

Research & Development



Avio involvement in major European RTD (Research and Technology Demonstration) programmes

Avio has a significant role in the European aero-engine RTD activities through representation in the Engine Industry Management Group (EIMG), a group that represents 11 leading industries in Europe, coordinating the preparation of research programmes for submission to the European Commission Framework Programme calls.

The Avio RTD network includes a significant number of qualified universities, research centres and SMEs in Italy and Europe, collaborating to develop innovative technologies applicable to the Company's main products (turbines, transmissions and combustion systems). The Avio research and technology activity is strongly focused on the ACARE Strategic Research Agenda (SRA) and the engine customer targets mainly relevant to environmental (Green Engine) and affordability subjects. Research activities are targeted on both short- and medium-term conventional engine enhancement and medium- and long-term conventional/radical engine development.



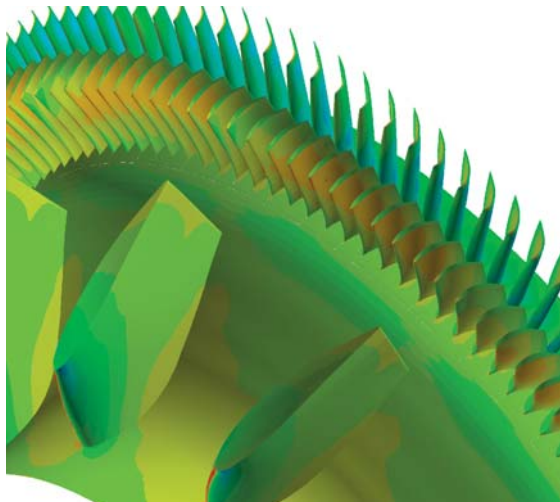
Framework programme 5

The Efficient and Environmentally Friendly Aero-Engine (EEFAE) programme was completed at the end of 2005. The aim of this programme was to demonstrate a first step towards the ACARE targets through two major projects: ANTLE and CLEAN.

ANTLE

The ANTLE (Affordable Near Term Low Emissions) programme, part of the EEFAE European technology platform, is based on an advanced three-shaft engine incorporating a smaller number of higher efficiency components. Major new elements will be a high-pressure compressor and intermediate- and low-pressure turbines. Avio developed, in partnership with Rolls-Royce, the intermediate-pressure turbine with variable capacity vanes.

The project contributed to the expected reduction in CO₂ emissions (less 10%) towards new turbines on the market that are much closer to the ACARE goals. The turbine is then fitted on the Power Optimised Aircraft (POA) demonstrator confirming expected performance.

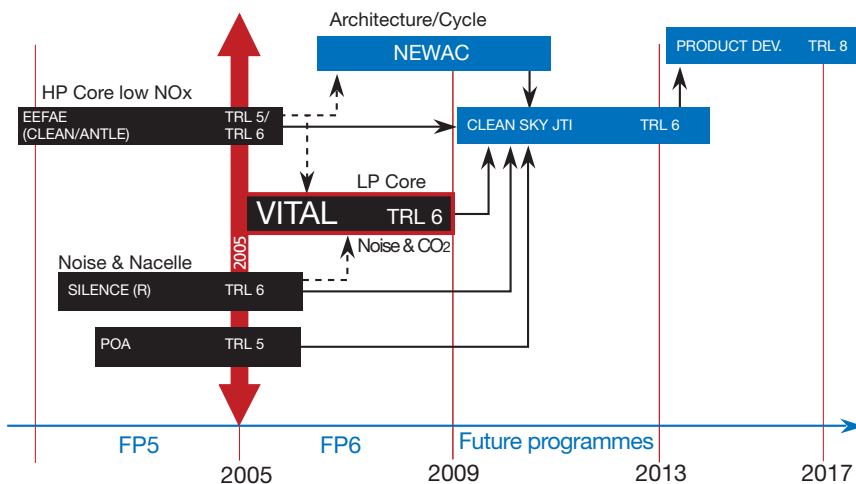


CLEAN

The CLEAN (Component validator for Environmentally friendly AeroEngine) goal was to validate some core technologies for a future Intercooled Recuperated Aeroengine (IRA) concept, which is capable of significantly reducing fuel consumption and emissions, and to predict emissions decrease for the Geared Turbofan (GTF) engine concept.

