

## Laminar wing: On the right path



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# EDITORIAL

**Tiit Jürimäe**

*Interim Executive Director  
Clean Sky Joint Undertaking*



As I temporarily join the Clean Sky team until the new Executive Director enters the office next year, our programme enters an important phase. On the one hand, we are fast approaching the closing of the Clean Sky 1 programme, with all the technical activities to be completed by the end of 2016. You could already mark in your agendas 21-22 March 2017, when we will hold the closing event for Clean Sky 1 in Brussels, or plan your visit to our stand at Le Bourget air show next June.

On the other hand, the EU Horizon 2020 mid-term review will soon start, with independent experts looking into what has been accomplished within the Horizon 2020 framework since 2014. Clean Sky and all the other six EU Joint Undertakings will undergo a separate independent evaluation of achieved goals, broad participation and other success criteria. Both the European Commission and the European Parliament will be involved in this process which will run until next autumn.

Meanwhile, Clean Sky 2 moves steadily forward. We have already welcomed 133 new Members to the programme through the first three Calls for Core Partners and the final call for membership is launched now in November. That would allow the membership to be completed in 2017 and speed up the implementation. At the same time, 236 entities have been selected as Partners so far and this number is expected to grow significantly in years to come with the next two calls opening in 2017.

In parallel, we continue to build partnerships with European regions to boost innovation and growth in aeronautics. We establish partnerships with regions and Members States (we have signed 11 Memoranda of Understanding to date), and we help synergies' projects to take form and show best practices to regions and stakeholders.

Our actions can be summarised in two main pillars. Firstly, at a political level, we are establishing partnerships with regions to build mutual trust and knowledge through the exchange of information. The second pillar is at content level, where the different opportunities offered by Clean Sky through synergies could lead to complementary activities to amplify or bring closer to the market the EU-funded projects or activities which contribute to Clean Sky's overall objectives. If requested, the JU is evaluating with experts these complementarities based on Horizon 2020 criteria and may issue a 'synergy label' certification which could then be used by the stakeholders to apply for structural funds or other funding sources.

I am confident we will be reporting further progress on this 'synergy label' in future issues – progress which has been much welcomed by the European Parliament and Commissioner Moedas, for the benefit of smart specialisation in European regions for citizens.

Back to this issue of Skyline: I hope you will enjoy our insight into BLADE project (Breakthrough Laminar Aircraft Demonstrator in Europe), this time discussing the participation of 5micron GmbH, a German SME, in this Clean Sky flagship project, as well as the view of the Spanish company Aernnova. In addition, you will read about technical updates on electrical flight tests carried out as part of our Systems for Green Operations platform, and news on the GLAMOUR project in Green Regional Aircraft. We also include news and pictures from recent events, including Farnborough Air Show in July and the Greener Aviation Conference in October.

Finally, I invite you to visit [www.cleansky.eu](http://www.cleansky.eu), our fully revamped website with success stories, videos, and facts and figures on how Clean Sky is part of the solution to reduce CO<sub>2</sub> emissions and noise by aircraft together with improving growth and competitiveness in the European aeronautics sector.

And keep engaging with us on social media (Twitter, LinkedIn and YouTube). Happy reading!

A handwritten signature in blue ink that reads "Tiit Jürimäe". The signature is fluid and cursive.

**Tiit Jürimäe**

# CLEAN SKY AT FARNBOROUGH AIRSHOW



## Maria-Fernanda Fau

*Advocacy and Communications Manager  
Clean Sky Joint Undertaking*

Clean Sky took part in Farnborough Airshow in July with a stand in the Innovation Zone, showcasing 20 pieces of innovative European hardware developed within the programme. The team welcomed thousands of visitors to the stand throughout the show, including industry members and representatives from universities and research centres. MEPs Marian-Jean Marinescu and Vicky Ford, as well as Clara de la Torre, Director of the Transport Unit of DG Research and Innovation, European Commission, also visited the stand and were guided around the hardware on show by the Clean Sky team.

