



FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING

*Fuel Cell Applications
for Transport*

*Next Generation of
Products*

Pietro Caloprisco

PRD 2019

20 November 2019

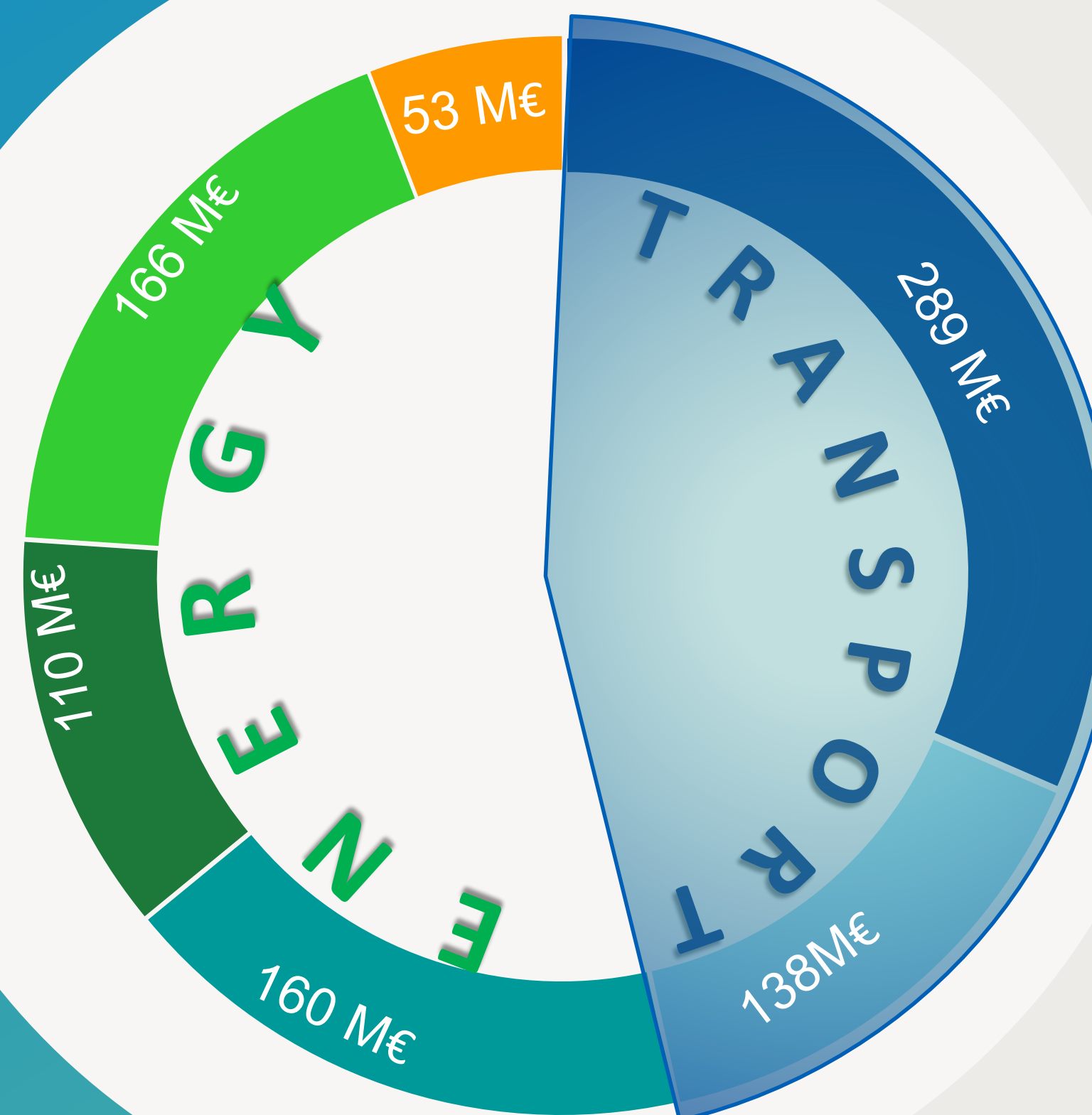


Next Generation of products - Transport



Reduce fuel cell
system costs for
transport
applications while
increasing lifetime

Reduce use of
critical raw materials



Transport - Total

42 %



427 M€

68 Projects

Next Generation products

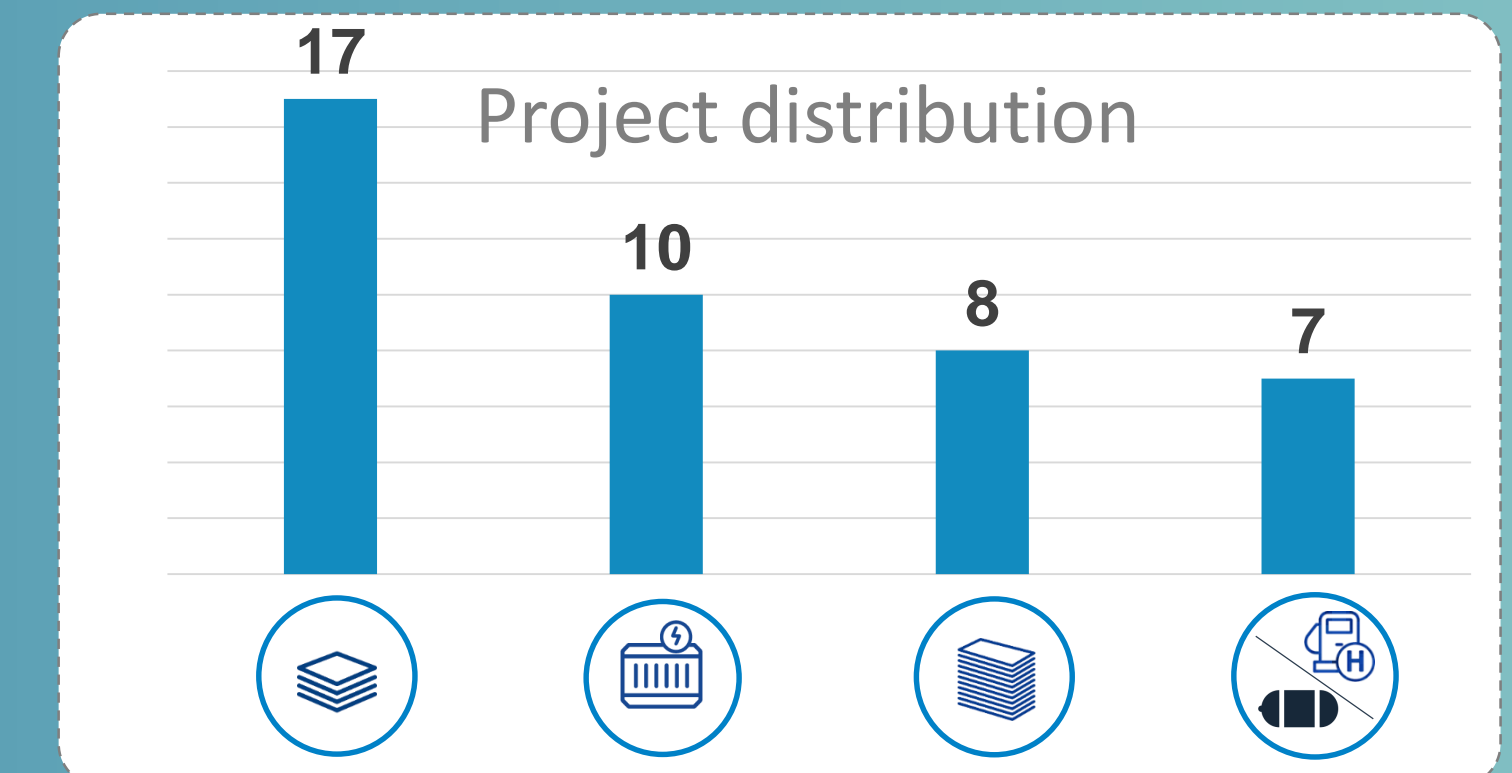
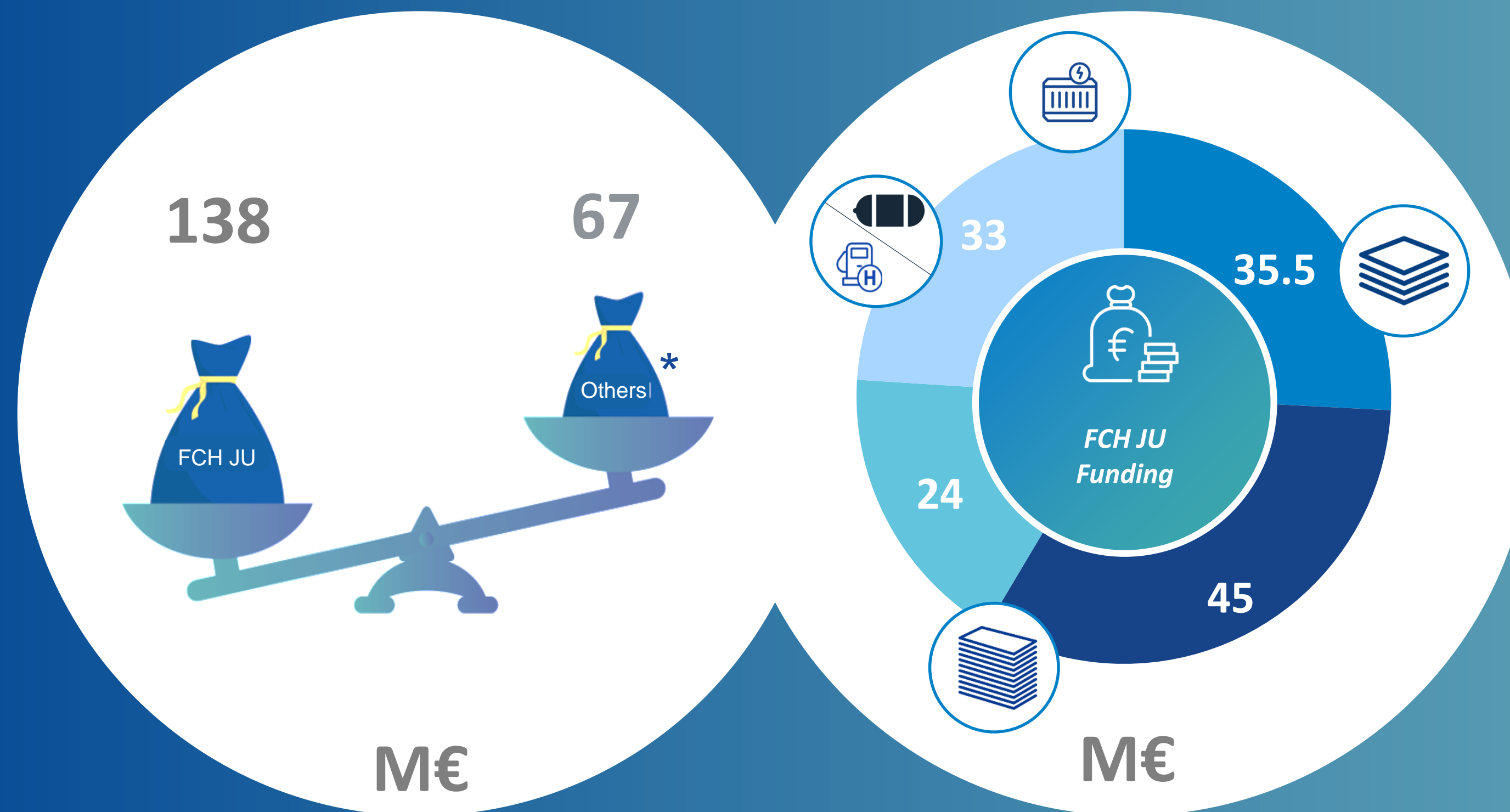


