EUROPEAN
COMMISSION

Brussels, 6.1.2014
SWD(2013) 539 final

PART 3/3

COMMISSION STAFF WORKING DOCUMENT

Annexes to Commission Staff Working Document Parts I & II

Accompanying the document

Report from the Commission to the European Parliament and the Council

Annual Progress Report on the activities of the Joint Technology Initiative Joint Undertakings (JTI JUs) in 2012

{COM(2013) 935 final}

TABLE OF CONTENTS

ANNEX I - DESCRIPTION OF THE 'INTEGRATED TECHNOLOGY DEMONSTRATORS' (ITD) ACHIEVEMENTS

A. SFWA - SMART FIXED WING AIRCRAFT ITD

In 2012 SFWA has been focussed on achieving progress on all key SFWA target technologies. Based on the progress made in year 2011, positive experience in the project and supported by the SFWA-ITD Reviewers all activities conducted were even stronger aligned along the eight "Technology Streams":

1. Natural Laminar Flow Smart Wing (NLF SW)
2. Hybrid Laminar Flow Smart Wing (HLF SW)
3. Innovative Control Surfaces (ICS)
4. Fluidic Control Surfaces (FCS)
5. Load Control Functions and Architectures (LCFA)
6. Buffet Control (BC)
7. CROR engine integration (CROR-EI)
8. Integration of Innovative Turbofan Engines to Bizjets (IITE)
9. Advanced Flight Test Instrumentation (FTI)

For all technology streams respective leaders have been well installed in order to manage the technical coordination and management through the overall SFWA-ITD work breakdown structure, which means the appropriate steering and interconnections between the work packages feeding inputs to the technology stream.

A review of the technology stream content elements towards reaching technical readiness levels of typically TRL 5 or 6 in each of the technology streams and careful "to completion" planning update have been conducted in the second half of the year in parallel to the technical activities.

With reference to the contract, the currently estimated overall consumption of resources amounts to 97% of the grant agreement value.

<u>Major achievements of the year 2012 were:</u>

- Launch of the detailed design for the "High Speed demonstrator Passive" (HSDP)
- Start of manufacturing of the laminar wing flight test articles for the "High Speed Demonstrator Passive"
- Closure of maturity "MAT B" gate of the High Speed Demonstrator Passive
- First part of the CROR feasibility study
- Major wind tunnel tests on the full span 1/7 model completed to select a CROR engine – blade target design.
- Completion of the smart wing leading edge structural demonstrator including test preparation

- “Smart Flap” and “Innovative Rear Empennage” large ground demonstrator Launch Design Review
- Initiation of ground and flight tests to prepare the “Low Speed Demonstrator”
- “Low Speed Demonstrator” - Review performed with external evaluators
- Wind tunnel tests with concepts for the integration of innovative engines in Business Jets.
- Wind tunnel tests with 2.5D active flow control high performance high lift concepts for laminar wings.
- In-flight testing of surface coatings for laminar wings
- Evaluate, select and contract new partners for work packages published in subsequent CleanSky call for proposals.
- Finalization of concept aircraft models for the evaluation of SFWA and other ITD technologies, primarily SAGE (SGO first loop planned in 2013), for use by the Technology Evaluator
- SFWA-ITD Annual Progress Review meeting on 21/23 March in Bucharest
- Preparation of the 2013 Consortium Plan
- Conduct the work specified in SFWA Consortium Plan 2012 including the envisaged milestones and deliverables

The majority of activities in the SFWA-ITD have been related to the detailed design and manufacturing of the major flight test demonstrators.

In particular building the two A340-based laminar wing tip sections for the “High Speed Demonstrator Passive” (project title: “BLADE” = Breakthrough Laminar Aircraft Demonstrator in Europe) ramped up to full pace in 2012.

A major share of work was dedicated to the detailed design of components for the large flight test demonstrations including the modification of the test aircraft. For the smart laminar wing and low speed flight tests, the manufacturing and assembly of parts will be continued.

The critical design review for the wing is re-scheduled to take place in the first semester of 2013.

The focus of work in 2012 was laid to launch the detailed design work and the launch of manufacturing of parts as well as the preparation of flight test instrumentation and measurement equipment.

For preparation of the “Low Speed Demonstrator” the work program was updated to allow for the different levels of the required technologies. The result is an intermediate step, namely two ground test demonstrators, one for the “smart flap” and one for an active vibration attenuation test, both have been initiated in 2012. For the active vibration attenuation test the decision was taken in February this year to go for a full size vibration suppression test on a Dassault Falcon F7X on ground. The low speed demonstrator of vibration control will fly in 2016.

The detailed design of the CROR-pylon and the modification of the Airbus A340-600 test aircraft started at the end of 2012 with the “CROR-demo-engine FTB” launch decision. Even though integration details will depend on the outcome of a feasibility study on the integration of the CROR into a “single aisle” short range aircraft to be concluded in 2013, some preparatory actions for the flying test bed are “long lead time items” and must start very early in year 2013.

The review of the CROR engine integration has been extended until mid of 2013.

This was considered necessary to review in great detail configurations other that the previously preferred rear fuselage mounted pusher installation.

The main challenges for all configurations are the minimization of the external noise, the dynamic loads to the structure, the complexity and weight of the propulsion system as well as handling quality certification issues. Activities have been added to provide additional information for the definition of certification rules in close coordination with engine manufacturers, and rulemaking authorities.

The preparation phase to start with the detailed design of the pylon, the engine related systems including the interfaces to the test aircraft, as well as the structural modifications to the Airbus A340-600 test bed has been launched and will be in the scope of activities addressed in 2013.

The preparation work done so far was reviewed after the proposed replacement of the SAGE 1 engine by the SAGE 2 engine as already agreed in autumn 2011 by Snecma, Rolls-Royce, Airbus and the Clean Sky JU.

While the engine related research and development work is mainly covered in CleanSky SAGE 1 and SAGE 2, the related development schedules are and have to be jointly harmonized between SAGE-ITD and SFWA-ITD.

Most of the experimental tests on the CROR in Wind tunnels have been jointly undertaken with Airbus, Snecma and Rolls-Royce in SFWA coordination with the relevant SAGE technical planning.

An entirely new noise-shielding rear empennage for business-jets which have been carefully designed in SFWA in the previous years led to the kick-off of building a full scale structural demonstrator in 2012. The detailed design will start in 2013 based on further numerical studies and a number of large scale wind tunnel tests

The development, integration and large scale ground and flight testing of the SFWA-ITD technologies are based upon a maturation of the underlying principle technologies.

In 2012, the majority of technologies typically reached TRLs between 3 and 4, allowing testing them in an integrated (ground) environment. In parallel to those tests, the pre-selected, integrated concepts will be assessed in the (virtual) SFWA-ITD aircraft concepts. A part of these tests, for example, like those feeding into the Technology Stream “Innovative Control

Surfaces" with the latest test article of a wing active flow control system done in cooperation with a dedicated CFP-topic, will come to conclusion in year 2013.

The matured SFWA-technologies are partially provided to the CleanSky Technology Evaluator for further evaluation.

SAGE and SGO-ITD contributions have been and will be incorporated as well.

The computer simulation model PANEM was prepared but difficulties with this new established model caused some delays in the on time delivery to TE. A high level of effort has been undertaken in order to harmonize engine model data with the aircraft models. Further effort beyond this year will be necessary within the program in order to get reliable results.

A large number of research and industry type wind tunnel tests have been prepared and performed in 2012.

Four large tests covered the testing of preselected CROR engines using different blade designs. The test articles will be at 1/5 respectively 1/7 scale and will address a wide range of noise and aerodynamic measurements. The most demanding test session has been finished at the end of the year in the DNW wind tunnel. Two large wind tunnel tests are planned to evaluate a preselected innovative tail design for business jets in combination with advanced turbofan engines. Most of the experimental tests on the CROR in Wind tunnels have been jointly undertaken with Airbus, Snecma and Rolls-Royce in SFWA coordination with the relevant SAGE technical planning.

Almost 50 days of testing have been conducted with the very complex 1/7 scale full span test article, with the engines being tested installed, uninstalled, and with typically three different CROR blade designs. The tests will continue in 2013.

A number of smaller research type wind tunnel tests have been prepared to mature various concepts of passive and active flow control technologies for the design of the smart wing; new loads control concepts, and the design of Riblet surface coating. In one wind tunnel test on advanced active flow control flap design which will be conducted and exploited in cooperation with a partner in a dedicated Call for proposal topic will be completed in early 2013. More test sessions will follow.

To test the long term robustness of selected innovative surface coatings against wear and aging, a "long duration" flight test campaign on two in-service A340-300 Lufthansa long-haul aircraft, initially planned for an end in June 2012 have been extended by 12 months due to success of the work package and the expected extra value of further data. Started in 2011, this test has been conducted in the frame of a CfP-topic with CleanSky partner Lufthansa Technik.

In early 2012, large scale ground "feature" demonstrators for the smart wing are in the last phases of completion for being tested form end of 2012 onwards. This includes an integrated structural demonstrator equipped with all major systems for the leading edge design. Dedicated test articles have been and will be prepared for bird strike and lightning strike tests as well as repair concepts. Many of the activities for the ground demonstrators have been carried out with strong support of Call for proposal partners who already joined in the years 2010 and 2011.

CFP status:

Twenty-Eight CFP- topics have been found a winner during the evaluations of Call #11, #12 and #13. The scope of topics of calls #11, #12 and #13 ranged from design and testing of individual components and systems for the laminar wing, surface coatings and repair methods, contribution to design and manufacturing of laminar wing ground demonstrator parts, as well as the preparation and qualification of new flight test instrumentation.

Further topics have been already partially prepared for Call#14 through Call#16 in order to be launched in 2013 and 2014. Among them a wide range of topics deals with innovative measurement technique, the development of optical systems, and a Blade deformation measurement system. Further subjects that have been prepared deal with the treatment, and repair and testing of surfaces for laminar wing panels, the design and development of laminar wing high speed performance test and the integration of a new, enhanced AFC system in a large scale W/T test model.

2012 and also 2013 Call topics have been and will contain major work packages to attribute to the design and build parts of the laminar wing's flight test articles and topics related to a manufacturing concept for the outer wing with special paint and coating, as well as the integration of Krueger flaps into a business jet wing.

B. GRA – GREEN REGIONAL AIRCRAFT ITD

2012 was a critical year for revising the global planning of GRA activities.

Due to the slow start GRA suffered from under-spending of yearly budget initially planned for this ITD over the first half of Clean Sky duration. The work requested by CS JU related to "multi-year" planning in order to cover the period of time 2013-2016 opened an opportunity for re-definition of GRA activities.

