Clean Sky Annual Implementation Plan 2011

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1. Introduction

The Council Regulation setting up the Joint Undertaking was adopted by the Council of the European Union on 20 December 2007 and published in the Official Journal of the European Union on 4 February 2008.

This 2011 Annual Implementation Plan covers the establishment of the 4th operating year of the Clean Sky Joint Undertaking (CS JU), and the second after the autonomy.

2. Reminder: Clean Sky research objectives

Clean Sky aims to create a radically innovative Air Transport System based on the integration of advanced technologies and full scale demonstrators, with the target of reducing the environmental impact of air transport through reduction of noise and gaseous emissions, and improvement of the fuel economy of aircraft. The activity will cover all main flying segments of the Air Transport System and the associated underlying technologies identified in the Strategic Research Agenda for Aeronautics developed by the Aeronautics Technology Platform ACARE.

Clean Sky is built upon 6 different technical areas called Integrated Technology Demonstrators (ITDs), where preliminary studies and down-selection of work will be performed, followed by large-scale demonstrations on ground or in-flight, in order to bring innovative technologies to a maturity level where they can be applicable to new generation "green aircraft". Multiple links for coherence and data exchange will be ensured between the various ITDs.

The ITDs are:

- The **SMART fixed wing aircraft** ITD, focused on active wing technologies that sense the airflow and adapt their shape as required, as well as on new aircraft configurations to optimally incorporate these novel wing concepts.
- The **Green Regional Aircraft** ITD, focused on low-weight configurations and technologies using smart structures, low-noise configurations and the integration of technology developed in other ITDs, such as engines, energy management and mission and trajectory management.
- The **Green Rotorcraft ITD**, focused on innovative rotor blades and engine installation for noise reduction, lower airframe drag, diesel engine and electrical systems for fuel consumption reduction and environmentally friendly flight paths.

- The **Sustainable and Green Engine** ITD will integrate technologies for low noise and lightweight low pressure systems, high efficiency, low NOx and low weight core, novel configurations such as open rotors.
- The **Systems for Green Operations** ITD will focus on all-electric aircraft equipment and systems architectures, thermal management, capabilities for "green" trajectories and mission and improved ground operations.
- The **Eco-Design** ITD will address the full life cycle of materials and components, focusing on issues such as optimal use of raw materials, decreasing the use of non-renewable materials, natural resources, energy, the emission of noxious effluents and recycling.

The **Technology Evaluator** will be the first available European complete integrated tool delivering direct relationship between advanced technologies, still under development, and high-level local or global environment impact. It will consider inputs from both inside and outside the "Clean Sky" perimeter to deliver environmental metrics at the levels of aircraft, airport and aircraft fleet level.

The environmental objectives are defined as follows:

	Technology Evaluator					
Programme	**Smart Fixed Wing Aircraft**	**Green Regional**	**Green Rotorcraft**	**Sustainable & Green Engines**	**Systems for Green Operations**	**Eco Design**
Activities	Active Wing New Aircraft Configurations	Advanced Aerodynamics (Low Drag & Noise) Low Weight Structures	New Powerplants Innovative Blades & Rotors New Aircraft Configurations	Advanced LP & HP System Technology New Engine Concepts (i.e. Open Rotor)	Mission & Trajectory Management Aircraft Energy Management	Whole Life Cycle Environmental Impact Analysis
Targets	CO2 ~12 to 20% Noise ~10dB	CO_2 ~10 to 20% Noise ~10dB	CO2 ~26 to 40% NOx ~53 to 65% Noise ~10dB	CO2 ~15 to 20% NOx ~60% Noise ~18dB	CO2 ~10 to 15% Noise ~9dB	CO2 ~10%

The members of the CS JU other than the European Commission have the responsibility to carry out the main technical activities required to reach these final Clean Sky objectives. The members of the CS JU will receive funding from the CS JU reaching up to 50% of their research costs and will contribute at least 50% of their research costs in kind. The total budget envelope of their activities is up to 75 % of the Commission contribution, with 50 % being allocated to activities carried out by the ITD leaders and 25 % to Associates. Two ITD leaders co-lead each ITD. The other 25% of the Commission contribution go to the funding of Partners through Calls for Proposals.

3. Clean Sky Objectives and indicators for 2011

Generally speaking, Clean Sky annual objectives are linked to the completion of the forecast operational tasks, the progress towards the technologies readiness, the environmental benefits assessment and the satisfactory sequence and outcome of calls for proposals and the further improvement of the JU's quality management and internal control system.

The following objectives are set for the period:

- A reliable financial management and reporting to the JU's individual stakeholders is ensured, in order to maintain the confidence of the financing parties, i.e. the European Community and the industrial members and partners of CS
- The Calls for Proposals result in less than 5 redress procedures per 100 proposals
- The proportion of SMEs in the winners is above 30% in the Calls for Proposals
- The ITD deliverables, milestones and budget curves are followed along the year and are within 90% of the prevision end of year
- The first TE evaluation is performed and the environmental targets are on track (Aircraft, Airport and Fleet)
- All recommendations of the mid-term review are fulfilled or actioned at the end of the year; all recommendations from the 2010 ITD annual reviews are fulfilled before the 2011 reviews
- Business continuity, IT security and data protection rules are ensured
- Ethical rules are established and clearly communicated to CS JU staff, members and other stakeholders
- A Clean Sky JU statement of recommendations is written and presented to the Commission in a timely way as input for any potential FP8 public-private partnership in aeronautics.

