

Electrified Propulsion Aircraft - Standardization Challenges

Electrification Challenge for AIRcraft (ECLAIR) Consortium

By JAXA, 28 November 2018, Tokyo Japan

We make it fly

Creating a better connected,
safer and more prosperous world

Richard AMBROISE

Electrification Flight Demonstrator

Head of Propelling

&

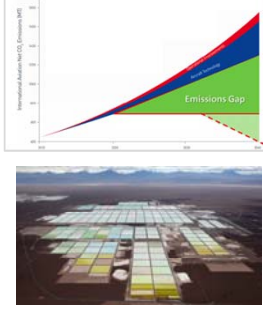
SAE E-40 « Electrified Propulsion » Committee Chairman

AIRBUS

AVIATION POSITIONING VERSUS EXTERNAL TRENDS

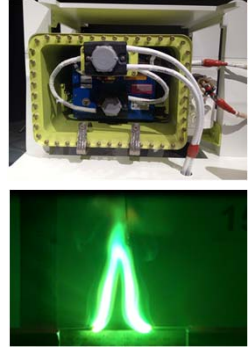
ENVIRONMENTAL & SOCIETAL TRENDS

- ❑ Aircraft noise certification levels will become more stringent (ch14 - 9dB by 2028) and Airbus needs to meet ICAO Noise Sustainable Growth objective (-3dB / 10 years)
- ❑ Airbus committed to meet ICAO CO2 reduction targets : Aviation: Neutral 2020-2035, -50% in 2050 vs 2005
- ❑ Raw materials usage on electrical equipment (e.g. lithium, cobalt, rare earth) will become critical with increasing electrification mega-trend



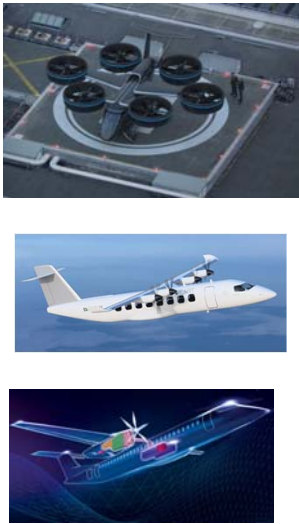
SAFETY & SECURITY

- ❑ Certification rules on lithium batteries becoming more stringent
- ❑ Voltage / Power increases lead to higher risk of electrical arcing / fire to be handled
- ❑ Safe design & installation rules for storage & distribution of non-drop-in fuels for aviation to be developed



AVIATION MARKET TRENDS

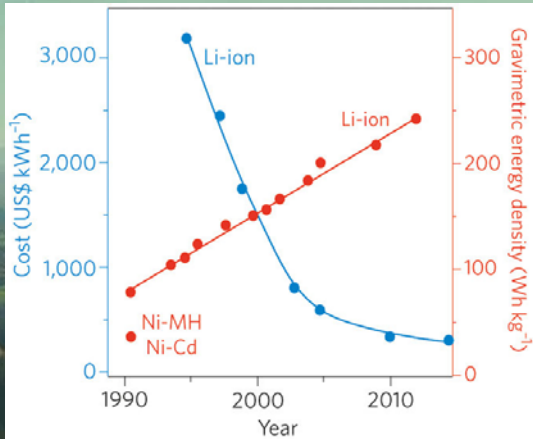
- ❑ UAM / Low-Zero emission aircrafts: strong competition in CS23 segment with many small and large players, wide design space enabled by electric or hybrid-electric propulsion,
- ❑ Heart Aerospace start-up disclosed Swedish National project to develop a 19-pax full-electric battery-based demonstrator
- ❑ Early 2019, UTC Group unveiled Project 804 to retrofit a Dash 8 turboprop with an Hybrid-Electric Propulsion System expected to yield an average fuel savings of 30 percent



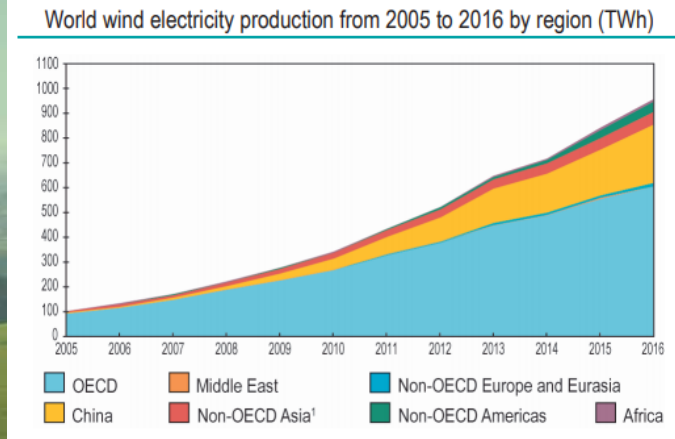
NON-AVIATION MARKET AND TECHNOLOGY TRENDS

- ❑ Distributed Propulsion and Wing-tip propellers, enabled by electric motors, open new configuration opportunities
- ❑ Electrification mega-trend disrupting all industry sectors, particularly automotive from 2020-22. It opens up new opportunities for aerospace
- ❑ Lightweight high-power-density electric motors and cost-efficient battery packs and semiconductors will soon become a commodity
- ❑ Carbon emission challenge will accelerate energy transition towards Non-fossil fuels

