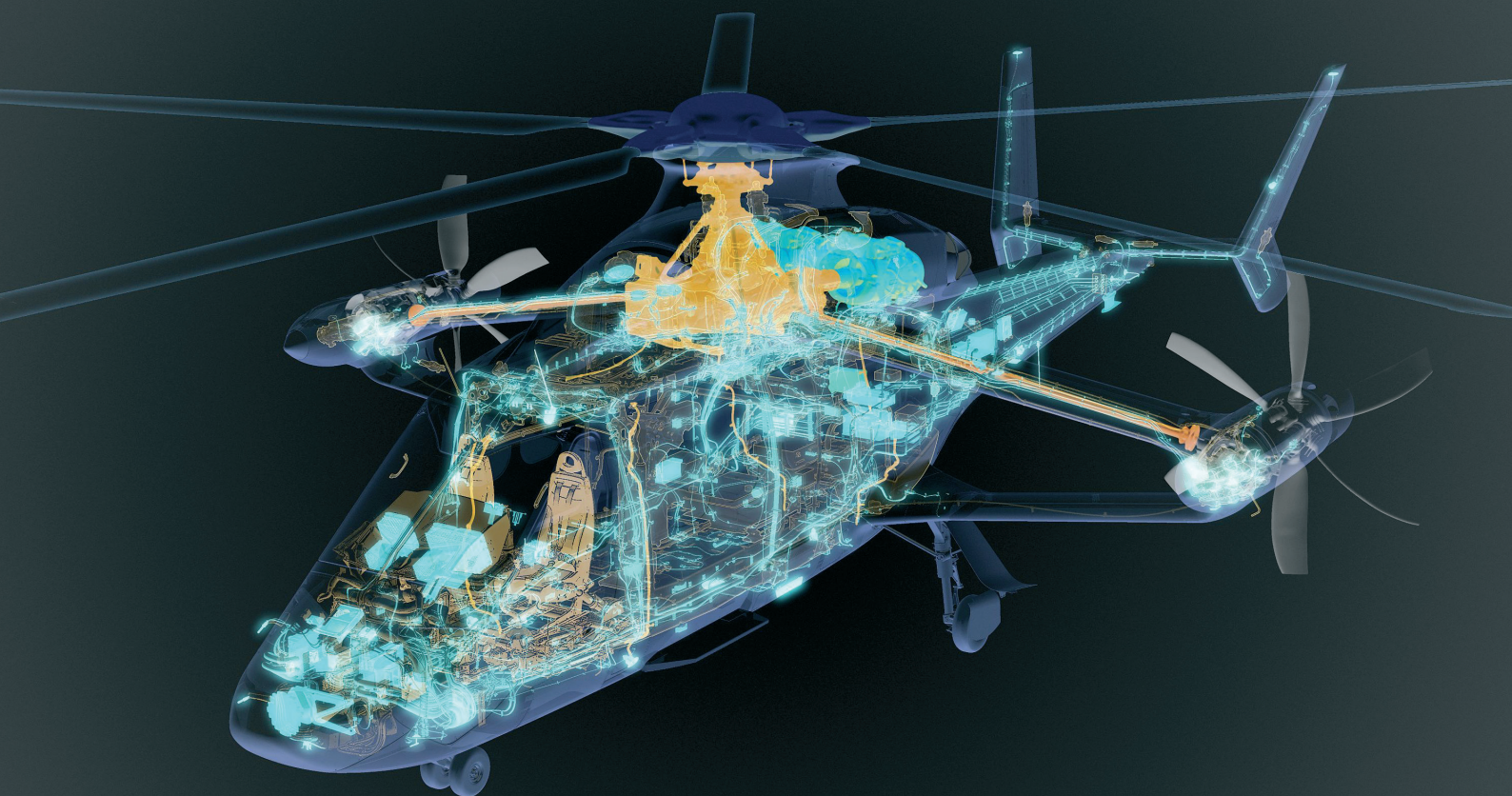


## Clean Sky 2 innovative results on track



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**The RACER demonstrator, led by Airbus Helicopters, has recently passed a milestone with parts starting to be manufactured. Learn more on page 8**

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# EDITORIAL

**Tiit Jürimäe**

*Interim Executive Director, Clean Sky 2 Joint Undertaking*



Since our last issue of Skyline, hundreds of visitors approached us at the Farnborough International Airshow in July to discover some of Clean Sky 2's first results. The joint Clean Sky/ European Commission stand included models of innovative hardware developed through the programme so far such as Leonardo's Tilt Rotor, the TU Delft NOVAIR aircraft and Airbus Helicopter's RACER demonstrator (shown on our cover page), which passed a milestone in October this year. After the preliminary design was unveiled in 2017, RACER has advanced to the next phase of development with the manufacturing of parts by a large number of European partners.

With these accomplishments, Clean Sky 2 has a keen eye on the future. After hosting several Info Days across Europe, we launched our 9<sup>th</sup> Call for Proposals in November. Clean Sky has a successful record of collaboration with the aeronautics industry, SMEs, research centres and universities, with now more than 1 200 participations to date, and we are eager to add to this number and further expand our community! We look forward to working with our future partners to develop

more innovative aeronautical technologies beneficial to the environment, including for CO<sub>2</sub> and noise reduction. In the meantime, take a look in this issue at the overview of some of the first Clean Sky 2 innovative results achieved.

I also invite you to read the articles in this issue on the future of research and innovation in EU aeronautics. Clean Sky has received a great deal of support from the European Parliament, the European Commission and several other public and private institutions. I would like to highlight contributors to this issue such as MEP Hohlmeier, Chair of Sky and Space Intergroup at the European Parliament, and French research organisation ONERA, as well as the German Federal Ministry for Economic Affairs and Energy. We hope that our European partnership will continue to grow as the cooperation of different actors, both public and private, is needed to ensure our common goals for sustainable aviation are achieved.

Do not miss the 4<sup>th</sup> EU aeronautics conference at the European Parliament on 5 December. A wide range of speakers from

across the European aeronautics sector will come together to discuss the importance of sustainable and performance-based aviation as well as the digitalisation of the aeronautics industry.

In addition, Clean Sky will be an active participant in Aerodays, which will take place in Bucharest on 27-30 May 2019. The theme of the event is Europe's Technological Achievements for a Sustainable Future of Aviation. Learn more on page 5 of this issue.

To conclude, I would like to invite you to take note of our upcoming event on 9-10 April 2019 'Clean Sky Private-Public Partnership - aeronautics research at its best: What next in Horizon Europe?' Join us for two days of discussions on the achievements of Clean Sky to date and the broader aeronautics research landscape, as well as the future of the Clean Sky programme in Horizon Europe. Stay tuned on [www.cleansky.eu](http://www.cleansky.eu) and our social media channels for more on this event and other Clean Sky 2 news.

A handwritten signature in blue ink, reading 'Tiit Jürimäe'.



