LEADING THE TRANSITION TO NET ZERO CARBON

netzero

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FOREWORD
OUR TRANSITION TO NET ZERO CARBON

By Warren East, Chief Executive Officer, Rolls-Royce

At Rolls-Royce, we believe in the positive, transforming potential of technology. We pioneer the power that matters. Power that has an impact and is central to the successful functioning of the modern world.

Warren East
Chief Executive Officer, Rolls-Royce PLC

To combat the climate crisis, we know that power must be made compatible with net zero carbon emissions. For us this is a societal imperative as well as one of the greatest commercial and technological opportunities of our time.

Our customers use our products and services in industries such as aviation, shipping and energy generation, where demand for power is increasing as the world's population grows, becomes increasingly urbanised, more affluent and requires more electricity. These are also among the industries where achieving net zero carbon is hardest. As other parts of the global economy decarbonise, they will contribute a more significant proportion of remaining emissions unless the technologies and the infrastructures underpinning them are completely reimagined. As a result, our innovation in sectors where reducing emissions is so tough, has a fundamental role to play in enabling and even accelerating the overall global transition to a net zero carbon future. Our pioneering work can have a positive impact across multiple areas of transport, energy and the built environment, three of the 'systems' defined by the UN Race to Zero as requiring the technological breakthroughs that we can help create.

We have always sought to make our products more efficient, but we need to go further. Last year when we joined the UN Race to Zero coalition[1], we pledged to play a leading role in enabling the sectors in which we operate reach net zero by 2050. We are already focusing the lion's share of our research and development investment on the necessary lower, net zero and zero carbon technologies we need to achieve that ambition.

Last year when we joined the UN Race to Zero coalition, we pledged to play a leading role in enabling the sectors in which we operate reach net zero by 2050.

We are now laying out our technology pathway to net zero and committing to ensuring our new products will be compatible with net zero operation by 2030, and all our products compatible by 2050.

Our decarbonisation strategy is founded on our understanding of the levels of control and influence we can have over the emissions with which we are associated. It starts with emissions in our own operations, which we have already halved over the past five years and plan to get to net zero by 2030 – faster in some of our facilities. It then extends into our value chain and ultimately focuses on the contribution we can make to the global transition.

We aim to meet our net zero goal firstly by working towards enabling our products to be used in a way which is compatible with net zero emissions. We have already made considerable progress through the testing of sustainable fuels and the development of new products and engine architectures, which will further increase fuel efficiency and help improve the economics of new forms of energy storage. We are now setting out clear short-term targets, connected to executive remuneration, to make all the commercial aero engines we produce, and our most popular reciprocating engines, compatible with sustainable fuels by 2023 and to work with our armed forces customers to achieve the same goal for the Rolls-Royce engines they use.

Secondly, we are pioneering new breakthrough technologies that can help decarbonise the complex, critical, carbon-intensive sectors, including transport and energy, in which we operate and drive sustainable economic growth for the future. Our innovation is taking us into exciting new areas, with novel technologies opening up new markets and significant growth opportunities: from all-electric urban air mobility and regional aviation, to hybrid-electric systems, fuel cells, microgrids and battery storage. Our innovation with small modular nuclear reactors, meanwhile, will see us develop existing technology to enter new markets and sectors where we can offer technological solutions that can abate emissions outside of our current footprint and provide further global growth opportunities.

Our belief in the power of technology as a force for good means we are ultimately optimists. We do believe that as the world emerges from the pandemic and looks to build back better, global economic growth can be compatible with a net zero carbon future. There is, however, no one single technological answer to decarbonising the industries in which we operate. We need to bring our legacy of innovation to bear in multiple areas. Furthermore, no individual player holds all the cards. We are forging new partnerships with leaders in other industries to improve the economics – and scalability – of net zero solutions. We will also step up our advocacy for net zero policies that can unlock and accelerate action. We need to work across borders, industries and technologies to succeed; and work with partners who are equally driven towards creating system breakthroughs – in areas such as sustainable fuels – because emissions are going to rise until we can scale a solution, and that scaling up requires whole ecosystems not just individual companies. This is, and will be, a complex and difficult process, but the longer carbon emissions rise, the more painful and disruptive the transition. The choices we make now will determine the future for our generation and for those to come.

The desire to be part of the solution to climate change is strong throughout Rolls-Royce and the ambition, ingenuity and skill of our people will be instrumental to our success. As an engineer, I readily admit to being envious of my younger colleagues who are just starting out on their careers with us. The technological innovations they are helping to pioneer and that they will be critical in implementing, will help shape our planet's destiny and the very future of humanity.

In a world that is at last beginning to really confront the reality of what science tells us about the climate crisis, we believe with greater clarity than ever before that the power we provide society must be net zero carbon. Pioneering sustainable, net zero power now sits at the heart of our strategy, future innovation and growth agenda. Our decarbonisation strategy will ensure that Rolls-Royce is not only compatible with, but actively supporting a net zero future. The societal need is great. The business imperative is clear. The commercial case is attractive. There are few companies better placed than Rolls-Royce to pioneer the vital solutions we need to create a net zero future.

Warren East
Chief Executive Officer
Rolls-Royce PLC

THE CHALLENGE WE FACE, THE BREAKTHROUGHS WE NEED

The science is clear – to avoid the worst effects of climate change, society must limit global warming to 1.5°C by the end of this century. An average global temperature rise above that level would create risks that the global economy is not equipped to withstand.

This requires the world to halve its carbon emissions over the next decade, halve them again during the 2030s and then do so yet again over the subsequent ten years to achieve net zero emissions by 2050, according to the Intergovernmental Panel on Climate Change[3].

The COVID-19 pandemic has given us a glimpse at the scale of the transformation required; 2020 saw the greatest reduction in CO_2 since World War II, around 8%[4]. To limit global temperature rise to 1.5ºC, science tells us we need to achieve a similar level of reductions every year for the next three decades. Achieving net zero carbon will require a wholesale transformation of the systems that make up the backbone of our global economy, including transport, energy and the built environment – some of the sectors in which reducing emissions is hardest.

In showing what a systemic shock can look like, COVID-19 has also demonstrated the importance of preparedness in a crisis and strengthened the case for accelerated action on climate change. Countries, regions and cities that have set a net zero carbon goal or announced an intention to do so now account for 70% of global GDP and two-thirds of carbon emissions (66%)[5]. Such commitments are only likely to grow in both coverage and ambition as the impacts of climate change increasingly manifest, and more governments are forced to act.

We recognise the urgency of the climate challenge and climate change is one of the principal risks recognised within our Annual Report. We are committed to playing our part in the global journey to net zero. Undoubtedly, the very nature of this transition will mean that there may be general and sector specific circumstances which will influence our ability to deliver our commitments. We have set these out more fully on page 33 of this report.

The effects of climate change are being felt today. However, it is crucial that the solutions which are adopted to address the impacts of climate change must build in adaptation and resilience requirements to ensure they meet both the immediate and long-term needs of society, support inclusive growth and do not inadvertently create negative impacts on people or the natural environment elsewhere.

At Rolls-Royce, we believe that the call for power to be more sustainable and net zero carbon will be stronger than ever as we emerge from the aftermath of the pandemic and look to build back better. We are a science-led business, and the science tells us that to avoid the worst impacts of climate change, society must limit global warming to 1.5ºC by the end of this century. That's why we joined the UN Race to Zero last year and have pledged to play a leading role in enabling the sectors in which we operate reach net zero by 2050.

We believe that the call for power to be more sustainable and net zero carbon will be stronger than ever as we emerge from the aftermath of the pandemic and look to build back better. We are a science-led business, and the science tells us that to avoid the worst impacts of climate change, society must limit global warming to 1.5ºC by the end of this century.

OUR EMISSIONS FOOTPRINT

We are a science-led business and our net zero strategy is grounded in data. Our emissions footprint reflects the scale of our business activities.

We estimate that total direct and indirect greenhouse gas emissions, across scope 1, 2 & 3 categories associated with Rolls-Royce, were approximately 276 $MtCO_2e$ in 2019, representing approximately 0.6% of global man-made CO_2 emissions.

Emissions from our own manufacturing, production and office facilities (scope 1 & 2) make up a very small but important proportion of our footprint. These emissions sit clearly within our immediate sphere of influence and under our direct control.

However, the majority of our emissions profile comprises value chain emissions, upstream and downstream of our company activities (scope 3). This includes emissions associated with our supply chain, particularly the extraction of raw materials, and emissions from the use of our sold products.

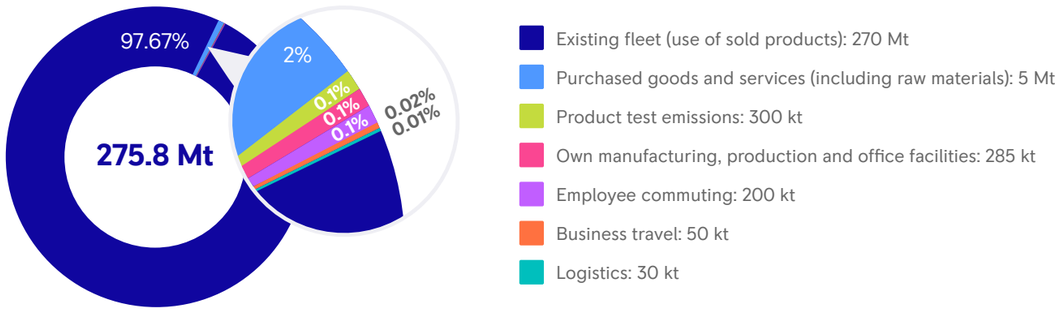
We operate in some of the most carbon intensive sectors – transport, energy and the built environment – and the use-phase emissions generated by our products are substantial, typically more than 99% of the product life cycle, due largely to the carbon composition of the fuel combusted when an engine is in service. As a result, abating product-related emissions is the substantive focus of our decarbonisation plan.

