

# INFORMATIVE DAY: GREEN HYDROGEN IN CYPRUS

15 September 2023

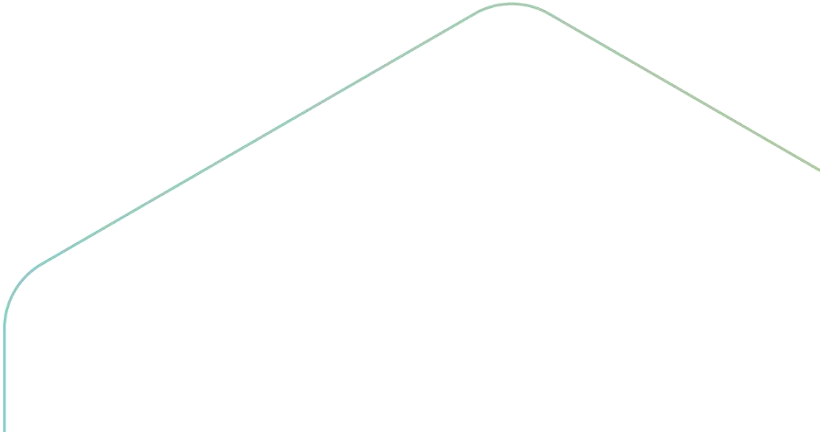


ΣΥΝΔΕΣΜΟΣ ΥΔΡΟΓΟΝΟΥ ΚΥΠΡΟΥ  
CYPRUS HYDROGEN ASSOCIATION





# Makis Ketonis, President of Cyprus Hydrogen Association



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# Green H<sub>2</sub> strategies towards hydrogen economy

**Dr. Andreas Poulikkas**

*M.Phil, Ph.D, D.Tech, FIET*

**Chairman, Cyprus Energy Regulatory Authority**

**[apoulikkas@cera.org.cy](mailto:apoulikkas@cera.org.cy)**

# Contents

- **The role of H<sub>2</sub> in energy transition** – long-term scenarios from carbon economy to hydrogen economy
- **National hydrogen strategies** – towards 2030-2050
- **Green H<sub>2</sub> economics** – the effect of carbon price

# The role of H<sub>2</sub> in Energy Transition

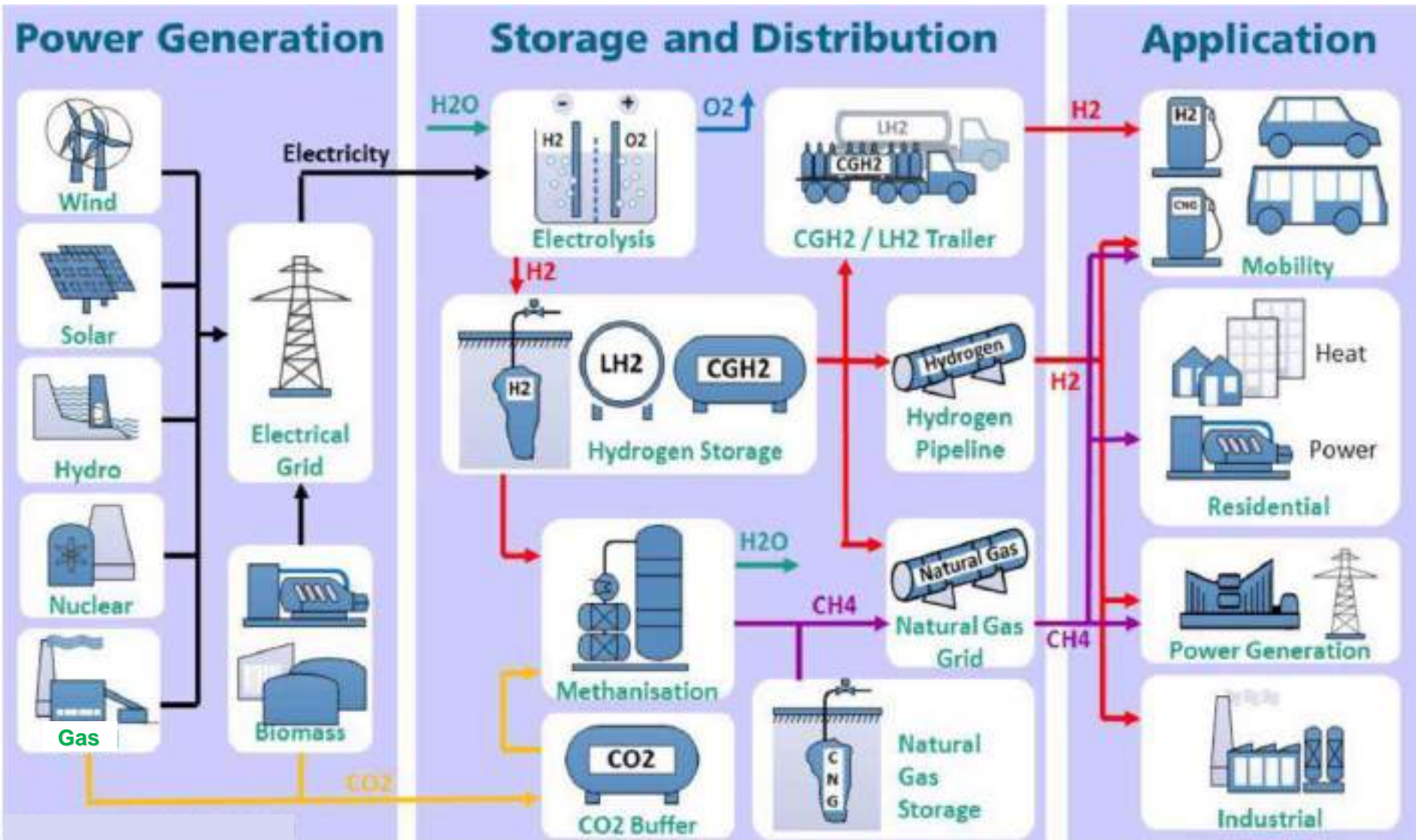
Long-term scenarios from carbon  
economy to hydrogen economy



# Ιούλιος Βέρν (1874)

- “...το νερό θα χρησιμοποιείται ως καύσιμο, το υδρογόνο και το οξυγόνο που το αποτελούν, θα χρησιμοποιούνται μεμονωμένα ή μαζί, και θα παρέχει μια ανεξάντλητη πηγή θερμότητας και φωτός, τέτοιας ισχύος της οποίας ο άνθρακας δεν είναι ικανός
- Κάποια μέρα, στους χώρους αποθήκευσης άνθρακα των ατμομηχανών, αντί για άνθρακα, θα αποθηκεύονται αυτά τα δύο συμπυκνωμένα αέρια, τα οποία θα καίγονται στους θαλάμους καύσης με τεράστια θερμογόνο ισχύ...”

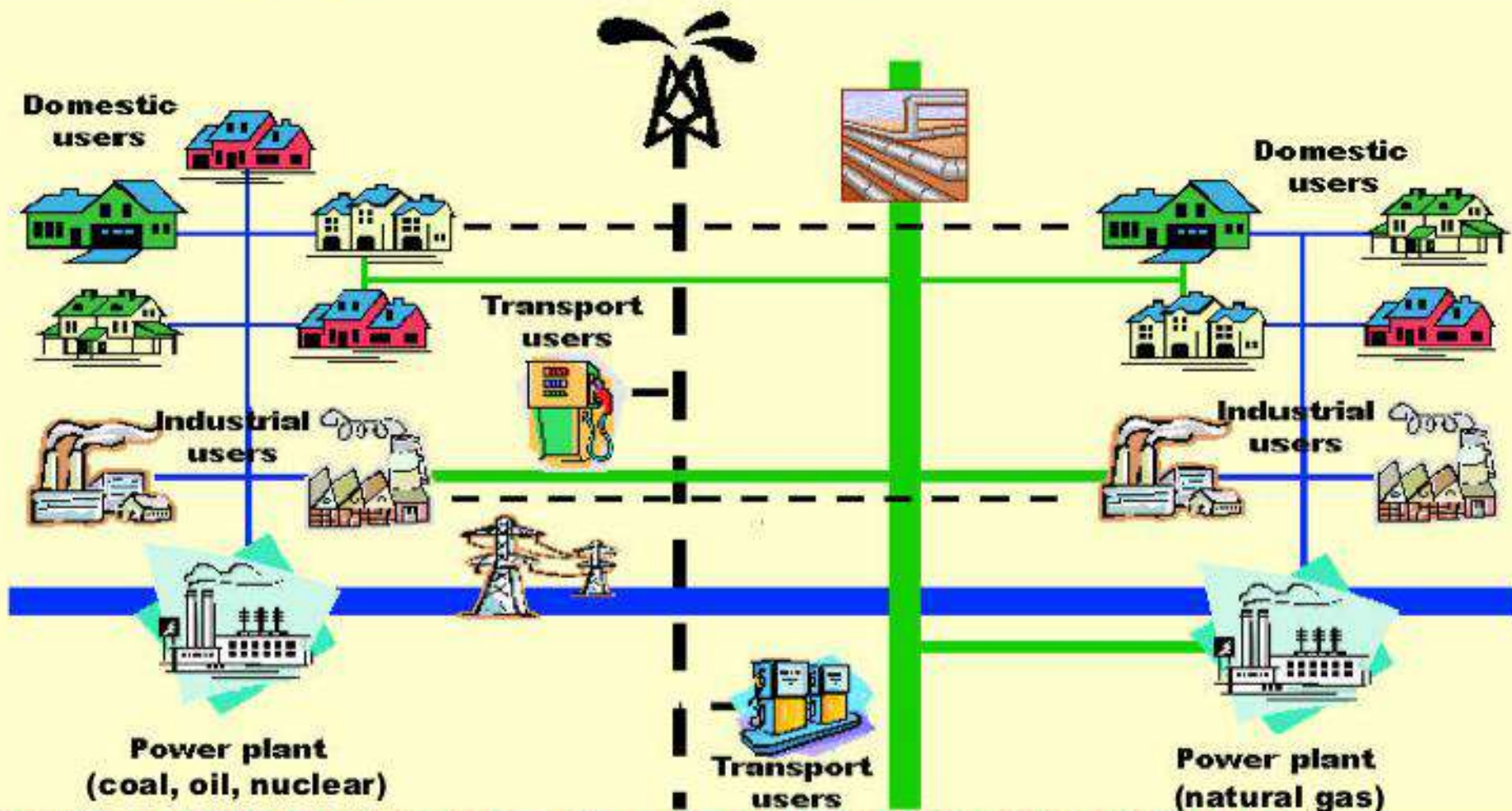
# Potential role of hydrogen in the energy transition\*



