?
IEMA Leading with Environmental Sustainability	Senior leaders in organisations	Enables senior executives to create an environmental sustainability strategy for their business.
IEMA Environmental Awareness	Steering groups and green champions	Helps to engage and empower people to be more focused and productive, ensuring that environmental objectives are achieved.
IEMA Sustainability Skills for the Workforce	Any worker or non-environmental specialist	Provides a practical introduction to environmental sustainability, to equip delegates with the knowledge, understanding and motivation to make a positive difference within their organisation.
IEMA Environmental Sustainability Skills for Managers	Managers, supervisors and team leaders with environmental responsibilities	Provides the understanding of the strategic and operational implications environmental sustainability has on them, their team and department, enabling them to contribute to the improved environmental sustainability of their organisation.
IEMA Foundation Certificate in Environmental Management	Environmental specialists	Provides a solid foundation of knowledge in environmental management. The course covers all the areas of knowledge required to become an Associate Member of IEMA (AIEMA).
IEMA Certificate in Environmental Management	Experienced environmental specialists	Delegates will gain the knowledge and skills that are needed to be an effective Environmental and Sustainability Practitioner. The course covers all the areas of training required to become an IEMA Practitioner (PIEMA).
IEMA Diploma in Sustainable Business Practice	Senior environmental specialists	Addresses a wide range of environmental and sustainability issues and topics, including environmental and social risk identification, strategies for improving performance and personal effectiveness to instigate and lead change.

8. CONCLUSIONS

Make UK has committed to help its members achieve net zero by 2050. On the pathway to net zero, the manufacturing industry will achieve a 67% reduction in Scope 1 and 2 emissions by 2035. Make UK and the manufacturing industry are also committed to engaging with Government and other stakeholders to create the right business and regulatory environment for the manufacturing industry to become net zero, supporting suppliers and customers to go net zero and developing net zero products. They also commit to supporting the establishment of 4 low-carbon clusters, 1 zero carbon cluster by 2040 and several mini, dispersed low-carbon clusters.

There are six key areas in which the manufacturing industry will play a major role in enabling the UK to achieve its 2050 net zero target:


resource efficiency


transport


low-carbon energy


built environment


greening supply chains


product standards

Many manufacturing sub-sectors have already made pledges and set targets to contribute to these six areas of decarbonisation.

When surveyed, Make UK members identified **opportunities around maximising innovation to develop and manufacture new products and services, meeting new consumer preferences and accessing new finance from grants/ funders/lenders/investors.** Further opportunities have been identified which include **improvements to process efficiency and productivity, development of new supply chains and attracting new workers** to green and innovate the industry.

Decarbonising long established manufacturing businesses and processes will not be easy. Changing existing processes and workflows will be costly and innovation will be required to develop new, low-carbon workflows.

The key challenges for manufacturers in reaching net zero are:

Decarbonising fossil fuel intensive processes:
Solutions at various stages of development include CCUS, BECCS, Switching from fossil fuels to low-carbon alternatives and/ or electrification. These solutions could all significantly help manufacturers reduce emissions from energy intensive processes.

Decarbonising raw materials supply:
Material Substitution, Circular Economy and Supply Chain Collaboration all have a big role to play in decarbonising the supply of materials for the manufacturing industry. The use of recycled raw materials rather than new, primary resources significantly reduces the embodied carbon of products, reduces waste and often reduces energy usage.

Decarbonising transport and logistics:
Solutions in various stages of development include electric and hydrogen vehicles, eHighways/electric motorways and decentralised supply chains. Although electric vehicles are now commonplace for personal transport, commercial electric trucks and other heavy-duty vehicles are not commercially available and therefore present an ongoing challenge that needs to be resolved

Staying cost competitive:
Reducing emissions and staying cost competitive by not losing out to global competition is a key concern of the manufacturing industry and needs to be supported with the correct policies to reduce the risks to the industry from transition to net zero.

To overcome these challenges and to speed up the development of the proposed solutions, the government will need to support the manufacturing sector by investing in low-carbon activities and developing the correct policies.

To create the right business and regulatory environment for the manufacturing industry to become net zero Make UK asks the Government to; manage carbon pricing, fuel switching and carbon leakage in a way that supports the manufacturing industry to transition to net zero without major impacts on their competitiveness; explain the EU Carbon Border Adjustment Mechanism (CBAM) to the sector so that they understand how it will impact their businesses; and provide the right access to finance that will support the development of low-carbon technologies and green skills.

