AirHelp

Cost of disrupted flights to the economy

AirHelp. Here to help.

Executive summary

Economic impact

In 2022, delayed and cancelled flights generated an **impact on economy of USD 30-34B in the US, USD 27-32B in Europe**[1] and up to **USD 1.5B in Australia, ~11% more vs 2019** despite less traffic

Across the 3 geographies, the impact split into: cost of **incremental operations time for airlines (32%), value of time lost by passengers (37%), spillover effects on other segments of the economy (16%)** and additional costs of accommodating **flight cancellations (15%)**

Passenger impact

At least 200M passengers were affected by delays and cancellations in the US, **330M in Europe** and **12M in Australia**, losing a total of 650M hours of their time in delays and requiring 30M hotel nights

The disruptions translate into **significant total costs per each air passenger carried** by airlines:
USD 40 per passenger in the US, USD 34 in Europe and USD 41 in Australia

Sustainability impact

Beyond financial cost, disruptions carry significant burden on the environment, **generating extra ~9M tons of CO2 emissions** (1.3% of industry total) and contributing to waste, noise pollution and health problems

The **added carbon footprint** is equal to annual emissions of **~2M passenger cars** and would require **~3K wind turbines** running for a year or **300-350M trees to offset**

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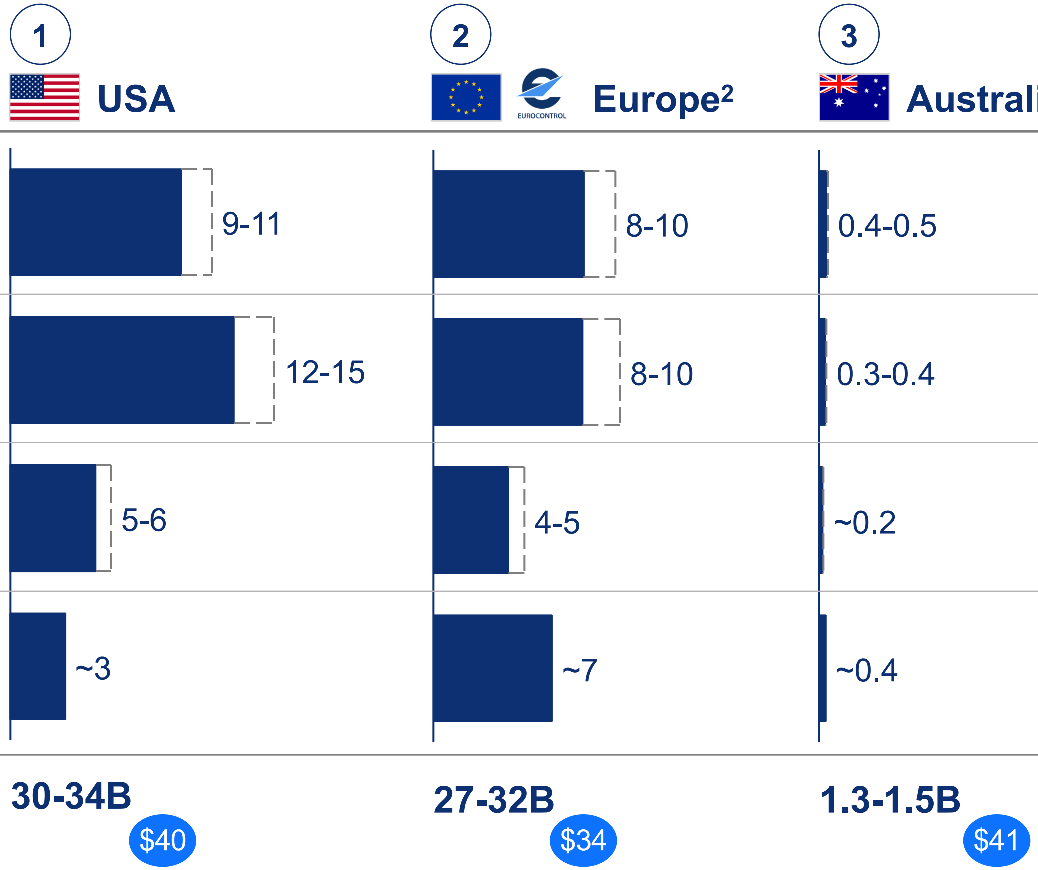
[1] Europe = 41 countries covered by EUROCONTROL

Estimated impact of delayed and cancelled flights on the economies of the US, Europe and Australia at USD 58-68B in 2022

