



Rolls-Royce

Powering a better world: Rolls-Royce and the environment

**Tony Davis
CEO Rolls-Royce Australasia**

**RAeS New Zealand Division
Sustainable Aviation Seminar, Wellington
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Rolls-Royce plc



**Civil
Aerospace**



**Defence
Aerospace**



Marine



Energy



Rolls-Royce Civil Aerospace

Corporate & Regional

Civil Large Engines



Australasia and the Pacific Islands



Skywest

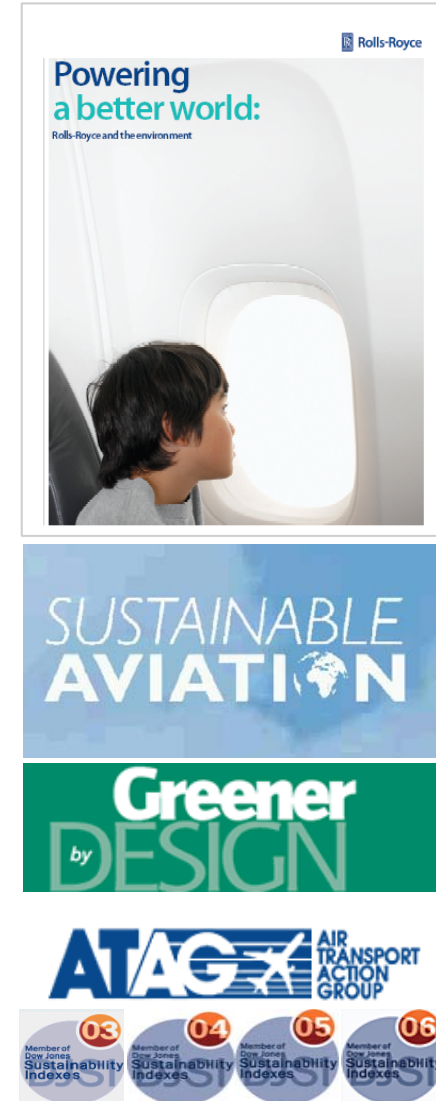


Alliance AIRLINES



Rolls-Royce Environmental Strategy

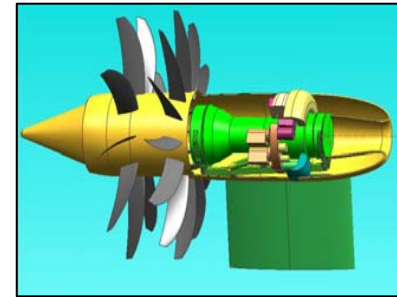
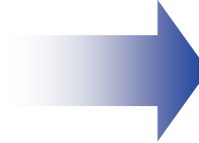
- **Committed strategy with three related elements:**
 - maintain drive to reduce environmental impact
 - further reduce environmental impact of products
 - develop new low emission & renewable energy products
- **Annual public domain reports:**
www.Rolls-Royce/community/environment
- **Investment in reducing environmental impact**
 - About NZD \$1.8 Billion per annum
- **Global research network**
- **Working together for the whole industry**



Rolls-Royce Technology 'Vision'

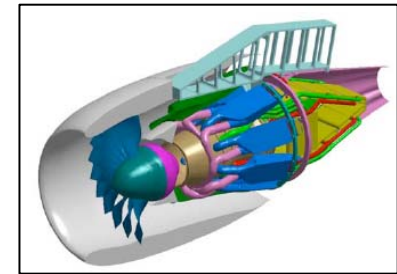
● Vision20 – Future generation

- Technologies that are currently emerging or as yet unproven
- Synthetic & Alternative fuels
- Targets for aircraft, engines and systems



● Vision10 – Next generation

- Leading edge, technology validation
- Synthetic & Alternative fuels
- Technologies at demonstration stage



