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Climate Action 100+
Global Investors Driving Business Transition

GLOBAL SECTOR STRATEGIES: INVESTOR ACTIONS TO ALIGN THE AVIATION SECTOR WITH THE IEA'S 1.5°C DECARBONISATION PATHWAY

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ABOUT CLIMATE ACTION 100+ AND THE GLOBAL SECTOR STRATEGIES

Climate Action 100+ is an investor-led engagement initiative that strives to ensure the world's largest corporate greenhouse gas emitters take necessary action on climate change. More than 615 investors, responsible for $65 trillion in assets under management, are engaging 167 focus companies to improve climate governance, curb emissions, align their emissions performance with net zero, and strengthen climate-related financial disclosures. Climate Action 100+ is delivered by five investor networks (AIGCC, Ceres, IGCC, IIGCC and PRI) working with the initiative's investor signatories.

In March 2021, Climate Action 100+ published the first company assessments from its Net-Zero Company Benchmark, which evaluates climate performance and corporate transition plans. Acknowledging that corporate net zero strategies will vary significantly by sector, Climate Action 100+ is developing a series of Global Sector Strategies to accelerate sectoral decarbonisation.

This workstream from the Climate Action 100+ initiative, launched officially in August 2021, aims to encourage the transition for specific high emitting sectors by identifying key actions for companies, investors and industries overall. Aligned with the Benchmark, the Global Sector Strategies guide investor engagement by Climate Action 100+ signatories, mapping out what corporates in carbon intensive industries need to do to build out effective transition plans and decarbonise value chains to reach net-zero emissions by 2050 or sooner.

More detail about the Climate Action 100+ Global Sector Strategies can be found here.

ABOUT THIS REPORT

Climate Action 100+ engages 10 aviation focus companies on their transition to net zero.[1] The Principles for Responsible Investment (PRI) coordinates investor engagements with nine of these companies as part of Climate Action 100+, while the tenth engagement is coordinated by the Investor Group on Climate Change (IGCC).

In February 2020, the PRI published an Investor Expectations Statement on Climate Change for Airlines and Aerospace Companies. Its purpose was to publicly signal investor support for key high-level actions that airlines and aerospace companies can take to effectively manage their climate risks and opportunities. The statement was initially signed by over 122 investors with nearly $6 trillion in collective assets under management.

In May 2020, the PRI commissioned Chronos Sustainability to prepare a more detailed investor engagement guide for the aviation sector that would build on the PRI's February 2020 statement and serve as the Climate Action 100+ global sector strategy for aviation – a pilot for the new workstream – and outline how the sector can transition to net zero. It was published in January 2021 on the Climate Action 100+ website and consisted of three key documents:

- A set of recommended investor expectations for the aviation sector
- A collection of case studies aligned to these expectations
- An in-depth landscape report of the aviation sector.

In October 2021, following the release of the International Energy Agency's (IEA) *Net Zero by 2050* report that clarified what is required to set the aviation sector on a 1.5°C pathway, the PRI commissioned Chronos Sustainability to update the Climate Action 100+ global sector strategy on aviation to ensure that it was 1.5°C-aligned. This report aims to inform and support Climate Action 100+ investor engagements with airline and aerospace companies by specifying the actions that investors, aviation companies and the sector as a whole need to take to accelerate the transition to net-zero emissions and limit global warming to 1.5°C.

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EXECUTIVE SUMMARY

The purpose of this report is to specify the actions that investors, aviation companies[2] and the aviation sector as a whole need to take to accelerate the transition to net zero and limit global warming to 1.5°C.

It is now widely known that the world needs to limit global warming to 1.5°C to avoid many of the worst effects of climate change (IPCC, 2018). This will require the global economy to reach net-zero emissions by 2050. The aviation sector's contribution to this is crucial. Aviation accounts for around 2.5% of global carbon dioxide (CO2) emissions and this is set to grow significantly as other sectors decarbonise and absolute air transportation emissions continue to rise. The aviation industry trade body, the Air Transport Action Group (ATAG), recently estimated that under its business-as-usual scenario, aviation CO2 emissions would double between 2019 and 2050.[3]

The climate impact of the aviation sector is not limited to the effects of its greenhouse gas emissions alone. Flying at altitude results in additional climate impacts, such as those caused by contrail and cirrus cloud formation, which have a net warming effect on the climate. While there is considerable uncertainty about the exact magnitude of these 'non-CO2' impacts, recent scientific research[4] indicates that the overall climate impact of aviation is currently around three times that of its CO2 emissions alone. Notwithstanding the importance of aviation's 'non-CO2' impacts, the focus of this report is on the sector's CO2 emissions.

Until recently, it was not clear what actions would be required to bring the aviation sector into alignment with a 1.5°C pathway. However, this was clarified in the International Energy Agency's (IEA) *Net Zero by 2050* report (IEA, 2021), which set out a roadmap for how the global energy sector, which includes transport,[5] can reach net-zero CO2 emissions (NZE) by 2050. This new 1.5°C pathway has important implications for investor engagement, as it highlights the key areas where aviation companies and the wider aviation industry need to act now to ensure a smooth and successful transition.

In parallel, there have been important climate-related developments within the aviation industry. Significantly, two key global aviation industry bodies, the International Air Transport Association (IATA) and ATAG have each announced a new industry-wide goal to reach net zero by 2050 and developed roadmaps in support of this.[6] These are less ambitious than the IEA 1.5°C pathway, particularly up to 2040,[7] and rely on the future scale-up of Sustainable Aviation Fuels (SAF)[8] and carbon offsetting to a much greater extent. However, by 2050, the industry roadmaps are broadly aligned with the IEA 1.5°C pathway, in that residual emissions (before offsets and Carbon Capture and Storage (CCS)) are in a similar range.

Under the IEA 1.5°C pathway for aviation, emissions need to have peaked by 2025 and by 2030 need to be 23% lower than in 2019 (the pre-pandemic level). Emissions in the sector will need to fall by 80% between 2019 and 2050, leaving some residual emissions from aviation in 2050. These residual emissions, together with those from other hard-to-abate sectors, such as shipping, will need to be covered by negative emissions,[9] so that the global energy system can reach net-zero emissions by 2050.

The new IEA pathway has five key implications for the aviation sector:

1. **SAFs play an essential role in delivering 1.5°C alignment.** A massive scale-up from current supply levels will be required for the sector to align with the 1.5°C pathway, which presents a number of delivery risks. Airlines and the sector as a whole will need to set clear interim targets for the adoption of SAF and outline their plans for achieving them. Investors will need to carefully scrutinise progress towards those targets. Should aviation companies and the industry fail to meet their SAF targets, the sector will need to take stronger demand management measures (see 3. below) in order to reach 1.5°C.

2. **Significant investment is required to scale up SAF and to develop other new technologies.** IATA estimates that US$2 trillion in investment will be required up to 2050 for the aviation sector to reach net-zero emissions by that date. This includes between US$1 trillion and US$1.4 trillion for SAF alone, which, annualised, is equivalent to around 6% of oil and gas capital expenditure (ICF, 2021). This increase in investment will have to be supported by clear government policy strategies and measures – ideally coming into force by 2025 – to provide the necessary certainty for investors and companies in the sector.

3. **Demand management[10] is critical in achieving the 1.5°C pathway**, and its contribution to emissions reductions is much greater than envisaged in previous IEA scenarios. Under the IEA 1.5°C scenario, SAF and new technologies alone are not sufficient to achieve the deep emissions reductions required by 2050; they need to be complemented by a reduction in air traffic growth. IEA estimates that by focusing on three priority areas – keeping business travel to 2019 levels; capping long-haul flights (of more than 6 hours) for leisure at 2019 levels; and shifting demand to high-speed rail – emissions in 2050 could be half of what they would otherwise be, while affecting only 12% of flights. Understandably, the increased emphasis on demand management will be unwelcome for the aviation sector recovering from the COVID-19 pandemic and will present challenges for both aviation companies and investors.[11] Nonetheless, it is vital that it now becomes a core part of the discussion.[12] Reducing emissions by managing the demand for air travel is a faster and lower-risk mitigation path compared to sole reliance on the potential future scale-up of SAF or other new technologies. Investors will need to understand how aviation companies are planning for potential policy and regulatory interventions aimed at constraining air travel demand and ensuring that their business remains viable once more decisive policy responses to climate change come into force. If air traffic growth cannot be curtailed fast enough, SAF would need to be adopted sooner and to a greater degree than planned. Given the uncertainties and costs associated with scaling up SAF, this would increase the risk that the aviation sector fails to align with a 1.5°C pathway.

4. **Aviation companies cannot use carbon offsetting to align with the IEA's 1.5°C pathway.** To help limit global warming to 1.5°C as per the IEA pathway, aviation companies must make actual reductions in emissions rather than relying on offsetting or CCS to meet their climate targets. Under the IEA's approach, negative emissions are allocated to the sector in which they occur and hence not available for use by other sectors.[13] Offsetting has been a common feature of industry bodies and aviation companies' decarbonisation strategies to date. However, going forward, aviation companies will need to focus on reducing their own emissions, rather than using offsets.

5. **In addition to absolute emissions targets, carbon intensity metrics are needed for company carbon performance assessment and comparability.** The IEA's 1.5°C pathway for aviation maps out the absolute emissions reductions required for the whole sector. In addition to setting targets for reducing their absolute emissions, aviation companies should also set interim and long-term carbon intensity targets that are aligned with the 1.5°C pathway. This will allow investors to understand more fully whether a company's climate targets are ambitious enough and whether it is making sufficient progress on decarbonising its business. Alongside this, carbon reporting in the sector, particularly around carbon intensity, will need to be standardised to ensure that it is sufficiently rigorous and comparable.