138 M€

42 Projects

Towards competitiveness

42 projects – 205 M€



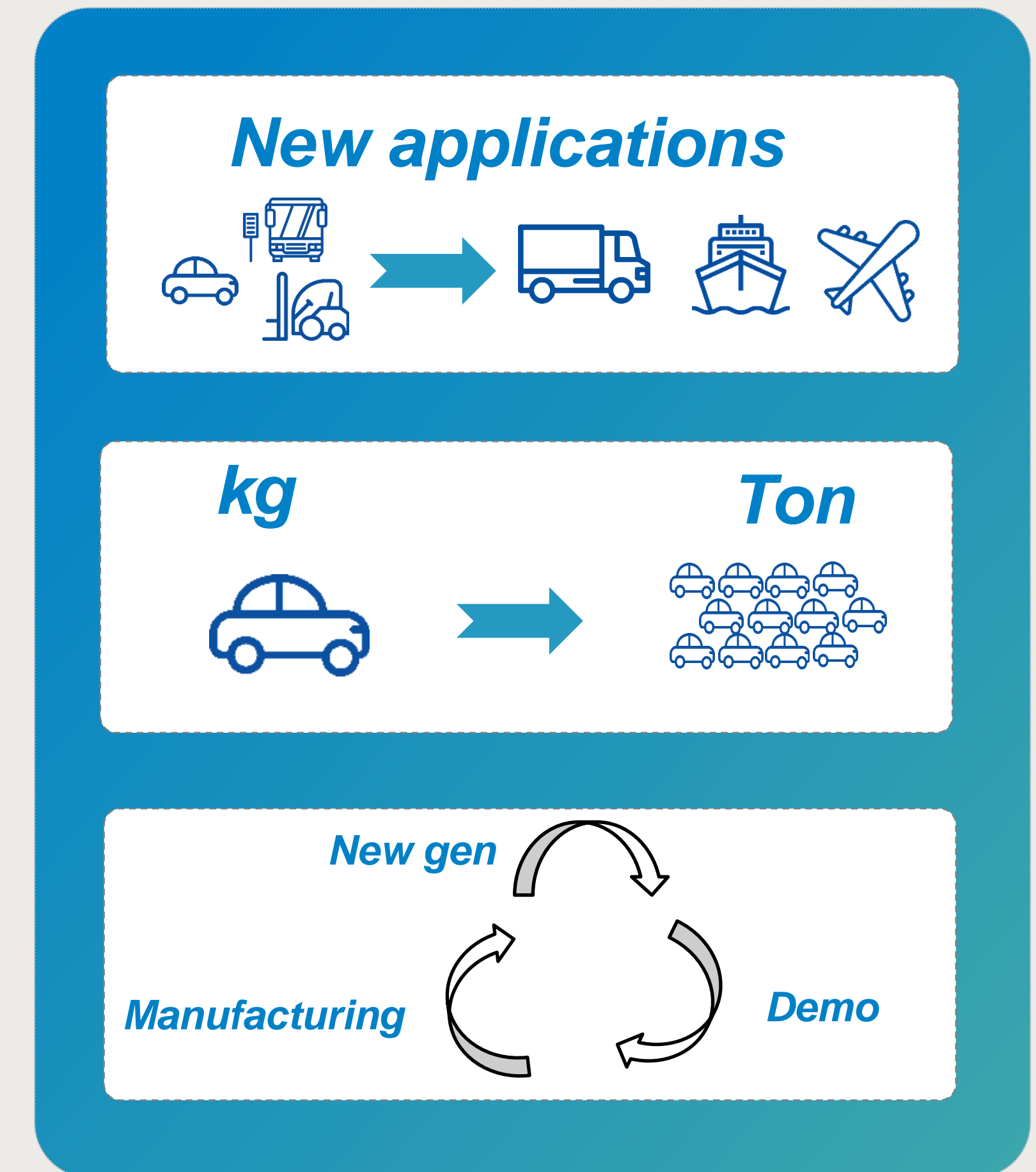
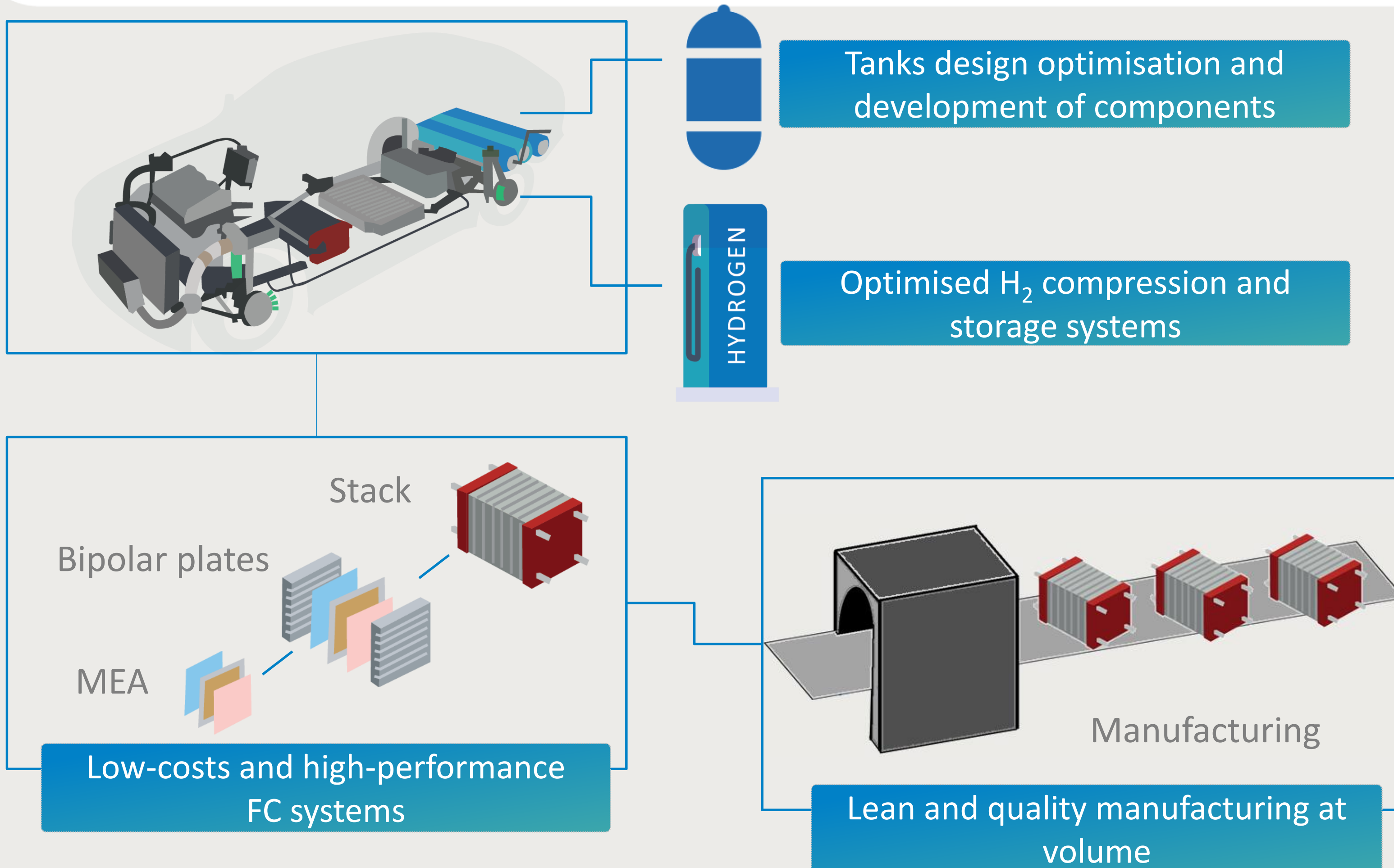
- MEA, catalysts, GDL, materials
- Auxiliary power units
- Stack modelling, development, BPP, manufacturing, next generation
- Hydrogen refueling station, On-board H2 storage

