

**Unlocking greater near-term efficiency, while transitioning to the next generation of planes
“There is no quick fix”**

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Unlocking greater near-term efficiency, while transitioning to the next generation of planes

“There is no quick fix”



Joris Melkert
Faculty of Aerospace Engineering

Spot the differences



1967



1987



2017

Content

- Snowball effect in aviation
- Developments so far
- Electric aircraft
- Alternative fuels
- New configurations
- Conclusion

Snowball effect in aviation

1 kg more mass

-> 1 kg more lift required

lift is not for free -> more aerodynamic drag

more drag -> more thrust

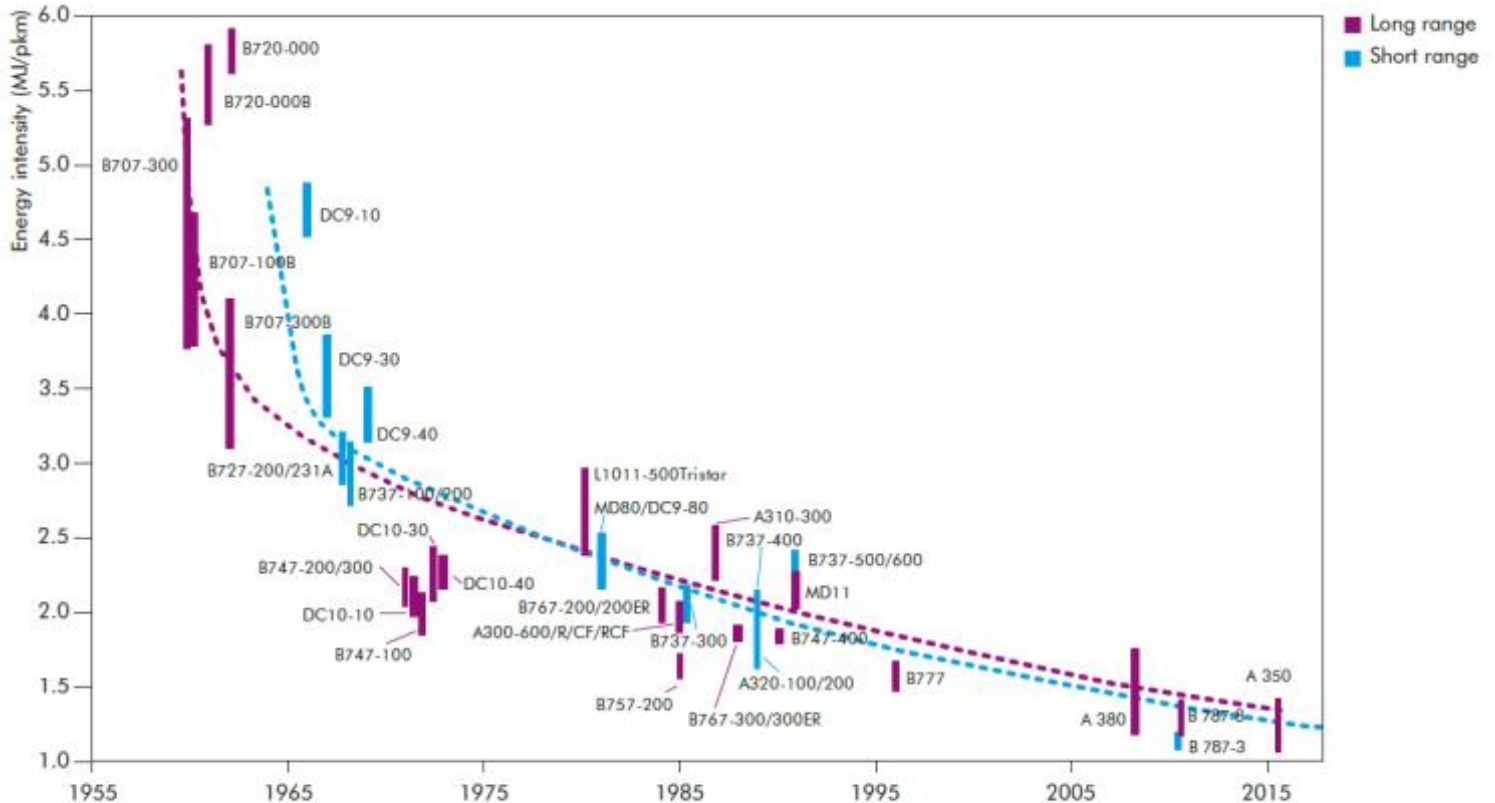
more thrust -> bigger engines

-> more fuel

-> more mass



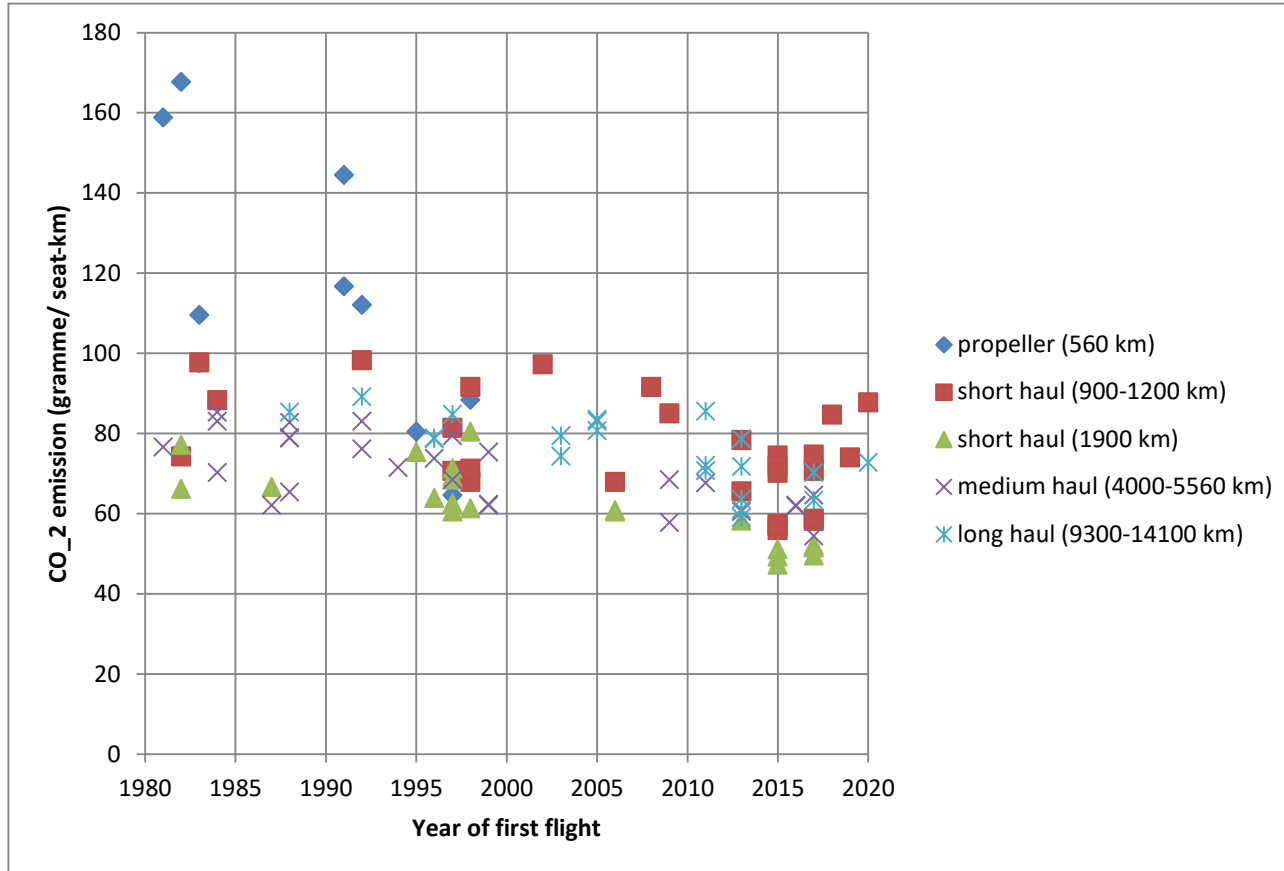
Developments so far – fuel consumption



Note: The range of points for each aircraft reflects varying configurations; connected dots show estimated trends for short-and long-range aircrafts.