ACTIONS FOR INVESTORS

Investors have a key role to play in accelerating the aviation sector's transition to net-zero emissions. Specific actions that investors can take to achieve the emissions reductions required under the IEA 1.5°C pathway for aviation are outlined below.

1. SUSTAINABLE AVIATION FUELS (SAF)

Investors should engage with airlines, aircraft and engine manufacturers, companies in other sectors (including fuel suppliers and corporate customers of airlines) and policymakers to scale up SAF.

1.1 Investors should ensure that **airlines make the necessary commitments to scale up SAF**, calling on airline companies to do the following:

- Set **short-, medium- and long-term SAF targets**, and outline how these compare with IEA milestones (see Figure 1) and industry targets.
- Outline the **actions that they are taking to scale up the use of SAF** to meet their targets, including which key performance indicators (KPIs) they are using to incentivise and measure this (e.g., the percentage of total current fuel expenditure represented by SAF and how this will change over the short-, medium-, and long-term).
- Indicate how they are **working in partnership with other stakeholders**, such as fuel suppliers and aircraft manufacturers, to scale up SAF production (e.g., detail any offtake agreements that have been signed and the contribution these will make to meeting the airline's short-, medium- and long-term SAF targets).
- Disclose how they are **allocating capital expenditures to the development of SAF** and to partnerships that will help them meet their SAF demand.
- Indicate how they are **managing the risk that SAF may not be scaled up to the levels required under the 1.5°C pathway**. This may include:
  - Specifying how they will decarbonise if they cannot secure the necessary amounts of SAF at key milestones. This should include providing information on the scenarios they are examining and how they are planning for such outcomes.
  - Assessing the risk that regulators will impose even more stringent tax, carbon pricing or other climate policy measures than anticipated, to limit air traffic growth and reduce sectoral emissions.
  - Disclosing how they are engaging with their industry associations (particularly IATA and ATAG) on SAF scale-up and holding them accountable for the industry-wide targets they have set.
- Support **policy measures that can help scale up SAF** (e.g., SAF incentives, fuel mandates, carbon pricing) and cease direct and indirect lobbying against policy measures that would impede the sector's ability to reach its decarbonisation targets. Investors should also encourage airline companies to disclose how they are addressing any misalignment between their own climate policy positions and those of their key trade associations, notably IATA and ATAG.
- Provide **transparent disclosure on their progress towards SAF targets** during regular reporting cycles and outline remaining uncertainties associated with reaching their SAF targets.

1.2 Investors should **call on airlines and fuel suppliers to ensure the sustainability of the SAF** that they produce and/or use by:

- Demonstrating that there is **sufficient availability** of feedstock from sustainable sources to meet their SAF targets.
- **Avoiding the use of biofuels that are derived from conventional, crop-based feedstocks** (which compete with food production), or that have other negative environmental/wider sustainability impacts.
- Ensuring the **chosen SAF offers significant life cycle emissions reductions** compared with fossil-based jet fuel according to independent certifiers.
- Supporting the development and adoption of **global standards and credible third-party certification processes** to ensure that the life cycle emissions and overall sustainability of SAF are adequately addressed.
- Disclosing on the above **actions taken to ensure the sustainability of the SAF used**.

1.3 Investors should **call on aircraft and engine manufacturers to indicate how they are supporting the scale-up of the SAF market** (e.g., through achieving certification that their aircraft can fly with 100% unblended SAF or investing directly in fuel suppliers).[14]

1.4 Investors should **call on companies in the oil and gas sector to invest in increasing the supply of SAF**.[15]

1.5 Investors should **call on companies in other sectors to source SAF for business travel or cargo** (and therefore reduce their Scope 3 emissions). This would provide a strong demand signal and help increase the supply of SAF by sharing the risk and cost premium associated with SAF between airlines, fuel suppliers and their end-customers.

1.6 **Investors should engage directly with policymakers**, to help accelerate policy measures that would support the aviation sector in scaling up SAF. This includes encouraging policymakers to set incentives for SAF use, for example through fuel mandates and taxing flights, and to remove jet fuel tax exemptions which distort pricing and provide a barrier to investment in SAF.[16] Investors should also engage policymakers on SAF feedstock: use of feedstock from unsustainable sources (crop-based) should not be allowed.

2. INVESTMENT IN SAF AND NEW TECHNOLOGIES

Investors should engage with companies and policymakers to accelerate investment in SAF, alternative propulsion technologies (electric battery and hydrogen) and technologies that improve fuel efficiency. Investors can also invest directly in decarbonisation technologies.

2.1 Investors should engage with aviation companies (airlines and manufacturers) to ensure that they are working to **decarbonise their future capital expenditures**, by asking them to:

- Explicitly commit to align annual capital expenditures with their long-term greenhouse gas reduction target(s).
- Explicitly commit to align their annual capital expenditures with the Paris Agreement's objective of limiting global warming to 1.5°C.

- Report on how capital expenditures are allocated to emissions reductions projects **year-on-year** and **embed this into their mainstream accounts**.
- **Reform their lobbying practices**, if they are directly or indirectly lobbying against policy measures that would help drive investment into decarbonisation strategies in the aviation sector.

2.2 Investors should **push aviation companies and their industry associations to engage with policymakers** to encourage the provision of policies that can drive investment in decarbonisation (e.g., making subsidies available to convert traditional oil refineries into SAF bio-refineries, committing to targets to wind down the use of fossil-based jet fuel, developing economy-wide low carbon hydrogen strategies, introducing certification schemes). Investors should also engage directly with policymakers on these matters.

2.3 Investors can **play a direct role in investing in the decarbonisation of the sector**, for example by direct investments in companies that drive decarbonisation in the aviation sector (e.g., SAF producers, hydrogen/electric aircraft developers) or through funding of new SAF production plants, research and development (R&D) for new SAF technologies, investing in infrastructure upgrades required for hydrogen and electric aircrafts, and R&D into these new propulsion technologies.

3. DEMAND MANAGEMENT AND BEHAVIOURAL CHANGES

Following IEA's publication of its 1.5°C pathway, demand management is now a central part of the agenda for decarbonising the aviation sector. While the focus on demand management will be challenging for the sector, investors committed to a 1.5°C future should **engage with aviation companies and industry bodies on their traffic growth plans and demand management scenarios**. This will help ensure that the related r*egulatory risks* of tighter policy measures and *delivery risks* that a company and the sector will not meet their climate targets are adequately managed. Investors should also consider the risk that stronger demand management measures may be needed should aviation companies and industry fail to scale up SAF to necessary levels in time.

3.1 Investors should **call on aviation companies** to:

- Set out how they are **addressing the risks associated with the increased emphasis on demand management by regulators**, for example, through the use of scenario planning to manage the risk of tighter policy measures being introduced in the future (e.g., flight taxes or bans on domestic flight journeys that can be done by train).
- Disclose how they are **lobbying on demand-related policies, both directly and indirectly**, and confirm that they intend to address the business impacts associated with demand management without lobbying in ways that contradict their stated climate commitments.
- Disclose their **assumptions around growth in demand** (by market segment, including business and long-haul leisure) and specify how these assumptions **interact with their SAF targets**. An airline's ability to grow, while at the same time aligning with a 1.5°C pathway, will critically depend on it meeting very ambitious SAF targets.
- Disclose how they are **engaging with ATAG and IATA to assess and manage the risk of overall traffic growth for the sector being higher** than that assumed in the industry roadmaps (of 3%) and how industry is mitigating the risk of not aligning with a 1.5°C pathway.
- Adopt **consumer facing transparency tools** supporting customers to make more sustainable decisions, e.g., by disclosing the carbon footprint of flights and seat-classes.

3.2 Investors should **push aviation companies and their industry associations to engage with policymakers around effective policies for demand management**, including development and implementation of comprehensive transportation strategies, limits on airport expansion, rail investment and subsidisation, flight taxes/frequent flier levies and awareness campaigns. In doing so, investors can cite examples of good practice. For example, France has banned domestic flights[17] on routes where passengers could complete the same journey by train in under 2.5 hours. Spain has signalled it is likely to implement similar measures[18] and Austria has also recently placed constraints on short-haul air travel.[19] Investors should also engage directly with policymakers on these matters.

4. AVOIDING CARBON OFFSETS

Investors should **encourage aviation companies, particularly airlines, to focus on actual reductions in emissions rather than offsetting in their decarbonisation strategies**. Companies and the sector as a whole need to demonstrate that they are aligned with the IEA 1.5°C pathway without the use of offsets or CCS. This will require a change in approach for many in the industry. Offsetting has been a common feature of airlines' decarbonisation strategies but, given the finite planetary carbon budget, the focus needs to be on emissions reductions *within* the sector.

