2022 Global Aviation Dialogues (GLADs) on the Feasibility of Long-term Aspirational Goal (LTAG) for International Aviation CO_2 Emissions Reductions

COMPILATION OF QUESTIONS AND ANSWERS

Note: This document is a compilation of the questions and answers exchanged, both verbally and in written format, during the first day of the five regional 2022 ICAO LTAG GLADs sessions.

The questions have been grouped into five categories: 1) LTAG Scenarios; 2) LTAG Costs; 3) Technologies; 4) Fuels; and 5) Other questions. To facilitate understanding, the ICAO Secretariat has further grouped similar questions for the same answer. Please note that some States and Observers provided questions in more than one of the regional sessions.

Although the answers provided during the LTAG GLADS are aligned with the conclusions of the LTAG report, the reader is invited to refer to the complete LTAG report whenever possible.

1. Questions on LTAG Scenarios

1.1	**Q:** After analysing the data, if States find out that they cannot achieve the goal, is it possible to adjust the goal? **Q:** Did the LTAG analysis take into account the developing countries, since the measures to be taken cannot be applied to them? **Q:** With respect to integrated scenarios 1, 2 and 3, will States be given to choosing an individual scenario and do their own study for their LTAG commitment? **Q:** Regarding slide 22 of LTAG report presentation, should ICAO present to the States all three scenarios and let them choose which level of commitment they can take, and then have the sum of all the commitments as the resulting LTAG? **Q:** Do all States have to agree on the same scenarios or does each State have the right to choose the scenario that suits its circumstances?	**A:** The LTAG is not an individual State goal. It is a sectoral goal to address the global CO_2 emissions from international aviation. The analysis was based upon a "bottom up" approach focused on global CO_2 reduction from "technology" "operations" and "fuels" as contributions to possible global aspirational goal levels. The report does not provide an option for the goal, but it is a technical report on the feasibility of a set of scenarios, highlighting the potential for substantial CO_2 reductions through the use of aviation in-sector CO_2 reduction measures. It serves as the basis for further consideration of the goal itself, by providing information on the range of in –sector measures potential for reduction. The report does not address out of sector measures. Section 6 of the LTAG report deals with regional impacts, and the regional impact analysis was carried out by CAEP, although it was limited due to available data for individual State levels. The LTAG report is not asking a question to States to choose, but it contains the technical and scientific information that will underline the decision of a collective long-term global aspirational goal. It is important to note that LTAG will not be a State by State goal. Any global aspirational goal would be a collective goal of the global international aviation sector, and as the current ICAO Carbon Neutral Growth (CNG) 2020 goal, it would not set obligations or targets to individual States. For any global aspirational goal, the contribution of individual States to the collective goal should be on a voluntary basis, based on the selection of best mix of CO_2 reduction measures by each State (which can be included in their voluntary State Action Plans to Reduce International Aviation Emissions submitted to ICAO). Once any decision on LTAG is made, States can be reacting and contributing to the collective goal differently. Their level of international aviation activity, the pace, the cost and many other specificities and implications might be different for individual States. For example, some States have already advanced in sustainable fuels, the others have different levels of advancement. The cost, the need for financing, the need for capacity building will all depend on what will be the choices of measures by each State (refer to 2. Questions on LTAG Costs below).

1.2	**Q:** Has historical responsibility for cumulative emissions (by countries and / or airlines) been considered? **Q:** In light of the historic responsibilities for emissions of the sector, especially in the case of developing countries, how would the carbon budget be distributed? Will it be distributed among States? How did the CAEP LTAG study take into account the historical responsibility of States or stakeholders on emissions? **Q:** How would the cumulative emissions referred to on slide 22 of LTAG report presentation be shared between States? On a per-capita basis?	**A:** Cumulative emissions of CO_2 over the LTAG analysis period are most relevant for scientific purposes as they are approximately linearly proportional to the global mean surface temperature response. However, this metric does not represent the contribution of international aviation CO2 emissions in any given year. Emissions from the LTAG scenarios are quoted for the period 2020–2070 for consistency with the global carbon budgets. The cumulative emissions do not represent the changing contribution of an individual sector to global emissions at particular points in time, particularly if the sector is on a dissimilar trajectory to the global economy as a whole. It is also important to note that any LTAG will not be a State by State goal but a global sectoral one. Any global aspirational goal would be a collective goal of the global international aviation sector, and it would not set obligations or targets to individual States (refer to the previous answer above).
1.3	**Q:** The LTAG Report states that cumulative total emissions would most closely translate into an atmospheric temperature response and allow for monitoring of progress without the need for intermediate waypoints. Can you please explain why do we not need intermediate waypoints with this option?	**A:** Cumulative emissions of CO_2 over the LTAG analysis period are most relevant for scientific purposes as they are approximately linearly proportional to the global mean surface temperature response. However, this metric does not represent the contribution of international aviation CO_2 emissions in any given year. Emissions from the LTAG scenarios are quoted for the period 2020–2070 for consistency with the global carbon budgets. The cumulative emissions do not represent the changing contribution of an individual sector to global emissions at particular points in time, particularly if the sector is on a dissimilar trajectory to the global economy as a whole.
1.4	**Q:** On slide 18 of LTAG report presentation regarding the carbon budget, I understand that for aviation 4 to 11% of 400 Gt, (e.g. 16 to 44 Gigatonnes) would be acceptable to reach 1.5°C, being accumulated overtime even well beyond 2070. Is this correct?	**A:** The slide shows the remaining budget per temperature goal for each of the three scenarios. The residual emissions are placed into context of that budget, which means the residual emissions of each scenario are a percentage of the remaining budget depending on which temperature goal is being aimed for.

1.5	**Q:** Does ICAO follow the UNFCCC National Determined Contribution (NDC) approach, similar to the Paris Agreement, to help ICAO States make their own decisions?	**A:** Although the temperature goals of the UNFCC Paris Agreement are global, emissions from international aviation are not included as part of the Nationally Determined Contributions (NDCs) under the Paris Agreement, and they are separately addressed by ICAO and its Member States. Under ICAO's leadership, Member States strive to reach global aspirational goals using a basket of measures to address CO2 emissions from the international aviation sector, without attribution of specific obligations to individual States. For domestic aviation (flight emissions over their national territory), States can decide on its goal and select measures to implement to reach that goal. However, when it comes to addressing international aviation emissions, a different approach is taken, as the goal is concerned with measures that could be applied outside of the national territory of the States. Therefore, a collective global approach under ICAO is needed. Once the collective sectoral goal is set, the contribution of individual States to the goal should be on a voluntary basis, taking into account the selection of the best mix of CO_2 reduction measures by each State (which can be included in voluntary State Action Plans to Reduce International Aviation Emissions submitted to ICAO).
1.6	**Q:** Is it correct that the LTAG report does not consider mandatory measures, but identifies "what is possible" in technology, operations and fuels, and it offers an answer on how far the sector can go?	**A:** This is correct. The LTAG report provides information on emission reduction potentials under three different integrated scenarios.
1.7	**Q:** When you considered the highest scenario, i.e. Scenario IS3, have you also considered the possibility of mandatory SAF?	**A:** The LTAG Report provides estimates of the potential quantities to be available in the future. The policies that will lead to the implementation to a long-term goal will have to be defined later. This means that an LTAG must be agreed upon first before defining the framework that will be used to achieve the goal. In the LTAG report there is a general understanding for the fuel scenarios that there would be need for increasing support and investments, but also policy support by States and governments leading to the most ambitious scenario. However, mandates or specific policies that could be State or region specific were not specifically modeled. They are acknowledged and documented in the report where relevant.

