



Hydrogen Europe Research

The European Research Community In The Field Of Hydrogen
CURRENT RESEARCH PRIORITIES

LUIGI CREMA, PRESIDENT

Delivering on EU's hydrogen ambitions

RePowerEU targets: 10 Mt domestic production and 10 Mt imports of clean hydrogen by 2030



H2 Production & Transport



Gas Package (Q4 2023)

Gases definitions and infrastructure



Net-Zero Industry Act (2024)

Response to the US Inflation Reduction Act.



Critical Raw Materials Act

(Q4 2023)

EU legislative framework on CRMs



Standards and Certification

Need for acceptance and harmonization of methodologies and rules.



RED3 (agreed)

42.5 % renewables target RFNBOs

Binding targets by 2030

Transport: RES-T: 14.5% GHG reduction or 29% RES

✓ 5.5% adv. biofuels & RFNBOs (of which **1% RFNBO**)

Industry: 42% of H2 to be RFNBO

- Can be reduced by MS by 20% if:
 - ✓ On track for RES 2030 target
 - ✓ Fossil fuel-based H2 consumption is > 23% in 2030

RFNBO H2 Definition

H2 derived from RES sources, meets additionality criteria & GHG emission reduction threshold of 70% **compared to fossil fuels comparator (94 g CO₂eq/MJ)** (agreed)

Low-Carbon H2 Definition

H2 derived from non-RES sources & meets GHG emission reduction threshold of 70% **compared to fossil fuels comparator or other criteria** (Q4 2023)

H2 end-use



ReFuel EU Aviation (agreed)

Quotas for SAF & specific quota for RFNBO



Fuels EU Maritime (agreed)

GHG saving targets & specific quota for RFNBO



AFIR (agreed)

Targets for the deployment of hydrogen refueling stations



ETS & CBAM (adopted)

Scheme for GHG emission allowance trading within the EU.

Hydrogen Europe Research at a glance

We represent the European Hydrogen Research Community with **155 members** in **29 countries**.



900+ scientists
involved in defining priorities
for the FCH sector

Our vision and mission

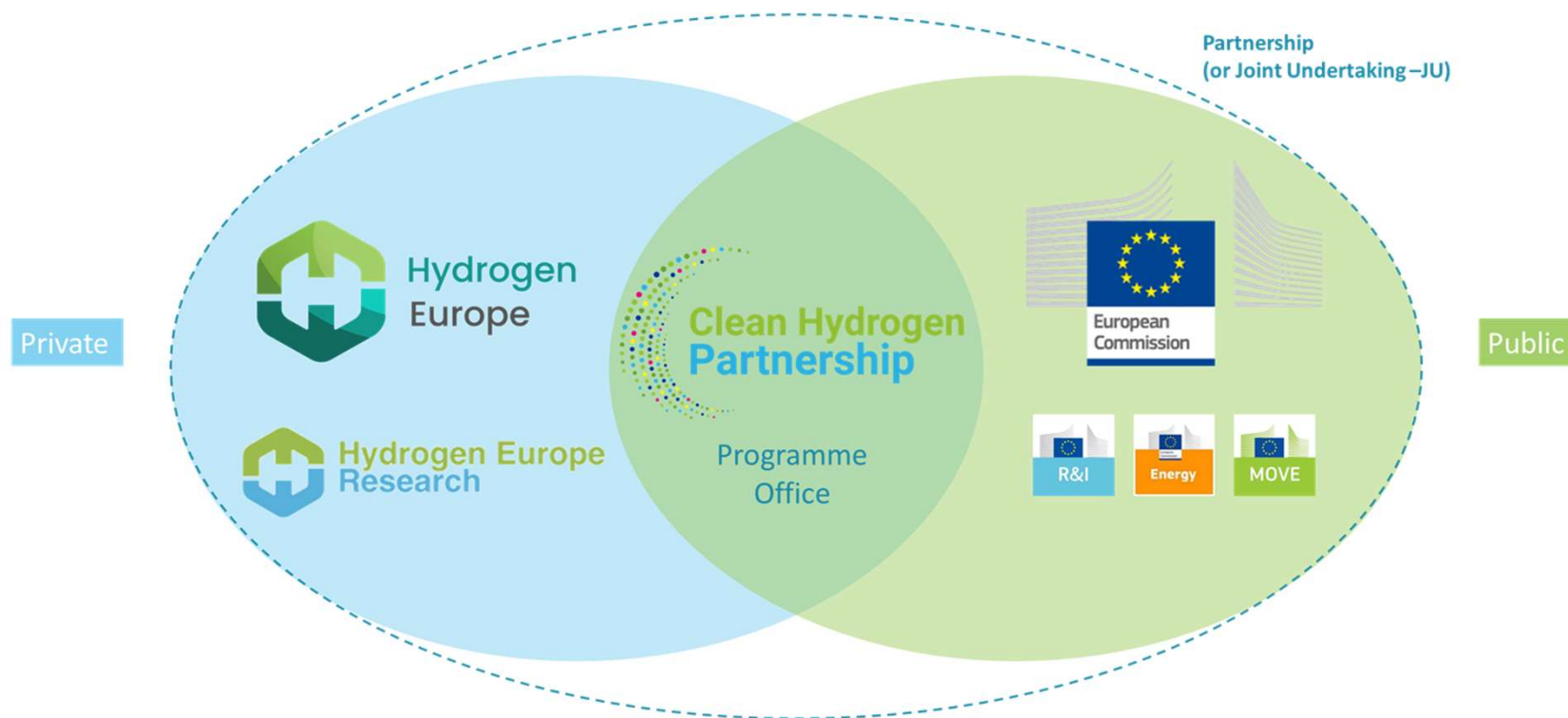
Hydrogen Europe Research aims to contribute to the achievement of carbon neutrality by strengthening the European hydrogen industry and ensuring high-level research in Europe. We actively support Research Institutes and Universities involved in the development of a new industrial ecosystem based on hydrogen.

