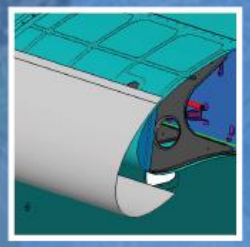













Innovation Takes Off

www.cleansky.eu

Clean Sky 2

Clean Sky 2
Information Day dedicated to the
4th Call for Proposal (CfP04)

REG IADP

Brussels, 22 June 2016

Innovation Takes Off

www.cleansky.eu

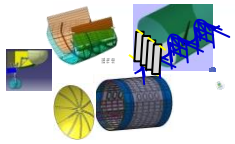
Clean Sky 2

From Clean Sky **GRA** towards Clean Sky 2 **REG**

- REG high level objective is to bring the integration of technologies for regional aircraft to a further level of complexity and maturity than currently under achievement in GRA. The global strategy is to integrate and validate, at aircraft level, advanced technologies for regional aircraft so as to drastically de-risk their integration on future products:
  - Near/midterm: Regional A/C with under-wing mounted turboprop engines
  - Long term (enter in service beyond 2035): Breakthrough Regional Aircraft Configurations, e.g. a/c with rear fuselage mounted turboprop engines

Setup and Implementation

FP-7 CS1 GRA



CLEAN SKY 2 "REGIONAL"

- Regional a/c IADP
- Airframe ITD
- Systems ITD
- Engines ITD

Technology Waves

- WV1 ADAPTIVE WING
- WV2 REGIONAL AVIONICS
- WV3 COCKPIT
- WV4 INNOVATIVE FCS
- WV5 ENERGY OPTIMIZED REGIONAL A/C
- WV6 FUSELAGE STRUCTURE
- WV7 PAX CABIN
- WV8 NACELLES FOR REGIONAL A/C(Jet and TP)

(Liquid Infusion, Morphing, HLD, Winglets, NLF, Drag Reduction,...)
(HMI, Health Monitoring,...)
(Advanced Composite Materials, Systems)
(Flight-By-Wire, EMA,...)
(Low Power WIPS, Electrical Landing Gears, EPGDS, E-ECS,...)
(Advanced Composite Materials, Advanced Manufacturing, ...)
(Human Centered Design, Green Materials, ...)
(Nacelles Materials, Ice Protection, Drag Reduction,...)

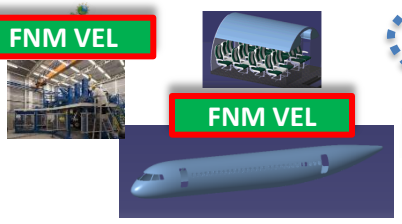
Flight Demonstration

FNM VEL

CASA

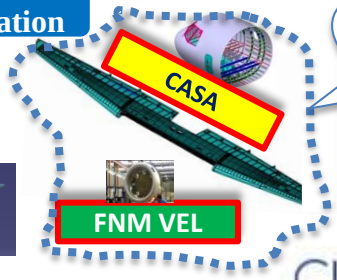
Ground Demonstration

FNM VEL



FNM VEL

FNM VEL



Airframe ITD

Clean Sky JOINT UNDERTAKING

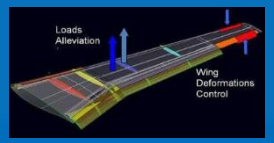
Setup and Implementation

REG IADP FULL SCALE DEMONSTRATORS

FLYING TEST BED#1 (Leader: Finmeccanica Aircraft Division)

Air Vehicle Technologies Demonstrator

(Aerodynamics enhancements and Load Control & Alleviation features through new generation wing and advanced Flight Control Systems)

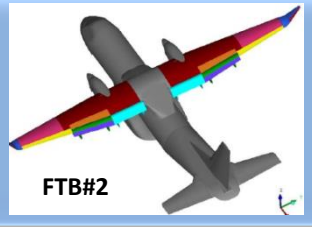


FTB#1

FLYING TEST BED#2 (Leader: Airbus DS)

Integrated Technologies Demonstrator

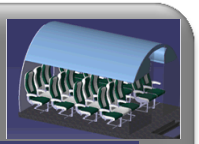
(Flight Demonstration of a high efficient and low noise Wing with Integrated Structural and related Systems solutions)

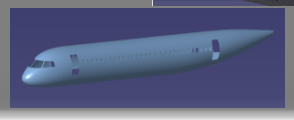


FTB#2

FUSELAGE / CABIN Ground Demonstrator (Leader: Finmeccanica Aircraft Division)

(Full scale composite fuselage and passenger cabin with innovative structural and architectural solutions aimed to weight and cost reduction , methodologies and technologies for structural health monitoring, NDI, repair and maintenance, human centered approach, confort)

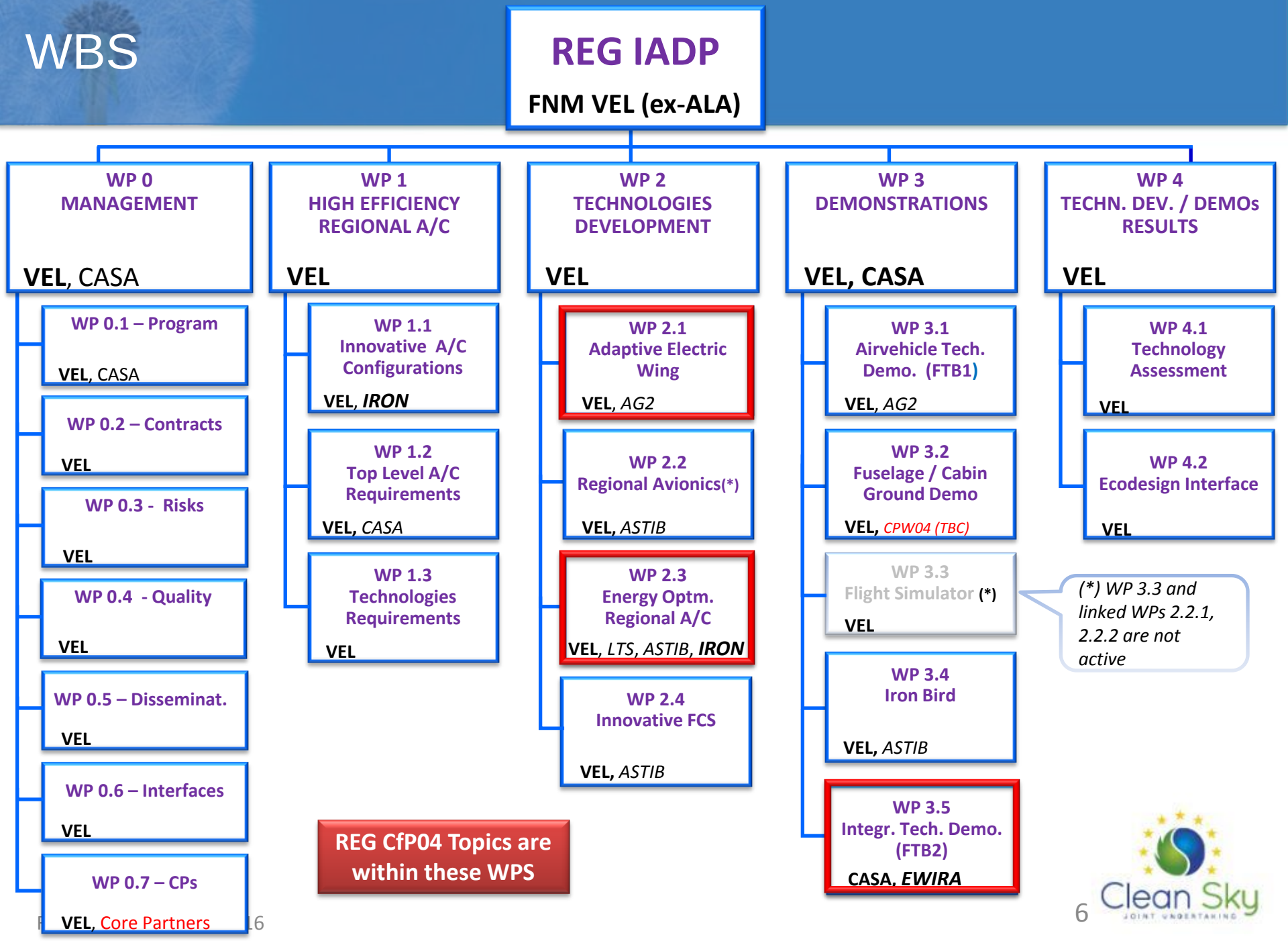




IRON BIRD Ground Demonstrator (Leader: Finmeccanica Aircraft Division)

(Integration and validation of FCS Load Control/Load Alleviation (LC/LA), Electrical Landing Gear, Electrical Power Distribution System, inter-system integration activity; support the achievement of the permit-to-fly for FTB#1)

WBS


REG IADP
FNM VEL (ex-ALA)
WP 0
MANAGEMENT
VEL, CASA
WP 0.1 – Program
VEL, CASA
WP 0.2 – Contracts
VEL
WP 0.3 - Risks
VEL
WP 0.4 - Quality
VEL
WP 0.5 – Disseminat.
VEL
WP 0.6 – Interfaces
VEL
WP 0.7 – CPs
VEL, Core Partners
WP 1
HIGH EFFICIENCY REGIONAL A/C
VEL
WP 1.1 Innovative A/C Configurations
VEL, IRON
WP 1.2 Top Level A/C Requirements
VEL, CASA
WP 1.3 Technologies Requirements
VEL
WP 2
TECHNOLOGIES DEVELOPMENT
VEL
WP 2.1 Adaptive Electric Wing
VEL, AG2
WP 2.2 Regional Avionics(*)
VEL, ASTIB
WP 2.3 Energy Optm. Regional A/C
VEL, LTS, ASTIB, IRON
WP 2.4 Innovative FCS
VEL, ASTIB
WP 3
DEMONSTRATIONS
VEL, CASA
WP 3.1 Airvehicle Tech. Demo. (FTB1)
VEL, AG2
WP 3.2 Fuselage / Cabin Ground Demo
VEL, CPW04 (TBC)
WP 3.3 Flight Simulator (*)
VEL
WP 3.4 Iron Bird
VEL, ASTIB
WP 3.5 Integr. Tech. Demo. (FTB2)
CASA, EWIRA
WP 4
TECHN. DEV. / DEMOs RESULTS
VEL
WP 4.1 Technology Assessment
VEL
WP 4.2 Ecodesign Interface
VEL
(*) WP 3.3 and linked WPs 2.2.1, 2.2.2 are not active
REG CfP04 Topics are within these WPS

