# Net Zero 2050

## Progress Tracking Methodology

### Background

In 2021, IATA member airlines approved a resolution to achieve net zero carbon emissions by 2050. Additionally, ICAO has recently adopted a Long Term Aspirational Goal (LTAG) for international aviation of net zero carbon emissions 2050. While these commitments have established an absolute goal with a clear end-date, no concrete plan has yet been formulated as to how progress will be monitored and tracked at an industry level.

The industry needs a consistent methodology and reporting mechanisms to be able to track progress towards the net zero by 2050 goal. If not, there is a risk for the industry: in the absence of industry initiatives, third parties may seek to position themselves in this regard, at the detriment of the industry with potential administrative burden and data ownership issues. False perceptions bring about a plethora of potential financial risks, such as mistargeted and ill-defined policy measures. In addition, public pressure to show progress on Net Zero will also create potential thorny situations if there is no consistency in the industry. Faced with these challenges, IATA had organized an industry support group[1], called TrackZero 2050, to leverage the members' expertise and focus on creating an industry-wide consistent Net Zero tracking mechanism.

Overall, achieving net zero is expected to be driven primarily by the increasing deployment of sustainable aviation fuel (SAF), next generation aircraft and propulsion technologies, infrastructure and operational improvements, complemented by carbon offsetting/removal of residual emissions. In turn, it is important to understand how these 'levers' contribute individually towards the realization of the net zero goal. The TrackZero 2050 industry support group identified the relevant emissions scope, sources, and appropriate process for tracking.

The group also provided recommendations with regards to aspects of data collection and data validation, with emphasis on the importance of maintaining data ownership within the industry. While external data may be readily available, ensuring the equal treatment of all airlines and maintaining data accuracy would be extremely challenging, if not impossible. The industry would not have control of the data narrative, which could in turn portray a wrong image of the industry's progress to the Net Zero target. The current proliferation of "Net Zero" calculators and methodologies only exacerbates the issue and poses new challenges in building trust and consumer confidence.

The industry stands united behind the Net Zero commitment, agreed on unanimously at the 2021 IATA Annual General Assembly, so it is only natural that IATA takes the leading role in monitoring the industry's progress towards the net zero target. This TrackZero Methodology, developed by industry experts and implemented through IATA, shall serve as the reference point for understanding where the industry stands on its path to decarbonization, and also serve as guidance for airlines' own reporting of their environmental performance to the general public, investors, and other stakeholders.

Annual data collection by IATA will ensure that IATA obtains a clear picture without unnecessary administrative burden, accurately and transparently. Building on IATA's proven track record of collecting and anonymizing

[1] TrackZero 2050 support group consists of 11 member airlines and four aircraft manufacturers.

performance data, airlines will be able to monitor their progress relative to each other, enhancing competition to further stimulate innovation and advancements in decarbonization.

# Scope of Emissions

The net zero commitment[2] covers the following aviation activities:

- International and domestic flights
- Passenger and cargo flights, including business aviation
- Revenue and non-revenue flights
- Emissions/reductions scope:
    - $CO_2$ emissions only (non-$CO_2$ GHG emissions excluded);
    - tank-to-wake for conventional jet fuel;
    - well-to-wake for SAF;
    - well-to-wake for hydrogen and electric propulsion.

# Emissions and Reduction Sources

Levers to reduce emissions are not all characterized in the same way, and there are substantial differences in technological maturity, availability of data, etc., which necessitates different sub-metrics and data collection processes for each. The following emissions and reduction sources have been identified:

1. **Conventional Jet Fuel**: conventional jet fuel use and related $CO_2$ emissions
2. **SAF[3], Offsets and CDR/CCS[4] Technologies**: $CO_2$ reductions resulting from SAF use (both voluntary and compliance-required), carbon offsets (both voluntary and compliance-required, but excluding opt-in passenger-funded offsets), and $CO_2$ reductions from CDR/CCS technologies
3. **New Aircraft Technologies**: $CO_2$ emissions related to hydrogen use, electric propulsion, and hybrid-electric aircraft usage

# Key Metrics

The net zero commitment is an absolute target, meaning that by 2050 the net emissions of the airline industry will be zero. Nevertheless, the path to 2050 does not necessarily imply an immediate decrease in absolute emissions. The expected traffic growth in the near term may exceed the effects of the implemented mitigation measures, which could give a misleading impression of the industry's efforts toward decarbonization.

