ANNEX 1 – Description of Work

Quantification of *Con*strained *S*cenarios on *Av*iation and *E*missions

- CONSAVE 2050-

(4 March 2002)

COMPETITIVE AND SUSTAINABLE GROWTH

Key Action:	GROW-2001-4: New Perspectives in Aeronautics
Accompanying Measure 2:	Studies in preparation of future activities, addressing with a European Perspective RTD policy issues related to industrial competitiveness and sustainable growth or focussing on important specific socio-economic problems, emerging technologies, industrial sectors, etc.

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1. CONFIDENTIAL SUMMARY

Objectives:

The work consists of developing quantified scenarios on aviation and emissions with focus on the Year 2050, with a look on the short (Year 2025) and long (Year 2100) term development relevant for aviation industry planning and climate models respectively. It will include constrained conditions and the newest "background" data on external fields to transport and air transport, which are setting the frame for the long term development in aviation.

The major objective of the CONSAVE 2050 programme is to contribute to ensuring sustainable growth of air transportation with regard to environmental issues. The output of the scenario quantification exercise will go a step beyond (and improve) existing scenarios on aviation and emissions (IPCC/SRES), helping to develop a common European understanding on constrained aviation scenarios and emissions. In addition, the project will generate valuable input for FP6 research programmes in terms of a defined range of boundary conditions for air transport development, and will help to support and enhance the competitiveness of European aviation industry.

Description of work:

During CONSAVE 2050 qualitative scenarios already developed under the European Thematic Network AERONET will be modified and adapted after having chosen the key factors to be quantified. IPCC/SRES work will be included in the following quantification of background scenarios, where "background scenarios" describe transport, the external fields to transport and the supply side of aviation, as air transport technologies. Finally the quantification of a set of scenarios on aviation and related emissions will be performed with the help of two models, owned by partners of the consortium. The preliminary results will be distributed to an external committee consisting of potential users of the results and interested experts, not involved in the project. These external experts will be invited to a final discussion, to review the quantification work, the results and the conclusions. The outcome of the European experts review will be included in the final report. In parallel to the scenario work relevant external activities will be carefully analysed in order to avoid duplication of work.

The project, with a duration of 24 months, will be supported by management and co-ordination activities. One of the major CONSAVE 2050 activities will be the dissemination of the results. Of paramount importance to the work is the broad distribution and acceptance of the results. Thus emphasis will be given to the preparation of "public domain" reports, the experts review and the web-based communication of results. Furthermore a strong contact to other relevant groups (Advisory Council for Aeronautics Research in Europe – ACARE) and stakeholders not involved directly in the project activities and the co-ordination with complementary projects working in a similar direction is envisaged.

Milestones and expected results:

Major milestones will be the completion of qualitative background scenarios at month 6 and their quantification at month 10, the internal mid term review around project month 12, the quantification of the aviation scenarios at month 18 and the experts review meeting around project month 21.

The expected project results will be in first case a set of broadly accepted quantified scenarios on aviation and emissions, valuable as input to IPCC/SRES scenario review and up-dating. In addition a significant contribution to the development of a common European understanding on aviation scenarios and related emissions will be given.

2. OBJECTIVES AND EXPECTED ACHIEVEMENTS

Introduction

The *CONSAVE 2050* proposal has been developed by participants in a long-term scenario activity within the EC/AERONET, a European Thematic Network. Responding to the declared needs of stakeholders, two AERONET workshops designed four outline qualitative scenarios ([1], [2]). Provision of usable scenarios, fully elaborated, tested and quantified, to customers requires detailed project work over a two-year period. The objective of *CONSAVE 2050* is to design a representative set of robust quantitative scenarios with focus on the time horizon year 2050, an intermediate view to year 2025 and an outlook to year 2100, as

- long-term constrained scenarios on aviation and its emissions are important as input for long-term assessment of the impact of these emissions on climate change and on local airport air quality,
- long-term constrained scenarios provide the basic information for long-term strategic planning in the field of air transport.

The report on "Aviation and the Global Atmosphere" IPCC published in 1999 [3] included a variety of scenarios, analysing the future development of global air transport demand and the consequences of aviation emissions until 2050. But, only scenarios with an unconstrained development of air traffic were considered ([4], [5], [6], [7]). This significant limitation will be addressed by *CONSAVE 2050*. The project foresees explicitly and as its most important and innovative topic, the development of constrained quantified scenarios on aviation and emissions.

Another key feature of this measure is the use of the most recent information from IPCC/SRES [8] on assumptions for the development of population growths, economy, and other areas frame-setting for the development in aviation, whereas the IPCC/1999 aviation scenarios, used for calculation of the effects on the atmosphere, were based on now outdated IPCC/1992 background scenarios [9].

This accompanying measure will deliver a fundamental prerequisite for many activities involving European stakeholders in the sphere of aviation and its environmental impacts that need to generate a long-term perspective. It addresses - from a European perspective - RTD policy issues (sustainable aviation) and competitiveness and sustainable growth issues in the aviation industry, such as the future implementation of clean propulsion technologies for aircraft. The project will account for emerging technologies in the important European aviation industry sector and for important macro and socio-economic factors influencing growth.

Relevant scientific, technical and socio-economic objectives

The project will develop a set of quantified scenarios that support the atmospheric science community, the aviation industry and the policy and regulatory community. Respectively, these sectors have a need to determine the possible growth of aviation and its emissions to deliver environmental response information, technology response strategies or policy or economic measures. The project, through the establishment of an Advisory Committee of customers, will provide for a broad review process on the preliminary results through intensive contacts to the many related external activities thus ensuring that a common European understanding on critical issues of aviation scenarios and related emissions will be achieved.

Main socio-economic objectives of the project are (i) to strengthen the European aeronautic industry by delivering sound information which can be used to develop *in time* strategic orientation of the short-, medium-,and long-term planning and (ii) to ensure

sustainable growth of air transportation with regard to environmental issues. To account for the fact that the various customers have different understandings of what might be the most relevant time frame for the scenarios, apart from the main focus on the year 2050, a view will be taken on 2025 developments as a consistency assessment with related industry work and a more simplistic outlook to 2100 to satisfy the scientific horizon. The long-term *constrained* scenarios will show the sensitivity of the air transport system to technological and societal changes and political measures. This will, for example, allow for better planning of infrastructure measures and of the long-term research activities for improvement of aircraft efficiency, environmental friendliness and safety (critical technologies). The outlook to year 2100 will generate special [Alf, Iam not sure what "special" means. Presumably it means higher level aggregate data for the more distant time horizon] data relevant for climatology, supporting the improvements of models for the calculation and assessment of global and regional impacts of emissions from aviation and other sources.