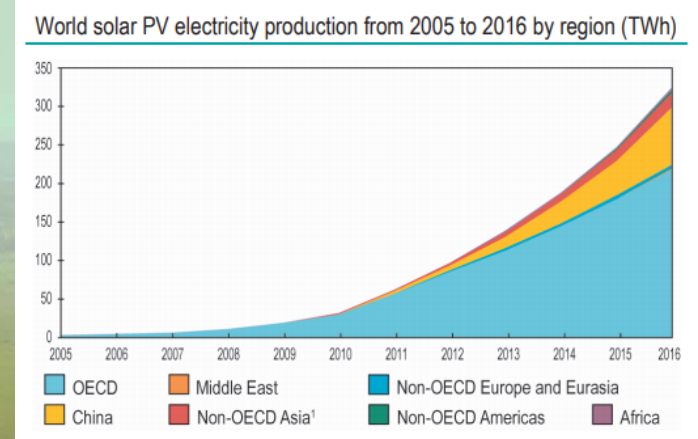




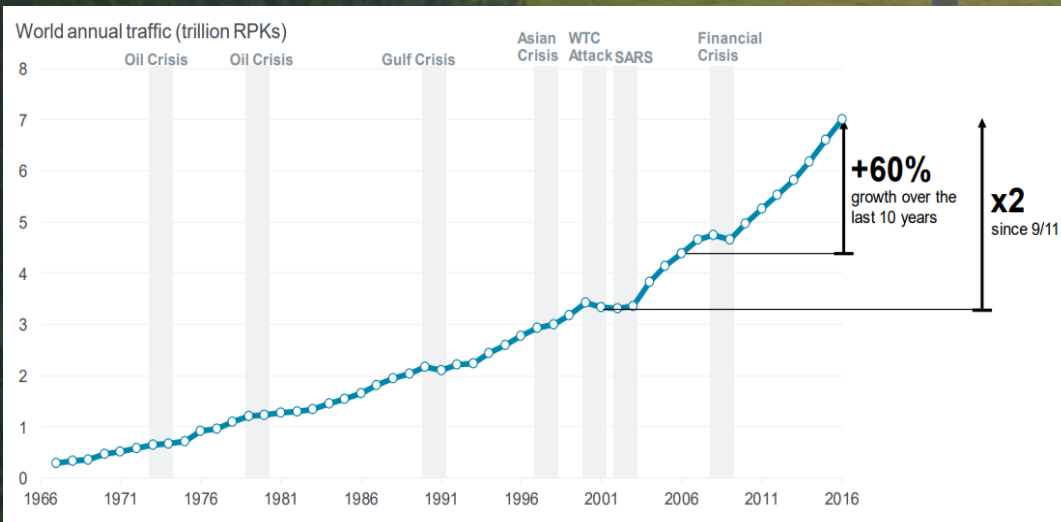
Battery cost & specific weight continues to decrease



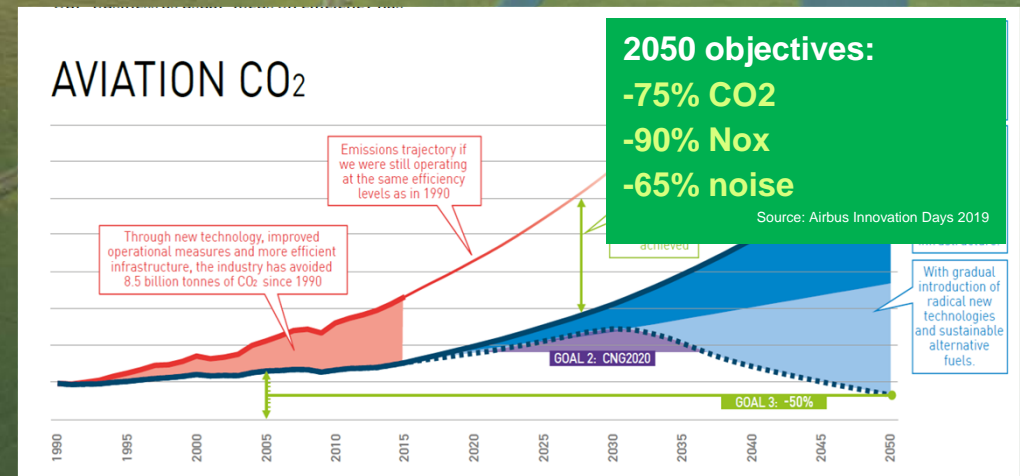
Doubling of wind production over last 5 years



Five times more solar in last 5 years

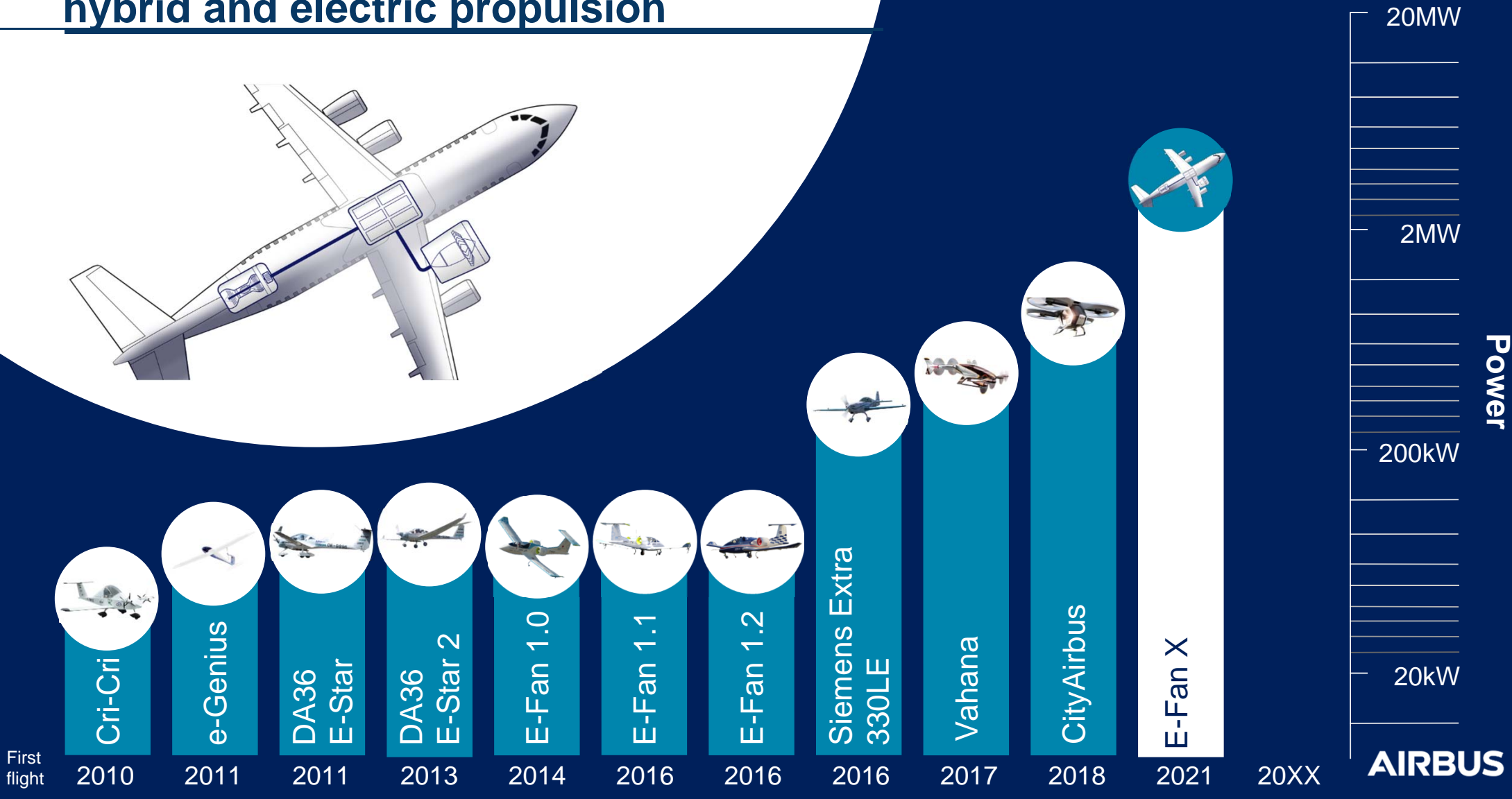
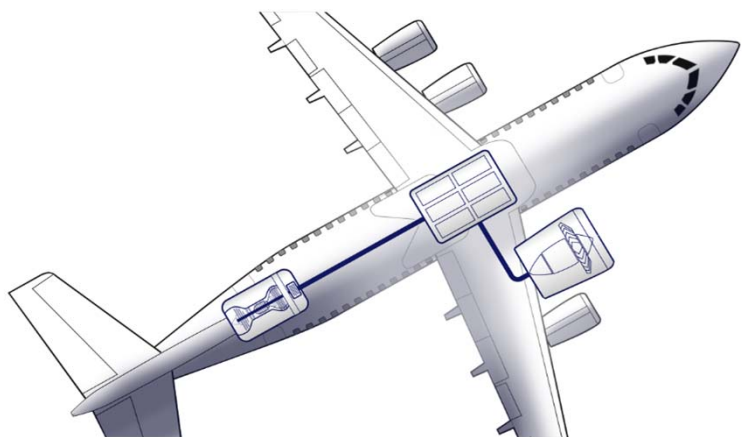


