



**FUEL CELLS AND HYDROGEN**  
JOINT UNDERTAKING

*Research activities for  
transport applications:  
MEAs, components,  
stacks and subsystems,  
HRS*

**Pietro Caloprisco**

**PRD 2018**

*15 November 2018*





# Agenda

**PROGRAMME REVIEW DAYS 2018**  
**FUEL CELLS AND HYDROGEN JOINT UNDERTAKING**  
 14 - 15 NOVEMBER, BRUSSELS



	TRIALS AND DEPLOYMENT OF FUEL CELL APPLICATION - TRANSPORT	NEXT GENERATION OF PRODUCTS - TRANSPORT	TRIALS AND DEPLOYMENT OF FUEL CELL APPLICATION - ENERGY	NEXT GENERATION OF PRODUCTS - ENERGY	HYDROGEN FOR SECTORIAL INTEGRATION	SUPPORT FOR MARKET UPTAKE
09:00 - 09:20	H2ME HAWL HYFIVE HYLIFT-EUROPE HYTRANSIT	AUTO-STACK CORE COBRA COSMHYC DIGIMAN Fit-4-AMandA	ALKAMMONIA AUTORE CH2P CLEARGEN DEMO D2SERVICE	Cell3Ditor DIAMOND ENDURANCE FLUIDCELL HEALTH-CODE	BIONICO BIOROBURplus Demo4Grid DON QUICHOTE Eco	HYACINTH HYCORA HyLAW HYFACTOR HySEA
09:20 - 09:40	JIVE SWARM H2ME 2	H2REF HYCARUS INLINE INN-BALANCE INSPIRE	DEMCOPEM-2MW DEMOSOFC ENE.FIELD ONSITE PACE	HEATSTACK INSIGHT MATISSE NELLHI PROSOFC	ELECTRA ELY4OFF ELYntegration GrInHy H2Future	HYTECHCYCLING KNOWHY NET-Tools SOCTESQA
09:40 - 10:00		MARANDA NANO-CAT SMARTCAT VOLUMETRIO	POWER-UP STAGE-SOFC	qSOFC SCORED 2:0 SECOND ACT SOSLeM INNO-SOFC	HELMETH HPEM2GAS HyBalance HYDROSOL-PLANT HyGrid INSIDE MEGASTACK	
10:00 - 10:20		COMPASS Giantleap			PECDEMO PECSYS QualyGridS SElySOs SOPHIA BIG HIT MEMPHYS	
10:20 - 10:40						
10:40 - 11:00						

rgy



# Next Generation of products - Transport

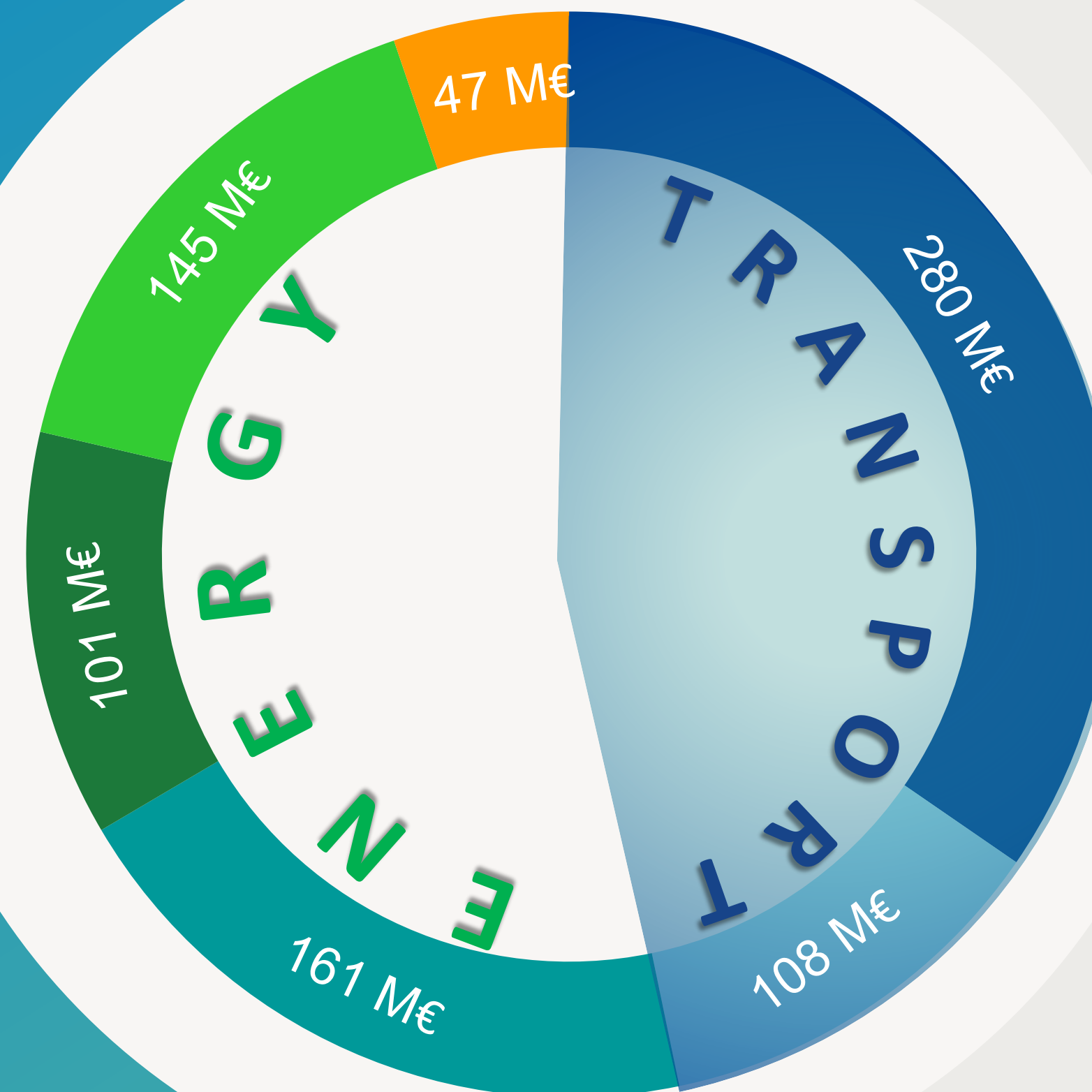


Related FCH JU objectives



Reduce fuel cell system costs for transport applications while increasing lifetime

Reduce use of critical raw materials



## Transport - Total

42 %



388 M€

60 Projects

## Next Generation products



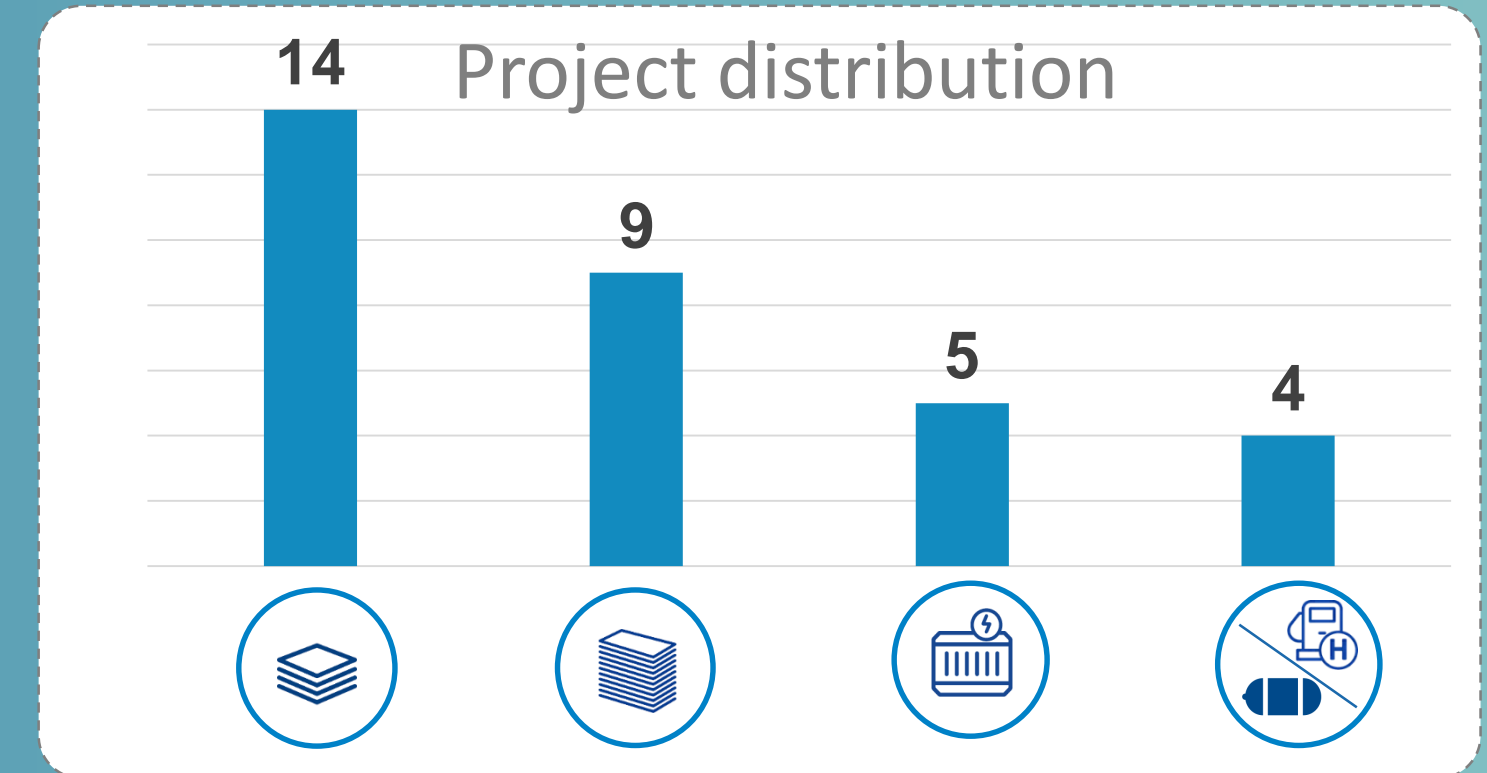
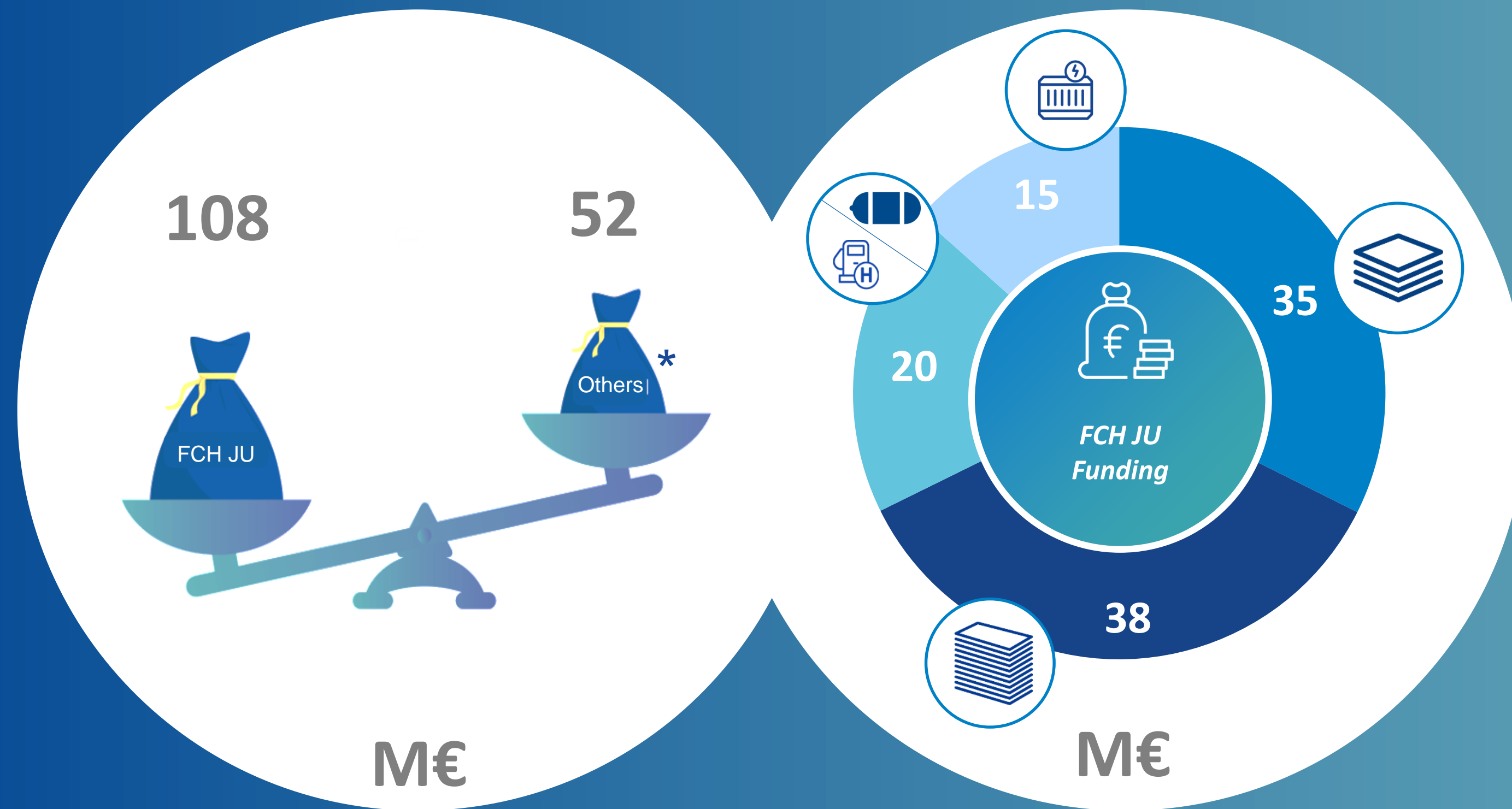
108 M€