* Other resources including private and national/regional funding

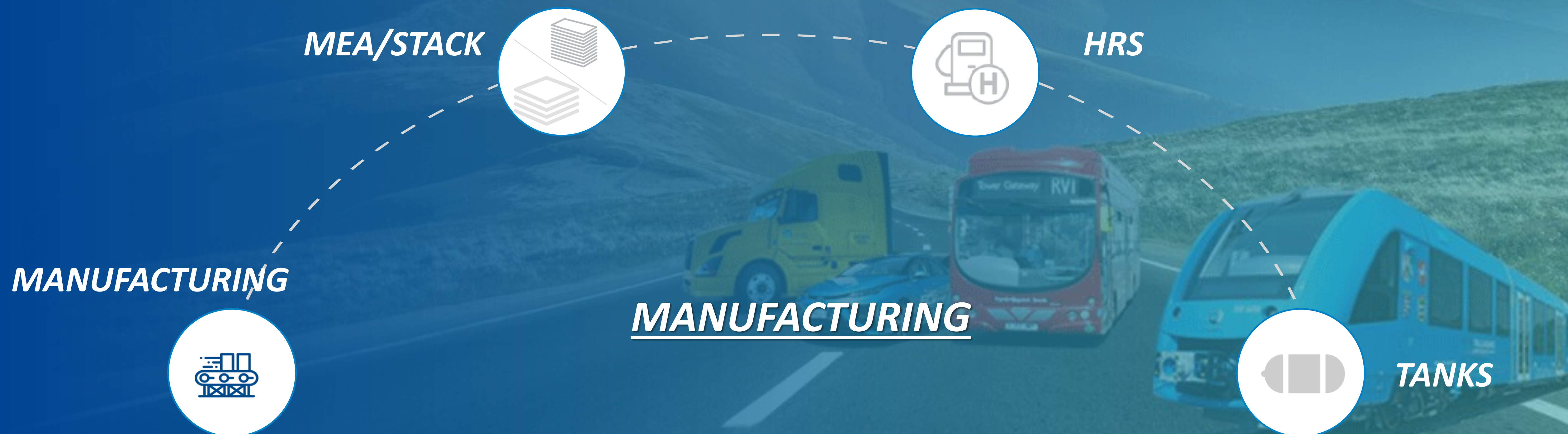


FCH JU support to all FCEV research aspects

Supporting the competitiveness of the technology and the EU supply chain

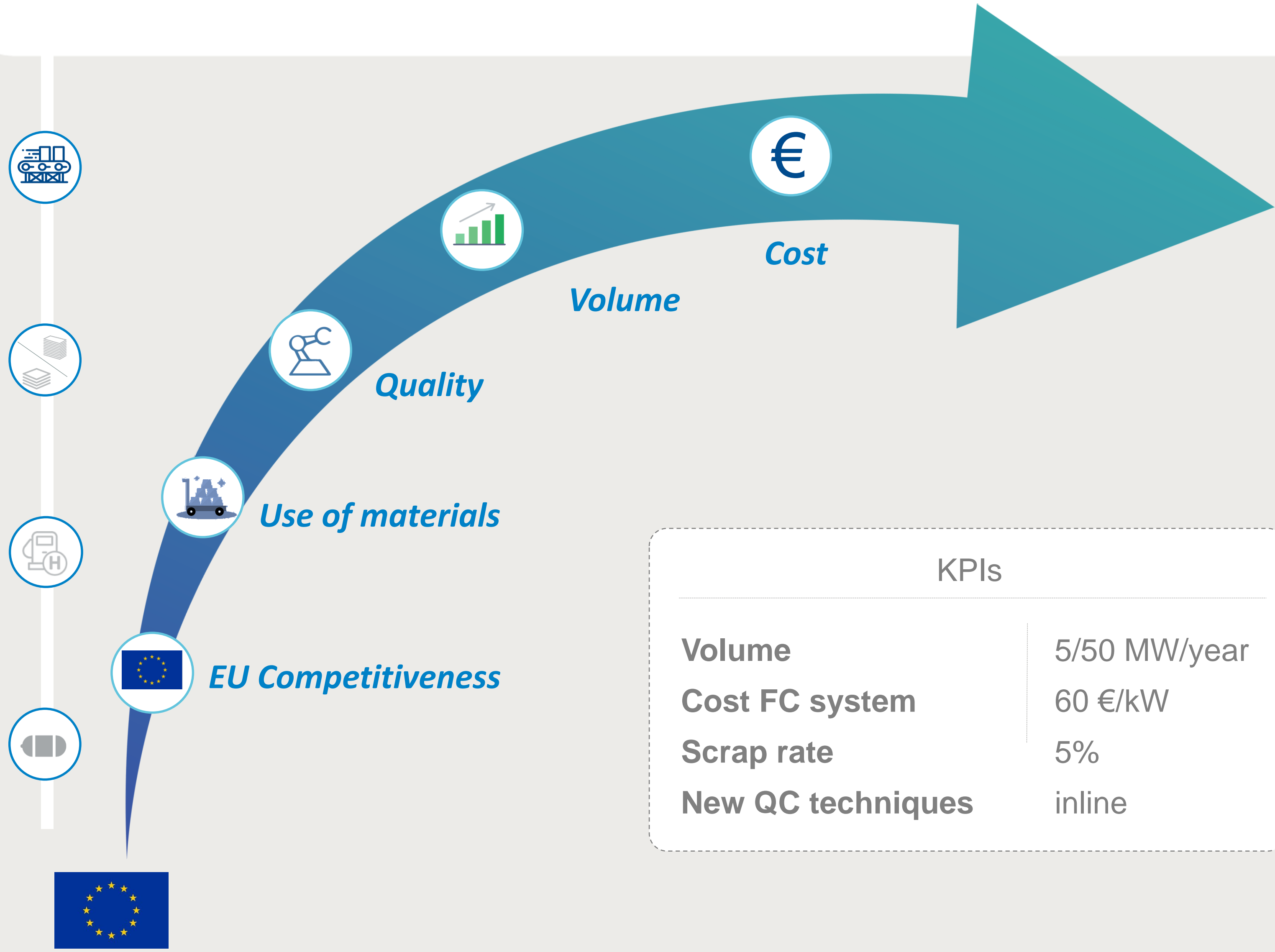


Transport Portfolio: Research & Innovation

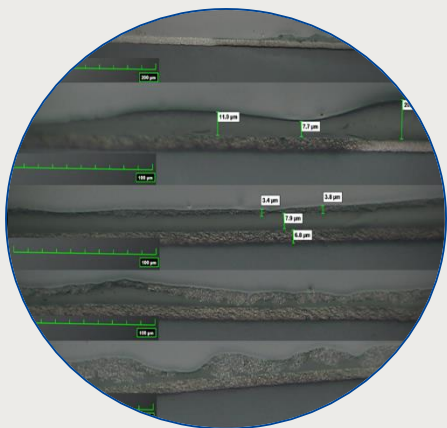
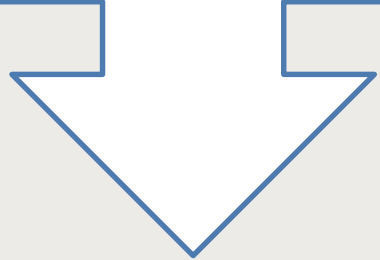


Manufacturing & quality control

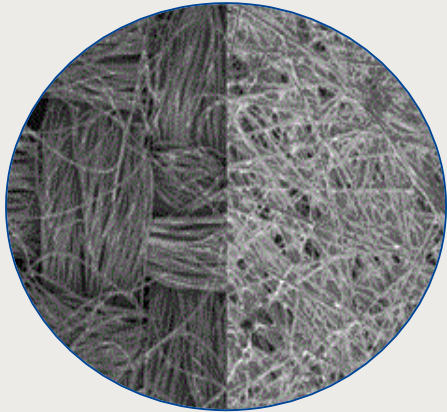
A challenge to be met today



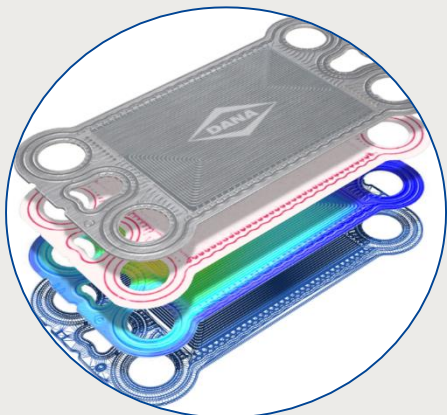
KPIs	
Volume	5/50 MW/year
Cost FC system	60 €/kW
Scrap rate	5%
New QC techniques	inline



- Membrane**
- Operational temperature
 - Proton conductivity
 - Mechanical resistance



- Gas Diffusion Layers**
- Thickness
 - Permeability
 - Density



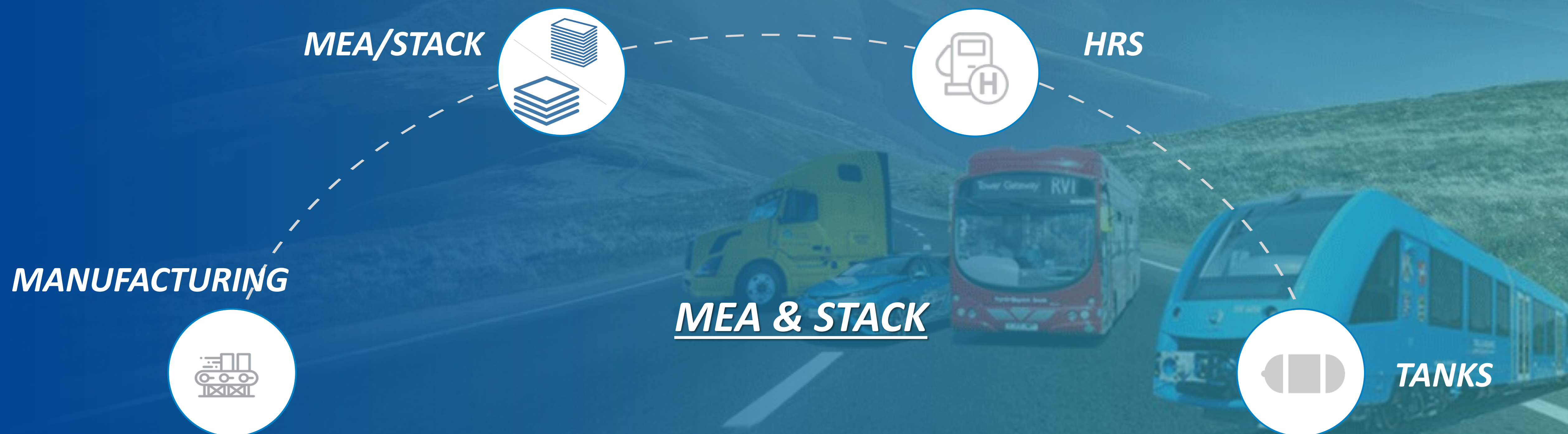
- Bipolar plates**
- Resistance to corrosion