1.8	Q: For the LTAG scenarios, what do the terms “readiness” and “attainability” mean?	**A:** Although the concept of “readiness” is slightly different between technology, operations and fuels, in practice CAEP considered the timeframe by which a specific measure can be achieved (for example by 2030, by 2040 or by 2050). The term “attainability” tries to answer if it is possible to implement a specific measure in terms of available resources, barriers, costs, location etc. The LTAG report provides a mapping of readiness and attainability and benefits for the measures considered.
1.9	**Q:** The LTAG report concluded that none of the 3 scenarios "low, mid, or high" would reach net zero CO_2 emissions through "in-sector measures" i.e. technology, operation and fuels as per slide 15 of LTAG report presentation. Based on that assumptions and the very large investments required by the governments and industry, how this report in compliance with A40-18 paragraph 9 would present any potential impacts such as market distortions between stakeholders regarding aviation growth, especially the developing States, taking into considerations the recovery time frame required to overcome the current pandemic of COVID and other challenges such as (technology transfer, capacity building, etc.).	**A:** The forecasts in the LTAG Report represent low, medium, and high forecasts of post-COVID international aviation traffic. The report captured the impact of COVID in 2020 and the anticipated recovery. This traffic impact and the recovery scenarios are integrated throughout the modeling process and are reflected in the summary results of each of these scenarios. The demand for new aircraft to meet future growth as well as the replacement of aircraft would be impacted by these scenarios which then influences the resulting technology benefits. With regard to the question of how the cost to developing countries is considered in the report, please refer to 2. Questions on LTAG Costs.
1.10	**Q:** How have the uncertainties associated with pandemics, wars etc. been taken into account when analyzing/exploring the feasibility for LTAG?	**A:** Appendix M1 of LTAG report describes various sensitivity analyses that were done. Specifically on pandemics, section 3.6 states “*Demand forecasts: These three LTAG integrated scenarios have been overlaid on three demand forecasts from FESG representing low, mid and high forecasts of post-COVID international aviation traffic, again consistent with the CAEP/12 Trends. These forecasts were extrapolated to 2070 to align with the time horizon for the LTAG analysis. This produced three trajectories over time for each integrated scenario – nine in total. While results have been reported for each combination of integrated scenario and demand scenario, time limitations meant that full fleet evolution modelling was only conducted for the mid demand scenario with appropriate scaling factors used to generate results for the other two scenarios”.*

1.11	**Q:** Paragraph 6.2 of the LTAG report refers to expected regional variances and limitations. Can you clarify how this conclusion was reached and what it entails in practice when we adopt the LTAG?	**A:** While the LTAG study is a global analysis and its scope was to look at a global goal without attributing obligations or costs to individual Member States, when data was available in some limited instances, regional level assessments were conducted, including on fuel burn reductions, costs and investments. Based on this limited assessment, regional differences are expected in terms of costs when considering aircraft technology, operations and fuel measures as well as the benefits associated with the various measures that vary between regions due to the nature of producers, suppliers and end users of the equipment of the aviation sector. For example, considering the future development of aircraft technologies and future aircraft programs, the required investment will be borne, not by all 193 ICAO Member States, but only by those States that have aircraft manufacturers and/or certification authorities. In relation to operational measures (small driver of the emissions reductions and a relatively small driver of the costs) that are expected to be implemented in the future, there are differences in terms of the precise operational measures that are available for regions and particular airports. The same applies to the potential rate at which such measures will be rolled out from region to region. While there is significant production potential for alternative fuels found in all regions, the precise nature of that varies from region to region, and without having more certainty about the direction in which particular States and regions intend to go it is difficult to make an accurate assessment. For example, some regions may be looking to move into cryogenic hydrogen, others may have more availability of biomass, while others may be more interested in municipal waste and the infrastructure to support all of that. Some of the dynamics and elements that were identified by the experts are summarized in Paragraph 6.2 of the LTAG report.
1.12	Q: The LTAG analysis is done at a global level, but regional data was considered. Are there any regional LTAG findings in the LTAG Report?	**A:** Appendix R1 includes regional breakdowns of many variables in its Section 2.11.

1.13	**Q:** The content of the LTAG Report is mostly about the technical potential information of emission reduction measures, and the feasibility analysis of the target is not sufficient. How to reflect the analysis of the feasibility of LTAG?	**A:** The report assists in answering Assembly Resolution A40-18 in supporting the Council in investigating the feasibility of a long term aspirational goal.
1.14	**Q:** Are there are any similarities or differences between the LTAG scenarios and the ATAG waypoint and IATA 2050 Net Zero scenarios, in particular, on the anticipated contribution of SAF?	**A:** The LTAG Integrated Scenarios are not built on the premise of net zero by 2050. They are built on the assessment of technologies, operations and fuels, contained within three scenarios built from the bottom up. Industry played a crucial role in the technical work to build these scenarios, introducing information contained within a wide range of available published reports.
1.15	**Q:** On slide 20 of LTAG report presentation: why does IS2/High-Traffic post-2060 not follow the same trend as mid/low traffic scenarios? For IS1 & IS3, low/mid/high traffic scenarios follow the same trend.	**A.** The metric on slide 20 is net (residual) CO_2 emissions. As such, it reflects CO_2 emissions (given a traffic forecast) and emissions reductions from technology, operations and fuels. The reason for the differences in trends between IS1, 2 and 3 under a High Traffic Forecast is due to the constraints on volumes fuels (e.g., SAF). Under an IS1 scenario, SAF and LCAF volumes are limited and there is increasing reliance on conventional jet fuels to accommodate high traffic growth (which results in an upward trending of residual CO_2 emissions). A similar effect occurs under IS2 with an increasing use of LCAF. Under IS3, the broader range of fuels (e.g., Atmospheric CO_2 and Hydrogen) limit the reliance on conventional jet fuels and LCAF in the 2050s and 2060s, which help stabilize residual CO_2 emissions.
1.16	**Q:** Has the LTAG analysis taken into consideration the improvement of other transport that may affect the growth of commercial air movement where improvements of other transport means decrease the aviation movement and the reduction of CO_2 emissions from the aviation?	**A.** Development of other transport modes could either increase or decrease demand for international civil aviation and therefore emissions. The analysis in the LTAG report utilized air traffic forecasts that included assumptions about this and, therefore, the CAEP did not treat it as a variable in the LTAG analysis. The CAEP also noted that the impact might not be very large as international civil aviation emissions are largely driven by the long-haul market segment, which by and large does not compete with other modes.