Problems addressed by the project

It is impossible to *predict with certainty* long-term futures: the longer the time horizons, the greater the uncertainties. But, any planning is based on assumptions on the future. The only way to address this dilemma is to design consistent alternative possible scenarios for the future using as much sound information, currently available, as possible. The goal of *CONSAVE 2050* is to strengthen the ability of European stakeholders to predict the future through new and improved understanding of critical aspects of sustainable aviation and its emissions. The work will include, for the first time, constrained scenarios on aviation and related emissions. It is unrealistic to perpetuate the use of unconstrained scenarios, similar to those described in the IPCC Report "Aviation and the Global Atmosphere", as these do not reflect the real world, just a worst case. The use of improved and more recent "background conditions" (i.e. population and economic growth) included in the IPCC/SRES will significantly enhance the quality of this scenario product.

Air transport is one of the strongest growing transport segments, and a further increase is expected for the next decades. Due to the relatively long life-span of an aircraft (~ 25-30 years), technological developments need a long time for implementation. As a special problem of aviation, this could risk the danger of an unacceptable late response to political (societal, economical and ecological) demands, like the reduction of aircraft noise, fuel consumption, local and global air pollution. With the help of robust scenarios, there is the prospect for improved stakeholder response to pressures arising from future air transport demand, its environmental impact and also the related political demands (and necessary policy measures). Fostering these activities will promote the sustainability of air transport.

Contribution to the overall programme, preparation of further RTD policies

It is critical to the effectiveness of technology development for emissions reduction to be well informed on the constraints and pressures arising from predicted emissions impact. Scenarios are integral to that process and allow for estimation of effects and needs to underpin stakeholder reaction in the long term. This includes assessing the need for new aircraft technologies, airline and fleet management, infrastructure development and changes in air transport management systems. Scenarios therefore improve the planning process of the whole air transport industry.

CONSAVE 2050 meshes well with existing RTD programmes. It builds upon the AERO2K inventory base case and forecast activity, seeks to draw in the information on the performance of emerging technologies from a number of projects and links to ATM and airport and airline developments through AERONET.

Contribution to further RTD activities

CONSAVE 2050 scenarios will support the future definition of RTD need by identifying the air traffic system and emissions consequences of certain boundary or intermediate developments in civil aviation. Factoring this information into proposed research and development activities by industry, operators or the scientific community can only serve to strengthen the way that the sector deals with strong challenges in keeping aviation on a sustainable path. Amongst other things, this will influence research and development in the fields of airframe design, fuel economy, emissions reduction, alternative propulsion systems, etc. Furthermore the scenarios will clearly help to identify the future need for political activities, at the European and global level, supporting the sustainable development of air transport and the aviation industry in the European Union.

3. PROJECT WORKPLAN

Introduction (structure of the workplan and overall methodology)
The envisaged scenario development and quantification work is broken down in three logical steps (WP1 – WP3), supported by the organisation of a European review on the preliminary results and a strong interaction with relevant external projects (WP4) and by the co-ordination and management activities (WP5).
The work will be performed by a Consortium which consists of DLR (Deutsches Zentrum für Luft- und Raumfahrt e.V., Co-ordinator), NLR, QinetiQ, DLH (Deutsche Lufthansa), with IIASA (International Institute for Applied System Analysis) and MVA as subcontractors of DLR and NLR (Nationaal Lucht- en Ruimtevaartlaboratorium), respectively, and EADS (Airbus) as supporter in the following structure:

WP1 Key factors and qualitative background scenarios
WP2 Quantification of background scenarios
WP3 Quantification of scenarios on aviation and emissions
WP4 Organisation of a European review on preliminary results and contacts to external activities
WP 5 Management and co-ordination

WP1 – Key factors and qualitative background scenarios: The substantive technical project work starts with the examination, review and choice of the key scenario descriptors (that have to be quantified) to be used as input for other workpackages. These will need to reflect the interests of key stakeholders *(WP1A).* This activity represents the development and completion of the qualitative work on „background" scenarios started already under the EU-funded Thematic Network AERONET. „Background" scenarios are defined as scenarios describing the "scene-setting frame" for the long-term development of aviation, for example, developments external to aviation but which will influence demand for air transport and the way that the air transport system reacts. This element of work includes, for instance, consistency checks and regularising for regional differences. The completion, adaptation and modification of these existing outline qualitative scenarios will be performed under *WP1B* and is critical to the validity of the end product. This work package will also include using the latest findings/developments from the IPCC/SRES macro-economic scenario process to check the background scenarios developed within the AERONET activity. It will include a project workshop to agree upon the constrained qualitative scenarios. Development and completion of the storylines for the individual scenarios will necessitate consultation with some of those involved in the AERONET scenario workshops, particularly the facilitator and storyline editor. A key element of this work package will be valuable assistance from the subcontractor IIASA, leader of the authors team of the IPCC Working Group III Special Report "Emissions Scenarios" (2000). [The support of IIASA will ensure, that the findings and experiences from this newest relevant IPCC scenario work on the long-term development of emission-causing areas of human activities (including those, which are framesetting for aviation) can be made available for CONSAVE 2050 in the necessary detail. Among others, IIASA will help to organise, host and participate in the planned workshop on constrained „background" scenarios".]

WP2 – Quantification of background scenarios: Selecting the appropriate background scenarios, drawing upon IPCC/SRES knowledge is the first element of this task. In turn this leads to quantification of the background scenarios for 2050 (and the identification of related factors for 2025 and 2100) as the foundation upon which to build the aviation specific

elements. IIASA expertise will support the quantification of the background scenarios. The involvement of this IPCC expertise, external to the aviation sector, promotes consistency with broader macro-economic scenario work, avoids duplication of effort and ensures robustness in the main underlying assumptions. The intention is to quantify the scenarios designed in WP1B by identifying, selecting and augmenting as necessary, the respective closest IPCC/SRES scenarios.

WP3 – Quantification of scenarios on aviation and its emissions: A core activity within *CONSAVE 2050* is the quantification of the scenarios on aviation and emissions (WP3). For this purpose the AERO model will be used (10). The detailed qualitative descriptions arising from WP1 will define the aviation and emissions specific factors comprising each of the boundary and intermediate scenarios for 2050. These elements of the scenarios will be modelled in WP3, to build upon the quantification of the background scenarios in WP2.