At the same time a strategic decision in respect to demonstration of GTF on 130 pax configuration has been implemented and a new "master schedule" emerged. On top of that, year 2011 resulted in significant delays in terms of pending deliverables, 31 out of 89 have been pending at the end of the year (85% of 89 deliverables). Approximately 11% of all delays have been caused by CFPs on the basis of the 2011 Technical Report.

Therefore, year 2012 became a critical one from the point of view of successful accomplishment of GRA targets.

Over 2012 the GRA did significant effort in order to reduce risk caused by delayed deliverables. This resulted in relatively small impact of delays on milestones related to Low Weight and Low Noise domains. Anyway, ground and flight demonstrations are under control and more likely would be finalized by the end of 2015. However a small probability of shift to 2016 by some 3 month still exists. An exception is cockpit demonstrator controlled by Eads-

Casa, which requests an extra budget in order to be finalized by 2015. There is also a risk related to Environmental Control System for flight testing, which needs some extra budget for the equipment provider (Liebherr).

Due to strategy changes, GRA has to deliver to TE only two GRASM models; the first one for advanced turbo-prop and another one for aircraft powered by GTF (Geared Turbo-fan). This plan seems to be plausible and neutralizes dependency of the models for TE on engine data.

In total, GRA's utilization of resources in 2012 was around 88% of planned value (1555/1767 MM, an estimate) vs. 80% progress in deliverables. The reason is a discrepancy between actual expenses for producing hardware and intermediate test results, reflecting real needs and risk mitigation against pre-programmed value of work and formal process of deliverables approval.

It is also worth to mention that in the course of the year, GRA has significantly improved the process of controlling CFPs. At present, not only negotiations but also implementation of critical CFPs is monitored by Steering Committee, in particular as a part of risk analysis related to demonstrators.

Interdependencies at ITD level represent critical factor from the point of view of risk of delays.

1. Low Weight Configuration (LWC)

In 2012, apart from PDR of Ground and in-Flight Demonstrators the Second Down- Selection of low weight technologies was a major event of Low Weight Domain. The manufacturing of stiffened flat large panels with different technologies selected by the First Down Selection was completed. All panels representative of fuselage and wing architectures have been instrumented. Static and fatigue tests were carried out. The respective test results analyses were performed. The definition of technical solutions on FWD fuselage, fuselage and wing of the future generic regional aircraft utilizing the selected technologies was progressing. The general layout of the structural component to be integrated on test A/C for flight demonstration was developed. The respective preliminary test plan for demonstration in-flight was defined. The general layout of ground demonstrators (fuselage barrel & wing box) and the respective tooling for ground test activities has been developed. The respective preliminary test plan for demonstrations on ground has been defined. The detailed design of the structural component to be integrated on test A/C and flight tested for demonstration has started. The detailed design of the fuselage barrel and wing box demonstrators to be tested on ground was started as well.

The Work Package on LWC has acchieved its goals and should not be continued in 2013.

GRA ITD effort and staff involved in LWC has switched his activities to ground and flight demonstrations.

<u>Milestone status:</u>

2 milestones have been planned and 2 have been successfully performed.

Deliverables status:

Nr of deliverables due in 2011 at the beginning of 2012:	16
Nr of deliverables due in 2011 at the end of 2012:	0
Nr of deliverables due in 2012:	24
Nr of deliverables pending by the end of 2012:	8

CFP status:

In 2012, GRA LWC has launched 9 successful Topics. In a significant part they will support preparation of ground demonstrators, for example manufacturing of floor for full scale fuselage barrel and cockpit.

2. Low Noise Configuration (LNC)

In 2012 LNC continued with definition of requirements and architecture of GRA conceptual aircraft.

In particular:

i) aerodynamic optimisation, aero-elastic modeling and preliminary structural layout of the Natural Laminar Flow (NLF) wing baseline configuration tailored to top-level requirements and general architecture of a green regional rear-fuselage engine Geared Turbo-Fan (130 pax) aircraft,
ii) aerodynamic design of the baseline High Lift Devices (HLD) architecture for the Geared Turbo-Fan A/C wing configuration and
iii) Updating of the V&V plan document to verify the achievement of HLD airframe noise reduction, wing highly efficient aerodynamics and load alleviation targets and validate relevant addressed concepts/ architectures/ technical solutions in a multi-physics view.

A work on enabling technologies (high lift devices, nose and main landing gear as well as load control and alleviation) was continued. The main planned event achieved was second down-selection of mentioned technologies.

Work on definition of Demonstrators has been performed. Specification of requirements for high speed Wind-Tunnel tests demonstration of aerodynamic performance at transonic cruise design point and in off-design conditions of the NLF wing design integrated with LC&A concepts, tailored to a GTF 130-seat A/C configuration has been done.

The Work Package on LNC has achieved its goals and should not be continued in 2013. GRA ITD effort and staff involved in LNC has switched his activities to ground and flight demonstrations.

Milestone status:

1 milestone has been planned and 1 has been successfully performed.

Deliverables status:

Nr of deliverables due in 2011 at the beginning of 2012:	9
Nr of deliverables due in 2011 at the end of 2012:	0
Nr of deliverables due in 2012:	16
Nr of deliverables pending by the end of 2012:	8

CFP status:

In 2012, GRA LNC has launched 1 successful topic regarding WTT addressing Natural Laminar Flow and Loads alleviations and control solutions. (topic: GRA-02-019)

3. All Electrical Aircraft (AEA)

Implementation of Level 1 (Architectural level), Level 2 (Functional level) and Level 3 (Behavioural level) in simulation models have advanced and integration of models into the Prototype Shared Simulation Environment (SSE) has been initiated. Those topics are essential for modeling and simulation of on-board systems.

Regarding "Application studies" number of steps has been achieved:

- Analysis of function and performance of on board systems for an All Electrical future regional A/C. (Activities were based on the input from WP 3.1.1 and WP 3.1.2 as well as data from GRA New Configuration Domain - A/C configuration definition).
- Implementation, analysis and Integration of Electrical Energy Management Functional logics for Future Regional Aircraft
- Analysis of functions and performance of on-board systems interested to in-flight demonstration, including definition of the modifications of the A/C demonstrator in order to integrate and to test in flight the innovative technologies for selected on-board systems:
    - Electrical Environmental Control System (E-ECS),
    - Electrical Energy Management (E-EM),
    - Hybrid Wing Ice protection System (H-WIPS) – CANCELED (after analysis of technical aspects as well as cost and availability of the test aircraft)
    - Electro mechanical actuation for LGS (Landing Gears: main and nose) and FCS (Flight Control System).

In a significant part those activities have been performed through research at COPPER Bird® (development of common ITDs (GRA, EDS, SGO).

Preparation of flight Demonstration for AEA has been advanced by performing:

- Initial preparation of the "Verification and Validation Plan for the Flight Test activities.
- Start of design of systems, parts and structural modification for the modifications to be implemented on the A/C demonstrator:
- Electrical Environmental Control System (E-ECS),
- Electrical Energy Management (E-EM),
- New Electrical Power Generation for Demo Supply Channel,
- EMA's Loads and associated Bench Test introduction on-board.
- Innovative FTI

Milestone status:

1 milestone has been planned and 1 has been successfully performed.

Deliverables status:

Nr of deliverables due in 2011 at the beginning of 2012:	0
Nr of deliverables due in 2011 at the end of 2012:	0
Nr of deliverables due in 2012:	5
Nr of deliverables pending by the end of 2012:	1

CFP status:

In 2012, GRA LNC has launched 2 successful topics regarding flight test equipment (electro-mechanical actuators for rudder and console for power management system). (topics: GRA-03-009; GRA-03-010)

4. Mission and Trajectory Management

The update of MTM functionalities and operational scenario has been continued (relevant input coming from SESAR (WP 4.1.1))

The preparation of upgraded prototyping tool architecture definition has been started.

The development of green FMS has been continued: a first release (including a subset of MTM functionalities) of green FMS was finalized (WP4.3).

Milestone status:

1 milestone has been planned and 1 has been successfully performed.

Deliverables status:

Nr of deliverables due in 2011 at the beginning of 2012:	0

Nr of deliverables due in 2011 at the end of 2012: 0

Nr of deliverables due in 2012: 7

Nr of deliverables pending by the end of 2012: 0

CFP status: In 2012, GRA MTM did not launch a CFP.

5. New Configurations

In year 2012 GRA has performed:

1. TLAR (Top Level Aircraft Requirement) – the last definition and power plant specifications (Loop 2)
2. Sizing and performance estimation for O/R (Open Rotor), T/P (Turbo – Prop) and T/F (Turbo-fan) configurations (2nd loop end)
3. GTF sizing finalization for two different configurations (trade-off between: under wing and rear engine installation). However, only under wing engine installation has been performed. Trade-off studies are due in 2013.
4. Calculation of relevant data (trajectories, mission results, etc.), noise and engine emissions evaluation for the Technology Evaluator for Green A/C (Main results of Loop 2 activities by means of proper tools) for Turboprop and for the best Geared Turbofan configurations. Modified GRASMs (simulation models of Green Regional Aircraft were provided to TE)

Milestone status:

Initially, 1 milestone has been planned for GRA NC but it has been cancelled due to change in strategy.

Deliverables status:

Nr of deliverables due in 2011 at the beginning of 2012: 5

Nr of deliverables due in 2011 at the end of 2012: 1

Nr of deliverables due in 2012: 15

Nr of deliverables pending by the end of 2012: 5

CFP status:

In 2012, GRA NC has launched 1 successful topic regarding WTT addressing overall architecture of 130 pax. turbo-jet and installation issues related to power plant. (topic: GRA-05-007).

C. GRC – GREEN ROTORCRAFT ITD

Progress over 2012 can be summarized through the following table, giving the comparison between the level of achievements (via deliverables and milestones) and resources assigned to the project.

Expenditure matches achievements with a level of 80% for both.

	Deliverables		Milestones		Effort (Man Months)	
	Due	Released	Due	Released	Forecast	Spent
GRC0	4	3	1	1	53,0	60
GRC1	13	11	11	09	311.6	203.57
GRC2	12	12	5	2	306,4	231,7
GRC3	38	33	44	33	224,2	172,23
GRC4	14	3	24	24	285,1	254,4
GRC5	12	11	23	20	227,0	200,3
GRC6	5	3	3	2	97,5	90
GRC7	3	3	3	3	109,6	86
Synthesis	4	3	1	1	53,0	60
	78%		1	1	53,0	60

<u>*Main GRC deliverables and milestones are as follows:*</u>

- For innovative blades (GRC1): active twist specimen tests; preliminary design of 3D optimised blade shape (PDR); design of major components for full scale rotor with active Gurney flaps (PDR);
- For airframe drag reduction (GRC2): wind tunnel component tests completed (TRL4) concerning the optimised hub caps and the synthetic jet flow control system and the active empennage. Comprehensive analysis completed for air intakes and exhaust nozzles integration.
- For on-board energy (GRC3): equipment design specifications at preliminary design or critical design levels, agreed between integrators and suppliers (TRL3).
- For the Diesel-powered helicopter (GRC4): demonstrator engine critical design review (TRL 3); first power pack delivered for ground test article; frozen configuration and specification of the optimised helicopter.