Our mission is based on
4 pillars:



Clean Hydrogen Partnership

In collaboration with the public and private members of the Clean Hydrogen Partnership, Hydrogen Europe & Hydrogen Europe Research participate in the identification of annual and multi-annual research & innovation priorities and the elaboration of research topics included in yearly Annual Work Plans.



Budget: 1B€ + 200M€ (extra funding from REPowerEU for Hydrogen Valleys)

The European Union approach

R&I private and public partnerships



Fuel Cells and Hydrogen
Joint Undertaking



2007-2013

2014-2020

2021-2027



470M

665M

1.2B



Development and deployment of fuel cells and hydrogen production technologies.

Maturation and commercialisation of fuel cells and hydrogen production technologies.

Coverage of the whole hydrogen value chain, targeting development and deployment of hydrogen technologies



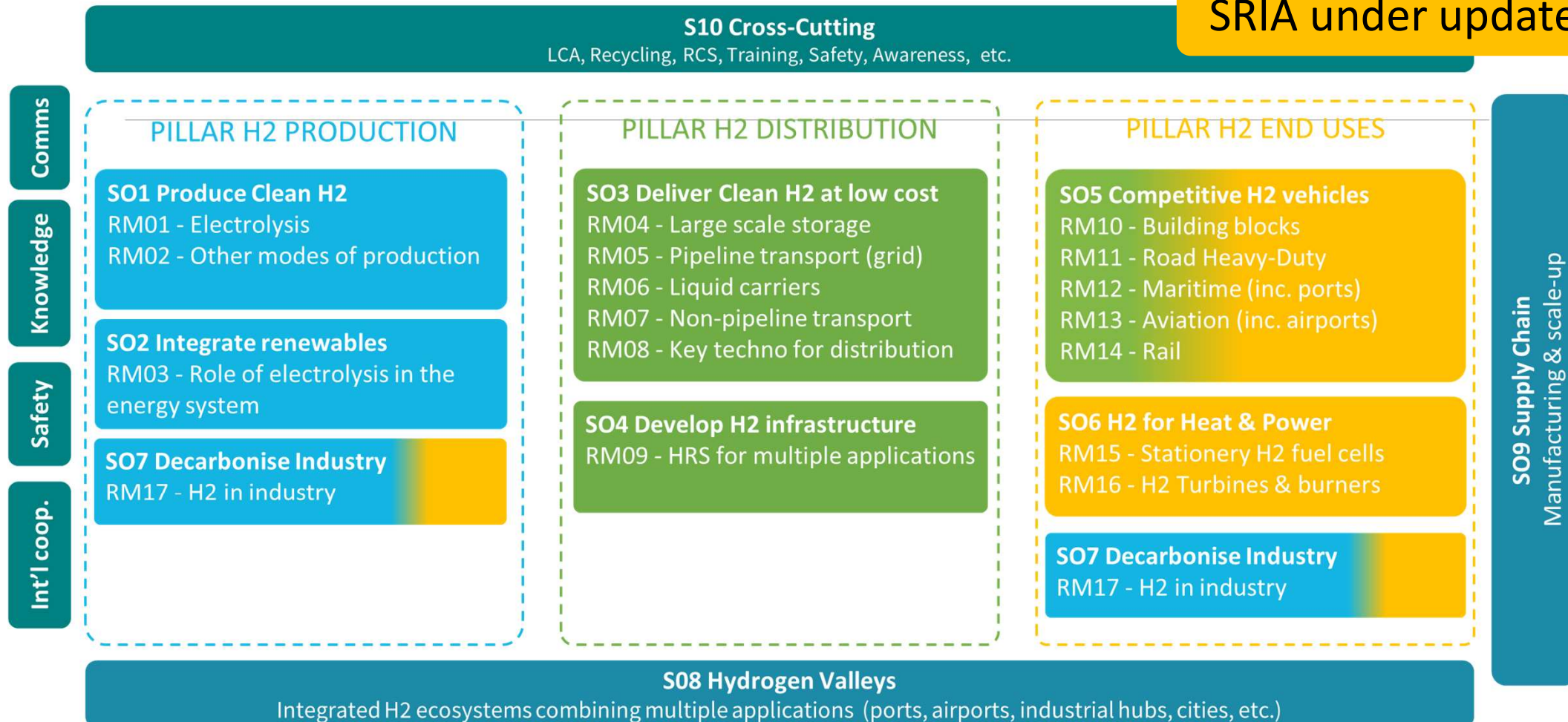
150 LDV & 45 buses
20 H2 refuelling stations (HRS)
Deployment of stationary FCs and CHP
Development of electrolyzers

1890 LDV & 55 buses & 31 trucks
113 H2 refuelling stations (HRS)
Development projects on maritime, aviation & rail applications.
2800 μ CHP. Improvements in electrolyser capacities

Hydrogen Valleys, development and demonstration actions on hydrogen storage & logistics, industrial & mobility demonstration projects, next generation technologies