Airbus research focused on continuing sustainable growth...



... whilst meeting aviation emission reduction objectives

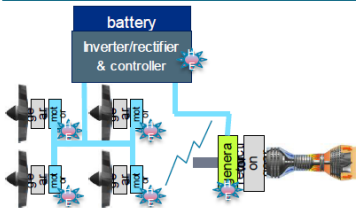
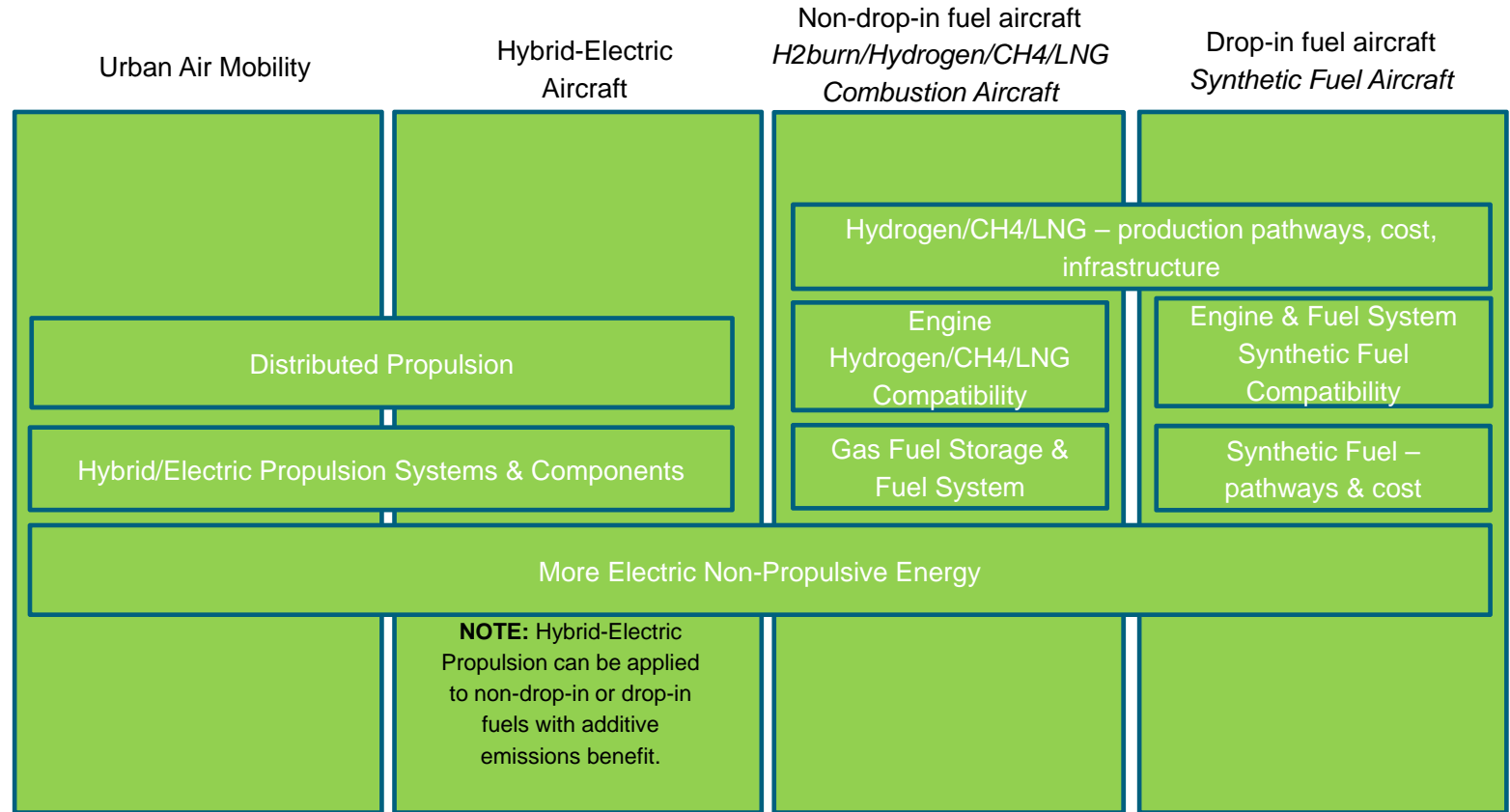
Airbus 10-years background with hybrid and electric propulsion