Whilst the AERO model is used as a tool to test policy-options (especially in relation to reducing cruise-altitude emissions), a vital feature of the model is that the user can define the (future) scenario as a context for testing policy measures. The model can then generate forecasts for the scenarios either without or with the measures being reflected. A great deal of flexibility is provided for defining different scenario specifications. The main scenario variables fall within four major domains: macro-economic, demographic, transport market and technological development. Most scenario variables also allow for differentiation by aircraft characteristics, traffic categories, and IATA region (-pair). The user can also vary basic input assumptions, such as demand elasticity, rates of depreciation, and aircraft emission indices.

The AERO model is thus extremely well-suited to forecasting the effects of alternative scenario assumptions. The subcontractor MVA will assist NLR in setting values to the variables available in the AERO model that best represent the *CONSAVE 2050* scenarios. However, there may be some aspects of the *CONSAVE 2050* scenarios that are "transparent" to the AERO model, as those features are not directly addressed through model variables. MVA will explore the possible chain of effects of these factors so far as they affect the aviation community, including resulting interactions within the community. To validate these effects and to maintain consistency with scenario tests conducted with the AERO, correlation between the factors considered outside and within the models will be addressed. It may then prove reasonable to proxy at least some of the effects of the non-modelled factors by adjusting model inputs, and thus ultimately obtaining quantified and consistent model results of the factors in combination. EADS, Toulouse will give support by placing its expertise in forecasting (with the Airbus-model) and its databases at the disposal of WP3.

The outcome and feed-back of the review process (see below) will be analysed carefully and used – if appropriate – as input for final modifications of the quantification procedure.

To apply the AERO model NLR assisted by MVA (its AERO partner, and subcontractor in the CONSAVE project) and EADS Airbus (in an advisory role in the CONSAVE project) will do the following work tasks:

1. Pre-processing: Preparation of data sets (partly from information from Work Package 2) for input in the AERO-model. Foreseen are one set for each year 1992 and 2000, and 2-3 sets for each year 2025 and 2050 (2100 as far as possible). Preparation includes small model adjustments (if needed) and preparatory work to use alternative variables within the models to represent key scenario factors which are not available in the models.
2. Processing: a) AERO-model runs and analyses of results. - b) Analyses of the effects of relevant external factors, which could not be taken into account by the models. Quantitative

projections of key descriptors of scenarios on aviation and its emissions are calculated, for instance factors on aviation demand and supply, emissions totals, etceteras.
3. Post-processing: a) Additional analyses of results of AERO model runs by comparison with available results from other projects or/and model runs as far as possible b) Post-processing the outcome of the European Review; additional use of the AERO model to take into account the recommendations for modifications developed during the European Review on the preliminary study results.

c) Work Package reporting, including contribution to the Final Report.

Furthermore, as part of WP3, the unconstrained IPCC/1999 scenarios will be modified for comparison reasons, substituting the "old" inputs of the IPCC/1992 background scenarios on the long-term development in economy by the new information of the IPCC/SRES work.

WP4 – Organisation of a European review on preliminary study results and contacts to external activities: In month 15 the preliminary results of the study will be reported. A key task within *WP4A* is to organise a broad review of this material among a representative group of European experts and stakeholders in aviation. This review process will be ongoing from an early stage within the project as it necessary to secure technical verification of elements within the scenarios before these are too advanced. The review process culminates with a workshop that explains the composition of the scenarios, exposes these to critical assessment and provides for the modification as necessary of preliminary study results. This process ensures that the scenarios produced in the project are robust, that they will reflect the key perspectives of the stakeholder community and are geared to use by the industry, the scientific community and the policy and regulatory communities. The process of ensuring valuable output from *CONSAVE 2050* requires continuing and close interaction with a number of related activities taking place within Europe and cognisance of other activities occurring in the broader international community. This process is critical to the success of the project and to its acceptance and application in the aviation community. WP4B involves linkages from the commencement of the project with a number of activities to promote consistency, information exchange, efficiency of effort and avoidance of duplication. Key linkages will be with the EC/AERO2K and TRADE-OFF projects, the EC/AERONET thematic network, the industry ACARE (Advisory Council for Aeronautics Research in Europe) scenario activity, Eurocontrol scenario work and with a number of national or collaborative scenario projects that bear upon aviation and its emissions. With *CONSAVE 2050* scenarios intended to be a significant European contribution to the international debate on aircraft emissions impacts, scenario activity taking place internationally will be monitored and appropriate linkages established.

WP5 – Management and co-ordination: The project work will be supported by management and co-ordination activities led by DLR. An important task will be to organise internal assessment of preliminary results of the various workpackages by the consortium. An Advisory Committee of stakeholders/customers will be organised as part of WP5 by DLH. Meetings are planned for month 4 and month 21 for an assessment of the outcomes of WP1 and the results of the project, respectively, to ensure that the requirements of users are taken into account.

Work in this work package will include the development of a Project Management Plan and the preparation of administrative report. Project meetings will be held on a regular basis (6 months) bringing together all partners for a discussion of the state of the ongoing work and the future activities.

The results of the workpackages WP1 – WP4 will be integrated in the final report within WP5. A major action will be the dissemination of the results - of paramount importance to the

work is the broad distribution and acceptance of the results. Thus emphasis will be given to the preparation of "public domain" reports, the experts review and the web-based communication of results.

Summarizing descriptions of resulting project tasks and subtasks are given in Tables 3.1-3.5.

Project planning and time table

The overall project life time will be 24 months with a total effort of 49 contractual person-months from which 3 person-months by DLH are not charged to the project.
The project planning over the 24 months period, the progress report delivery dates, the project meetings and the date for the Review Meeting are shown in the following graph, for topical reports and milestones see the detailed workpackage descriptions.

