



# Skyline

n°2

Clean Sky newsletter

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## Clean Sky

TAKES UP IN THE AIR

- 2 Editorial
- 3 Cenaero, an active SME working with Clean Sky
- 4 Advanced Lip Extended Acoustic Panel
- 5 Going local
- 6 Zoom on the open rotor
- 7 Calls for proposals
- 8 Short News



**CLEANSKY**

*Innovating together, flying greener*

# Editorial



Eric Dautriat, Executive Director of the Clean Sky Joint Undertaking

**“Clean Sky  
is truly an  
open club”**



Clean Sky Info sessions: an important way to disseminate information about calls for proposals.

Cover page: 29<sup>th</sup> September 2010: the first flight test campaign for the Clean Sky SFWA integrated platform started with the take-off of the Airbus A380 MSN 001 test aircraft, equipped with one of the engines being substantially modified at the engine intake.

## Dear reader,

The year 2010 is coming to an end. It is time to look back and check what has been accomplished by the Clean Sky Joint Undertaking during this first year of autonomous operation – but also the first year of an activity which can be considered as close to a steady-state level, as far as budget and resources are concerned.

As a matter of fact, the Integrated Technology Demonstrators (ITD- or technology platforms) are working hard. Of course, as in any research programme, particularly with the high integration stage which characterizes most of Clean Sky activities, you have to be patient before seeing and touching the major achievements, i.e. the system-level demonstrators. *“Roma die uno non aedificata est”* (Rome was not built in a day). Nevertheless, first pieces of hardware and even first in-flight tests are coming now.

In this second issue of Skyline, you will read an article about flight testing on board a A380 of an advanced air intake acoustic protection. This is the first flight test of a technology in Clean Sky, and as such, this is an event to celebrate: Clean Sky is starting to deliver and this is becoming visible... in the sky.

Helicopter flights have also started for acoustic measurements in the framework of the flight trajectory optimization. These two sets of flights remind us, by the way, that Clean Sky is not only about fuel consumption and CO<sub>2</sub> emissions, but also about noise reduction.

In the advanced three-shaft turbofan engine (SAGE 3), the fan blades for the bird strike test have been manufactured, as well as the injectors of the turboshaft engine (SAGE 5) which features a NOx-optimized combustor. In the Systems for Green Operations demonstrator, where more efficient ice protection systems are at stake, icing wind tunnel tests for tools calibration were performed.

For regional aircraft composite structures, new nano-modified composite materials have been developed and successfully tested for hail impact. Five first projects selected during the 1<sup>st</sup> Clean Sky Call for Proposals, are finalized. All of them delivered valuable results in terms of new composite materials and structural health monitoring.

The eco-design team has achieved the first tests of a manufacturing process replacing

chemical machining by mechanical milling in order to eliminate the need for chemicals usage (acid baths), and at the same time, to reduce logistics. The tests have been carried out on rolled fuselage panels.

While these first concrete technological achievements are taking place, the Technology Evaluator is coordinating a first re-assessment of environmental targets at mission level. These results, which do not question the initial set of “rough” objectives but re-organize them into a more precise rationale, will be synthesized in the next issue of this newsletter.

These activities could not take place without the support of the partners which are selected through the calls for proposals, on topics proposed by the ITDs to the JU. The 7<sup>th</sup> call was launched at the end of September; the proposals from the 6<sup>th</sup> call were evaluated in November. At the level of this 6<sup>th</sup> call, we have now approximately 325 partners involved (already started, or still in negotiation phase). Clean Sky is truly an open club! In particular, the SME share, already satisfactory last time (see *Skyline n°1*), has still increased, up to 42% in funding.

Such a result is demonstrating that Clean Sky is “SME-friendly”, thanks to the nature of the topics.

This shows that Clean Sky can be a stepping stone for newcomers, allowing them to get a first experience before applying further in more “upstream” European research activities.

This is also evidence that the efforts made in order to disseminate the information about these calls and to improve the process have proven to be successful.

You will read an interesting, and, to my opinion, encouraging account of an SME experience in Clean Sky, from CENAERO in the following pages.

