



EASA
European Aviation Safety Agency

Electric & Hybrid Aviation Project / Innovation



General presentation of the Project

31-Oct-2018

Your safety is our mission.

An agency of the European Union 



Development of e-aircraft worldwide



Bertini



Venturi



Vahana



Cartercopter



Hepard



Hornisse



ZeroG



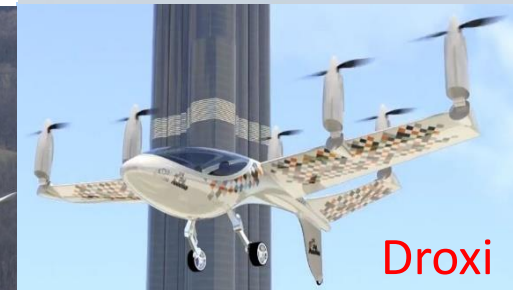
Sora-e



CityAirbus



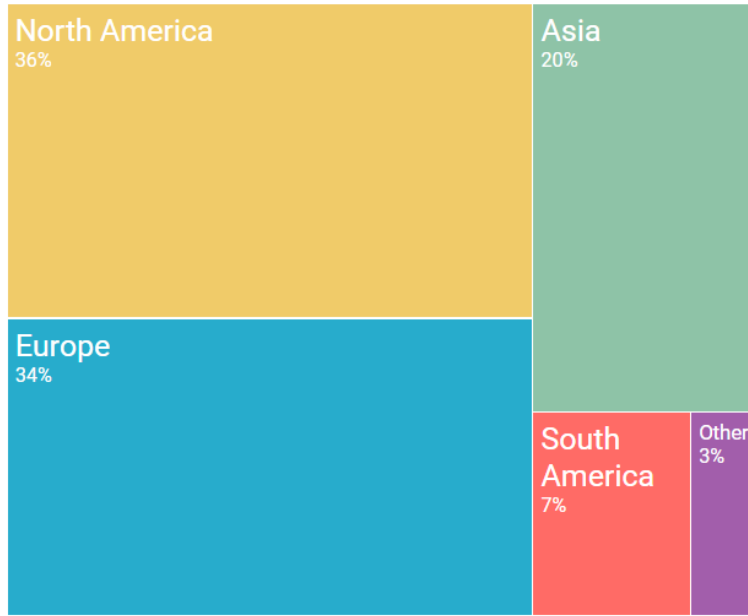
EPOS+



Droxi

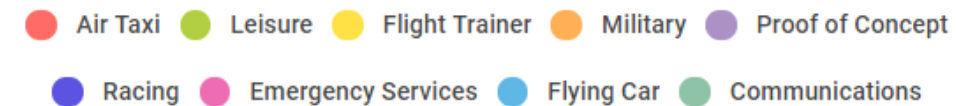
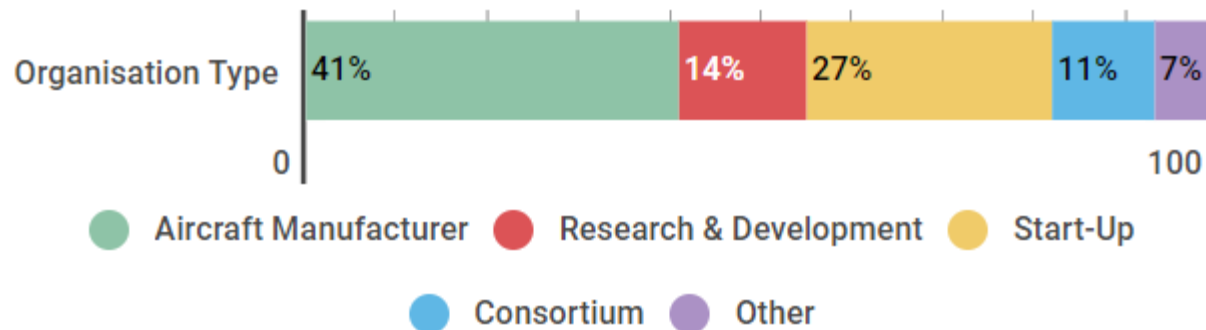
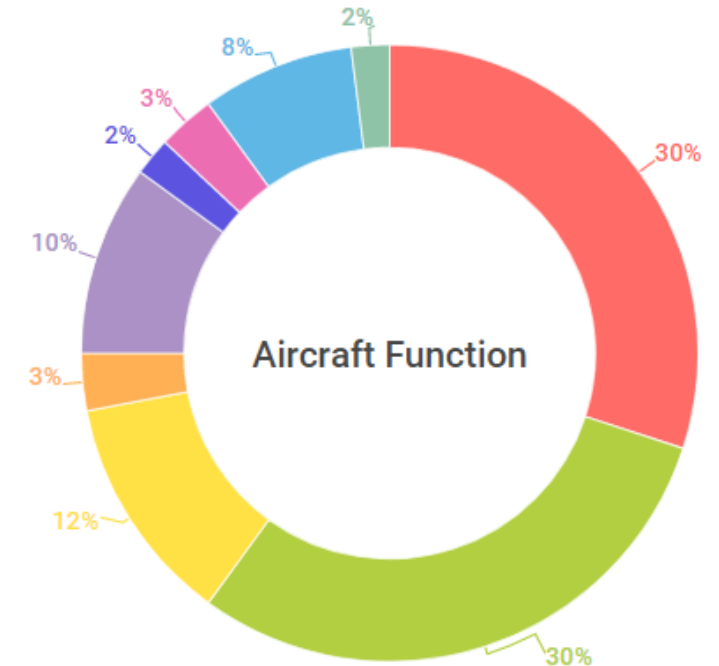


