



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

ORGANIZZATO DA



Bologna: un hub di ricerca per lo sviluppo
dell'idrogeno - 9 ottobre 2024

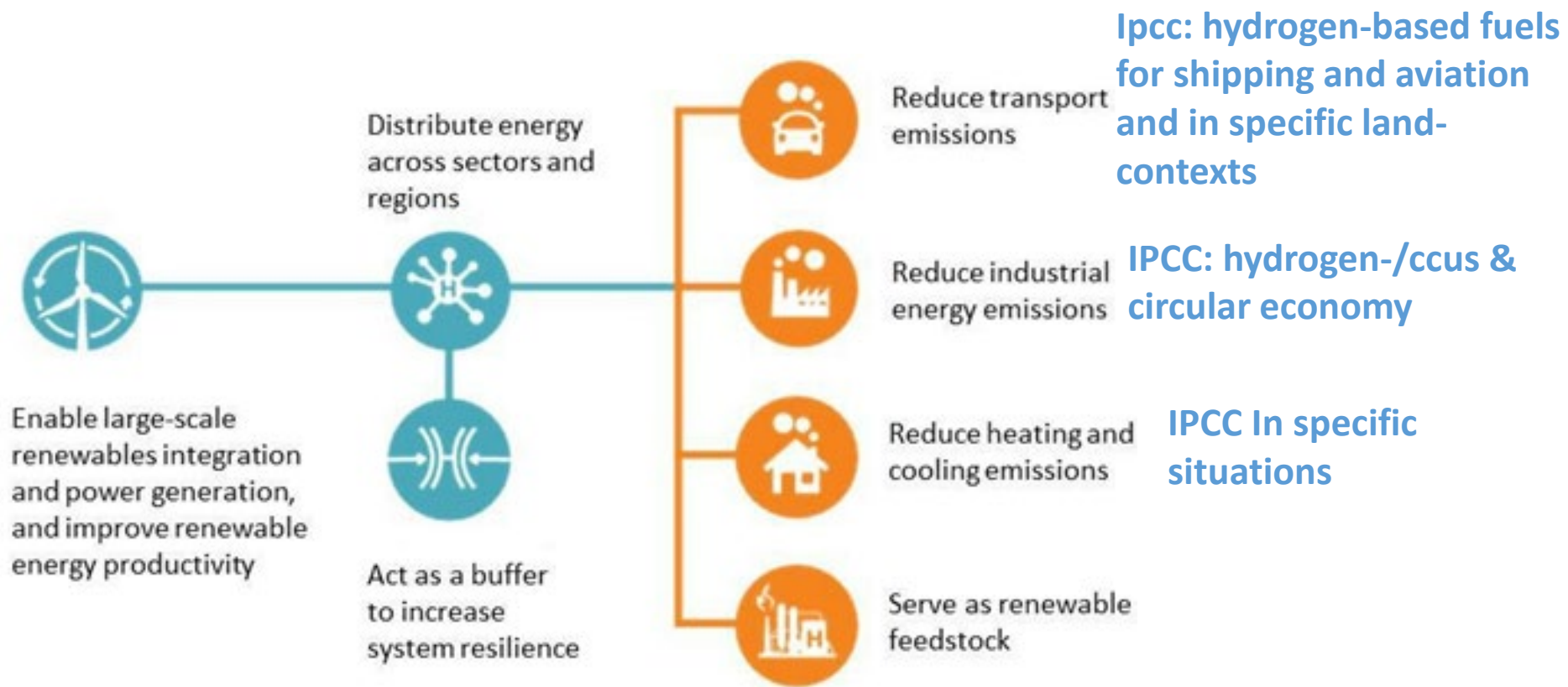
L'idrogeno nella strategia europea

Francesco Basile

Dipartimento Chimica Industriale
Delegato IT cluster clima energia e mobilità

BolognaFiere 9-11 ottobre

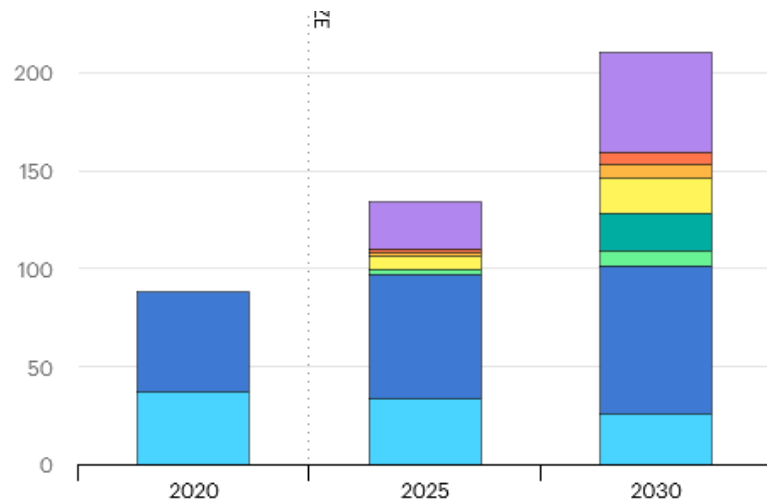
International background: Last IPCC report



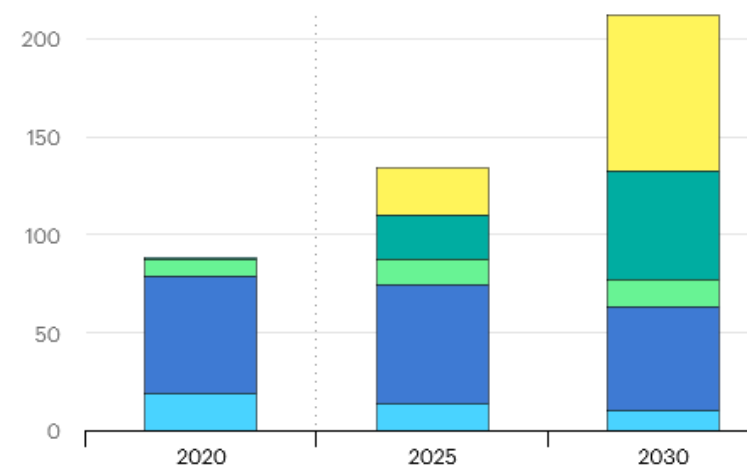
TX BOX 9 : IPCC report: The Transformation in Energy Carriers: Electrification and Hydrogen

International main scenario

Net Zero by 2050 Roadmap (IEA 2021)



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● Refining ● Industry ● Transport ● Power ● Ammonia - fuel ● Synfuels
● Buildings ● Grid injection

● By-product in refineries ● Fossil ● Fossil with CCU ● Fossil with CCS
● Electrolysis

From 90 Mt in 2020 to more than 530 Mt in 2050, with 62% predicted to come produced from electrolysis and 38% from fossil-fuels with CCUS (IEA, 2021).