The extent to which we can control these scope 3 emissions is limited by other actors within the system. For gas turbine and reciprocating engines this is particularly dependent upon which fuel the customer chooses to use, which in some cases is controlled through regulation.

As the global population continues to grow and economic development increases demand for power, without intervention, that emissions profile could hypothetically double to meet societal need for increased energy, transport and power – in reality, we know this emissions growth will never be realised as society transitions towards net zero.

We are committed to ensuring our new products will be compatible with net zero operation by 2030, and all our products compatible by 2050. We will continue to advocate for the necessary enabling environment to achieve this.

Our emissions footprint



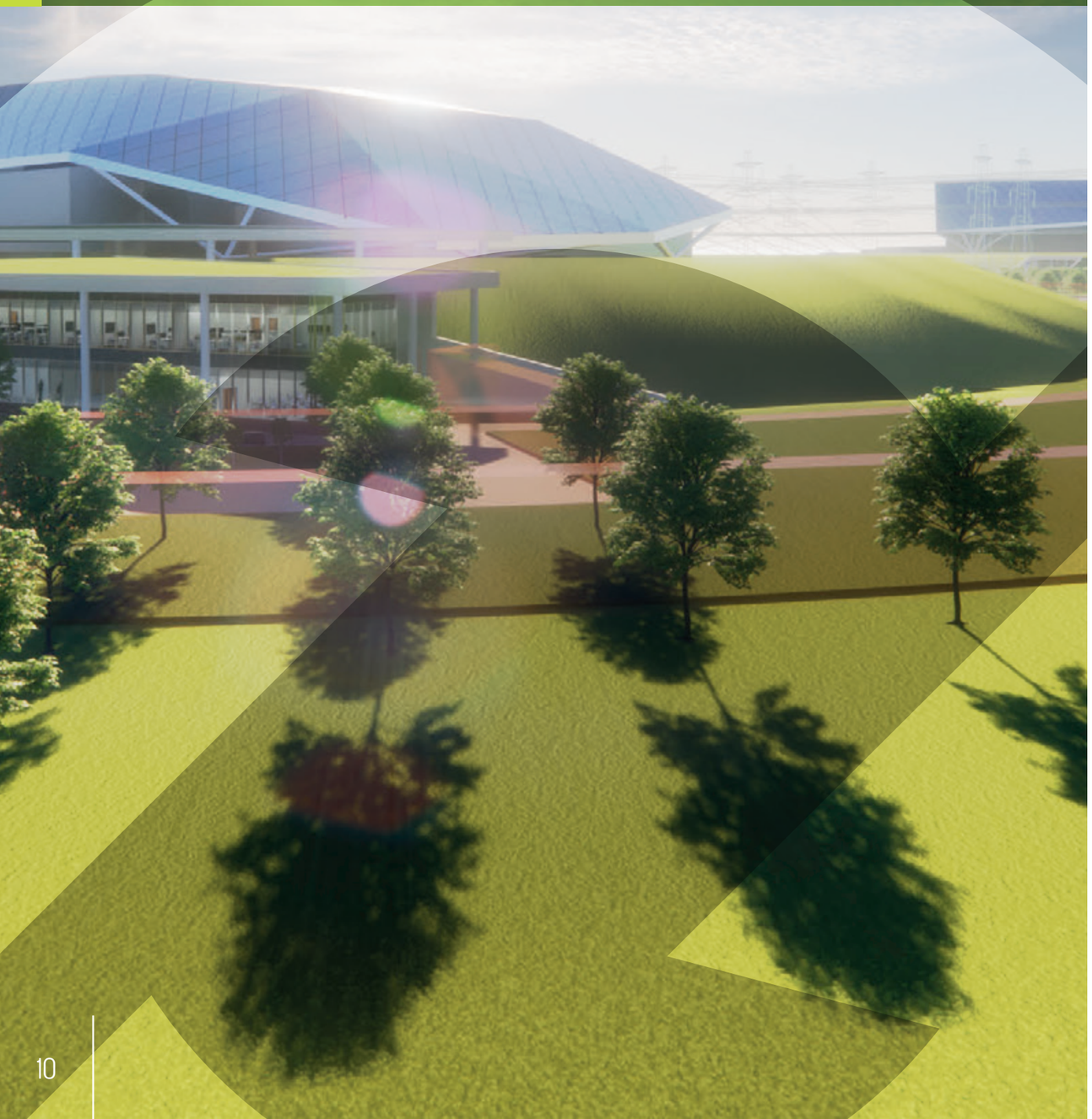
NOTES:

We have calculated our GHG emissions footprint in accordance with the WRI/WBCSD GHG Protocol Scope 3 Standard (2011), which classifies emissions according to three scopes: scope 1 includes direct on-site emissions. Scope 2 includes indirect on-site emissions (e.g. purchased electricity). Scope 3 includes upstream or downstream emissions in the value chain outside a company's own operations.

The emissions disclosed are based on 2019 data given the impact of COVID-19 on our business activities and product operations during 2020. This contains some estimations based on best available data and methodology at time of publication, informed by a preliminary scoping exercise to detemine which scope 3 categories, besides emissions associated with the use of sold products, are relevant. We continue to focus on improving the completeness of our data which may lead to further disclosures in future.

This report focuses specifically on carbon dioxide, however we recognise the broader environmental and social impacts associated with Rolls-Royce's products. The technology levers discussed have the potential to address some of these impacts simultaneously.

OUR DECARBONISATION STRATEGY



Through our decarbonisation strategy, we will become a net zero carbon company across our value chain by 2050, at the latest, and play a leading role in enabling the sectors in which we operate to get there too.

In line with the commitments we have made under the UN Race to Zero campaign, we are aligning our entire business model to the Paris Climate Agreement goals, to limit global temperature rise to 1.5ºC. This plan will put Rolls-Royce at the forefront of the historic innovation and future growth opportunity that the net zero transition represents.

As net zero intent gets translated into net zero action, it will become increasingly costly to be part of the problem and – we believe – increasingly profitable to be part of the solution. That's why we will continue to pivot our technology platform towards pioneering power for a net zero world.

Our decarbonisation strategy has three interconnected pillars:

1. **Making Rolls-Royce a net zero carbon company through how we operate**;
2. **Decarbonising complex, critical systems at the heart of global society, by:**
   a. **enabling our products to be used in a way that is compatible with net zero, and;**
   b. **pioneering new breakthrough technologies that can accelerate the global transition to net zero;**
3. **Advocating for the necessary enabling environment, with public and policy support to achieve this ambition.**

Our decarbonisation strategy starts with the emissions in our own operations, extends to our value chain, and ultimately focuses on the contribution we can make to the global transition.

Technology driven transition

We believe in the primacy of technological innovation to create long-term solutions to the climate crisis, and we remain focused on delivering the breakthroughs society requires of us as technology leaders. Our priority is the development of technical solutions that can directly abate or remove carbon emissions, permanently. For instance, we expect our Bristol, UK, production site to be the first Rolls-Royce facility to achieve net zero carbon status in 2022. We will not use carbon offsets to achieve this.

Net zero operations

Our short-term target is to eliminate emissions from key parts of our own operations. This may be a small part of our total emissions footprint, but it is where we have the most control. We will achieve net zero greenhouse gas emissions from our operations and facilities by 2030.

We will build on this to mitigate the emissions associated with product development and test, which also form part of our scope 1 & 2 footprint but which are currently excluded from our target.

Our decarbonisation strategy starts with the emissions in our own operations, extends to our value chain, and ultimately focuses on the contribution we can make to the global transition.

At present we cannot certify a civil aviation engine with a testing regime that solely uses 100% unblended Sustainable Aviation Fuel [SAF]. Currently, only a 50% blend with traditional fuels is approved for use in commercial aviation. We expect to set a target for these emissions in future as we play an active role in advocating for a change in the current regulatory regime. As an interim measure we are committing to 10% of the fuel we use in Civil Aerospace testing and development activities being SAF by 2023 and have tied executive remuneration to this goal.

Action along our value chain

Along our value chain, we have opportunities to reduce emissions through targeted interventions, both upstream and downstream. For example, working with suppliers and partners to set robust, science-based net zero targets or with logistics partners to incentivise the use of lower emissions transport options, including utilising Rolls-Royce capabilities. We expect our company resource efficiency targets to act to reduce the emissions associated with waste generated in our business activities, as well as contributing towards reducing our need for raw materials.

However, as providers of products to customers and organisations who ultimately choose how to operate them, the majority of these value chain emissions lie outside our direct control. We are already working in partnership with our customers, regulators and policy makers to create the necessary enabling environment to allow us to deliver the required technical advances, meet our targets, and, more importantly, to support society in its efforts to meet the Paris Climate Agreement goals. We will use our skills, capabilities and technologies to support the complex critical sectors we are part of, in reaching net zero carbon by 2050. This means enabling our products to be used in a way that is compatible with net zero carbon, and pioneering new breakthrough technologies that will accelerate the global transition.

Tracking our short-term progress on technology levers and setting interim targets

We are now setting out clear short-term targets, linked to executive remuneration, that will progress the technology levers we need to pull to meet our 2050 net zero pledge. This includes **making all the commercial aero engines we produce, and our most popular reciprocating engines, compatible with sustainable fuels by 2023** and to work with our armed forces customers to achieve the same goal for the Rolls-Royce engines they use. We believe these targets are especially important to measure progress because several of the sectors in which we operate – particularly aviation – have lengthy research and development timescales, which include rigorous safety testing.

By 2030 all our new products will be compatible with net zero operation. In markets with relatively fast development cycles, we are setting a clear interim target for how those new products will already be reducing emissions by 2030. **As a result, our Power Systems portfolio has sufficiently reliable data to be able to define a science-based interim target to reduce by 35% the lifetime emissions of new products sold by the business by 2030, relative to 2019.** This exceeds the carbon emission reductions needed to curb global temperature rise to well below 2ºC and is a significant step towards our 2050 net zero carbon goal.