4.1. Investors should **call on aviation companies** to:

- Specify the **current role of offsetting in their decarbonisation strategy**, and report on the proportion of overall planned emissions reductions coming from offsets.
- Set **climate targets that phase out offsets** and are based on companies' own emissions reductions (rather than offsets).
- Indicate **by what date their targets will align with the IEA 1.5°C pathway for aviation**, excluding the use of offsets and CCS.
- Ensure that **where offsetting is used, only high-quality carbon credits are purchased**.[20] Note that offsetting can continue to play a role in an airline's 'beyond value chain mitigation', which involves – *in addition* to reducing its own emissions in line with a 1.5°C pathway – purchasing carbon credits or investing in carbon removal technologies to help to accelerate the decarbonisation of *other* sectors (see Component 4 below for more detail).
- **Engage with IATA and ATAG to set targets and define roadmaps that do not rely on the use of offsets or CCS** for the aviation industry as a whole and that align with the IEA 1.5°C pathway.
- Ensure that **any marketing or public claims to being "carbon neutral" or "net zero" adhere to the official definition set out by the Intergovernmental Panel on Climate Change (IPCC)**. IPCC specifies that "carbon neutrality" or "net zero CO2 emissions" requires that 'anthropogenic CO2 emissions are balanced globally by anthropogenic CO2 removals over a specified period'. Carbon credits, commonly purchased by companies, which try to *avoid* CO2 emissions, do not meet this definition as they do not *remove* from the atmosphere the equivalent of CO2 emitted.

5. COMPLEMENTING ABSOLUTE EMISSIONS REDUCTIONS WITH CARBON EMISSIONS INTENSITY METRICS

Carbon intensity metrics allow investors to assess the adequacy of individual aviation company targets and to compare carbon performance of companies of different sizes. Aviation companies need to **set intensity targets alongside targets to reduce absolute emissions**. Short- and medium-term targets (e.g., to 2030) are needed in addition to long-term targets to ensure that companies are taking the necessary actions now, rather than delaying or back-loading mitigation efforts.

5.1 Investors should **call on aviation companies to set 1.5°C-aligned intensity targets** that are independently validated by the Science Based Targets initiative (SBTi) or other credible verifiers, and to report on progress towards meeting the targets in CDP questionnaires or other public disclosure frameworks.

5.2 Investors should call on aviation companies to **engage with IATA and ATAG to set sector-wide intensity targets that are 1.5°C-aligned** and report on progress in meeting those targets.

5.3 Investors should call on aviation companies to work with investors and with other stakeholders to **develop standardised intensity measures and related disclosures**, including full life cycle emissions intensity metrics.[21] Currently, there is no standard approach for reporting carbon intensity in the aviation sector and companies use a range of metrics, which makes comparisons difficult.

THE IEA 1.5°C PATHWAY FOR AVIATION: AN OVERVIEW

Under the IEA's 1.5°C pathway for aviation, emissions need to fall by 80% between 2019 and 2050, leaving some residual emissions from the sector in 2050. These residual emissions need to be covered by negative emissions generated elsewhere in the energy sector, so that the global energy system as a whole reaches net zero by 2050.

The IEA *Net Zero by 2050* report sets out a pathway for the global energy sector, including transport, to reach net-zero emissions by 2050. This pathway is based on carbon emissions reductions *within* the energy sector. It is achieved:

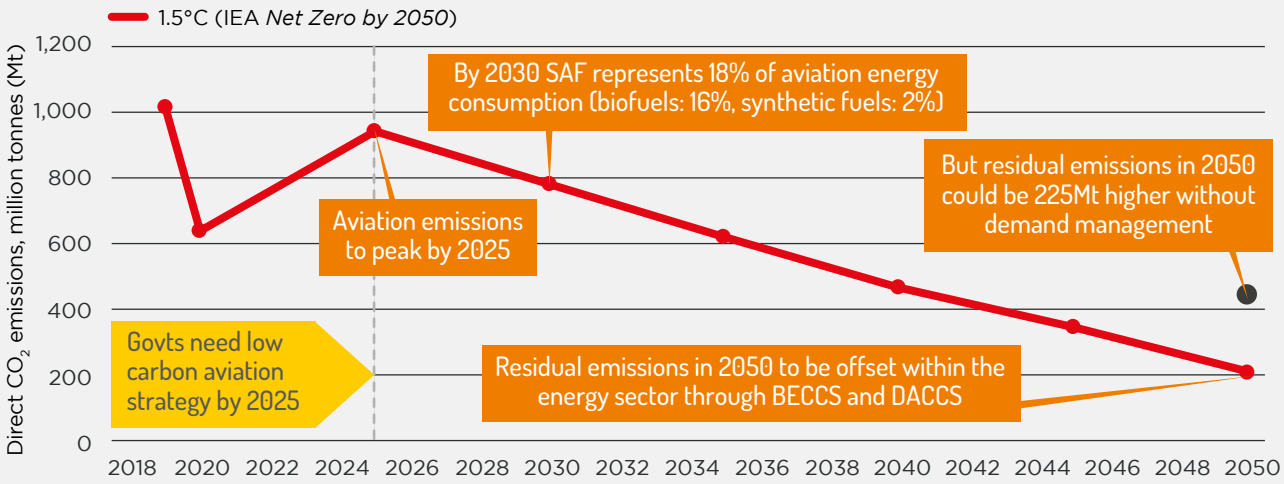
- Without relying on offsets from *outside* the sector (i.e., from land-based carbon removals), as these are allocated to the agriculture sector in the IEA carbon budget.
- With only limited reliance on negative emissions technologies (such as Bioenergy with Carbon Capture and Storage (BECCS)), as these are still under development.

While there are various pathways to reach global net zero, IEA focuses on the one that is *'the most technically feasible, cost-effective and socially acceptable'*. IEA indicates that this pathway is '*narrow but achievable*', as long as the higher level of ambition seen recently from countries, sectors and companies is now matched by action. This will require a stronger focus on innovation, greater international and cross-sectoral cooperation, and the setting of near-term milestones and policies to ensure that the 2050 net-zero target can be met.

The IEA *Net Zero by 2050* report provides carbon emissions data specifically for the aviation sector, which allows for a 1.5°C aviation pathway to be drawn, as shown in Figure 1 below.[22] Under the pathway, **direct emissions from aviation need to peak by 2025** and then the **sector needs to decarbonise at an annual average rate of almost 6% until 2050**. Overall, emissions will need to fall by 80% between 2019 and 2050, leaving small residual emissions from aviation of 210 million tonnes (Mt) by the end of this period. These residual emissions, together with those from other hard-to-abate sectors, such as shipping, would need to be covered by carbon captured during the production of biofuels (BECCS) and by Direct Air Capture combined with Carbon Storage (DACCS), so that the global energy system as a whole can reach net-zero emissions by 2050.[23]

The five key components of the IEA 1.5°C pathway for aviation are outlined below.

Figure 1: The IEA 1.5°C sector-specific decarbonisation pathway for aviation[24]



Source: This analysis is based on data provided by International Energy Agency (2021), *Net Zero by 2050*, IEA, Paris, Figure 3.21 (data for all years except 2019) and Annex A (data for 2019).

COMPONENT 1: SUSTAINABLE AVIATION FUELS (SAF)

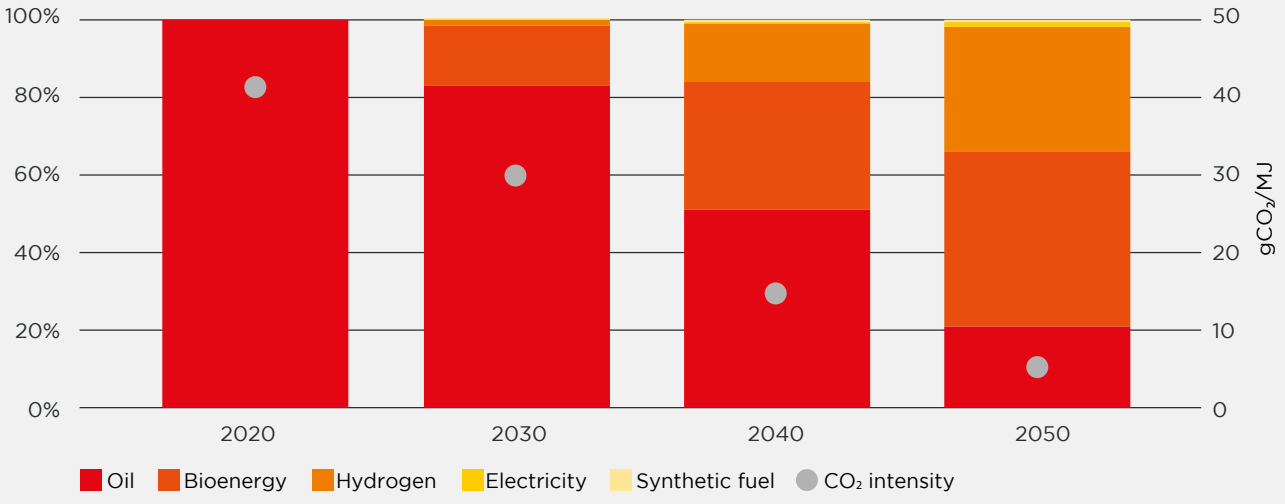
SAFs play an essential role in the IEA's 1.5°C pathway. A massive scale-up from current supply levels will be required, which will be challenging for the sector and presents a number of risks. Aviation companies need to set clear interim targets for the adoption of SAF and outline how they plan to achieve them.