Manufacturing projects

A complementary approach

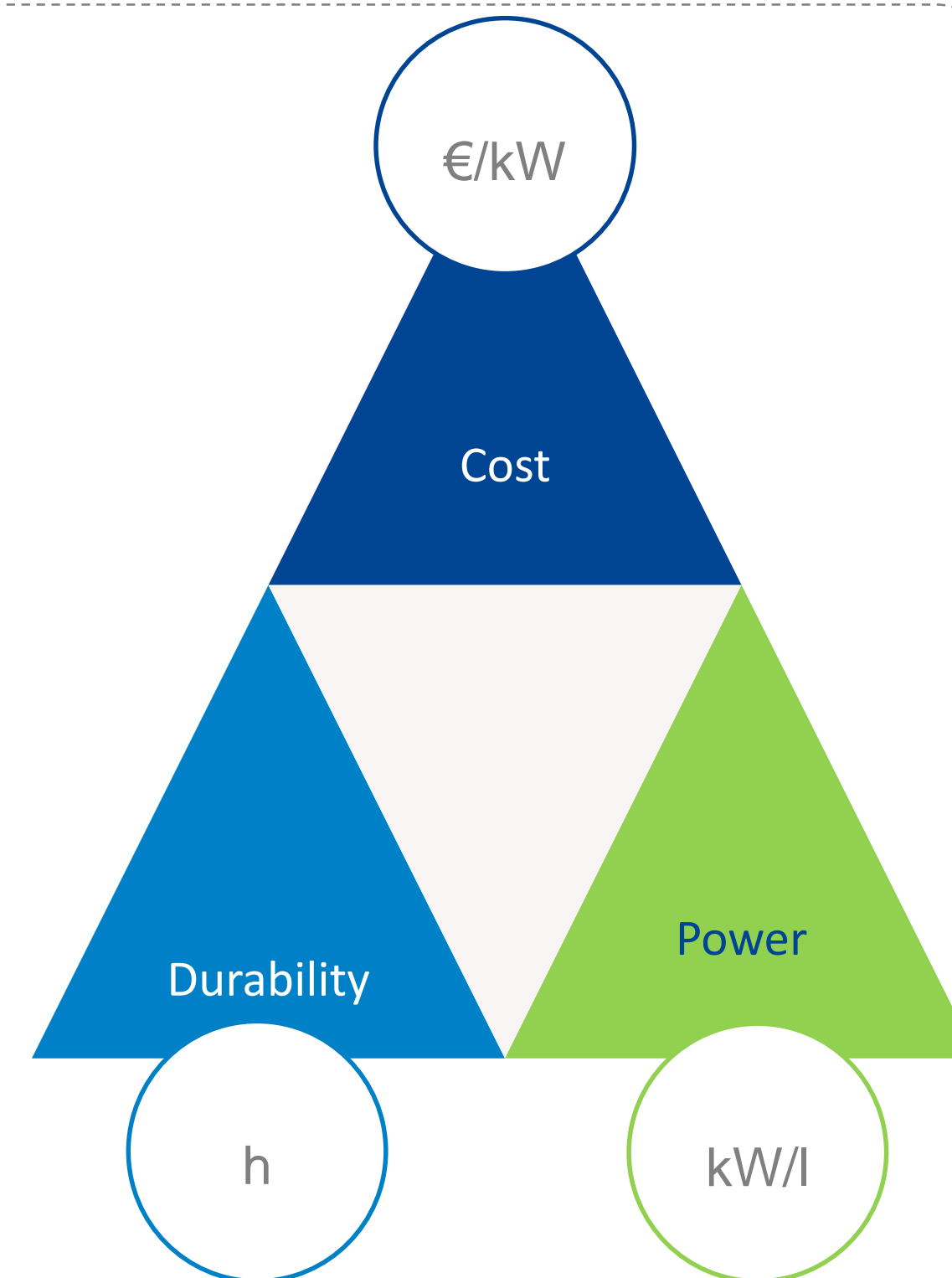
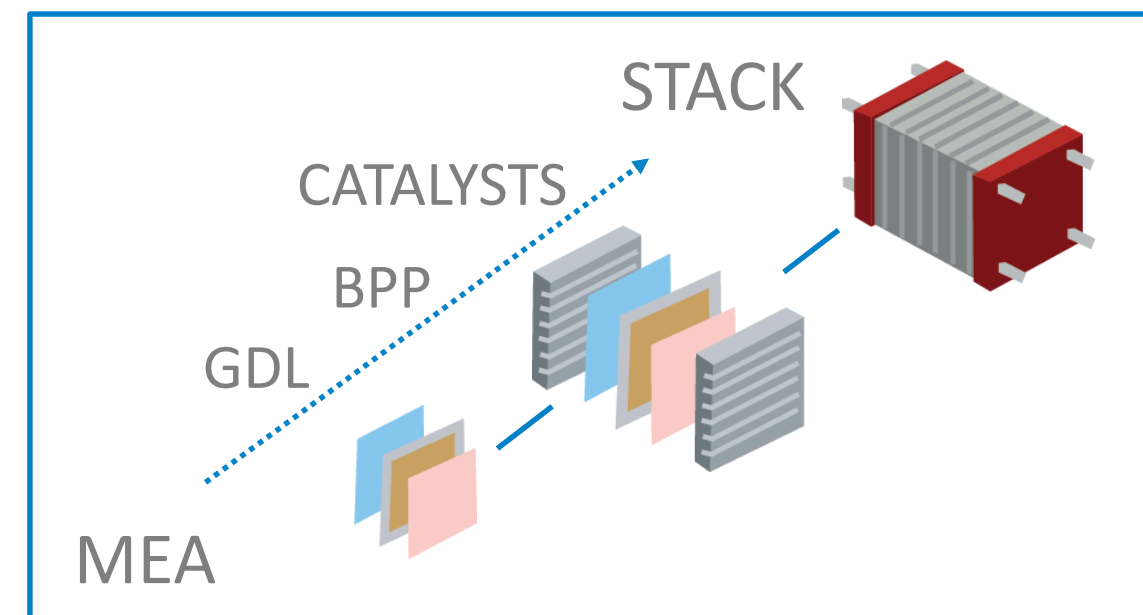
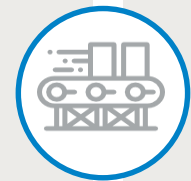


Transport Portfolio: Research & Innovation



MEA & STACK

Cost and performance



KPIs - 2020

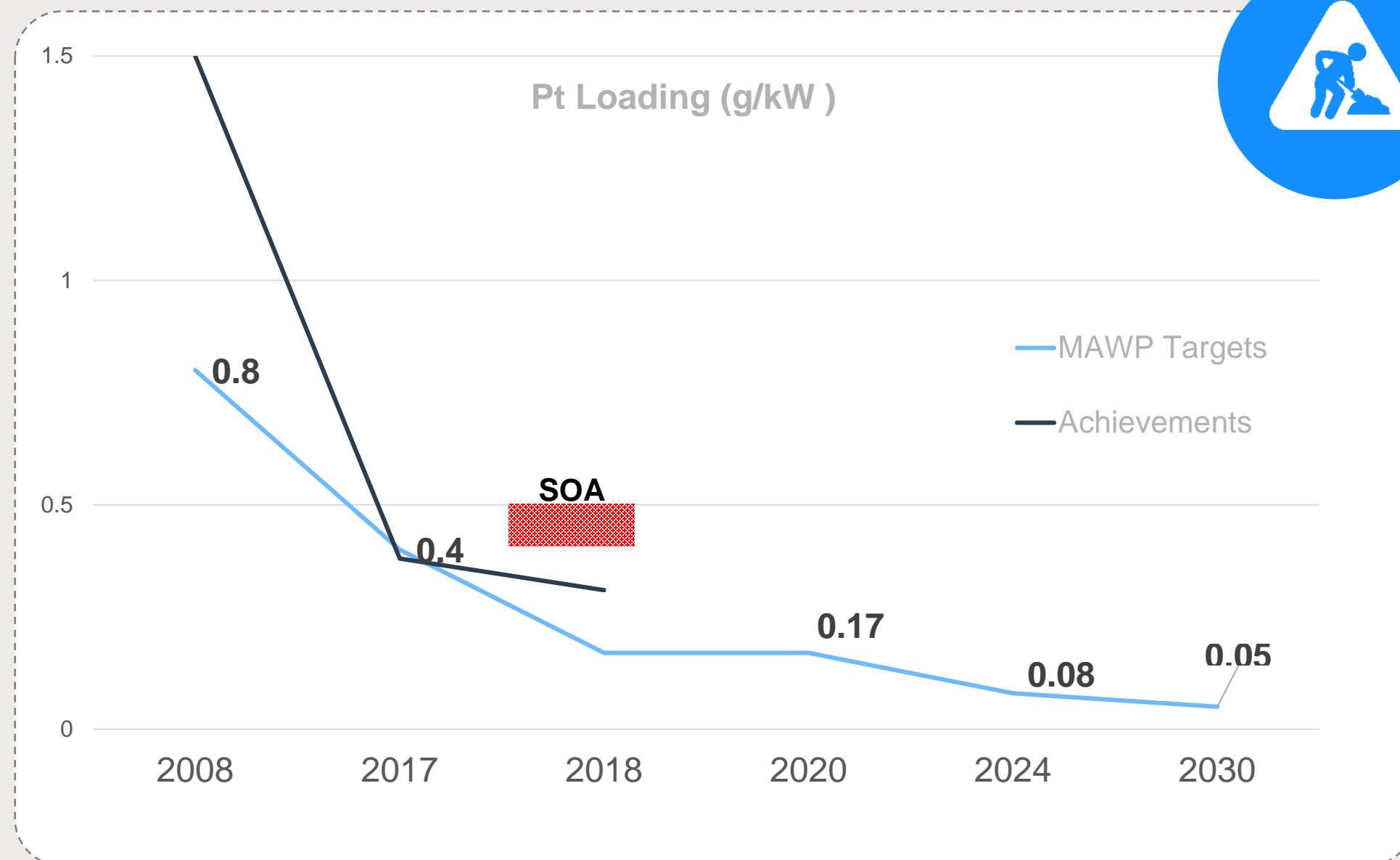
FC system cost	60 €/kW
Cell Power Density	1.5W/cm ²
PGM loading	0.17 g/kW
Durability	5.000 h

Platinum loading

Refuse, Reduce, Reuse, Recycle



Historic development



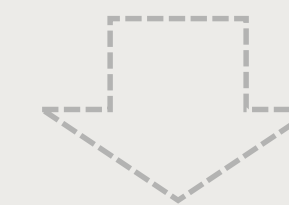
- Since 2011 efforts to reduce/replace PGM
- 9 projects/ € 41.5 Million funding
- - 80 % Pt loading between 2008 and 2017
- Pt still important cost driver
- steep targets for 2020/2024

NO PGM



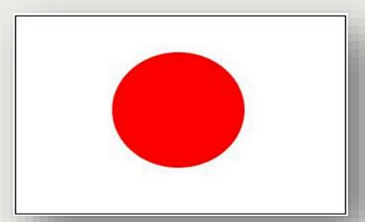
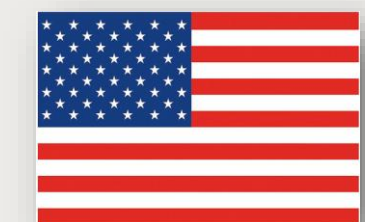
Approach

- Novel catalysts materials & structures;
- Develop diagnostic methods to characterize their active site density;
- Assessment of the catalyst layers to understand high losses with current non-PGM cathode;



- **0.42 W/cm² with a loss of performance < 30 % over 1000 h**

- Low TRL: scientific publications
- International cooperation
- Not the only way to decrease costs



