European Parliament briefing: Aviation emissions and ICAO's CO2 standard for new aircraft

Its design is compromised; industry and Transport Ministries saw to that. Now the EU, under pressure from Airbus, is weak on stringency.

January 2016

Aviation is one of the fastest growing sources of GHG emissions and the most climate-intensive form of transport. Its CO2 and non-CO2 impacts are responsible for an estimated 4.9% of man-made global warming. CO2 emissions alone are predicted to grow 300% by 2050. Barely a month after Paris set a new objective of keeping global warming below 1.5°C, ICAO is set to agree a CO2 standard for new aircraft which it holds up as a flagship element of its climate change basket of measures. Europe is the world's biggest aviation emitter.

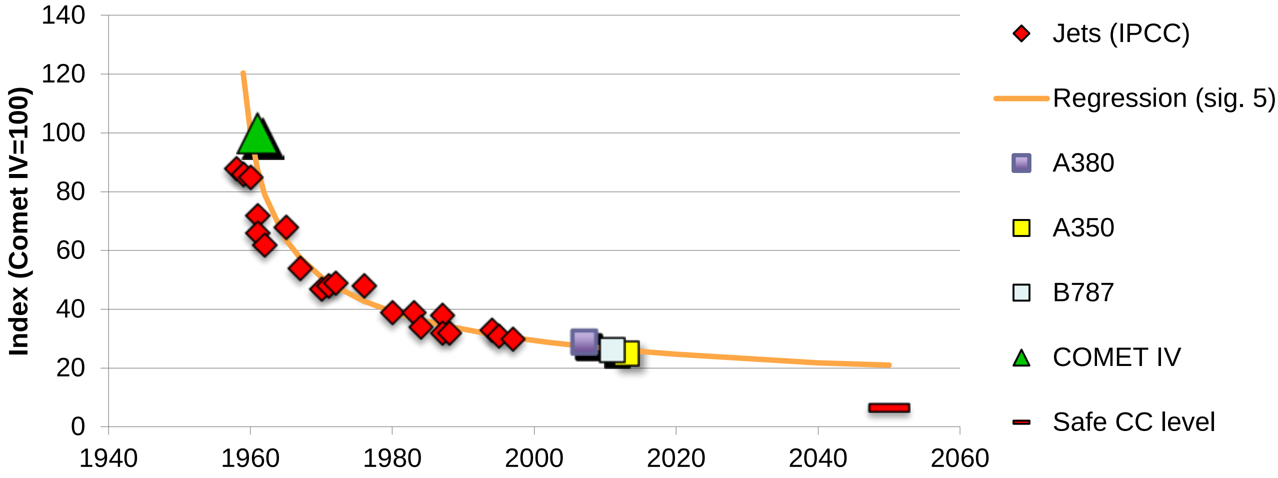
1. Aircraft fuel efficiency

The introduction of jet aircraft in the early 1960s involved a huge penalty in fuel efficiency compared to the piston aircraft they replaced due to jets' much higher speed, payload-range capability and cruising altitude (to avoid bad weather) Since then, jet aircraft have improved efficiency 60-70%; starting at 5%+ a year and now tapering off to around 1%. These improvements have been driven by various commercial imperatives of which reducing the cost of fuel is only one. The less fuel burn, the better the aircraft's payload and range and therefore revenue-generating capability. More efficient ie lighter take-off weight aircraft means lower landing and takeoff airport fees and, importantly, greater accessibility to airports with short or high altitude runways. So better fuel efficiency is an integral factor in aircraft design even at very low fuel prices. But its not the deciding factor; airlines buy aircraft based principally on the lowest operating costs all other factors being equal. Optimising operating costs can mean a fuel efficiency penalty of up to 5% because, for instance, a fuel efficiency optimized wingspan is greater and more costly in general than a cost optimized wingspan.

