European Low Emission Combustion Technology

CA ELECT - AE

An overview

Duration: 1.1.2005 – 31.12.2008
Budget: 1,49 MEUR
Coordinator: Rolls-Royce Deutschland

Presented by: R. v.d.Bank / RRD

ALSTOM Avio propulsione aerospaziale MTU Aero Engines Rolls-Royce Snecma Moteurs groupe snecma Turbomeca snecma group DLR ONERA

European Low Emission Combustion Technology

What are the objectives of the project ?

Implementation of the ACARE goals / Vision 2020 on Emissions

- ➔ **Strategy on How-To-Do combustor technology development**
- ➔ Integration & strengthening of the European Research Area
- ➔ Enhance exploitation in Europe
- ➔ Dissemination of European Research results and exchange of information in Europe
- ➔ Active search and identification of appropriate SMEs and of capable research partners from the new EU member states

ALSTOM Avio propulsione aerospaziale MTU Aero Engines Rolls-Royce Snecma Moteurs groupe snecma Turbomeca snecma group DLR ONERA

European Low Emission Combustion Technology

European Aeronautics 2001 (SRA1) / The Challenge of the Environment (perspective of 20 years)

Objectives of ACARE (Advisory Council on Aeronautics Research in Europe)`s

Vision 2020 / Strategic Research Agenda 2

1. Reduce NOx by 80%

   Interpretation: 80% LTO cycle relative to CAEP/2 & maintain current level of CO, soot, UHC

2. Reduce fuel consumption and CO_2 emissions by 50%

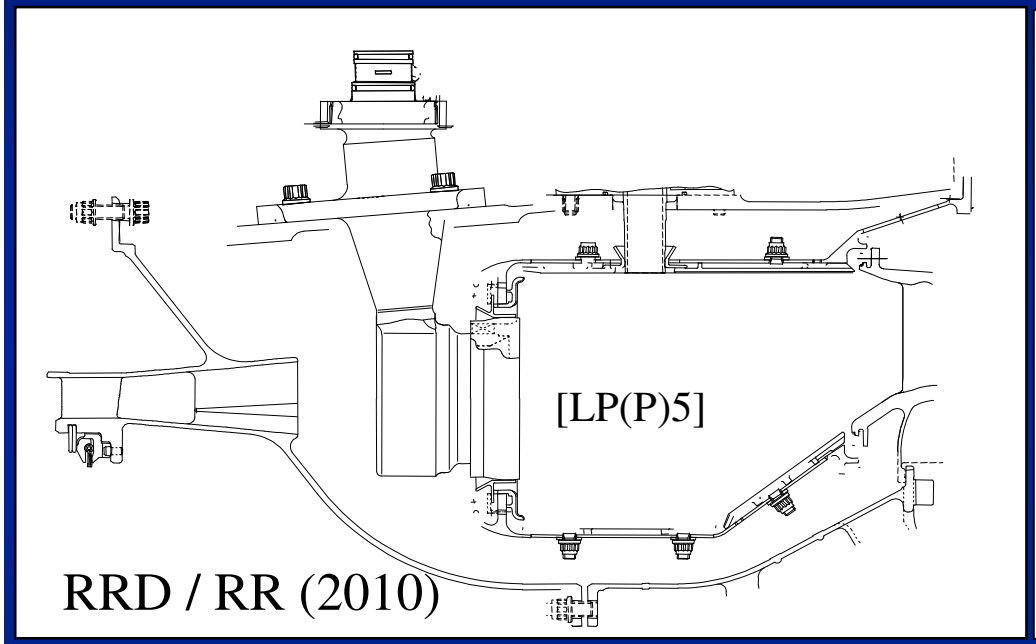
   (P30⇑ T30⇑ ⇒ NOx⇑)
   (BPR⇑ OAFR⇓ ⇒ NOx⇑)