32 Projects



# Towards competitiveness

32 projects – 160 M€



MEA, catalysts, GDL, BPP, materials

Stack modelling, development, manufacturing, next generation

Auxiliary power units

Hydrogen refueling station, On-board H2 storage

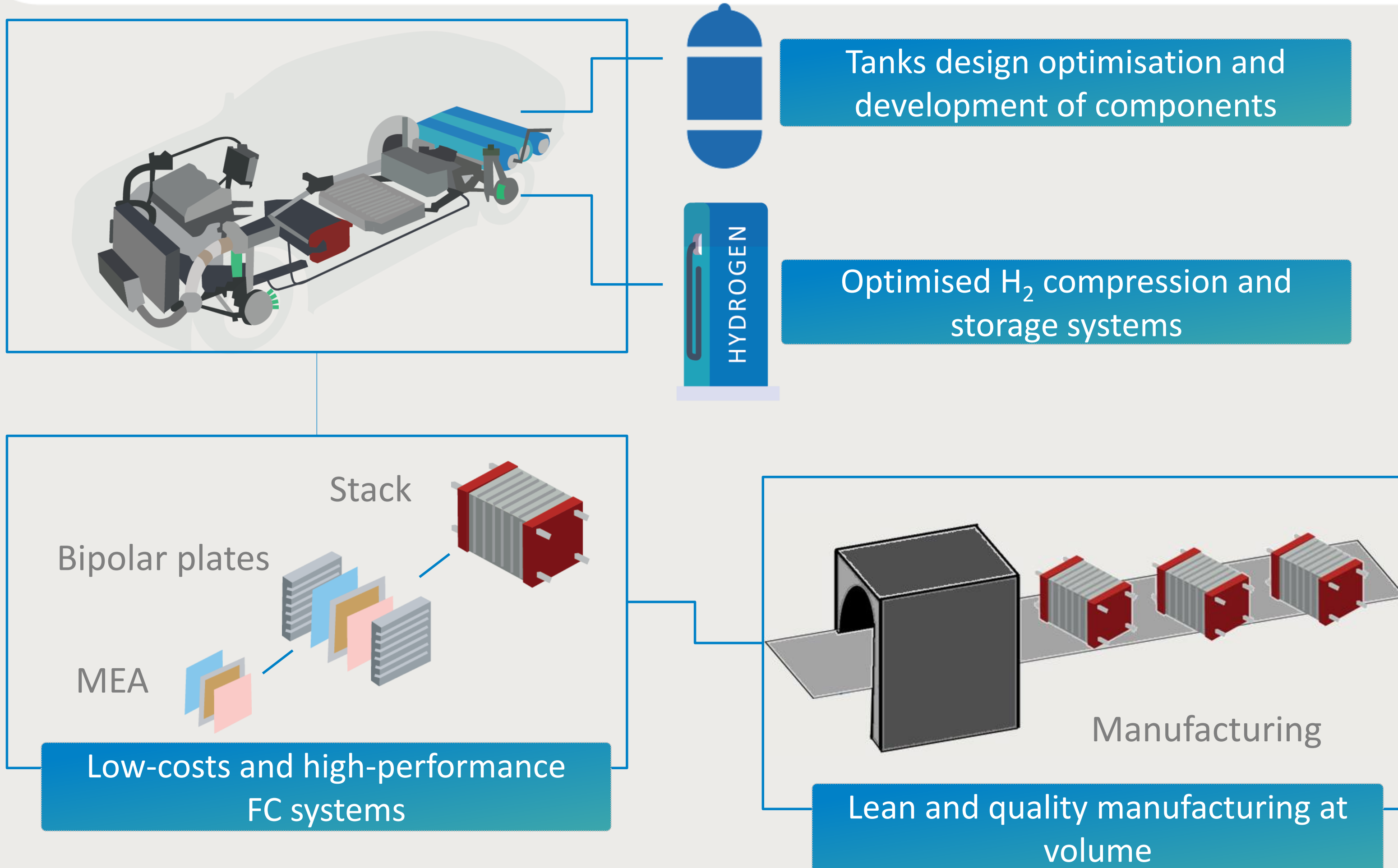


\* Other resources including private and national/regional funding



# FCH JU support to all FCEV research aspects

Supporting the competitiveness of the technology and the EU supply chain

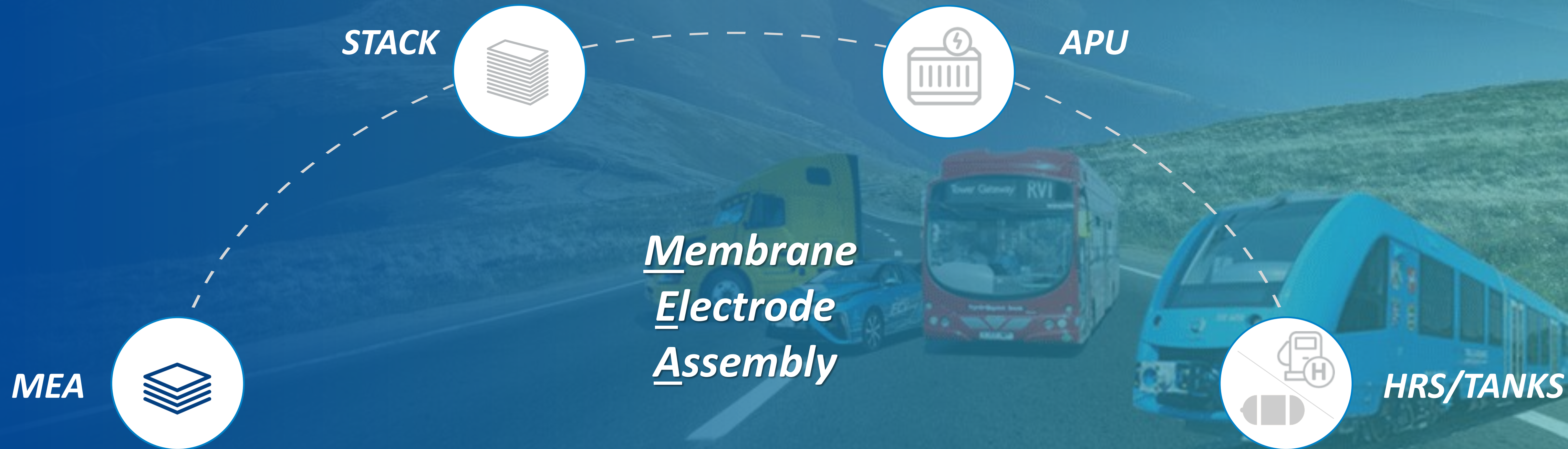


-  From basic research to validation and testing
-  From materials to manufacturing
-  Very strong industrial and academic cooperation
-  Connected projects