# THE IMPORTANCE OF DELIVERING FOR A STRONGER CLEAN SKY 3

**Monika Hohlmeier**

*Member of the European Parliament*



The Clean Sky Joint Undertaking is the success story of a public-private partnership between the European Union and the European aeronautics industry. Clean Sky together with SESAR have proven to be vital European programmes, which boost accelerations of breakthrough research and innovation towards the market launch of new products. Their contribution to strengthening European leadership of aircraft manufacturing is remarkable in terms of ambition and novel technologies. Ahead of the Aeronautics Conference on the 5<sup>th</sup> of December in the European Parliament, it is time to reflect on our expectations towards the next Multiannual Financial Framework (MFF) 2021-2027, the contributions of Clean Sky to Europe's economic competitiveness, and its role in the ecologic improvements regarding the Paris COP21 goals.

Aviation is one of the key industrial sectors of Europe. With €160 billion of revenue, over 550,000 direct employees and more than 1.5 million indirectly supported jobs, the European aeronautics industry is one of the main pillars of European competitiveness. The sector is expected to see a large increase in passenger numbers, as we can foresee a duplication of passenger volume until 2035. However, there is no time to rest as international competition from established competitors like the US and Canada and upcoming challengers from China, India and other third states are becoming more numerous and fiercer in their approach. Changes resulting from digitalisation, a shift towards electrification/hybridisation and a transformation into Factory 4.0 require creative solutions.

CO<sub>2</sub> emissions resulting from air traffic are estimated to quadruple by 2050 compared to 2010. It is a key challenge to give an answer on the growing public demand and to decrease the emissions and immissions. Sustainable and noiseless transportation with environmentally friendly aircrafts and technologies requires drastically cut emissions and decreased noise pollution. Clean Sky is already significantly contributing to the reduction of the environmental footprint of air traffic, delivering constantly to achieve the Paris Agreement COP21 goals.

Clean Sky was set up from 2008 – 2014 with a budget of €1.6 billion as the largest aeronautics research programme in Europe so far, providing, for example, improvements in weight reduction, fan blade efficiency, better flow control, reduced fuel consumption, reduced emissions and noise pollution. The current budget of Clean Sky 2 from 2014 to 2020 amounts to €4 billion with the EU contributing a share of €1.8 billion from the Horizon 2020 programme budget and €2.2 billion financed by the industry. Evaluating the importance of this sector for Europe and the global challenges it is facing, we see a clear need for a European level of intervention and would welcome a healthy increase of the budget in the next MFF. As the industry is experiencing rapid changes, while developing investment-heavy technologies, the current budgetary policies are at its limit.

The demand for Clean Sky 3 and SESAR is continuously rising and we are working on an increase of the budget of up to €2 billion from the current funding level on the side of

the EU to support industrial leadership in the sector and deliver a cleaner European sky. Combined with the long-term commitment by its partners to the Research & Innovation roadmap, which shall serve as a reference agenda of aviation Research & Innovation throughout Europe, this will guarantee continued leadership in the global civil aviation market.

Additionally, the focus on synergies will be crucial under Horizon Europe and the next MFF. In order to progress, the Joint Undertaking requires a clear mandate to proceed in that direction and to pursue greater synergies with the European structural and investment funds (ESIF) and other European and national programmes. The next period is an opportunity for Clean Sky 3 to take on a strategic role as a coordinator between European Research & Innovation investments and domestic programmes as well as Smart Specialisation Strategies.

In view of the upcoming European Parliament elections in May 2019, it is necessary to establish without delay a clear funding strategy for Clean Sky 3, which stresses that an operational programme is in place and ready to deliver by the end of 2020. Both the European Commission and the European Parliament have a duty to agree on the roadmap and financial framework for the Joint Undertaking to guarantee a successful continuation of this European accomplishment. We need to fly high to contribute towards greener aviation, while boosting competitiveness and the economic success of the aviation sector.



**EU  
AERONAUTICS  
CONFERENCE**

**5 DECEMBER 2018**  
**European Parliament, Brussels, Belgium**

**REGISTER NOW >**



# EUROPE'S TECHNOLOGICAL ACHIEVEMENTS FOR A SUSTAINABLE FUTURE OF AVIATION ACROSS THE ROMANIAN PRESIDENCY OF THE EU COUNCIL

**Claudia Dobre**

*Head of International Cooperation Unit in the National Institute for Aerospace Research "Elie Carafoli", INCAS Bucharest*



2019 will be a year of great importance for the evolution of the research and innovation policy in Europe. It is the year when the new European framework programme – Horizon Europe (HE) – is expected to appear in its entire form and structure. It is the moment when the European institutions and all Member States will work together to fine-tune the programme's missions and partnerships. It is the time when research organisations and universities, industry and SMEs, governmental institutions and non-governmental institutions continue debates trying to find out their expectations in the new HE programme. And all this will happen in a very consistent manner in the first semester of 2019, when Romania comes for the first time to the Presidency of the EU Council.

Therefore now is the right time to launch in Bucharest a large and exciting forum for debates such as the already well-known AEROdays event. AEROdays (European Aeronautics Days) is the leading event in aviation research and innovation, a solid platform to share and review the latest developments in aeronautics and

air transport across the European Union. Almost three decades after the launch of this event, its 8<sup>th</sup> edition features a new and collaborative approach with two integrated events organised in Romania in May 2019 and Germany in May 2020, based on a unifying concept: TandemAEROdays19.20.

Funded by Horizon 2020, TandemAEROdays19.20 is supported by a consortium coordinated by INCAS Bucharest, having as partners the German Aerospace Center (DLR), the Executive Agency for Higher Education, Research, Development and Innovation Funding in Romania (UEFISCDI), and German Aerospace Industries Association (BDLI).

This synchronised initiative will bridge the achievements of Horizon 2020, currently the largest EU Research Framework Programme, with the strategic goals and expectations for the next decade, further strengthening European and national competitiveness in aeronautics and the air transport sector, while at the same time reinforcing the academic, research and industrial network from all the EU Member States.

The first event under the TandemAEROdays19.20 concept will take place in Bucharest on 27–30 May 2019, during Romania's mandate at the rotating Presidency of the Council of the European Union.

As the first AEROdays host in Central and Eastern Europe, Bucharest offers both a prominent location for the event – the Romanian Palace of Parliament – and an open environment for regional synergies in aerospace research and education, confirming the rapid expansion and development of a coherent European strategy in the transportation sector, especially in the aeronautics and air transport area.

This AEROdays event is aiming to promote regional policies for research and education in aeronautics, to facilitate and encourage the participation of Eastern European countries to a high-level event and to share their expertise in specific areas of industrial competitiveness, taking full advantage of the opportunities fuelled by the enlargement of the EU. It also offers a platform for the dissemination and implementation of world-leading EU projects and technical programmes based on the Horizon 2020 framework, providing at the same time communication links between European companies, from small and medium-sized enterprises to multinational companies, nurturing a fruitful exchange of ideas with the research community.

More than 800 participants are expected at the AEROdays event next May, bringing together a global audience including major European stakeholders, high-level political representatives from Romania and Germany, and leaders from the European Commission and the European Parliament.

