Europe-Japan Symposium
Electrical Technologies for the Aviation of the Future

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Summary Session

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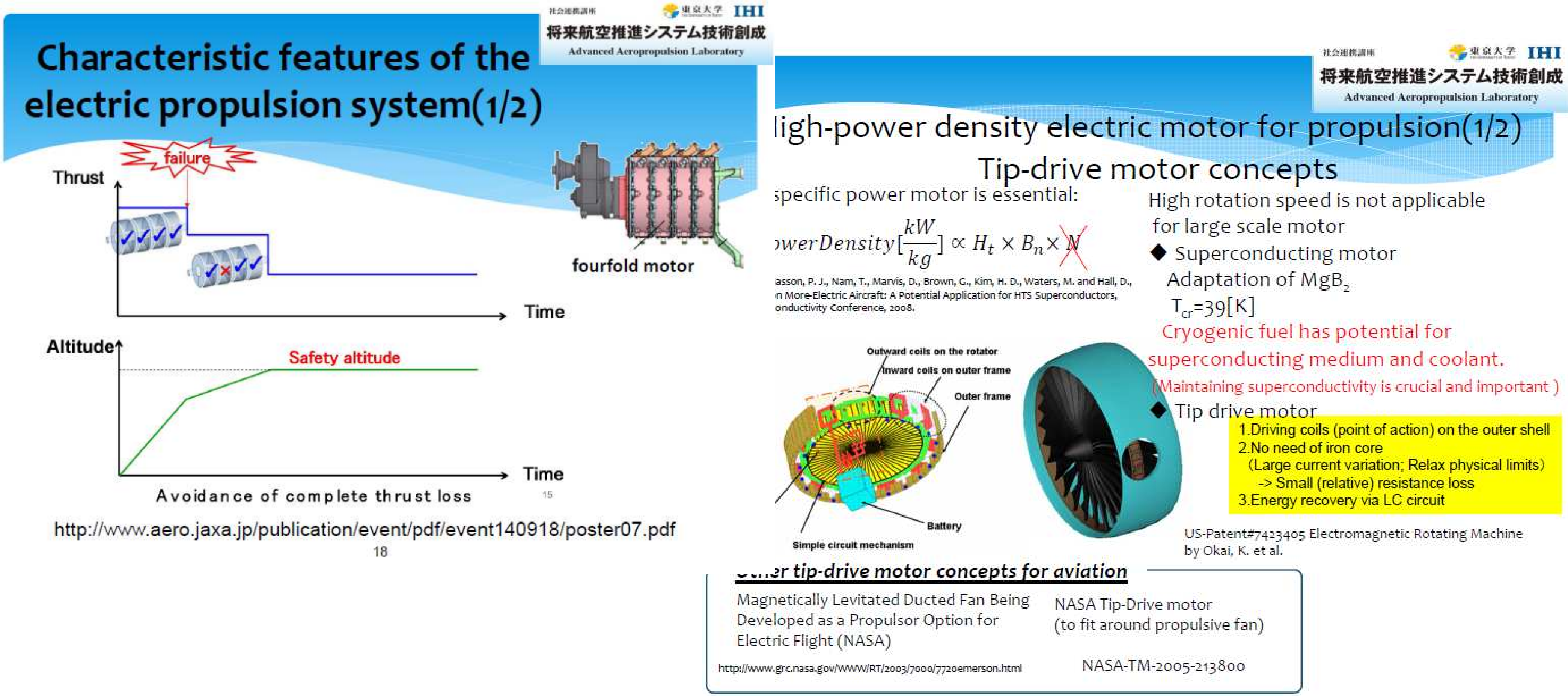
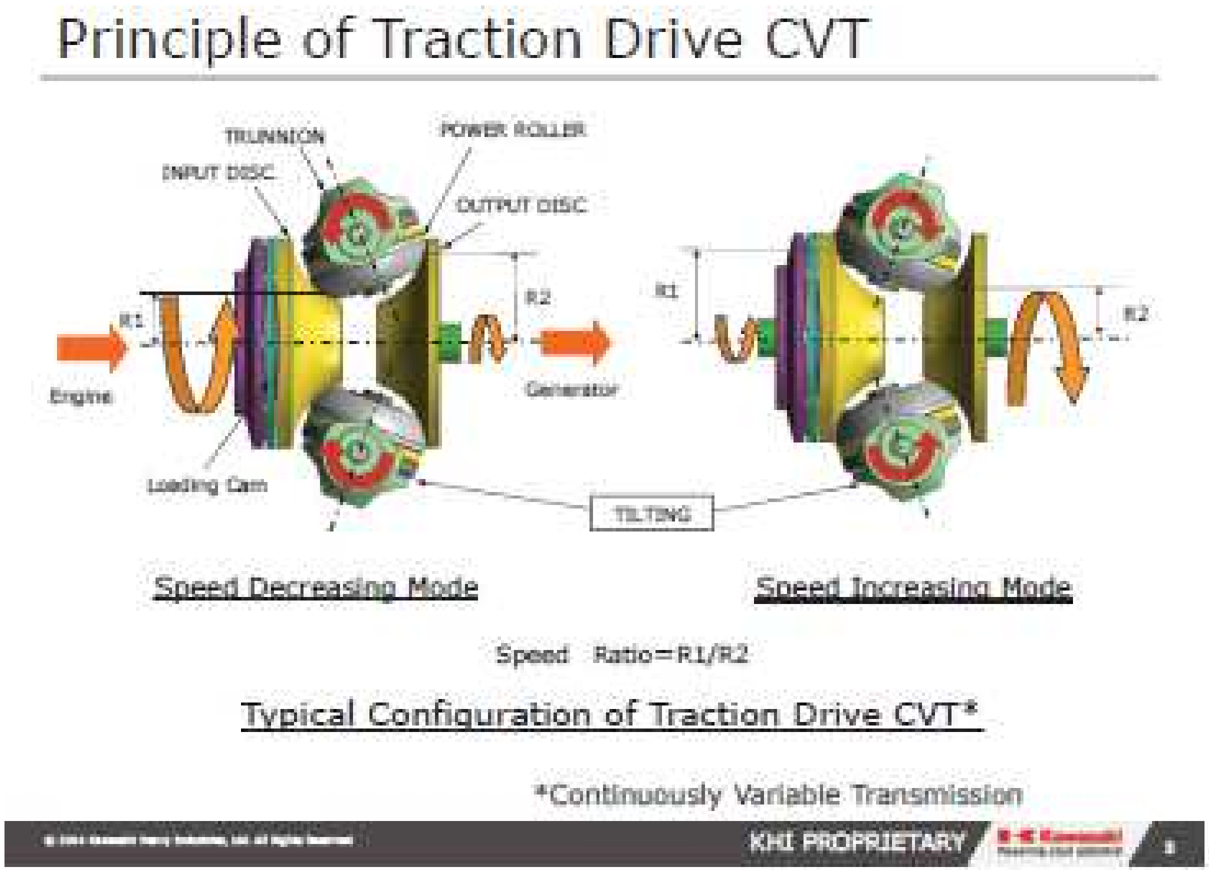
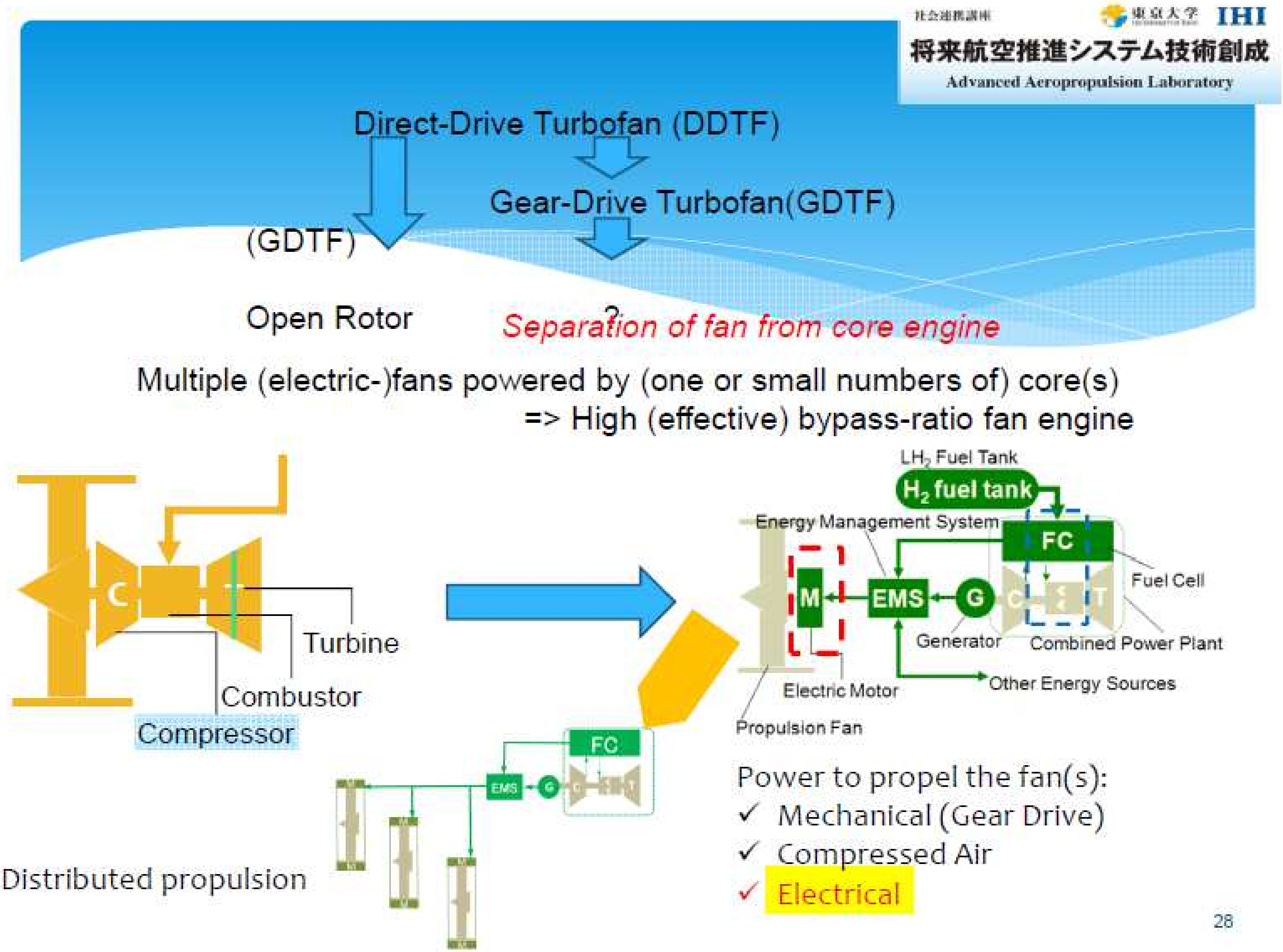


