

Reducing Air Travel's Carbon Footprint

Modeling flight efficiency reveals new opportunities for travelers

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Complete paper (Air Travel Carbon and Energy Efficiency) available from <http://brighterplanet.com/research>

Introduction

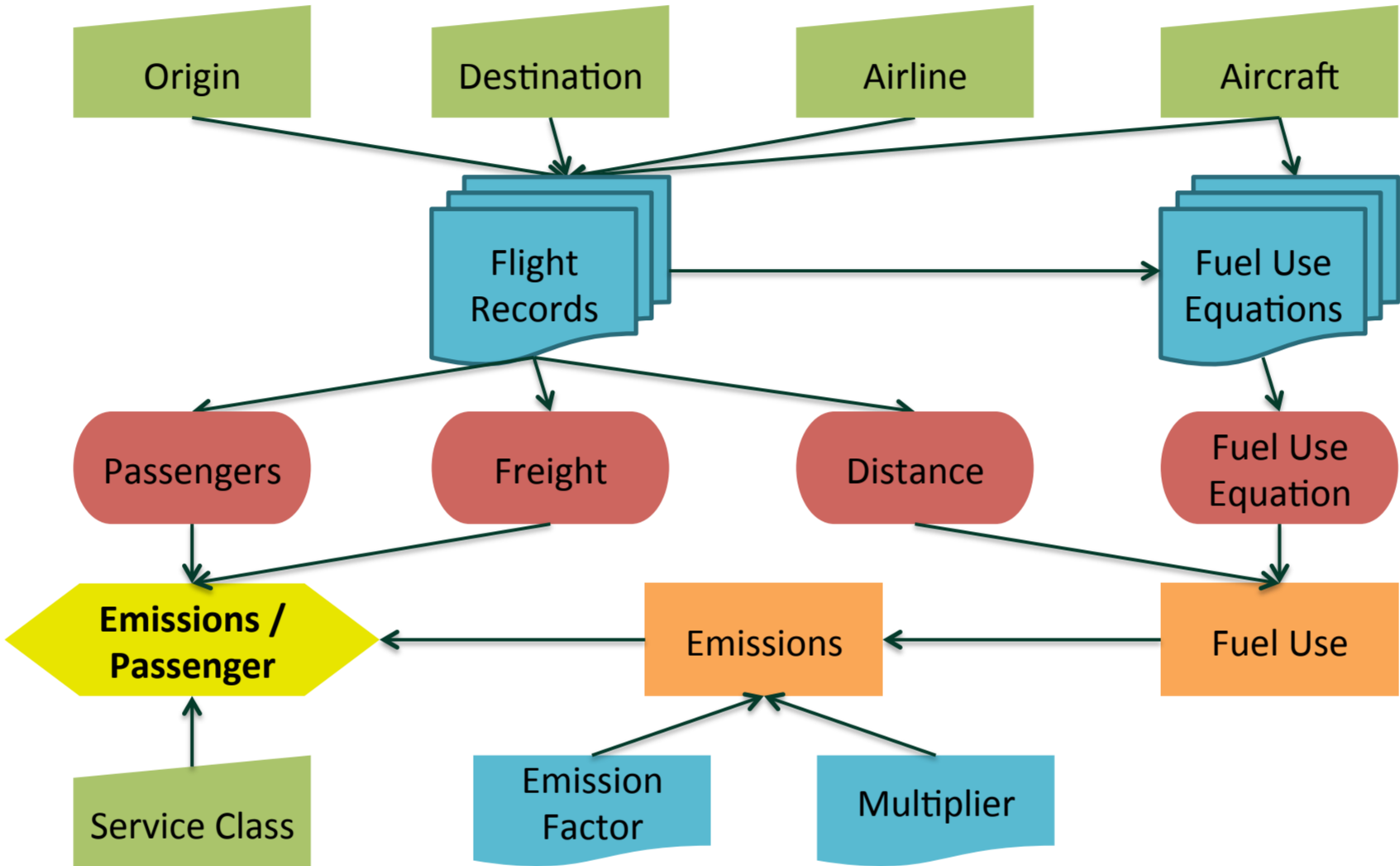
Air travel accounts for 3% to 5% of total anthropogenic climate impact, and it's a rapidly-growing emissions source. Travel volume is expected to increase by more than 4% per year through 2025 (ICAO 2010), outpacing aircraft fuel efficiency increases of just 1% to 1.5% per year (IATA 2009, Owen et al. 2010).

Reducing the growth in demand is a key objective for tackling air travel's climate impact. To date the main tactic used has been consumer education – making people aware of the impact of air travel and promoting alternatives like teleconferencing, other modes of transport, or vacationing closer to home. This is good advice, but even travelers who heed it often continue to fly.

Our goal was to help companies and individual travelers reduce the impact of their remaining 'unavoidable' air travel. To do this we created a model that allows emissions comparisons between alternate flights serving the same route.