Working together will be an important part of overcoming the challenges facing the industry. Therefore, Make UK calls for its members to join in the collective effort of decarbonising the manufacturing sector. In return, Make UK commits to supporting its members by re-enforcing its existing net zero framework by continuing to refine roadmap milestones, awareness-building and training programmes and facilitating the sharing of best practice amongst members, while collaborating with government and other stakeholders to create the conditions needed for businesses to transition to the low carbon economy.

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ANNEX A

Existing sector specific roadmaps, including key roadmap details and sector contributions to a net zero economy.

Manufacturing Sector Group	2019 GHG Emissions[10]	Net Zero Ambitions & Roadmaps	Key Roadmap Details & Milestones	Sector Contributions to Net Zero Economy
Basic & Fabricated Metals				
Steel (UK Steel)	10,837 $ktCO_2e$	The sector ambition will be to achieve the Climate Change Committee's recommendation on decarbonising ore-based steel production by 2035.	*Not currently applicable*	Steel is essential for net zero solutions e.g. wind turbines, electric vehicles, low-carbon homes, nuclear powerplants etc. Steel products can help the construction sector reduce Scope 1, 2 and 3 emissions. – Through R&D, S460M structural steel grade can offer a much-reduced weight, offering an embedded carbon reduction in building projects. – Site waste can be reduced, any that occurs can be returned to the steel supply chain and multi-cycled. – Steels strength means buildings can be designed with extended life spans – Future benefit of the 100% recyclability of steel Significant investment opportunity, which will support the conversion of high-emission-jobs to high-paid green jobs in areas the Government wants to level up
Metal Forming (CBM)	2,680 $ktCO_2e$	Currently no sector commitment or roadmap	*Not currently applicable*	Steel has unique properties of durability and recyclability; light-weight steel structures can help to significantly reduce use of energy and other resources. Deploying a circular economy and material efficiency methodologies is a key opportunity to reduce carbon emissions within the manufacturing industries. Steel is widely used in key sectors including infrastructures, construction, and vehicle manufacturing but is also instrumental in renewable energy technologies and for enabling trade.
Metal Casting (CMF)	772 $ktCO_2e$	No sector commitment, CMF Sustainability Policy recognizes that the steel industry needs a net zero roadmap.	CMF members take a complete lifecycle approach to sustainability, looking at everything from refining to production to use in all aspects of the casting and foundry manufacturing process. This includes elements such as energy management, responsible sourcing and the use of suppliers with ethical and sustainability credentials.	Foundries have a vital role in the circular economy as they take scrap metal from products and components at the end of life and use this as the raw material for our manufacturing process. E.g., the feedstock used for highly engineered ferrous parts includes old brake discs, used rails, and re-processed drinks cans, which are used to make new near-net-shape light weight components for a wide range of applications in aluminium alloys. The castings sector is a strategic part of the supply chain for UK infrastructure projects and for all the high value manufacturing sectors, including renewable energy, electric vehicles and rail transport.

[10]Source: BEIS https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-to-2019

Aluminium (ALFED)	481 $ktCO_2e$	Net zero by 2050 (emissions scopes covered unclear). ALFED Sustainability Roadmap	– Decarbonisation: R&D to transform end-of-life aluminium into semi-fabricated and finished products in the UK. – Capex support to enable investment in low-carbon, energy- and water-efficient – Sustainable Sourcing: Traceability (through the Aluminium Stewardship Initiative, ASI), Domestic supply chain development, skills development – Circular Economy: Closed loop supply chains, whole-life design innovation, national recycling strategy	As a lightweight and highly recyclable material, aluminium is a key contributor to the UK's low-carbon economy. Its role will continue to expand as industries contribute towards the Government's green growth ambitions and net zero. From providing alternatives to single-use plastics to supporting more sustainable transport, aluminium is boosting recycling, driving the circular economy and helping reduce carbon emissions. – 8 grammes of carbon emissions saved per kilometre for every 100kg reduction in a car's mass, thanks to aluminium-driven light weighting – Up to 50% reduction in a building's energy consumption with intelligent façades incorporating aluminium systems
Non-Metallic Minerals				
Cement & Concrete (MPA)	7,688 $ktCO_2e$	Net negative by 2050 (focus on scope 1 & 2, and some scope 3 emissions). Concrete & Cement Industry Roadmap.	Contribution to Net Zero Roadmap Technology Levers: – 4% Indirect emissions from decarbonised electricity – 7% Transport emissions – 12% Low carbon cements and concretes – 16% Fuel Switching – 61% Carbon Capture, Usage & Storage Contribution towards Beyond Net Zero – 12% Carbonation - the process where concrete absorbs CO_2 from the atmosphere throughout its lifetime – 44% Thermal mass - The cumulative deployment of concrete's thermal mass produces a building stock which has an estimated 14% saving of 2050 UK electricity consumption from avoided heating and cooling	Potential for the sector to go beyond net zero by 2050 and for the construction sector to use domestically produced zero carbon concrete. Concrete is a net consumer of waste, using over 200 times more waste and by-products from other industries than the waste sent to landfill. Concrete is 100% recyclable and naturally absorbs atmospheric CO_2 throughout its lifetime, a process called carbonation. Therefore, concrete can act as a carbon sequestration solution. Concrete's thermal performance properties help construct highly energy efficient buildings and infrastructure. Thermal mass of concrete enables heat to be absorbed, stored and released slowly. Concrete buildings with high thermal mass generally have lower energy requirements and emissions from heating and cooling. This will help produce net zero homes and buildings.
Ceramics (CMF)	2,669 $ktCO_2e$	No sector commitment, but have published 'Ceramic Sector Joint Industry – Government Industrial Decarbonisation and Energy Efficiency Roadmap Action Plan'	– Creation of decarbonisation leadership group for ceramics sector – Increase adoption of state-of-the-art technology – Define innovation requirements & implement mechanisms for collaborative innovation, including funding – Increase R&D – Develop advanced heat recovery technologies – Increase use of bioenergy – Implement on-site renewables for self-generation of electricity – Collaboration with customers to create market pull for decarbonisation – Develop long term engagement strategy with suppliers – Increase skills and knowledge within sector	There are a number of ceramic products that save consumers energy and carbon across society, including: – Built Environment – High thermal mass construction products e.g. bricks & electric storage heater components – Power Generation – Refractory insulation, renewable applications (wind turbines/ solar) & nuclear applications – Industry – High temperature process insulation – Transport – Fuel-efficient components, Electric vehicle battery components

