Decarbonising Aviation: CLEARED FOR TAKE-OFF

Industry Perspectives

EXECUTIVE SUMMARY

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INTRODUCTION

Aviation connects people, provides global access to goods and services, and has played a vital logistical role in the fight against COVID-19. It is fundamental to the world economy and in 2019, supported $3.5 trillion (4.1%) of the world’s GDP. In the same year, before the pandemic, 4.5 billion passengers took flights. But it was also a source of around 3% of global carbon dioxide emissions. And aviation could represent up to 22% of global emissions by 2050, as other sectors decarbonise more quickly.

There is a lot at stake when it comes to the future of aviation. If the industry is to cut carbon emissions at the speed and scale needed, it must act together to make change. The International Air Transport Association, which represents most of the world’s airlines, aims to halve net emissions by 2050 (from 2005 levels). But the industry must go further and faster if it is to achieve net-zero emissions.

This means not only setting out a clear route to net-zero emissions but showing greater ambition and stronger leadership. Roughly half the industry has committed to achieving net-zero emissions by 2050, including suppliers such as Shell, but we must all do more – and collaboration is critical.

We have to work together to understand the challenges, then identify and agree on solutions. This report is a starting point. It brings together more than 100 aviation business leaders and industry experts representing 68 global organisations. I would like to thank them all for their time, energy and enthusiasm. The resulting report explores the sector’s net-zero targets and what is needed to meet them. The report seeks to answer three key questions: why the sector should change, how it can change and how fast this change can happen. It is accompanied by a report on the actions Shell itself is taking. At Shell we are exploring routes to zero-carbon aviation, including hydrogen, sustainable aviation fuels (SAF) and nature-based solutions.

The report shows how a complex industry has the potential to make even greater progress, provided the right parties – government, customers, energy companies or airlines – are aligned on the right actions. Take SAF, perhaps the most promising of today’s solutions for cutting carbon emissions. There are still many challenges before it can be deployed at the scale needed. They include the need for greater availability of raw materials, better supply infrastructure and clearer policy to encourage production. These elements have to come together – and the faster, the better.

So, whether your employees would normally fly for business, or your company transports cargo by air, or you are an airline hoping to use more SAF – we invite you to collaborate with Shell. Together, we can work to identify opportunities to lower carbon emissions in your operations and help the sector achieve net-zero emissions by 2050.

This is the third report we have published with Deloitte on decarbonising sectors where low-carbon change is hardest to achieve. All three share a common message: whether you operate exclusively in aviation or have a supply chain that also spans road freight or shipping, it is time for action.

As Executive Vice President of Shell’s Sectors & Decarbonisation business, I believe these reports show how much potential there is for change if we act quickly enough. The industry has a chance to reset after the global shock of the pandemic. By working together, I believe we can make the aviation sector fit for a net-zero world.
REPORT OBJECTIVES

This report reflects the perspectives of over 100 executives and experts, representing 68 organisations across almost all segments of the aviation sector, complemented with input from 6,000 travellers worldwide, both leisure and corporate. (see Exhibit 01). It aims to:

- **Take a comprehensive view.**
  Many decarbonisation studies focus on specific challenges or stakeholder groups in isolation. Given the interdependency of factors, the sector needs a more comprehensive view, which includes economic, regulatory and organisational factors. This report builds on the existing body of knowledge in the market.

- **Accelerate the pathway to net-zero.**
  Aviation experts who participated in this research are at a point where they need to make decisions around decarbonisation. We worked with them to converge on a set of solutions and a flight plan that can help the industry act now and clarify the path forward.

- **Reflect the voice of the sector.**
  No one stakeholder group can do this alone, and everyone will have a role to play. It is essential to understand the unique motivations and challenges of different groups and locations, for the sector to be able to take collective action that will make an impact.

This report reflects the insights industry executives and experts shared with us through interviews and working sessions with the industry, not the views of Shell or Deloitte. All engagements with participants were conducted in a manner that respects competition law boundaries.