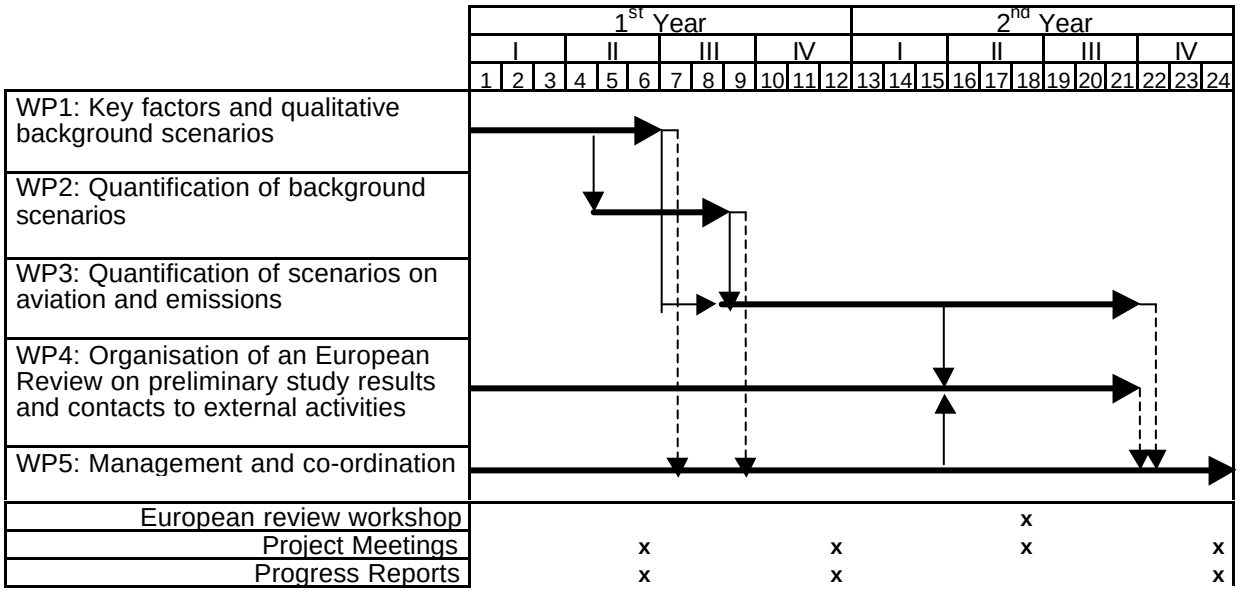

Fig. 1: CONSAVE 2050 Project planning

Detailed project description

- Lists of workpackages and deliverables (Tables 1 and 2)
- Description of each workpackage (Table 3.1-3.5)

Table 1. Workpackage List

WP No.	Workpackage Title	Lead Contractor No.	Person - Months	Start Month	End Month	Deliverable number No.
WP1	Key factors and qualitative background scenarios	DLR	11	0	6	D5, D6
WP2	Quantification of background scenarios	DLR	5	5	8	D7
WP3	Quantification of scenarios on aviation and emissions	NLR	13	8	21	D8, D9
WP4	Organisation of an European Review on preliminary study results and contacts to external activities	QinetiQ	9	0	21	D10, D11
WP5	Management and co-ordination	DLR	11	0	24	D1, D2, D3, D4
		TOTAL	49			

Table 2. Deliverable List

Deliverable No.	Title and Nature of the Deliverables	Delivery Date	Dissemination Level
D1	6 months report (WP 5)	month 6	CO
D2	Mid-term/12 months report (WP 5)	month 12	CO
D3	CONSAVE 2050 - Preliminary report (WP 5)	month 15	RE
D4	CONSAVE 2050 - Final report (WP 5)	month 24	PU
D5	Catalogue of key factors to be quantified in CONSAVE 2050: report (WP 1A)	month 4	RE
D6	Representative set of qualitative "background" scenarios: data and report (WP 1B)	month 6	RE
D7	Quantification of "background" scenarios: data and report (WP 2)	month 8	RE
D8	Quantification of scenarios on aviation and its emissions – Preliminary results for review: data and report WP 3)	month 14	RE
D9	Quantification of scenarios on aviation and its emissions –Final results: data and report (WP 3)	month 21	RE
D10	Findings and proposals from the review process and the related concluding workshop: report (WP 4A)	month 19	CO
D11	Report on the contacts to external activities (WP 4B)	month 21	RE

Dissemination Levels:
PU: Public
RE: Restricted to groups specified by the consortium depending on the deliverable including the Commission Services (possible groups: research, airport operators, airlines, manufactures, transport enterprises, politics)
CO: Confidential, only for members of the consortium including the Commission Services

Table 3.1	**Workpackage Description**	
WP 1	**Key factors and qualitative background scenarios**	
Start/End Date:	Month 0-6	**Duration:** 6 months
Total Effort:	11 pm	
Partners Involved	**Activities**	**Effort (pm)**
DLR	**Workpackage owner** Completion and design of new background scenarios, support to choice of key scenario descriptors, reporting	5
IIASA (DLR-Subcontractor)	Support to design of new background scenarios	*2*
NLR	Determination of input factors for AERO-model, support to scenario completion, and reporting	2
QinetiQ	Support to new scenario design and reporting	2
DLH	Choice of key scenario descriptors, reporting	[2]

Objectives:
Choice of key factors and features which should be quantified in the study because they are of main interest for the design scenarios on aviation and its emissions from the perspective of possible customers (aviation industry, policy makers, climatologists, transport researchers) and/or are needed as inputs for study-models. Selection of respective external factors affecting the aviation descriptors. Completion of the work on a set of qualitative „background" scenarios of key fields frame-setting for the long-term development in aviation and related emissions – initiated during the workshops of the AERONET Scenario Activity and taking into account the results of WP 1A.

Description of Work:

WP 1A
1. Choice of scenario descriptors which are of key interest as strategic information for customers and should be quantified in the study (Group involvement: DLR, **DLH**).
2. Determination of factors needed as input for the AERO-model (Group involvement: **NLR**).
3. Contribution to preliminary and final report (DLR, NLR, **DLH**).

WP 1B
1. Check of the „background" scenarios developed during two AERONET workshops, especially with respect of the completeness of the list of key descriptors which should be quantified in the study, following the findings of WP 1A and with respect to internal consistency – using information from the results of the IPCC/SRES work. (Group involvement: **DLR,** NLR).
2. Design of additional qualitative „background" scenarios underpinning constrained aviation scenarios using the outcomes of a project workshop on this topic. (Group involvement: DLR, QinetiQ)
3. Contribution to preliminary and final report (**DLR**, NLR, QinetiQ).

Deliverables:
- Catalogue of key factors to be quantified for CONSAVE 2050: report. (D5).
- Representative set of qualitative "background" scenarios: report (D6).