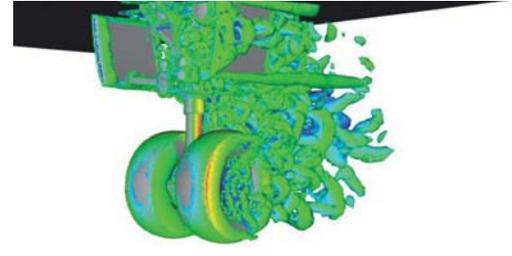
However, we know we have still a lot to do, in order to have still more and more harmonized, topic descriptions, to shorten the time to contract, to provide the partners with a better access to information. *Skyline* is a modest attempt to provide for such a general information, well beyond our partners, to a general public.

**Eric Dautriat**

Executive Director of the Clean Sky Joint Undertaking

# Interview with an active SME working with Clean Sky

## Dr Michel Delanaye, Managing Director of Cenaero (Belgium)



LES simulation of the flow around an A340 nose landing gear for noise prediction.

### **What role can SMEs play in a European initiative like Clean Sky?**

Innovative SMEs can bring their dynamism and very specific technical knowledge in the Clean SKY program. Flexibility is also a key characteristic of SME which can be very valuable for supporting large companies in their research efforts. SMEs can also bring new ideas and crossover with other disciplines.

### **What would you recommend to other SMEs interested in joining CS?**

Clean Sky represents a great opportunity and a financial leverage to develop specific and promising capabilities. Indeed, with respect to FP7, it is easier for an SME to set up a proposal in Clean Sky. Moreover, participating in Clean Sky shows its technological expertise and represents a quality pledge.

### **Any views on future perspectives?**

Let's hope Clean Sky Initiative will last many years, and be somehow represented within FP8.

### **Mr Delanaye, what is CENAERO?**

Cenaero is a private applied research centre providing to companies involved in a technology innovation process high fidelity numerical simulation methods and tools to invent and design more competitive products.

### **How did you join the Clean Sky initiative?**

We were aware that the newly set Clean Sky joint Technology Initiative was frequently looking for partners to perform specific research studies. We were informed by our local National Contact Point about research topics, analyzed calls for proposal published on the Clean Sky website, selected topics in line with our activities, and submitted proposals, either alone or with partners. Two of them were selected, and we joined the Clean Sky Initiative within the Green Regional Aircraft Integrated Technology Demonstrator (ITD).

We are currently working on an optimized design of the nose landing gear in order to reduce noise emission during the take-off and landing phase.

### **What are the (technical) challenges you faced so far?**

The major challenge is that topics are indeed highly technical and require a very specific and high-level competence. Competition for selection is also very strong as there is only one proposal selected for each topic. Once selected, meeting the deadline within the allowed budget represents a real challenge too as indeed in any research activity.

### **When will the results of your project be put on the market?**

Our projects address a low Technology Readiness Level. We expect a time to market for our development to be around 5 to 7 years.

# Advanced Lip Extended Acoustic Panel (ALEAP)

## Technology demonstrator takes up in the Air



Airbus A380 with modified Rolls-Royce test engine

At the 29<sup>th</sup> September the first flight test campaign in the frame of the Clean Sky SFWA-ITD started with the take-off of the Airbus A380 MSN001 test aircraft, equipped with one of the engines being substantially modified at the engine intake. The purpose of the flight test is to validate the "Advanced Lip Acoustic Panel" aerodynamics and nacelle anti-ice protection of this new technology that enhances the acoustic performances of the engines and hence the aircraft.

Even though the most recent generations of turbofan aircraft engines operate at very low noise levels already, the need for a further decrease of engine noise emission is a firm commitment by the aeronautical engineering community. The development of related new noise reduction technologies is a challenge for the engine but also

the aircraft manufacturers, as many of such technologies do require an improved design of components or the layout of the engine, or else at aircraft level.

On modern civil aircraft, forward fan noise remains a critical noise source of turbofan engines. The actual high bypass ratio engine designs reflect the latest status of improvements made in aerodynamic and acoustic engineering made in the last two decades. An important point to understand is that effective noise reduction techniques can have typically detrimental consequences on the engine efficiency and the engine performance, which makes it more and more difficult to gain further noise reduction improvements.

The technique, which has the potential to provide another increment of noise improvement is the "Advanced Lip Extended Acoustic Panel", which is a carefully designed noise absorbing panel fitting seamlessly into the critical area of the inner engine intake just aft to the annular leading edge.