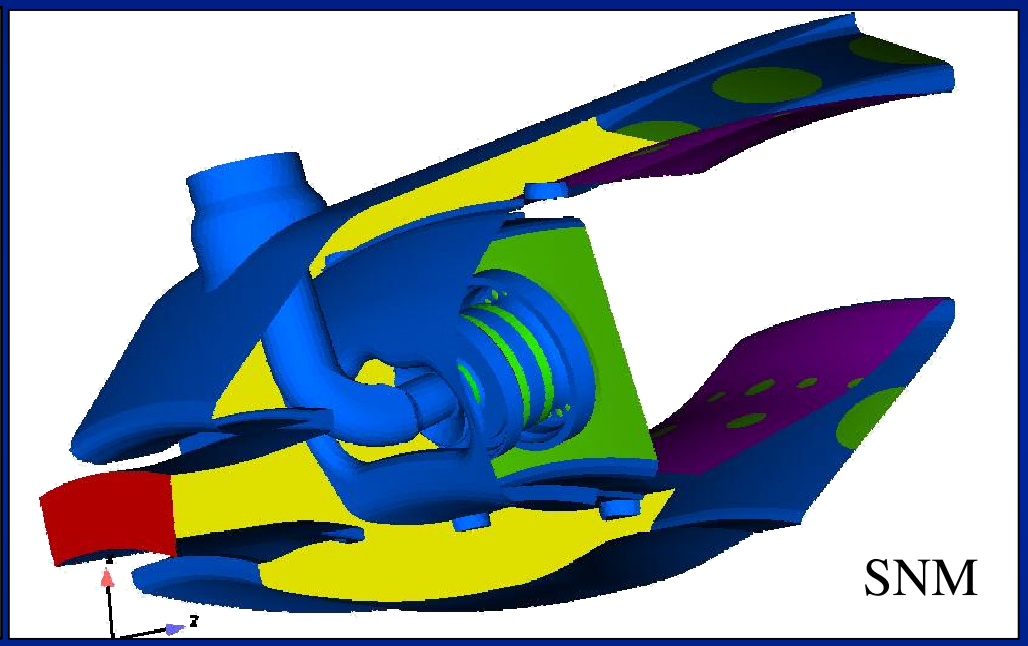
   Contribution split: 20-25 % airframe / 15-20 % engine / 5-10 % operations & air traffic (ATM)

European Low Emission Combustion Technology

Low NOx Single Annular Combustor Concepts in Europe

Medium Term Perspectives





- Efforts have to be increased to cope with the challenge
- Economic growth requires technological innovation

Presented by: R. v.d.Bank / RRD

ALSTOM Avio propulsione aerospaziale MTU Aero Engines Rolls-Royce Snecma Moteurs groupe snecma Turbomeca snecma group DLR ONERA

European Low Emission Combustion Technology

Interdependencies

Architecture:
RQL
DAC
ASAC
Internally Staged

Injectors:
Air Blast
LP(P) & LDI

Fuel Injection
Spray Break-Up
Spray Vaporisation
Droplet Diameters

Pressure Loss
Air Feeding
Pre-Diffuser

Fuel Coking
Fuel Supply
Schedule
Fuel Types
Aromatics

Operability:
Cold start,Ignition
Altitude Relight
Hail & Rain
Slam Deceleration
Weak Extinction