2. ICAO CAEP

Under pressure to take action on aviation emissions, and having first rejected a fuel efficiency standard in 2002 and a global ETS in 2004, ICAO finally decided in 2009 to develop a global CO2 (fuel efficiency) standard for new aircraft types. It would regulate the fuel efficiency design of new aircraft not emissions from operations and complement noise and NOx emissions regulations dating back to the 1970s. The US was pushing hard for a standard then, as it opposed market-based measures. The EU had already agreed to a market based measure in 2008 – the incorporation of aviation in the EU ETS from 2012. In the end CAEP, ICAO's environment committee, agreed to develop a CO2 standard and in 2013 ICAO agreed to develop, in parallel, a global market based mechanism (GMBM).

Past & extrapolated fuel efficiency NT



Source: page 42-47 in http://www.pa.op.dlr.de/tac/2006/proceedings/proceedings.pdf

The potential for fuel efficiency improvements from new aircraft is significant but diminishes over time because today's new aircraft require some 10 years of development time to reach flight stage whereas developing the first jets took less than 2 years. The improvement margins are much smaller than, say, for cars and the challenge is precision; to set the standard such that it is intrusive enough without being impossible to achieve. Before work began, ICAO's own fuel burn experts concluded that future fuel efficiency improvements would be at least 0.5% per year, but could rise to 0.9% to 1.25% per year depending on regulatory pressure and industry efforts. In 2011, CAEP agreed that the purpose of the standard is to achieve emissions reductions beyond what would otherwise be achieved without the standard. The ICCT has set out the average fuel efficiency trends of sold aircraft[1]. Technology trends as described are more stable[2]. In the end, both trends should be about the same with a time lag.

3. Establishing the metric

Right at the beginning, CAEP members and industry set some significant ground rules; *all* aircraft would be covered by the one standard – from small business jets to the A380 – even though over 90% of the aircraft flying today are large aircraft produced by Boeing and Airbus. Data was provided by manufacturers under confidentiality agreements – covering aircraft of all sizes and ages – some back to the 1980s. It was also agreed with industry that the standard would be "transport capability neutral" i.e. range or payload would not influence the metric value (efficiency score) of aircraft being regulated nor would reductions in design speed be imposed. These conditions reflected manufacturers' concerns not to have the flexibility of design options constrained by regulators, and the airline industry (IATA's) emphasis on non-stop services, range, payload and speed. Crediting lightweight designs with a better efficiency score was also taken off the table. There was a late attempt to take account of aircraft size by adding a factor representing floor area (for passengers and freight). All it seems to have done is increase the scatter of aircraft MV and introduce a third dimension to the MV score making it conveniently impossible to compare the fuel efficiency of aircraft with other modes of transport.

The agreed MV formula requires measuring fuel burn at three representative "specific air range" (SAR) points at cruise – similar measurements are widely used in assessing aircraft performance. But by ignoring fuel burn at climb, MVs are somewhat less representative of short haul aircraft which are about 80% of all aircraft flying – the remaining 20% long-haul aircraft account, however, for over 80% of all emissions; the