In addition to the financial rules applicable to Clean Sky, the CSJU has implemented various tools to monitor the execution of the programme in terms of productivity, achievements, planning and risks:

- Internal rules to set the Grant Agreements Annex 1B, including technical risks associated to the Work Packages (CS Management Manual)
- Quarterly Reports of the ITDs, which inform on the resources consumption, the achievements and the resulting forecasts for level of project implementation
- Steering Committees at ITD level with involvement of the CS project officers
- Annual Reviews of the ITDs' performance organised by the JU with the involvement of independent experts

The results of the monitoring activities are summarized via a Dashboard on the CS JU level, which includes at least the following indicators:

	Gen.	TE	ITD x	ITD y	ITD z	ITD t	ITD u	ITD v
% budget exec. vs planned								
% deliverables + Milestones on time								
% GAPs signed < 6 months								
% SMEs in winners (number of partners)								
% kick-off meetings with Partners on time								
Gates / reviews passed								
% audit / review recom closed								
Others								

4. Risk Assessment for 2011

Achievements in 2010:

In 2010, the JU started to establish its risk assessment methodology. Based on a process approach, the management aims to steer the various tasks of the JU in an efficient and effective way. Each area of work of the JU team is broken into processes which have been mapped out in order to capture the main steps involved for each task and setting out the actors, inputs and outputs of each process.

The risk assessment approach developed by CS management provides for three elements:

- A top-down risk assessment of the CS management team related to strategic programme objectives
- A bottom–up risk assessment covering operational, financial and managerial objectives on JU- and project level. This has been started through a risk assessment workshop and regular process reviews.

- A harmonised risk assessment on ITD level, performed by the ITDs and reported to the JU. The process will be governed by the CS Management Manual, which is in the final stage of reconciliation with the ITDs and will be sanctioned by the end of 2010.

Road map for 2011:

The risk register of the JU as attached to this AIP (see Annex 8 (c)) reflects presently the top-down assessment performed by the CS management team. In this table, the major risks for the JU are listed. In 2011 the register will be complemented by the results of the bottom-up risk assessment as described above and by the results of the ITDs' risk assessment. The JU will implement risk responses and monitor these risks during 2011 according to the methodology set out in the Risk Management Manual.

With regard to Risk Management within the ITDs, the JU has identified the main aspects in its Management Manual. This process, just implemented, should start at the beginning of 2011. For each Work Package of the program, a risk analysis is conducted by the Work Package Manager regarding the technical performance (achievement of the objectives) and the schedule.

The risks are reported:

- at Work Package Level once a year by the ITD to the JU in the Annex 1B of the GAM Amendment
- at Sub Project Level by the ITD to the JU in the Quarterly Report
- at ITD Level to the Executive Director via the Quarterly Dashboard

The ITDs Risk Registers at Sub Project Level and ITD level are consolidated in the CSJU Risk Register for those risks which can impact the objectives of the programme.

Results of the JU's Risk Assessment for 2011:

For the achievement of the JU's core objectives, no critical[1] risks have been identified by the management. As stated in the risk register in Annex 8 (c), the main risks for the JU relate to the operational aspects of the Programme and managing potential occurrences in the day-to-day activities which could have an impact on the overall programme. The JU has identified actions to tackle each of these identified risks and will continue to implement the actions and monitor these risks during 2011.

[1] 'Critical' risks in the Risk Management Manual are defined as 'strong political impact with key stakeholders; material financial impact and/or failure would create major disruption to critical activities with high impact on key stakeholders

5. The Integrated Technology Demonstrators and Technology Evaluator

Activities carried out by the ITD

a) SFWA – SMART Fixed Wing Aircraft

SFWA will be focussed on achieving progress of work along priority key SFWA target technologies towards a maturing them up. A scheme of eight principles "SFWA Aircraft Concepts" have been settled and established during the year 2009:

1. High Speed Demonstrator Passive (HSDP)
2. Low Speed Demonstrator (LSD)
3. Short Range Aircraft Concept (SRA)
4. Low Sweep Bizjet Concept (LSBJ)
5. High Speed Demonstrator Active (HSDA)
6. Long Range Aircraft Concept (LRA)
7. High Sweep Bizjet Concept (HSBJ)
8. CROR Engine Demo FTB

The year 2011 work program includes a continuation of the declared strategy for the ground and flight test demonstration for the HSDP, further maturation of concepts chosen for the CROR demo-FTB and a number of concepts related to the integration of innovative engine concepts for large transport aircraft and for Bizjets.