1.17	**Q:** How much is the likelihood of operations and infrastructure and technology being put in place taken into account? How much of new projects, new developments, new technologies that are being looked at the moment were takes into consideration in the process to develop the integrated scenarios?	**A.** The LTAG work is a scenario-based assessment and ICAO CAEP tried to make the three scenarios as close to reality as possible. The LTAG scenarios represent emission reductions after the implementation of in-sector measures based on a range of readiness and attainability levels. For example, for technology the CAEP developed a matrix (cube) of readiness, attainability and the associated benefits. For each one of the technologies investigated, CAEP identified its technical barriers and how many years it would take for a given project to go from a Technology Readiness Level 6 (TRL 6) to enter into service. For the cases of advanced configurations, the CAEP did not consider anything that was not legitimately pursued by some entity and was not in the roadmaps.
1.18	**Q:** What is the relationship between the suggested LTAG report results and long-term national goal with sustainable development of domestic aviation?	**A:** The focus of the work was on exploring the feasibility of an LTAG for international civil aviation. Although a regional impact analysis was carried out by CAEP, it was limited due to available data for individual State levels. The analysis was based upon a "bottom up" approach focused on global CO_2 reduction from "technology" "operations" and "fuels" as contributions to possible global aspirational goal levels. The LTAG did not assess the national situation of individual States for domestic aviation. This is outside the scope of the assessment as laid out in Assembly Resolution A40-18. However, any technologies, operations and fuels developed my have a benefit at both the international and domestic levels.
1.19	**Q:** How will this analysis impact the discussion about the LTAG considering that the scenarios demonstrate the industry will not reach net-zero without out of sector measures?	**A:** The LTAG report is a technical report on the feasibility of a set of scenarios, highlighting the potential for substantial CO_2 reductions by using only in-sector measures. Industry has already taken a decision on 2050 net-zero, however, ICAO has not yet decided on the goal. LTAG report provides information on emission reduction potentials under different scenarios and residual emissions for each scenario. Regardless of any decision, the report provides information on what would be the gap to reach net zero emissions. Based upon the decision to be taken, States will need to consider complementary measures as they already did in 2010 with the decision on carbon neutral growth (CNG). ICAO decided to achieve CNG with a basket of (in-sector) measures and then complemented the basket of measures with a global scheme – CORSIA - to achieve the CNG.

2. Questions on LTAG Costs

2.1	**Q:** Where can we find the analysis of the impact of any LTAG on developing countries as it was requested by the Assembly resolution? **Q:** If the LTAG report lacks the analysis on developing countries, how could it fulfill the Assembly and ICAO Council's requirements? **Q:** As requested by Assembly Resolution, can you please provide information on the cost impact analysis of LTAG in developing States? Has the report assessed the cost implications of LTAG on the developing countries? **Q:** The LTAG report is only providing limited information data but not considering the impact on all the countries...can you clarify? **Q:** Does the LTAG Report contain information on the impacts of an LTAG on developing countries? **Q:** Where can we access the disaggregated costs of the scenarios IS1 to IS3 per Region in order to compare the potential impact in the different aviation markets especially the developing ones?	**A:** CAEP conducted a cost investment analysis at a global level for all international aviation combined, as well as regional impact analysis where data is available. So all the results in the LTAG report are comprehensive at that level. This is summarized on page 7 of the LTAG report. For more detailed disaggregation of cost investments, when the data was available at the regional level, refer to Appendix M1, part C and Appendix R1. It should be noted that the costs in the LTAG Report are for specific measures for the sector as a whole and not for individual States. Some States and regions would have more costs based on the measures considered (for example States and regions that manufacture aircraft would have to make investments for new airframes and technologies, some States may invest in SAF, while others in hydrogen). Without an agreement on an LTAG and detailed information from States (some of which is confidential), it was not possible to do a detailed analysis on costs per State for all 193 ICAO Member States. It is important to note that LTAG would be a collective goal of the global international aviation sector, and it would not set obligations or targets to individual States. Once any decision on LTAG is made, States can be reacting and contributing to the collective goal differently. The pace, the cost and all other implications will be different for States. The cost, the need for financing, the need for capacity building will all depend on what will be the choices of measures by each State While not being part of the LTAG report, CAEP also developed the data that could help States in conducting their own analysis for their own purposes, which will not be considered as part of the work of ICAO. The data will be reviewed by the ICAO Council in June 2022 and would be shared with the Member States once approved.

2.2	**Q:** The costs and investments associated with the scenarios are largely driven by fuels (e.g., SAF) and will also require significant investments from governments and industry, how was the feasibility assessed for the developing countries? How can I identify which part of these cost corresponds to my State and my industry, so that I can decide on the commitment that I will be taking if we agree upon an LTAG at the Assembly?	**A:** The CAEP conducted an analysis that is based on incremental costs (i.e., scenario costs minus baseline analysis costs) for a period of 30 years for technologies, operations and fuels. In the case of fuels, the baseline scenario assumes that international aviation would be fueled or powered by conventional jet fuel only, and the price of fuel was set to $0.60 per liter. For scenario IS3, with 100% replacement of conventional jet fuel with different types of fuels that are captured under IS3, including atmospheric CO2 based fuels, e-fuels, cryogenic hydrogen, the price of fuel would effectively double to about $1.20 per liter by 2050. All assumptions have been documented in the report in Appendix M1, Part C, including how the cost evolves, the unit cost evolves overtime with economies of scale etc. Such an incremental increase in the is not necessarily foreign to the international aviation industry. The price of jet fuel has doubled in the past, and we've just seen that recently. In all such situations, the industry has adapted to new prices.
2.3	Q: In terms of investment requirements to implement LTAG, what are the proposed plans to support the developing countries in different parts of the world to meet the financing gap and technology?	**A.** The LTAG report analysis was based upon a "bottom up" approach focused on global CO_2 reduction from "technology" "operations" and "fuels" as contributions to possible global aspirational goal levels. Any global aspirational goal would be a collective goal of the global international aviation sector, and it would not set obligations or targets to individual States. For any global aspirational goal, the contribution of individual States to the collective goal should be on a voluntary basis, based on the selection of best mix of CO2 reduction measures by each State (which can be included in voluntary State Action Plans). The mechanisms for how, as a sector, the goal is achieved is part of future discussions. The LTAG report provided some considerations, such as the need for capacity building, which should be further discussed and elaborated.

