

Scope

- Airbus Acoustics Engineering Activities
- Aircraft Noise Management & Regulations
- Current and Future Aircraft Noise Design
- Noise Abatement Procedures Concepts
- Demonstration of tailored operations on Heathrow
- Conclusions

Scope

- Airbus Acoustics Engineering Activities
- Aircraft Noise Management & Regulations
- Current and Future Aircraft Noise Design
- Noise Abatement Procedures Concepts
- Demonstration of tailored operations on Heathrow with A380
- Conclusions

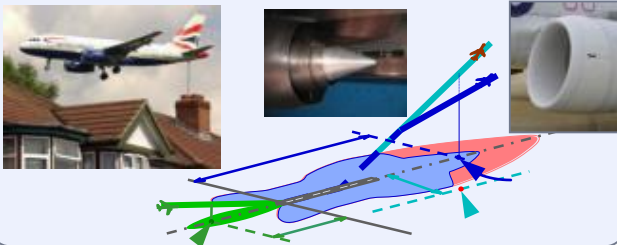
Acoustics within Airbus Design Office

Acoustic Design office missions :

Enable & support development of **competitive** and **innovative A/C solutions** fulfilling **acoustic regulatory requirements**, **customer expectations** and **business challenges**.

Three types of noise considerations :

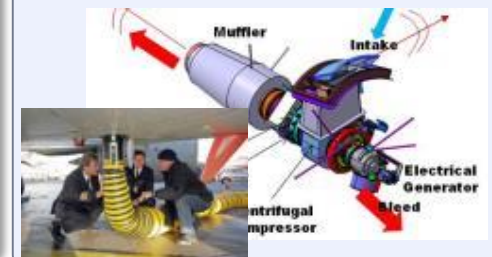
Community noise : Design, certification and operation



Interior noise : cabin & cockpit



A/C : Ramp noise



Acoustic activities cover the whole aircraft program lifecycle :

R&T ; Method & Tools
Predevelopment
Prepare our future challenges

Development
Prediction
Drive multidisciplinary noise design

Certification:
Verification & Validation cycle
Demonstrate compliance

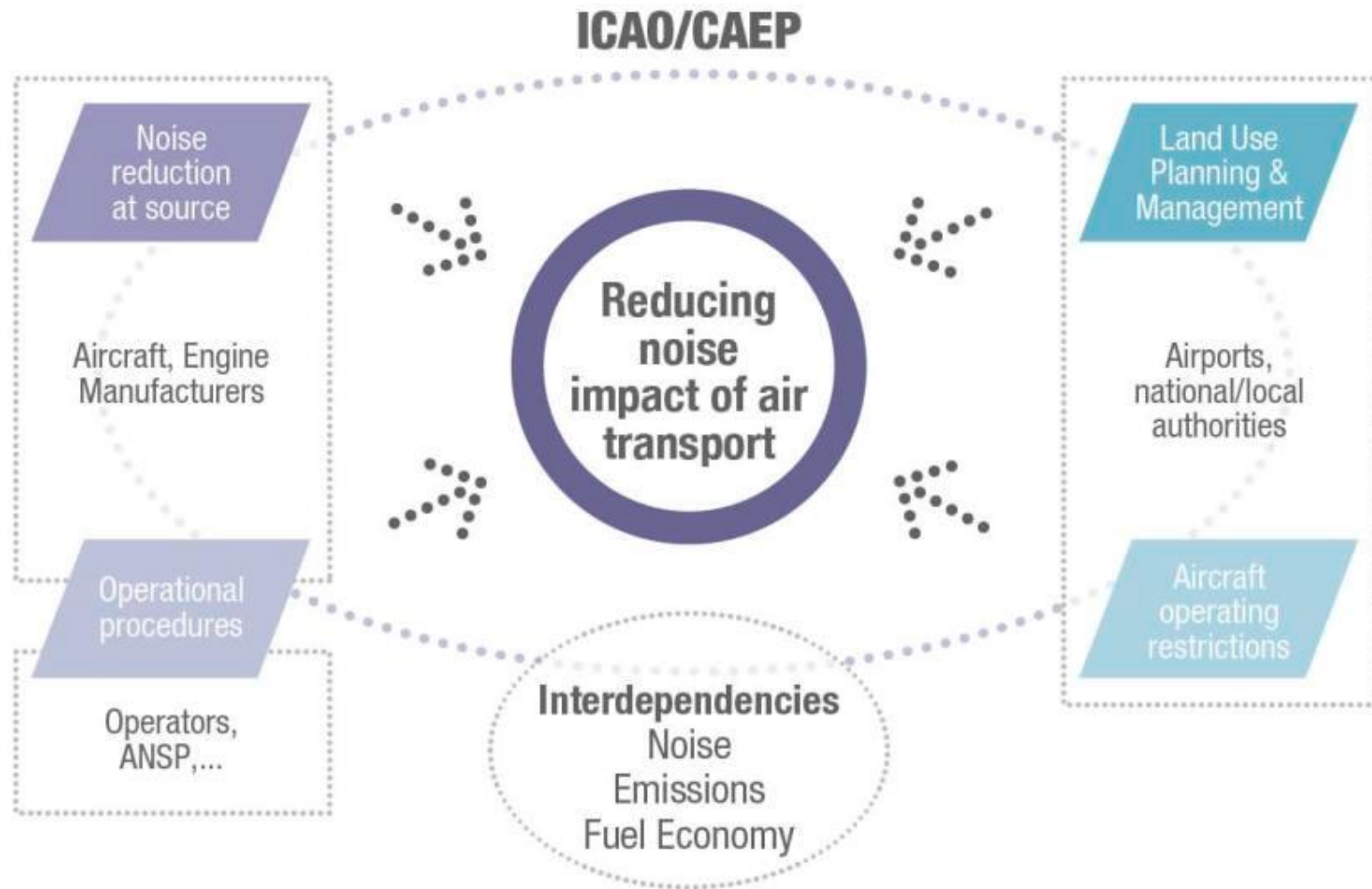
Series
Support In-service A/C,
Cont Dev and Operations

Scope

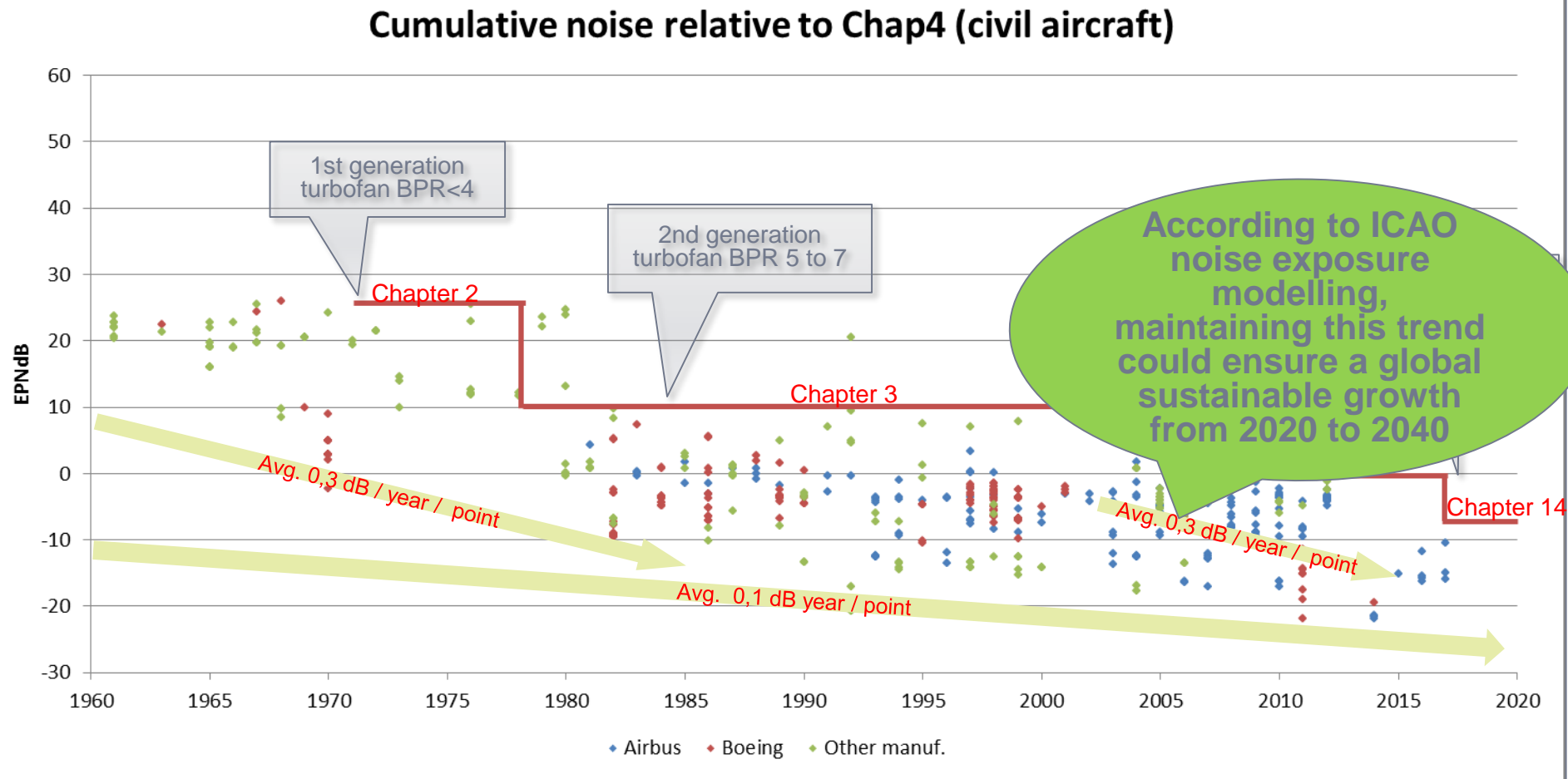
- Airbus Acoustics Engineering Activities
- Aircraft Noise Management & Regulations
- Current and Future Aircraft Noise Design
- Noise Abatement Procedures Concepts
- Demonstration of tailored operations on Heathrow with A380
- Conclusions