Milestone and Expected Results:
M4 Catalogue of key factors to be quantified produced (month 2).
M5 Contribution from WP 1A to study report complete (month 4).
M6 Modified set of representative qualitative "background" scenarios (month 5).
M7 Contribution from WP 1B to study report complete (month 6)

Interrelation with other Workpackages:
Provides: Inputs for WP 2, WP 3

Table 3.2	**Workpackage Description**	
WP 2	**Quantification of background scenarios**	
Start/End Date:	Month 5-8	**Duration:** 4 months
Total Effort:	5 pm	

Partners Involved	**Activities**	**Effort (pm)**
DLR	**Workpackage owner** Quantification of scenario key factors, reporting	4
NLR	Support to quantification and reporting	1
IIASA (DLR-Subcontractor)	Support to quantification	*2*

Objectives:
Quantification of the long-term projections of the key factors identified during two AERONET workshops and finally in WP 1A and qualitatively described in WP1B – following the quantification elaborated in the IPCC/SRES work for those SRES-Scenarios closest to the different respective study scenarios and taking into account the IPCC/1999 scenarios 2050 for the reduction of emissions of aviation due to improvements in aviation technologies.

Description of Work:
1. Investigation of the IPCC/SRES work to find those respective SRES-scenarios closest to the different „background" scenarios designed in WP 1B. (Group involvement: **DLR**, NLR).
2. Quantification of the projection of those key factors/features which are affecting – following the results of WP 1A – those main descriptors of scenarios of aviation and its emissions of interest for possible customers and are needed as input for the models used in WP 4. The quantification of the long-term development of reductions in aviation emissions will be based on the respective scenarios 2050, developed for IPCC/1999 (Group involvement: **DLR**, NLR)
3. Contribution to preliminary and final report (**DLR**, NLR).

Deliverables:
- Quantification of "background" scenarios: data and report (D7).

Milestone and Expected Results:
M8 Quantification of "background" scenarios complete (month 7).
M9 Contribution to study report available (month 8).

Interrelation with other Workpackages:
Requires: inputs from WP 1A, WP 1B
Provides: information for WP 3

Table 3.3	**Workpackage Description**	
WP 3	**Quantification of scenarios on aviation and its emissions**	
Start/End Date:	Month 8-21	**Duration:** 14 months
Total Effort:	13	
Partners Involved	**Activities**	**Effort (pm)**
NLR	**Workpackage owner** AERO-model calculations, reporting	 11
DLR	Modification of IPCC/1999 scenarios	*2*
MVA (NLR-subcontractor)	Assisting model work of NLR. Analyse of effects of key factors on study results, not taken into account by the models used	*2* *2*

Objectives:

- Construction of a representative set of quantitative scenarios of aviation and its emissions which includes especially 2-3 relevant constrained aviation scenarios.
- Provide, with a European consensus, quantitative projections of key descriptors of scenarios on aviation and its emissions. The representative sets of quantitative scenarios for the years 2025 and 2050 (and 2100 as far as possible) include especially 2-3 relevant constrained aviation scenarios. Effects of relevant external factors on key features of scenarios which could not be directly modelled are included through analysis.

Description of Work:

1. Use of the AERO-model to calculate quantitative projections of key descriptors of scenarios on aviation and its emissions: calculation for relevant aviation demand factors, relevant aviation supply side factors, related emissions features. (Group involvement: **NLR**)
2. Analysis of the effects of relevant external factors – not be taken into account by the AERO model - on key features of scenarios on aviation and its emissions. (Group involvement: **NLR**)
3. Additional use of the AERO- and Airbus- model to take into account the recommendations for modifications developed during the European Review on the preliminary study results. (Group involvement: **NLR**, EADS as supporter)
4. Modification of the unconstrained IPCC/1999 scenarios (Group involvement: **DLR**)
5. Contribution to final report (**NLR**)

Deliverables:

- Quantification of scenarios on aviation and its emissions – Preliminary results: data and report (D8).
- Quantification of scenarios on aviation and its emissions - Final results: data and report (D9).

Milestone and Expected Results:

M10 Contribution to mid-term progress report of CONSAVE 2050 complete (month 11).
M11 Preliminary results of the quantification of scenarios on aviation and its emissions available (month 13).
M12 Contribution to preliminary report on CONSAVE 2050 complete (month 14).
M13 Additional work, proposed by reviewers, finalised (month 20).
M14 Contribution to final report complete (month 21).

Interrelation with other Workpackages:
Requires: Input from WP 1A, WP 2
Provides: Information for WP 4A

Table 3.4	**Workpackage Description**	
WP 4	Organisation of a European Review on the preliminary study results and contacts to external activities	
Start/End Date:	Month 0-21	**Duration:** 21 months
Total Effort:	9 pm	
Partners Involved	**Activities**	**Effort (pm)**
QinetiQ	**Workpackage owner** Conception and performance of an European review on preliminary results, reporting. Monitoring, analysis of external work, support for harmonisation of work-plans, reporting	2 4
DLR	Organisation of workshop as final step of the review, support to reporting	3

Objectives:

The preliminary findings of the study should be intensively reviewed in Europe by potential customers and interested experts. As a final step of a 4-month review period, a workshop will be organised to enable the elaboration of a widely agreed resume on the findings of the Review and recommendations on how to improve the preliminary study results during the final phase of the study work, following the Review –workshop. Relevant external work should be monitored and analysed with appropriate exchange of information and data. Contacts to those activities should be organised with the aim to harmonise – as far as possible – the respective work-plans, in order to avoid unnecessary duplication of work, to mutually use useful information elaborated from other activities, and to support the development of a common European understanding on the long-term development in aviation and its emissions.

Description of Work:

WP 4A

1. Development of a detailed concept for the performance of the review: contribution to the mid-term progress report for CONSAVE 2050. (Group involvement: **QinetiQ**).
2. Distribution and necessary explanation of the preliminary Report on the study findings among a representative group of European (elsewhere?) experts on aviation and other interested specialists. (Group involvement: DLR, **QinetiQ**).
3. Handling reaction to comments of the review (Group involvement: DLR, **QinetiQ**).
4. Organisation of a workshop to summarise the outcomes of the Review process and to develop recommendations for modifications of the preliminary findings of the study. (Group involvement: **DLR**, QinetiQ).
5. Contribution to final report (DLR, **QinetiQ**).

WP 4B

1. Contact to ACARE with the goal to harmonise its work-plans with the work-plan for this study. (Group involvement: **QinetiQ**).
2. Contact with the EC/AERO2K and TRADE-OFF projects to ensure that the results of the studies are of added, mutual and complementary value. (Group involvement: **QinetiQ**).