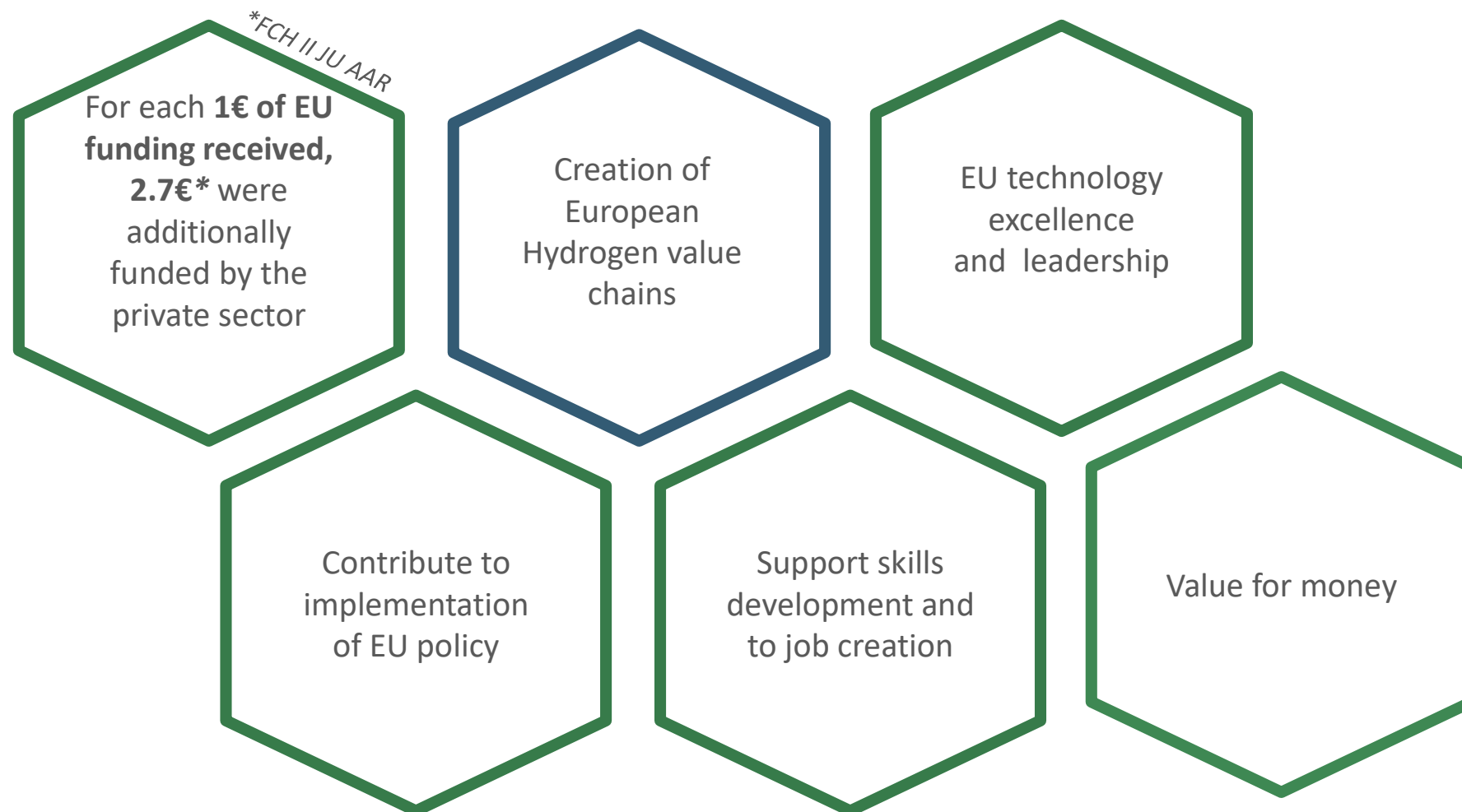
Working Level – Set of 20 Roadmap composing the core of the SRIA