Development of e-aircraft worldwide



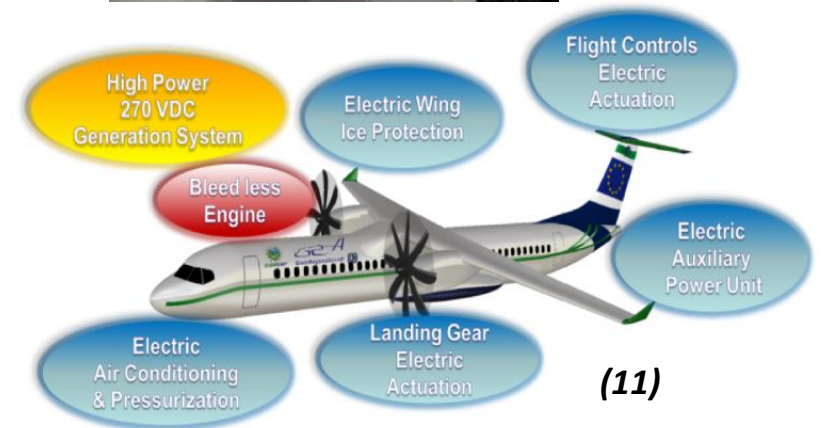
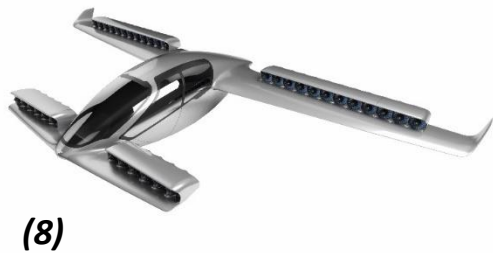
Percentage spread of worldwide electric & hybrid aviation projects

Performance Data	Min	Max
Cruise Speed (km/h)	60	426
Endurance (mins)	20	660
Range (km)	21	1278
MTOW (kg)	240	13380





Out of the Internet purely Europe... (not exhaustive)





Electric Aviation -- New Philosophies

➤ Conventional Aircraft

➤ More Electric Aircraft

- Replacing hydraulic and pneumatic systems with electrical powered systems, electric taxiing, spool up using electric motor

➤ Hybrid Propulsion

➤ All Electric Aircraft

➤ New Designs & Basic Layout

➤ Distributed Propulsion & Influencing Boundary Layer

➤ Electric VTOL ...



Electric Aviation -- New Technology

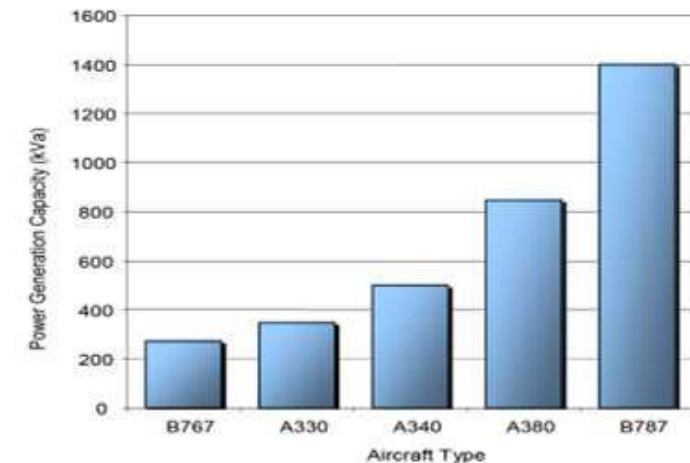
➤ Energy

- New battery types
- Fuel cells
- Solar Panels
- Increasing Voltage, ...