Highlights of the week included a meeting on Monday 11 July between Clean Sky and a Canadian delegation to discuss the importance of worldwide research, and an electrical propulsion workshop held on Tuesday 12 July, which discussed the current state of play of electric and hybrid propulsion as well as what the aeronautical sector could aim for in the future and the research needed to reach these goals. On Wednesday 13 July, Clean Sky's Executive Director Eric Dautriat was proud to present a commemorative plaque to the University of Nottingham's Institute for Aerospace Technology, to celebrate their participation in Clean Sky and the launch of 8 new projects under Clean Sky 2. The week finished on a high note with Futures Day in the Innovation Zone, focusing on the next generation of innovators.

Thank you to everyone who visited the Clean Sky stand at Farnborough! You can read more about the event and see pictures and videos on our website now.



Virtual Community Noise Simulator



Full-scale Open Rotor Propeller Section



The Clean Sky stand at Farnborough



Next Generation Civil Tilt Rotor (NextGenCTR) Model



Business Jet Wind Tunnel Model



MEP Marinescu learns about the E-Thrust model hardware

# HOW BIG R&D PROJECTS CAN BENEFIT FROM START-UPS AND VICE VERSA

**Ute Franke**

*Co-founder of 5micron GmbH*



For big or small industrial companies, funded R&D projects are often the basis on their strategic journey to bring a new method or technology to the first step of technical readiness level. Therefore such undertakings can be an enabler for products and processes the companies may then establish in the future.

It was the end of 2014 when the European Commission (EC), via the Clean Sky Joint Undertaking, made its positive decision that our newly-founded start-up 5micron GmbH from Berlin – Adlershof should undertake an important part of the SFWA ITD project (Smart Fixed Wing Aircraft – Integrated Technology Demonstrator): the inflight measurement of deviations of the surface of the new wings up to a few micrometres. Our method is ‘reflectometry’ – calculating the wing surface as mirror from the reflection. We felt honoured and at the same time we were fully aware about this leap of faith of all participants. But we knew that we had a highly motivated team with the best expertise in this field and fresh ideas to comply with the expectations of our project leader Airbus SAS. We had also built a good reputation through previous collaborations in other fields so our impression was that both sides felt prepared for the challenges of this project and of integrating a start-up into the team.

In this final phase of the project (the flight test campaign is scheduled to start in summer 2017), the new manufactured laminar wings are being integrated onto an A340 aircraft together with specialised measurement systems and, of course, our reflectometry system. So the moment is close when the reality shows if all theoretical assumptions, requirements and pre-tests performed beforehand on the developed system will confirm the expected performance.

Our task - to deliver the complete measurement system to monitor and measure deviations of the wing surface occurring during flight (due to changing environmental conditions such as temperature and/or pressure, for example) – is a big responsibility to cope with. Wing topography deviations up to a few micrometres will be acquired and analysed from our optical measurement system during flight.

The developed system consists of hardware components which had to be tested according to the strict aircraft design standards (DO-160), even if it has limited operation time for flight test only. Our software has been developed to acquire, transfer and store the data and then analyse it to provide the results to the ‘customer’ - the Design Office from Airbus. As a small team we could react very flexibly to adapt our system to needs appearing when the project was maturing. On the other hand Airbus had to deal with a very small company, which is an exception to the normal supply chain they usually deal with. Special challenges for us as a very small company (a so-called ‘micro-company’) are the immersive administrative and reporting effort to the partners and the EC. The support of the EC via the Clean Sky team was at some points unconventional, but very supportive with regards to shortening and easing the processes on the official side.

The goal and first results of this Cfp16 project have influenced and defined one main strategic objective for 5micron GmbH: our

7 team members are developing special optical measuring methods and solutions for non-standard applications in the fields of:

- Highly precise measurements on large or faraway objects
- Geometric measurement of inaccessible surfaces
- Geometric measurements in harsh environments

The methods we have established for surface topography measurement are:

- Deflectometry (geometric measurements of dimensions such as length, torsion, roughness etc.). Resolution: 50µm
- Shadow method (defects inspection (OK/ NOK decisions). Resolution: 20µm
- Pattern projection (analysis of surface structure/topography). Resolution: 5µm

Our reflectometry system will be completed before the end of 2016 and we are excited to see the system flying soon.



