Airbus – where are we going next (evolution or revolution)?

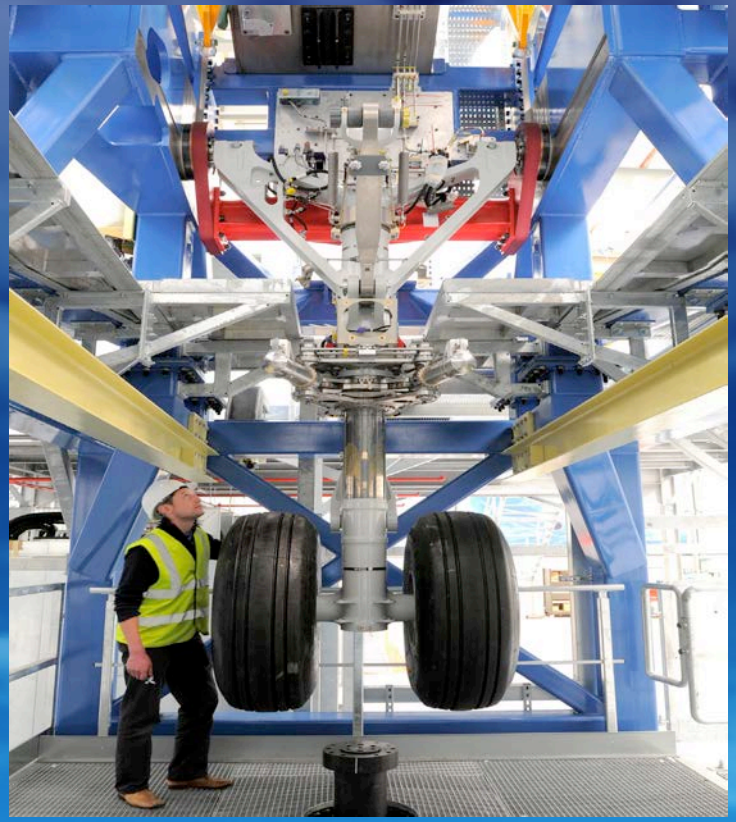
Neil Scott
Vice President Engineering
Airbus UK

IMechE Western Aerospace Centre 2013 Prestige Lecture

Airbus in the UK
History/background
Market
Evolutions
Future challenges
Future by Airbus


AIRBUS

Filton



- Filton provides design and support of wings for all Airbus aircraft. Half of the Filton workforce are in engineering.
- The A400M wing assembly facility pioneers bespoke manufacturing techniques & the use of advanced composite materials.
- Airbus in Filton also has design and supply responsibility for fuel systems and for most variants, the landing gear.
- There are over £100M worth of test facilities at Filton including the fuels test centre, wind tunnel, structures and landing gear test facilities
- Customer Services teams are also based at Filton.
- Aircraft design and manufacturing has taken place on this site for over 100 years.
- Airbus Aerospace Park is under construction and will open next month.

Airbus family

The most modern and efficient aircraft families

Passenger aircraft: from single-aisle A320 family to the 500-seat A380

Corporate Jets: VIP and government aviation

Freighter aircraft: the freight market sector

Military aircraft: airlift and support missions

Airbus family

A380 Family

A340 Family

A350 Family

A330 Family

A320 Family

Passenger aircraft: from single-aisle A320 family to the 500-seat A380

Corporate Jets: VIP and government aviation

Freighter aircraft: the freight market sector

Military aircraft: airlift and support missions

Innovation

40 years of innovation, a driver for success

A300B:
First ever widebody twin-engine in the 70s forward-facing crew cockpits in the 80s

A320 Family:
Side-stick & electronic engine controllers
Digital auto flight system
Aerodynamic improvements (winglets, sharklets)

A380:
Unprecedented fuel efficiency and comfort

A350 XWB: a game changer
over 53% of composite material

Environment:
First aircraft manufacturer awarded ISO 14001 - all sites and products

Airbus family

A full range of market leading civil airliners

A320 family:
A take-off or landing every 2.5 seconds,
7 billion passengers carried since EIS in 1988

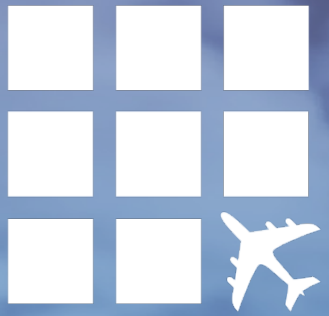
A330 family:
A take-off or landing every 25 seconds,
More than 800 A330s sold since 787 launch

A350 XWB:
First Flight mid 2013
582 firm orders from 34 customers

A380:
Takes-off or lands approx. every 6 minutes
125 flights per day and 1 million pax per month

Market

GLOBAL COMMERCE



JOBS

JOBS SUPPORTED BY THE
AIR TRAVEL INDUSTRY

SOURCE ATAG 2012

GLOBAL GDP

SOURCE ATAG 2012

GLOBAL RANKING

#19

SAME SIZE
AS POLAND

SOURCE ATAG 2012

TOURISM

SOURCE ATAG 2012

Daily Mail

Airbus predict 'global air fleet will double by 2032' with two thirds of the population taking at least one flight a year

Media type The Daily Express (GBR) - uk

Edited by PETER CUNLIFFE

City&Business

Airbus predicts an Asia-Pacific boost

CNN

Eastern promise raises hopes at Airbus

Airbus predicts 29,000 new planes needed by 2032

Bloomberg Our Company | Professional | Anywhere

HOME QUICK NEWS OPINION MARKET DATA PERSONAL FINANCE TECH POLITICS SU

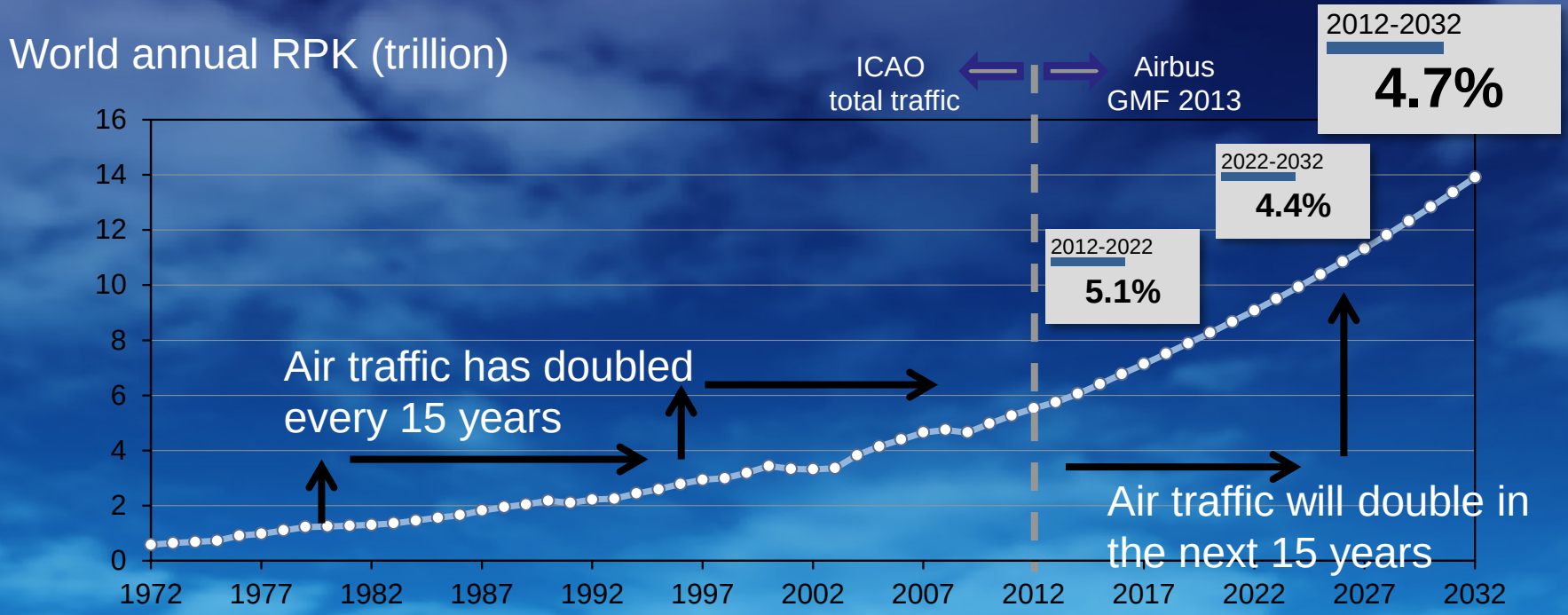
WATCH LIVE Boehner Has 'Fed the Beast, and the Beast Is Insatiable' --Rep. Chris Van Hollen (D., Maryland)