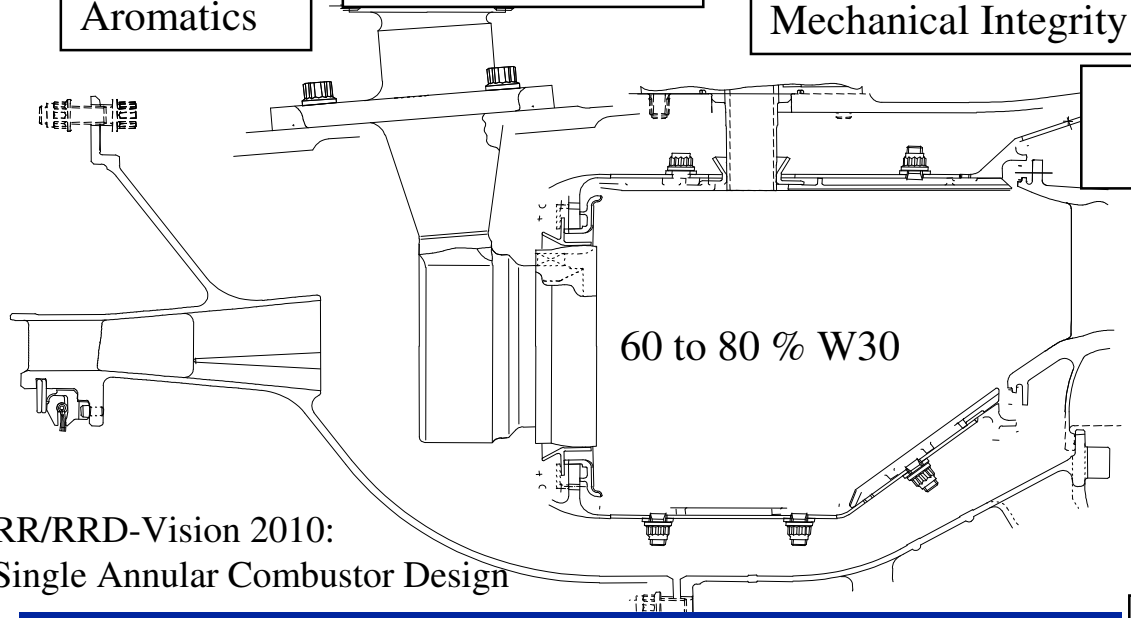
Costs
Competitiveness

Weight
Length
Part Count
Complexity

Burn-out
Combustion Efficiency

Thermo-Acoustic Instabilities
Combustion Driven Pressure Oscillations
Mechanical Integrity / Lifing

Temperature, Emissions
Chemistry, Exit Profiles



RR/RRD-Vision 2010:
Single Annular Combustor Design

Emissions

NOx
Soot
CO
UHC

Liner Cooling / Lifing
Surface / Volume Ratio

➔ Low NOx design is highly complex and requires substantial amount of efforts and resources to address all key elements
➔ Extensive leading edge research is required

Presented by: R. v.d.Bank / RRD

ALSTOM Avio propulsione aerospaziale MTU Aero Engines Rolls-Royce Snecma Moteurs groupe snecma Turbomeca snecma group DLR ONERA