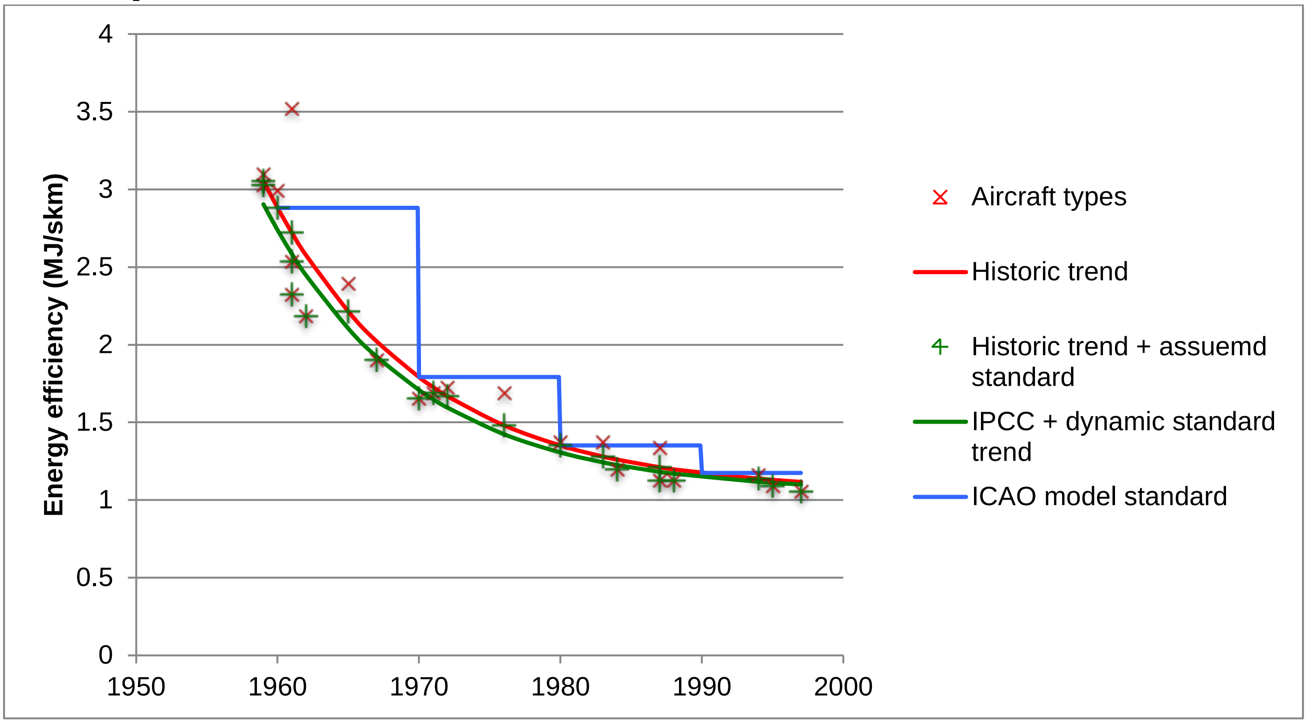
[1] http://theicct.org/fuel-efficiency-trends-new-commercial-jet-aircraft-1960-2014
[2] http://www.pa.op.dlr.de/tac/2006/proceedings/proceedings.pdf

"80-20 rule." Having agreed the MV, CAEP then moved to address stringency by plotting all aircraft MV. This meant plotting MVs for ALL in production aircraft stretching back nearly 40 years. A bit like setting 2020 car efficiency standards by referring to 1980s models.

More extraordinary is the static concept of the standard – seemingly not challenged at the time. ICAO noise and NOx standards require bolt-on technologies to meet a fixed regulatory limit for, say, 10 years. When a more stringent limit is agreed, better technology to meet the new limit is required, again for say 10 years. Such a standard is not appropriate for regulating fuel burn in aircraft since designing jet aircraft is one of constant efficiency improvement. How can a straight line regulate a dynamically changing parameter in the precise way required here?

This is what the standard would have looked like versus actual average annual improvements in fuel efficiency, had it been introduced at the dawn of the jet age in 1960.