\* EU, 2019

# Energy system in 2010

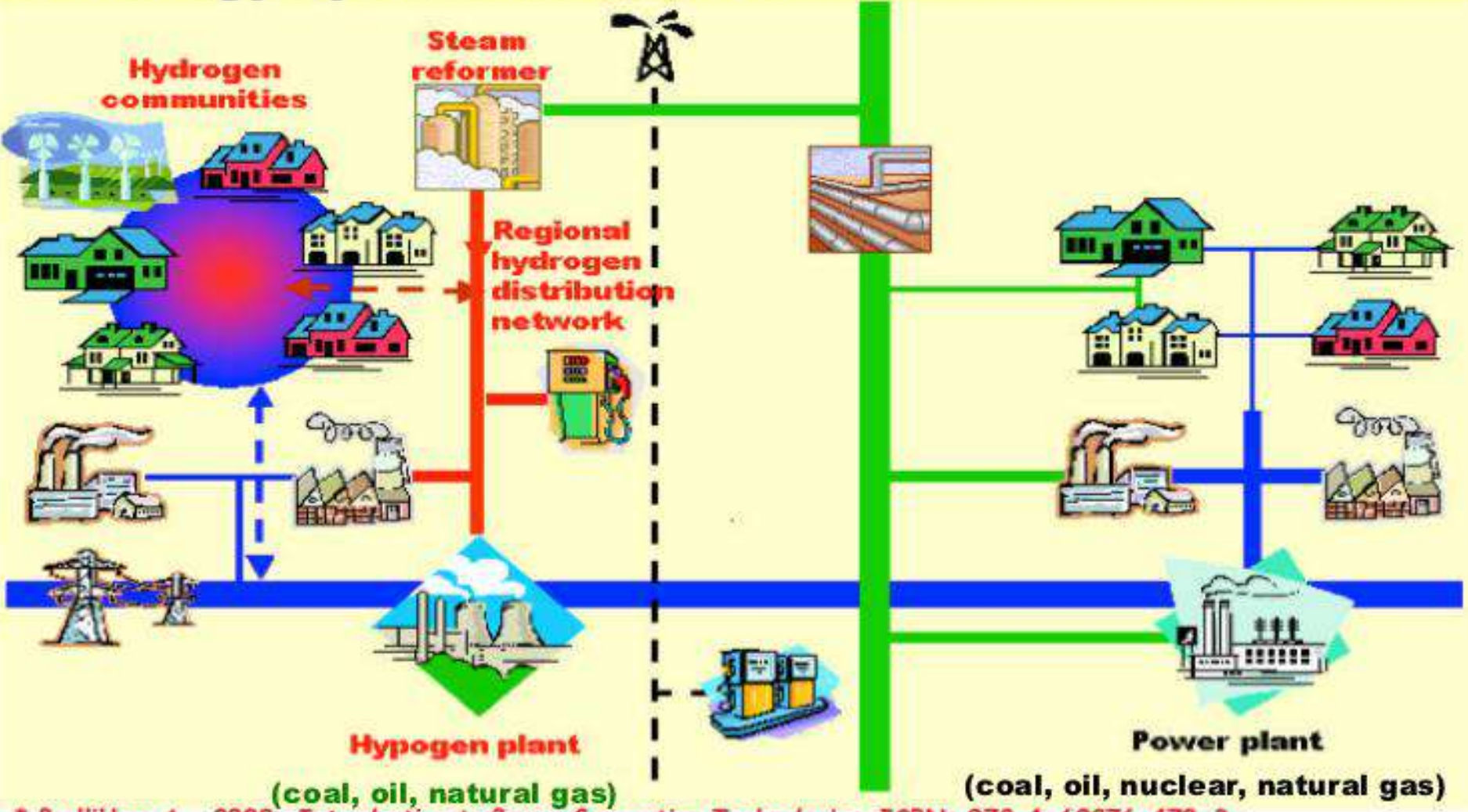
## EU energy system in 2010\*



\* Poullikkas A., 2009, *Introduction to Power Generation Technologies*, ISBN: 978-1-60876-472-3

# Future energy systems (optimistic scenario)

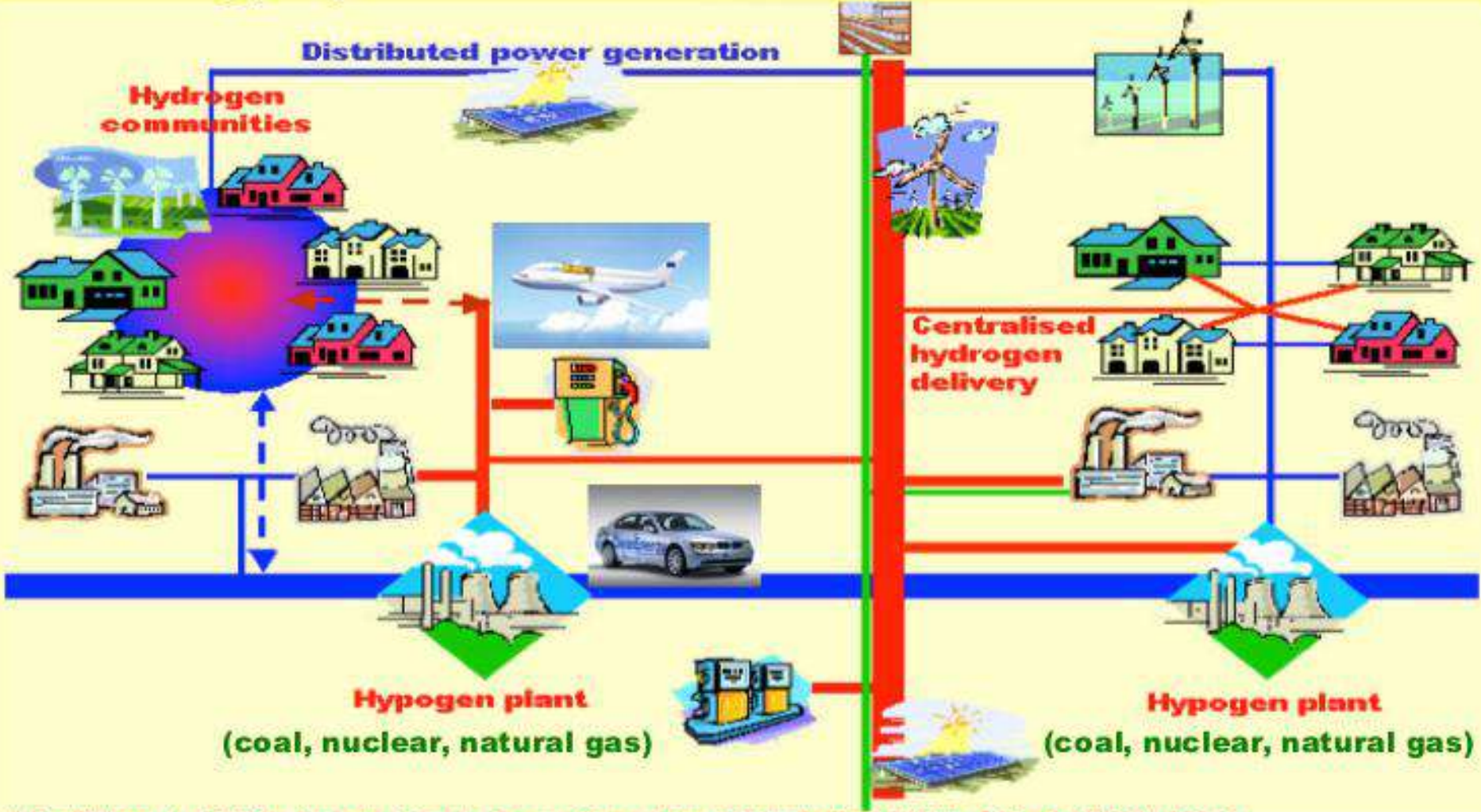
## EU energy system in 2020-30\*



\* Poullikkas A., 2009, *Introduction to Power Generation Technologies*, ISBN: 978-1-60876-472-3