Conclusions

Ultra-low NOx aero-combustion technology is highly challenging

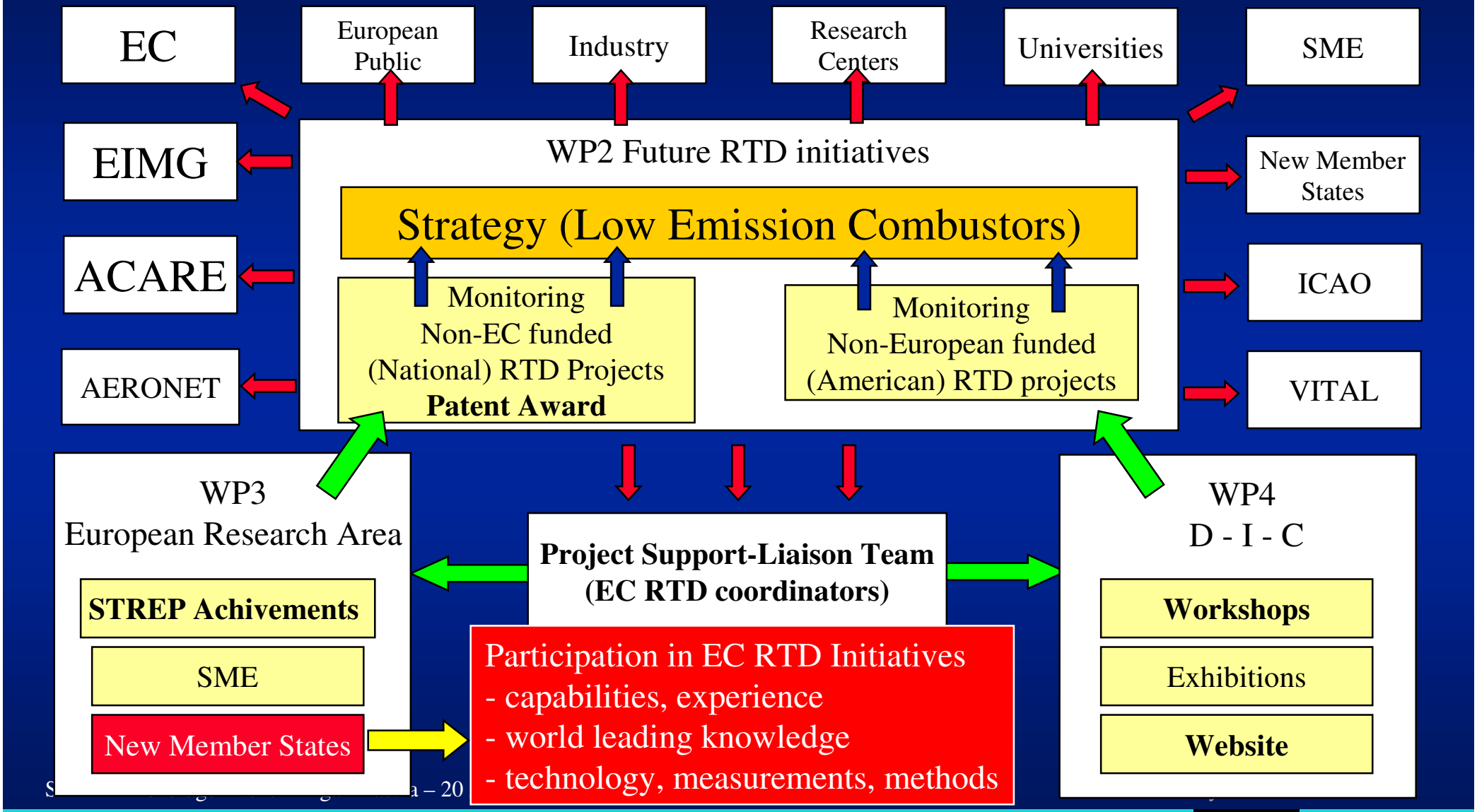
Cost reduction & competitiveness / pre-requisite / successful implementation

Focus: • Technology • Methods & Tools • Design Methodologies

Major technological issues:

- Emissions (Nox / Soot)
- Operability
- Thermo-acoustic high-amplitude pressure oscillations
- Cooling / Lifing

European Low Emission Combustion Technology



ALSTOM Avio propulsione aerospaziale MTU Aero Engines Rolls-Royce Snecma Moteurs groupe snecma Turbomeca snecma group DLR ONERA

European Low Emission Combustion Technology

RTD Initiatives

FP6 C3

Method Development

STREP TimeCop-AE

Towards Innovative Methods for Combustion Prediction in Aero-Engines

Turbomeca, Pau
(Lorenzo Hernandez)

AVIO, MTU, RR, RRD, SNM
NMS: Czenstochowa (PL)

LES / URANS development
2-phase flow with combustion
Numerical and experimental validation of models

Budget: ~ 8,5 MEUR
EC funding: ~ 70 %
2006 – 2010 (48 months)

Fundamental Knowledge Generation

STREP TECC

Technology Enhancement for Clean Combustion

Snecma Moteurs, Villaroche
(Michel Cazalens, Arnaud Platz)

AVIO, RRD, RR, SNM, VOLVO
(+ MTU, TM ???)
NMS: Gleiwitz (PL), Budapest (H)

Cooling fundamentals including radiation, liner materials, CMC, near-wall effects, multi-physics, ...
Spray break-up, fuel types, tbd ...

Budget: ~ 9 MEUR (estimate)
EC funding: ~ 70 %
2006 – 2010 (48 months)

Presented by: R. v.d.Bank / RRD


European Low Emission Combustion Technology
6
ELECT is wishing you success
ALSTOM
Avio
propulsione aerospaziale
MTU
Aero Engines
ROLLS
ROYCE
Rolls-Royce
Snecma Moteurs
groupe snecma
Turbomeca
snecma group
DLR
ONERA