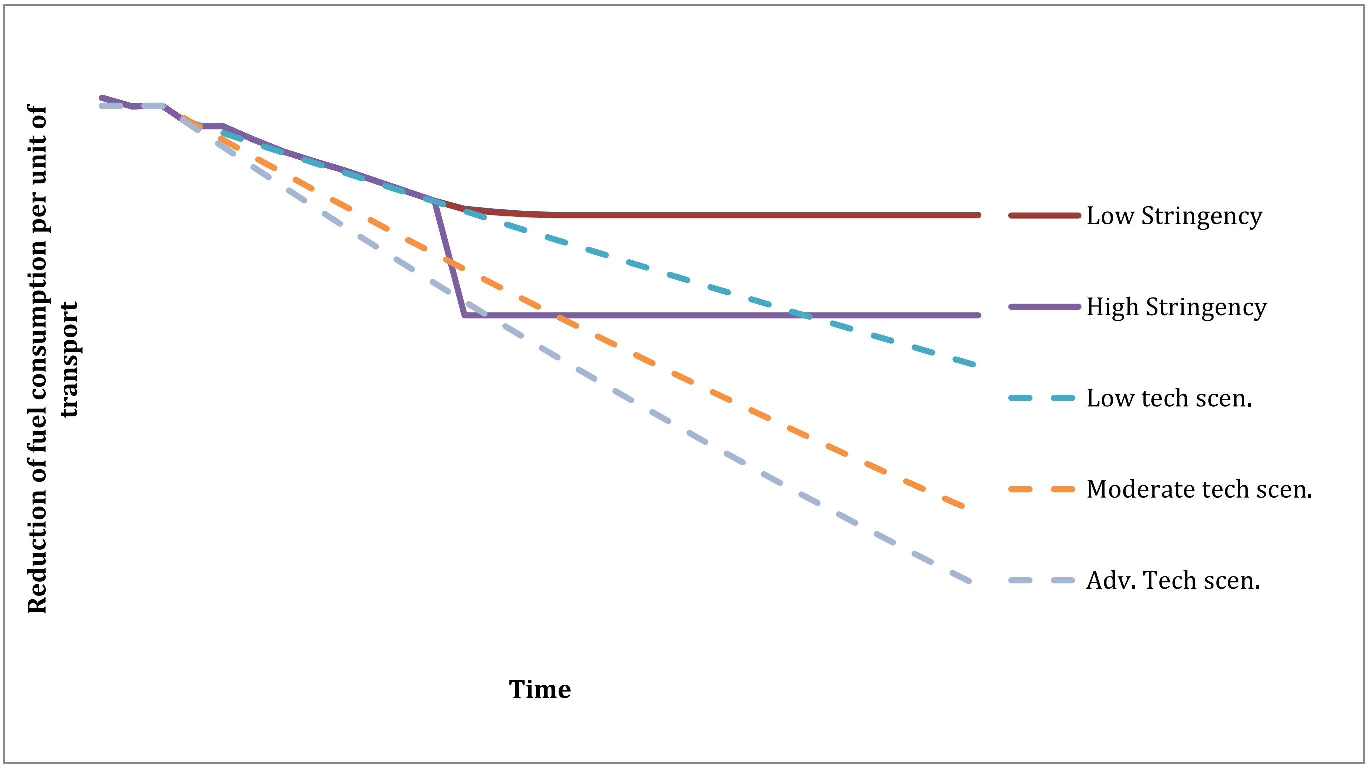
Consequences of a static standard when introduced in 1960



A sloping stringency coupled with averaging and banking as is used with car standards was a potential option. But how could a certain aircraft type which failed the CO_2 part of certification requirements, be certified only because manufacturers sold sufficient compliant other types? The world is black and white. This of course begged the question of why the MV itself needed to be a certified value. Certification is a safety question. Fuel efficiency is not. If car manufacturers in Europe don't comply with CO_2 standards, they pay a fine per vehicle sold. Requiring aircraft MV to be certified, conveniently complicates the process no end and allows manufacturers to hold the whole process hostage. New aircraft types today may take 10 years to bring to production and cost $15 billion to develop. Which regulator will fail such an aircraft and see its manufacturer potentially go bust?

Here is a representation of what the static standard, as envisaged, will do. Even if there is an impact at the start, the historical progression of real efficiency (dotted line scenarios) soon overtakes the straight lines.