Glass (BCC)	2,669 $ktCO_2e$	No sector commitment, but have published 'Glass sector net zero strategy 2050'	Reducing combustion emissions by 2028: – Replacing raw materials with cullet – Oxyfuel combustion & liquid biofuels Reducing combustion emissions 2030 onwards: – All-electric melting – Hybrid furnaces – Hydrogen combustion Reduce process emissions: – Increased cullet use – Calcined and alternative raw materials – CCUS Circular economy: – Glass recycling	Glazing products have a significant part to play in reducing CO_2 emissions from residential and commercial properties. If all buildings in the UK updated their glazing to high efficiency glazing (1.4 U value) by 2030, it is estimated that the UK could save 14,376 $KtCO_2$ per year which equates to a 32% reduction in energy consumption from buildings. Flat glass has an important role to play in transport by reducing the weight of vehicles to reduce transport emissions. It is also a key component in solar technology, although the majority of this is not manufactured in the UK due to higher manufacturing costs and international competitiveness. Continuous filament glass fibre products reduce vehicle weight, increasing fuel efficiency, and reducing transport CO_2 emissions. Glass fibre plays key role in the construction of wind turbine blades as it has enabled manufacturers to construct longer, lighter, and more efficient rotor blades for larger wind turbines.
Other Mineral Products (MPA)	1,492 $ktCO_2e$	Currently no lime specific commitments or roadmap. General goals for the MPA outlined in their 'Sustainable Development Report'.	Optimise the use of energy whilst maximising the use of non-fossil fuels. Reduce the climate change and other impacts of the transportation and delivery of products. 100% of sites to have an Environmental Management System in place by 2025. Promote the development and use of sustainable and responsibly sourced mineral products	Mineral products are the input materials into so many different markets and industries, that reducing their embodied emissions could help a wide range of other sectors from steel, glass, ceramics and paper to construction, water treatment, energy generation, agriculture and pharmaceuticals. The Mineral Products industry supplies the raw and manufactured materials for building our homes, as well as vital new and upgraded infrastructure to support future economic growth and our quality of life.
Pharmaceuticals & Chemicals				
Chemicals (CIA)	11,755 $ktCO_2e$	Net zero by 2050 (Scopes 1, 2 & 3). No roadmap but have published Accelerating Britain's Net Zero Economy The Chemical Industry: Combating Climate Change	– Low carbon clusters by 2025 – More Low carbon clusters by 2030 – Zero carbon cluster by 2040	Energy: enabling larger rotor blades on wind turbines and more efficient solar panels, essential for the development of cost-effective renewables and savings. Home: high rated energy efficient windows and doors are manufactured from PVC with emissions nearly three times lower than aluminium or wood, providing significant savings over their 35+ year lifespan. Transport: chemical products for vehicles enable lighter plastic parts which reduce a car's weight, provide better quality tyres, and act as fuel additives that improve energy efficiency. Hydrogen and CCS: The sector's main clusters are planning to achieve decarbonisation of multiple facilities using shared infrastructure with other key industrial sectors. Collaboration between the sectors will make CCS possible - 4 Low Carbon Clusters and 1 Zero carbon Cluster could save almost 100 million tonnes of CO_2.
Pharmaceuticals (ABPI)	639 $ktCO_2e$	Currently no sector roadmap or commitments but a large number of their member companies have.	*Not currently applicable*	Reducing the emissions embedded in pharmaceutical products will help hospitals and other medical providers reduce their Scope 3 emissions.

