TRACKING AVIATION EFFICIENCY

WAYPOINT 2050

How is the aviation sector performing in its drive to improve fuel efficiency, in line with its short-term goal?

In 2009, the aviation industry agreed an ambitious set of goals for addressing climate change by dealing with its carbon emissions. The first goal is to deliver a global average annual fuel efficiency improvement of 1.5%. In other words, the combined fleet of commercial aviation aircraft would improve its fuel efficiency by an average of 1.5% per year until 2020, with further goals set to cap net CO_2 emissions from 2020 and to halve them by 2050 (based on 2005 levels).

The aviation sector's short-term goal to improve fleet fuel efficiency by an average of 1.5% per annum from 2009-2020 is on track, with analysis showing a 2.1% improvement on a rolling average – a cumulative efficiency improvement of 22.8% since 2009. Due to the impact of Covid-19 and the massive disruption in air traffic, 2020 cannot be seen as a typical year and has not been included in the fuel efficiency analysis.

The full set of goals can be found at: www.enviro.aero.

Fuel efficiency performance of commercial aviation

- Airlines have continued to improve their fuel efficiency performance between 2009-2019, securing an average annual improvement of 2.1% — above the industry goal of 1.5%.
- The cumulative efficiency improvement between 2009 and 2019 has been 22.8%.
- Since the year 2000 (until 2019), industry fuel efficiency has improved 37.4% and CO_2 tonnes per thousand tonne kilometres performed has improved from 1.36 to 0.85.
- Since 1990 (until 2019), industry fuel efficiency has improved by 54%.
- Improved fuel efficiency has been driven by airlines investing over $1 trillion in 15,000 more efficient new-technology aircraft since 2009; and by improving performance through higher load factors and other operational measures.
- High and volatile fuel costs have also made it economical to retire older aircraft at higher rates further contributing favourably to fuel efficiency performance.
- A current production backlog of over 8,073[1] new technology aircraft from the major manufacturers will be entering the global fleet over the next few years, suggesting continuing improvements in fleet efficiency, although this could be impacted by Covid-19 related financial pressure on airlines. The early retirement of many older aircraft could also impact fleet efficiency.
- Weight-based load factors improved by nearly five percentage points moving from 64.9% in 2008 to 69.3% in 2019, as airlines continued to make better use of space available on aircraft. Passenger load factors averaged 82.5% globally in 2019.

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020E
Revenue tonne-kilometres performed *(RTK, billions)*	625	602	670	701	724	758	803	851	906	983	1,042	1,066	498
Commercial aviation CO_2 *(million tonnes)*	669	633	667	685	694	711	734	775	812	863	896	905	475
Fuel efficiency *(CO_2 tonnes per thousand RTK)*	1.07	1.05	0.99	0.98	0.96	0.94	0.92	0.91	0.90	0.88	0.86	0.85	0.95
Rate of fuel efficiency improvement *(% change over previous period)*		1.8%	5.3%	1.7%	2.1%	2.0%	2.5%	0.5%	1.6%	2.1%	2.0%	1.3%	-12.3%
Rolling average fuel efficiency improvement *(compound improvement % per annum 2009-19)*												**2.1%**	0.9%*

2008-2018: actual data from IEA and IATA Economics (available 22 months after year end)
2019-2020E: IATA Economics data

2009-2019 rolling fuel efficiency improvement

2.1%

Fleet fuel efficiency improvement since 1990 (2019)

54%

Fleet fuel efficiency improvement since 2000 (2019)

37.4%

Passenger load factors average

82.5%

globally (2019)