CFP04 Overview of REG topics

Topic #	Topic Title	WP Ref. (JTP V5)	Duration (in Mths)	Indicative Funding Value (in M€)	ToA	Type of Agreement
REG-01-05	**Green Turboprop - High lift configuration integrating adaptive wing concept - Low Speed experimental validation**	2.1	18	1,200	IA	Implementation Agreement
REG-01-06	**High Fidelity Integrated Non-Linear MBS Modelling of Morphing Wing**	2.1	18	0,350	RIA	Implementation Agreement
REG-01-07	**Innovative alloy development for structural part fabrication with Additive Manufacturing Technology**	2.1	36	0,600	IA	Implementation Agreement
REG-01-08	**Advanced Energy Storage and Regeneration System for Enhanced Electrical Energy Management**	2.3.4	36	0,800	RIA	Implementation Agreement
REG-02-03	**Electrohydraulic integration of an hybrid surface actuation systems**	3.5	36	0,230	IA	Implementation Agreement

Clean Sky 2

Information Day dedicated to the 4th Call for Proposal (CfP04)

Green Turboprop - High lift configuration integrating adaptive wing concept - Low Speed experimental validation (WTT1)

IADP Regional Aircraft - WP 2.1

Brussels, 22nd June 2016

Innovation Takes Off

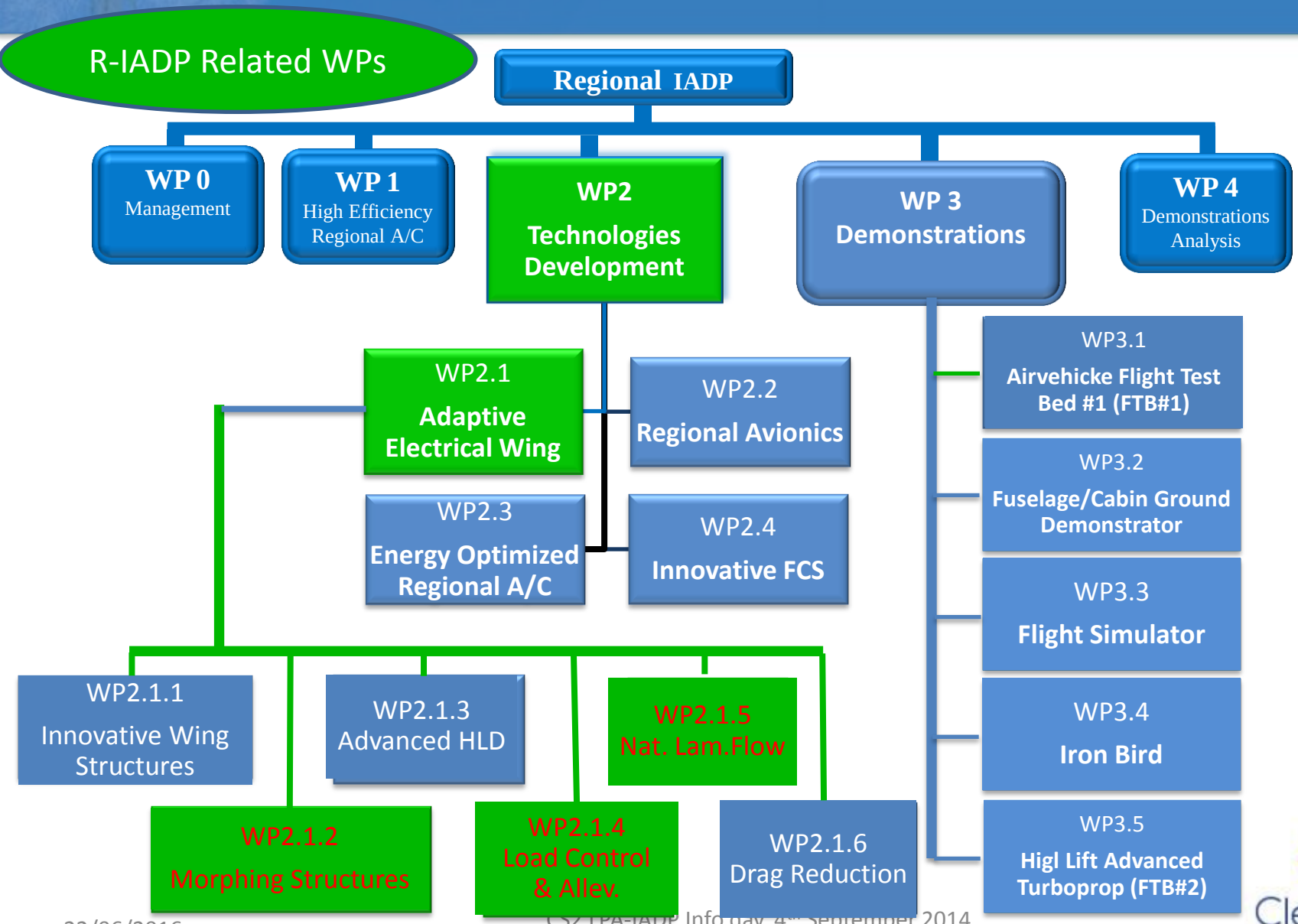
www.cleansky.eu

Clean Sky 2

REG-01-05

- Estimated Funding Topic Value: **1200k€**
- Duration: **18** months
- Start date: **Q2 - 2017**
- SoW overview:
  - **Green Turboprop - High lift configuration integrating adaptive wing concept - Low Speed experimental validation (WTT1).**

REG-IADP: Overview



REG-01-05: Scope of the work

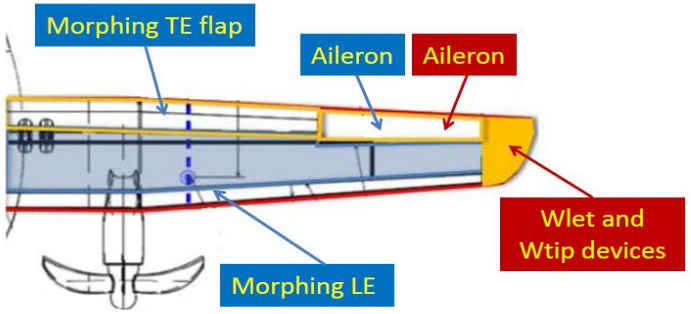
Goals:

Low Speed Experimental Investigation of a Large scale complete aircraft model integrating different High lift morphing devices. Activities include modifications of an existing large scale A/C model (scale 1:7) to include new morphing high lift device shapes (droop nose, fowler flaps) and to validate the relevant aerodynamic performances at A/C level.

CfP Activities:

An existing 1:7 scaled complete A/C powered wind tunnel model will be modified to achieve an improved turboprop green configuration as well as to ingrate innovative HLD morphing devices.

As second step of the activities low speed wind tunnel tests will be performed to validate A/C performances in take-off, landing and approaching conditions



REG-01-05: : Tasks

Tasks		
Ref. No.	***Title - Description***	***Due Date***
Task 1.1	Management	M18
Task 2.1	WT Model modification- Mechanical Design	M09
Task 2.2	WT Model Instrumentation	M09
Task 2.3	WT Model - Manufacturing and Assembling	M15
Task 3.1	WT testing	M16
Task 3.2	Data analysis and Report	M18

REG-01-05
Task 2.1: WT Modification – Mechanical Design

- An existing large scale (1:7) complete powered wind tunnel model representative of the green turboprop configuration has already been designed and manufactured within a previous Clean Sky 1 CfP to be tested in RUAG LLF WT.
- Model has been designed with a modularity philosophy to allow different testing capabilities.
- The model is equipped with powered rotor blade engines powered by a oil pressurized oil system. Engine units have been designed to simulate desired thrust coefficients during wind tunnel tests.

- Based on TM inputs (TP A/C geometry, High Lift devices, technical specification for WT testing) the existing model has to be modified to achieve the new TP green A/C configuration. In detail:

  - **Front – Central Fuselage: overall A/C fuselage length, wing body fairing and Main Landing gear region.**
  - **Tail Plane: Fuselage-tail plane interface**
  - **Wings: modification of the whole wing to allow the installation of innovative morphing HLD devices (Trailing Edge(TE), Leading Edge (LE) and wing tip devices). Removable wing components will allow testing clean and morphing shape configurations (no morphing actuations is foreseen).**
  - **Engine nacelle: new engine nacelles shape and engine nacelle-wing interfaces**.

- Other large facilities than RUAG could be proposed by the applicant. In the latter case, the design of dedicated wind tunnel-model interfaces are part of the present task and complete new model propulsion systems have to be designed, realized and tested:

- Capability to set and keep thrust developed by each of the Engine Simulators within 5% of the target value is required. Expected requirements for the engine power units are:
  - Engine power > 50 Kw
  - Trust > 450 N
  - Torque Moment > 80 Nm
  - Rpm > 6000 rpm

- Stress analysis is requested to verify the compliance with Wind tunnel safety needs and to estimate the impact of modifications on the static and dynamic behaviour of the overall model (static model deformation under wind tunnel loads and natural frequencies).