Tweet 25.9K

Airbus Sees $4.4 Trillion Commercial Jet Market Over 20 Years

By Robert Wall - Sep 24, 2013 11:10 AM GMT+0200

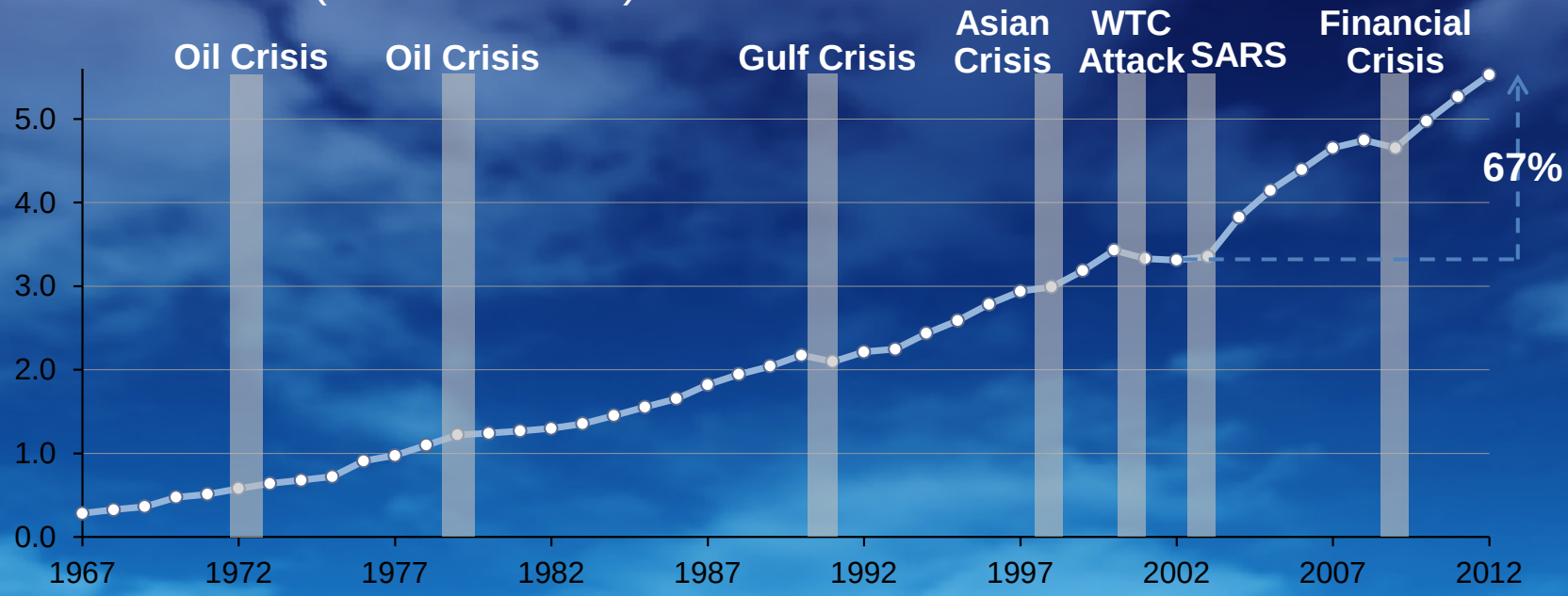
Traffic will double in the next 15 years



Source: ICAO, Airbus GMF 2013

Air travel has proved to be resilient to external shocks

World annual traffic (RPKs - trillions)