Cost to economy[1], 2022, USD B

Scenario[1] ■ Min ☐ Max

$ Max cost / passenger



	① USA	② Europe[2]	③ Australia	**Description**
Airline cost	9-11	8-10	0.4-0.5	Additional fuel, crew, maintenance, aircraft ownership and other costs resulting from longer operational time due to delay
Passenger cost	12-15	8-10	0.3-0.4	Value of time and productivity lost by passengers due to flight delays
Spillover cost	5-6	4-5	~0.2	Spillover effect of flight delays on other sectors of the economy, e.g., food service, hospitality, retail
Cancellation cost	~3	~7	~0.4	Cost of hotels and other arrangements for impacted passengers, lost cargo revenue & fuel savings resulting from cancellations
Total	**30-34B** $40	**27-32B** $34	**1.3-1.5B** $41	

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1. Max scenario adds 15 min to average delay time, thus inflating the result; the rationale is that airlines build up predictable delays into schedules and actual time lost is undervalued
2. Europe = 41 countries covered by EUROCONTROL

Source: internal analysis based on FAA, DoT, EUROCONTROL, BITRE data, industry reports, press releases

Agenda

- **Methodology**
- Regional deep dives
- Sustainability
- Appendix

Structured calculation logic was applied to all four disruption cost categories to derive impact estimations

Calculation logic overview

Flight disruptions cost to the economy =

Category	Description	Logic
Airline cost	Additional fuel, crew, maintenance, aircraft ownership and other costs resulting from longer operational time due to delay	**Delay time (min)** (based on delayed flights & pax numbers, average delay time, delay structure) × **Cost of 1 min of operations**[2] (Based on fuel, crew, maintenance and other cost categories)
+ **Passenger cost**	Value of time and productivity lost by passengers due to delays	**Number of passengers affected by flight delays** (based on punctuality, flight capacity and load factor data) × **Avg. time lost per passenger (hours)** (based on avg delay per flight) × **Value of 1 hour of pax time** (based on aviation agencies' estimates of alternative cost)
+ **Spillover cost**	Spillover effect of flight delays on other sectors of the economy, e.g., food service, hospitality, retail	**USD 0.5 of spillover for every USD 1.0 of airline costs incurred**[2] (based on similar reference studies from the US market)
+ **Cancellation cost**	Cost of hotels and other arrangements for impacted passengers, lost cargo revenue & fuel savings resulting from cancellations	**Number of pax affected by flight cancellations** (based on total pax/flight volumes and cancellation statistics) × **Cancellation-related costs per passenger** (based on average cost of rebooking, hotel, meals per passenger) + **Lost potential belly cargo revenue** on non-operated flights − **Fuel savings** from not operating selected flights

! *Approach is conservative: estimates exclude small proportion of air traffic not covered in government reports (e.g., minor carriers in the US), as well as potential additional impact on selected aviation industry sub-sectors, lost demand for airlines, reputational damage and social consequences (insufficient data or non-quantifiable effects).*

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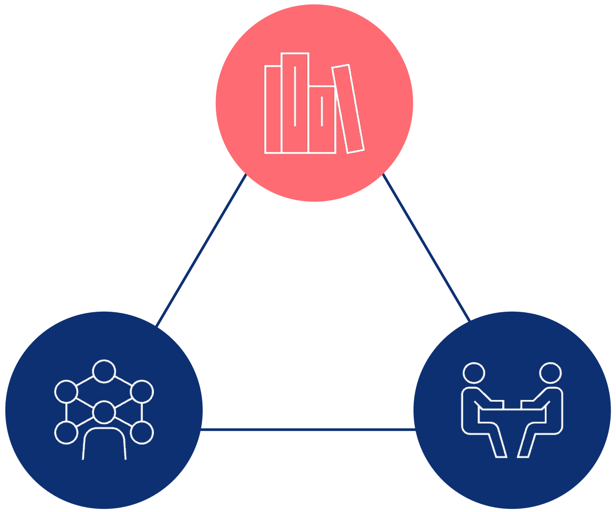
1. Different unit costs used for ground, taxi and airborne delay time
2. Not included: additional impact from lost demand for flights, brand damage to airlines, passenger personal losses, social effects

Triangulation based on 3 main pillars: aviation industry data, AirHelp expertise and expert interviews

Approach summary

Sources used for estimation



Industry reports, airline and government data

AirHelp internal expertise and data

Expert interviews

● Deep dive next

Calculation process

1 **Identify relevant flights and passenger volumes**

2 **Estimate the scale and depth of disruptions**

3 **Calculate unit costs per disruption minute, per affected passenger and per flight**

4 **Calculate the impact and do necessary adjustments**

Key actions

1.
- Identify total volume of passengers and flights in each market
- Cross-check country data with global industry reports and normalize values