- For environment-friendly flight paths (GRC5): helicopter flight profiles optimised for low emission; low level/narrow IFR routes for noise abatement with feasibility assessed (TRL3); on-board flight management available; in-flight validation started.
- For eco-design for rotorcraft airframe (GRC6): design of demonstration articles completed; parts manufactured (partially).
- Concerning the GRC contribution to TE (GRC7): second annual release of rotorcraft software and data packages for the SEL and TELU1 were delivered to TE.

Activities performed in 2012 are detailed here after and the description is given against each work package of the ITD GRC, from GRC0 to GRC7.

1. GRC1 – Innovative rotor blades

In 2012, GRC1 activities proceeded to plan except for a delay in committing the required resources to the full scale blade design activities.

The Active Twist Technology advanced significantly with the successful CDR (Critical Design Review) for the new system and maturing to TRL3.

Some trial manufacturing using the newly developed actuators within a model scale blade was achieved. Design of a complete blade, optimised at all radial sections for the inclusion of active twist elements was completed. Detailed design and planning for bench testing of a full scale blade section now continues.

The CDR for the Twente wind tunnel test of an Active Gurney Flap system was delayed to February 2013. Similarly, the Preliminary Design Review for the model rotor blade. Work with CFP partners for actuation system continues.

A Preliminary Design Review (PDR) was completed on an optimised full scale passive rotor blade and detailed design work is proceeding to plan.

A further assessment of the performance and acoustic benefits of GRC1 technologies, along with mass and electrical power penalties, was also completed and supplied to GRC7.

Three new CFP partners were successfully chosen (innovative rotor blade production tooling, at full scale and model scale; support 2D dynamic wind tunnel testing).

2. GRC2 Reduced drag of airframe and dynamic systems activities

In GRC2 (Reduced drag of airframe and dynamic systems activities), main tasks focused on the optimisation of the rotor hub, the fuselage and the engine installation. The first wind tunnel campaign to measure the baseline configuration of the EC135, including fuselage cabin, landing skids and rotor head, has been concluded in the context of the ADHERO project. Moreover the aerodynamic and structural design of a new full scale hub cap for light helicopter progressed and the one for the heavy helicopter started. Concerning the reduction of airframe drag, especially for blunt aft bodies and for the tail, improved aerodynamic design of the common helicopter and tilt rotor platforms had been conducted, incorporating passive and/or active flow control systems. Concerning the common tilt rotor platform, optimization of nose, sponsons and wing-fuselage junction was completed, while the wing-nacelle and empennage optimization is still on-going. The optimized tilt rotor geometry will be tested in wind tunnel within the next period.

Concerning engine installation tasks, aerodynamic studies and noise propagation analysis about new side air intakes integrations for the light helicopter of ECg was performed.

As far as the common tilt rotor platform is concerned, a study for evaluation of emission, engine performance and noise had been accomplished in order to reach TRL3 in 2013.

In 2012 GRC2 supported GRC7 in defining the aerodynamic characteristics of fuselage and empennage of the Single Engine Light (SEL) and Twin Engine Heavy (THE) helicopter models for the "Y2020 reference" and "Y2020+CS conceptual" fleets, whereas the Twin Engine Medium (TEM) model for the "Y2000 reference" was revised and corrected.

In 2012, GRC2 delivered 100% of planned reports but only 40% of the planned milestones, which reflects on budget under-spending. The main reasons are personnel availability and bureaucratic delays in authorizing wind tunnel model manufacturing.

3. GRC3 Integration of Innovative Electrical Systems for Rotorcraft

In GRC3 (Integration of innovative electrical systems activities), analysis reports covering technologies across differing helicopter types were delivered and data regarding system mass and future electrical power requirements provided to GRC7.

The Brushless Starter Generator Preliminary Design Review (PDR) was achieved in early 2012, work then concentrated on the associated power electronics and a preparatory CDR which was held in November 12. The final CDR is rescheduled to early 2014.

The previously unsuccessful Call for Proposal's for Power Convertor and Energy Storage systems were merged, and subsequently awarded and launched in July 12 as REGENESYS.

Regarding the energy recovery systems, RECYCLE progressed to parts manufacture, and the RENERGISE has undergone a revised topology to ensure weight targets are realised.

The Electromechanical Actuators (EMA) for the very light helicopter has been re-planned using a new supplier following a failure to proceed with the originally selected partners. The EMA for Landing Gear delivered an overall characteristics document early in the period, passed its CDR in October 12 and was also declared to TRL3 in October 12. EMA for the Rotor brake HERRB achieved a successful PDR in December 12. Joint technical reviews have been held between AW, HERRB & REGENESYS CFP partners to establish technology interoperability to maximise the system efficiencies and benefits.

The conventional Electric Tail Rotor also successfully completed a PDR in November 12. The Fenestron Electric Tail Rotor study identified and investigated concept issues and now plans to provide a deliverable progress report in 2013.

The Piezo Electric Power activities included the issuing of an overall characteristics report and the on-going closure of PDR actions.

Preparatory work for the demonstration of GRC3 technologies on the Electric Test bench has included the provision of interface definition documents, and detailed test plans for the technologies to be demonstrated. Additionally the selection of the partner for the HEMAS adaption kit was concluded.

Overall in 2012 GRC3 progressed well against its work plan, and delivered 90% of its planned reports.

4. GRC4 – Integration of a Diesel engine on a light helicopter

Regarding definition of the "Optimal Helicopter Architecture", the study of an advanced ideal Diesel engine to be installed onto the optimized helicopter, all milestones - base data to continue PZL tasks in 2012 were achieved. The delay in issuing deliverables by PZL's Partner LUT - basis for continuing PZL's work– the ideal Diesel design was recovered by the end 2012. Due to delay of studies the consumption of the budget in 2012 was under requested value.

Regarding Demonstrator Helicopter and its accordingly developed Powerpack, the forecasted milestones have been achieved, with slight delay for Preliminary Design Review (Powerpack and Helicopter PDR were done together in February 2012), and on-time for Critical Design Review (Powerpack in June 2012, Helicopter in September 2012). Both Powerpack and Helicopter have achieved TRL3 at their respective CDR Milestone.

The total requested budget has been totally consumed in 2012 (with slight overspending) thanks to the delay recovery from beginning of the year and due to additional effort of Eurocopter to support activities under Partners responsibility.

5. GRC5 – Environment-friendly flight paths

To respond to JU request to focusing the organization of the activities on specific and well-defined Technology Products, in 2012 GRC5 (Environment-friendly flight paths) was heavily reviewed and restructured, with some significant impact on subproject technical productivity and deliveries. Relevant modifications to the initial activities are: higher focus on instrumental flight procedures with respect to visual ones (due to higher expected benefit on vehicle operational capability); re-scoping of final tilt rotor demonstrations from flight tests to piloted simulations (due to test bed vehicle unavailability in GRC5); diversion of gas emission experimental measurements from the AW139 (due to unavailability of combustor numerical model) to the SW4 single-engine light helicopter (combustor model available to partners). TPs are grouped in four Technology Streams: eco-Flight Procedures, eco-Flight Planner, eco-Flight Guidance and eco-Technologies.

For eco-Flight Procedures, computational tools for helicopter low-noise procedures were completed; trajectory optimization mostly finalized and tilt rotor activities started. AW139 acoustic tests are now confirmed for spring 2013.

For eco-Flight Planner, the development of numerical tools started., For eco-Flight Guidance, the planned upgrades were completed and systems are ready for the integration of the advanced guidance concepts under study. EC135 “tunnel-in-the-sky” in-flight validation is scheduled in spring 2013. The Low-Noise on-board Algorithm developed is ready for delivery and integration into the AW139 experimental FMS.

For eco-Technologies, most of the expected numerical tools for sound diagnosis and synthesis were deployed; preliminary ground tests for pollutant measurements were performed on the SW4 with positive results, and final flight test activity is expected to take place in mid-2013.

6. GRC6 – Ecodesign Rotorcraft Demonstrators

In GRC6 the definition of the demonstrators has been the main topic during 2012. Specific designs, stress analysis and production details have been defined for all four demonstrators. These demonstrators are two thermoplastic composite structures (A stiffened helicopter tail cone and an aerodynamic fairing) for composite manufacturing technologies and two metallic demonstrator groups (a tail rotor gear box including a thermoplastic drive shaft and a main rotor gear box) for new treatment methods. The most important milestones and deliverables of 2012 were the “Demonstrator definition” and the creation of “(Pre-) designs” as well as manufacturing documents.

Two new Calls for proposal were started, both focusing on the end-of-life solution for the affected demonstrators, one for thermoplastic components and one for metallic parts.

One deliverable, the assembly of the main rotor gear box, had to be delayed until March 2013 because manufacturing in a serial production environment cannot always get a high priority during strong production periods. Mitigation for this issue is among others an intensified outsourcing of demonstrator production to external partners.

Budget and time consumption developed as planned with no substantial under spending.

7. GRC7 – Interface with the Technology Evaluator

GRC7 had three deliverables and milestones relating to delivery of the Phoenix platform V2.1 for the Technology Evaluator’s (TE)’s Second Assessment. The data and software packages deliverables for the Twin Engine Light update (TELU1) and Single Engine Light (SEL) generic rotorcraft were delivered to the TE in early June 2012 as planned. Following the long awaited resolution of the IPR agreement issue in period 5, Phoenix platform V2.1 GSP engine model outputs were verified by Turbomeca (TM). GRC7 milestones are based on the receipt and integration of the Phoenix V2.1 into the TE’s platform and the generation of their assessment results.

The successful completion of 100% of all GRC7 deliverables and milestones were as a result of a Project Management decision to stagger GRC7 outputs to a more realistic, achievable and manageable level.

GRC7 although completing 100% of the planned deliverables and milestones had a 15% estimated under-spend.

CFP status:

Three calls were planned in 2012. GRC submitted a total amount of 12 topics in the three calls for proposals (CfP) published: CfP n°11 – 4 topics (total budget: 1, 45 M€; CfP n°12 – 5 topics ((total budget: 4, 59 M€; CfP n°13 – 5 topics (including 2 resubmitted topics) :

Shared Information Repository

The GRC on-line repository is hosted and maintained by AgustaWestland, with support to two CFP projects (TRAVEL and ANCORA) and to activities on Active Gurney flap -GRC1. All documents (deliverables) are uploaded.