# BLADE DEMONSTRATOR JOURNEY

## Sébastien Dubois

*Project Officer*

*Clean Sky Joint Undertaking*



Two major milestones have been achieved over the past few months for Clean Sky's BLADE (Breakthrough Laminar Aircraft Demonstrator in Europe) project. BLADE aims to play a key role in a new approach towards the development and maturation of Natural Laminar Flow (NLF) wing technology. In this objective, new NLF outer wings will be mounted onto an existing Airbus flight test aircraft (A340-300 MSN1).

The first milestone was the assembly of these new Laminar wings, which took place at Aernnova in Berantevilla, Spain, and was completed on 15 July

2016. The Left Hand NLF External BLADE wing features an integral composite leading edge and upper cover from Saab, which enables the reduction of Aernnova assembly working hours with fewer fastener connections and penetrations into the Laminar Upper Cover. The Right Hand NLF External BLADE wing features a separated composite leading edge and upper cover from GKN, which has been adjusted by Aernnova with best fit practices.

The second milestone in the BLADE project was celebrated on 20 July 2016 in Bucharest, Romania,

as Romaero, together with Dassault, INCAS, and the Aeromac-Aernnova group, completed the manufacturing for both wings of the Aerofairing and the Transition Structure Leading Edge. This follows the delivery of the Wing Tip Pod to Aernnova and the Transition Structure Trailing Edge to Airbus, at the end of May.

The different components will now be shipped to Airbus for final assembly on the A340 Blade demonstrator, with the objective to perform and demonstrate the benefits of the laminarity in 2017.

# AERNNOVA'S CONTRIBUTION TO BLADE

## Miguel Angel Castillo

*VP Technology Development*

*Aernnova*



Aernnova, as associated partner of Clean Sky's Smart Fixed Wing Aircraft (SFWA) platform, has been a major player in the development of Natural Laminar Flow (NLF) technologies within the BLADE project. We have focused on the design of the two outer laminar flow wings, the manufacturing of the metallic components of the wing torsion boxes, and the final assembly of those two wings, which were successfully delivered to Airbus in July 2016.

The wing assembly has been quite challenging because of the strict requirements for fulfilling natural laminar flow, in particular those referring to the dimensional tolerances of the final produce, which can be up to 3 times more demanding than the usual standard.

Aernnova's key achievements on the wing assembly include:

- Very high quality smooth surfaces and very tight aerodynamic tolerances

- Tooling tolerance target:  $\pm 0.04\text{mm}$
- Assembly and Metrology Integration & Monitorization
- New Fastening Processes
- Tooling & Assembly Sensitivity to Temperature Variations

These are some of the Research and Technology developments that have been performed by Aernnova to achieve these goals:

- Numerical Simulation from the small to the whole assembly, including the tooling, trying to find out the behaviour of the structure.
- Fastening processes influence: torque, misalignments, tightness, deformations, etc.
- Material and geometry of joining elements influence: washers, bolt head diameter, etc.
- Drilling templates based on 3D printing.
- Temperature influence all the way through the assembly, for similar and dissimilar materials making up the wing. This includes fasteners, tooling and its fixations to wing.

- Tests plan to validate the simplifying assumptions taken for the numerical simulation.

In the coming years, Aernnova will capitalise on the lessons learned through the BLADE project to enhance its competitiveness in aerostructures assembly with more automation means. Based on the knowledge developed and experience gained during the labour-intensive assembly, there will be an analysis of the suitability of different automated solutions for a more industrial set-up. These solutions cover aspects such as the parts positioning through numerically controlled systems; the riveting and drilling of the joints among parts through Numerical Control machines; and the continuous measuring and monitoring of the 'key characteristics' of the product. The goal is to evaluate whether they can be practical in wing type structures assembly with dimensional tolerances that fulfil NLF requirements.

# GREENER AVIATION 2016

## 11-13 OCTOBER, BRUSSELS

The 2<sup>nd</sup> Greener Aviation conference took place in Brussels on 11-13 October. Organised by 3AF with the support of Clean Sky and the Council of European Aeronautical Societies (CEAS), the conference brought together over 300 participants and more than 100 speakers to discuss the opportunities and challenges with regards to the greening of aviation.

The conference opened with a plenary session which included keynote addresses from Ric Parker (Chairman of the Clean Sky Governing Board), who outlined the Clean Sky programme, and Robert-Jan Smits (Director General of DG Research and Innovation, European Commission), who highlighted the importance of sustainability in aviation and how this can be achieved.