Novel electric machinery configurations for power to mass and safety



Optimum fit of electric machinery elements may need advanced gearbox or other rpm adapting technologies



New power providing concepts request improvement on component level: e.g. fuel cell

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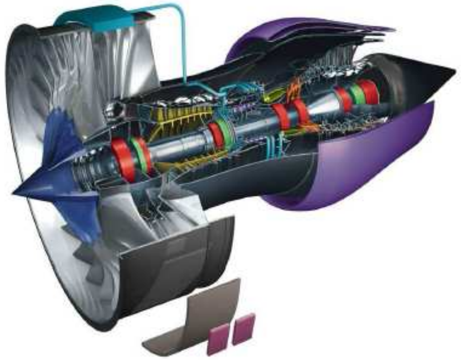
The move to a More Electric Engine
Key technology components

10



- Novel Starter Generator
- Electrical Accessories
- Electric Actuators
- Advanced Bearings
- Potential to remove the Accessory Gearbox
- Can be Bled or Bleedless engine

Rolls-Royce

The move to a More Electric Engine
The main challenges

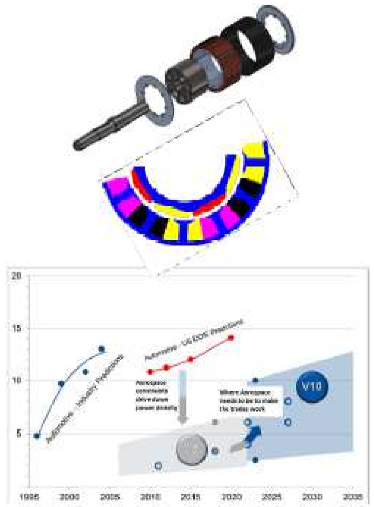
11

Technology

- x1 order of magnitude for Thermal Integration
- X2 order of magnitude for Power Electronics
- X3 order of magnitude for Technology

Risk

- Customer has zero tolerance to programme delay



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Higher integrated solutions to drive positive active / passive functional element mass

Challenge – High Power Airworthy Cryogenics 18

- There are no high power (>1 kW available cooling power) aerospace cryocoolers currently in existence
- Aerospace designs typically designed for IR missile sensors and satellite instrument cooling are in the multi-Watt range; Distributed Propulsion with superconducting technology will require multi-kilowatt capacity designs.
- Non-aerospace versions capable of delivering the cooling power required are very heavy and bulky.

- This design weighs 8 tonnes, and provides 25 kW of cooling power at 77 K
- At 1 MW required input power, the cooler has a specific mass of 8 kg/kW and an overall efficiency of just 2.5 %
- NASA have outlined goals to cut this down to below 3 kg/kW input.