➤ Propulsion & Systems

- Brushless high power motors
- Electric Fans
- Power reserve (helicopter)
- Electric Actuators, ...

Commercial Aviation Electrical Power Systems and Infrastructure Market:
Aircraft Electrical Power Generating Capacity by Aircraft Type





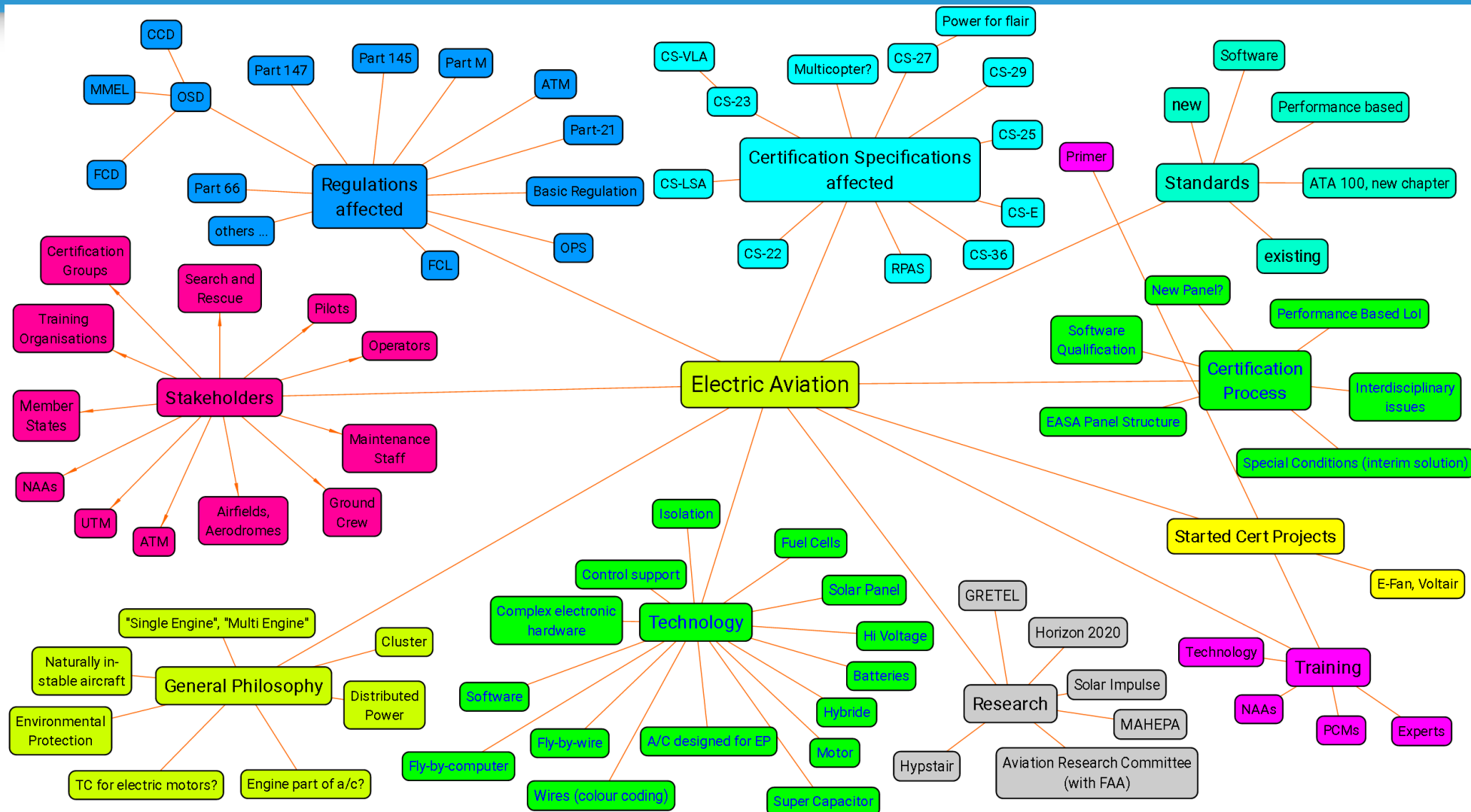
Electric Aviation -- New kind of Operation