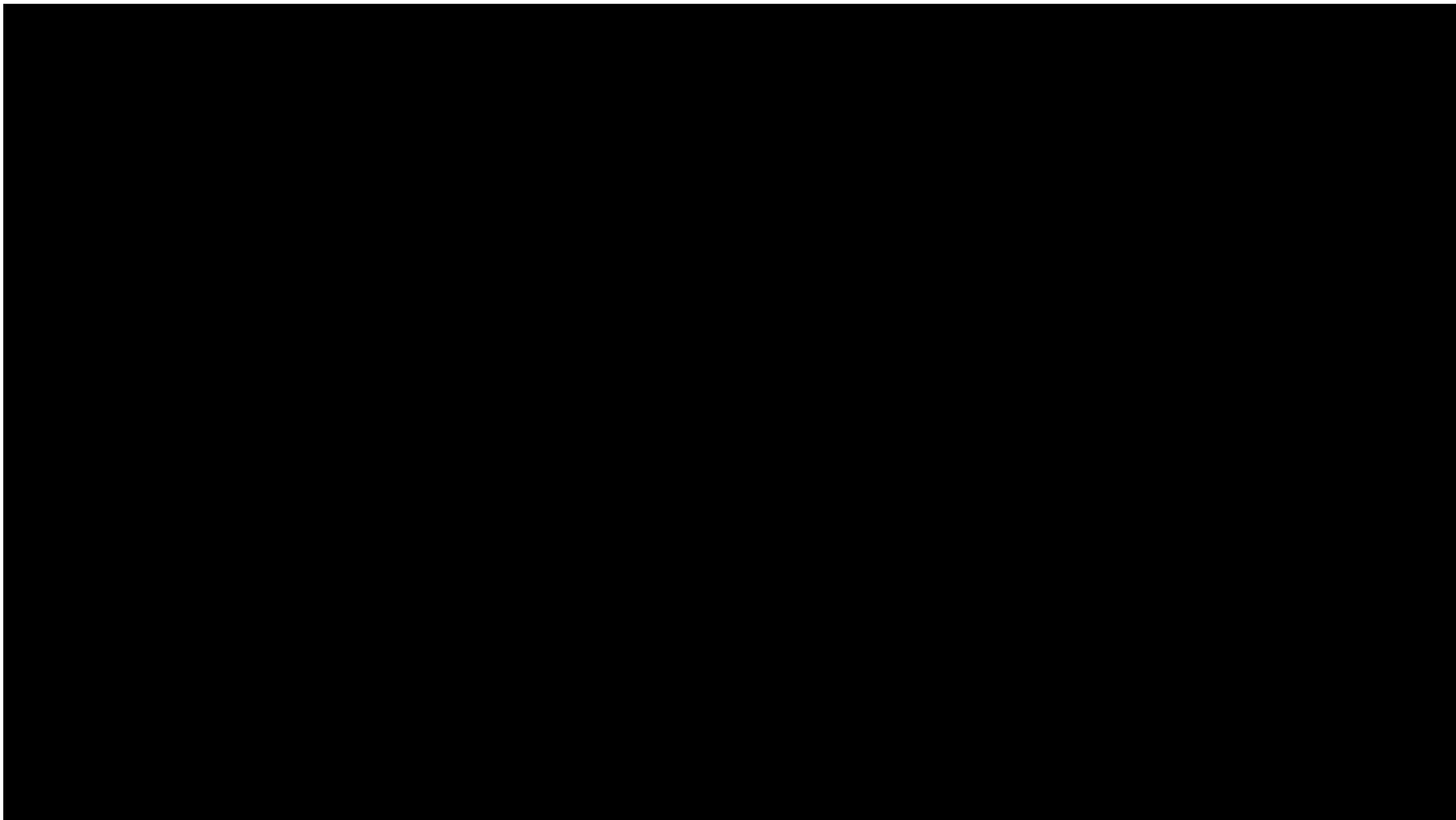
AIRBUS

Proposed technology responses

*Electrified Propulsion
Technology has been identified
as a key enabler to reduce
fleet carbon foot print*



Source: Airbus/Cryoplane

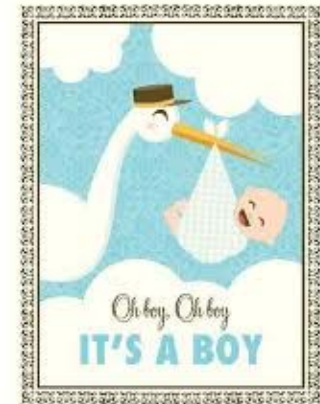


SAE E-40 Electrified Propulsion Committee

The E-40 « Electrified Propulsion Committee » has been created in November 2018 and borned in February 2019 at Orlando.

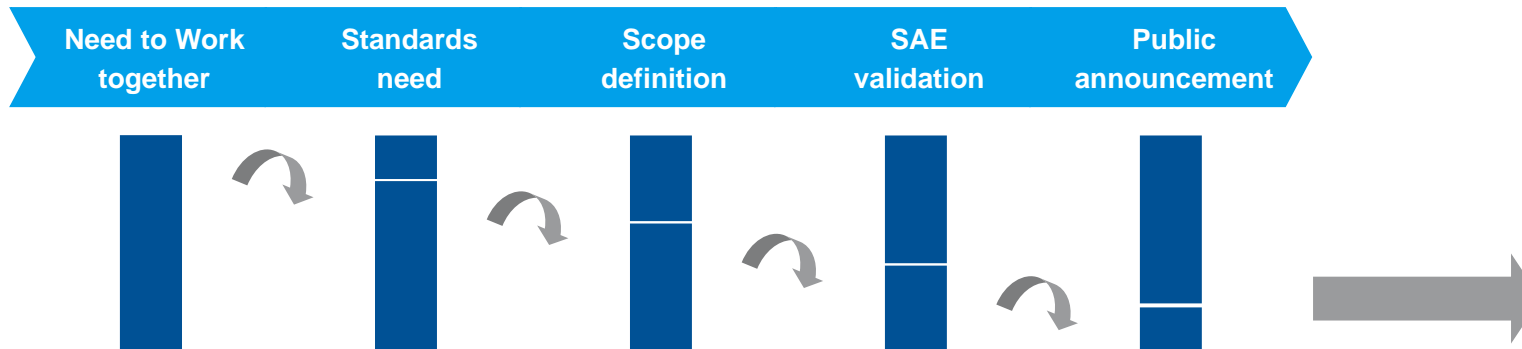
Today he is two meetings old

- *Richard Ambroise is the Chairman,*
- *Ed Lovelace is the Vice Chairma,*
- *Gabriel Godfrey is the Secretary.*