REG-01-05
Task 2.2: WT Model Instrumentation

- This task is responsible for the wind tunnel/model instrumentation definition.
- In detail, the model will be equipped with about 200 steady pressure taps and 10-15 unsteady pressure sensors (such as Kulites) for local steady and unsteady pressure measurements.
- The Applicant shall propose a suitable way to integrate instrumentation with minimal flow disturbance.
- In order to detect global aerodynamic loads acting on the complete A/C model, a suitable six components balance system shall be integrated in the A/C model sting while a Rotating balance system (or other equivalent systems) will allow gathering Trust loads generated by engine unit during tests.
- At least two accelerometers measuring wing tip accelerations will be installed for test security reasons in order to prevent possible occurrence of dynamic aero-elastic instability phenomena

REG-01-05
Task 2.3: Model Manufacturing and Assembly

- This task is responsible for the manufacturing of the designed sub-components to achieve the TP green A/C configuration.

- The challenge in the final assembly will be to provide a complete full model respecting challenging requirements in terms of step. In this regard, prior to the delivery of the model, the quality of the assembled model shall be verified by means of dedicated inspections

REG-01-05
Task 3.1: WT Testing

- The wind tunnel test campaign shall be performed in a wind tunnel facility large enough to install 5-6m A/C model.
- Tests are planned at low speed regime (Mach range ≈ 0.2 - 0.3) and high Reynolds numbers in order to validate in a representative environment Active High lift systems.

- The concerned tests will be split into following phases:
  - Phase #1: Validate at take-off and approach conditions (M 0.2-0.3) the whole A/C configuration in terms of high-lift design performance to validate the effectiveness of Morphed LE and TE devices in High Lift conditions.
  - Phase #2 : Experimentally detect optimal HLD configurations in terms of LE and TE devices (deflection angle, flap distance, etc).

- During tests, the following measurements are envisaged:
  - - Steady and unsteady pressure measurements;
  - - Aerodynamic forces balance measurements to gather lift, drag, pitching moment and roll (bending) moment;
  - - Engine Thrust parameters

REG-01-05
Task 3.2: Wind Tunnel Data

- This task is responsible for the critical analysis of wind tunnel data to achieve the aerodynamic database of the green turboprop A/C.
- Effectiveness of LE-HLD and wind tip morphing surface in A/C take-off and landing configuration will be analysed.
- Experimental data analysis shall be supported by relevant CFD simulations, in charge to the applicant, to estimate Reynolds number and scaling effects referred to full scale conditions.

REG-01-05: Major Deliverables

Deliverables			
Ref. No.	***Title - Description***	***Type(*)***	***Due Date***
Del 1.1	Project Final Status of Activities: This Document reports a summary of the technical and dissemination activities performed in the different phase of the project evidencing positive and negative aspects. Lessons "learnt" are highlighted.	R	M18
Del 2.1	Model Preliminary Design Report (PDR): the preliminary design of the model evidencing the main design solutions is delivered supported by preliminary stress verifications	R, D	M06
Del 2.2	Model Critical Design Report: The design of the TP green complete scaled powered A/C integrating HLD morphing systems is performed supported by extensive stress verifications	R, D	M09
Del 2.3	Model Manufacturing Inspection Report: The wing models has been manufactured and assembled to integrate morphing devices. Ground checks supported by documentation are performed to check the model quality.	R	M15
Del 3.2	WT test plan: The wind tunnel and instrumentation setup for each test phase are described. The test matrix is agree with Topic manager and WT specialist highlighting instrumentations	R	M15
Del 3.3	WT test Outcome: Based on the carried-out experimental and numerical data performed by Applicant:Test data are fully described and HLD and morphing devices relevant aerodynamic data base is created supported by CFD simulations. Wind Tunnel test corrections procedures are described;	R, D	M17
Del 3.4	A/C High Lift performances: this report will provide a detailed analysis of wing performances in regard to the different tested technologies.	R,	M18

Milestones (when appropriate)			
Ref. No.	***Title - Description***	***Type***	***Due Date***
M1	Model Design: Modification to the existing TP green A/C model have been designed to integrate HLD technologies	R	M09
M2	Model ready: The design of the TP green complete scaled powered A/C integrating HLD morphing systems is performed.	R	M15
M3	Green Turboprop aerodynamic database: The experimental aerodynamic database concerning HLD and morphing shapes, is available.	R	M18

REG-01-05: Special skills, Capabilities, Certification expected from the Applicant(s)

- Expertise in CATIA V5 software for aeronautical applications
- Consolidated experience in designing and manufacturing of large wind tunnel models
- Consolidated experience in design of powered engine simulator for wind tunnel model
- Large experience in Wind tunnel test activities and data analysis
- General aerodynamic CFD modelling and simulations

Clean Sky 2 Information Day

Brussels, 22th of June 2016

High Fidelity Integrated Non-Linear MBS Modelling of Morphing Wing

IADP Regional Aircraft - WP 2.1

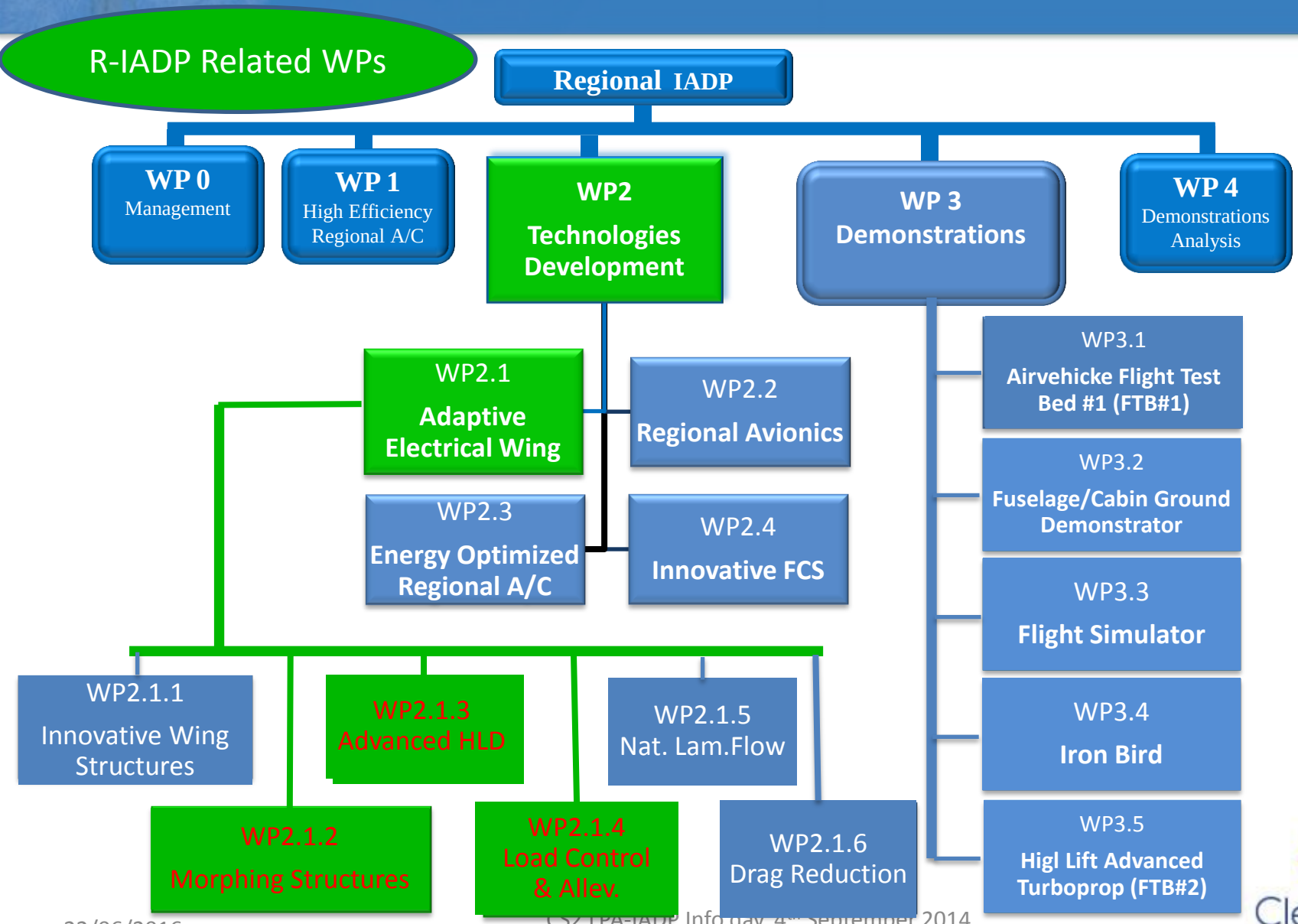
www.cleansky.eu

FINMECCANICA
AIRCRAFT DIVISION

REG-01-06

- Estimated Funding Topic Value: **350k€**
- Duration: **18** months
- Start date: **04 - 2017**
- SoW overview:
  - **Investigation of efficient modelling methods for high fidelity numerical simulation models based on non-linear multi-body mechanical structural models (MBS) for the qualification of morphing devices and validation with a wing model integrated a winglet, Fowler flap, wing tip & droop nose.**

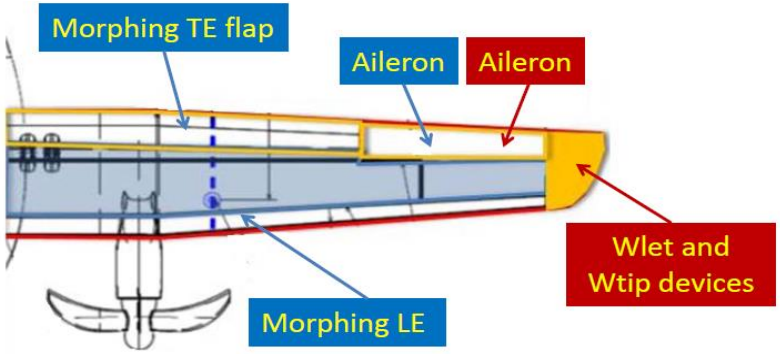
REG-01-06 : Overview



REG-01-06 : Scope of the work

Goals:

Investigation of efficient modelling methods for high fidelity numerical simulations, based on non-linear multi-body mechanical structural models. These modelling methods will be used to carry out the qualification of morphing devices (TE, LE, Winglet, wing tip)



CfP Activities:

- The modelling methods shall be capable to condensate aerodynamic pressures pertinent to load conditions into an equivalent set of distributed forces.
- Structural stiffness, damping and lumped masses shall be modeled coherently with the structural design FEM models of morphing elements.
- The modeling methods will include the actuators static and dynamic modeling and will enable the recovery of the target morphed shape under applied loads. Methods to model displacements sensors for the devices shape reconstruction during tests shall be considered in order to estimate the values of displacements expected to be measured by all sensors during experimentation, both on ground and in flight.
- Method to predict mechanical failures dynamic conditions shall be included so to verify the safety assessment requirements.