- Taxiing without engine running
- Lower flight idle
- All electric conventional
- All electric VTOL
- PtP transport from airfields
- On demand Mobility from everywhere to anywhere





Some Thoughts -- Mind Map





Remember the Scene

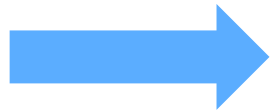
- Due to the nature of aviation, the high level of public attention aviation gets, and the complexity of the worldwide network in the back, aviation is internationally well regulated, defined and organised with limited flexibility.
- The future possibilities with the upcoming new technology of electric aviation go far beyond what has been imagined few years ago. They present an important potential for the development of civil applications in a wide variety of aviation sectors and applications



Some Thoughts -- Does it fit?

Do all these new concepts fit in the current regulation?

Not yet!



However, we have started to do something ...



European perspective



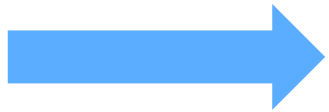
European aviation regulatory system with shared competencies between EC, EASA and NAAs.

	Building blocks
EASA is Competent Authority	<ul style="list-style-type: none">• Initial Airworthiness of the Type design• Environment (noise and emissions)
In the EASA Remit but EASA is not competent authority	<ul style="list-style-type: none">• Individual Certificate of Airworthiness• Air Crew• Air Operations• Continued Airworthiness• ANS Common Requirement• ATM/ANS safety oversight• Airspace Usage Req.• SERA• Aerodromes
Outside EASA world	<ul style="list-style-type: none">• Environment• Insurances• Supporting infrastructures



Some Thoughts -- What to do?

- New Specifications needed
- New flight routes needed
- New landing strips / pads needed
- New licenses needed
- New Rules needed



Rulemaking Activities needed ?

Yes, but



Some Thoughts -- The Short Term Way forward

- All different kind of designs
- So far no fix design still
- Different intended operation
- Thinking out of the box is needed



