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EXECUTIVE COMMITTEE

Agenda Item: 17: Environmental Protection – International Aviation and Climate Change

CARBON REDUCTION TECHNOLOGY – REGULATORY FRAMEWORK TO FACILITATE AEROPLANE AND ENGINE TECHNOLOGY DEVELOPMENTS FOR CARBON REDUCTION

(Presented by the International Coordinating Council of Aerospace Industries Associations (ICCAIA))

EXECUTIVE SUMMARY

ICCAIA has worked to identify carbon reduction targets and related solutions that have the potential to change the shape of aviation. In the mid- and long-term, innovative propulsion technologies, sustainable and alternative energy sources, and changes in overall aeroplane configurations and operations will impact both regulations and operations. The manufacturer-supported technology roadmap developed as part of CAEP's Long-Term Aspirational Goal (LTAG) effort identifies technologies likely to arrive in various time frames and market segments. This roadmap provides the most complete technology picture available and could thus be used as a basis for a complete review of the impact on SARPs of new technologies. Such a review could then be used to develop the necessary regulatory framework and associated timing to enable the development, certification and delivery of the revolutionary technologies and operations.

Action: The Assembly is invited to:

a) request ICAO to prepare a comprehensive regulatory framework leveraging the CAEP LTAG technology roadmap to promote development and deployment of new energy sources, propulsion and airframe technologies, new efficient operations and vehicle configurations to achieve sustainability goals; and

b) request ICAO to conduct a review of existing SARPs, a consideration of interdependencies, and a gap analysis to understand what adaptations will be necessary to enable new technologies and new operational practices.

Strategic Objectives:	This working paper relates to Strategic Objectives: Environmental Protection, Safety, Air Navigation Capacity and Efficiency.
Financial implications:	The activities referred to in this paper will be subject to the resources available in the Regular Programme Budget and/or from extra budgetary contributions.
References:	LTAG Report

[1] English, Arabic, Chinese, French, Russian and Spanish versions provided by ICCAIA.

1. INTRODUCTION

1.1 Environmental sustainability has been recognised by the civil aerospace sector as the most consequential medium and long-term goal for aviation following recovery from the immediate impacts of the COVID-19 pandemic. The manufacturing community has been developing technology solutions to reduce the carbon emissions of civil aerospace vehicles for a number of years, but the current need to rebuild aviation in a more sustainable way has presented unique opportunities to drive larger changes.

1.2 ICCAIA manufacturers have worked intensively with the ICAO Committee for Aviation Environmental Protection (CAEP) in support of an Assembly request to explore the feasibility of a Long-Term Aspirational Goal for international civil aviation CO_2 emissions reductions, consistent with Assembly resolution A40-18. Over 75 technical specialists from engine and airframe manufacturers provided information, data, and expertise that enabled development of an extensive technology roadmap included in the final report. The roadmap explores future propulsion technologies, airframe technologies, and aeroplane configurations while providing a timeline of what technologies may be ready in what timescale and in which market segments.

1.3 The result is that CAEP has as complete a roadmap of manufacturers' suites of technologies extending to 2050 as is possible to create, given the uncertainty associated with such predictions. While the roadmap is not appropriate for immediate SARP development, this unique view enhances the understanding of likely future possibilities, giving ICAO the tools to create environmental regulatory strategy and processes attuned to what the future is most likely to bring.

1.4 However, the regulatory framework outside of the environmental sphere is disconnected from this vision of the future. Manufacturers are already making significant investments in research and development to deliver innovations and technologies to decarbonise aviation. ICAO must move at a pace that secures these investments with a modern, predictable, global and performance-based regulatory framework across all aspects of design and operations, not only for development of environmental SARPs.

1.5 In A41-WP/167, the industry calls on ICAO to develop outcomes-focused regulatory frameworks. Considering that industry and States recognise that decarbonisation of the sector will be key to a sustainable future, one major desirable outcome is to have a holistic regulatory framework that enables the delivery of the technologies needed to realise this ambition.

1.6 This paper calls on the Assembly to ask ICAO to develop enhanced SARP processes in the areas of airworthiness, operations, vehicle performance, airport infrastructure, and others as required. In concert with enhanced processes at CAEP, this will support regulatory outcomes that promote introduction of evolutionary and revolutionary technologies essential to accelerating reductions in CO_2 emissions from aeroplane operations.

2. DISCUSSION

2.1 Since the dawn of the jet-age, engine and airframe manufacturers have worked to reduce the fuel burn and CO_2 emissions of their products. Todays' large turbofan aircraft are up to 80% more fuel efficient than the earliest turbojet powered airliners. Along with turboprops, these aircraft have had similar design characteristics – a tube with a wing attached using turbine engines powered by kerosene. However, the capabilities of these configurations and powerplants are reaching the limits of what can be done to reduce fuel burn and thus, in the mid- to long- term, revolutionary propulsion systems, configurations and/or energy sources will be needed.