2.4	**Q:** How to ensure that LTAG will not have a negative impact on the development of air transport industry and will not discriminate against the development of air transport industry in various countries, especially the rapidly growing air market?**Q:** If an LTAG is voluntary and will not impact on the aviation growth (including international aviation), how to keep the growth of the international aviation in developing and transition countries without influence LTAG (if they will be adopted)?	**A:** As stated in Section 6 of the LTAG report, CAEP considered the potential impacts of the overall costs (and investments) related to measures that would underline LTAG scenarios on aviation growth. While difficult to quantitatively assess these impacts on aviation growth far out in the future, CAEP noted that while an LTAG may increase operating costs, some costs may be passed on to the flying public. Given the relatively lower price elasticity associated with international aviation (and limited travel alternatives for long haul trips), the impact on aviation growth may be limited. Some study reviewed found statistically significant differences between different geographic air travel markets. The main drivers pointed as possibly increasing elasticity are the low level of maturity of the market, the predominance of shorter distances of routes, the arising of low-cost carriers and presence of charter airlines, the emergence of the middle class and the existence of liberal pricing regulation.
2.5	**Q:** In slide 24 of LTAG report presentation: where the capacity building is presented, it mentions "workshops on measures, including understanding costs". Can we have some clarification on "including understanding costs''?	**A:** The LTAG report shows that establishment of a long-term goal requires training on new initiatives, new technologies, new pathways for fuels etc. On the other hand, the interest of States in innovations are increasing, mainly on Sustainable Aviation Fuels. ICAO is looking into additional capacity-building and training options related to SAF, which could be similar to ACT-CORSIA. It would explore potential initiatives that each State could do to encourage the production of SAF in their State. The volume of SAF required for goals that are more ambitious necessitates the participation of all States in the development of production. This is also in accordance with the No Country Left Behind strategy, which allows each ICAO Member State to contribute to a long-term goal by using diverse feedstock.
2.6	**Q:** The report makes it clear that SAF is the material lever, but comes at a cost. All the global literature, analysis and real world case studies make it clear that State support is critical to scaling the SAF industry (supportive policy and investment) yet it isn't mentioned in the "Investments from States" component of the "Costs and Investments Associated with Integrated Scenarios". Why was this omitted?	**A:** Investments from fuel suppliers can (and are expected to) be supported by governments (i.e., States). The exact contribution from government would be State or region specific and it could not be quantified (also as SAF is a nascent industry i.e., there is no/limited historical data on the contribution from States to investments - unlike aircraft manufacturers).

2.7	**Q:** It was discussed about additional cost implications of LTAG. I just wanted to know that can this additional amount generated be utilised to assist, directly for development in the Technology or the Fuels in aviation field.	**A:** The LTAG report cost and investment analyses considered the costs (and investments) to support the development of aircraft technology, operations improvements and fuels. The LTAG report describes the expected level of investments by OEMs and Fuel suppliers (and potential contribution from governments/States) towards the development of Technology and Fuels. Details are also available in Appendix M1 Part C.
2.8	**Q:** When the amount of reduction accounted in each scenario, is the cost competitiveness among the three reduction technologies compared within the scenario? I understood the cost of each scenario has been compared. Is it based on availability? Is it considered simultaneously?	**A:** The three scenarios were developed as self contained set of assumptions. For each scenario, the emissions reductions and costs were assessed based on the assumptions associated with each scenario. Within each scenario, the relative contributions from aircraft technology, operations and fuels are based on technical feasibility and attainability e.g., operations improvements have more limited emissions reductions and costs (compared to fuels) due to the technical limitations and current level of operational efficiency of the aviation sector. Finally, the CAEP did not recommend or point to a particular integrated scenario based on cost "competitiveness" (or cost effectiveness).
2.9	**Q:** Could you clarify the magnitude of the costs associated with the LTAG scenarios? For example is the 4 trillion USD figure associated with the IS3 scenario cumulative over the full time period considered?	**A:** The cost figures for the three scenarios are cumulative for the time period 2020-2050, and possibly beyond. However, these costs would have to put in context given that they are driven by the fuel-related costs. The 4 trillion USD is the highest cost under scenario IS3, which assumes that the international aviation industry would have replaced 100% of its fuel from conventional to SAF, e-fuels, hydrogen and so it implies a major energy transition. Under IS3, the most aggressive cost and scenario, the effective cost of fuel would be doubling by 2050. Although this may sound large, it is not uncommon for the international aviation industry considering the recent fuel price variations as well as past variations due to the situation in the international market place. In addition, these numbers should be put in the context of the total operating costs or revenue that would be more than 30-32 trillion USD. Furthermore, it is important to consider the co-benefits (not quantified in the context of the LTAG) as result of the transition to SAF, for example, through feedstock purchase and investments in the production of fuel, employment, benefits of creating a new market. Other considerations include meeting sustainability goals taking into account the three sustainability pillars (environment, social, economy).

2.10	**Q:** The costs associated with the three scenarios are very high. For example, the additional costs associated only to fuels in scenario IS3 are 4 trillion USD. This corresponds to an average of 133 more or less billion per year. This is more than individual GDP of around 140 States and only 50 states have a GDP like this. So has ICAO assessed this impact on developing countries?	**A:** The costs of the three scenarios are not exclusively costs for individual States. Much of the costs will be for the fuel producers for the aircraft manufacturers etc. The way the LTAG report approached the cost and investment was to look at the chain of stakeholders (States, aircraft manufacturers, fuel producers, airports, ANSPs, airlines) which goes beyond the international aviation industry as it includes fuel producers. It should also be noted that the LTAG report presents a summary of investments with cost to each group of stakeholders, and these costs cannot be added up for a given scenario. Some of the investment costs from one stakeholder, for example, a fuel supplier who is investing in facilities to produce SAF some of these investments will be passed on to downstream stakeholders such as the airlines through an incremental minimum selling price of fuel. Based on the above, it is clear that it is not appropriate to take the overall cost and divide it by a number of States or a number of volumes to come up with figures for individual States or stakeholders. The total cost was estimated for addressing a specific CO2 emissions reduction within the sector. Dividing the total cost and comparing with the GDP of countries, is not an appropriate comparison given the disparities between smaller countries or countries with smaller GDP whether because of the size of the country or the level of debt.
2.11	**Q:** In the near future, before 2030, how that affect the cost in the tickets, take into consideration this transformation go to 700 billions? **Q:** Paragraph 6.1 of the LTAG Report refers to the potential of LTAG affecting some markets and then others considering the price elasticity of air traffic. Could you further elaborate on this? How would the LTAG affect different markets according to price elasticity? **Q:** What about income price-elasticity: are those States with lower average income going to perceive more the increase in the air ticket price brought by the adoption of an LTAG? How fair will be the adoption of an LTAG in terms of impacts around the globe, considering the capacity of people to absorb an increase in ticket price?	**A**: The LTAG analysis is not a study on how to assign cost to individual flights, individual routes, individual airlines and calculate these impacts, but the focus was on identifying cost effective measures to get to the goal and how the market will evolve towards that as well. The scenarios that underlie the LTAG analysis are not a goal. They are not putting obligations on airlines or States. The LTAG analysis tries to answer the question: What are the measures and pathways available to reduce CO_2 emissions? Different States and regions will contribute towards the aspirational goal in different ways. At the same time, both income and price elasticity were considered in the context of the LTAG analysis. Income elasticity was taken into account in the forecast work under the LTAG across regions and countries through the consideration of generation of demand, and differential demand for transportation across countries. It is difficult to do State level analysis for price elasticity due to the associated uncertainty, route level or segment level analysis for 30 years from now.