These targets are in addition to our existing goal **to be net zero in our operations and facilities by 2030,** excluding product testing and development.

At this point in time we are not in a position to set a Group-wide science-based interim target. Our products operate at the heart of complex, critical systems and we do not yet have enough clarity on the exact shape of the sector decarbonisation pathways of these systems, particularly aviation, or on the full extent of the potential future markets for all the breakthrough technologies we are developing today. We will work with partners within our sectors, and with organisations like the Science Based Targets initiative and UN Race to Zero campaign, to generate breakthrough convergence on the significant 'tipping points' that must occur beyond 2030 to reach net zero by 2050, to enable us to set a science-based interim target in the near term.

Breakthrough for sustainable fuels

We believe that, based upon the current science and plausible technology scenarios available today, sustainable fuels (fuels with a lower life cycle carbon impact than fossil fuels) will play a vital role in the decarbonisation of carbon-intensive sectors, particularly aviation[7], which makes up the majority of emissions from our products in use. We must ensure that our products are compatible with such fuels, known as Sustainable Aviation Fuels (SAFs) in aviation, in order to accelerate their take-up. **We are committing to have proven, through testing, that all our in-production commercial aero engines are compatible with 100% SAFs by 2023. This aligns with the UN Race to Zero breakthrough goal of 10% of all fuel used in aviation being SAF by 2030[5].**

By assisting our defence customers to reach net zero, we can play a major role in assisting governments to achieve their nationally determined contributions under the Paris Agreement goals, due to the fact that CO_2 emissions from armed forces are often a significant portion of state-owned emissions. This includes working with key partners, like the UK Ministry of Defence, to support the decarbonisation of their estates, building on our experience in progressing our own 2030 operations and facilities target, and developing low and net zero carbon technology solutions to support decarbonising military operations. **We will support our defence customers in achieving net zero by showing compatibility with SAF in all products by 2023,** subject to customer engagement.

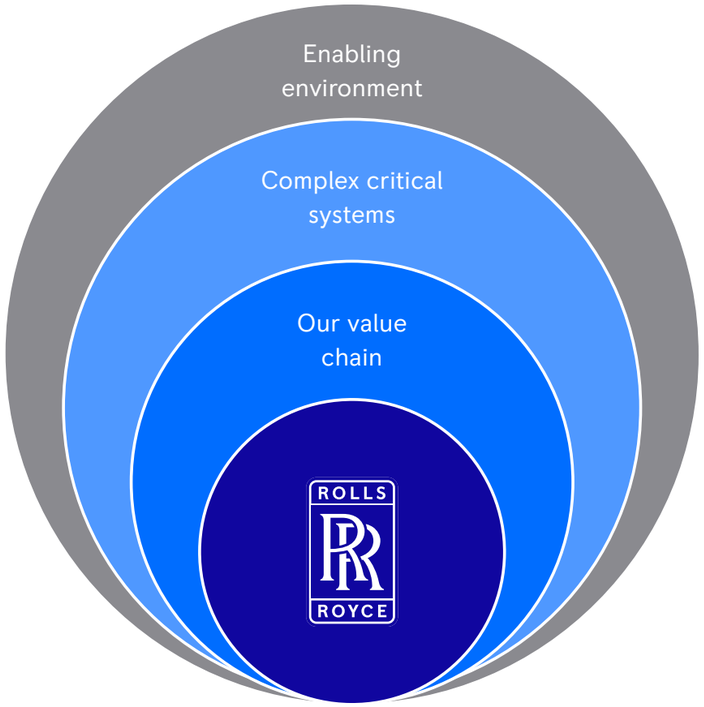
We also intend to **certify the new generation of our mtu Series 2000 and Series 4000 engines for use with sustainable fuels by 2023.** These represent the majority of the reciprocating engines we manufacture and are used across a range of applications from power generation to rail and shipping.

The 2023 targets outlined above, for products to be proven compatible, through testing, with sustainable fuels, form part of our executive remuneration policy.

Game changers in low and zero carbon power

Beyond ensuring our products are compatible with net zero, we have a major role to play in accelerating the global transition through pioneering new breakthrough technologies. This presents a very significant commercial opportunity.

We are developing new technologies that will take us into new markets such as urban air mobility, regional aviation, power generation through small modular reactors, microgrids and fuel cells. On the latter technology, **we are targeting to have integrated 2MW of hydrogen fuel cells into operational microgrid demonstrators by 2023.** That is enough to power roughly 400 homes, or a small community, and this demonstrator will provide us with further insights into the integration of multiple power sources in a microgrid. We expect low and net zero carbon technologies to present significant growth opportunities for Rolls-Royce out to 2030 and beyond and will be providing further details in the future.



We are already boosting our research and development (R&D) expenditure to pivot towards more lower carbon, net zero and zero carbon technologies: moving from approximately 50% of our gross R&D in these areas today to at least 75% by 2025. We understand the need to set out further detail on capital allocation in the future.

This report sets out our roadmap for getting to net zero. It is part of our strategic planning as we build back better after the impact of the COVID-19 pandemic.

Our ability to deliver on our decarbonisation roadmap hinges on an external environment that enables us to successfully transition to a net zero carbon future. To support this we continue to actively engage policy makers and others to advocate for the necessary conditions society needs to achieve its net zero target.

Over the following pages we set out our vision and the actions we will be taking to accelerate that transition.

Making Rolls-Royce a net zero carbon company

Delivering net zero carbon emissions from our operations and facilities is a vital step towards our 2050 target, and will help ensure our business is more resilient for the future.

We will achieve net zero GHG emissions from our operations and facilities by 2030, excluding product testing and development, **and will work to abate our remaining scope 1 & 2 emissions to ensure we are a carbon neutral, climate resilient business by 2050.** Emissions associated with our Rolls-Royce owned and operated property footprint and operational activities sit clearly within our immediate sphere of influence where we can exert more control over their reduction.

We have had targets to reduce the GHG emissions associated with our operations and facilities for over a decade and have made substantial progress, halving our emissions in the past five years alone. This progress has been achieved through: continued focus on improving energy efficiency to reduce our overall energy demand; investment in the installation of on-site renewable energy generation, including utilising our own microgrid technologies; and the purchasing of clean and renewable electricity.

By 2030, we will achieve zero GHG emissions from all energy purchased and consumed in the operation of our buildings, facilities and manufacturing processes. This target is well aligned with the ambition and emissions reduction trajectory required to curb global temperature rise to 1.5ºC. To meet our goal, new techniques and solutions will need developing and scaling, driven by further innovation over the next few years particularly in regions where viable zero carbon energy is not yet available for purchase. We expect our Bristol, UK, manufacturing site to be the first Rolls-Royce site to achieve net zero carbon operations in 2022.

Much of our manufacturing involves the use of specific alloys and forming them into complex shapes. The extraction, supply and subsequent processing of these materials is very energy intensive and is responsible for the majority of the carbon embedded within the manufacture of our products. As we deliver more efficient and lower carbon emission products, these processes will remain an important part of our production activities. As such, innovations in material supply and component manufacturing technology, targeted specifically at increasing resource efficiency and enabling circular material flows, are a vital element of our roadmap for making Rolls-Royce a net zero company. We are developing a net zero manufacturing strategy to maximise resource efficiency and reduce carbon impacts across our global operations.

One of the toughest but most important challenges within our scope 1 & 2 emissions is linked to the necessary and rigorous product safety testing we must conduct. Product safety testing is a critical part of our engine development and production programmes. Each individual engine is required to undergo an extensive suite of tests before it can be dispatched to a customer. As well as being intrinsically linked to product safety, robust testing is an essential component of our research and development activities. We will seek to mitigate the emissions associated with product testing through a suite of new techniques and alternatives, including digital modelling and replacing some physical testing where appropriate. We recognise the need to ensure these activities are aligned with our decarbonisation goals and are committed to working with customers, regulators and industry partners to explore ways to meet our product testing demands without generating carbon emissions.

Some of the testing we carry out must take place using the fuels that have been certified by the relevant regulatory authorities for in-service use. For example, at present we cannot certify a civil aviation engine with a testing regime that solely uses 100% unblended Sustainable Aviation Fuel (SAF). Currently, only a 50% blend with traditional fuels is approved for use in commercial aviation. As the regulatory pathway towards acceptance of 100% SAF becomes clearer, we will be setting a target to achieve net zero in our remaining scope 1 & 2 emissions. We believe this can be reached before 2050, with industry and regulatory collaboration. As an interim measure, **we are committing to 10% of the fuel we use in Civil Aerospace testing and development activities being SAF by 2023** and have tied executive remuneration to this goal.

The actions we are taking to make Rolls-Royce a net zero carbon company:

- Delivering against our existing target of zero greenhouse gas emissions from operations and facilities by 2030 (excluding product testing and development);
- Increasing the use of sustainable fuels in our product testing and development, with an interim measure that 10% of the fuel we use in Civil Aerospace testing and development activities will be SAF by 2023; we have linked executive remuneration to this goal;
- Advocating for the regulatory measures to be put in place to enable us to increase use of sustainable fuels in our testing and development activities;
- Continuing our waste action programme to reduce solid and liquid waste from our production processes, reducing our materials consumption and in turn reducing carbon emissions from manufacturing activities;
- Developing a net zero manufacturing strategy to maximise resource efficiency and reduce carbon impacts across our global operations.