Two intensity metrics will therefore complement the absolute emissions metrics to help illustrate the progress after accounting for changes in traffic, as presented in Table 1, below.

| Metric | Description |
|---|---|
| Absolute: $MtCO_2$ | To track the evolution of total $CO_2$ emissions, after accounting for all emissions and emissions reduction sources |
| Intensity 1: $gCO_2$/RTK | To track the evolution of $CO_2$ emissions intensity, whilst accounting for changes in traffic volumes |
| Intensity 2: $gCO_2$/ATK | To track the evolution of $CO_2$ emissions intensity, whilst accounting for changes in available capacity |

Table 1: Key Metrics

[2] IATA (2021): https://www.iata.org/contentassets/dcd25da635cd4c3697b5d0d8ae32e159/iata-agm-resolution-on-net-zero-carbon-emissions.pdf
[3] Including low carbon aviation fuels (LCAF).
[4] CDR/CCS technologies include: CDR (carbon dioxide removal), CCS (carbon capture and storage), CCUS (carbon capture utilization and storage), BECCS (Bioenergy with carbon capture and storage), and DAC (direct air capture).

# Traffic Data

Deriving the improvements over time within any intensity metric (e.g., g$CO_2$/RTK) requires emissions data to be complemented by air traffic information. IATA has access to traffic data covering 900+ airlines and has extensive experience in collecting and validating this information.

When collecting and processing traffic data, utmost consideration is given to statistical consistency and adherence to international standards, e.g., with regards to the classification of non-revenue passengers and no-shows. It is therefore recommended that IATA's existing database constitutes the source of traffic information.

# Conventional Fuel

While SAF and new technologies are key decarbonization enablers, it is inevitable that the aviation industry will still be primarily fueled by conventional fuel for years to come. However, alongside advancements in SAF uptake and entry into service of new aircraft designs, continuous gains in fleet and operational efficiency are also expected. It is proposed to track $CO_2$ emissions from conventional fuel according to the information below.

| CONVENTIONAL FUEL | | |
|---|---|---|
| **Data** | **Scope** | **Notes** |
| • Total fuel consumption – tonnes<br>• Optional breakdowns:<br>○ International vs. Domestic<br>○ Passenger vs. Cargo | • All conventional jet fuel types:<br>○ Jet A/A-1 (or equivalent)<br>○ Jet B | • Reported by member airlines to IATA on an annual basis for the preceding calendar year<br>• Recommending CORSIA MRV practices be applied[5] |

Table 2: Conventional Fuel

[5] Using flight level monitoring based on five CORSIA Fuel Use Monitoring Methods and gap filling approaches for limited number of flights.

# SAF, Offsets and CDR/CCS Technologies

Regardless of progress in new aircraft technologies between now and 2050, SAF is expected to be the primary contributor to the decarbonization of the airline industry, in line with the Net Zero 2050 commitment. It is therefore paramount to accurately monitor SAF usage over time.

Detailed SAF-related data is to be monitored and reported by airlines accordingly, which enables the tracking of both the quantity and quality (i.e., emissions savings per kilogram) of SAF, as outlined below. SAF accounting will follow the internationally recognized CORSIA principles[6].

| SAF | | |
|---|---|---|
| **Data** | **Scope** | **Notes** |
| • Total neat SAF delivered[7] by SAF type – mass<br>• Total blended SAF delivered by SAF type – mass<br>• Lifecycle emissions factor per SAF type ($LS_f$)<br>• Total $CO_2$ emissions reductions from SAF | • All SAF based on ownership of environmental attributes in a calendar year | • Possibly some data to be collected by airlines from suppliers and/or reference databases<br>• Reported by member airlines to IATA on an annual basis for the preceding calendar year<br>• The recommended scope and calculation methodology may be subject to change should a widely accepted SAF Book & Claim system be developed |

Table 3: SAF

Although SAF will bring a notable reduction in net carbon emissions for the airline industry, there will likely be some residual $CO_2$ emissions that are to be mitigated with carbon offsets and/or CDR/CCS technologies. Data related to carbon offsets and CDR/CCS technologies will be reported by member airlines to IATA, in tandem with their SAF data.