Please register to get the latest news about TandemAEROdays 2019

<http://eepurl.com/dK2USQ>



For more information please contact:  
[info@tandemaerodays19-20.eu](mailto:info@tandemaerodays19-20.eu)



# HORIZON EUROPE - AERONAUTICS RESEARCH REMAINS ESSENTIAL FOR THE COMPETITIVENESS OF THE EUROPEAN AVIATION INDUSTRY

**Holger Schlienkamp**

*Deputy Director-General, Directorate IV D – Industry for tomorrow's mobility,  
Federal Ministry for Economic Affairs and Energy, Germany*



Aeronautics is a growing global business based on excellence, technology and high-level skills. With a turnover of €160 billion it directly provides more than 550,000 people with work and indirectly creates more than 1.5 million jobs in Europe. In Germany, around 110,000 people employed in the sector itself generate approximately €40 billion per year. The outlook for growth and jobs in the sector remains healthy, particularly in the medium and long term. Global market forecasts predict a doubling of global aircraft demand by 2030, with average annual growth rates of around 5%, and offer the major civil aircraft manufacturers and their suppliers the prospect of well-filled order books.

But this is only one side of the story. The competitive technology and business landscape of the aerospace sector is changing rapidly. Increasing environmental requirements for future air transport and growing international competition are presenting new challenges for the European aviation industry. These include the reduction of CO<sub>2</sub> emissions as well as of air pollutants and noise, the rising demand for all forms of air transport and the heavy load this places on air traffic management, increased expectations about passenger comfort, safety and security, the continuing US support for its domestic aircraft manufacturers, the rise of new competitors such as China, and the technology effects driven by digitalisation and electrification.

So, how can Europe's aviation industry cope with these challenges? Whilst there are many aspects to the answer to this, there is no

doubt that increased research efforts are an indispensable prerequisite for the continuation of the European success story in aerospace. Spending on research and development (R&D) by the sector has already reached a very high level. In Germany, about 12% of the industry's turnover is reinvested in R&D activities, making the aviation industry one of the most research-intensive sectors in our economy. But despite the massive investments by the private sector in Germany and in Europe in the development of new aircraft, public grants and public-private partnerships are also needed to foster innovation for sustainable mobility.

Germany therefore welcomes the proposal of the European Commission for the next Framework Programme for Research and Innovation for 2021-2027. Overall, we believe this proposal is balanced. Horizon Europe can make important contributions to strengthening the scientific and technological basis, increasing competitiveness, tackling the most important global challenges and ensuring the sustainable development of the European Union. With regards to strategic planning, we believe that the member states are the key players in this process, and that their role must be clearly distinguished from the advisory functions of various stakeholders and expert groups. The future process should be conducted within the parameters of comitology, and member states must have a say in the definition of missions and the nature and scope of the use of partnership instruments.

From a German point of view, the division of the thematic clusters in the pillar "Global Challenges and Industrial Competitiveness"

requires further fine-tuning. Mobility research should be retained as a research priority with its own dedicated programme area in order to properly reflect its scientific, innovative and social importance for Europe. Integrating mobility research into a combined "Climate, Energy and Mobility" cluster will lead to too narrow an approach: it would run the risk that opportunities for new solutions in important fields of technology, fields of action and application of mobility research will go unused.

Concerning aeronautics, we advocate a continuation of the successful public-private Clean Sky 2 and SESAR partnerships, albeit with improved governance which reflects the role of the member states. More exploratory research has been given limited attention under Horizon 2020, and it could be successfully incorporated into the partnerships. This would also facilitate the allocation of a dedicated budget for aviation which we deem necessary and appropriate to reach the goals and objectives of the ACARE SRIA (Strategic Research and Innovation Agenda) and of Flightpath 2050. Industry should continue to play a major role in defining and contributing to demonstrator-oriented activities; but suppliers, academia and research institutions have to become more involved, especially in the field of collaborative research. With such a set-up, the European aviation industry will be properly prepared to face global competition. Germany stands ready to work closely together with all public and private aeronautics stakeholders to achieve sustainable air transportation and to remain a global player in aviation technologies.

# ONERA: A MAJOR CONTRIBUTOR TO FOUR CLEAN SKY 2 STRATEGIC PLATFORM DEMONSTRATORS

**Bruno Sainjon**  
CEO, ONERA



Within Clean Sky 1, ONERA was selected as an Associate Partner of 3 Integrated Technology Demonstrators (ITDs): SFWA (Smart Fixed Wing Aircraft), GRA (Green Regional Aircraft) and GRC (Green RotorCraft). In addition, ONERA participated in the Technology Evaluator to assess the environmental benefits of some technologies developed in the ITDs. ONERA clearly contributed to the objectives of the 3 ITDs thanks to its multidisciplinary competences and its ability to adapt strategy changes inherent to such large programmes. Therefore, as an example, SFWA-ITD was a great success in enhancing our R&D work through 49 publications and attendances to conferences, including 15 peer-reviewed papers which is prerequisite for ONERA as a research centre.

In Clean Sky 2 (CS2), ONERA was selected in mid-2015 as a Core Partner in 2 ITDs and 2 IADPs (Innovative Aircraft Demonstration Platforms) for long-term involvement, and as a Partner for shorter periods. Acting as a strategic Core Partner of CS2 allows ONERA to consolidate its acknowledged position within the European aeronautical landscape.

ONERA contributed to 13 successful proposals and is a member of several consortia involving industry, SMEs, research centres, universities and academia. As a Core Partner, ONERA has launched calls for partners and is leading the Scaled Flight Testing demonstrator "D3" of LPA (Large Passenger Aircraft) IADP as well as the "Advanced Laminarity" Technology Stream in AIRFRAME ITD.

In all the above-mentioned projects, the involved ONERA teams have brought their multidisciplinary expertise, their powerful numerical tools, their

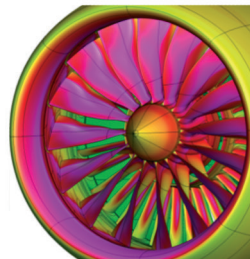


Fig. 1

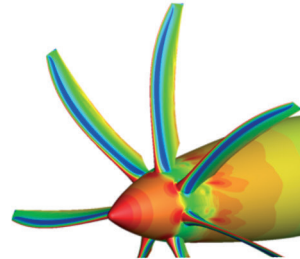


Fig. 2 - 7 blades propeller  
ONERA final design

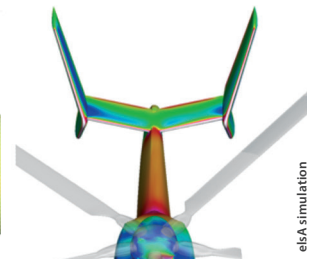


Fig. 3

research facilities or ground tests as well as industrial wind tunnels for developing research activities in the frame of technology streams defined by the industrial leaders in all CS2 platforms. These streams are closely linked to complementary research axes, in which ONERA is highly contributing throughout the CS2 programme through the winning proposals that can be applied for any aircraft or rotorcraft type:

- Higher performances via incremental evolution (flow and load control, weight and noise reduction, optimised design...);
- New engine integration (Open Rotor, Ultra High Bypass Ratio, Turbofan...);
- New aircraft radical/disruptive configurations;
- Integration of emergent technologies such as Distributed/Hybrid Electric Propulsion, or Boundary Layer Ingestion.