**102 aviation executives and experts...**

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...and 6,000 travellers worldwide

| 3,000 leisure travellers | 3,000 corporate travellers | Across 6 countries: Australia, Canada, China, Germany, UK and USA |

**Note:** Regions indicate organisations’ headquarters. Most organisations involved operate globally. Aviation executives and experts were consulted in individual one-on-one interviews. Travellers were consulted through a detailed survey. OEMs refers to original equipment manufacturers.
Executive Summary
Aviation is fundamental to the world economy, supporting $3.5 trillion (4.1%) of the world’s GDP. It helps foster cultural exchange and provides global access to goods and services. Throughout the COVID-19 pandemic, the industry has provided vital logistical support in the fight against the virus: empty planes have been modified to carry personal protective equipment (PPE), vaccines and other essential cargo. The sector also connects people around the world. The lockdowns of the past two years have accentuated the need for human contact, and aviation allows people to fly to see friends, relatives and business relations.

But aviation is also a source of around 3% of global carbon dioxide (CO₂) emissions, and as the global economy continues to develop in the coming years – with new parts of society joining the middle class – aviation volumes will grow. The pandemic may have caused some changes to the future of air travel, as people find new ways to meet virtually and work remotely. But the long-term forecasts suggest that overall, COVID-19 is unlikely to have a lasting impact on aviation volumes. If nothing is done, emissions are expected to more than double by 2050 (from 2019 levels).

Through our engagement with over 100 executives and experts across the global aviation industry, we have broken down what is often seen as an insurmountable problem into manageable components. We did that by focusing on three core questions: Why should the sector change? Can the sector change? How fast can the sector change? This produced nine main research highlights (see Exhibit 02).

## Research highlights

| Why should the sector change? | 1. Aviation has often been considered a sector that will decarbonise later than others, because of the complexity involved and the view that aviation accounts for “just 3% of global emissions”. But there is a need to act now. |
| Can the sector change? | 2. The sector is facing several barriers to decarbonisation, mainly: • targets are insufficiently ambitious, unsupported by local regulation, and constrained by the perceived need for international alignment; • cost of Sustainable Aviation Fuel (SAF) is prohibitively high, with many in the sector expressing uncertainty about how to reduce it and concerns about the availability of feedstock; • leisure passengers are reluctant to absorb the cost of lower emission solutions; and • concerns about offsets relating to quality, transparency and communications lead to limited uptake. |
| How fast can the sector change? | 3. Long-term customer demand enabled by recognition mechanisms and differentiated propositions will play a fundamental role in providing the funding and incentives for airlines to invest in lowering their emissions. |
| | 4. Country- and region-based policy incentives relating to supply and demand will accelerate the adoption of SAF and regulation at regional and global level. |
| | 5. Offsets can play an essential role in funding the early stages of decarbonisation. But for this to happen, they must be made more transparent and verifiable. They need to be more emotionally appealing to passengers, and their impact should be clearer. |
| | 6. Choosing SAF as the primary means of decarbonisation will have a disproportionate impact on lowering emissions, because there is no need to redesign aircraft. As a result, investments and R&D efforts can focus mainly on scaling production and lowering cost. |
| | 7. Collaboration with other sectors is essential to the successful deployment of SAF. It can drive down the cost of required technologies, such as hydrogen production, direct air capture and biomass conversion, and ensure effective use of scarce resources. |
| | 8. The pathway to decarbonisation needs to be more ambitious and investments need to start sooner to address societal expectations, reach sufficient SAF volumes and bring down cost to the levels required for large-scale adoption within 15 years. |
| | 9. Individual initiatives should be integrated into comprehensive plans representing all points along the value chain – from energy producers to end-customers. These plans should be systematically deployed in areas with favourable policies, market conditions, and access to SAF. |
Aviation has been excluded from some major efforts to tackle climate change, because decarbonising the sector is perceived as complex and it currently accounts for 3% of global emissions. For example, aviation was excluded from the Paris Agreement on climate change and partly excluded from the EU Emission Trading System (ETS), which only counts flights within the EU.

“Policymakers and those within the sector use the proportionately low emissions as an excuse to defer action,” said one NGO.

But, as other sectors decarbonise, aviation’s share of total emissions will increase. Many participants in this research said that it is now time to increase the global focus on aviation decarbonisation. We have a chance to redefine the way we fly; to break the link between aviation and emissions.