SRIA under update



The European Union approach

Value added by RD&I

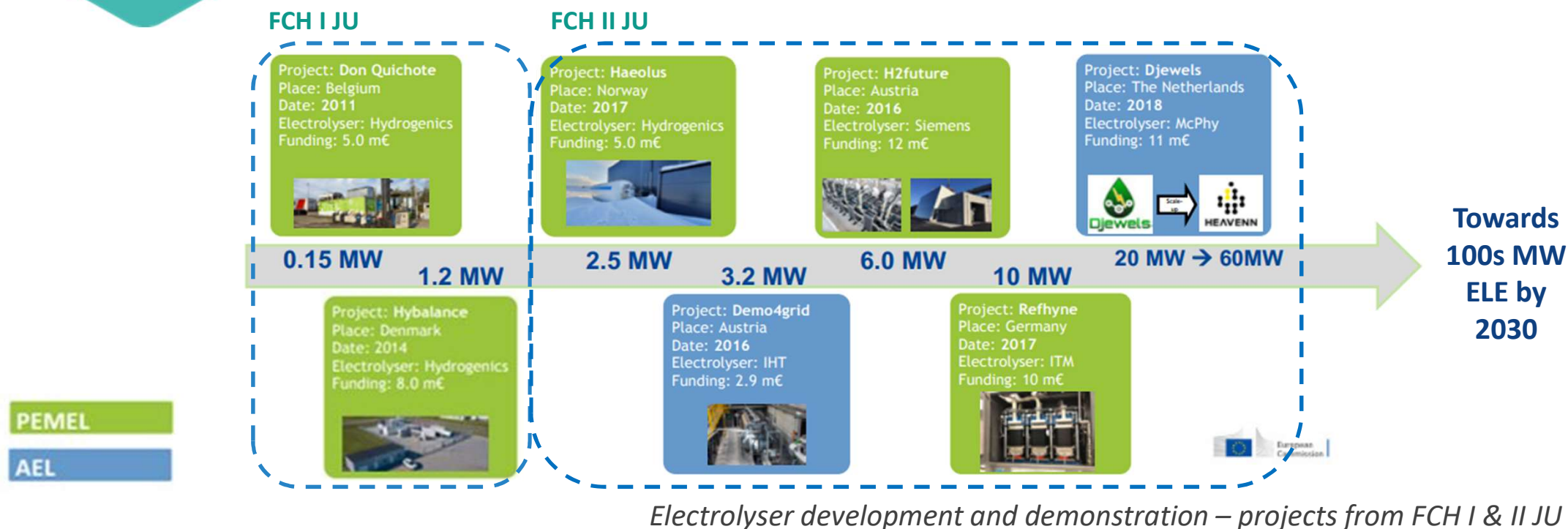


European Union approach

R&I Success stories

Electrolyser Capacity

Close to 100-fold increase (PEMEL) and 7-fold increase (AEL) in electrolyser capacities since 2007.