International Air Transport Association (IATA). A global approach to reducing aviation emissions. IATA: Switzerland, 2009.
International Civil Aviation Organization (ICAO). ICAO Environmental Report 2010. ICAO: Montreal, Canada, 2010.
Owen, B., D.S. Lee, and L. Lim. Flying into the future: aviation emissions scenarios to 2050. *Environ. Sci. Technol.*, 2010, 44, 2255-2260

Model Outline



Model Description

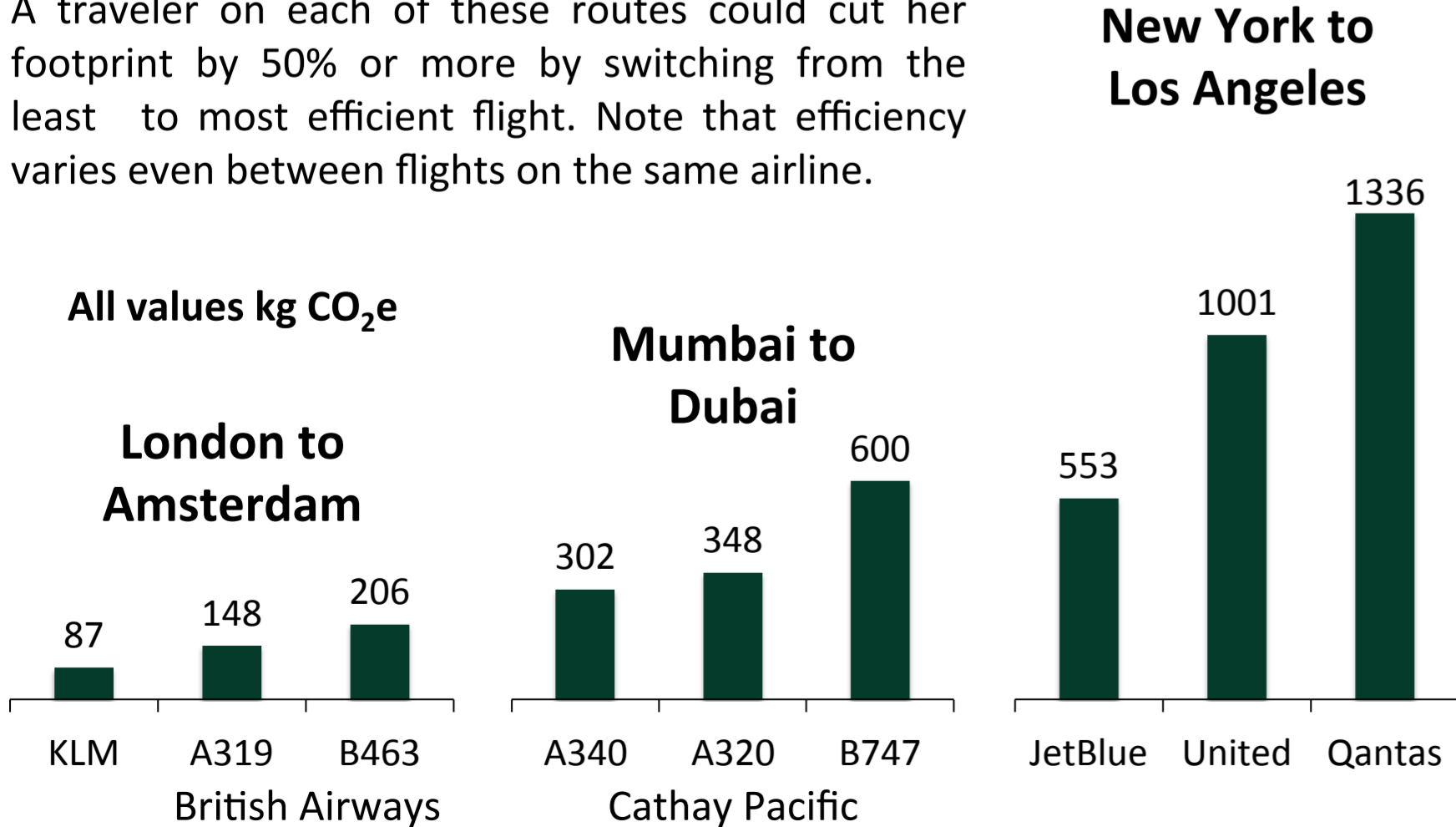
Our model assumes most users will only be able to provide the origin, destination, and possibly airline and aircraft for a flight. We match these inputs to historical flight records in a database covering almost 37 million flights worldwide in 2009, 2010, and 2011, taken from the U.S. BTS T-100 and ICAO Traffic by Flight Stage datasets. We then average across the matching records to estimate the number of passengers, quantity of freight, distance, and aircraft model-specific third-order polynomial fuel use equation for the modeled flight.

We calculate fuel use from distance and the fuel use equation and multiply by an emission factor and a multiplier to account for the climate impact of high-altitude emissions to give total greenhouse gas emissions. We distribute emissions between passengers and freight based on weight, then divide emissions among passengers by service class based on the average size of each service class' seats.