2.
- Identify number of flights and passengers affected by delays and cancellations
- Calculate average delay per flight and resulting delay time volumes

3.
- Calculate the cost of 1 minute of additional airplane ops (fuel, crew, maintenance, etc.)
- Estimate the value of passenger time, accommodation, meals, rebooking

4.
- Calculate total impact of flight disruptions
- Adjust results to account for potential double counting between regions

Deep dive: data sources used included government and industry statistics and reports, economic datasets, aviation insights and similar publications

Data sources (non-exhaustive)

Category	USA	Europe[1]	Australia
Passenger traffic & delay data, standard inputs and ratios	• DoT Bureau of Transportation Statistics detailed data and reports on passenger volumes, flights, delays, cancellations • IATA, ICAO aviation statistics and reports	• EUROCONTROL (EC) reports and data on flight numbers, delay times and reasons, ANS performance dashboard • EC standard inputs for cost-benefit analyses, cost-effectiveness reports • IATA aviation statistics and reports	• Australian Bureau of Statistics data on passenger volumes, flight numbers, basic delay and cancellation data • Selected parameters adapted from US and EU sources (e.g., delay cost structure)
Existing reports on disruption cost	• FAA 2019 report • Senate committee 2007 report	• EC/ITA 1999 report • 2013 IATA briefing	• n/a
Aviation insights and reports	• Specific airlines' data and publications • Airlines for America reports • FAA reports, statistics and cost estimate inputs for analysis • DoT reports and analyses	• "All-cases Delays to Air Transport in Europe", EC report, 2022 • "Arriving on time: the passenger priority", EC, 2020 • Air traffic management reports from EC • Airlines4Europe reports • Eurostat/European Commission reports	• "Airline Competition in Australia", ACCC 2022 report • BITRE government reports on airline activity and punctuality
Economic data and other sources (all countries)	• World Bank, Eurostat and local government GDP, PPP, population data • FlightRadar24 data on flight disruptions • Airline websites and press releases • Aviation blogs, news articles, press releases, specialist newsletters • EPA, World Bank, IATA, IEA data on CO_2 emissions		

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[1] Europe = 41 countries covered by EUROCONTROL

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Methodology

Regional deep dives

Sustainability

Appendix

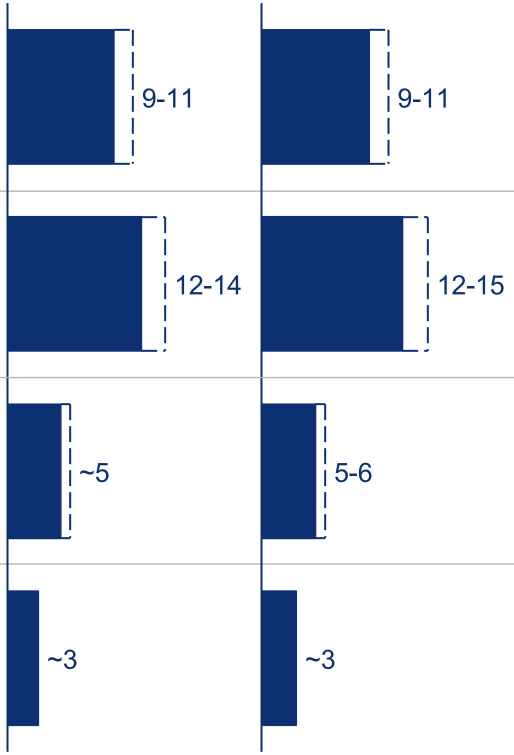
1 | US: cost of disrupted flights to the economy in 2022 estimated at USD 30-34B; ~42% attributed to lost time and productivity of passengers

Scenario[1] ■ Min ⌜⌟ Max

Disruption cost expected to...

↗ Increase in the future ↘ Decrease in the future

Cost to US economy[1], USD B



	2019	2022	Trend	Key assumptions
Airline cost	9-11	9-11	↗ More pax, growing unit ops costs	9.5M flights and 927M pax in 2019, 8.2M/853M in 2022 Avg. delay of 13-14 minutes across all flights (incl. on-time flights, with grace period excluded) Assumed delay time structure: 58% gate, 28% taxi, 15% airborne based on FAA data Cost/block minute of USD 82-101; fuel cost removed from proportion of ground delays
Passenger cost	12-14	12-15	→ More pax, but disruption levels will eventually improve	Up to 180M pax affected by delays in both 2019 and 2022 250-300M hours lost by pax depending on scenario[1] Value of time of USD 50/hour based on DoT data
Spillover cost	~5	5-6	↗ Proportional growth to airline costs	FAA/US Senate reports assume USD 0.5 of spillover for every USD 1.0 of direct airline cost of delays; same assumption used Additional effects such as lost demand, brand damage, lost passenger cost, or social effects not included – lack of meaningful data to quantify
Cancellation cost	~3	~3	→ More pax, but disruption levels will eventually improve	Up to ~230K cancelled flights and ~24M pax affected in 2022 30% of passengers requiring hotels and meals at USD 150/pax 75% pax require rebooking, of that 25% on different carrier for USD 400/pax USD 7.5K lost potential belly cargo revenue per flight USD 3.9-6.6K savings on fuel from not operating the flights[2]
Total[3]	**28-33B**	**30-34B**		