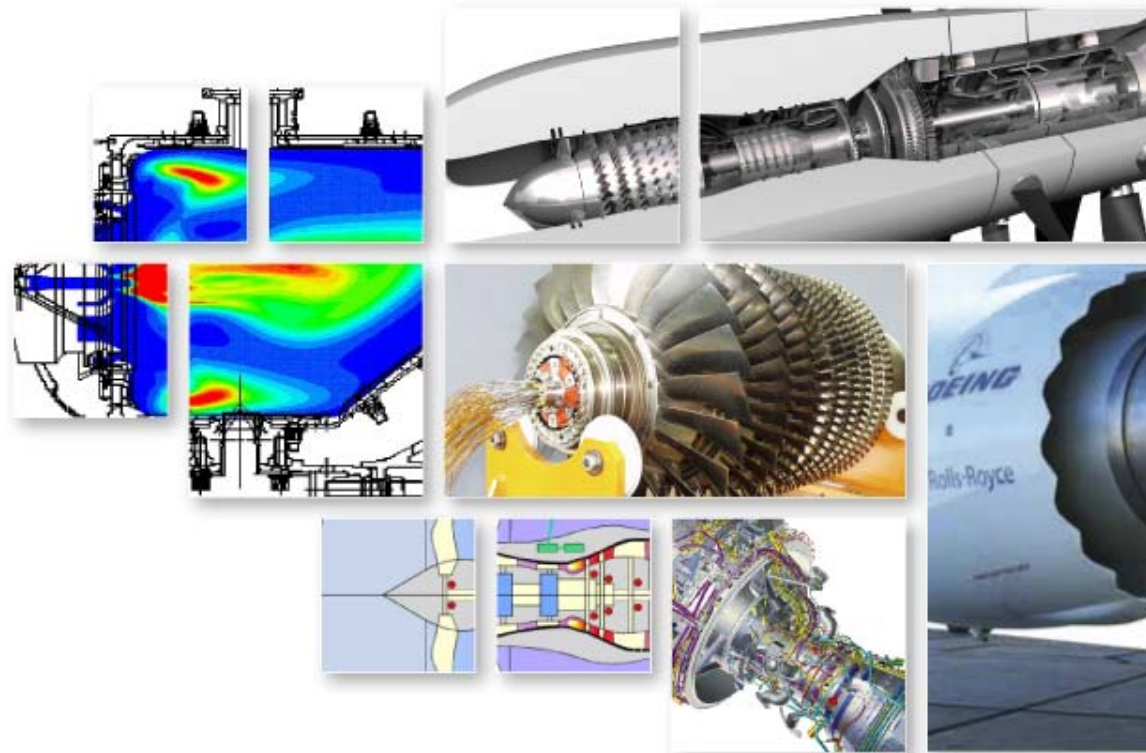
● Vision5 – Near term

- Latest 'on-the-shelf' technologies applied to existing architectures
- Near term upgrade and improvement programmes



Trent 1000
Trent XWB

Key technology programs



ANTLE

SILENCER
- EU programme

Power Optimised
Aircraft

E3E HP system

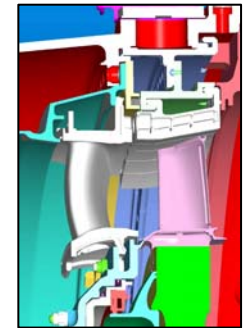
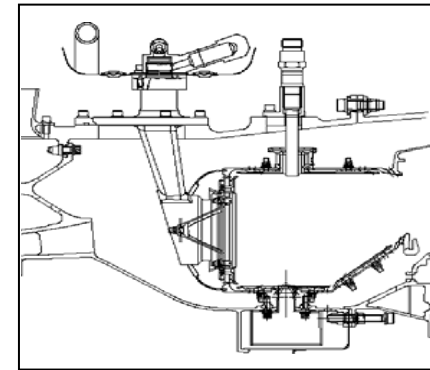
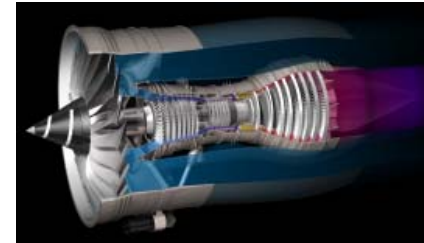
Environmentally
Friendly Engine

