Low Emissions Core-Engine Technologies

Results in Brief

Building a better aero-engine

The EU-funded LEMCOTEC project used a new technological approach to build a more efficient aero-engine, helping to ensure Europe's aviation sector not only reaches its ambitious carbon emission targets – but exceeds them.

TRANSPORT AND MOBILITY

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When it comes to emission reduction targets, Europe sets the bar high. According to the 2020 Vision targets set by the Advisory Council for Aeronautics Research and Innovation in Europe (ACARE), the European aero-engine sector alone is committed to reducing its total 2000 CO2 and fuel consumption levels by 15 to 20 %, depending on engine size. Furthermore, the entire European air transportation sector is aiming to attain a 50 % reduction relative to the year 2000.

But with more people taking to the skies and ongoing pressure to keep air travel economically feasible and safe, some may see these targets as a hurdle too high.

Not LEMCOTEC.

To reduce CO2 emissions by 20 to 30 %, LEMCOTEC developed further core-

engine technologies at the sub-system and component levels. These technologies allow for operations at higher pressures and temperatures, which increase the engine's thermal cycle efficiency. The research includes designing engine casings for higher stiffness and lower weight and reducing the cooling air requirements for hot structures.

'Higher pressure ratios would usually lead to increased weight and costs,' explains Project Coordinator Ralf von der Bank. 'LEMCOTEC achieved an overall benefit by reducing the weight of components, improving the aerodynamics and cooling efficiency and by applying advanced materials with higher temperature capability and lower densities.'

Improving technology

LEMCOTEC didn't build new engines per se. Instead, it worked to improve the technology of the components that make up the engine's sub-systems, such as the compressors, lean combustion systems, combustor-turbine interfaces, turbines and advanced ultra-high-pressure ratio engine structures. 'As a so-called Level 2 integrated project, LEMCOTEC validated the core-engine technologies that are needed for future ultra-high overall pressure ratio aero-engines up to sub-system level,' explains von der Bank. 'As such, we helped to close the gap between basic research and innovation actions and the pre-competitive technology demonstrations of the Clean Sky initiative.'

During the course of the project, researchers defined three generic study engine architectures representing regional, medium and long-range applications. For example, as to the regional engine, researchers identified various components that had the potential to improve efficiency from an emissions point of view. To achieve this potential, the project developed combustion sub-systems that integrate lean-burn technology with advanced fuel injection. Armed with this new lean combustion sub-system, the engine is now on track for meeting its 65 to 70 % NOx reduction targets.

Encouraging results

Researchers are currently testing one of the three low emission combustor technologies. 'The results we are achieving are very encouraging,' says von der Bank. 'Our assessment showed that for all three engine types, the project's targets regarding CO2 emission reduction have almost been met.' Ralf von der Bank adds that the emission reduction of CO2, water vapor and of sulphur oxides is proportional to the fuel burn decrease. Due to the very effective lean burn systems, NOx emission reductions are larger than originally targeted.

What this means is that by improving the efficiencies of engine sub-systems, the aircraft's overall environmental footprint can be reduced to around two litres of fuel

per passenger per 100 kilometres travelled. ‘This is a substantial improvement in efficiency earned from a focus on the core-engine, which is an important element of an aircraft propulsion system,’ adds von der Bank. ‘When combined with efficiency improvements happening in airframes, operations and air traffic management, the Vision 2020 goals are very realistic. A consumption of just one litre fuel per 100 passenger kilometres has become feasible in the long term.’

Keywords

LEMCOTEC, aero-engines, CO2 emissions, Vision 2020

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Project Information

LEMCOTEC

Grant agreement ID: 283216

Project website

Project closed

Start date
1 October 2011

End date
30 June 2017

Funded under
Specific Programme "Cooperation": Transport (including Aeronautics)

Total cost
€ 67 909 374,00

EU contribution
€ 39 980 815,00

Coordinated by
ROLLS-ROYCE DEUTSCHLAND LTD & CO KG
Germany

Last update: 27 November 2017

Permalink: https://cordis.europa.eu/article/id/147233-building-a-better-aeroengine