Further details and the model source code are available at <http://impact.brighterplanet.com/models/flight>

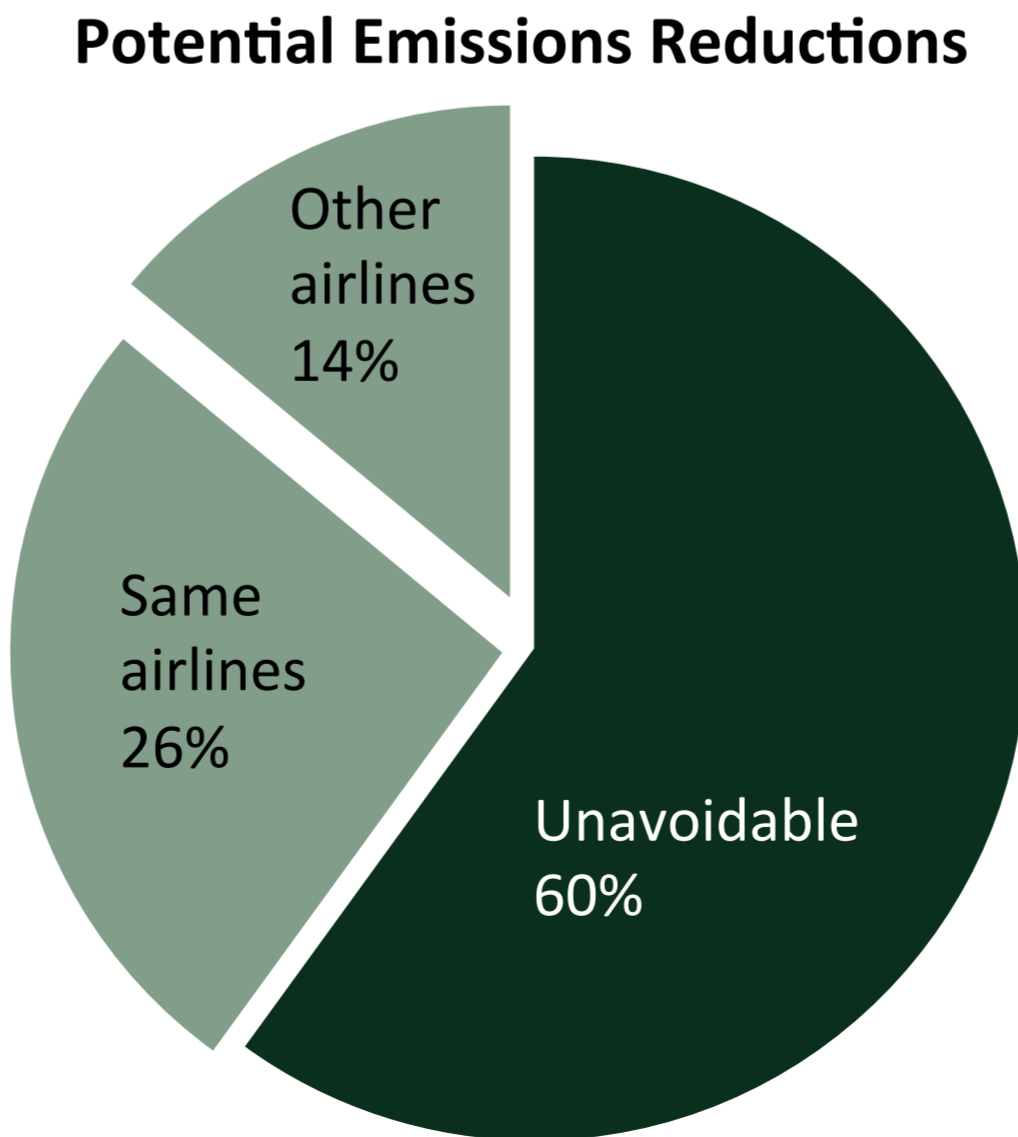
Typical Variation in Flight Efficiency

These examples illustrate typical opportunities for emissions savings from considering flight efficiency. A traveler on each of these routes could cut her footprint by 50% or more by switching from the least to most efficient flight. Note that efficiency varies even between flights on the same airline.



