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# **CabinAir - Innovative approach to improving air quality in aircraft cabins**

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## Overall aim

Improving air quality in aircraft cabins using 'measurements in the sky' and innovative designs and technologies

- To address the widespread concerns about air quality in commercial passenger aircraft
- Enable airlines to provide a healthier environment for passengers and crew

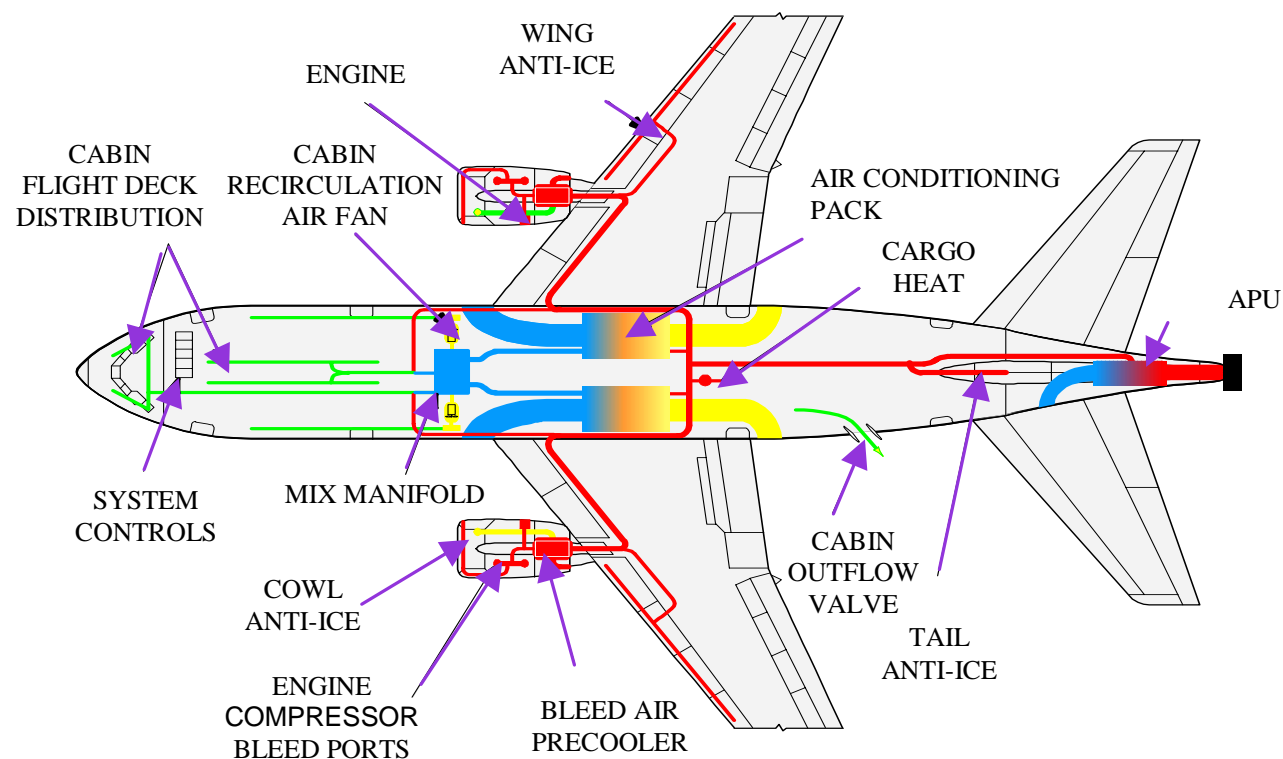


## Need for this work

- Serious and widespread concern about impact of cabin air on passengers and crew
- Exacerbated by growth of air traffic, and future generation of aircraft
- No European or international Standards for environmental quality in aircraft
- Problems clearly transnational and needed to be addressed as such