Over the three-day event, Clean Sky was the focus of many presentations and roundtables, several of which were chaired by Clean Sky Project Officers. These technical presentations covered various aspects of aviation to reduce emissions and noise, and asked how engines, equipment and systems technology can be improved in the future to meet Clean Sky's ambitious environmental goals. Panels focusing on Clean Sky and moderated by the Project Officers included Materials & Eco-Design 4 (Paolo Trinchieri), On-board energy management 4 (Antonio Vecchio), Structures 1 (Vittorio Selmin) and Evaluation of environmental impact 3 (Ron van Manen, Clean Sky 2 Programme Manager). A roundtable on the 'Atmospheric Impact of Aviation' was moderated by Giuseppe Pagnano (Coordinating Project Officer), while Ron van Manen spoke again on the final day in a roundtable dedicated to 'Airlines and airports point of view on disruptive configurations and operations', which was chaired by Clean Sky's former Executive Director Eric Dautriat.

Visit our website now to see pictures from the event and read a full overview of the conferences.

### Opening plenary session



The Clean Sky stand at Greener Aviation



Christian Mari, 3AF, President of the Scientific Committee



Ric Parker, Chairman of the Clean Sky Governing Board



Robert-Jan Smits, Director-General, DG Research and Innovation, European Commission



Valérie Guéron, Programme Committee Conference Chair, Safran Group



# VIEW FROM THE REGIONS

## Valeria Fascione

*Regional Minister for Innovation, Startups and Internationalization  
Campania Region, Italy*



The aerospace industry plays a key role in the economic and productive system of the Campania Region, and represents a fundamental element of the local economy, in terms of both industrial presence and high tech know-how.

The major industrial players join an ecosystem made up of small and medium-sized companies capable of implementing high quality production processes as well as ensuring the technical standards required by the aerospace industry. This ecosystem is enriched by the presence of numerous research centres, universities, technology transfer centres and a rich and heterogeneous start-up scene, all working together in according to a public-private partnership model.

The Campania Aerospace Hi-tech District (DAC), born in 2012, represents an interesting Public-Private platform aimed at the development of shared strategies and projects. The DAC is the biggest Hi-tech District at national level, with the largest number of members and the highest amount of capital employed: 12 large industries (such as Leonardo, MBDA, Magnaghi Aeronautica, Atitech, DEMA, Telespazio, ALA, I.D.S.), 12 research centres and Universities (CIRA, CNR, ENEA), and 130 SMEs.

In 2013 RITAM was launched: a public-private network operating in the sector of technologies and components for aviation engines. A more recent example is the new European Pole of Aerospace Micro Fusions in Irpinia (Campania Region, Italy), led by EMA.

This dynamic, highly innovative industrial environment puts the aerospace sector among the key strategic areas in the Campania Region, according to what has been defined

in the RIS3 - Research and Innovation Smart Specialisation Strategy recently approved by the Regional Government.

To better meet the challenges of global competitiveness, the Campania Regional Government considers as a critical issue the creation of a partnership with the Clean Sky 2 Joint Undertaking, the European aviation research programme, which plays a strategic role in the development of sectoral policies.

The Memorandum of Understanding signed with Clean Sky in October 2015 puts the Campania Region in the lead among the other Italian areas and sets ambitious objectives in terms of research and innovation policies. Furthermore, it increases the capability to develop joint programmes and – in line with the latest EU guidelines promoted by the Commissioners Carlos Moedas and Corina Crețu – promotes a closer interaction between the Structural Funds (ERDF 2014-2020) and the European financial programmes, always aiming to implement R&I initiatives at regional level in the framework of the Smart Specialisation Strategy.

The identification of shared R&I priorities and appropriate synergies in terms of financial instruments has been identified as the main approach to encourage a higher participation of regional companies and stakeholders in the European programmes promoted by Clean Sky, as well as a strategic leverage to enhance the positioning of our regional ecosystem into international markets.

The first step of this synergic action with Clean Sky was its involvement in the regional public consultation process for the RIS3 strategy, which led to the definition of technological challenges for the coming years.