SAF, including advanced biofuels and synthetic fuels, are 'drop-in' fuels that can be used in existing aircraft, for both long and short-haul flights. As a result, they play a central role in the decarbonisation of aviation (see Figure 2 below). In the IEA 1.5°C scenario, by 2030, 16% of the aviation sector's energy consumption would need to come from advanced biofuels, and a further 2% from synthetic fuels.[25] By 2040, advanced biofuels and synthetic fuels, combined, would represent half of the total aviation fuel consumption. To achieve these adoption levels, a very significant ramp-up in SAF will be required, particularly in the period to 2030. Given that less than 0.1% of aviation fuel demand was met by SAF in 2020, this will clearly be challenging.[26]

IEA anticipates that battery electric and hydrogen aircraft will enter the market by 2035.[27] However, as these technologies will be suitable only for short-haul distances (unless there are significant breakthroughs), they are expected to account for only around 2% of aviation's energy use by 2050. Nevertheless, for certain regions and airlines, these technologies may play a more significant role in decarbonisation.[28] Operational efficiency improvements by airlines and advances in fuel efficient technologies will also contribute to emissions reductions, but to a lesser extent.

Figure 2 below shows how, under the IEA 1.5°C pathway, the energy mix for aviation is expected to change in the coming decades so that by 2050 only 20% of the sector's energy needs comes from fossil fuels. As a result of the growing contribution expected from biofuels, synthetic fuels, electric battery and hydrogen, the carbon intensity of aviation (measured as grams of CO2 per megajoule) falls by 87% over the next three decades.

Figure 2: Aviation energy consumption by fuel and CO2 intensity under the IEA 1.5°C pathway for aviation



Source: International Energy Agency (2021), *Net Zero by 2050*, IEA, Paris, Figure 3.25 (extract)

Like IEA, the aviation industry anticipates that SAF will play a very significant role in decarbonising the sector, although the industry assumes that they will take longer to scale up, with the IATA and ATAG roadmaps showing lower rates of SAF adoption in 2030 than the IEA does. However, the industry assumes that SAF can play an even greater role by 2050 than assumed by IEA. The ATAG and IATA roadmaps indicate that by 2050, the sector will require between 330 and 445 Mt[29] of SAF (depending on the specific scenario), which is significantly higher (between around 35% and 80% higher) than the estimated equivalent under the IEA pathway of around 245Mt.[30]

The industry places greater emphasis on the use of SAF by 2050 because the ATAG/IATA roadmaps do not build in any curtailment of air transport demand, meaning that overall fuel consumption in 2050 is higher than under the IEA pathway. In contrast, IEA assumes that a cap on air traffic, through behavioural changes, could make a significant contribution to decarbonisation by 2050 (see Component 3).

The industry estimates that between 5,000 and 7,000 SAF production plants will be required by 2050 to meet the sector's requirements.[31] It will be extremely challenging to scale up to this level of production, given that there were fewer than 20 SAF plants in service worldwide in 2021, according to analysis by the International Civil Aviation Organization (ICAO).[32] In addition, the industry does not have a good track record of meeting its SAF targets. In 2009, IATA set a target to reach 10% adoption of SAF by 2017, which was later revised downwards to 6% by 2020 (ICCT, 2021b). However, by 2020, SAF represented less than 0.1% of fuel consumption for aviation (ICF, 2021). **Clearly, scaling up SAF to the levels projected by the sector in time will be extremely difficult, indicating that there is a significant risk of the 1.5°C goal not being met under the industry association scenarios.**

Both IEA and the industry recognise that policy support is vital to scale up SAF. Governments will need to define their strategy for SAF by 2025, including an assessment of the availability of feedstocks in their region (see Box 1), and put in place policy measures to support the development and rapid deployment of SAF. Such measures could include low carbon fuel standards; fuel mandates; carbon pricing; ending jet fuel tax exemptions; funding of R&D; and financial support for new SAF plants (e.g., providing incentives for co-processing advanced biofuels in existing oil refineries or for the full conversion of these oil refineries to bio-refineries).[33] It is important that SAF policy measures should incentivise only alternative fuels that achieve significant carbon emissions reductions relative to fossil-based fuel and are certified as sustainable. Aviation companies and industry bodies can play an important role in supporting well-designed SAF policies.

BOX 1: IS THERE SUFFICIENT AVAILABILITY OF SUSTAINABLE BIOFUELS?

A key question when considering the massive scale-up of SAF that is required for the aviation sector to decarbonise is whether there will be capacity to produce enough sustainable biofuels to supply the sector. The environmental issues associated with biofuel production include deforestation, soil degradation, loss of biodiversity and adverse effects on food security and water systems. For its *Net Zero by 2050* report, IEA carried out a detailed analysis of the sustainability impacts of total bioenergy demand (including liquid biofuels for use in aviation) under a 1.5°C scenario. It concluded that, by 2050, all bioenergy can come from sustainable sources and that the level of bioenergy used in the 1.5°C scenario is '*well below estimates of global sustainable bioenergy potential, thus avoiding the risk of negative impacts on biodiversity, freshwater systems, and food prices and availability*' (IEA, 2021, p.77).

Separately, the aviation industry commissioned consultants, ICF, to carry out an in-depth review into the availability of sustainable biofuels to 2050, which is outlined in the reports *ATAG Waypoint 2050 (Second Edition)* and *Fuelling Net Zero*.[34] The findings of the ICF study indicate that there would be sufficient sustainable biofuels (from a range of non-food/rotational crops and waste sources, which will vary by region) to meet around 50% of the total SAF needs of the aviation industry up to 2050 and beyond, but the balance would need to be met by synthetic fuels.

However, not everyone is of the view that there will be sufficient availability of sustainable feedstock[35] to meet the needs of aviation, particularly in the 2030s when there will still be competition for biofuels from other sectors, such as road transport, before these are electrified.

Both IEA and the industry have highlighted the need to develop a framework of rigorous global sustainability standards for SAF, together with independent certification schemes, to direct investment towards the most sustainable fuels. This global framework could draw on the various sustainability frameworks already in place that set out criteria for life cycle emissions reductions for biofuels and other sustainability issues (e.g., ICAO's SAF framework under the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA),[36] EU Renewable Energy Directive II (RED II) and the Californian Low-C Fuel Standards). In addition, the Roundtable on Sustainable Biomaterials and the International Sustainability and Carbon Certification system provide certification for sustainable biofuels.

COMPONENT 2: INVESTMENT IN SAF AND NEW TECHNOLOGIES

In the IEA's 1.5°C scenario, SAFs play a crucial role in reducing the aviation sector's reliance on fossil fuels. Therefore, significant investment is required to scale them up. In addition, investment will be needed to develop alternative propulsion technologies (e.g., electric battery and hydrogen aircraft), as well as other technologies that improve fuel efficiency and related infrastructure.

By 2030, a massive, unprecedented scale-up of aviation decarbonisation technologies will be required. Many of these technologies are still immature – IEA estimates that only 8% of aviation emissions reductions up to 2050 will come from technologies already in the market – so significant investment will be required to develop new technologies (such as synthetic fuels, electric aircraft and hydrogen). In addition, investment is required to scale up technologies that are closer to commercialisation (e.g., advanced biofuels or synthetic fuels produced using the Fischer-Tropsch or Alcohol-to-Jet production pathways). One way to increase investment is through long-term offtake agreements. By entering into such agreements, airlines can secure future SAF supply, whilst also de-risking investments into SAF production plants.

IATA estimates that US$2 trillion in investment will be required through to 2050 in order to reach net-zero emissions by that date. This includes between US$1 trillion and US$1.4 trillion for SAF alone, which, annualised, is equivalent to around 6% of oil and gas capital expenditure (ICF, 2021).

Both IEA and the industry stress that governments and other policymakers play an essential role in directing private finance towards decarbonisation of aviation. **Clear policy strategies and measures with long time horizons need to be established by 2025 to provide certainty for investors and companies in the sector**. Potential policy measures to increase private investment include de-risking early-stage investment through co-funding, loan guarantee schemes or subsidies.[37] Another way that policymakers can direct investment towards decarbonisation is through mandatory disclosure requirements, such as the European Union (EU) taxonomy (see Box 2).

ICAO, as the body responsible for climate policy for international aviation, can contribute to providing policy certainty for investors. Currently, it has no long-term goal in place to reduce aviation carbon emissions. Industry bodies and some non-governmental organisations (NGOs) are strongly in favour of ICAO agreeing to a long-term goal for aviation at its General Assembly in late 2022,[38] although reaching agreement on this is likely to be challenging.[39]

BOX 2: THE EU TAXONOMY FOR AVIATION

The *EU Taxonomy Regulation* is a sustainable finance framework introduced to support the EU's *Fitfor55* climate package, which aims to direct funding towards environmentally sustainable activities. From 2023, companies will be required to disclose the proportion of their economic activities that fall within the EU sustainable finance taxonomy, according to six environmental objectives (including climate change mitigation and adaptation) and based on technical screening criteria. At the time of publication, for most sectors, these criteria have already been established, but work is still in progress for aviation and the criteria are expected to be finalised in 2022.

The taxonomy will have a direct impact on investors, in terms of disclosures required in relation to their investments in the aviation sector. The taxonomy may also serve as a tool for investor engagement with companies, by opening up discussion around the proportion of their revenues and capital expenditure that can be defined as low carbon (e.g., the operation of aircraft fuelled by SAF) and how this is expected to change based on company climate strategies.

COMPONENT 3: DEMAND MANAGEMENT AND BEHAVIOURAL CHANGES

IEA places increased emphasis on demand management in the 1.5°C pathway compared with its previous scenarios. Curtailing air traffic growth is a faster and lower-risk way of reducing emissions from the sector compared to relying solely on the future scale-up of SAF or other new technologies. Keeping air transportation demand at 1.5°C-aligned levels will require policy interventions and actions by aviation companies as well as investors.