2.2 Whilst fuel burn reduction is still a primary goal from an economic perspective, the reduction of CO_2 emissions and their attendant climate impact has also become a key driver of engine and aircraft design. Recognition of the sector's responsibility to reduce carbon emissions is driving research and development programmes of airframers and engine manufacturers, and a host of potential solutions is being examined. Some of these will have significant impacts on the design, certification and operations of the vehicles.

2.3 A key short-term action has been to develop compatibility with Sustainable Aviation Fuels, or SAF. These fuels are more environmentally sustainable on a life cycle basis than oil-based kerosene but have almost identical characteristics, maintaining compatibility with current aeroplane designs. These 'drop-in' fuels, despite their improvements, still emit CO_2 into the atmosphere. In the future, burning kerosene of any kind will become less acceptable since CO_2 is still emitted in the exhaust, regardless of the carbon captured during manufacturing of the fuel. A change to different sources of energy will be needed, and some of these changes will also require a change in overall architecture of the vehicle.

2.4 Many revolutionary propulsion system technologies have been explored at various stages of development, with a range of probabilities for future use. ICAO SARPs need to be capable of responding to each of them as they mature. Three types of revolutionary propulsion systems were considered as part of the LTAG effort, with three different sources of energy, as a way to broadly represent likely emissions reductions over the next 30 years:

a) Electric: requiring on board batteries that will need to be recharged on the ground with a new charging infrastructure;

b) Hybrid: smaller quantities of kerosene burned to generate electricity on board and stored in batteries which drive electric engines; *may* need to be charged on the ground; and

c) Hydrogen: liquid or gaseous hydrogen will be carried in aeroplane fuel tanks and either used in fuel cells to supply electric engines or burned by new propulsion systems; this will require new tank and distribution systems and new fuelling infrastructure.

2.5 Each of these propulsion systems has potential to complicate aircraft performance and operational characteristics on its own. When these propulsion systems are added to revolutionary vehicle designs with improved aerodynamic or structural characteristics, further complication to the performance and airport compatibility is added. Blended-Wing-Body and truss-braced wing configurations could potentially have a significantly increased wingspan compared to today's tube-and-wing designs, presenting new challenges for airport access. Increased weight associated with alternative energy sources may translate into higher gear loading, requiring structural upgrades to runway and taxiway pavement. Revolutionary operational strategies may also be pursued, with potential consequences on air traffic management.

2.6 The CAEP must be congratulated on its Long-Term Aspirational Goal effort; its working with industry and research establishments to identify the list of revolutionary technologies and the timescales for the introductions into the fleet; and in the integration of all of this into an environmental technology roadmap. The roadmap will help the CAEP predict when technologies will arrive and thus when updated environmental SARP reviews may be needed. So far, CAEP is the only body within ICAO with such a complete picture.

2.7 Future revolutionary designs will, though, have impacts far beyond just the environmental SARPs. These may include: Take-off field length and climb performance differences (airworthiness);

Time-to-climb and cruise speed differences (ATM/compatibility assessment); Wingspan driven runway/taxiway separation and airport gate compatibility (ground operations); Fuel safety and logistics differences (onboard the aircraft); Ground handling, fuel storage, supply and infrastructure differences (ground operations); Flight reserves policy for very short range vehicles (airworthiness).

2.8 These issues are all managed outside of the CAEP, requiring a more holistic examination of identified propulsion and airframe technologies and new operational practices to understand which existing SARPs may be impacted and when new SARPs are required by the revolutionary designs. For example, within aerodrome standards, nothing yet exists for an all-electric or hydrogen infrastructure.

2.9 Only with a predictable framework for all aspects of regulation can manufacturers successfully invest to bring revolutionary, carbon-saving technologies to market in a way that maximizes the environmental benefit from these new designs and new operations, ensuring a sustainable future for aviation. The regulatory framework must include all aspects of design, certification and operation of the new products, eliminating the risk that new or modified SARP requirements needlessly block certification or entry into service.

2.10 With the availability of the industry-supported LTAG technology roadmap as a starting point, ICCAIA believes that the time is right to start the process of reviewing the current suite of SARPs across all areas of ICAO to understand their appropriateness and to conduct a gap analysis to understand what new or revised SARPs may be required to enable the introduction of the new, sustainable technologies.

3. CONCLUSION

3.1 ICCAIA congratulates ICAO on the identification by the CAEP of a viable environmental technology roadmap developed during the Long-Term Aspirational Goal Process that may serve as a guide to predict the need for future SARP review.

3.2 In order to achieve significantly reduced carbon emissions, manufacturers are already developing revolutionary energy, powerplant and airframe and operational concepts that have the potential to change the face of aviation, but regulatory certainty is needed to maximize the benefits of these designs.

3.3 To be able to bring these sustainable technologies and operations to market, manufacturers need a robust, complete set of SARPs across all areas of regulation that are available in good time to enable development, production and delivery of revolutionary sustainable aircraft technologies.

3.4 We believe the time is right to start building a picture of the necessary regulatory framework.

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