Mobilising our value chain

Meeting the challenge of net zero requires us to look comprehensively across our emissions profile and innovate throughout our value chain, rethinking what raw materials we use and how we procure, how we design and manufacture products, and how we manage our products at the end of their life – **to enable us to meet this challenge we are seeking to enlist the support of our entire value chain to join us in the Race to Zero.**

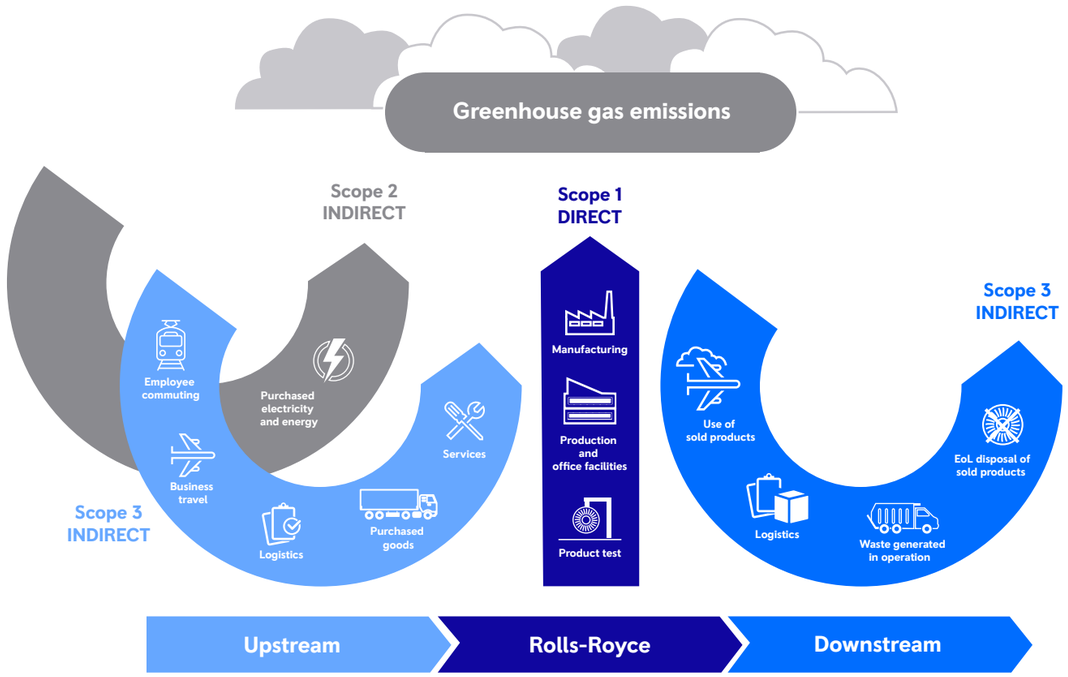
Along our value chain we have opportunities to reduce emissions through targeted engagement both upstream and downstream, as well as opportunities to learn from best practice within the value chain and collaborate to address common challenges.

Our external supply chain represents the second largest proportion of our emissions footprint after the use of products by our customers. This is dominated by the procurement of raw materials, critical to the complex technical nature of our products, but which also carry a significant socio-environmental impact. Improving our resource efficiency and continuing to implement circular business practices will help reduce the amount of raw materials we need to procure.

Alongside our net zero manufacturing strategy for addressing our internal operations, we are also developing a sustainability and net zero strategy for supplier engagement, and working to identify high carbon impact areas of our supply chain for prioritised engagement.

We have targets to reduce our liquid and solid waste. This links closely with our manufacturing technology strategy, incorporating innovative techniques such as additive layer manufacturing and near net forging, as well as developing improvements in the efficient and responsible use of water, energy and consumable resources. This is important for our own operations but is even more important for reducing emissions in our supply chain. We are collaborating with key suppliers to explore opportunities to share our knowledge, learn from supplier best practices, and expand our resource efficiency programmes into the supply chain.

Our value chain



Where waste is unavoidable, we look to deploy circular manufacturing practices to maximise the use of materials and other resources. This year, we set a new target to increase the recycling and recovery rate of materials used within our manufacturing and production operations to 68% by 2025, while continuing to progress towards zero non-hazardous waste to landfill. This new target will help to drive increased circularity, and therefore reduce carbon, in our value chain.

An example of where we are already leading in this area is our use of circular, closed loop manufacturing practices for our titanium and nickel alloys, which make up the main components in our gas turbine products. This matters because we use more than 20,000 tonnes of high-value metal alloys each year, equivalent to two and a half Eiffel Towers. As a result of investments already made, more than 95% of a used aero engine can be recycled today and around half of the recovered material is of such high quality it can be safely used again to make a new engine. The remainder can be used in other manufacturing processes outside of aerospace. This programme is already saving around 300,000 MW hours of energy a year, and 80,000 tonnes of CO_2 compared to using virgin materials, and we have plans to further expand our recovery and recycling programme – we call Revert – into our supply chain.

Working with our supply chain partners to identify opportunities to reduce carbon impacts will be a key priority over the short to medium term.

Elsewhere in our value chain we are considering the emissions associated with activities such as business travel, employee commuting and logistics. We are working to incentivise lower carbon choices, including introducing electric vehicles in our inter/in site logistics. In many cases Rolls-Royce technologies can play a direct role in decarbonising these activities, particularly business travel, and air and sea freight.

While we still have work to do to fully understand the scale of our scope 3 emissions outside of products in use, we will be setting further targets to reach net zero across our value chain in the near future.

The actions we are taking to mobilise our value chain:

- Setting a new target to increase the recycling and recovery rate of materials used within our manufacturing and production operations to 68% by 2025;
- Identifying high carbon impact areas of our supply chain for prioritised engagement;
- Convening our high performing suppliers to actively share sustainability, resource efficiency and decarbonisation best practice within our supplier community;
- Expanding our Revert programme of high value metals recovery and recycling;
- Working with logistics and transport providers to implement lower carbon solutions, including utilising Rolls-Royce technologies to decarbonise air and sea freight;
- Developing a net zero manufacturing strategy to maximise resource efficiency and reduce carbon impacts across our global operations.

Meeting the challenge of net zero requires us to look comprehensively across our emissions profile and innovate throughout our value chain, rethinking what raw materials we use and how we procure, how we design and manufacture products, and how we manage our products at the end of their life. To enable us to meet this challenge we are seeking to enlist the support of our entire value chain to join us in the Race to Zero.

Decarbonising complex, critical systems

Achieving net zero carbon will require a wholesale transformation of the systems that make up the backbone of our global economy, including transport, energy and the built environment, some of the very sectors in which reducing emissions is the hardest.

We believe that decarbonising these parts of the economy is both technologically possible and economically vital. At Rolls-Royce, we want to bring our capabilities as a global power group to this challenge and be part of the solution to how society builds, moves and powers towards a net zero carbon future.

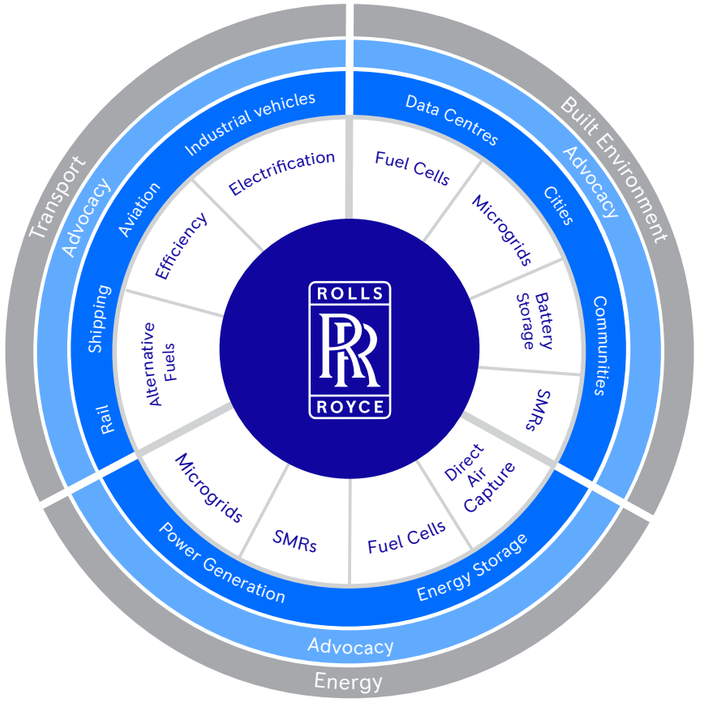
To keep pace with increasing demand for power, we must widen the availability, lower the cost, and scale-up the deployment of low carbon technologies in these critical sectors. As the global population rises, so too will demand for power and it is likely we will see emissions associated with these sectors increase in parallel until decarbonised solutions can be scaled. As providers of products to companies and organisations that ultimately operate them, we do not control the final usage or emissions of our products, but we can – and will – provide a roadmap to ensure they can be used in a way that results in net zero carbon emissions by 2050. We will control what we can control: to work to provide the technology to enable a pathway to net zero.

The complex nature of the sectors in which we operate means that the transition towards net zero will not be easy or straightforward; it will require a combination of technology and policy levers to execute and while some of these technologies are known today, others we must continue to explore, develop and ultimately scale.

To decarbonise complex, critical systems we must continue to act across three areas:

- Pioneering new low and zero carbon technologies and sustainable solutions;
- Accelerating the availability and affordability of sustainable fuels;
- Continuing to improve engine efficiency and environmental performance.

The suite of technologies that we have developed – and are developing – to do this, have the potential to act across the systems in which we play a part.



Technology pathways to net zero

Our decarbonisation pathway sets out our two primary aims; to reduce the emissions associated with our products to net zero; and, to pioneer breakthrough new technologies that can accelerate the transition to a net zero carbon future.

Achieving these aims will require us to ensure all our existing fleet can be operated in a net zero carbon manner, and to introduce new low and net zero carbon products to the market which can act to abate emissions in areas we are not present in today.

These pathways are based on our understanding of the technological solutions available to us today, and our current understanding of the potential future market application for those technologies.

Enabling our products to be used in a way that is compatible with net zero

To achieve net zero carbon we must ensure that our fleet is compatible with net zero carbon operation by 2050, at the latest. This will be achieved through further advancing the efficiency of our engine portfolio through next generation technologies and introducing new low or zero emission products, including fuel cells, microgrids, hybrid-electric and all-electric technologies. These new technologies represent a significant commercial opportunity. By 2030 new products will be compatible with net zero operation.