REG-01-06 : : Tasks

Tasks		
Ref. No.	***Title - Description***	***Due Date***
1	Investigation of non-linear multi-body modelling methods for morphing mechanisms	M3&M18
2	Global 3D FEM-MBS integration model architecture	M2
3	Droop nose MBS model	M9
4	Trailing Edge Flap MBS model	M9
5	Winglet MBS model	M9
6	Wing Tip MBS model	M9
7	Composite Wing Box model	M12
8	Integration of the mechanism models and the wing box model	M15
9	Integrated model verification and validations	M18

REG-01-06

Task 1: Investigation of non-linear multi-body modeling methods for morphing mechanisms

This task will investigate optimal modeling methods for morphing mechanisms that are used for load control and alleviation and high lift purposes

- The modeling methods will be based on non-linear multi-body simulation and will be demonstrated using software of Siemens PLM Software.
- modeling of sensors
- modeling of the non-linear flexible components
- modeling of aerodynamic loads
- modeling of actuators and controllers and tuning of the solver for optimal performance

Input:	***Output***:
- Review of state-of-art of modelling method for multi-body simulation and modelling of compliant structures	D1: Synthesis report of best modelling methods and modelling guidelines

Duration:

This task will run over the full duration of the project with a first version of the deliverable expected at M3 and then an updated version at the end of the project

REG-01-06
Task 2: Global 3D FEM-MBS integration model architecture

- In this task, the Partner will prepare the specifications of global 3D FEM-MBS integration model architecture based on the requirements of the TM.
- The configuration and parameterization requirements as well as the requirements for sensors and simulation outputs will also be considered.

Input:	***Output***:
TM specifications and general requirements - Configuration and parameterization requirement - Output and sensor requirements	D2: Specifications of the global 3D MBS modeling integration environment architecture

REG-01-06
Task 3: Droop nose MBS model

- This task addresses the preparation of the droop nose MBS model.
- The MBS model will be based on the design results from the activities by the core partners. Therefore, the partner will be provided with the final design and related data needed to prepare a MBS model of the Morphing Leading Edge.
- Due to the large deformation of the skin, it will be modeled non-linearly.
- Static and dynamic actuation models as well as simplified local control logic needs to be included

Input:	***Output***:
- LE: Technical documentation of the morphing flap design - LE: Technical documentation of the actuators and local controller - LE: Aerodynamic pressures maps and forces corresponding to stationary loading - LE: Digital mock-up (3D CAD)	D3: NL-MBS model of Droop nose with documentation

REG-01-06
Task 4: Trailing Edge Flap MBS model

- This task addresses the preparation of the Trailing Edge flap MBS model.
- The MBS model will be based on the design results from the activities by the core partners. Therefore, the partner will be provided with the final design and related data needed to prepare a MBS model of the Trailing Edge.
- The model will integrate the morphing flap and its relevant deployment system.
- The model will include an appropriate representation of the segmented skin that will be used in the design of the trailing edge flap.
- Static and dynamic actuation models as well as simplified local control logic needs to be included.

Input:	***Output***:
- TE-FLAP: Technical documentation of the morphing flap design - TE-FLAP: Technical documentation of the deployment system - TE-FLAP: Technical documentation of the actuators and local controller - TE-FLAP: digital mock-up (3D CAD)	D4: MBS model of the TE-Flap with deployment system with documentation

REG-01-06
Task 5: Winglet MBS model

- This task addresses the preparation of the Winglet MBS model.
- The MBS model will be based on the design results from the activities by the core partners. Therefore, the partner will be provided with the final design and related data needed to prepare a MBS model of the Winglet.
- Due to the large deformation of the skin, it will need to be modeled non-linearly.
- Static and dynamic actuation models as well as simplified local control logic needs to be included.

Input:	***Output***:
- Winglet: Technical documentation of the morphing flap - Winglet: Technical documentation of the actuators and local controller - Winglet: digital mock-up (3D CAD)	D5: Winglet MBS model with documentation

REG-01-06
Task 6: Wing Tip MBS model

- This task addresses the preparation of the Wing Tip MBS model.
- The MBS model will be based on the design results from the activities by the core partners. Therefore, the partner will be provided the final design and related data needed to prepare a MBS model of the Wing Tip.
- As this is not a compliant mechanism, only linear flexibility will be considered.
- Static and dynamic actuation models as well as simplified local control logic needs to be included.

Input:	***Output***:
- Wingtip: Technical documentation of the morphing flap concept - Wingtip: Technical documentation of the actuators and local controller - Wingtip: digital mock-up (3D CAD)	D6: Wing Tip MBS model with documentation

REG-01-06
Task 7: Composite Wing Box model

- This task addresses the preparation of the Composite Wing Box to be included in the integrated MBS model.
- The partner will be provided with the final design and related data needed to prepare a Wing Box model, this will include the composite material properties and ply layup.

***Input*:**	***Output*:**
- Wing Box: Technical documentation of the Composite Wing Box	D7: Updated Composite Wing Box model with documentation

REG-01-06

Task 8: Integration of the mechanism models and the wing box model

- This task addresses the integration of all the mechanisms with the wing box in one high fidelity NL-MBS model.
- Sensors need to be included that measure the required outputs.
- Aerodynamic loads will be applied on the wing box and aerodynamic surface of the mechanisms.

Input:	***Output***:
- All previous deliverables - Aerodynamic pressures maps and forces corresponding to stationary loading	D8: Integrated MBS model of updated Composite Wing Box model assembled with the mechanisms and compliant structures, including actuators, local control logic and aero loads

- Improvement and tuning of integrated MBS model of the integrated wing with simulation runs that verify that the simulation models produces meaningful results for all required load cases and validate the results with respect to results obtained during the design phase of the wing structure and the mechanisms.

Input:	***Output***:
- D7 - Test cases and validation data	D9: An optimized integrated MBS model of the integrated wing and simulation results together with documentation and user guidelines

REG-01-06 : Major Deliverables

Deliverables			
Ref. No.	***Title - Description***	***Type****	***Due Date***
D1	Synthesis report of best modelling methods and modelling guidelines	R	M3
D2	Specifications of the global 3D MBS modelling integration environment architecture	R	M2
D3	NL-MBS model of Droop nose with documentation	M, R	M9
D4	MBS model of the TE-Flap with deployment system with documentation	M, R	M9
D5	Winglet MBS model with documentation	M, R	M9
D6	Wing Tip MBS model with documentation	M, R	M9
D7	Updated Composite Wing Box model with documentation	M, R	M12
D8	Integrated MBS model of updated Composite Wing Box model assembled with the mechanisms and compliant structures, including actuators, local control logic and aeroloads	M	M15
D9	An optimized integrated MBS model of the integrated wing and simulation results together with documentation and user guidelines	M, R	M18

Milestones (when appropriate)			
Ref. No.	***Title - Description***	***Type***	***Due Date***
MS1	Multi-body models of Morphing Devices – Acceptance of D1, D2, D3, D4, D5	R	M9
MS2	Morphing Devices Model integrated in wing box and model Validated – Acceptance of D6, D7, D8	R	M18

(*R=Report; M=simulation model)

Clean Sky 2

Information Day dedicated to the

4th Call for Proposal (CfP04)

JTI-CS2-2016-CFP04-REG-01-07

Innovative alloy development for structural part fabrication with Additive Manufacturing Technology.

Brussels, 22 June 2016

Innovation Takes Off

www.cleansky.eu

Clean Sky 2

REG-01-07

Title: Innovative alloy development for structural part fabrication with Additive Manufacturing Technology

WP Location: REG IADP WP 2.1

Indicative Funding Topic Value: 600 K€

Duration of the action: 36 Months

Objectives:

- Development of a new high performance aluminium alloy feasible by powder metallurgy
- Development of the additive manufacturing process
- Characterization of the new alloy obtained by powder technology and Additive Manufacturing process
- Demo part design / manufacturing and verification

REG-01-07

Tasks description:

- Task 1: Definition of innovative alloys feasible by powder technology

With the contribution of powders manufacturers, shall be defined the chemical composition of new alloys that potentially meet the specifications required and are suitable for the Additive manufacturing process.

- Task 2: New powders manufacturing

The powders of the new alloys will be produced and will be assessed which are suitable for Additive Manufacturing process.

Out of the alloys identified in the previous task two or three alloys will be selected for further investigation.

REG-01-07

Tasks description:

- Task 3: Deposition test and powder selection

In this task shall be assessed which powder is the most suitable for the additive manufacturing process. Deposition test with all powders produced shall be done. The most performing alloy will be selected for the next tasks

- Task 4: Heat treatment cycle optimisation

In order to improve the mechanical performances end corrosion resistance of the new alloy, a certain number of test will be done to define the best thermal treatment. Representative coupons will be thermally threated and tested.

