Propelling the Future of Aviation

23rd International Society of Air-breathing Engines (ISABE) Conference

Charles Champion, Executive Vice President Engineering Airbus

6 September 2017

AIRBUS

A commercial aircraft manufacturer with the two Divisions
Defence and Space and Helicopters

134,000+
Total workforce

€1,060billion
Order book

€67billion
Annual revenue

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Commercial Aircraft

Passion

Commercial Aircraft's global workforce is united by a passion for aviation and restless desire to create better ways to fly

54,000
Employees

€49.2billion
Annual revenue*

6,705
Backlog

400
Operators

Data to end 2016

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Aviation in figures

3.6billion
Passengers

51.2million
Tonnes of freight

$2.7trillion
Global GDP* annually

62.7million
Jobs supported

Source: ATAG 2016

***GDP:** Gross Domestic Product

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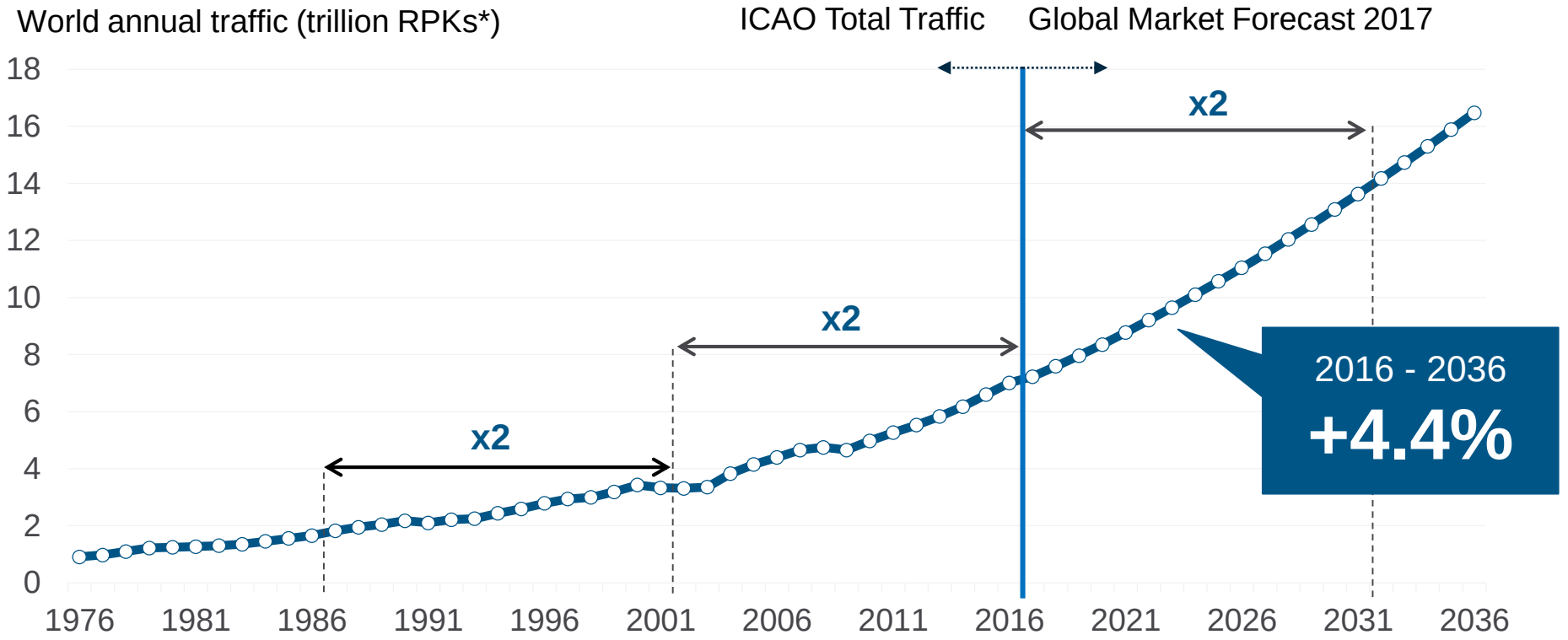
Air Traffic will Double in the Next 15 Years



Air Transport is a Growth Market

60% over the **last 10 years**

More than double since **2001**

**RPK: Revenue Passenger Kilometres*

Source: ICAO, Airbus GMF 2017

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The Challenge for Aviation: Sustainable Growth