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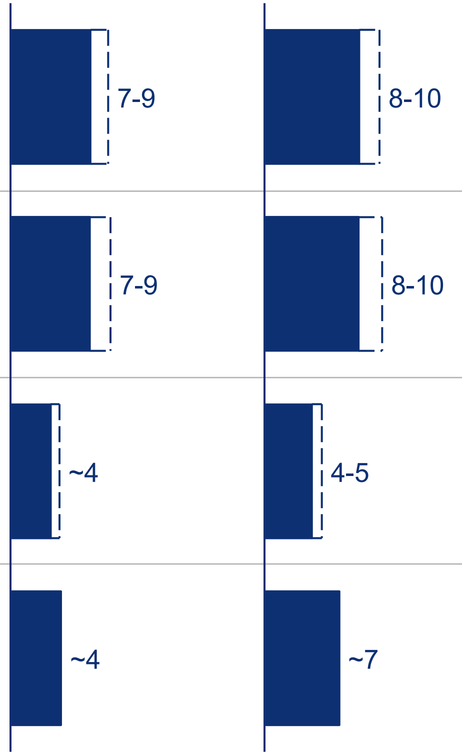
1. Max scenario adds 15 min to average delay time, thus inflating the result; the rationale is that airlines build up predictable delays into schedules and actual time lost is undervalued
2. Using values for Boeing 737-800 & average fuel prices in 2019/22 to calculate cost on a flight of average length (1300 km)
3. Data covers US carriers only; for international traffic, double counting (e.g., on EU-US flights) is avoided by including US carrier international flights but excluding foreign carriers

Source: Internal analysis based on FAA and DoT data, Industry reports, Press releases

2 | Europe: cost of air disruptions in 2022 below the US at USD 27-32B; ~32% attributed to lost time and productivity of passengers

Scenario[1] ■ Min ⬚ Max

Disruption cost expected to...
↗ Increase in the future ↘ Decrease in the future



	Cost to EU economy[1], USD B			
	2019	**2022**	**Trend**	**Key assumptions**
Airline cost	7-9	8-10	↗ More pax, growing unit ops costs	• ~10M flights and 1.2B pax in 2019, ~8M/950M in 2022 • Avg. delay of 13-17 minutes across all flights (incl. on-time flights) • Avg. cost per minute of delay and delay structure deducted from EUROCONTROL data and adjusted for PPP and inflation changes • Resulting unit costs higher than in the US due to higher share of airborne delays
Passenger cost	7-9	8-10	→ More pax, but disruption levels will eventually improve	• 250M+ pax affected by delays in both 2019 and 2022 • 245-335M hours lost depending on scenario[1] • Value of time of USD 33-36/hour based on EUROCONTROL and US data and adjusted for lower PPP vs the US
Spillover cost	~4	4-5	↗ Proportional growth to airline costs	• Same assumptions as for the US: FAA/US Senate reports assume USD 0.5 of spillover for every USD 1.0 of direct airline cost of delays • Additional effects such as lost demand, brand damage, lost passenger cost, or social effects not included – lack of meaningful data to quantify
Cancellation cost	~4	~7	↘ Unusually high cancellation levels expected to improve	• Up to ~600K cancelled flights and ~70M pax affected in 2022 • 30% of passengers requiring hotels and meals at USD 107 per pax on hotel and meal; 75% pax require rebooking, of that 25% on different carrier for USD 284/pax (based on US values & adjusted for PPP) • USD 7.5K lost potential belly cargo revenue per flight • USD 2.8-4.8K savings on fuel from not operating the flights[2]
Total[3]	**22-26B**	**27-32B**		

1. Europe = 41 countries covered by EUROCONTROL; Max scenario adds 15 min to average delay time, thus inflating the result; the rationale is that airlines build up predictable delays into schedules and actual time lost is undervalued
2. Using values for Boeing 737-800 & average fuel prices in 2019/22 to calculate cost on a flight of average length (~1000 km)
3. To avoid double counting (e.g., impact of EU-US traffic), half of the estimated impact of international travel was removed from each category (coefficient of 85-87% of max potential calculated based on passenger numbers)