Additionally, over shorter time periods, ONERA is increasing its field of competencies with either SMEs, or other research centres or academia in specific areas such as new ideas in the domain of acoustic liners and in-duct modal detection for air conditioning systems (IDEAS project), or

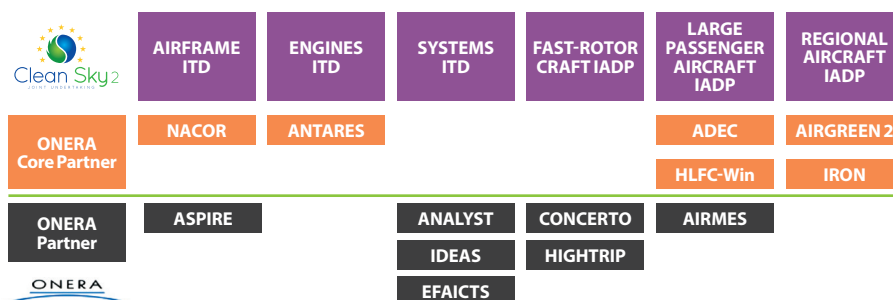
the modelling methodology for electromagnetic compatibility analysis of cable harnesses in aeronautics (ANALYST project).

Recent achievements recorded using in-house Low- and High-Fidelity numerical tools, such as elsA software, include:

- UHBR engine integration (Fig. 1): 360° URANS (Unsteady Reynolds Averaged Navier-Stokes) simulations with rotating fan blades and fixed engine parts (AIRFRAME ITD WP 1.2, ASPIRE project, Airbus Commercial Aircraft)
- Turboprop (Fig. 2): Optimised 7-bladed propeller geometry and concept to reduce acoustic emissions at similar aerodynamic performances (ENGINES ITD WP3, ANTARES project, Safran Helicopter Engines)
- Contributions to RACER demonstrator (Fig. 3): Vertical Tail design optimisation (AIRFRAME ITD TS B-1/-4, NACOR project, Airbus Helicopters)

ONERA is supporting the future of the European aeronautics sector by i) developing and consolidating in-house experimental and numerical tools for industrial competitiveness; ii) increasing the performance of flying vehicles (mainly aircraft and rotorcraft) by fostering new configurations for positive environmental impact.

Following its successes in CS1 and CS2 programmes, ONERA is looking forward to being a major partner within CS3 and the future Horizon Europe framework programme, based on a flexible roadmap going from upstream research to demonstrators and managing both incremental innovations and disruptive aircraft configurations.





# KEY CLEAN SKY 2 ACHIEVEMENTS TO DATE

APRIL  
2017



Noise Shielding  
Tail Plane  
**Airframe**  
Dassault

APRIL  
2017



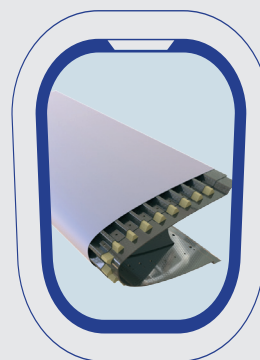
Successful flight  
tests of MEMS  
based GPAHRS  
on A330  
**Large Passenger  
Aircraft**  
Airbus

NOVEMBER  
2017



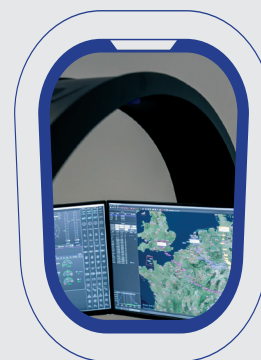
Advance3  
Demonstrator  
**Engines**  
Rolls-Royce plc

NOVEMBER  
2017



Hybrid  
Laminar Flow  
Control (HLFC)  
Horizontal Tail  
Plane passed  
review to enter  
detailed design  
**Large Passenger  
Aircraft**  
Airbus, Aernnova, DLR

DECEMBER  
2017



Primary  
development  
of the Aircraft  
Monitoring  
Chain & Ground  
Support System  
(AMCGSS) - part  
of REACTOR  
project  
**Large Passenger  
Aircraft**  
Coventry University



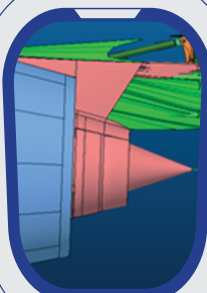
DECEMBER  
2017

JANUARY  
2018

JANUARY  
2018

JANUARY  
2018

FEBRUARY  
2018



Advanced  
Geared Engine  
Configuration  
- HPC & LPT  
Technology  
Demonstration

**Engines**

DLR, MTU, GKN

Printed Electronics  
Aircraft Cabin  
Sidewall  
demonstrator

**Large Passenger  
Aircraft**

Airbus

UltraFan® key  
aircraft integration  
design features  
and roadmap  
for flight test  
demonstration  
settled

**Large Passenger  
Aircraft**

Rolls-Royce plc.

Wind tunnel test  
with active flow  
control on a real  
aircraft geometry  
equipped with  
a classical and  
an Ultra High  
Bypass Ratio  
(UHBR) nacelle  
successfully  
completed in  
the Kryogenic  
Cologne Wind  
Tunnel

**Large Passenger  
Aircraft**

Airbus

ALECSys  
(Advanced  
Low Emissions  
Combustion  
System)  
Demonstrator

**Engines**

Rolls-Royce plc

# ZOOM IN ON SOME NEW CLEAN SKY 2 RESULTS

## RACER PASSES PRELIMINARY DESIGN REVIEW MILESTONE

Clean Sky 2's RACER demonstrator for Fast Rotorcraft has reached a major milestone in its development with a successful preliminary design review, following the validation of the demonstrator's aerodynamic configuration in 2017. RACER aims to provide the best trade-off between speed, cost-efficiency, sustainability and mission performance.

Long-lead items are already being manufactured for RACER. Airbus Helicopters has already launched production of the lateral drive shaft, one of the most innovative components for the demonstrator. Other partners working on the project include GE Avio (procurement and manufacturing for the lateral gear boxes housing); GE Aviation Systems (the wing's titanium cradle part); INCAS/Romaero (the composite side panel) and Aernnova (the tail parts primary structure).

"I want to thank all of our European partners for the excellence of their work and for their commitment in this fantastic project", said Tomasz Krysinski, Head of Research & Innovation at Airbus Helicopters. "The PDR marks a major achievement for the Racer program as it allows to freeze interfaces and 3D definitions of the main subsystems, prior to detailed design and manufacture of key components"

Final assembly of the RACER demonstrator is planned to start in Q4 2019. Airbus Helicopters and its partners are currently

refining the content of the future RACER flight demonstration in Clean Sky 2 which will begin in 2020 and include about 200 flight hours. The first part will focus on the progressive opening of the flight envelope and on assessing key performance objectives as well as speed, handling qualities, stability and aerodynamics. The second phase will

aim to demonstrate RACER's suitability to carry out missions where increased speed and efficiency would bring significant added value, such as emergency medical services and search & rescue, and will also focus on maturing low-noise flight procedures which are a key aim of RACER.