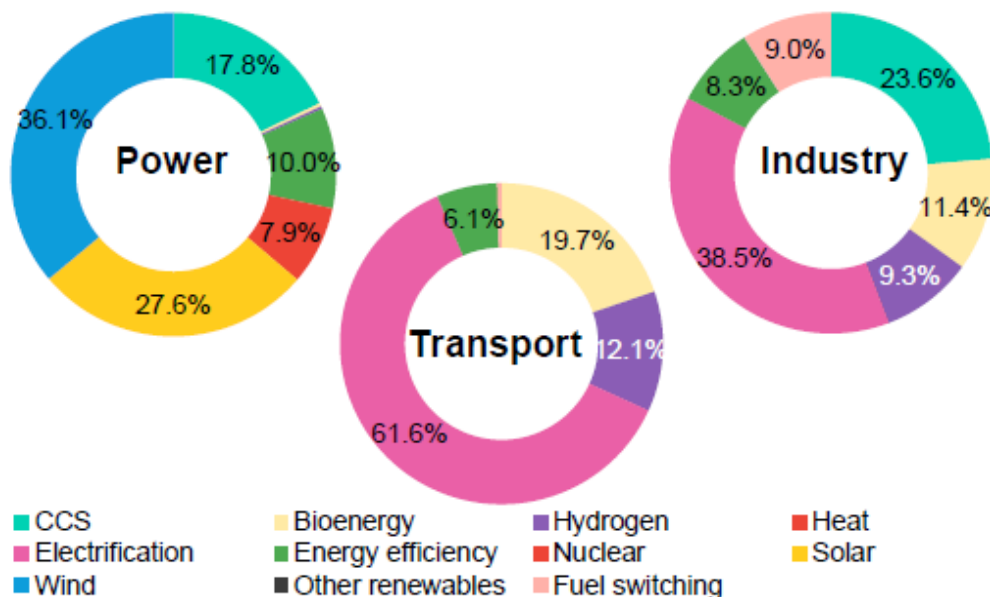
Clean hydrogen is currently more expensive than grey hydrogen, costing between USD \$3-6/kg to produce from electrolysis and approximately USD \$1.5-2.5/kg from fossil fuels using carbon capture technologies, with distribution costs additional to this (IRENA, 2021).

Clean Energy Ministerial 2024

BloomberghNEF scenario (30/09-04/10 Brasil) Net zero 2050 $\Delta T: 1,75^{\circ}\text{C}$

A collection of solutions are needed to reach net zero by 2050

Emissions abatement, by solution, from 2024 to 2050

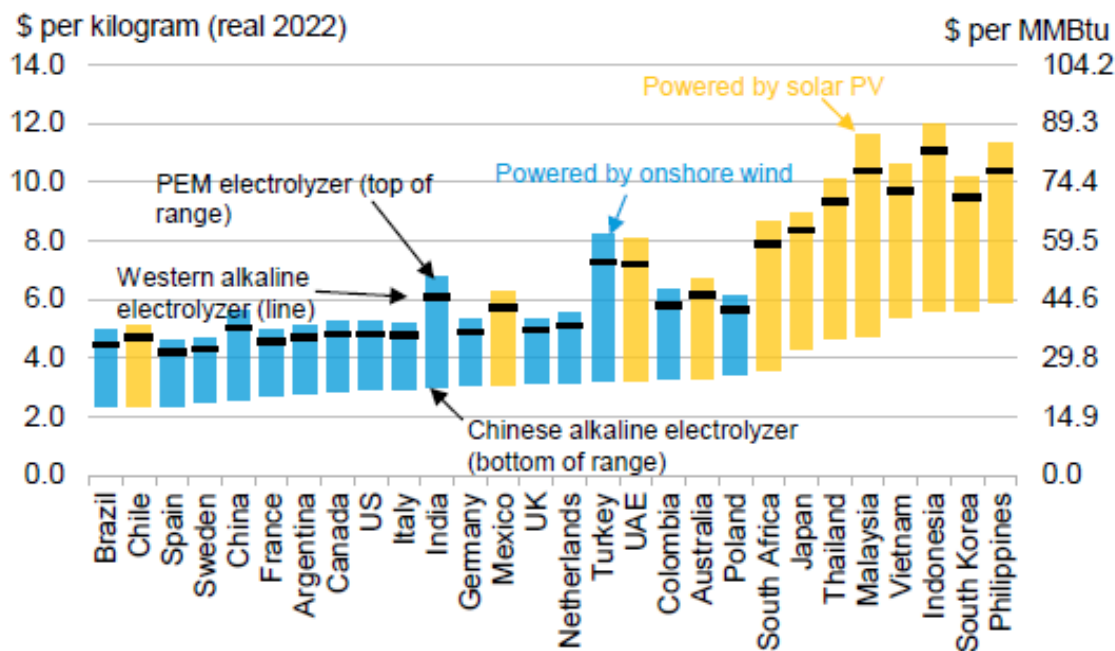


Clean Energy Ministerial

BloomberghNEF scenario: cost of Hydrogen

Pricey electrolyzers and renewables are keeping green hydrogen expensive for now

Levelized cost of hydrogen from cheapest available renewable power in 28 markets



Strong importance of the type and costs of the renewable.