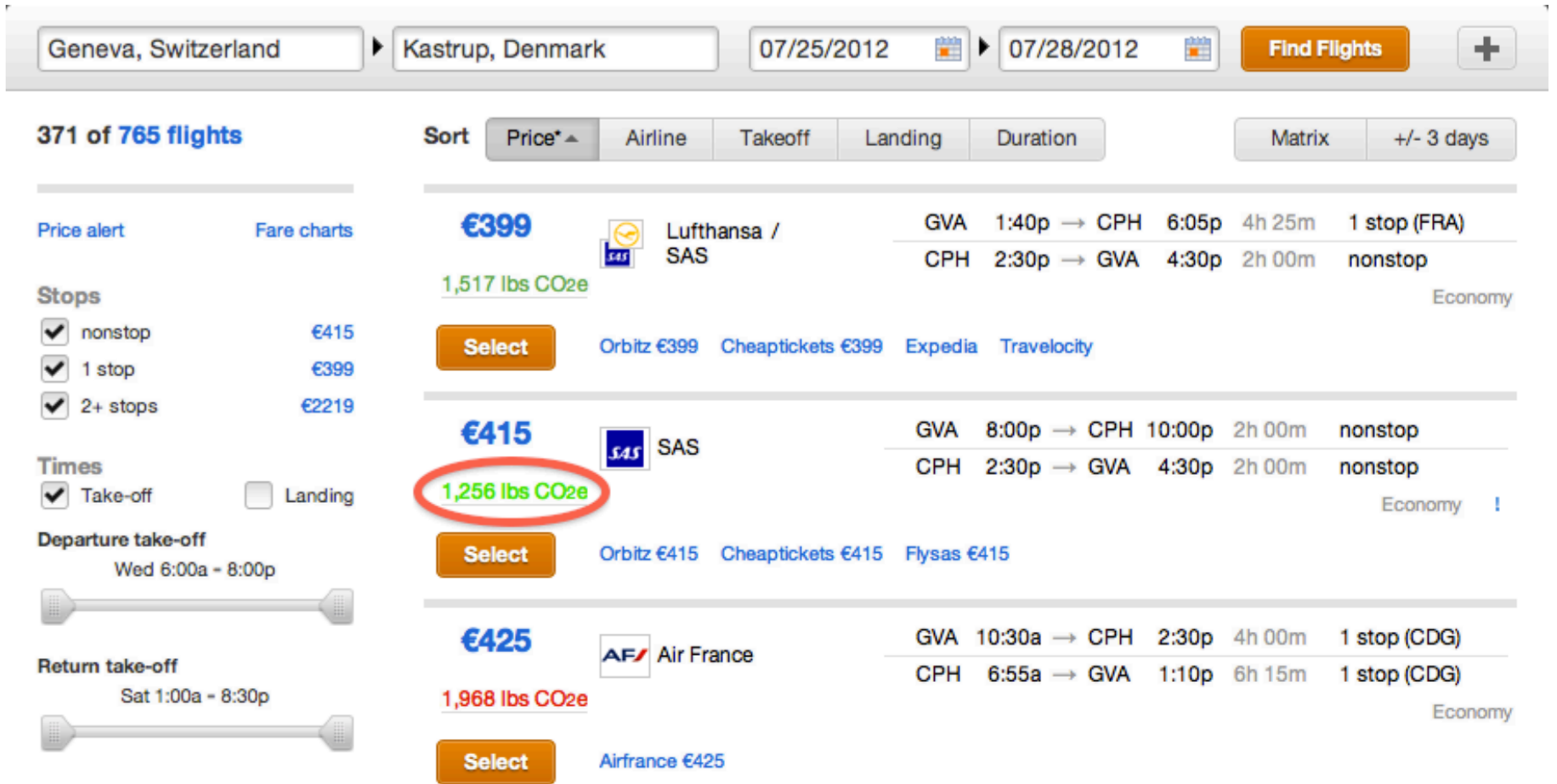
Case Study: A Fortune 500 Company

We used the model to analyse emissions reduction possibilities on the 100 most-flown routes of a Fortune 500 company, representing 187,000 flights each year. The company could reduce emissions up to 40% by always choosing the most efficient flights offered – the equivalent of cutting 74,000 flights. They could reduce emissions by a quarter while still flying on the same airline for each route, obviating the need to renegotiate any airline contracts.