As regards the CROR, the 2011 feasibility studies will include:
- a review of existing certification rules and proposal new OR certification rules with industry and authorities
- the development of high fidelity tools for aerodynamic assessment of A/C configuration with OR integration including the calculation of drag effects, as well as high fidelity rig tests
- the development of calculation methods to forecast low and high frequency induced vibration effects of installed OR
- working together with engine manufacturers in order to further investigate mounting and installation configurations, with the aim to come to a choice by mid-2011.

Concerning the laminar wing: preliminary design activities will continue, on several high performance high-lift concepts chosen to be integrated into such a laminar wing, as well as maturation of active loads control concepts to support the concept of a smart laminar wing.

Within 2011, a number of CFP topics are scheduled to be published and finally taken by new partners to the SFWA-ITD. A wide range of subjects is expected related to the manufacturing, treatment, and repair and testing of surfaces for laminar wing panels, the design and

development of innovative sensors and actuators for control surfaces in laminar wings. Year 2011 calls will also include major work packages to attribute to the design and build parts of the laminar wing flight test articles and one topic related to a manufacturing concept for a double curved "acoustic panel" for a noise reduced large turbofan engine intake.

The envisioned major achievements / milestones for 2011 are:

- Prepare and conduct the Critical Design Review for the High Speed Demonstrator Passive (CDR).
- Continue the detailed design work and initiate manufacturing of time critical High Speed Demonstrator Passive flight test articles.
- Complete the preliminary design work for the Low Speed Demonstrator concept, prepare and conduct the Preliminary Design Review (PDR).
- After passing the Concept Evaluation Review, continue the preliminary design for the CROR-engine integration and CROR demo-FTB including numerical simulation, and subscale ground and wind tunnel testing.
- Conduct of a major SFWA-ITD Annual Progress Review
- Prepare a detailed follow-on year 2012 work and budget plan to be issued s a Consortium Plan 2012 at the end of 2011.

In the SFWA WP1 Smart Wing Technology Development, similar objectives about NLF wing will be defined, issuing both numerical and experimental methodologies.

The objective of SFWA WP2: –New Configuration, is to design "smart" wing concepts, innovative powerplant concepts (especially focussed on CROR (Counter-Rotating Open Rotor)) and innovative after bodies, up to Technology Readiness Level of 6. The related assessment will be passed to the Technology Evaluator.

The "Smart Wing" and the CROR are the main aims of SFWA WP3: Flight Test Demonstration, in terms of criteria for industrial implementation. The large passive laminar wing demonstrator is scheduled to fly in the second semester of 2014. The large engine test bed is scheduled to fly in 2015.

Main deliverables in 2011:

- Critical Design Review passed for the laminar wing demonstrator onboard the Airbus A340-300 (October 2011)
- Flight Test instrumentation manual for the High Speed Demonstrator Passive (October 2011)
- Maintenance and repair concept for CFRP type laminar wing (September 2011)
- Draft report of advanced CROR configuration designs (Aug. 2011)
- Choice of flight test demo vehicle for Low Speed Demonstrator (June 2011)
- First phase of Preliminary Design Review for Low Speed Demonstrator passed (April 2011), Critical Design Review for Low Speed Demonstrator passed (Dec. 2011).

- SFWA Aircraft modelling (SFWA reference and conceptual a/c models) software models for Technology Evaluator

b) GRA – Green Regional Aircraft

GRA will continue the work packages defined in the baseline program, with internal review of the technologies to be further enhanced.

GRA will also integrate in the plans of each WP the activities conducted by the partners selected by means of the CFPs (it is worth recalling that GRA had the greatest number of topics issue in 2009 for CFPs).

The areas of interest are the following:

- GRA1 – Low Weight Configuration (LWC) domain
- GRA2 – Low Noise Configuration (LNC) domain
- GRA3 – All Electrical Aircraft (AEA) domain
- GRA4 - Mission and Trajectory Management (MTM) domain
- GRA5 – New Configuration (NC) domain

Three domains activities, LWC, LNC and AEA reached significant milestones in 2009 and new ones are expected in 2010, in particular in 2011:

- LWC domain will be largely involved in design, manufacturing and initial testing of large scale structural panels. These panels will be tested for different technologies selected after the "first down selection" based on coupons testing.
- Major activities in LNC domain will be carried out for HLD (High Lift Devices), LA (Load Alleviation) and MLG/NLG (Main Landing Gear/ Nose Landing Gear) technologies.
- Further improvement to all electric architectures, moreover AEA domain will be a major contributor to Flight test with some advanced systems (WIPS, ECS, EMA etc) equipments and Energy Management Systems where specifications will be performed

Flight Test is currently planned using an ATR aircraft and in 2011 feasibility studies and assessment will be performed to prepare the PDR (Preliminary Design Review) scheduled in 2012.

LWC and LNC are also contributors to Large Scale Ground Test, since some selected structural technologies will be tested only on Ground. For LWC a preliminary integration activity is planned in 2011 for the full scale test article definition.
Similarly Landing Gear for Low Noise will be tested in wind tunnel full scale, therefore in 2011 test requirements and specifications will be developed.