In line with the priority areas selected, the regional aerospace ecosystem will pursue the following technological trajectories: methodologies, processes and systems for new configurations and components for the flight; board, communications and defence systems; propulsion and energy efficiency; technologies for space and health management and maintenance of facilities and systems.

In addition, we are defining joint actions and dedicated instruments in order to promote the complementarity of the funds, including the development of preferential paths for projects that have obtained the synergy certification from Clean Sky, borrowing the performing mechanism introduced by the Seal of Excellence. On one hand, this complementarity ensures that the sectoral calls – which will be launched soon by Campania Region – will better match the European challenges, and, on the other hand, may offer more opportunities to local actors to implement their investment plans through a supply chain qualification process.

We would be extremely proud to share this strategic approach with other European regions already in partnership with Clean Sky, to design innovative joint actions and select best practices together.

At this important stage in our development strategy, we would like to invite all European regions already in partnership with Clean Sky to meet in Naples before the end of the year, to create a common working platform and a solid and highly competitive aerospace network to enhance joint innovation processes at regional level.

*See you soon in Napoli!*

# AIRBUS FLIGHT LAB TAKES OFF

**Antonio Vecchio**

*Project Officer*

*Clean Sky Joint Undertaking*



The first flight of the Airbus 'Flight Lab' test aircraft (A320 MSN1) took place on 3 June in Toulouse. The aircraft featured a number of innovative technologies developed within Clean Sky's Systems for Green Operations (SGO) platform, including the electrical Power Centre by Airbus/Thales, the electrical Environmental Control System (eECS) by Liebherr, the Scoop Inlet with integrated acoustic and anti-ice systems by the Sandit consortium/Airbus, and the Primary In-Flight Icing Detection System by Zodiac.

The first flight test campaign lasted 4 hours and allowed the robustness, performance and integration of these technologies over the aircraft operating envelope to be validated. Of particular relevance is the validation of the eECS behaviour in heating and cold mode up

to 35,000 ft. The test campaign continued until the end of June and allowed for the validation of the eECS performances across the whole A320 flight envelope (39,000ft). Preliminary analysis of test results is extremely promising.

All the tested technologies, fully developed within the SGO platform, are perfectly framed in

the Clean Sky technology roadmap and its main demonstrators, and pave the way towards the more electric aircraft concept, where electric systems complement and/or replace legacy systems using non-electric technology, with a view to achieve better aircraft performance and minimise aircraft weight while reducing the environmental impact of air transport.



# WIND TUNNEL TEST DEMONSTRATIONS UNDERWAY FOR GLAMOUR PROJECT

In the framework of Clean Sky's Green Regional Aircraft (GRA) ITD – LNC (Low Noise Configuration) domain, a wind tunnel (WT) test demonstration is currently taking place for the GLAMOUR project (Partners: IBK, Revoind Industriale, TECHNION - Israel Institute of Technology, University of Bristol and Politecnico di Milano as Coordinator). The aim is to assess the viability of the Gust Load Alleviation (GLA) control system (control laws, sensors and devices), tuned to the 130-seat GRA concept, within an experimental aerodynamic environment, thus validating the relevant load alleviation strategy.

In particular, the objectives being tracked are:

- the validation of the simulation performed to define the GLA concepts
- the verification of the control laws capability when coupled to an aeroelastic system during gust occurrence (simulated in wind tunnel)
- the verification of the interaction and signal chain functionality between control laws and feed forward/wing accelerometer sensors

To achieve these aims an aero-servo-elastic A/C half-model has been manufactured, with flexible wing reproduced by stiffness scaling the real-size wing dynamic response under gust excitation loads, equipped with active control movables (aileron and elevator), relevant actuation system and sensors (accelerometers, alpha flow sensor); and integrating control laws engineering models.



**WT gust generator devices**

Tests are currently in progress in the WT facility of Politecnico di Milano. A six-vane (air flow deflectors) gust generator system has been realised in order to provide gust profiles at proper scaled frequencies.



**Model installed in the WT test section**

# PAST EVENTS

## Check out our new website!

With Clean Sky 1 coming to a successful close and Clean Sky 2 now in full swing, the Clean Sky website has been revamped to showcase our work so far. Check out [www.cleansky.eu](http://www.cleansky.eu) now to find out how to participate, learn about our achievements through pictures, videos and interactive timelines, and see what the future might hold for Clean Sky. We hope you enjoy your browsing!