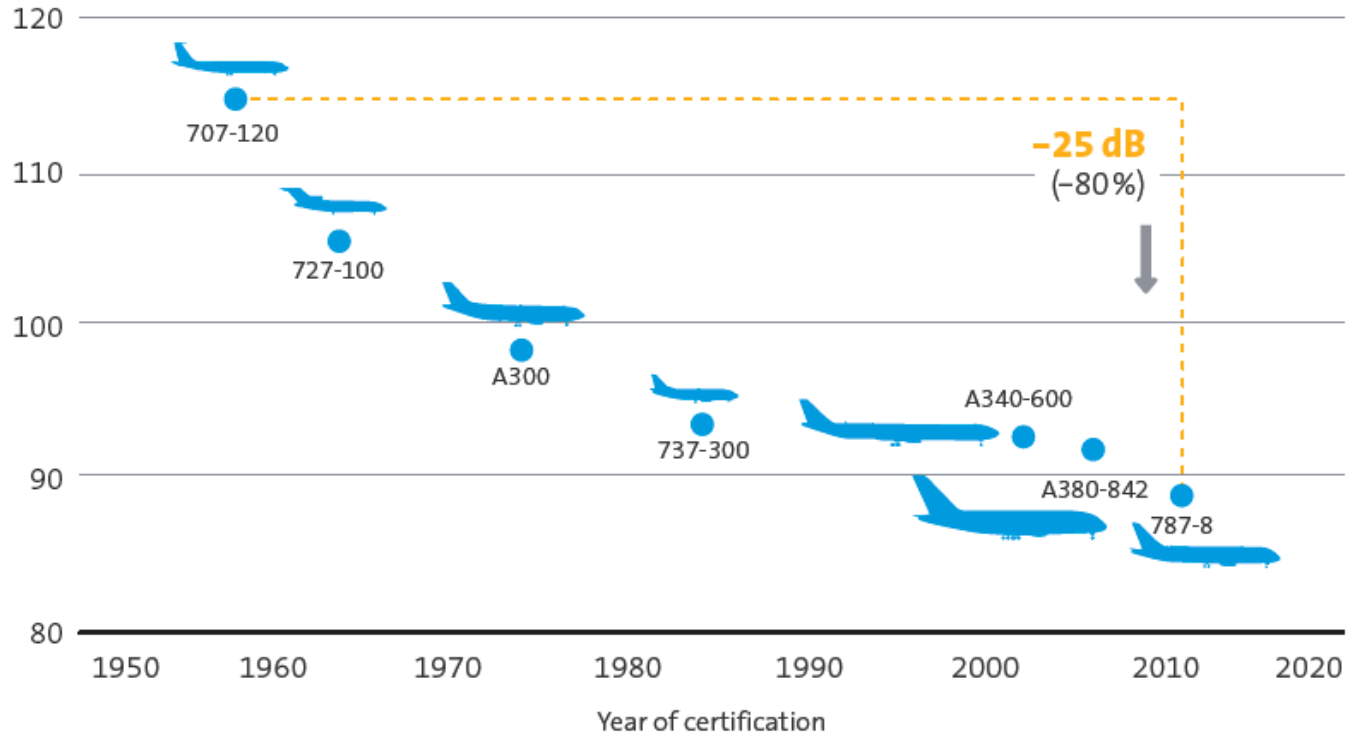
Sources: Lee, et al., 2001 IEA updates.

