

FUTURE RESEARCH NEEDS ON H₂ & FUEL CELL TECHNOLOGY

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REVIEW ON FUEL CELL DEVELOPMENT



FFF 2050 (EU)
No ICE 2030 (D)
ZEV Mandate 2024
OS 2020 / Tokyo



Paris /
Kyoto
(Fukushima,
Diesel-Gate)

Infrastructure?

Battery development
(capacity, cost, recycling)

1842:
W. R. Grove
Grove Voltaic Cell

1960's:
Appollo
Programme

1970's:
Energy
Crisis

1990's:
Climate Change
Technology
Immaturity?

Infrastructure?
Frustration?

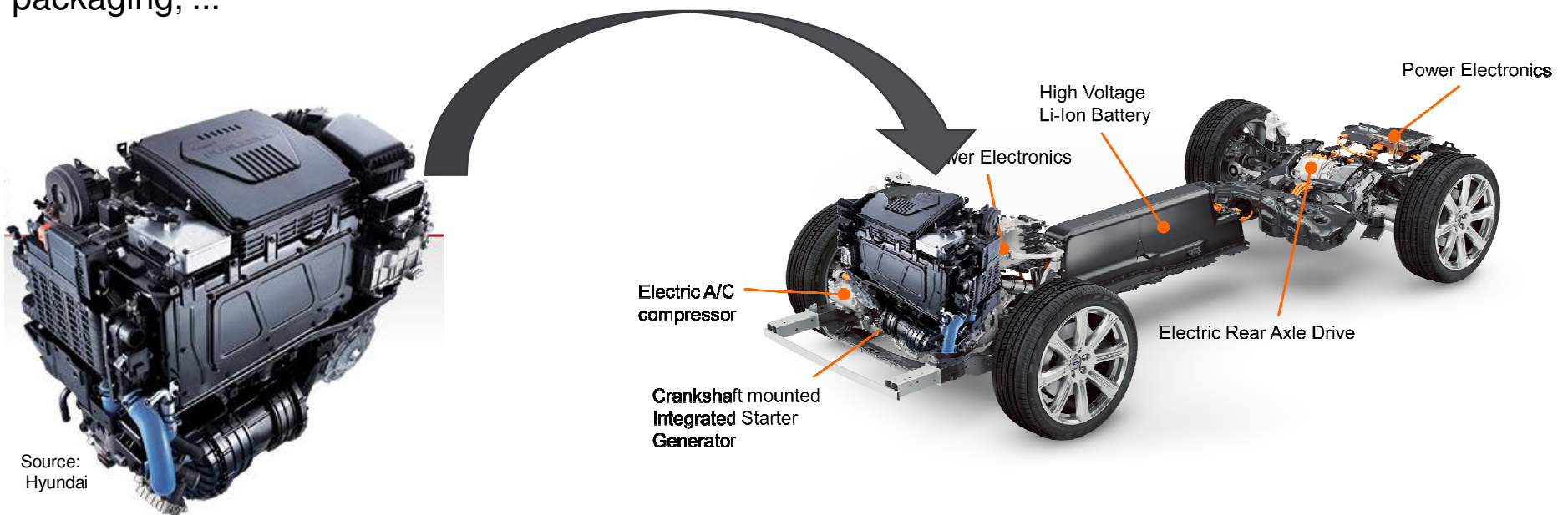
Financial
Crisis
2008

WHAT IS DIFFERENT NOW?



Technology Maturity: Lifetime of MEA, reduced Pt-content, reduced weight / packaging, ...

Availability of Electrical Powertrain Architectures:



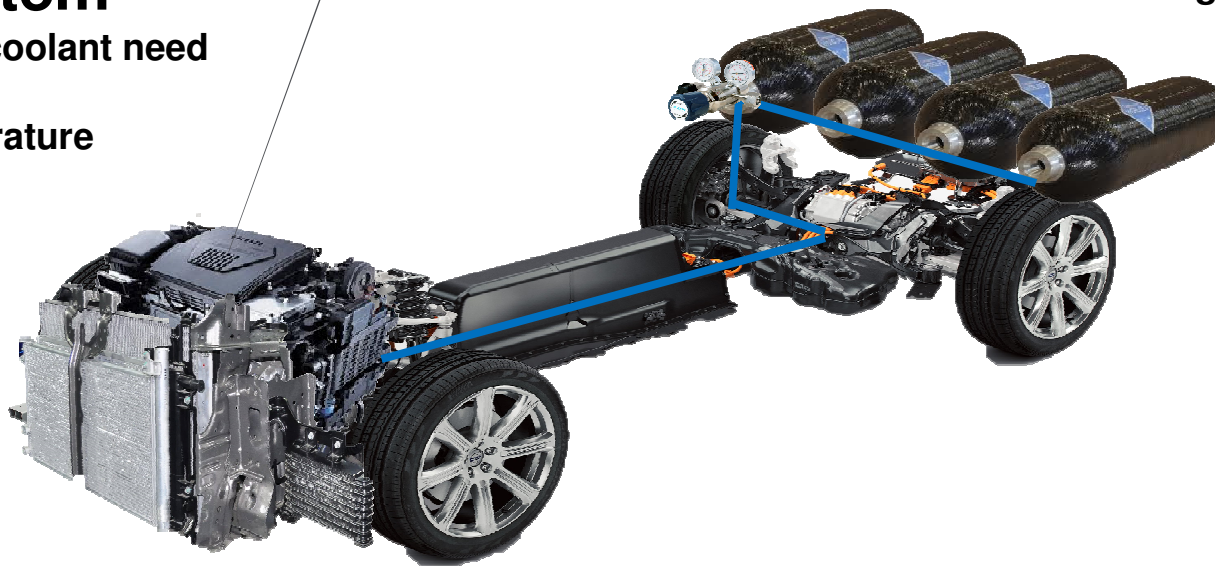
WHAT IS (STILL) MISSING?



Coolant system

- ~2 times higher coolant need than ICE
- Low delta temperature

FC Efficiency: 40 – 60 %
 T_{Clnt} : 40 – 80 deg C



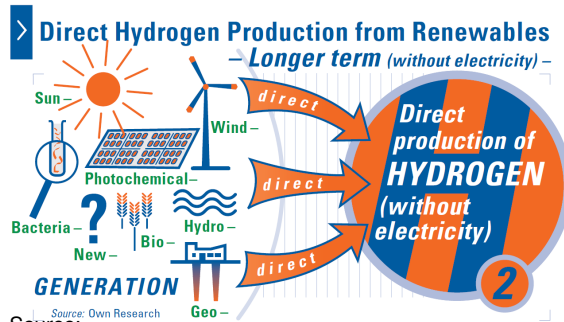
Storage:

- Low energy / volume & energy / weight ratio
- High pressure

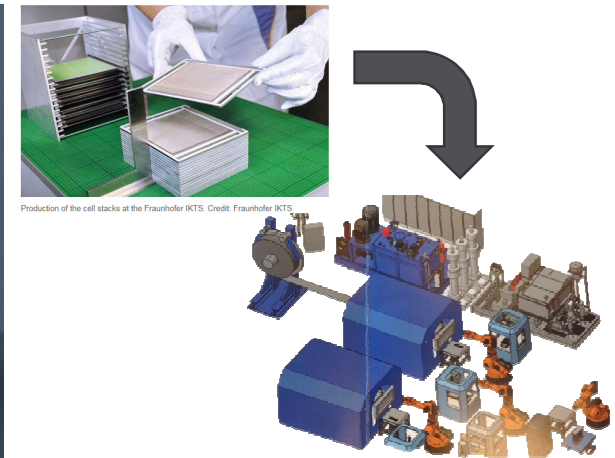
WHAT IS (STILL) MISSING?



Source: Woikoski



Source:
http://www.hydrogenambassadors.com/background/images/state_of_art_hydrogen_production.pdf



FURTHER NEED FOR R&D



Fuel Cell Stack:

- is a supplier part (until a certain product volume is reached), with possibility for world wide sourcing
- Adaption to automotive targets and requirements
- Further improvements on power density, efficiency, cost & durability to compete with ICE's and BEV's
- Industrialisation: manufacturing processes and quality assurance for stack components and assembly to enable large scale production and smooth ramp up

FURTHER NEED FOR R&D



Fuel Cell Integration:

- Definition of targets & requirements for automotive application – no standards developed yet
- Development of system design guidelines and requirements
- Balance battery size vs. stack power vs. el power vs. H2-range
- Improvement of system efficiency: heat recovery, operation strategies, reduced electrical losses, ...
- Cost reduction on electrical components (DCDC-converter)

FURTHER NEED FOR R&D



Hydrogen Storage:

- Packaging solutions for smaller platforms
- Crash / Safety
- New technologies to reduce volume space (cryogenic, MOF, ...)
- Cost reduction

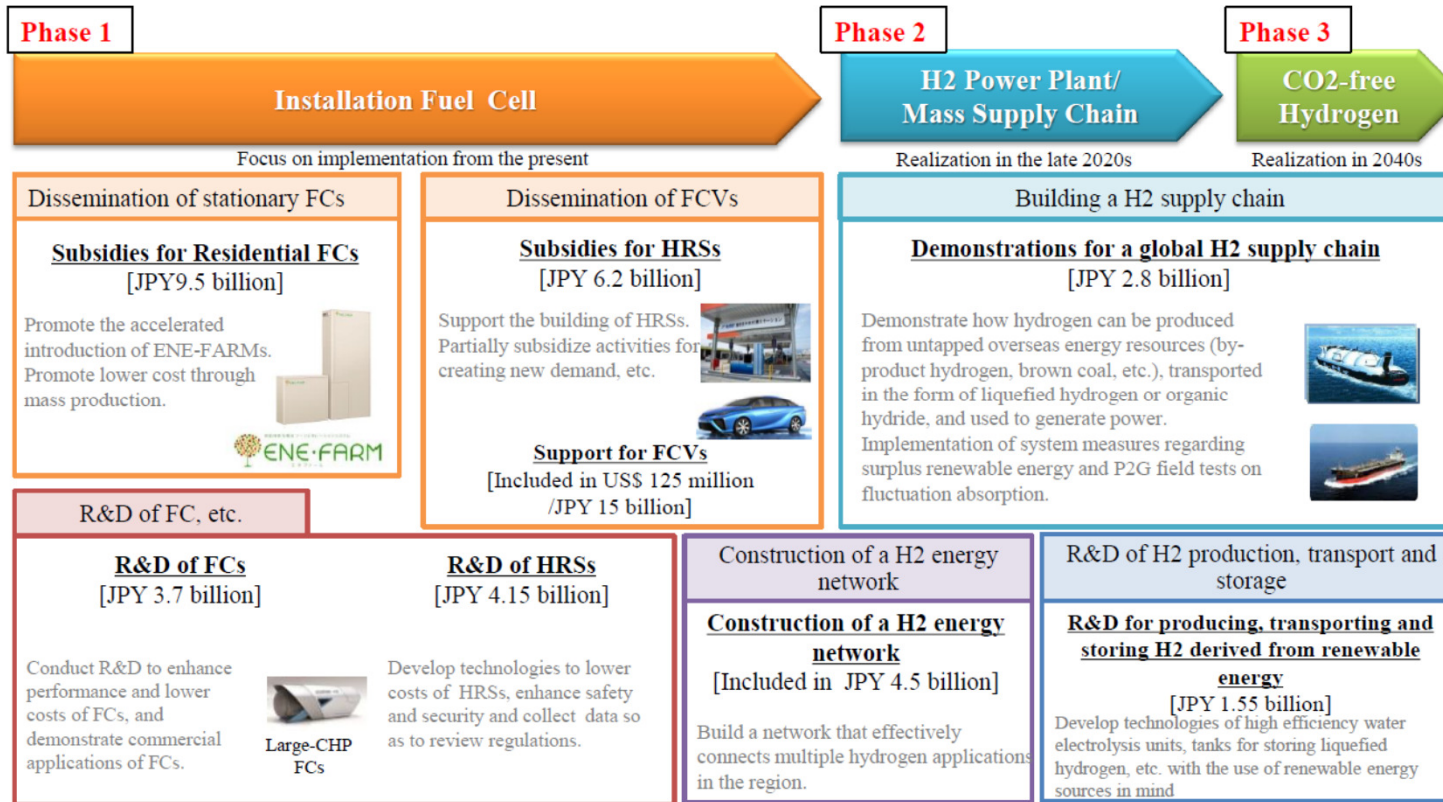
FURTHER NEED FOR R&D



Hydrogen Production & Supply:

- Roll-Out plan for H2-stations
- Development of Supply solutions: power to gas, grid interaction, on site electrolysis
- Distribution solutions

JAPANESE H2 R&D PROGRAMME 2016:



Source:
Y. Maehiro: NEW ERA OF A HYDROGEN ENERGY SOCIETY
World of Energy solutions 2016, Stuttgart

INTERNATIONAL COOPERATION!