# Future energy systems (optimistic scenario)

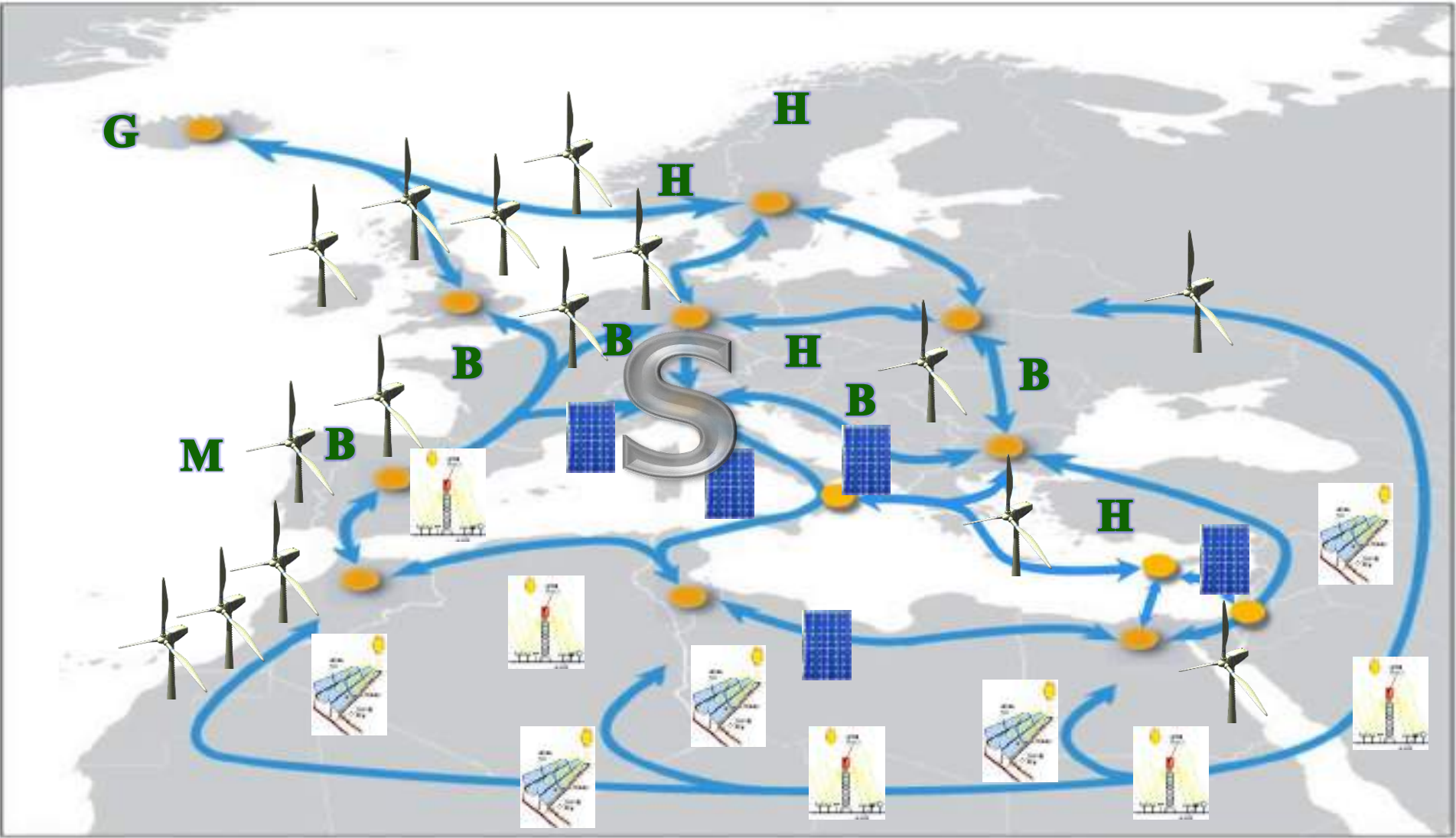
## EU energy system in 2040-50\*



\* Poullikkas A., 2009, *Introduction to Power Generation Technologies*, ISBN: 978-1-60876-472-3

# The Super Smart Grid after 2050\*

(may allow for 100% RES)

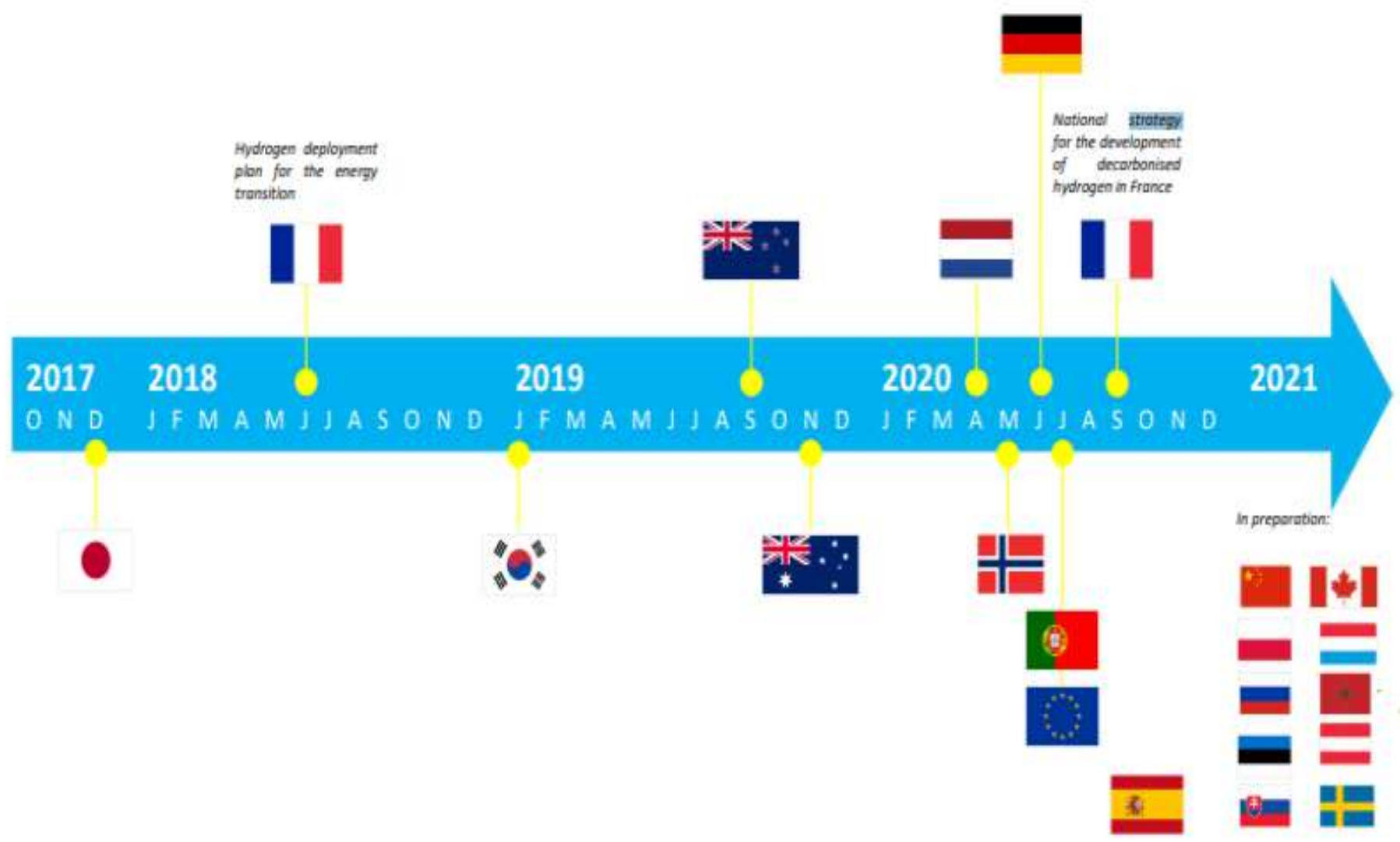


\* Poulikkas A., 2013, Sustainable Energy Development for Cyprus, ISBN: 978-9963-7355-3-2