Representation of static stringency options under consideration

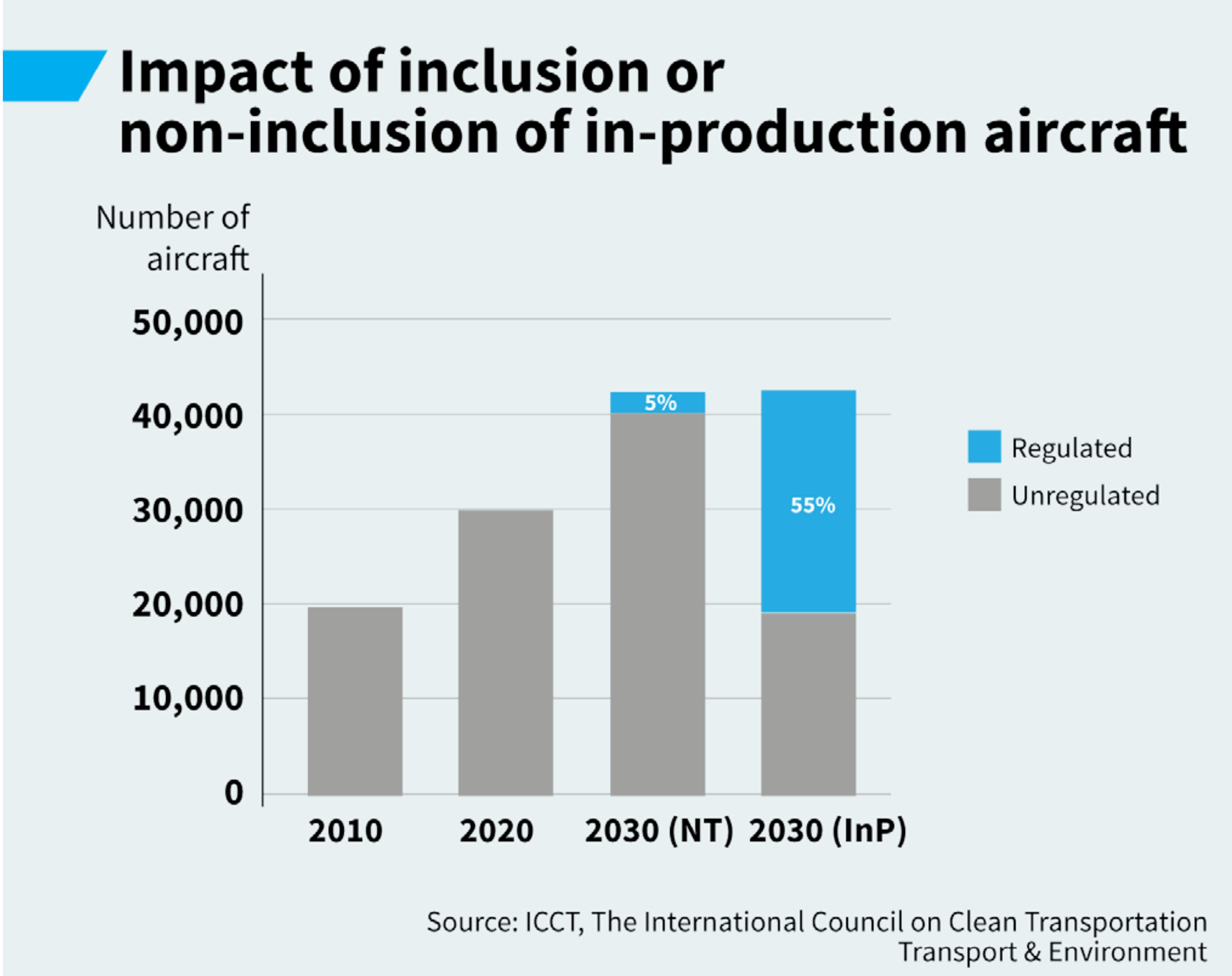


4. Stringency

In 2013, CAEP decided that the stringency options for the standard would all be based on TRL8 (technology readiness level 8 – ie technology already flying) in year 2016. This decision was strongly promoted by industry and just as strongly opposed by civil society. The problem with this is that the standard for new aircraft types will probably come into effect in 2020 which means the first newly designed aircraft type certified under the standard will not fly before 2024. So there is 8+ years of technology and efficiency improvements to be had before the aircraft flies yet its CO2 metric value regulatory requirement can't be based on anything better than 2016 technology.

