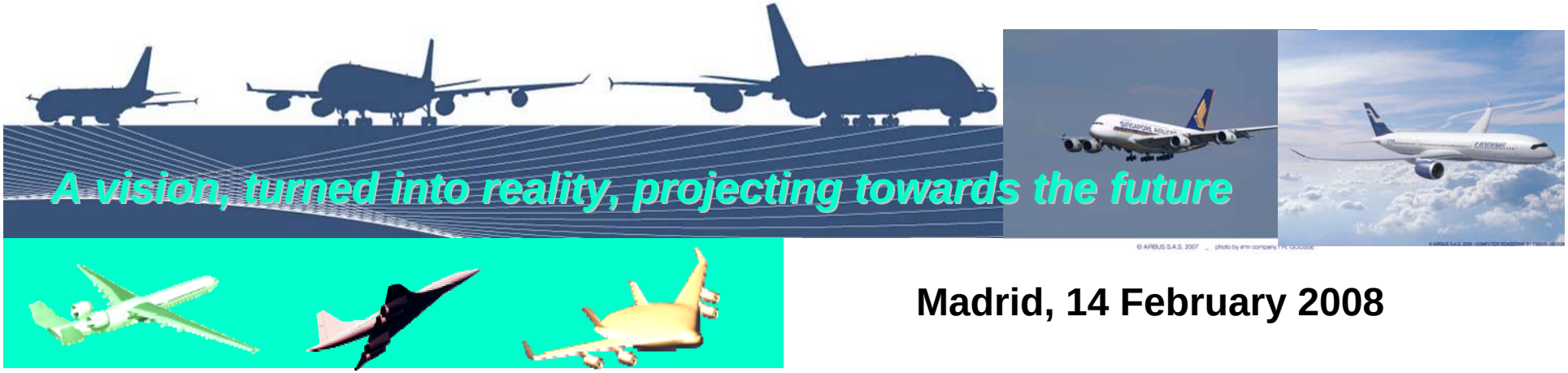
February 2008

Presented by

Alain Joselzon

for the ***COPAC Convention on Air Transport and Environment***

Reducing Noise, Fuel Consumption and Emissions



Madrid, 14 February 2008

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Contents & Summary

- Introduction
- Aviation *is* Technology…partly…
- Technology: source of environmental progress…
- …even if interdependencies and trade-offs exist
- …and Aviation *is* Operations
- Global vision, integration, and cooperation of all actors are key to prepare the future
- Conclusion

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Introduction - Aviation today

- A worldwide safe, highly performing mass transportation system.
  - Accessible, affordable and used by an increasing majority,
  - Indispensable vector of multiple economic and social activities
- An easy target
  - Despite unmatched improvement records, resulting from the sector's continuous quest for perfection (safety, reliability, cost and performance – including fuel burn reduction)
    - Every achievement is taken for granted
    - High expectations of technology-related progress
      - Extensive R&D programmes that require huge investments to support needed technology and product development
      - Environmental dimension at the top of company and product requirements, to meet to-day's & to-morrow's challenges
  - A high traffic growth sector, making it more visible
- Airbus is on its way towards an eco-efficient enterprise through its full range of activities – ISO14001 certified (sites and products throughout the whole life cycle)

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Aviation *is* Technology…partly…

- **Strong Technology incentive resulting from high requirements**
  - Complex technical products - very high reliability and safety standards
  - Multi-disciplinary technical domains, multiple criteria to integrate, sophisticated design & optimisation tools, test & validation processes
  - Relying on top expertise in all domains and very resource-intensive R&D activities (time, expertise, costs)
- **Very sensitive to operations**
  - Meteorological and flight conditions - Operational procedures
  - Air traffic management - Infrastructure and Land use Planning
- **Very dependent on socio-economic context**
  - fuel price, high competition among manufacturers and airlines, small profit margins

    ➔every new product only worth developing if it brings a significant improvement step: mature technologies selected and integrated in line with product requirements and overall optimisation