# Environmental control system (ECS)



# Environment that we need



# CabinAir consortium



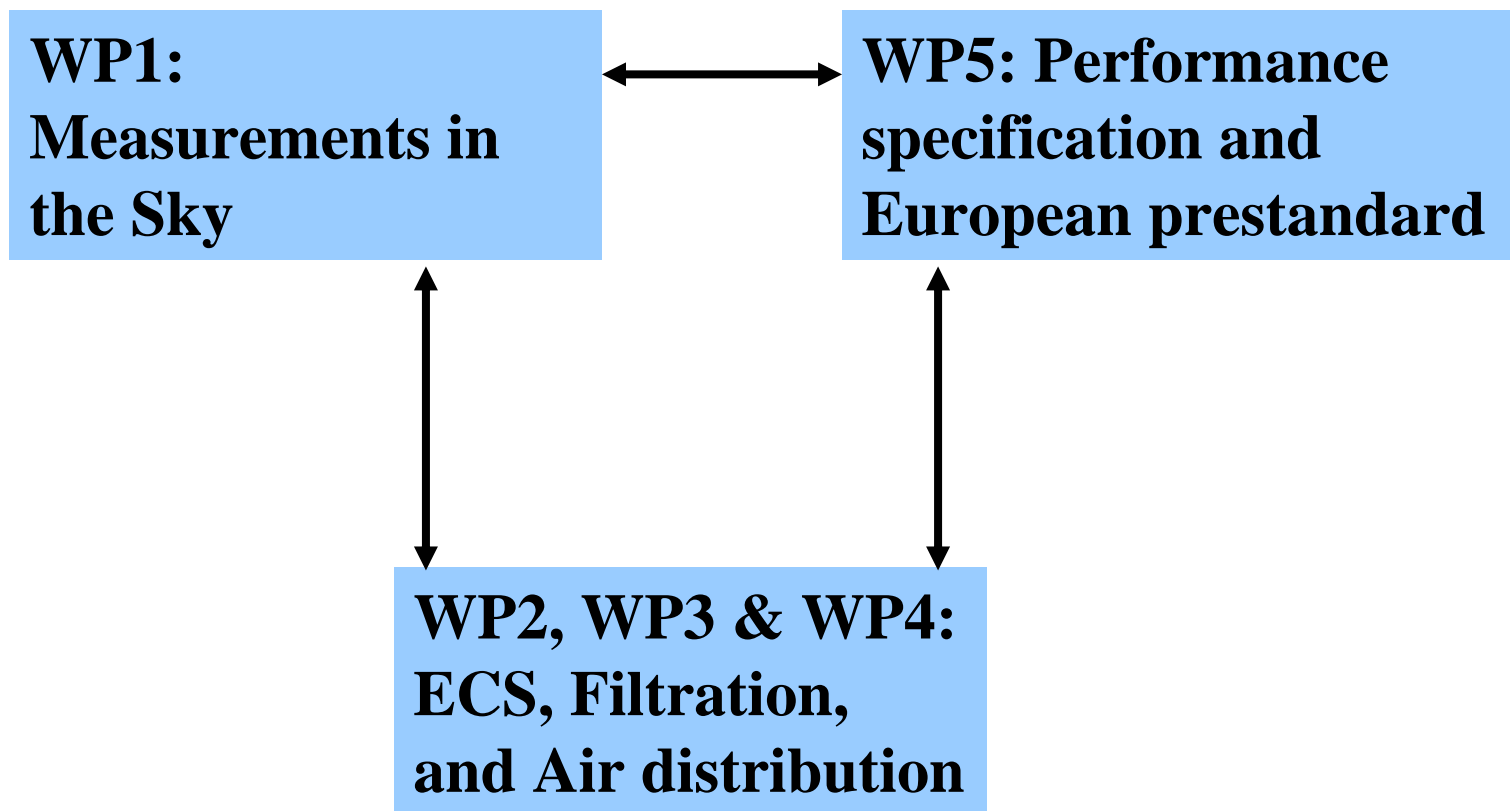


## Key objectives

- Establish current air quality through ‘measurements in the sky’
- Produce information on relationship of air quality with ECS, filtration, air distribution and ‘impact’ performance
- Provide innovative designs in ECS, filtration, air distribution, and control
- Develop performance specification and propose draft Pre-Standard



## Workpackage inter-relationship







## WP1: Measurements in the Sky

- To establish current air quality in four generic aircraft types representing commercial passenger fleet
- Comprehensive investigation through a planned programme of monitoring and surveys of aircraft in flight