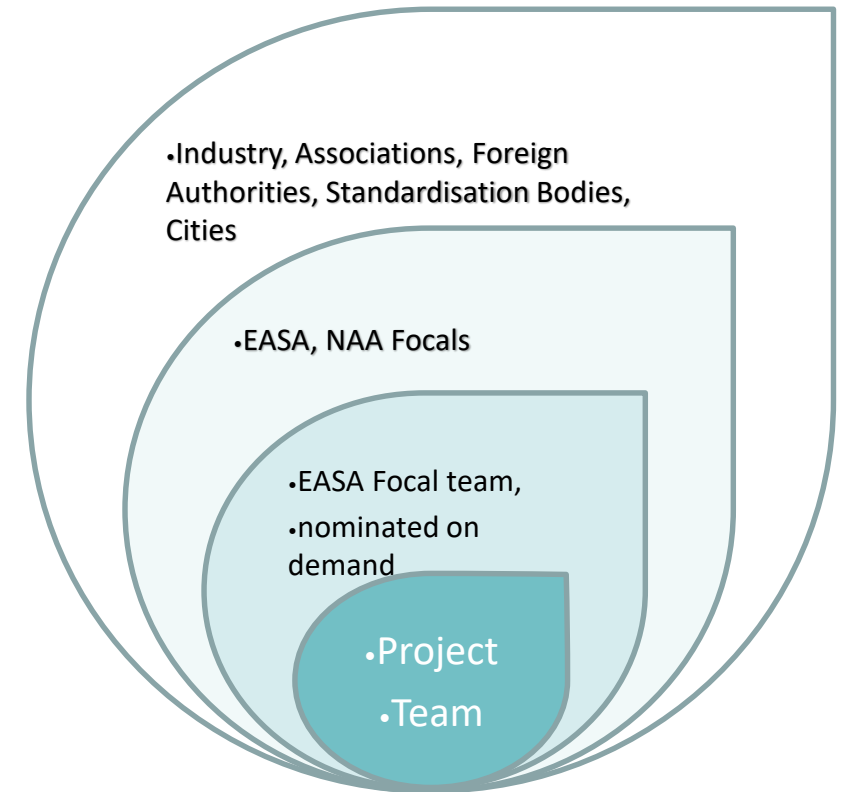
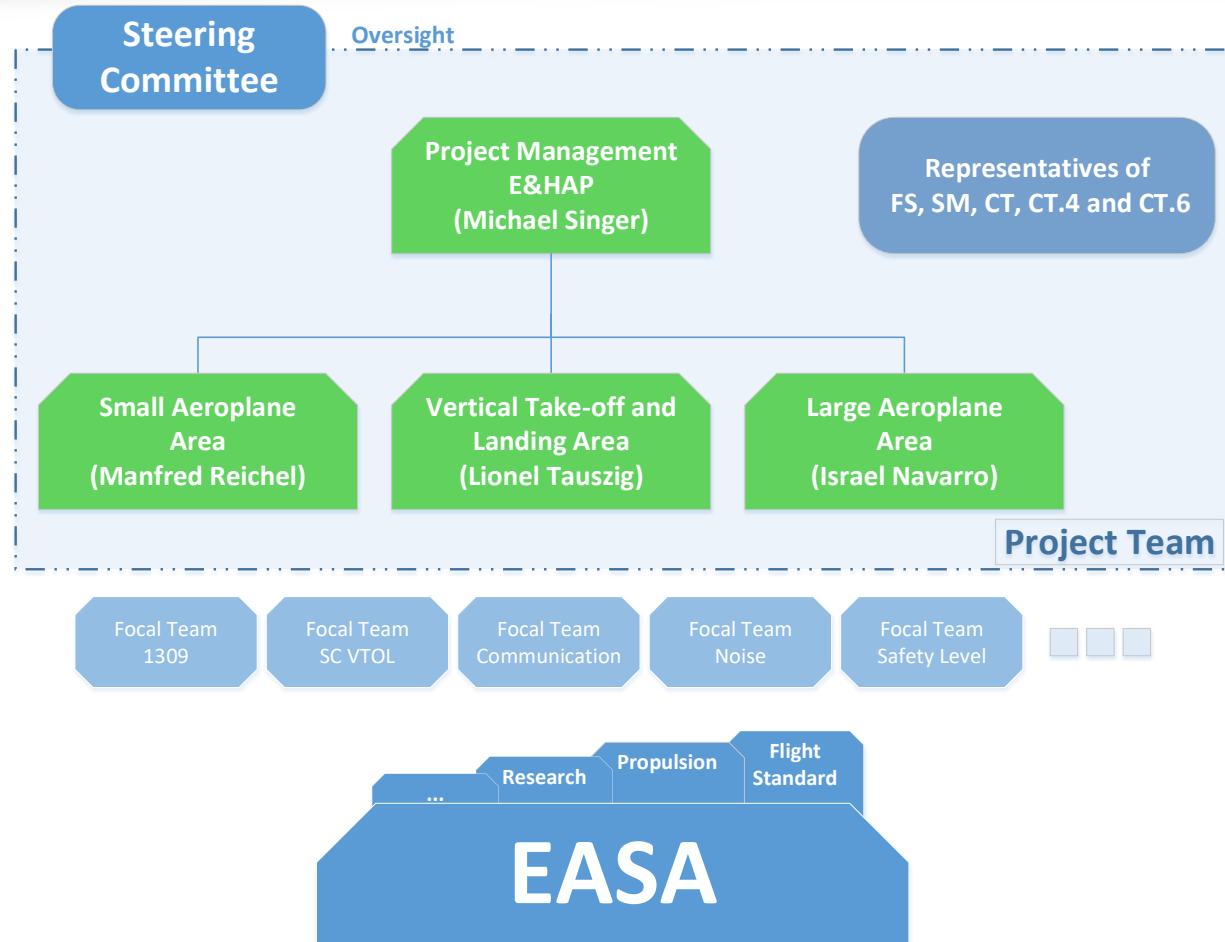
- Avoid limitation of technology by too early regulation
- Use built-in flexibility
 - For technology → Special Conditions (SCs by EASA)
 - For rules → Derogations / Exemptions (both by NAAs)

Challenge!

and ...