67% growth through multiple crises over the last ten years

Source: ICAO, Airbus GMF 2013

Manufacturers: An attractive market for new competitors

Evolutions

Airbus A320 family

A320 family - one type, four equally spaced models

The most efficient and comprehensive coverage of the single aisle market

Seats*

185 to 220

150 to 180

124 to 156

107 to 132

Balanced capacity

+ ~20%

+ ~20%

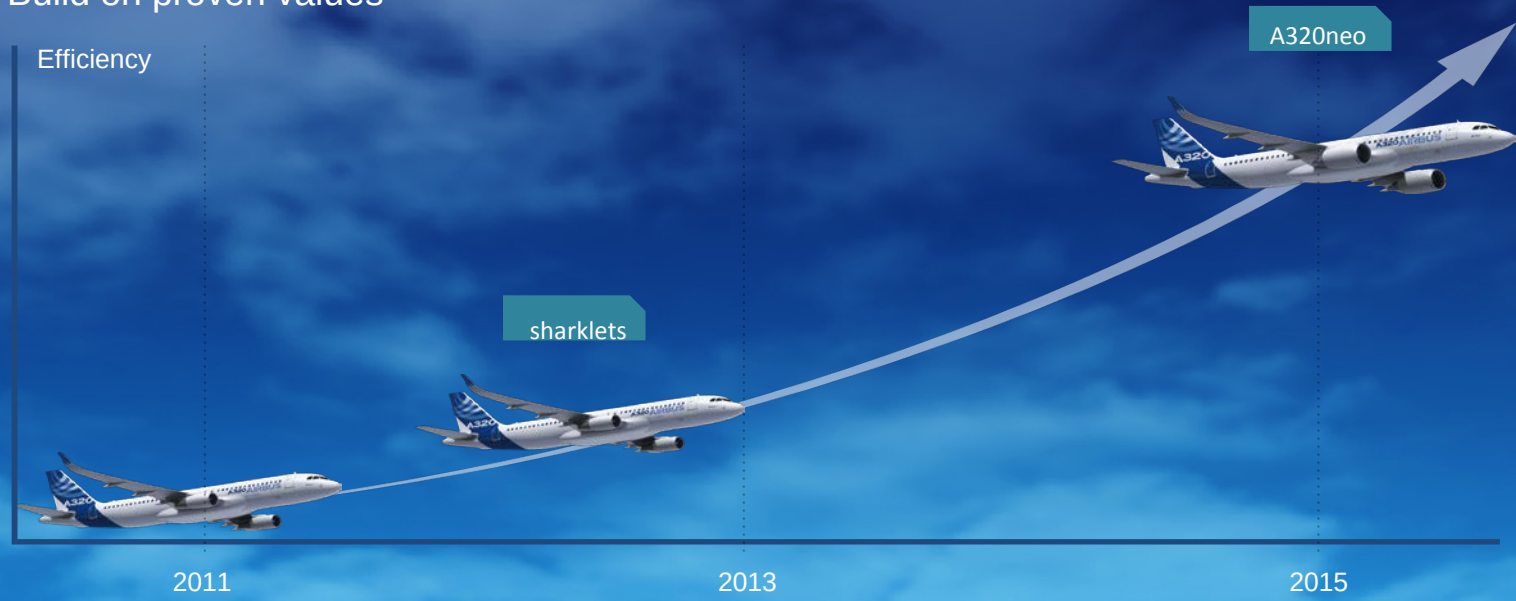
+ ~20%

*Typical two-class and high-density seat counts

Airbus A320 family

A320 family - evolution

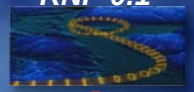
Build on proven values



A320 Family non-stop innovation

New cabin

Engine improvements



RNP 0.1

Maintenance programme

Extended Service Goal

Sharklets

2007 *2008* *2009* *2010* *2011* *2012*

HUD

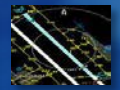
Aerodynamic improvements

GPS Landing system

78t A320

EFB

OANS



ROPS

Improved comfort

Reduced fuel burn

Reduced DMC

Improved capability

Improved navigation

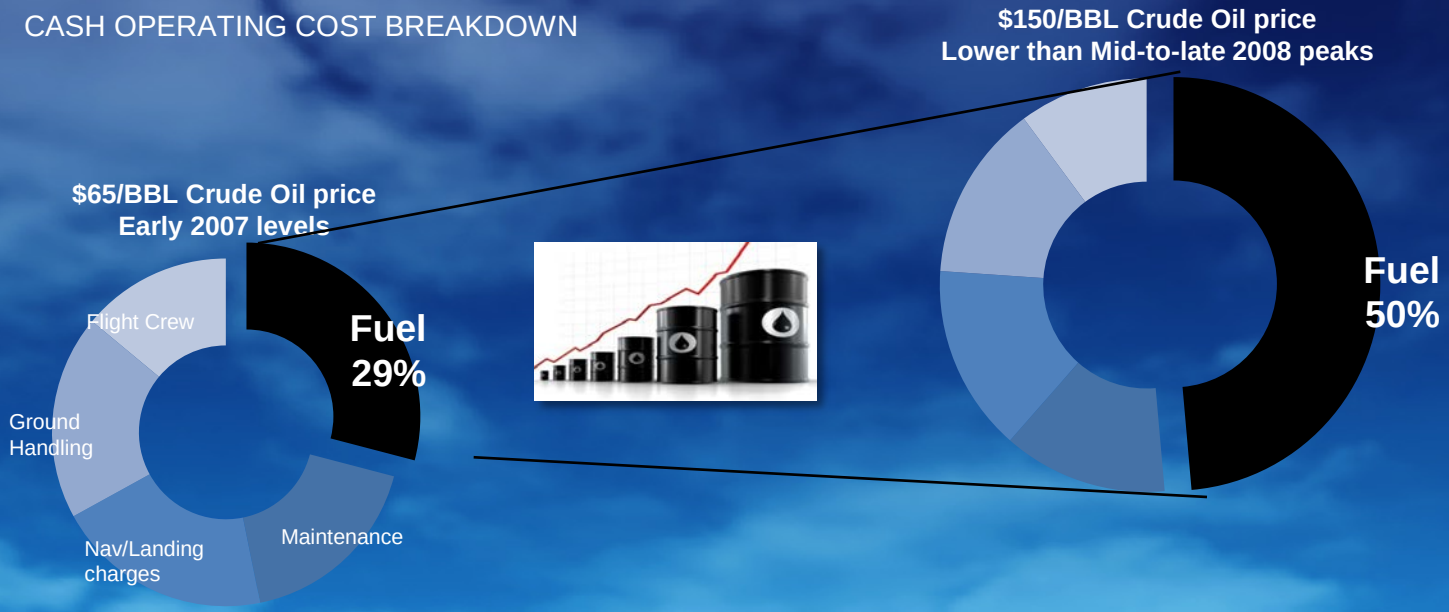
ROPS: Runway End Overrun Protection

OANS: On-board Airport Navigation System

Cash Operating Cost for Single Aisle Aircraft

A320 2-class 150 pax
On a 500nm mission

CASH OPERATING COST BREAKDOWN



Fuel will become the dominant cost item

A320neo

- Efficient engines
  - CFM56-5B featuring a 68” fan diameter
  - IAE V2500 featuring a 63” fan diameter
- Wing tip fences

- More efficient engines
  - CFM LEAP-X featuring a 76” fan diameter
  - PW1100G featuring a 81” fan diameter
- Sharklets

Low risk, minimum change aircraft ... up to 15% fuel burn reduction

Global changes on the aircraft

Sharklets + **Local wing reinforcement** + **Local CWB reinforcement** + **Adapted Flight Controls Computer Software**

Reinforced aircraft

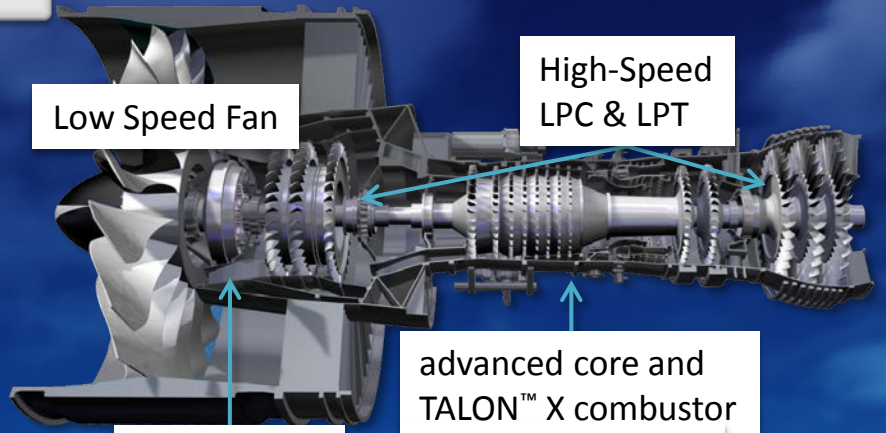
PurePower ® PW1100G engine by Pratt & Whitney

Geared Turbofan enables:

- Double digit lower fuel burn
- Significant reduction in noise and emissions
- Lower engine operating costs
- Wide design space for future technology insertion

Proven reliability and product maturity at A320neo EIS:

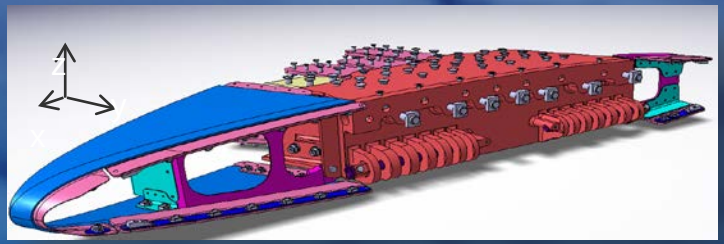
- Benefits and durability validated in engine demonstrator and core test programs
- Fan Drive Gear System matured through extensive test program
- First GTF validation and certification engine at test
- Revenue service by EIS

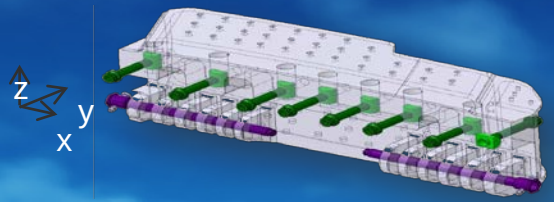


A340 Demo Engine Flight Test

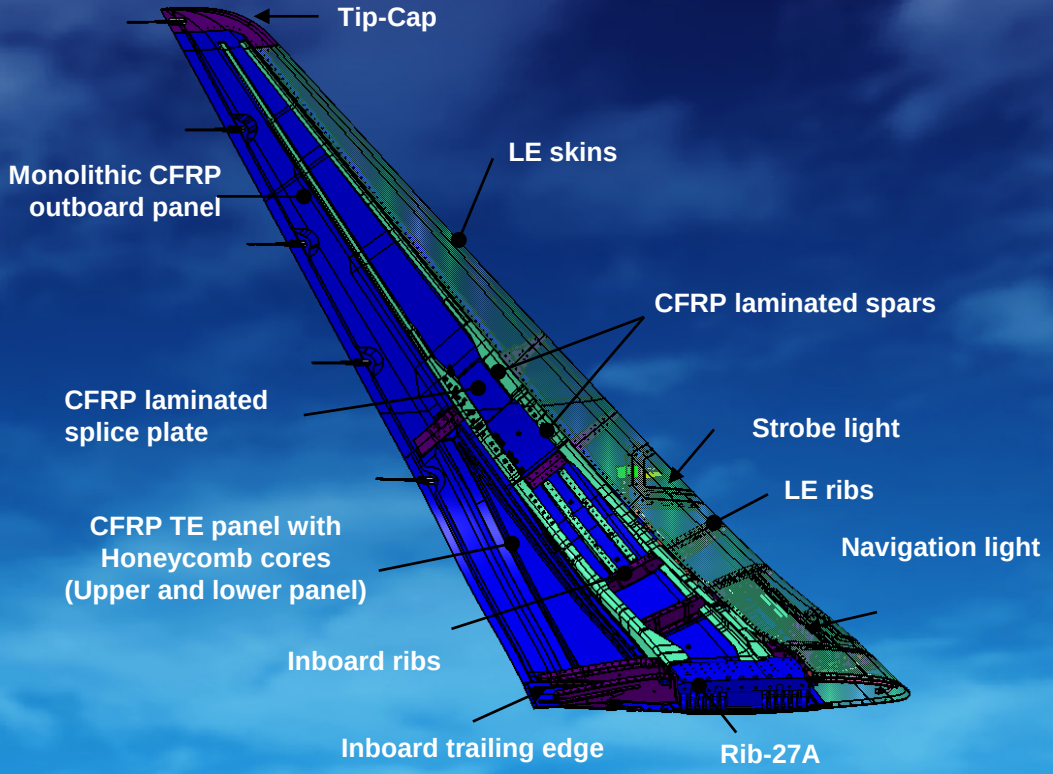
Sharklets design: new wing-sharklet join & sharklet device assembly

Rib 27 (wing-side)





Rib 27A (sharklet-side)



A320 Wing Changes

Covers:

Skin thickness increase outboard of Rib 11.

Topskin material 7449

Bottomskin material 2024HDT.

Strip milling introduced in change area.

Stringers:

Increased height outboard of Rib 11.

New material 2026.

Mid and Outer Rear Spars:

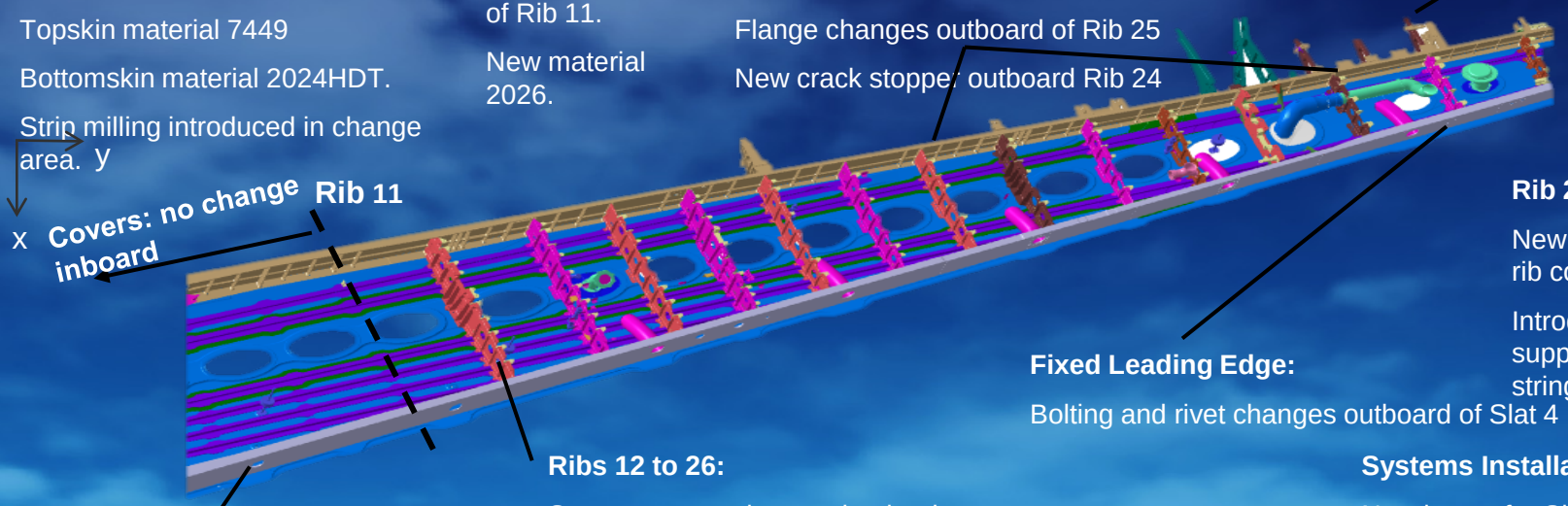
Front spar Web thickness increase outboard of Rib 9

Flange changes outboard of Rib 25

New crack stopper outboard Rib 24

Fixed Trailing Edge:

Aileron Hinge bracket changes



Rib 27:

New large machined rib concept

Introduction of support straps to stringers

Fixed Leading Edge:

Bolting and rivet changes outboard of Slat 4

Ribs 12 to 26:

System penetrations maintained.

Thicker web features and taller stringer cut outs.

Larger cleats used to fit larger fasteners.

Systems Installation:

New looms for Sharklet, routed outside rib 27.

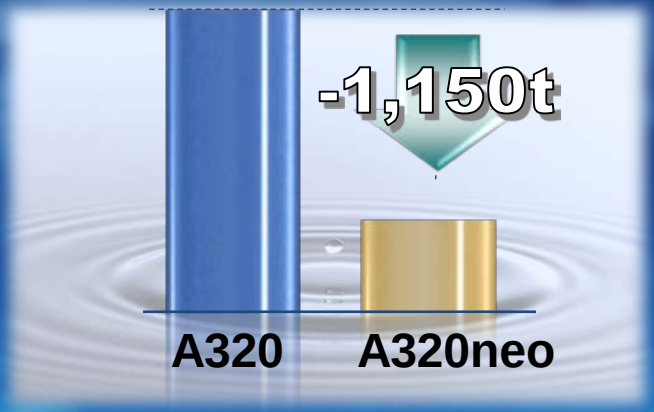
Centre Tank Vent Pipe Modified.

Front Spar:

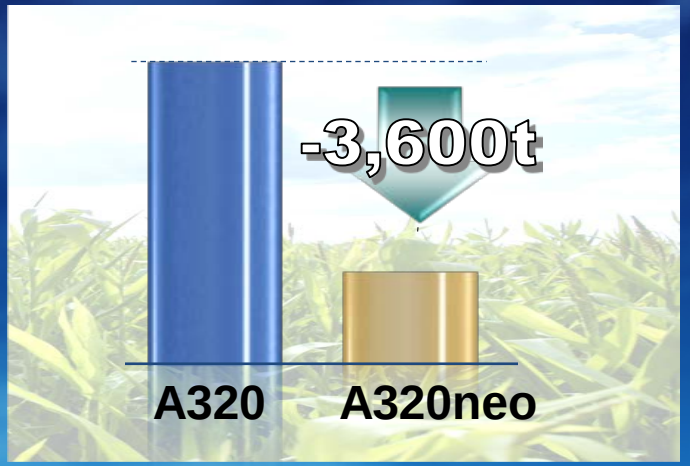
Front spar Web thickness increase outboard of Rib 9

What does 15% fuel burn reduction represent?

- Reduced fuel burn
  Per aircraft per year



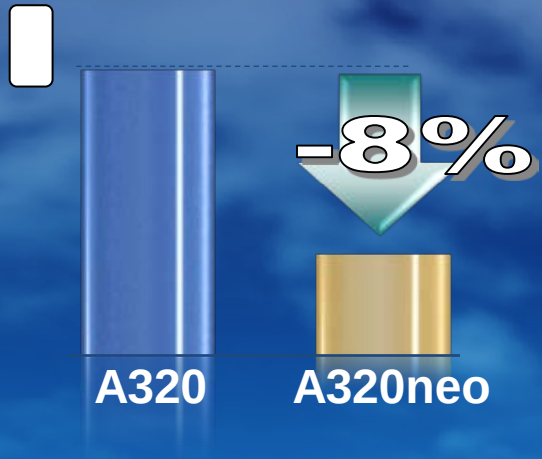
- Reduced CO_2 emissions
  Per aircraft per year



800 nm sector
1585 trips per year

Cash Operating Cost Comparison

- Better cash operating cost



- $1MUSD annual COC savings per aircraft

Fuel $2.5 per USG
800 nm sector
1585 trips per year

A significant efficiency improvement package

A380


A350-900 AIRBUS
A350

A350-1000

Latest Airbus Technology

-15% fuel burn

Lower noise levels – up to17dB below ICAO Ch4 standard

NOx emissions 50% below CAEP6 Standards

-25% fuel burn

Lower noise levels - up to 16dB below ICAO Ch4 standard

NOx emissions 35% below CAEP6

-20% fuel burn

Lower noise levels – up to 17 dB below ICAO Ch4 standard

Challenges

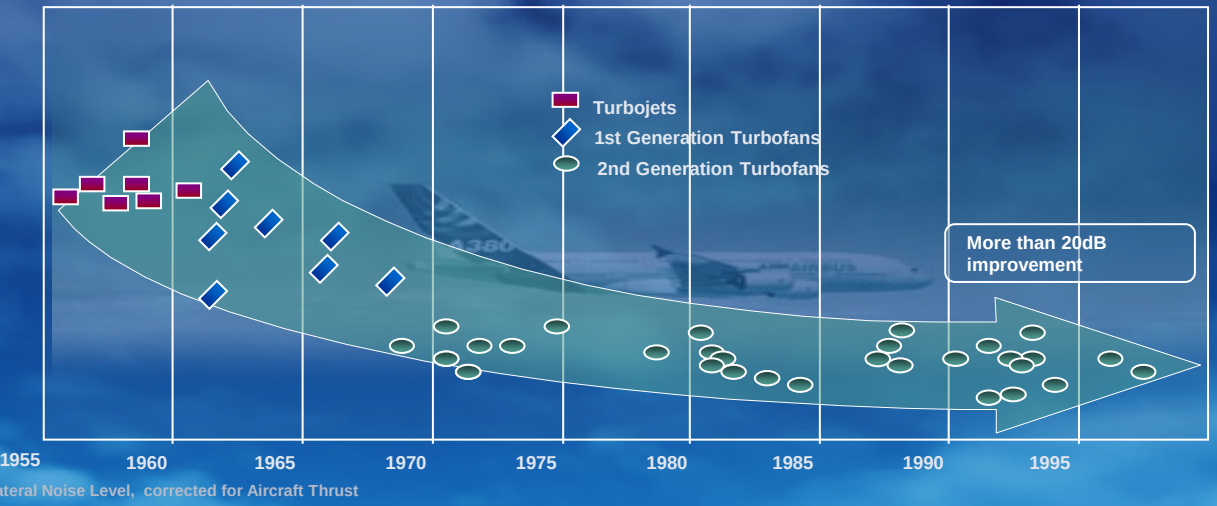
To reduce :

- **CO_2 by 75%**
- **NOx by 90%**
- **Noise by 65%**

Other Challenges :