# Measurement Programme

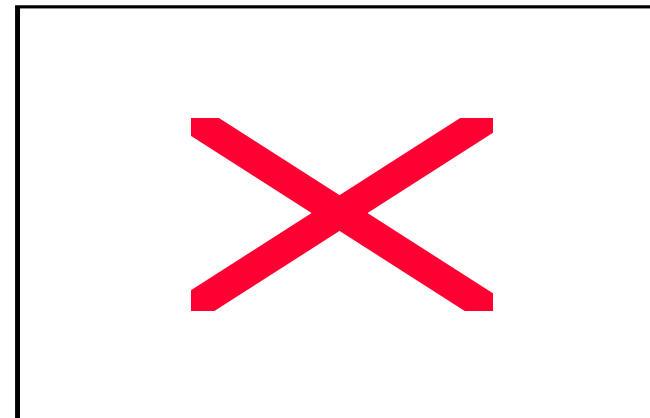
- Four types of generic aircraft
  - Short narrow body (SN)
  - Long narrow body (LN)
  - Twin aisle (TA)
  - Double deck (DD)
- 50 commercial flights (plus ground tests)
- National flag-carrier airlines: BA, SAS, KLM





## AHWG cabin air monitoring

- **Aircraft used in high-volume, short haul operations**
- **Two older generation aircraft**
  - **BAE146 (UK regional operator)**
  - **B737 Classic (regional, 'budget', or flag-carrier)**





## Physical Measurements

- Cabin altitude
- Air and globe temperature
- Air velocity
- Carbon dioxide
- Relative humidity
- Ozone
- Carbon monoxide

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# Contaminant Measurements

- Organic compounds
  - Aldehydes and ketones
  - Very volatile organic compounds (VVOCs)
  - Volatile organic compounds (VOCs)
  - Semi volatile organic compounds (SVOCs)
- Microbiologicals
  - Fungi
  - Bacteria
  - Endotoxins
  - Cat and mite allergens
- Ultrafine particle counts



## Cabin crew questionnaire

- Change in symptom intensity during flight
- Assessment of the cabin and galley environments



