In 2016, the International Civil Aviation Organization (ICAO) adopted the world’s first CO₂ Standard for new aircraft types. This Q&A document provides details on this standard, which comes into force from 2020.

Following six years of negotiations between governments, with industry and environmental group observers, the International Civil Aviation Organization (ICAO) has designed the world’s first CO₂ efficiency standard for aircraft. New technology is one of the sector’s pillars of climate action (as well as sustainable aviation fuels, improved operations, efficient infrastructure and a global market-based measure). The CO₂ Standard is a key step in formalising new technology efficiency measures.

The CO₂ Standard for aircraft:

- Reduces aircraft CO₂ emissions by encouraging the integration of fuel efficient technologies into aircraft design and development.
- Ensures that less-efficient older aircraft models end production in an appropriate timeframe or that manufacturers invest in technology to improve their efficiency. The standard also ensures that new designs go beyond the highest fuel efficiency of today’s aircraft.
- Is a challenging and robust standard that brings CO₂ emissions into the formal certification process that new aircraft need to pass in order to enter service.
- Is a significant milestone for the sector: the first such standard for aircraft and is key to the sector’s long-term commitment to reduce CO₂ emissions from aviation.
- Is part of a basket of measures to deal with industry’s climate impact which include improved operations, sustainable alternative fuels, better use of infrastructure and new technology (which the CO₂ Standard will support).
- Is complementary to an agreement in 2016 on a global market-based measure to cap the growth in aviation CO₂ emissions and meet the industry’s mid-term goal.
- Was developed by the ICAO Committee on Aviation Environmental Protection (CAEP) over a six-year period through 26 meetings and some 700 papers and pieces of analysis by 170 aviation experts from governments, industry and environmental groups.

Why develop the CO₂ Standard?

- It is the right thing to do — for the future of the sector, for our customers and partners and for the environment.
- Fuel efficiency is central to aviation’s business and sustainable growth strategy — as evidenced by the huge gains in fuel efficiency over the decades.
- The formalisation of a CO₂ Standard for aircraft is an important part of the sector’s overall basket of measures for climate action and is complementary to the significant work already underway in the sector: new aircraft and alternative fuels technology; optimising operational procedures; and improved infrastructure.
- The Standard will ensure that all newly-developed aircraft and engines incorporate the latest commercially-available proven technologies, mindful that no single technology can be applied across the entire range of new aircraft and engine models from small regional and business aircraft to the very large capacity long-range commercial aircraft.
- The industry has always prioritised efficiency improvements — in fact, aircraft and their operations have been consistently improving since we started flying jets — this formalises existing practices.
- Importantly, the CO₂ emissions of aircraft become part of the certification process, alongside safety compliance and noise measures, among other elements.
- The establishment of the first global CO₂ Standard will allow monitoring and progress in the future towards achieving CO₂ emissions reductions in line with research and development targets and technical feasibility.

Which aircraft will be covered by the CO₂ Standard?

- Jet aircraft which have a maximum take-off weight of over 5.7 tonnes (in other words, all commercial jet aircraft and all except the smallest business aviation jets).
- Higher stringency level for jet aircraft over 60 tonnes (which make up over 90% of commercial jet aircraft).
- Propeller aircraft which have a maximum certificated take-off weight of over 8.6 tonnes (which includes all but the smallest commercial propeller aircraft).
» These cover virtually all of the aircraft types in the global commercial fleet.
» Passenger, cargo and business aircraft are covered.
» Two categories are included, new aircraft types and aircraft that are ‘in-production’:
» All new aircraft types, for which manufacturers will apply for a ‘type certification’ after 1 January 2020, will be covered (with aircraft below 19 seats covered from 2023).
» All aircraft models that are currently being produced will have to meet the ‘in-production’ CO₂ Standard after 2023 if they undergo modifications that require re-certification.
» All remaining in-production aircraft will have to comply by 2028. This effectively means a production cut-off from 2028 for aircraft that do not meet the CO₂ Standard.
» Very small aircraft (weighing less than 5.7 tonnes) have not been included. They are often operated either privately or by very small airlines (such as single-aircraft operators flying between islands) and collectively emit a very small proportion of CO₂.
» Under sensible exceptional circumstances, certification authorities can grant exemptions from the obligation to be CO₂-certified to aircraft produced in very low volumes. Some special-purpose models such as firefighting aircraft are also exempted from CO₂ certification.

How does the CO₂ Standard work?
» The metric is complex and not easily explained, as it has been developed to be equally applied to a range of aircraft types and treat them similarly.
» However, put very simply, it is based on the aircraft’s performance during the ‘cruise’ phase of flight, expressed in kilograms of fuel per kilometre of flight, which is then adjusted to account for the fuselage size. Instantaneous fuel burn is determined under optimal cruise conditions and averaged over three measurement points at the beginning, in the middle and at the end of cruise flight.
» The CO₂ Standard focuses on cruise flight performance because the cruise portion of a flight is typically when the most fuel is consumed and the majority of CO₂ is emitted.
» It takes account of the ‘transport capability’ of the aircraft — i.e. how much can be transported and how far it is transported. These two elements, the payload and the range, are essential in the design of any aircraft.
» For each aircraft type, depending on its size and weight, the CO₂ Standard defines a maximum metric value (fuel burn per flight kilometre) that may not be exceeded.