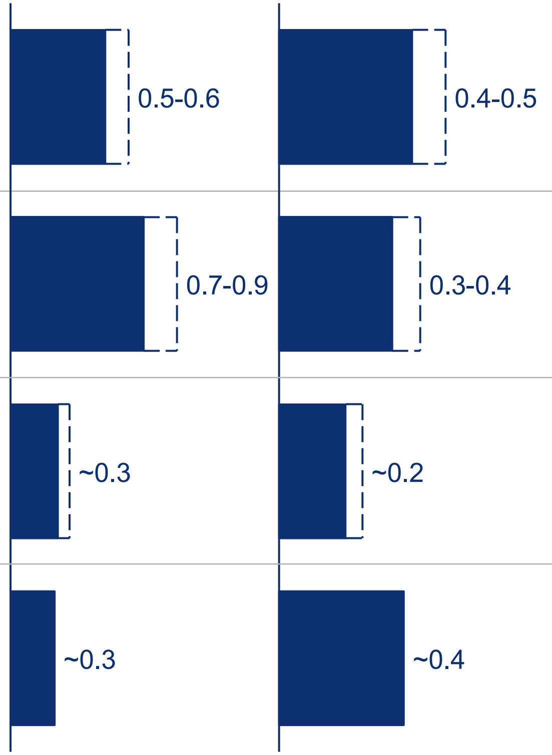
Source: Internal analysis based on EUROCONTROL, EU, FAA and DoT data, Industry reports, Press releases

3 | Australia: cost of air disruptions in 2022 at up to USD ~1.5B; ~27% attributed to lost time and productivity of passengers

Scenario[1] ■ Min ⬚ Max

Disruption cost expected to...
↗ Increase in the future ↘ Decrease in the future

Cost to Australian economy[1], USD B



	2019	2022	Trend	Key assumptions
Airline cost	0.5-0.6	0.4-0.5	↗ More pax, growing unit ops costs	- ~840K flights and 103M pax in 2018-19, ~486K/37M in 2011-22 - Avg. delay of 13-17 minutes across all flights (incl. on-time flights) based on EU statistics due to limited Australian data - Avg. cost per minute of delay and delay structure identical to US estimates and partially adjusted for PPP
Passenger cost	0.7-0.9	0.3-0.4	→ More pax, but disruption levels will eventually improve	- 21M+ pax affected by delays in 2018-19, 9M in 2021-22 - Hours lost by passengers due to delays: 21-27M in 2018-19 and 9-11M in 2021-22 depending on scenario[1] - Value of time of USD 39-41/hour based on US data and adjusted for PPP
Spillover cost	~0.3	~0.2	↗ Proportional growth to airline costs	- Same assumptions as for the US: FAA/US Senate reports assume USD 0.5 of spillover for every USD 1.0 of direct airline cost of delays - Additional effects such as lost demand, brand damage, lost passenger cost, or social effects not included – lack of meaningful data to quantify
Cancellation cost	~0.3	~0.4	↘ Unusually high cancellation levels expected to improve	- Up to ~44K cancelled flights and ~3M pax affected in 2021-22 - 30% of passengers requiring hotels and meals at USD 123 per pax; 75% pax require rebooking, of that 25% on different carrier for USD 328 per pax (based on US values & adjusted for PPP); USD 7.5K lost cargo revenue per flight; USD 4.1-6.2K savings on fuel from not operating the flights[3]
Total[4]	**1.7-2.1B**	**1.3-1.5B**	Lower 2022[4] cost to economy due to strong COVID impact visible: 60% less pax vs 2019[4]	

1. Max scenario adds 15 min to average delay time, thus inflating the result; the rationale is that airlines build up predictable delays into schedules and actual time lost is undervalued
2. Reporting in fiscal years ending in June – calendar year data for 2022 not available; 2019 = 7/2018-6-2019; 2022 = 7/2021-6/2022;
3. Using values for Boeing 737-800 & average fuel prices in 2019/22 to calculate cost on a flight of average length (~1300 km)
4. To avoid double counting (e.g., impact of AUS-Asia traffic), half of the estimated impact of international travel was removed from each category (coefficient of 88-94% of max potential calculated based on passenger numbers)

Source: Internal analysis based on BITRE, EU, FAA and DoT data, Industry reports, Press releases

Airline costs deep dive: 42% of costs attributed to crew, followed by maintenance and other categories