European Union's Flightpath 2050

-75%	-90%	-65%
CO2	NOx	Noise

Reference year: 2000

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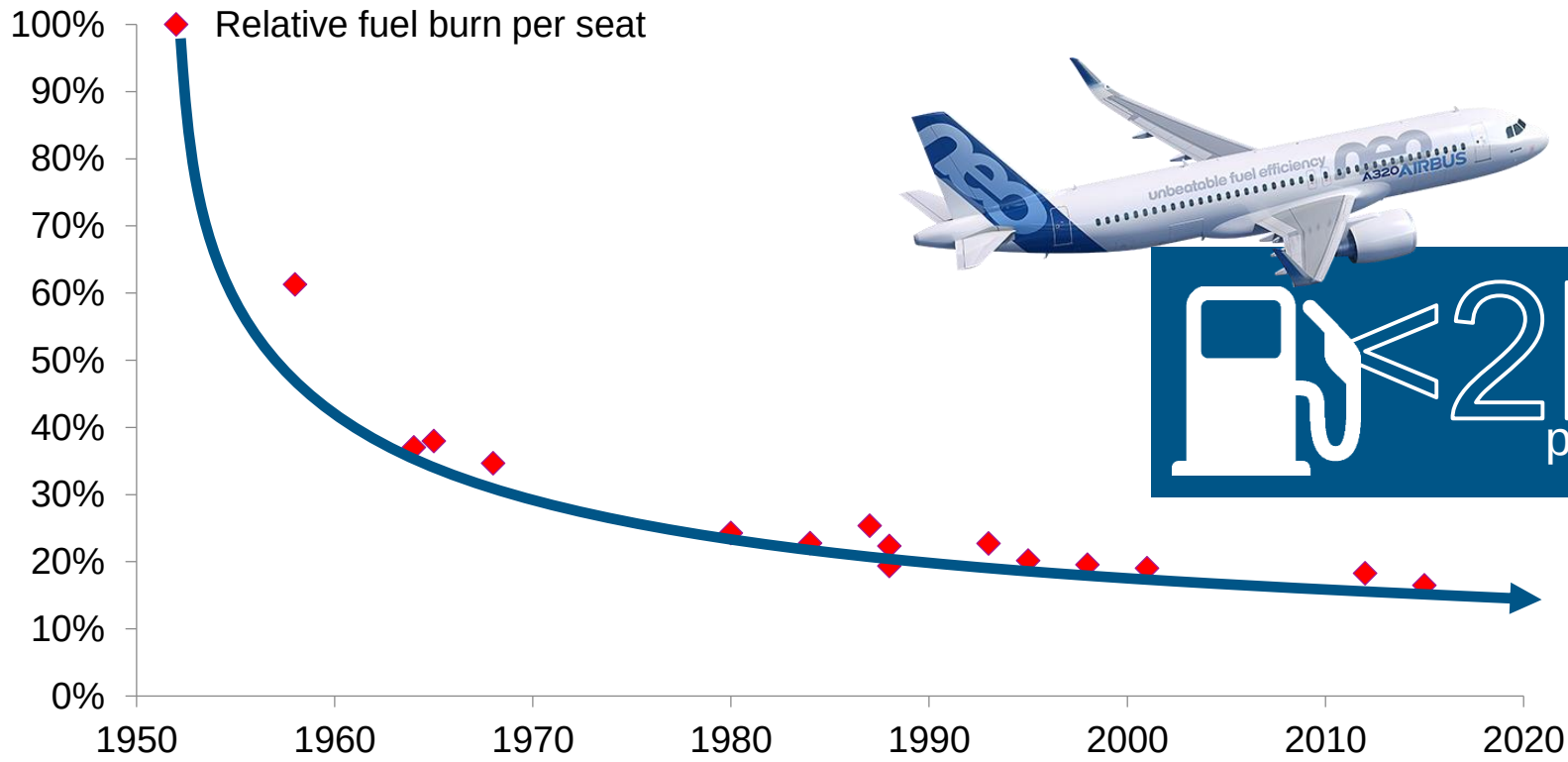
History of a Continuous Fuel Burn Reduction