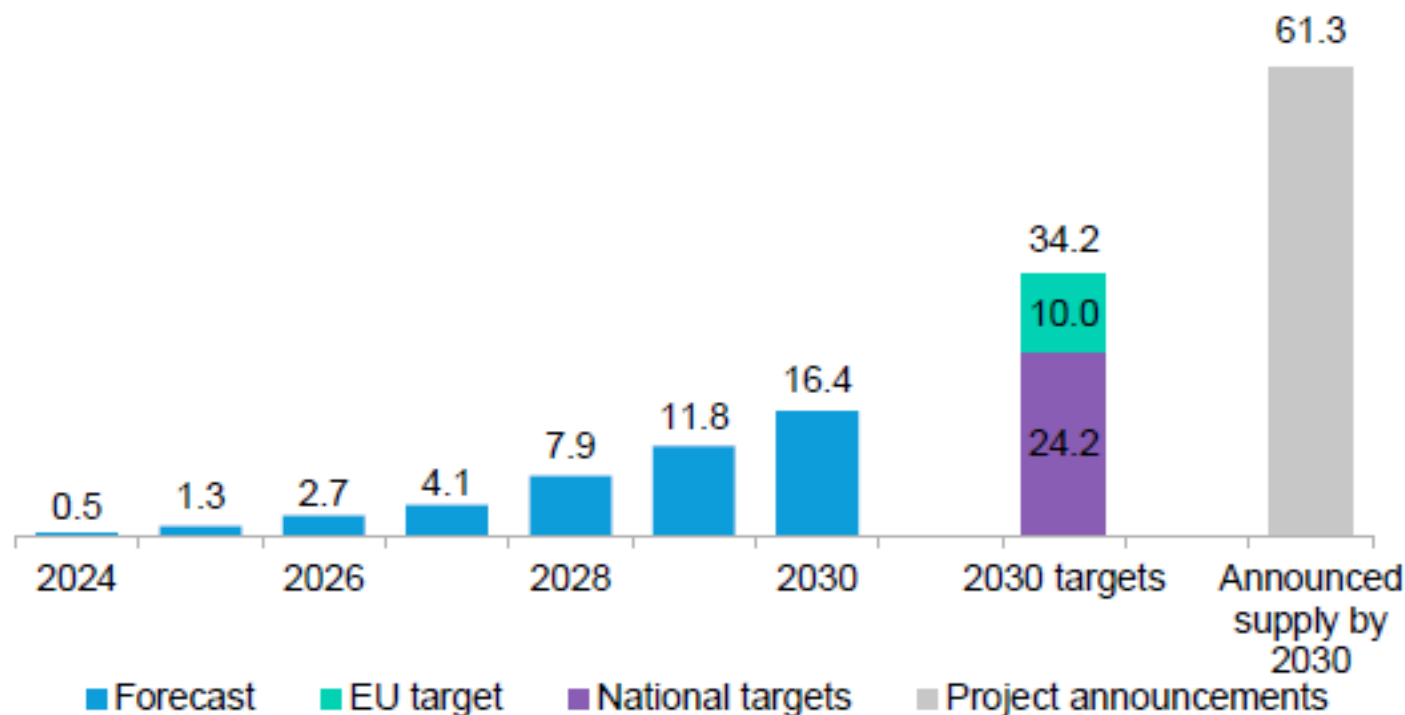
Source: BloombergNEF. Note: Based on project financing year. Values at the bottom show cheapest hydrogen using a Chinese alkaline electrolyzer; values atop the range show cheapest values using a proton exchange membrane (PEM) electrolyzer, and black lines show cheapest values using a western alkaline electrolyzer. Electricity source is either solar or wind, whichever is cheaper. "MMBtu" refers to million British thermal units, and "PV" is solar photovoltaic. Chart considers values as of 2023.

Clean Energy Ministerial

BloomberghNEF scenario: Hydrogen Production government goal and scenario

Clean hydrogen supply forecast

Million metric tons per year



Source: BloombergNEF.

Clean Energy Ministerial

BloomberghNEF scenario: cost of Hydrogen, support price and users

Hydrogen strategies as of May 2024

Policy signpost	AMER	APAC	EMEA
<u>H₂ strategies and targets</u>	Most major markets have an H ₂ strategy. Some have targets.	Most major markets have an H ₂ strategy. Some have targets.	Most major markets have an H ₂ strategy and targets.
<u>Government funding</u>	\$188 billion in funding available, most for H ₂ producers.	\$32.5 billion available, an order of magnitude below AMER, EMEA.	More than \$140 billion available, more for users than AMER.
<u>Enforceable demand quotas</u>	No quotas for clean hydrogen use in AMER.	South Korea has hard to enforce quotas; not all are for clean H ₂ .	EU has the strongest H ₂ quotas; some may be hard to enforce.
<u>Carbon prices that bite</u>	Missing or insufficient carbon prices in all AMER markets.	Missing or insufficient carbon prices in all APAC markets.	EU and UK have CO ₂ prices and plan to limit exemptions.
<u>H₂ midstream development</u>	US firms are building salt caverns, but with little policy support.	Chinese firms are planning pipelines, but policy support is low.	Pipeline policy is starting to emerge in the EU and UK.

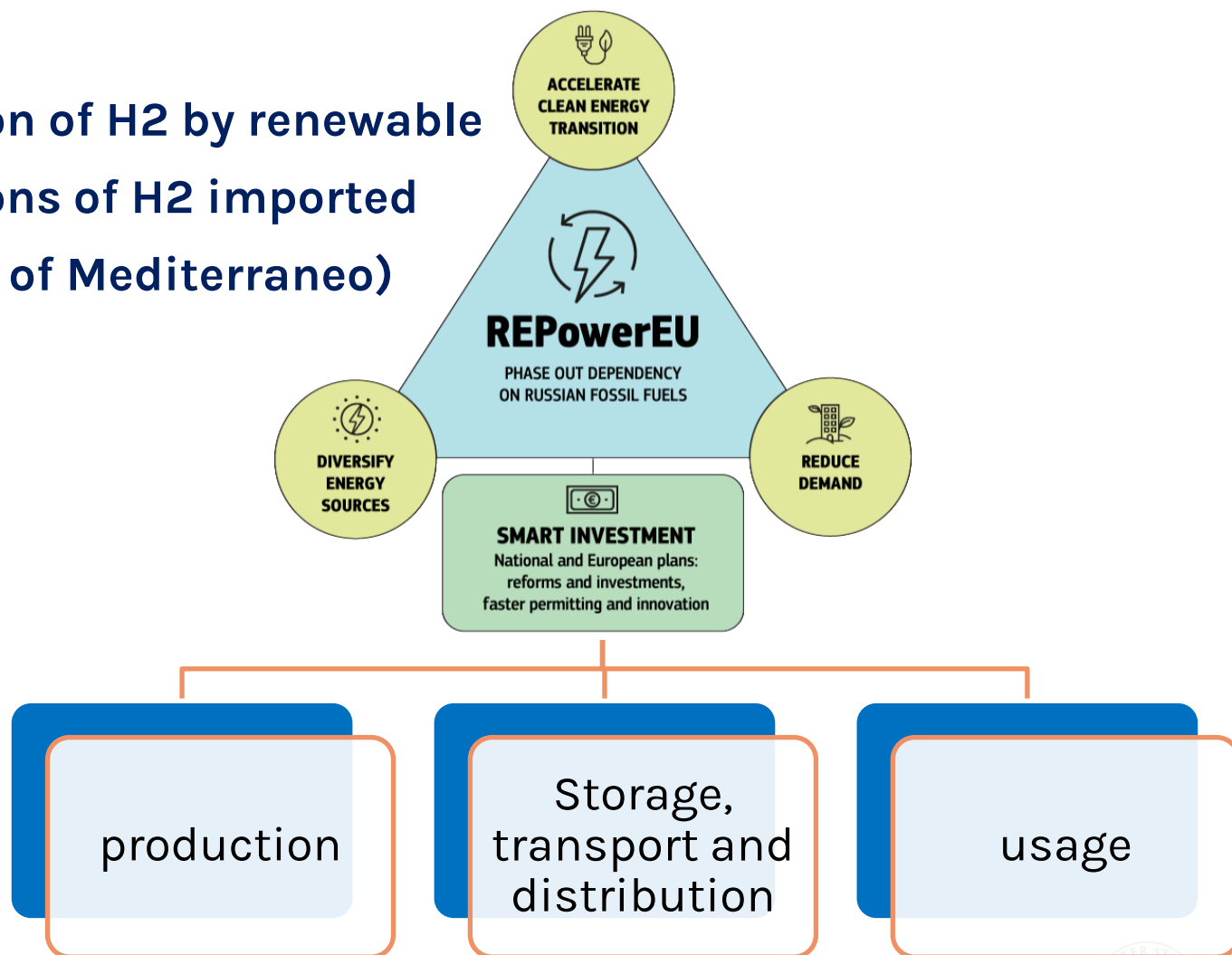
Source: BloombergNEF. Note: Green indicates *on a good track*, yellow indicates *some progress*, and red indicates *more effort needed*. 'AMER' refers to the Americas, 'APAC' is Asia Pacific, and 'EMEA' is Europe, the Middle East and Africa.