| OFFSETS AND CDR/CCS TECHNOLOGIES | | |
|---|---|---|
| **Data** | **Scope** | **Notes** |
| • Total number of offsets retired in a calendar year, broken down by:<br>○ Mandatory vs. voluntary<br>○ CORSIA-eligible vs. Other schemes<br>• Total $CO_2$ removed/captured using CDR/CCS technologies[8] | • All types of certified offsets are accepted<br>• Opt-in passenger-funded offsets/ removals may voluntarily be reported to IATA but shall not be accounted for in progress towards Net Zero 2050 | • Reported by member airlines to IATA on an annual basis for the preceding calendar year |

Table 4: Offsets and CDR Technologies

[6] ICAO: https://www.icao.int/environmental-protection/CORSIA/Pages/CORSIA-Eligible-Fuels.aspx
[7] "Delivery" refers to the delivery/handover of environmental attributes from supplier to airline.
[8] Excluding DAC in relation to production of synthetic aviation fuels.

## New Aircraft Technologies

New aircraft technologies are also anticipated to have a prominent role in reaching net zero $CO_2$ emissions by 2050. The anticipated advancements can loosely be grouped into three categories: hydrogen aircraft, electric aircraft, and hybrid-electric aircraft. Tracking $CO_2$ emissions for these technologies is somewhat similar, however, each technology has specific nuances.

| HYBRID-ELECTRIC AIRCRAFT | | |
|---|---|---|
| **Data** | **Scope** | **Notes** |
| • Total electricity charged and used for aircraft propulsion[9] – GWh<br>• Total emissions from the electricity charged and used for aircraft propulsion – $CO_2$<br>• Total fuel consumption – mass | • Lifecycle $CO_2$ emissions of electricity use for aircraft propulsion (production, transport, storage, etc.)<br>• Recommended CORSIA MRV practices be applied for conventional fuel | • Possibly some data to be collected by airlines from airports/OEMs/reference databases (e.g., IEA[10]) before being reported to IATA<br>• Reported by member airlines to IATA on an annual basis for the preceding calendar year |

Table 5: Hybrid-electric Aircraft

| ELECTRIC AIRCRAFT | | |
|---|---|---|
| **Data** | **Scope** | **Notes** |
| • Total electricity charged and used for aircraft propulsion – GWh<br>• Total emissions from the electricity charged and used for aircraft propulsion – $CO_2$ | • Lifecycle $CO_2$ emissions of electricity used for aircraft propulsion (production, transport, storage, etc.) | • Possibly some data to be collected by airlines from airports/OEMs/reference databases (e.g., IEA) before being reported to IATA<br>• Reported by member airlines to IATA on an annual basis for the preceding calendar year |

Table 6: Electric Aircraft

| HYDROGEN AIRCRAFT | | |
|---|---|---|
| **Data** | **Scope** | **Notes** |
| • Total hydrogen used – in mass per hydrogen type[11]<br>• Total emissions from hydrogen use – $CO_2$ per hydrogen type | • Lifecycle $CO_2$ emissions of hydrogen use (production, transport, storage, compression, liquefaction etc.) | • Possibly some data to be collected by airlines from hydrogen producers/ airports/OEMs before being reported to IATA<br>• Reported by member airlines to IATA on an annual basis for the preceding calendar year |

Table 7: Hydrogen Aircraft

[9] For hybrid-electric, electric, and hydrogen aircraft, the scope of available data is unclear, hence a limit to "propulsion" energy use. Should more detailed data be readily available, consumption from all flight-related activities (including, e.g., consumption at a gate) will be included.
[10] International Energy Agency: https://www.iea.org/
[11] There are different production processes of hydrogen that lead to different amounts of $CO_2$ emissions. Therefore, it is important to report the use and emissions per type of hydrogen. Currently, the most common types are **grey** hydrogen (Steam Methane Reforming (SMR) based on natural gas), **blue** hydrogen (SMR with CCS), **green** hydrogen (Electrolysis based on renewable electricity), and **pink** hydrogen (Electrolysis based on nuclear power).