80% Fuel Burn & CO_2 Reduction

per seat

since the dawn of the jet age

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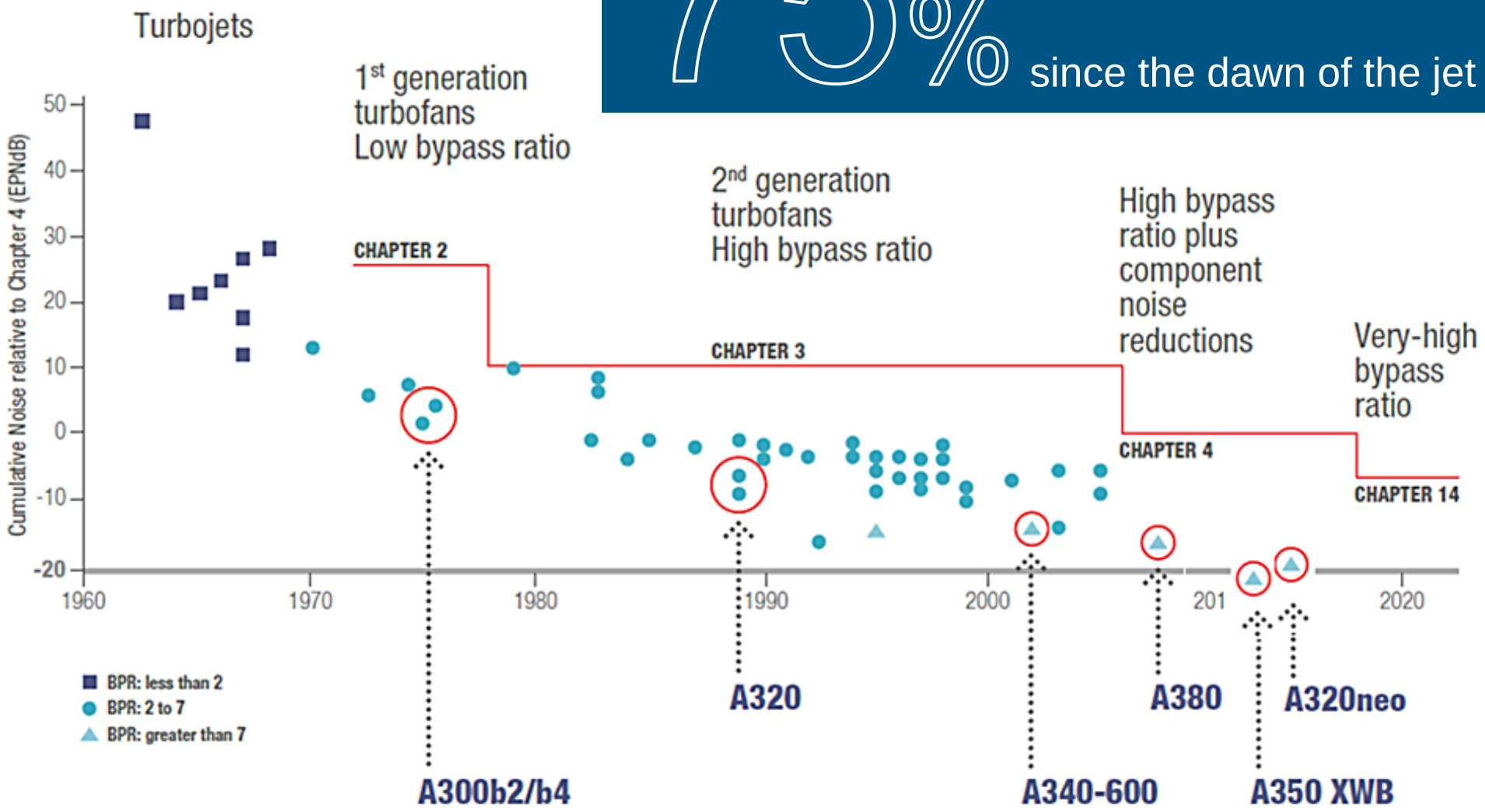
History of a Continuous Noise Reduction

75% Noise Reduction since the dawn of the jet age



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Airbus Challenges

Sustainable growth &
traffic doubling every 15 years

Commitment to the Flightpath 2050
technology targets

Remain consistently ahead of the competition

Being a game-changer is in Airbus DNA
Innovation is key to success!

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The Eco-Efficiency & Performance Levers

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Road to the Future

Enhance existing platforms & preparing for new configurations

On the track of improving

Through better integration & architecture

Towards new configurations & Urban Air Mobility

Operations

Weight

Fuel

Aerodynamic

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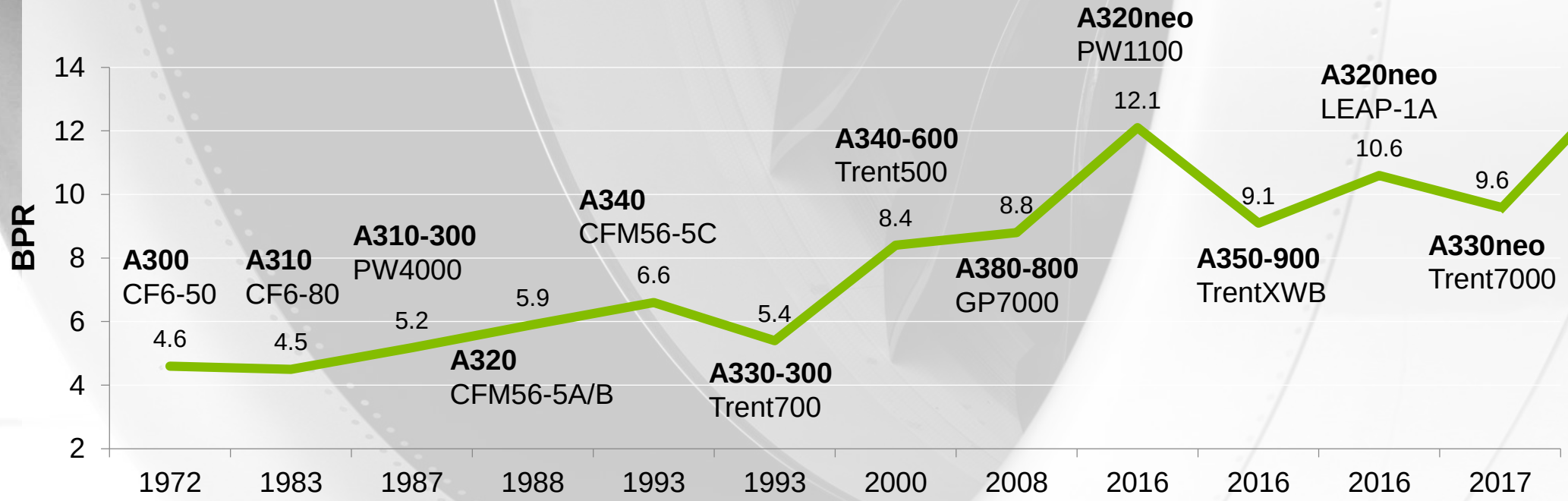
New engines on existing products