EU main policy background: Repower EU

2030 goals

10 Millions of ton of H2 by renewable

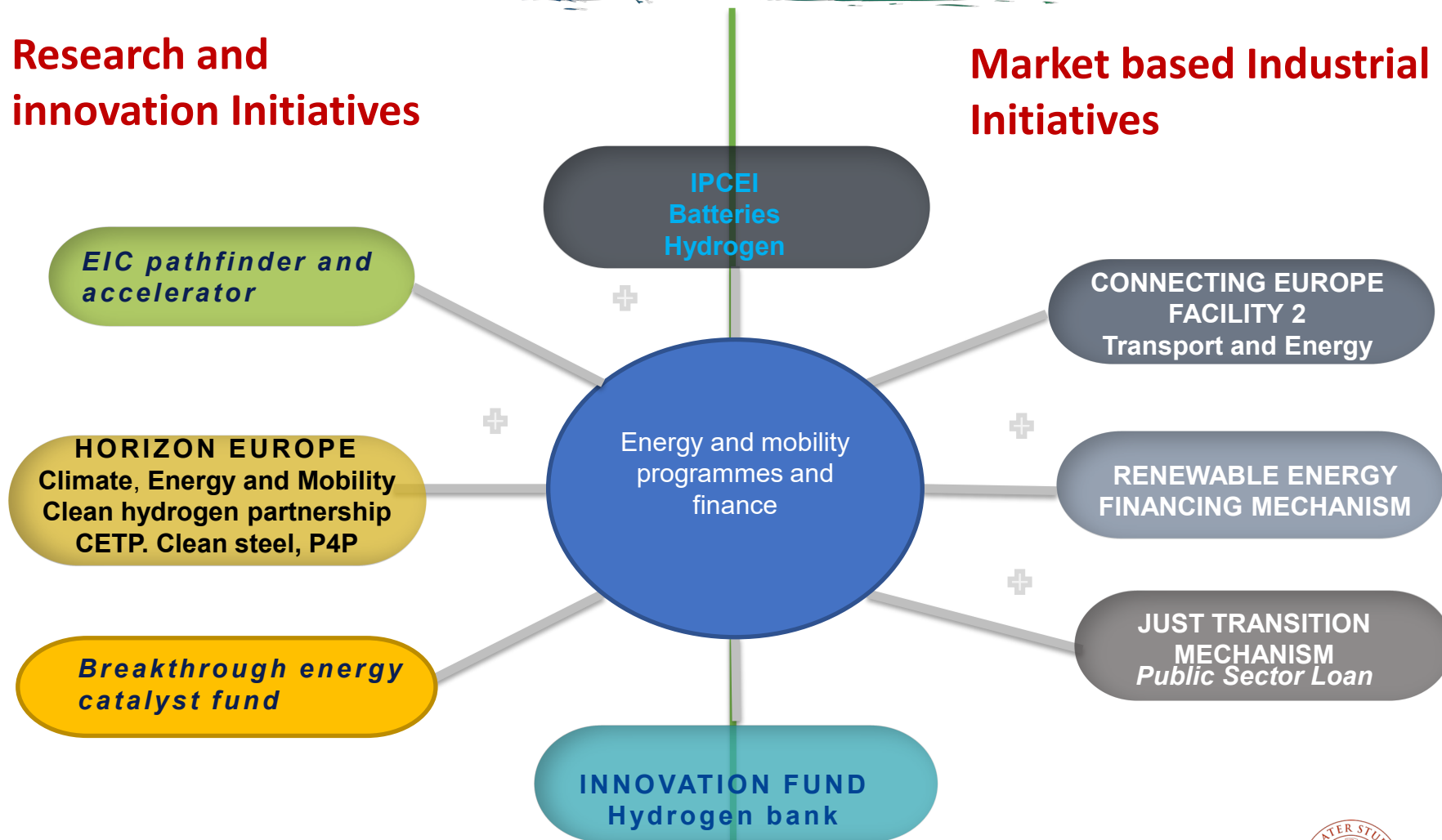
10 Millions of tons of H2 imported
(important role of Mediterraneo)