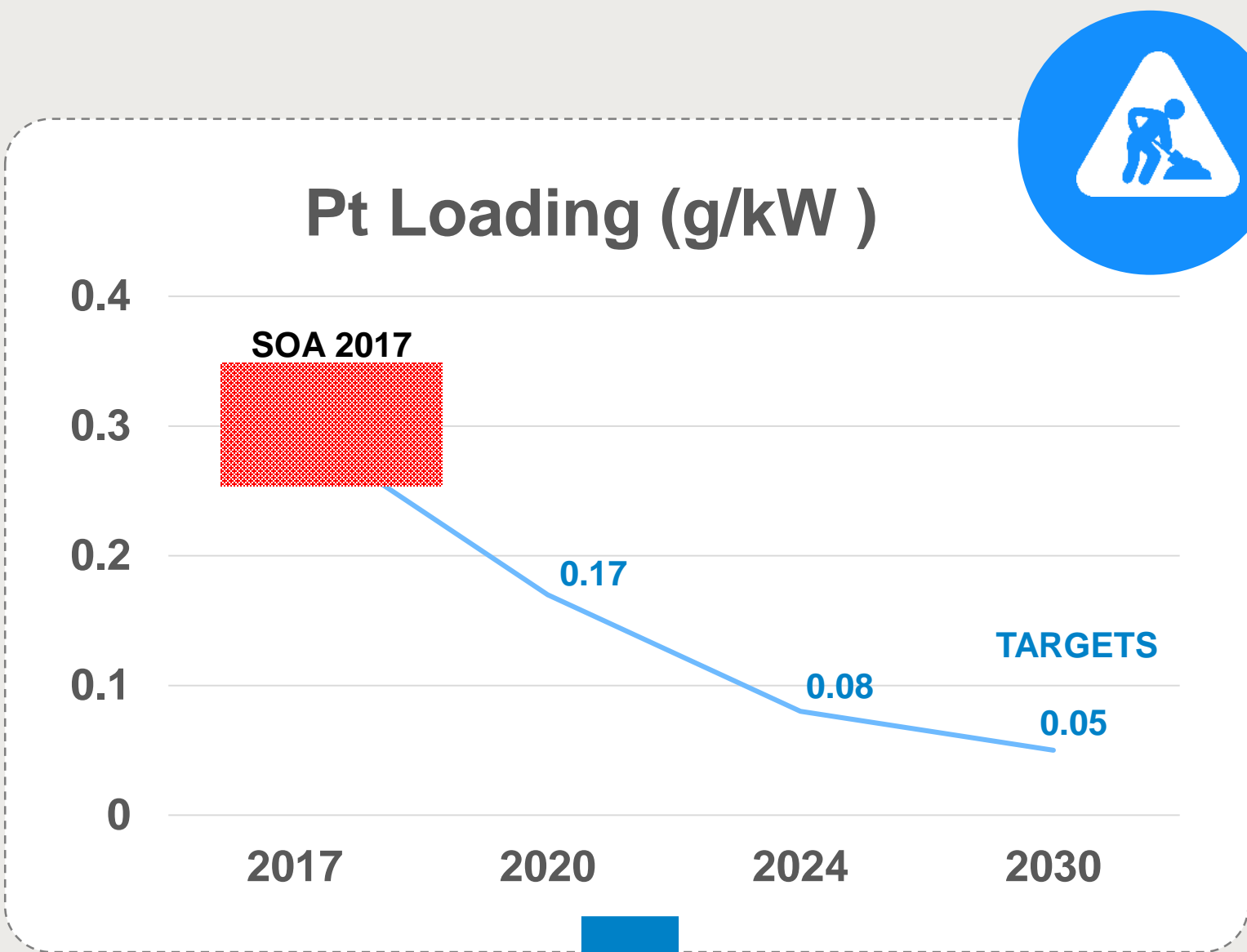
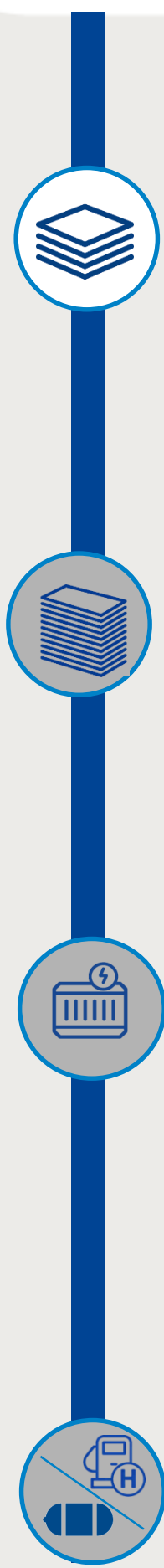
# Transport Portfolio: Research & Innovation



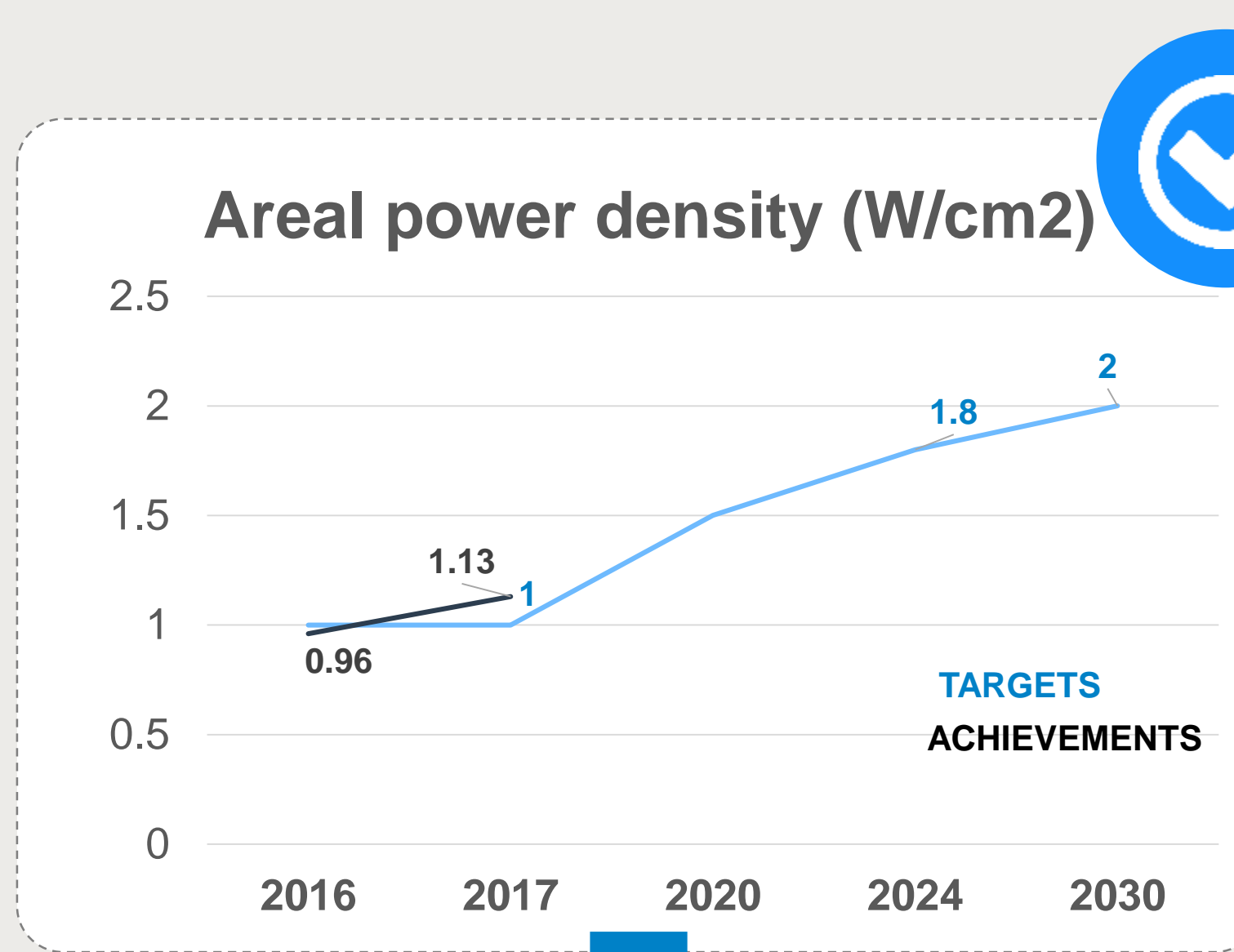


# Delivering durable and competitive building blocks for H2 mobility

Reducing use of critical materials remains a priority



Towards next generation of PEMFC: Non-PGM catalysts



18% improvement compared to previous year

Indicator	2017
Durability	> 5.000 h

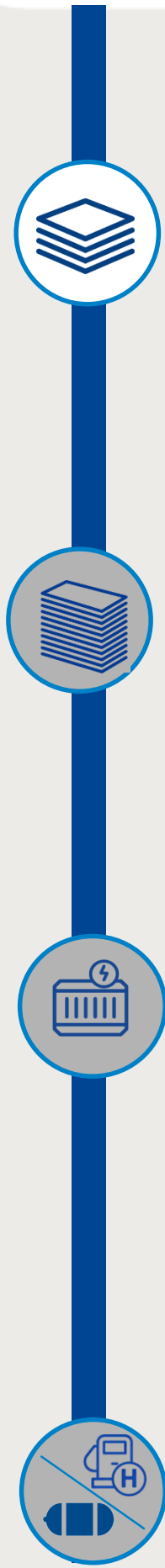
No changes to be reported compared to 2016




All results yet to be achieved simultaneously in a single project

# Other activities

## Harmonisation of testing procedures







JRC SCIENCE FOR POLICY REPORT










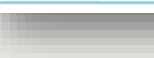


### EU HARMONISED TEST PROTOCOLS FOR PEMFC MEA TESTING IN SINGLE CELL CONFIGURATION FOR AUTOMOTIVE APPLICATIONS

Georgios Tsotridis, Alberto Pilenga, Giancarlo De...

2015

	Automotive Fuel Cell Cooperation	Robert Boulianne
	Bayerische MotorenWerke Aktiengesellschaft	Johannes Schmid Zacharias Veziridis Peter Wilde
	CEA Commissariat à l'énergie atomique et aux énergies alternatives	Pierre-André Jacques
	Daimler Aktiengesellschaft	Georg Frank Martin Heinen
	Deutsches Zentrum für Luft- und Raumfahrt e. V.	Andreas Friedrich Jens Mittel Mathias Schulze
	Fraunhofer ISE	Ulf Groos
	FuMA-Tech Gesellschaft für funktionelle Membranen und Anlagentechnologie mbH	Tomas Klípcera
	IRD fuel cell A/S	Madeleine Odgaard
	Johnson Matthey Fuel Cells Ltd	Silvain Buche
	Technische Universität München	Oliver Schneider
	Toyota Motor Europe	Isotta Cerri
	Université de Montpellier	Deborah Jones
	Volkswagen Aktiengesellschaft	Gerold Hübner Miriam Stiefel
	Zentrum für Sonnenenergie- und Wasserstoff-Forschung BW	Ludwig Jörissen Alexander Kabza