To make meaningful progress in reducing emissions in the next 20-30 years, the aviation sector must make more use of the options available now.

One of the most important of these options is sustainable aviation fuel (SAF). It comes in a variety of forms, the large majority of which have lower life-cycle greenhouse gas emissions than conventional fossil fuels. All forms of SAF have the further advantage of being drop-in fuels, meaning they can be used without the need for major changes to aircraft design or supporting airport infrastructure.

Offsets are another option that is available now. They allow passengers and other people in the aviation industry to compensate for the emissions by buying carbon credits generated by projects that either reduce the global stock of greenhouse gases - for example, by using plants to absorb CO₂ - or avoid adding to it - for example, by preventing deforestation. The result can be net-zero emissions, such as when the CO₂ emitted by a flight is cancelled out by the greenhouse gas absorbed by the offset project.

Interviewees suggested that these two options should be the priority to reduce emissions in the short term. At the same time, the sector must work to continue improvements in aircraft and operational efficiency, and develop the alternative propulsion technologies, such as batteries and hydrogen. These technologies offer the possibility of zero-emission flying, but changing to them will be much harder than switching from kerosene to SAF. By starting to develop alternative propulsion technologies now, they could become viable for some applications by the late 2040s and 2050s.

Aviation is a highly concentrated industry, meaning that a relatively small number of manufacturers, airlines and airports have a large share of their respective markets. This concentration of market share and influence means decisions can be made relatively quickly and have a global impact. But the sector’s long investment horizons and fleet renewal cycles mean that aviation must act now to sufficiently reduce emissions by 2050.
Targets are insufficiently ambitious, unsupported by local regulation, and constrained by the perceived need for international alignment. This creates a widespread wait-and-see approach across the sector. “Targets without incentives - or without clarity on when those incentives will come - paralyse the industry participants,” said an airline representative.

Cost of SAF is prohibitively high, with many in the sector expressing uncertainty about how to reduce it and concerns about the availability of feedstock. SAF today is two to eight times more expensive than traditional jet fuel, depending on the feedstock. If all kerosene on a typical long-haul flight were replaced with SAF tomorrow, without any policy incentives, this would equal an increase of 30–200% of airline operating costs or ticket prices. Within decades this could break even, as supply and demand grows and the cost of carbon increases. Bio-SAF, which is made from plant or animal material, such as crops, forestry or agricultural waste, is currently the cheapest form of SAF available, but its supply is structurally constrained and costs are likely to increase as readily available feedstocks are exhausted. Synthetic SAF is made using hydrogen obtained from low-emission sources and CO₂ captured from other industrial processes or captured from the air. The technology behind synthetic SAF is less developed than that for bio-SAF, so production costs are considerably higher. Synthetic SAF also competes with other sectors for hydrogen supplies, but it is thought that towards 2050 it could be cheaper and produced in bigger volumes than bio-SAF.

Leisure passengers are reluctant to absorb the cost of lower emission solutions, because they have come to expect cheap air fares and do not feel personally responsible for emissions. “It will be very difficult to pass an extra cost for sustainability to passengers who choose the cheapest seat,” said an interviewee from a research and development (R&D) organisation. Although 85% of surveyed leisure passengers say they are willing to pay to offset emissions, less than 1% do in practice. At the same time, corporate travel is likely to reduce in share after the pandemic, putting more pressure on airline margins, which might impact ticket prices for all passengers.

Concerns about offsets relating to quality, transparency and communications lead to limited uptake. Some offsets are perceived to be of low quality and the market is fragmented with many standards and project types. Many relate to projects that have happened in the past, in places far removed from where emissions occurred, and with no clear link between the payment and the reduction of greenhouse gases. “People expect that when they pay for offsets, actual trees are planted somewhere in the world, and it’s still questionable whether that is happening or not,” said an aircraft operator. As a result, offset uptake is limited, which makes it difficult for the aviation sector to compensate for its emissions during the period when it is developing other ways to decarbonise.
These four barriers were mentioned most frequently by interviewees, but they also identified barriers relating to all six of the readiness factors listed in the Exhibit 03. One manufacturer said: “If you don’t have the assets, infrastructure, political support and the customers’ willingness to move, you will not proceed. All these elements have to be in place, and everyone has to be aligned – and we have to work on all those together.” As the manufacturer’s comment might suggest, “softer” barriers are also preventing the industry from making progress, such as an incremental mindset, a lack of co-operation across the sector, and the tendency to work on many scattered and small-scale initiatives, instead of approaching the problem in an integrated way.