D. SAGE – SUSTAINABLE AND GREEN ENGINE

2012 has been a key year for the SAGE, when critical decisions have been made and projects have started to come to fruition and deliver engine demonstrations.

The focus in the programme has been largely expended in preparing for demonstrations: defining technology demonstration requirements and validation strategies, managing the risk to engine demonstrations by raising the Technology Readiness Level of selected technologies through sub-system rig testing, developing engine test component designs and enabling manufacturing technologies and reviewing the demonstrator plans.

Components have been manufactured and demonstrators assembled and delivered for test: the first engine demonstrations in SAGE3 (advanced dressing), SAGE5 planned end of 2012 but postponed to beginning of 2013 for technical reasons.

A Lean Burn Demonstrator was introduced into a new SAGE project called SAGE 6.

SAGE1 has continued to develop Geared Open Rotor Technology.

The significant technologies to be developed and finally demonstrated are the open rotor assembly including the counter rotating blades, the blade pitch control and the transmission systems.

The CROR technology acquisition effort under SAGE 1 proceeded in parallel to the SAGE 6 Lean Burn demonstration, to assist in the outstanding SFWA CROR key decisions in 2012 and 2013. As such, support to the rule making process for CROR flightworthy assessment including associated engineering effort was provided to enable definition of key technologies to be demonstrated and to enable CROR demonstration after the current Clean Sky. An installation Functional Hazard Analysis for the demonstrator engine has been carried out in 2012 to identify major installation risk and design recommendations for future ground and flight test demonstration. Evaluations of CROR blade design and material options as well as aeromechanical implications and methods have been progressed. Design and manufacturing methods for the rotating structures have been further investigated. Aero- acoustic design and prediction methods related to Far Field and Near Field Noise as well as Transposition to Flight methodologies linked to test data for validation has been further developed in close cooperation with SFWA activities.

The programme of work is focussed on the R&T necessary to develop the TRL of the fundamental enabling technologies and assess the feasibility of the open rotor concept for full demonstration. This will be achieved by both on-going design studies, methods and tool development and validation and component rig test programmes. Additional rig testing at aircraft level will be carried out in the Smart Fixed Wing Aircraft ITD in 2013 and 2014.

For **SAGE2**, a Concept Review took place in 2012 to consider the feasibility and configuration of the open rotor demonstrator. The Preliminary Design Review has been postponed to mid-2013. Configuration and installation feasibility studies have been performed in the period leading up to the review, together with gas generator adaptation and open rotor propulsor design studies. The design of two sets of propellers has been performed. Propeller mock-up tests have been done in 2012 in the framework of SFWA. Combined with high speed tests performed in 2011, they enabled aerodynamic and acoustic design tools calibration. Low and high speed wind tunnel tests of demonstrator propeller have been prepared and the test matrix has been defined. Several activities have been launched through CFP to support the demonstrator.

The **SAGE3** project demonstrates technologies for large 3-shaft turbofan engines and has delivered its first engine demonstration in November 2012 and has completed a large proportion of the preparation for the second engine build.

The first technology for engine demonstration is the advanced dressings, which will be demonstrated in two phases, through trial builds and subsequently through engine testing. The second engine test, to demonstrate the composite fan, is scheduled to commence in 2013 and work in 2012 has focused on preparing of components manufacture and completing associated rig tests.

Technologies to support higher temperature capability and lower weight intercase structures have been demonstrated through a series of rig tests. Demonstration of low pressure turbine technologies commenced through rig testing in 2011 and tests have continued in 2012, both in preparation for the engine tests and to provide validation data. Preliminary design of the LP turbine module for engine demonstration has been completed and long lead item procurement has been launched in preparation for assembly of the turbine in 2014.

Project **SAGE4**, the Geared Turbo Fan Demonstrator Project, has started the procurement activities to ensure its readiness for the engine demonstrator test, whose starting is now postponed to the first quarter of 2015. The demonstrator design has been frozen during Critical Design Review. Preliminary engine design and detailed design work has been delayed to 2013.

Project **SAGE5** has delivered its first engine demonstration, but First Engine Test Trial has been postponed in early 2013 for some technical issues. Final parts for the first build has been delivered, engine has been assembled, and delivered for test.

Preparations for the second engine build incorporating hot section technologies has continued with final detail design activities being completed and manufacturing of components for the second build launched during 2012, although final delivery of parts is not due until 2013.

The aim of the **SAGE6** lean burn project is to demonstrate a lean burn whole engine system to a TRL6 maturity level, suitable for incorporation into civil aerospace applications in the 30,000lb to 100,000+ thrust classes.

Lean burn combustion is a vital technology acquisition for the European aerospace industry to remain competitive in the world marketplace and comply with future CAEP & ACARE emissions legislation.

To increase current TRL levels of subsystems from typically TRL 3-4 to TRL-5 a proposal has been made to develop a new demonstrator vehicle based on a Rolls-Royce Trent 1000 engine for ground test and suitable for installation on a flying test bed.

The LEVER project (through CFP call 8) has completed the design activities for a System Test Facility in support of the engine tests.

E. SGO – SYSTEMS FOR GREEN OPERATIONS

In 2012 SGO has been focussed on achieving progress on all developed technologies to prepare the major demonstrations – both in flight and on ground – which are planned between end 2013 and 2015.

For all technology streams, significant steps forward have been made, as described in each work-package below and positively assessed by the external reviewers, both during the Annual Review in June and in the mid-term meeting end of November. In line with the recommendations of the reviewers the relevance of various work streams has been reviewed and some major decisions concerning the redefinition of objectives have been taken:

- The activities on the Fuel cell domain have been significantly reduced, and the effort focused on more promising technologies (Wing Ice Protection, Environmental control system)
- The development of the Atmospheric Data Transmission System including a Vapour Sensor has been stopped after TRL3, due to an inconclusive model for the operation of the system by different stakeholders (airline, Meteo Office, etc.) and the indirect link to the environmental objectives.

With reference to the annual grant agreement, the currently estimated overall consumption of resources amounts to 88% of the planned value. This reduction is partly due to the modifications in the work plan and partly to resource issues for some beneficiaries. This has been mitigated by a complete re-estimation of the cost to completion and associated planning of the program carried out in the second half of 2012.

For large aircraft, WP1 has completed the V&V master plan for the Management of the Aircraft Energy. The update of requirements and V&V strategy for cycle 2 has been shifted from end 2012 to March 2013. Indeed, the aim of cycle 2 is to take advantage of cycle 1 lessons learnt in order to improve the green benefits of the SGO concepts, which is mainly given by technologies maturity. As some technologies maturity gates have been delayed, it was decided to postpone cycle 2 documents to take full benefits of cycle 1 findings. This resulted in a slight under consumption as the work has been postponed.

For regional aircraft, WP1 has delivered the final document that contains the reference configuration data for the green regional aircraft. This achievement materialises the end of WP1 activity dealing with regional aircraft

In WP1.3, exchanges with SESAR have been increased in 2012. Some relevant SESAR documents as for mission and trajectory functions analysis have been identified by WP1.3 and provided by SESAR. In addition, material has been prepared to present the SGO green functions that are potentially impacted by SESAR concepts in view of a bilateral meeting to exchange between the two projects.

In WP2 – Management of Aircraft Energy (MAE), work on technologies for energy management intended for demonstration activities has moved on. Throughout 2012, the designs based on frozen architectures for cycle 1 have been completed and first equipment and subsystems are now prepared and have been delivered to test benches for demonstrator testing.

In 2012, WP2.4 was focused on the final quantitative large aircraft level assessment of cycle 1 technologies, which gave promising results but without delivering targeted benefits. Also, based on that evaluation a workshop was organised to gather improvement topics for cycle 2 that could increase environmental benefits of the More Electrical Aircraft.

For electrical and thermal systems, demonstrations were planned to be assembled during 2012, and WP2 delivered some equipment for these platforms.

Zodiac ECE completed the detailed design of the electrical power distribution centre. The detailed design review with Airbus, Thales and Liebherr was passed and the manufacturing was launched.

The MAE Wing Ice Protection technology demonstrators have been delivered to NASA Glenn Research Center in October 2012 in order to support the icing tunnel tests which have been carried out in November 2012. The test campaign was successfully completed for all partners end 2012 and will be finally assessed during the TRL4 gate in the first quarter of 2013.

First equipment intended for flight testing such as a prototype skin heat exchanger subsystem is on the way. The manufacturing of the heat exchanger is close to completion. The flight test campaign is planned in the fall 2013.

The development of the electrical ECS pack was facing technical challenges in 2012. In order to withstand all performance and safety of flight requirements design modifications on the turbo machines are required. Finally this will contribute to a delay of the flight test by one year into 2015. The associated mitigation road map has been agreed.

First hardware for the first large scale ground tests was delivered to the COPPER Bird. Engine nacelle systems such as the nacelle actuation system have been tested and passed TRL3 and TRL4 reviews. The generator specifically developed for the nacelle anti-ice system passed the TRL3 review, however, it failed to pass TRL4, leading to the decision to stop this activity within CLEAN SKY.

After the Saab withdrawal from the thermal management function this work package was re-organized. The new scope and the related dedicated interfaces have been re-defined by the remaining partners Airbus, DLR and Liebherr. The final TRL target has been reduced to TRL4 in 2014 following the TRL3 milestone end 2013.

A key result of the Method and Tools work package WP2.1, the "Model-based energy system design process", has reached TRL 3 in November 2012. The Use Case implementations proceeded well and several tests were conducted. Finally, in the Modelica Benchmark, it was proven that modelling and simulation of electric power system components and subsystems with Modelica is feasible in industrial quality.

In the field of WP3 – Mission and Trajectory Management (MTM), 2012 has brought major progress towards the main demonstrations planned in 2014 and 15.

Flight management functions have progressed towards TRL4, with some pilot-in-the-loop validations. An implementation into a product prototype has been achieved for the take-off phase and the initial specification for the cruise function has been issued. Both functions will reach TRL4 by mid-2013. Concerning the descent and approach phase, a TRL4 has been passed for the Time and Energy Managed descent, whereas the adaptive Glide Slope - targeting the final approach - has reached TRL3.

TRL4 for mission optimisation functions have been successfully passed, paving the way to prototype implementation and demonstrations in 2013 and 14.

In the field of the Smart Operations on Ground, the TRL3 at system level has been achieved in January 2012, followed by a number of gates in various sub-parts of the work, like the detailed Aircraft model and the brake cooling fan. In the last quarter, a TRL4 on the fast-time simulation supporting the environmental benefit analysis was passed successfully. This will lead to the TRL4 at system level in April 2013.