EU energy & mobility

Research and innovation Initiatives

Market based Industrial Initiatives



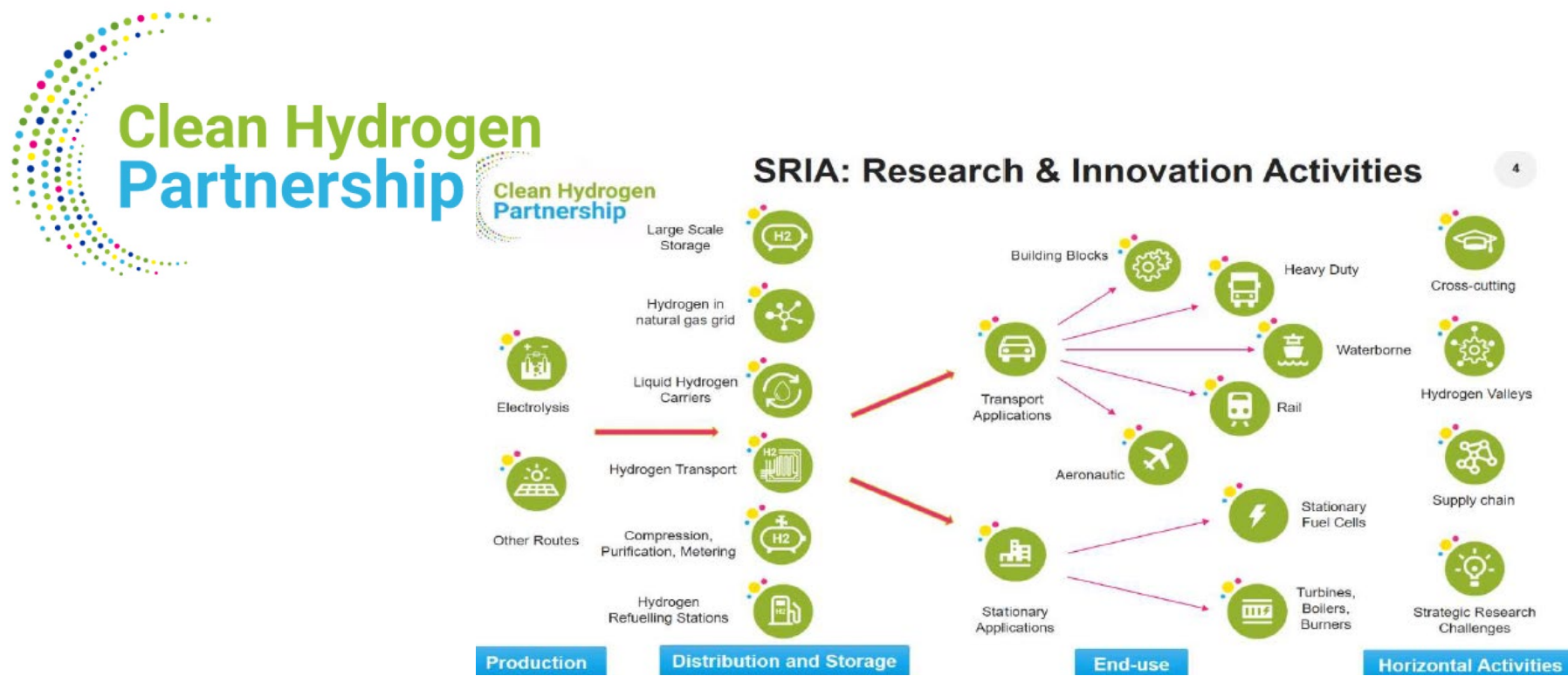
Clean Hydrogen JU: PPP

the most important funding scheme for research and innovation

State representative Group IT: Antino Aricò (CNR ITAE)

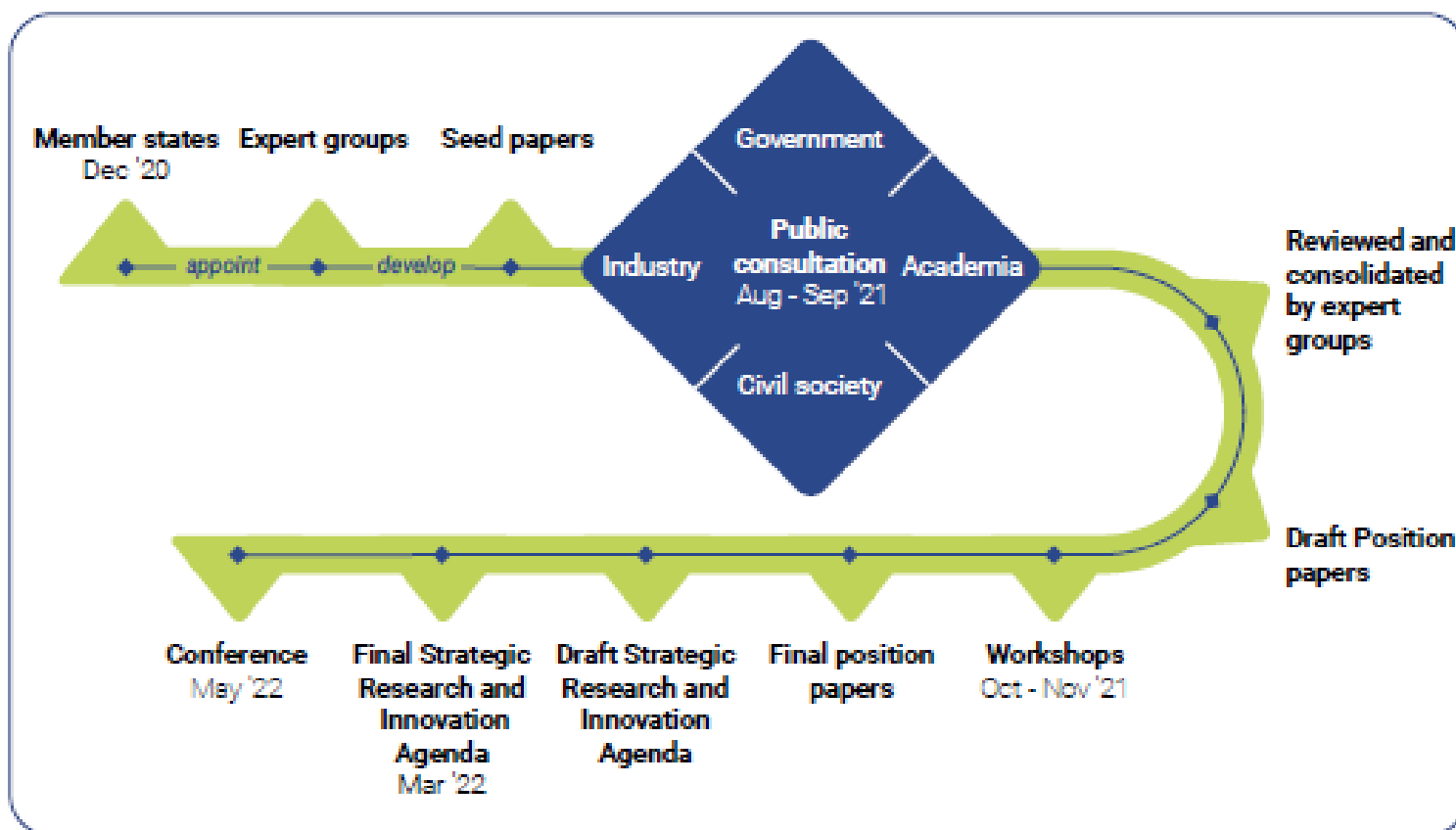
Board Viviana Cigolotti (ENEA)