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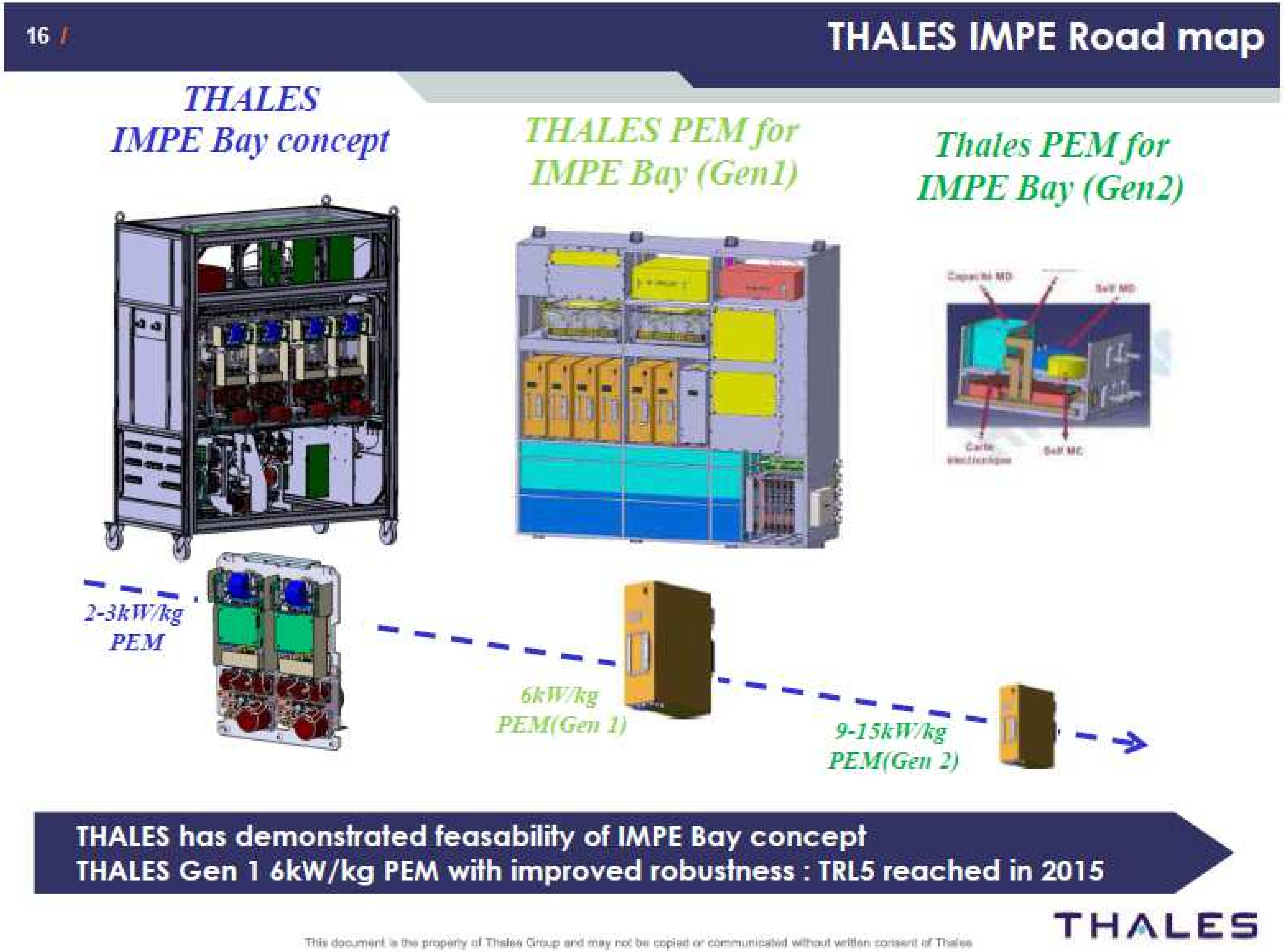
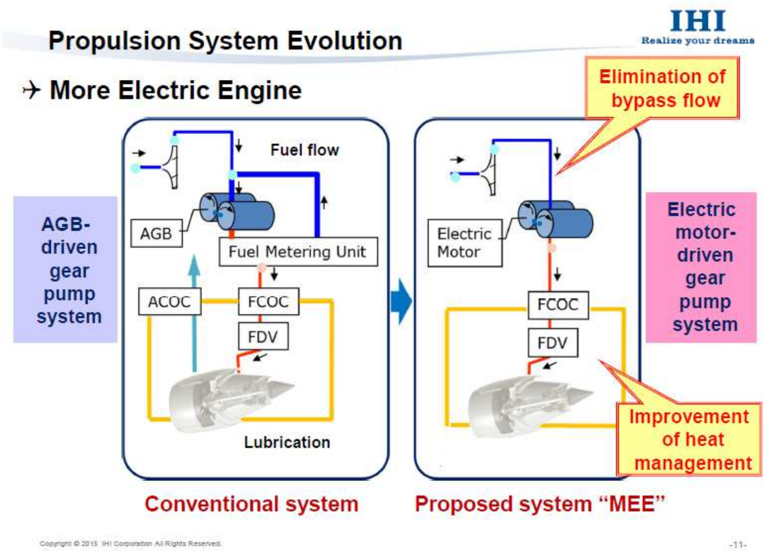
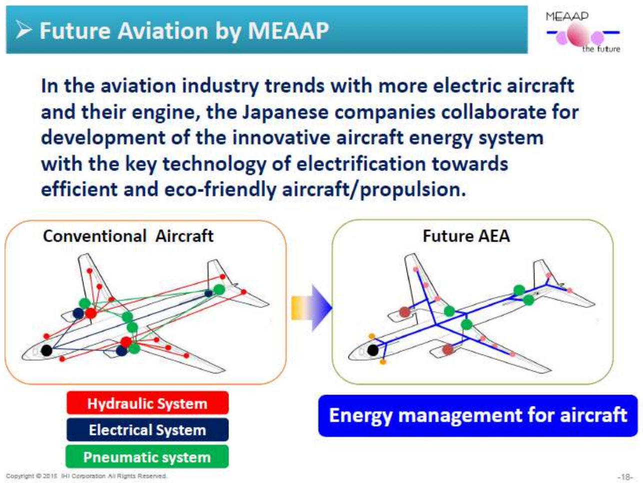