2.12	**Q:** Does the estimated cost on fuel savings for airlines take into consideration the investments that airlines made on fleet and operational improvements (Page 6 of the LTAG report)?	**A.** LTAG report acknowledged that fuel savings from aircraft technology improvements may be reduced by an increase in aircraft acquisition costs driven by price after technology improvement i.e. aircraft technology improvements are not expected to "come for free". Quantifying these additional costs and investments in a scenario minus baseline cost analysis is challenging. Airline acquisition of new aircraft is a multi-attribute decision-making process, including aircraft capabilities, operating costs (including fuel efficiency), and commonality with other aircraft types in the fleet, etc. The transactions are also not publicly available, and it is challenging to extract/isolate the contribution of aircraft technology improvement to aircraft total price.
2.13	**Q:** In scenario 3, the costs are estimated at $4,000 billion, some of which will be passed on to passengers. What would be the concrete impact of the ticket price increase on traffic? Do you have any idea of the average increase in ticket price?	**A.** Firstly, the $4,000 billion value is estimated for the most ambitious scenario which is IS3. Please note that this cost is a cumulative cost from 2020 to 2050, so the numbers may look large when you do a cumulative over 30 years of operating international aviation. It should be put in context of total revenue or operating cost of running international aviation through the 30-year time horizon through 2050. There is obviously uncertainty in that analysis since extrapolation is done based on historical statistics. With regard to the impact on the ticket prices, CAEP did not quantify the cost per passenger because FESG forecasts are not conducted on a per passenger basis. To provide a first order estimation, under the most ambitious scenario IS3, by 2050 the incremental cost of the fuel could mean that a potential doubling of the effective cost of fuel would be observed (compared to a IS0 baseline scenario that assumes unit jet fuel costs at $0.60 per liter). Doubling may sound a lot, however, it should be noted that the aviation industry experienced this over the last few months as well as between when the LTAG study was completed (end of 2021) and 5 years prior. Therefore, the aviation industry is not foreign to seeing such changes in price of fuel. If fuel cost represents about 20% of total operating cost and assuming that over a long-time horizon incremental cost would be passed on from the airlines to a consumer, a doubling of the fuel cost in a given year (e.g., 2050) could result in an increase of about 20 percent of airline tickets. Nevertheless, this is the rough estimation under the most ambitious scenario and in 2050. The detail in terms of how the airlines will pass on this cost in over a 30 year time horizon is not certain, but this can provide you with first order estimates for the most ambitious scenario. For context/reference, IATA Industry Statistics Fact Sheet report a share of fuel costs ranging from 19-23% from 2016-2022 (ref. https://www.iata.org/en/iata-repository/pressroom/fact-sheets/industry-statistics/).

2.14	**Q:** How do we ensure that the operators/airlines are protected in terms of cost? Looking at the costs and investments associated with integrated scenarios, they all boil down to the airline.	**A.** The LTAG scenarios do not put obligations on airlines and are not forcing airlines to bear the implementation costs. They define an aspirational goal that does not prejudge the decisions by the Council and the Assembly on downstream decisions. But there are mechanisms to address that if that were the case. One example is protections in terms of costs that are built within the CORSIA framework, with the periodic review every three years to ensure that there is not an unreasonable economic impact on the international aviation sector.
2.15	**Q:** I know the mandate of the ICAO is to see the feasibility and the cost implications. Yet the most variable costs are related to fuels. Fuel is something that is outside the control of ICAO. Did you consider here the cost implication of those fuels on international aviation? (Simply: How LTAG considered the cost especially for the aviation fuels?)	**A.** The cost analysis in the LTAG report includes not only the overall cost but also the investments that may be required. The scenario minus baseline approach is used in the analyses. In the integrated scenarios, there are measures that result in emission reductions, in the cost analysis the incremental cost of implementing and developing these measures against a baseline was assessed. In other words, rather than quantifying the total cost of fuel to support international aviation through 2050 and 2070, the incremental cost of fuels, as well as the investments associated with fuel categories and types of fuels, was quantified in the cost analysis. Obviously the cost was driven by the volume and the specificities of developing and producing these types of fuels. In addition to that, LTAG scenarios were quantitatively assessed to develop a total and temporal distribution of costs and investments across different groups of stakeholders. For example, States can support research development costs, moreover there is a large amount of investments that are expected from fuel producers as investments to develop the facilities that will produce fuels, whether it is SAF or hydrogen in the future. The cost to the airlines in terms of the difference between the minimum selling prices of these fuels versus a baseline cost of conventional jet fuel is also assessed in the LTAG report. Detailed summary chart can be found on the LTAG Report page #6, Figure 3. Integrated cost and investments associated with LTAG Integrated Scenarios. This chart provides a summary of the costs and investments associated with the different types of fuels. Also page #13 of the LTAG Report gives the overall cost assessment.

2.16	**Q:** Wouldn't an assessment of cost for each individual State be incompatible with the notion of aspirational goal which shall not prejudge on the individual level of commitment of each individual State to itself contribute to this goal, by putting in place measures of its own, choice?	**A:** A regional impact analysis was carried out by CAEP, although it was limited due to available data for individual State levels. The analysis was based upon a "bottom up" approach focused on global CO_2 reduction from "technology" "operations" and "fuels" as contributions to possible global aspirational goal levels. Any global aspirational goal would be a collective goal of the global international aviation sector, and it would not set obligations or targets to individual States. For any global aspirational goal, the contribution of individual States to the collective goal should be on a voluntary basis, based on the selection of best mix of CO_2 reduction measures by each State (which can be included in voluntary State Action Plans).
2.17	**Q:** We need agree that all necessary investments shown in the LTAG Report mostly must be taken over by developed countries and countries with emerging economy. Are we ready to be so ambitious at the moment?	**A:** The LTAG report provides information on emission reduction potentials under different scenarios and residual emissions for each scenario. Any global aspirational goal would be a collective goal of the global international aviation sector, and it would not set obligations or targets to individual States. For any global aspirational goal, the contribution of individual States to the collective goal should be on a voluntary basis, based on the selection of best mix of CO2 reduction measures by each State (which can be included in voluntary State Action Plans). ICAO has yet to agree to a long-term aspirational goal. The LTAG work will support the discussions leading up to and during the 41st Assembly, and consideration of a future goal.
2.18	**Q:** Regarding cost issues for aviation long term aspirational goals, has the LTAG analysis taken into consideration the benefits from avoiding climate change impacts, which have nowadays tremendously impacted our planet and especially less developed countries?	**A:** Benefits from avoiding climate change impacts were not specifically captured in the LTAG Report. The cost components focused on how to achieve CO_2 emissions reductions using technology operations or fuels for the three scenarios that have been elaborated. Cost avoidance is certainly an important part in the wider climate change debate and such ancillary benefits should be considered further.