# Supporting metrics

While the three key metrics can provide a larger picture of the progress toward net zero, they fail to capture the details related to how that progress is being achieved. IATA will therefore utilize the data collected from airlines to derive a number of supporting sub-metrics.

| Sub-metric | Description |
|---|---|
| Total neat SAF delivered (mass) | Monitoring the progress in neat SAF uptake |
| Total blended SAF delivered (mass) | Monitoring the progress in blended SAF uptake |
| Average SAF blend ratio (%) | Derived from the above sub-metrics |
| Average $LS_f$ emissions reductions (%) | SAF carbon intensity tracking |
| Percentage of neat SAF of all fuel globally (%) | Tracking the share of SAF in global jet fuel use |
| Total number of offsets retired, broken down as:<br>○ Mandatory vs. voluntary<br>○ CORSIA-eligible vs. other | Monitoring the use of offsets by the airline industry, with a breakdown to help illustrate the motivation behind offset retirements (regulatory compliance or voluntary actions) as well as their composition (CORSIA-eligible offsets or all other offset types) |
| $CO_2$ removed by CDR/CCS technologies[12] | Tracking the emissions reductions arising from the use of CDR technologies |
| Average kg $CO_2$/kWh | Monitoring the carbon intensity of the electricity used to power hybrid-electric and electric aircraft |
| Average share of electric propulsion in hybrid-electric aircraft | Determining the distribution between electricity and jet fuel (in terms of energy) in powering of electric aircraft<br>To be calculated by IATA with the underlying data provided by airlines |
| Average kg $CO_2$/kg $H_2$ | Monitoring the carbon intensity of hydrogen used to power hydrogen aircraft |
| $CO_2$ avoided as a result of new technologies | To be calculated by IATA and provide insights into the contribution of different mitigation pathways |

Table 8: Sub-metrics

[12] Excluding DAC in relation to production of synthetic aviation fuels.

# Unresolved Items

In identifying the relevant metrics and data sources, a number of items were identified for which further investigation and discussion will be needed:

- **CDR/CCS**: There is currently no universal set of $CO_2$ accounting rules and principles in relation to CDR/CCS and similar technologies. To avoid double-counting, it is necessary to clarify what exactly gives one the right to ownership of the mitigated emissions using CDR/CCS. This is likely to be similar to offsets, and related metrics have been proposed accordingly.
- **SAF**: SAF accounting principles are not harmonized across the world, which creates an administrative burden to airlines and increases the risk of inaccurate data being reported. To resolve this, it should be considered a key priority to create globally accepted $CO_2$ and SAF accounting principles, followed by a worldwide recognized Book & Claim system.
- **Intermediate target(s)**: Prompted by increased public interest in the topic and demand for accountability, evaluating the feasibility of setting intermediate intensity-based targets to achieve Net Zero 2050, including the availability of necessary data for accurate modeling and analysis.
- **Conventional fuel emissions scope**: Inconsistency in the scope of emissions has been identified, namely in that for conventional fuels tank-to-wake emissions are considered, whereas for new technologies well-to-wake emissions are considered, which also adds complexity in SAF accounting. An investigation of the possibility of including the well-to-tank emissions of conventional jet fuels is recommended, recognizing that it would increase the required $CO_2$ to be mitigated to achieve the Net Zero 2050 target.

# Appendix A – Airline Reporting Example

To better illustrate what the proposed tracking would entail, we can consider an example case of Alpha Airlines. Alpha is a passenger-only airline that monitors fuel consumption using block-off/block-on method. In the previous year, the total jet fuel consumed was 100,000 tonnes (excluding hybrid-electric aircraft), with 80,000 tonnes on international flights and the remaining 20,000 on domestic flights.

Alpha Airlines has taken delivery [of environmental attributes] for two kinds of SAF: 2,000 tonnes of neat HEFA-produced and 1,000 tonnes of neat alcohol-to-jet (ATJ, isobutanol), with used cooking oil and agricultural residues as feedstock, respectively. The HEFA SAF was a 25% blend, and the ATJ was a 20% blend, resulting in 8,000 tonnes of blended HEFA and 5,000 tonnes of blended ATJ SAF. Alpha opted to use the CORSIA-default lifecycle emissions factors ($LS_f$), which are 13.9 $gCO_2e/MJ$ and 29.3 $gCO_2e/MJ$, respectively. The associated emissions reductions were calculated just like in CORSIA:

$$Emissions\ Reduction\ (ER)_{HEFA} = (3.16 * 2{,}000) * \left(1 - \frac{13.9}{89}\right) = 6320 * 0.8438 = 5{,}333\ tCO_2$$

$$Emissions\ Reduction\ (ER)_{ATJ} = (3.16 * 1{,}000) * \left(1 - \frac{29.3}{89}\right) = 3160 * 0.6708 = 2{,}120\ tCO_2$$

Alpha Airlines voluntarily offsets all domestic flights with CORSIA-eligible offsets and has therefore retired 20,000 offsets in the previous calendar year. Alpha also offers passengers the possibility to offset their flights, however those retired offsets are not accounted for in the progress towards Net Zero 2050. In other words, the 20,000 offsets Alpha voluntarily retired are in addition to those retired through passenger contribution. On top of the offsets, Alpha has permanently removed 1,500 tonnes of $CO_2$ via Carbon Capture and Storage (CCS).