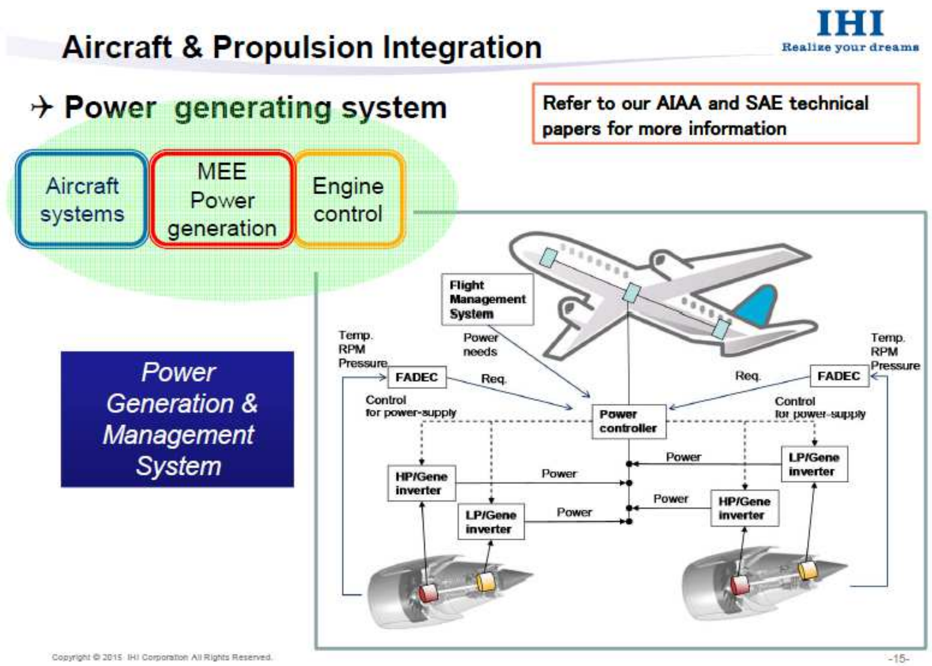
Cooling technologies become more important in ME / hybrid electric architectures especially with HTS



