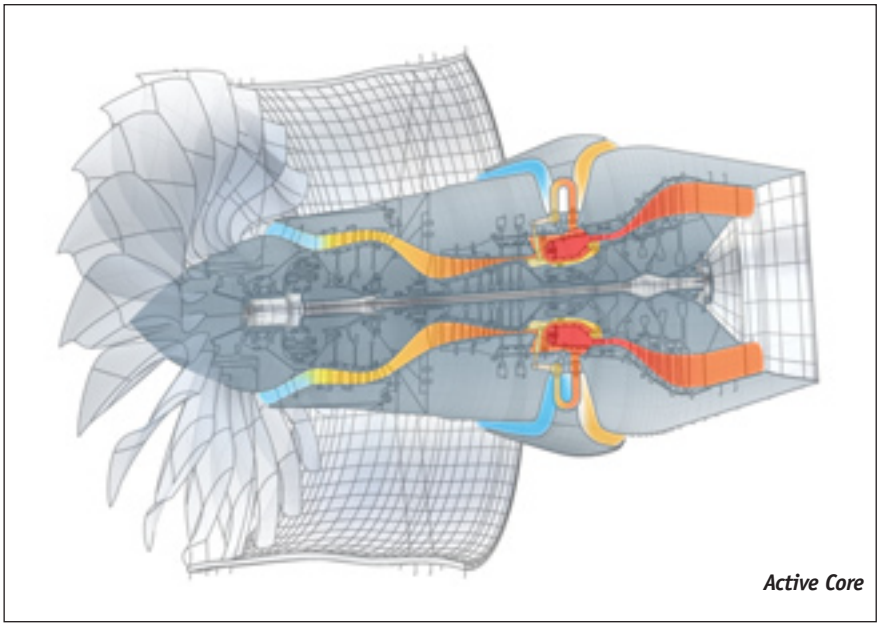
Less fuel – less CO_2 – less NO_X

NEWAC – NEW Aero engine Core technology for environmentally-friendly air traffic...

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 this demand whilst ensuring economic, safe and environmentally-friendly air travel. In particular, alternative engine configurations need to be researched in order to achieve a significant and durable reduction of pollution.

Large investments have already been made in Europe through R&T programmes and collaborations to reduce the negative environmental effects of aircraft use. Research is therefore providing the technologies to improve the performance of existing engine components. However, their existing limitations will not allow the industry to reach the goals set in the field of aeronautics research in the Vision 2020 report made by the Advisory Council of Aeronautical Research in Europe (ACARE). To reduce CO_2 and NO_X emissions, new engine core configurations with heat management and active systems, as well as advanced combustor technology, have to be investigated. These will be developed under the EU integrated programme for NEW Aero engine Core concepts (NEWAC).



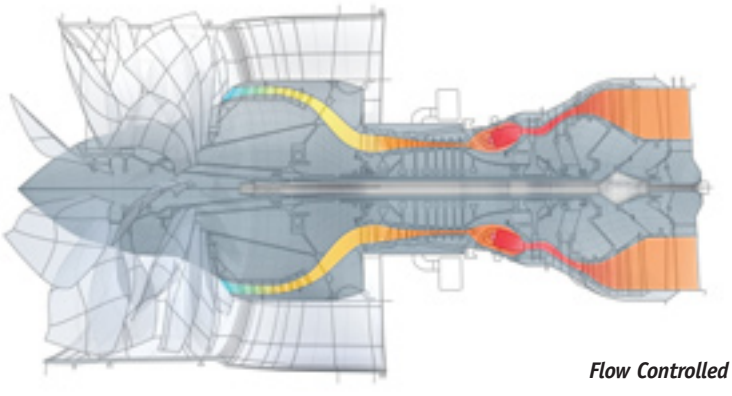
Active Core

Emission reduction by 6% CO_2 and 16% NO_X

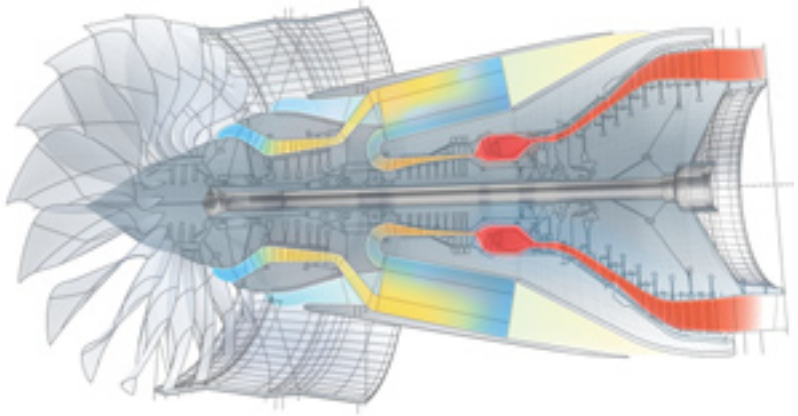
Previous technology programmes have already identified concepts and technologies to achieve the ambitious environmental targets set by the ACARE. To strongly reduce CO_2 and NO_X emissions, innovative core configurations will be developed and validated under the NEWAC programme. These concepts will use heat management (intercooler, cooling air cooler, recuperator), improved combustion, active systems and improved core components. NEWAC will design and manufacture these innovative components and perform model, rig and core tests to validate the critical technologies. 40 actors from the European leading engine industry, the engine industry supply chain, key European research institutes and SMEs with specific expertise will jointly develop new aero engine core technology under the €71m programme, of which, €40m is funded by the EC. The following four core concepts will be investigated:

- **Active Core** with active systems applicable to a Geared Turbo Fan (GTF);
- **Flow Controlled Core** for the Counter-Rotating Turbo Fan (CRTF);
- **Intercooled Core** for a high OPR engine concept based on a three-shaft Direct Drive Turbo Fan (DDTF);
- **Intercooled Recuperative Core** for the Intercooled Recuperative Aero engine concept (IRA) operated at low OPR.

The main result will be fully validated new technologies, enabling a 6% reduction in CO_2 emissions and a 16% reduction in NO_X.



Flow Controlled Core



Intercooled Core

Active Core Concept

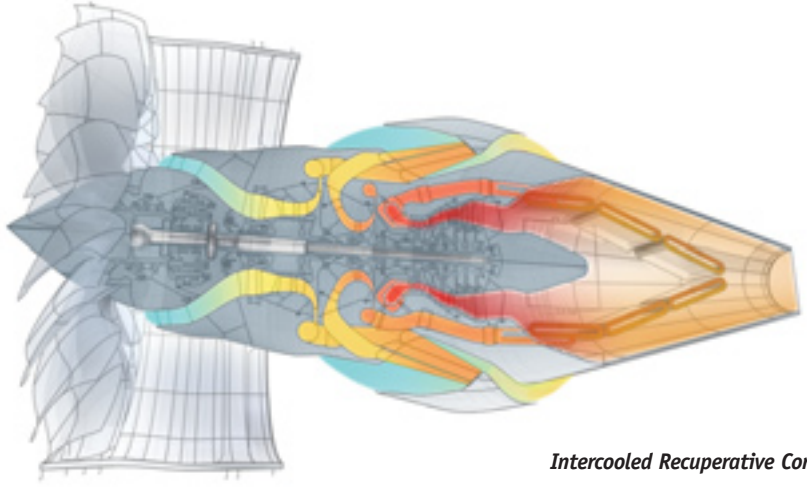
Active systems open up a new area of technological opportunities. They offer the possibility to adapt the core engine to each operating condition of the mission and, therefore, have the potential to optimise component and cycle behaviour. An active cooling air cooling system, an active or semi-active clearance control system and an active surge control system for the High Pressure Compressor (HPC) are the most promising active systems. The candidates with the highest overall potential will be developed and validated in a final core test. A Partially Evaporating Rapid Mixing (PERM) combustor is best applicable to the active core engine and will be investigated under NEWAC.

Intercooled Core Concept

The introduction of an intercooler to a core configuration permits very high Overall Pressure Ratios (OPR). It leads to fuel burn improvements by reducing the compression work and also reduces the high pressure delivery temperature to reduce NO_X formation. The intercooler and the related ducting and specific HPC technologies will be investigated. These HPC technologies will be validated with rig tests. An advanced Lean Direct Injection (LDI) combustor based on the EEFAE technology will be investigated as most appropriate for the intercooled core cycle at high OPR.

Flow Controlled Core Concept

Flow control technologies offer new opportunities to achieve an increase in high pressure compressor efficiency, additional surge margin and reduced in service deterioration. Tip flow control technologies including tip-injection and aspiration, advanced 3D aerodynamics and air aspiration, blade/casing rub management will be investigated by analysis, elementary tests and validated in a compressor rig test. For this application, the LDI or PERM combustor are well suited.



Intercooled Recuperative Core

Intercooled Recuperative Core Concept

This concept exploits the heat of the engine exhaust gas and maximises the heat pick up capacity of the combustor inlet air by intercooling in front of the HPC. The results of the EEFAE-CLEAN technology programme showed improvement potential in the optimisation of the recuperator arrangement, by introducing an innovative duct design and investigating a radial compressor in a new design regime. Finally, an advanced Lean Premixed Prevapourised (LPP) combustor, which is well suited for the intercooled recuperative cycle with its low overall pressure ratio, will support further NO_X reduction.

All new configurations investigated in NEWAC will be compared, assessed and ranked regarding their benefits and contributions to the global project targets. As a result, NEWAC will identify the technology routes to environmentally-friendly and economic propulsion solutions.

More information about the programme can be found on the NEWAC website: www.newac.eu or contact Dr Günter Wilfert, the details are listed below.

Active systems offer the possibility to adapt the core engine to each operating condition of the mission.

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