Overall, while aviation is a hard-to-abate sector, drop-in fuels will reduce the need for new aircraft and infrastructure. Sectors like road transport will need to change the asset fleets, produce the alternative energy carriers like batteries and hydrogen, and set up the infrastructure required to supply them. Aviation can take advantage of existing aircraft and refuelling infrastructure.

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**03 Barriers to decarbonising aviation**¹

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Notes: ¹ Based on SAF drop-in solution. Ease of asset replacement and ease of infrastructure replacement will be more of a barrier for battery electric and hydrogen aircraft.
Large corporate flyers like big tech, financial institutes and consultancies, and cargo shippers like food and electronics manufacturers need to lead in creating demand for lower-emission aviation. Their own net-zero ambitions require them to reduce emissions from employee travel and transporting goods. Many of these customers are less price-sensitive than leisure passengers, because air travel typically accounts for a relatively small proportion of their costs. Aggregating the corporate demand for SAF and offsets creates a market pull that incentivises airlines to act.

Leisure passengers must also be encouraged to play their part, through offers related to SAF and offsets that reward customers for supporting decarbonisation. These rewards can either be functional, such as priority boarding or meal upgrades, or more emotional, such as dedicated seats or waiting areas. One airline said: “We started offering more loyalty points for customers who use offsets, and adoption grew well beyond the 1% industry average.”

Net-zero targets need to be set for 2050, with ambitious interim steps for 2030, to align aviation with the rest of the energy system, and to create the urgency to act now. Targets should be underpinned by policy measures. On the supply side, fuel producers can be triggered to invest in producing SAF through blending mandates, contracts for difference, tax credits and market-based incentives like California’s Low-Carbon Fuel Standard. On the demand side, incentives around buying choices can be created by route restrictions, pricing mechanisms and fossil-fuel taxation – for example, a carbon tax or an emissions trading scheme.

The sector does not need to wait for global regulatory alignment – country- and region-based policies that target key transportation hubs and flagship routes will go a long way to creating momentum. Examples can be found in recent announcements in the UK to include aviation in the national footprint, and Germany’s synthetic-SAF roadmap.
Offsets have an immediate role to play in helping aviation to reduce its net emissions. They will be particularly important during the time it takes to fully develop other ways to decarbonise the sector.

Offsets will probably also play a role in the longer term, while SAF supply and demand scales, and to address the remaining 20–40% of emissions relating to bio-SAF.

With this in mind, the sector must address the concerns about offsets. Aviation must better communicate the important role they can play in decarbonisation. It must make sure that all offsets are subject to rigorous standards and assurance mechanisms, and that customers know this. Offsets can be made more emotionally appealing to customers by including more projects that remove CO₂ rather than those that avoid emitting it, as well as more projects that are closer to passengers’ homes and businesses. The way offsets are marketed and sold should also be improved – for instance, by moving towards an opt-out rather than an opt-in approach.

Interviewees flagged “insetting” – where funds raised are used directly within the sector – as an example for how the industry could keep investments within the sector to promote R&D and SAF production.

**5. RESEARCH HIGHLIGHT**

Offsets can play an essential role in funding the early stages of decarbonisation. But for this to happen, they must be made more transparent and verifiable. They need to be more emotionally appealing to passengers, and their impact should be clearer.

**6. RESEARCH HIGHLIGHT**

Choosing SAF as the primary means of decarbonisation will have a disproportionate impact on lowering emissions, because there is no need to redesign aircraft. As a result, investments and R&D efforts can focus mainly on scaling production and lowering cost.