3. Questions on Technology

3.1	**Q:** For the case of cryogenic hydrogen, what is causing the increase in energy intensity for the blue advanced concept aircraft (refer to slide 40 of LTAG report presentation)?	**A:** During the LTAG process all different fuels were considered starting with gaseous, but the conclusion was that it will not be feasible from a volume unit energy standpoint for aircraft with range necessary to be considered for international aviation. "An increase in energy intensity is likely with cryogenic hydrogen fueled aircraft due to the extra volumetric and thermal management requirements relative to conventionally fueled aircraft. The weight of larger tanks and resulting structure and drag offsets the mass benefits of the fuel if mission requirements are held constant. As shown in Appendix M3, figure 6-13, this general trend could reverse for the largest and longest range aircraft". In the figure provided, the vertical axis represents the impacts to the aircraft advances and technologies. That MJ per ATK shown needs to be multiplied with CO2 equivalent per MJ, and that's where you see any potential benefits. These benefits will be dependent on how the hydrogen was created so you don't see these effects until the fuel effects are included at the fleet analysis where it was handled. Cryogenic hydrogen fuel has energy density and mass benefits relative to traditional jet fuel, but also requires a greater volume per unit energy than traditional jet fuel, and additional requirements for thermal management. The increase in energy intensity is typically driven by the larger volume required per unit energy which results in impacts on aircraft design, size, weight, and drag, assuming mission capability – payload and range – are held constant relative to a traditional fuel powered aircraft. The larger, heavier tank grows the structure and increases the mass of thermal management systems, and the larger structure also results in more surface area and more drag, all contributing to more energy use. From an energy intensity perspective, the energy density and mass benefits are not generally offset by the lighter mass of the fuel for equivalent energy, though some studies contradict this under certain technology and/or mission capability trade assumptions. For additional information, refer to Appendix M3 page 21, and Section 6.6.

3.2	**Q:** On slide #33 of LTAG report presentation, it is mentioned that the use of advanced concept includes alternative energy sources. What are these energy sources and are they considered equally on all five aircraft categories?	**A:** The LTAG report contains a mapping of readiness and attainability and benefit for each of the advanced configurations that they were considered. For some aircraft categories we had a lot of experience because these were based on existing vehicles. These categories were modelled correctly. However, for vehicles that do not yet exist, the modelling was as best as possible given the associated uncertainties. For these categories, due to time limitations, it was not possible to go into a detailed analysis, and had to rely on existing literature and data from the industry. The collected data was used to identify the benefits with regards to the baseline used to compare against. These increments were added to the existing fleet and assumptions to maintain a consistency between the studies. The analysis considered various alternative energy sources. Under IS3, hydrogen-powered aircraft were considered to enter in operation in 2035, however its benefits are limited by 2050 due to the time it takes for new aircraft to penetrate the fleet and the size of hydrogen aircraft being considered initially. Benefits are more pronounced in the 2060s timeframe. Electricity and Liquefied gas aviation fuels (ASKT) were considered in the scoping study and development of scenario phase. Based on the size of electric aircraft expected to be operating in the future, they would be focused on short-range domestic operations. Similarly, aircraft powered by ASKT would only operate in very specific situations. Therefore, these fuels would not present substantial benefits for international aviation and were not considered in the fleet composition for the analysis.

4. Questions on Fuels

4.1	**Q:** It seems that the gaseous waste and atmospheric CO2 based SAF will be used in the future. Could you explain how can we deploy such kind of SAF? What is the key facilitating factors during this process?	**A:** Please refer to section 3.3.2 of the Appendix M5 that provide a lot of information on LTAG SAF Waste CO_2 and Atmospheric CO_2 based fuels.
4.2	**Q:** Did the analysis consider synthetic aviation fuels?	**A:** Yes, the models did estimate potential volumes of synthetic jet fuel which is produced using CO_2 from gaseous waste CO_2 streams (for example, from iron, steel and cement plants) or from the atmosphere (such as Direct Air Capture- DAC) out to 2070 based on the size of the waste stream, availability of DAC and availability of renewable electricity and considered under each scenario. Refer to pages 35/36 of Appendix M5 and its section 4.2.2.
4.3	**Q:** Any direct relation to CORSIA?	**A:** The CORSIA values and methodologies for life-cycle emissions of SAF were considered in the analysis of biomass and waste-based SAFs. However, please note that the LTAG analysis only considered aviation in-sector CO_2 reduction measures, and therefore a possible contribution of offsets or out-of-sector measures was not assessed.
4.4	**Q:** Is ICAO planning to provide to States some low cost technologies guide or innovation map in order to consider some technologies for producing SAF on-site in airports or upstream using in-sector own resources (oil, waste, and others) most accessible to developing countries?	**A:** There are already various materials available in the ICAO SAF website (https://www.icao.int/environmental-protection/pages/SAF.aspx). As a highlight, the "rules of thumb" information has been used to support the LTAG report and can give order of magnitude estimations related to SAF costs, investment needs and production potential for various technologies. ICAO will continue to consider additional means to support States' initiatives to deploy SAF.

4.5	**Q:** Considering that SAF it is very important driver in LTAG, how are linked LTAG and CORSIA plan with more general goals in Bio-Fuels as the raised by International Energy Agency and considering the limited feedstock worldwide?	**A:** The analysis considered feedstock availability and concluded that enough feedstock would be available to meet aviation's demand. The higher ambition scenarios assume that electrification of ground transport will lead to increased availability of SAF. Please refer to Appendix M5, Table 3.1. Also refer to Appendix M5, Section 3.3.1, which states that "Under each scenario, modelers carried out feedstock availability checks to ensure that projected volumes do not exceed potential feedstock resources."
4.6	**Q:** Appendix M5 4.2.2 shows the composition of the SAF; F2 is shown as waste from the iron industry and cement industry. Is this CO2 from fossil fuels? I assume that, to avoid double counting with emission reductions in SAF producing countries, corresponding adjustment is made. Is this correct?	**A:** Yes an assessment on double counting needs to be made on this situation, more details on the LCA analysis of waste gases are available in the CORSIA supporting document "LCA methodologies", Part II, Section 5.13.