UNIBO representative :Cesare Saccani, Francesco Luca Basile

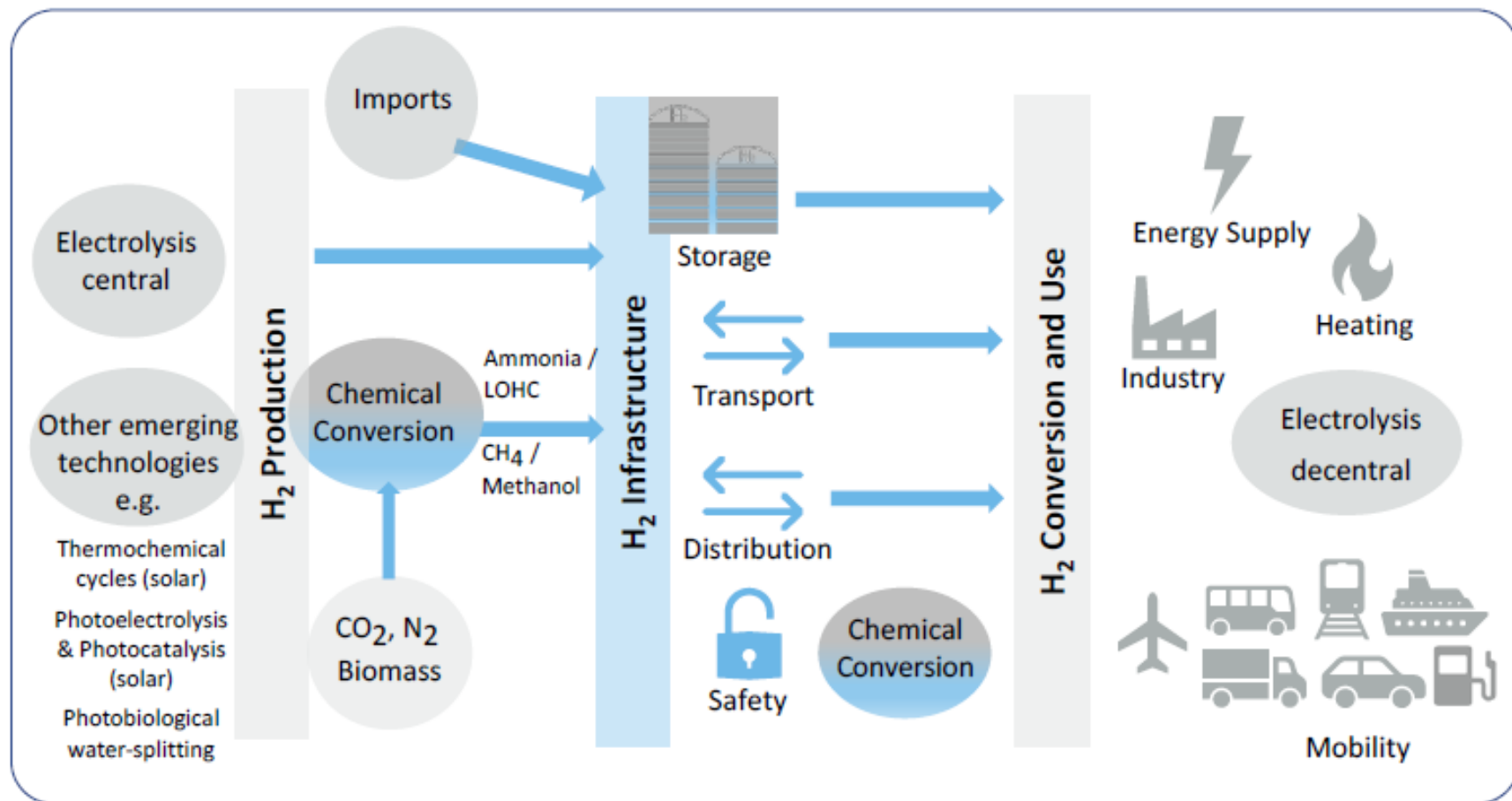


Agenda process on green hydrogen: ERA (European Research Area) overall coordination Germany: Italy, Bulgaria, Austria co-lead

	Production	Transport and Infrastructure	Market Stimulation
Coordinating country	Italy, Bulgaria	Germany	Austria