Maximum impact per country

■ USA
■ Europe
■ Australia

Split of airline costs by category[1], 2022, USD B

	% share, 2022	Unit cost per minute[2], USD	Description	Comments
Crew	42%	~30	Pay and benefits of crew members working longer hours due to delay	Crew cost is the largest category due to relatively high unit cost and the fact that it applies to every minute of delay
Fuel	15%	~42	Additional fuel used during longer flights or incremental taxiing time	Despite the highest cost per minute, fuel constitutes only 15% of total costs due to the fact that airborne delays are only a small proportion of total delays
Maintenance	23%	~16	Proportional allocation of maintenance costs related from longer aircraft operations	Maintenance and other cost items apply to entire flight delay times, thus a relatively high share attributed despite lowest unit costs
Other	21%	~14	Additional costs – ownership of the aircraft (leasing), administrative costs, etc.	

Total[1] **22B**

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1. Showing maximum estimated values (with padding added); for Australia 2022 = 7/2021-6/2022
2. Estimated 2022 cost per minute in the US – based on FAA/airlines reports

Source: Internal analysis based on FAA/BTS/EUROCONTROL data

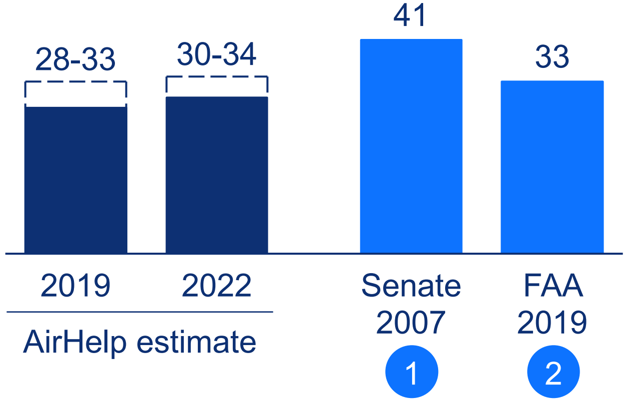
US cost estimates in line with existing reports; impact on Europe larger vs previous studies due to significantly higher traffic and disruption levels

AirHelp estimates & reference studies[1], USD B

Differences & rationale

USA

AirHelp estimates in line with existing reports given slight methodology differences and inflation impact



① Significantly higher value despite 25% lower traffic in 2008 vs 2022 due to much broader inclusion of schedule padding in the senate report

Senate report does not include cost of lost demand or cancellations, but uses broader assumptions on passenger value of time

② AirHelp-estimated cost to airlines above FAA due to included effect of padding; without padding the value is almost identical to FAA

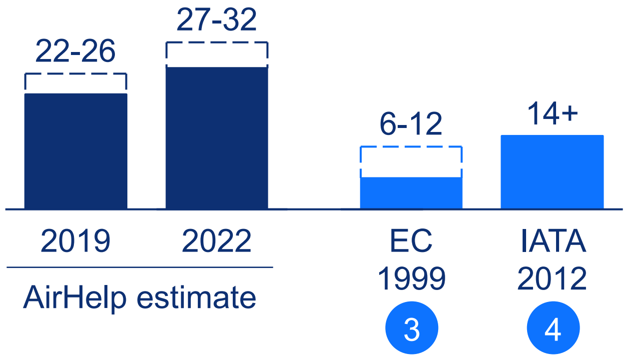
AirHelp estimates more conservative on pax value of time – only the value of delay time is calculated, no additional costs/adjustments made

FAA also adds cost of lost demand that AH does not quantify due to insufficient data points, but does not treat cancellation cost separately

Europe[2]

EUROCONTROL

AirHelp estimates higher, but reasonable given age of existing reports and different methodology used



③ 2022 pax numbers roughly 3x higher than in 1999; significant inflation and disruption levels increase since

The study only looked at airline and passenger time costs (spillover and cancellation costs not included)

④ AirHelp-estimated 2022 plane and passenger hours lost (delay volume) 2x higher than in 2012, but this is explained by 50%+ more pax in 2022 and significantly higher disruption levels observed

The study only looked at airline and passenger time costs (spillover and cancellation costs not included)

1. Australia not shown due to lack of comparable reports
2. Europe = 41 member states of EUROCONTROL

Agenda

- Methodology
- Regional deep dives
- **Sustainability**
- Appendix

Beyond direct financial costs to the economy, disrupted flights carry significant burden on the environment and human well-being

