

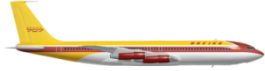


# Aviation's Active Commitment to Sustainable Alternative Fuels

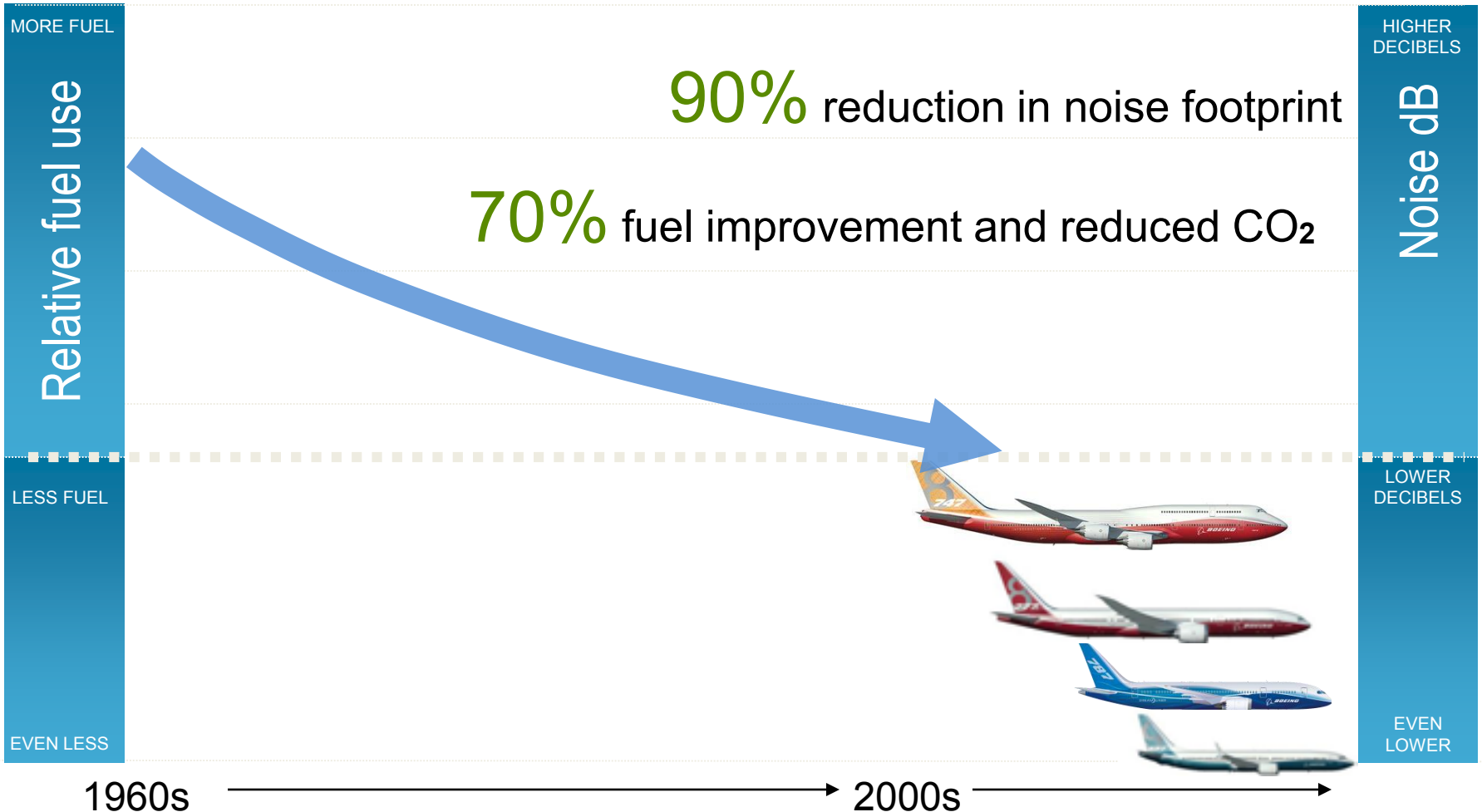
July 11, 2017

Michael Lakeman, Ph.D.  
Director, Biofuel Technology Strategy  
The Boeing Company