REG-01-07

Tasks description:

- Task 5: New alloy characterization before and after heat treatment, with and without surface machining

A characterization campaign will be performed on ASTM standard specimens, for the new selected material in conditions before and after thermal treatment. In order to evaluate the influence of the surface roughness, the most representative tests shall be done on specimens with the surface as deposed and on machined specimens.

The following test will be performed:

- Static
- Fatigue
- Metallographic
- Chemical
- Galvanic compatibility

REG-01-07

Tasks description:

- Task 6: Demo part manufacturing and verification

The design metodologies will be developed in order to maximize the advantages of the additive manufacturing technology.

Two identical demonstrators will be produced by additive manufacturing process with the new aluminum alloy. These demonstrators will be subjected to destructive and non-destructive test to be compared with the results of the characterization phase.

The following test will be performed:

- Traction
- Micrography
- NDI
- Dimensional control

REG-01-07

Major Deliverables:

Ref. No.	Title – Description	Type	Due Date
D1.1	Innovative Alloys feasible by Powder Metallurgy	Report	T0 + 6
D2.1	New alloys powders manufacturing	Hardware	T0 + 18
D3.1	AM process development for new alloys	Report	T0 + 21
D3.2	Specimens manufacturing	Hardware	T0 + 24
D3.3	Specimens analysis and best alloy selection	Report	T0 + 27
D4.1	Possible Thermal treatment cycles definition	Report	T0 + 28
D4.2	Thermal treatment optimization	Report	T0 + 30
D5.1	Characterization specimens manufacturing	Hardware	T0 + 29
D5.2	Characterization tests results	Report	T0 + 32
D6.1	N. 2 Demonstrator manufacturing	Hardware + Report	T0 + 34
D6.2	Demonstrator analysis	Report	T0 + 36

Clean Sky
JOINT UNDERTAKING

REG-01-07

Special skills:

- Proven competence in metallurgy and powder metallurgy tecniques
- Proven competence in manufacturing of aeronautical structural parts with additive manufacturing process
- Proven experience on non-destructive inspections. Evidence of NDI qualification shall be provided
- Proven experience in experimental testing. Evidence of laboratories qualification shall be provided
- Proven competence in aluminum alloys powder manufacturing

Clean Sky 2 Information Day

Brussels, 22th of June 2016

Advanced Energy Storage and Regeneration System for Enhanced Electrical Energy Management

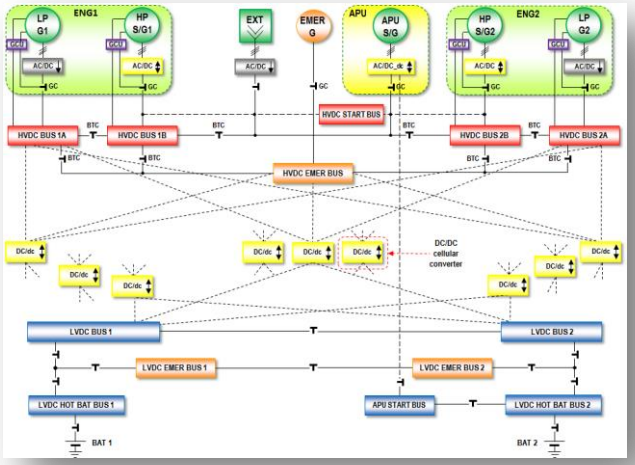
IADP Regional Aircraft - WP 2.3.4

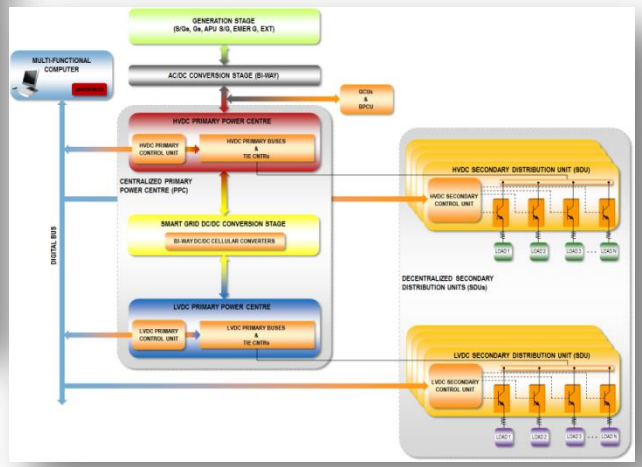
www.cleansky.eu

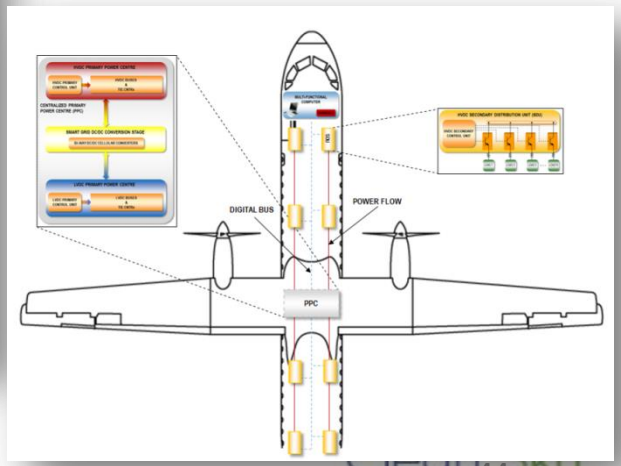
FINMECCANICA
AIRCRAFT DIVISION

REG-01-08

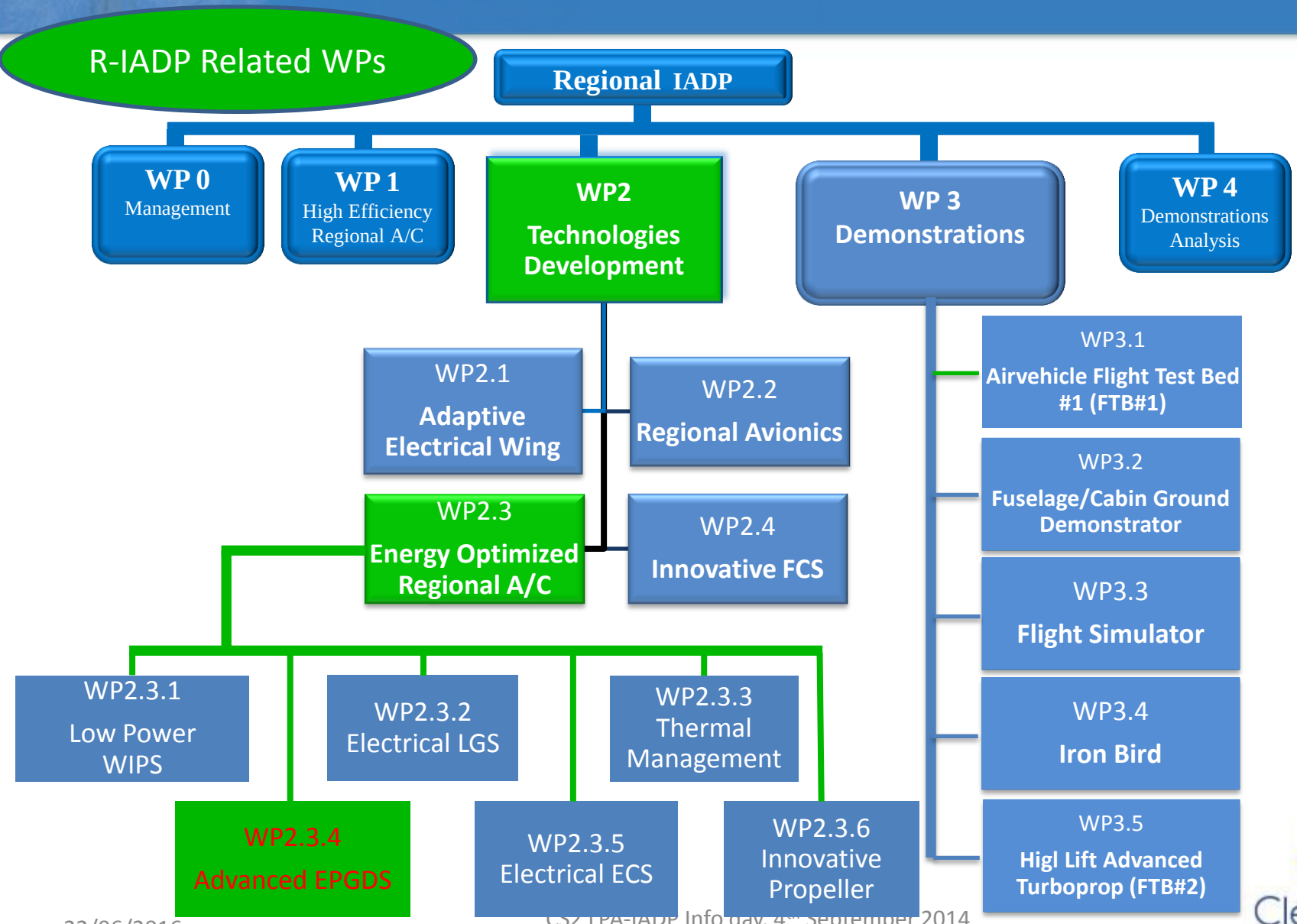
- Estimated Funding Topic Value: **800k€**
- Duration: **36** months
- Start date: **Q2 - 2017**
- SoW overview:
  - **Technologies Development – Energy Optimized Regional A/C – Advanced Electrical Power Generation & Distribution System**







REG-IADP: Overview



REG-01-08:
Scope of the work

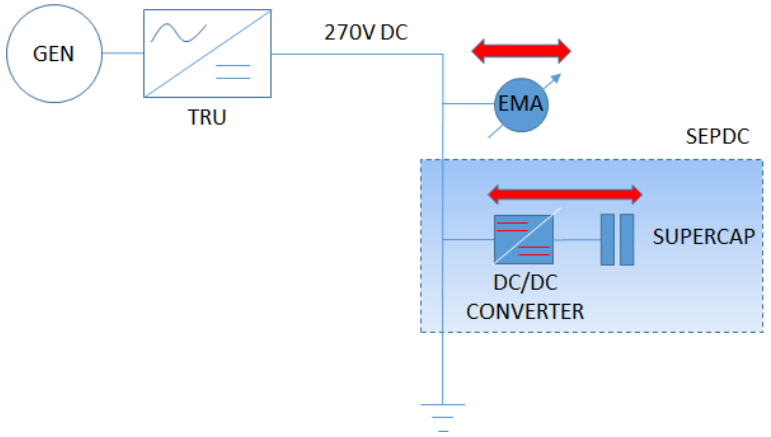
Goals:

Design, development, manufacturing, validation and integration of an innovative Energy Storage and Regeneration System (ESRS) including DC/DC bi-directional converter equipped with local supercapacitor-based energy storage elements for smart control of regenerative loads (EMAs).