Behavioural changes related to flying play an important role in reducing emissions in the IEA 1.5°C pathway for aviation. IEA identifies three priority areas where demand management can have a significant effect on emissions:

i. keeping business travel to 2019 levels;

ii. capping long-haul flights (of more than 6 hours) for leisure at 2019 levels; and

iii. shifting demand to high-speed rail (HSR), where possible.

IEA estimates that, while these measures would reduce total flights by only 12%, they would avoid 225Mt of emissions by 2050. In other words, **without these three demand management measures (or alternative ones with an equivalent impact on emissions), residual emissions in 2050 could be over double than what is required under the IEA 1.5°C pathway (see Figure 1)**.

IEA recognises that behavioural changes that would limit air traffic growth may not occur. In this case, it estimates that for the industry to stay on the 1.5°C pathway, the already ambitious rate of SAF adoption would need to be even higher than anticipated. For example, **by 2030, in the absence of effective demand management measures, SAF would need to account for 26% of aviation fuel consumption, compared with 18% if demand can be constrained. Given the slow progress of SAF development globally, such a large increase in SAF supply will clearly be difficult to achieve and hence represents a risky strategy for the transition of the aviation sector to net zero by 2050**.

Demand management will require policy interventions, which may take the form of market-based measures (e.g., carbon pricing, passenger flight taxes, frequent flyer levies); regulation (e.g., banning short-haul domestic flights where there is an HSR alternative, as has been proposed in France[40]); HSR investment; rail subsidies; company disclosure requirements around corporate travel; and public awareness campaigns.[41] In addition, aviation companies themselves can take measures to manage demand or bring about behavioural changes, for example, by ending frequent flyer reward programmes, ending advertising campaigns that target growth in developed markets with already high per-capita flights, disclosing the carbon footprint of flights at the point of ticket purchase or by entering into partnerships with rail operators to offer combined air and train tickets.[42] Corporate customers of airlines also have a role to play in reducing their own business travel levels.

The aviation industry has adopted a different approach to forecasting demand in its net-zero roadmaps. Unlike IEA, ATAG and IATA assume that there will be no curtailment in air traffic growth to 2050 and base their projections on a compound annual growth rate in air passenger traffic of 3% (although this varies across regions) between 2019 and 2050. This is higher than the equivalent growth rate used by IEA of just over 2% (see Figure 3). So, by 2050, air passenger traffic (in Revenue Passenger Kilometres (RPK)) is projected to be over 40% higher in the industry roadmap than in the IEA 1.5°C pathway. As a result, the industry places a greater emphasis on SAF and new technologies as a means of decarbonising than IEA.

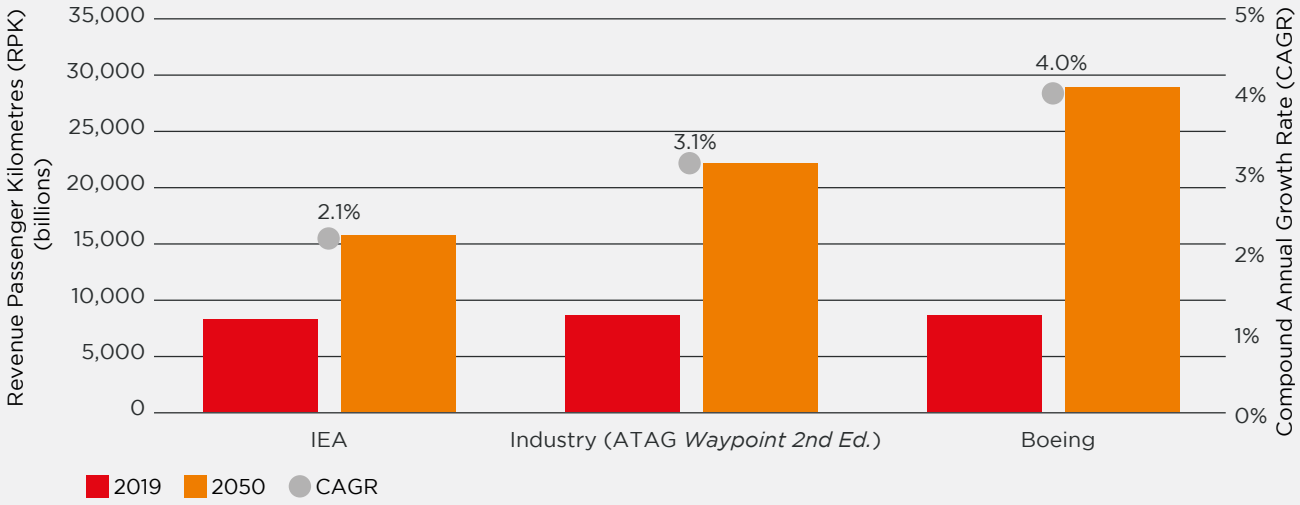
This represents significant risks for the sector as a whole, and for individual aviation companies, because:

i. The **aviation sector may not be able to align with a 1.5°C pathway** if the assumptions used by the industry associations – that SAF will be available at the scale and in the timeframe required, and that other technologies, still under development, will come on stream – are not realised.

ii. Without efforts to curtail demand, the **growth in air passenger traffic may be even greater** than the 3% per year assumed in the industry roadmap. In fact, the industry's traffic growth projection appears conservative in the context of Boeing's *Commercial Market Outlook (2021 to 2040)*, which forecasts a recovery in air passenger traffic growth rates to pre-COVID-19 levels, resulting in a long-term average growth rate in passenger traffic of 4% (Boeing, 2021). If this level of growth materialises, it will be even more difficult for the sector to achieve the 1.5°C pathway. Figure 3 compares the traffic growth projections used by the IEA, ATAG/IATA and Boeing and shows the resulting RPK forecast for 2050.

iii. At a company level, the potential introduction of policy measures to curtail demand **presents an important regulatory risk**; companies will need to assess the impact of such policies on their business models (e.g., the impact of ticket taxes on their long-haul leisure and business segments). Companies will also need to consider the risk that policymakers may impose even stronger measures to limit growth in demand if SAF and new technologies do not deliver the necessary emissions reductions.

Figure 3: Comparison of air passenger traffic projections (2019 to 2050) used in the IEA's 1.5°C pathway, ATAG's roadmap and Boeing's forecast



Sources: Analysis is based on data provided in the IEA *Net Zero by 2050* report (Annex A), ATAG *Waypoint 2050 (Second Edition)* and Boeing's *Commercial Market Outlook 2021 to 2040* (note that the Compound Annual Growth Rate (CAGR) (2019 to 2040) used by Boeing has been extrapolated to 2050 for comparison).

COMPONENT 4: AVOIDING CARBON OFFSETS

Under the IEA 1.5°C pathway, aviation companies are required to make actual reductions in emissions, without using offsets or CCS. IEA specifies that CO2 removal activities are allocated to the sectors in which they arise. As a result, offsetting is not a credible or feasible decarbonisation strategy for aviation companies seeking to align with the IEA's 1.5°C pathway. Instead, aviation companies need to focus on reducing their own emissions.

The IEA *Net Zero by 2050* scenario carbon budget takes account of negative emissions[43] in the sector *in which they arise*.[44] To avoid double counting of negative emissions, aviation companies and the industry need to demonstrate their alignment with the IEA's 1.5°C pathway based on emissions reductions *within* the sector, before taking account of any offsets or other GHG removal technologies. Offsetting can play a valuable role in allowing aviation companies to fund decarbonisation in *other* sectors, but this needs to be *in addition* to aviation companies aligning with the 1.5°C pathway through their own emissions reductions.

This is consistent with the approach taken by the Transition Pathway Initiative (TPI)[45] and SBTi. For example, SBTi identifies[46] two specific roles for offsetting and CCS in corporate net-zero strategies:

- **Residual emissions:** Offsetting and CCS may be used to 'neutralise' any residual emissions that remain in 2050, and that are permitted under the 1.5°C pathway for aviation.[47] This would allow a company to reach net zero in addition to being aligned with the 1.5°C pathway.
- **Beyond value chain mitigation:** In addition to reducing their own emissions in line with a 1.5°C pathway, SBTi strongly encourages companies transitioning to net zero to act beyond their own value chain, for example, by purchasing high-quality REDD+ credits or investing in Direct Air Capture (DAC).[48] This would accelerate the transition in other sectors and provide much needed finance. It would also help ensure that, by 2050, technologies are available to allow companies to neutralise their residual emissions. SBTi recommends that companies should report on their beyond value chain mitigation.[49]

The industry adopts a different approach. The ATAG and IATA net-zero roadmaps rely on offsetting, particularly in the period up to 2035. The level of offsetting varies depending on the scenario used. IATA's *Net Zero Carbon 2050 Resolution* indicates that in 2035, 77% of emissions reductions from the aviation sector will come from offsets. The scenarios set out in ATAG's *Waypoint 2050 (Second Edition)* anticipate lower usage of offsets in 2035, but higher reliance on SAF than IATA. As a result of the inclusion of offsetting and CCS in these industry roadmaps, they cannot be compared directly with the IEA 1.5°C pathway, which is based on emissions reductions within the sector.

COMPONENT 5: COMPLEMENTING ABSOLUTE EMISSIONS REDUCTIONS WITH CARBON EMISSIONS INTENSITY METRICS [50]

The IEA's 1.5°C pathway for aviation maps out the absolute emissions reductions required for the whole sector. This can also be expressed in terms of a carbon intensity pathway. Carbon intensity metrics allow investors to assess the adequacy of individual company targets and compare carbon performance of companies of different sizes. Companies should set carbon intensity targets that are aligned with a 1.5°C intensity pathway, in addition to setting targets to reduce their absolute emissions.[51] Additionally, a move towards full life cycle emissions reporting in intensity metrics will become increasingly important as the fuel mix in aviation changes and emissions potentially move upstream.