- Contact with Eurocontrol, aviation sector groups and scientific and regulatory bodies participating in scenario activities bearing upon the conduct of CONSAVE 2050. (Group involvement: **QinetiQ**)
- Contributions to preliminary and final report (Group involvement: **QinetiQ**).

Deliverables:

- Findings and recommendations of the review and the concluding workshop: report (D10)
- Report on contacts to external activities including appropriate material/data supporting the CONSAVE 2050 scenarios (D11)

Milestone and Expected Results:

M15 Concept for review (as contribution to the mid-term progress report of CONSAVE 2050) complete (month 11).
M16 Preliminary Report on CONSAVE 2050 released to a representative group of experts on aviation for review (month 15).
M17 Recommendations for modifications of the preliminary results from review and related workshop available (month 18).
M18 Contribution to final report complete (month 19).
M19 Status report of WP 7 for mid-term progress report of CONSAVE 2050 available (month 11)
M20 Contribution to final report complete (month 21)

Interrelation with other Workpackages:

Requires: Inputs from WP 5, WP 3.

Provides: Information for WP 1, WP 3.

Table 3.5	**Workpackage Description**	
WP 5	**Management and co-ordination**	
Start/End Date:	Months 0 – 24	**Duration:** 24 months
Total Effort:	11 pm	
Partners Involved	**Activities**	**Effort (pm)**
DLR	**Workpackage owner** Overall co-ordination and project management	5
DLH	Management of an Advisory Committee	[1]
DLR, NLR, QinetiQ	Final report compilation and dissemination	3, 1, 1
All others	Support to final report compilation and dissemination	

Objectives:
Co-ordination of project and overall project management. Compilation of the mid-term and final reports and organisation of dissemination of the study results including web-site posting.
Formation and co-ordination of an advisory committee which consists of representative of possible customers which should ensure that the final study results are in line with customers demand.

Description of Work:
1. Co-ordination of project and overall project management (Group involvement: **DLR)**.
2. Formation and organisation of the work of the advisory committee (Group involvement: **DLH**).
3. Compilation of the mid-term and final reports and dissemination of the final study results (Group involvement **DLR**, QinetiQ).

Deliverables:
- 6 months report on Consave 2050 (D1).
- Mid-term/12 months report on Consave 2050 (D2).
- Consave 2050 – Preliminary report (D3).
- Consave 2050 – Final report (D4).

Milestone and Expected Results:
M1 Mid-term progress report on Consave 2050 complete (month 12).
M2 Report on preliminary results of Consave 2050 compiled (month 15).
M3 Final report on Consave 2050 complete and disseminated (month 24)

Interrelation with other Workpackages:
Requires: Contribution from all workpackages.
Provides: Inputs for WP 4A, WP 4B .

4. COMMUNITY ADDED VALUE AND CONTRIBUTION TO EU POLICIES

The need for this accompanying measure co-ordinated on a European level stems from the nature of aviation and its emissions. As both are not limited to national borders, the complexity of aviation management and thus also of aviation scenarios development, needs the broad expertise of the whole community. This is reflected in the consortium consisting of DLR (D), NLR (NL), QinetiQ (UK), DLH (D) as partners, MVA (UK) and IIASA (A) as subcontractors, and EADS (F) as supporter.

The development of a "Single European Sky" and of sustainable air transport necessitates a common understanding in the most important issues related to aviation. The scenario results, as developed in this project, will be important for and have a broad impact on the aviation industry (strategic planning for investments, infrastructure, technological development) and policy makers decisions. For these reasons a broad European-wide development and acceptance of the project's approach and conclusions, not only by those who generated the results but by all major groups involved in European aviation, is necessary. This will be accomplished by the European Experts Review process during the last months of the project, where the preliminary results and conclusions will be discussed by an external panel consisting of representatives from air transport industry, airport operators, airlines, politics, science and regulation. This panel will develop a common position on the (constrained) scenarios to promote their value and application.

This product will support policy development within European industry and through the work of the regulatory and scientific communities. It will provide a valuable resource to aviation environmental projects supported under the 6th EC Framework Programme as well as EU for a considering transportation policy development to meet predicted need.

This accompanying measure has been developed from the European Thematic Network AERONET. During the course of two workshops on long-term scenarios it was felt by the participants that there is a strong need for a quantification exercise on aviation and related emissions to assist the work of European stakeholders. The sound basis for the scenarios, developed by the AERONET consortium, will be used for the *CONSAVE 2050* work. Expertise from the International Institute for Applied System Analysis (IIASA), main author of the IPPC Special Report "Emissions Scenarios", will also be included to ensure the highest relevance of the results and conclusions for further developments of scenarios by IPCC groups and their use in the Community.

During the life-time of the project a strong link to relevant groups and co-ordination with related projects will be established. It is intended to avoid duplication of work and to transfer achieved results to the on-going activities. ACARE, the Advisory Council for Aeronautics Research in Europe and ist supporting project ASTERA will be contacted on a regular basis as well as other related but complementary projects like AERO2K which also aim to assist strategic work geared to securing a sustainable future for civil aviation.

5. CONTRIBUTION TO SOCIETAL OBJECTIVES

The CONSAVE 2050 work will contribute to better prediction of expected aviation demand and to efforts to reduce uncertainties over future air transport development. Although the focus of the project is on the Year 2050, a intermediate look on Year 2025 is planned, covering the range for aviation industry foresight. This will help strengthen European air transport industry, thus helping to save or secure the number of working places in this important industrial segment.

Furthermore, decreasing uncertainties in air transport predictions will help to develop new perspectives for sustainable air transport development: it should allow for safer/better planning and for the efficient and well supported implementation of new environmentally friendly technologies. This would help to promote in future, the environmental benefits of lower emissions and lower noise aircraft, and has to be seen as a positive step forward towards an environmentally friendly and sustainable transport mode.

In the longer term element of the project looking at the Year 2100, the development of constrained aviation scenarios will give valuable input to climatological modelling efforts. In turn, this Europen scientific work contributes to the broad international assessment activity under the auspices of the Inter-governmental Panel on Climate Change and the Montreal Protocol that seeks to define the nature and effect of anthropogenic emissions upon the atmosphere and climate system so that governments can take appropriate response action. The European Union and its member states have been prominent in pushing forward the agenda for action and in supplying much of the scientific information upon which it is founded.