CfP Activities:

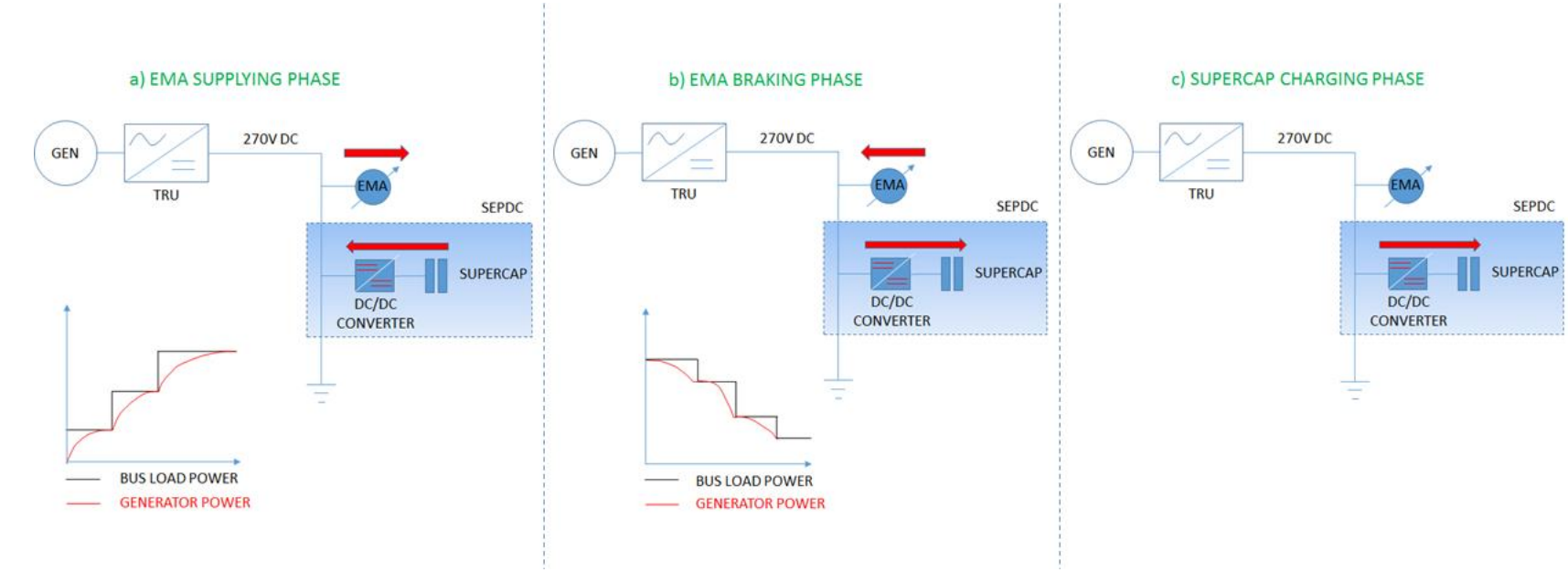
A number of items shall belong to this project:

- A SEPDC, embedding a 270 VDC bus bar, with relevant contactors and protections, as well as the computational core (namely the "supervisor") of the energy management system
- An ESD based on supercapacitors, used as a rapid energy buffer
- A bidirectional DC/DC converter connected to the ESD (both constituting the Energy Storage System, ESS), able to manage the power flows related to the ESD
- A motor load simulating an Electro-Mechanical Actuator used for primary A/C surfaces or landing gear, as example of regenerative load, without dissipation resistors



REG-01-08:
Key Requirements / Points

- Objective of this CfP is to propose an innovative **Energy Storage and Regeneration System** (ESRS) in order to avoid dissipation resistors, replacing them with supercapacitor-based systems. Moreover, the energy recovered and stored within the supercapacitors can be intelligently and effectively reused in order to smooth the power variations experienced by the generator, in EMA supplying phase



- The advanced ESRS shall be **integrated and tested on the Regional Iron Bird** platform in order to demonstrate that relevant solutions for innovative EPDS correctly perform in a relevant operative environment (**TRL 5**).

REG-01-08:
Key Requirements / Points

- A key challenge of the CfP is to **design the ESS control to effectively limit the rate-of-change in load experienced by the generator** over the full load range, while also ensuring careful use of the ESD energy, as sufficient energy must be reserved to minimize the rate-of-change of load experienced by the generator at high loads.

- Given the complexity of the scenario, **a strong formal and theoretical approach must be proposed** in order to properly define the structure of the energy management strategy, using control methods for rate-limit of the ESS operations and supervisory control strategies for global coordination of the operations.

- **The bi-directional DC/DC converter shall be able to manage bi-directional power flows** between the 270 VDC bus bar, embed into the SEPDC, and the supercapacitors, recharging them at a predefined voltage. Reductions of weight and volume by using innovative solutions with respect to the current state of the art are desirable.

- **An adequate number of supercapacitors must be chosen** and arranged in order to comply with the energy flows to be managed (i.e. charging and discharging phase). The supercapacitors shall be electrically interfaced with the DC/DC converter, using technical solutions in order to guarantee the installation safety and the correct charge/discharge cycles operations.

REG-01-08:
Key Requirements / Points

- A **motor load simulating an Electro Mechanical Actuator** representative of a Regional A/C primary surface or main landing gear shall be provided by the applicant, and adequately interfaced with the SEPDC for the purposes of the E^2-EM. The EMA load shall not embed any resistor for energy dissipation, to be instead managed with the ESS.

- **The SEPDC and any other equipment shall be modeled and tested** in a simulation environment in order to pretest their functionalities and performances. Detailed models (preferably SABER models) shall be provided demonstrating the effectiveness of the proposed converter topology by means of accurate simulations. Also the equipment supervisory control and monitoring strategy effectiveness and performances shall be demonstrated by means of simulations, in SABER or other simulation tools. **Both "behavioral" and "functional" level models shall be implemented**.

- **The firmware for equipment control and monitoring shall be automatically or semi-automatically generated** starting from the simulation models. Multi-platforms simulation approach shall be preferred. A preliminary testing phase for the firmware using simulation tools is required.

REG-01-08:
Tasks

Tasks		
Ref. No.	***Title - Description***	***Due Date***
KOM	A Kick off meeting will be organized to review the technical requirements and the project logics and organization agreed with the partner during the negotiation phase.	T0
Task 1	Requirements analysis: To review the customer requirements, and describe the equipment to be designed, manufactured, validated and provided to the customer for testing.	[T0 ; T0+ 3M]
Task 2	Converters modelling and simulation: To derive an accurate model of the ESRS with all its components and associated control (low level), suitable for enhanced energy management scopes (both behavioural and functional level).	[T0 + 3M ; T0+ 9M]
Task 3	Preliminary Design: To validate the equipment requirements and check that equipment preliminary design is consistent with these requirements: architecture concept according to performance and safety requirements, sizing, interfaces definition, substantiation of design choice.	[T0 + 3M ; T0+ 12M]
Task 4	System behaviour and energy management strategy definition: To analyse, design and theoretically proof the effectiveness of the ESRS and energy management strategy. Software and mathematic tools are required to be used in order to prove the benefits and the formal properties of the designed system and energy management strategy.	[T0 + 12M ; T0+ 16M]
Task 5	Firmware definition and testing: To define the ESRS and energy management strategy as a firmware for the computational core of the supervisor. Simulation based approaches shall be used for proving the firmware correctness in terms of energy management objectives achievement.	[T0 + 16M ; T0+ 21M]
Task 6	Critical Design: To realize the detailed design (mechanical, electrical, thermal, …), realize detailed cad drawings, finalize safety analysis, prior to launch equipment manufacturing.	[T0 + 12M ; T0+ 24M]
Task 7	Manufacturing: To manufacture the ESRS associated equipment, following the CDR documentation.	[T0 + 24M ; T0+ 30M]
Task 8	Testing and validation: To perform the final tests for validating the ESRS actions in terms of energy management objectives achievement.	[T0 + 30M ; T0+ 34M]
Task 9	Optimization and support: To analyse the feedbacks coming from the customer and provide further support for optimization activities.	[T0 + 34M ; T0+ 36M]

REG-01-08:
Major Deliverables / Milestones

Deliverables		
Ref. No.	***Title – Description***	***Due Date***
D1	Analysis phase: Requirements matrix and support documentation	T0 + 3M
D2	ESRS topology and control: Simulation models of the ESRS structure and associated controls	T0 + 9M
D3	PDR: Preliminary Design Review and associated deliverables	T0 + 12M
D4	Energy management definition: Analysis of the results of the simulation models for energy management preliminary tests	T0 + 16M
D5	Firmware specification: Implementation of a preliminary firmware for energy management purposes	T0 + 21M
D6	CDR: Critical Design Review and associated deliverables	T0 + 24M
D7	Installation and commissioning: Delivery of the complete system with its associated documentation (preliminary DDP), installation and commissioning on site	T0 + 30M
D8	Validation final tests and DDP: Validation test report and final results (final DDP)	T0 + 34M
D9	Optimization and support: The CfP Supplier shall support the rig operations to correct potential faults during this probation period	T0 + 36M

Milestones		
Ref. No.	***Title – Description***	***Due Date***
M1	Preliminary Design Review	T0 + 12M
M2	Critical Design Review	T0 + 24M
M3	Final results	T0 + 36M

REG-01-08:
Special skills, Capabilities, Certification expected from the Applicant(s)

The Candidate organization shall have:

- expertise in electrical system design (power generation, power conversion, power distribution network, power consumer),
- a well recognized experience in advanced control system techniques,
- knowledge of Industrial/Aeronautical field constraints and procedures,
- experience in system simulation methods and modeling,
- good practice in English language.