Recycling

Recover of critical raw materials

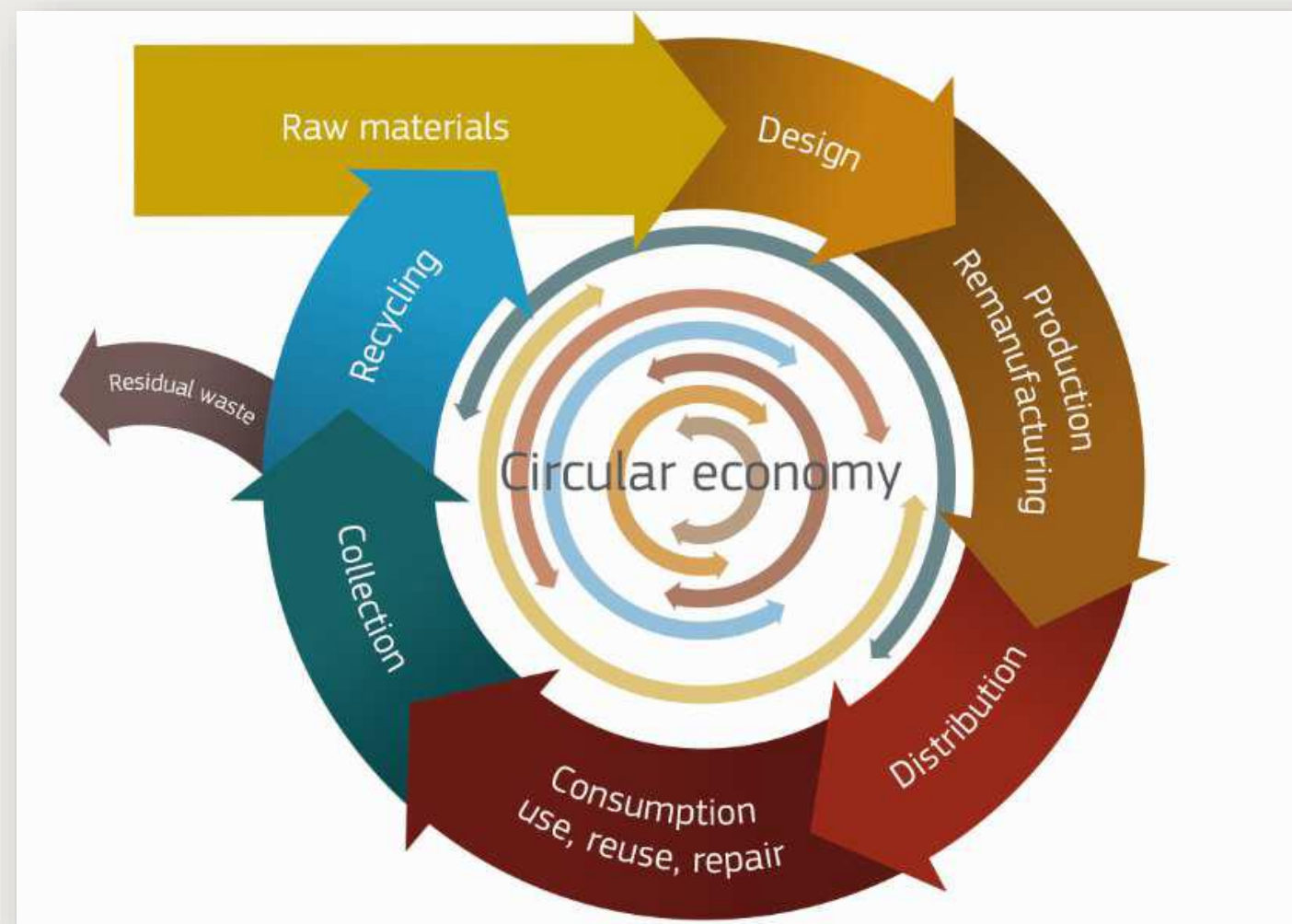


Sustainability

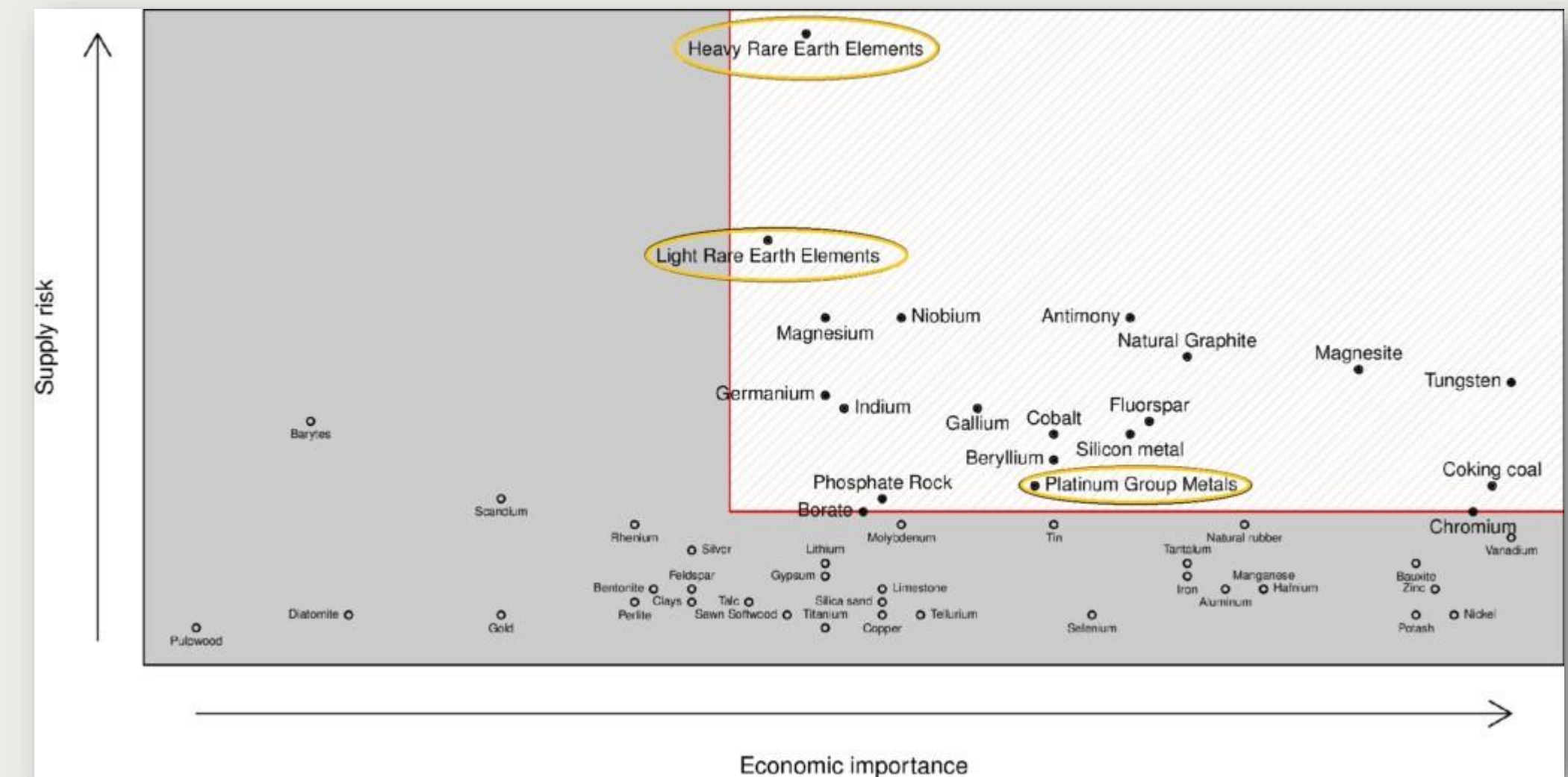


RECYCLING & DISMANTLING

Circular economy



Critical raw materials



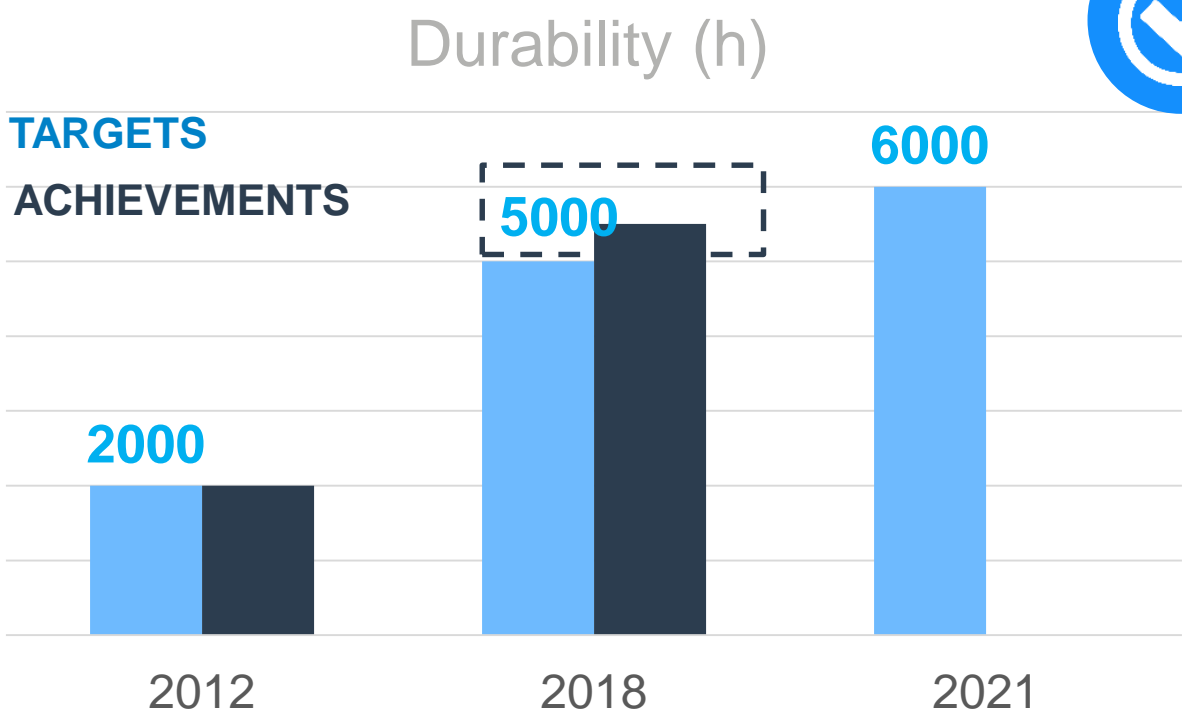
- Assessment of critical materials and components in FCH technologies
- Report on existing recycling technologies applicable to FCH products

- Regulatory framework analysis and barriers identification
- LCA approach in end of life cycle of FCH technologies



Durability and power density

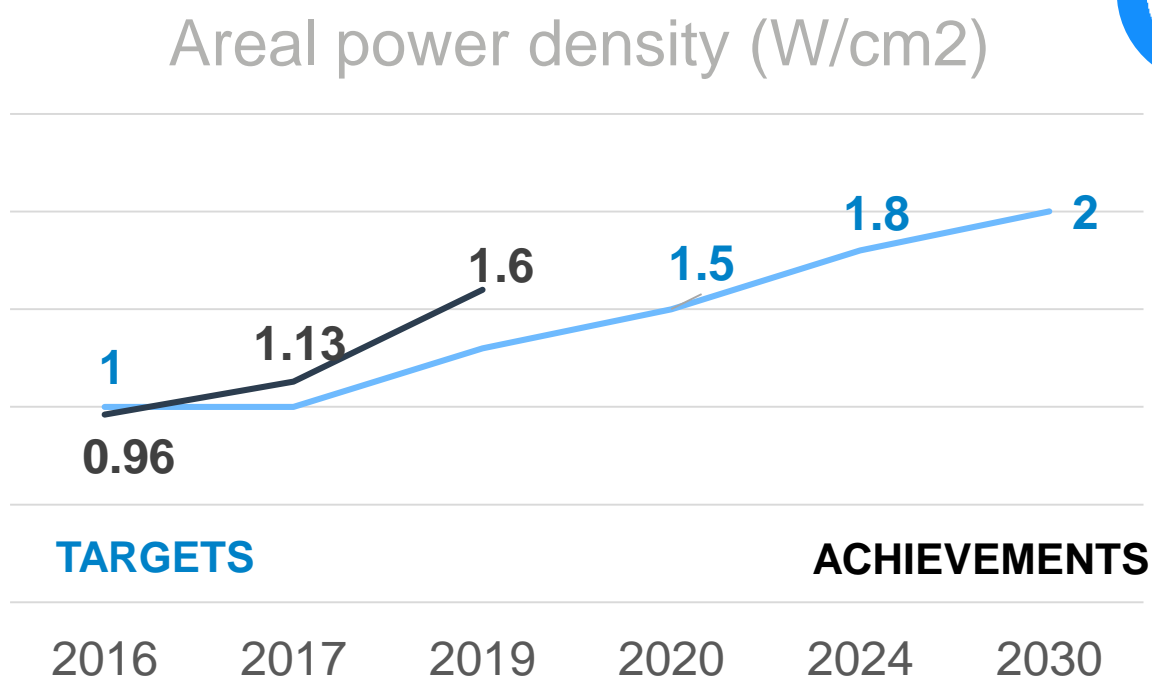
Good results and new applications



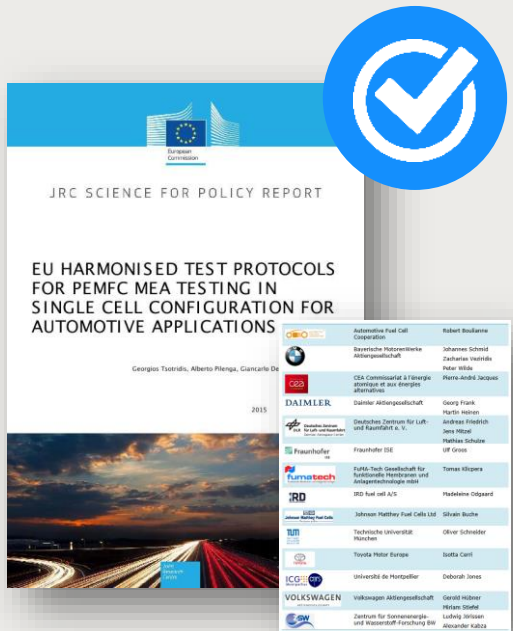
- Degradation analyses started on components aged in real conditions.
- Real ageing data base: new protocol based on fleet data adopted and several aged samples analysed postmortem
- Improved models for PEMFC performance decay