Using SAF as the main way to decarbonise in the next 20 to 30 years creates focus. By converting a few production sites to bio-SAF around key hub airports, entire routes and even regions can be decarbonised relatively quickly. By investing early in synthetic SAF to move production from small quantities in labs to sustained scale production, widespread SAF use can be made possible. Towards 2050, research participants expect bio- and synthetic SAF to contribute to over 60% of the reductions in emissions from aviation.

Demand for SAF can be significantly accelerated by increasing transparency around feedstock, reducing friction in
the purchasing process, greater use of certification, simplicity in communications, and using “book and claim” mechanisms to open up access to those who are far from points of supply.

New financing mechanisms should also be developed to create clarity on returns. An indexed investment fund could help investors spread technology risk across multiple projects and help attract institutional investors in the early stages of the transition.

Many of the technological developments needed to produce SAF at scale and lower its costs will also be useful for other sectors. For example, bio-SAF requires exploration of new bio-feedstocks and innovation in new production pathways – both of which can help decarbonise sectors such as chemicals and shipping as well. Synthetic SAF requires significant improvements in large-scale electrolyzers that can produce zero-carbon “green hydrogen” by using renewable electricity to split water into oxygen and hydrogen. The steel, road freight, shipping and fertiliser sectors also need green hydrogen to help their decarbonisation efforts. More efficient technologies are also needed for capturing CO₂, which will be required to produce synthetic SAF. These technologies include carbon capture storage and utilisation (CCSU), where CO₂ comes from other industrial processes, such as steelmaking, and direct air capture (DAC), where CO₂ would be extracted directly from the air. These technologies will also have wide-ranging applications beyond aviation.

Companies across different sectors should pool their resources and direct them to the most promising R&D projects. Those companies or organisations operating across these sectors like energy providers, financiers and research institutes will need to play a critical coordination role. In this way, the required technologies are likely to develop more quickly than if each sector worked on them alone. While collaboration will be critical to accelerate progress, cross-sector coordination and policy measures will be needed to help ensure limited feedstocks are directed to where they can have the largest impact.

7. RESEARCH HIGHLIGHT

Collaboration with other sectors is essential to the successful deployment of SAF. It can drive down the cost of required technologies, such as hydrogen production, direct air capture and biomass conversion, and ensure effective use of scarce resources.

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Shell’s Energy and Chemicals Park Rheinland, Germany, home to Relphyne European consortium PEM hydrogen electrolyser.
Photo credit: © Dieter Jacobs/welcome for Shell International Ltd.
One airline executive said: “Society does not accept aviation’s special status anymore. We need to decarbonise, as do all other sectors, to remain credible.”

A net-zero target will require a significant acceleration of efforts now (see Exhibit 04).

Investment must be significantly accelerated - or front-loaded - compared with typical plans, and need to span all currently feasible decarbonisation options - efficiency, bio-SAF, synthetic SAF and offsets. No single option alone can reduce net emissions by the required amount and the options themselves should be approached differently than at present.

The pathways for decarbonising aviation are directionally right, but the details need changing.

Airline executive

Firstly, many interviewees said the sector should stop taking efficiency improvements resulting from better aircraft design or operations for granted. They are an important way to reduce fuel usage and emissions, but will become increasingly difficult to achieve.

Secondly, energy companies and other aviation stakeholders must accelerate developing synthetic SAF sooner and at larger scale than previously assumed, because there is uncertainty about the availability of sustainable feedstock for bio-SAF - especially in the long term. Investing in both types of SAF will make it possible to scale-up production and bring down cost to the levels required for large-scale adoption, which can already happen within 15 years.

Thirdly, aviation must significantly increase the uptake of offsets and ensure that they all meet rigorous quality standards. This will be especially important in the short term, while SAF is still being fully developed.

Finally, continued investment in alternative propulsion technologies is needed, to prepare the sector for a truly decarbonised future - even if such technologies will make limited contributions before 2050.
Industry stakeholders identified 15 solutions, or recommendations for action, to overcome the barriers to decarbonisation and accelerate aviation’s progress. Some of these are already being investigated. Others are new, or provide a more efficient way to overcome a specific barrier (see Exhibit 05).