Balanced approach to A/C noise management

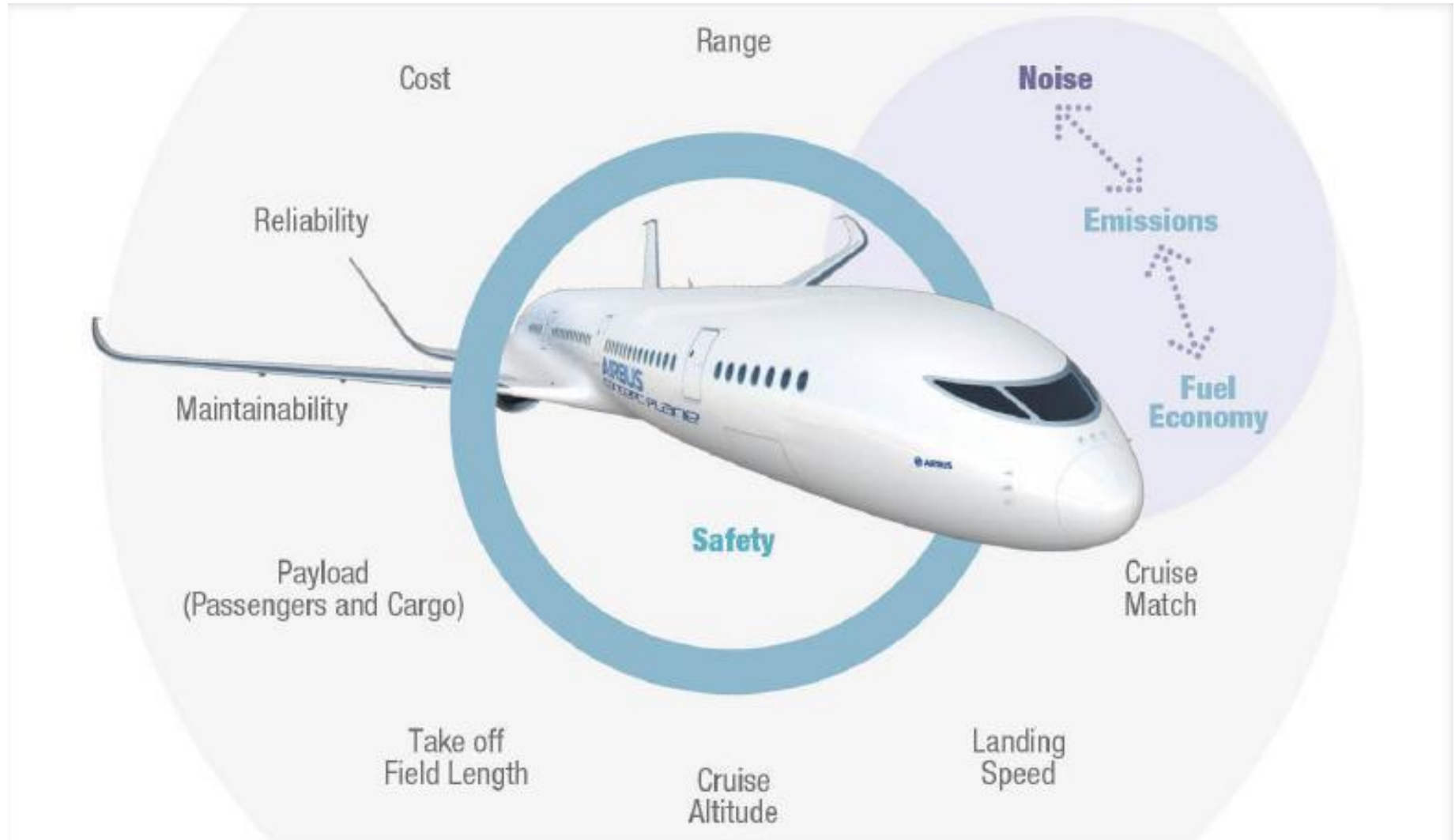
ICAO resolution A33-7, voted in October 2001



History of Increased ICAO Noise Stringency / Noise Reduction Achievements + trends



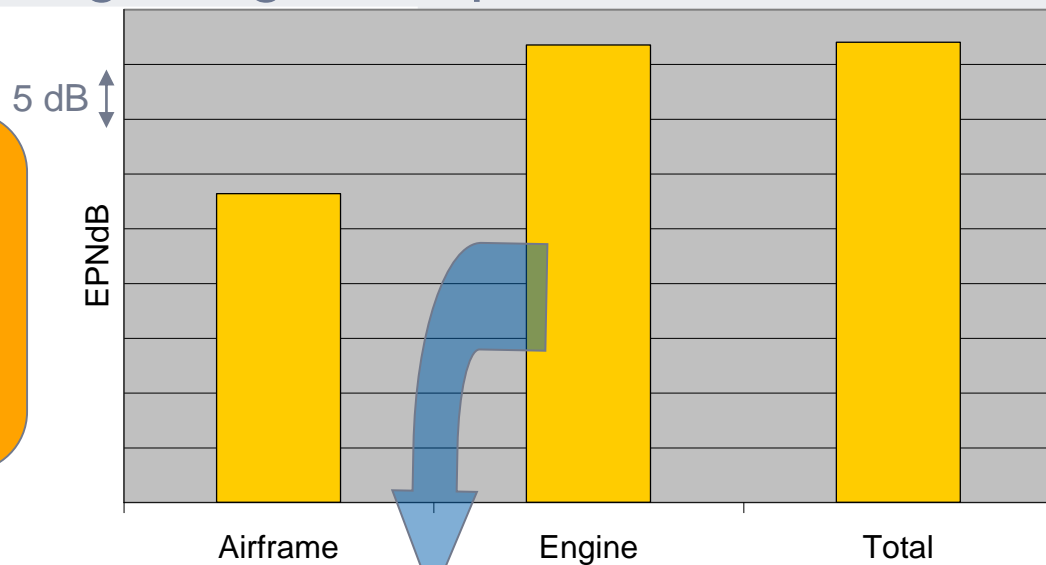
Airplane Design: a Balance of Various Objectives



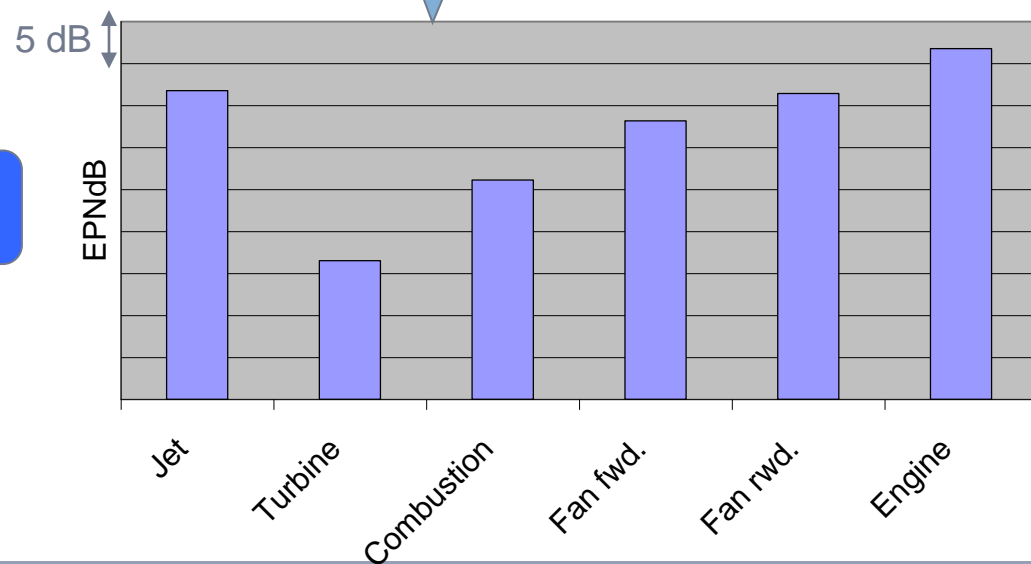
Noise sources breakdown on **Take-off** flight path

Representative Twin-engine Long Range transport aircraft

For take-off operation, engine noise is the major contributor to the overall aircraft signature. Quieter the engine noise will be, greater the airframe noise contribution will be.



Main engine noise sources come from jet and fan.