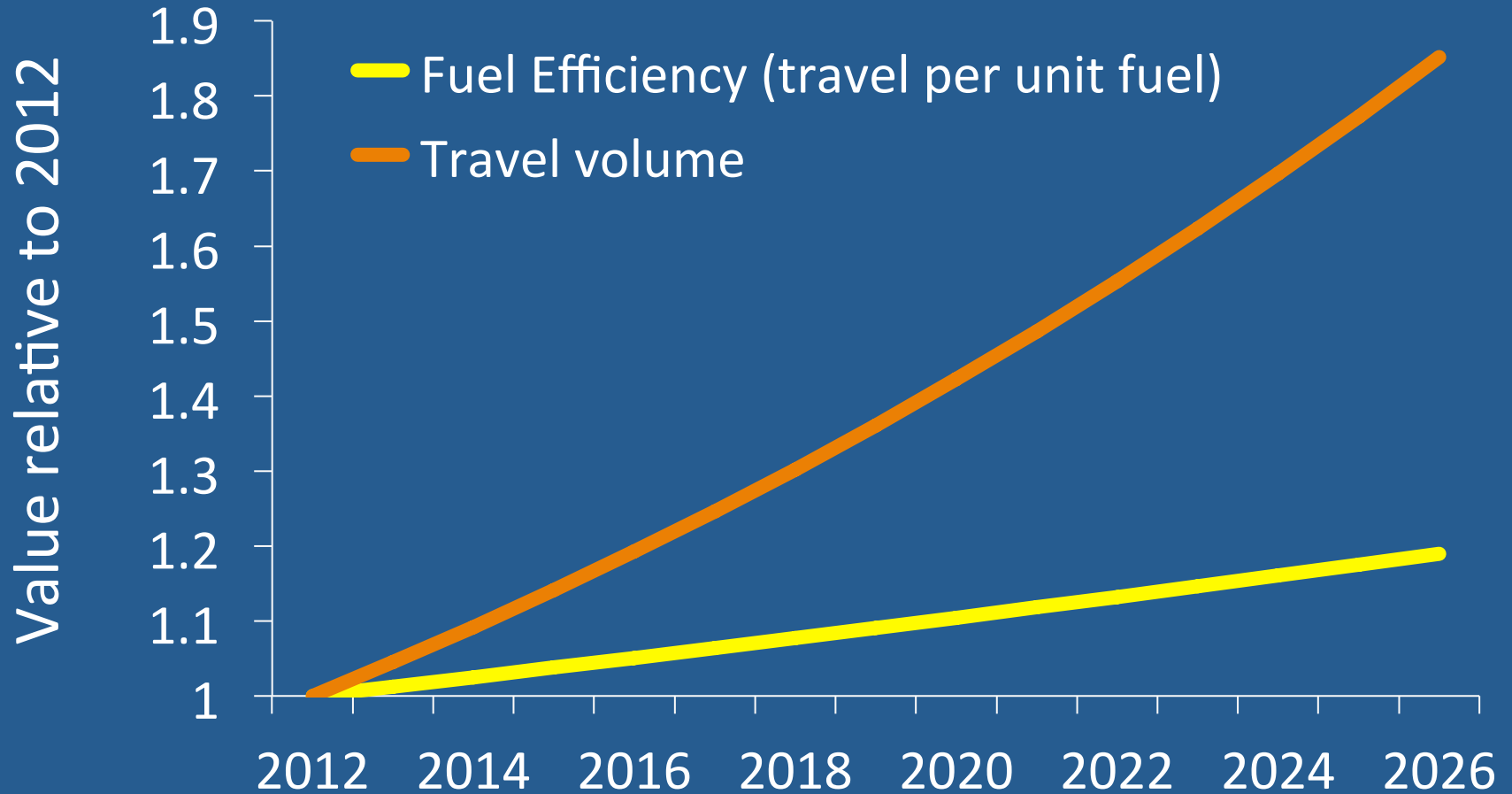


Example Application: Careplane

Careplane (<http://careplane.org>) is a browser plugin that uses the flight model to add emissions to online flight search tools, allowing a traveler to consider climate impact when choosing an itinerary. Shown here is an example on kayak.com.



Air travel: a growing problem



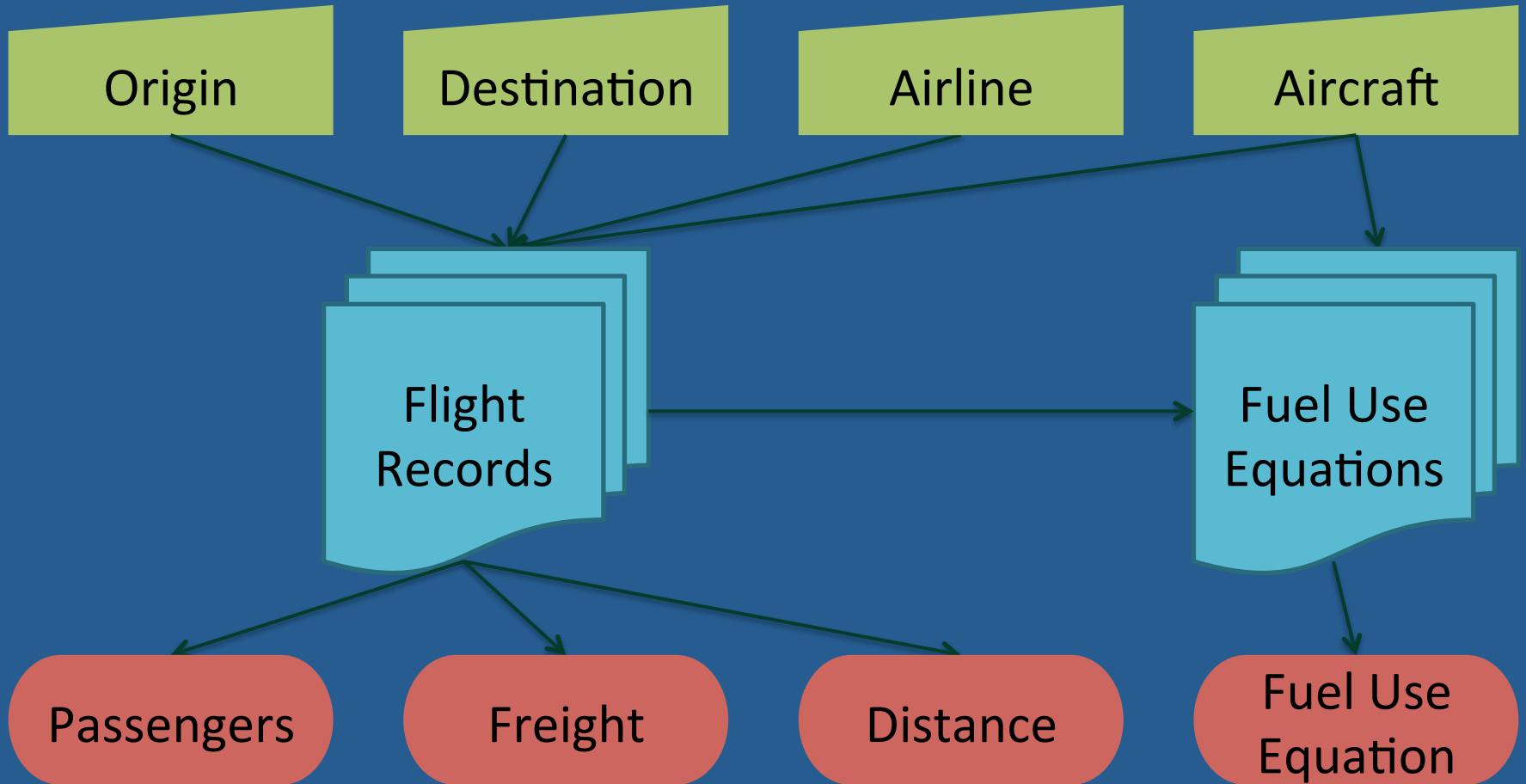
How can we reduce emissions?