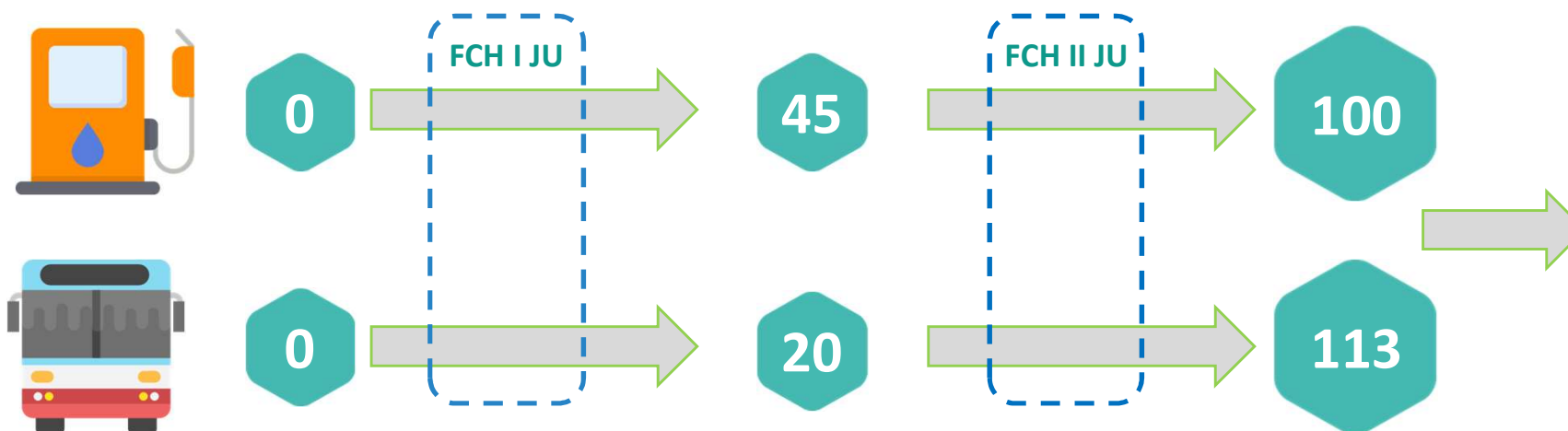
European Union approach

R&I Success stories



Buses and
HRS

Steady deployment of buses and Hydrogen Refueling Stations during FCH I & II JU