Further the NC (New Configuration) and MTM (Mission and Trajectories Management) domains are also contributors to the ground demonstrations, in particular:

- NC is finalized to perform a large scale wind tunnel test for the assessment of the final new regional aircraft configuration, selected as result of all the sizing and integration loops. WTT test campaign will be performed to investigate aero-acoustic behaviour of OR regional A/C configurations.
- MTM domain will converge towards a final demonstration of Green FMS (Flight Management System) using a realistic Flight Simulator specifically developed. During 2011 definition of Green Functionalities for FMS will be completed and development of Flight Simulator will be started.

A GRA Annual Review Meeting (ARM), already planned in the first half of 2010, will also take place in 2011.

GRA is also working closely with TE for the definition of the GRA reference and conceptual aircraft models to be used for assessment of performance and benefits resulting from the introduction of technologies in the future aircraft. A first release of the GRA reference and conceptual aircraft models will be delivered in 2011.

Main deliverables are:

- Design & Manufacturing of Large Panels for different selected technologies for Testing activities;
- Synthesis of HLD Low-Noise Technology studies and down-selection of concepts for 3D wind tunnel tests validation ;
- Energy Management logics for on-ground and in-flight demonstration;
- Report of integration of basic FMS in the GRA Flight Simulator;
- Architecture and Integration of new configurations for TP-TF/OR;
- Green Regional Aircraft modelling (GRA reference and conceptual a/c models) software system for Technology Evaluator.
- 1st Down Selection (materials selected)
- 1st Down Selection HLD concepts
- WTT 2D for HLD selection.

c) GRC – Green Rotorcraft

The activities in 2011 will continue in the five areas already running in 2010 and will start in one additional area, as follows.

GRC1 – Innovative rotor blades

Aiming to reduce rotor noise and power to fly, the development of active blade technology bricks e.g. active twist blade construction, sensory data transmission, power transfer, control algorithms will further extend over the year 2010 and should approach completion. Basic component tests will be prepared. Parametric study of active and passive blade lay-out for global rotor benefits will continue during this period.

The development of appropriate numerical tools for prediction and design optimisation of innovative blades will be pursued in parallel with technology developments.

Three new call topics will be opened during the year 2011, concerning design and manufacturing of active model test articles and active systems to be incorporated in full scale blades in preparation of a demonstration on a whirl tower.

GRC2 – Drag reduction of airframe and non lifting rotating systems

With the aim to increase airframe and non lifting rotating systems efficiency, activities will further address the aerodynamic drag abatement for rotorcraft rotor hubs, fuselage body, empennage, tilt rotor wings, and the optimisation of engine installation architectures.

The design process of several passive and active drag control systems will be pursued using computational prediction tools and steps to prepare the experimental verifications will start.

One new call topic will be opened in 20011 concerning design and manufacturing on an actively controlled empennage. Several other topics will be prepared at the end of 2011 and opened to CFP in 2012 in view of preparing wind tunnel and flight tests.

GRC3 – Integration of Innovative Electrical Systems

The programme has two major technical objectives, in line with Eco-design and SGO objectives: to replace the use of “non-green” hydraulic systems on rotorcraft by electrically-powered systems; and to improve the overall rotorcraft efficiency and reduce weight, with consequent reduction of carbon (and other undesirable) emissions through new electrical system technologies.

After the specification phase to be completed beginning of 2012, the design of the future on-board rotorcraft power architecture (network, power management strategy) along with the design of individual innovative electrical equipments e.g. electrical flight control actuators, power supply for piezo-electrical actuators, energy recovery subsystem, advanced electrical generation will be further advanced throughout the year 2011.

These activities will be conducted in close collaboration which several Partners selected following Calls for Proposals which took place in 2009 and 2010. Five (possibly six) new call topics will be opened for proposals in 2011.

GRC4 – Integration of a Diesel engine on a light helicopter

The aim is to integrate the turbocharged Diesel engine technology on helicopters and drastically reduce their gas emission level, taking advantage of the extremely low specific fuel consumption.

In the year 2011, the pre-design study (configuration, performance) of the ideal Diesel-powered helicopter will be completed and the corresponding integration studies will continue. Concerning the in-flight demonstrator, the pre design studies and general sizing will be completed and the development or modification of specific adaptation components e.g. airframe and transmission interfaces, fuel system, pilot controls and displays, etc will start. These activities will be conducted in close collaboration which Partners selected from Calls for Proposals which took place in 2010.

GRC5 – Environment-friendly flight paths

The aim of the work package is to define flight strategies and associated flight guidance systems needed to minimise both noise impact and gas emission during rotorcraft operations.

The general specification package will be completed. The development of on-board flight guidance systems specifically needed for helicopters will continue, including some flight trials. Flight paths will be optimised numerically for both noise (departure, approach) and emission (en route) then validated through dedicated flight tests.

These activities will be conducted in close collaboration which several Partners selected from Calls for Proposals which took place in 2009 and 2010.