Benefit from the continuous technology progress Allow engine configuration changes
Increase aircraft platform capabilities



R&D target
BPR > 15

&

new technos
far beyond

BPR: Bypass ratio

Constantly enhance performance of our flying platforms
Build future & disruptive technologies

The neo story

Aircraft changes mainly contained at **engine** level

-20%
fuel burn
per seat

A320, a commercial **success!**

60%
NEO market share

13,000
orders from 300 customers

A321
high demand

-50%
Noise & NOx emissions

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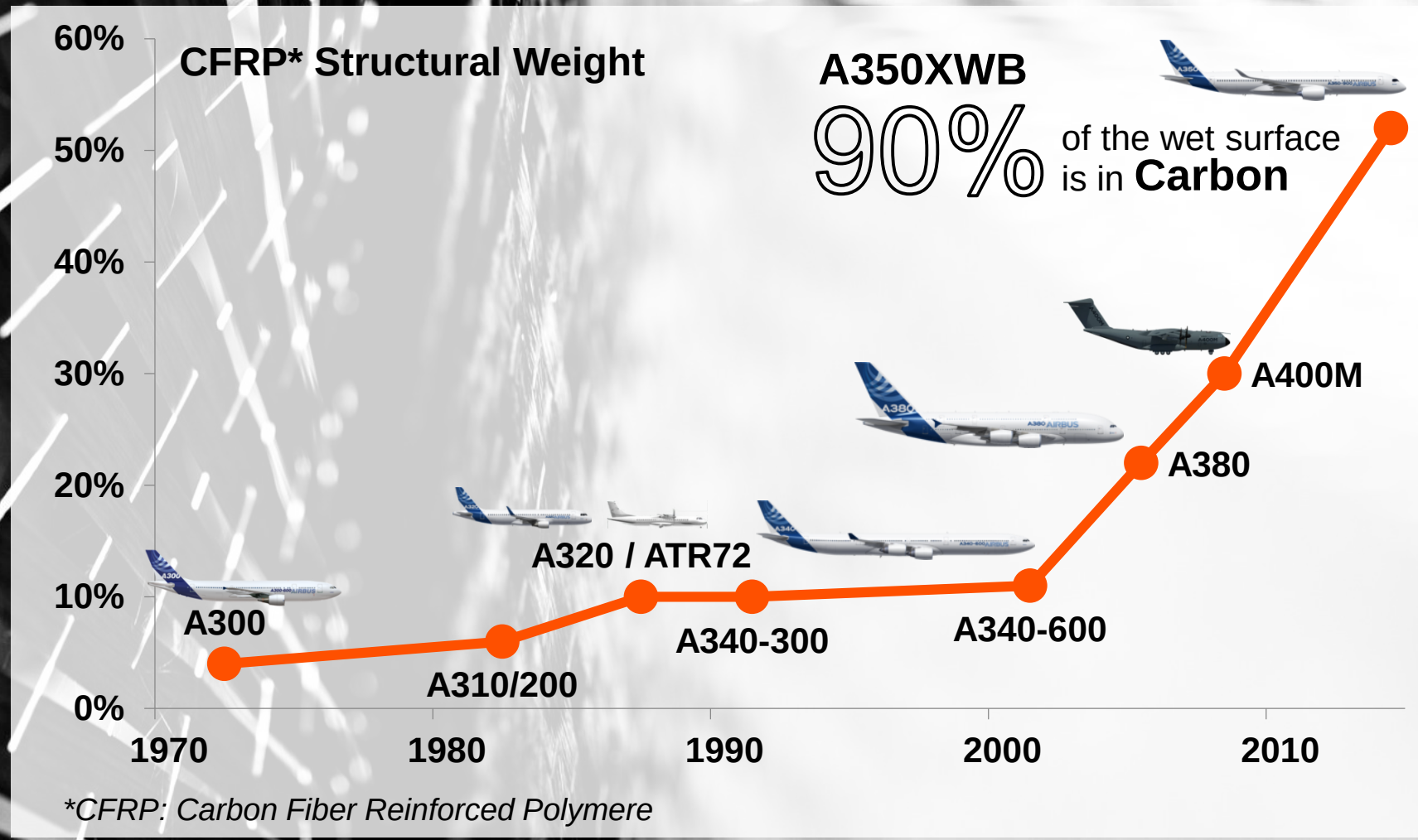
Advanced Composites