Developments so far – fuel consumption



Developments so far - noise

Lateral noise level standardised
to 500 kN in EPNdB



Developments so far - manufacturers

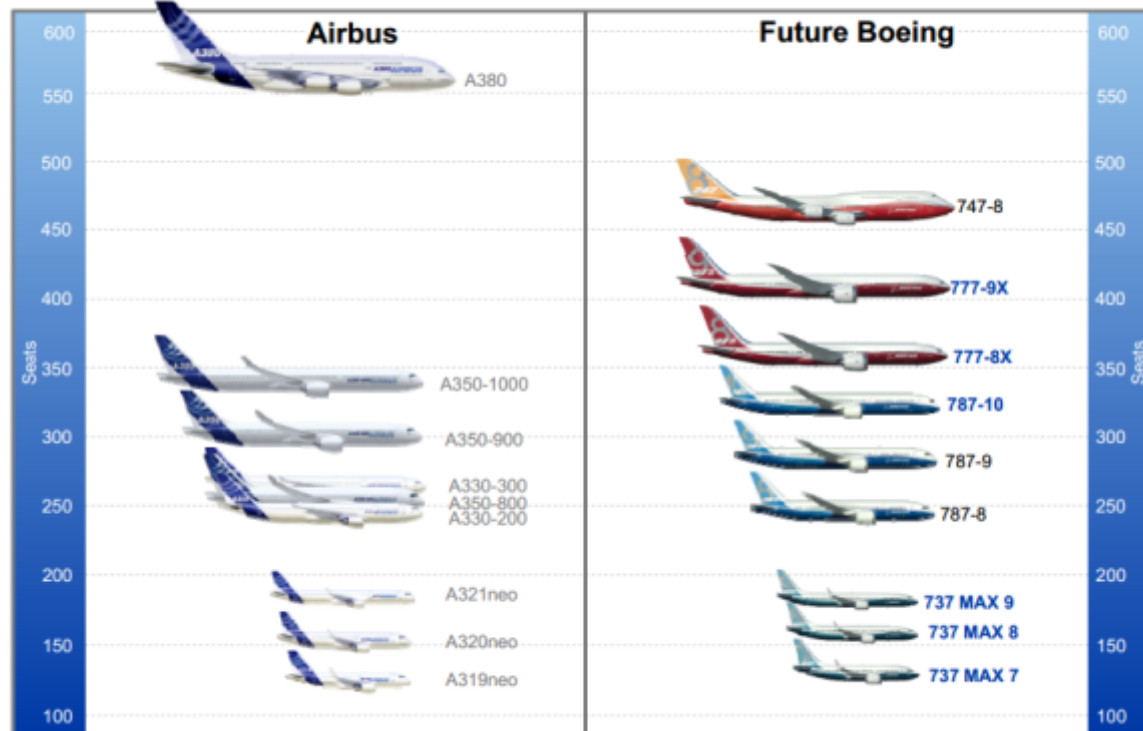
Competitive widebody positioning



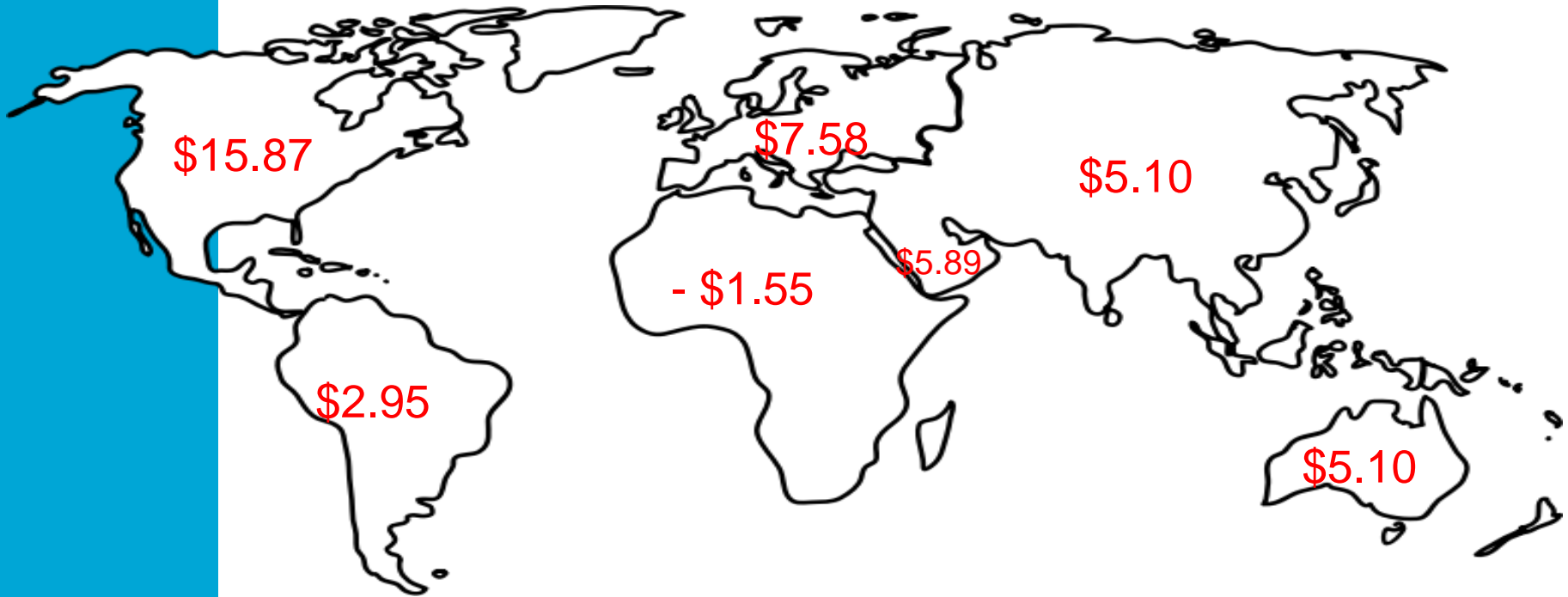
Developments so far - manufacturers

Boeing product line-up vs. the competition

Superior value, efficient market coverage



Developments so far - airlines



Net profit per ticket

Electric Aircraft



Electric Aircraft



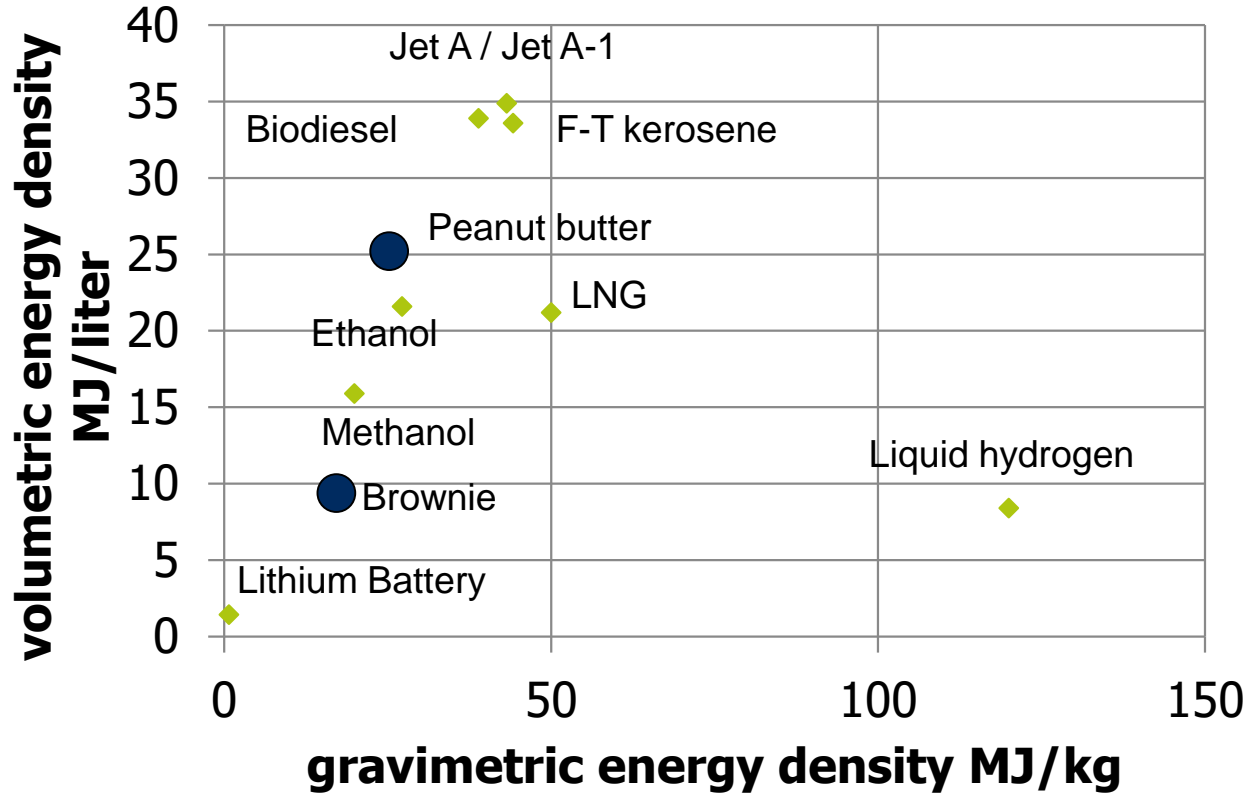