Ask people not to fly!

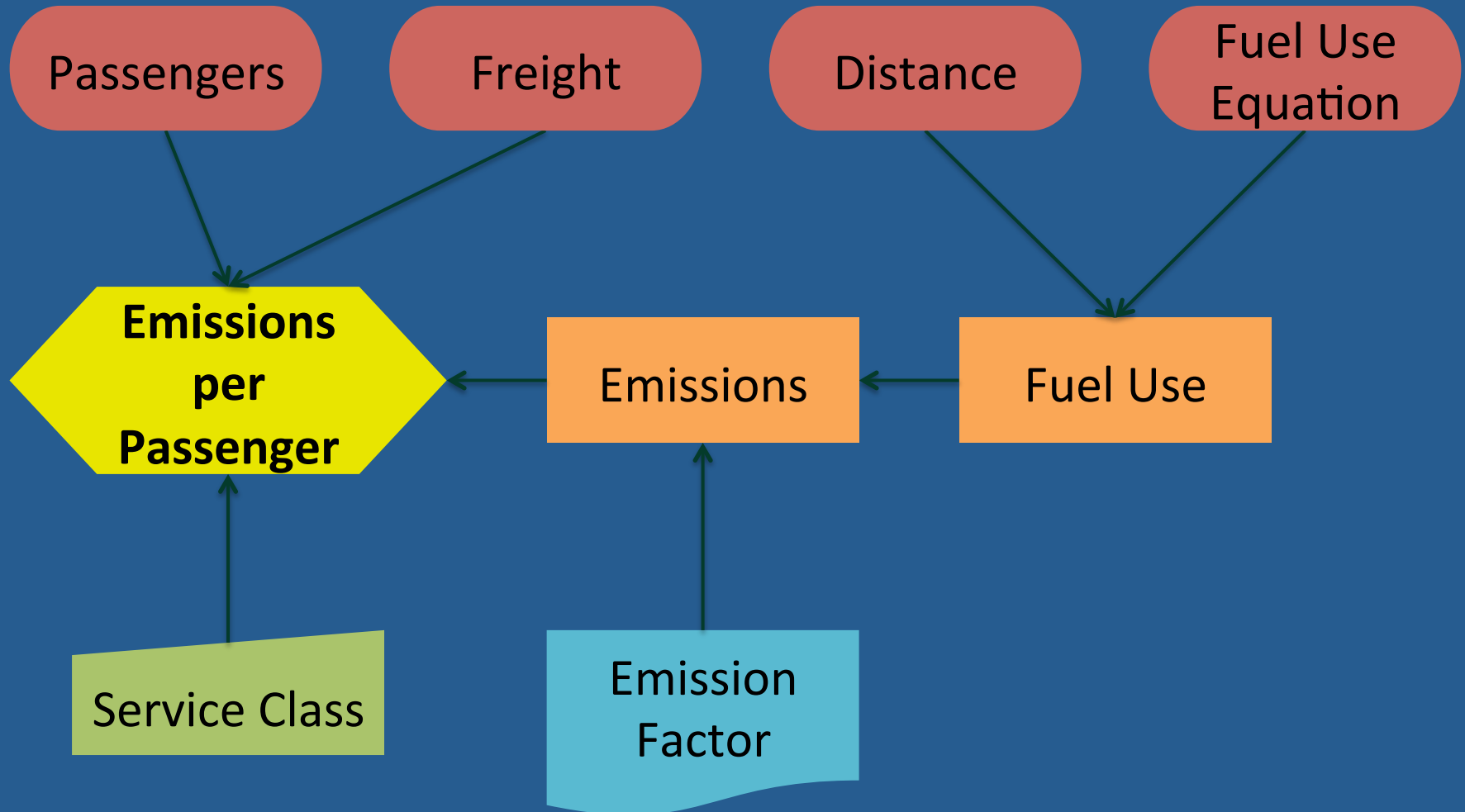
But many will anyway.