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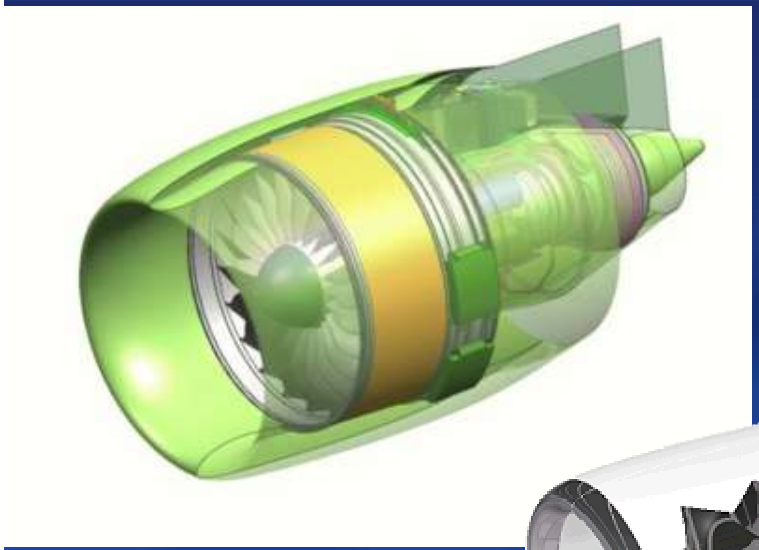
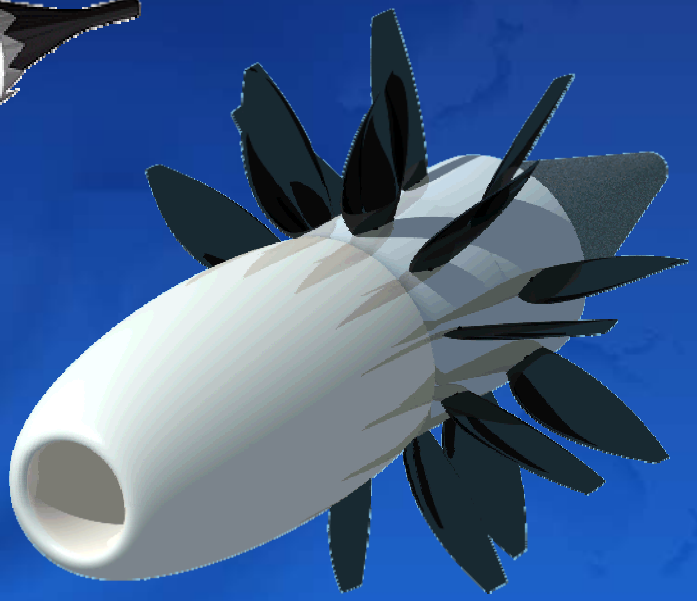
Propulsion System high performance design prospects



Innovative Turbofan Architecture

- **Geared Turbo Fan**
- **Counter-Rotating Fans**



Counter- Rotating Propfan Engines

By Pass Ratio up to 80 ←→ open Rotor technology

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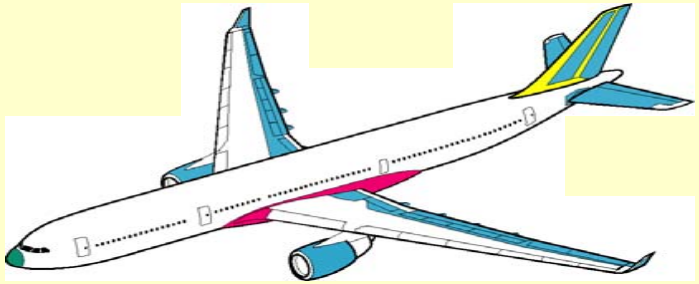
Structural Weight Reductions: a considerable progress story

Composite + Advanced Materials

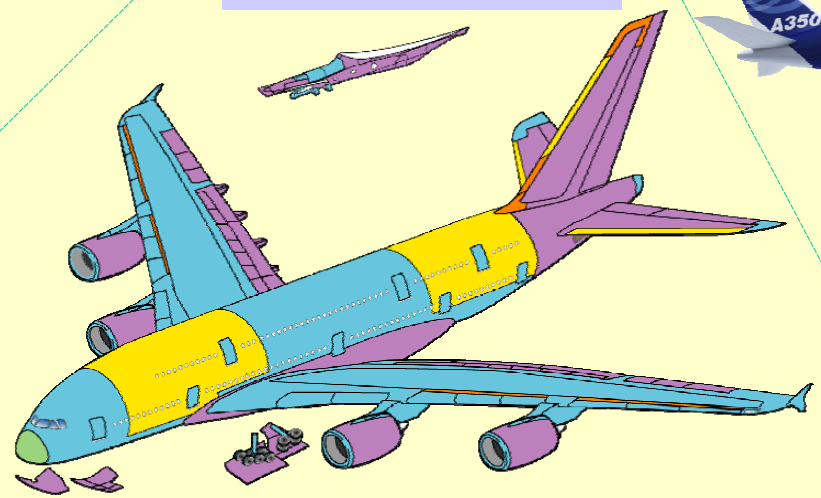
1990 (10-12% *)



« Materials Baseline »