Food & Drink				
Food & Drink (FDF)	7,230 $ktCO_2e$	Net zero by 2040 (Scopes 1, 2 & 3). Roadmap to Net Zero Overview for the UK food and drink sector	– Net Zero 2040 roadmap and handbook launched in November 2020 – Target 60% absolute reduction in CO2 emissions by 2025 against the 1990 baseline – Transport: support and contribute to the Government Road to Zero Strategy	The UK food and drink manufacturing sector is an integral part to achieving sustainable food systems which currently contribute 21% of the UK's carbon footprint. There are actions that manufacturers can take at each supply chain stage to make a real contribution to building food system resiliency for both current and future generations. The sector can help influence the agriculture industry both in the UK and abroad through: continuing to progress in the production, use and disposal of food and drink packaging in the UK, moving to electric light goods vehicles, reducing onsite emissions through procuring renewable electricity, decarbonising process heat through electrification and low carbon fuels in addition to transitioning to sustainable refrigerants.
Water (Water UK)	2,961 $ktCO_2e$	Net zero by 2030 (Scope 1 & 2 only), Net Zero 2030 Routemap	Three pronged approach: – Demand Led - efficiency interventions & Alternative Technologies (Water, Wastewater, Transport & Admin) – Technology Led – Renewables & Green Procurement – Removals Lead – Residual emissions (Removals/Offsets)	Construction and housing: increasing the use of grey water and rainwater decreases water demand and the emissions associated with its supply White good manufacturing: more water efficient reduces treated water demand Agriculture: working with farmers on better ways to spray chemicals and chemical alternatives improves water quality and so limits the requirement for treatment
Other Manufacturing				
Engineering (ECIA)	5,961 $ktCO_2e$	Currently no sector commitment or roadmap	*Not currently applicable*	Engineering skills are required to build net zero solutions/ infrastructure. The engineering design of buildings and infrastructure can increase energy efficiencies during use, reduce construction time, reduce material quantities, make use of low carbon materials and increase lifespan all of which will provide carbon reduction opportunities.
Rubber & Plastics				
Plastics & Rubber (BPF)	3,162 $ktCO_2e$	Currently no sector roadmap or commitments, but they have published a 'Recycling Roadmap' which will contribute towards net zero goals	Forecasts by 2030 (for recycling) – 4 times more plastic recycling tonnage – 50 times less tonnage to landfill – 6 times more energy recovery tonnage	The UK's target of net zero emissions by 2050 will not be possible without plastic, as the material is not only essential for creating insulation, lightweight vehicles and wind turbines but also because alternative materials are often heavier and require more resources to produce, which can lead to increased emissions.
Paper & Printing				
Paper & Pulp (CPI)	1,998 $ktCO_2e$	Net zero by 2050 Scope 1 & 2. They have published a 'Pulp and Paper Sector Joint Industry - Government Industrial Decarbonisation and Energy Efficiency Roadmap Action Plan', which is currently being revised post COP26	– Finance energy efficiency and decarbonisation related projects (2017 and ongoing). – Identifying and implementing waste heat recovery projects: introduce Industrial Heat Recovery Scheme (IHRS) 2017-2021 – Raising awareness of state-of-the-art energy efficiency technology and improving related skills through training support (2018 BEIS) – Encouraging greater use of sustainable biomass to deliver a lower carbon footprint within the sector (2017 and ongoing) – Identifying and delivering innovation, including demonstration projects (2017 and ongoing) by funding Innovate UK, BEIS and the Research Councils.	– Offers a substitution for fossil oil derived products in packaging and other applications. – European forests absorb over 260 million tonnes of CO_2e each year. Paper offers re-creation of viable forest in the UK with commercial, climate and ecosystem value - a replacement for marginal agriculture. – The UK paper sector has already reduced its carbon emissions by 72% from 1990 levels to 2020. Lighter weight paper-based packaging products reduce transport emissions in supply chains. – Contributing UK pulp and paper expertise to bolster UK bio-refining initiatives and to developing the bio-economy. – Paper making bi-products (pine resin) can be used to lower the carbon footprint of other products e.g. bitumen