**A principal target criterion for the design of the panel is that the intake flow towards the fan close to the boundary may not suffer from any distortion under the excessively varying engine operation conditions. Another**

**important target criterion is that the modification of the inner engine intake does not affect the performance of the engine and nacelle anti-icing system installed at the leading edge of the engine intake.**

Following a large number of tests on ground, there is no other way to achieve a final proof that such a technology is ready for application than to test it under realistic conditions in flight. For this purpose, a modified conventional turbofan engine with the new intake technology is mounted at the "No.#3" port side inboard engine position on the Airbus A380 MSN001 test aircraft. Pressure rakes, observation cameras and a large number of different other probes are installed in the fan intake, the engine and the aircraft to measure all relevant parameters during the flight test. A conventional, not modified engine at "No.#2" position is equipped with the same instrumentation to acquire a full set of data for reference

After a first system "qualification flight test" at the 28<sup>th</sup> of September the planned test matrix could be fully covered in a number of 5 flight tests with more than 20 flight test hours in three weeks time.

Even a first "quick look" exploitation of the data is showing already that the ALEAP



← SFWA-ITD ALEAP technology flight demonstrator prepared for first flight

↓ Engine inlet with Advanced Lip Extended Acoustic Panel



technology works well as expected. With the current setup, the modification leads results in a noise reduction of 0,5dB in a fully representative integration environment. A detailed analysis need to be done to draw conclusions how to use the ALEAP technology most efficiently in future applications, and to identify possible further improvement potentials with the technology.

In parallel to this analysis, another challenge of the "ALEAP" technology will be tackled in 2011: the production of the large, slim double curved acoustic panel in a single piece, at high quality, high production rate, but at a low price. A major part of this work is under preparation to be proposed in a dedicated Clean Sky Call for Proposal topic, to be published early in 2011.



*The SFWA team: Annual Review Meeting, March 2010, Toulouse.*

## Going local

The Clean Sky Joint Undertaking values direct information of companies and potential candidates in their own country. At the initiative of several Member States, a few information sessions have already taken place. For future events, please check the [www.cleansky.eu](http://www.cleansky.eu).

### **4<sup>th</sup> November, Nootdorp (The Hague)**

The JU held an information & progress session at the initiative of the Dutch Agent-schapNL.

The morning focused on presentations and interviews dealing with the progress of Clean Sky, and in particular the experiences and activities of the Dutch participants and clusters (National cluster for Eco Design, Cluster International Group On Rotorcoustics, cluster Green Systems for Aircraft Foundation).

Debate and discussion were really the priority of the day: the panel of speakers were addressed a wide range of ques-

tions like the relevance of the programme for the public and private sector, the way European (and especially Dutch) SMEs can be involved in Clean Sky, how could a university become involved in the programme, etc. A question that proved to be a difficult one for the panel was what a traveller going on a holiday across the ocean would notice in 10 years time as a



result of Clean Sky. In the end the panel concluded that the effects would be more likely to become visible in 20 years and probably the aircraft would look different, the interior would be more comfortable and people living near the airports would not notice you flying away.

An "Information market" allowed potential candidates to discuss directly a specific topic with the JU Project Officers at several stands.

The 53 participants were also largely informed on the possibilities to join Clean Sky, from an administrative point of view.

### **17<sup>th</sup> November, London**

Organised at the initiative of the Aerospace & Defence Knowledge Transfer Network (A&D KTN), this Clean Sky UK update session introduced the relevance of Clean Sky to the UK aeronautics sector, including the current UK involvement and success in the Calls. Presentations on the progress of the Clean Sky programme, with a particular focus on the activities and direct experiences of the UK participants in the programme were followed by a briefing on the possibilities for potential partners to join the Clean Sky programme, via calls for proposals, from a content and legal point of view.

The day focused on particular Clean Sky thematic areas of interest for UK participants.

