





Hybrid Laminar Flow Control activities within the frame of Clean Sky 2

Presented by Alexander Bismark (DLR)











• If the laminar boundary layer can be extended, i.e transition laminar to turbulent is delayed, significant drag reductions can be achieved





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Introduction





Laminar flow requires 3 transition mechanisms to be controlled simultaneously



3



Introduction



Target for Clean Sky 2: Advance HLFC technology to pave the way for its industrial implementation







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SCIECH OF **Work Breakdown Structure**





- Outer wing considered (total span: 20 m), split into four segments
- 7 compressors required for wing to generate suction
- ALTTA concept chosen to achieve target pressure distribution





the European Union

Leading Edge Concept



• Challenge: Allow space allocation for all systems in wing leading edge

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SCLOTECH





- Perforation of titanium on industrial level achieved, variable porosity allows introduction of single chamber concept
- Bird strike simulation of complex structure improved by various impact tests





Ambient air sucked to



- Equipment inside special suction rib \rightarrow no ducting, easy access
- Identical compressor model used for whole wing
- Major simplification compared to previous designs





Video by courtesy of DLR

HLFC System





- Simple installation and removal of coils and support structure
- Functionality proven in representative icing wind tunnel test campaign



Picture by courtesy of Sonaca







- Krueger: Prevention of suction blockage and contamination protection
- Use of a scissor kinematic driven by three stations per panel
- Panel with 2.5 m span and manufactured by filament winding





Picture by courtesy of Sonaca



Video by courtesy of DLR

Picture by courtesy of Sonaca







- Ground-Based Demonstrator (3 m span) for outer wing segment
- Validation of integration, functional tests performed for each system
- Supports overall value assessment





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SCIETFCH







- Integration of simplified HLFC system could be shown on long-range aicraft
- Validation of assumptions based on several demonstrators
- Significant contribution for a possible industrial application achieved: Manufacturing processes at TRL 5, Integration at TRL 4
- Elaborated technologies also useful outside of HLFC context (e.g. inductive ice protection system, leading edge assembly, tolerance management)
- Value assessment indicates profitable operation of HLFC solution

Outlook:

- Application on real aircraft should be targeted
- Enhance knowledge by data gained through operation under realistic conditions





Thank you for your attention!

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