GRC6 – Eco-Design for Rotorcraft Airframe

The aim of the work package is to implement and adapt the generic manufacturing technologies developed in the Eco-Design ITD on helicopter specific components and demonstrate their efficiency throughout their life cycle. GRC6 will start beginning of 2011. The work package will initiate the design of four demonstration articles: cabin door, structural parts, transmission, gear box, using a Life Cycle Analysis to evaluate the environmental benefits.

Following the two call topics submitted in 2010, one new call topic will be opened, requesting participation of companies having expertise in green manufacturing, dismantling and recycling for both composite and metallic parts.

GRC7 – Interface with the Technology Evaluator

Simulation models, configuration data, fleet and mission will be synthesised using the available outputs of other GRC subprojects and delivered to the TE in order to assess the environmental impact of rotorcraft and GRC progress towards ACARE goals.

Main deliverables:

a. for active blade control (GRC1): design of component test set-ups i.e. full scale active twist segment and 2D active profile model;
b. for airframe drag reduction (GRC2): completion of design for the wind tunnel model concerning hub cap optimisation;
c. for on-board energy (GRC3): configuration for Copper Rig tests defined and corresponding equipments fully specified;

d. for the Diesel-powered helicopter (GRC4): pre-design studies for both ideal helicopter and demonstrator; demonstrator modified components specified;
e. for flight path optimisation (GRC5): general specifications fully completed, in-flight emission data base collected, low noise procedures for trials defined;
f. For GRC contribution to TE (GRC7): complete set of rotorcraft models delivered to TE for first assessment exercise.

d) SAGE - Sustainable and Green Engines

The SAGE1 (Geared Open Rotor Demonstrator) project will continue to progress on development of key technologies required for technology demonstration, such as CROR aero and noise methods and prediction tool sets. High Speed CROR next generation blade tests will be carried out under SAGE1 complemented by Low Speed testing under the SFWA ITD, to establish a validated basis for later confirmation of technology feasibility, able to achieve defined CO2 and Noise reduction goals. Effort on design, development and manufacturing of complex lightweight rotating structures will continue in 2011, mainly related to manufacturing processes. Enabling technology definition such as a new booster required for the demonstrator engine will be further progressed.

In addition, work will be performed in the fields of aircraft safety and certification feasibility, aerodynamics, acoustics and physical design, to establish understanding of technology implications on potential future product design and feasibility. Co-operation with the SFWA ITD regarding the feasibility and integration of the demonstrator with a flying test bed will continue. The feasibility and first top level concept of new associated new technology demonstrator engine control and its integration with an existing flight test aircraft will be evaluated.

To mitigate the risk that the mid-2012 review will not support the demonstration feasibility, preparatory work on an alternative demonstrator will be developed in parallel with continuing open rotor work. The alternative technology will be a lean burn combustion system with potential to significantly contribute to reduction of NOx emissions. The intended total scope of the project would be to demonstrate the functionality and operability of the new technology as an integrated system and to raise the lean burn system to TRL6. This highly complex and integrated system includes combustor, fuel distribution and control system, engine control system and engine heat management system.

For SAGE 2, the 2010 activities were dedicated to the comparison between the Direct Drive Open Rotor and the Geared Open Rotor configurations. The fuel consumption benefit of the geared configuration has been established leading to re-direct the SAGE 2 activities on this configuration. The SAGE2 (Geared Open Rotor Demonstrator) project will be in a feasibility phase in 2011. A feasibility Review is scheduled end 2011. The Concept review is planned for mid 2012 and the Preliminary Design Review for end 2012.

The Demonstrator feasibility studies in 2011 will focus on aero-acoustic and performance aspects of the CROR, as well as on the concept development and mechanical integration of key technologies such as Propellers, the Pitch Control System, the front and rear rotating structures, the Nacelle rotating parts, and the Power Gear-Box. The Lubrication & Cooling Systems and the Control Systems will answer the ground test demonstrator requirements. In 2011 partners will be selected through Calls for Proposals to support the feasibility studies mentioned above. .

The SAGE3 (Large 3-shaft Demonstrator) project will be in the preliminary design phase throughout 2011, having completed outline concept definition during 2010. Specific technologies for the first build of the engine demonstrator and for the intercase will transition from preliminary design to detail design during 2011, while technologies to be demonstrated on later builds will continue to develop from concepts into preliminary designs.

Partners for the intake liner, composite pipes and high temperature printed circuit board technologies will be selected through Call for Proposal and the designs and manufacturing plans progressed through 2011. This work will include impact analysis iterations between the Partners and Members to achieve an integrated design and material selection that is optimised in conjunction with the manufacturing system. The technologies to be integrated into the engine demonstrator require detail analysis and modelling work to fully understand the potential impact of inserting these technologies into an architecture not originally designed for the new hardware. This work is planned to be conducted during 2011. In parallel, the SAGE3 project will be developing the demonstrator vehicle, test programme and facilities. Reviews for first build of the engine demonstrator are planned for September 2011 and preliminary design reviews will be held for technologies, including the low pressure turbine, to be demonstrated on later builds. Rig testing of the intercase features will commence during 2011.