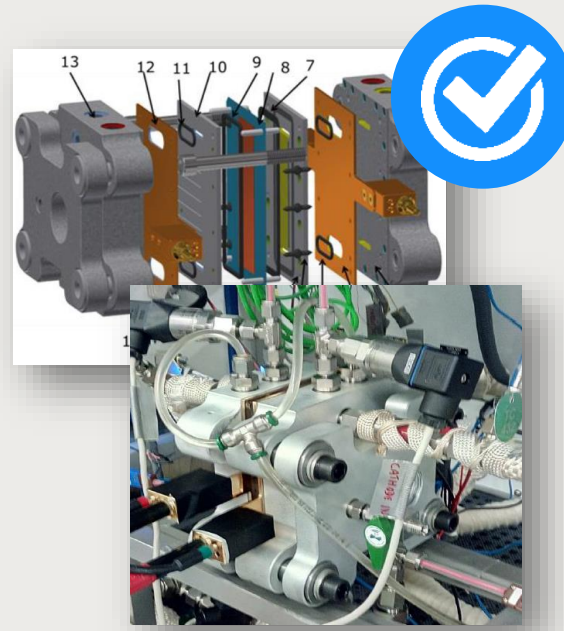
- Advanced diagnostic, prognostic and control systems
- Improved understanding of rejuvenation phenomena
- Development of a control unit, optimal operation of the FC system



EU harmonized test protocols for PEMFC



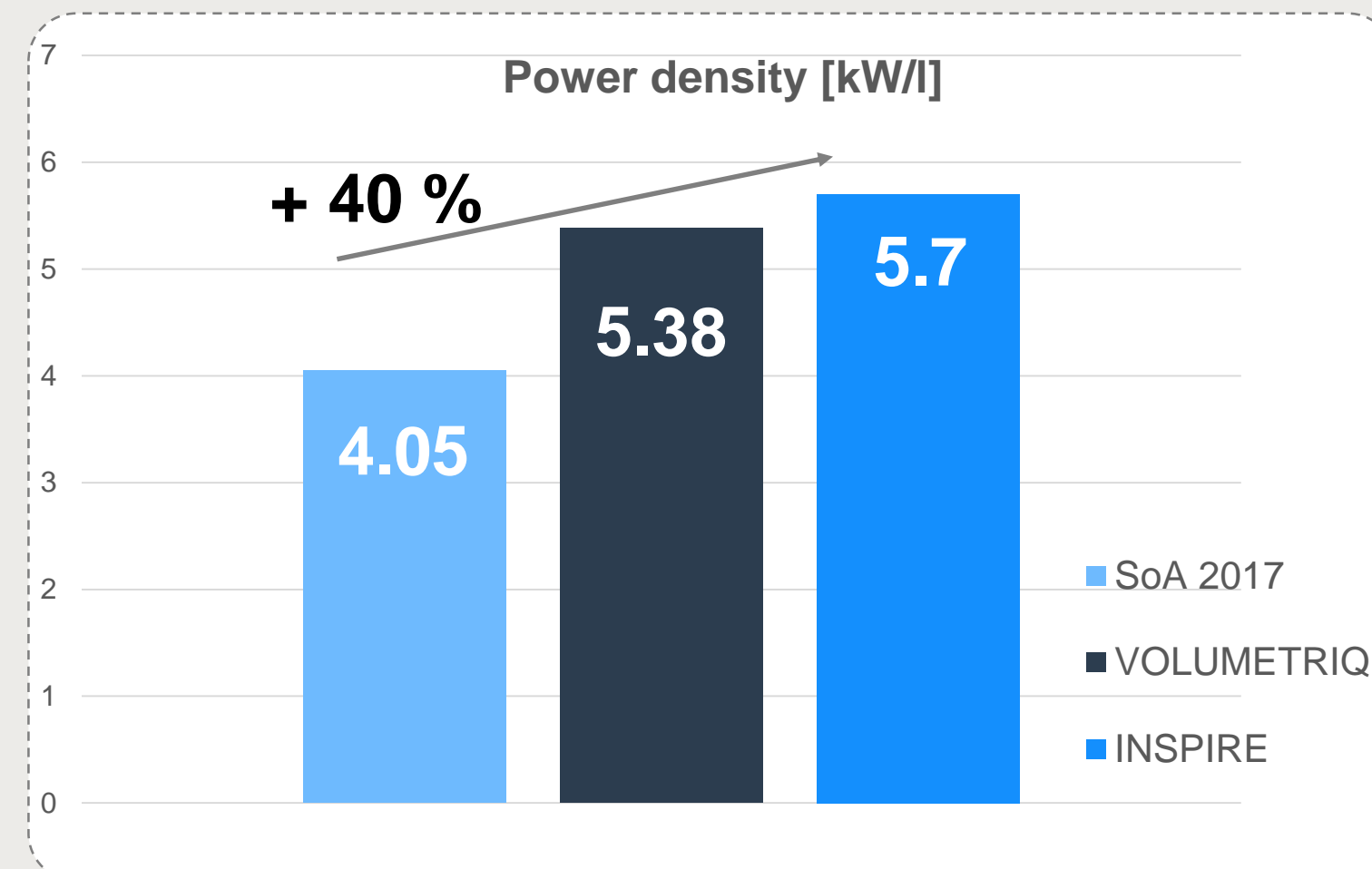
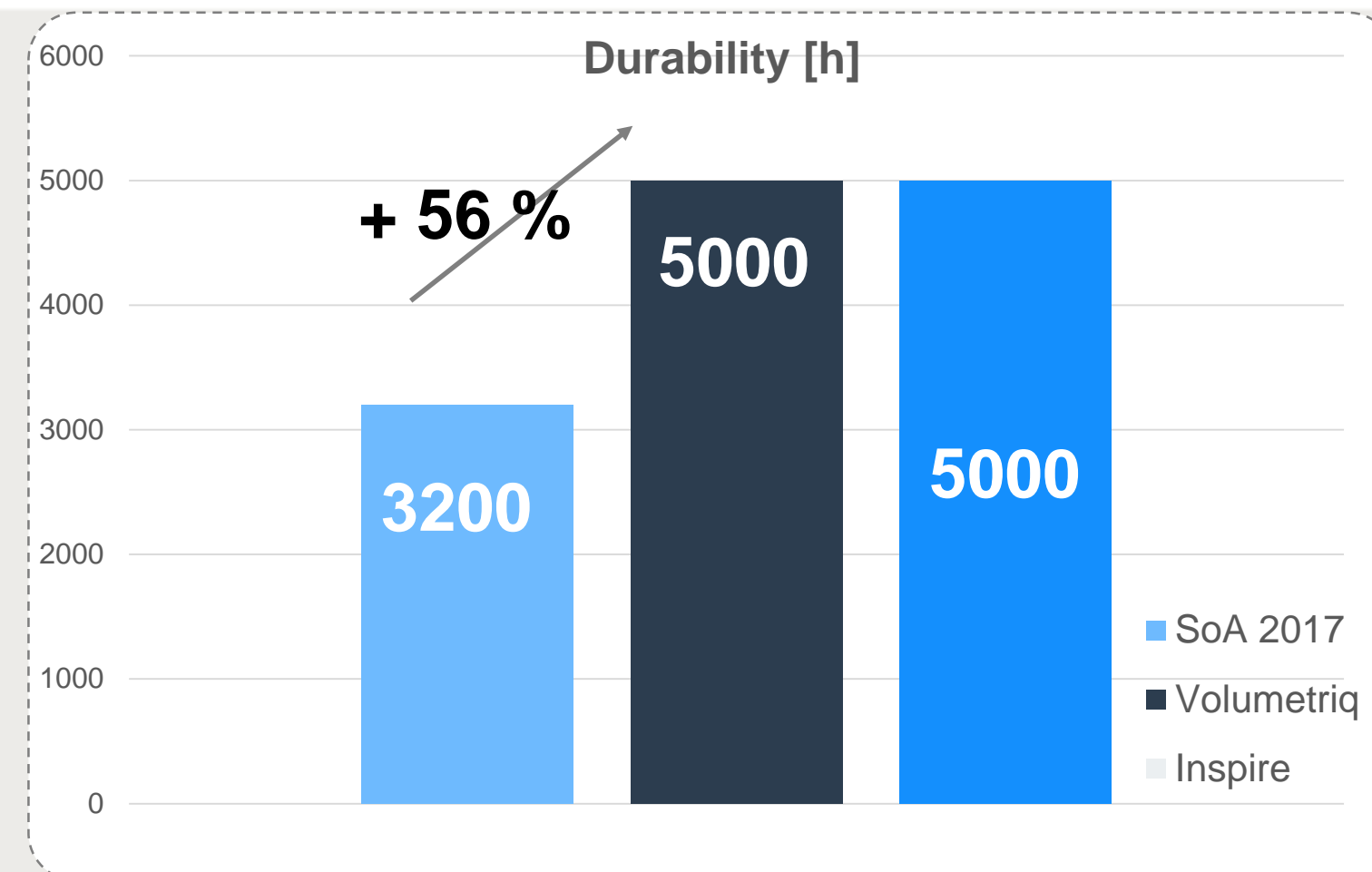
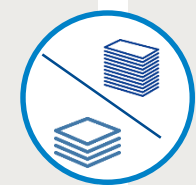
Protocols