“I want to thank all of our European partners for the excellence of their work and for their commitment in this fantastic project”

Read the press release from Airbus Helicopters: <https://www.airbus.com/newsroom/press-releases/en/2018/10/racer-high-speed-demonstrator-passes-preliminary-design-review-m0.html>



## CLEAN SKY'S PIPS HARNESSES SPACE TECH FOR PLANE DE-ICING

As much as three percent of an aircraft's fuel-burn is spent on de-icing the engine intakes and the wings' leading edges during flight. What if some of that energy could be saved? Clean Sky's Passive Ice Protection System (PIPS) project uses technology originally developed for orbiting space satellites to bring fuel savings and reduced CO<sub>2</sub> emissions for aviation.

Ice poses a potential threat to flight operations at all stages of the journey and can occur unexpectedly – pre-flight, at altitude whenever ambient temperatures drop below 10 degrees Celsius, or when flying through clouds containing tiny water droplets within a certain temperature range that can quickly freeze as they attach to

the aircraft. Ice accumulating on aircraft distorts their aerodynamic profile, resulting in drag, reduced lift, impaired maneuverability and higher stall speeds. Furthermore, ice ingested into jet engines compromises their performance and can cause undue wear. All of this means greater fuel consumption and an increase in CO<sub>2</sub> emissions.

Current measures deployed to prevent ice build-up include the use of bleed-air (whereby hot air is bled off from the engine's compressor stage) which is ducted internally to parts of the aircraft that are prone to freezing; through the use of pneumatic 'boots' on the leading edges of wings which inflate and contract to physically break the ice up; or by the use of electro-thermal

systems which electrically heat the parts of the wings and engine cowlings where ice is prone to lurk. But all these systems, one way or another, take their toll on the aircraft's fuel supply.

"Existing ice protection systems use a lot of energy and the primary aim of Clean Sky's PIPS (Passive Ice Protection System) project is to reduce the consumption of energy while keeping the weight and increasing reliability", says Elena Pedone, Clean Sky's Project Administrator for PIPS. The specific objective of this project is to attain a TRL5 (testing in icing wind tunnel) anti-icing solution which will help Europe's aeronautical industry to produce more efficient aircraft with less environmental impact, and to this end



"the PIPS solution will be a bit lighter and more efficient than existing systems, which in the long term will all add up to a significant reduction in the CO<sub>2</sub> emissions" says Pedone.

EHP (Euro Heat Pipes), a Belgian company specialising in 'two-phase' (also known as biphasic) thermal control systems for orbiting space satellites, is steering the PIPS program through its paces and has drawn on its niche expertise in maintenance-free passive heat management technologies to address the issue of aircraft icing. Airbus DS has defined the area to be protected (engine chin air intake), the scenarios in which the system will operate, and the heating power demand, and is assuring that a proper integration can be attained in aircraft. The program kicked off in June 2016 and runs until March 2020. "The project is running smoothly in spite of the challenging technical requirements. EHP is demonstrating great flexibility and teamwork spirit and the evidence available so far indicates that capillary biphasic technology can be a competitive solution that could even be expanded to increase thermal efficiency of power plant installations" says Francisco Redondo, Senior Expert in Environmental Systems at Airbus DS.

"Sometimes you can spend up to 3% of the plane's energy on anti-icing, and there are two main zones where this occurs: the leading edge of the wings and the air intake of the aircraft engine" says EHP's design engineer Romain Rioboo. "The technology we're using in PIPS is the Capillary Pump Loop (CPL) which is used by orbiting space satellites to manage temperature changes without using energy, because in space you have no choice – you cannot put any pump or have maintenance – you need a system which is passive. This concept was developed by the Americans and Russians at the end of the 1960s and it's commonly used in space applications".

Though the principles of the system have been proven for use in satellites, adapting them for use in aviation for this specific engine de-icing task has been a significant undertaking, explains Rioboo: "We spent two and a half years at the very beginning of the project because when we answered the Clean Sky call we were thinking about all the various two-phase systems – but they weren't strong enough to transport enough heat, so we modified them more and more and took a lot of time perfecting the performance. We also spent a lot of time with the proof-of-concept, which we did on a full-scale system

because in such an application the technology is also dependent on the dimensions".

"In PIPS we're working on the air intake in order to protect it from icing up using a 'two-phase' system. We need to have a heat source – which in this case is the hot air coming from the engine – and the idea is to bring this heat up to the air intake zone that we have to protect, as well as further inside the front of the engine where you have a large zone which is about 1.5 metre long and 0.9 metre square that you have to de-ice" says Rioboo.

The PIPS system is comprised of five elements: an evaporator; a fluid reservoir; a condenser; fluid transport lines; and fluid inside the system to transport the heat between the evaporator and the condenser through the transport lines.

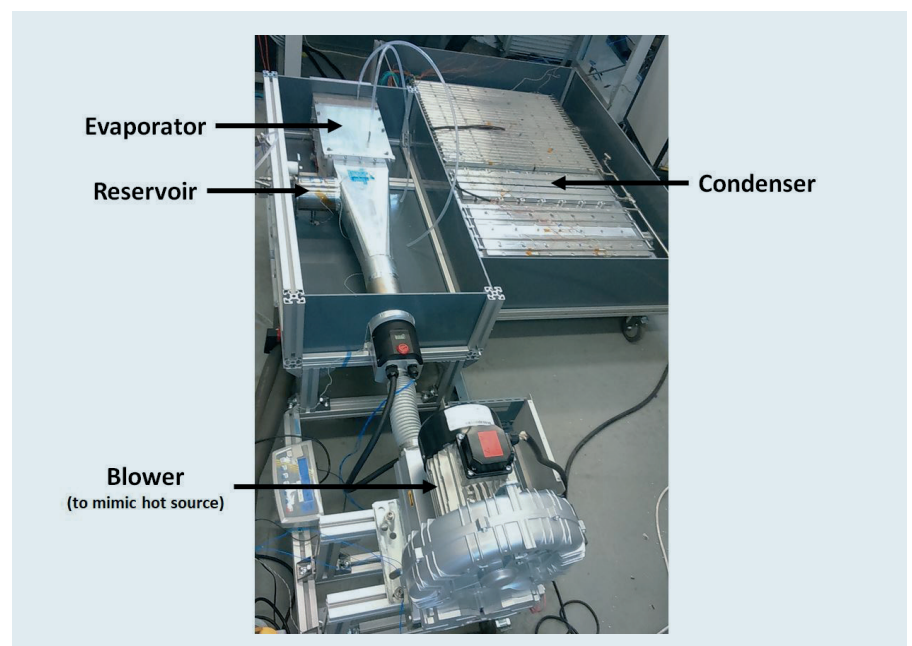
"You have a zone which is called the evaporator. The evaporator is in contact with a heat source and inside you have the heat exchange fluid. This fluid turns from liquid to vapour because it receives the heating from the engine. The vapour then goes to another zone which is the condenser (the cold zone) where you have condensation of the fluid. And because of the condensation of the fluid the heat is released. Then, at the evaporator the fluid is in contact with porous metallic media while it evaporates; this porous metallic media acts as a pump while

the vapour is let go to the condenser making the fluid's journey circular from the evaporator to the condenser and then back to the evaporator. And it works autonomously, you just need a difference of temperature between your evaporator and the condenser – the condenser is the cold zone and the evaporator is the hot zone", explains Rioboo.