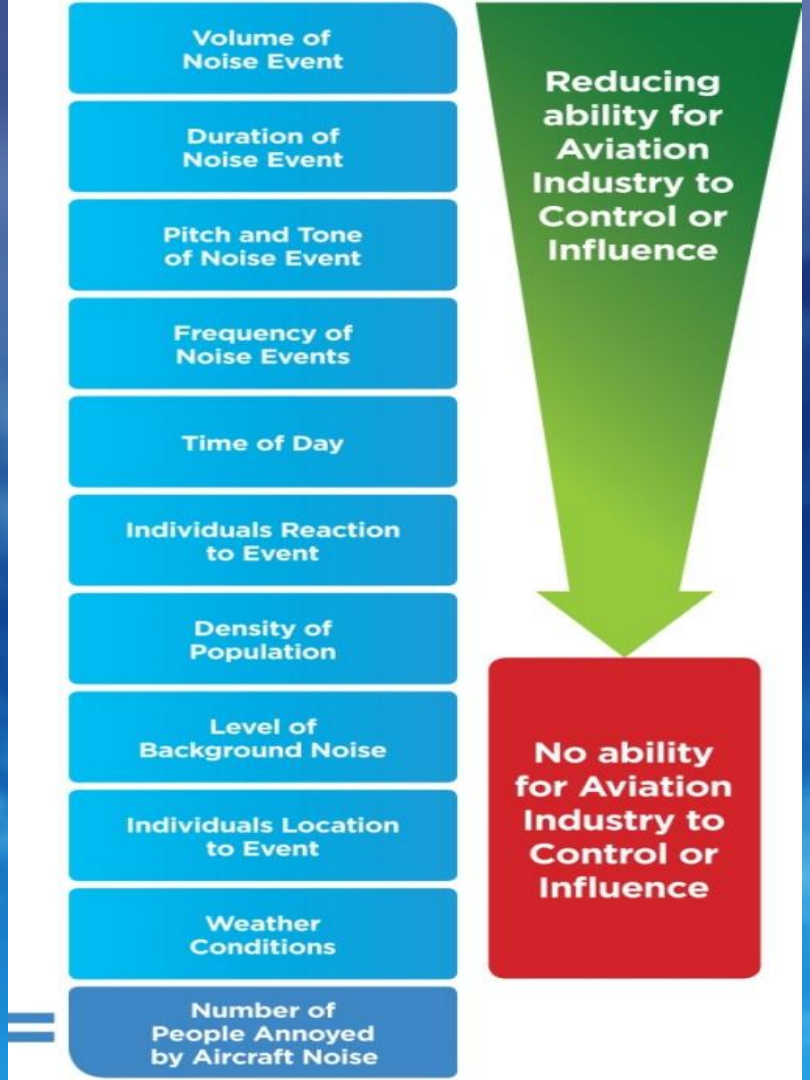
Aircraft Cost/Price
Air traffic and
Airport congestion

Reduced the last 40-50 years:

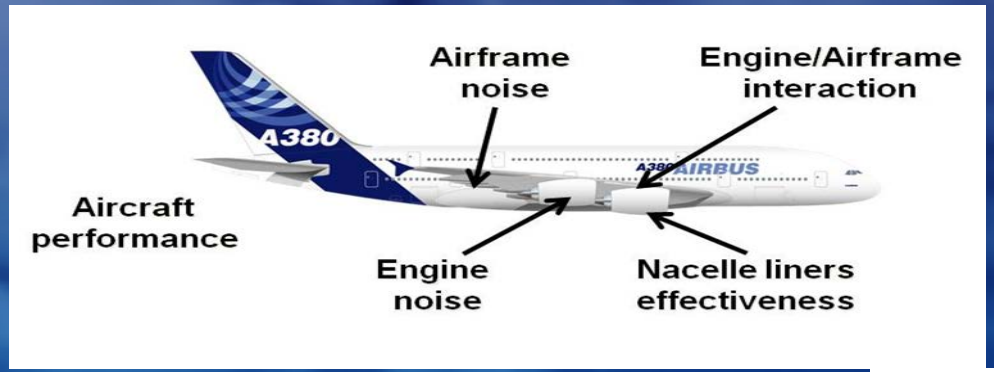


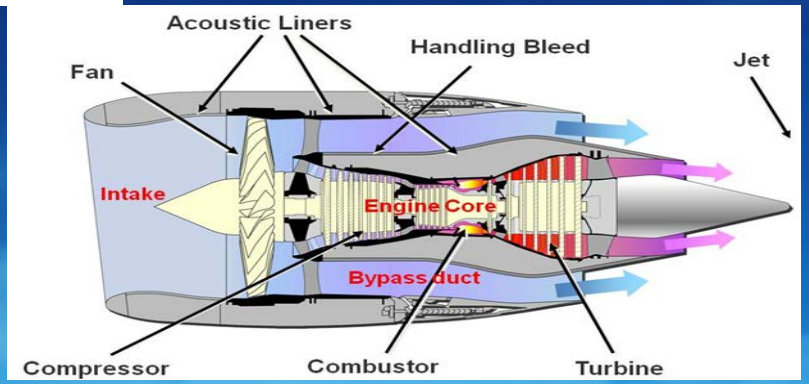
- CO2 by 70%
- NOx by 90%
- Noise by 75%

The Noise Challenge



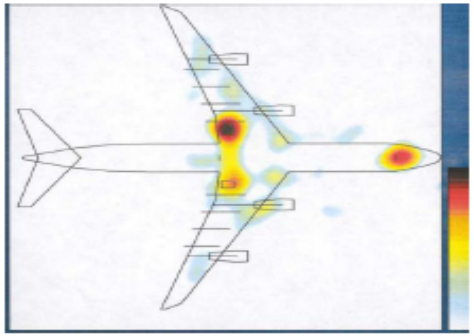
Aircraft and engine technology





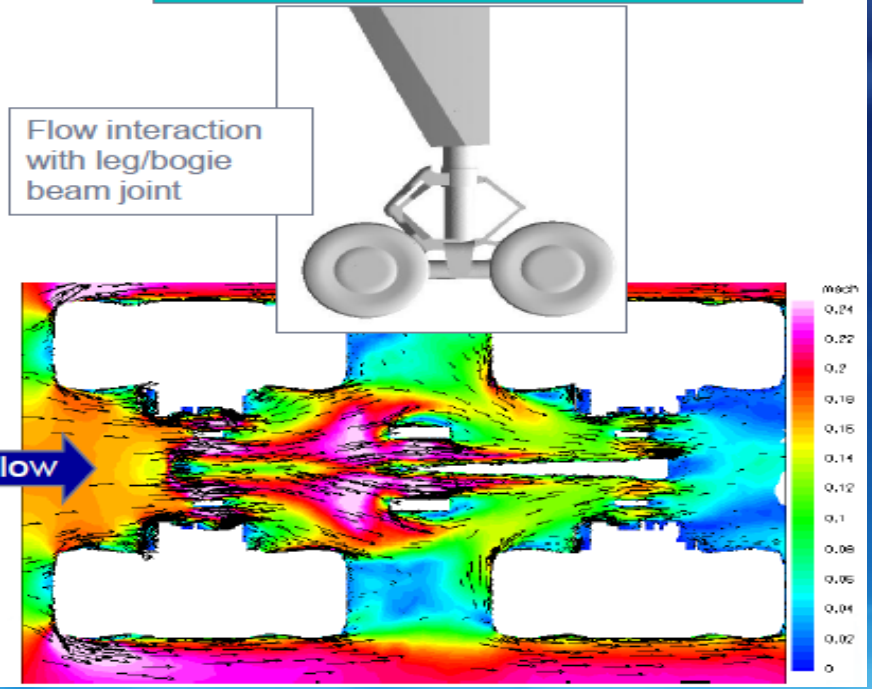
Main airframe noise sources
Landing gear

Noise source localization
Slat/Flap extended, LG down



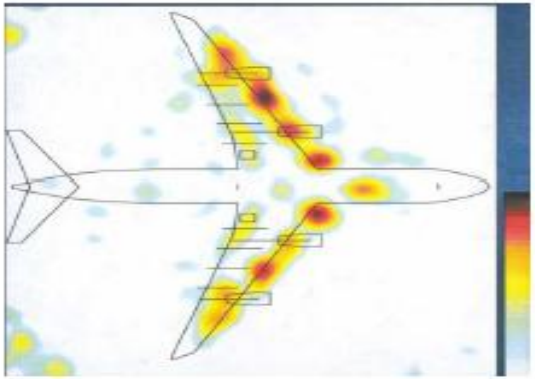
Driving parameter: aircraft airspeed
ΔSPL ~ 60 log (V)
Rough Order of Magnitude

MLG: Velocity Distribution in Horizontal Plane for z = - 3.300 m



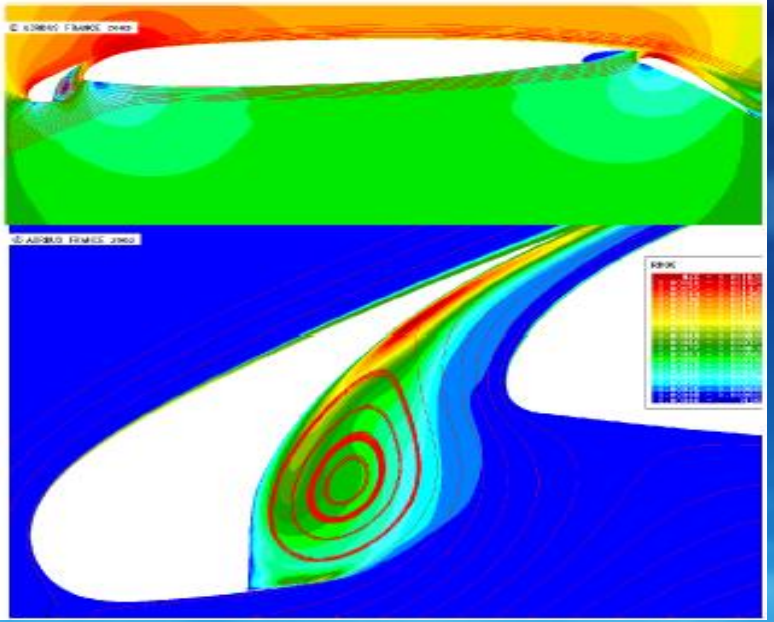
Main airframe noise sources
High lift systems