4.7	**Q:** As you just said, this is a global aspirational goal feasibility analysis, using SAF or other alternative fuels may have a great burden which will require significant investment from governments and industry. Are we going to set a specific goal related to the amount of SAF use? **Q:** What would be the Impact of goals on States? How to avoid voluntary commitments becoming binding (e.g. goal of using SAF that some States have decided to make mandatory)? How will the LTAG impact the development of States?	**A:** The LTAG Report provides estimates of the potential quantities to be available in the future. The policies that will lead to a long-term goal will have to be defined later. This means that an LTAG must be agreed upon first before defining the framework that will be used to achieve the goal. In the LTAG report there is a general understanding for the fuel scenarios that there would be need for increasing support and investments, but also policy support by States and governments leading to the most ambitious scenario. However, mandates or specific policies that could be State or region specific were not specifically modeled. They are acknowledged and documented in the report where relevant. The implementation of the LTAG will require putting in place policies and identifying the appropriate measures to allow States to voluntarily participate in the best way they can. Not all States will do exactly the same thing, but their contributions will be under a harmonized framework. A standardized approach will ensure that there is no discrimination to avoid unfair competition and a patchwork of measures. There will be opportunities to create a new market and embark on a much more sustainable development for the aviation sector. With regards to a specific goal on SAF, it should be noted that the third ICAO Conference on Aviation and Alternative Fuels (CAAF/3) will be convened in 2023 with a view to update the 2050 ICAO Vision for SAF to include a quantified proportion of SAF use by 2050.
4.8	**Q:** To what extent did the production of sustainable aviation fuels and low carbon aviation fuels consider carbon reductions from increased soil organic carbon and carbon capture and sequestration? **Q:** Can you please clarify the assumptions on the use of carbon capture and sequestration in the LTAG analysis and the implications on the residual emissions associated with the LTAG scenarios?	**A:** Carbon capture and sequestration (CCS) is broken down into two parts: carbon capture and the use of the carbon from that capture; and sequestration. In the LTAG report and as part of the fuel analysis, CAEP considered carbon capture to the extent that carbon is captured from the atmosphere in atmospheric CO_2 based fuels or from wastes CO_2 from industrial processes and waste CO_2 based fuels with carbon capture as in the case of lower carbon aviation fuels (LCAF). Sequestration, however, was not included as part of the scope of the LTAG analysis. Sequestration could result in lower life cycle emissions values for fuels or could be accounted for as an out-of-sector mechanism through emissions units, such as under CORSIA, but that was outside the scope of the LTAG analysis. If sequestration had been included in the LTAG analysis, it could have resulted in lower (or even zero) residual emissions for the LTAG scenarios.

4.9	**Q:** SAF development and availability is very different amongst many countries. With some countries with no SAF capability and limited ability to start / upscale development within LTAG timeframes. How was this considered under the ambitious integrated scenario that assume total SAF replacement of conventional jet fuels?	**A:** From the Appendix R1 "2.5.3 Fuels: The uptake of SAF/LCAF is not anticipated to be consistent across all world regions due to differences in market dynamics (i.e. countries/regions with favourable low GHG fuel policies will attract greater volumes of these fuels). Additional regional variances are expected regarding the production of SAF/LCAF due to regional availability of feedstock resources (biomass, solid/liquid wastes). Finally, availability of waste CO/CO_2 resources will have additional regional variability as regions decarbonize at different rates out to 2070.
4.10	Q: Are there considerations regarding the availability of SAF regionally?	**A:** LTAG analysis did not consider specific locations for the SAF production facilities or distribution; it is true that today the SAF is only available in a few networks but this is changing rapidly. ICAO is tracking various indicators of SAF deployment (distributing airports, production facilities, offtake agreements), and there has been a substantial increase in 2021, which is expected to continue. For more information https://www.icao.int/environmental-protection/pages/SAF.aspx.
4.11	**Q:** Does the LTAG report take into account that SAF production needs to be available globally in each continent? If yes, does it address the percentage of SAF that will be produced from developing countries?	**A**. The fuels assessment considered SAF production potential in all regions. This is summarised qualitatively in LTAG Report, Appendix R1, paragraphs 2.11.3, 3.11.3 and 4.11.3 with more information in Appendix M5. It is assumed that SAF production does not have to be in the region in which it is used, so there are opportunities for all regions to contribute to the global SAF supply required.
4.12	**Q:** Sustainable aviation fuel production will encompass the use of various biomass sources. Has there been any analysis considering how much additional land vs existing land sources for biomass will be needed to meet the IS2 or IS3 scenario? **Q:** Has the LTAG analysis taken into consideration the risks related to the global food and water security in relation SAF production? Do you believe that in reality biomass will play so essential role as forecasted in the LTAG Report?	**A:** Yes the analysis of biomass-based fuels relied on previous analysis done by CAEP, which considered land use aspects. More details in https://www.icao.int/environmental-protection/Documents/CAEP10%20Fuel%20Production%20Assessment%20%282016%29.pdf, section 3.

4.13	**Q:** If LTAG-TG considers only in-sector measures, SAF development and its future are not in-sector measures. So the share of SAF (and hydrogen) for international aviation is too unpredictable and does not depend on the demand of aviation. How could we consider the measure?	**A.** Fuels (e.g., SAF, LCAF, hydrogen) were considered in-sector measures when it comes to CO_2 emissions reductions. The control or predictability of supply of fuels is not expected to be different from conventional jet fuels. International aviation will need (i.e., generate demand for) aviation fuels that would be supplied by fuel producers (same as today's market for conventional jet fuels).
4.14	**Q:** The LTAG Report says that addresses only in-sector measures, but SAF are produced outside the sector. Can you please explain? Also SAF production could be limited by feedstock availability and availability of renewable energy sources due to increased demand by other sectors. How has the potential lack of feedstock for aviation fuels been addressed in the LTAG analysis?	**A:** In the context of the LTAG analysis, SAF have been considered in the same way as conventional fuels and LCAF. In this respect, SAF was considered as an in-sector measure. For the LTAG, the important factor was to consider the life cycle emissions of the fuels across all production pathways and feedstocks. In relation to competition from other sectors, the development of the scenarios took this into account at a high level, but there are no equilibrium models that can help determine the optimal allocation of resources across sectors.
4.15	**Q:** What kind of hydrogen fuel did the report consider? Liquid, Gaseous, synthetic fuel. Would the report consider as well different hydrogen production technologies (green, blue, grey H2)? Does the affirmation "hydrogen powered aircraft would exhibit worse energy efficiency, relative to aircraft operating on drop—in fuels, noting that emissions reductions would come from life cycle emissions reductions from the hydrogen" refers to hydrogen in general or to a particular hydrogen fuel and production technology?	**A:** In Appendix M5 of LTAG report, you will find further information, but the cryogenic hydrogen (LH2) was the only non-drop-in fuel that was included in the detailed analyses, and it was limited to consideration under the scenario F3.
4.16	**Q:** Based on announcements from some in industry, it might have been expected hydrogen to play a more prominent role in 2050 than it appears in the results. Could you please comment on why role of hydrogen appears so limited?	**A:** The analysis is primarily looking at international aviation (and not domestic) and it was consideration was given to what extent LH2 would have an impact on international aviation, as it currently is aiming at smaller short/midrange aircraft.

4.17	**Q:** Can you please share information on any airports that have implemented Hydrogen Energy?	**A:** The use of hydrogen for international aviation is in development involving many stakeholders from ICAO Member States, manufacturers, airlines, fuels providers and airports. There is some excellent information on the ICAO website regarding the future use of Hydrogen. Please check ICAO tracker tools from here: https://www.icao.int/environmental-protection/SAC/Pages/GCSA%20main%20page.aspx ACI also has published a document on the Integration of Hydrogen Aircraft into the Air Transport System: An Airports Operations and Infrastructure Review. This was detailed at the recent ICAO Pre-Stocktaking event on "Infrastructure development for supplying clean energy for air travel" and more information can be found on ICAO TV: https://www.icao.tv/stocktaking
4.18	**Q:** Do the assumptions on non-drop in fuel (i.e. Hydrogen) take into account potential competing uses?	**A:** The analysis did not assume fuel production to constrain the uptake of liquid hydrogen as a fuel, for more details refer to LTAG report, Appendix M5, section 3.4.4.