FUEL CELLS AND HYDROGEN JOINT UNDERTAKING




### EU HARMONISED SINGLE PEM FUEL CELL TESTING HARDWARE

Georgios Tsotridis; Tomasz Bednarek

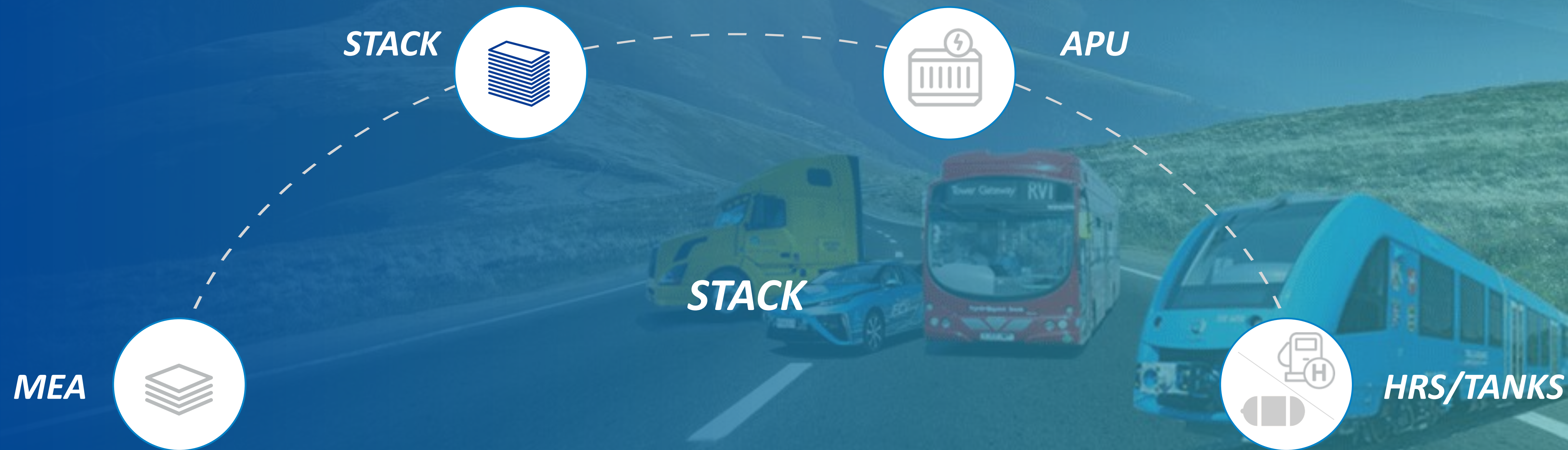
European Commission,  
Joint Research Centre (JRC),  
Directorate C – Transport, Energy and Climate,  
Petten, The Netherlands







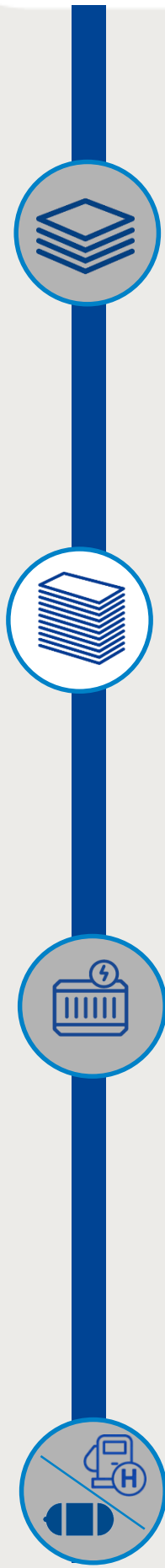
# Transport Portfolio: Research & Innovation