**** Percentage of composites in structural weight***

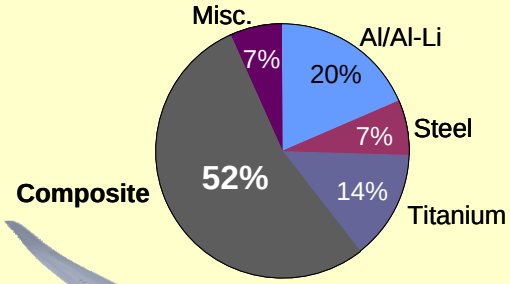
2005 (20-25%*)

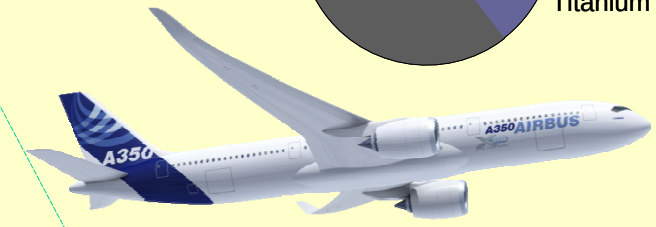


GFRP (Glass)
QFRP (Quartz)
CFRP (Carbon)
Metal
Glare

est. structural weight saving ~ 8%

2010-2015 (50+%*)





Composite wing and fuselage

est. structural weight saving ~ 15%

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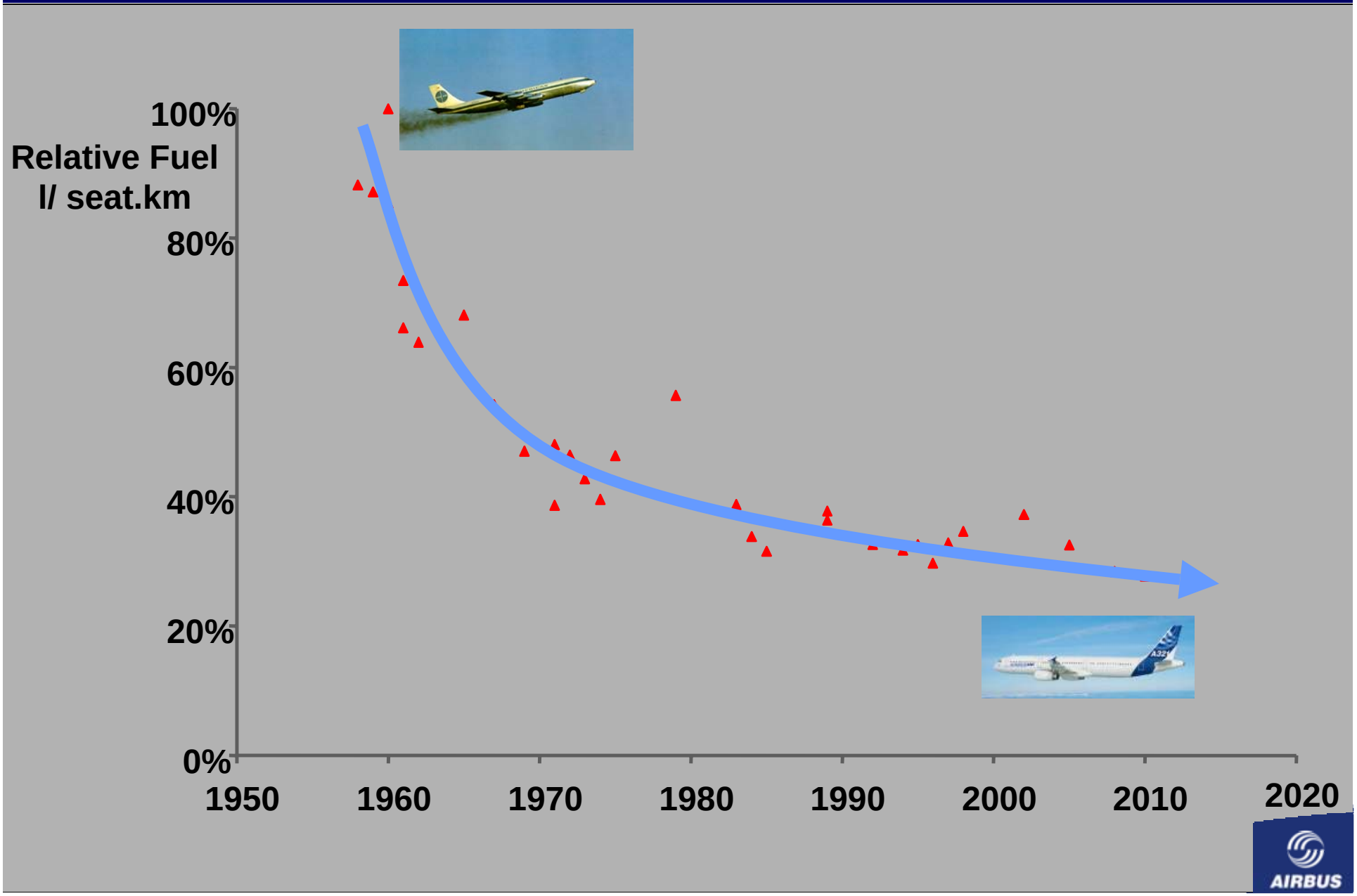
Achievements: 70% reduction in fuel burn