Clean Skies Joint
Technology Initiative

Vcom 14702

Vision Technology Research: Environmentally Friendly Engine (EFE)

- 5 year, NZD \$240m programme
 - Trent family donor hardware
 - Six builds, first run 2008
- Focused technology validation:
 - HP turbine (materials, cooling, aero)
 - operating at turbine entry temperatures over 200 °C hotter than today 's engines
 - delivering turbine efficiency >90%
 - Lean-burn combustion
- Programme identified as opportunity to run back-to-back tests with several alternative fuels on latest technology hardware



Rolls-Royce progress to future goals

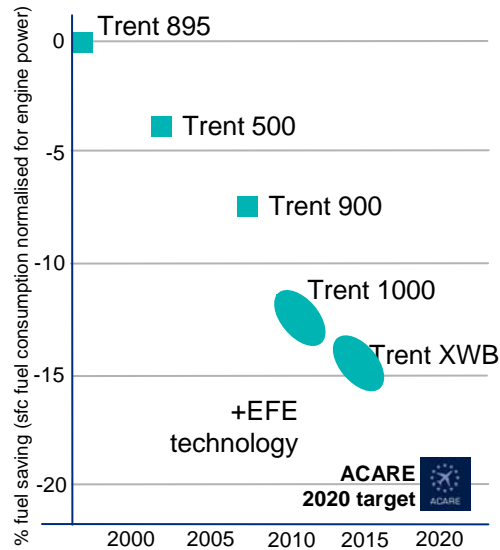
- **Targets based on ACARE* cf 2000**
- **Reduce CO2 by 50% per pax km:**
 - **20% from engines**
 - **20% from airframes**
 - **10% from Air Traffic management**
- **Reduce NOx by 80%**
- **Reduce perceived average noise levels by 50%**
- **7 years into 20-year program and on-target to achieve goals**



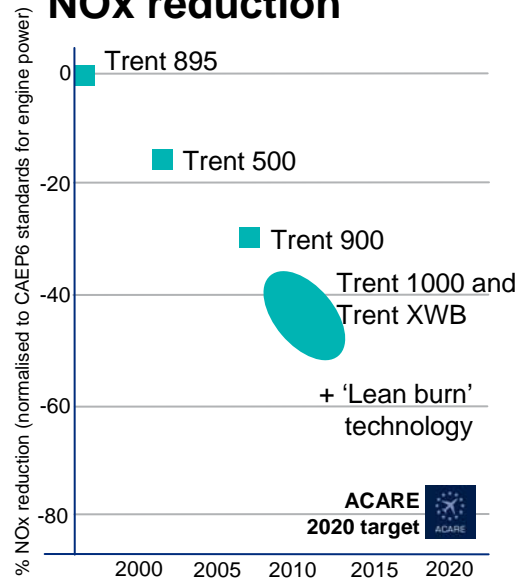
* **Advisory Council for Aeronautics
Research in Europe**