# Zoom on... the Open Rotor



## Sustainable and Green Engine Counter Rotating Open Rotor (CROR) architecture

In the current economical and environmental context, efficiency and operating cost of aero engines have become major issues for airlines and airframers as well as for engine manufacturers. The counter rotating open rotor (CROR) architecture, sometimes referred to as a propfan, is one technology with the potential to deliver significant reductions in fuel burn, CO<sub>2</sub> emissions and operating costs. The CROR concept is to have two large diameter propellers driven by a single gas turbine engine but rotating in opposite directions. In contrast with traditional propellers, though, the CROR blades are shaped similarly to the wide chord fan blades of a turbofan engine. By releasing the blades from the size constraints imposed by turbofan nacelles, CROR engines have ultrahigh bypass ratios and are intended to offer the speed and performance of a turbofan, with the fuel economy of a turboprop.

The CROR concept has been considered before. High fuel prices in the 1980s encouraged engine manufacturers to study the concept and two demonstrators were flown by GE (the GE36) on a Boeing 727 and by Pratt & Whitney (the P&W Allison 578DX) on an MD80. Both programmes were cancelled when fuel prices dropped again shortly after the first tests, and the noise emissions were found to be very high. Since 2000, though, fuel prices have risen again and the contribution of CO<sub>2</sub> emissions to climate change has increased the environmental imperative, rekindling interest in CROR engines.

*So why do we need to demonstrate CROR technologies again?* The first reason is to demonstrate solutions to the very high noise levels generated by the two previous demonstrators, secondly to demonstrate full operability (the previous demonstrators were not fully functional) and, third, to demonstrate that obstacles to flight clearance and certification can be overcome.

The 1980s demonstrations were valuable in identifying the main technological issues, enabling the current studies to start from a higher level of understanding. New solutions are being developed and the technologies have matured to the point where further demonstration is warranted.

This open rotor configuration raises challenges in terms of aerodynamics, aero acoustics and structural dynamics. The two propellers

are positioned very close to each other and to the airframe, with strong rotor/rotor and rotor/airframe interactions, creating noise and making unsteady aerodynamics predictions mandatory. The absence of a shroud makes noise reduction an important issue for passengers and community comfort, while the consequent interaction with the airframe requires higher levels of engine/airframe integration studies than are necessary for ducted engines. Finally, for obvious safety reasons, removal of the containment casing requires the structural integrity of the power plant to be demonstrated to a very high level.

**Open rotor is more than ever seen as a breakthrough technology for SFC (Specific Fuel Consumption) reduction, with a potential of 25 to 30% benefits at engine level: this is a game-changing technology in Clean Sky.**

The SAGE ITD (Sustainable and Green Engines Integrated Technology Demonstrator) includes two Open Rotor Demonstrators: SAGE1, led by Rolls-Royce, and SAGE2, led by Safran (Snecma).

The confirmation of the feasibility of the technology and final commitment to flight test within the Clean Sky timescale is foreseen in 2012. The target date for this flight demonstration is 2015, consistent with the currently anticipated market readiness. This implies ground tests, the objectives of at least one of which be a flight readiness test some months earlier.

One of the demonstrators, still to be selected will be flight-tested in the frame of the SFWA ITD (Smart Fixed Wing Aircraft).

This means a very tightly managed schedule for developing and building these novel and complex machines; conversely these target dates have some margin with respect to the Clean Sky

timescale in order to accommodate technical contingencies.

A key decision for any open rotor demonstrator is that between the geared (as demonstrated by the 578DX) and direct drive (as demonstrated by the GE36) architectures. Direct drive CROR engines have two contra-rotating low-speed turbines (effectively releasing the stators to rotate) with one propeller connected to each of the turbines, whereas geared CROR engines have a high-speed power turbine driving the propellers through an epicyclic gearbox. In geared solutions, the gearbox also reduces the shaft speed by a factor of between 7 and 8 to allow both the turbine and propellers to operate at their optimum speeds.

Originally, both architectures were to be demonstrated in Clean Sky but, in a recent development, the SAGE2 project has also selected the geared architecture. Following two years of study, and with the input of contra rotating propeller rig test results, Safran has concluded that the direct-drive architecture, while attractive due to its simplicity, was clearly inferior to the geared architecture in terms of fuel burn, weight and noise. This conclusion came from the open rotor ultra high by-pass-ratio which induces a significantly high optimum speed ratio between propellers and power turbine (between 7 and 8 as mentioned above) Furthermore, the direct drive open rotor simply did not feature enough performance gain with respect to more the classical ducted architecture, to justify carrying on developing such an otherwise expensive and risky technology. The range and complexity of technologies in a geared CROR, coupled with packaging and integration challenges, leads the Joint Undertaking to still expect the SAGE1 and SAGE2 projects to deliver significantly different demonstrations to reduce the risk associated with this exciting propulsion technology.