Amount of buses and HRS funded – Projects from FCH I & II JU

Some of the open
R&I challenges

Multi modal

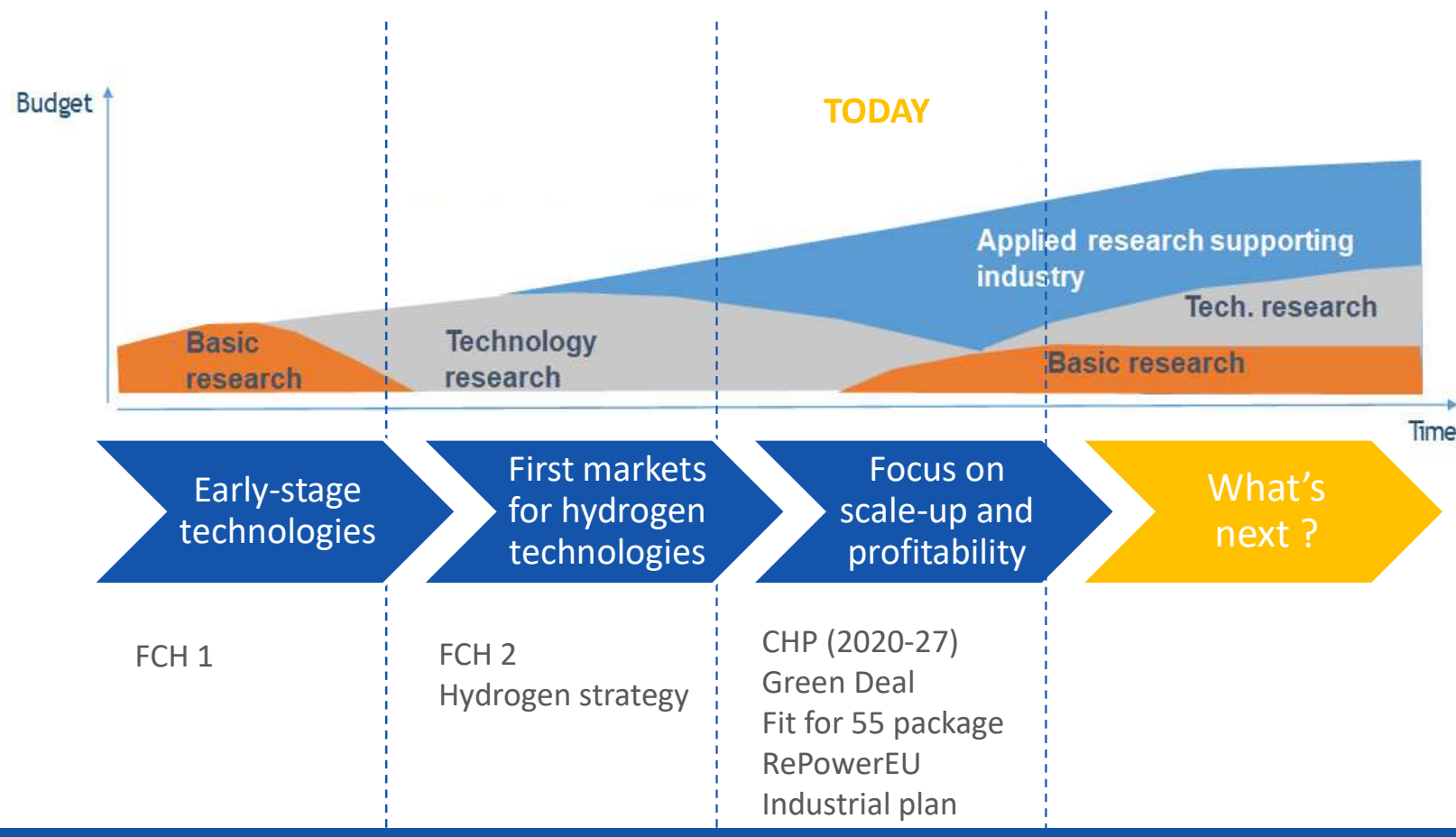
Fast delivery

Large size

FCs Durability