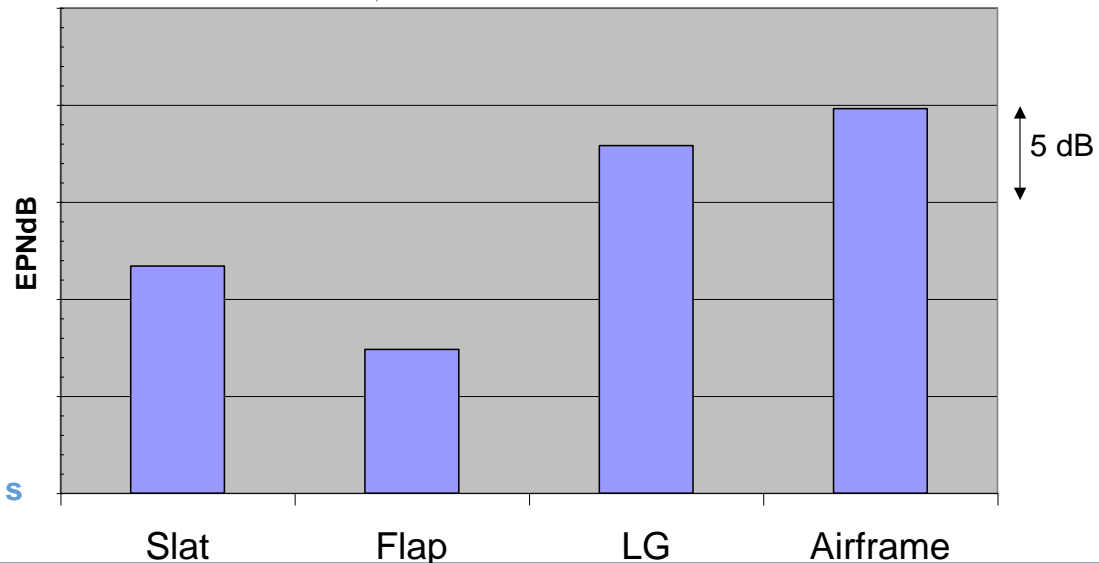
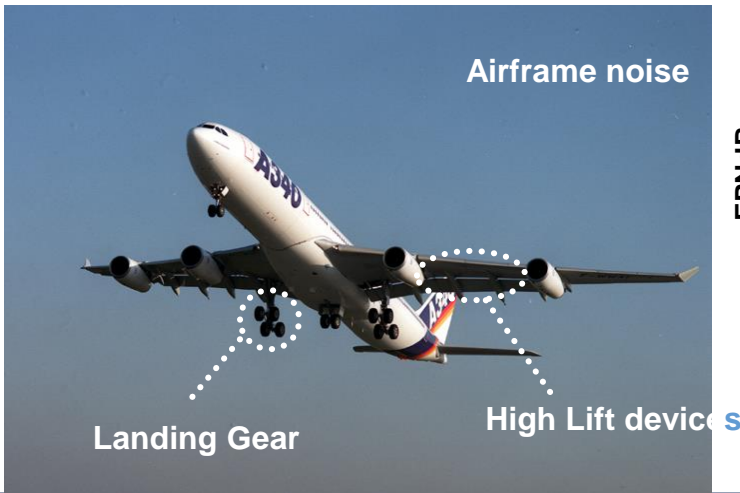
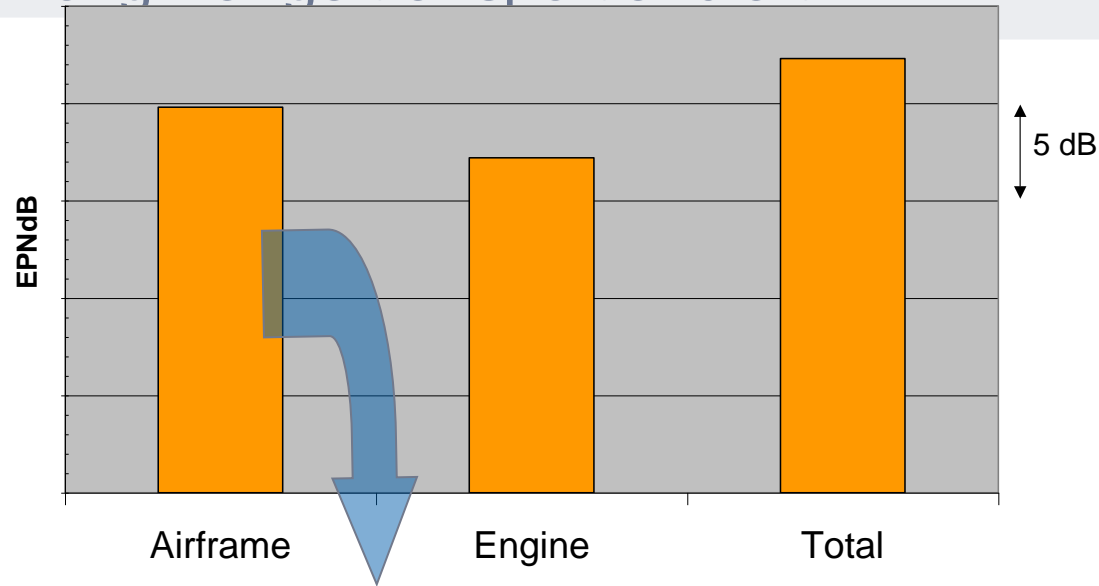


Noise sources breakdown on **approach** flight path

Representative Twin-engine Long Range transport aircraft

For **approach** operation, airframe noise is the major contributor to the overall aircraft noise signature

High-Lift Devices and Landing Gears are the main airframe noise sources



Scope

- Airbus Acoustics Engineering Activities
- Aircraft Noise Management & Regulations
- **Current and Future Aircraft Noise Design**
- Noise Abatement Procedures Concepts
- Demonstration of tailored operations on Heathrow with A380
- Conclusions

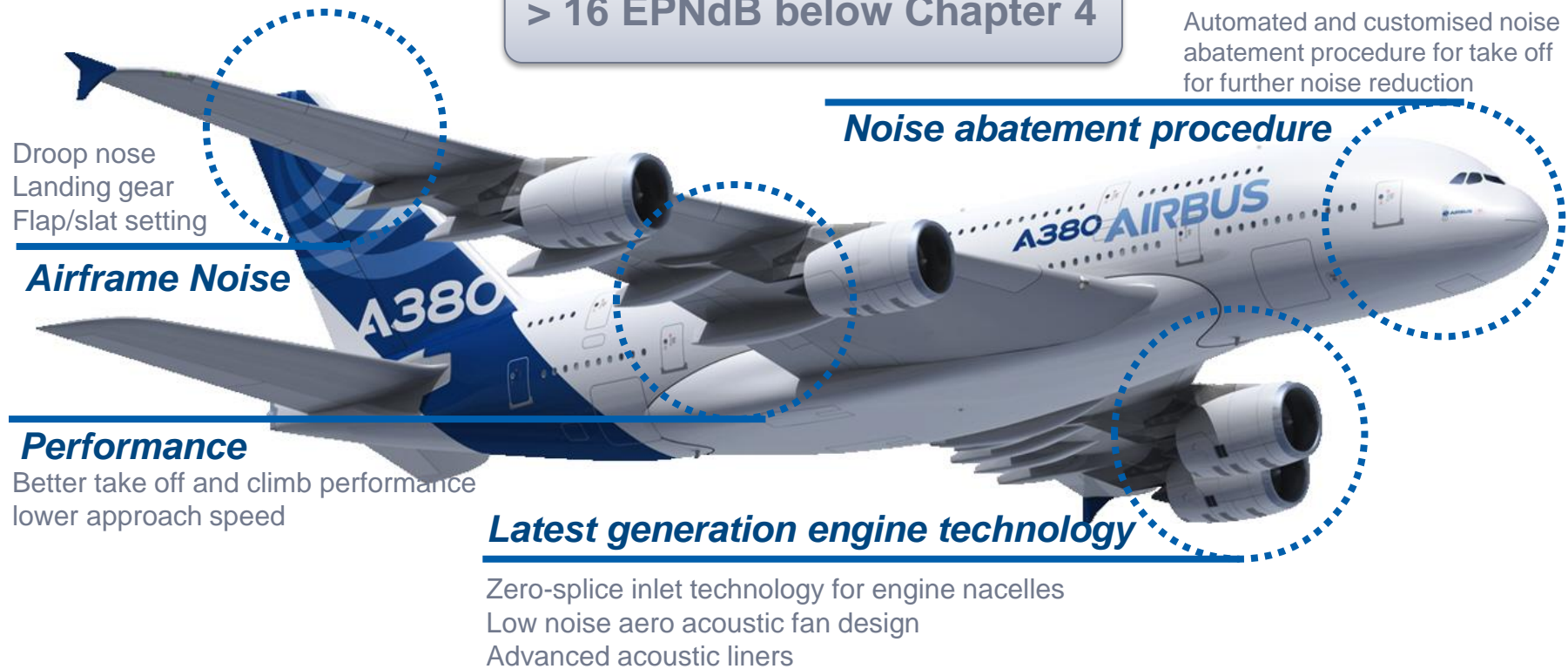
Benefit of current Airbus A/C In Service A380-800

The double-solutions: capacity + technology

The A380 offers the biggest change yet in noise reduction technology at airports. It can carry 42% more passengers than the competing aircraft but produces half the noise energy when taking off and three to four times less noise energy when landing.

> 16 EPNdB below Chapter 4

Automated and customised noise abatement procedure for take off for further noise reduction





A350 XWB

The 'Hushliner'