# National hydrogen strategies

## towards 2030-2050

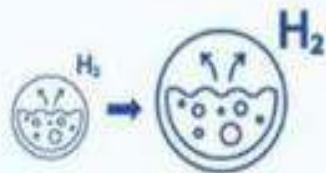
# National Hydrogen Strategies\*



\* Possible regulation of hydrogen networks, ACER 2021



# EU H<sub>2</sub> strategy\*



**Today - 2024**

**2025-2030**

**2030**

- Installation of Electrolysers: at least 6GW for green H<sub>2</sub> production
- Production of green H<sub>2</sub>: up to 1mt

- H<sub>2</sub> to become part of the integrated energy system
- Production of green H<sub>2</sub>: more than 10mt

- Large scale integration of green H<sub>2</sub>

\* A hydrogen strategy for a climate-neutral Europe, EU, 2020

# Saudi Arabia \$5bn Helios H2 project

- Desert area = Belgium
- 4GW of Wind and PVs
- Production of 650t/day of H<sub>2</sub>
- Reduce of H<sub>2</sub> production from 5US\$/kg to 1.5US\$/kg
- Long-term: Saudi Arabia to become H<sub>2</sub> exporter



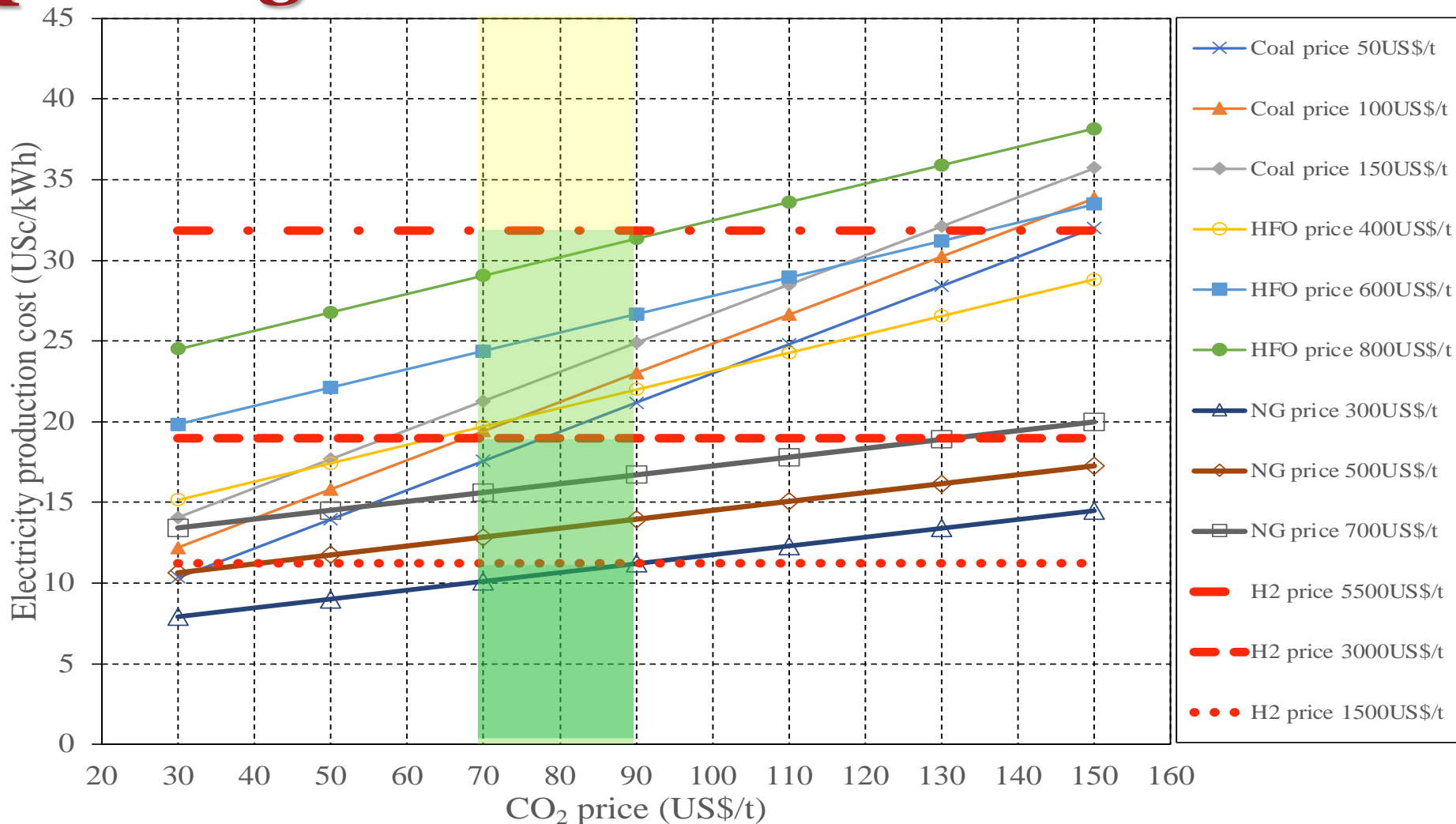
# Cyprus H<sub>2</sub> strategy?

- **Recognition of hydrogen as a key component of the energy mix for 2030 and up to 2050**
- **Creation of a long-term national energy strategy considering hydrogen**
- **Creation of a legislative framework - allow the introduction of participants in H<sub>2</sub> market**
- **Harmonization of national regulatory framework with the relevant European Directives**
- **Targeted measures to kick-start the hydrogen value chain: production; transport and storage; use in final consumption**

# Green H<sub>2</sub> economics

## The effect of carbon price

# Carbon price vs green hydrogen power generation\*



\* Venizelos V., Poullikkas A., 2023, "The effect of carbon price towards green hydrogen power generation", in preparation



## Presentation by Mr. Jorgo Chatzimarkakis, CEO of Hydrogen Europe

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# European and National strategies and policies for Green Hydrogen