Aircraft Fleet Fuel Efficiency Recent Trend

⇨ ***~ 70% Fuel Efficiency improvement up to 1990 at product level***

⇨ ***Continuing improvement reflected at fleet level (average > 1.5%/year)***

⇨ ***IATA goal to improve fuel efficiency by at least 25% by 2020 from 2005***

⇨ ***Driven by strong & efficient market forces, combined with inherent fast- evolving high technology, improved operational practices & ATM***

⇨ ***Needs sustained research & technology funding from Industry & Governments***

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ACARE Vision on CO_2 Reduction

Potential for fast broad-based solutions to be taken into account!

2000

ATM	5-10%
Aircraft	20-25%
Engine	15-20%
Total	50%

2020

ACARE = **A**dvisory **C**ouncil for **A**eronautics **R**esearch in **E**urope

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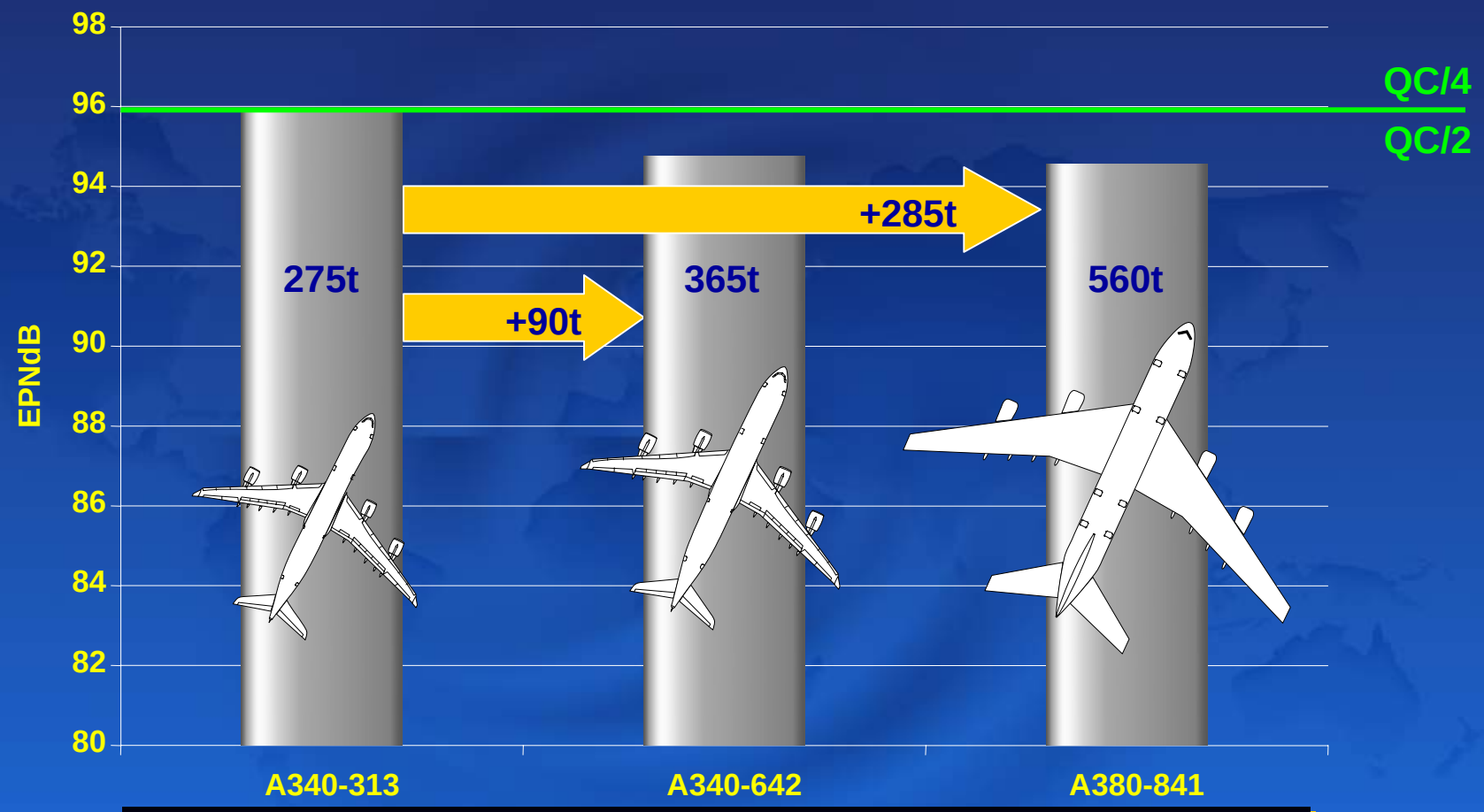
Capacity growth without noise increase