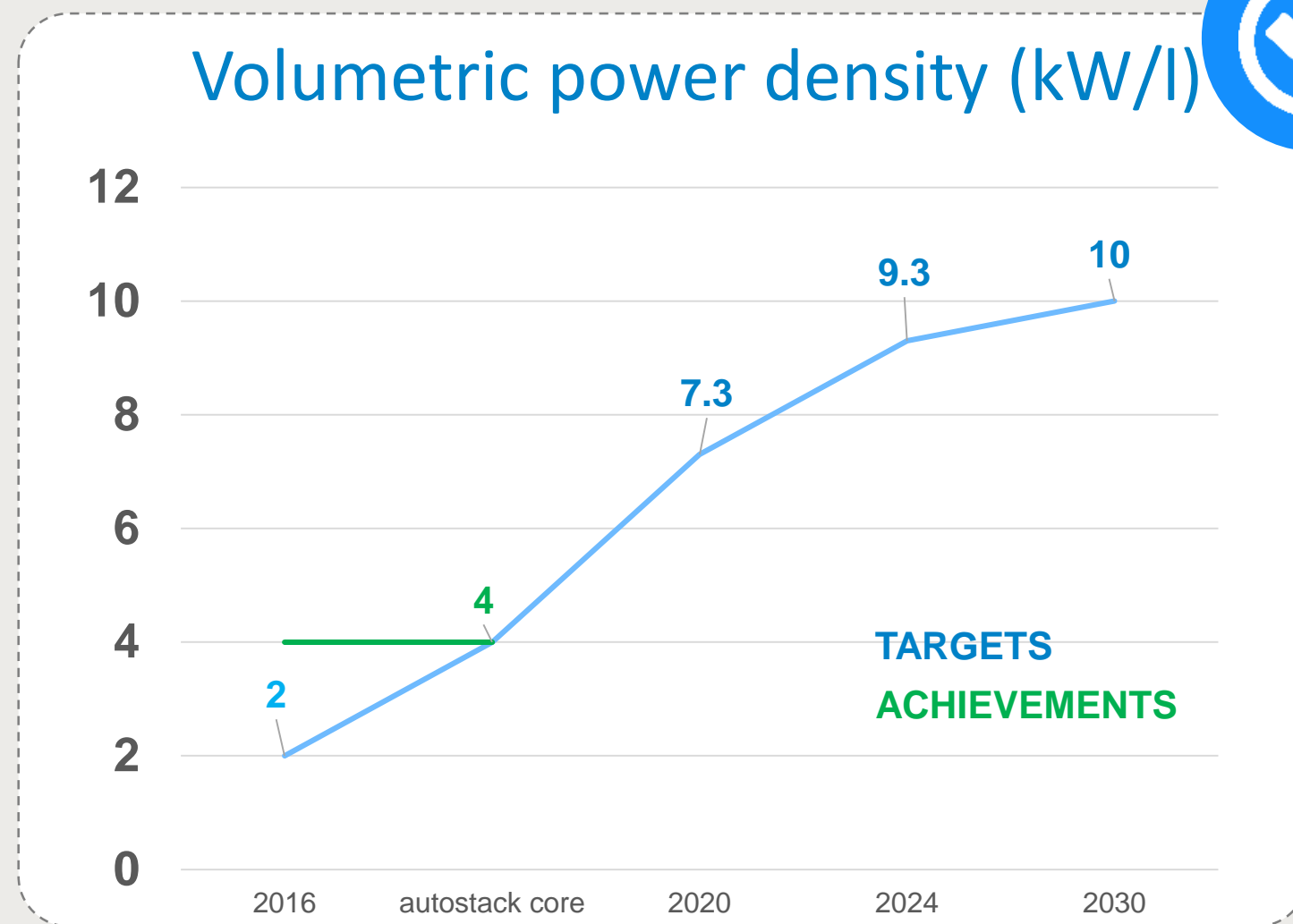


# Supporting the next generation of EU stacks

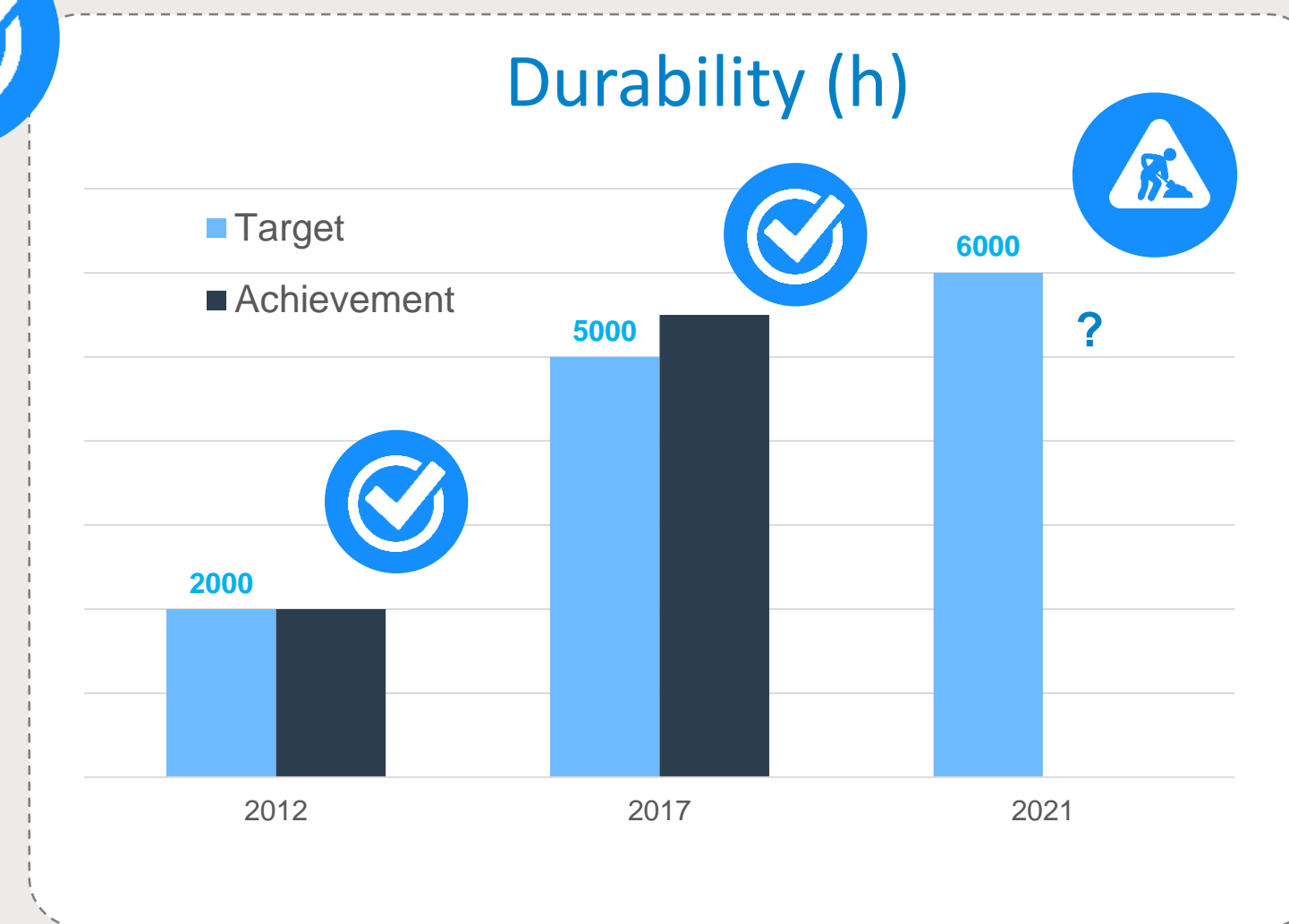
Increased performance



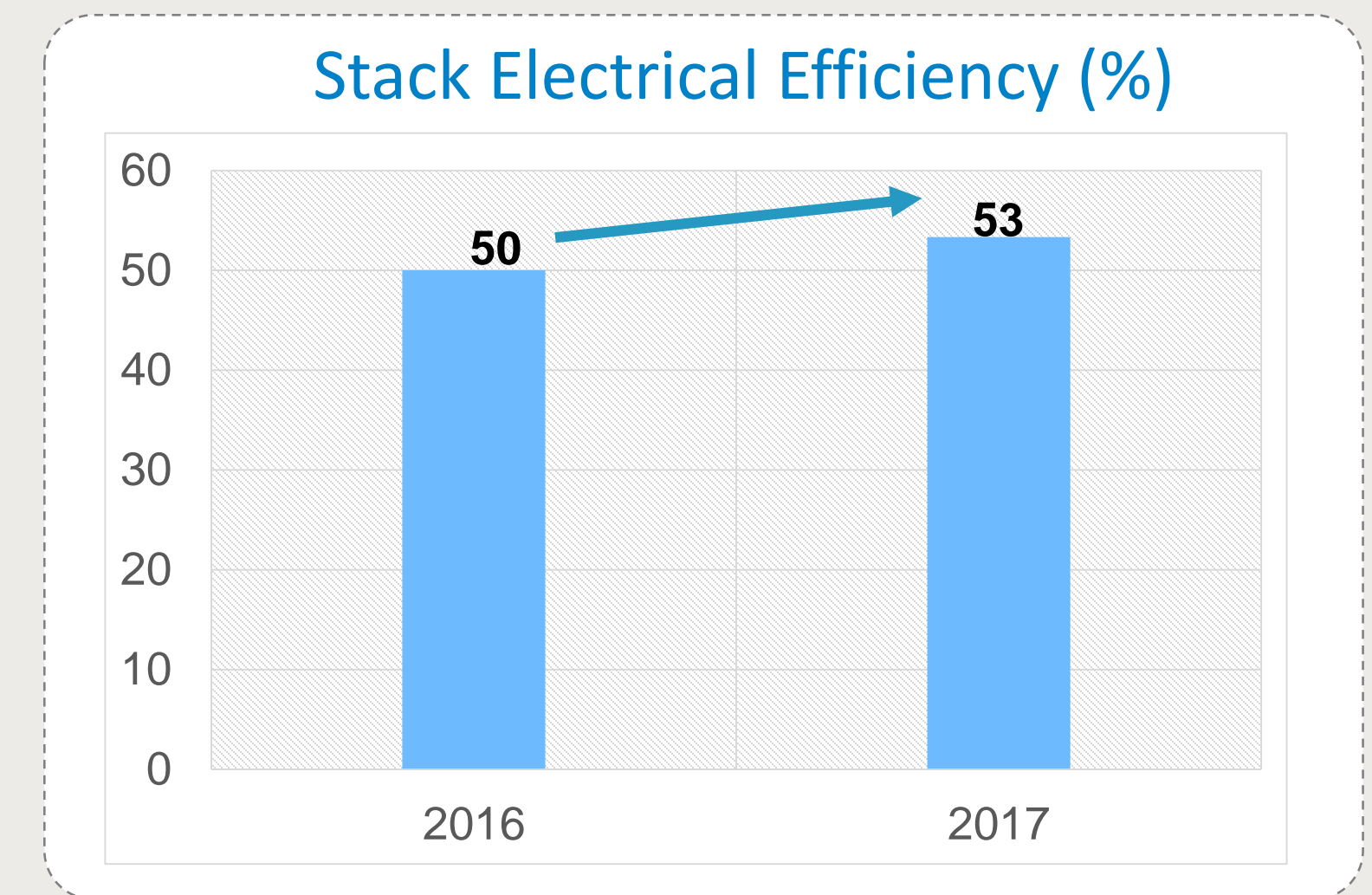
## Performance



On the right path



6.000 h stack durability next goal



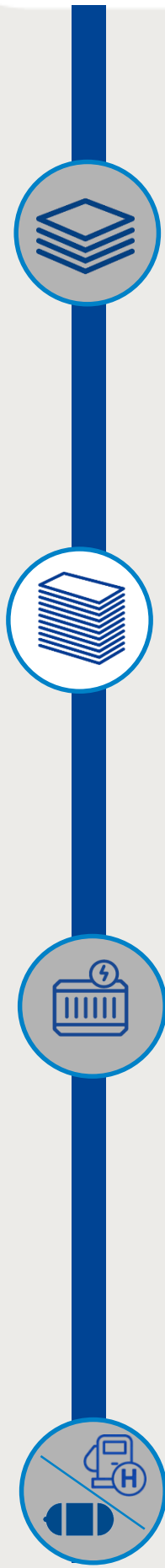
Improvement in efficiency compared to previous year.