Rolls-Royce progress to global green targets

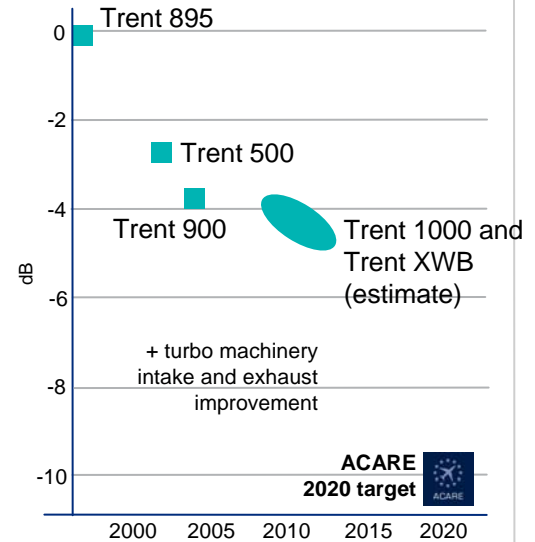
Fuel burn (CO₂) reduction



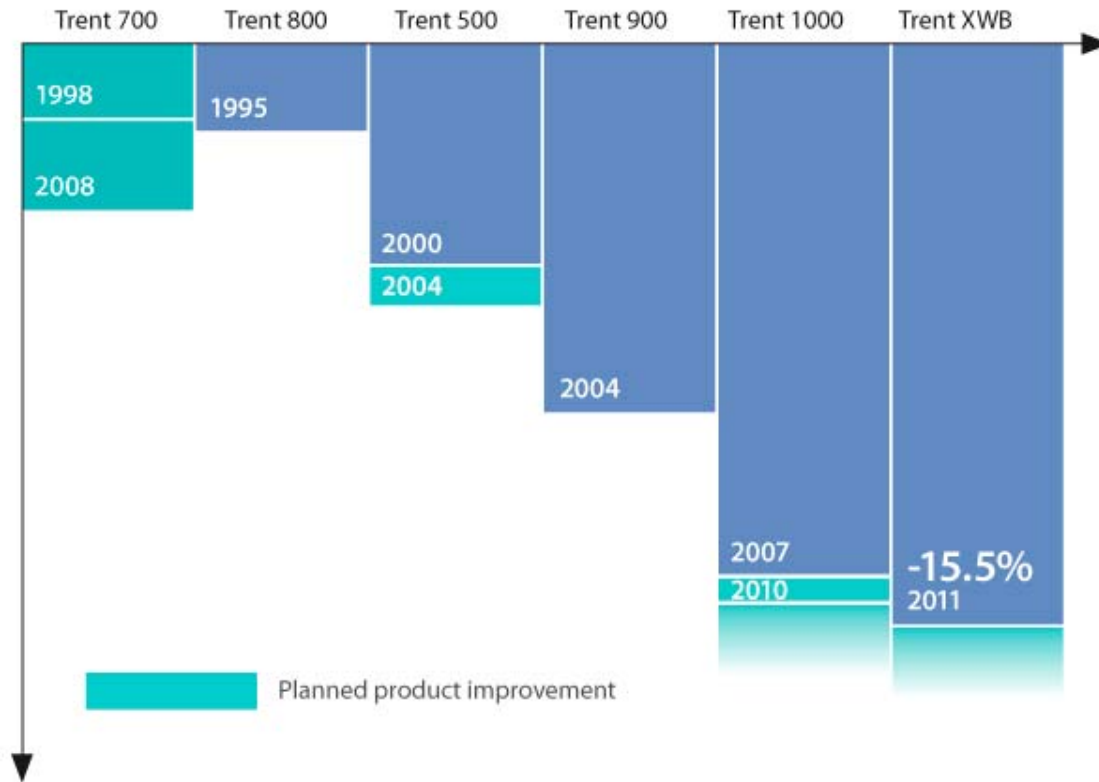
NOx reduction



Noise reduction



Reducing fuel consumption



07/08/07 in Seattle...Trent 1000



Launch engine for all models of the 787

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Trent 1000 on the Boeing 787

Cycle and components designed for high efficiency, low noise and minimum environmental impact