Sustainability considerations of flight disruptions

Aspect	**Emissions**	**Waste**	**Noise pollution**	**Public health**
Description	Incremental CO2 and other greenhouse gas emissions resulting from longer flying and taxiing time of delayed airplanes, but also additional services used (taxi, hotels, etc.)	Cancelled and delayed flights requiring additional hotel nights, meals, transportation and related services, thus contributing to waste production and misuse of resources	Additional flying and taxiing time contributing to the problem of noise pollution, especially in densely populated areas (delayed flight landing after curfew)	Negative implications on passenger physical and mental health resulting from stress, extended travel, loss of productivity, missed plans, incurred costs, etc.
Impact	Equal to up to 1.3% of total aviation industry footprint[1] Deep dive next	Up to ~90K tons of waste per year resulting from hotel stays and meals for pax affected by cancellation	Affected cities include Sydney, Warsaw, London, Zurich and many more[2]	

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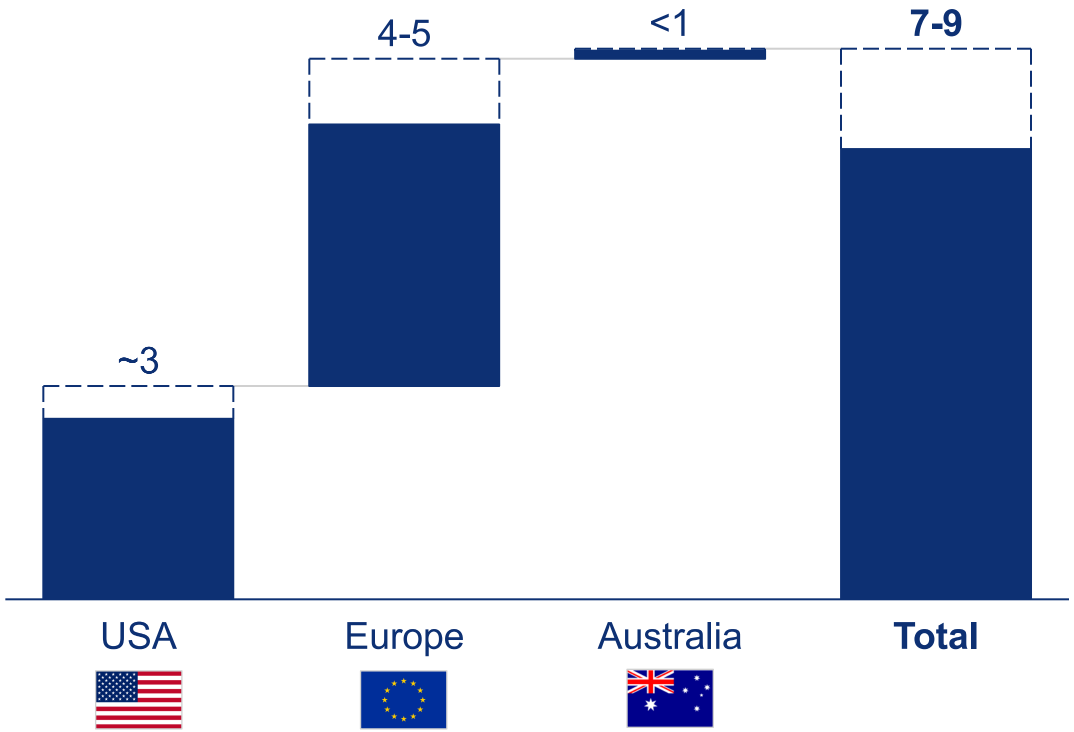
1. Estimated emissions for US, Europe and Australia in 2022 compared to total 2022 emissions estimate based on IATA data
2. Cities hosting airports with strict curfew policies; flight experiencing airborne delay will typically be allowed to land after curfew

Source: Press releases, Expert insights

Flight delays in the analyzed markets generated up to additional ~9M tons of CO2 emissions, more than 1% of total airline industry footprint in 2022

Scenario ■ Min ⬚ Max

CO2 emissions from delays[1], 2022, M tons



Equal to…

Up to 1.3%
of total aviation CO$_2$ footprint in 2022[2]

~3K wind turbines
emissions avoided when running them for a year

~2M cars
annual emissions of passenger vehicles[3]

300-350M trees
required to offset the incremental emissions

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1. Emissions resulting from longer flying time and extended taxiing pre/post flight; incremental emissions from taxis, hotels and other passenger facilities used during delay not included
2. Estimated at 700M+ tons of CO2 emissions in 2022 according to IATA data
3. Average passenger vehicle emissions estimated at 4.6 tons of CO2/year

Source: IATA, EPA, Eurostat, Press search

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Estimated impact of delayed and cancelled flights on the economies of the US, Europe and Australia at USD 58-68B in 2022