Illustration: A380 and London QC departure noise

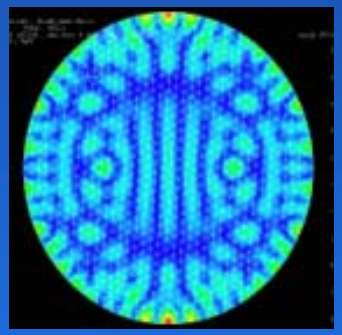


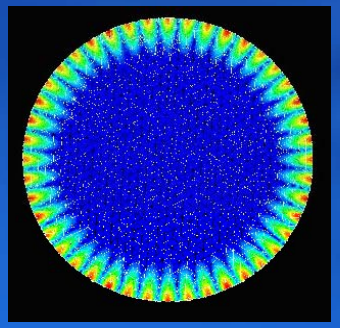
Capacity doubled at constant departure noise

Some Technology Advances in Acoustics

Low noise Nacelle
(Air Intake)

0-Splice Air Intake Liner





Low noise Nozzle

Low noise Landing Gear

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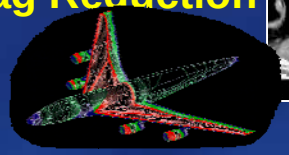
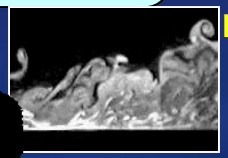
Aircraft Design / Configuration : future advances

New materials, sensors & effectors

Flow Control Technologies

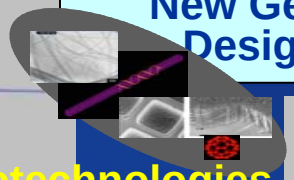
Drag Reduction



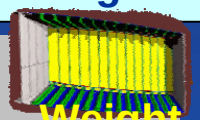


Advanced Wing management

(The Right) **Advanced Material**
New Generation Composite Design & Manufacturing

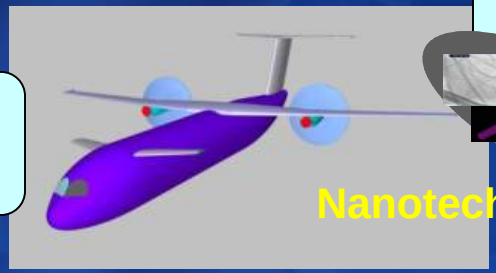


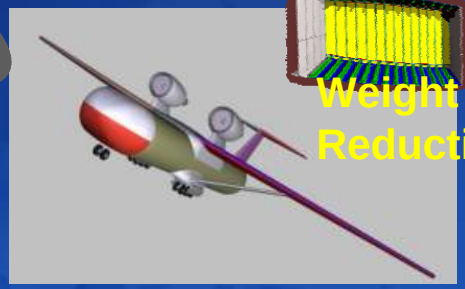
Nanotechnologies



Weight Reduction

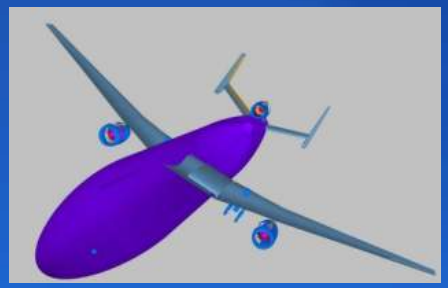
New Aircraft Designs





Low Emissions Systems:
Low Pressure Bleed Systems
Fuel Cells

Innovative Engine Architecture



Powered by bio-fuels

Breakthroughs for fuel burn & emissions reduction are possible…
Fuel Saving is part of aircraft manufacturer's core business

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Synergies and Architectures: Energy generation