## New book on Clean Sky published!

'Innovation Takes Off' is a newly-published book by Cherche Midi publishing house. It charts the story of European aviation from its beginning to today, with a focus on how the European Union's vision and policy on excellent research and innovation has led to Clean Sky as a tool to develop innovative technologies to reduce the environmental footprint of aviation. You will read about the highlights of the Clean Sky 1 programme alongside pictures and quotations from the public and private participants involved. **'Innovation Takes Off' is available on our website now - we hope you enjoy it!** A limited number of copies of 'Innovation Takes Off' are available in print, please contact us at [info@cleansky.eu](mailto:info@cleansky.eu)

## Clean Sky Synergies with Regions

Five JTI's (Clean Sky, ECSEL, FCH, IMI and BBI) joined forces for a debate on synergies with European Structural and Investment Funds (ESIF) on 11 October at the Committee of Regions in Brussels. The debate focused on best practices on forms of cooperation with Regions as well as the associated opportunities and challenges. Clean Sky was represented by Bruno Mastantuono, Legal and Strategic Advisor, who spoke about how Clean Sky is building partnerships with regions to boost innovation and growth in aeronautics.

Clean Sky was highlighted during the debate as a best practise of cooperation with the Regions, with concrete examples being illustrated to the audience. The panels included experts in smart specialisation policy such as Prof. Dominique Foray from EPFL (Ecole Polytechnique Fédérale de Lausanne), who highlighted how the Regional Smart Specialisations Strategies and their priorities should be coordinated with the Joint Undertakings - big potential for cooperation to boost innovation, growth and jobs through regional policy. Prof. Foray also stressed that Memoranda of Understanding between Regions and Joint Undertakings could considerably contribute to the increase of GDP for Research and Innovation.

The event concluded with some closing remarks by the MEP Soledad Cabezón Ruiz (European Parliament Rapporteur of H2020 Interim Review), who highlighted the political importance of synergies between H2020 and ESIF and the key role being played by Clean Sky 2 JU which should be seen as a model to be followed in other areas.



## Clean Sky at EASN Conference 2016

Clean Sky featured in the 6th EASN International Conference, which took place on 18-21 October in Porto to discuss the latest research and development activities in aeronautics and air transport. The conference brought together the entire aeronautical community including industry, SMEs, research centres and academia. Two keynote speeches were dedicated to Clean Sky: "The Clean Sky Academy Initiative: How to better involve students in Europe's largest Research Program for Aeronautics" by Jean-François Brouckaert (Clean Sky Project Officer), and "Sustainable development in Aeronautics – Role & Perspectives of the Clean Sky Initiative" by Giuseppe Pagnano (Clean Sky Coordinating Project Officer).

# UPCOMING EVENTS

## EU Agencies Forum at the European Parliament, 6-7 December 2016

The EU Agencies Forum takes place on 6-7 December at the European Parliament in Brussels. The first day will feature high-level speakers from the European Commission and the European Parliament, including Martin Schulz and Kristalina Georgieva, as well as MEPs and representatives from EU Agencies and industry. The conference aims to discuss how EU Agencies contribute to the implementation of EU policies for the benefit of citizens and industries.

Limited places available. For more information, visit [www.euagencies.eu](http://www.euagencies.eu)



## Save the date: Clean Sky Forum, 21-22 March 2017

To mark the closing of Clean Sky 1, the annual Clean Sky Forum will take place on 21-22 March 2017. The first day will feature a series of keynote speeches by high-level representatives from the industry, European Parliament and the European Commission, all involved in Clean Sky. The second day will focus on the technical platforms of Clean Sky 1, with breakout sessions dedicated to reporting the results and achievements. Save the date now – full programme coming soon!

## Save the date: Clean Sky at Le Bourget 2017

The International Paris Air Show (Le Bourget) will take place on 19-25 June 2016. Clean Sky will participate with a demonstration stand showcasing many pieces of innovative technology. Save the date now!



Interim Executive Director: Tiit Jürimäe  
Editor: Maria-Fernanda Fau, Advocacy and Communication Manager

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

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