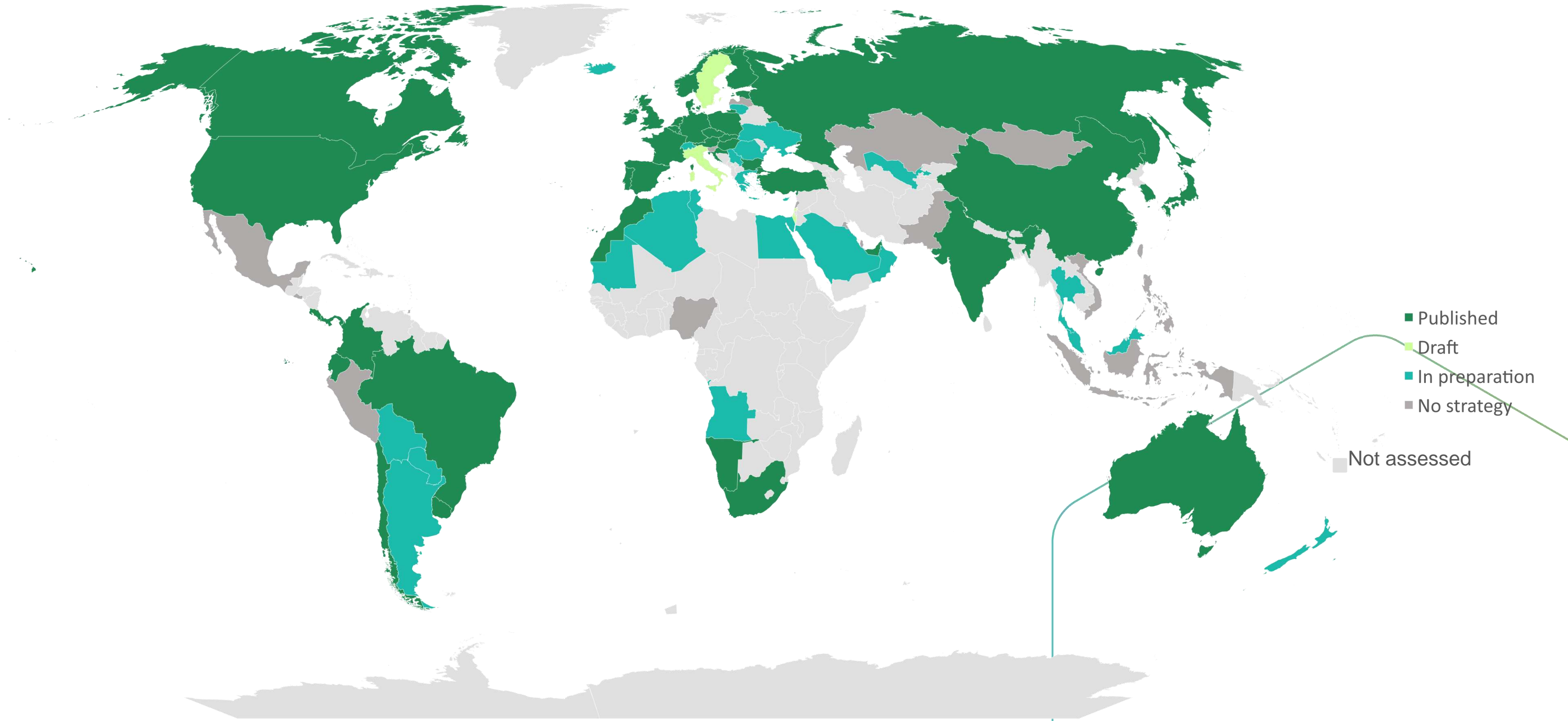
15 September, Nicosia – Cyprus

# National Policy Updates



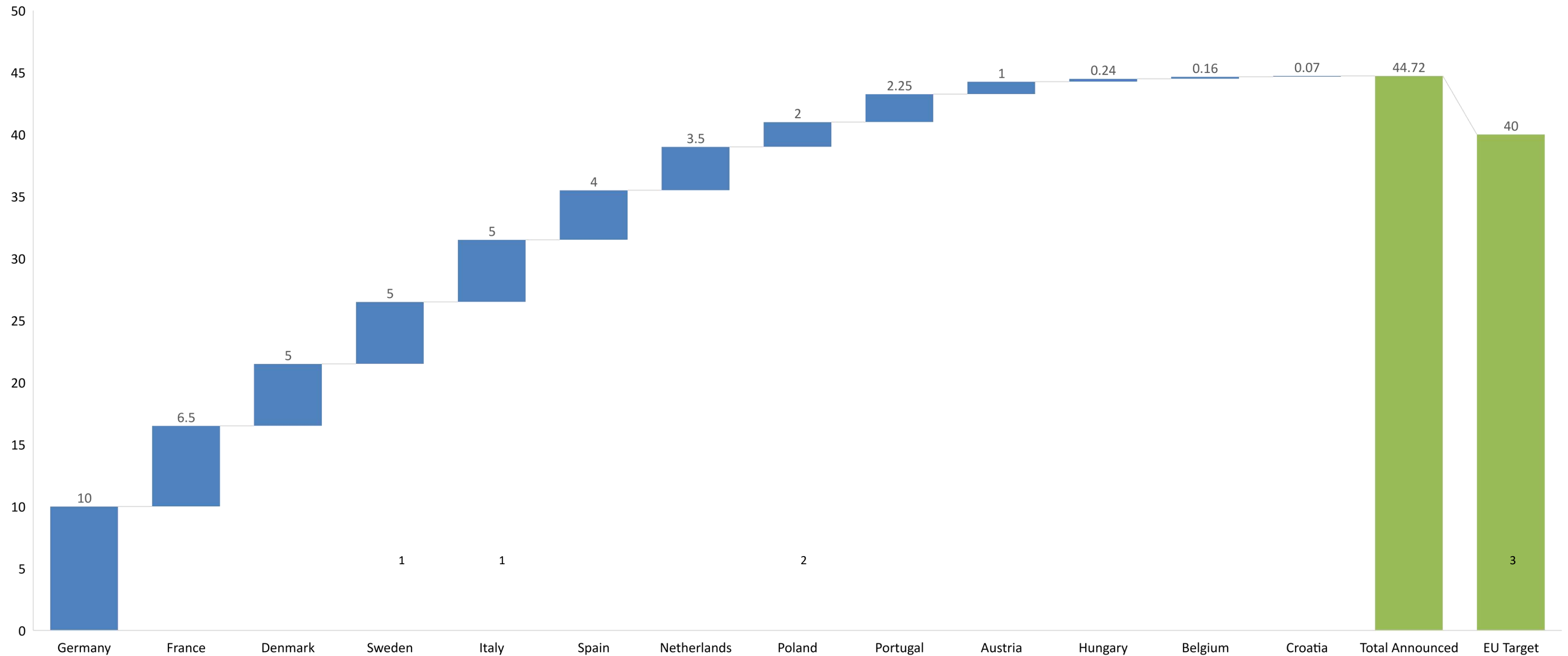
# 43 countries have published a national hydrogen strategy

Data as of 03/08/2023



# Electrolyser capacity commitments by 2030 amount to 39.76 GW

Data as of 07/06/2023



Included countries are the only ones with specific targets for planned electrolyser capacity.

When the target is a range, the median value of that range was used.











<sup>1</sup> Target is provisional and subject to change in the final version of the national H2 strategy.

<sup>2</sup> Polish target is for low-carbon emission sources, including electrolyzers.

<sup>3</sup> EU target is in electrolyser capacity output, while for the values in national strategies no indication is given.

# 10 countries have committed €20.9bn of public funds towards H2

Data as of 07/06/2023









	Country	National Funding Committed (€)	Details
	Austria	<b>0.545bn</b>	Non-exclusive for R&D, IPCEI and subsidies for electrolysers/biomethanation
	Belgium	<b>0.401bn</b>	Energy Transition Fund (non-exclusive) & Infrastructure;
	Czech Republic	<b>0.522bn</b>	Non-exclusive, available through 3 funds and operative programmes
	Denmark	<b>0.176bn</b>	Exclusive, PtX subsidies based on tender and PtX task-force
	Estonia	<b>0.121bn</b>	IPCEI & H2 in transport and chemical industry support
	France	<b>5bn</b>	Priorities: Industry & heavy-duty transport decarbonisation and R&D
	Germany ('20)	<b>11.11bn</b>	Non-exclusive, spread among 6 funds/programmes
	Poland	<b>0.446bn</b>	Non-exclusive, available through 4 programmes and funds
	Portugal	<b>0.525bn</b>	Exclusive for H2 production in the form of a variable feed-in-premium until 2030
	United Kingdom	<b>2.45bn</b>	Non-exclusive funds through 14 funds, competitions and programmes

When the committed funds are a range, the median value of that range was used.

# 8 countries with FCEV mobility targets for 2030

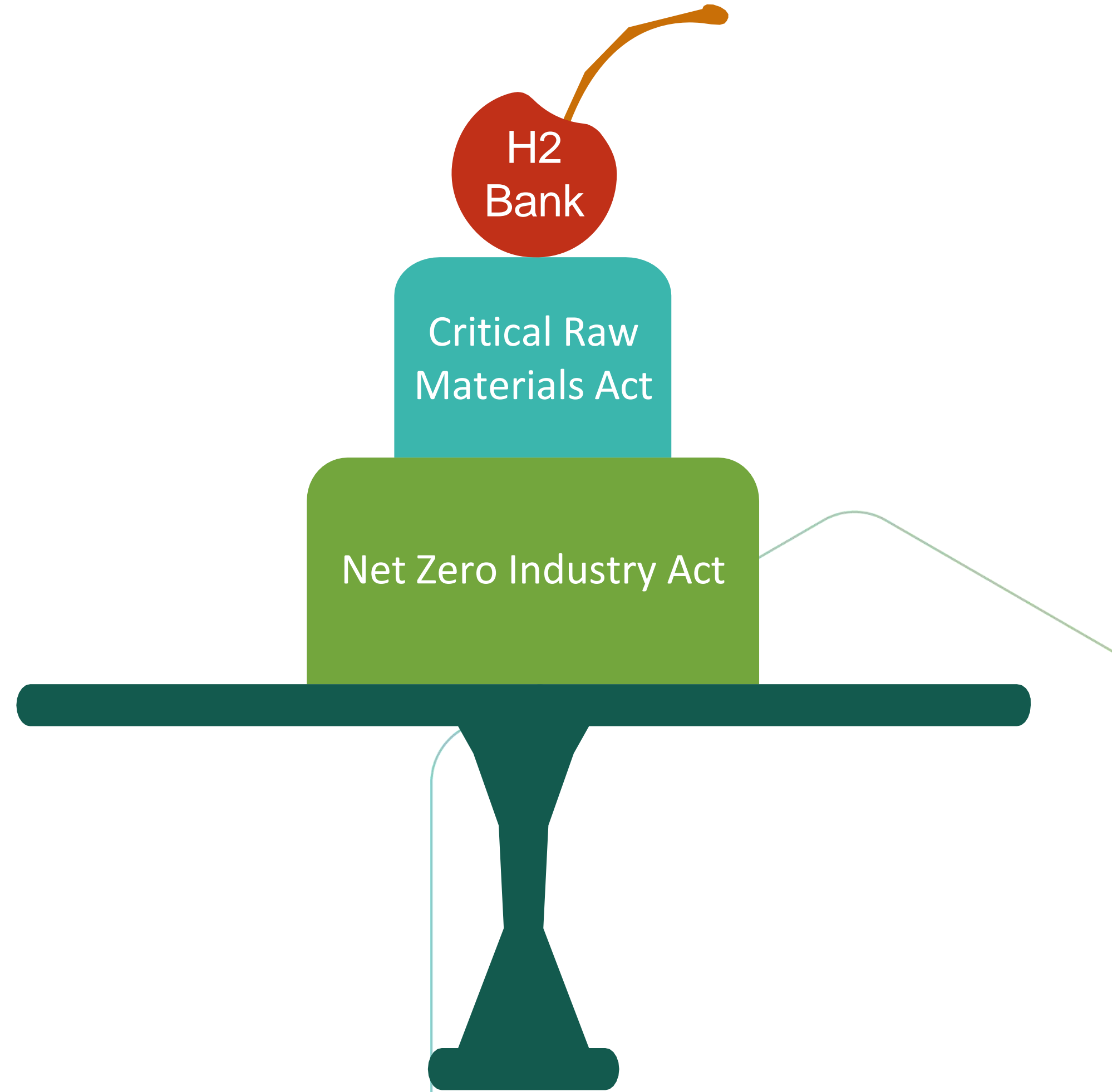
Data as of 24/05/2023



Country	Car	Bus	Truck	Train	Station
 Croatia					15
 Czech Republic	4,500	900	4,000	3	
 Hungary			4,800		20
 Netherlands	300,000		3,000 (2025)		50 (2025)
 Poland		900		1 train line	32
 Portugal	875	275	325		75
 Spain		175		2 train lines	125
 Estonia					3 to 5

# European and International Policy Updates





# Commission presents criteria for the first call under the H2 Bank (Internal Leg H2 Bank)

## Upcoming EU Hydrogen Bank pilot auction: European Commission publishes Terms & Conditions

An important step towards scaling up production of renewable hydrogen in the EU.