**Could travelers choose
cleaner flights?**

Our model: inputs & averaging



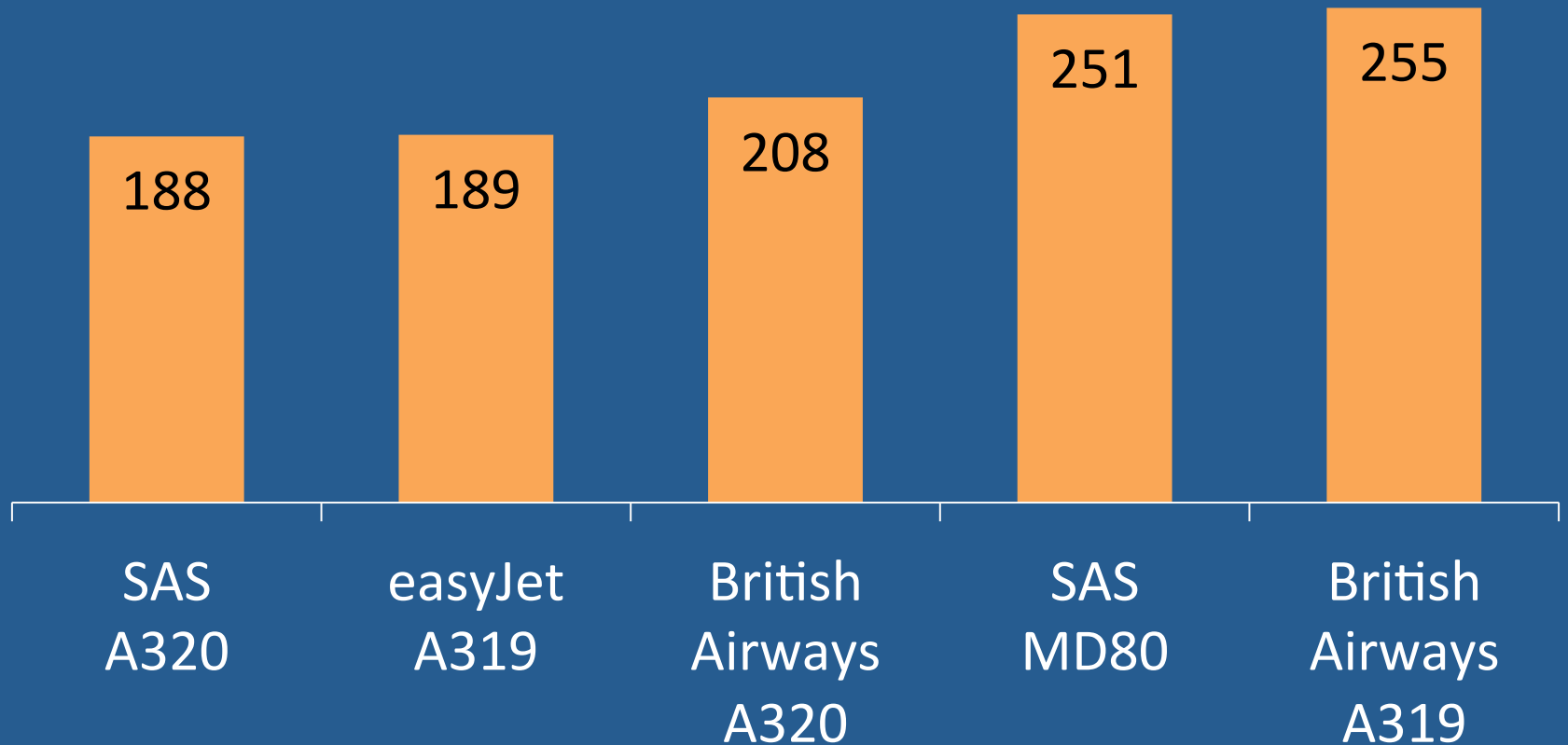
Our model: emissions calculation



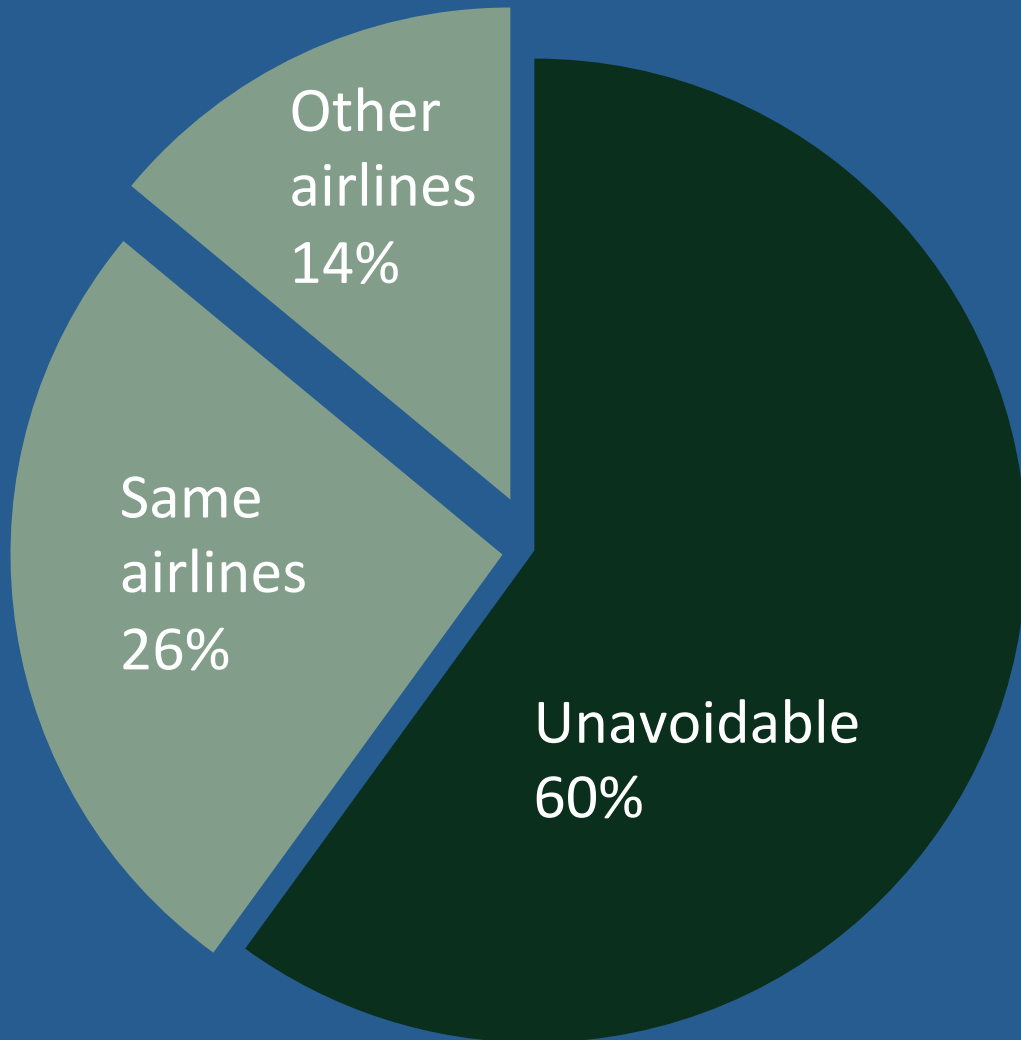
Flights vary in efficiency.

London - Copenhagen

kg CO₂e per passenger



A Fortune 500 company



Top 100 routes

40% potential savings

Application: careplane.org

The screenshot shows the Kayak website interface for flight searches. At the top, the Kayak logo is displayed in orange blocks, followed by navigation tabs for Flights, Hotels, Cars, Deals, and More. The search bar is set for Geneva, Switzerland to Kastrup, Denmark, with dates 07/25/2012 to 07/28/2012. A 'Find Flights' button is visible. Below the search bar, the results are sorted by Price* (ascending). The first result is a Lufthansa / SAS flight for €399 with 1,517 lbs CO2e. The second result is a SAS flight for €415 with 1,256 lbs CO2e, which is circled in red. The third result is an Air France flight for €425 with 1,968 lbs CO2e. On the left side, there are filters for Stops (nonstop, 1 stop, 2+ stops) and Times (Take-off, Landing). The flight details for each result include the price, airline logo, flight segments, duration, and stop information.