The Candidate shall preferably rely on a background in control and supervision of complex systems. Experience in laboratory or industrial test benches design, manufacture and installation will be an asset.

Clean Sky 2
Information Day dedicated to the 4th Call for Proposal (CfP04)

Electro-hidraulic integration of hybrid surface actuation systems

IADP Regional Aircraft - WP 3.5

Brussels, 22nd June 2016

Innovation Takes Off

www.cleansky.eu

Clean Sky 2

REG-02-03

- Estimated Funding Topic Value: **230k€**
- Duration: 36 months
- Start date: **Q2 - 2017**
- SoW overview:
  - **The actuation systems of the Regional FTB#2 Demonstrator will combine hydraulic and electrical systems that will be on-ground tested before aircraft installation. The topic deals with design, development and installation of hydraulic installation representative of aircraft in terms of pressure loss and flow rate and instrumentation systems for the on-ground actuation test bench.**

REG-02-03

CASA, CPW02

WP 3.5
Integrated Technologies
Demonstrator FTB#2

	3rd Level WBS	Leader, Participants
Running 2016 - 2017	WP 3.5.0 Demonstrator FTB#2 Management	**CASA**, CPW02
	WP 3.5.1 FTB#2 Wing Integration	**CASA**, CPW02 & Partners
	WP 3.5.2 FTB#2 Systems Integration	**CASA** & **PARTNER CfPW04**
Start 2018	WP 3.5.3 FTB#2 Propulsion Systems	**CASA**
Running 2016 - 2017	WP 3.5.4 FTB#2 Flight Demonstrator	**CASA**, CPW02

REG-02-03

- **OBJECTIVES:**
- Design, development and verification of On-Ground Rig Systems with HYBRID interaction between hydraulic and electro-mechanical control surface actuation
- ELECTROHYDRAULIC INTEGRATION OF INNOVATIVE HYBRID ACTUATION SYSTEMS (AILERON) + EMA ACTUATION SYSTEMS (SPOILER, FLAP, WINGLET)
- HYBRID (EMA + SERVO AT THE SAME SURFACE) SYSTEM EVALUATION
- REPRESENTATIVE HYDRAULIC:
  - PERFORMANCES EVALUATION OF HYBRID ACTUATION AT SURFACE LEVEL
  - INTERACTION BETWEEN ELECTRICAL SYSTEM AND HYBRID ACTUATION SYSTEM
  - INTERACTION BETWEEN HYDRAULIC SYSTEM AND HYBRID ACTUATION SYSTEM
  - INTERACTION WITH BOTH ELECTRICAL & HYDRAULIC SYSTEM AND HYBRID ACTUATION SYSTEM –ENGINE FAILURES-
- Innovative Rig Instrumentation aspects for control of hydraulic and electrical data acquisition
- SW data treatment for rig (and likely a/c system) design and optimization

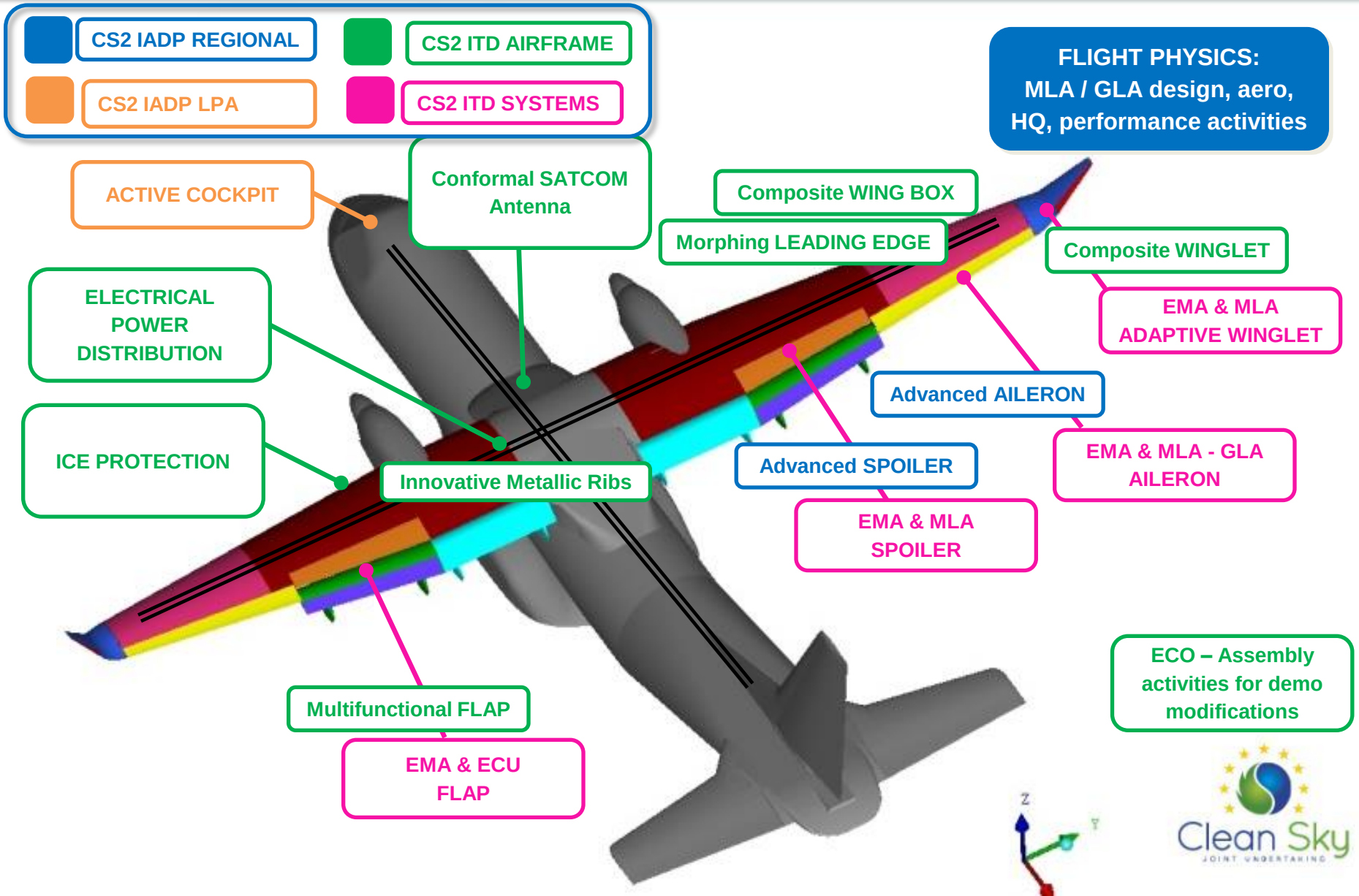
REG-02-03

- **INNOVATIVE ASPECTS FOR THE PARTNER:**

- Develop systems for highly innovative on-ground rig of complete Regional Aircraft
- Close interaction with Airbus DS System Labs facilities – Concurrent Engineering with Aircraft Systems Integrators
- Develop new approaches to link electrical and hydraulical actuation systems on the same control surface (ailerons)
- Integrated control in full FCS rig
- Smart use of instrumentation information from the system for reliable data acquisition and SW treatment for design optimization

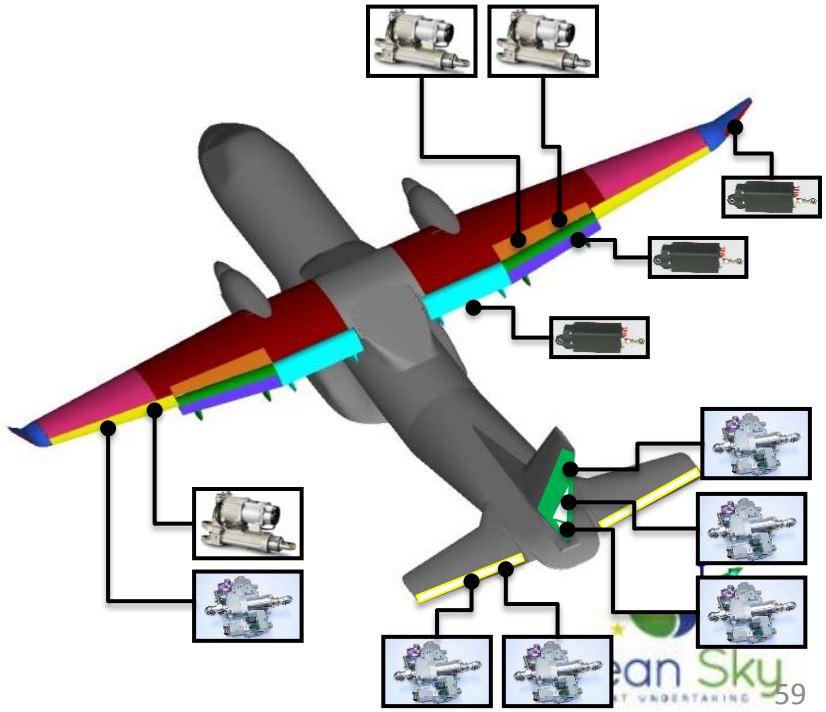
- Call for Proposal Wave 04
- Indicative Funding 230 k EUR