State of the art
Aerodynamics &
engine
technologies for
noise reduction -

Unmatched
quietness

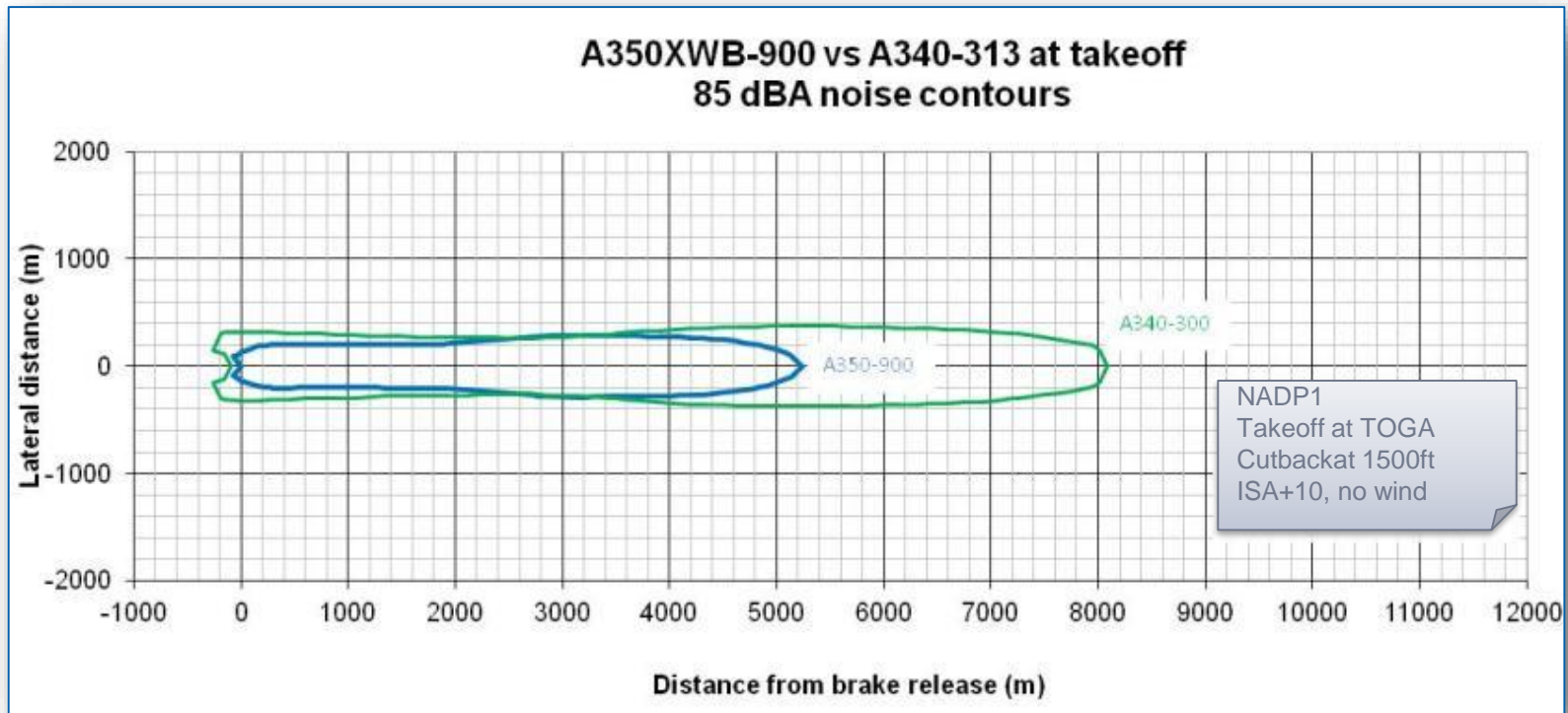
21dB

below ICAO Ch4
limit

Low noise design and technologies implemented on A350XWB

Benefit of Latest Airbus A/C in-Service A350-900

Noise benefit



Noise benefit compared to A340-300

About -7 EPNdB at take-off with 35 additional passengers

Benefit of Current Airbus A/C Developments

SA NEO : EIS in 2015 for A320 NEO

The new eco-efficient single-aisle

The New Engine Options for the A320 NEO offer high bypass ratio engines (PW GTF and CFM Leap 1A) with latest propulsion system acoustic design and technologies.

~ 19 EPNdB below Chapter 4

Sharklets

Improved
aerodynamic
performance

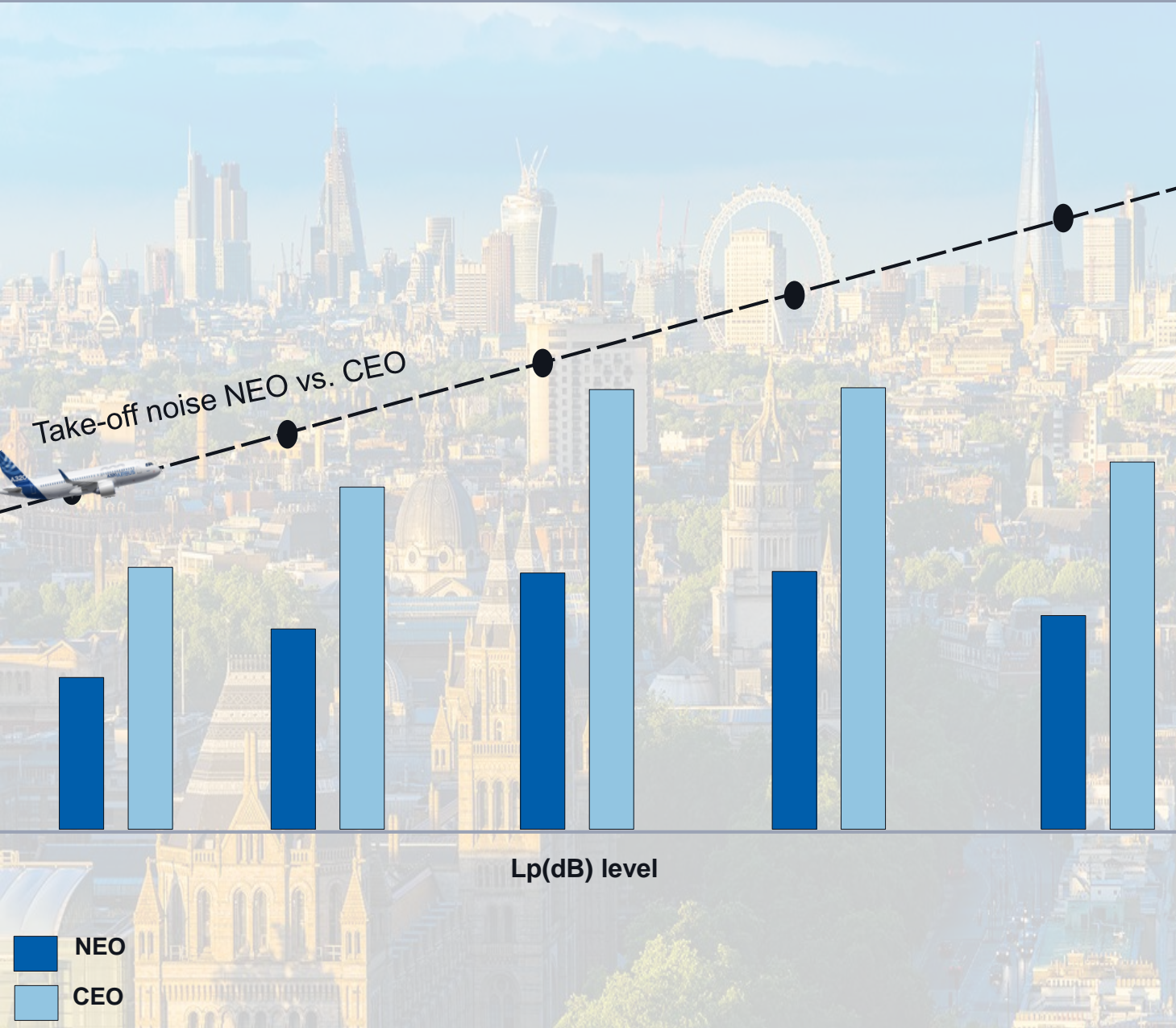
Air Flow Deflectors

Cavity noise
suppression

New engines

Bypass ratio 9 to 12
Up to 81 inch fan diameter
Lower noise levels
Latest nacelle liners technology





New Environmental Option

-19db

Noise level compared to Chapter 4

\$10M

PV savings from saving noise charges at London Heathrow

Serial Improvement

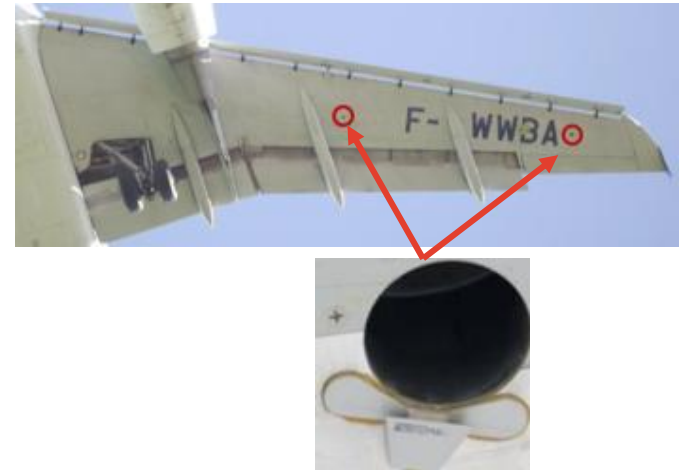
Sharklets : New wing tip devices developed to enhance low speed and high speed A/C performance.

Benefit vs. in-service SA family (with current wing tip fence) :
Up to -1 EPNdB in operational take-off conditions



SA Fuel Over Pressure Protector Air flow Deflector

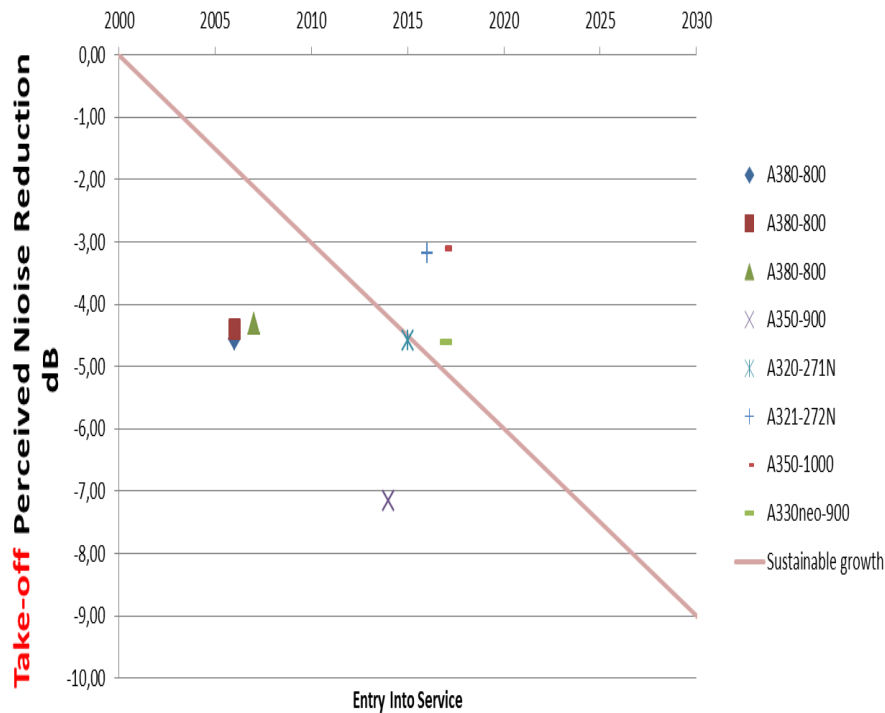
Benefit of vortex generators in approach conditions :
Up to -9 dBA in a speed range between 180 and 240 kts, corresponding typically to a distance between 15 and 50km from the airport