Lighter & **Stronger** by Design

Maximise **weight reduction** & **fuel efficiency**



CFRP: Carbon Fiber Reinforced Polymere

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Design for Additive Layer Manufacturing

3D-printing: a strong asset for the future

only 5% waste material

up to 50% potential weight saving

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Operations

Predictive Maintenance

skywise

An Open Digital platform for the aviation industry

Give prior indication of a component/system failure

Thanks to systematic transmission of massive data & data analytics

Allow anticipation & planning of the maintenance

Prevent unexpected failures & operational interruptions

PERFORMANCE **RELIABILITY** **SYSTEM INTEGRITY**

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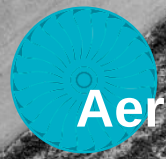
Towards new configurations & Urban Air Mobility



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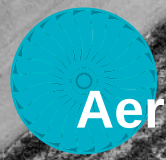
On the track of improving

- More Electrical Aircraft
- Heat management
- Optimized operations
- BLADE

Through better integration & architecture

Towards new configurations & Urban Air Mobility



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More Electrical Aircraft

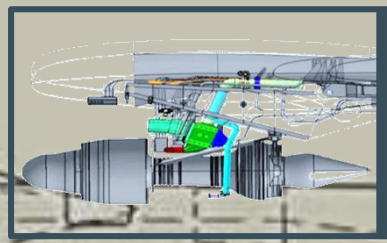
Electrical technologies have to be further explored