Beyond that, the scale up of sustainable fuels will play a crucial role in reaching net zero carbon. To accelerate this, we will make all the commercial aero engines we produce, and our most popular reciprocating engines, compatible with sustainable fuels by 2023 and work with our armed forces customers to achieve the same goal for the Rolls-Royce engines they use. We are working in partnership with fuels manufacturers to encourage the ramp-up of sustainable fuels production and with policy makers to create the necessary environment to support this.

Pioneering new breakthrough technologies that can accelerate the global transition to net zero

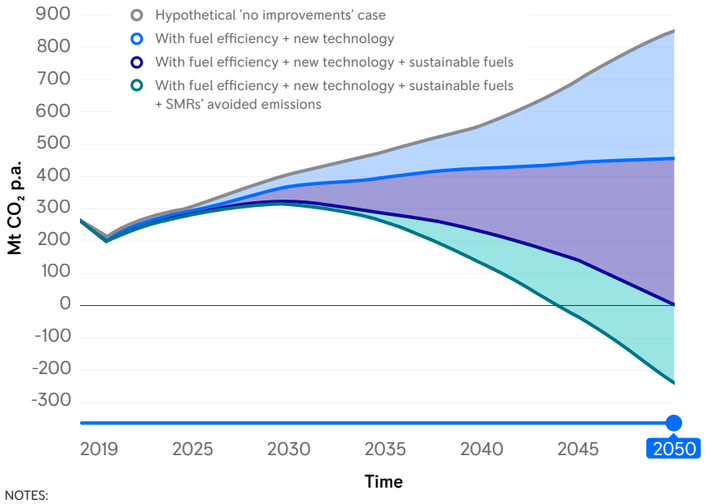
As we pivot to become a net zero carbon business, we will enter new markets and sectors where we can offer technological solutions that can abate emissions outside of our current emissions footprint. This will help further drive our future innovation and growth. These technologies are depicted as additional compensation actions as they do not abate emissions within Rolls-Royce's current scope 3 footprint but instead support the decarbonisation of other sectors.

Our strategy includes the development and deployment of small modular nuclear reactors (SMRs) which will play a vital role in supporting the decarbonisation of the energy grid and meeting increased demand for clean electricity. SMRs also have potential application as a route to the production of sustainable fuels, including SAFs for aviation, hydrogen or other e-fuels, through the provision of low cost, reliable and clean power.

We are also actively researching new technologies that can deliver net negative carbon emissions, for example direct air capture (DAC).

These technologies, when scaled, have the potential to deliver further carbon benefits to society beyond decarbonising our current product portfolio.

Technology pathway to net zero



Technology assumptions:

These pathways are based on our best understanding of the technological solutions available to us today, and our current understanding of the potential future market application for those technologies.

We have calculated our GHG emissions footprint in accordance with the WRI/WBCSD GHG Protocol Scope 3 Standard (2011). Scope 3 emissions accounting includes estimates and assumptions, in this instance these assumptions include the life cycle CO_2 saving of sustainable fuels will reach 100% by 2050, from approaching 70% today.

In this chart we have depicted future business growth opportunities in new low, or net zero, technologies that serve markets in which we are not currently present (e.g. SMRs for large scale power generation). They are therefore depicted as additional compensation actions as they do not abate emissions within Rolls-Royce's current scope 3 footprint but instead support the decarbonisation of other sectors.

NOTES:

The hypothetical 'no improvements' line depicted indicates a potential emissions growth through increased demand for power – in reality, we know this emissions growth will never be realised as we continue to improve engine efficiency.

The avoided emissions line takes account of 100% share of the expected energy output from SMRs built by consortium and under licence. This chart assumes that the electricity produced by SMRs is used to decarbonise activities not currently carried out by Rolls-Royce products, including large-scale fossil-based power generation, and/or other sectors such as road transport, space heating etc. which are currently largely based on fossil fuel consumption but are amenable to electrification. In this chart we have assumed that each kWh of electricity produced by SMRs avoids 400 grams of CO_2 being emitted. The actual amount will depend on the particular combustion activity that is being displaced and could be greater or less than this assumed figure. In the event that some output from the anticipated SMR fleet is used to manufacture sustainable fuels specifically for use by Rolls-Royce products, the lower line would need to be adjusted upwards to avoid double counting with the reductions shown for sustainable fuels.

Applying technical pathways to decarbonise complex, critical systems

Rolls-Royce pioneers the power that matters – power that is central to the successful functioning of the modern world. From land, sea and air transport, to energy generation and powering the built environment, we power, connect and protect society.

Being an integral part of so many systems allows us to play a fundamental role in helping them achieve net zero emissions. This will require a wholesale transformation of the systems that make up the backbone of our global economy, including some of the hardest to abate sectors; transport, energy and the built environment. Our technology levers offer cross-cutting solutions that can deliver significant carbon savings, directly or indirectly.

Transport

Land, sea and air transport contribute 23% of global CO_2 emissions[8]. Air travel contributes 3% of CO_2 emissions today but is expected to increase in proportion as other transport modes decarbonise faster.

Transport has been predominantly powered by fossil fuels; the energy density offered by conventional hydrocarbon fuels allows for efficient travel over long distance. Alternatives such as hydrogen and electrification are becoming established to power land-based transport such as automotive and rail. For shipping and aviation, particularly long haul, the challenge lies in finding a way to transition away from carbon-intensive fuels without compromising levels of connectivity, affordability, comfort and safety.

The actions we are taking to decarbonise transport:

- Continuing to invest in improving the efficiency of the gas turbine, through developments such as our next generation civil aero engine, UltraFan, which will deliver a 25% efficiency improvement over our first generation Trent engines; and reciprocating engines;
- Making all the commercial aero engines we produce, and our most popular reciprocating engines, compatible with sustainable fuels by 2023 and working with our armed forces customers to achieve the same goal for the Rolls-Royce engines they use;
- Increasing the use of sustainable fuels in our product testing and development activities, with an interim measure that 10% of the fuel we use in Civil Aerospace testing and development activities will be SAF by 2023, aligned to the Race to Zero breakthrough goal of 10% SAF usage across aviation by 2030;
- Developing a range of hydrogen products based on fuel cells and hydrogen combustion engines that will be ready for service in the coming years;
- Exploring the application of hydrogen in aviation recognising its potential opportunity as an alternative fuel;
- Working with customers, industry partners and scientific institutions on various initiatives to examine the entire Power-to-X eco-system – from electricity provision to fuel production and finally its use in various applications;
- Actively developing and deploying hybrid-electric and all-electric solutions for use in aviation, marine, and rail, including:
  - Hybrid-electric PowerPacks for rail applications;
  - Integrated hybrid ship propulsion systems for marine applications;
  - Hybrid-electric and all-electric applications for aviation, particularly in the urban air mobility (UAM), commuter and regional markets.

Energy

The provision of heating, electricity and power contribute almost 40% of global CO_2 emissions today, primarily from the extraction and combustion of coal, oil and gas[9]. Demand for electricity is expected to rise in order to meet the need to decarbonise multiple sectors of the economy. That's why decarbonising the production of electricity and making the shift to 100% clean, affordable and reliable energy is a major part of achieving net zero. Renewable energy solutions will need to be scaled, and society will need to draw on other forms of affordable, zero carbon power, like the technologies Rolls-Royce can provide.

Significant future opportunities lie in the pivot of the energy industry to decarbonised solutions, including greenhouse gas removal technologies (or net negative emission solutions), like direct air capture.

The actions we are taking to decarbonise energy:

- Supporting the scale up of renewable energy with our microgrid solutions, which provide reliable back up power and stability of supply to support intermittent renewables such as wind and solar;
- Using microgrids to support the decarbonisation of our own operations and facilities, and to help reduce our reliance on grid energy;
- Creating a consortium with partner organisations to commercialise our small modular nuclear reactor (SMR) concept to deliver low cost, low carbon energy;
- Developing a range of hydrogen fuel cell solutions and targeting to have integrated 2MW of hydrogen fuel cells into operational microgrid demonstrators by 2023;
- Launching a pilot direct air capture (DAC) project in the UK.

Built environment

Cities, infrastructure and buildings, and the energy required to heat and power them, contribute 10% of global CO_2 emissions today. The majority of the world's population lives in cities and that is projected to rise to 70% by 2050.