Structure of E&HAP

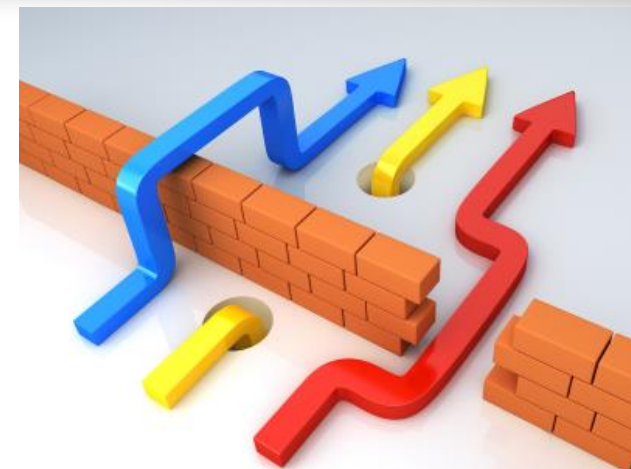


EASA Electric & Hybrid Aviation Project



Actual Status

- ✚ A first regulatory barrier / gap analysis has been done.
- ✚ Most of the items for the FE Aeroplane and already some items for eVTOL are identified.
- ✚ However, the analysis will go on to identify also items resulting from interaction and common operation of different designs.
- ✚ SC CS-VTOL has been published for comments





Main Items - General

- TC scope for Aircraft and Engine may evolve
- Do we consider electric motors as product, as part, or can it be both? Powertrain?
- Technologies not covered by current regulations?





Main Items - Rules

- Airworthiness
 - * Mainly Gaps
- Environmental Protection
 - * Mainly Gaps (no requirements)
- Aircrew
 - * Gaps & Barriers (no adequate licence)
- Operations
 - * Gaps & Barriers (only helicopter in cities)
- Continued Airworthiness
 - * Gaps & Barriers (licences & approvals)
- Aerodromes
 - * Mainly Gaps (no Vertiport)
- Air Navigation
 - * Gaps & Barriers (in case of autonomous)

PRELIMINARY



Main Items: Airspace integration

- For eVTOL aircraft there is the intention to do short distance air taxi service (CAT)
- Due to the limitations on available electric power no complicated departure route is intended but direct, low flight. This currently doesn't fit into the system → Corridors, NOTAM, etc necessary?
- A major part for that are the local authority and the cities
- In this respect the acceptance and reaction of the public needs to be checked



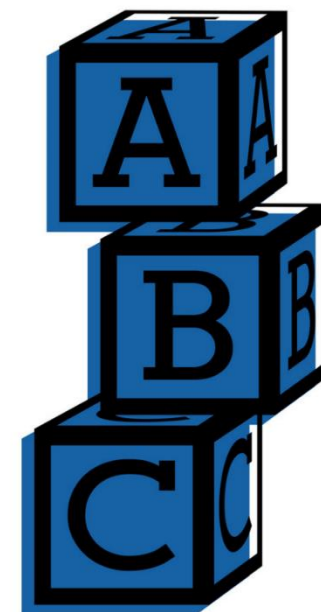
Focal Group on “CS-VTOL”

Adapted requirements for eVTOL aircraft

E&HAP Focal Group working on the definition of a set of requirements to properly cover eVTOL aircraft. This is done using the latest, performance based CS-23 in comparison with CS-27. By that also aircraft flying into hostile and congested areas intended to be addressed.

Process in 4 steps:

- A. Comparison of the two specifications
- B. Check of the relevancy of the found differences for the new design
- C. Specific thoughts on the type of operation
- D. Developing a Special Condition for eVTOL





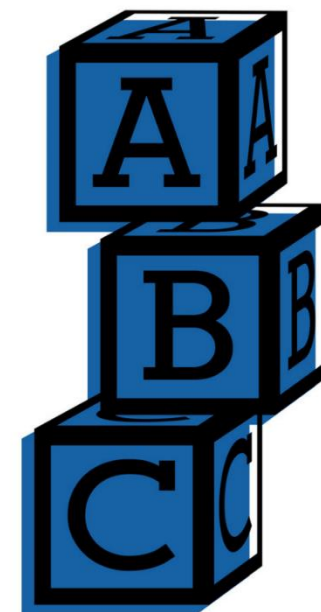
Focal Group on Safety Objectives

Required Safety Levels Focal Team

E&HAP focals working on the definition of the Required Safety Levels for modern eVTOL aircraft flying into hostile environment.