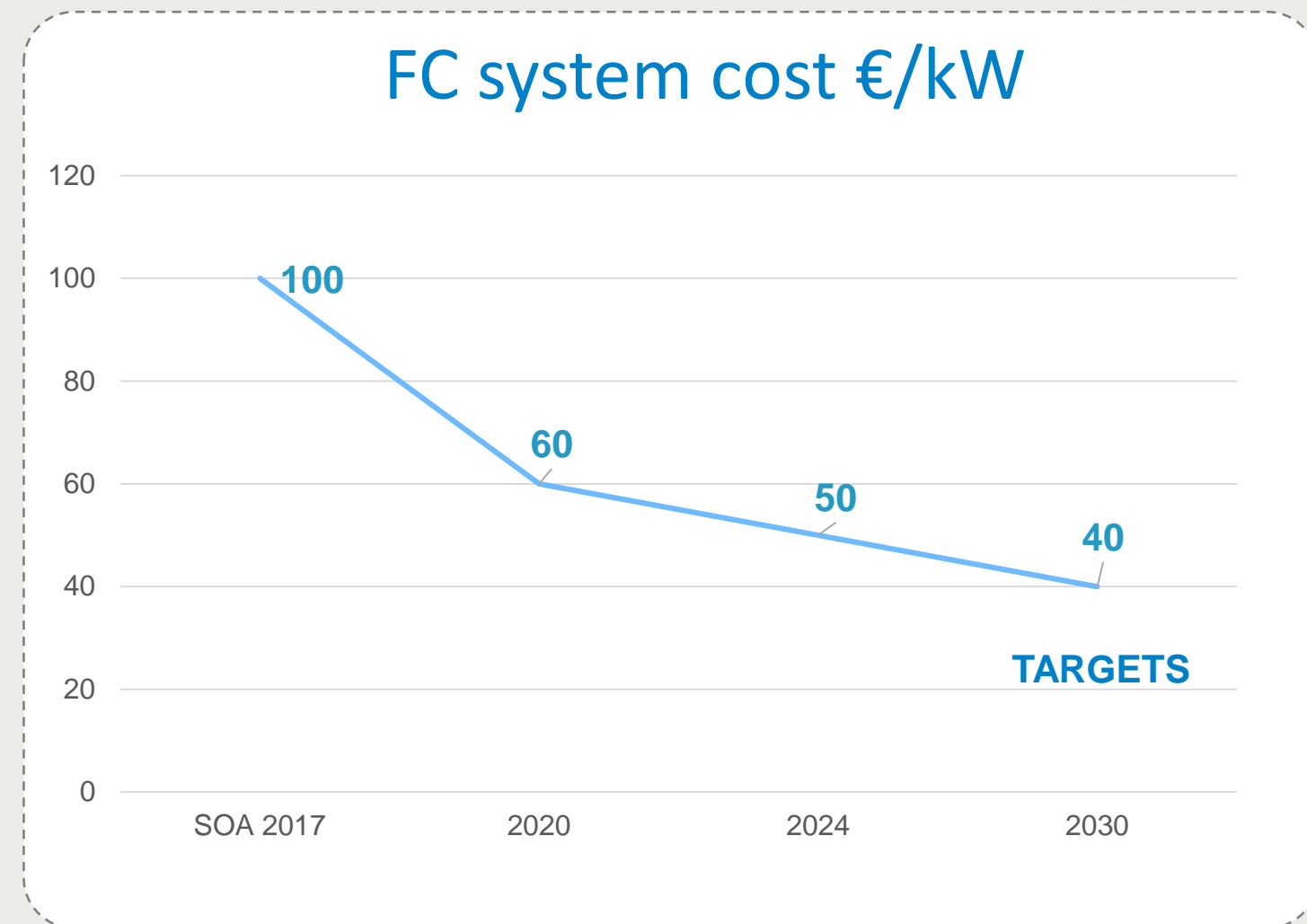


# Supporting the next generation of EU stacks

Competitive production at mass scale

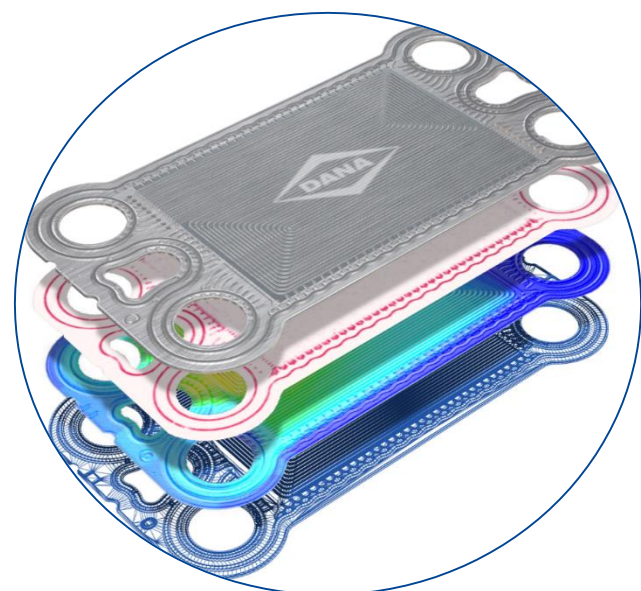


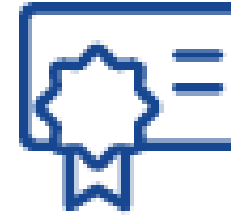
## Costs

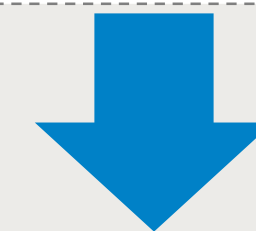


Contributing to FC system cost reduction

### Bipolar plate



Nominee Innovation award 



Manufacturing costs – 85%



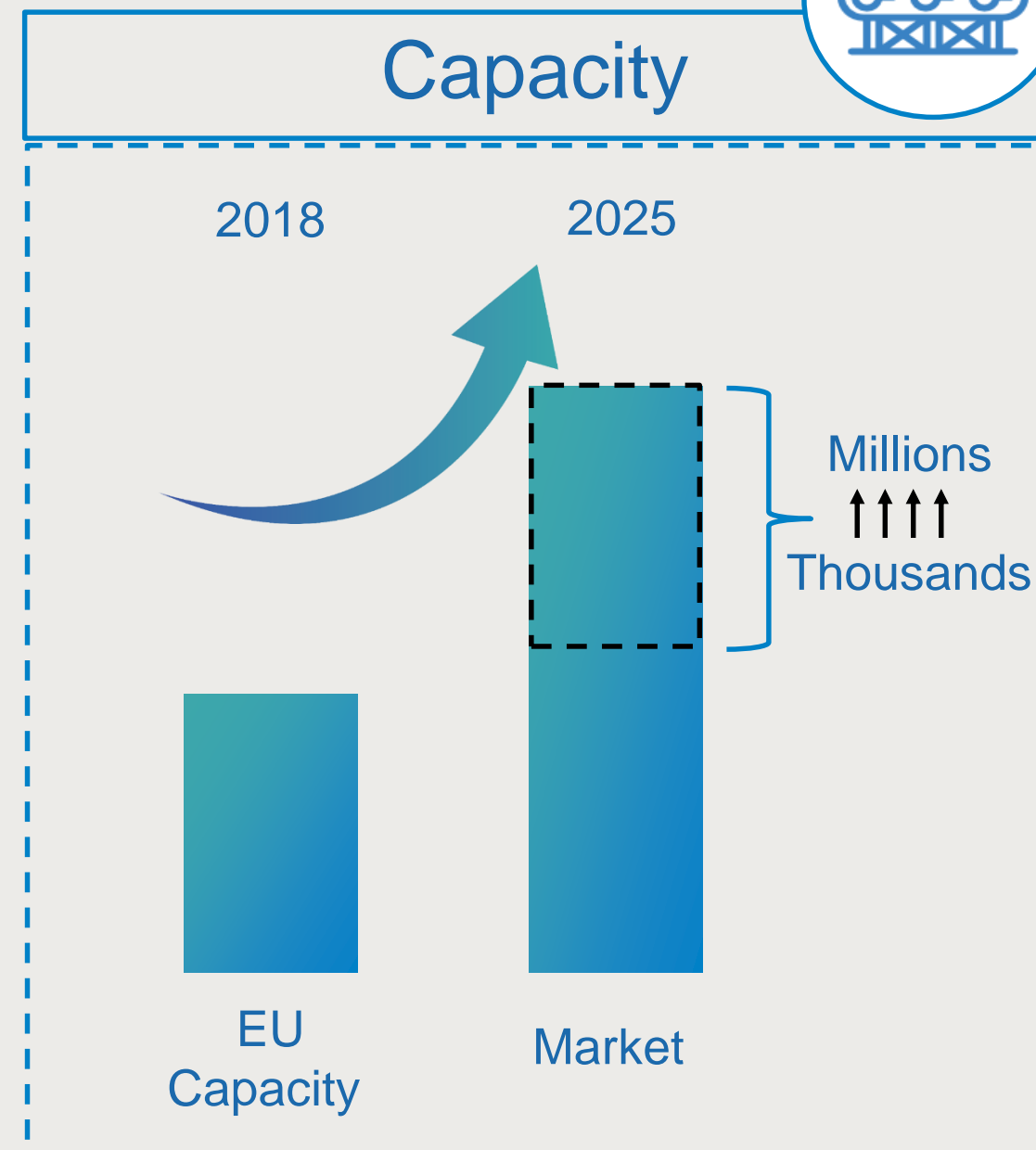
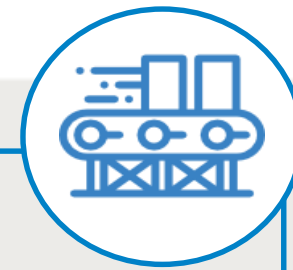


# PEMFC stack and MEA manufacturing workshop; volume & quality challenges workshop, 11 October 2018, Brussels

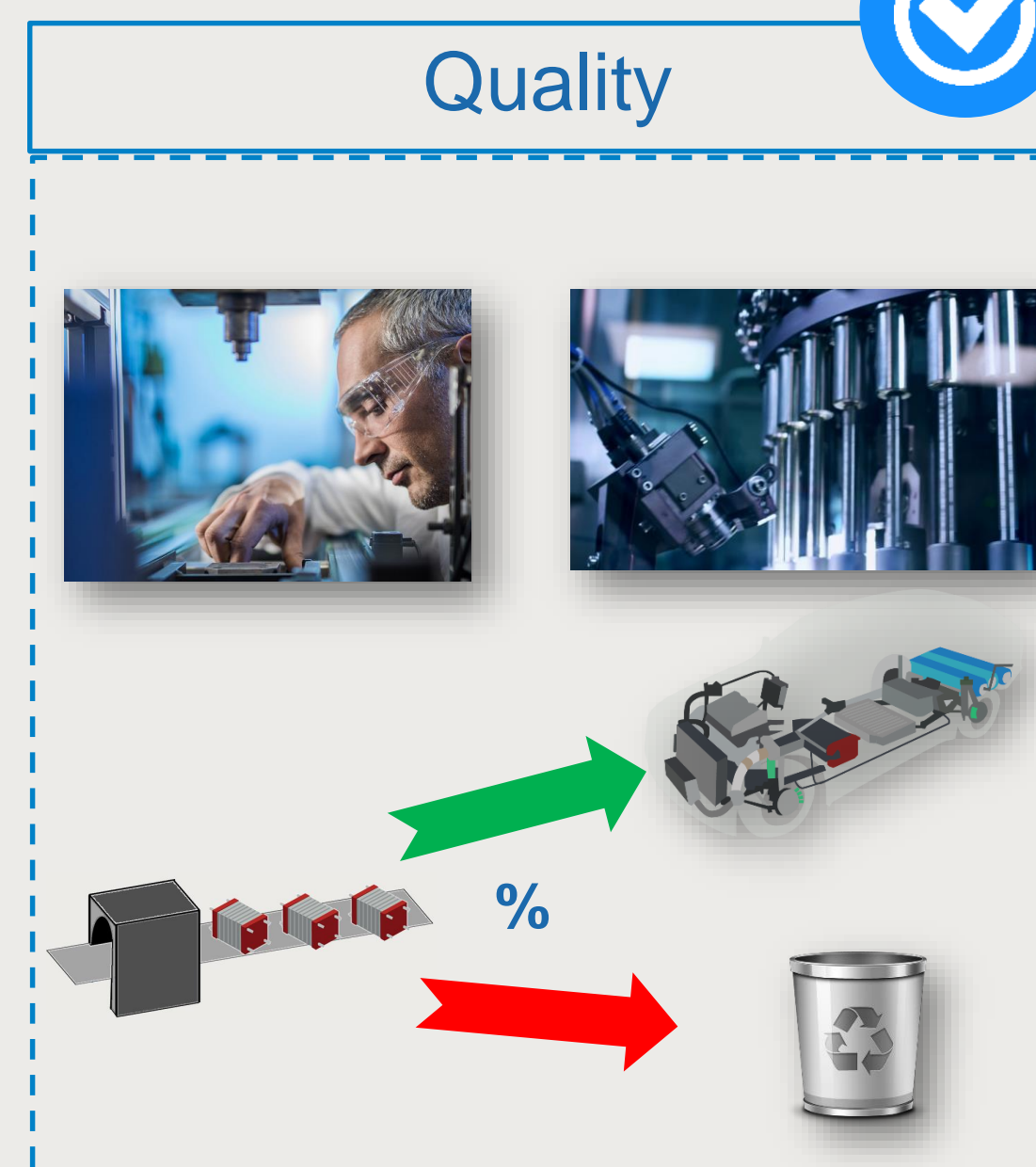
Volume, quality and cost



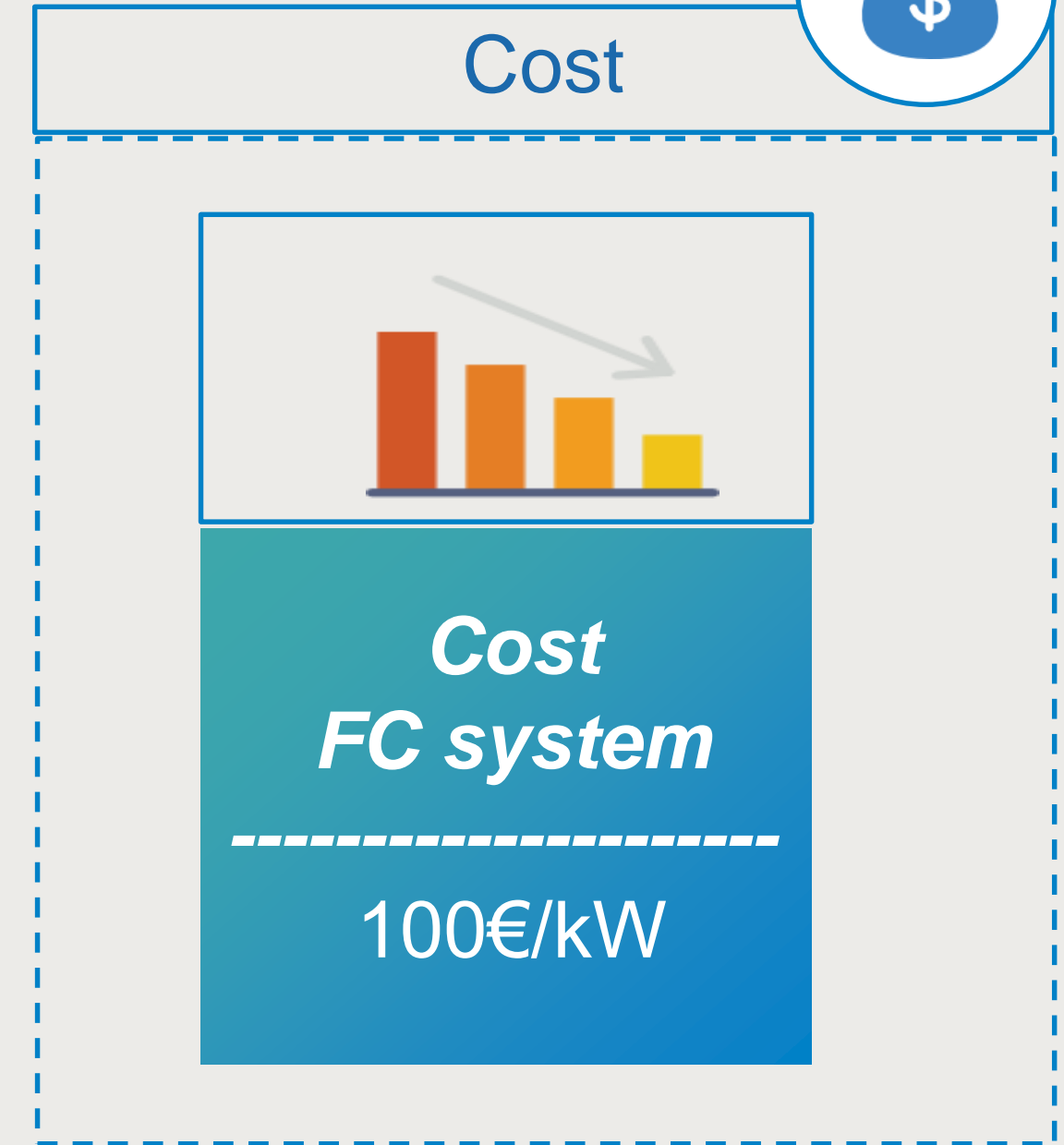
FCH FUEL CELLS AND HYDROGEN JOINT UNDERTAKING	
PEMFC stack and MEA manufacturing workshop; volume & quality challenges workshop, 11 October 2018, Brussels	
<b>Agenda</b>	
08:30 - 09:00	Welcome coffee
09:00 - 10:40	<b>INTRODUCTION</b>
Welcome & introductory remarks, Mrs. Mirela Atanasiu, Head of Operation and Communication	
- Overview of the FCH JU manufacturing activities, Pietro Caloprisco, Project officer, FCH JU	
- Victoria Petrova, adviser DG GROW, directorate Industrial Transformation and Advanced Value Chains	
- Overview of the European FC supply chain, David Hart, director, E4tech	
- Optimisation of the manufacturing value chain, Alicia Arce Rubio, Head of Control Systems Lab-R&D Project Manager, AYESA	
10:40 - 11:10	Coffee break
11:10 - 12:30	<b>SESSION I - OEMs' vision &amp; requirements</b>
- Toyota Europe, Isotta Cerri, General Manager	
- BMW, Thomas Mertens, Head of Technology Development and Prototyping Battery and Fuel Cell	
- Viessmann, Volker Nerlich, Project manager PACE in the Viessmann Group	
- OEM tbc	
12:30 - 13:30	Lunch break
13:30 - 15:10	<b>SESSION II - Stack, manufacturing processes &amp; quality techniques - presentations and panel discussion</b>
- Elingklinger, Jurgen Kraft, Head of PEM Fuel Cell Development (presentation and moderation of the panel)	
- Panel discussion	
• PowerCell, Thomas Tingelöf, CTO	
• Proton Motor, Thomas Wainemacher, Team Leader Mgt & Dev	
• Intelligent Energy, Peart Richard, Head of Manufacturing Development	
• Borit, Joachim Kroemer, Manager Marketing and Sales	
- Open discussion	
15:00 - 15:30	Coffee break