CLEAN incorporates an improved, high-efficiency HP compressor with active surge control, a low emissions axially-staged combustor and high temperature HP turbine. Avio supported the design and manufacture of the combustor module, based on the technologies developed within the framework of the on-going Brite Low NO_x- III project. In particular, the Lean Premixed Pre-vaporised (LPP) concept for the injection system was tested.

The project demonstrated that CO₂ emissions were cut by 12%, and NO_x by a remarkable 60%. Also in the field of combustion, Avio is continuing to develop new technologies to meet the ACARE targets.



TRL= Tecnologie Readines Level, 1 to 9



Framework programme 6

In 2002, the European Commission launched new large aeroengine research programmes to further contribute to the 2020 ACARE targets, thus continuing the effort carried out on the EEFAE programme.

Avio is responsible for major tasks in all the Integrated Programmes (IP) launched (Vital and NEWAC), which will release new advanced technologies at high Technology Readiness Level (TRL 5-6) for aero-engines entering into service from 2015 onward.



Vital programme

The Vital Integrated Programme lead by Snecma will provide a major advance in developing the next-generation engine low-pressure technologies in order to achieve the ACARE goals for high performance, low-noise and low-pollutant engines.

Vital targets are to reduce CO₂ emissions by 20%, and noise level by 6dB. The achievement of these targets will be demonstrated through the assessment of different LP system concepts (direct-drive turbofan, geared turbofan and counter-rotating turbofan).

Within this framework, Avio, as world leader for Low-Pressure (LP) turbines, is committed to leading different tasks in the LP turbine "light-weight design and technology validation project". In fact, the LPT currently accounts for 20% of total engine weight for Very High Bypass Ratio (VHBR) engines. As more stages are needed, the expected LPT module weight increases by 45% for a mid-thrust engine, doubling the bypass ratio compared with present technology (from 7 to 14). With VHBR engines, the fan and jet noise decreases, and the relative noise contribution of the low-pressure turbine increases. For these reasons, it is mandatory to define and validate new technologies for future aero-engine LP turbines.

The Vital programme is completing the demonstration phase through mechanical rig and aero-acoustic tests (full scale cold flow) to validate the innovative concepts and low-weight technologies defined. The project will be completed by year-end 2010 with immediate impact on advanced turbine technology for next-generation engines.



NEWAC programme

NEWAC will provide a step change for low-emission engines by introducing new innovative core configurations to reduce strongly CO₂ and NO_x emissions. This breakthrough will be achieved by developing and validating new core configurations, improved combustion, active systems and improved core components. NEWAC will design and manufacture these innovative components and will perform model, rig and core tests to validate the critical technologies. NEWAC will complement past and existing EC projects in the field (e.g. EEFAE in FP5, and Vital in FP6).

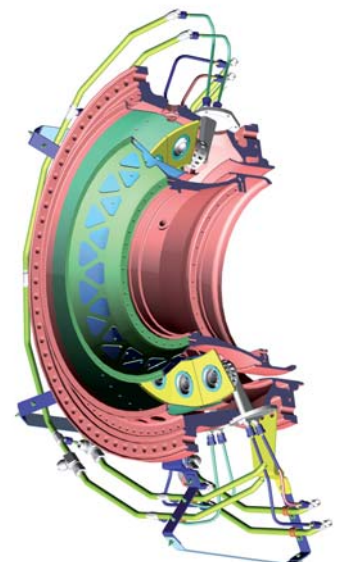
The main result will bring about fully validated new technologies enabling a 6% reduction in CO₂ emissions, and a further 16% reduction in NO_x, relative to the ICAO-LTO cycle.