Plausible and robust future scenarios of aviation activity and aircraft emissions are a key underpinning element in the process of assessing long-term effects upon atmospheric processes. All three time frames (2025, 2050, 2100) that will be addressed in the CONSAVE 2050 scenario quantification work will generate directly and indirectly (i.e. through further modelling) important data, helping and supporting policy makers in their short term decision making process.

6. ECONOMIC DEVELOPMENT AND S&T PROSPECTS – EXPLOITATION OF RESULTS AND DISSEMINATION

The CONSAVE 2050 aviation scenario quantification work will generate no direct or immediate economic impact, but results will help to improve long-term foresight and planning. Especially for the future development of an efficient, sustainable and environmentally friendly air transport system, the scenario development and quantification is prerequisite.

Effective exploitation, dissemination and transfer of know-how related to future aviation developments, and thus their impact upon the aviation system and technology advance will be achieved by the direct co-operation of the CONSAVE 2050 consortium with other relevant groups. For instance, linkages between the project and the industry scenario activity under ACARE, focusing upon a shorter term horizon of about 25 years, will build upon the value of such complementary work and strengthen the intelligence used by European industry in deciding its future technology strategies. Direct transfer and implementation of results to and from ongoing complementary projects (AERO2K and TRADE-OFF) with which partner links are already established will only serve to increase the value of existing projects already supported by the EC and Governments, let alone those that may arise from the 6th Framework Programme. This will optimise the resources and create a maximum benefit.

The short-, medium- and long-term foresight of the scenarios on aviation and emissions, assists in tackling environmental concerns like local air pollution, GHG emissions and noise emissions, together with other aspects of sustainability like resources consumption. Improved definition of long-term targets for environmental improvement will contribute to the definition of future RTD objectives through the identification of major fields for research need in aviation.

Exploitation and dissemination are key aspects of CONSAVE 2050. The results of the scenario quantification exercise will be rigorously scrutinised and assessed within a European review of experts and stakeholders in aviation. It is considered essential that peer reviewed output of the project is widely used within the customer communities and, to this end, the project workshop will expose the scenarios to a broad range of expertise and enhance the prospects of the final product being widely used as the project aspires to the broadest acceptance of the results, thus public reports and web pages including the latest results will be published soon after acceptance by the steering committee.

7. MANAGEMENT AND RESSOURCES

7.1 The Management

Management of this accompanying measure will be quite simple and straight forward as the project structure itself is not complicated. Direction, control and management of the project will be achieved through a hierarchy of:

- the **Co-ordinator**,
- the **Project Board**, consisting of the partners, and invited experts
- the **work package leaders** steering individual tasks
- the **Advisory Committee**, consisting of relevant European aviation stakeholders from industry, research, legislation and policy

Possible members of the Advisory Committee are:

Research:
CENTRO DE CIENCIAS MEDIOAMBIENTALES, Madrid/Spanien; ENVIRONMENT INSTITUTE, Ispra/Italien; CENTRE INTERNATIONAL DE RECHERCHE SUR L`ENVIRONNEMENT ET LE DEVELOPPEMENT, Nogent sur Marne/Frankreich; SUOMEN YMPÄRISTÖKESKUS Helsinki/Finnland; ARIC (Manchester University) --> AERONET Partner; DLR; MPI; NLR

Airport Operators:
ADP (Aeroports de Paris) Charles de Gaulle/Orly Paris; Amsterdam Airport Schipol; Fraport AG Frankfurt/Main; BAA Heathrow; BIAC Brussels International Airport Company; ADR Aeroporti di Roma

Airlines:
Air France; British Airways; Iberia; SAS Scandinavian Airlines; Finnair; KLM; Lufthansa

Manufactures:
GIE Airbus Industrie / Airbus France; SNECMA; Air BP; Shell Aviation Ltd.; MTU; Rolls Royce

Transport enterprise:
Deutsche Post AG and European partner companies; Lufthansa Cargo AG; DHL; SNCF

Politics:
National transport ministries of the EU-states

The co-ordinator will be responsible for following and supervising the day-to-day work in the different workpackages, will be contact point for the consortium and the European Commission. The co-ordinator will be the project spokesman and will be the prime contact point responsible for the internal and external communication.

The progress and successful completion of the work packages will be monitored by the Project Board. After the first year a mid-term assessment will be performed to analyse the overall progress and to decide upon continuation of the work. The decision criterion is related to the milestones: having reached all milestones foreseen for the first year will be the sign for continuation.

Starting in month 15, organised by WP4a a broad European review of the preliminary results and conclusions will be performed among a representative group of European experts and stakeholders. The review process culminates in a workshop in month 18.

The advisory committee will meet early in the project to assist in deciding upon the direction of the work and after the review workshop to discuss the scenario approach, the achieved results and the preliminary conclusions. It will give an opinion on the overall work and suggestions on how the preliminary results can be enhanced in the remaining project live time.

Communication amongst the partners will be done mainly by electronic mail. Development and progress of the project will be discussed during the 6-months progress meetings.

Project management will be conducted in accordance with ISO 9001 quality procedures.

AERO-Model property rights

The permission to use parts of the AERO-Model for the CONSAVE project has been granted by the AERO project leader Mr. J.W. Pulles, Ministry of Transport, Public Works and Water Management, The Netherlands. A written permission and the conditions for use are in the possession of the co-ordinator.

7.2 The Partnership

The consortium is a group of partners and sub-contractors, having all several years of broad experience in the field of transport demand, aviation and scenario development. They have also worked together for some years in different activities and EU funded projects. Most of them are members of the AERONET consortium, that identified the strong demand for quantified constrained aviation scenarios. In addition the two sub-contractors have taken a leading position in the AERO group (MVA) and in the IPCC scenario development activities known from the Special Report on "Emissions Scenarios" (IIASA). The *CONSAVE 2050* consortium consists of the following five partners:

- DLR (Deutsches Zentrum für Luft- und Raumfahrt e.V., Co-ordinator)
- NLR (Nationaal Lucht- en Ruimtevaartlaboratorium)
- QinetiQ
- DLH (Deutsche Lufthansa)

with supporting activities from

- EADS (Airbus)

and the two sub-contractors

- MVA
- IIASA (International Institute for Applied Systems Analysis)

Partner 1: DLR profile

DLR is the aerospace agency of the Federal Republic of Germany. In this function DLR is in charge of a broad scope of research and development projects involving national and international partnerships. Numerous results of its research and development work go into industrial production processes. The scientific and technological expertise gained at DLR institutions makes a substantial contribution to securing a high standard in aerospace and transport research. Moreover, the contributions of aeronautics, space and energy technology are indispensable in other areas as well. Many projects emphasise environmental aspects. DLR develops technologies for tomorrow's traffic vehicles: low emissions and greater safety.