Impetus for committee – industry need

From the beginning



At Toulouse Sept 2018, the legacy aircraft propulsion actors shared the view on the need of working together

An initial shopping list of standards has been established at Toulouse Sept 2018 meeting

A scope of a new group has been drafted

The creation of a new group has been approved by the SAE AEROSPACE Council Nov 2018

Press released and E-40 presentation in Nov 2018 at:

- SAE ASTC, London
- JA2018, Tokyo

“Electrified Propulsion” technology:

Considered as to be an enabler to reduce carbon foot print of our industry

E-40 “Electrified Propulsion”

A tool to pave the way of the introduction of electrical technology to the propulsion of our future aircrafts

E-40 Committees Scope & Objectives

The SAE International E-40 Electrified Propulsion Committee is a **technical committee** in SAE's Aerospace Propulsion Systems Group with the responsibility to **develop and maintain technical reports** (Aerospace Standards, Aerospace Recommended Practices and Information Reports) covering **electrified propulsion for aircraft**. The committee recommends standardized nomenclature, defines applicable terms and example architectures , and addresses considerations for performance, airworthiness, safety, aircraft integration, components **and interfaces within and between propulsion system and other aircraft equipment.**

E-40 Committees Scope & Objectives

In addition, the E-40 committee provides recommendations to and **collaborates with** the SAE Electric Aircraft Steering Group and **other relevant standards committees** to develop necessary standards, recommended practices and information reports in related areas, including but not limited to:

Electromagnetic Compatibility (AE-4), Lightning Effects (AE-2), Health Management (HM-1, E-32), Ground Support Equipment (AGE-3), Distributed Propulsion, Maintenance (G-11), Aircraft Operations, Cockpit Indicators (A-4), Electrical Wiring & Interconnect Systems (AE-8), Aerospace Electrical Power & Equipment (AE-7), Electronic Engine Controls (E-36) and Electrical Materials (AE-9). Hybrid EV Steering Committee, ASTM F39/F44

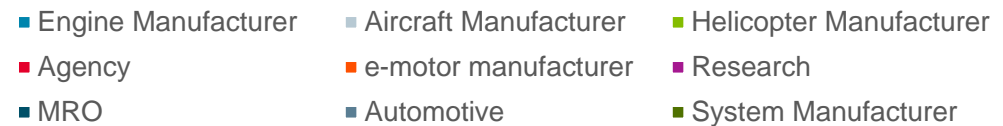
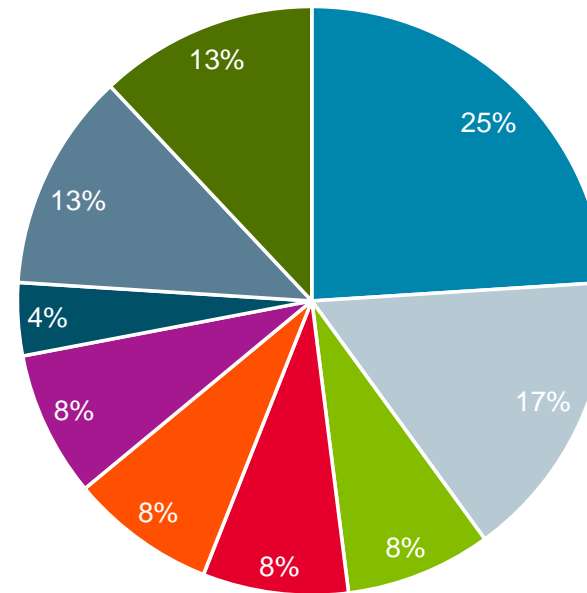
E-40 #1 Meeting Attendance

45 Members are present in Orlando Feb 19
(including 2 SAE representatives).

Markets:

- Rotorcraft
- Large Commercial Aircraft
- General Aviation & Urban Air Mobility
 - Business Aircraft
 - Automotive

E-40#1 Industry Segments



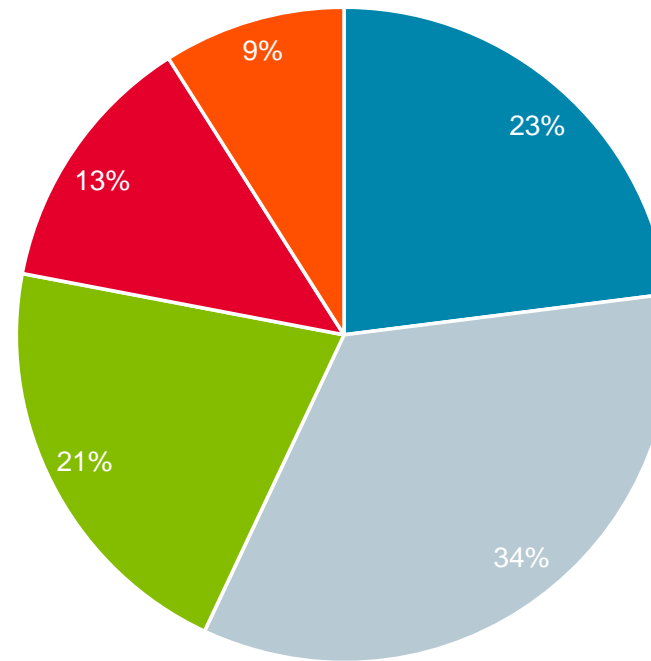
E-40 #2 Meeting Attendance

54 Members are present in Barcelona Sept 19
(including 3 SAE representatives).

Markets:

- Rotorcraft
- Large Commercial Aircraft
- General Aviation & Urban Air Mobility
 - Business Aircraft
 - Automotive

E-40#2 Industry Segment



■ Engine/Motor Manufacturer ■ Aircraft Manufacturer ■ System/Component Manufacturer
■ Government/Regulatory Agency ■ Research/Academia

E-40 Road map and skills

Online survey launched between E-40#1 & E-40#2 to:

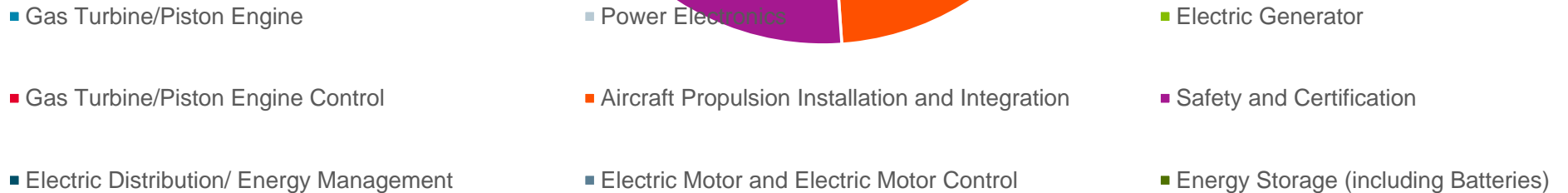
- **Refine Industry Road Map**
 - **Measure E-40 Industry Representativeness**
 - **Measure E-40 Skills**
-
- **70 members have responded (out of 123 on the committee roster)**

E-40 Member Survey Results

Markets:

- Rotorcraft
- Large Commercial Aircraft
- General Aviation & Urban Air Mobility
 - Business Aircraft
 - Automotive

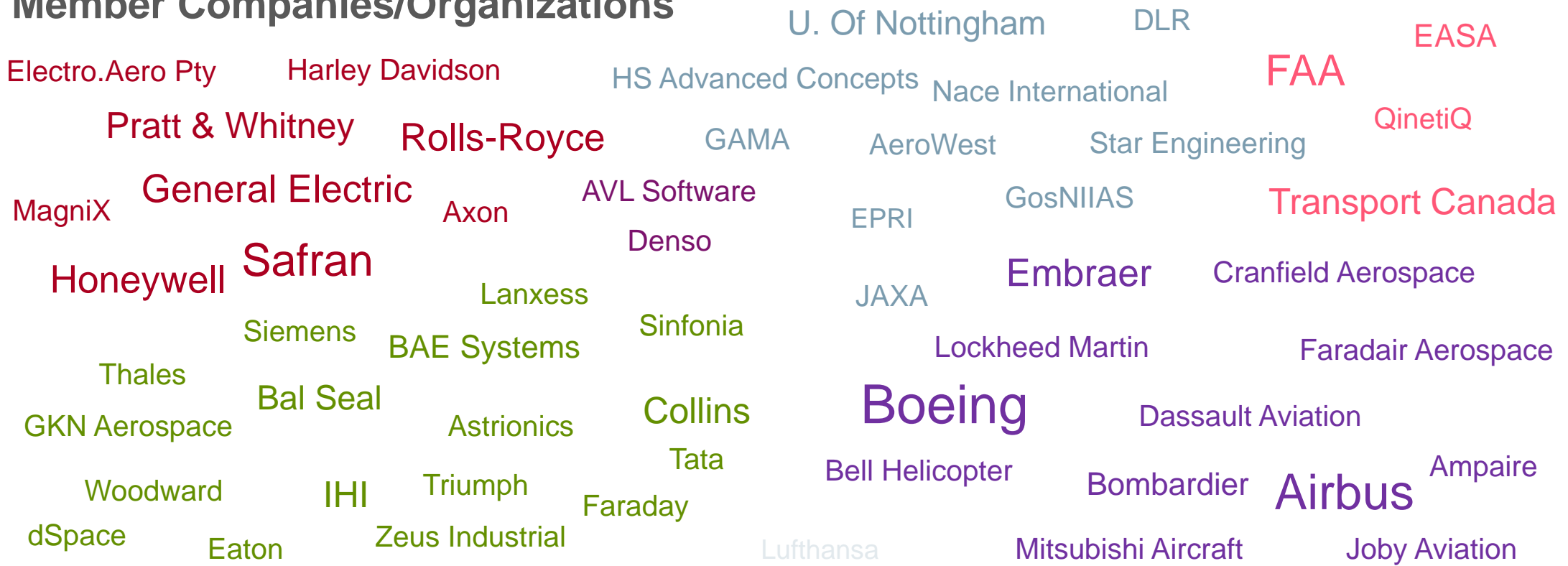
E-40 Roster Main Skills



Note: based on 70 responses

E-40 Member Survey Results

Member Companies/Organizations



Aircraft/Rotorcraft Manufacturer | Government/Regulatory Agency | Research Institute | Engine/Motor Manufacturer
System/Component Manufacturer | Airline/MRO | Automotive

E-40 Member Survey Results

Expectations from E-40 Members – Main Keywords

Safety

Regulation/Certification

Introduction

Standards & Guidance

Technology

Future

Collaboration

E-40 workgroups, the voice of our industry

E-40 Subgroup Main Skills

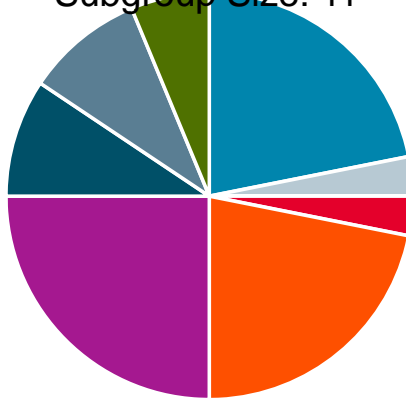
ARP 8676: *Nomenclature & Definitions for Electrified Propulsion Aircraft*