In order to decide stringency, MVs for all aircraft flying as at 2016 were plotted. Estimated project aircraft MVs were then added. Project aircraft being defined as all new aircraft under development since about 2012, i.e. the early stages of the standard development, which took 6 years which would be flying by 2020. However it was agreed that any regulatory stringency would not require project aircraft to comply – since it was conceded that the project aircraft were already in development and couldn't be expected to undergo a "technology fix" by 2020 to make them comply. This affects aircraft such as the A319NEO, A320NEO, all B737-MAX's, all A350's and all B787's. On top of this, industry declined to provide any estimates on what were called "parametric aircraft" – aircraft not yet under 'official' development but that might fly for the first time after about 2025. So "parametric" aircraft that will first fly in 2025 will also only have to meet the 2016 frozen technology standard. Such technology will fly on new aircraft this year. It is a fact that new aircraft with a lower fuel efficiency than their predecessors are effectively unsellable. Civil society therefore believes that current proposals for the standard for new aircraft types when applied to new types first flying in 2025 will, if agreed, have no effect whatsoever on their CO2 performance – other than permitting industry to stick a green label on the fuselage.

Aside from regulating new aircraft types - for example a Boeing 797 or an Airbus A390 - which these days appear infrequently because of cost etc –– the vast bulk of new aircraft to be delivered over the next generation are existing in production aircraft or their derivatives – e.g. the neos or stretches. Things seem to be moving in the direction of regulating these in-production (inP) aircraft.



In 2030 only regulating NT aircraft might cover 5% of the then global fleet – although "regulating" doesn't mean the standard has necessarily impacted fuel efficiency. By "regulating" inP aircraft as well, potentially 50% of the world's fleet would be "covered" i.e. hold a CO_2 standard compliance certificate. That doesn't necessarily mean the standard will have had an impact on inP fuel efficiency – that depends on stringency. The fleet will grow 70% to over 40,000 aircraft between 2015 and 2030.

5. ICAO CAEP 10

CAEP will meet in early February 2016 to agree on the standard which then must be approved by the ICAO Council and adopted by ICAO members as "SARP"s to Annex 16 of the Chicago Convention. States can agree to comply or file a difference. The US is under pressure to see a robust standard agreed because under the US EPA's June 2015 endangerment finding, the EPA has the option to develop its own domestic standard if it finds the ICAO result wanting. A US standard would bind US manufactures and any non-US manufacturers with regards to aircraft sold and registered in the US. Europe is reported to be starting the negotiations with a much weaker proposal. There is also the question of other manufacturing countries eg Russia, the Ukraine, China, Brazil, Canada – relatively small volume manufacturers and less sophisticated products. Over 90% of global emissions stem from large Airbus and Boeing aircraft. They are the emissions which the standard must first address effectively.

6. Transparency

Aircraft efficiency scores (MVs) are planned to be declared on a voluntary basis only and with only partial data revealed making it very difficult to compare aircraft efficiency. Civil society believes all efficiency data including the three measured and certified specific air ranges, should be published. The IMO has banned the publication of shipping's equivalent CO2 scores – the EEDI. Under the 2015 EU shipping MRV Regulation, all ships calling at EU ports must nevertheless declare their EEDI scores and efficiency date which will be published on an EU website from 2018. While the interests of the aviation industry are clear and well covered by all parties involved in the ICAO process, the global interest focusses on dangerous climate change affecting all of mankind. These concerns should be paramount and thus transparency is the very least that the standard can achieve as the fuel consumption data of aircraft are currently trade secrets.

7. Conclusions

The Paris Agreement requires all sectors and Parties to increase their ambition to come into line with the 1.5°C target. International aviation should be no exception to this. With a target as ambitious as 1.5°C, there is no time for delay. ICAO must in 2016 prove that it is capable of adopting environmentally effective measures. Action at the global level is essential. But, if only a common denominator approach is possible at ICAO, then the two manufacturing countries responsible for the vast bulk of emissions must act. The EU is the world's largest aviation emitter. Intra-EU aviation emissions alone are set to grow by over 80% by 2030. The EU must work for the best possible agreement at global level supplemented by ambitious European measures.

Further information

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