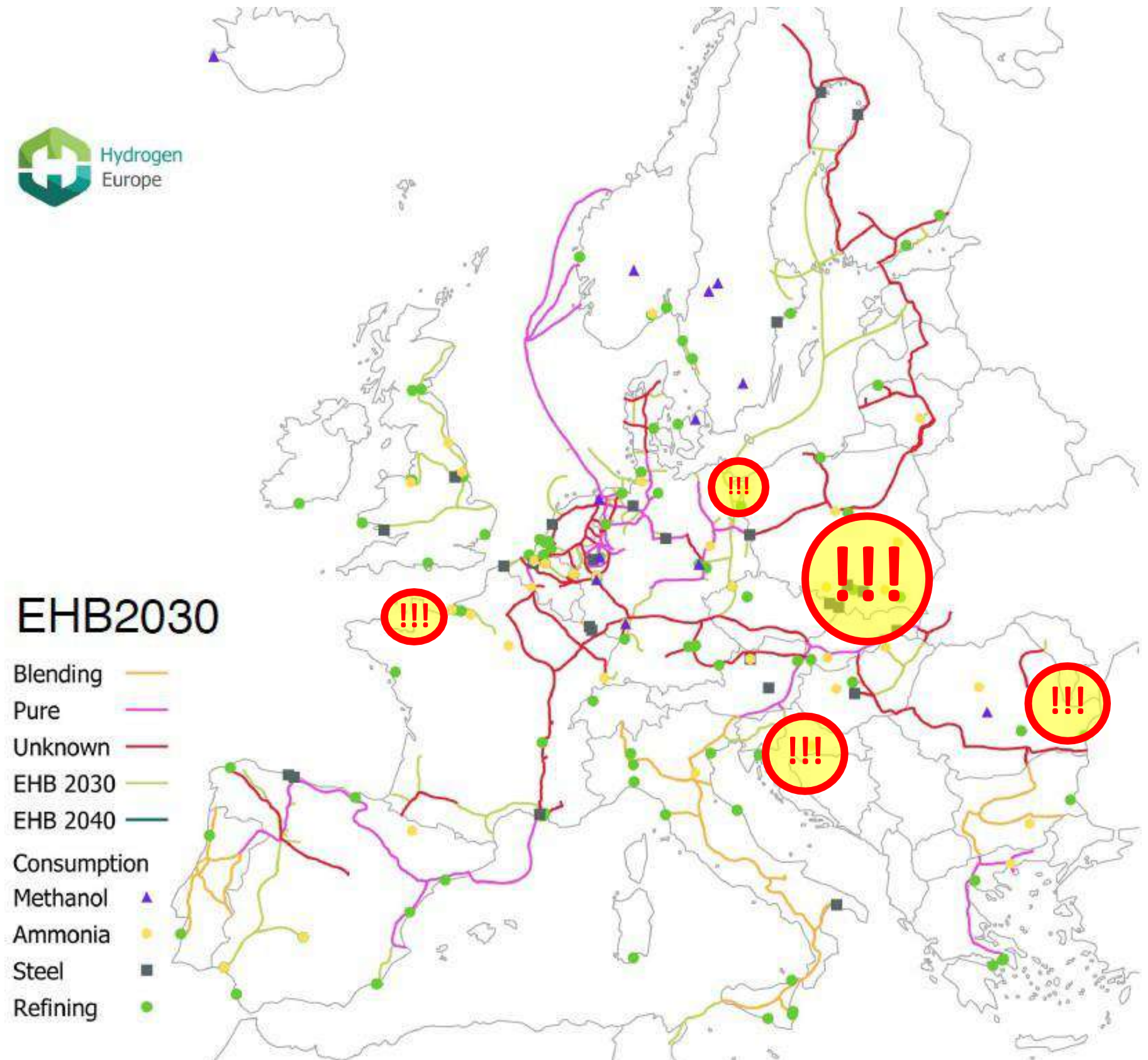
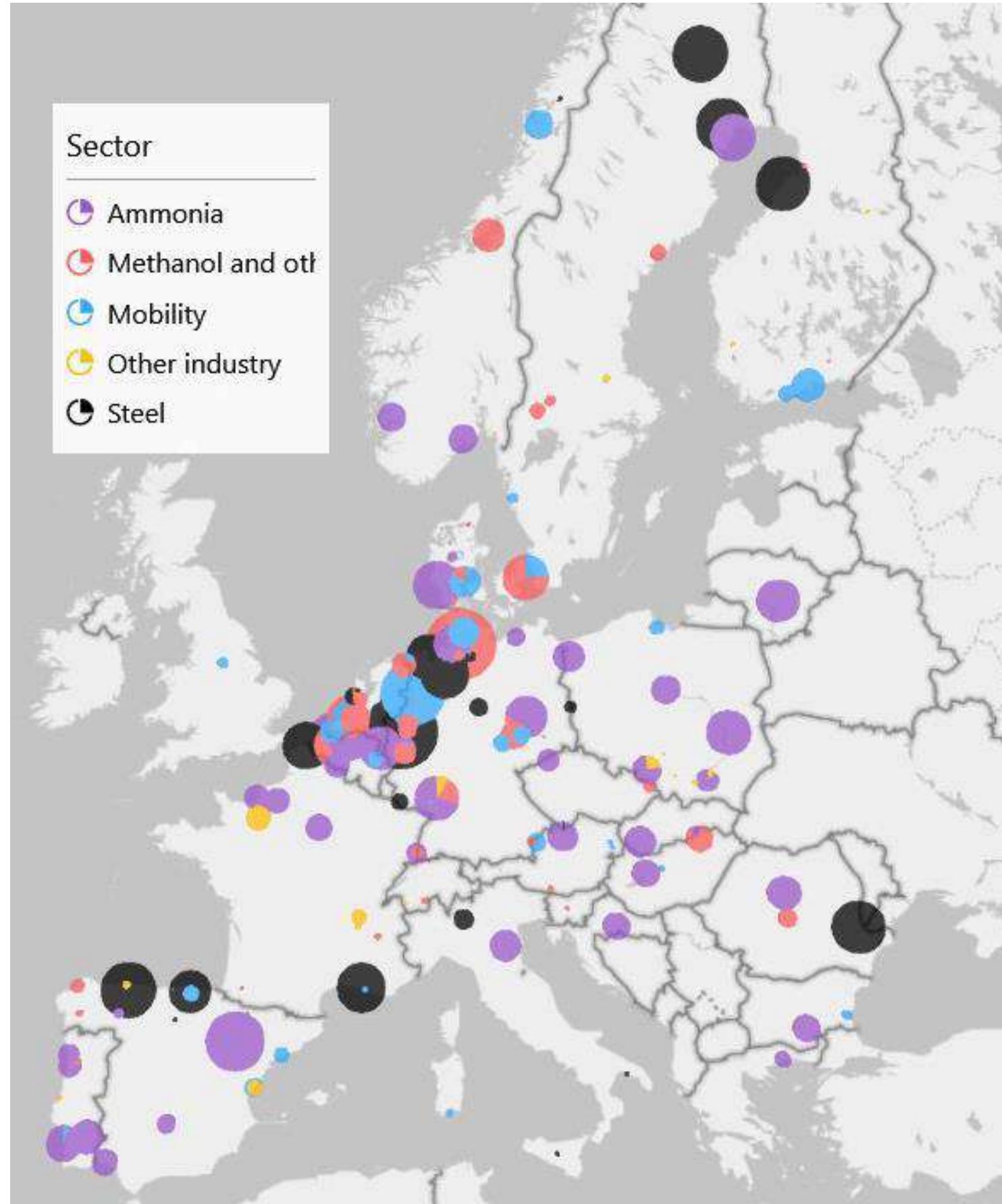