ARP 8677: *Safety Considerations for Electrified Propulsion Aircraft*

AIR 8678: *Architecture Examples for Electrified Propulsion Aircraft*

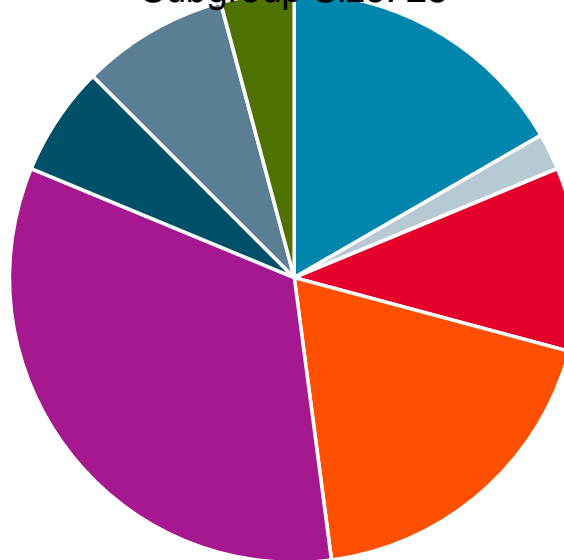
ARP 8676 Skills

Subgroup Size: 11



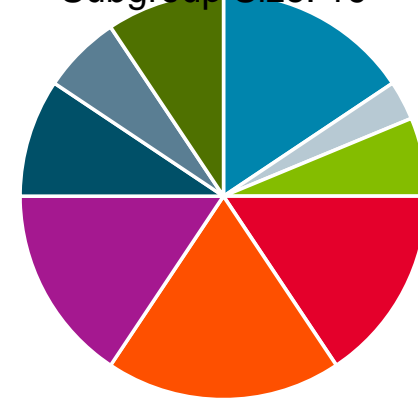
ARP 8677 Skills

Subgroup Size: 28



AIR 8678 Skills

Subgroup Size: 19



- Gas Turbine/Piston Engine
- Gas Turbine/Piston Engine Control
- Electric Distribution/ Energy Management
- Power Electronics
- Aircraft Propulsion Installation and Integration
- Electric Motor and Electric Motor Control
- Electric Generator
- Safety and Certification
- Energy Storage (including Batteries)

E-40 Member Survey Results

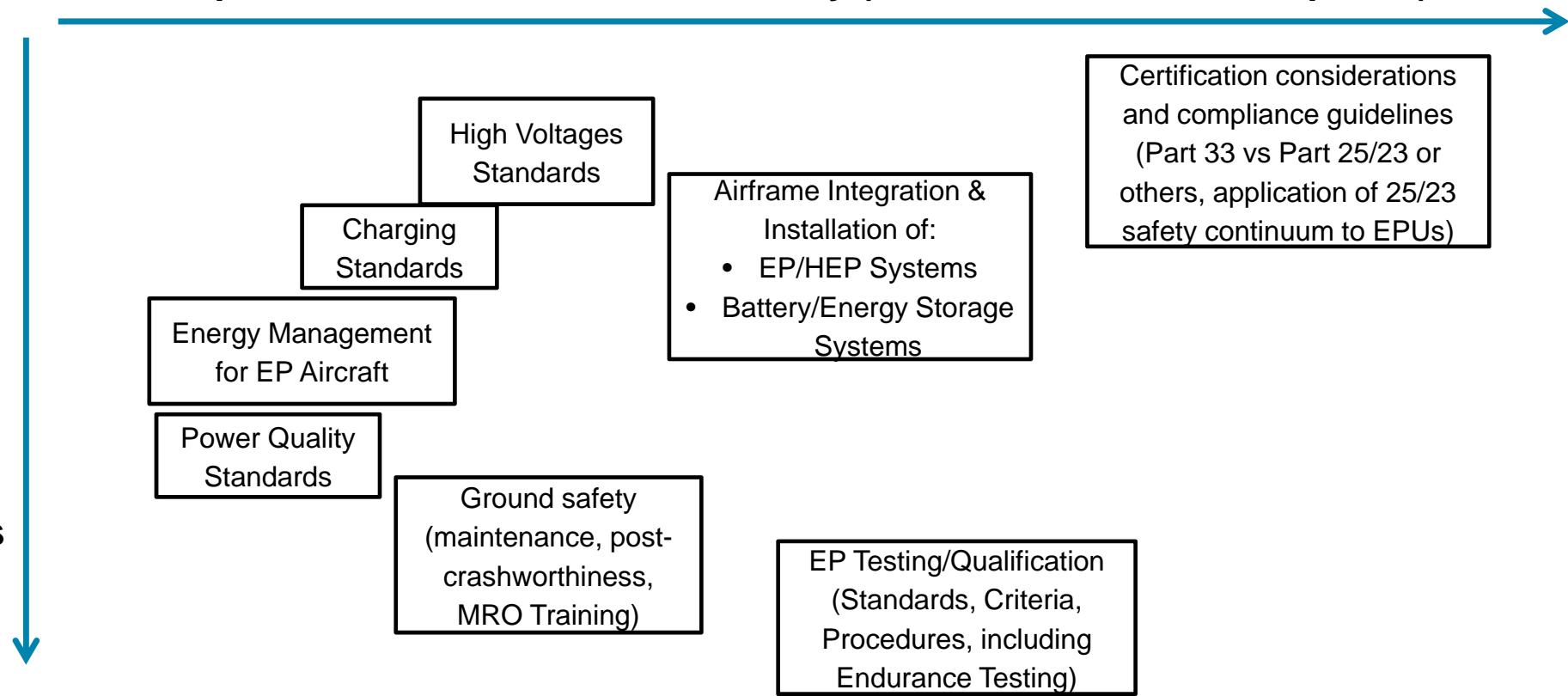
Industry Need for New Publications – Main Proposals

Importance of Publication for Industry (Based on # of Times Proposed)

Time of Industry Need for Publication

Now

Within
2 Years



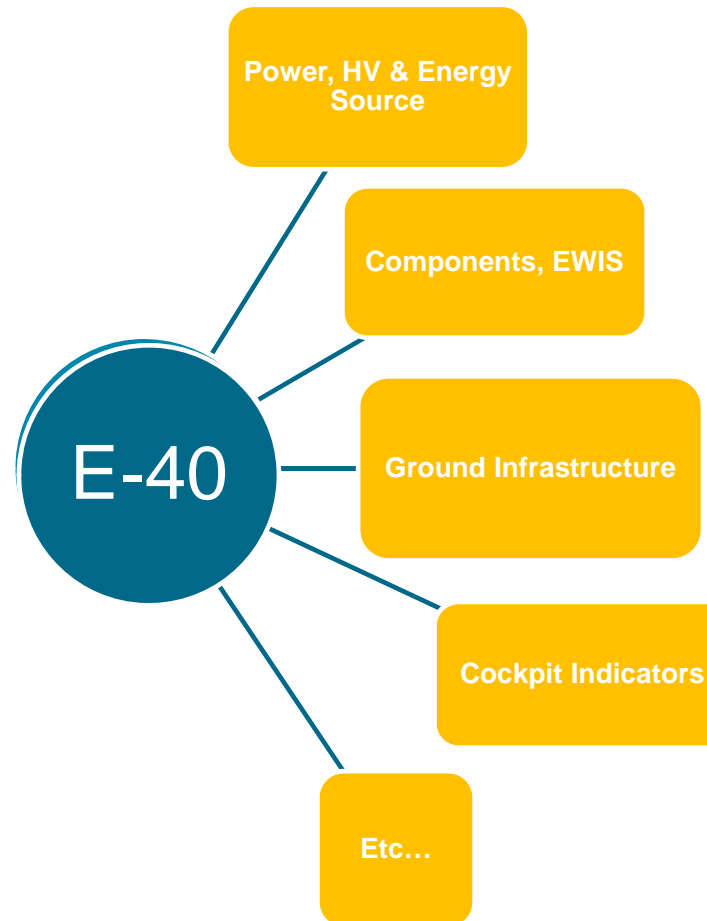
E-40 Survey Conclusion

Online survey had confirmed:

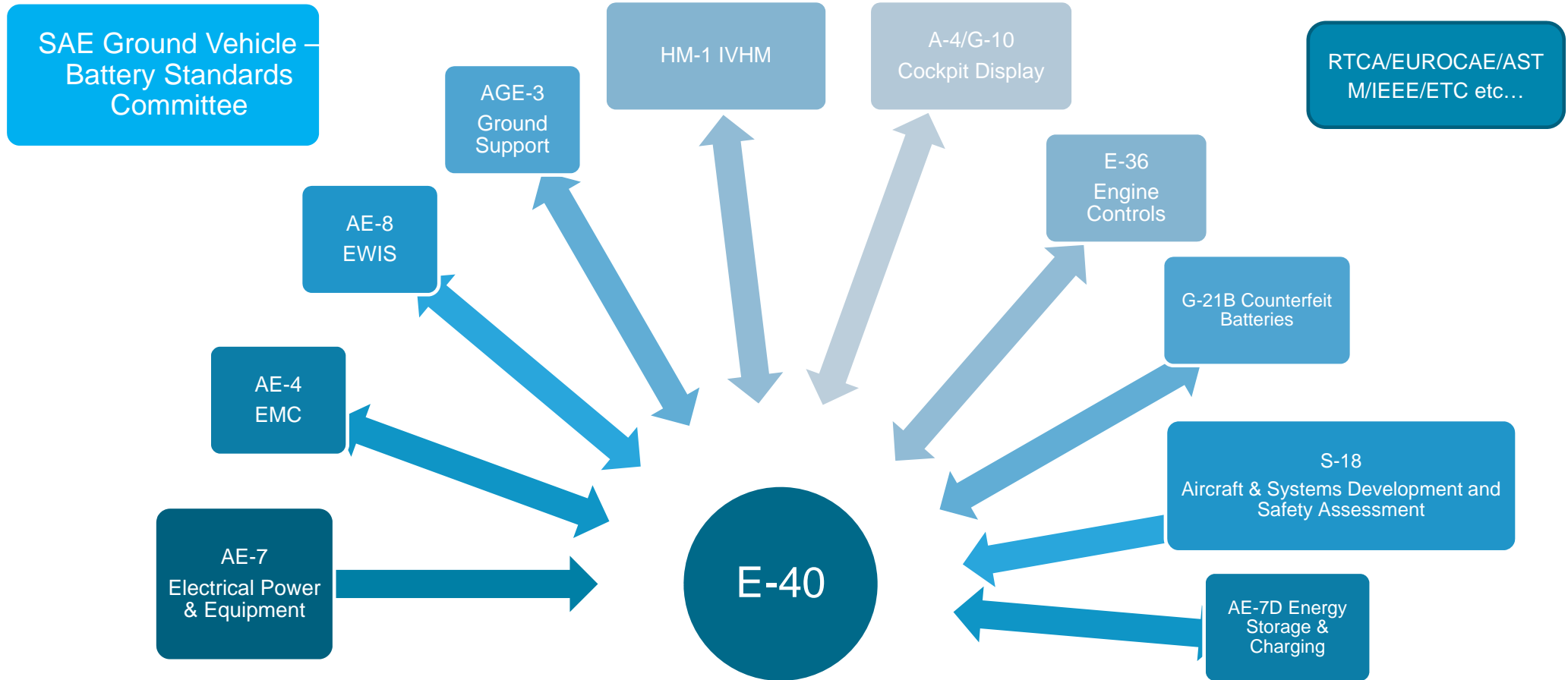
- Our Road Map
- The E-40 Industry Representativeness
- The Skills Requested to Deploy our Road Map

The E-40 Committee is the appropriate one to produce the standards for Electrified Propulsion

E-40 Committee Addresses All Facets of Electrified Propulsion



Interaction With Others Committees and Initiatives



Interaction With Others Committees and Initiatives

E-40 Liaisons

SAE Committees

EASG Electric Aircraft Steering Group (keiichi)
AE-7 Aerospace Electrical Power Systems (Kamiar)
AE-7D Aircraft Energy Storage & Charging (John)
AE-2 Lightning (TBD)
AE-4 Electromagnetic Environmental Effects (TBD)
AE-6 Starting Systems & Auxiliary Power (TBD)
AE-8 Aerospace Electrical/Electronic Distribution Systems (Arnaud)
AE-9 Electrical Materials (Eddie)
A-21 Aircraft Noise Measure & Emissions Modelling (Ed to find a name)
A-6 Aerospace Actuation, Control and Fluid Power Systems (TBD)
E-36 Electronic Engine Controls (Bill)
E-32 Aerospace Propulsion Systems Health Management (Nasser)
HM-1 Integrated Vehicle Health Management (Nasser)
S-18 Aircraft & Systems Development and Safety Assessment (Louis – David)
S-12 Helicopter Powerplant (Louis – David)
E-39 (Mark)+ SAE hybrid ground vehicle+ Fuel cell automotive (Tao)

Other Organisations

ASTM F-39, F-44 (Bill. F + Gary)
GAMA EPIC/ELC (Luciano)
AIAA Electric Propulsion Technical
Committee (Keiichi)
RTCA/EUROCAE (David)

**Ambassadors
List**

E-40, an Itinerant International working group

E-40 policy:

To alternate face to face meetings with Americas, Europe and Asia.

Past:

- E40#1: Orlando, USA Feb 2019
- E40#2: Barcelona, Spain Sept 2019

Upcoming:

- E40#3: Tokyo, Japan March 2020
- E40#4: San Diego, USA Sept 2020

JOIN US

THANKS !!!!!!!!!!!!!

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