Using the inputs from SESAR gathered by WP1.3, an updated analysis of the SESAR Concept of operation was issued.

The major 2012 achievements of WP5 in the field of industrial exploitation was to down select a first set of topics to be worked out in the next steps: the impact of Electronic Flight Bag (EFB) on the airline operations, certification issues for the more electrical aircraft, as well as specific technological topics like e.g. impacts of new cooling fluids, the management of regenerative energy in power quality aspects, etc.

In the domain of system and aircraft level assessment of SGO results, a further exchange of information with SFWA has been prepared, to allow integration of models of SGO systems into conceptual aircraft models. The list of targeted SGO technologies has been agreed and first models will be provided in 2013.

Main SGO <u>deliverables and results in 2012:</u>

<u>In WP2/ MAE</u>

- Quantitative assessment of Cycle 1 technologies for Large Aircraft has been done. Based on promising results cycle 2 has been kicked-off
- IWT test campaign for the MAE WIPS technologies has been successfully completed. The TRL4 reviews for each technology are now planned for first quarter 2013
- Design Reviews for electrical power generation and conversion equipment have been held end of 2012 in view to upcoming deliveries of prototypes in 2013 and 2014 to other ITDs
- Development of flight test demonstrator of the skin heat exchanger is close to completion. Following the TRL 5 review mid 2013 the flight test campaign is scheduled in fall 2013.
- TRL 4 of nacelle actuation has been passed. TRL5 is planned mid-2013. TRL3 of the nacelle anti-ice generator has been past but TRL4 gate has not been reached. It was decided to stop this development.
- The work on the electrical load management architecture has been completed in 2012, followed by a TRL3 review in January 2013
- After Saab withdrawal from thermal management end of 2011, this work package has been re-planned by Airbus, DLR and Liebherr. TRL3 review is now planned end 2013.
- TRL3 for “Model based energy system design process” has been successfully passed end of 2012

<u>In WP3/ MTM</u>

- First TRL 4 milestone for vertical Flight management functions has been passed. Significant progress has been made for all flight phases, with TRL4 being planned in second half of 2013.
- A first TRL 4 milestone for Smart Operation on Ground System has been passed. The complete TRL4 at system level is now foreseen in the first half of 2013.
- TRL 4 milestones for on board trajectory optimisation were successfully completed

- TRL 3 milestone for the Atmospheric Data Transmission System and Water Vapour Sensor was passed but led to the decision to stop the development in Clean Sky for this concept.

F. ED – ECO-DESIGN

The Eco-Design ITD, which is organised in the two major areas - EDA (Eco-Design for Airframe) and EDS (Eco-Design for Systems (small aircraft) - .used around 85% of the resources planned for 2012, according to the end-of-year estimate.

The **EDA** part of the Eco-Design ITD is meant to tackle the environmental issues by focusing on the following challenges:

- To identify and maturate environmentally sound ("green") materials and processes for a/c production.
- To identify and maturate environmentally sound ("green") materials and processes for a/c maintenance and use processes.
- To improve the field of end-of-life a/c operations after several decades of operation, including reuse, recyclability and disposal ("elimination") issues.
- To provide means for an eco-design process on order to minimize the overall environmental impact of a/c production, use/maintenance, and disposal.

In 2012, the work performed in the frame of **EDA** was a continuation on the following Work Packages:

1. WP A.1 Alternative Solution Requirements,
2. WP A.2 Technology Development,
3. WP A.3 Application Studies,
4. WP A.4/A.5/A.6 Ground Demonstration.

The activities in WP A.1.5 ended at end of 2011. This WP was meant to analyse social/societal requirements and to identify key socio-economic aspects of A/C Eco Design.

In WP A.2, the work was dedicated to continuation of the maturation of the most innovative technologies selected at the end of 2010. The end of the development phase is planned for beginning of October 2013.

In WP A.3, WP A.3.1, A.3.2 and A.3.3 were active:

- In WP A.3.1, the work continued in the field of LCA. A first simplified LCA tools will be made available in March 2013. Eco-assessments were carried out on baseline technologies and reference alternatives, using LCA databases tailored for aerospace industry, and starting from October 2012. Interactions with TE and Vehicle ITDs have been fully formalised. The Bill of Materials (BoM) associated to each kind of A/C have been produced for airliner and business jet; the Bill of Processes (BoP) is not requested by the extrapolation method developed in collaboration with TE.
- At the end of 2011, activities also started in WP A.3.2 which is meant to extrapolate the technologies developed in WP A.2 to industrial conditions, thus validating these

technologies for industrial applications. Activity continued along 2012 with launch of 6 topics on CFP 13.

- The activities in WP A.3.3 started in 2011 continued on 2012 to develop Eco-Design Guideline to optimize the A/C design, production and end of life phase from an overall environmental perspective. Two topics were launched on CFP 11 and 13.
- In WP A.4/A.5/A.6, ground demonstration activities were carried out, especially for the equipment parts for which demonstrators manufacturing started late 2011. For airframe demonstrators, only preparation i.e. CAD drawings, sizing, Test Plan preparation were undertaken.

The general objective of the Eco-Design ITD **EDS** part is to gain a valuable and comprehensive insight into the concept of all-electric aircraft. It is expected that the use of electricity as the only energy medium, by removing the hydraulic fluid and by the use of on-board power-by–wire will offer significant benefits in terms of aircraft maintenance and disposal environmental impact, and will yield new possibilities in terms of energy management (e.g.: intelligent load shedding, power regeneration on actuators, sharing of Electrical Control Unit over actuators…).

The work performed in 2012 consisted in: pursuing the common activities (WP S.1), performing the characterization of the business jet sub-systems architectures (WP S.2) and continuing the preparation of the bench related activities (WP S.3 and WP S.4).

The WP S.1 activity led to the final laying out of the simulation process (WP S.1.1). After the preparation on first half of the year, the modelling activities started in the second half (WP S.1.6). The definition of the Generic Architecture (WP S.1.3) was finalised even if the synthesis will be produced beginning of 2013. The activities pertaining to the definition and the development of the subsystems populating the architectures which will undergo tests (WP S.1.5) continued throughout 2012.

On WP S.2 main activity was the characterization of the main sub-systems populating the Business Jet architecture candidates (WP S.2.3). The definition and the development of the associated equipment items which populate the test architecture continued (WP S.2.4). The modelling activities related to the Business Jet configuration were initiated end of 2012 (WP S.2.5).

The WP S.3 (Electrical Test Bench) activities continued in 2012. The definition of the ground infrastructure (WP S.3.1) has been finalized in the first half of the year, and the early manufacturing operations continued (WP S.3.3) to get prepared for the integration of the components in 2013 (WP S.3.4). The definition of the electrical tests was undertaken to come to closure on May 2013 (WP S.3.2).

The WP S.4 (Thermal Test Bench) activities also continued in 2012 with definition of the bench systems (WP S.4.1) and continuation of their manufacturing (WP S.4.3). The preparation of the integration of the thermal mock-ups and their supporting systems (WP S.4.4) has been initiated in the second half of the year. The final definition of the thermal tests to be performed continued on 2012 (WP S.4.2).

G. TE – TECHNOLOGY EVALUATOR

All TE Work Packages had activities and produced deliverables in 2012:

- WP0: TE Management and Coordination

- WP1: TE Requirements and Architecture

- WP2: Models Development and Validation

- WP3: Simulation Framework Development + IVV

- WP4: Assessment of impacts and Trade-off studies

In WP1, during 2012 the definitions of the aircraft (fixed wing and rotary wing) missions were updated. The metrics for the Assessment were further refined based on the learning done in 2011, and the requirements for the „Airport‟ and Air Transport System (ATS) evaluations were refined.

In WP2 major obstacles needed to be overcome in the preparation and delivery of aircraft conceptual models by the vehicle ITDs (namely GRA and SFWA).

Several milestones as defined by the TE AIP 2012 for the delivery of the aircraft models to the TE were missed, with delays of up to 7 months. As a consequence, the scope of the 2012 Assessment was reduced yet again during the course of the assessment preparation in the 4th Quarter of 2012. Moreover, it was necessary to delay the delivery of the 2012 Assessment Report to the JU until April 2013 (estimated).

These changes of scope included:

- SFWA LR (Long Range)
- SFWA SMR (Short and Medium Range) / CROR evaluation reduced to one conceptual aircraft / engine combination only and use of a simplified approach to the noise analysis
- Updated SFWA business jet aircraft
- Limiting the evaluation of rotorcraft to two conceptual vehicles (TEL, Twin Engine Light, and SEL, Single Engine Light)
- Limiting the number of airports used for the Airport Evaluation for fixed wing aircraft to 4
- Performance of the evaluation of the updated GRA-90 Turboprop
- Performance of the evaluation of the GTF-powered GRA130 including noise

It must be noted that in WP2 the TE consortium operates as a de-facto supply chain manager: all the major component conceptual models are delivered by the 'Aircraft ITDs'.
In this respect, these first two assessments of 2011 and 2012 continue to show delivery challenges from the Clean Sky ITDs into the TE, in many cases caused by the 'Tier-2' effect of deliveries of data from SAGE into the Aircraft ITDs SFWA, GRA and GRC.

In WP3 the TE-Information System was further developed with an updated database structure, role and usage. The foreseen extensions were defined and results of the 1st assessment integrated. Configurations and versions of all data and software used for the 2012 Assessment were documented including all ITDs deliveries to the TE.

WP4, or 'Assessment of Impacts and Trade-Off Studies', contained the key output from the TE to the JU, i.e. the 1st Assessment Report (2011 Assessment).

Leading up to the actual (2012) Assessment, other key activities and deliverables included:

- Detailed specification report of the mission-level assessment
- Detailed specification report of the airport level assessment
- Detailed specification report of the ATS level assessment
- Detailed specification of the life-cycle analysis and a demonstration of the calculation using reference aircraft.

Overall, the execution of the 2012 plan has remained a significant challenge for the TE.

It must be noted that the late supply of crucial inputs was the overriding factor in the delivery performance. The supply chain issues originated in the SFWA and GRA ITDs (in this order in terms of contributing delays); noting that SFWA had major interface challenges with SAGE.

Despite the difficulties encountered the TE, with the support from the JU, managed to put in place reinforced planning and control mechanisms for 2012.

The 1st Assessment planned for 2011, which was delayed due to late delivery of models from the ITDs was ultimately successfully completed in February of 2012 and well received, despite its limited scope.

The quality of the Assessment will be improved in 2013 (with the delivery of the delayed 2012 Assessment), although the timeliness of the TE Assessments remains disappointing. This will remain closely monitored by the JU, as a top-ranking priority, and the deliveries from the ITDs (in particular SFWA/SAGE and GRA) will be checked and discrepancies tackled promptly

ANNEX II - CALLS FOR PROPOSALS: OVERALL LIST OF TOPICS PUBLISHED BY ITD AND AREA

CS JU call 11 (SP1-JTI-CS-2012-01). Topics overview.

