NEWAC
NEW Aero Engine Core Concepts

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1. Background

Global air traffic is forecast to grow at an average annual rate of around 5% in the next 20 years. This high level of growth makes the need to address the environmental penalties of air traffic all the more urgent. Consequently, Europe's aviation industry faces a massive challenge to satisfy the demand whilst ensuring economic, safe and environmentally friendly air travel.

A first step to reach these 2020 objectives has been set-up through the FP5 and FP6 projects targeting noise, NO_X and CO_2 emission reductions. The recently started VITAL project is focusing on technologies for low pressure system improvements to reduce CO_2 and noise. There is however complementary research to be performed on combustor technologies and introduction of new engine configurations to reduce NO_X emissions and further reduce CO_2 to achieve the SRA 2020 objectives.

Alternative engine configurations consequently need to be researched in order to find a more significant and durable reduction of pollution. Such reductions can only be achieved by considering in a first step new configurations with innovative components and in a second step by integrating and optimising these components in new engines.

2. Objectives

ACARE identified the research needs for the aeronautics industry for 2020; regarding the engine a 20% reduction in CO_2 emissions per passenger-kilometre whilst keeping specific weight of the engine constant and a significant reduction of the NO_X emissions during the landing and take-off cycle in order to achieve the 80% reduction.

The existing programmes have already identified concepts and technologies to meet these goals; NEWAC will close the gap in the enabling technologies and will develop fully validated novel core engine technologies based on the results of past EC project, that will deliver a further

- 6% reduction in CO_2 emissions
- 16% reduction in NO_X emissions.

If these results are combined with the expected results of the VITAL (low spool technology) and other national programs and the different technology readiness levels are taken into account the ACARE targets can be attained with an overall CO_2 reduction up to 20% and a NO_X reduction close to 80% at a Technology Readiness Level of 5.

3. Description of work

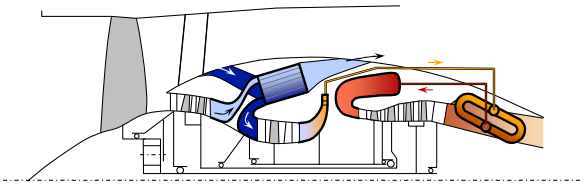
NEWAC will provide through its research programme, technological breakthroughs for the field of aero engines efficiency and emissions. These innovations will include:

- **Intercooled Recuperative Aero Engine** (IRA), which includes optimisation of the recuperator arrangement, innovative duct design and a radial compressor in a new design area.
- **Intercooled core,** with compact and efficient intercoolers, aggressive ducting and advanced compressor capable of performing at the extremely demanding conditions of the intercooled cycle and with improved transient behaviour for intercooler integration. The intercooler is also a critical technology for the IRA concept which was not developed during the EEFAE-CLEAN programme.
- **Active core**, with active heat management systems like active cooling air cooling, active rotor venting system, smart compressor casing and active compressor flow control
- **Flow controlled core** with outer flow-path control technology from casing air aspiration applied on blades and vanes, new advanced 3D aerodynamic compressor design and robust rotor/stator tight clearance management.
- **Innovative combustors** with LPP (Lean Premixed Prevaporized) technology applied for low OPR engines (IRA), with PERM (Partially Evaporated Rapid Mixing) technology for low to medium OPR engines (engine with active heat management or flow controlled core) and LDI (Lean Direct Injection) technology for medium to high OPR engines (intercooled engine).

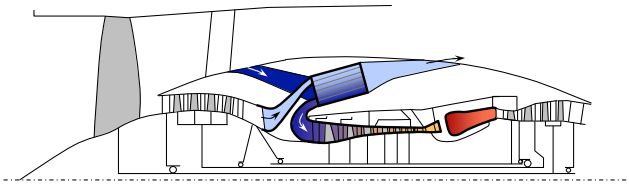
The work in NEWAC is organised along 7 sub-projects:

- Sub-project 1 (SP1) provides a definition of the requirements to be applied to the technologies to be researched in NEWAC and later the assessment at the whole engine level of the corresponding benefits through technical reviews leading to dissemination and exploitation plans of the NEWAC technologies.
- Four sub-projects (SP2 to SP5) covering development of innovative and complementary core solutions aimed at reducing NO_X and CO_2 emissions. Each of these provides a breakthrough beyond the state of the art configurations proposed by the companies leading the subprojects:
  - SP2 on future architectures, which proposes the Intercooled Recuperative Aero Engine (IRA engine) and is a step beyond developments of AEROHEX and CLEAN
  - SP3 on intercooled high overall pressure ratio (OPR) configuration and which will give the CO_2 reductions associated with very high OPR whilst using the intercooler to avoid the associated NO_x penalties
  - SP4 on active heat management core configuration to reduce CO_2 without penalties for NO_X
  - SP5 which proposes a flow controlled core, which is a post CLEAN new generation technology contributing to efficiency gain.
- SP6 will cover developments concerning innovative combustor solutions which will complete the work done on new core configurations to support lean combustion.
- SP0, a management and dissemination sub-project, will assure the coordination of the work, its dissemination outside the consortium and proper exploitation and technology transfer.

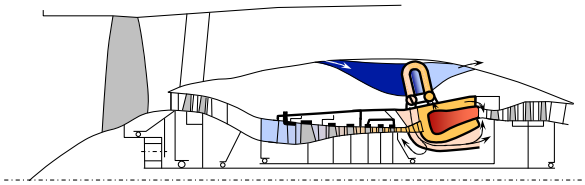
Intercooled Recuperative Core Configuration



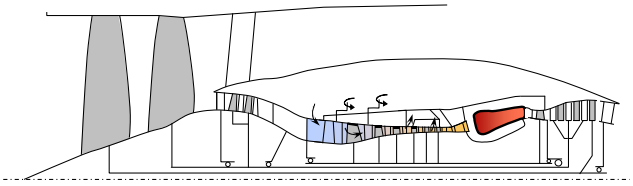
Intercooled Core Configuration



Active Core Configuration



Flow Controlled Core



4. Expected results

NEWAC main result will be fully validated novel technologies enabling a 6% reduction in CO_2 emissions and a further 16% reduction in NO_X. Most importantly, the project will address the particular challenges involved in delivering these benefits simultaneously contributing to the attainment of the ACARE targets.

All new configurations investigated in NEWAC will be compared, assessed and ranked regarding their benefits and contributions to the global project targets. Detailed specifications will be provided for all innovative core configurations. As a result, NEWAC will identify the technology routes to environmentally friendly and economic propulsion solutions. The developed components will further result in optimised engine designs based on the NEWAC technologies but also in combination with the results of the EEFAE, SILENCER and VITAL programmes. To be able to exceed the ACARE 2020 objectives also even more innovative core configurations will be investigated and benchmarked with the engine specification mentioned above.

Acronym:	NEWAC
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Instrument:	Integrated Project
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EU Contribution:	€ 40 000 000
Starting Date:	01/05/2006
Duration:	48 months
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	Università degli Studi di Firenze	IT
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