The actions we are taking to decarbonise the built environment:

- Actively developing and deploying hybrid-electric and all-electric solutions for use in aviation, marine, and rail, that will help decarbonise airports, ports and innercity commuter networks including:
  - Hybrid-electric PowerPacks for rail applications;
  - Integrated hybrid ship propulsion systems for marine applications;

  Hybrid-electric and all-electric applications for aviation, particularly in the urban air mobility (UAM), commuter and regional markets.
- Supporting the scale up of renewable energy with our microgrid solutions, to provide reliable back up power and stability of supply to support intermittent renewables such as wind and solar; and can assist the decarbonisation of facilities such as data centres, hospitals, offices and other aspects of the built environment;
- Creating a consortium with partner organisations to commercialise our small modular nuclear reactor (SMR) concept to deliver low cost, low carbon energy;

Technology levers

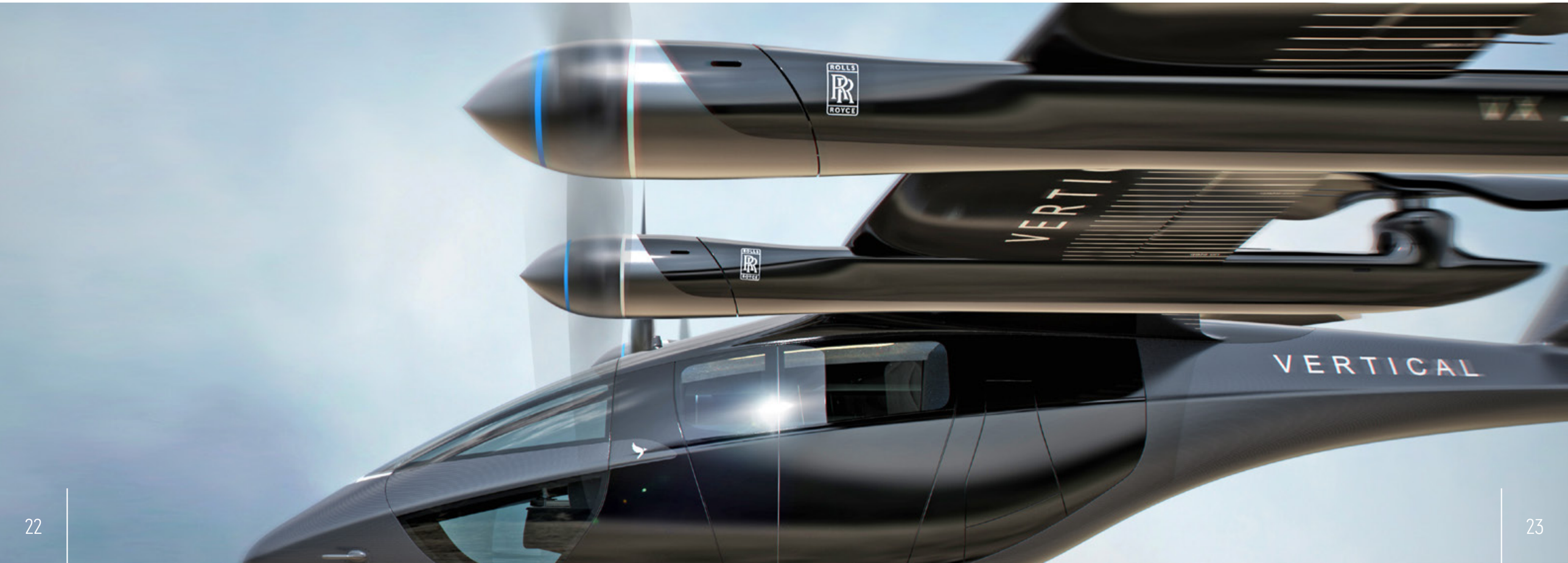
Efficiency gains and engine architecture

Carbon emissions are closely linked to fuel burn. By developing and implementing technologies to improve efficiency, we can substantially reduce the CO_2 impact of our products in operation.

In aviation, thanks to collective industry efforts and contributions from a number of governments and funding partners around the world, flying is cleaner and quieter than ever before with aircraft efficiency increasing by ~1% every year to date. CO_2 emissions per passenger kilometre have been reduced by 80% since the first commercial jet aircraft in the 1950s, with emissions growth decoupled, in relative terms, from traffic growth. Improvements in efficiency will be critical to reaching net zero.

Highly efficient gas turbines will be fundamental for many years, both for larger aircraft, potentially fuelled by SAF, and for hybrid-electric aircraft. More efficient engines such as

Demand for electricity is expected to rise in order to meet the need to decarbonise multiple sectors of the economy. That's why decarbonising power and making the shift to 100% clean, affordable and reliable energy is a major part of achieving net zero.



our UltraFan, co-funded by the UK Government and 25% more efficient than the first generation of Trent engines, will assist in the take-up of SAFs by helping to improve their economics. We estimate that up to 30% more efficiency can be gained from the gas turbine taking into account practical limits in thermal and propulsive efficiency. Beyond that, a fuel burn improvement of up to 5% can be achieved by making the gas turbine more electric.

We are also continuing to increase the efficiency of our reciprocating engines, such as our existing Series 4000 diesel engines for marine applications. Ongoing projects such as efforts to reduce friction in high power gas and diesel engines will drive further emissions reductions. On the ground, we are developing more efficient diesel and gas-powered generators used to power hospitals, data centres, airports, manufacturing plants and independent power grids. Diesel generator sets have been refined to provide high power density efficiently.

Transition to sustainable fuels

Moving away from traditional fossil fuels to lower, and ultimately net zero, carbon fuels will make a significant contribution towards net zero carbon in both transport and energy. Whilst the majority of our products may technically be capable of running on synthetically derived low carbon fuels, we must test and validate their performance, and industry faces significant shortages in supply based in part on the high costs associated with manufacturing such fuels.

We consider the quickest and most achievable solution to significantly decrease product in-service emissions related to CO_2 is through widespread adoption of non-fossil derived fuels, that offer a significantly lower life cycle carbon impact than traditional kerosene.

We have a key role to play in accelerating the availability of sustainable fuels, including advocating for the necessary policy changes and market based measures to stimulate supply, and ensuring all our products are compatible with non-fossil derived fuels, through testing and regulatory approvals.

To accelerate this transition, we are setting out clear short-term targets, connected to executive remuneration, to make all the commercial aero engines we produce, and our most popular reciprocating engines, compatible with sustainable fuels by 2023 and to work with our armed forces customers to achieve the same goal for the Rolls-Royce engines they use. We are also increasing the use of sustainable fuels in our product test activities, with an interim measure that 10% of the fuel we use in Civil Aerospace testing and development activities will be SAF by 2023, aligned to the Race to Zero breakthrough goal of 10% SAF usage across aviation by 2030[10].

Hydrogen as a fuel

Hydrogen has great potential for use as a fuel in transport and energy applications, particularly decentralised energy, marine and rail transport. Within our Power Systems division, Rolls-Royce is developing a range of hydrogen products based on fuel cells and hydrogen combustion engines. We are also exploring the application of hydrogen in aviation, recognising its potential. Hydrogen does need to be created in a sustainable and scalable way across its life cycle through renewable or zero carbon energy (green hydrogen).

Power-to-X

E-fuels such as e-hydrogen, e-methane, e-methanol, e-diesel or e-ammonia, which are produced in a process called “Power-to-X” (PtX) from renewable energy sources, can be converted into electricity and propulsive power. We are currently working with customers, industry partners and scientific institutions on various initiatives to examine the entire PtX eco-system – from electricity provision to fuel production and finally its use in various applications. E-fuels, produced from clean electricity, have an important role to play in the transition to net zero.

Electrification & hybridisation

We are actively developing hybrid electric and all-electric solutions for use in aviation, marine and rail. Hybrid-electric solutions typically use a combustion engine to produce power for an electrical system (in a configuration known as serial architecture) or they can combine a conventional engine with a parallel electrical drivetrain (parallel architecture). These systems work well in the rail and marine environments where there are frequent shifts between low and peak load. The electric motor is used for the peak load and the combustion engine for other load ranges. Hybrid-systems can also be operated in electric-only mode where needed, for example within inner cities for rail applications or within harbours for marine applications. These solutions have lower emissions as well as other benefits for urban environments, such as low noise. In the rail industry we have developed a hybrid-electric PowerPack, and in marine we have developed a range of integrated hybrid ship propulsion systems.

In aviation, there are opportunities for hybrid-electric and all-electric applications, particularly in the urban air mobility (UAM), commuter and regional markets.

Through our ACCEL project and with support from the UK Government, we are aiming to build the world’s fastest all-electric plane. The zero-emission Spirit of Innovation single seater aircraft is powered by a unique 6,000-cell battery pack. It has a range of about 200 miles on a single charge and a target speed of 300mph (480kph) or more. We will be using the technology from this project and applying it to products for markets including UAM.

Our electrical power system is also set to power Vertical Aerospace’s flagship UAM aircraft. This will be integrated into the piloted all-electric vertical take-off and landing (eVTOL) vehicle, which will carry up to four passengers for 100+ miles at cruise speeds of over 200mph and is on course to certify in 2024. We have also joined forces with airframer Tecnam and Widerøe, the largest regional airline in Scandinavia, to deliver an all-electric passenger aircraft for the commuter market, tergeted to be ready for revenue service in 2026.

Microgrids

Rolls-Royce is at the forefront of developing and delivering microgrids. Microgrids are electricity distribution systems containing energy sources such as diesel or gas generators, combined with solar and other renewable energy and energy storage that can be operated in a controllable, coordinated way. They can either function off-grid or be connected to the main power grid. The ability of microgrids to seamlessly balance the energy demand and production at local level is important for a resilient grid and supporting remote communities. A further benefit is the ability to separate a microgrid from the main grid in the event of a potential power outage or emergency, as a decentralised energy solution. We are using microgrids to support the decarbonisation of our own operations and facilities, and to help reduce our reliance on grid energy. Microgrids, coupled with on-site renewable power, are installed at our Friedrichshafen, Germany, and Aiken, US, sites and we will soon begin construction at our Bristol, UK, site.

Nuclear SMRs

As a constant and reliable energy source, nuclear power provides stability to electricity grids and, alongside renewables, will play an important role in the transition to a net zero carbon economy. We have brought together the UK SMR Consortium, a cross-sector collaboration of engineering, manufacturing and construction partners.

The consortium proposes the construction of 16 SMRs in the UK, each with a generation capacity of 470 MW, in a plan that could produce around 20% of the country’s grid

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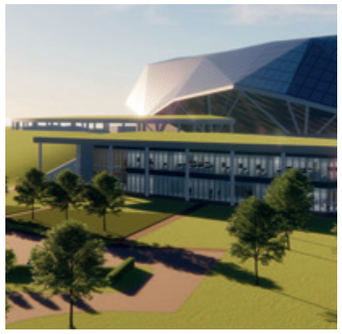
energy by 2050. With each power station designed to operate for at least 60 years, the proposal could generate long-term green jobs, skills and prosperity in communities across the UK. Outside of the UK, fleets of SMRs could form the backbone of decarbonised, decentralised and flexible energy systems across the world.