The IEA 1.5°C pathway provides a carbon budget for the aviation sector as a whole for each year to 2050. To allow this carbon budget to be allocated across individual companies in the sector, the budget can be expressed in terms of a carbon intensity pathway.[52] A company's carbon intensity can then be compared with a 1.5°C carbon intensity pathway and with the carbon intensity of other companies in the sector. Various tools can help investors translate the IEA's 1.5°C pathway into a carbon intensity pathway, including:

1) Transition Pathway Initiative (TPI)

TPI is an investor-backed initiative that provides sectoral intensity pathways, based on IEA data for emissions and activity. It allows investors to benchmark the carbon performance of companies, based on publicly disclosed information. The TPI 1.5°C intensity pathway for aviation, based on the IEA's 1.5°C absolute emissions pathway, was released in February 2022 (TPI, 2022).

2) Science Based Targets initiative (SBTi)

The SBTi also produces intensity pathways for aviation. A 1.5°C intensity pathway is due to be released in 2022 (SBTi, 2021a). This will allow aviation companies to set **near- and long-term intensity targets** that are aligned with a 1.5°C pathway and submit them to SBTi for validation. This can provide assurance to investors that the company is 1.5°C-aligned.[53]

There is a need for improvement in company reporting around intensity measures. Currently, there is no single metric or standard approach across the aviation sector for calculating or disclosing carbon intensity.[54] This makes it difficult for investors to compare carbon intensities across companies and therefore understand if they are taking the necessary action on climate change. For example, there are differences in the activity measure used by companies in calculating carbon intensity. In addition, there are differences around whether the full life cycle emissions or only direct emissions on combustion are used in intensity metrics. **A move towards full life cycle emissions reporting will become increasingly important as the fuel mix in aviation changes and emissions potentially move upstream (e.g., from SAF, hydrogen or electricity production), so that companies can be held accountable for their choice of fuels.**

APPENDIX

Climate Action 100+ Net-Zero Company Benchmark Disclosure Framework: indicator and description		Recommended Investor Expectations for Aviation Companies	Additional Notes
1. Ambition	The company has a stated ambition to achieve net-zero greenhouse gas emissions by 2050 (or sooner).	Companies' ambitions should encompass all segments of the business, including subsidiaries and joint ventures. The ambition should account, to the extent feasible, for the non-CO2 impacts associated with aviation.	Flying at altitude results in additional climate impacts, such as those caused by contrail and cloud formation. While there is still uncertainty about the exact magnitude of these 'non-CO2' impacts, recent scientific research indicates that the overall climate impact of aviation is currently around three times the impact of its CO2 emissions alone.
2-4. Targets	The company has set clearly defined short-, medium- and long-term targets to reduce greenhouse gas emissions, and these targets cover all material emission scopes and are aligned to the goal of limiting global warming to 1.5°C.	Companies' targets should account, to the extent feasible, for the non-CO2 impacts associated with aviation.	See above.
		These targets should be based on companies' actual emissions reductions (rather than offsets). Companies with targets that currently include offsets should develop and disclose plans for phasing them out, as well as include the year in which offsets will no longer be used and their targets will consist only of actual emissions reductions.	Under the IEA 1.5°C pathway, aviation companies must make actual reductions in emissions rather than relying on offsetting or CCS to meet their climate targets. Offsetting has been a common feature of aviation companies' decarbonisation strategies. However, going forward, to be aligned with the IEA 1.5°C pathway, companies will need to focus on reducing their own emissions. Offsetting can, however, play a role in a company's wider decarbonisation efforts (e.g., through purchasing carbon credits or investing in carbon removal technologies to help accelerate the decarbonisation of other sectors).
		Companies should have their targets independently validated by the Science Based Targets initiative (SBTi) or another credible verification body.	
		Companies should set short-, medium- and long-term targets for using SAF, and outline how these compare with IEA milestones and wider industry targets.	SAF is crucial to decarbonising the aviation sector. In the IEA 1.5°C scenario, by 2030, 16% of aviation's energy consumption would need to come from advanced biofuels, and a further 2% from synthetic fuels. By 2040, advanced biofuels and synthetic fuels, combined, would represent half of the total aviation fuel consumption.
		Companies should set carbon intensity targets that are aligned with a 1.5°C intensity pathway, in addition to setting targets to reduce their absolute emissions.	The IEA's 1.5°C pathway for aviation maps out the absolute emissions reductions required for the whole sector. These reductions can also be expressed in terms of a carbon intensity pathway. Carbon intensity metrics allow investors to assess the adequacy of individual company targets and compare carbon performance of companies of different sizes. Intensity targets should be used in conjunction with absolute emissions targets because, if a company's activity turns out to be higher than expected, it may exceed its share of the sector's absolute emissions budget, even if it meets its intensity target.
5. Decarbonisation Strategy	The company has established a decarbonisation strategy to meet its short-, medium- and long-term greenhouse gas emission reduction targets. The strategy includes a commitment to 'green revenues'.	Companies should specify the actions they will take to meet their short-, medium- and long-term targets and should specify the quantified contribution each action will make to these targets.	Under the IEA's 1.5°C pathway, a company's decarbonisation strategy should not include offsets in place of its own emissions reductions. Companies should indicate by what date their targets will align with the IEA 1.5°C pathway for aviation, excluding the use of offsets and CCS.
		Companies should accelerate the adoption of SAF, including advanced biofuels and synthetic fuels.	The actions companies could take include: • Actively supporting investment in SAF (e.g., through procurement commitments, offtake agreements, buyer alliances for joint purchasing agreements). • Developing pricing and ticketing options for consumers that cover the cost of using SAF on flights. • Forming coalitions/partnerships – with airlines and other stakeholders – that support interventions to promote SAF uptake. • Supporting the development and adoption of global standards and credible third-party certification processes to ensure that the life cycle emissions and overall sustainability of SAF are adequately addressed and managed. • Supporting the development and adoption of metrics for measuring, reporting and verifying the life cycle greenhouse emissions and other environmental impacts of SAF. Companies need to ensure the use of SAF results in real emissions reductions and that their production does not result in negative social and environmental externalities.
		Companies should support the research, development and scaling of key decarbonisation technologies. These may include SAF, new aircraft technologies that can improve efficiency and can reduce emissions and fuel use, and alternative propulsion technologies such as hydrogen and electric aircraft.	While SAF forms the backbone of most 1.5°C pathways for the aviation sector, other technologies also have an important (although smaller) role to play and require support to scale up. IEA anticipates that battery electric and hydrogen aircraft will enter the market by 2035, although, as these technologies will be suitable only for short-haul distances (unless there are significant breakthroughs), they are expected to account for only around 2% of aviation's energy use by 2050. Synthetic SAFs are critical to a 1.5°C pathway and become increasingly important. Research and development is needed in synthetic SAF to ensure future availability.
		Companies should support efforts to positively impact customer behaviour, for example, by disclosing the carbon footprint of a flight at the point of ticket purchase or by entering into partnerships with rail operators to offer combined air and train tickets.	Behavioural changes around flying play an important role in reducing emissions in the IEA 1.5°C pathway for aviation. IEA identifies three priority areas where demand management can have a significant effect on emissions: keeping business travel to 2019 levels, capping long-haul flights (of more than 6 hours) for leisure at 2019 levels and shifting demand to HSR, where possible. IEA estimates that, by focusing on these three priority areas, residual emissions in 2050 could be half what they would otherwise be, while affecting only 12% of flights.
		Companies should support research into the impacts of non-CO2 effects from aviation and how these impacts can be mitigated.	
		Companies should explain how they expect to manage the following issues: • The risk that SAF may not be scaled up to the levels required under the 1.5°C pathway. • The implications of overall traffic growth for the sector being higher than that assumed in industry roadmaps, such as those produced by IATA and ATAG (i.e. 3%), and how the industry is mitigating the risk of not aligning with the 1.5°C pathway.	Demand growth in excess of that predicted and/or a failure to scale SAF at the rate required increases the likelihood that governments will take other policy actions aimed at reducing air traffic growth to limit temperature rise to 1.5°C.