Noise source localization
Slat/Flap extended, LG down



Driving parameter: aircraft airspeed
ΔSPL ~ 60 log (V)
Rough Order of Magnitude

Flow distributions
-hight lifted profile
-slat cove



The Perfect Flight

- Implementing sustainable best practices for a “Perfect Flight”…

5 MILLION HOURS EXCESS FLIGHT TIME

9 MILLION TONNES EXCESS FUEL

28 MILLION TONNES OF CO_2

CO_2

Industry Commitments – CO2

Transport Action Group Source

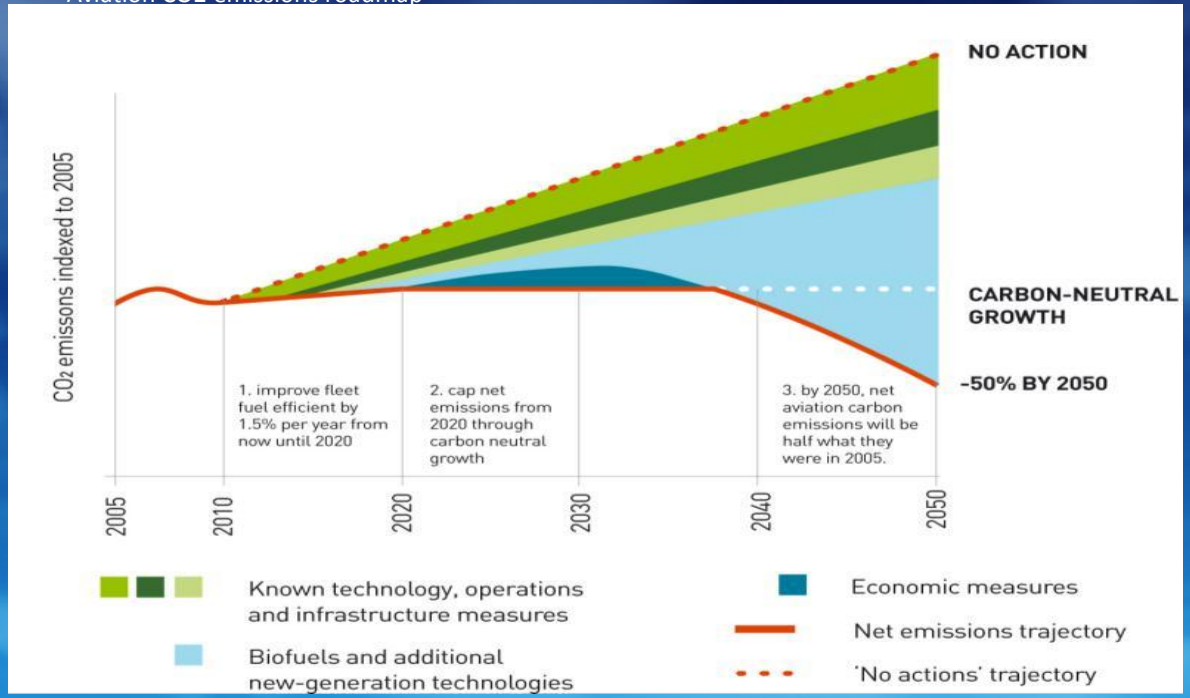
•Targets

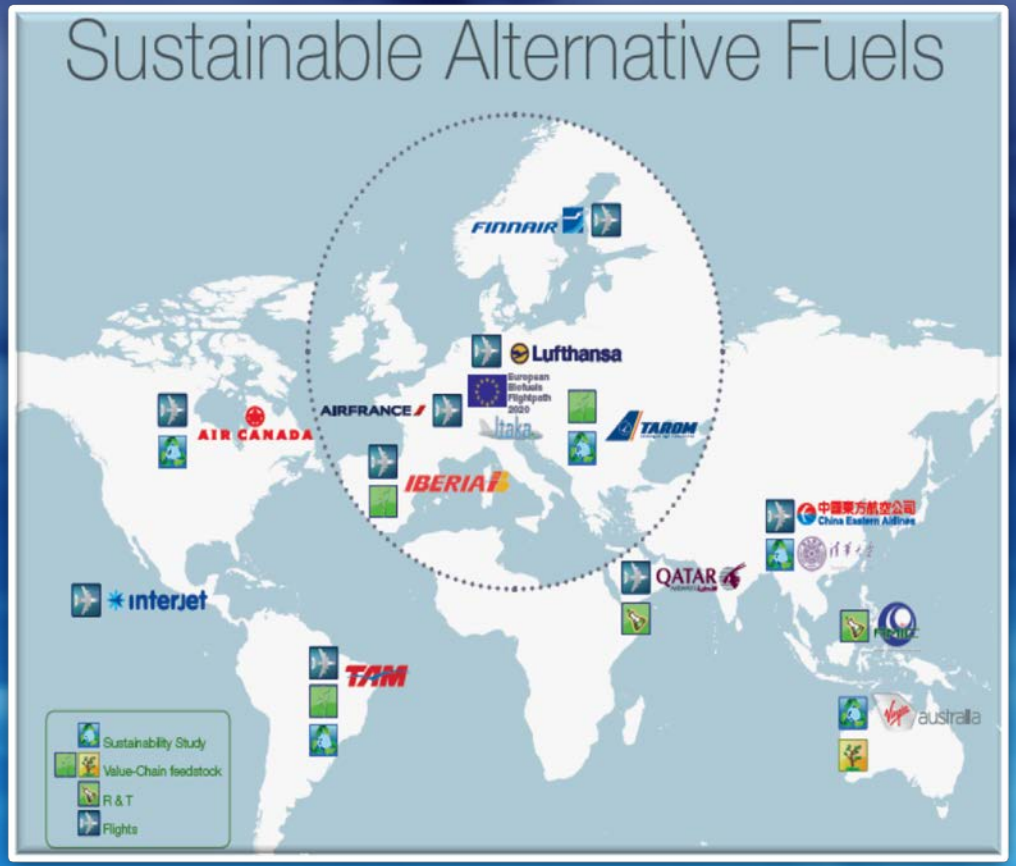
1. Improve fleet fuel efficiency by 1.5% to 2020
2. Cap net CO2 emissions through carbon-neutral growth
3. Reduce net CO2 emissions by 50% below 2005 levels by 2050

The four pillars

- Technology (incl. biofuels)
- Operations
- Infrastructure
- Economic measures

Aviation CO2 emissions roadmap





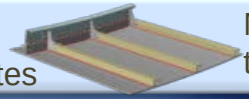
- Demonstration flights
- Value chains
- Commercial flights

The future

“Game Changing” technology readiness

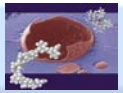
Innovative structure

Composites



Metallic technologies

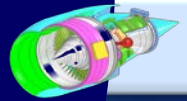
Nano technology



New engines

Advanced turbofan (Leap X and GTF)