*The future of open rotor in Clean Sky.*

# Calls for Proposals



The submitted proposals are evaluated by teams of experts selected by the Clean Sky JU.

## Calls for proposals

- ✓ Clearly defined topics
- ✓ Focused to fit into the demonstrators or demonstrations
- ✓ Easy to apply and compete: one company can apply alone, and "the winner takes all"
- ✓ Infos days in different countries
- ✓ Fair and straight selection process, closely inspired by the FP's process and spirit

Joseph Cosgrave, IT Manager



### What is the average size of the call topics?

The research topics published to date vary in value from less than 100 thousand up to 10 million Euro so the size of an

organisation is not a barrier to participation. Proposals may be submitted by individual entities or consortia and applicants from around the world are eligible to apply.

### May applicants from countries not eligible for funding under FP7 (i.e. outside the European Union and FP7 associated countries) apply?

Yes, but if selected, they will not receive a financial contribution from Clean Sky. So far we have one example of a participant

in a winning proposal which comes from a non-FP7 country.

### How does one access the content of the call topics?

The full content of the almost 250 topics published to date in calls 1 to 7 can be accessed via the Clean Sky web site. The topics are defined by the ITDs and cross-checked by Clean Sky project officers before publication to ensure completeness and to avoid overlaps.

### What particular advice could you give to potential applicants?

Care should be taken to understand the meaning of the topic value because exceeding this limit will render a proposal ineligible. Also, organisations already associated to Clean Sky should check the eligibility criteria and funding rules before participating in open calls.

The calls are managed by dedicated I.T. tools from submission of proposals to evaluation

and on to contract negotiation and generation. This is the sole mechanism for applicants to provide proposal information to Clean Sky.

We encourage potential applicants to monitor the calls via our web site and to submit a proposal when a topic suitable for them is published.

### Are there any improvements being made to the process of calls for proposals and negotiations?

We are currently optimizing the full process in order to shorten the negotiation phase. As part of that we have started organising joint kick-off meetings with the coordinators of winning proposals prior to contract negotiations. Many of the ITDs topic managers also attend and the sessions cover the administrative and legal requirements related to the Grant Agreements for Partners. The first such meeting took place on 18<sup>th</sup> November and it was really well appreciated by all the parties concerned.

## Updated global statistics from Call 1 to Call 6

 **172** topics

 **200 M€** total public funding

 **2** partners by proposal in average

 Average duration **21** months

 **325** partners involved (coordinators or participants)

 **32 %** success rate

 **SME share: 42 %** (in funding), still increased from the previous statistics (34%)

 **6** months targeted as time to contract

# Clean Sky at ICAS



ICAS: a golden opportunity to encourage the development of increasingly ambitious international cooperation initiatives.

The 27<sup>th</sup> Congress of the International Council of the Aeronautical Sciences (ICAS) took place in Nice on 19-24 September 2010.

Hosted this year by the Association Aéronautique Astronautique de France, this edition brought together over 700 world aeronautics experts, attending some 500 presentations coming from around 40 countries.

This world congress provides a golden opportunity for scientists, engineers, researchers and students from industry, government agencies and universities to meet, present the expertise of their laboratories and companies, compare worldwide scientific and technological advances and encourage the development of increasingly ambitious international cooperation initiatives.



The Clean Sky JU welcomed on its stand numerous experts from all over the world.

Michel Goulain, Clean Sky Project Officer, presented the latest developments of the Smart Fixed Wing Aircraft integrated demonstrator platform, while Mark Pacey, leader of the SAGE demonstrator, presented the objectives, plans and first achievements of the Sustainable and Green Engine demonstrator. Other JU participants attended visitors on the Clean Sky stand.

## Short news

### Meet us ...

- At the Green Aviation symposium, 6<sup>th</sup> January 2011, London
- At the Aerodays, 30<sup>th</sup> March to 1<sup>st</sup> April 2011, Madrid
- During the regular Info days on calls for proposals we organise for the interest of potential applicants. Check our website regularly for new dates of events! { [www.cleansky.eu](http://www.cleansky.eu) }

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