In SAGE4, on Full Geared Turbofan demonstrator level concept optimisation results will freeze the demonstrator concept and lead in 2012 into pre- and detail design activities with the relevant milestones. This work will be accompanied by the same level of activity on a module level for the High Pressure Compressor, High Speed LPT, Fan Drive Gear System and Turbine Exhaust Case. Detail design for other engine modules (engine modifications) are planned at the same time. Test stand preparation and adaptation work will ensure to support demonstrator testing later in the program. Components and modules development will be facilitated by rig testing in 2012 in order to minimise the risk at full demo testing.

In SAGE5, the pre-detailed design will be completed with the issuance of all technical specifications for turboshaft engine parts. The demonstrator will go on with detailed design study in order to hold the Critical Design review mid 2011. This work will be accompanied by the raw parts supply and the preparation of industrialisation of engine parts. In addition, the demonstrator engine test plan will be finalised, the test bench specific parts will be studied (such as electrical harnesses, engine to bench interfaces, etc.) Moreover, to prepare the engine test campaign, the demonstrator engine instrumentation detailed study will start. In parallel with the engine

components, the rig test module will be manufactured and assembled in order to start test by last quarter of 2011 in order to minimise the risk at full demo testing.

e) SGO - Systems for Green Operations

The major areas of this ITD are concentrated in the WP2 (Management of Aircraft Energy) and in the WP3 (Management of Trajectory and Mission).
WP1 and WP4 aim at defining the requirements and performing the validation whereas the WP5 is in more about the overall assessment.

In 2011, WP1 will monitor the development and update the architecture assessment thanks to the refined knowledge of the technologies developed in WP2 and WP3. WP1 will also update the requirements for cycle 2.

In WP2, work on technologies for energy management will move towards deliveries which are to begin in 2011. In 2010, the designs based on frozen architectures were completed, and work on the construction of demonstrators began. Throughout 2011, these systems will go through in-house testing in order to ensure that they are ready for large-scale demonstrator testing.

For electrical and thermal systems, large-scale demonstrations are planned to be assembled during 2011, and WP2 will deliver much of the equipment for these platforms. In addition, icing tunnel tests have been planned for 2011 which will lead to validation of technologies which will be proposed for flight testing campaigns in 2012.

Parallel to the construction of equipment, the use cases which began to be examined in 2010 will go through a refinement process, particularly in order to improve the fidelity and accuracy of the models being used. Use-cases which can be tested at equipment level will begin to receive validation data in 2011 which can be used for a direct comparison in 2011.

In-house testing will also be used to prepare the models being used in the architectural work, to ensure that the planned integration of equipment on large-scale rigs goes smoothly. It is thus expected that by the end of 2011, most equipment will be built, and the process of rig assembly will be on-going.

In 2011, activities concerning the Management of the Trajectory and Mission (MTM) will be performed in WP3.

The preliminary analysis of the SFWA outcomes, especially the propfan engines impact (i.e. Open rotor) on the trajectory of the Aircraft will be started. This analysis will mainly be focused on the Large Aircraft Applications and should come out to an identification of candidates technologies to be selected for further analysis (i.e navigation and localization sensors, aircraft performance database,…) and the in-progress ones to be matured or modified with the associated schedule.

This first analysis round will be completed by the 1st set of High Level Requirements for the Mission Management (focused on the Flight Management System, the Cockpit features and the Human Man Interface) .

In parallel, technologies down selected in 2010 and covering the different aircraft species (departure, in-cruise, landing, arrival and surface movement solutions) will be further matured up to TRL4 in between 2011 and 2012. Those works will concern the technologies aspects (algorithms and computational techniques, weather radar sensors, high integrated steering systems).
Enhanced environmental models developed in WP3.1 will support it. An advanced version of the theoretical optimisation framework will be delivered, which will provide improved accuracy of the optimal trajectories in various flight phase.

Coordination with SESAR will also be pursued, in order to ensure that trajectory optimisation is compatible with future ATM context evolution. We will analyse procedure envisaged for new functionalities having passed the TRL3/4 gate, in order to further assess environmental benefits in operational conditions and to orientate the development constraints in the upper stages. Those works will be performed in close relation with the TE.

Again in 2011, WP4 will prepare the demonstration means (ground physical or virtual test rigs, flight test aircraft).
Whereas the major electrical and thermal test rigs will be prepared for further integration in 2012, the first demonstration campaigns will occur in 2011 with the icing wind tunnel testing of electrical wing ice protection systems for large aircraft.
WP4 will also continue the integration of mock-up of green functions on large scale flight simulator for the evaluation of green functions in an operational environment all along the mission profile.
The definition of the flight test plans, installation and instrumentation will be consolidated on the targeted flight tests aircraft.

WP5 will initiate the industrial exploitation of the more mature solutions, especially the ones concerning the Management of Aircraft Energy.

About the link between Clean Sky and SESAR, the launch of joint meetings in 2010 allowed the interface between the two programs to develop, discussing and integrating the Air Traffic Management constraints in a SESAR concept of operations for all flight phases, in all interested Clean Sky ITDs.