Electric Aircraft



Electric Aircraft



Electric Aircraft



Electric Aircraft

Electric flight will be there!

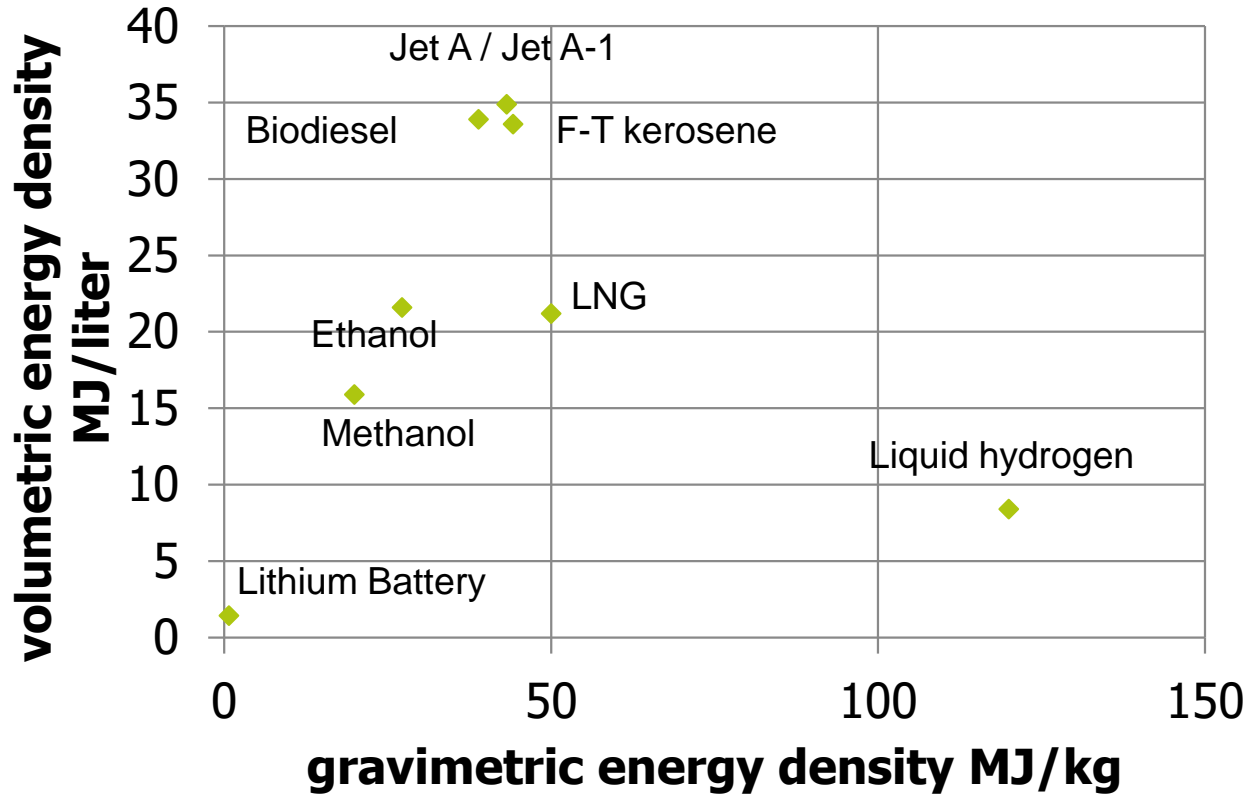
However:

- It will not be the next generation aircraft
- It will come via two routes
 1. General aviation
 2. Hybrid passenger aircraft

Alternative fuels



Alternative fuels



Alternative fuels



Area-averaged probe

Measurement of ICAO LTO emissions by DLR

Direct particle size and number

- Cessna Citation II - P&W JT15Ds
- GTL 0-50% in two base fuels (ground tests)
- GTL 0-90% in flight tests