Move from technology bricks development

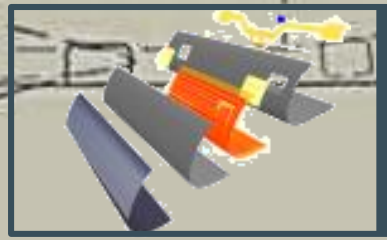
to aircraft architecture & integration

Architecture & Integration challenges

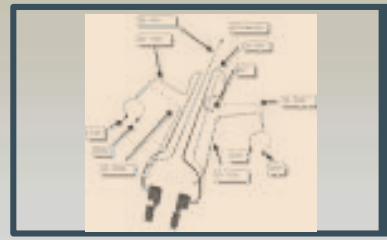
E-ECS



Propulsion Offtake & Starting



Ice Protection



Electrical Network

E-ECS: Electrical - Environmental Cabin System

Heat Management

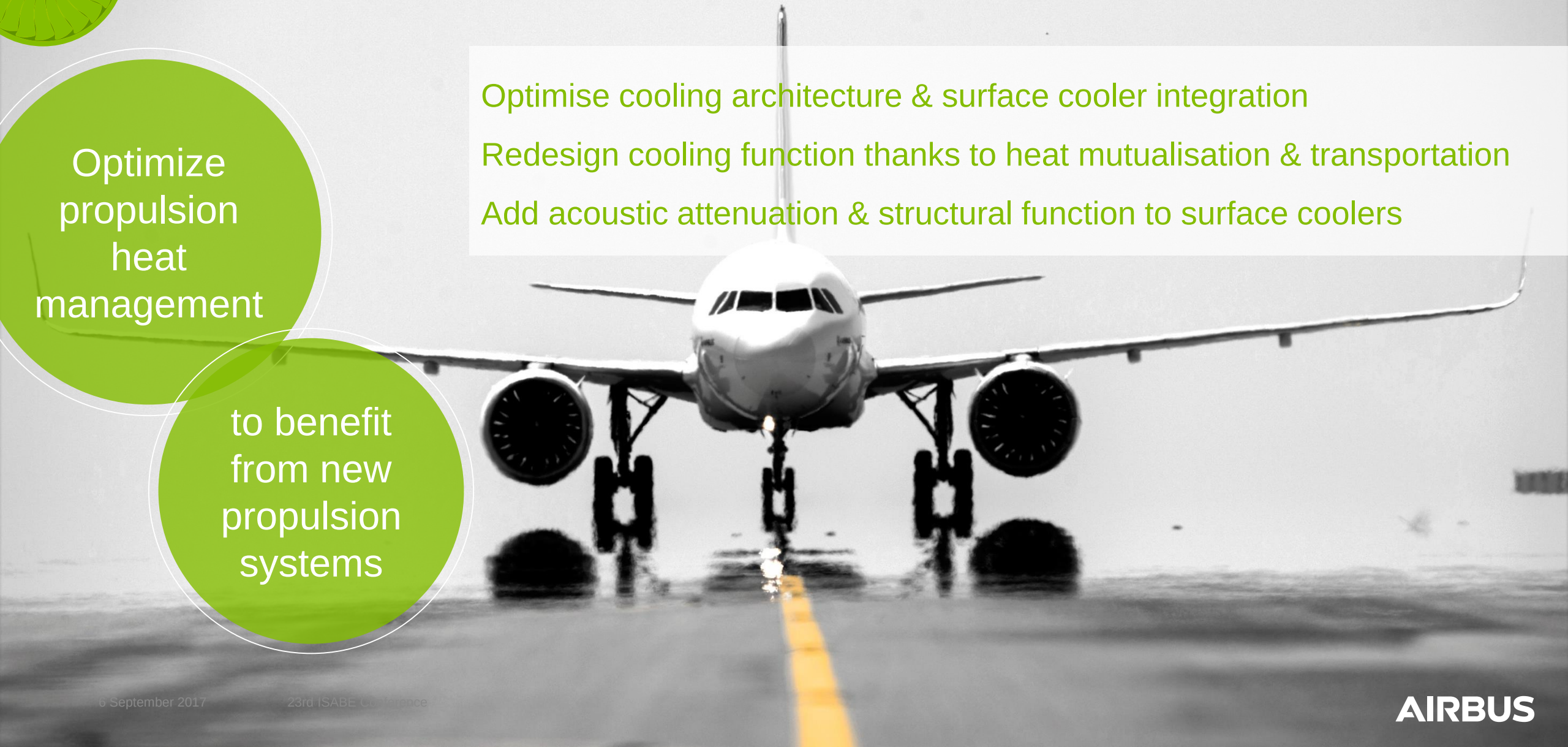
Optimize propulsion heat management

to benefit from new propulsion systems

Optimise cooling architecture & surface cooler integration

Redesign cooling function thanks to heat mutualisation & transportation

Add acoustic attenuation & structural function to surface coolers

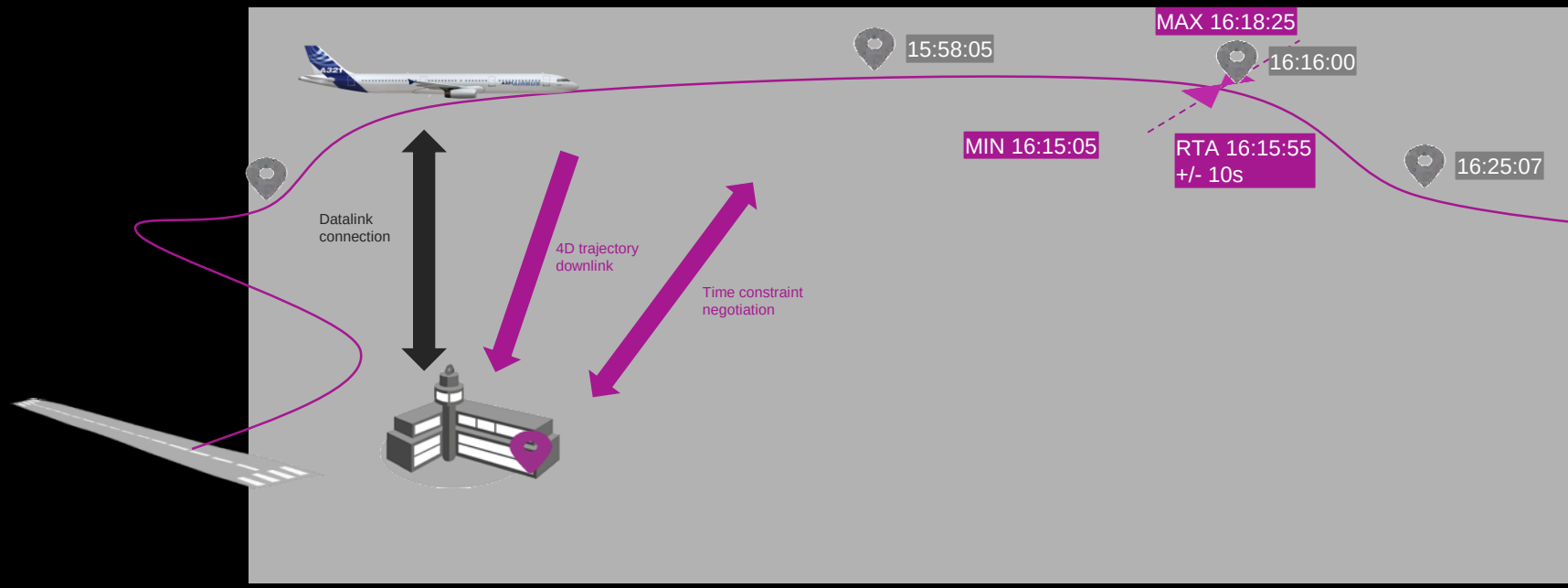


Optimized Operations: 4D trajectory exchange

Enhance ground trajectory prediction

Solve conflicting trajectories upfront

& Reduce traffic congestion



Aerodynamic

Breakthrough Laminar Aircraft Demonstrator in Europe (BLADE)