Identification	**ITD - Area - Topic**	**Nr of topics**	**Indicative budget (K€)**	**Maximum funding (K€)**
JTI-CS-ECO	**Clean Sky - EcoDesign**	**14**	**3,295**	**2,471**
JTI-CS-ECO-01	**Area-01 - EDA (Eco-Design for Airframe)**		**3,045**	
JTI-CS-2012-1-ECO-01-041	*Autoclave cycle optimisation*		100	
JTI-CS-2012-1-ECO-01-042	*Technology Development for CFRP recovery/recycling*		150	
JTI-CS-2012-1-ECO-01-043	*Process Investigations for Liquid Resin Impregnation (LRI) and Out-of-autoclave (OoA) curing of composites*		500	
JTI-CS-2012-1-ECO-01-044	*Methodology Toolbox for Accelerated Fatigue Testing of Fiber Reinforced Laminates*		200	
JTI-CS-2012-1-ECO-01-045	*Process scale up for recovery and recycling of glass-fiber a/c insulation material in pilot scale*		220	
JTI-CS-2012-1-ECO-01-046	*End of life aircraft material identification and material ageing characterization by Raman Spectrometry*		250	
JTI-CS-2012-1-ECO-01-047	*End of life aircraft material identification and thermal damage characterization by Fourier Transform Infra Red*		150	
JTI-CS-2012-1-ECO-01-048	*End of life aircraft material identification by Laser-Induced Breakdown Spectroscopy*		150	
JTI-CS-2012-1-ECO-01-049	*Direct Manufacturing of stator vanes through electron beam melting*		150	
JTI-CS-2012-1-ECO-01-050	*Metal recycling: Recycling routes*		280	

Identification	ITD - Area - Topic	Nr of topics	Indicative budget (K€)	Maximum funding (K€)
	screening and design for environment			
JTI-CS-2012-1-ECO-01-051	*Environmental friendly ancillary materials development*		160	
JTI-CS-2012-1-ECO-01-052	*Development of a fully automated preforming line for the production of 3-D shaped composite dry fiber profiles*		300	
JTI-CS-2012-1-ECO-01-053	*Disintegration of fibre-reinforced composites by electrodynamic fragmentation technique*		435	
JTI-CS-ECO-02	**Area-02 - EDS (Eco-Design for Systems)**		**250**	
JTI-CS-2012-1-ECO-02-013	*Electrical Test Bench Generic Configuration Behavioural Electrical Network Analysis Model*		250	
JTI-CS-GRA	**Clean Sky - Green Regional Aircraft**	**11**	**9,960**	**7,470**
JTI-CS-GRA-01	**Area-01 - Low weight configurations**		**4,260**	
JTI-CS-2012-1-GRA-01-042	*Advanced Floor Grids for Green Regional A/C. New concept of design, manufacturing and installation in Ground Full Scale Demo*		2,200	
JTI-CS-2012-1-GRA-01-043	*Smart Distributed Sensory Systems*		260	
JTI-CS-2012-1-GRA-01-044	*Design, development and realization of a novel micro-wave based curing device for out-of-autoclave carbon fiber reinforced composite components manufacturing*		150	
JTI-CS-2012-1-GRA-01-045	*Advanced Liquid Infusion Technology for regional wing structure: Numerical simulation and validation through an innovative test bench*		330	
JTI-CS-2012-1-GRA-01-046	*Collapsible Tooling Proposal for a/c nose fuselage & cockpit*		300	

Identification	ITD - Area - Topic	Nr of topics	Indicative budget (K€)	Maximum funding (K€)
JTI-CS-2012-1-GRA-01-047	*Advanced light pressure bulkhead for a/c cockpit*		320	
JTI-CS-2012-1-GRA-01-048	*Modelling and Simulation of a self sensing Curved composite panel to predict/control damage evolution in real load condition*		400	
JTI-CS-2012-1-GRA-01-049	*Optimal tooling system design for large composite parts*		300	
JTI-CS-GRA-02	**Area-02 - Low noise configurations**		**4,300**	
JTI-CS-2012-1-GRA-02-019	*Transonic NLF wing and LC&A integrated technologies: Experimental Validation by Innovative WT Tests*		4,300	
JTI-CS-GRA-03	**Area-03 - All electric aircraft**		**1,400**	
JTI-CS-2012-1-GRA-03-009	*Advanced Flight Control System – Design, development and manufacturing of EMA with associated ECU and dedicated test bench*		1,100	
JTI-CS-2012-1-GRA-03-010	*Control Consolle and Electrical Power Center per Flight Demo*		300	
JTI-CS-GRC	**Clean Sky - Green Rotorcraft**	**4**	**1,450**	**1,088**
JTI-CS-GRC-01	**Area-01 - Innovative Rotor Blades**		**400**	
JTI-CS-2012-1-GRC-01-008	*Mould design and manufacture for the production of a very high tolerance model helicopter blade*		400	
JTI-CS-GRC-03	**Area-03 - Integration of innovative electrical systems**		**650**	
JTI-CS-2012-1-GRC-03-012	*Development and delivery of EMA for a light helicopter*		650	
JTI-CS-GRC-06	**Area-06 - Eco Design for Rotorcraft**		**400**	
JTI-CS-2012-1-GRC-	*Recycling of Metallic Materials from*		200	

Identification	ITD - Area - Topic	Nr of topics	Indicative budget (K€)	Maximum funding (K€)
06-005	*Rotorcraft Transmissions*			
JTI-CS-2012-1-GRC-06-006	*Disassembly of eco-designed helicopter demonstrators*		200	
JTI-CS-SAGE	**Clean Sky - Sustainable and Green Engines**	**11**	**16,150**	**12,113**
JTI-CS-SAGE-02	**Area-02 - Open Rotor Demo 2**		**13,150**	
JTI-CS-2012-1-SAGE-02-011	*Pitch Change Mechanism development, test and supply for engine demonstrator*		7,000	
JTI-CS-2012-1-SAGE-02-012	*Optimal High Lift Turbine Blade Aero-Mechanical Design*		850	
JTI-CS-2012-1-SAGE-02-013	*Advanced Non Destructive Testing methods and equipment development for fabricated structures.*		500	
JTI-CS-2012-1-SAGE-02-014	*Enhanced material and lifting model including sustained peak Low Cycle Fatigue*		900	
JTI-CS-2012-1-SAGE-02-015	*Advanced electrical machine manufacturing process implementation and tuning based on composite material process technologies*		200	
JTI-CS-2012-1-SAGE-02-016	*Study and durability of electrical insulating material in aircraft engine chemical environment*		200	
JTI-CS-2012-1-SAGE-02-017	*Variable thickness lamination machine-tool design and manufacturing*		500	
JTI-CS-2012-1-SAGE-02-018	*Engine Mounting System and Engine In-flight Balancing System*		3,000	
JTI-CS-SAGE-03	**Area-03 - Large 3-shaft turbofan**		**2,600**	
JTI-CS-2012-1-SAGE-03-012	*Non-metallic Pipes for Aero engine Dressings*		1,800	

Identification	ITD - Area - Topic	Nr of topics	Indicative budget (K€)	Maximum funding (K€)
JTI-CS-2012-1-SAGE-03-013	*Extended operation temperature range for compressor structure materials*		800	
JTI-CS-SAGE-05	**Area-05 - Turboshaft**		**400**	
JTI-CS-2012-1-SAGE-05-016	*Telemetric System Acquisition in harsh Environment*		400	
JTI-CS-SFWA	**Clean Sky - Smart Fixed Wing Aircraft**	**15**	**11,350**	**8,513**
JTI-CS-SFWA-01	**Area01 – Smart Wing Technology**		**4,500**	
JTI-CS-2012-1-SFWA-01-041	*Icephobic coatings – development of test methods*		350	
JTI-CS-2012-1-SFWA-01-042	*Flow control actuator with fast switching elements; unsteady operation with mass transfer*		400	
JTI-CS-2012-1-SFWA-01-043	*Testing the operational performance and robustness of Active Flow Control hardware*		400	
JTI-CS-2012-1-SFWA-01-044	*MEMS Gyrometer – Maturity assessment of performance and integration*		800	
JTI-CS-2012-1-SFWA-01-045	*MEMS Gyrometer – Miniaturisation of the analogue electronics in an Asic*		800	
JTI-CS-2012-1-SFWA-01-046	*MEMS Accelerometer – Miniaturisation of the analogue electronics in an Asic*		800	
JTI-CS-2012-1-SFWA-01-047	*High Lift Actuator Electronics*		700	
JTI-CS-2012-1-SFWA-01-048	*Magnetic Gearbox*		250	
JTI-CS-SFWA-02	**Area02 - New Configuration**		**6,850**	
JTI-CS-2012-1-SFWA-02-020	*Development of an automated gap filler device*		550	
JTI-CS-2012-1-SFWA-02-022	*Design and manufacturing of an innovative cryogenic wind tunnel model*		1,800	

Identification	ITD - Area - Topic	Nr of topics	Indicative budget (K€)	Maximum funding (K€)
	with motorized empennage			
JTI-CS-2012-1-SFWA-02-024	*Laminar Wing Optimisation using Adjoint Methods*		250	
JTI-CS-2012-1-SFWA-02-025	*Development of ice-fracture criteria for different ice-cases, in an electro-mechanical de-icing system application*		300	
JTI-CS-2012-1-SFWA-02-026	*Experimental and numerical investigation of acoustic propagation through a boundary layer in high speed conditions (refraction and scattering)*		750	
JTI-CS-2012-1-SFWA-02-027	*Transonic High Reynolds Number Testing of a Large Laminar Wing Half Model*		1,200	
JTI-CS-2012-1-SFWA-02-028	*Low speed aerodynamic test of large CROR aircraft model in a closed test section*		2,000	
JTI-CS-SGO	**Clean Sky - Systems for Green Operations**	**14**	**6,540**	**4,905**
JTI-CS-SGO-02	**Area-02 - Management of Aircraft Energy**		**4,700**	
JTI-CS-2012-1-SGO-02-021	*Development of key technology components for high power-density power converters for rotorcraft swashplate actuator*		350	
JTI-CS-2012-1-SGO-02-035	*Disconnect device for jam tolerant linear actuators*		800	
JTI-CS-2012-1-SGO-02-038	*Passive cooling solution validation*		300	
JTI-CS-2012-1-SGO-02-039	*Optimisation of heat pipe to cool high speed motorised turbo-machine*		300	
JTI-CS-2012-1-SGO-02-040	*Compressor air inlet protection for electrical ECS*		600	