Achievements versus highest ICAO technology goal

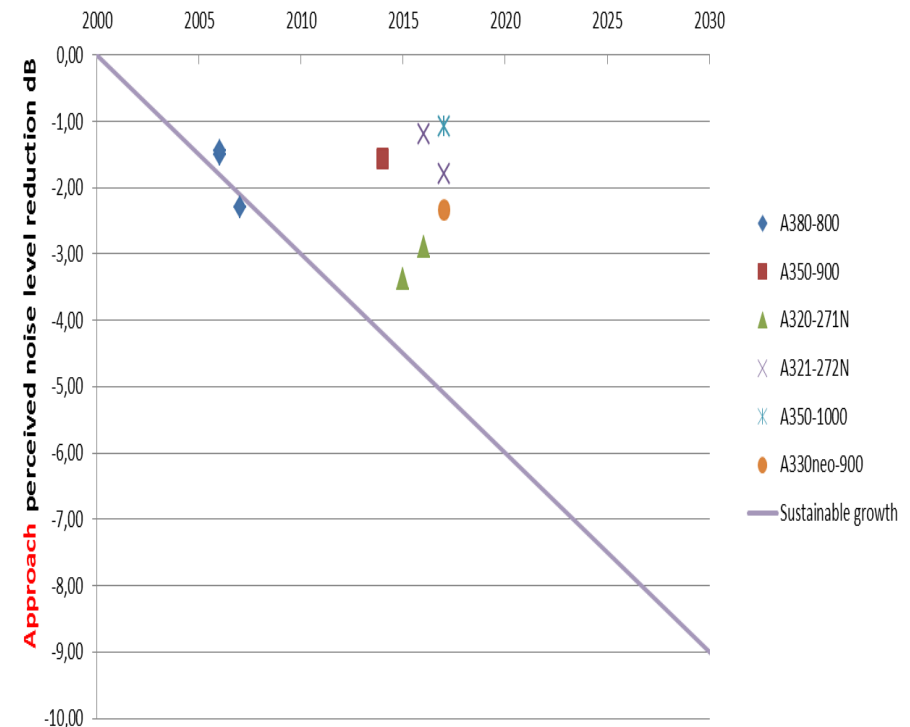
TAKE-OFF

Recent certified and Project Aircraft vs. < 2000 technology



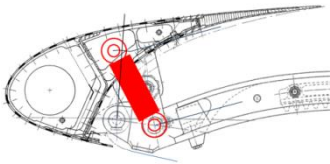
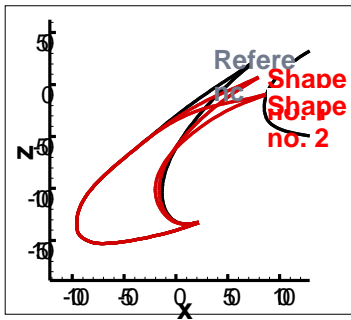
APPROACH

Recent certified and project aircraft vs. <2000 technology



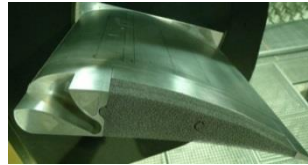
- Main achievements have been made on Take-off. Mainly thanks to engine / nacelle integrated aero-acoustic design

Next Steps for Design Optimization: examples of Future Green Technologies

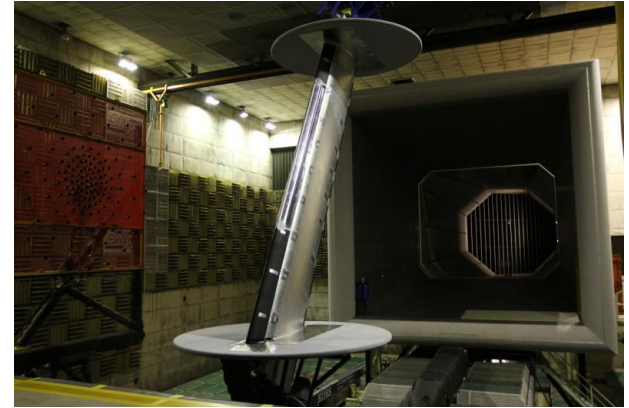


Adaptive slat

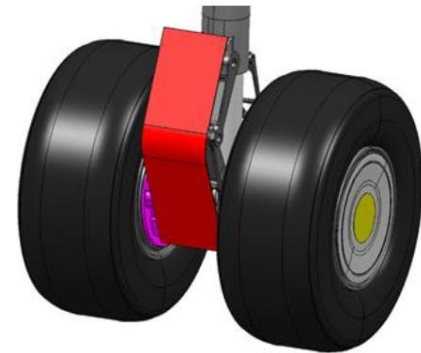
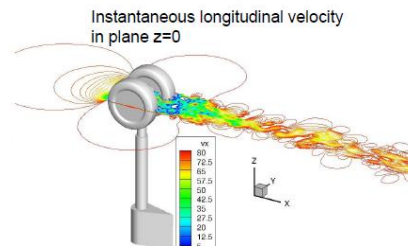
Slat/Flap technologies



Low-noise flap side edge technologies

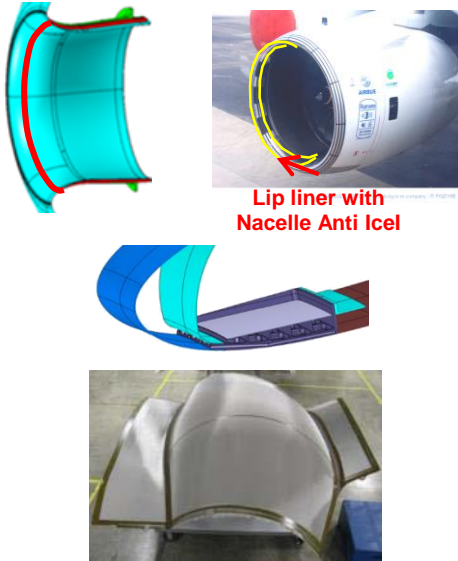


Low noise landing gear design

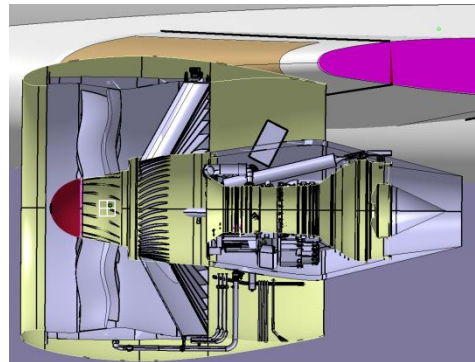


Next Steps for Design Optimization: examples of Future Green Technologies

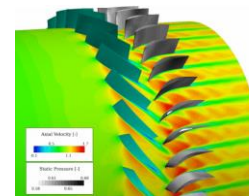
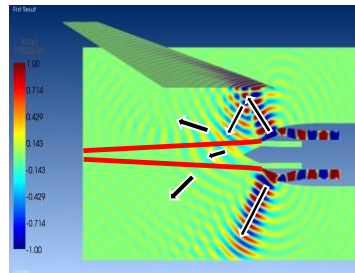
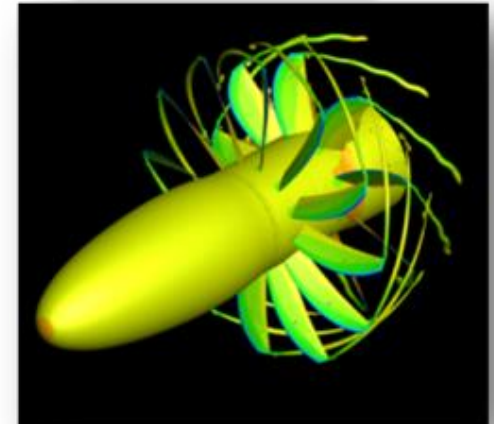
Novel nacelle acoustic technologies



Ultra High Bypass Ratio Turbofan



Open Rotor



Scope

- Airbus Acoustics Engineering Activities
- Aircraft Noise Management & Regulations
- Current and Future Aircraft Noise Design
- **Noise Abatement Procedures Concepts**
- Demonstration of tailored operations on Heathrow with A380
- Conclusions