Nuclear power stations are designed to feed into low carbon electricity grids, however their high power output relative to their size also opens up further applications. They could, for example, produce zero carbon power for energy-intensive activities, such as smelting, chemical processing, desalination, and other industrial processes. SMRs also have potential application as a route to the production of sustainable fuels, including SAFs for aviation, hydrogen or other e-fuels, through the provision of low cost, reliable power.

Fuel cells

Fuel cells have the potential to accelerate the energy transition.

They convert a fuel's chemical energy directly into electricity which can then be used to power a growing number of electrified systems. This makes them especially useful for stabilising the supply of energy for emergency power generation and as a supply of power for mobile applications. When powered by zero carbon fuels, such as green hydrogen, a fuel cell offers a zero carbon energy solution.

We are developing a range of hydrogen fuel cell solutions including stationary fuel-cell generators which can provide net zero carbon emergency power generators for safety-critical facilities such as data centres. We are also targeting to have integrated 2MW of hydrogen fuel cells into operational microgrid demonstrators by 2023.

Direct air capture (DAC)

We are actively developing new technologies that can deliver net negative carbon emissions, particularly direct air capture (DACs). In partnership with the CSIRO, the Australian Government agency responsible for scientific research, we are in the early stages of implementing a UK-based concept development programme capable of removing more than 100 tonnes of CO_2 per year from the atmosphere.

Battery storage technologies

We are advancing battery technologies across our business. Decentralised energy storage is vital to stabilising the supply of renewable energy to the grid and enabling remote, off-grid power generation, anywhere in the world. Battery packs act as buffer storage units to resolve quality or stability problems in power supplies and to compensate for fluctuations in the grid, especially in combination with renewable energy sources like solar and wind. Our MTU EnergyPacks, for example, already provide low carbon grid stability on islands in the polar sea and store solar power in Costa Rica and the South Seas. For the production of these battery containers, we have expanded our plant in Ruhstorf, Germany, to a capacity of up to 50 units per year.

In aviation, we are developing energy storage solutions to complement our electrical propulsion systems to ensure that we can offer our customers the complete package for their platform whether that is an UAM or a commuter aircraft. Battery pack design is inherently a mechanical, thermal and containment design challenge with a strong focus on safety and low weight. These skills are core to all the products that Rolls-Royce has a long history of delivering into aerospace. This makes us ideally placed to deliver industry leading solutions and to be at the forefront of providing propulsion systems across the aviation sector. For example, the Spirit of Innovation aircraft will have an advanced battery and propulsion system that is ground-breaking in terms of electrical technology. This system and the capabilities being developed will help position us as a technology leader offering power systems to the UAM market.

CREATING AN ENABLING ENVIRONMENT

The successful execution of our decarbonisation plan is dependent on the external landscape within which we operate; to achieve the monumental shift required to reach net zero will require collaboration and action across all parts of the value chain and wider economic system in which we operate.

For Rolls-Royce, two core externalities are critical to our ability to deliver our strategy: the pace and prioritisation of technological solutions, and global consistency and collaboration in policy. Determining these externalities is beyond the control of any individual company or sector, but we have identified tangible actions we can take at a global level, and in our interactions with national governments and policy makers, trade associations and other partners.

Global policy principles

Decarbonising the complex, critical systems in which we operate will require collaboration and consistency in policy. We consider that there are five core policy principles which national governments and other policy makers should take account of. These underpin our net zero advocacy. They are aligned with the framework for decarbonising heavy industry set out by The Climate Group[11] and the sector breakthrough goals of the UN Race to Zero campaign.

1. **Global consistency**
   Governments should look to take national leadership on climate action, but effective co-ordination and consistency in policies between countries and regions should be established to ensure consistent regulation across operating landscapes and ultimately prevent emissions leakage between economies. Governments can embrace this convening role to drive positive change and technology uptake.

2. **Prioritise technological solutions**
   Solutions that can abate or remove greenhouse gas emissions should be prioritised over measures that look to neutralise (or offset) emissions. Policies should be agnostic on the technological solution to stimulate innovation. While compensation actions may have an important role to play in mitigating emissions in the shorter term, the successful achievement of a 1.5ºC future will depend on the absolute reduction of emissions best delivered through a technology driven transition, including low, zero and ultimately, in the longer term, net negative emission technologies. Public financing should be invested in the development and deployment of these technologies.

3. **Inclusive growth and opportunity**
   Policies and investments must ensure that industrial transformation and the transition to net zero is sustainable, creates green and inclusive growth and job opportunities, and ultimately meets both the immediate and long-term needs of society – supporting growth and not inadvertently creating negative impacts on people or the natural environment elsewhere – particularly in the aftermath of the COVID-19 pandemic.

4. **Consider the life cycle impact**
   Policies should drive demand for efficient and circular practices to engage and incentivise action across the entire end-to-end value chain. This must ensure that the energy transition protects biodiversity and nature, human health and social mobility, and economic growth, and does not have an inadvertently negative impact on developing economies.

Decarbonising the complex, critical systems in which we operate will require global collaboration and consistency in policy. Five core policy principles underpin our net zero advocacy.

5. **Mobilise finance**
   Innovation in net zero technologies must accelerate rapidly and public R&D spending can play a key role in unlocking solutions, attracting and leveraging private investment and in boosting deployment levels to reduce costs. Appropriate carbon pricing can play an important role in levelling the economics of decarbonised systems.

National policy levers

National governments and policy makers have a critical role to play in creating the necessary policy environment to incentivise and enact a global transition to net zero carbon. Governments set the ambition to which businesses can deliver and it is the contract between governments and business that will drive the pace and impact of decarbonisation levers. As we approach COP26 we see a fundamental role for national governments in setting ambitious, technology-led, commitments to address climate change which will act as a necessary precedent to company action.

We believe there are a number of ways we can collaborate with governments to deliver and potentially accelerate our decarbonisation strategy, with governments acting as:

- customers;
- research, technology & development funders and supporters;
- policy makers and regulators;
- conveners; and
- promoters of net zero technology exports.

As our technology levers and breakthrough technology solutions mature and scale we will work with national governments and supranational bodies to help create the policy and regulatory environment for their adoption.

Leveraging our convening power to unlock decarbonisation solutions

Rolls-Royce is proud to be a signatory to the UN Race to Zero campaign and to be committed to the global target of net zero carbon by 2050.

We have responded to this global call for action and the technologies in which we are investing are critical to the delivery of this global ambition, but it will require real collaboration across borders, sectors and technologies and we cannot do it alone.

Our industry partners have a crucial role to play in accelerating the journey to a net zero carbon future, and we are working closely with our peers to not only seek new technological collaborations, but also to encourage the adoption of an advocate position on net zero and the sector breakthroughs we need. In addition, we are reviewing the climate policy positions of the trade associations and industry groups we are members of to understand alignment with our climate commitments. Where there is a divergence between our climate position and those of our partners, particularly trade associations, we will work with them to seek to reconcile those divergences where we can and where appropriate, particularly advocating for climate commitments in line with the Paris Climate Agreement goals.

We will continue to play a role in convening partners across complex systems to converge on technological solutions, such as the recent maritime summit we hosted.

Engaging our partners and seeking new collaborations to accelerate our journey

Rolls-Royce technologies sit at the heart of complex critical systems. Reaching net zero carbon in those systems will require collaboration across all dimensions. We will need to work across borders, industries and technologies to succeed, with partners who are equally driven towards creating critical system breakthroughs, in areas such as low carbon alternative fuels. Along our value chain we have opportunities to reduce emissions through targeted engagement both upstream and downstream, as well as opportunities to learn from best practice and collaborate to address common challenges. We will work with existing partners, including customers, to help them realise their own net zero ambitions, and encourage further commitments and action where appropriate.

The actions we are taking to engage and advocate for the enabling environment we need:

- Engaging our government partners in our core geographies in support of the policy principles set out above;
- Advocating for partners in our value chain, both upstream and downstream, to join us in the Race to Zero and in committing to reach net zero by 2050 at the latest;
- Working with industry groups and trade associations to accelerate climate commitments in line with the Paris Climate Agreement goals;
- Reviewing the climate policy positions of the trade associations and industry groups we are members of to understand alignment with our climate commitments;
- Working with existing partners, including customers, to help them realise their own net zero ambitions, and encourage further commitments and action where appropriate.

Challenges to consider

The successful execution of our decarbonisation plan is dependent on the external landscape within which we operate; achieving the monumental shift required to reach net zero will require collaboration and action across all parts of the value chain and wider economic system.

Our decarbonisation plan will continue to evolve over time in response to external factors beyond our immediate control, including the pace and prioritisation of technological solutions, global consistency and collaboration in policy, regulation and law, and the ability and willingness of suppliers and customers to engage and implement.

We have set out the actions we are taking across the short and medium term to meet our net zero commitments, however there are challenges to consider in order to reduce emissions across our footprint, particularly where these emissions fall outside our immediate control and influence, including but not limited to:

Emissions from sold products	Inability to control customers' choice of fuel, which in some cases is controlled by regulation, and their use of final products. Lack of availability of sustainable fuels including as a result of lack of policy in this area. Potential lack of customer engagement. High costs of manufacture of synthetically derived low carbon fuel. Continued requirement to use certified fuels for certain testing activities, which are not currently sustainable fuels. Testing and validation of product performance using sustainable fuels.
Supply chain	Potential lack of supplier engagement. The need for innovations in material supply and potential shortage of raw materials.
Facilities/Business travel/commuting	The need for new techniques and solutions in energy efficiency to be developed and scaled.