Is the CO₂ Standard ‘strong’ enough?
» Yes. The agreed CO₂ Standard has achieved the best balance of environmental benefit, technological feasibility, economic reasonableness and consideration of interdependencies. It embodies an appropriate level of regulatory pressure whilst allowing the marketplace to determine the makeup of the global aircraft fleet.
» The more stringent the standard is, the longer it will take to get new technology to market in order to meet the standard — it will also probably be more costly. This in turn could lead to airlines flying older, less-efficient aircraft for longer, causing more CO₂ emissions. The final CO₂ Standard is therefore sufficiently stringent, without being restrictive in such a way that would have been counter-productive.
» The interdependencies of any given metric must be considered. For example, technical measures can be implemented which reduce CO₂ from aircraft but will increase noise and/or other emissions. When setting the CO₂ Standard, a determination had to be made on how best to balance those interests.
» A CO₂ Standard for aircraft was always going to be a complex exercise, more so given the international nature of the sector: aircraft are not only manufactured in Europe and North America, but also in Russia, China, Ukraine, Japan and Brazil.
» As part of the negotiations on any standard such as this, a balance must be reached between what is desirable for the maximum environmental benefit and what is ultimately practical and reasonable to implement.
» In the end, the stringency levels agreed at ICAO are both ambitious and realistic.
What will the Standard mean in CO₂ reduction?

» Even in the absence of regulations, the economics of aviation have dictated for decades that each new generation of aircraft is roughly 15-20% more efficient than the model it replaces. The CO₂ Standard mandates that these improvements continue.

» However, the continuous development of new aircraft and engine technology, underpinned by the CO₂ Standard, is only one part of overall aircraft efficiency improvements.

» The aviation industry approach focuses on several pillars of climate action: reducing fuel use (and CO₂ emissions) through new technology and alternative fuels; better operations of existing aircraft; and improvements in infrastructure.

» For all emissions that cannot be reduced through these pillars, a global market-based measure will be used to offset the remaining emissions in order to meet the targets set by the industry.

Is this about overall efficiency, or just the new aircraft technology?

» The CO₂ Standard is specifically related to the technology, e.g. aircraft performance.

» The industry and ICAO have also set overall efficiency goals which relate to the full operation of the aircraft and the efficiency of the system as a whole.

Will the CO₂ Standard be subject to review?

» Yes, the CO₂ Standard will be reviewed as part of the regular cycle of ICAO’s Committee on Aviation Environmental Protection (CAEP).

» With other environmental standards related to noise and local air quality, CAEP periodically undertakes technology reviews to determine whether an update to the standard is required. Our expectation is that CAEP will follow this same approach with respect to the CO₂ Standard.

» The existing standards related to noise and local air quality have been reviewed and updated multiple times, most recently in 2010 (NOx), 2013 (noise) and 2019 (particulate matter).

Why is the work being undertaken at ICAO?

» A globally interconnected sector such as aviation requires global standards in all areas.

» ICAO delivers those global standards and the CO₂ Standard follows on from past regulatory experience in areas such as safety, security and noise.

» ICAO has been creating standards for decades and, once created, stringency levels are increased and certification procedures improved to reflect technological and scientific advancements.

» For this agreement, ICAO brought together member states, global aviation stakeholders and NGOs into the negotiation process. The resulting standard is a consensus agreement.

How does it differ from business as usual?

» “Business as usual” in aviation actually already means constant efficiency improvements — it can be seen in the fact that today’s aircraft are well over 70% more efficient than the first jets: efficiency is part of the aviation sector’s DNA.

» The CO₂ Standard formalises the improvements that have, until now, been purely market-driven.

Why does the CO₂ Standard only come into effect in 2020? Why not immediately?

» Once the standard is approved, it must be translated into local legislation by national civil aviation authorities. This takes time and therefore 2020 is a practical start date.

» Aircraft and their engines are incredibly complex machines and, with safety the number one priority for the industry, any modifications must be properly tested and certified before they enter commercial service. This takes time.

» A typical aircraft can take a decade to design, test and build due to the complexity, technology, advanced materials and rigorous testing and certification processes involved. They can stay in service for around 20 years.

» The standard also ensures that new type designs exceed the highest fuel efficiency of today’s aircraft.

Will the CO₂ Standard require retrofitting to in-service aircraft?

» No. That is not practical and the CO₂ Standard does not apply to in-service aircraft.

» A certain amount of retro-fitting already takes place under the ‘operations’ pillar of the industry’s strategy for reducing emissions. These retrofits tend to be items such as wingtip devices which can save significant amounts of fuel. However, retrofitting new engines or making substantial changes to the airframe of existing in-service aircraft is prohibitively expensive.

» Whilst it will take place over time, in-service aircraft are anyway being replaced with newer aircraft. The CO₂ Standard will ensure that these newer aircraft are more efficient.

» The new standard also specifies that changes to an aircraft design affecting emissions beyond a certain minimum level would require such aircraft to meet the standard.

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