# A track record of success ... Cleaner and quieter with each new model



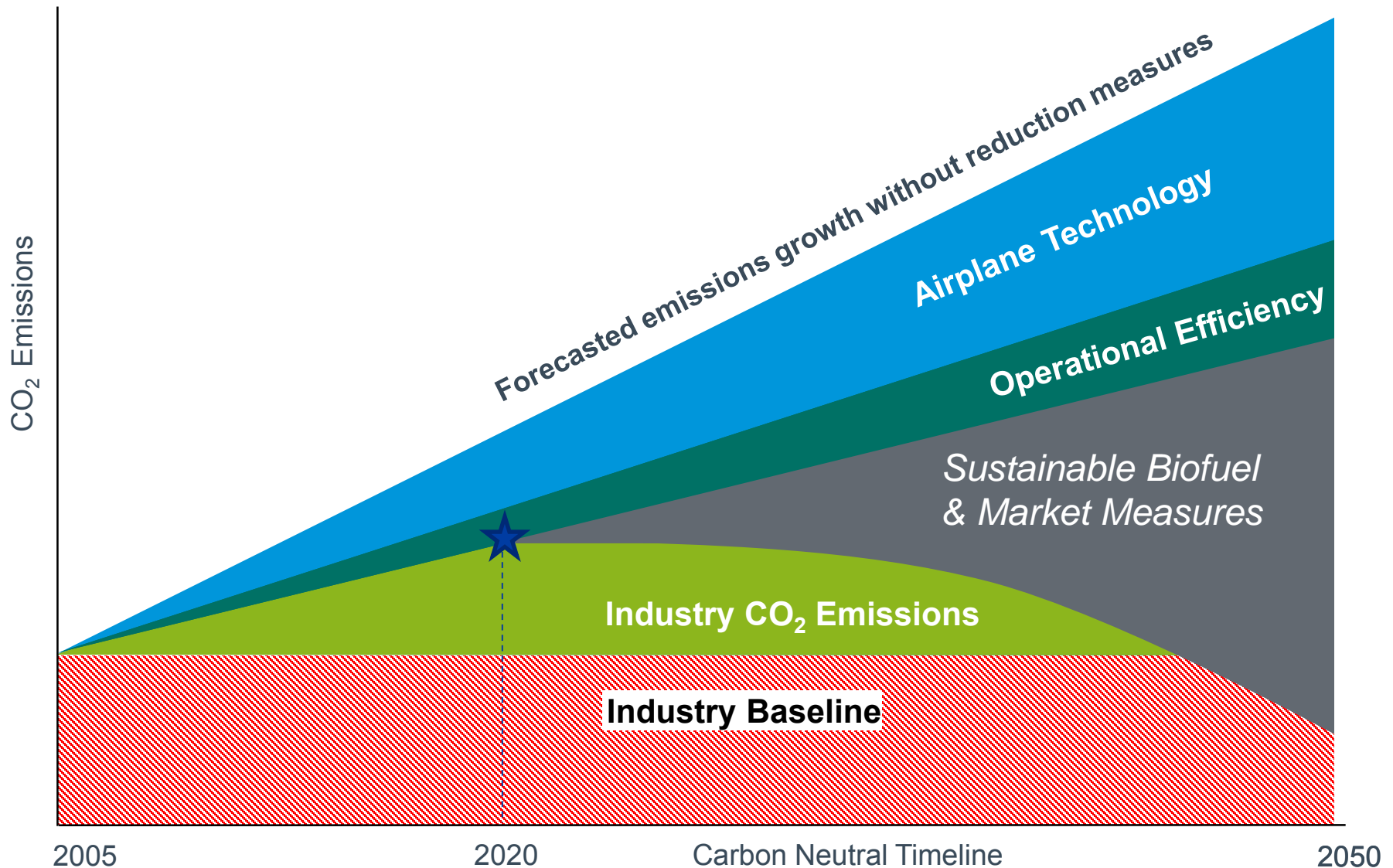
Early jet airplanes



Noise footprint based on 85 dBA

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# Aviation's strategy for reducing emissions



# Status of biofuel industry

## ✔ Technically viable

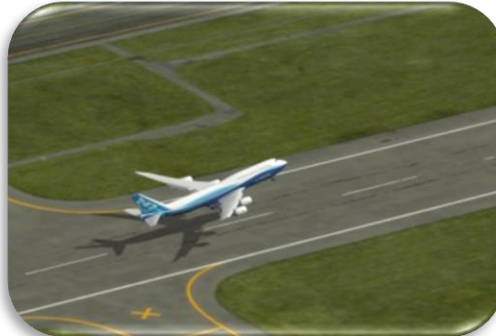


ASTM and Def Stan approved

High-quality standard, drop-in fuels

Five pathways approved since 2011

## ✔ In demand



Airline offtake contracts signed

Airline support – Countless commercial flights

Continued global military interest

## 🔹 Sufficient supply



Limited but growing refinery capacity

Shrinking premium for approved fuels

Parity on incentives with ground transport needed

# Announced airline offtakes of aviation biofuel



375 million gallons, est. 2019



24 million gallons, est. 2019



330 million gallons, est. 2019



915 million gallons, '16-'19



2.5 million gallons, 2016



24 million gallons, est. 2019

Source: 1. Lufthansa commitment of 2.5 million gallons out of Oslo Airport in 2015 2. United Airlines commitment to 5 million gallons over 3 years from AltAir Fuels from 2015 onwards; equity investment in Fulcrum over 10 years from 2018 onwards 3. Offtake from Red Rock Biofuels from 2017 for 3 million gallons per year for 5 years 4. Offtake from Red Rock Biofuels for 3 million gallons per year over 5 years 5. Commitment to Solena for minimum 10 years 6. Equity stake and offtake with Fulcrum for 10 years