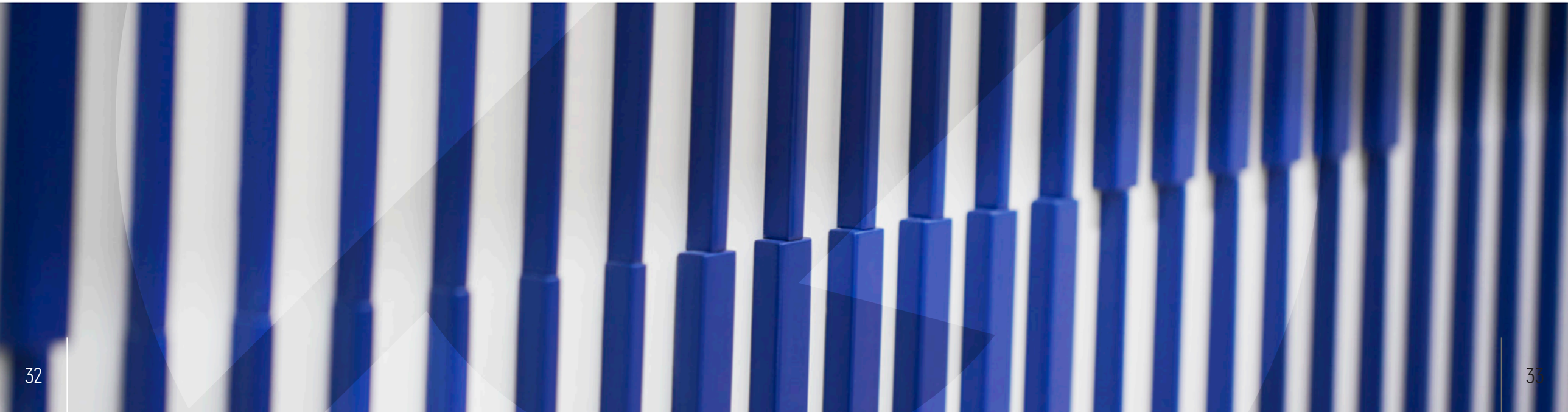
In addition to emission reduction challenges, we will continue to face other risks and uncertainties which may impact our ability to execute our decarbonisation plan, including but not limited to:

- the varied and ongoing effects of the COVID-19 pandemic;
- disruption to business continuity (including natural hazards, political events, financial insolvency of a critical supplier, scarcity of materials, loss of data or fire);
- the competitive environment;
- compliance with existing and new legislation and regulatory policy;
- cyber threats;
- market and/or financial shock;
- the geopolitical environment (including changes in key political relationships, explicit trade protectionism, differing tax or regulatory regimes, potential for conflict or broader political issues, and heightened political tensions); and
- the attraction and retention of highly skilled employees.

Given the multiplicity of potential challenges, progress to achieving our decarbonisation plan may at times be unavoidably hindered.

This report may contain projections and forward-looking statements. The words "believe", "expect", "anticipate", "intend" and "plan" and similar expressions identify forward-looking statements. All statements other than statements of historical facts included in this report, including, without limitation, those regarding Rolls Royce's (the Company) financial position, potential business strategy, potential plans and potential objectives, are forward-looking statements. Such forward-looking statements involve known and unknown risks, uncertainties and other factors which may cause the Company's actual results, performance or achievements to be materially different from any future results, performance or achievements expressed or implied by such forward-looking statements. Such forward-looking statements are based on numerous assumptions regarding the Company's present and future business strategies and the environment in which the Company will operate in the future. Further, certain forward-looking statements are based upon assumptions of future events which may not prove to be accurate. The forward-looking statements in this report speak only as at the date of this report and the Company assumes no obligation to update or provide any additional information in relation to such forward-looking statements.

The merits or suitability of investing in any securities previously issued or issued in future by the Company for any investor's particular situation should be independently determined by such investor. Any such determination should involve, inter alia, an assessment of the legal, tax, accounting, regulatory, financial, credit and other related aspects of the transaction in question.



OUR DECARBONISATION PLAN ON A PAGE

Making Rolls-Royce a net zero company	Mobilising our value chain	Decarbonising complex critical systems
2030 Achieving zero greenhouse gas emissions from our operations & facilities	**68%** Recovering and recycling 68% of material within our operations	**Pioneering new technologies** to accelerate the global transition including electrification, hydrogen, SMRs, fuel cells, battery storage & microgrids
2023 Making all in-production civil aero-engines **100% SAF** compatible	Identifying high **carbon impact** areas of our supply chain for priority intervention	Further **advancing the efficiency** of our engine portfolio through next generation technologies
2023 Have the majority of Power Systems engines ready for **sustainable fuels**	Convening our high performing suppliers to share **best practice**	**2030** **Ensuring new products are fully compatible with net zero**
Continuing our **waste action programme**	**Implementing lower carbon** solutions with logistics & transport providers	**75% of R&D** invested by 2025 in lower carbon and net zero technologies
Developing a net zero **manufacturing** strategy to reduce carbon impacts	Developing a net zero manufacturing **strategy**	Linking **executive remuneration** to the technology levers that will accelerate the net zero transition
Further investing in on-site renewable energy generation and the **purchase of renewable electricity**		**Advocating for the sector breakthrough goals** identifed by the UN Race to Zero campaign for the critical, complex systems we are part of

We have pledged to achieve **net zero carbon** in our operations by 2030, be a net zero carbon business by 2050, and play a crucial role in enabling the sectors in which we operate reach **net zero by 2050**.

Our new products will be **compatible with net zero operation by 2030** and **all** our products will be compatible with net zero by 2050.

Setting targets to get our products compatible with sustainable fuels by **2023** we will:

- Have proven **all our in-production commercial aero engine** types compatible with **100% SAFs**, two-thirds of Trent engine fleet* and three-fifths of business jet fleet**;
- Have replaced 10% of the fuel we use in all Civil Aerospace testing and development activities with SAF;
- Show compatibility with sustainable fuels for our in-production Defence engines, subject to customer agreement;
- Have certified in-production Series 2000 and Series 4000 engines from Power Systems with sustainable fuels, our most popular reciprocating engines***, they represent the majority of our reciprocating engines;
- Have integrated 2MW of hydrogen fuel cells into operational microgrid demonstrators by 2023.

Defining a **science-based interim target** to reduce the **lifetime emissions** of new sold products from our Power Systems business by **35% by 2030**, relative to 2019. We are finalising our detailed roadmap and targets for 2030 and this will happen later this year.

*Trent XWB-97, Trent XWB-84, Trent 7000, Trent 1000 TEN, Trent 700; based on 2019 installed engine fleet.
**Pearl 700, Pearl 15, BR725 and BR710 based on 2019 installed engine fleet.
***Compliant with DIN EN 15940

GLOSSARY & REFERENCES

Glossary

1.5ºC trajectory
A pathway of greenhouse gas emissions that provides a significant chance of limiting global warming to below 1.5ºC or returning to 1.5ºC by around 2100 following an overshoot.

Additive layer manufacturing
A modern fabrication process that builds up successive layers of three-dimensional parts in two-dimensional layers enabling the manufacture of complex, interlinked components using a variety of materials. It is commonly referred to as 3D printing.

Carbon offsetting
Reducing greenhouse gas emissions or intensity caused by one emissions source to compensate for emissions made elsewhere.

CO_2e
Carbon dioxide emissions equivalent. This is a proxy for measuring and summing the cumulative effect of GHGs.

COP26
A global United Nations Climate Change Conference that will be held in Glasgow, UK in November 2021.

Direct air capture (DAC)
The process of capturing carbon dioxide directly from the air and generating a concentrated stream of carbon dioxide for sequestration or other uses.

Greenhouse gas emissions (GHGs)
Gases that absorb heat to create a warming effect, including carbon dioxide (CO_2), methane, nitrous oxide (N_20) and water vapour.

Intergovernmental Panel on Climate Change (IPCC)
The United Nations body for assessing the science related to climate change, including assessing scientific, technical and socioeconomic information relevant to understanding the scientific basis of risk of human-induced climate change, its potential impacts and options for adaptation and mitigation.

Interim targets
Shorter term (between 5 to 10 years) decarbonisation targets, which apply before a longer-term net zero target.

Near net forging
A manufacturing process that produces components that are close to the finished size and shape, requiring a minimal amount of finishing processes such as machining.

Net zero carbon
Net zero carbon for a company refers to the systems level reduction of value chain greenhouse gas emissions, in line with a 1.5ºC trajectory, and balancing the impact of any remaining greenhouse gas emissions with an appropriate amount of carbon removals.

Paris Climate Agreement
A multilateral agreement to hold the increase in global average temperature to well below 2ºC above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5ºC, recognising this would significantly reduce the risks and impacts of climate change. The agreement also aims to strengthen the resilience and adaptation capability of countries in the face of climate change. It was adopted by 196 Parties to the United Nations Framework Convention on Climate Change (UNFCCC) at COP21 in 2015 in Paris.

Science-Based Targets initiative (SBTi)
A NGO-led partnership that works with businesses to define and promote best practice in emissions reductions and net-zero targets in line with climate science.

Scope 1, 2 and 3 emissions
Categories of a company's greenhouse gas emissions footprint as defined by the GHG Reporting Protocol.

Small Modular Reactors (SMRs)
Nuclear reactors with a smaller output than conventional large scale power plants, designed with modular technology using module factory fabrication, pursuing economies of series production and short construction times.

Sustainable Aviation Fuels (SAFs)
Sustainable fuels for application specifically in aviation.

Sustainable fuels
Collective term for non-fossil based fuels for application across multiple sectors, including transport and power generation. Typically, these fuels come from sources with a neutral or negative carbon footprint and can be produced using biological sources or through capturing carbon and combining it with sustainably manufactured hydrogen.

UN Race to Zero campaign
A UN-backed global campaign rallying non-state actors – including companies, cities, regions, financial and educational institutions – to take rigorous and immediate action to achieve net zero emissions by 2050.

Value chain
The set of activities and stakeholders involved throughout the lifecycle of the products and/or services that a business delivers.

Well below 2ºC trajectory
A pathway of greenhouse gas emissions that provides a significant chance of limiting global warming to well below 2ºC above pre-industrial levels.

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