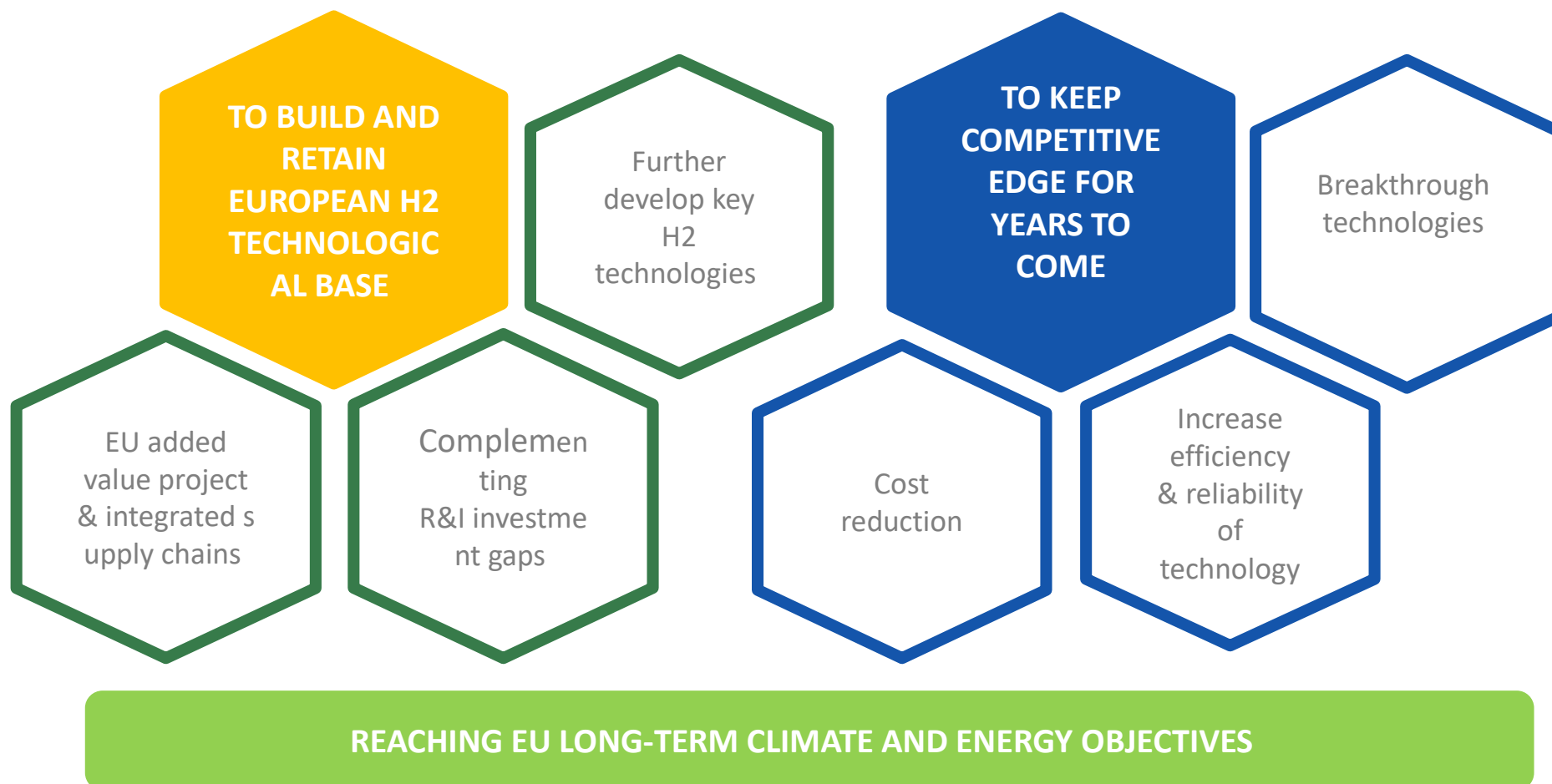
European Union approach

Circular R&D&I approach

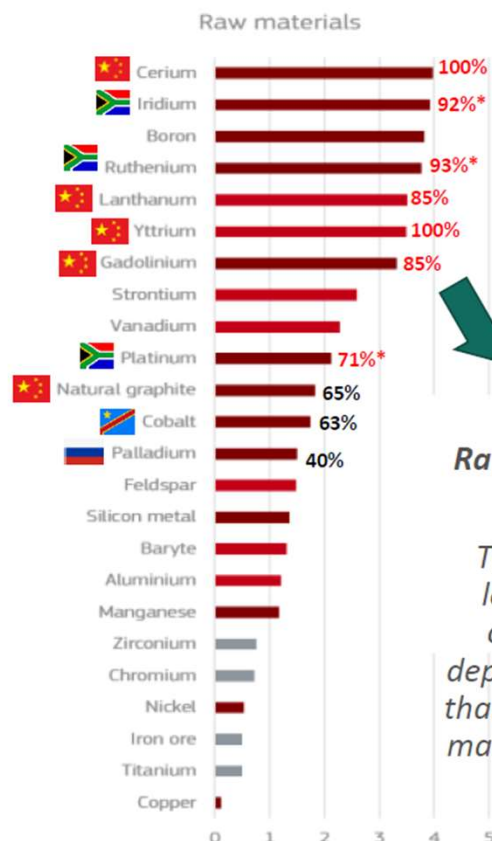


European Union approach tomorrow

Why EU investment in R&I is still needed?