Institute of Transport Research

A key element in DLR transport focus is the Institute of Transport Research (IVF). In order to pave the way for an environmentally and socially tolerable transport system, the Institute concentrates on trans-modal transport concepts and the use of new technologies in transport, the analysis and forecast of transport as well as its effects on the environment. The IVF activities in the field of environmental

assessment of transport take advantage of DLR work in the development of regional and global emission registers, numerical models and their application, as well as research on noise. Experiences with environmental impact analyses and evaluation have been gained at regional, national and European scale, in particular in the assessment of the Trans-European transport networks.
These studies (on behalf of the German parliament, the German traffic forum, German ministries of research and of transport) contribute to decision-making on the introduction of new traffic technologies and political measures. For these purposes assessments of the effects of technologies and measures and their optimal use have to be elaborated as well as specific comparisons of alternative or additional measures. The emphasis in these studies were analysing environmental effects of the transport system and a quantification of the potentials for emission reductions for all traffic modes.
The Institute is also involved in two national network projects. While one deals specifically with traffic noise perception and reduction for all traffic modes, the goal of the other project is to define indicators and measures for a sustainable Germany.

Partner 2: NLR profile

The National Aerospace Laboratory NLR is the central institute for aerospace research in the Netherlands. NLR provides scientific support and technical assistance to aerospace industries and organisations, civil and military aircraft operators and government agencies all over the world. NLR is a non-profit organisation, and conducts a basic research and development program funded by the Netherlands government.
The activities of the Transport and Environmental Studies Department of NLR are related to noise exposure in the surroundings of airports and to emission of engine exhaust gases (in relation with operations of aircraft). Furthermore services are offered to support policy and decision-making. The mission of the department is to provide their customers with products and services conforming to defined and acknowledged requirements and conditions in a cost effective way, in the area of environmental aspects of aviation.
Regarding the central issue of the CONSAVE project: the development and modelling of future scenarios in the field of aviation and the environment, NLR has good knowledge and a long experience. From 1994 until present, NLR has been participating in a large Netherlands policy analysis project 'AERO', Aviation emissions and Evaluation of Reduction Options. NLR has been developing the parts in the AERO system related to the modelling of current and future aviation technology, aircraft operations and emissions, and direct operating costs. MVA Ltd., AERO-partner and NLR's subcontractor in the CONSAVE project, took care of the air traffic database and the models within the AERO system concerning current and future aviation demand and supply, and overall cost aspects. NLR as well as subcontractor MVA are both partners in AERONET, and were also both involved in the AERONET workshop activity on Long Term Scenarios.

Partner 3: QinetiQ profile

QinetiQ, incorporates the bulk of the UK Ministry of Defence's non-nuclear research, technology and test and evaluation establishments. It is one of Europe's largest research organisations, with an annual turnover of approximately £1 billion. QinetiQ provides five types of service: research, consultancy, assessment, test & evaluation and access to intellectual property rights.
Among its 8,500 staff, QinetiQ employs many leading scientists and internationally acclaimed experts. It offers a unique range of services, from the highest level of operational studies and analysis, through the various categories of basic and applied research, to consultancy advice on the procurement process and the test and evaluation of specific equipment in both the development phase and during actual operations.
QinetiQ test facilities include indoor and outdoor ranges for weapon effectiveness trials, underwater target ranges and marine testing facilities, automotive test tracks and climatic testing laboratories.
All QinetiQ services have a defence application; this reflects the needs of our largest customer, the UK Ministry of Defence. However, QinetiQ actively seeks to collaborate with industry, academia and government departments, both in the defence and civilian markets. In addition, QinetiQ is to develop mutually advantageous relationships with businesses in the civilian world.

The markets in which QinetiQ is involved include aerospace, defence, demilitarisation, environment, health and safety, information technology, electronics and communications, offshore and transport.
In December 1997 DERA, the QinetiQ predecessor, achieved ISO 9001 certification across all of its activities.

Centre for Aerospace Technology, Combustion and Environment Group

The Centre for Aerospace Technology (CAT) is one of 9 Centres of the Future Systems Technologies Divisions of QinetiQ and comprises approximately 3000 staff. CAT comprises nine Groups including the Combustion and Environment Group.
The Combustion and Environment Group comprises approximately 40 staff and deals with aspects of combustion, emissions and atmospheric processes, mainly in relation to aero and industrial gas turbines but also other combustion systems. The Group has 5 Technical Team Leaders, overseen by 2 Technical Chiefs. Amongst other things and of relevance to CONSAVE 2050, the group has conducted research in relation global aircraft emissions databases and forecasts, long-term emissions scenarios, future aero-engine fuel and emissions performance, global and regional emissions modelling of aircraft and participation in the IPCC Secial Report on the effects of aviation on the global atmosphere. The group has extensive links and collaborations with the technology and scientific community in relation to the issue of aviation and its environmental impact.

Partner 4: DLH profile

Lufthansa German Airlines is the major German airline covering both passenger and freight air-transport. Besides this core-business, the Lufthansa Group comprises independent companies such as Lufthansa Technik AG (maintenance and overhaul of aircrafts), LSG Lufthansa Service Holding AG (catering), Lufthansa Systems GmbH (information technologies) and many others. In 2000, there had been 69.523 employees world-wide.
Close co-operation with science and research is an integral part of Lufthansa's approach to environmental protection. Lufthansa supports numerous research projects to increase the knowledge of aviation's impact on the Earth's atmosphere and climate and to discover more about the causes and nature of aircraft noise. Scientific knowledge alone can guide aviation's future developments along an environmentally compatible course.
The co-ordination of the AERONET activities will be performed within Lufthansa by the unit „Environmental Issues". This includes an active involvement in research, documented by the participation in a number of national and international projects. In the past years, these included the EC-funded projects ACREM (Air Crew Radiation Exposure Monitoring), ESCAPE (European Study on Cancer Risk among Airline Pilots and Cabin Crew), MOZAIC (Measurement of Ozone and Water Vapor by Airbus In-Service-Aircraft) and a pilot project on the introduction of organic food in canteens (ARINCO 95 DE 06.002).

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