- Design for manufacturability
- Optimisation of the assembly processes
- Innovation & disruption



- Irregularities & defects
- “Big Data”
- Inline quality controls
- 100% testing > samples



- Modularity & scalability
- Materials research
- Long term purchase contracts



# SLIDO Question



Use your smartphone; go to [www.sli.do](http://www.sli.do) and insert the code **#PRD2018**

**Q: In order to build 100.000 FCEVs each year, how many cells have to be produced on yearly basis ?**

**A1: ~ 40.000**

**A2: ~ 400.000**

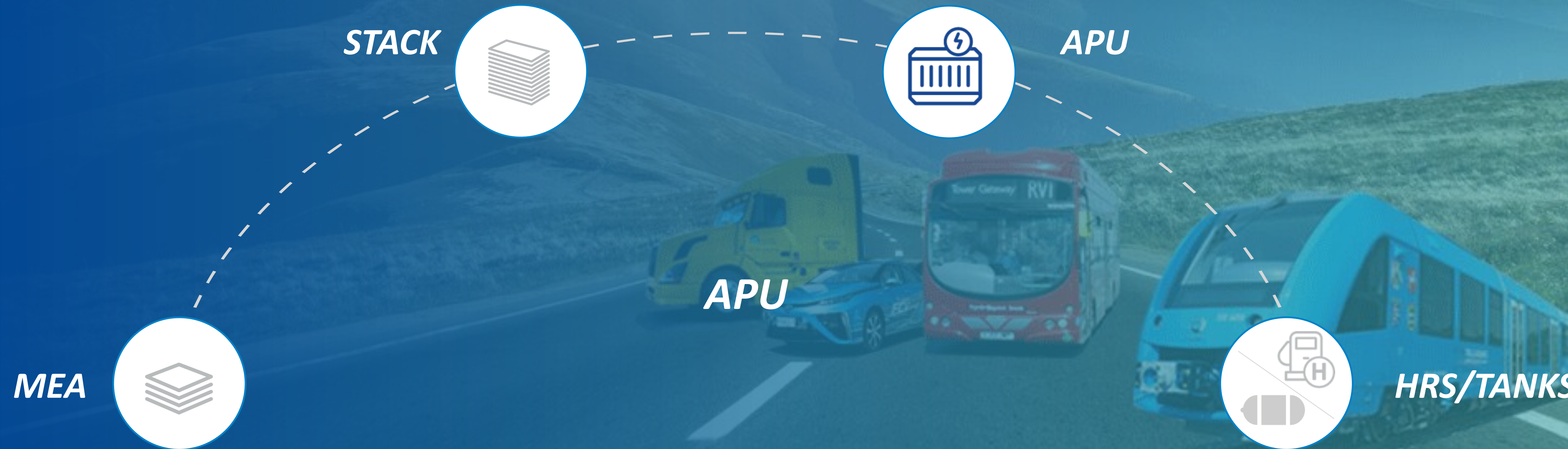
**A3: ~ 4.000.000**

**A4: ~ 40.000.000**





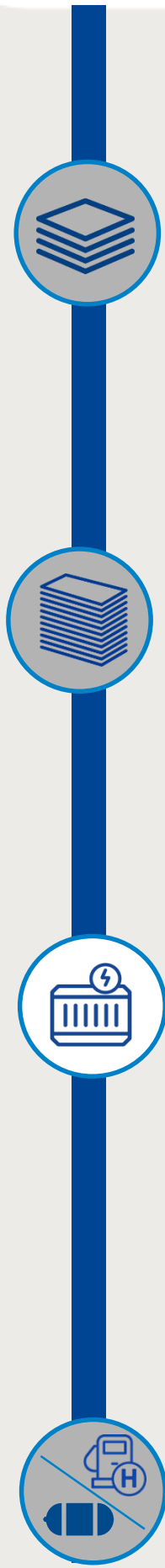
# Transport Portfolio: Research & Innovation





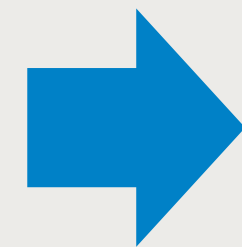
# Auxiliary Power Units

Road, water & air

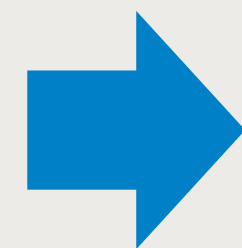


## Shared goals

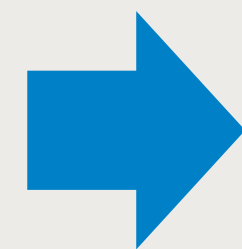
- Stack durability
- Efficiency
- Weight & Dimension
- Cost



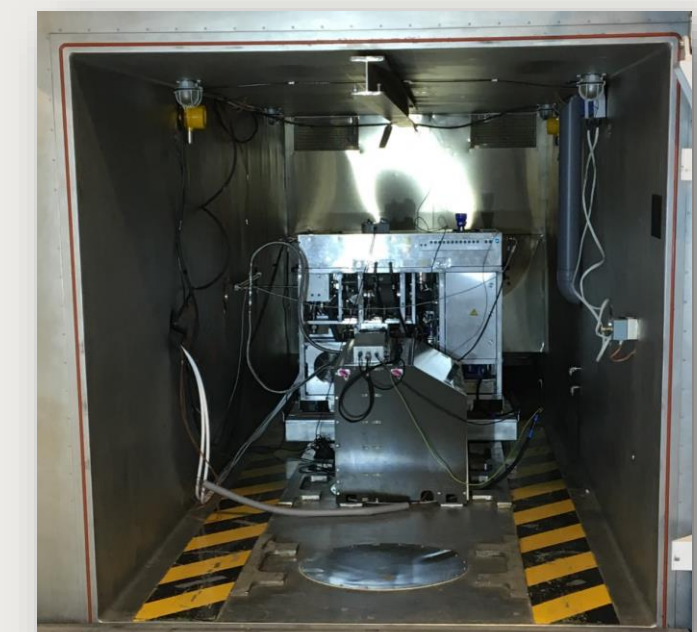
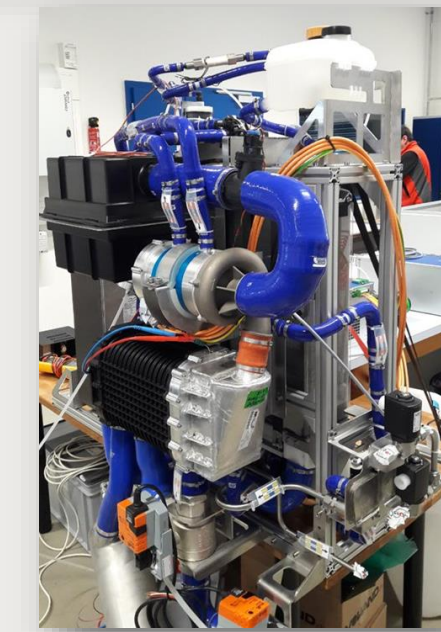
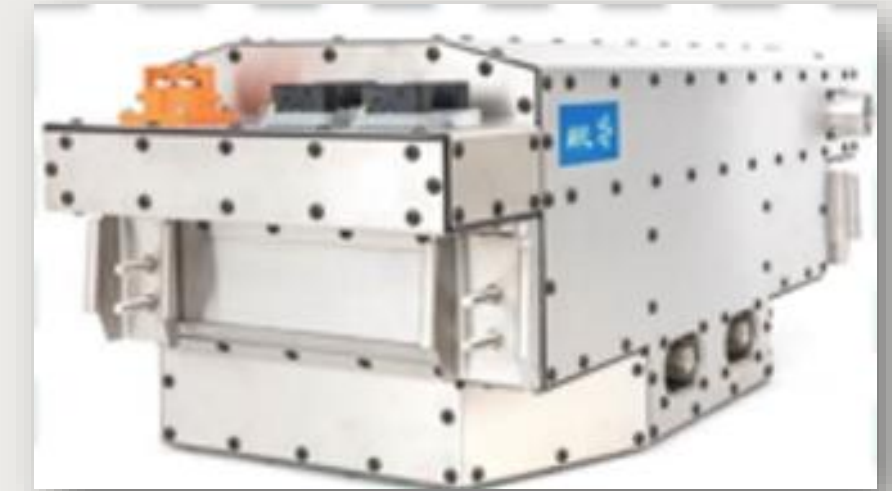
- Startup
- Efficiency
- Packaging