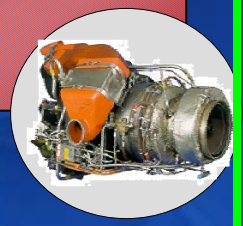
FUEL CELLS

Alt. fuel | Fuel Cell System

Expected ~ Next Decade

Kerosene | Primary Power Supply

Kerosene | APU Replacement



H2 Bottle | RAT Replacement

TIME

Step by Step approach

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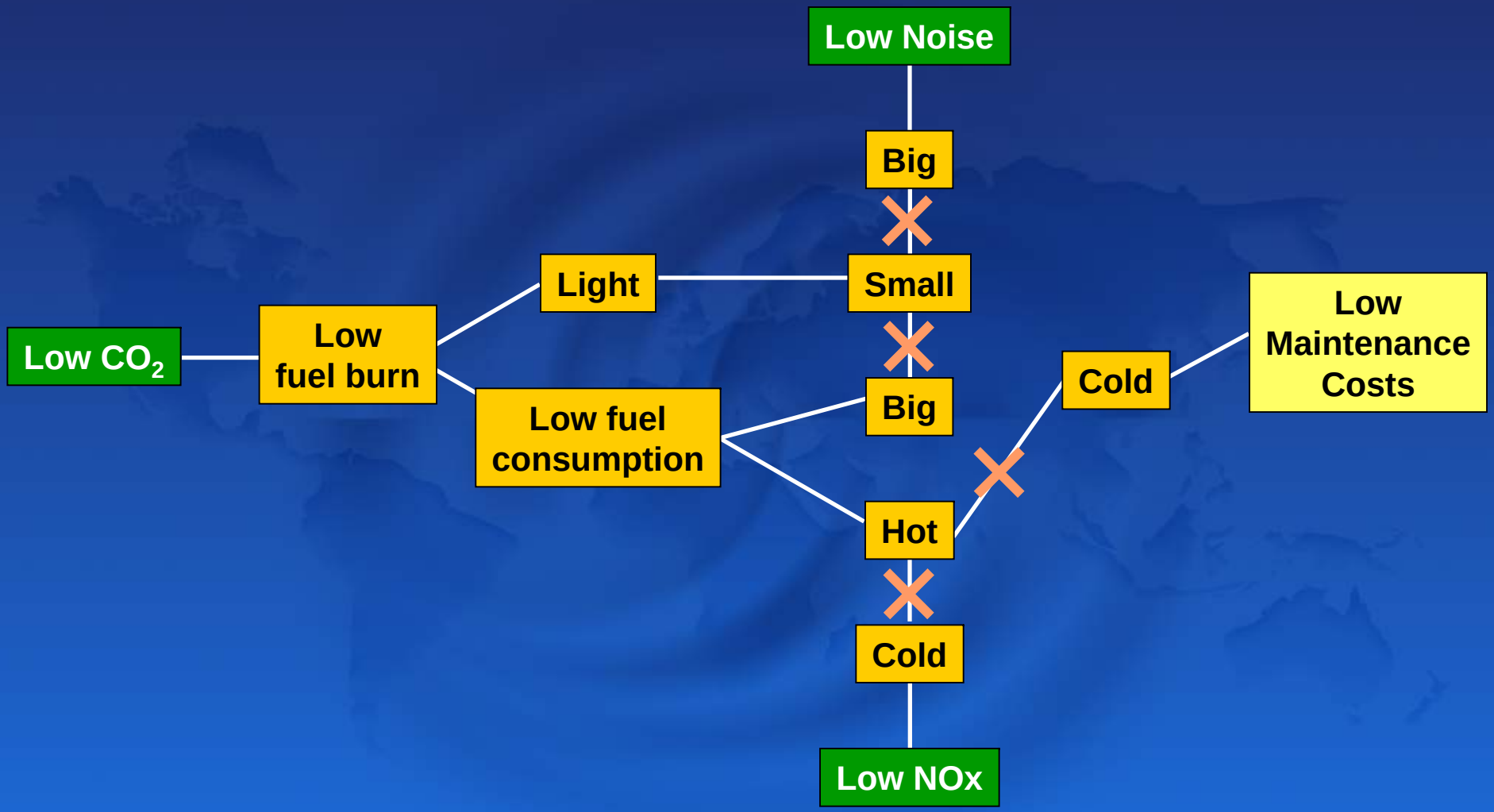
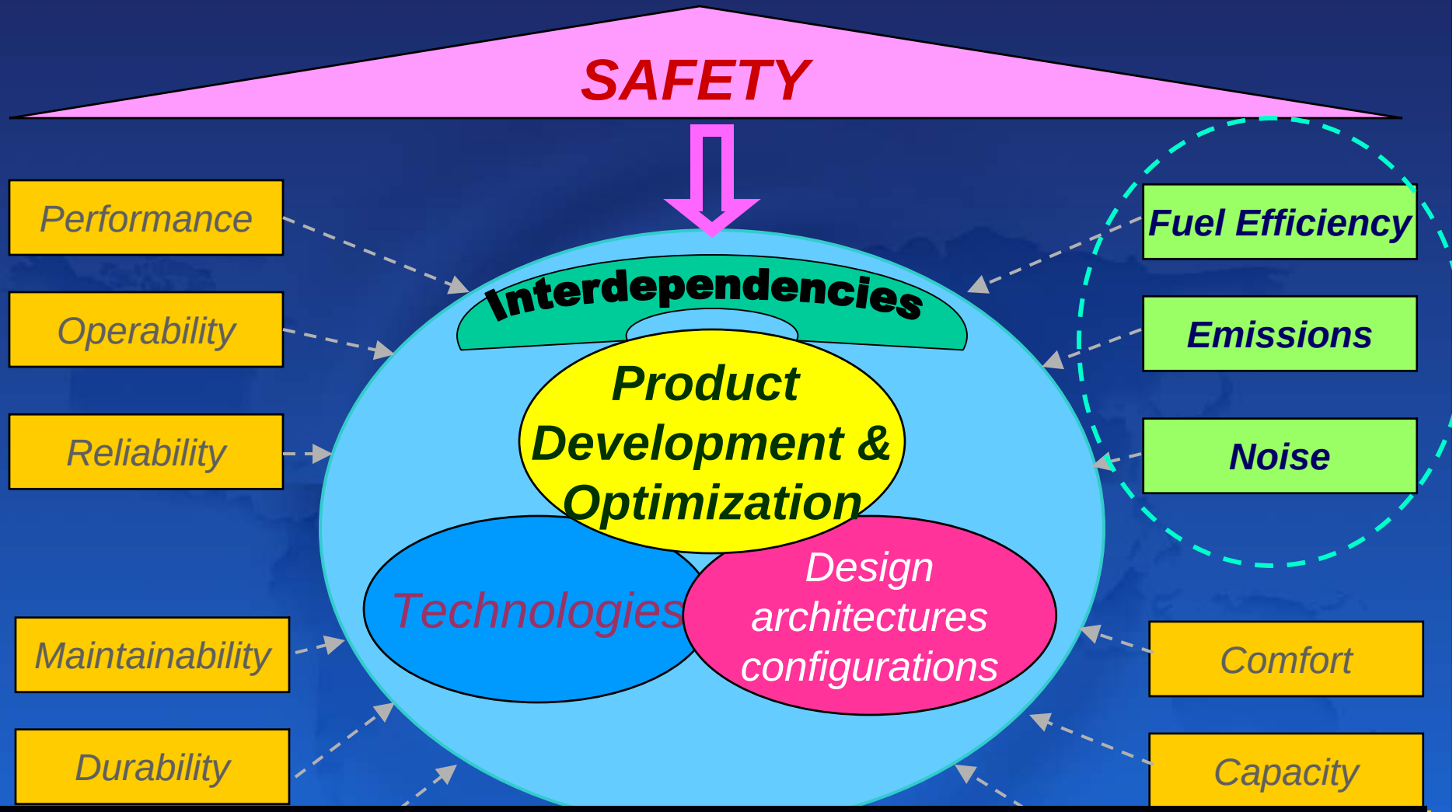
Interdependencies & Trade-offs: a permanent challenge