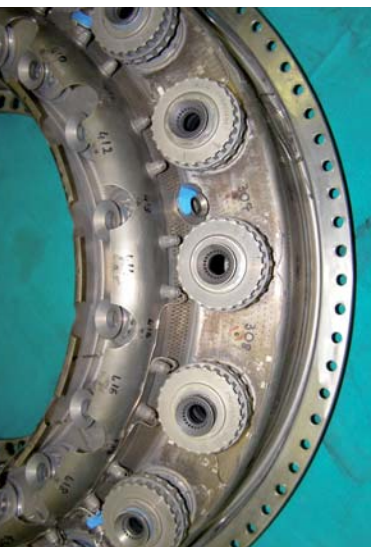
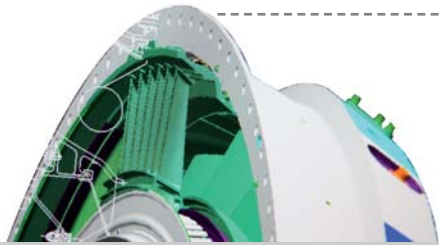
Avio is the leader of Sub-Project 6 (SP6), focused on combustion module configurations and technology. The work includes Advanced Injection System (AIS) and Fuel Spray Technology Development (SFTD). It will contribute to the design of fuel injectors for the required range of aeroengine applications, with significant NO_x improvements, while offering full combustor operability performance.

The main goal is to define an Ultra-Low NO_x (ULN) combustion chamber, based on three different injection system lean technologies (i.e. LDI, PERM and LPP) to be applied to a broad range of engine applications.

Component tests on innovative injection systems were completed, contributing to develop a full-scale combustor to be tested and validated using a full annular combustor rig within 2010.

Some examples of FP6 projects: VIVACE, INTELLLECT, ULTMAT, AIDA, ADVACT, TATEF2, AITEB2, ELECT, TLC, TURNEX, VERDI, AITEB 2, NANOKER, TOPPCOAT, TIMECOP, FANTASIA, PREMECCY, TATMO, MAGPI and AFFIX.





Framework programme 7

Avio is involved in several 7th Framework Programme (FP7) projects both in Collaborative Research and Clean Sky Joint Technology Initiative (JTI) frames.

Within the framework of collaborative research projects, Avio is partner in the DREAM project led by Rolls-Royce, which focuses on engine technology integration and validation conducted on component and system levels by using rig components and/or system demonstrators, with emphasis on the testing of contra-rotating open rotors with variable pitch, alternative fuels, passive and active control of aerodynamics and vibrations, and innovative engine structures. The first major DREAM objective is to design, integrate and validate new engine concepts based on open rotor contra-rotating architectures to reduce fuel consumption and CO₂ emissions by 7%, beyond the ACARE 2020 objectives. The second major DREAM objective is a 3dB noise emission reduction per operation point for just the engine, compared to the Year 2000 engine reference.

Within DREAM, Avio is partner of Snecma on the contra-rotating open rotor engine, with the task of performing advanced design studies and technology validation through partner activity coordination, on non-conventional LPT components for radical engine architecture. In addition, Avio is also in charge of a work package to evaluate combustor design with the use of alternative fuels. Activities are ongoing with the target to reach the expected TRL for a project conclusion early in 2011.

Some other examples of ongoing FP7 projects are FLOCON, FUTURE, TECC 2, ALFABIRD, FLEXA, ACCENT and TEENI.

In addition, the following new projects were selected in Call 2 - OPENAIR, CRESCENDO, KIAI, and ERICKA. In Call 3, Avio participates in the submission of proposals. Moreover, it is working on the preparation of future calls.

Avio is also associated partner in the Clean Sky Joint Technology Initiative (JTI) engine platform, led by the two major European aeronautical companies, Rolls-Royce and SAFRAN.

JTI is a new instrument created by the European Commission for the 7th Framework Programme for Research (FP7) in order to allow large-scale and long-term public/private research partnerships to implement the ambitious research priorities of the SRA. These are on such a large scale that they will require the mobilisation and management of very substantial public and private investment.

Clean Sky will develop breakthrough technologies to improve significantly the impact of air transport on the environment. To pursue this, the first demonstrators launched in Clean Sky are in radical configuration in order to anticipate the development of technologies to meet the ACARE, environmental and expected new regulation goals.

Avio started the concept design activity on two innovative power gearboxes for both open rotor engine and geared fan applications. At the same time, the design phase was launched on a section of an innovative LPT, always addressed to open rotor engines. Technologies have to be developed to allow the entry into service of an engine in 2018-2020.