Next Generation turbofan

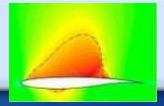


Open rotor

Aerodynamic efficiency

Sharklet

Laminar Flow & “Smart” wings



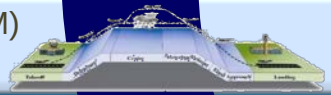
Alternative fuel

Biofuels

Fuel cell technology

Air Traffic Management

SESAR/Next Gen (ATM) Green trajectories



Innovative cockpit

2010 to 2020

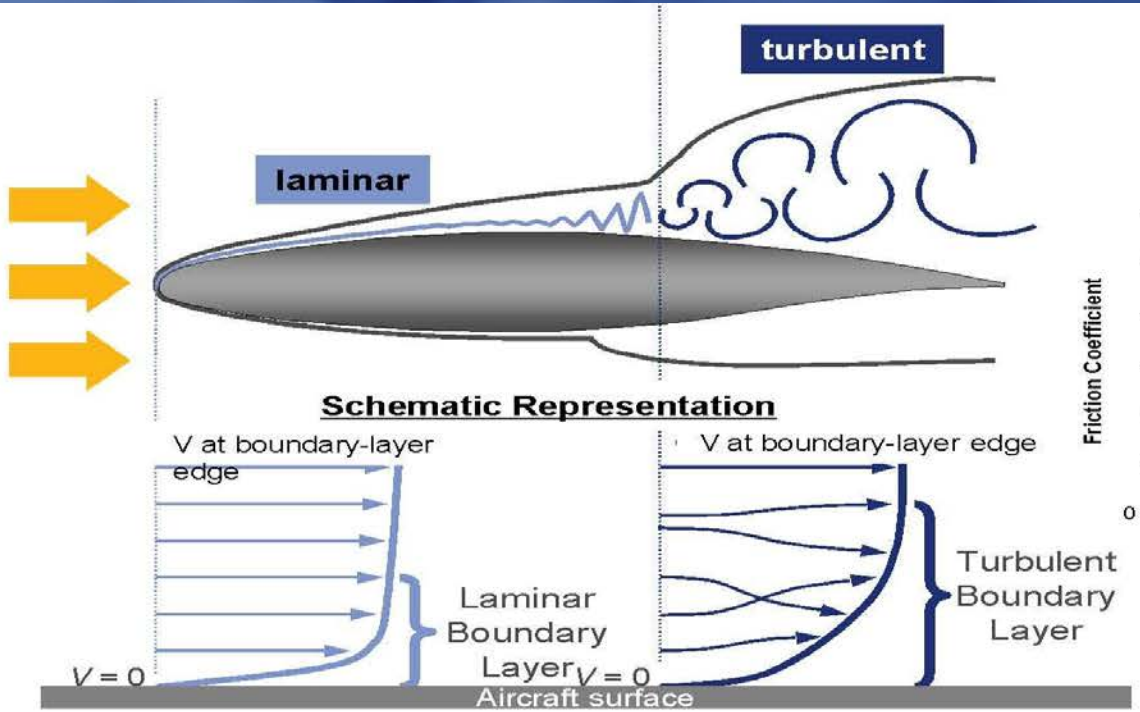
Beyond 2025

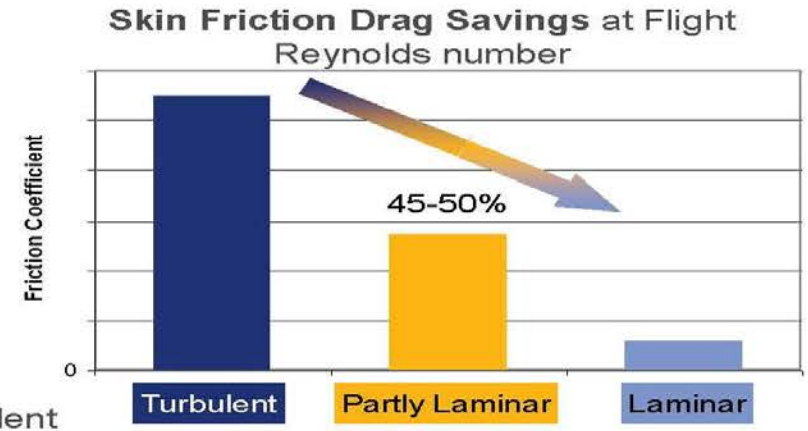
Innovation

A long term future technology vision

Configuration and new power plant	Non-conventional aircraft concept New propulsion concepts
Flow control	Full active flow and load control
Airframe	Adaptive, intelligent structures
Value adding cabin	New passenger services full wireless
Mission management	Flight or ground based Mission management

Drag reduction through Laminar Flow

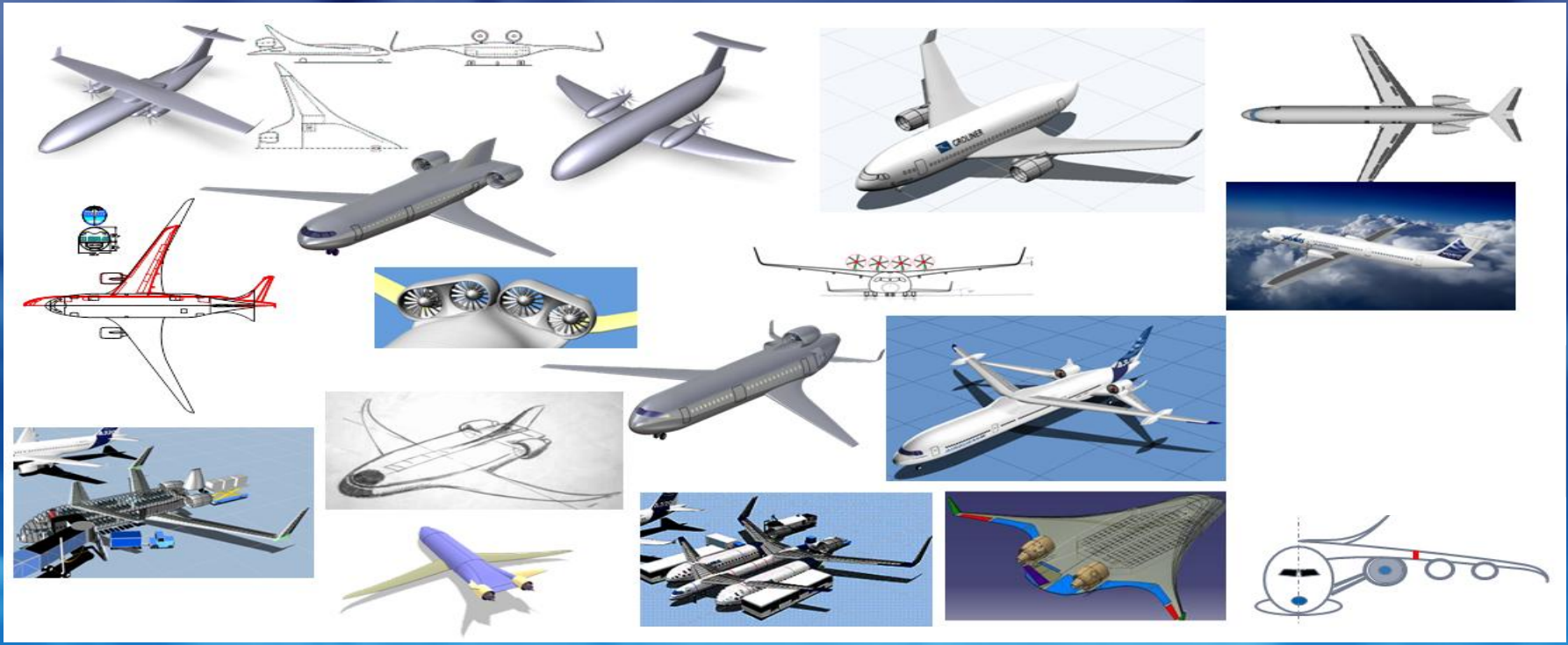




SFWA WP3.1 BLADE

FTI GROUP Specialist in System Development
DASSAULT AVIATION
asco
ONERA THE FRENCH AEROSPACE LAB
GKN AEROSPACE
SAAB
AERnnova
DLR
NLR
INCAS
bias
ita
VEW
AIRBUS