KAYAK Flights Hotels Cars Deals More

Geneva, Switzerland ▶ Kastrup, Denmark 07/25/2012 ▶ 07/28/2012 Find Flights +

371 of 765 flights

Sort Price* ▲ Airline Takeoff Landing Duration Matrix +/- 3 days

Price alert Fare charts

Stops

- nonstop €415
- 1 stop €399
- 2+ stops €2219

Times

- Take-off Landing

Departure take-off

Wed 6:00a - 8:00p

Return take-off

Sat 1:00a - 8:30p

€399 Lufthansa / SAS
1,517 lbs CO2e

Select Orbitz €399 Cheaptickets €399 Expedia Travelocity

GVA 1:40p → CPH 6:05p 4h 25m 1 stop (FRA)
CPH 2:30p → GVA 4:30p 2h 00m nonstop
Economy

€415 SAS
1,256 lbs CO2e

Select Orbitz €415 Cheaptickets €415 Flysas €415

GVA 8:00p → CPH 10:00p 2h 00m nonstop
CPH 2:30p → GVA 4:30p 2h 00m nonstop
Economy

€425 Air France
1,968 lbs CO2e

Select Airfrance €425

GVA 10:30a → CPH 2:30p 4h 00m 1 stop (CDG)
CPH 6:55a → GVA 1:10p 6h 15m 1 stop (CDG)
Economy

For more information...

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Model details & source code:

<http://impact.brighterplanet.com/models/flight>

Paper on Air Travel Carbon and Energy Efficiency:

<http://brighterplanet.com/research>

Careplane browser plugin

<http://careplane.org>