Technology & Design drivers



Environmental requirements need to be balanced with multiple other aircraft design requirements

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Aviation is Technology… and Operations

Operational aspects are a major element in aviation environmental effects

- **Operational improvements are crucial to environmental efficiency**
  - Important potential gains from operational procedures optimisation (ground, flight, maintenance)
  - Important potential gains from traffic management optimisation
  - Some impacts are by essence operational-dependent
- **Operational improvements are often combined with / dependent on / technology developments**

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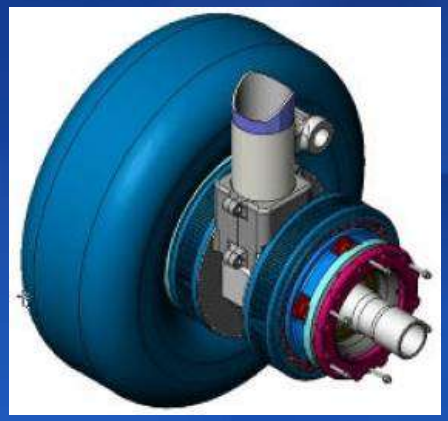
Operations can bring important environmental benefits, often combined with Technology - Full analysis needed

Motored Gear

→Reduced noise

→Autonomy, but …

→Not a fuel burn reduction technology (benefit on ground compensated by penalty in flight)



Source: WheelTug 2007

High Speed Towing

→ Significant fuel burn benefit potential (tractor vehicle more efficient than aircraft engines at idle)

High-Speed Towing may save up to 10,000 tonnes fuel per aircraft over a 20 year A320 lifetime !