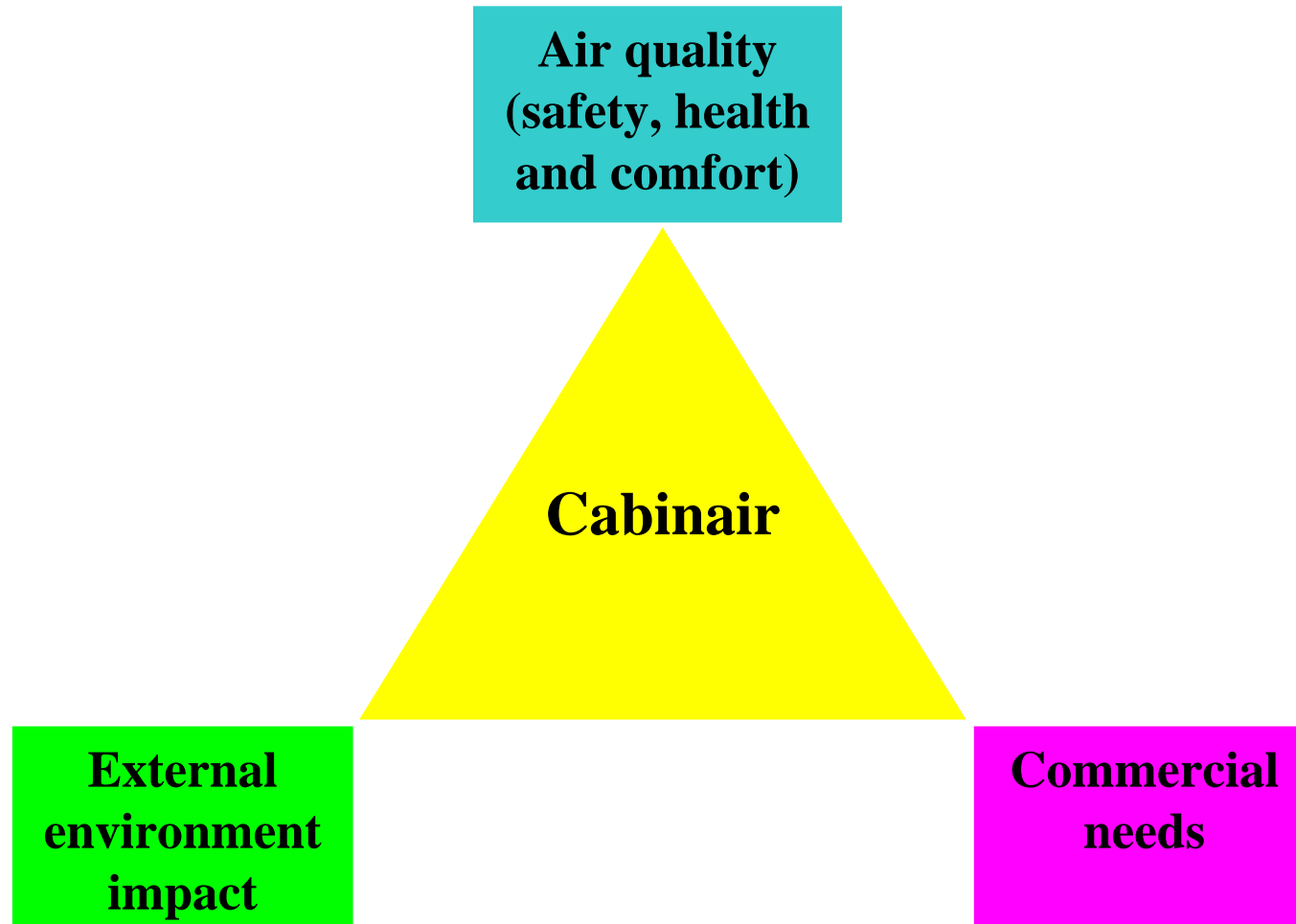
## WP2: Environmental Control System



- To provide innovative designs and technical solutions in the areas of the ECS
- Evaluating the impact and influence of ECS on cabin air quality and environment and providing and assessing improved designs



# Cabinair strategy







## WP3: Filtration system

- To provide innovative designs and technical solutions in the areas of filtration
- Providing new designs and technologies - striking a balance between filtration efficiency for contaminant removal, and energy consumption





## WP4: Air distribution

- To provide appropriate air quality for passengers and crew together with local control and maximum effectiveness
- Developing new design strategies and technologies





## WP5: European Prestandard

- Guidelines for draft European Prestandard (ENV) on cabin air quality
- Developing specifications and proposing Standards that are technically feasible, and economically justifiable





## Development of Prestandard

- Review existing JAA, FAA, SMACs from NASA
- Assess standards, guidelines and regulations concerning other indoor environments
  - transport, buildings : EU, WHO, ASHRAE, AGCIH, ...
  - air pollutants : TLVs, time of exposure, health effects
  - CO<sub>2</sub>, CO, O<sub>3</sub>, NO<sub>x</sub>, VOCs, particles, ...
  - thermal comfort : temperature, radiation, air velocity, humidity
- Evaluate data from CabinAir 'Measurements in the Sky' for full international fleet
- Markers for air pollution (safety and health) and thermal (comfort) established



## Specification of markers

- prEN 4618 only performance based, without any requirements concerning technical solutions
- Criteria established according scientific reasons
- Scientific justifications and references given for each criteria
- Measurement method of associated markers provided (description or references)
  
- No sectorial considerations
- No requirements for ventilation rate level
  - Possibility to reduce current ventilation rate if existing alternative solution to guarantee an equivalent air quality level
  - Information about current regulation's requirements