Alternative fuels



Alternative fuels

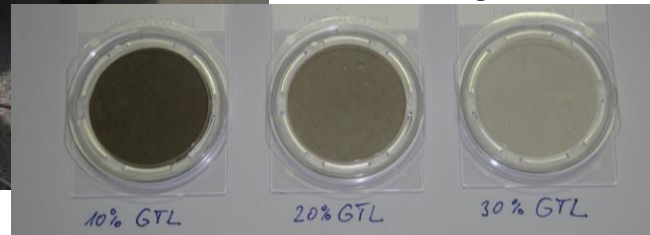


- Cessna Citation II - P&W JT15Ds
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Area-averaged probe

Measurement of ICAO LTO emissions by DLR

Direct particle size and number



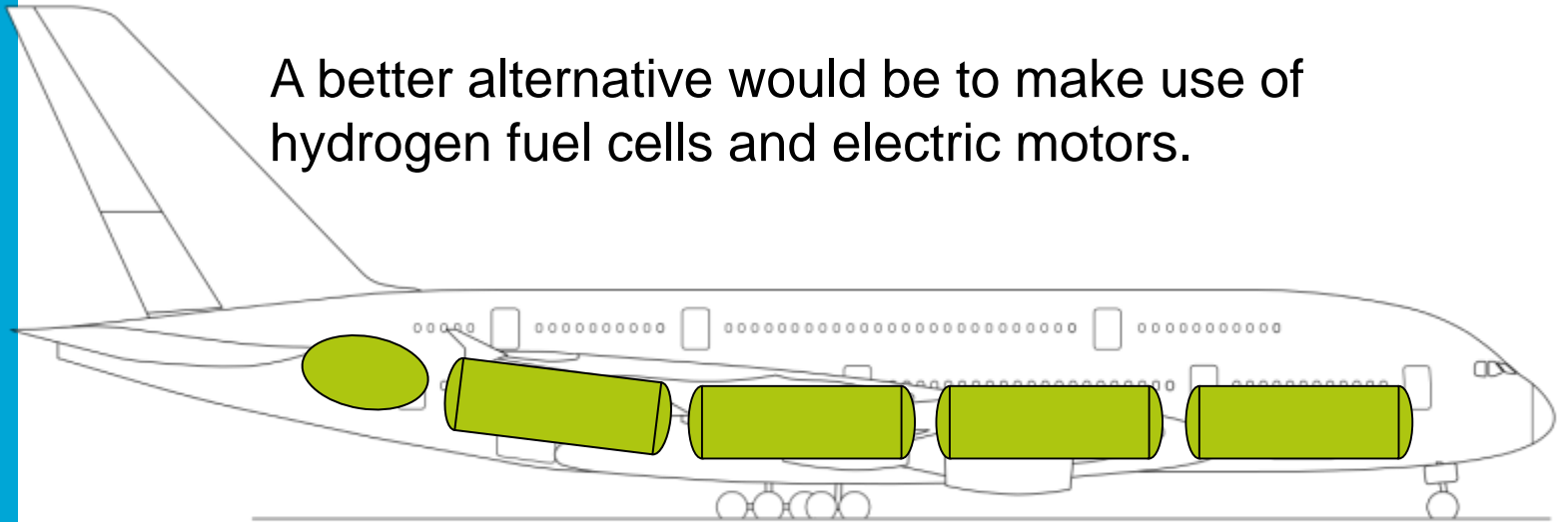
Soot filters in undiluted flow

Alternative fuels

Is hydrogen an option?

Yes, you can use hydrogen in jet engines.
But you will need some modifications.