Energy value chain scenario : from the Agenda process on Hydrogen SRIA

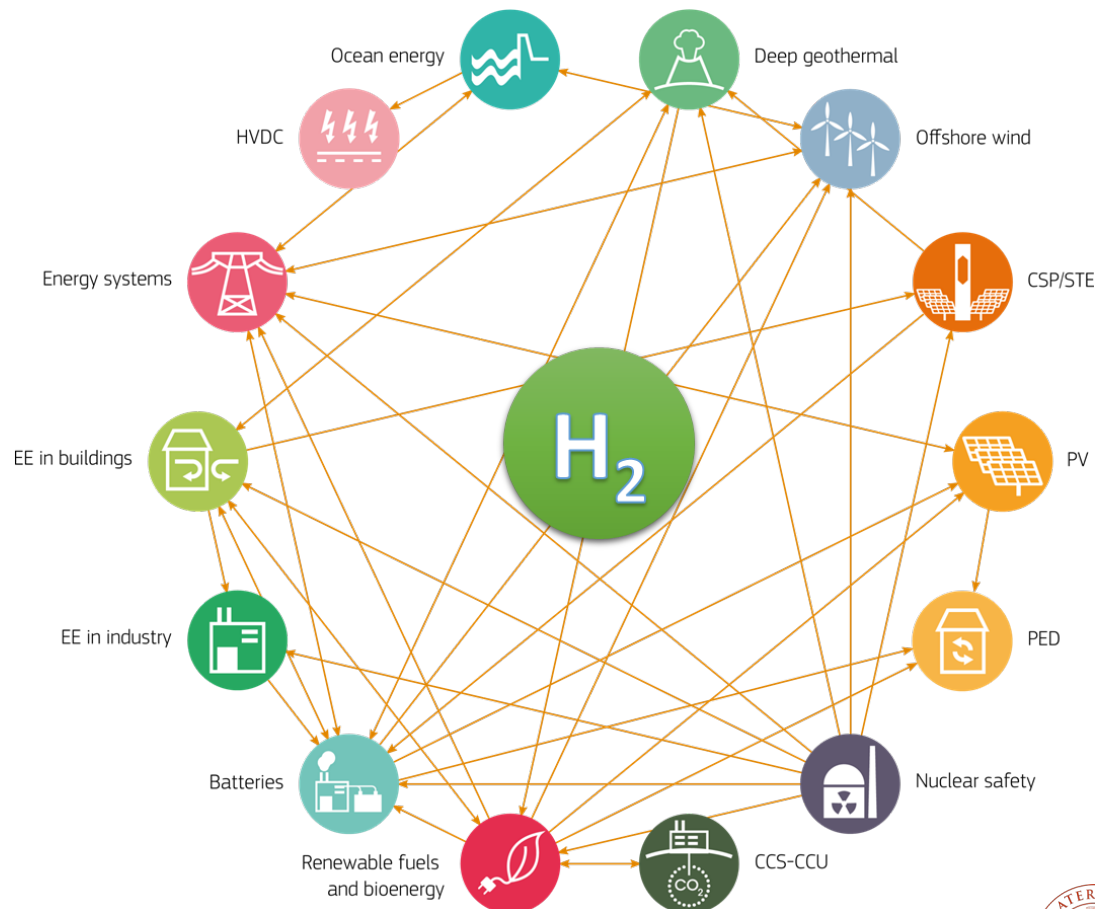


Preliminary identification of Technologies and solution for H2 : from the Agenda process on Hydrogen SRIA

Production and Sources	Separation and Purification	Storage	Infrastructure, Distribution and HRS	End use and Market stimulation	Cross-cutting issues
<ul style="list-style-type: none"> Electrolysis (water) Electrolysis (steam) incl. direct coupling with industrial processes, waste heat sources Thermochem. water splitting (e.g. solar, Cu-Cl loop) Gasification/ pyrolysis (waste, residual biomass) Plasma gasification (municipal solid wastes) ... 	<ul style="list-style-type: none"> Membranes Adsorption Metal hydrides, Cryogenic separation ... 	<ul style="list-style-type: none"> Physical-based (compressed gas, cold/cryo compressed, liquid), Material-based (adsorbent, liquid organic, interstitial hydrides, complex hydrides, chemical H2) ... 	<ul style="list-style-type: none"> Pipelines Smart grids Points of production, shipping and deployment Refueling Liquid organic hydrogen carriers (LOHC) ... 	<ul style="list-style-type: none"> Industry (Fischer Tropsch process, Haber-Bosch process) Mobility (fuel-cells, biofuels, e-fuels, H2 ICE) Power (fuel-cells, combined heat & power, Power-to-X) Buildings (fuel-cells, micro combined heat & power), Gas grid ... 	<ul style="list-style-type: none"> Life-cycle assessment (LCA, S-LCA) Critical raw materials Circularity Safety Public acceptance Regulation and standards Education and training Policies and roadmaps ...


Definizione del temporary working group on H2 e interconnessioni con altri working group del set plan (strategic energy technology plan):

ref. IT: TWG-H2 Viviana Cigolotti (ENEA), Francesco Luca Basile (UNIBO)




SET4H2: il progetto di supporto al set plan

Resp MUR MariaRachele Nocera, Resp UNIBO Francesco Luca Basile



Funded by
the European Union

1	2	3	4	5	6	7	8
DLR	MUR	UniBO	DGEG	BGH2A	AEA	EUREC	HER



european
research area

SET4H2

Coordination and Support Action

Kick-off meeting
30 May 2024 in Dresden



SET4H2: workpackage and workpackage leaders

WP	Topic	WP Leader
1	Organization and Management	DLR
2	Secretarial support to the IWG and transfer of SRIA results into IWG and SET Plan	DLR, BGH2A
3	R&I on H2 Integration in SET-Plan and beyond	DGEG
4	Networking and cooperation with EU and international initiatives	MUR, UNIBO
5	Exchange between Member States and stakeholders on best practices and lessons learnt, EU societal involvement and outreach	AEA
6	Dissemination, communication and outreach	DLR, EUREC

Workpackage coordinated by MUR/UNIBO



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WP 4: Overview and Objectives