Power electronics elements have seen enormous progress but need even more progress







Monitoring and Controlling algorithms and corresponding key technologies for optimum use and safety of ME /HE configurations

4. NEDO Project s: PEFC

NEDO

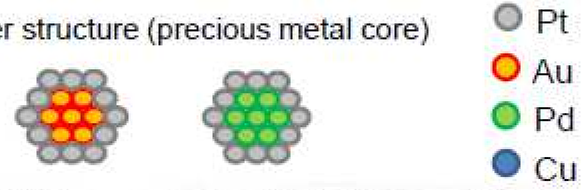
"Technology Development to reduce platinum usage"

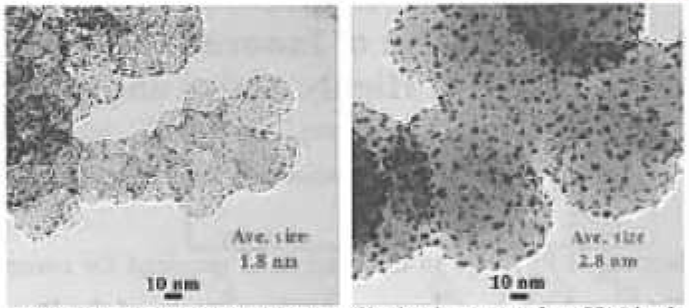
PL: Prof. Inaba (Doshisha Univ.)

Doshisha Univ., Chiba Univ., Osaka Pref. Univ., Kyoto Univ., Toyota Central lab., Tohoku Univ., Shinshu Univ., Toshiba Fuel Cell System, Kyusyu Univ., Toray Research Center, Aishin Seiki, Ishifuku

-Development of highly-active core-shell catalysts in order to substantially reduce platinum used in PEFC cathode.