5. Other Questions

5.1	**Q:** A robust assistance mechanism is imperative for any global joint efforts on mitigation and adaptation. This is also an important issue required by the Assembly. However, this is insufficient in the final report. Is there a specific implementation plans for technology transfer and financial assistance to developing countries in the report? How do developed countries plan to financially assist developing countries to implement additional action towards an LTAG? **Q:** I do not see a robust implementation roadmap for LTAG being projected....for eg. it mentions State action plans to monitor the progress, however it is voluntary in nature and more oriented on domestic front...also it does not mention anything on technology or financial transfer to the developing states.	**A:** The LTAG Report is focused on the technical analysis of measures in technology, operations and fuels, and recommendations have been made on the implementation roadmap. It is true to say that aircraft technologies, operations measures improvements and fuels development will require a sequence of enablers and conditions for implementation, such as technology transfer and financial assistance, along a timeline through 2050 and beyond.
5.2	**Q:** How can one define trade-offs between time of goal implementation and available resources of the States for the implementation especially taking into account unpredictable impact factors like COVID?	**A:** Please look at Appendix R1 of the LTAG report and the relevant methodological appendix. In terms of implementation, the aircraft technologies, operations measures improvements and fuels development and scale-up will require a sequence of enablers and conditions along a timeline through 2050 and beyond. The analysis presented has taken on board the latest global situation, including the impact of the COVID19 pandemic.
5.3	**Q:** How feasibility of considered LTAG will provide the same level of safety (without LTAG implementation)? All LTAG scenarios should provide keeping the safety level, and then environmental (CO2) benefit. I did not see anything about that in the LTAG report. How could we accept any LTAG without understanding its impact on safety?	**A:** All the technologies considered in the development of aircraft, fuels and operation would need to meet the requisite international Standards for Safety and airworthiness **A2:** Everything that has been considered under the LTAG analysis will be subject to the safety and security provisions of ICAO. Any new sustainable fuel or any new aircraft type will be certified and airworthiness and certification processes will be embedded in any product that will be developed in the future.

5.4	**Q:** Has ICAO taken into consideration what is happening in the European Union in terms of a package of legislations "Fit for 55" that may constitute financial burdens at the level of airlines, especially since the near, long and medium goals simulate each other between ICAO and EU.	**A**. CAEP took into account all input from States and stakeholders, including through the ICAO Stocktaking seminars and questionnaires. The cost and investment assessment also used all relevant information, while noting that the measures and investments being considered now by some regions may not be indicative of the global long-term picture. It is also important to note that ICAO does not currently have a long-term aspirational goal and that EU decarbonisation goals are in general terms more ambitious than those currently adopted by ICAO. SAF-related policies were not considered at an individual State level under the LTAG report, but its scenarios do consider the policy landscape, (e.g. the IS3 Scenario assumes maximum policy enablers for tech, ops and fuels). For more information, refer to LTAG report, Appendix M5, Table 3.1.
5.5	**Q:** Is it the intention to collect information from each airport? Is there a baseline for the goal? Have you collected data for this year?	**A:** Identifying a baseline for the international aviation sector is part of the decision to be taken by the Assembly. Although ACI/IATA have decided on net-0 by 2050, ICAO and Member States have not done consideration yet. The LTAG Report shows what is feasible and we can have a basis based on feasibility. ICAO will consider the options for a goal with how much to reduce, how to monitor, how to implement. The role of airports will change; they will become hubs of energy transformation. ICAO has a tracker for airport distributing SAFs; this information could help incentivise the industry.

5.6	**Q:** How can States' Action Plans can be improved and supported by ICAO to increase States' voluntary and individual CO_2 reduction in order to achieve the collective objective?	**A**. The LTAG analysis was based upon a "bottom up" approach focused on global CO_2 reduction from "technology" "operations" and "fuels" as contributions to possible global aspirational goal levels. Any global aspirational goal would be a collective goal of the global international aviation sector, and it would not set obligations or targets to individual States. For any global aspirational goal, the contribution of individual States to the collective goal should be on a voluntary basis, based on the selection of the best mix of CO_2 reduction measures by each State (which can be included in voluntary State Action Plans to Reduce International Aviation Emissions submitted to ICAO).
5.7	**Q:** How has the LTAG analysis taken into account the experiences of States in implementing the mid-term goal in accordance with the request by the Assembly Resolution?	**A:** The experience of States in addressing climate change is documented in the States Action Plans. By the next Assembly, it is expected that we will have more State Action Plans, taking into account those that are in the pipeline. Each APP incorporates actions that individual States have identified and are implementing to address emissions from international aviation. The development of the SAPs requires the existence of a national structure with the involvement of all relevant stakeholders to address different aspects of the work (technology, operations, fuels). In relation to the LTAG, the scope of this work could be expanded to include new aspects such as the issue of clean energy, new technologies etc. that will contribute towards the achievement of the LTAG. Furthermore, the SAPs could be the vehicles to identify financing needs for the green transition of aviation. Another example of the experience of States thus far is the voluntary participation in CORSIA. Already 108 States voluntarily participate in the pilot phase of CORSIA and we hope that more States will come forward soon.
5.8	**Q:** When we say "in-sector'' does that include the CORSIA (carbon-offsetting) or not?	**A:** CORSIA is not part of the analysis in the LTAG report, because the report covers only aviation in-sector CO_2 reduction measures (i.e. technology, operations, and fuels).

5.9	**Q:** Do you believe that the CORSIA and LTAG can coexist in the future?	**A:** The LTAG report provides information on emission reduction potentials under different scenarios and residual emissions for each scenario. The report provides information on what would be the gap to address the full responsibility of the aviation sector in order to limit global temperature rise. Based upon the decision to be taken on a goal, States may need to consider complementary measures as they did in 2010 with the decision on carbon neutral growth. ICAO decided to achieve this with a basket of measures (in-sector measures) and then complemented the basket of measures with CORSIA to achieve that goal.
5.10	**Q:** How do you integrate the Action Plan, CORSIA and the implementation of the LTAG?	**A:** In the LTAG Report section 6 includes the topic on the monitoring of progress towards a goal, as a process is anticipated for monitoring progress towards any goal ultimately adopted. It would be preferable not to duplicate existing processes or place reporting expectations on non-state actors. State Action Plans, voluntarily submitted by States under Article 10 of Resolution A40-18, may be a mechanism for States to share progress towards a goal. If and once a goal is adopted, ICAO could conduct future work towards development of reporting mechanisms, etc. building on expertise from the development of CO2 emissions reporting mechanisms as contained in Annex 16 Volume IV.

-END-