Noise efficiency

Quieter operations in development

Pool of Noise Abatement Procedures

Departure

Arrival

MCDP

CDO/A

Segmented

Standard

E-G/S

IGS

UP to 10dBmax

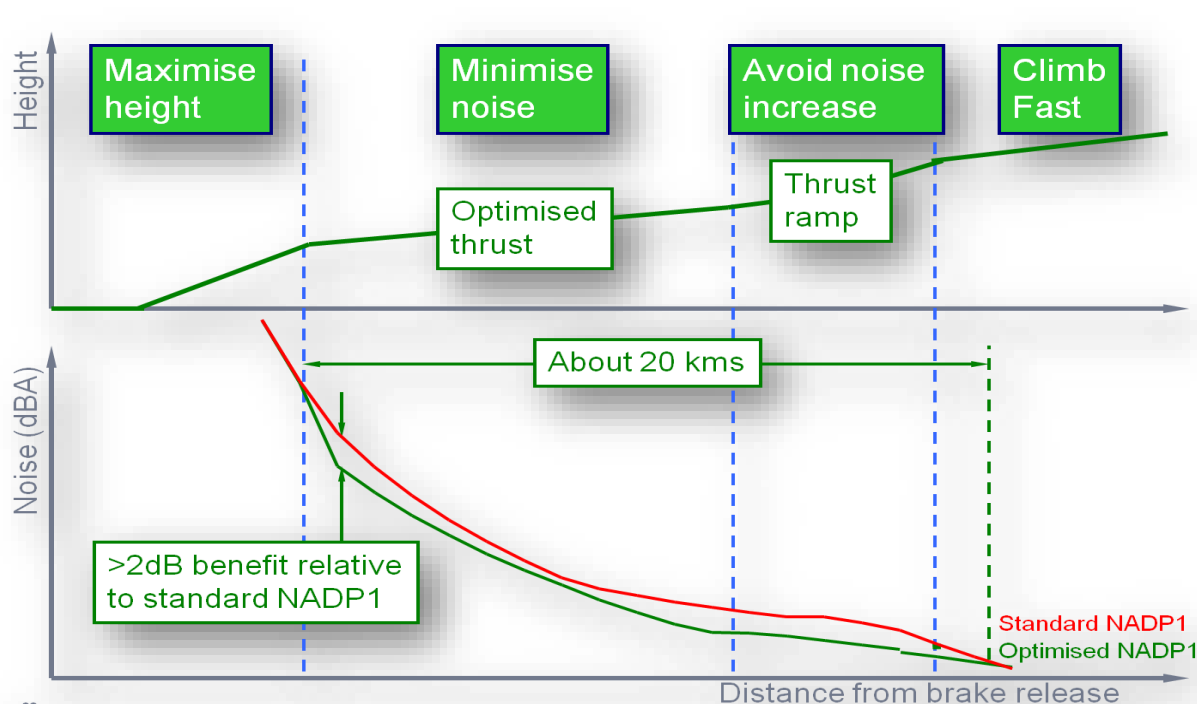
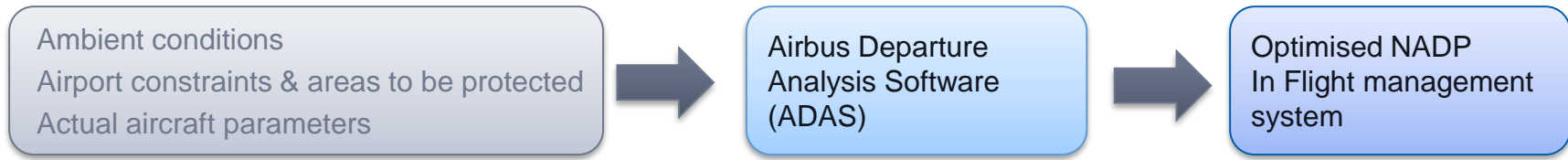
UP to 5dBmax

UP to 3dBmax

Optimization of Operational Procedures

Noise Abatement *Departure* Concept

Departure optimized function : A380 & A350 have a new automatic flight function to reliably & continuously handle NADP with optimum noise trajectories

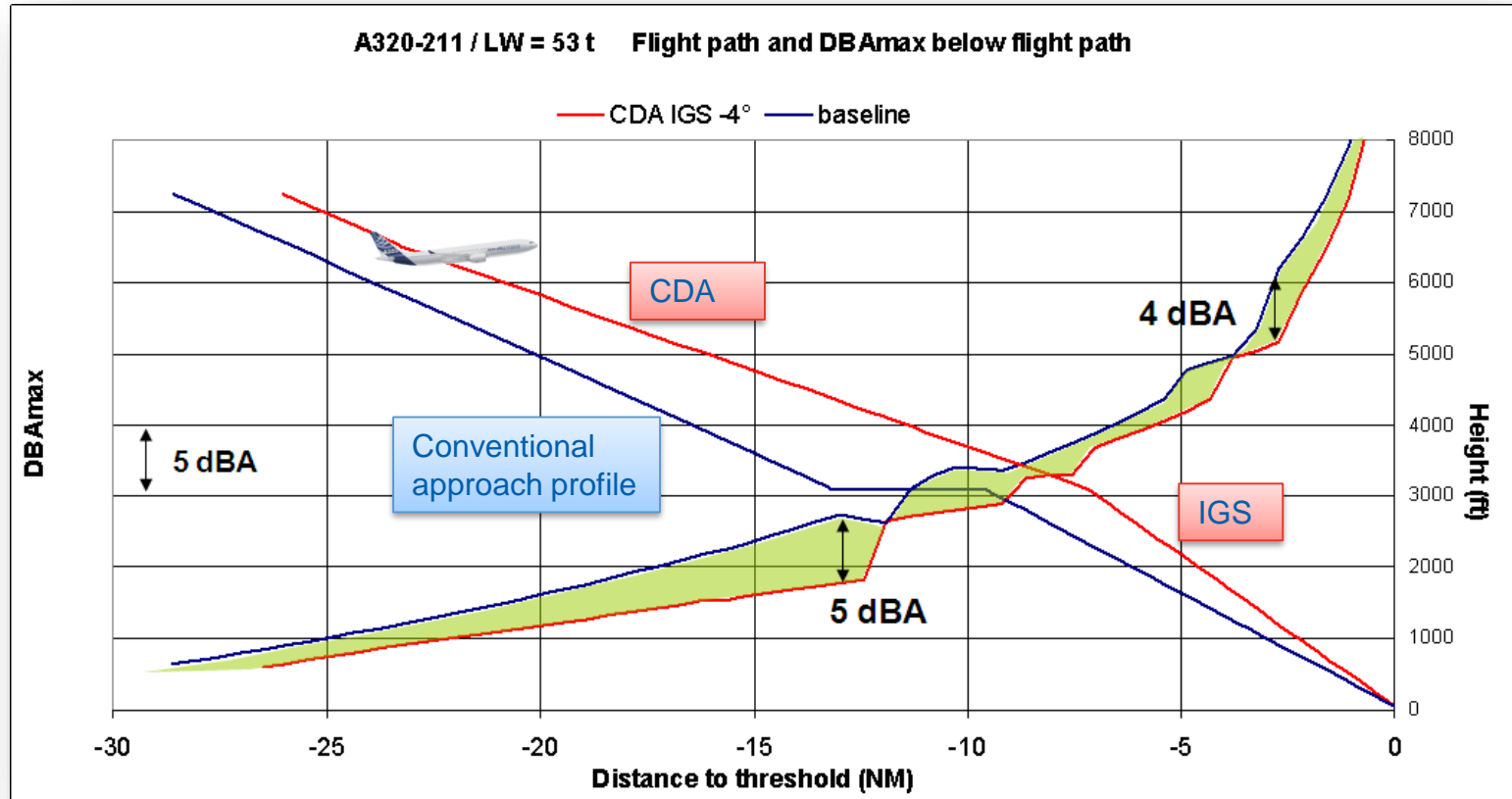


- Noise Thrust: Fixed thrust
- Noise Speed: Fixed speed
- Noise End Altitude (NEA): End of acoustic procedure
- Thrust ramp: Thrust transition from noise thrust to max climb thrust

Optimization of Operational Procedures

Noise Abatement *Approach* Concept

CDA with Increased Glide Slope (-4°)



Large area of noise benefit
Noise relief: 5dBA intermediate approach, 4dBA final approach

New ATM procedures to reduce environmental impact

➔ **Without Required Navigation Performance (RNP)**



116 arriving flights, RWY 34, Kelowna (Canada)

New ATM procedures to reduce environmental impact

➔ With Required Navigation Performance (RNP)



➔ Significantly less people affected with same traffic, same A/C

Scope

- Airbus Acoustics Engineering Activities
- Aircraft Noise Management & Regulations
- Current and Future Aircraft Noise Design
- Noise Abatement Procedures Concepts
- Demonstration of tailored operations on Heathrow with A380
- Conclusions

Tailored Operation on Heathrow Airport with A380

- Challenge: reduce aircraft noise impact on ground around LHR airport
- Proposed solution:
 - Take advantage of A380 noise performance and capabilities to comply with tailored operations:

➔ **Design new procedures for late departures and early arrivals**


- Stakeholders involved in the project
 - Airline: British Airways (BA)
 - Airport: Heathrow (HAL)
 - Air Navigation Service Provider (NATS)
 - UK Civil aviation Authorities (CAA)
- Proposed solutions to be used on BA revenue flights