Historical aviation emissions

Efficiency has been improving since the start of commercial aviation

Year	Total aviation CO_2 *(million tonnes)*	Revenue passenger kms *(millions)*	CO_2 per passenger km *(grams, global average)*	Revenue tonne kms *(billions)*	CO_2 per tonne km *(grams, global average)*	CO_2 split *(CO_2 from international flights)*
1990	453	1,912,086	237	246	1,845	48%
1991	438	1,836,923	239	241	1,818	48%
1992	464	1,949,413	238	255	1,823	49%
1993	469	1,948,313	241	261	1,794	50%
1994	490	2,117,907	231	288	1,698	50%
1995	502	2,270,617	221	310	1,616	51%
1996	524	2,470,642	212	336	1,561	51%
1997	541	2,661,058	203	366	1,478	51%
1998	554	2,775,569	199	379	1,460	52%
1999	571	2,945,897	194	406	1,409	53%
2000	595	3,176,064	187	439	1,356	53%
2001	586	3,084,406	190	423	1,386	53%
2002	591	3,127,670	189	441	1,341	55%
2003	588	3,146,373	187	450	1,306	55%
2004	626	3,613,534	173	514	1,218	56%
2005	651	3,934,896	165	550	1,183	58%
2006	659	4,204,474	157	584	1,128	59%
2007	675	4,538,473	149	621	1,087	59%
2008	669	4,648,512	144	625	1,070	61%
2009	633	4,591,755	138	602	1,051	61%
2010	667	4,959,671	134	670	995	61%
2011	685	5,273,116	130	701	978	62%
2012	694	5,552,591	125	724	958	61%
2013	711	5,869,089	121	758	938	61%
2014	734	6,221,234	118	803	915	61%
2015	775	6,681,606	116	851	911	61%
2016	812	7,176,045	113	906	896	61%
2017	863	7,757,801	111	983	878	60%
2018	896	8,329,776	108	1042	860	-
2019	905	8,679,621	104	1066	849	-
2020E	475*	2,921,129*	163*	498*	954*	-

Source: IATA Economics

Data and analysis supplied by IATA Economics: www.iata.org

[1] A combination of backlogs 2020-2025 from Cirium Fleet Dashboard.

[2] Data from the International Energy Agency database: www.iea.org

[3] http://bitly.com/1yz3oCO

[4] http://bit.ly/1uhXxhf

[5] http://bit.ly/1DTWJaX

* Given the extreme disruption in air traffic in 2020 and 2021 due to the impact of the Covid-19 pandemic and subsequent shutdown of air traffic in many parts of the world, the 2020E used in this fact sheet is not included in the efficiency figures.

28% Industry 2050 goal will reduce aviation CO_2 emissions 28% below 1990 levels (64% below 2019)

Commentary

The significant 2010 fuel efficiency improvement number was driven by a rebound in traffic and a large jump in weight load factor performance, with improved load factors on both the passenger and cargo side as part of the recovery from the global financial crisis.

Given the extreme disruption in air traffic in 2020 (and 2021) due to the impact of the Covid-19 pandemic and subsequent shutdown of air traffic in many parts of the world, the 2020E used in this fact sheet is not included in the efficiency figures. This is for several reasons, including:

- For a number of months, airlines in the United States were required to continue serving airports even if there was no passenger traffic.
- Other airlines maintained services for cargo purposes which would normally have been on passenger-filled flights.

So the 2020 efficiency figures cannot be seen as representative of the state of the industry in a normal year. This disruption is likely to continue in 2021 and perhaps for a few years beyond, partially offset by early retirement of older and less-efficient aircraft.

Key inputs to assess fuel efficiency performance

- IEA data[2] is used to determine global jet fuel uplift. The IEA data is only available ~18-22 months after the year ends. This is adjusted to remove military and general aviation fuel use, leaving commercial aviation only. Apportionment of jet fuel uplifted to commercial aviation is based on several industry level assessments on the types of aviation activity, sources include:
  - ↳ Scheduled and charter — sourced from the UN IPCC 4th Assessment Report WG 3 and Allocation of International Emissions from Scheduled Air Traffic[3]
  - ↳ General aviation — Boeing and NASA studies Matlock and Alsyne
  - ↳ Military aviation — Estimates based on AERO2K exercise[4]
  - ↳ The above assessments are combined with bottom-up modelling of commercial aviation to take an informed view of the respective share of the fuel used under each category
- ICAO data on historical traffic performance[5]. IATA estimates for other industry related activity is used to scale up ICAO reported traffic data.
- CO_2 emissions for 2019 and 2020E are based on IATA estimates and incorporate international airline reporting on fuel efficiency performance.