Minimised drag with **laminar flow**

-5%
fuel burn expected

2014 – 2015
Wind tunnel tests
Laminar wing & Krueger flap demonstrator

2016
First aircraft parts

2017
Flight tests on Airbus A340

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Towards new configurations & Urban Air Mobility

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Through better integration & architecture

- Boundary Layer Ingestion
- Open Rotor
- Distributed propulsion
- Hybrid propulsion

Towards new configurations & Urban Air Mobility

2050

2040

Operations

Weight

Fuel

Aerodynamic

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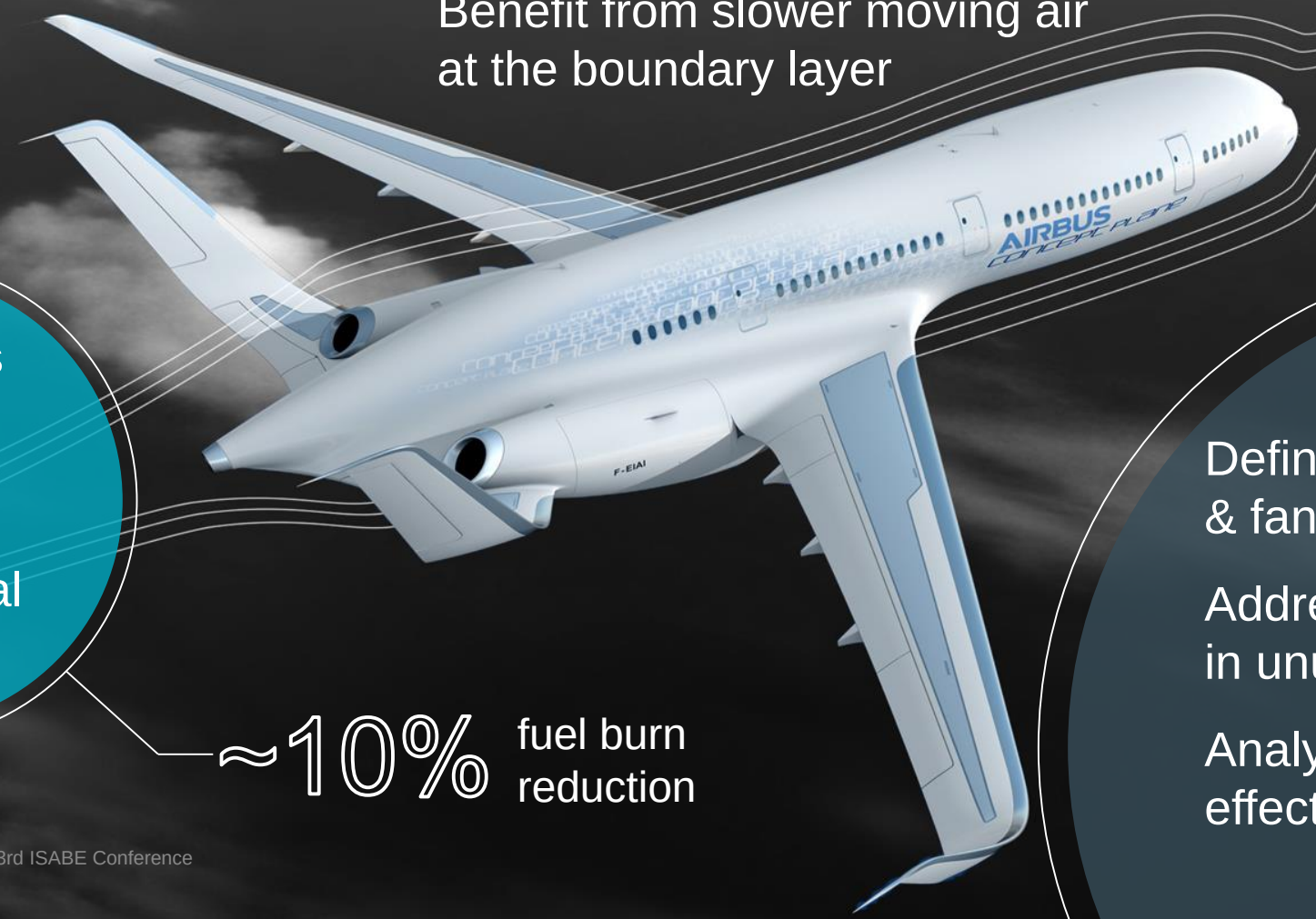
Towards new aircraft configurations

Boundary Layer Ingestion

Benefit from slower moving air at the boundary layer

Minimises propulsor **effort** & reduce total **drag**

~10% fuel burn reduction



- Define optimum inlet distortion & fan reinforcement
- Address propulsion integration in unusual location
- Analyse & solve integration effects