In the short term (2022-25), the focus should be on solutions that “unlock” progress. This phase includes demand commitments from corporate and cargo customers, developing offers for leisure passengers that support sustainability, and improvements around offsets. This stage should see large-scale investments in SAF production – particularly in regions with the most favourable policy and customer environment, for example in USA and Northwestern Europe. Policymakers and financiers should support initial investments with targeted incentives.

The “accelerate” phase (2025-2030) follows. Net-zero targets for 2050 are likely to be widely adopted. R&D and supply partnerships will be formed to enable more SAF to be produced, at lower cost. Operational efficiencies from fleet renewal and optimising the use of airspace will enable further reductions in fuel consumption, making SAF use more economically viable. Standards, certification and reporting will make it easier to track progress. Progress will also need to be made around electric and hydrogen aircraft to accelerate the development of technologies which can enable zero-emission aviation. Putting these solutions in place by 2030 will allow the sector to lay the foundation required to decarbonise by 2050.

Although each solution is important on its own, the true value lies in their combined deployment, applying the principle of “think big, start small, scale fast.”

**The “flight plan” for decarbonising aviation**

| Corporate and cargo customers’ demand for SAF | Collaboration with other sectors on SAF R&D |
| Offers and rewards encouraging customers to make choices that support sustainability | Airports and airspace optimisation to reduce operational emissions |
| Airports extending influence to promote SAF uptake and fleet upgrades | Aircraft efficiency improvements and accelerated fleet renewal |
| Focused “green” financing to support more investment in decarbonisation | R&D of electric and hydrogen aircraft |
| Bio-SAF production | Net-zero targets and aligned plans |
| Synthetic SAF production | Standards, certification and reporting to assure the quality of carbon reductions from SAF and offsets |
| Supply-side mandates, incentives and feedstock allocation | |
| Demand-side emission taxation, restrictions and incentives | |
| Carbon offset improvements | |

Unlock (2022 – 2025)

Accelerate (2025 – 2030)

Note: Timing of solution is related to period in which most activities are expected; however, most solutions require effort across short, medium and/or long term
We cannot wait for a technical salvation, we must act now using all the options that are available today.

Travel agent

The first net-zero value chains and regularly scheduled net-zero routes can be created relatively quickly in some places. They will require favourable factors such as supportive regulation, a strong connection between airports, a significant proportion of environmentally conscious business travellers, and an ability to increase the production of SAF. Such an environment could allow airlines to use SAF and high-quality offsets to launch their first regular net-zero flights. Beyond having a marketing effect, such connections would create scale in demand, which would make it cheaper to produce SAF. They would allow airlines to test customer offers that support sustainability before putting them on other routes in the expectation that they will gradually become industry standard. These net-zero value chains should be systematically expanded as technologies mature and market conditions improve.

We just need to have one systematic sustainable flight route that operates daily, and very quickly others will follow - because they will have to.

Energy expert

Interviewees recognise that the challenge of decarbonising aviation is too large for any one organisation or even one stakeholder group to solve alone. But a joint effort will allow aviation to launch specific solutions in the short term, and hit crucial targets in the long term. First movers are likely to reap the benefits of early access to insights that set them apart. They are likely to be able to share risks and investments, and influence outcomes in their favour. Engaging with their customers and others in the aviation sector during the early phases of the transition will pay dividends for such relationships in the future. As these early initiatives expand, momentum will build, and more companies will join to create the necessary scale and impact across the sector.

In this way, decarbonising aviation will be cleared for take-off.
### Supporting government:
Attractive local regulation enables the growth of SAF production clusters. Mandates ensure allocation of scarce resources to aviation and close the cost gap versus existing fuel.

- **Airline taxation, regulation and incentives**
- **Standards, certification and reporting to assure the quality of carbon reductions from SAF and offsets.**
- **Supply-side mandates, incentives and feedstock allocation**
- **Fuel producer SAF mandates and incentives**

### Customer demand:
Collaboration of like-minded and committed customers on key business and cargo routes with a book and claim mechanism enables net emission-free travel and transport of goods.