Identification	ITD - Area - Topic	Nr of topics	Indicative budget (K€)	Maximum funding (K€)
JTI-CS-2012-1-SGO-02-041	*Identification of a fluid for diphasic cooling adapted to aircraft applications*		550	
JTI-CS-2012-1-SGO-02-042	*Study and development of a carbon sleeve made by filament winding and directly wound on an electric motor rotor*		200	
JTI-CS-2012-1-SGO-02-043	*Aerospace housing for extreme environment*		300	
JTI-CS-2012-1-SGO-02-044	*Bus system housing for extreme environment*		300	
JTI-CS-2012-1-SGO-02-045	*Regenerative Snubber & innovative control algorithm*		400	
JTI-CS-2012-1-SGO-02-046	*High Dense Smart Power Capacitor (HDSPC) for next generation Aircraft converters*		600	
JTI-CS-SGO-03	**Area-03 - Management of Trajectory and Mission**		**1,590**	
JTI-CS-2012-1-SGO-03-014	*Smart Operations on Ground (SOG) power electronics with energy recycling system*		1,390	
JTI-CS-2012-1-SGO-03-017	*Real time optimiser for continuous descent approaches*		200	
JTI-CS-SGO-04	**Area-04 - Aircraft Demonstrators**		**250**	
JTI-CS-2012-1-SGO-04-003	*Solid State Power Controllers test benches*		250	
	Totals (€)	**69**	**48,745**	**36,559**

CS JU call 12 (SP1-JTI-CS-2012-02). Topics overview

Identification	ITD - Area - Topic	Nr of topics	Indicative budget (K€)	Maximum funding (K€)
JTI-CS-ECO	**Clean Sky - EcoDesign**	**5**	**720**	**540**
JTI-CS-ECO-01	**Area-01 - EDA (Eco-Design for Airframe)**		**520**	
JTI-CS-2012-2-ECO-01-054	*Chromium free surface pre-treatments and sealing of Tartaric Sulphuric Anodizing*		150	
JTI-CS-2012-2-ECO-01-055	*Laser welding of newly developed Al-Mg-Li alloy*		150	
JTI-CS-2012-2-ECO-01-056	*Development and demonstration of Direct Manufacturing technology for High Strength Aluminium Alloys*		120	
JTI-CS-2012-2-ECO-01-057	*Advanced Composite Integrated Skin Panel structural testing*		100	
JTI-CS-ECO-02	**Area-02 (EDS - Eco-Design for Systems)**		**200**	
JTI-CS-2012-2-ECO-02-014	*Characterization of batteries in expanded range of operation*		200	
JTI-CS-GRA	**Clean Sky - Green Regional Aircraft**	**2**	**2,840**	**2,130**
JTI-CS-GRA-01	**Area-01 - Low weight configurations**		**240**	
JTI-CS-2012-2-GRA-01-050	*Development of CNT doped reinforced aircraft composite parts*		240	
JTI-CS-GRA-05	**Area-05 - New configurations**		**2,600**	
JTI-CS-2012-2-GRA-05-007	*Development & optimization of advanced propulsion system installation through innovative complete A/C powered WT model*		2,600	
JTI-CS-GRC	**Clean Sky - Green Rotorcraft**	**5**	**4,590**	**3,443**
JTI-CS-GRC-01	**Area-01 - Innovative Rotor Blades**		**710**	
JTI-CS-2012-2-GRC-01-010	*Low weight, high energy efficient tooling for rotor blade manufacturing*		710	
JTI-CS-GRC-02	**Area-02 - Reduced Drag of rotorcraft**		**800**	

Identification	ITD - Area - Topic	Nr of topics	Indicative budget (K€)	Maximum funding (K€)
JTI-CS-2012-2-GRC-02-007	*Wind tunnel tests on a common helicopter platform and contribution to its optimised aerodynamic design*		800	
JTI-CS-GRC-03	**Area-03 - Integration of innovative electrical systems**		**1,000**	
JTI-CS-2012-2-GRC-03-014	*Design and Implementation of a Load Simulator Rig and Ground Test Bench Adaptation Kit for a HEMAS Test Rig*		1,000	
JTI-CS-GRC-05	**Area-05 - Environmentally friendly flight paths**		**2,080**	
JTI-CS-2012-2-GRC-05-006	*Sensoring and cockpit monitoring to reduce noise in manoeuvring flight*		1,500	
JTI-CS-2012-2-GRC-05-007	*Curved SBAS-guided IFR procedures for low noise rotorcraft operations*		580	
JTI-CS-SAGE	**Clean Sky - Sustainable and Green Engines**	**9**	**16,350**	**12,263**
JTI-CS-SAGE-02	**Area-02 - Open Rotor Demo 2**		**13,500**	
JTI-CS-2012-2-SAGE-02-019	*Air cooled Oil Cooler development, test and supply for Open Rotor*		2,000	
JTI-CS-2012-2-SAGE-02-020	*Electro-hydraulic servo development, test and supply for Open Rotor*		4,000	
JTI-CS-2012-2-SAGE-02-021	*Propellers Blades Bearings Design and Manufacturing*		1,500	
JTI-CS-2012-2-SAGE-02-022	*Rotating cowls*		2,000	
JTI-CS-2012-2-SAGE-02-023	*Rotating nozzle*		2,000	
JTI-CS-2012-2-SAGE-02-024	*Rotating plug*		2,000	
JTI-CS-SAGE-03	**Area-03 - Large 3-shaft turbofan**		**1,850**	
JTI-CS-2012-2-SAGE-03-014	*Weight saving through used of CFRC components in high temperature application (=>360C) for efficient aero-engine design*		850	

Identification	ITD - Area - Topic	Nr of topics	Indicative budget (K€)	Maximum funding (K€)
JTI-CS-2012-2-SAGE-03-015	*Ring Rolling of IN718*		1,000	
JTI-CS-SAGE-04	**Area-04 - Geared Turbofan**		**1,000**	
JTI-CS-2012-2-SAGE-04-019	*Development of physically based simulation chain for microstructure evolution and resulting mechanical properties*		1,000	
JTI-CS-SFWA	**Clean Sky - Smart Fixed Wing Aircraft**	**9**	**12,700**	**9,525**
JTI-CS-SFWA-01	**Area01 – Smart Wing Technology**		**1,700**	
JTI-CS-2012-2-SFWA-01-049	*Demonstration of the feasibility of an in-flight anti-contamination device for business jets*		650	
JTI-CS-2012-2-SFWA-01-050	*Development and construction of master moulds for riblet application*		350	
JTI-CS-2012-2-SFWA-01-051	*New aircraft de-icing concept based on functional coatings coupled with electro-thermal system*		400	
JTI-CS-2012-2-SFWA-01-052	*Innovative aircraft ice protection system – sensing and modelling*		300	
JTI-CS-SFWA-02	**Area02 - New Configuration**		**7,500**	
JTI-CS-2012-2-SFWA-02-029	*Design and manufacturing of baseline low-speed, low-sweep wind tunnel model*		1,000	
JTI-CS-2012-2-SFWA-02-030	*Low speed aeroacoustic test of a large CROR rig in an open jet test section*		1,300	
JTI-CS-2012-2-SFWA-02-031	*Aeroacoustic and aerodynamic wind tunnel tests at low speed for a turbofan model equipped with TPS*		2,000	
JTI-CS-2012-2-SFWA-02-032	*Low speed aeroacoustic test of large CROR aircraft model in an open jet test section*		3,200	
JTI-CS-SFWA-03	**Area03 – Flight Demonstrators**		**3,500**	
JTI-CS-2012-2-	*BLADE wing structural test to derive*		3,500	

Identification	ITD - Area - Topic	Nr of topics	Indicative budget (K€)	Maximum funding (K€)
SFWA-03-010	*test data for subsequent validation of GFEM modelling*			
JTI-CS-SGO	**Clean Sky - Systems for Green Operations**	**12**	**5,990**	**4,493**
JTI-CS-SGO-02	**Area-02 - Management of Aircraft Energy**		**4,540**	
JTI-CS-2012-2-SGO-02-034	*EWIS Safety Analysis Tool*		600	
JTI-CS-2012-2-SGO-02-036	*Design and optimisation of locally reacting acoustic material*		300	
JTI-CS-2012-2-SGO-02-047	*Development and validation of sizing method for screw drives and thrust bearings*		1,050	
JTI-CS-2012-2-SGO-02-048	*Modelica Model Library Development Part II*		200	
JTI-CS-2012-2-SGO-02-049	*Smart erosion shield for electro-mechanical de-icers*		250	
JTI-CS-2012-2-SGO-02-050	*Optimization of air jet pump design for acoustic application*		300	
JTI-CS-2012-2-SGO-02-051	*Ram-air fan optimization for electrical ECS application*		600	
JTI-CS-2012-2-SGO-02-052	*Electrical Starter / Generator disconnect system*		700	
JTI-CS-2012-2-SGO-02-053	*Design and manufacturing of the PFIDS Laser sources (VCSELs)*		540	
JTI-CS-SGO-03	**Area-03 - Management of Trajectory and Mission**		**900**	
JTI-CS-2012-2-SGO-03-018	*Operational expertise for function definition and validation - support to experimentations*		400	
JTI-CS-2012-2-SGO-03-019	*OTC-Operational (Technical) Constraints Model & OBM - Operation Business Model AUI - Aircraft Usage*		500	

Identification	ITD - Area - Topic	Nr of topics	Indicative budget (K€)	Maximum funding (K€)
	Impact Model			
JTI-CS-SGO-04	**Area-04 - Aircraft Demonstrators**		**550**	
JTI-CS-2012-2-SGO-04-005	*Virtual integration of electrical equipment and rig correlation*		550	
	Totals (€)	**42**	**43,190**	**32,393**

CS JU call 13 (SP1-JTI-CS-2012-03). Topics overview

Identification	ITD - Area - Topic	Nr of topics	Indicative budget (K€)	Maximum funding (K€)
JTI-CS-ECO	**Clean Sky - EcoDesign**	**7**	**1,270**	**953**
JTI-CS-ECO-01	**Area-01 - EDA (Eco-Design for Airframe)**		**1,270**	
JTI-CS-2012-3-ECO-01-058	*Validation of TSAA coating technology. Development of procedures and standards manual. Technical and economical study.*		100	
JTI-CS-2012-3-ECO-01-059	*Design and Modification of existing spraying facilities for automated sol gel application.*		140	
JTI-CS-2012-3-ECO-01-060	*Investigation and Modification of existing standard universal milling machine in order to achieve LBW capabilities*		200	
JTI-CS-2012-3-ECO-01-061	*Sustainability assessment for EcoDesign-Guideline*		200	
JTI-CS-2012-3-ECO-01-062	*Technology Development for CFRP Recovery/ Recycling*		150	
JTI-CS-2012-3-ECO-01-063	*Extrapolation to industrial condition of a cured composite and thermoplastic recycling process*		230	
JTI-CS-2012-3-ECO-01-064	*Extrapolation to industrial condition of the liquid infusion manufacturing process*		250	
JTI-CS-GRA	**Clean Sky - Green Regional Aircraft**	**1**	**400**	**300**
JTI-CS-GRA-01	**Area-01 - Low weight**		**400**	