- Marinisation
- Freeze start
- Durability



- Flying conditions
- Capture re-use byproducts
- Permitting - safety





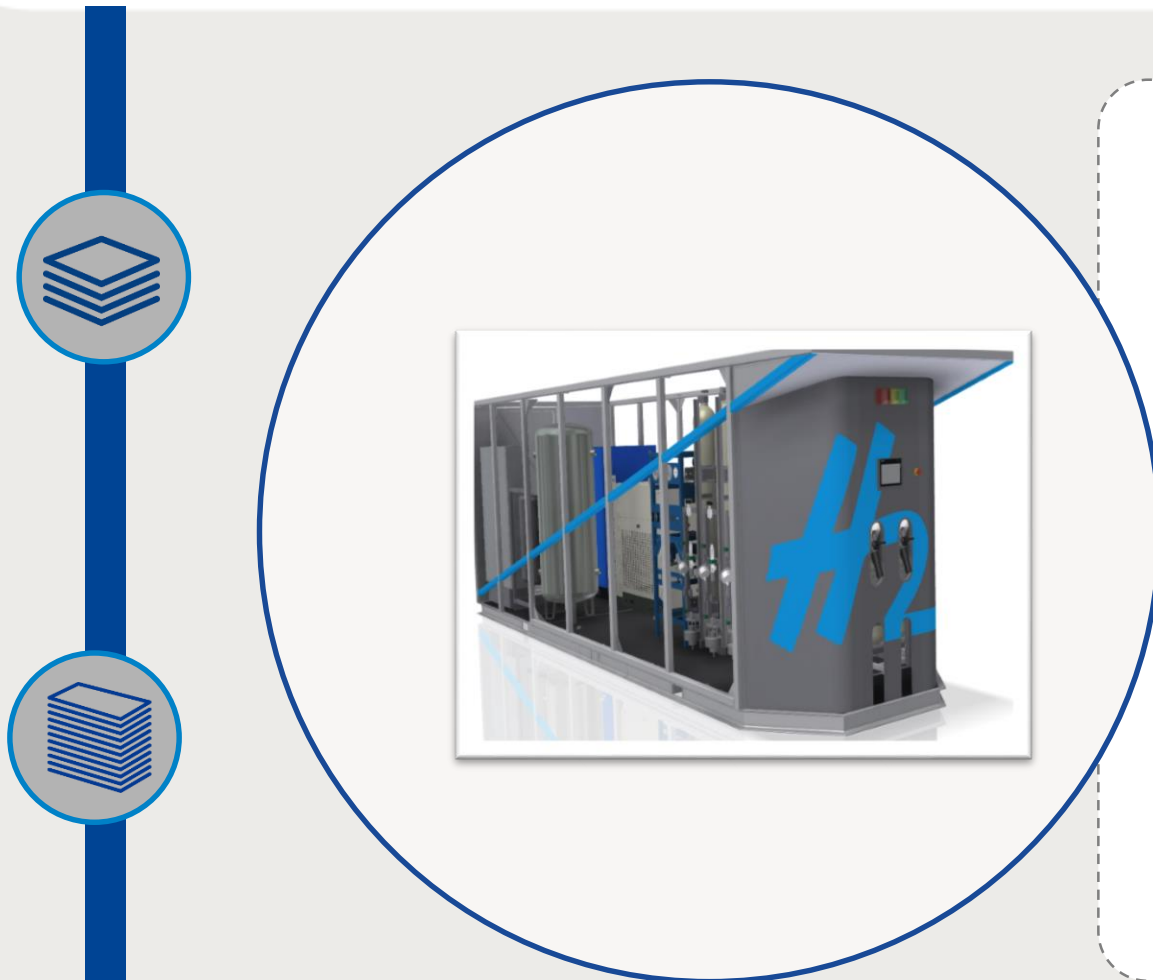
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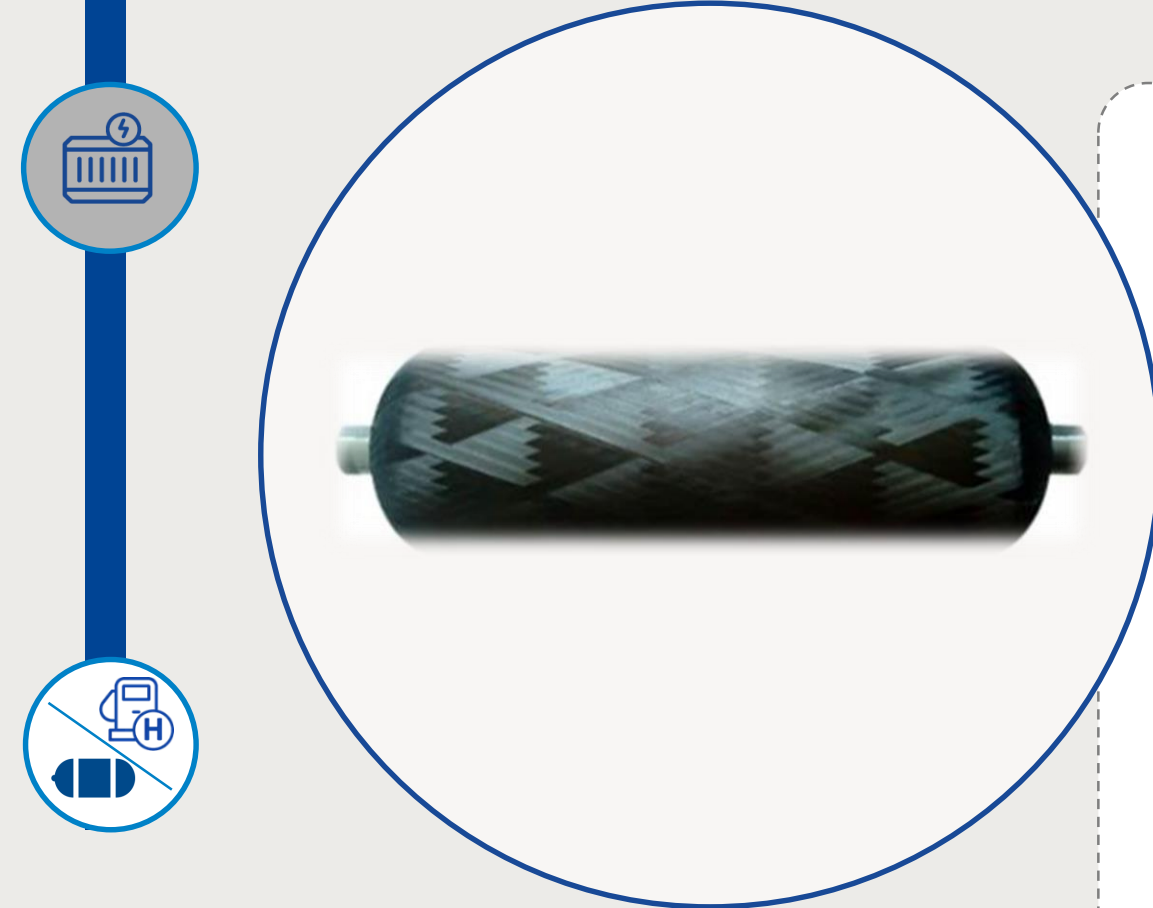
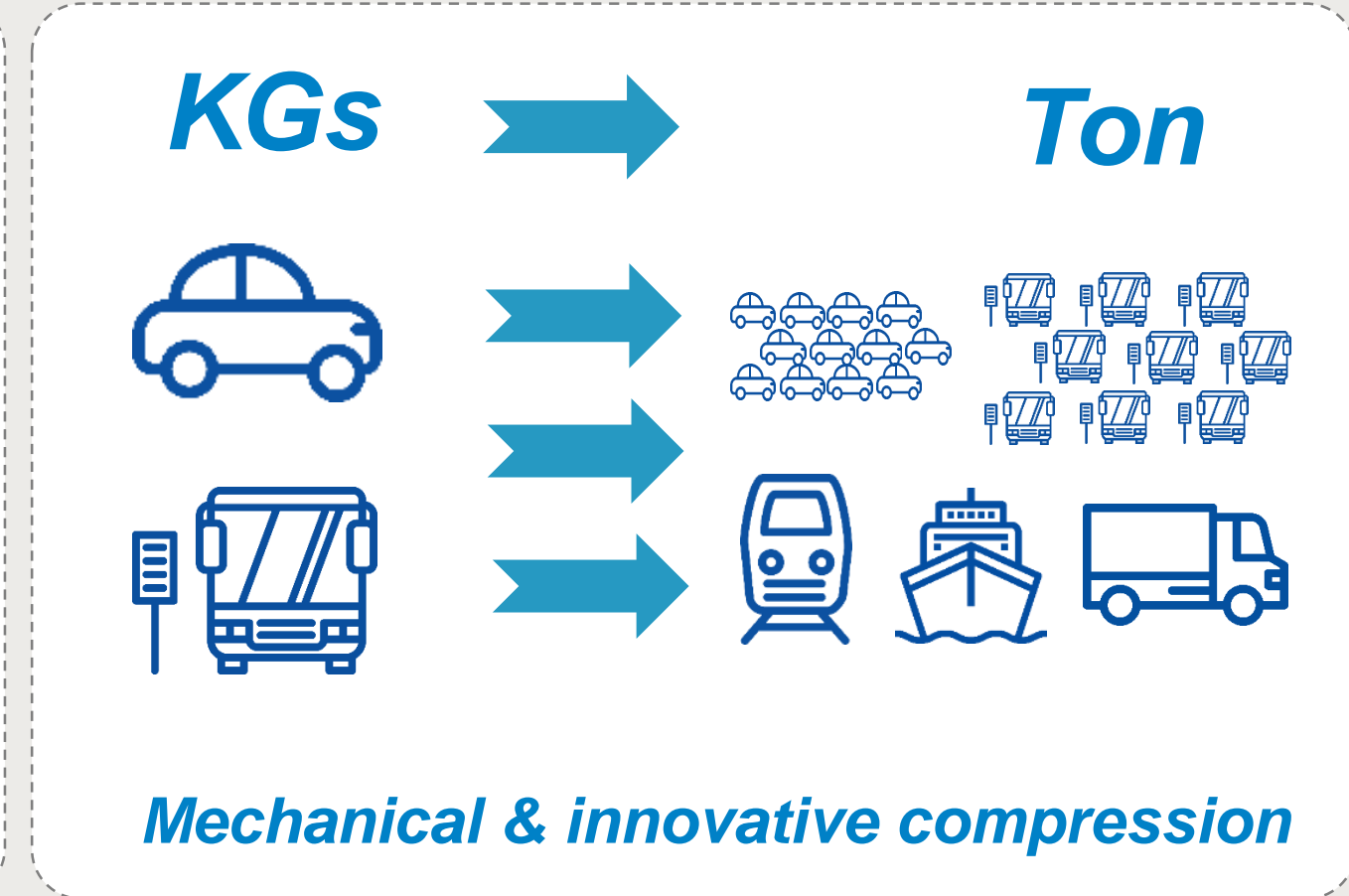


# Hydrogen Refuelling Stations and On-board H<sub>2</sub> storage

Improved performance and technology



KPI	2017	2020	2030
Energy demand (kWh / kg H <sub>2</sub> )	10	5	3
System cost (Thousands € kg H <sub>2</sub> /day)	7	4 – 2,1	2,4 - 1,3
Availability ( %)	95	96	99



KPI	AWP 2012	COPERNIC	2020
Volumetric capacity (kg/l)	0.023	0.02	0.035
Gravimetric capacity %	4	5	6
Estimated cost (€/kg H <sub>2</sub> ) @ mass prod	2.000	608	500





# Horizontal aspects



# Key messages



**The need for low TRL research remains strong**



**Manufacturing & Quality Control key to competitiveness**



**Research and industry alignment**



**Increased importance of all transport modes**







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## **Pietro Caloprisco**

Project Officer  
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### **For further information**

[www.fch.europa.eu](http://www.fch.europa.eu)



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