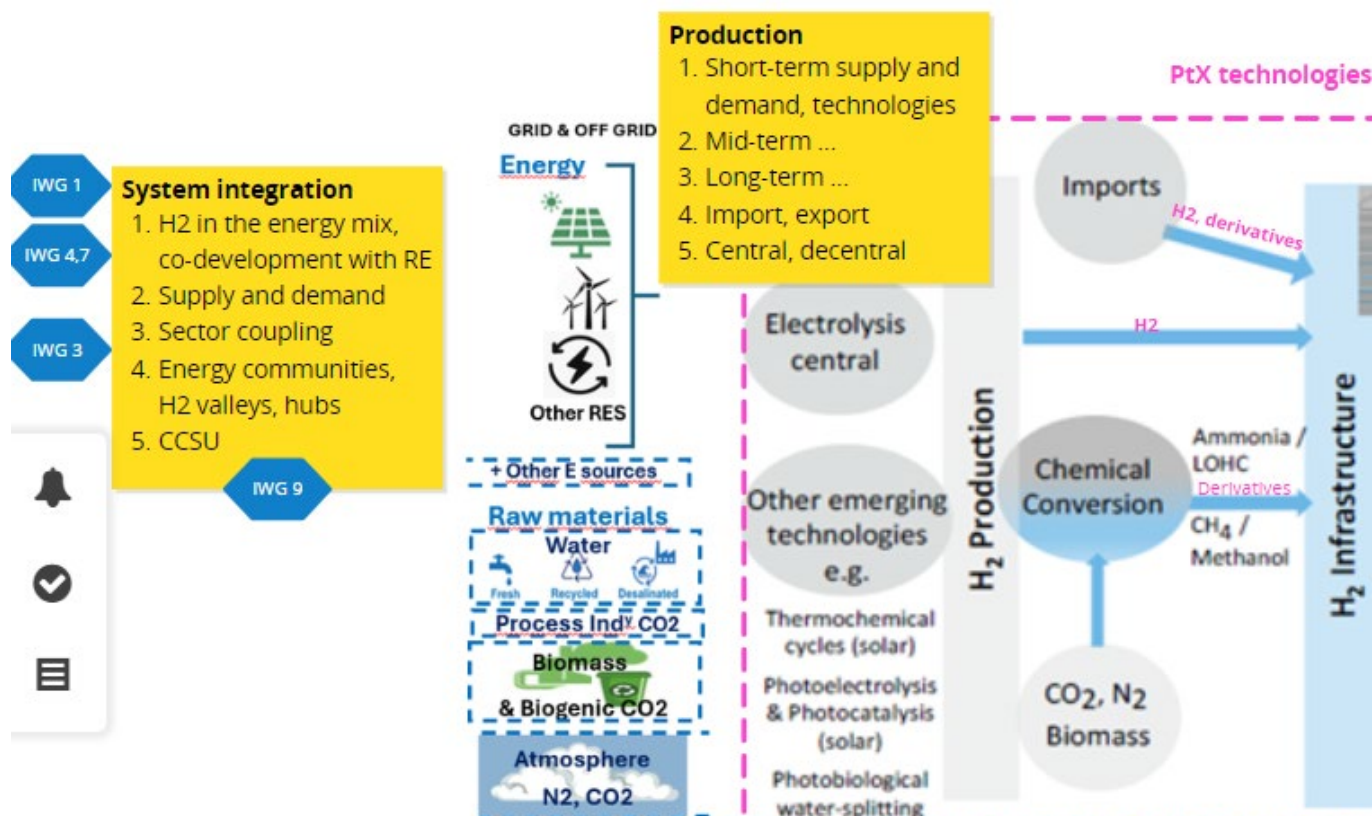


Work package number	4			Lead beneficiary			IT MUR	
Work package title	Networking and cooperation with EU and international initiatives							
Participant number	1	2	3	4	5	6	7	8
Short name of participant	DLR	MUR	UniBO	DGEG	BGH2A	AEA	EUREC	HER
PM per participant	2,5	2	4	0,6	1,2	0,6	0	1,5
Start month	M1			End month			M22	

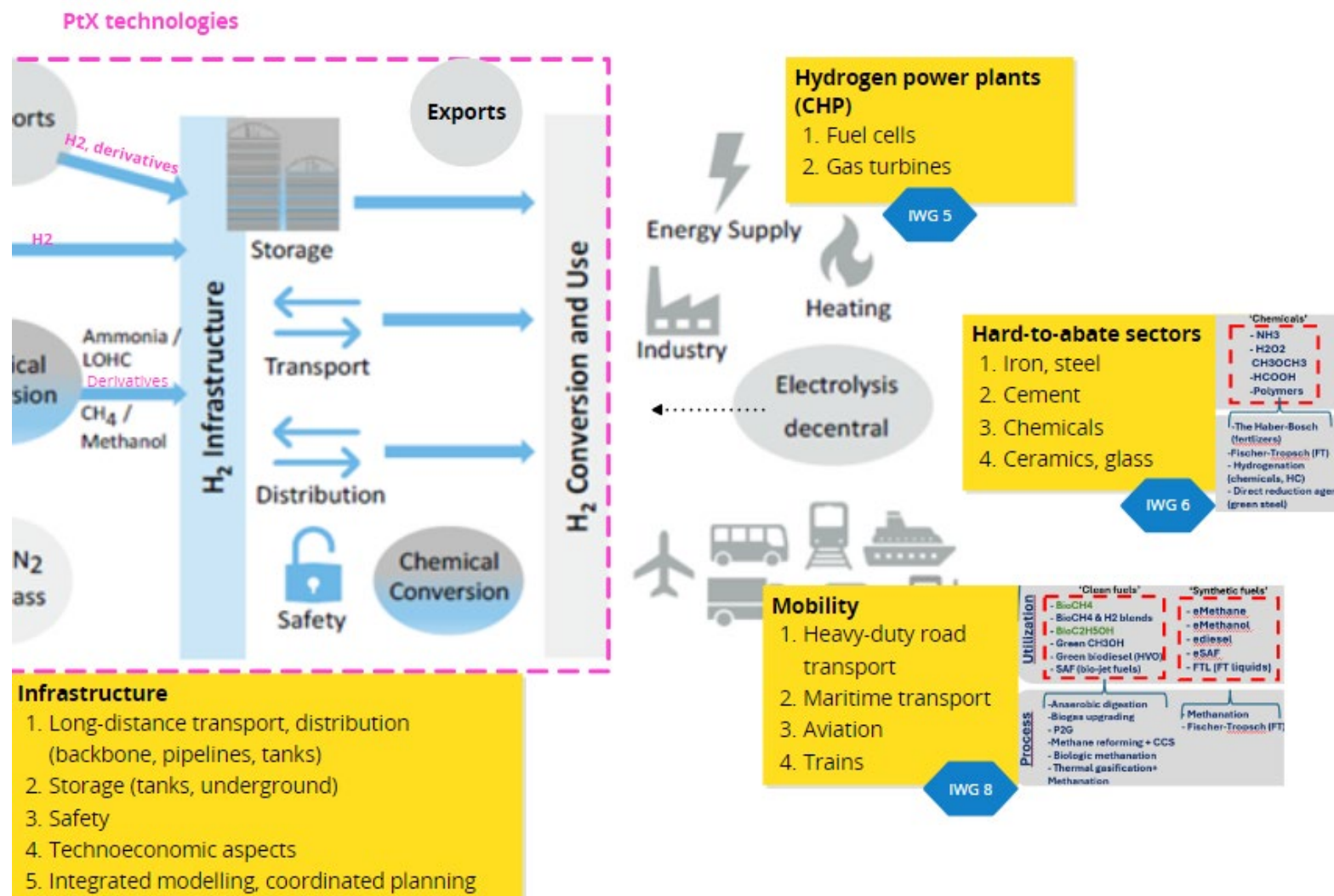
Objectives:

- to define and implement a process to map align and coordinate with networks, platforms and hydrogen-related initiatives at EU and international levels.
- The activities will focus on research and development with the goal of strengthening synergies and alignment between the different initiatives.

Il piano di sviluppo della road di ricerca e innovazione del temporary working group Idrogeno set plan



Il piano di sviluppo della road di ricerca e innovazione del temporary working group Idrogeno set plan



Il piano di sviluppo della road di ricerca e innovazione del temporary working group Idrogeno set plan: cross cutting issues

Cross-cutting issues:

Governance and collaboration

- Policy/legal: Establishing a common European framework for standards and regulations
- Change of organisational structures in regulation/training
- R&D (infra-)structures, organisation and funding instruments
- Collaboration across countries and value chains, energy partnerships

Cross-cutting issues:

Sustainability

- Environmental: circularity, impacts, critical raw materials, LCA
- Economic: level-playing field, market conditions, business models, externalities
- Social/societal: public awareness and acceptance, education, training, (re)skilling

Cross-cutting issues: (not yet assigned/grouped)

Cross-cutting (technical: safety, firefighting, cyber-security)
Cross-cutting (legal: standards, certification and tracking) -> move to system integration or env sustainability?

Industrialization NZIA
materials research



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Credits:

Grazie per l'attenzione

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