Climate Action 100+ Net-Zero Company Benchmark Disclosure Framework: indicator and description		Recommended Investor Expectations for Aviation Companies	Additional Notes
6. Capital Allocation Alignment	The company has explicitly committed to align its capital expenditures with the goals of the Paris Agreement.	Companies should commit to aligning their future capital expenditures with their long-term net zero greenhouse gas emissions reduction targets.	Aviation companies should disclose the methodology used to align their capital expenditure with their decarbonisation goals, including underlying assumptions and KPIs.
		Companies should have explicit capital expenditures commitments for SAF and for other decarbonisation technologies (e.g., energy efficiency and hydrogen/electric aircraft).	IATA estimates that US$2 trillion in investment will be required up to 2050 for the aviation sector to reach net-zero emissions by that date. This includes between US$1 trillion and US$1.4 trillion for SAF alone.
7. Climate Policy Engagement	The company has explicitly committed to conduct all of its lobbying in line with the goals of the Paris Agreement, and the company demonstrates how its direct and indirect lobbying is consistent with this commitment.	Companies should make a formal commitment to conducting all of their lobbying – both their own lobbying and the lobbying of their trade associations and industry bodies such as ATAG and IATA – in line with the goals of the Paris Agreement, at the global and at the national/regional level.	This requires companies to ensure that they do not lobby – whether directly or through trade associations and other organisations – in a way that undermines the goals of the Paris Agreement or that undermines ambitious national or regional climate change policy.
		Companies should establish robust governance procedures on climate lobbying, including conducting regular reviews of whether the lobbying activities of their trade associations and industry bodies align with the goals of the Paris Agreement. Companies should take actions to correct misalignments whenever their lobbying activities or the lobbying activities of their trade associations or industry bodies are not aligned with ambitious climate policies.	
		In the specific context of international aviation policy, companies should lobby IATA and ATAG to set targets and define roadmaps that do not rely on the use of offsets or CCS for the aviation industry as a whole and that align with the IEA 1.5°C pathway.	While IATA and ATAG have both developed net-zero roadmaps, these roadmaps are less ambitious than the IEA 1.5°C pathway, particularly up to 2040, and rely on the future scale-up of SAF and carbon offsetting to a much larger extent than the IEA.
		Companies should actively support policy measures that can help scale up SAF (e.g., SAF incentives, fuel mandates, carbon pricing).	Both IEA and the aviation industry stress that governments and other policymakers play an essential role in directing private finance towards decarbonisation of aviation. Potential policy measures to increase private investment include de-risking early-stage investment through co-funding, loan guarantee schemes or subsidies.
		Companies should support policy measures focused on demand management and modal shifts. Companies should confirm that they intend to address the risks associated with demand management without lobbying (either directly or indirectly via their trade associations) in ways that contradict their stated climate commitments.	Demand management has a critical role to play in achieving the IEA's 1.5°C pathway, and this contribution is much greater than envisaged in previous IEA scenarios. The more the aviation sector can scale up SAF and other solutions to decarbonise, the less demand management will ultimately be needed for the sector to align with a 1.5°C pathway.
8. Climate Governance	The company's board has clear oversight of climate change, the company's executive remuneration scheme incorporates climate change performance elements, and the company's board has sufficient capabilities and competencies to assess and manage climate-related risks and opportunities.	Companies should incorporate climate change performance elements – specifically the delivery of their net-zero commitments, their short-, medium- and long-term climate change targets and their SAF targets – into their executive remuneration schemes.	
9. Just Transition	The company considers the impacts from transitioning to a lower-carbon business model on its workers and communities.	Companies should publish a board level report setting out how the company will address workforce and community needs in the implementation of the company's transition to net zero. The report should cover the implications of demand management or changes to modes of transport on employment, local economic development, and access to transport services.	
10. TCFD Disclosure	The company has committed to implement the recommendations of the Task Force on Climate-Related Financial Disclosures (TCFD) and employs climate scenario planning to test its strategic and operational resilience.	Companies should report, for the entire business including all subsidiaries and joint ventures, on the specific metrics set out in Box 3 below. They should report both absolute and intensity metrics.	The IEA's 1.5°C pathway for aviation maps out the absolute emissions reductions required for the whole sector. These reductions can also be expressed in terms of a carbon intensity pathway. Carbon intensity metrics allow investors to assess the adequacy of individual company targets and compare carbon performance of companies of different sizes.
		Companies should work with investors and other stakeholders to develop and adopt standardised intensity measures and related disclosures, including full life cycle emissions intensity metrics.	Box 3 sets out the indicators that Climate Action 100+ believes are likely to be most useful to investors, and these provide the starting point for this discussion. One of the key challenges faced by investors is that carbon emissions disclosure in the aviation sector is inconsistent, making it difficult to directly compare companies or to assess how individual companies and the sector as a whole are performing against the goals of the Paris Agreement.
		Companies should specify the role of offsetting in their decarbonisation strategy.	Given the strong emphasis on offsets to reduce emissions within the aviation sector to date, companies should specify the extent to which their emissions reduction targets and decarbonisation strategies rely on offsets, including any offset phaseout plans. Companies should also specify the measures they take to ensure that any offsets used are high-quality (e.g., that they are additional, permanent and have no adverse sustainability effects). See further details on recommended standard reporting expectations related to offsets in Box 3 below.

BOX 3: RECOMMENDED STANDARD REPORTING EXPECTATIONS SPECIFIC TO AIRLINES

For their **objectives, targets, and annual performance reporting**, airlines should provide the following information:

- Greenhouse gas emissions (in CO2-equivalent terms) per Revenue Passenger Kilometre.
- Greenhouse gas emissions (in CO2-equivalent terms) per Revenue Tonne Kilometre.
- Greenhouse gas emissions (in CO2-equivalent terms) per Available Seat Kilometre.
- Total – i.e. Scope 1, 2 and 3 – greenhouse gas emissions in CO2-equivalent terms.
- The contribution of carbon offsetting to reducing each of the intensity and absolute measures listed above. This should include information on the types of offsets used, the vetting procedures applied in their purchase, the name(s) of the certifying organisation(s) and the average prices for these offsets.

For SAF, including advanced biofuels, synthetic fuels, and other alternative fuels, airlines should provide the following information:

- The quantities used and company commitments to future use.
- Sustainability certification organisations used if applicable.
- Material sustainability considerations for any fuels used, including feedstocks, life cycle emissions, land-use changes, biodiversity, human rights and other relevant environmental or social impacts associated with their production.

For the **just transition**, companies should report on the implications for employees, supply chains, customers, and communities of the transition to a lower-carbon business model, and how any negative impacts are to be managed in line with 'just transition' principles.

Companies should be transparent about their **lobbying** activities. They should provide:

- A comprehensive description of the positions they have taken on all relevant climate-related policies.
- A comprehensive description of their policy engagement activities (e.g., meetings, policy submissions), with both domestic and international policymakers and with organisations such as IATA, ATAG and ICAO.
- A detailed explanation of how they govern/oversee their lobbying activities.
- A list of their trade association and industry group memberships, including the payments made to each of these organisations.

ENDNOTES AND ADDITIONAL REFERENCES

ENDNOTES

1 These include Airbus, Air France-KLM, American Airlines, Boeing, Delta Air Lines, Lockheed Martin, Qantas Airways, Raytheon Technologies, Rolls-Royce Holdings and United Airlines.

2 This report focuses on airline companies and aerospace companies (the manufacturers of aircraft and engines). The term 'aviation companies' is used to refer collectively to these players. While other players in the industry, such as airports, have an important role to play in decarbonisation, they are not addressed here.

3 Air Transport Action Group (ATAG), 2021a.

4 Lee et al, 2020.

5 In IEA's modelling, the energy sector's CO2 emissions include those from transport, buildings and industry (including from industrial processes). In its model, a reduction in CO2 emissions from the energy sector to net zero by 2050, with a corresponding reduction outside the energy sector (i.e., in the Agriculture, Forestry and Other Land Use (AFOLU) sector), is consistent with a 50% probability of limiting the increase in average long-term temperature to 1.5°C, without a temperature overshoot.

6 In September 2021, ATAG published '*Waypoint 2050 (Second Edition)*', which sets out a roadmap, based on a number of scenarios, of how the sector expects to reach net zero by mid-century. In October 2021, IATA published its '*Net Zero Carbon 2050 Resolution Factsheet*', setting out key milestones in reaching net zero.

7 For example, in 2035, the IEA 1.5°C pathway requires aviation's direct CO2 emissions to be around 625Mt but the ATAG report *Waypoint 2050 (Second Edition)*, which sets out various decarbonisation scenarios, indicates that in-sector aviation emissions (i.e. before taking account of offsets from outside the sector) will be much higher, in the region of 1,000Mt, at that date.

8 SAF includes (1) sustainable biofuels and (2) 'synthetic fuels' defined as low-emissions synthetic hydrogen-based fuels. Sustainable biofuels refer to 'advanced' biofuels that, unlike conventional biofuels, do not compete with food production and offer significant life cycle emissions reductions relative to fossil-based jet fuel. Examples include short rotation woody crops, domestic and industrial waste, and agricultural and forest residues. For further discussion on SAF, please see PRI, 2021a; Air Transport Action Group (ATAG), 2021b.

9 Such as carbon captured during the production of biofuels (Bioenergy with Carbon Capture and Storage (BECCS)) and by Direct Air Capture combined with Carbon Storage (DACCS).

10 Here, the term demand management refers to the actions taken by policymakers and the aviation sector to limit the demand for jet fuel through the curtailment of demand for air transportation. In some mature markets, curtailing demand may involve reducing air traffic or maintaining it at current levels. In other less developed markets, it may involve a reduction in the *growth* in air traffic, compared to what it would be under business as usual. Demand management can involve measures such as carbon taxes, limiting airport expansion, investing in high-speed rail (to induce a modal shift) and providing information to consumers, as discussed further below.

11 For investors, engaging with companies on the issue of demand management should not be seen to conflict with their fiduciary duties. By constraining air traffic growth, it is more likely that the sector can become aligned with the 1.5°C pathway, which ultimately helps mitigate the long-term systemic risk to investors' portfolios resulting from climate change. Further discussion can be found in the report: Modern Interpretation of Fiduciary Duty (PRI, 2019).

12 Some parallels may be drawn with the oil and gas sector, where companies have had to consider the strategic implications for their business of constraints on growth.