Hardware:
JRC ZEROCELL

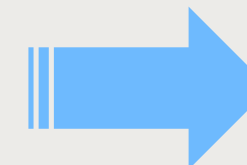
Stack performance results

Progress on main KPIs in a single stack



2017

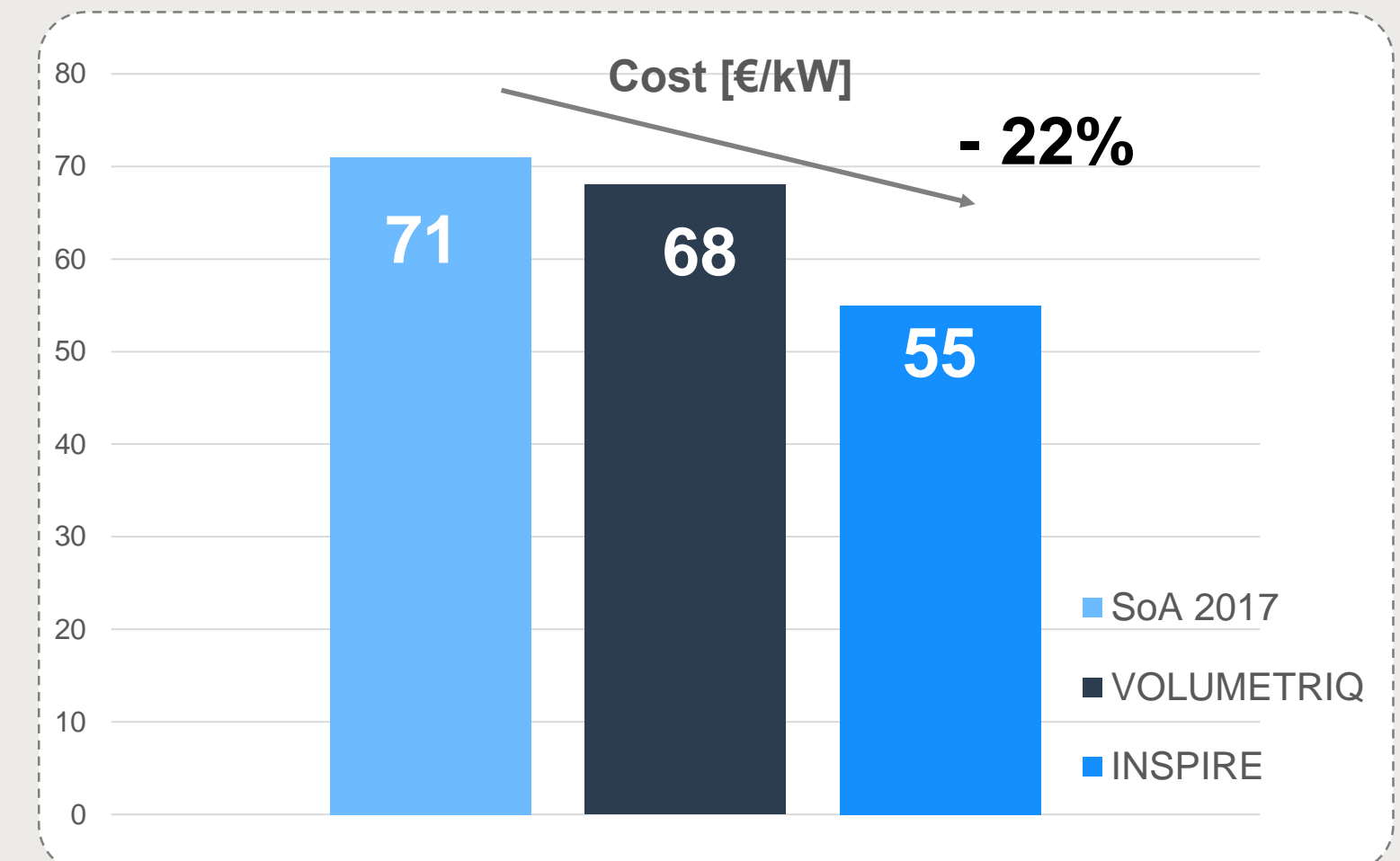
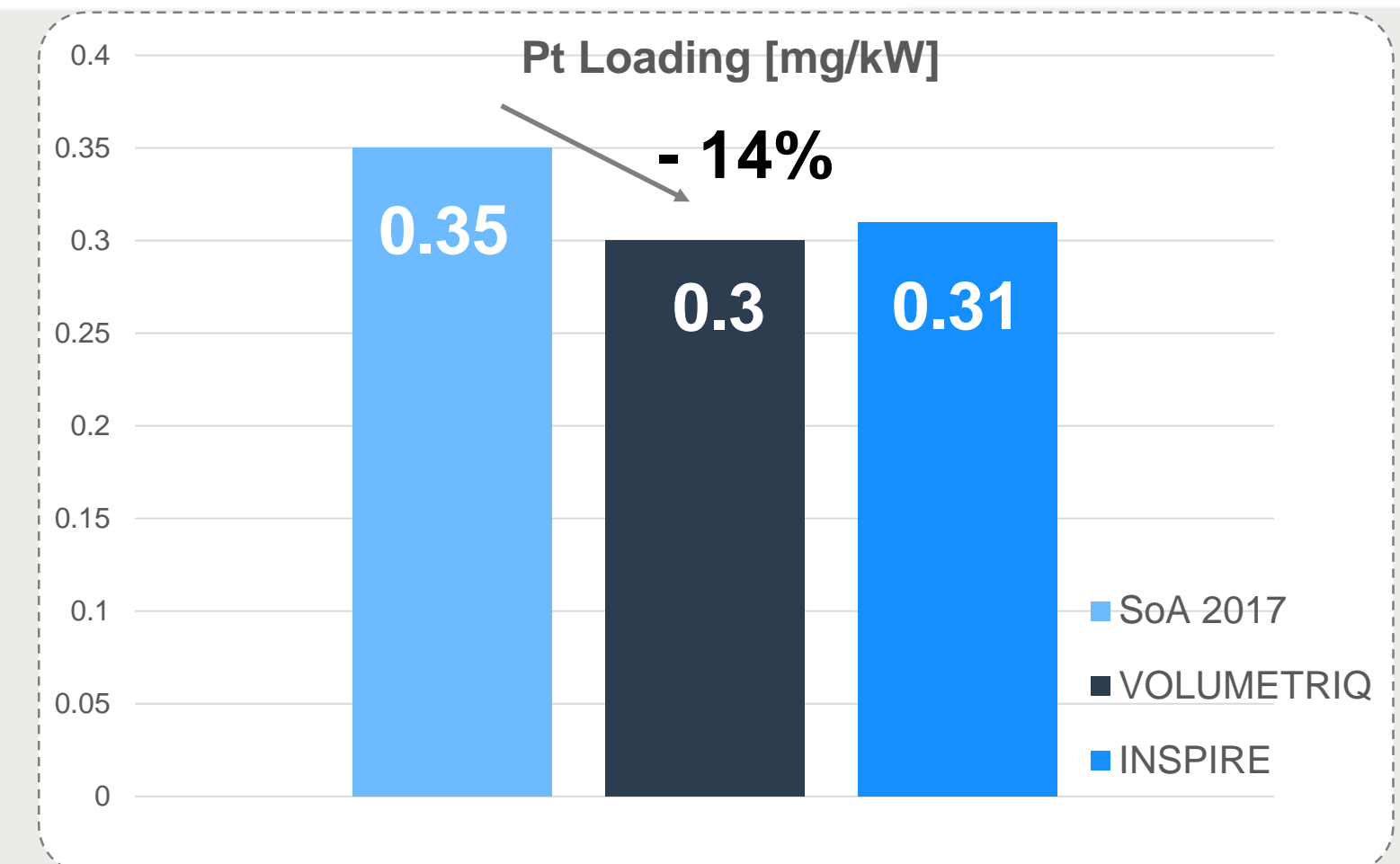
2019



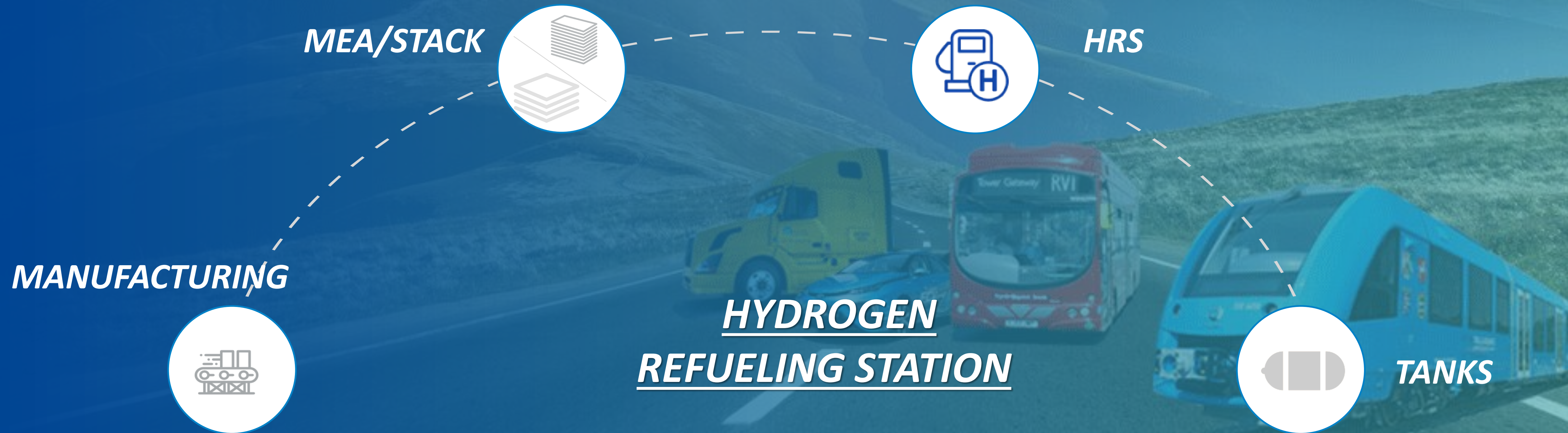
~~No project has reached
all indicators simultaneously~~



Stack on display

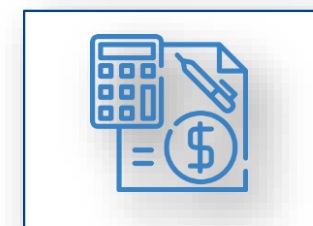
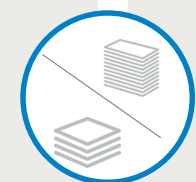
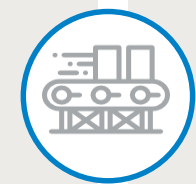


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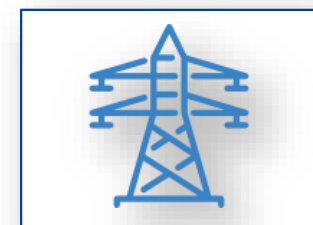