Electrical				
Electronics (Tech UK)	692 $ktCO_2e$	Net zero by 2050. Tech UK has confirmed it has joined the climate campaign Race to Zero	Halve emissions by 2030, achieve net zero before 2050 and disclose progress on a yearly basis	Digitalisation is an essential enabler for a decarbonised world. Data centres, along with telecommunications networks, provide the core digital infrastructure that supports our modern internet economy, which in turn facilitates low carbon solutions like home-working, automation and energy management. The data centre sector, a large energy user with consistent and predictable demand, high embedded capacity, and a strong appetite for renewable power could, over time, also enable greater adoption of intermittent renewables and a more distributed grid.
Electrical Equipment (BEAMA)	652 $ktCO_2e$	Net zero by 2050 (Scopes 1, 2 & 3). No roadmap, but have published 'Net zero by design - our vision of a zero carbon home and how we get there'	The BEAMA climate commitment supports the science-based targets approach; as a result many of their members are following this route.	Electrical manufacturing provides a gateway to a number of net zero solutions including EV charging points, energy storage in buildings, smart metering & heat pumps and electricity network infrastructure
Motor Vehicles				
Automotive (SMMT)	1,181 $ktCO_2e$	No sector commitment, but End of Sale dates (2030/ 2035) have been imposed by the government. Roadmap in progress.	SMMT states that they are fully committed to electrification & journey towards zero tailpipe emission vehicles and greener and more sustainable mobility. Most OEMs made commitments (see SMMT Sustainability Report). Currently ~140 plug-in vehicle models on offer. By 2035 only zero emission cars/LCV can be sold. By 2030 no petrol/diesel cars/LCVs can be sold. CO_2 regulations on new cars/LCVs in place. Zero emission mandates due 2024. HCVs also have CO_2 regulations in place.	Support shift to decarbonised vehicles by producing up to one million electric vehicles a year domestically, sustaining and growing the domestic EV supply chain – power electronics, motors and drives (PEMD). In addition to providing the fuel cell capacity needed to support cars, heavier vehicles and rail units by 2030. In the immediate term, fleet renewal remains the quickest way to lower emissions, with older, more polluting vehicles being replaced by new vehicles which have significantly lower emissions. This would further support essential net zero technologies, like light weighting and advanced materials, increasing the UK's capabilities, IP and content in finished vehicles.
Textiles				
Textiles (UKFT)	1,168 $ktCO_2e$	Net zero by 2050 (Scopes 1, 2 & 3), Textiles 2030 Roadmap	Target in 2022 to reduce the amount of virgin textile materials used to meet consumer needs. Reduce water footprint by 30% of new products sold. Carbon footprint reduction scenario by 2030: – 8% Low Carbon Energy (UK) – 10% Low Carbon Energy (Supply Chain) – 4% Improved Fibres – 2% Lower impact production processes – 12% Recycled fibres – 7% Product Design for Longer Life	Increasing durability, recyclability, use of recycled content and minimising waste will contribute to a circular economy and reduce absolute emissions. Reducing the embedded carbon in textile products will help other companies and consumers reduce their Scope 3 emissions. Note that local production of textiles would significantly reduce its carbon footprint through the reducing of transport emissions (textile fibres) and more sustainable production in the UK

Other Transport				
Aerospace (ADS & Regional Aerospace Alliances)	403 $ktCO_2e$	Scope 1 & 2: No sector-specific net zero commitments/ manufacturing roadmap. Scope 3: Net zero by 2050. There is a UK Government high level Jet Zero roadmap for aircraft emissions. Underpinning these are more detailed roadmaps, for both small aircraft and larger commercial aircraft	Scope 1 & 2: Not currently applicable Scope 3: Aviation CO2 emissions reduction trajectory for 2025 to 2050 "High Ambition" scenario for sector: 2030 = 23-32 Mt 2040 = 12-19 Mt 2050 = 0 Mt with offsetting & removals taken into consideration. Roadmap recognises that the precise technological solutions are not yet known, but potential solutions include: – Sustainable Aviation Fuel (SAF) in the near-term – Electric power – Hydrogen power	Aerospace sector is working on enabling technologies for: – More fuel-efficient conventional aircraft including lighter-weight solutions and associated manufacturing technologies, utilisation efficiencies through more intelligent control solutions etc. – Sustainable Aviation Fuel (SAF) – High-power density, safety critical, electric systems – Hydrogen fuel (for fuel cells and/or propulsion) systems linked to infrastructure and distribution solutions (resolved on a global basis for international flight).

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