Ribbed titanium
fancase
Lightweight / strong

3D aero compressors
More efficient

Low emissions combustor
Clean environment

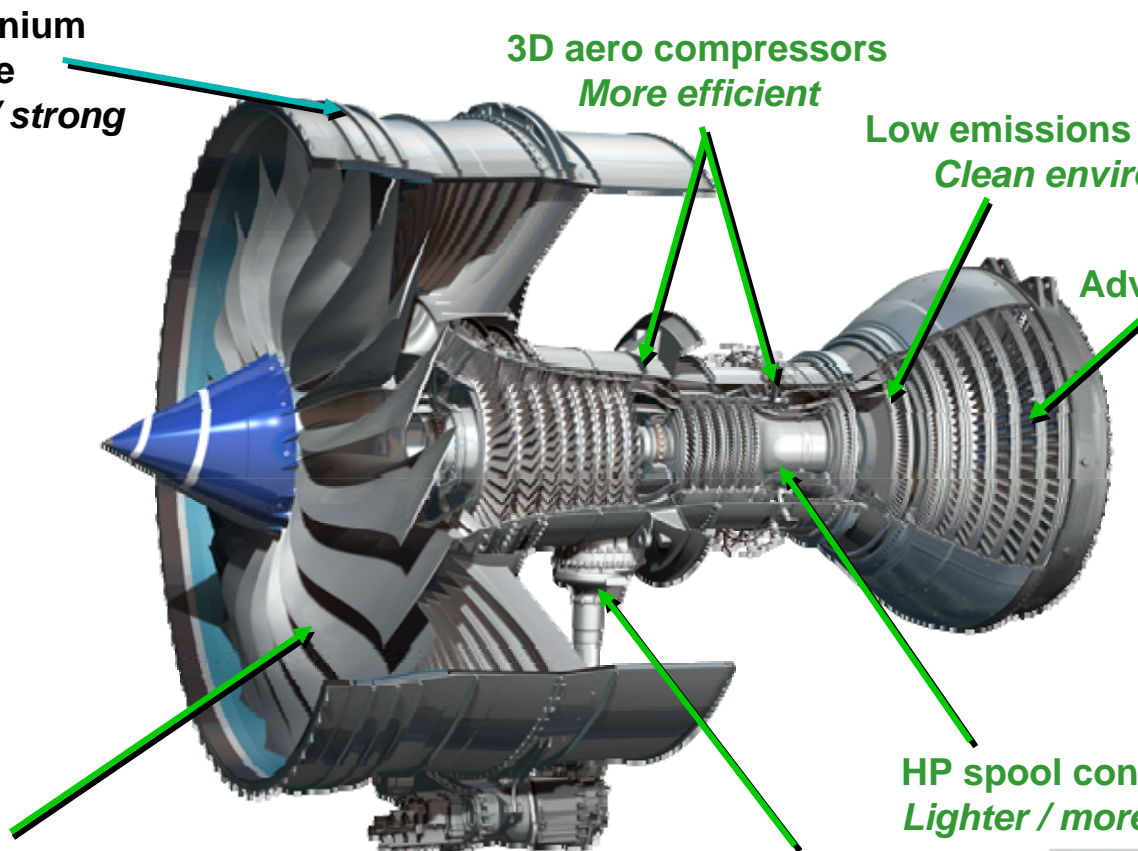
Advanced turbine blades
More efficient