Hydrogen Refueling Stations

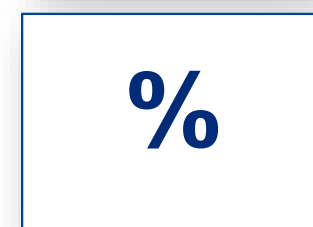
Focus on compression



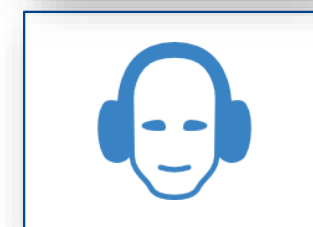
Cost



Energy Consumption

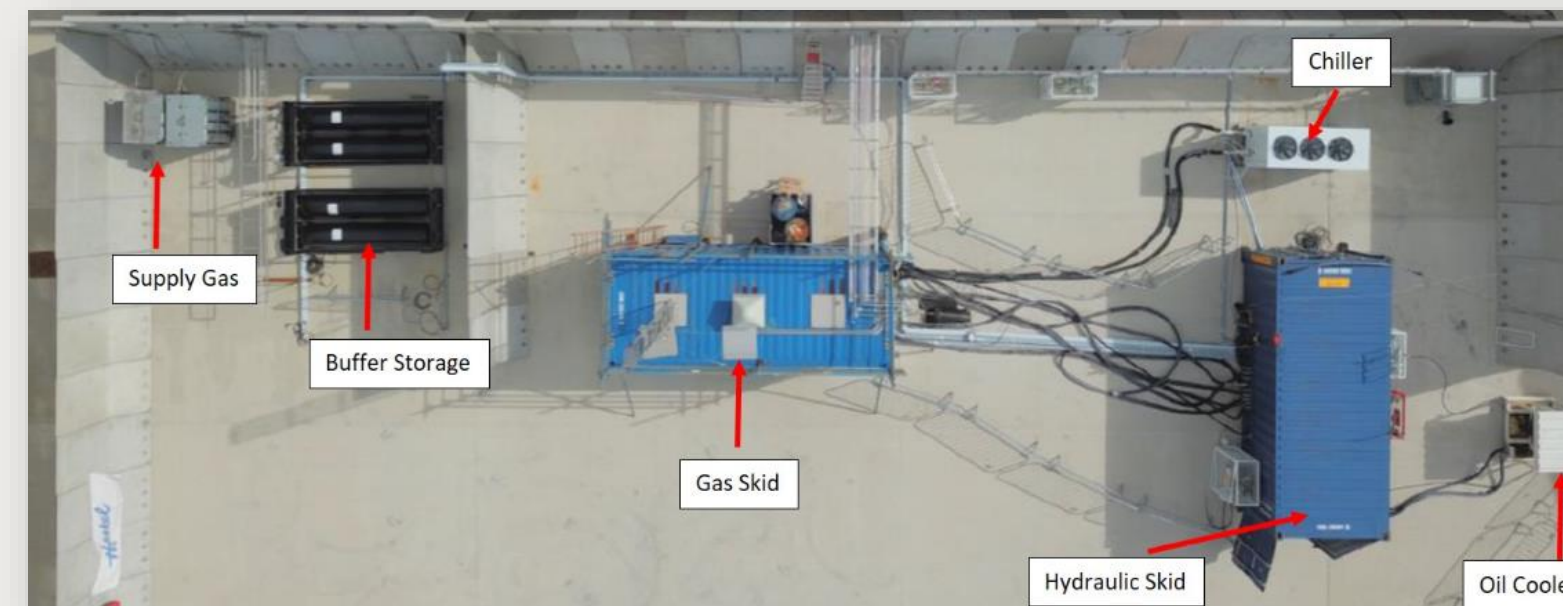


Availability



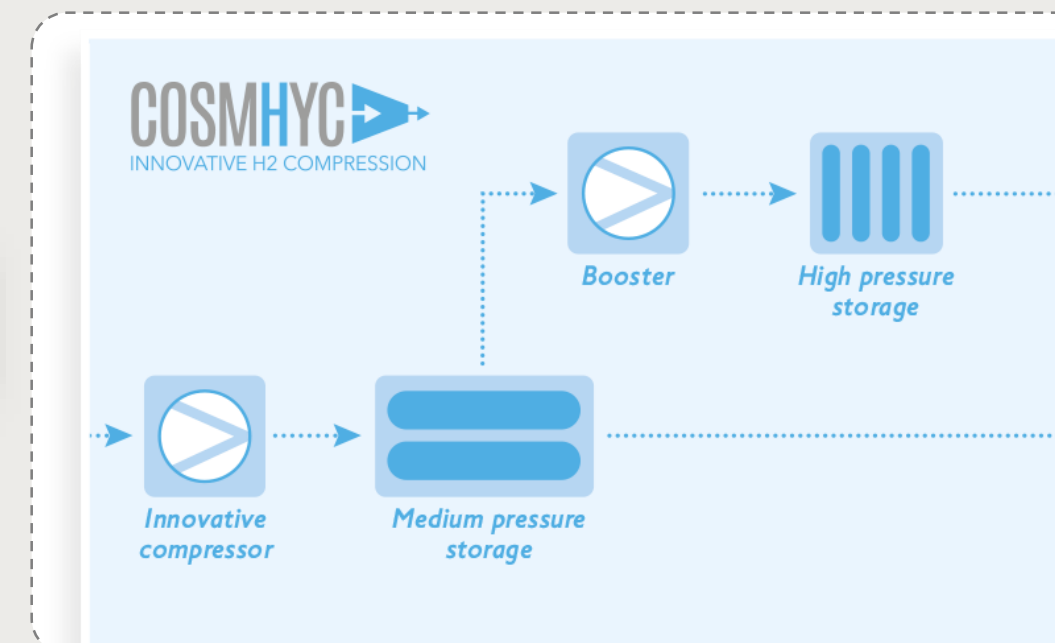
Noise

Innovative Compression technologies



CBM process developed & full scale prototype system built

Next: Endurance testing



Metal hydride

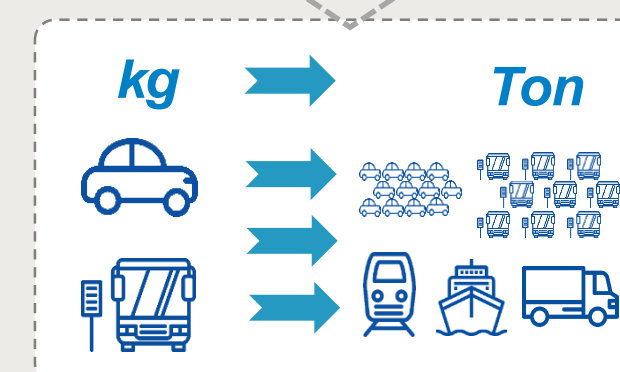
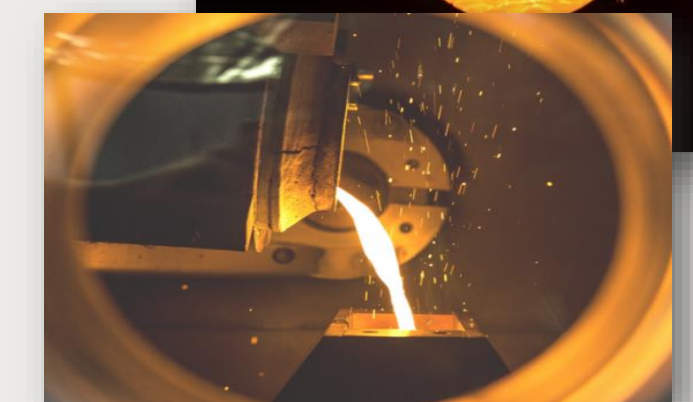
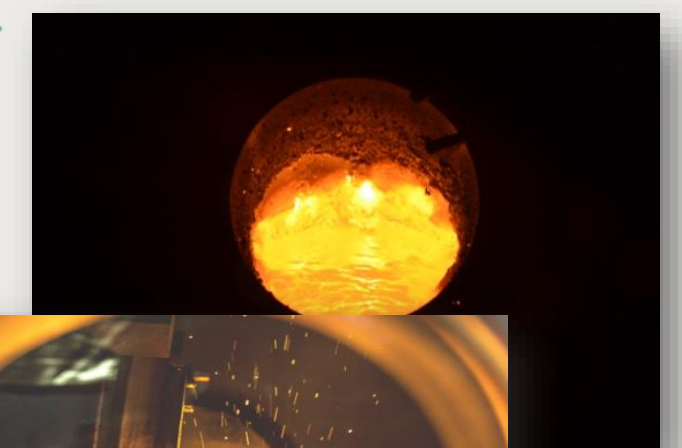
No moving parts

Heat reutilization

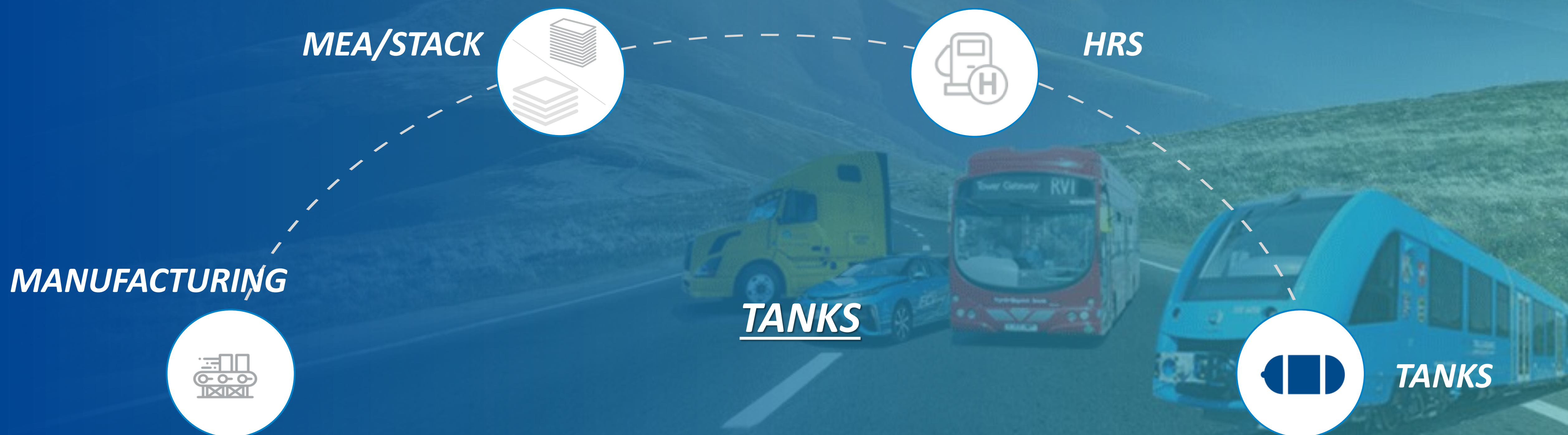
Purity of gas

Scalable

PROJECT TARGET:
0% CRITICAL RAW
MATERIALS
TARGET REACHED

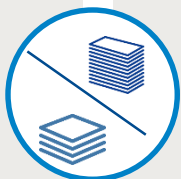


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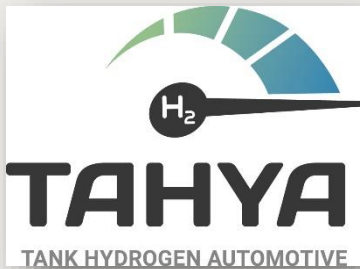


On-board hydrogen storage

Manufacturing, design and materials



	Progress	
	2017	2020
CAPEX	600 €/kg H ₂	500 €/kg H ₂
Volumetric capacity	0.023 kg/l	0.03 kg/l
Gravimetric capacity	5 %	5.3 %



MATERIAL

DESIGN

MANUFACTURING

COST

WEIGHT

SAFETY

TEMPERATURE



Key messages



Manufacturing & Quality Control key to competitiveness



Good results at stack level



Pt Loading: an application-specific challenge



Increased attention towards Heavy Duty



FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING

Pietro Caloprisco

Project Officer
Pietro.Caloprisco@fch.europa.eu

For further information

www.fch.europa.eu



@fch_ju



Fch-ju@fch.europa.eu



FCH JU