Overall configuration challenge

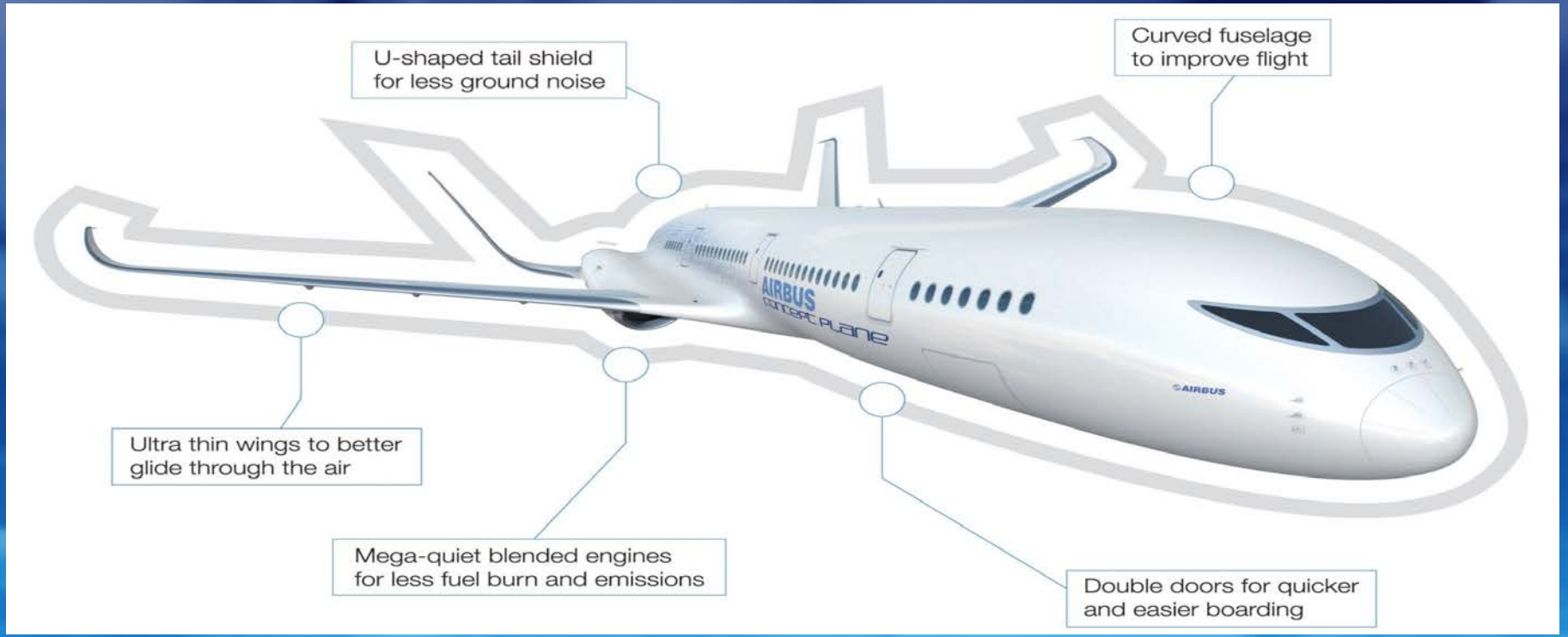


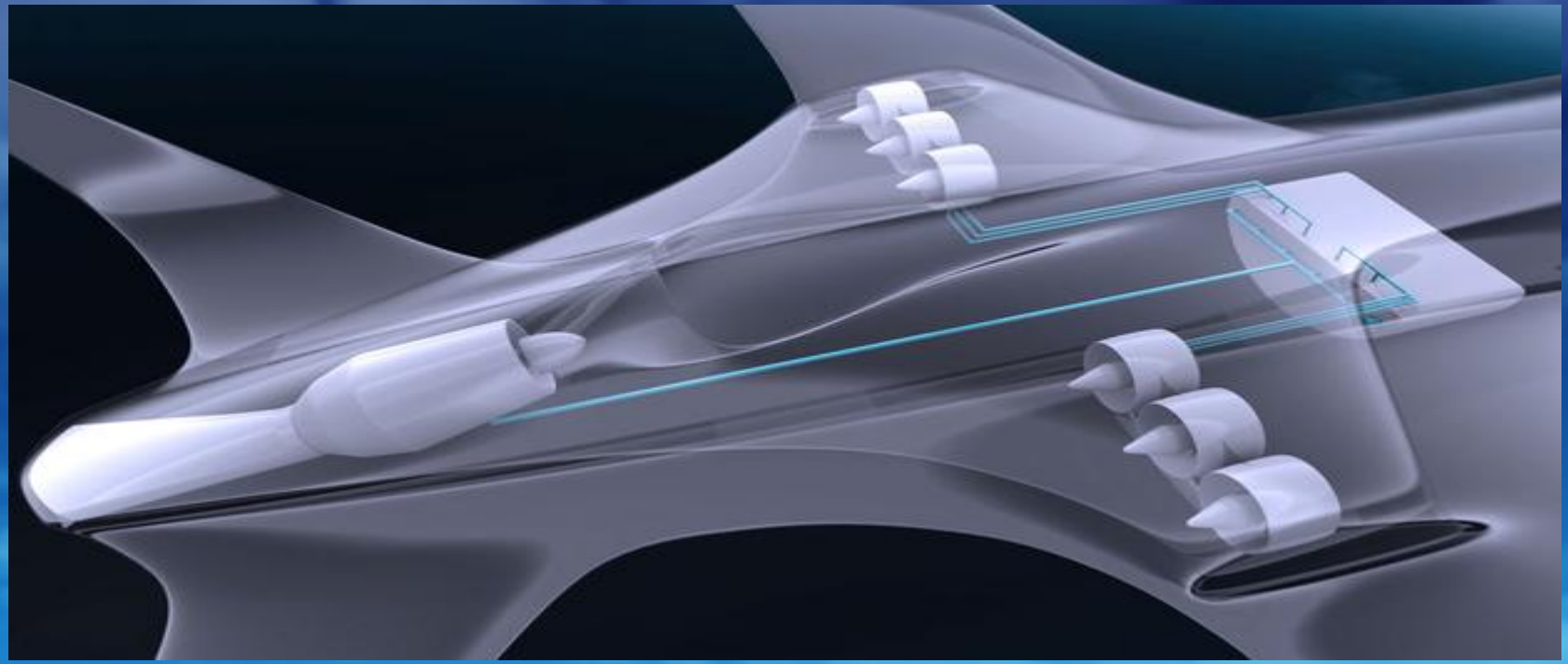
Need to shift from single discipline asymptotic trend...
thanks to capabilities and skills enabling multipoint and multidisciplinary configuration optimisation

Blended wing

VELA 2 (from DLR website)

The Future – Our Vision, Our Concept Plane

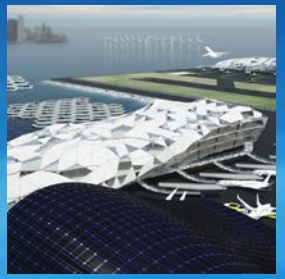




AIRBUS SMARTER SKIES





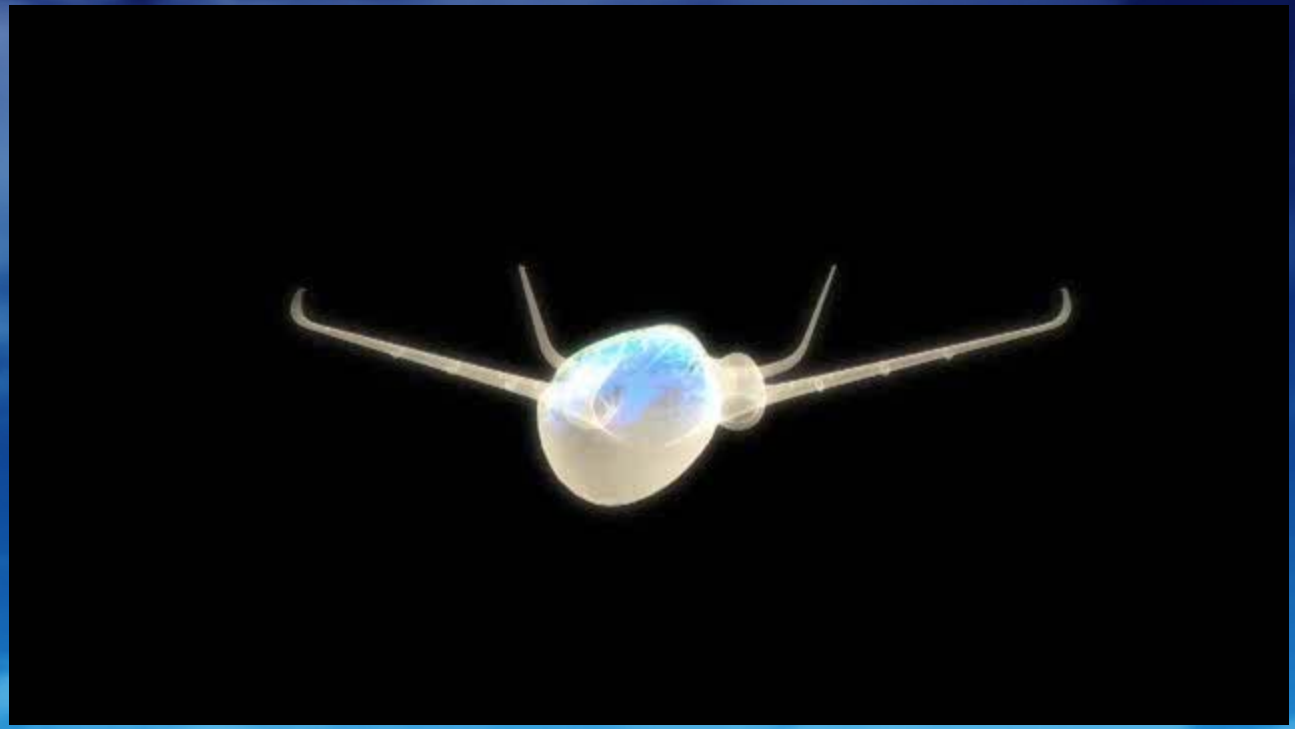


Assisted take off and continuous ‘eco-climb’

Aircraft in free flight and formation along ‘express skyways’

Low-noise, free-glide approaches and landings

Low emission ground operations



Main ambitions for future

Highly differentiating

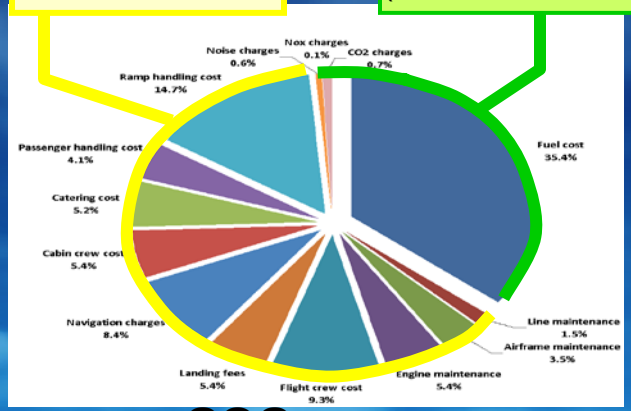
Prepared for future

OPERATIONS
↘Operations cost
↗Revenue

EMISSIONS
↘Fuel
(+ ↘Noise, Nox, CO2…)

RECURRING COST

FUTURE PROOF
Flexible toward **Energy**, Green, Growth



COC

The technical rupture is pulled by multiple drivers


the future
by Airbus