Operation: Noise abatement procedures

➢ *Major Stakes with respect to Operations, Noise & Environmental footprint*

- *Noise gains & rapidity of optimisation process, TOW, mission, FLEX-TOFF, traffic growth, airport capacity, airborne systems, procedure automation & crew workload, fuel burn & emissions*

➢ *What Airbus is doing*

- ***High achievements** in enabling optimised and automated procedures, maximised environmental benefits and aircraft operability, minimised operator and crew workload, while maintaining or enhancing safety level*
- ***Leading** or actively involved in further research & development for enhanced optimisation capability & benefits*
- ***Very active** in international efforts to stimulate & frame progress through ICAO/CAEP*

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Aircraft Life Cycle: a manufacturer challenge, and a global environmental vision

Airbus fully committed & operational, with ISO 14001, Environmental Management System, Eco-Efficiency concept & policy in place

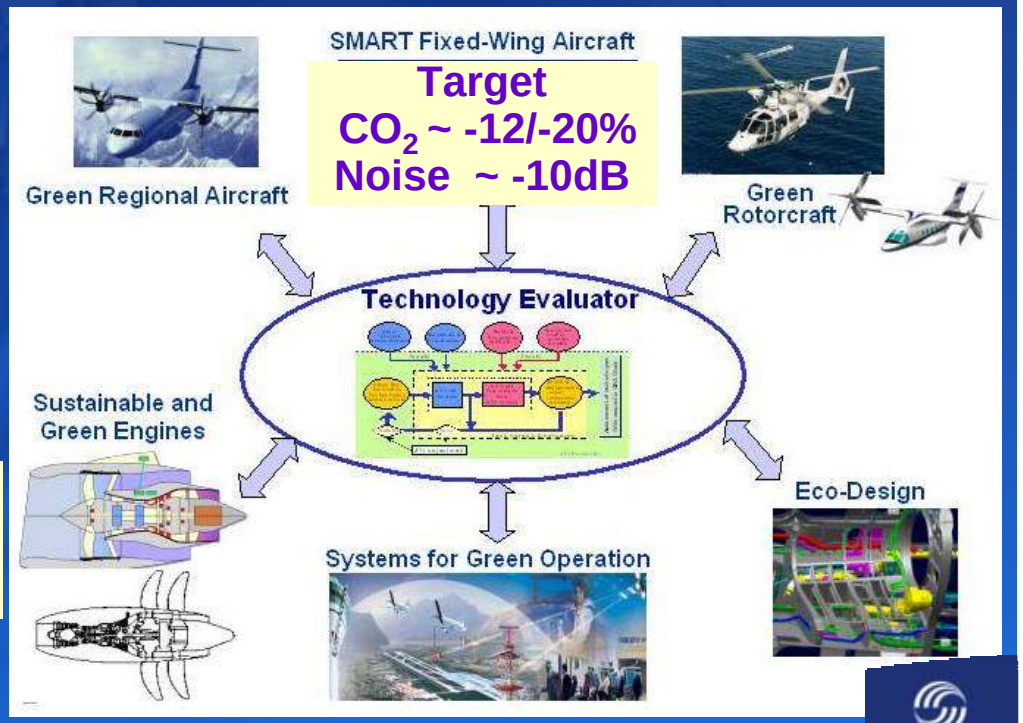
Airbus is deeply involved in Clean Sky JTI

- Will demonstrate & validate technological breakthroughs needed to reach ACARE environmental goals for 2020 *

- Mega-project = 1.6 Bn € - 86 partners - 7 years - Ambitious objectives - Wide scope (engines, aircraft, rotorcraft, operations, eco-design) - Actual Demonstrators to be tested - Technology Evaluator to assess realistic technological integrations/combinations

- Launched 5 February 2008

- **Airbus, founding member, plays a leading role**
  (Integrated Technology Demonstrator)



***-50% CO2 emissions, -80% NOx emissions, -50% perceived noise**
compared to aircraft in service in 2000

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CONCLUSION

In summary, Airbus:

- ***strives to leave no stone unturned, and rationally assess what is underneath,***
- ***works with thorough determination, full strength, and in close cooperation with all other actors, to:***

  - maximise its eco-efficiency,

  - help the Industry prosper responsibly, with less and less impact on the environment, and

  - contribute to the eco-efficiency of the whole aviation sector.

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As for the future,

you do not have to foretell it,

but to enable it.

No debes prever el porvenir

sino permitirlo

Antoine de Saint Exupery

Muchas Gracias

AIRBUS

AN EADS COMPANY