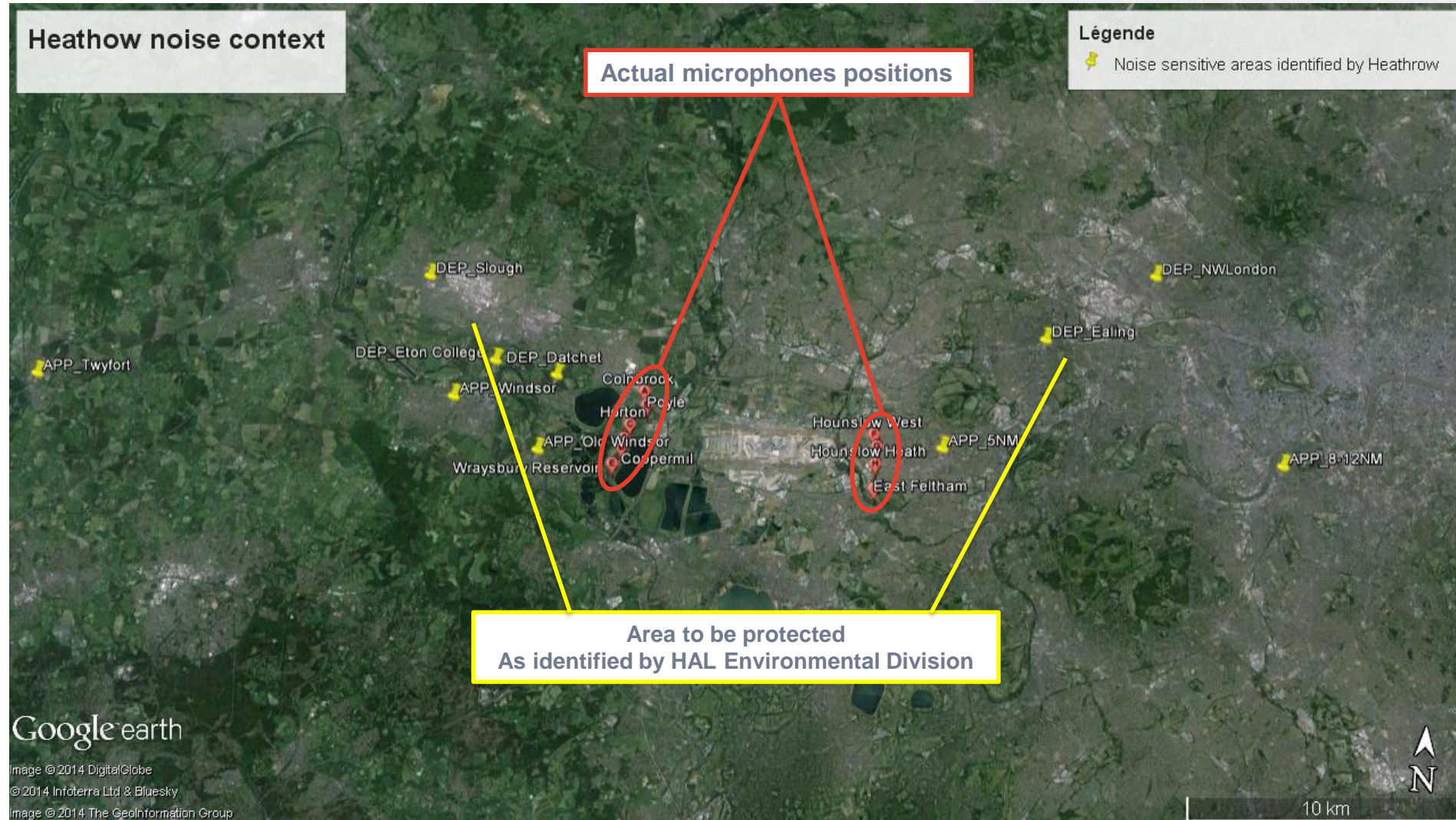
Tailored Operation on Heathrow Airport with A380 – Noise context

Heathrow noise context

Actual microphones positions

Légende

 Noise sensitive areas identified by Heathrow



Tailored Operation on Heathrow Airport with A380 – Departures

New lateral path designed by Airbus Prosky

- RNP procedure to ensure repeatability
 - No more lateral dispersion
- ➔ Procedure coded in A/C Nav database

Vertical path optimization by customization of

- Thrust reduction and acceleration altitudes
 - Intermediate speed value
 - Thrust value
- ➔ Values entered in A/C FMS page during cockpit preparation

ACTIVE/PERF

CRZ **FL 350** OPT **FL 370** REC MAX **FL 393**

T.O CLB CRZ DES APPR GA

RWY **14L**

V1 **135KT** F **169KT** **TOGA**

VR **140KT** S **220KT** **FLEX**

V2 **145KT** **246KT** **DERATED**

FLAPS **2** THS FOR **39.0%** T.O SHIFT **----M**

THR RED **3000FT**

ACCEL **800FT** EO ACCEL **1990FT**

NOISE END **5000FT** SPD **235KT**

CANCEL NOISE N1 **82%**

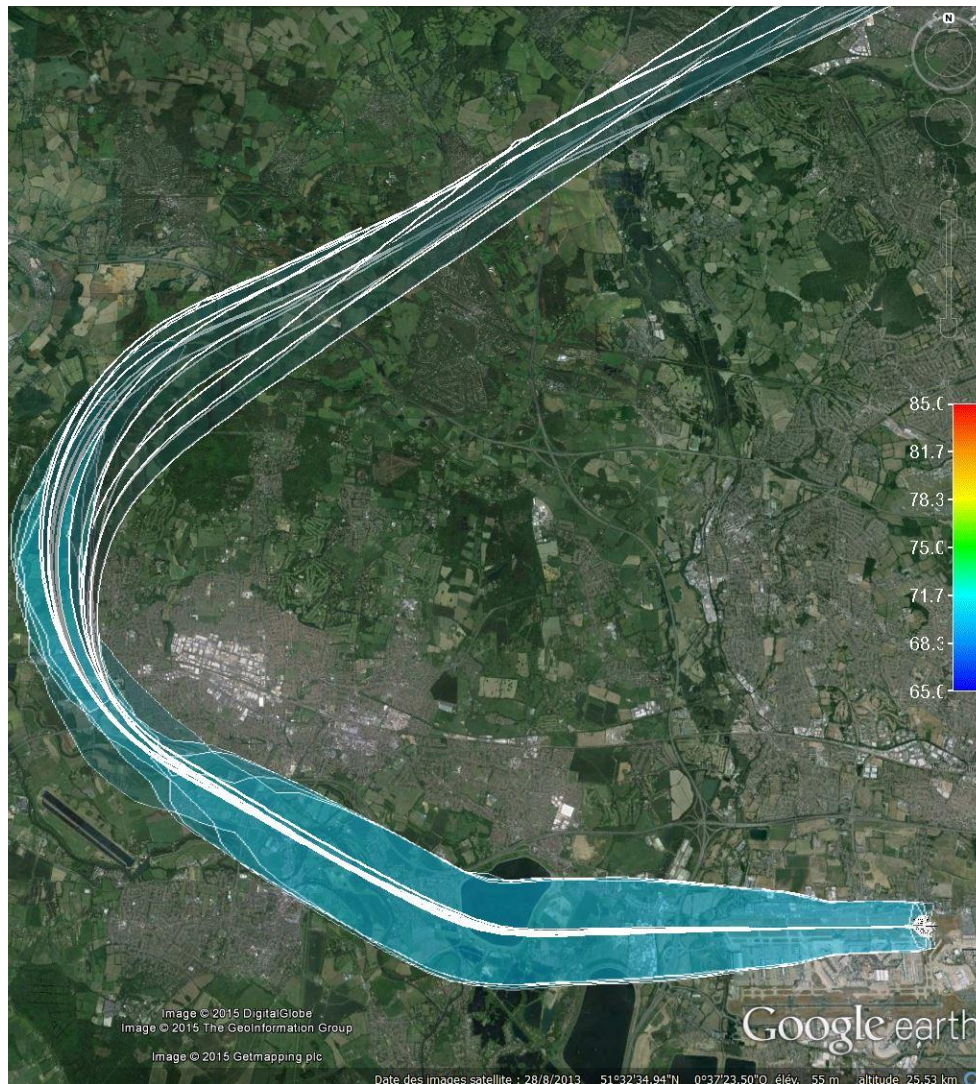
TRANS **5000FT** CPNY T.O REQUEST

RETURN POS MONITOR

CLEAR INFO



Tailored Operation on Heathrow Airport with A380 – Departures Noise Performance Analysis: Optimised vs. Reference flights



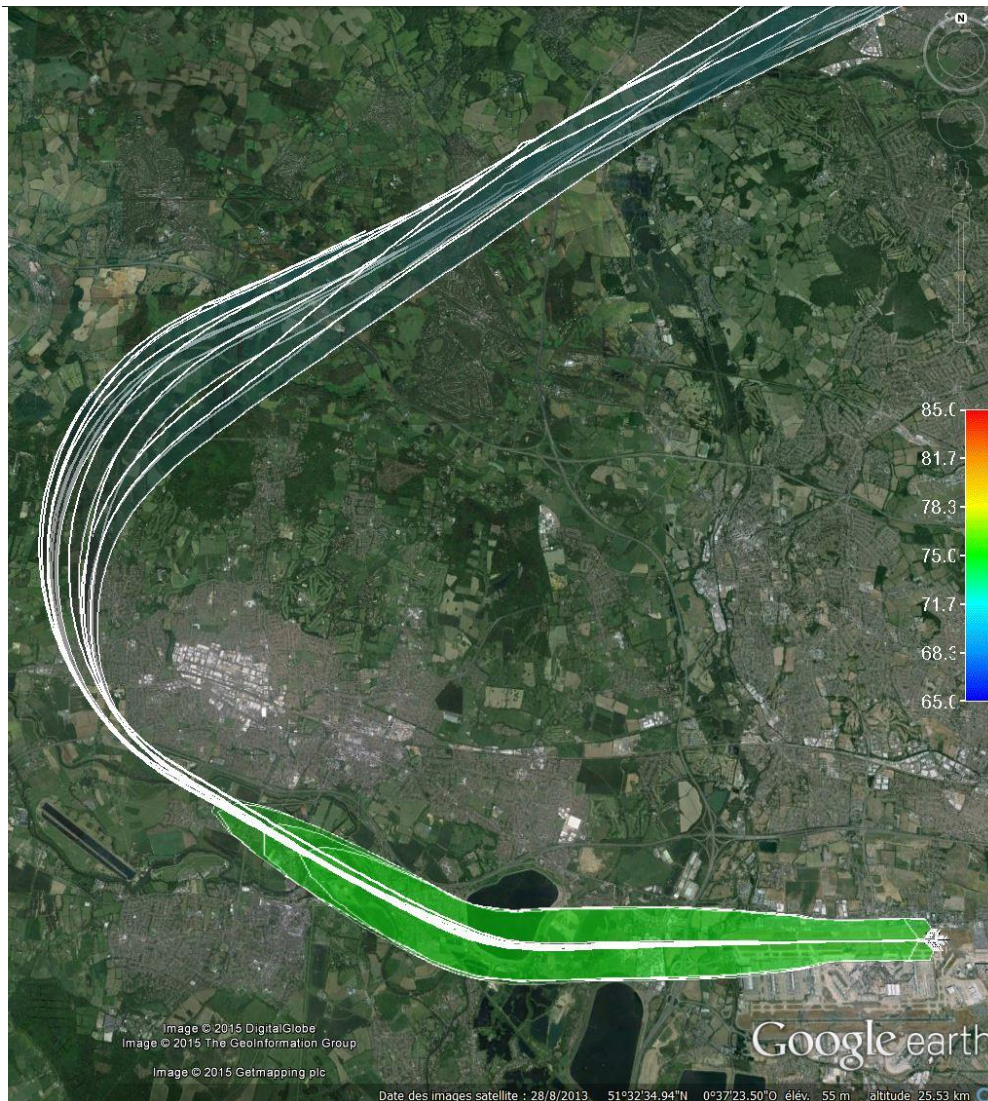
70dBA iso-contours

Footprint shape and surface
evolution from reference flights to
optimised procedures