<https://planefinder.net/custom/icao-fuel.php>

- **United Airlines and KLM flights departing from LAX**
- **Lufthansa, SAS and KLM / KLC flights departing from OSL**
- **SAS, KLM and Braathens flights departing from ARN**

# Challenges to commercialization remain



Expansion  
of options



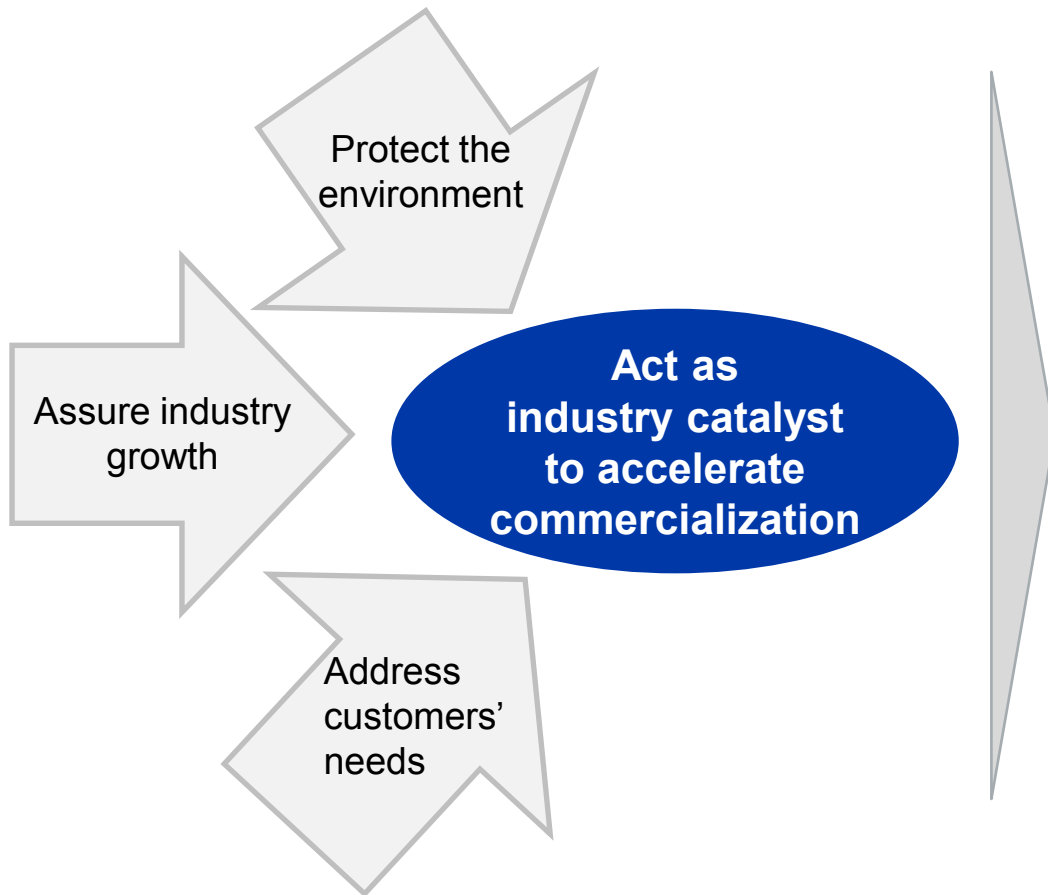
Financing  
and affordability



Project  
execution

# Boeing's role and actions

## Boeing's role

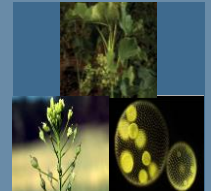


## Core activities

Support  
and  
advocacy



Feedstock  
and pathway  
R&D



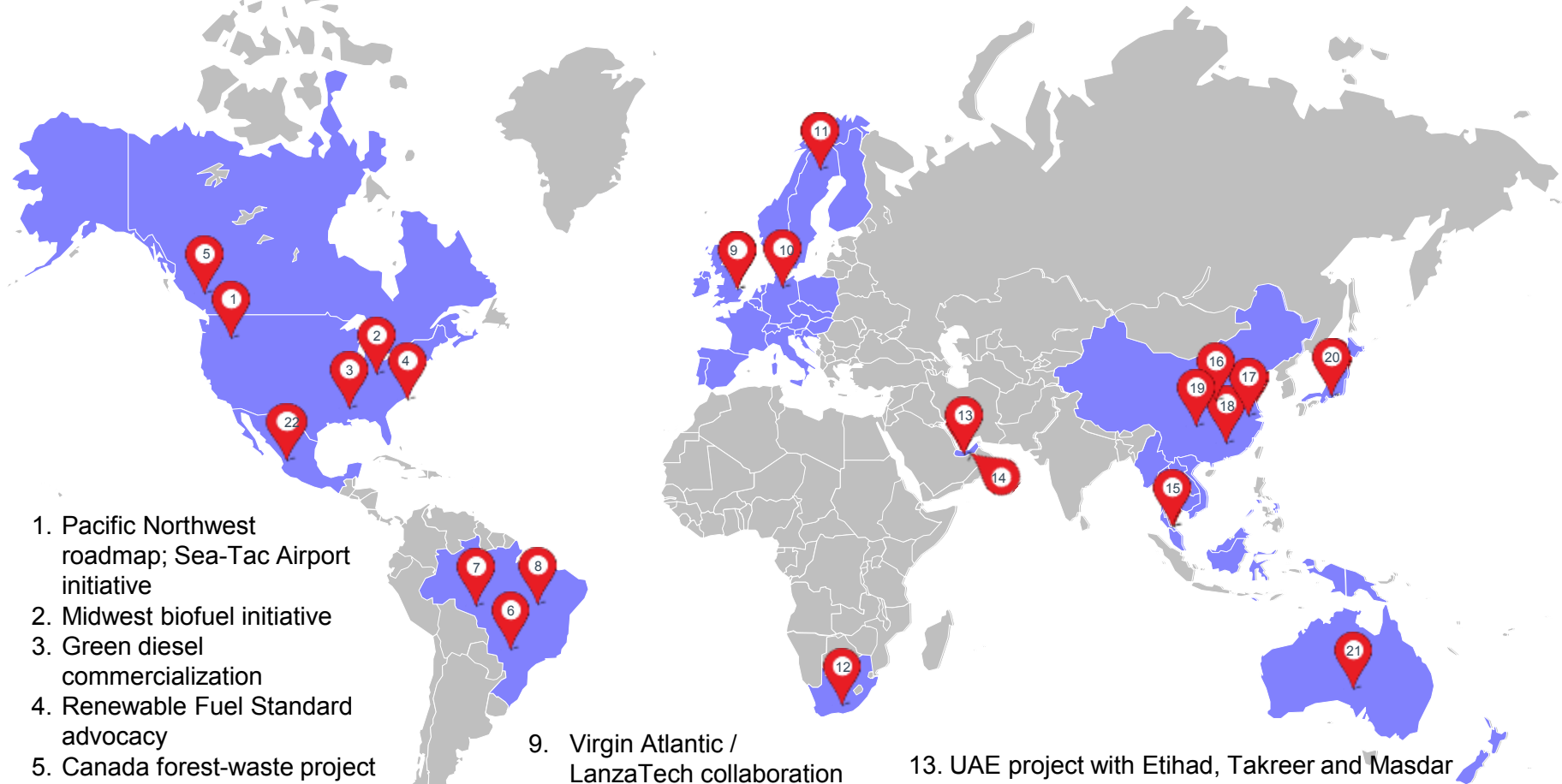
Fuels  
approval



Ultimate goal is to catalyze a vibrant commercial market



# Boeing's global biofuel engagements



1. Pacific Northwest roadmap; Sea-Tac Airport initiative
2. Midwest biofuel initiative
3. Green diesel commercialization
4. Renewable Fuel Standard advocacy
5. Canada forest-waste project
6. Brazilian Biojetfuel Platform
7. Joint research with Embraer
8. GOL biofuel flights

9. Virgin Atlantic / LanzaTech collaboration
10. AIREG Membership
11. Nordic Initiative for Sustainable Aviation
12. South African Airways national roadmap

13. UAE project with Etihad, Takreer and Masdar
14. BIOjet Abu Dhabi with Etihad
15. Southeast Asia smallhold farm initiative
16. Biofuel R&D in China
17. "Gutter oil" facility with COMAC
18. Hainan Airlines commercial flight
19. Agricultural waste project in China
20. Japan biofuel roadmap
21. Australia biofuel roadmap
22. Mexico biofuel center of excellence

# Highlights from the global portfolio

## US & EUROPE HEFA+



## CHINA Waste cooking oil



## UNITED ARAB EMIRATES Saltwater-tolerant desert plants



## WASHINGTON STATE Feasibility study



## SOUTH AFRICA Nicotine-free tobacco plant



## JAPAN Roadmap to 2020 Olympics



Boeing and the aviation industry  
are committed to partnering  
for a better future