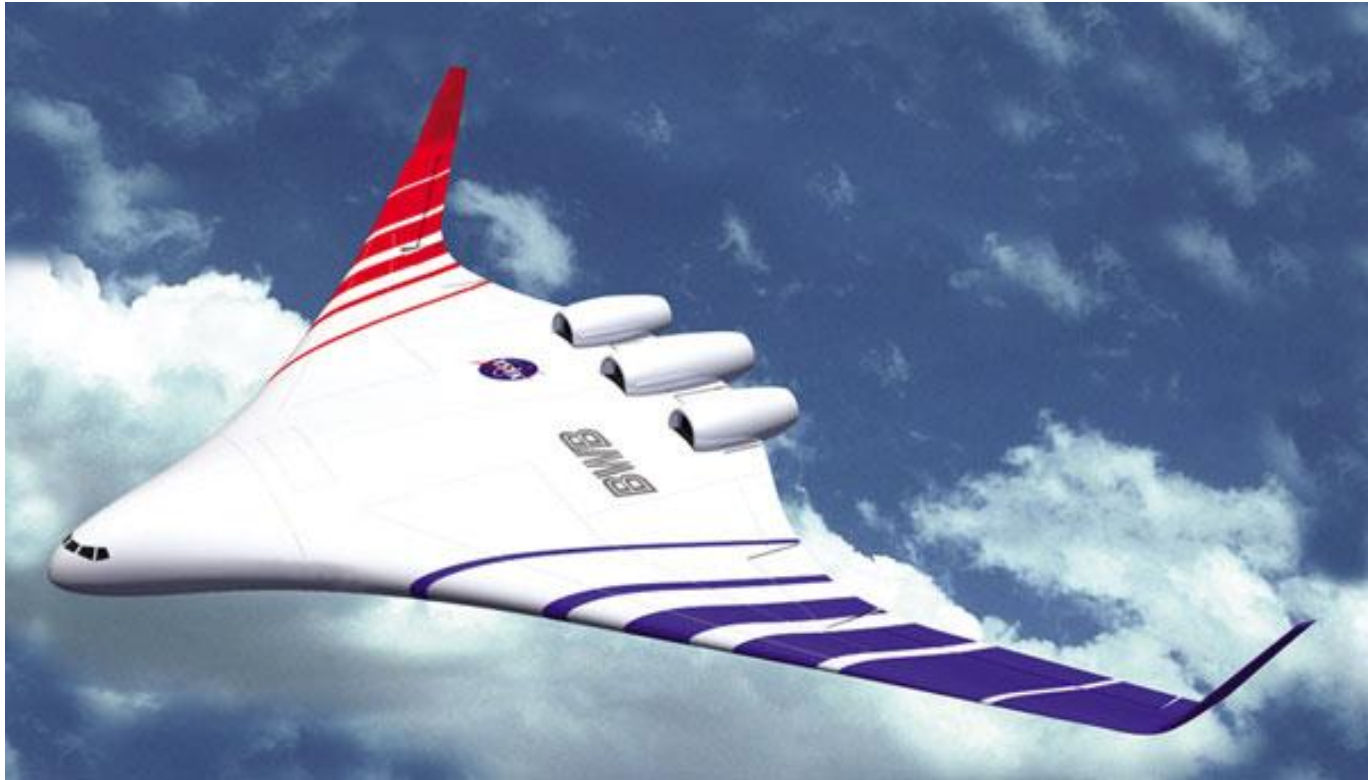
A better alternative would be to make use of
hydrogen fuel cells and electric motors.