Tailored Operation on Heathrow Airport with A380 – Departures Noise Performance Analysis: Optimised vs. Reference flights

75dBA iso-contours

Footprint shape and surface
evolution from reference flights to
optimised procedures



Tailored Operation on Heathrow Airport with A380 - Outcomes

- New designed procedures have been flown on BA revenue flights.
 - Positive feedback from BA pilots
 - ATCo well received these new procedure (no impact on traffic)

➔ **Noise benefits expected from modelling confirmed with real flights analysis.**

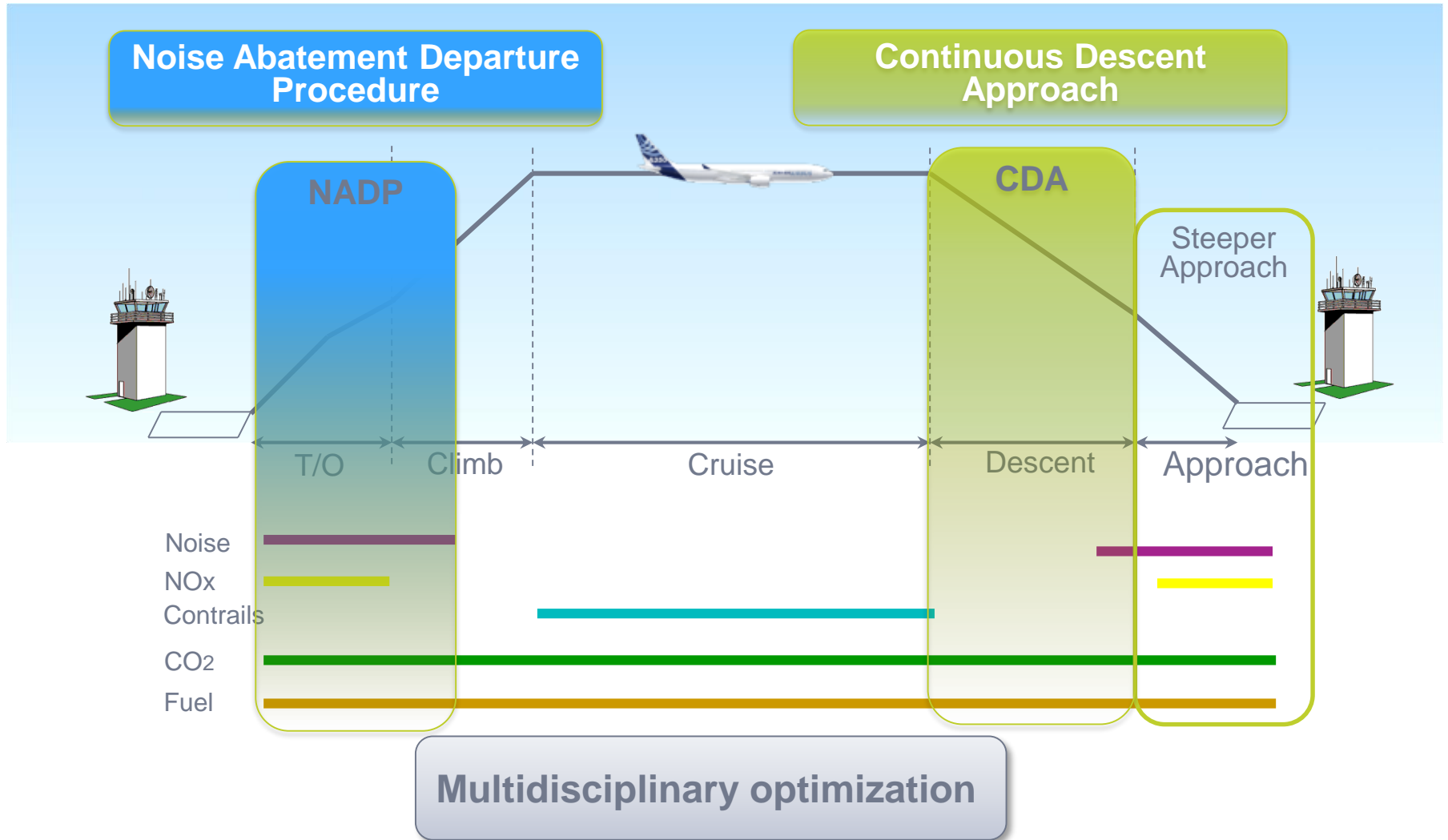
➔ **Demonstrate operations with a airlines are an efficient lever to tackle airport noise.**

© AIRBUS Operations S.A.S. All rights reserved. Confidential and proprietary document. This document and all information contained herein is the sole property of AIRBUS Operations S.A.S. No intellectual property rights are granted by the delivery of this document or the disclosure of its content. This document shall not be reproduced or disclosed to a third party without the express written consent of AIRBUS Operations S.A.S. This document and its content shall not be used for any purpose other than that for which it is supplied. The statements made herein do not constitute an offer. They are based on the mentioned assumptions and are expressed in good faith. Where the supporting grounds for these statements are not shown, AIRBUS Operations S.A.S will be pleased to explain the basis thereof. AIRBUS, its logo, A300, A310, A318, A319, A320, A321, A330, A340, A350, A380, A400M are registered trademarks.

Thanks for your attention

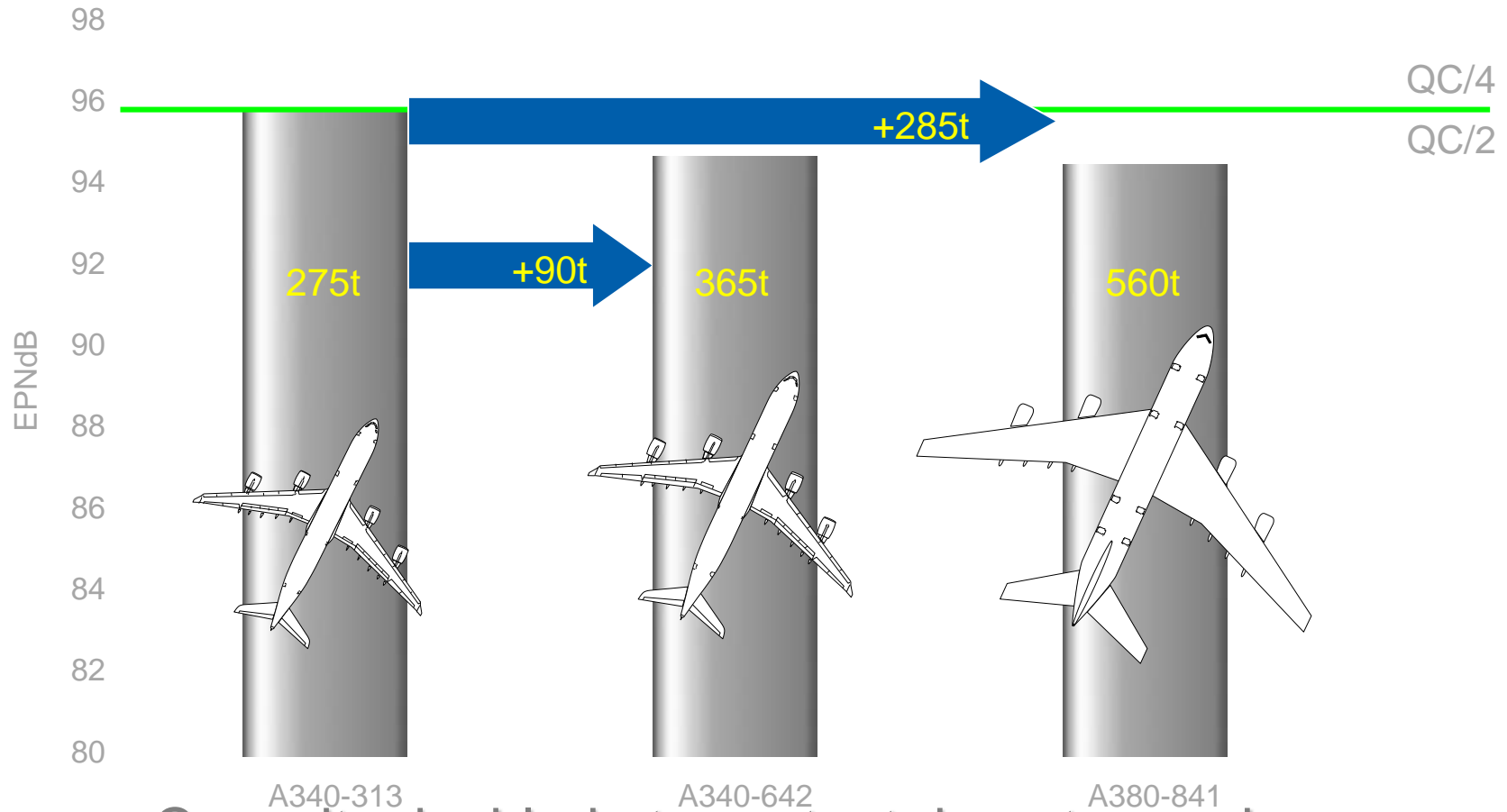
Any questions ?

Optimization of Operational Procedures



Benefit of Current Airbus A/C In Service A380-800

Capacity growth without noise increase : Departure



Capacity doubled at constant departure noise