# EU Commission invites Member States to join H2 Global (External Leg H2 Bank)



# Hydrogen demand by 2030 – RED targets Impact

*Demand in industry driven by the RED targets defines the bottom line*



AFIR deal reached on March 27th



	HRS in Urban nodes TEN-T	HRS on TEN-T Core Network every 200km	Total	Number of petrol stations
Austria	9	5	14	2,733
Belgium	11	4	15	3,085
Bulgaria	7	8	15	4,600
Croatia	5	6	11	N/A
Cyprus	3	1	4	315
Czechia	7	5	12	4,008
Denmark	6	4	10	2,051
Estonia	2	2	4	495
Finland	7	5	12	1,869
France	42	26	68	11,160
Germany	77	32	109	14,459
Greece	17	9	26	6,100
Hungary	9	5	14	2,014
Ireland	3	2	5	1,850
Italy	49	21	70	21,750
Latvia	1	4	5	612
Lithuania	5	3	8	718
Luxembourg	1	1	2	238
Malta	1	1	2	69
Netherlands	24	3	27	4,142
Poland	30	19	49	7,739
Portugal	13	5	18	3,418
Romania	22	12	34	1,615
Slovakia	4	4	8	973
Slovenia	2	2	4	N/A
Spain	49	29	78	11,650
Sweden	18	15	33	2,701
<b>TOTAL</b>	<b>424</b>	<b>233</b>	<b>657</b>	<b>110 364</b>

Final deal	
Density	200km
Network	Core only
Daily capacity	1t/day (Cumulative)
LH2	Revision 2024
Urban nodes	1 HRS
Deployment date	End 2030 (linear dep. pl.)

Cyprus	3	1	4	315
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600 tons green hydrogen per day



# BRICS Summit invites new members



# Thank You



Avenue Marnix 23  
1000, Brussels / Belgium

[secretariat@hydrogeneurope.eu](mailto:secretariat@hydrogeneurope.eu)  
[hydrogeneurope.eu](http://hydrogeneurope.eu)





## Mr. Stavros Stavrinos, Cyprus TSO, Guarantees of origin

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# The Cyprus GO System

## Transmission System Operator Cyprus

### an Overview

15 September 2023



# Contents

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1. Introduction
2. TSOC Authorized Issuing Body
3. AIB Membership
4. Hydrogen GO s

# Introduction

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Electricity does not have **Colour** or **Smell**, it is just flowing electrons

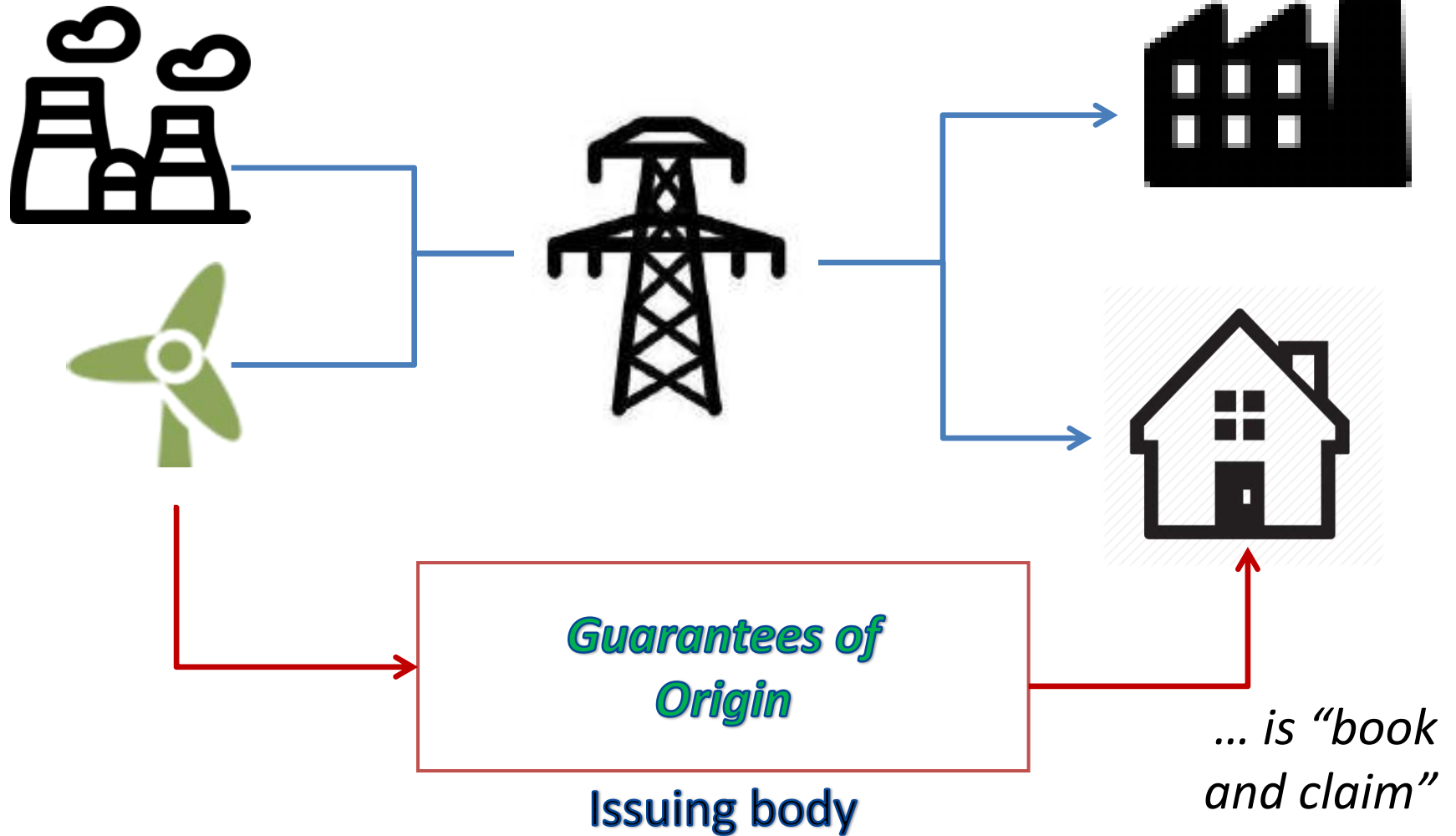
Thus, the electricity consumed by a specific Consumer connected to the Electricity Grid cannot be identified based on any characteristic, i.e., energy source (e.g., coal, gas, nuclear, wind, sun), place of generation (e.g., region, country), age of power plant, e.t.c.

# Guarantee of Origin (GO)

---

The Guarantee of Origin (GO) is defined as:  
a unique, tradable and transferable electronic document  
with the sole function of providing proof to a final customer  
that a given share of energy was produced from Renewable sources / High  
Efficiency Cogeneration

# GOs: the principle...



# Use of GOs:

---

To claim to have used 1 MWh of electricity from renewable sources, the associated GO needs to be cancelled in the Registry of the Issuing Body of the country of consumption

This prevents double counting, guaranteeing that no RES MWh can be sold/claimed twice

# TSOC and GOs

TSOC Authorized issuing Body for GOs:

- RES Electricity
- High Efficiency Cogeneration (HECHP)

Cyprus GO Registry, since 2010

Registered installations:

- 6 Wind Plants (157 MW)
- 54 Solar Plants (130 MW)
- 2 Biomass Plants (1 MW)

## Association of Issuing Bodies (AIB)

### European Energy Certificate System (EECS) Electricity 2002

- 35 members from 28 European Countries (EU, EEA and Energy Community member states)