Main deliverables:

Project	Principal Deliverables	Planned Date
WP1	Cycle 1 Detailed architecture for Energy and Thermal systems	oct-11

WP2	Architecture Assessment for Cycle 1	juin-11
WP3	Electrical equipment to the Large Aircraft test bench (HLVDC converter, ATU, ATRU)	oct-11
WP3	Environmental assessment of MTM solutions studied for larges aircraft applications	déc-11
WP3	A set of enhanced trajectory management tools (Nox and CO2 modelling, trajectory optimizer, Economical modelling, weather database for real time simulation, …)	juin-11
WP4	Ground test specification	oct-11

f) ED – EcoDesign

Eco-Design ITD is organized in the two major areas of EDA (Eco-Design for Airframe) and EDS [Eco-Design for Systems (small aircraft)].

The Airframe Application 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.

These areas will be considered for significant parts of the aircraft: structure, cabin covering and furniture, vehicle systems components / equipments, engine components, electronics.

In 2011 work in the frame of the Eco-Design ITD – Airframe Application will continue on the following Work Packages:

- WP A.2 Technology Development,
- WP A.3 Application Studies.

In WP A.2, the work will be focused on the most innovative technologies selected through the trade-off process performed during the second half of 2010.

In WP A.3, the work will continue on the field on Life Cycle Analysis or LCA (WP A.3.1). A simplified LCA tool will be made available at T0+36 months i.e. in September 2011. At the end of 2011 (or early 2012), activities will also start 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.

Among the most significant objectives of 2011, results from the partners activities launched in 2010, on the analysis of existing LCA tools and associated databases, and standards like European Platform on Life Cycle Assessment (EPLCD) and the European Reference Life Cycle Data System (ELCD), will be reviewed.
Further progress about usability of LCA tools in consideration of special requirements in aircraft industry will be reviewed.

In 2011 work in the frame of the Eco-Design ITD – Systems, work will continue on the feasibility of an all-electrical aircraft, through the study of innovative energy management architectures, requiring joining forces to provide appropriate requirements to Systems ITD.

The general objective of this part of the Eco-Design ITD is to make a significant step towards the concept of the all-electric vehicle systems aircraft, by removing of hydraulic fluid (with significant benefits in terms of aircraft maintenance and disposal environmental impact); by on-board power by wire. The use of electricity as only media offers a lot of possibility in terms of energy management (e.g.: Intelligent load shedding, power regeneration on actuators, sharing of Electrical Control Unit over actuators).
For the purpose of the all electric small a/c objective, the existing work packages are completed with activities hosted by the GRA, GRC and SGO ITDs.

Among the significant milestone of 2011 there are:

- The final definition of the Generic Architecture, which will serve as the basis for the tests to be conducted on the Electrical Test Bench;
- The completion of the definition of the subsystems requirements and the development follow-up, for the Generic Architecture and for the Business Jet architectures;
- The completion of the definition of the Electrical Bench and Thermal Bench;
- The first phases of test bench manufacturing;
- The completion of the definition of the electrical tests to be conducted on the Electrical Bench;
- The delivery of the process to use the selected generic simulation tools: Energy Management Model (EMM), Electrical Network Analysis Model (ENAM), Thermal Model (TM), Ecolonomic Model (EM) and the associated process to use them and interconnect them.

g) TE – Technology Evaluator

All TE Work packages shall be active in 2011:

- 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

The general objective of WP1 is the definition of Requirements and Architecture of the Clean Sky Technology Evaluator. In 2009, the basic TE requirements have been issued. The 2010 work has completed and detailed these requirements, in particular with respect to the first assessment cycle. Additionally TE has performed an update of the Clean Sky environmental targets while reporting the 2010 main ITDs results. The design of the TE information system has progressed on the basis of a GRC test case. In 2011 the 1st Clean Sky overall assessment will be done using the TE system. In 2011 the exchanges with SESAR will be continued.

In 2011, WP2 will define and deliver the models for the first assessment to WP3 which is integrating them into the TE system framework.
The WP3 activities will be essentially to complete a first release of the TE framework, and to integrate in it the set of ITDs aircraft models, and models developed in WP2 to get the system ready for performing the first assessment.

The main WP4 activity this year will be to prepare the data and to perform the first assessment using the TE system delivered by the WP3 at the three following levels: Mission, Operation, and ATS assessment levels. For sake of completeness, the descriptions of the three levels are here reported again:

1. The Mission level concerns a single aircraft operation. Mission level will assess the environmental performance (noise / fuel / emissions) of conceptual versus reference aircraft along the whole trajectory (i.e. all flight phases) of typical missions. Conceptual and reference aircraft and rotorcraft models will be delivered by SFWA, GRA, and GRC ITDs. Additional models will be developed in the TE, e.g. existing aircraft models where necessary.