Advanced
materials and
coatings
*Lightweight /
long life*

HP spool contra-rotation
Lighter / more efficient

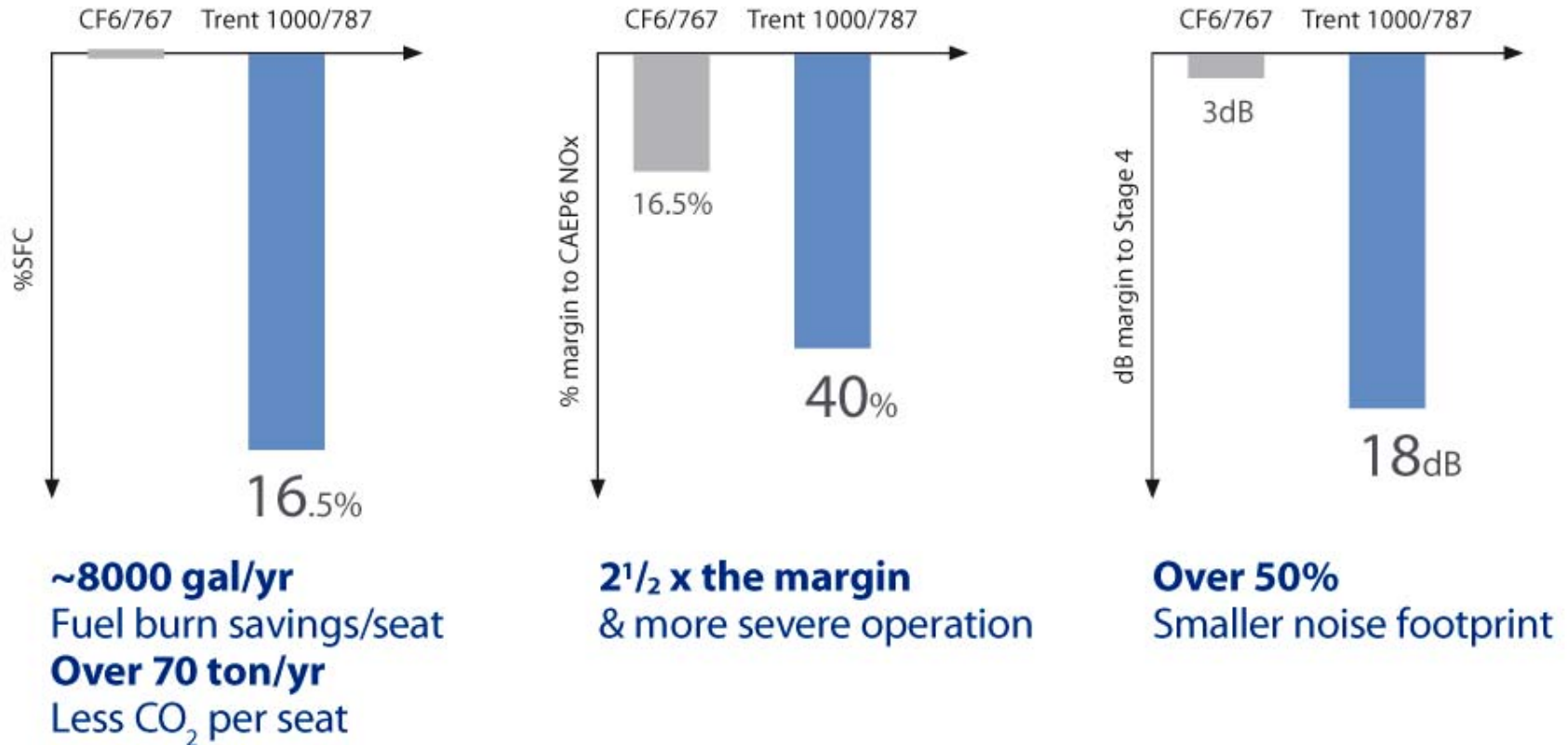
IP shaft power offtake
Unique to Trent engines