- **Collaboration with other sectors on SAF R&D**
- **Corporate and cargo customers’ demand for SAF**
- **Offers and rewards encouraging customers to make choices that support sustainability**

### Availability of feedstock:
SAF production clusters close to feedstock sources, such as biomass and hydrogen, provide opportunity to use SAF locally and remove the need for new production and distribution infrastructure. Demand will scale supply.

- **Bio SAF production**
- **Synthetic SAF production**
- **Collaboration with other sectors on SAF R&D**

### Mitigation through offsets:
High-quality offsets and insets that are subject to stringent certification, and directly fund the development of low-carbon fuel pathways.

- **Carbon offset improvements**
- **The 2025 industry ambition**
  - Have regularly scheduled net-zero routes.
ACKNOWLEDGEMENTS

We wish to thank all those who were involved in the development of this research. We appreciate your time, energy and enthusiasm – particularly during the period of disruption caused by the COVID-19 global pandemic.

SOURCES

1. Aviation benefits beyond borders “Adding value to the economy”, accessed on 26 May 2021
2. gov.uk “UK enshrines new target in law to slash emissions by 78% by 2035”, accessed on 2 August 2021
3. Reuters “German govt aviation sector agree on ‘green’ aviation fuel plan”, accessed on 2 August 2021
Ultimately, whether society meets its goals to decarbonise scenarios are one of many variables that we consider. Forecasts of the future. Shell scenarios including the third-party indirect ownership interest held by Shell in an entity or are referred to as “associates”. The term “Shell interest” is significant influence but neither control nor joint control to entities over which Royal Dutch Shell plc either directly or indirectly has control. Entities and unincorporated arrangements over which Shell has joint control are generally referred to as “joint ventures” and “joint operations”, respectively. Entities over which Shell has significant influence but neither control nor joint control are referred to as “associates”. The term “Shell interest” is used for convenience to indicate the direct and/or indirect ownership interest held by Shell in an entity or unincorporated joint arrangement, after exclusion of all third-party interest.

This Decarbonising Aviation: Cleared for Take-off report contains data and analysis from Shell’s Sky 1.5 scenario. Shell Scenarios are not intended to be projections or forecasts of the future. Shell scenarios including the scenarios contained in the Decarbonising Aviation: Cleared for Take-off report are not Shell’s strategy or business plan. When developing Shell’s strategy, our scenarios are one of many variables that we consider. Ultimately whether society meets its goals to decarbonise is not within Shell’s control. While we intend to travel this journey in step with society, only governments can create the framework for success. The Sky 1.5 scenario starts with data from Shell’s Sky scenario, but there are important updates. First, the outlook uses the most recent modelling for the impact and recovery from COVID-19 consistent with a Sky 1.5 scenario narrative. Second, it blends this projection into existing Sky (2018) energy system data by around 2030. Third, the extensive scale-up of nature-based solutions is brought into the core scenario, which benefits from extensive new modelling of that scale-up. In 2018, nature-based solutions required to achieve 1.5°C above pre-industrial levels by the end of this century were analysed as a sensitivity to Sky. This analysis was also reviewed and included in the IPCC Special Report on Global Warming of 1.5°C (SR15). Fourth, our new oil and natural gas supply modelling, with an outlook consistent with the Sky 1.5 narrative and demand, is presented for the first time. Fifth, the Sky 1.5 scenario draws on the latest historical data and estimates to 2020 from various sources, particularly the extensive International Energy Agency energy statistics. As with Sky, this scenario assumes that society achieves the 1.5°C stretch goal of the Paris Agreement. It is rooted in stretching but realistic development dynamics today but explores a goal-oriented way to achieve that ambition. We worked back in designing how this could occur, considering the realities of the situation today and taking into account realistic timescales for change. Of course, there is a range of possible paths in detail that society could take to achieve this goal. Although achieving the goal of the Paris Agreement and the future depicted in Sky 1.5 while maintaining a growing global economy will be extremely challenging, today it is still a technically possible path.