Two-layer structure (precious metal core)

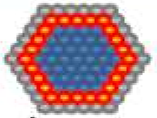




(a) As prepared Au/C (DDT/NaBH$_4$) (b) After heat-treated at 300°C in air

Fig. 2. TEM images of Au/C cores (DDT/NaBH$_4$).

Three-layer structure (non-precious metal core)



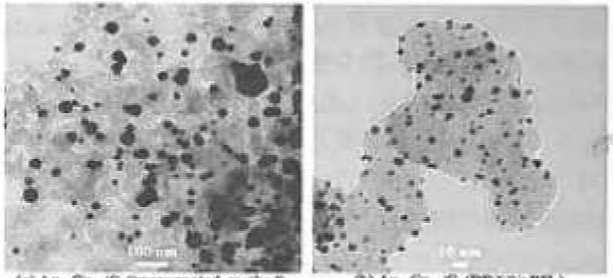
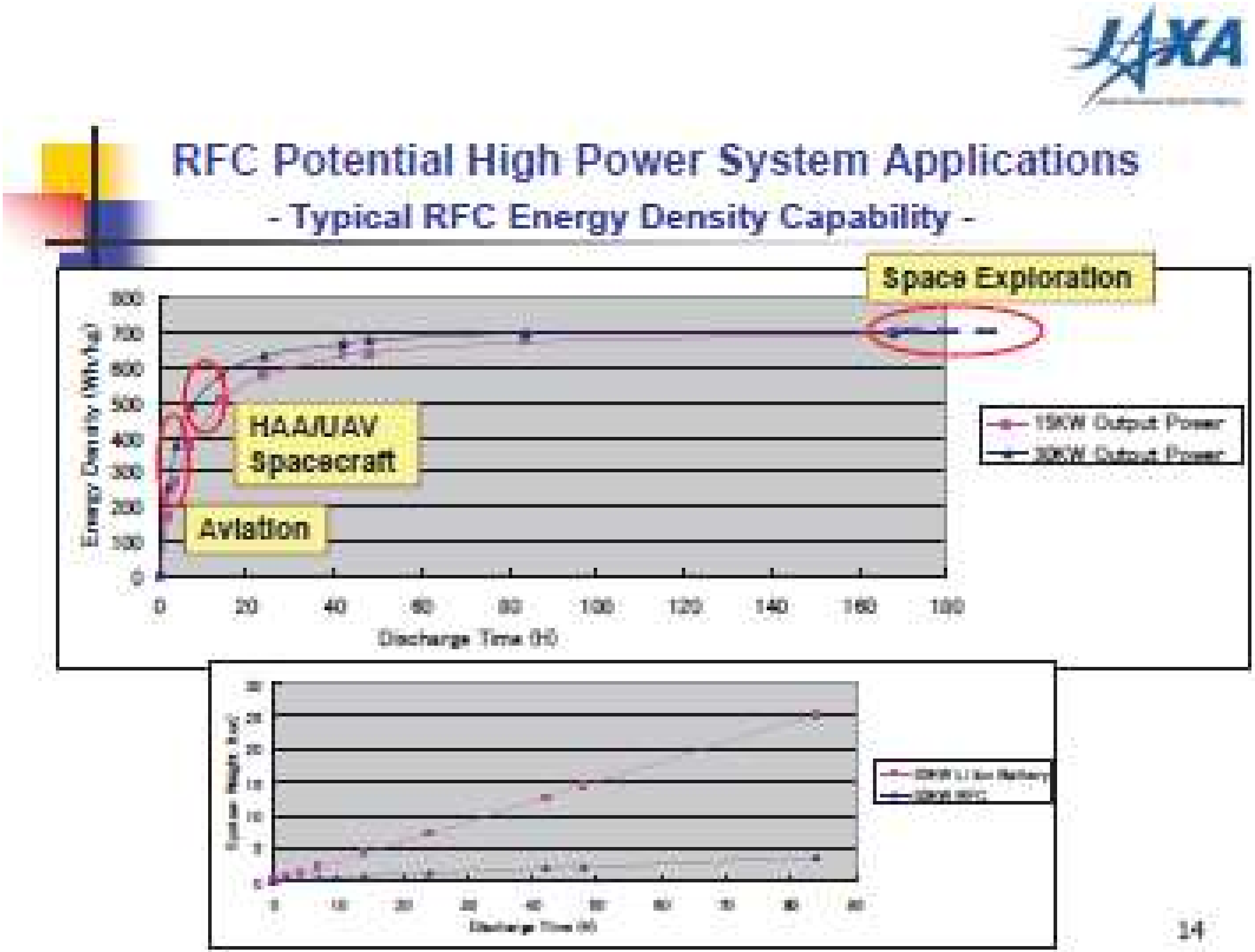