A significant milestone was announced in September 2018 when a test of the complete system was successfully undertaken to validate the analytical performances model of the system prior to construction of the system to be fitted in an engine air intake and nacelle mockup.

In the meantime EHP, having collated the final proof-of-concept data from last Summer's complete system test, is now modelling it to extrapolate and define what the operational limits of the technology are, says Rioboo: "We now have a model which is rough and not precise which is working stationery and we saw that the system has to work in a non-stationery way. So we have to model and understand all that – this is now our main focus."

As the PIPS project progresses, further tests will be conducted in the Icing Wind Tunnel at Rail Tech Arsenal in Austria in the framework of another Clean Sky 2 project, I3PS (Integrated Innovative Ice Protection System), by the beginning of 2020.



# ZOOM IN ON SOME NEW CLEAN SKY 2 RESULTS

## LEVERAGING MOTOR RACING EXPERTISE FOR CLEAN SKY'S FASTCAN

For time-sensitive flights – particularly 'Golden Hour' emergency medical evacuations and search and rescue operations – speed and agility are key. Airbus Helicopter's RACER (Rapid And Cost-Effective Rotorcraft) demonstrator – one of two demonstrators to be built for Clean Sky's "Fast Rotorcraft" Innovative Aircraft Demonstrator Platform (IADP) – incorporates a whole host of inventive projects, including FastCan, which draws on motor racing knowhow to bring innovative design possibilities for the rotorcraft's canopy.

Since February 2017, KLK Motorsport GmbH and Modell und Formenbau Blasius Gerg GmbH have been teamed up as the FastCan consortium, designing and manufacturing the carbon fibre canopy structure for Airbus Helicopter's RACER (Rapid And Cost-Effective Rotorcraft). The project runs until the end of September 2020 and leverages the automotive design expertise of these SMEs to ensure that the RACER's canopy will be lightweight, safe and optimised for low aerodynamic drag, with a best field of view, and compliant with CS 29 requirements regarding bird strike impacts.

"This project within the framework of Clean Sky 2 allows us to demonstrate our extensive experience and capabilities in the field of cutting-edge composite solutions from the concept stage to the finished product" says Steve Dubs, Head of Design at KLK Motorsport. "Introducing proven and innovative design and manufacturing technologies from motorsport and the automotive world to the aviation industry can bring a competitive edge to the European market place".

That's a view mirrored by Clean Sky's FastCan Project Officer Andrzej Podsadowski: "When KLK Motorsport answered the call it was clear that their knowhow in automotive design would have relevance and add an extra dimension to this project. They showed us their specialist tools for calculating air-flow around the canopy and even presented us with a database filled with crash test data. It was obvious that bringing fresh thinking from outside of aviation and their understanding of how to design a lightweight, impact resistant, low cost solution would be beneficial for FastCan".

In terms of the project's current status, Dubs reports that KLK is in the development phase

of the project which has already passed its Preliminary Design Review and is now in the final stages of the detail design of the canopy structure: "In parallel with our design engineers, our stress department is optimising the laminate lay-up of the carbon fibre structure to fulfil all necessary requirements with regards to strength, stiffness and bird impact" says Dubs. "Here, the close relationship between engineering and manufacturing plays a crucial role in ensuring both a structurally sound and lightweight structure as well as efficient production economics".

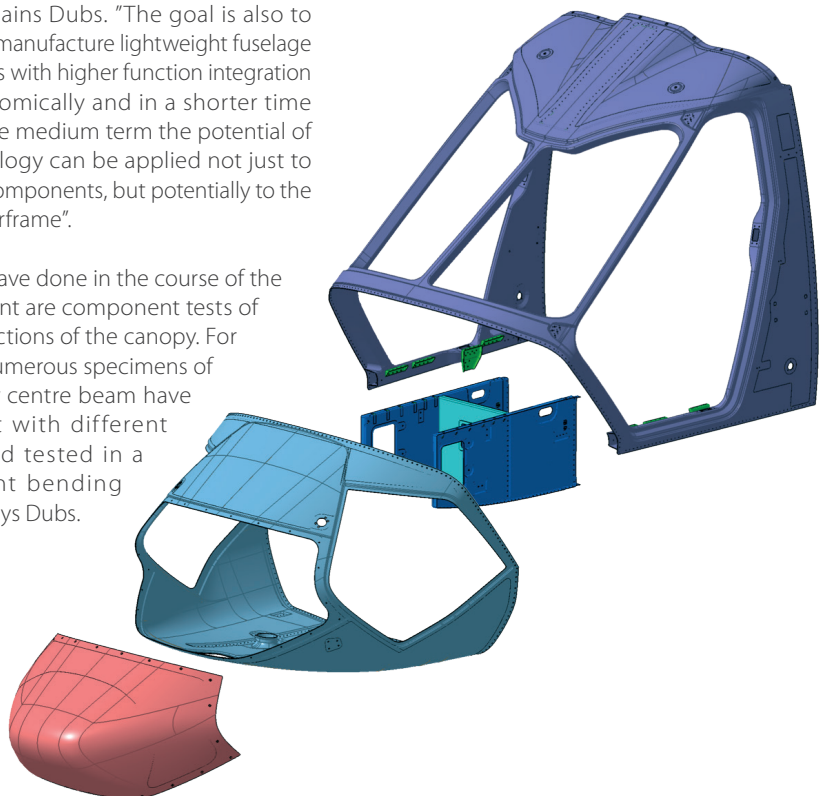
But there's also a bigger potential in terms of the synergies between the automotive and aeronautical worlds and the value of pooling expertise, with the FastCan team's objectives being to "optimise, mature and prove proprietary and innovative design processes and manufacturing technologies for new aerospace applications. The goal is to provide an innovative and highly integrated technologies demonstrator that successfully applies motorsport and automotive knowhow to the aviation industry. This technology transfer serves to improve and complement existing industry procedures for structural CFRP (Carbon Fibre Reinforced Plastic) components" explains Dubs. "The goal is also to design and manufacture lightweight fuselage components with higher function integration more economically and in a shorter time frame. In the medium term the potential of this technology can be applied not just to individual components, but potentially to the complete airframe".

"What we have done in the course of the development are component tests of different sections of the canopy. For example, numerous specimens of the canopy centre beam have been built with different lay-ups and tested in a three-point bending machine" says Dubs.