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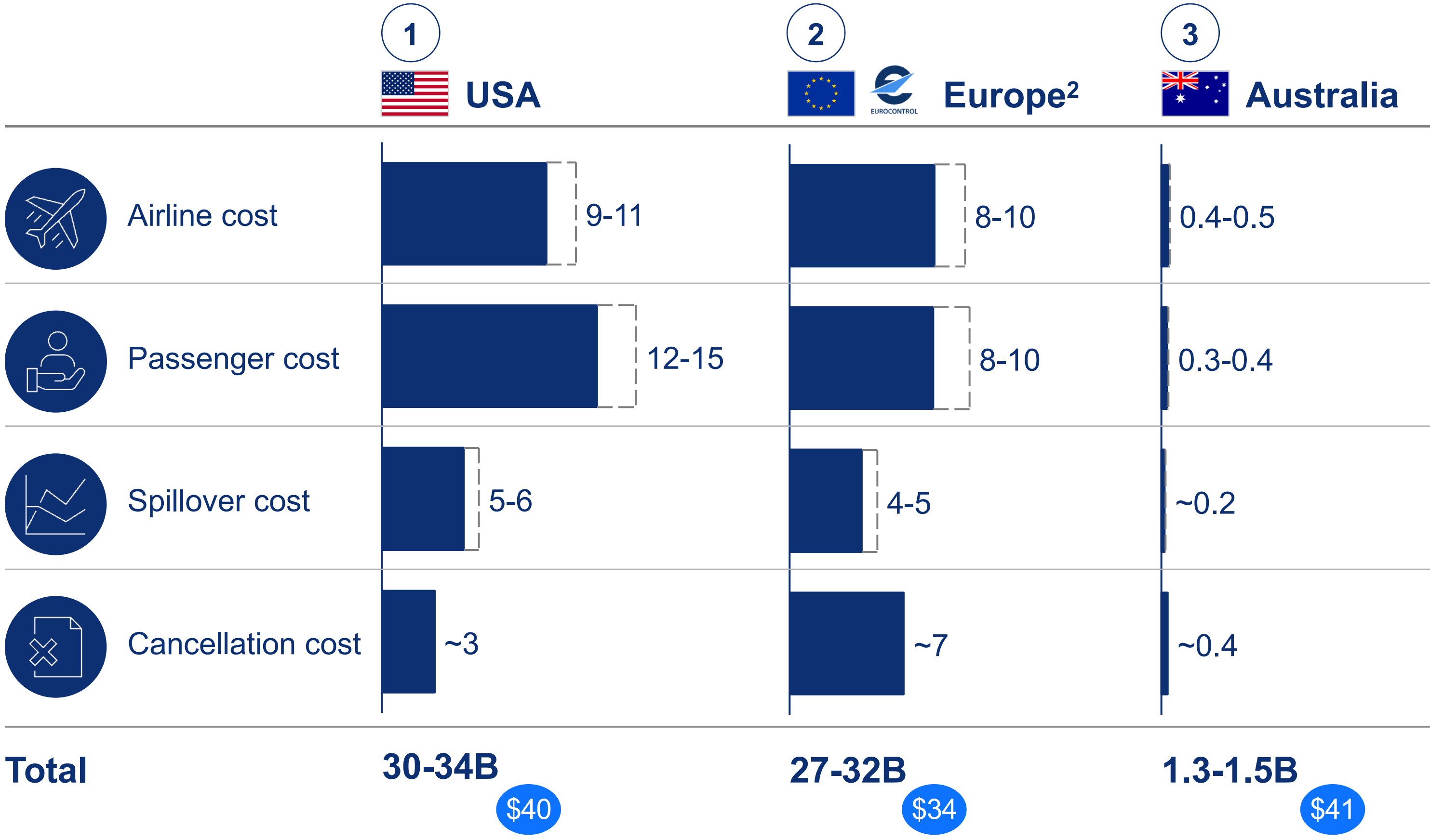

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Spillover cost	5-6	4-5	~0.2	Spillover effect of flight delays on other sectors of the economy, e.g., food service, hospitality, retail
Cancellation cost	~3	~7	~0.4	Cost of hotels and other arrangements for impacted passengers, lost cargo revenue & fuel savings resulting from cancellations
Total	**30-34B** $40	**27-32B** $34	**1.3-1.5B** $41	

While in Europe 100% of cost of post-cancellation arrangements (hotels, meals, rebooking) can be attributed to airlines, in markets with less passenger protection such as the US a proportion of the estimated costs will be carried by the passengers themselves (e.g, paying for a hotel)

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Source: internal analysis based on FAA, DoT, EUROCONTROL, BITRE data, industry reports, press releases

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