Fig. 6. TEM images of AuCu/C cores prepared by the (a) impregnation and (b) DDT/NaBH$_4$ methods.

- New synthesis method using DDT ($C_{12}H_{25}SH$)/$NaBH_4$ resulted in smaller particle size and good dispensability.

17

In addition to Power/Mass and lifetime requirements, driving technologies for lower cost is key.



For primary propulsion use: the tank technology and corr. Energy density is the critical factor.

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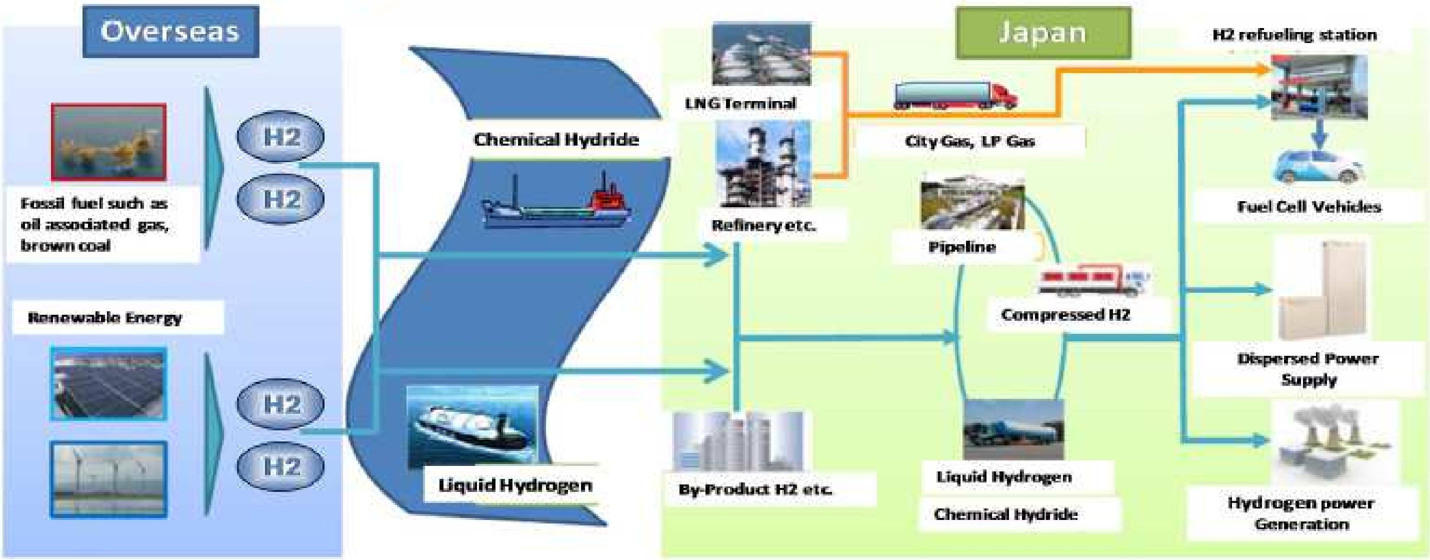
4.NEDO Project :Energy Carrier Project

Future image of production, storage, transportation and utilization



(Source: Advisory Committee for Natural Resources and Energy, METI)

30

Infrastructure, secured supply chain and cost of H2 will be the additional crucial factors for a decisions to use it in aviation.

Thank you for your attention!