Shell’s operating plan, outlook and budgets are forecasted for a ten-year period and are updated every year. They reflect the current economic environment and what we can reasonably expect to see over the next ten years. Accordingly, Shell’s operating plans, outlooks, budgets and pricing assumptions do not reflect our net-zero emissions target. In the future, as society moves towards net-zero emissions, we expect Shell’s operating plans, outlooks, budgets and pricing assumptions to reflect this movement.

Also, in this Decarbonising Aviation: Cleared for Take-off report we may refer to Shell’s “Net Carbon Footprint”, which includes Shell’s carbon emissions from the production of our energy products, our suppliers’ carbon emissions in supplying energy for that production and our customers’ carbon emissions associated with their use of the energy products we sell. Shell only controls its own emissions. The use of the term Shell’s “Net Carbon Footprint” is for convenience only and not intended to suggest these emissions are those of Shell or its subsidiaries.

This Decarbonising Aviation: Cleared for Take-off report contains forward-looking statements (within the meaning of the U.S. Private Securities Litigation Reform Act of 1995) concerning the financial condition, results of operations and businesses of Royal Dutch Shell. All statements other than statements of historical fact are, or may be deemed to be, forward-looking statements. Forward-looking statements are statements of future expectations that are based on management’s current expectations and assumptions and involve known and unknown risks and uncertainties that could cause actual results, performance or events to differ materially from those expressed or implied in these statements. Forward-looking statements include, among other things, expectations concerning Shell’s Net Carbon Footprint to market risks and statements expressing management’s expectations, beliefs, estimates, forecasts, projections and assumptions. These forward-looking statements are identified by their use of terms and phrases such as “aim”, “ambition”, “anticipate”, “believe”, “could”, “estimate”, “expect”, “goals”, “intend”, “may”, “objectives”, “outlook”, “plan”, “probably”, “project”, “risks”, “schedule”, “seek”, “should”, “target”, “will” and similar terms and phrases. There are a number of factors that could affect the future operations of Royal Dutch Shell and could cause those results to differ materially from those expressed in the forward-looking statements included in this Decarbonising Aviation. Cleared for Take-off report, including (without limitation): (a) price fluctuations in crude oil and natural gas; (b) changes in demand for Shell’s products; (c) currency fluctuations; (d) drilling and production results; (e) reserves estimates; (f) loss of market share and industry competition; (g) environmental and physical risks; (h) risks associated with the identification of suitable potential acquisition properties and targets, and successful negotiation and completion of such transactions; (i) the risk of doing business in developing countries and countries subject to international sanctions; (j) legislative, fiscal and regulatory developments including regulatory measures addressing climate change; (k) economic and financial market conditions in various countries and regions; (l) political risks, including the risks of expropriation and renegotiation of the terms of contracts with governmental entities, delays or advancements in the approval of projects and delays in the reimbursement for shared costs; (m) risks associated with the impact of pandemics, such as the COVID-19 (coronavirus) outbreak; and (n) changes in trading conditions. No assurance is provided that future dividend payments will match or exceed previous dividend payments. All forward-looking statements contained in this Decarbonising Aviation: Cleared for Take-off report are expressly qualified in their entirety by the cautionary statements contained or referred to in this section. Readers should not place undue reliance on forward-looking statements. Additional risk factors that may affect future results are contained in Royal Dutch Shell’s Form 20F for the year ended December 31, 2020 (available at www.shell.com/investor and www.sec.gov). These risk factors also expressly qualify all forward-looking statements contained in this Decarbonising Aviation: Cleared for Take-off report and should be considered by the reader. Each forward-looking statement speaks only as of the date of this Decarbonising Aviation: Cleared for Take-off report, September 20, 2021. Neither Royal Dutch Shell plc nor any of its subsidiaries undertake any obligation to publicly update or revise any forward-looking statement as a result of new information, future events or other information. In light of these risks, results could differ materially from those stated, implied or inferred from the forward-looking statements contained in this Decarbonising Aviation: Cleared for Take-off report.

We may have used certain terms, such as resources, in this Decarbonising Aviation: Cleared for Take-off report that the United States Securities and Exchange Commission (SEC) strictly prohibits us from including in our filings with the SEC. Investors are urged to consider closely the disclosure in our Form 20F. File No 1-32275 is available on the SEC website www.sec.gov.