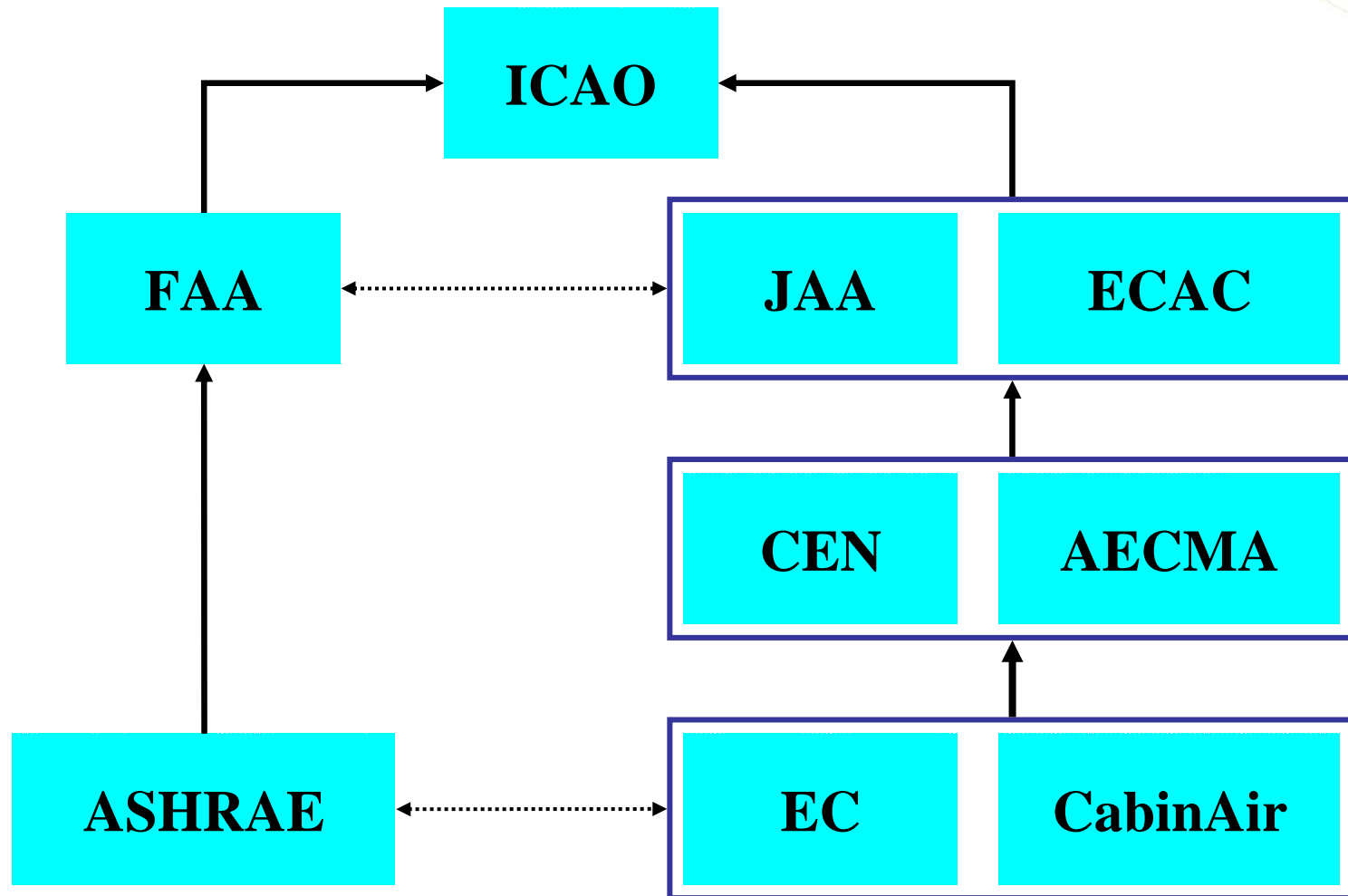


## Markers for air quality

| Pollutants                           | Sources   |
|--------------------------------------|---|
| CO <sub>2</sub>                      | Occupants, Galleys                              |
| CO                                   | Engine failure                                  |
| Ozone                                | External atmosphere                             |
| PM <sub>2,5</sub> ; PM <sub>10</sub> | Occupants, Food                                 |
| Ultra-fine particles                 | Exhaust gases, Food preparation                 |
| Ketones                              | Solvents, Fuel                                  |
| Acetaldehyde                         | Lubricants, Solvents                            |
| Acrolein                             | Lubricants                                      |
| Formaldehyde                         | Lubricants, Solvents, Plastics, Cleaning agents |
| Benzene                              | Exhaust gases, Fuel                             |
| ToCP                                 | Lubricants, Hydraulic fluids                    |
| Methyl Chloride                      | Solvents  |
| Naphtalene                           | Fuel, Oil                                       |
| Endotoxins                           | Gama Negative Bacteria                          |
|                                      |   |



# CabinAir and its linkages





## Some of the outputs

- Survey of cabin air quality in generic aircraft types
- Instrumentation to mimic thermal and microclimate of passengers
- New ECS design proposals
- Demonstrator for assessing new filtration systems
- New approach to air distribution
- External environmental impact assessment
- European Pre-Standard



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