REG-02-03


CS2 IADP REGIONAL
CS2 ITD AIRFRAME
CS2 IADP LPA
CS2 ITD SYSTEMS
FLIGHT PHYSICS:
MLA / GLA design, aero,
HQ, performance activities
ACTIVE COCKPIT
Conformal SATCOM
Antenna
Composite WING BOX
Morphing LEADING EDGE
Composite WINGLET
EMA & MLA
ADAPTIVE WINGLET
ELECTRICAL
POWER
DISTRIBUTION
Advanced AILERON
ICE PROTECTION
Innovative Metallic Ribs
Advanced SPOILER
EMA & MLA - GLA
AILERON
EMA & MLA
SPOILER
ECO – Assembly
activities for demo
modifications
Multifunctional FLAP
EMA & ECU
FLAP
Z
Y
Clean Sky
JOINT UNDERTAKING

REG-02-03

- **FROM <u>ON GROUND ACTUATION RIG FTB#2 WING</u> TO <u>REGIONAL FTB#2 AIRCRAFT</u>**
  - Systems On-Ground Demonstration -FCS (AIR – REG – SYS ITDs)
  - Definition of specifications of control surfaces actuators
  - Integration in a rig of actuation systems with airframe counteracting loads
  - Interaction between Hydraulic, Electrical and Cockpit systems with FCS actuation on ground: **system design, system validation, systems verification, in-flight demonstration Permit to Fly**



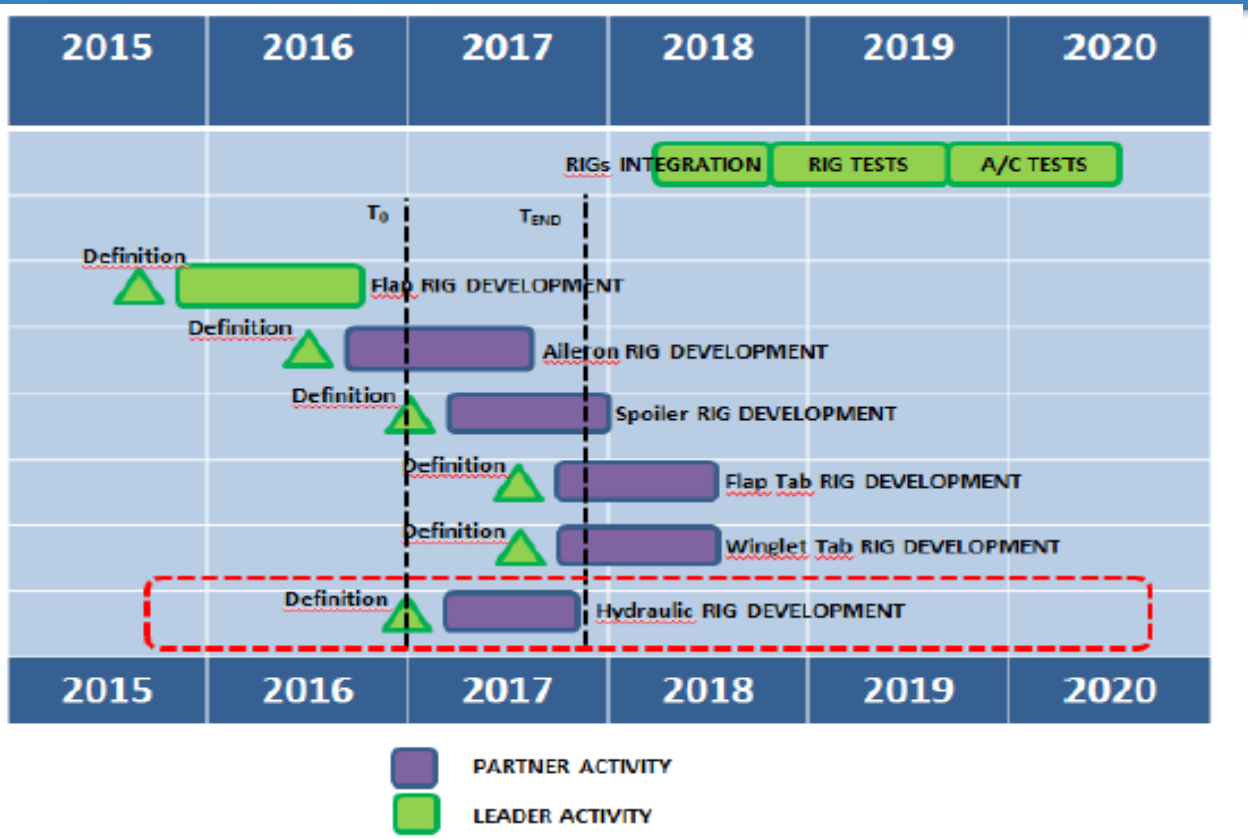
REG-02-03

Special skills:

- Capabilities for designing and manufacturing mechanical and electronic test benches, CATIA model design, resistance of materials calculations and material selection properties for designing the test benches, Structural and Systems Design and Simulation capacities: structural analysis (i.e. NASTRAN), and design tools (CATIA v5)
- Solid knowledge of control and acquisition systems based on National Instruments HW&SW
- Proven experience in collaborating with reference aeronautical and aerospace companies in R&T programs, Participation in international R&T projects cooperating with industrial partners
- Engineering software and licenses for Computer Aided Design (CAD), and appropriate high performance computing facilities, Engineering software and licenses for Labview, and appropriate high performance computing facilities
- Capability of specifying, performing and managing, in collaboration with the Leader, the following
  - Analysis of the mechanical, electrical and control/acquisition requirements
  - Control system definition
  - Trade-off for selection of the industrial elements to be included in the bench
  - Mechanical CATIA design for bench manufacturing
  - SW specification for Control System
  - Acceptance Test Procedure Definition
- Deep knowledge and experience in the following standards: DO-178C, DO-160G, ARINC 791, ARINC 429, MIL 1553, ARINC 600
- Quality System international standards (i.e. EN 9100:2009/ ISO 9001:2008/ ISO 14001:2004)

Clean Sky
JOINT UNDERTAKING

REG-02-03 - Roadmap



Ref. No.	*Title - Description*	*Due Date*
M0	**Test Bench KOM**	T0
M1	Test Bench PDR	T0+3
M2	Test Bench CDR	T0+4
M3	Test Bench CISS	T0+12
M4	**Test Bench POWER ON**	T0+13

REG-02-03 - TASKS

Ref. No.	*Title – Description*	*Due Date*
Task 1.1	KOM: kick off meeting	T0
Task 1.2	Analysis of the mechanical, electrical and control/acquisition requirements	T0 + 1
Task 1.3	Mechanical and Bench Structural calculations	T0 + 2
Task 1.4	Control system definition	T0 + 2
Task 1.5	Trade-off for selection of the industrial elements to be included in the bench	T0 + 3
Task 1.6	Mechanical CATIA design for bench manufacturing	T0 + 3
Task 1.7	SW specification for Control System	T0 + 3
Task 1.8	PDR: preliminary design review	T0 + 3
Task 1.9	CDR: critical design review	T0 + 4
Task 1.10	Manufacturing	T0 + 5
Task 1.11	SW specific development for Control System	T0 + 6
Task 1.12	Acceptance Test Procedure Definition	T0 + 7
Task 1.13	Bench installation at purchaser site	T0 + 11
Task 1.14	CIPS: customer inspection at purchaser site	T0 + 12
Task 1.15	POWER ON: power on of the test bench	T0 + 13
Task 1.16	ATP at purchaser site	T0 + 13
Task 1.17	Support of Rigs Integration	T0 + 36

REG-02-03 - Deliverables

Ref. No.	Title – Description	Type	Due Date
D1	KOM: kick off meeting	Document	T0
D2	Analysis of the mechanical, electrical and control/acquisition requirements	Document	T0 + 1
D3	Mechanical and Bench Structural calculations	Document	T0 + 2
D4	Control system definition	Document	T0 + 2

Ref. No.	Title – Description	Type	Due Date
D5	Trade-off for selection of the industrial elements to be included in the bench	Document	T0 + 3
D6	Mechanical CATIA design for bench manufacturing	CATIA model	T0 + 3
D7	SW specification for Control System	Document	T0 + 3
D8	PDR: preliminary design review	Document	T0 + 3
D9	CDR: critical design review	Document	T0 + 4
D10	SW specific development for Control System	Document + SW Files	T0 + 6
D11	Acceptance Test Procedure Definition	Document	T0 + 7
D12	CIPS: customer inspection at purchaser site	Document	T0 + 12
D13	ATP at purchaser site	Document	T0 + 13

Questions ?

Any questions on the Call and topics can be addressed to the following mailbox:

Info-Call-CFP-2016-02@Cleansky.eu

Deadline to submit your questions:

16th August 2016, 17:00 (local time)

Thank You

AIRBUS

AIRBUS HELICOPTERS

FINMECCANICA HELICOPTER DIVISION

FINMECCANICA AIRCRAFT DIVISION

DASSAULT AVIATION

DLR

AIRBUS DEFENCE & SPACE

evektor

Fraunhofer

LIEBHERR

MTU Aero Engines

PIAGGIO AEROSPACE

Rolls-Royce

SAFRAN AEROSPACE · DEFENCE · SECURITY

SAAB

THALES

Clean Sky

JOINT UNDERTAKING