Hollow titanium fan
Lightweight / efficient





Environmentally friendly & economical



Creating a cleaner, quieter world

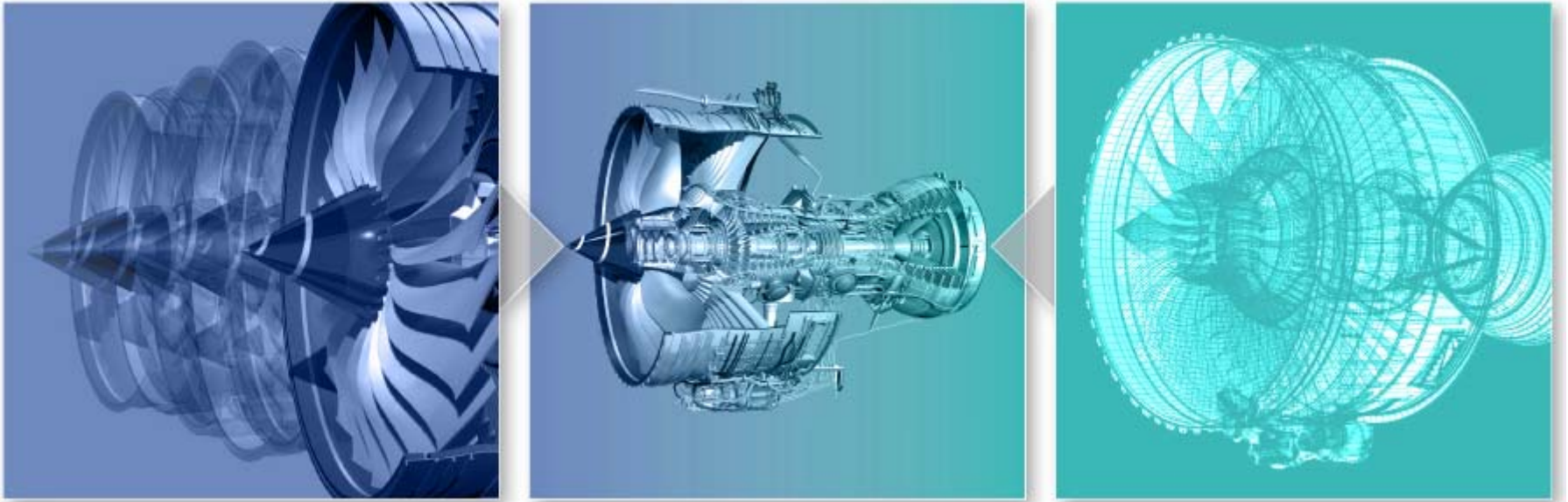
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Evolutionary and revolutionary

Trent experience

+

Vision technology



Intelligent innovation

Alternative fuels

- **Safety, energy density, low freezing point - critical for aviation fuel**
- **Currently main drivers for alternative fuels are CO2 reduction and diversity/security of supply**
- **Need to consider the total carbon life cycle and non-CO2 based emissions**
- **Potential alternative fuels:**
 - **Synthetic Fuel - aviation kerosene from Fisher-Tropsch synthesis**
 - **Bio-Fuels - Hydrogenated oils**
 - **Bio-Fuels - kerosene plus bio-derived Fatty Acid Methyl Esters**
- **Rolls-Royce is an active partner into alternative fuel research with airlines, aircraft manufacturers and fuel companies**

Airbus, Rolls-Royce & Shell A380 demo

- Flight evaluation of a 40% GTL kerosene fuel blended with conventional fuel
- Part of research programme to understand renewable fuels and potential future applications.
 - Aircraft - Airbus A380 MSN4
 - Engine - one Trent 900 engine powered using the derived fuel
 - Test Date - 1 Feb 2008
- Data gathered throughout the test process will contribute to understanding of the capabilities and limitations of renewable synthetic fuels



Air New Zealand, Boeing & Rolls-Royce Renewable Fuels Study Program

- Flight evaluation of a renewable bio fuel blended with kerosene fuel source
- Part of research programme to understand renewable fuels and potential future applications.
 - Aircraft - Air New Zealand Boeing 747-400
 - Engine - only one RB211-524 engine will use the derived fuel
 - Timing - Second half of 2008 depending on availability of fuel
- Data gathered throughout the test process will contribute to understanding of the capabilities and limitations of renewable fuels



Summary

Rolls-Royce:

- **is committed to helping society address the problem of climate change**
- **has a proven environmental track record with our products**
- **is committed to a strategy of continuous improvement**
- **invests in advanced technologies and programs focussed on reducing environmental impact**
- **is at the forefront of understanding and addressing aviation environmental issues**
- **is determined to be an active part of the solution to the environmental challenge**

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Questions?