2. The Operational level concerns the air traffic movements at and around airports, including local surrounding airspace like terminal Manoeuvring Areas. Operational level will assess the environmental impact of a fleet around an airport for noise, fuel and emissions considering the introduction in the fleet of various percentages of clean sky aircraft. Models include, e.g., an airport model with various traffic scenarios and procedures, a database of the surrounding population, a local noise model, a fuel burn model, and a local emissions and air quality model.

3. The ATS level concerns air traffic operations at Regional and Global level. ATS level will assess the environmental impact of a global fleet for fuel and emissions considering the introduction in the fleet of various percentages of Clean Sky aircraft. Required models include a Y2000 Flights/movements and Fleet reference build-up, a Y2020 traffic and fleet forecast model, a simplified life cycle model, and an Emissions Inventory model.

The results of this first assessment cycle will be reported at the end of 2011.

Among the significant milestone of 2011 there are:

- Individual platforms (Mission, Operation, ATS) tests and validation through Implementation of model chains and workflows with 2000 baseline data and aircraft
- TE computer system test and validation (interaction between the 3 levels)
- Integration of ITD models in TE and preparation of TE system for the 2011 1st assessment
- Performance of the 1st assessment at the 3 levels

Main deliverables for 2011 are:

- Performance of the 1st assessment with results for:
  - Mission level reference versus conceptual aircraft
  - Operational level fleet with and without Clean Sky aircraft providing airport noise contours and airport fuel and emission inventories
  - Global level fleet with and without Clean Sky aircraft providing global fuel and emission inventories
- Report providing the synthesis of the assessment at the 3 levels

Preliminary List of Topics for calls in 2011

The preliminary list of Topics for calls in 2011 is attached to the AIP in Annex 8 (c).

6. Summary Annual Budget Plan

The detailed annual budget plan is a separate document to the AIP and is provided together with the AIP. (See document ' CS-GB-2010-12-17 doc4b Annual Budget Plan 2011')

It is summarized as follows:

Commitment appropriations:	**M €**	**Payment appropriations:**	**M €**
Running costs:	5	Running costs:	5
Operational costs:	170	Operational costs:	154
Total	**175**	**Total**	**159**

7. Justification of the financial resources request

Running costs

The running costs are close to the level of 2010 (+1.8%) with:

- an increase of staff costs, because the JU has recruited 20 staff members (17 temporary agents + 3 contractual agents) in 2010 and is making provision for one more Temporary Agent (Technology Evaluator Project Officer) and a possible recruitment for a contract agent;
- a decrease of costs linked to the call process compared to the previous estimation.

The main features of the 2011 expenditure allocations in the budget are set out below:

Title 1 (Staff):

2011 will be the first year the JU will have the majority of its foreseen staff in place for a full 12 months. Therefore, the main lines of the Title 1 budget will have reached a steady state and the planning of expenditure is more stable than in the past. On the other hand, it is expected that the missions budget will be used to a greater extent given the increased number of Project Officers, whose job it is to stay in close contact with the ITDs and Partners to ensure the smooth project management of the Programme. In addition, the JU has developed a training plan which will give JU staff the opportunities to develop their knowledge and skills relating to research programmes and their implementation together with regular career development training.

Title 2 (Buildings, IT, Equipment, Communication, Management of Calls and Miscellaneous expenditure for running activities):

Clean Sky JU will move to its new premises in January 2011. The costs relating to the items in Title 2 are based on estimates provided to date and it is inevitable that some changes to these will be necessary upon implementation of the various contracts once on site in the new building. Most of the initial expenses have been budgeted in the 2010 budget – however, some remaining expenses will arise once the move takes place. Expenditure on Communication will continue to remain at the same level with the new website being contracted following a successful call for tender in 2010. The costs relating to calls have been reduced during 2010 and it is foreseen, with fewer calls in 2011 that the costs will continue to reduce.

Title 3 (Operational Expenditure):

This is the main title of the Budget and based on the AIPs of the ITDs, the implementation of the financial resources should reach 'cruising speed' in 2011. Given that the JU is in existence for 3 years, activities will be well under way and execution of this title should reflect this. The JU continues to work closely with the ITD coordinators to plan their budgetary needs around the technical activities foreseen in earlier chapters of the AIP.

Operational costs

The total expenditure (commitments) for operational costs requested for 2011 is:

- 108 M€ for Members
- 62 M€ for Calls, with the assumption of a 65% funding

The updated **total expenditure (commitments) forecast** is then:

108 + 62 + 5 = **175 M €**

Revenue

The European Commission subsidy is foreseen to be 156 M€. The estimated income from Members towards running costs in 2010 is 2.6 M €.

A carry-over from 2010 was planned and will be used for a value of 16.3 M €.

This results in a **total (estimated) revenue** of **175 M €.**

This budget is subject to the adoption of the EU 2011 budget in accordance with Article 314 of the Treaty on the Functioning of the European Union (TFEU) or the availability of appropriations, in 2011, under the rules of provisional twelfths referred to in Article 315 TFEU and Article 14 of the Clean Sky Financial Rules.

8. Annexes

a) Preliminary List of Topics for calls in 2011

b) Work Programme of the JU Executive Team 2011

c) Risk Register 2011