Process in 3 steps:

- A. Safety objectives very specific and tailored for eVTOL taking into account different Certification Specifications (CS-23 vs. CS-27).
- B. Take into account the type of operations (OPS rules framework) in relation to the safety objectives.
- C. Developing .1309 for Electrical eVTOL / New CS.





E&HAP and Industry

- EHAP supports the needs of industry for the development of electrical & hybrid aircraft
- EASA remains open to involvement in further regularity activities based on the development models driven by industry



EASA Pre-application Meetings

- Up to 4 hours, free of charge, at the EASA premises
- Main objectives :
 - to create a possibility for EASA to have a meeting with possible applicants about their project prior to an application for certification
 - for specific technical and procedural discussions (no EASA commitment on proposals for certification basis or on compliance demonstration!)
 - target is to have at the end of the meeting a clearer picture of the project, the necessary procedures, ways forward, challenges and trapfalls as well as the necessary additional items to be considered (SCs, ELOS', etc.)



EASA Technical Advisory Contract (TAC)

- Up to about 20 hours, charged on an hourly rate, at EASA premises
- Main objectives :
 - to create a possibility for EASA to work together with industry / research centre on technical issues without a certification project
 - for specific technical discussions (no EASA commitment on proposals for certification basis or on compliance demonstration!)
 - target is to have at the end a report giving possible ways forward, highlighting challenges and pitfalls as well as the necessary additional items to be considered (SCs, ELOS', etc.)



EASA Innovation Cell

- Small team of 2 persons, reporting directly to the ED
- Main objectives :
 - to create a dynamic of innovation in the Agency and foster the sharing of innovation knowledge and information across domains;
 - to manage or coordinate changes necessary to adapt the Agency activities and processes to innovation;
 - to support the Industry on innovation.



EASA Innovation Network

- Set-up of an Innovation Network
 - 100+ EASA colleagues have joined
 - Objectives:
 - Fostering “knowledge communities”
 - Sharing of knowledge and information
 - Encouraging cross-directorate / cross-domain collaboration on innovation
 - Supporting foresight/monitoring activities
 - Supported by an intranet based community tool
- Organisation of thematic lectures on innovation
- Set-up of dedicated task forces to develop thematic roadmaps (e.g. on Artificial Intelligence)



Memorandum of Cooperation on Innovation

Memorandum of Cooperation on innovation

- establish a formal framework:
 - to cooperate in the early stage identification of key risk areas of innovation projects and possible support that the EASA could provide; and
 - to enable EASA to adapt its processes, organisation, staff competence plans rules and procedures to support innovation, by involving it upstream EASA in industry innovative projects.
- Possible related tasks and actions:
 - Specific Innovation Partnership Contracts
 - Workshops
 - Research cooperation (PhD thesis, ...)
 - Universities networking
 - Exchanges of experts on limited period
 - Training



Innovation Partnership Contracts

Innovation Partnership Contracts:

- cover the supply of technical knowledge and support within an innovation project to support the development of:
 - novel technologies,
 - new business models, or
 - new services;
- focus on the exchange of expertise on a multi-disciplinary scale (certification, operation, crew qualification, ATM, etc...);
- address the concept development phase (feasibility), do not cover any pre-certification task (this is done via Technical Advice Contracts – TAC).



E&HAP & Standardisation Bodies

► EASA involvement in Standardisation bodies:

- EASA is involved in about 140 Standardisation Bodies Working Groups
- EASA is involved in **SAE, Eurocae, ASTM, RTCA** and **others**.





E&HAP - EASA and Eurocae & ASTM

➤ Eurocae

- WG80 Hydrogen Fuel Cell Systems
 - Group very active



➤ ASTM

- F39.05 standard for design of “Electric Propulsion Units” for GA
 - *ASTM WK47374 standard for the design of “Electric Propulsion Units”*
 - ASTM WK41136 Aircraft Electric Propulsion Systems
- F44.40 of electric propulsion installation in GA.
 - ASTM WK56255 Energy Storage Systems
- Electric propeller





➤ Standard for Batteries

- RTCA DO-311A “Minimum Operational Performance Standards for Rechargeable Lithium Battery Systems.”
- SAE J2929 “Safety Standard for Electric and Hybrid Vehicle Propulsion Battery Systems Utilizing Lithium-based Rechargeable Cells.”
- SC-225 Rechargeable Lithium Batteries and Battery Systems





EASA

European Aviation Safety Agency

Questions?

Your safety is our mission.

An agency of the European Union