Identification	ITD - Area - Topic	Nr of topics	Indicative budget (K€)	Maximum funding (K€)
	configurations			
JTI-CS-2012-3-GRA-01-051	*Methodology platform for prediction of damage event for self sensing curved composite panel subjected to real load conditions*		400	
JTI-CS-GRC	**Clean Sky - Green Rotorcraft**	**5**	**2,550**	**1,913**
JTI-CS-GRC-01	**Area-01 - Innovative Rotor Blades**		**1,650**	
JTI-CS-2012-3-GRC-01-011	*Low cost design approach through simulation and manufacture of new mould concepts for very high tolerance composite components*		400	
JTI-CS-2012-3-GRC-01-012	*Design and Manufacturing of an innovative oscillating airfoil provided with Gurney flap*		900	
JTI-CS-2012-3-GRC-01-013	*Development and Correlation of CFD Methods to Model Active Gurney Flaps on Helicopter Main Rotor Blades*		350	
JTI-CS-GRC-02	**Area-02 - Reduced Drag of rotorcraft**		**600**	
JTI-CS-2012-3-GRC-02-008	*Assessment of tiltrotor fuselage drag reduction by wind tunnel tests and CFD*		600	
JTI-CS-GRC-06	**Area-06 - Eco Design for Rotorcraft**		**300**	
JTI-CS-2012-3-GRC-06-005	*Recycling of Metallic Materials from Rotorcraft Transmissions*		300	
JTI-CS-SAGE	**Clean Sky - Sustainable and Green Engines**	**12**	**18,450**	**13,838**
JTI-CS-SAGE-02	**Area-02 - Open Rotor Demo 2**		**8,550**	
JTI-CS-2012-3-SAGE-02-025	*SAGE2 Engine Mounting System*		3,000	
JTI-CS-2012-3-SAGE-02-026	*SAGE2 Engine In-flight Balancing System*		4,000	
JTI-CS-2012-3-SAGE-02-027	*Validation of high Load Capacity Gear Material*		550	
JTI-CS-2012-3-SAGE-02-028	*Study and durability of electrically insulative material in aircraft engine chemical environment*		400	

Identification	ITD - Area - Topic	Nr of topics	Indicative budget (K€)	Maximum funding (K€)
JTI-CS-2012-3-SAGE-02-029	*Development and validation of a metallurgically based simulation model for crack generation during welding and heat treatment of superalloys.*		600	
JTI-CS-SAGE-03	**Area-03 - Large 3-shaft turbofan**		**6,400**	
JTI-CS-2012-3-SAGE-03-016	*Surface protection of composite aeroengine components to enable weight savings in high temperature applications (≥360oC)*		750	
JTI-CS-2012-3-SAGE-03-017	*Electric Pump for Safety Critical Aero engine applications*		1,750	
JTI-CS-2012-3-SAGE-03-018	*Variable fluid metering unit for Aero engine applications*		750	
JTI-CS-2012-3-SAGE-03-019	*Development of materials, processes, and means to enable the application of piezoelectric materials in aero engine controls.*		1,500	
JTI-CS-2012-3-SAGE-03-020	*Net shape Hot Isostatic Pressing of IN718*		1,650	
JTI-CS-SAGE-06	**Area-05 - Lean Burn**		**3,500**	
JTI-CS-2012-3-SAGE-06-001	*Advanced materials for lean burn combustion system components using Laser- Additive Layer Manufacturing (L-ALM)*		1,000	
JTI-CS-2012-3-SAGE-06-002	*Economic manufacture of lean burn combustion liner tiles using Laser-Additive Layer Manufacturing*		2,500	
JTI-CS-SFWA	**Clean Sky - Smart Fixed Wing Aircraft**	**8**	**10,725**	**8,044**
JTI-CS-SFWA-01	**Area01 – Smart Wing Technology**		**300**	
JTI-CS-2012-03-SFWA-01-053	*Adaptation of a generic wind tunnel model for attachment line transition measurements (MAALTSU)*		300	
JTI-CS-SFWA-02	**Area02 - New Configuration**		**9,750**	
JTI-CS-2012-03-SFWA-02-033	*High speed wind tunnel test of Laminar configuration bizjet*		2,000	
JTI-CS-2012-03-SFWA-02-034	*Design, Manufacture and Wind Tunnel of a large laminar half model*		4,400	

Identification	ITD - Area - Topic	Nr of topics	Indicative budget (K€)	Maximum funding (K€)
JTI-CS-2012-03-SFWA-02-035	*Characterisation, Modelling & Passive Control of 3D transonic wing buffet*		1,300	
JTI-CS-2012-03-SFWA-02-036	*In-service assessment of Leading Edge Contamination and Damage*		250	
JTI-CS-2012-03-SFWA-02-037	*Blade trajectory testing*		1,800	
JTI-CS-SFWA-03	**Area03 – Flight Demonstrators**		**675**	
JTI-CS-2012-03-SFWA-03-011	*Wireless Sensor Nodes for continuous flight test measurements*		400	
JTI-CS-2012-03-SFWA-03-012	*Engine Pylon load measurements and prediction of accuracy*		275	
JTI-CS-SGO	**Clean Sky - Systems for Green Operations**	**14**	**6,450**	**4,838**
JTI-CS-SGO-02	**Area-02 - Management of Aircraft Energy**		**5,950**	
JTI-CS-2012-3-SGO-02-043	*Aerospace housing for extreme environment*		300	
JTI-CS-2012-3-SGO-02-045	*Regenerative Snubber & innovative control algorithm*		400	
JTI-CS-2012-3-SGO-02-046	*High Dense Smart Power Capacitor (HDSPC) for next generation Aircraft converters*		600	
JTI-CS-2012-3-SGO-02-054	*Design and manufacturing of Flight test version of Electro-mechanical Wing Ice Protection assembly (Modified A320 slat 5)*		500	
JTI-CS-2012-3-SGO-02-055	*Tool for wiring optimization regarding lightning threat*		800	
JTI-CS-2012-3-SGO-02-056	*Integrated design tool to support EWIS optimisation*		300	
JTI-CS-2012-3-SGO-02-057	*High Voltage connectors and moving links*		200	
JTI-CS-2012-3-SGO-02-058	*Optimized power cable for skin effects*		200	
JTI-CS-2012-3-SGO-02-059	*Certified Code Generation of Model-Based Modelica Controllers*		200	
JTI-CS-2012-3-SGO-02-060	*Electrical Machine Magnetic Properties Characterisation Setup for*		800	

Identification	ITD - Area - Topic	Nr of topics	Indicative budget (K€)	Maximum funding (K€)
	Aerospace Application			
JTI-CS-2012-3-SGO-02-061	*Technology development and fabrication of integrated solid-state power switches*		650	
JTI-CS-2012-3-SGO-02-062	*Concepts and solutions for health monitoring of electro mechanical actuators*		500	
JTI-CS-2012-3-SGO-02-063	*Investigation of electric components used in aerospace environment in terms of partial discharge issues*		500	
JTI-CS-SGO-03	**Area-03 - Management of Trajectory and Mission**		**500**	
JTI-CS-2012-3-SGO-03-020	*Adaptation of optimisation algorithm to avionics constraints*		500	
	Totals (€)	**47**	**39,845**	**29,884**

ANNEX III - CALLS FOR PROPOSALS: OVERALL LIST OF TOPICS PUBLISHED IN 2012 BY FHC JTI/JU

No.	Topic	Indicative FCH JU Funding Million €
Transportation & Refuelling Infrastructure		**26.0**
1	*Large-scale demonstration of road vehicles and refuelling infrastructure V*	
2	*Next Generation European Automotive Stack*	
3	*Compressed hydrogen onboard storage (CGH2)*	
4	*Development of peripheral components for automotive fuel cell systems*	
5	*New catalyst structures and concepts for automotive PEMFCs*	
6	*Fuel cell systems for airborne application*	
7	*Recommendations for the measurement of the quantity of hydrogen delivered and associated regulatory requirements*	
Hydrogen Production & Distribution		**8.75**
8	*Demonstration of MW capacity hydrogen production and storage for balancing the grid and supply to vehicle refuelling applications*	
9	*Demonstration of hydrogen production from biogas for supply to vehicle refuelling applications*	
10	*Biogas reforming*	
11	*New generation of high temperature electrolyser*	
12	*Thermo-electrical-chemical processes with solar heat sources*	
13	*Pre-normative research on gaseous hydrogen transfer*	
Stationary Power Generation & CHP		**27.0**
14	*Cell and stack degradation mechanisms and methods to achieve cost reduction and lifetime enhancements*	

No.	Topic	Indicative FCH JU Funding Million €
15	*Improved cell and stack design and manufacturability for application specific requirements*	
16	*Robust, reliable and cost effective diagnostic and control systems design for stationary power and CHP fuel cell systems*	
17	*Component and sub-system cost and reliability improvement for critical path items in stationary power and CHP fuel cell systems*	
18	*System level proof of concept for stationary power and CHP fuel cell systems at a representative scale*	
19	*Validation of integrated fuel cell system for stationary power and CHP fuel cell systems*	
20	*Field demonstration of large scale stationary power and CHP fuel cell systems*	
21	*Field demonstration of small scale stationary power and CHP fuel cell systems*	
Early Markets		**10.25**
22	*Demonstration of fuel cell powered material handling equipment vehicles including infrastructure*	
23	*Demonstration of portable generators, back-up power and Uninterruptible Power Systems*	
24	*Research and development on fuel supply concepts for micro fuel cell systems*	
25	*Demonstration of portable fuel cell systems for various applications*	
26	*Research and development of 1-10kW fuel cell systems and hydrogen supply for early market applications*	
Cross-cutting Issues		**5.5**
27	*Hydrogen safety sensors*	
28	*Computational Fluid Dynamics (CFD) model evaluation protocol for safety analysis of hydrogen and fuel cell technologies*	
29	*First responder educational and practical hydrogen safety training*	

No.	Topic	Indicative FCH JU Funding Million €
30	*Pre-normative research on fire safety of pressure vessels in composite materials*	
31	*Assessment of safety issues related to fuel cells and hydrogen applications*	
	Total indicative FCH JU Funding	**77.5**