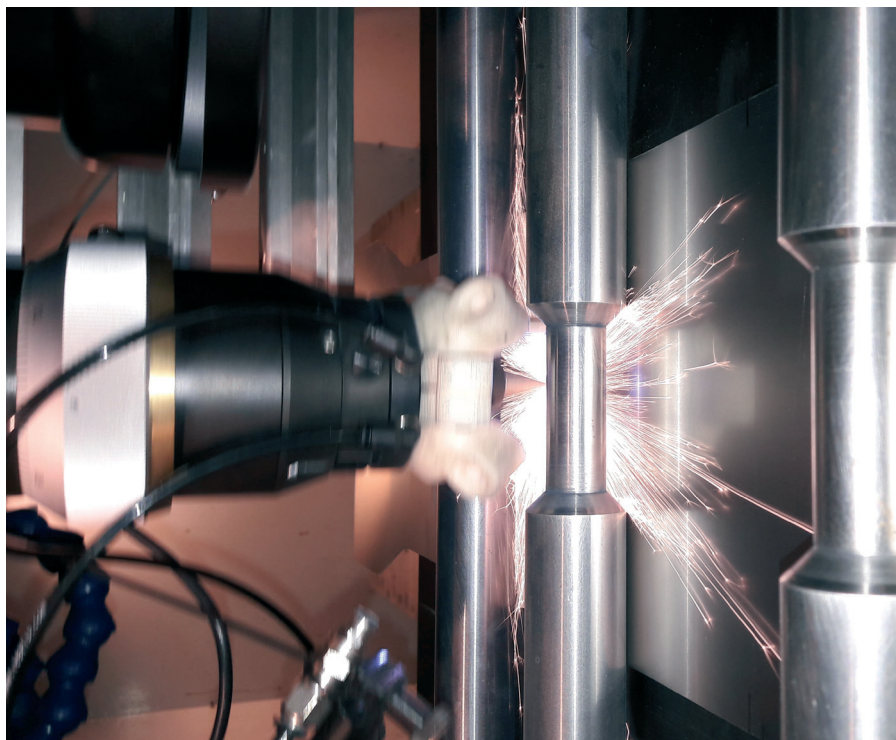
These physical component tests are an important step in the sizing of the carbon fibre structure and also for the validation of the simulation results. For the same reason, and in addition to KLK's computer simulations, they are planning physical bird strike tests (using jelly birds) on representative carbon fibre sandwich panels.

"From the Clean Sky perspective, the inclusion of non-aviation SME's is added value, because people from outside the industry think out of the box" says Clean Sky's Podsadowski. "They're not accustomed to working within the constraints of airworthiness regulations and certification processes. Sometimes outside players are seen as disruptive, but they're very experienced engineers, so plenty of things are possible. The tubular structure for the canopy proposed by FastCan is highly innovative".

Going forward, the flightworthy canopy will be delivered to Airbus Helicopters for installation and integration into the complete airframe prior to the flight tests. Concurrently, KLK Motorsport will support the test program with relevant flight documentation and engineering support.



## GETTING UNDER THE SKIN OF CLEAN SKY – WITH HYPERDRILL



Airliners of the future could benefit from fuel savings of up to 5% by using Hybrid Laminar Flow Control, also known as 'hybrid laminarity', a technique whereby part of the turbulent airflow around an aircraft is sucked through microperforations in its skin, creating a more stable aerodynamic flow. Clean Sky's HYPERDRILL project is evolving the unique and ultra-efficient production process for the manufacture of these skins, contributing to significant environmental benefits for European aviation.

Drilling over 300 holes per second through titanium sheets sounds like the stuff of science fiction, but that's the ambition of the HYPERDRILL consortium, coordinated by IK4-TEKNIKER in the city of Eibar, Spain, and supported by BIAS (Bremer Institut für Angewandte Strahltechnik GmbH) of Bremen, Germany. The 36 month project (2017-2020) is one of a number of 'contributing projects' in the Clean Sky portfolio, which focus around highly specific technical challenges that must be overcome in order to facilitate larger scale projects. In this case, HYPERDRILL contributes towards Demo 1 of the Hybrid Laminar Flow Control (HLFC) Large Scale Demonstrator, part of Clean Sky's Large Passenger Aircraft IADP.

On the HYPERDRILL project's checklist is the design, manufacture, assembly and testing of a High Throughput laser Micro-drilling (HTMD) prototype machine with process monitoring and quality control for micro-perforating large titanium sheets with a throughput of over 300 holes per second, to be tested within an industrial environment. The objective is that the machine will be able to generate millions of holes, of less than 100 µm in diameter, on titanium panels up to 5 m x 2 m.

"Hybrid laminarity uses a system which sucks the air from the upper parts of the wing through micro holes in the aircraft skin. The purpose of the HYPERDRILL project is to define the machining tools to enable manufacture of the titanium sheets that will be located on the leading edge of the horizontal tailplane for integration for the full system and device, and this project is very specific to this laminar flow application" says Sebastien Dubois, Clean Sky's Project Officer for Large Passenger Aircraft.

The technology, at demonstrator level, will be applied to the tail of the aircraft, but the full potential of the system will ultimately be realised when it is eventually installed in the aircraft wings. "In Clean Sky we are defining

and maturing the technologies into an industrial context and HYPERDRILL contends with the preparation of the manufacturing techniques to demonstrate the feasibility in actual conditions", adds Dubois.

By sucking the layer of turbulent air on the surface of the aircraft through the microperforated skin, the air flow around the aircraft can be more predictably managed, creating a laminar flow which reduces drag and therefore leads to savings in fuel and lower emissions. But developing and perfecting the industrial process to produce the perforated sheets with the necessary precision, uniformity, and in a timely manner, is no easy task.

"Laminar Flow Control research began in the 1930s and became important in the 1970s, however first test flights using HLFC techniques on a passenger aircraft didn't take place until the 1990s. Even now it has been very difficult to find the right technology to carry out the manufacture of an HLFC suction chamber integrated into the wing" says Carlos Soriano Reyes of Tekniker's Advanced Manufacturing Technologies Unit, adding that "the design and manufacture of each part of such a device's structure involves major technological challenges, one of which is the ability to micro-perforate millions of identical tiny holes at high speed on a large metal sheet. The machine is an excellent test bench for the aeronautical sector to evaluate the effectiveness of the system".

In terms of measurable results achieved to date the design of the machine has been completed and the components are currently being prepared for assembly. It is expected that the assembly will be completed, and the setting up will begin in the middle of 2019. At the end of the project there is a validation task lasting seven months where different large titanium panels will be microperforated and delivered to the aeronautical industry for testing.

As for the environmental benefits, Carlos Soriano Reyes says that "Hybrid laminar flow control technology can result in a reduction of up to 5% in the fuel consumption of civil transport aircraft, which in turn represents a significant environmental improvement through the reduction of CO<sub>2</sub> emissions and other pollutant agents into the atmosphere. The improvement, in turn, brings with it the possibility of increasing the level of aircraft payload".



# GET INVOLVED: 9<sup>th</sup> CALL FOR PROPOSALS IS OPEN

“Clean Sky 2’s 9<sup>th</sup> Call for Proposals is now open! The call opened on 6 November 2018 and has a budget of €69.1 million for 55 topics, including 4 Thematic Topics.”