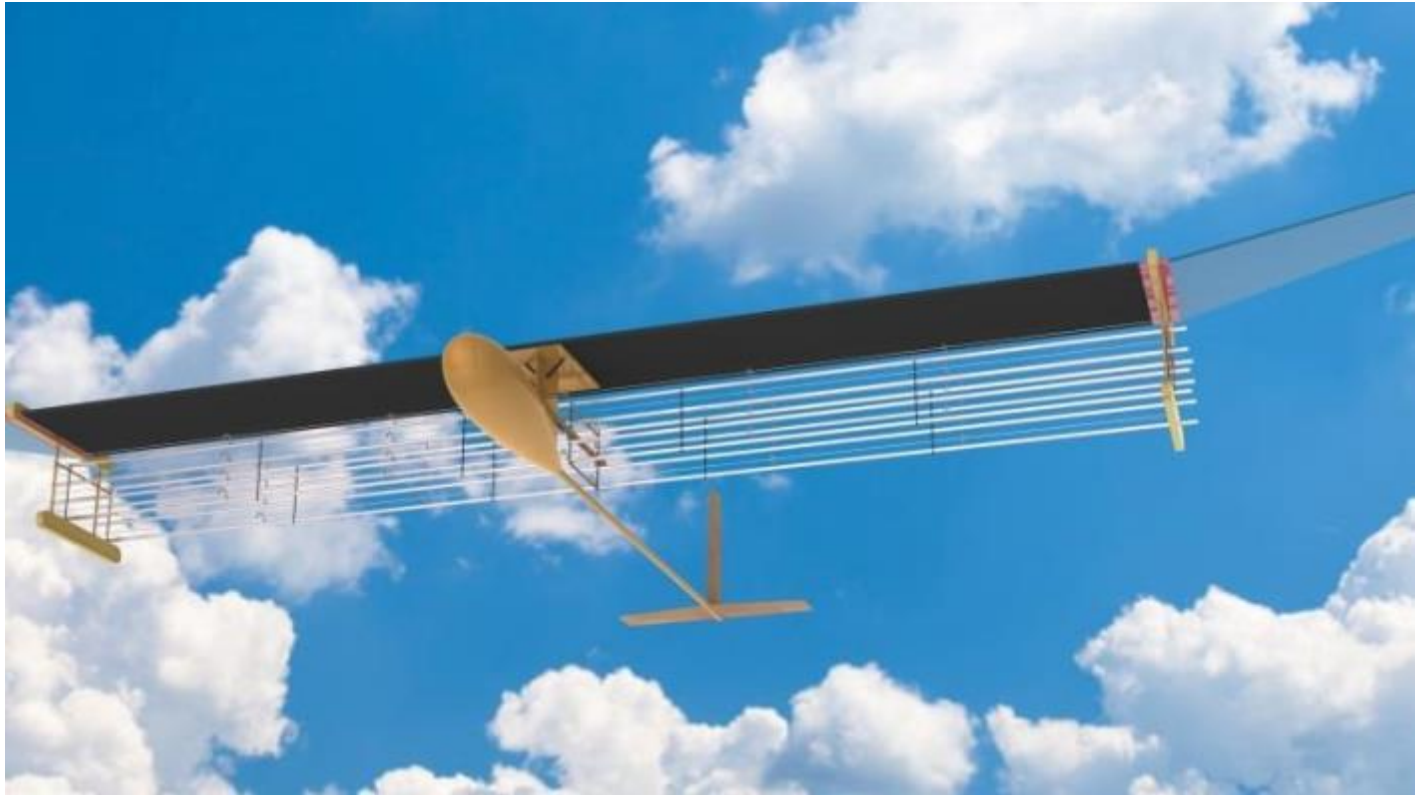
New configurations



New configurations



New configurations



New configurations



New configurations



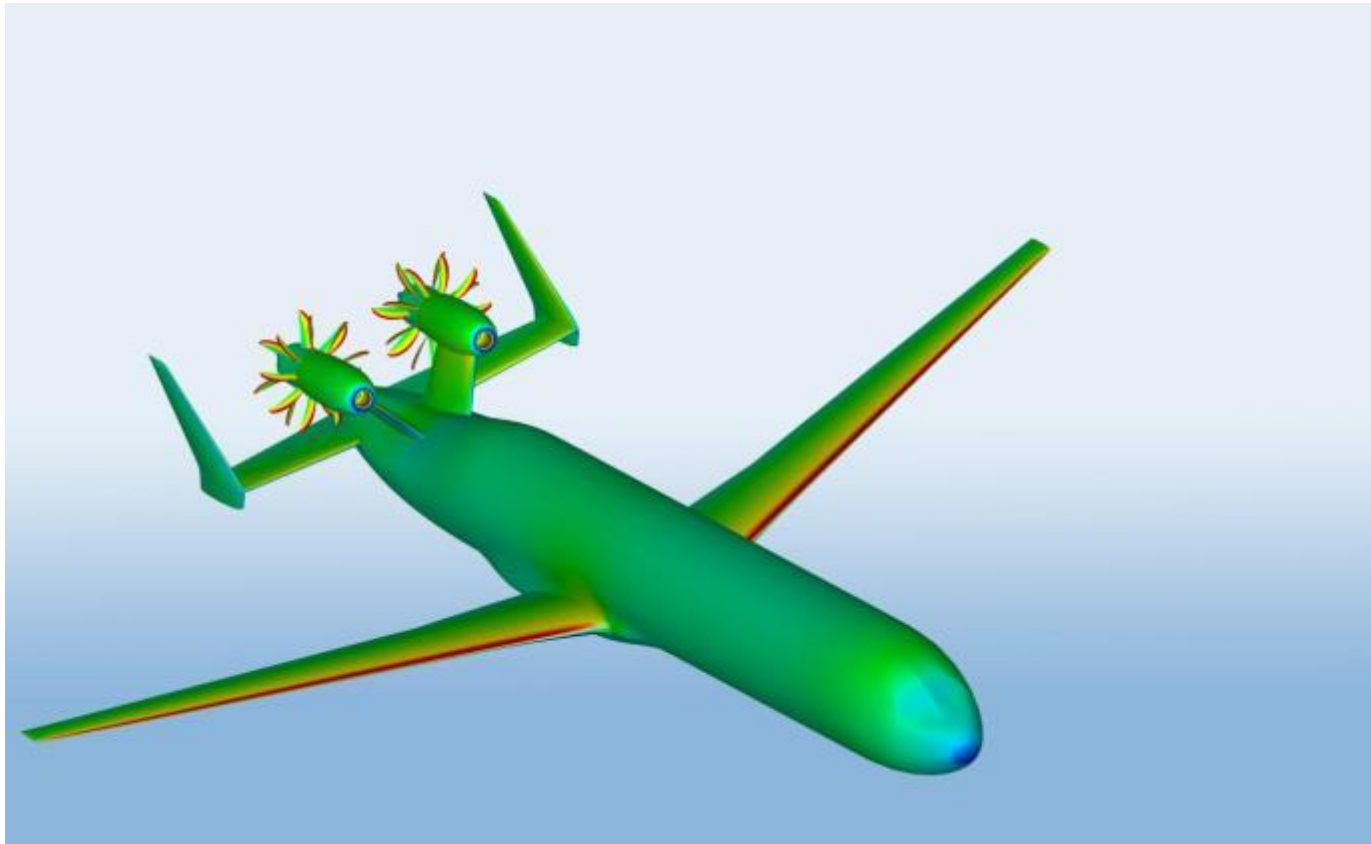
New configurations



New configurations



New configurations



New configurations



New configurations – quick fixes



New configurations – quick fixes



New configurations – quick fixes



New configurations – quick fixes



New configurations – quick fixes



New configurations – quick fixes



Conclusions

There is no quick fix

We need more research and development

+

We replace old aircraft sooner (fleet renewal)

+

We need to look into alternative “drop-in” fuels

+

We need better procedures (climate optimized routing)

+

We need to compensate (CORSIA and beyond)

+

We need stronger incentives (legislation + societal pressure)

+

We need to limit the growth, preferably reduce soon