Dependency on raw materials (extraction and processing) for electrolyser and fuel cells



**Critical
Raw Materials Act
proposal**

*The EU wants to
lower its supply
chain risks and
dependencies of less
than 65% on a single
material, on a single
country*

Source: JRC Supply chain analysis and material demand forecast in strategic technologies and sectors in the EU –A foresight study (2023)

Platinum Group Metals (Ir, Pd, Pt, ...)

- **Iridium** (Ir, IrOx) used for oxygen evolution reaction (OER) catalyst at the anode of the PEM electrolyser – best tradeoff between activity and stability
- **Palladium** used in both fuel cells and electrolyzers. 47% mining capacity in Russia

Rare earths:

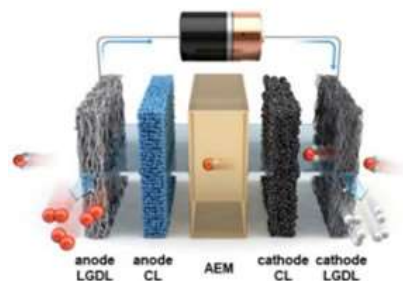
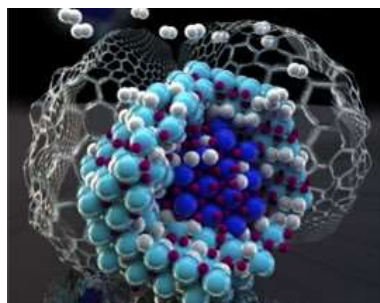
- **Scandium** (3/4 of the global Scandium market in 2017 was on SOFC to be used as an electrolyte), supplied by China and Russia. Then **Yttrium**

Total metals required for one generation of technology to phase out fossil fuels

Metal	Required Production (tons)	Known Reserves (tons)	Comment
Copper	4,575,523,674	880,000,000	Reserves cover 20% of requirements
Cobalt	218,396,990	7,600,000	Reserves cover 3.48% of requirements
Graphite	8,973,640,257	320,000,000	Reserves cover 3.57% of requirements
Lithium	944,150,293	95,000,000	Reserves cover 10% of requirements
Manganese	227,889,504	15,000,000,000	Adequate reserves
Nickel	940,578,114	95,000,000	Reserves cover 10% of requirements
Silicon (metal)	49,571,460		Adequate reserves
Silver	145,579	530,000	Adequate reserves
Vanadium	681,865,986	24,000,000	Reserves cover 3.52% of requirements
Zinc	35,704,918	250,000,000	Adequate reserves
Zirconium	2,614,126	70,000,000	Adequate reserves

Fonte: Michaux, S.P. (2023 Feb): Material Supply Challenges for the Green Transition to Phase out Fossil Fuels, SEB's The Green Bond report: Raised forecasts for transition investment, Page 11,

Clean Hydrogen Partnership *Strategic Research Challenges*



- **Long term projects** with important financial support, 5 years and 10 M€
- Participated by **relevant EU research** and innovation community
- Topics supported in the **Clean Hydrogen Partnership**:
 - Low or free **platinum group metal (PGM) catalysts** (including bioinspired catalysts), reducing **critical (raw) materials** use in electrolyzers and fuel cells, and safe and sustainable use of all material, including developing of **perfluorosulfonic acid (PFAS)** - free ionomers and membranes
 - Advanced materials for **hydrogen storage** (e.g., carbon fibres, H₂ carriers)
 - Advanced understanding of the performance / durability mechanisms of electrolyzers and fuel cells

Research Requirements/Recommendations for the Hydrogen Sector

By end of 2024 HER will release a new book:
“HER Position Paper for Hydrogen Research”

It will be distributed at the **HYDROGEN WEEK**



Key aspects

- Emphasis on next-generation hydrogen technologies for production, logistics, and applications
- Diversification of production methods
- Developing sustainability & safety standards

Conclusions

- There are **a lot of gaps** where research and innovation can give a support
- **Researchers and innovators** are representing two complimentary roles
- **Infrastructures at a relevant industrial scale** will be a key element to accelerate technology deployment
- Research and innovation will support **competitiveness**, together with other pillars we need to be supported such as **industrialisation** and **market creation**

Jules Verne



I believe that water will one day be employed as fuel, that hydrogen and oxygen which constitute it, used singly or together, will furnish an inexhaustible source of heat and light, of an intensity of which coal is not capable.

L'Ile Mystérieuse (The Mysterious Island) 1874

THANK YOU!



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