13 Under the IEA approach to carbon budgeting, nature-based removals (e.g., from afforestation or soil management) are included in the AFOLU sector, which sits outside of the energy sector. The IEA NZE pathway for the global energy sector does not rely on negative emissions from AFOLU, as it is assumed that such negative emissions will be required to enable that sector to reach net zero by 2040. Any net negative emissions from AFOLU after that date have been taken into account in setting the global cumulative energy sector 1.5°C carbon budget. Unlike nature-based removals, negative emissions from technologies such as BECCS and DACCS fall in the energy sector carbon budget. However, these are allocated to the bioenergy production and DACCS sectors, so are separate from the aviation sector carbon budget.

14 Boeing, 2021a.

15 Note that oil and gas companies should be discouraged from issuing 'carbon neutral' petroleum products that are merely paired with carbon credits to an amount that covers the real embedded emissions created in the production phase.

16 Included in the EU *Fitfor55* climate package is a proposal to remove mandatory jet fuel tax exemptions for intra-European flights over a 10-year period from 2023. Some NGOs have criticised the proposal for not being ambitious enough, arguing that the change should include flights to/from the EU and be introduced over a shorter period (Green Air, 2021a).

17 Railway-News, 2021.

18 Information Design, 2021.

19 Airport Watch, 2020.

20 This should include information on the types of offsets used, the vetting procedures applied in their purchase, the name(s) of the certifying organisation(s) and the average prices for these offsets.

21 This would ensure any emissions from production and transportation of a fuel are taken into account.

22 We refer to the IEA's aviation sector pathway as a '1.5°C pathway' rather than a 'Net Zero pathway' as IEA allows for this sector to have residual emissions in 2050. However, at a global energy sector-wide level, a 1.5°C pathway is synonymous with a Net Zero pathway, that is, if the global energy sector and the AFOLU sector each reach net zero by 2050, planetary net zero can be achieved, which is consistent with efforts to limit the global temperature rise to 1.5°C.

23 In the IEA NZE pathway, by 2050, 10% of the bioenergy used globally is assumed to be produced in facilities that include CCS. Biofuels are considered to have climate benefits, as the carbon absorbed during the growth phase of a plant offsets the carbon emitted when the fuel is burned. However, carbon is also emitted during the production and transportation of biofuels, so over their life cycle, biofuels are not carbon neutral. In the case of BECCS, carbon is removed from the atmosphere during biofuel production, which can offset the emissions from biofuel production (and transportation) and, if sufficient carbon is captured and permanently stored, can result in negative emissions over the full life cycle of the biofuel. Similarly, DACCS involves removing carbon from the atmosphere and storing it permanently (instead of using it, for example, to produce hydrogen).

24 Unlike in previous IEA reports, the IEA *Net Zero by 2050* report does not include the traditional wedge diagram for aviation showing how the various mitigation elements contribute to decarbonisation, and there is not sufficient information provided to recreate this. This report uses IEA data to produce a 1.5°C pathway and superimposes the various milestones for aviation set out in the IEA report (IEA, 2021), in Figure 1.

25 The feasibility of this target is being questioned by some commentators given that the European Commission's (2021) ReFuel Aviation initiative, already seen as ambitious (SkyNRG, 2021), is legislating for a 5% SAF blending obligation from 2030, with plans to increase this to 20% from 2035. Further, the International Council on Clean Transportation (ICCT, 2021a) estimates that the EU resource base for SAF is sufficient to support 5.5% of projected EU jet fuel demand in 2030. The implication is that more demand management would be required if the IEA's SAF target cannot be met.

26 ICF, 2021.

27 Commercial battery electric flight is planned in some niche markets before this date.

28 For example, for the Nordic region, where there are several national policies and multi-stakeholder initiatives in place to accelerate the development of domestic and regional electric flight (Bloomberg, 2020), and elsewhere, for certain airlines that are focused on serving some short-haul segments of the market (The Hill, 2021).

29 This is around 8,000 times the level of SAF used in 2020, which was around 50,000 tonnes (ICF, 2021).

30 IEA, 2021, indicates that aviation will consume 10.75EJ of energy from biofuels and synthetic fuels, combined, by 2050, which is equivalent to around 250Mt of SAF (assuming for simplicity that the Net Calorific Value of SAF is the same as jet kerosene of 44.1 TJ/Gg (i.e. 0.044.1EJ/Mt), using the conversion factor from 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

31 ICF, 2021.

32 ICAO, 2022.

33 The airline industry has a strong preference for financial incentives for SAF rather than other measures such as carbon pricing or fuel mandates, particularly if these are imposed at a national or regional level, which can affect competitiveness.

34 This builds on analyses by the Energy Transition Commission, IEA and the World Economic Forum (ICF, 2021).

35 ICCT (2021a) discusses the EU SAF feedstock availability.

36 For example, under CORSIA, three sustainability criteria have already been adopted (relating to minimum life cycle emissions reductions of allowable biofuels and land use change rules). Work is ongoing around another 14 criteria (related to water, soil, food security, etc.) (ICAO, 2019).

37 As discussed in the previous component, the aviation industry is in favour of financial incentives over other forms of emissions regulations (e.g., carbon taxes), due to competitiveness issues.

38 ICAO's 2022 General Assembly is currently expected to be held from 27 September to 7 October.

39 Others support a move to include international aviation emissions in individual Nationally Determined Contributions to the Paris Agreement (Green Air, 2021b).

40 In April 2021, the French Assemblée Nationale voted in favour of banning domestic flights on routes that are covered by train journeys that can be completed in less than two and a half hours (Reuters, 2021).

41 As discussed previously, the airline industry is generally not in favour of measures such as passenger flight taxes, particularly if these are imposed at a national or regional level, which can affect competitiveness.

42 Air France has such a partnership with rail operator SCNF (Air France, 2021).

43 The IPCC uses the terms 'negative emissions', 'carbon dioxide removal' and 'greenhouse gas removal' to describe activities that remove carbon dioxide from the atmosphere.

44 Under the IEA approach to carbon budgeting, nature-based removals (e.g., from afforestation or soil management) are included in the AFOLU sector, which sits outside of the energy sector. The IEA NZE pathway for the global energy sector does not rely on negative emissions from AFOLU, as it is assumed that such negative emissions will be required to enable that sector to reach net zero by 2040. Any net negative emissions from AFOLU after that date have been taken into account in setting the global cumulative energy sector 1.5°C carbon budget. Unlike nature-based removals, negative emissions from technologies such as BECCS and DACCS fall with the energy sector carbon budget. However, these are allocated to the bioenergy production and DACCS sectors, so are separate from the aviation sector carbon budget.

45 Transition Pathway Initiative, 2022.

46 SBTi, 2021a.

47 Under the IEA 1.5°C pathway for aviation, the permitted sector-level residual emissions in 2050 are 210Mt, equivalent to around 20% of emissions in 2019 (see Figure 1).

48 See Appendix 3 of the Climate Action 100+ Aviation Sector Strategy Landscape Analysis (PRI, 2021a) for details on how a company can ensure any offsets used for this purpose are high quality (e.g., that they are additional, permanent and have no adverse sustainability effects).

49 Further SBTi research on how to incentivise companies to fund investments beyond their value chain is in progress.

50 Carbon emissions intensity can be defined as carbon emissions per unit of economic activity. The most common units of activity in aviation are Revenue Passenger Kilometres and Revenue Tonne Kilometres.

51 Intensity targets should be used in conjunction with absolute emissions targets because, if a company's activity turns out to be higher than expected, it may exceed its share of the sector's absolute emissions budget, even if it meets its intensity target.

52 For example, for 2030, the carbon intensity for aviation in a 1.5°C intensity pathway would be the total carbon emissions allowed under the IEA 1.5°C absolute emissions pathway in that year divided by the projected aviation activity (Revenue Passenger Kilometres or Revenue Tonne Kilometres) in that year. See Transition Pathway Initiative (2020) for further discussion on carbon intensity pathways.

53 Other benefits to investors of aviation companies signing up to the SBTi are: the targets are based on data submitted by the company itself so they can be specifically *tailored to the company* (taking account of the business segments in which it operates); the targets *are based on full life cycle emissions making a company accountable for emissions, across their supply chain*; companies are requested to disclose *their non-CO2 impacts, and how they are working to address them*; companies need to *comply with specific sustainability criteria for any biofuels used to meet their targets*. For further details, see the recently published guidance for the aviation sector in setting science-based targets (SBTi, 2021b).

54 As a result, Climate Action 100+ has called on companies to report against a range of intensity metrics (e.g., emissions per Revenue Passenger Kilometre, per Revenue Tonne Kilometre and per Available Seat Kilometre) (PRI, 2021b).

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The Principles for Responsible Investment (PRI)

Although this report forms part of the Climate Action 100+ global sector strategy for aviation, the report and its contents were produced by the PRI.

The PRI is an investor initiative in partnership with the UN Finance Initiative and UN Global Compact. The PRI works with its international network of signatories to put the six Principles for Responsible Investment into practice. Its goals are to understand the investment implications of environmental, social and governance (ESG) issues and to support signatories in integrating these issues into investment and ownership decisions. The PRI acts in the long-term interests of its signatories, of the financial markets and economies in which they operate and ultimately of the environment and society as a whole.

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Chronos Sustainability

The PRI commissioned Chronos Sustainability to develop this report.

Chronos Sustainability was established in 2017 with the objective of delivering transformative, systemic change in the social and environmental performance of key industry sectors through expert analysis of complex systems and effective multi-stakeholder partnerships. Chronos works extensively with global investors and global investor networks to build their understanding of the investment implications of sustainability-related issues, developing tools and strategies to enable them to build sustainability into their investment research and engagement.

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