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Open Rotor

Push propulsive efficiency to the limit

~6% Fuel burn saving vs. advanced UHBR

Lower cruise speed

Position propulsion system for safety and comfort

Cost challenge

UHBR: Ultra High Bypass Ratio

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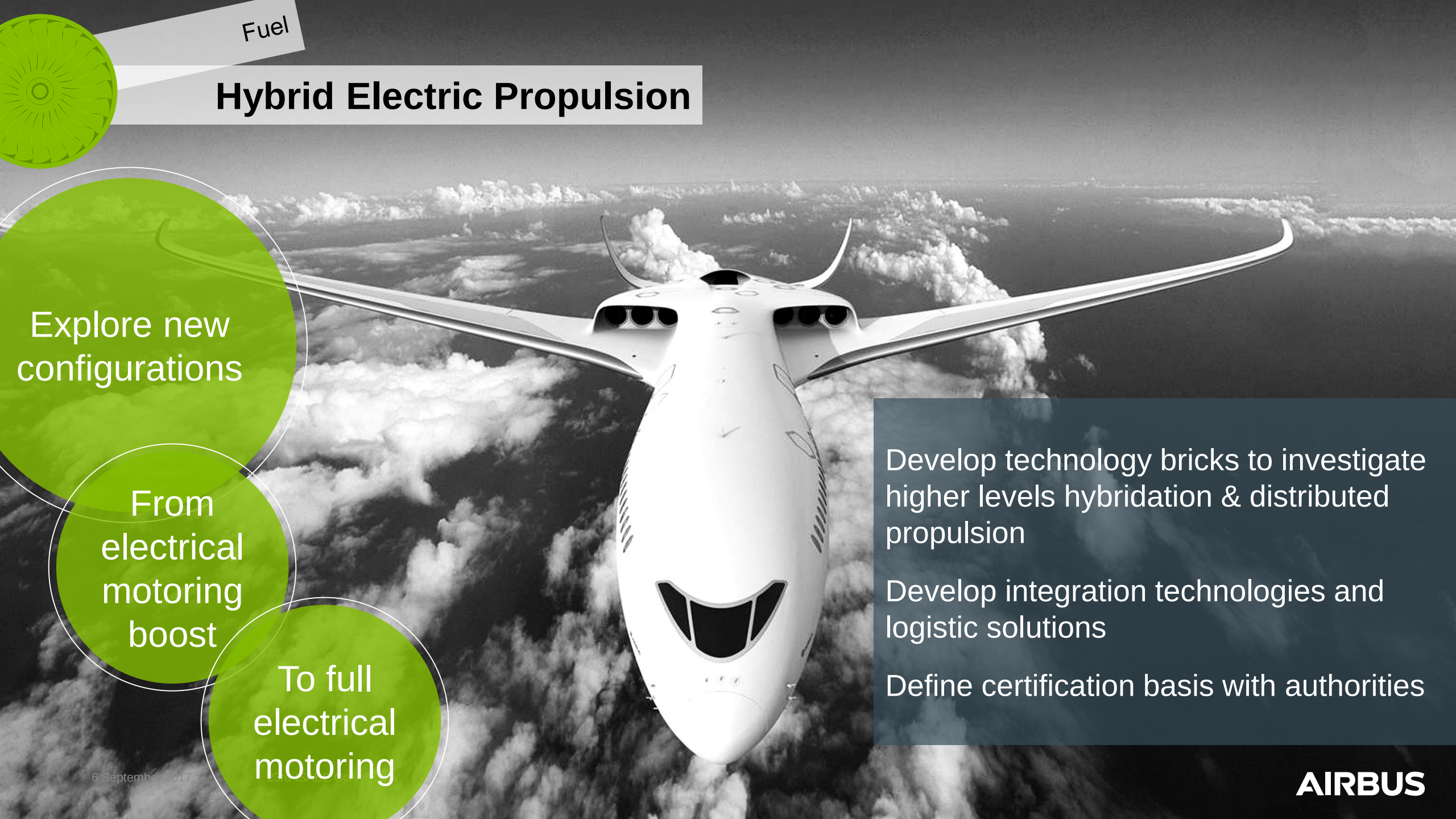
Fuel

Hybrid Electric Propulsion



Explore new configurations

From electrical motoring boost

To full electrical motoring

- Develop technology bricks to investigate higher levels hybridation & distributed propulsion
- Develop integration technologies and logistic solutions
- Define certification basis with authorities

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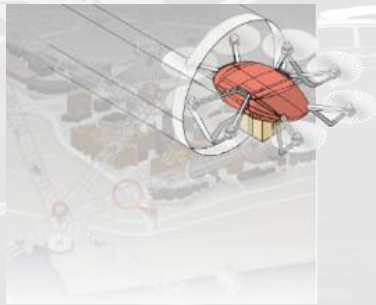
Towards Urban Air Mobility

Airbus is taking a pioneering role in opening the market, while developing and exploring new vehicle concepts, systems and business models

VOOM

SKYWAYS



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VAHANA

POP.UP

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Conclusion

Fusion of Propulsion System with the Overall Aircraft Design is a must

The engine is the key contributor to Aviation environmental challenges

Will we still need air breathing engines in 2050?

Are you ready for the paradigm shift?


Thank You
Q&A
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