In addition to their conventional-fuel fleet, Alpha operates a regional hybrid-electric turboprop, which has used 1,095 tonnes of Jet A-1 and 13 GWh of electricity in the previous calendar year. The average emissions factor of the used electricity (grid emissions factor) was 0.5 $kgCO_2/MWh$, and hence the electricity-related emissions were 6,500 t $CO_2$.

In summary, Alpha Airlines would undergo an "expanded" CORSIA verification to ensure the accuracy of the pertinent data, and would subsequently report the following to IATA by June 30$^{th}$ for the previous calendar year:

| Source | Data point reported to IATA | Value & unit |
|---|---|---|
| Conventional Fuel | Total conventional jet fuel consumption: Jet A-1 | 100,000 tonnes, of which:<br>• 80,000 international<br>• 20,000 domestic |
| SAF | Total neat SAF delivered: HEFA | 2,000 tonnes |
| | Total blended SAF delivered: HEFA | 8,000 tonnes |
| | Lifecycle emissions factor ($LS_f$): HEFA | 13.9 $gCO_2e/MJ$ |
| | Total neat SAF delivered: Alcohol-to-jet (ATJ) | 1,000 tonnes |
| | Total blended SAF delivered: ATJ | 5,000 tonnes |
| | Lifecycle emissions factor ($LS_f$): ATJ | 29.3 $gCO_2e/MJ$ |
| | Total emissions reductions from use of SAF | 7,453 tonnes $CO_2$ |
| Offsets | Total offsets retired | 20,000 offsets, corresponding to 20,000 t $CO_2$ offset<br>Of which, all 20,000 were CORSIA-eligible offsets |
| CDR/CCS | Total carbon permanently stored/removed | 1,500 tonnes $CO_2$ |

| Source | Data point reported to IATA | Value & unit |
|---|---|---|
| New Technologies | Hybrid aircraft: total electricity used for propulsion | 13 GWh |
| | Hybrid aircraft: total emissions for electricity used for propulsion | 6,500 tonnes $CO_2$ |
| | Hybrid aircraft: total conventional fuel use (Jet A-1) | 1,095 tonnes |

After receiving the above data, IATA will complement it with traffic data, and calculate the key metrics as shown below. For illustration purposes, Alpha Airlines had 1,800,000 ATK and 1,530,000 RTK.

| Metric | Description | Alpha Airlines |
|---|---|---|
| Absolute: $MtCO_2$ | To track the evolution of total $CO_2$ emissions, after accounting for all emissions and emissions reduction sources | 297,007 tonnes $CO_2$<br>[0.297007 $MtCO_2$] |
| Intensity 1: $gCO_2$/RTK | To track the evolution of $CO_2$ emissions, whilst accounting for changes in traffic volumes | 194.122 $gCO_2$/RTK |
| Intensity 2: $gCO_2$/ATK | To track the evolution of $CO_2$ emissions, whilst accounting for changes in available capacity | 165.004 $gCO_2$/ATK |

Detailed breakdown of the calculations:

| Help table – calculation check | Emissions/reduction source | Amount |
|---|---|---|
| Absolute emissions | Conventional jet fuel: 100,000 t Jet A-1 | $100{,}000 * 3.16 = 316{,}000$ t $CO_2$ |
| | SAF reductions | -7,453 t $CO_2$ |
| | Offsets: 20,000 | -20,000 t $CO_2$ |
| | CCS/CDR | -1,500 t $CO_2$ |
| | Hybrid: electricity | 6,500 t $CO_2$ |
| | Hybrid: 1,095 t of Jet A-1 | $1{,}095 * 3.16 = 3{,}460$ t $CO_2$ |
| | TOTAL | 297,007 tonnes $CO_2$ |
| Intensity $gCO_2$/RTK | $gCO_2$ = 297,007*1,000,000 = 297,007,000<br>RTK = 1,530,000 | $gCO_2$/RTK = 194.122 |
| Intensity $gCO_2$/ATK | $gCO_2$ = 297,007*1,000,000 = 297,007,000<br>ATK = 1,800,000 | $gCO_2$/ATK = 165.004 |