Clean Sky owes its success to the diverse expertise, skills, knowledge and resourcefulness of its participants, including specialists from across the aviation industry, research centres, universities, SMEs, and others. Since its launch in 2014, Clean Sky 2 has gathered over 1200 participations from 500 unique entities from industry, SMEs, research centres and universities. With more Calls for Proposals to come over the next two years, learn how you can become a part of Clean Sky 2 with our FAQs below!

## Who is eligible to apply to Calls for Proposals?

Clean Sky 2’s Calls for Proposals (CfPs) are open to:

- Single entities (industry, SMEs, research organisations, academia etc.)
- Consortia of legal entities
- Clusters (groupings of entities applying as a single entity to perform work jointly)

There is no requirement to build a consortium with a minimum number of participants or representing a minimum number of Member States or H2020 Associated Countries. This is based on a derogation that the Clean Sky 2 Joint Undertaking has from the H2020 rules for

participation, due to the fact that a selected entity, once joining the programme, is basically joining an already-established European-level collaborative effort involving a large number of participants. This derogation was already applicable to Clean Sky 1 projects under FP7, where about 50% of the Calls for Proposals were answered by single applicants and about 30% were answered by 2 joint applicants, often an SME and a university.

## What are the applicable funding rates for the projects?

In Clean Sky 2 there are three types of actions: ‘Research & Innovation Actions’ (RIA), generally more ‘upstream’ in their research nature, which are related to technology enablers and/or a somewhat lower Technology Readiness Level (TRL); ‘Innovation Actions’ (IA) which generally involve the progression towards higher levels of technology integration, demonstration, and often a higher TRL; and Coordination and Support Actions (CSA), which generally provide service e.g. for the preparation of studies. In accordance with H2020, RIAs and CSAs are funded at 100% of the Total Eligible Cost (direct costs), and IAs at 70% of the Total Eligible Cost (direct costs). However, if an organisation is recognised and validated as a Non-Profit Entity (NPE), it can apply for 100% of the Total Eligible Cost for both types of actions.

The indirect costs are always funded at a 25% flat rate level, again in full compliance with H2020 rules.

In our Calls for Proposals (for Partners), each topic is separately categorised based on the nature of the actions required.

## If my company wins a CfP topic, is it entitled to pre-financing?

Pre-financing is foreseen for all projects/actions in Clean Sky 2 in accordance with the Clean Sky 2 model grant agreements which are mainly based on the H2020 model. Nevertheless, there is no standard percentage of pre-financing payment. In principle, up to 100% of the average JU funding per reporting period can be paid up-front as pre-finance for actions with at least two reporting periods; however, this is only a general guideline and pre-finance levels may vary based on the individual calls, the type of project, and the budgetary availability of the Joint Undertaking.

## What is the ‘Participant Guarantee Fund’?

‘The Fund’ was established in order to mitigate the risks associated with the amounts due and not reimbursed by any defaulting participants. The participants’ contribution to the Fund (5%) will be deducted from the initial pre-financing. At the end of the action the amount contributed to the Fund will be released and returned to the participants, via the coordinator.

## If I am a Core Partner, can I still apply for CfPs?

- Core Partners may apply to Calls for Proposals only in another IADP/ITD/TA where they are not selected as a Member.
- Partners selected via a Call for Proposals may apply to other Calls for Proposals in all IADP/ITD/TAs.

More information is available on our website: <http://cleansky.eu/calls>

# CLEAN SKY AT FARNBOROUGH INTERNATIONAL AIRSHOW 2018

**Maria-Fernanda Fau**

*Advocacy and Communications Manager, Clean Sky 2 Joint Undertaking*



Thank you to everyone who visited the joint Clean Sky/European Commission stand at Farnborough International Airshow from 16-22 July! The exhibition stand showcased several pieces of innovative hardware developed through the Clean Sky programme to reduce CO<sub>2</sub>, gas emissions and noise levels produced by aircraft, and project officers and experts were on hand throughout the week to explain Clean Sky and the EU's investment in aviation research through the Horizon 2020 programme.

The stand also hosted presentations by Christophe Diette from Safran Helicopter Engines, on innovations in turboprop and turboshaft engines; and by Catherine Thibaud from UTRC on the Adaptive Environmental Control System (aECS). Other highlights of the week included a visit to the stand from Signe Ratso, Deputy Director-General of DG RTD, and a celebration hosted by the University of Nottingham to mark its 10 years of participation in Clean Sky. This has translated into 21 projects of excellent research in Clean Sky 2 so far – here's to the next 10 years!

See all news and photos on our <http://cleansky.eu/event/farnborough-international-airshow-2018>





# ANNOUNCEMENTS

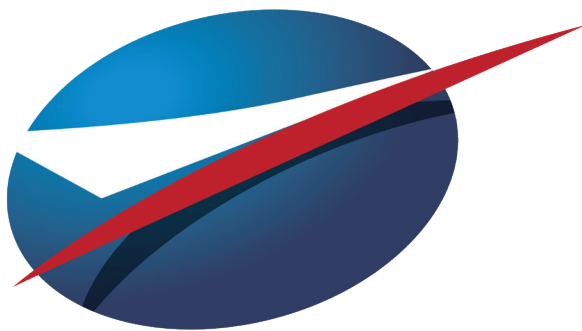
## CLEAN SKY 2 EVENT APRIL 2019

Save the date! Clean Sky will hold a two-day high-level conference on 9-10 April 2019 in Brussels, focusing on aeronautics research at its best and the future of the programme in Horizon Europe. The first day will feature speakers from the European aeronautics industry, the European Parliament and European Commission, as well as research centres and academia, while the second day will take a closer look at achievements of the Clean Sky 2 so far. Stay updated on our website <http://cleansky.eu/events>



## LE BOURGET 2019

From 17-23 June 2019, Clean Sky will again join forces with the European Commission at the Paris Air Show- Le Bourget to showcase the innovative results of the programme so far and discuss the future of aviation research in Europe! More information coming soon.



**53<sup>rd</sup> INTERNATIONAL  
PARIS AIR SHOW  
LE BOURGET**  
JUNE 17-23, 2019

**53<sup>e</sup> SALON INTERNATIONAL  
DE L'AÉRONAUTIQUE & DE L'ESPACE  
PARIS • LE BOURGET**  
17-23, JUIN 2019

## AERODAYS 2019 BUCHAREST

Mark your calendars for the first installment of TandemAERODays19.20, which will take place on 27-30 May 2019 in Bucharest, Romania. AERODays (European Aeronautics Days) is the leading event in aviation research and innovation, a solid platform to share and review the latest developments in aeronautics and air transport across the European Union. Learn more on page 5 of this magazine!



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Editor: Maria-Fernanda Fau, Advocacy and Communications Manager

The Clean Sky 2 Joint Undertaking receives funding under the Horizon 2020 Programme for research and innovation.

Views expressed in this publication do not represent any official position but only those of its author.

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