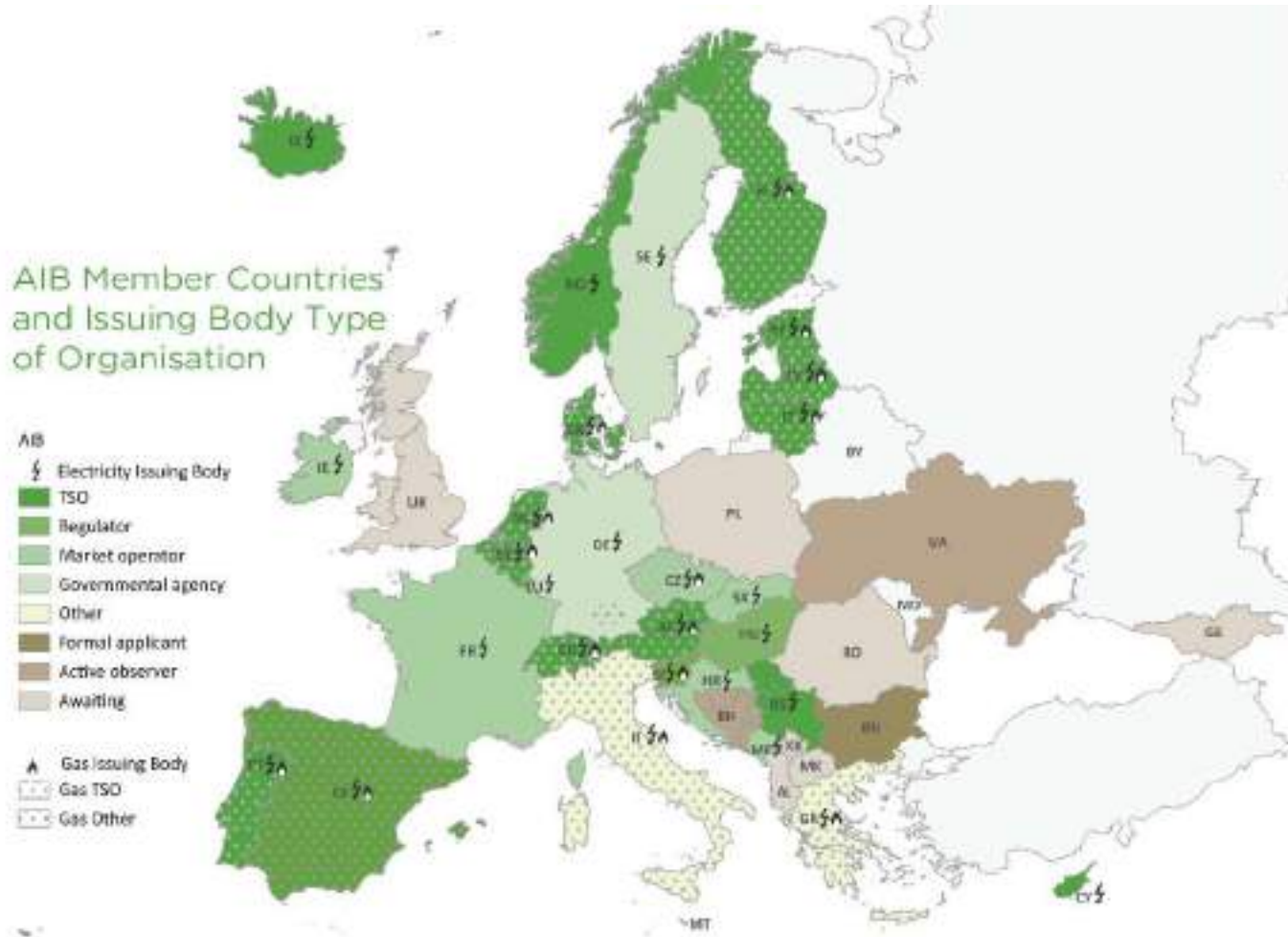
## TSOC

- Joined in 2015
- Connected to the Hub 2020, ability to import and export GOs

2022:

- Imports: 43454 MWh
- Exports: 39608 MWh

# AIB Members





## EECS Gas Scheme (November 2019)

- fully facilitates GOs for gaseous energy carriers (including hydrogen) under Article 19 of the Renewable Energy Directive 2018/2001, and their effective cross border transfer.

# Hydrogen GOs in Cyprus

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RES Law 107(I)/2022, articles 2, 23(1,3), provide of GOs for Renewable Gas including hydrogen

- CERA Designated Competent Body appoints Authorized Issuing Body

# TSOC

**Thank you for your attention**



**Mr. Lakis Mesimeris,  
Department of Environment,  
Decarbonisation of the Energy Sector (NECP)**

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# Ο Ρόλος του Υδρογόνου στον Εθνικό Σχεδιασμό για Μείωση των Εκπομπών Αέριων του Θερμοκηπίου

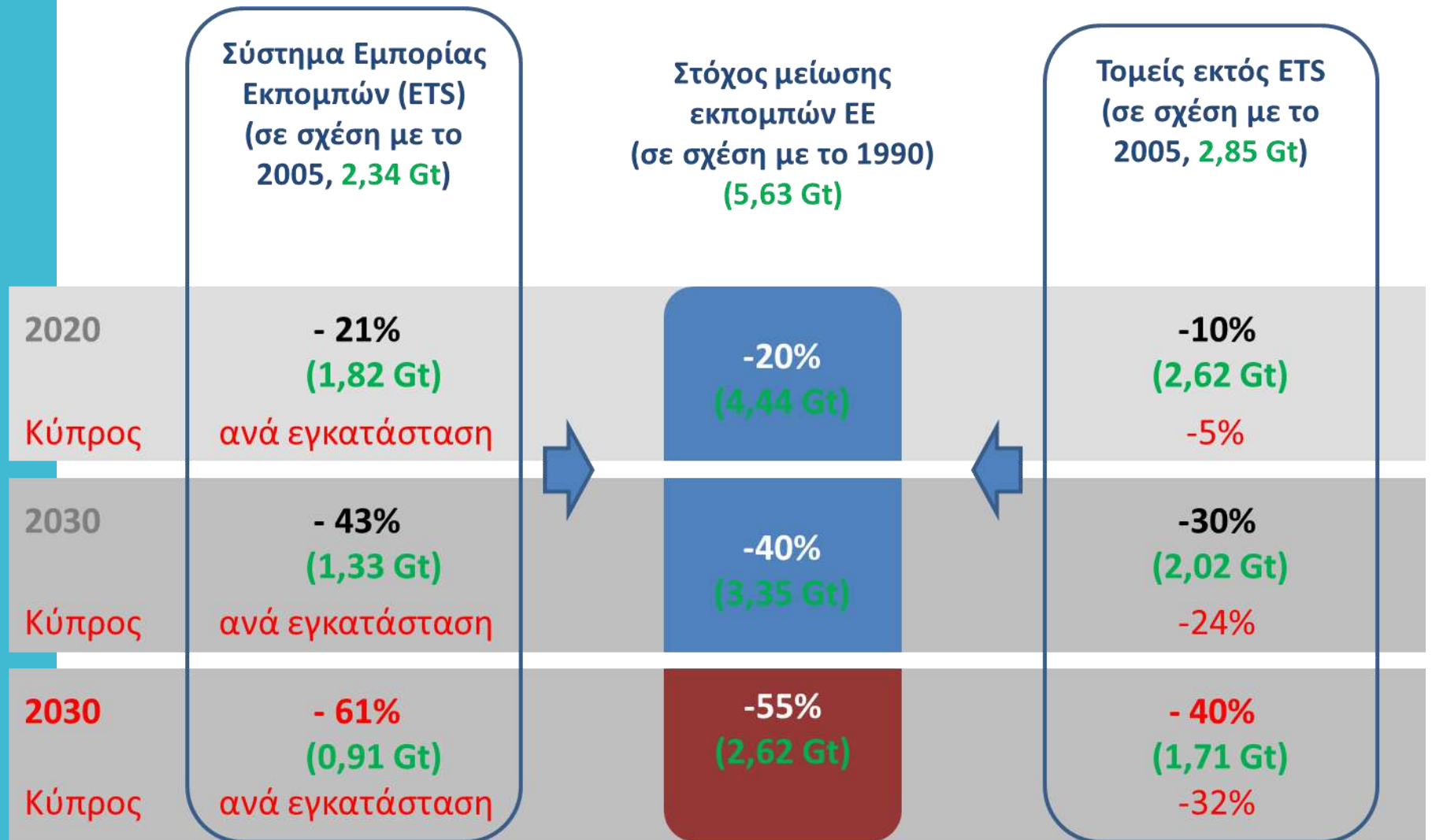
Δρ. Θεόδουλος Μεσημέρης

ΤΜΗΜΑ ΠΕΡΙΒΑΛΛΟΝΤΟΣ

Informative Day "Green Hydrogen in Cyprus" 15/9/2023



# Εθνικές υποχρεώσεις



# Εθνικό Σχέδιο για την Ενέργεια και το Κλίμα 2021- 2030

- Αποτελεί τον βασικό μεσοπρόθεσμο σχεδιασμό των κρατών μελών της ΕΕ για επίτευξη των υποχρεώσεών τους στους συγκεκριμένους τομείς.
- Καταρτίζεται βάσει του Κανονισμού για την Διακυβέρνηση της Ενεργειακής Ένωσης.
- Το πρώτο Εθνικό Σχέδιο της Κύπρου υποβλήθηκε την Ευρωπαϊκή Επιτροπή το 2020, μετά από τη σχετική έγκριση του Υπουργικού Συμβουλίου.
- Για την ετοιμασία του Εθνικού Σχεδίου θεσπίστηκε και λειτούργησε το **Εθνικό Σύστημα Διακυβέρνησης για το Κλίμα και την Ενέργεια**, το οποίο στη συνέχεια μετεξελήχθηκε στο Εθνικό Σύστημα Διακυβέρνησης για την Πράσινη Συμφωνία.

# Υφιστάμενη Κατάσταση (2021)

Εθνικές Εκπομπές της Κύπρου εκτός Συστήματος Εμπορίας Δικαιωμάτων Εκπομπής Αερίων του Θερμοκηπίου





# Προσχέδιο Αναθεώρησης Εθνικού Σχεδίου

ΠΟΛΙΤΙΚΕΣ ΚΑΙ ΜΕΤΡΑ  
(1/2)

## Ανανεώσιμες Πηγές Ενέργειας

- Σχέδιο για παραγωγή ηλεκτρικής ενέργειας από ΑΠΕ για ίδια κατανάλωση
- Ανταγωνιστική Αγορά Ηλεκτρισμού και την Μεταβατική Αγορά Ηλεκτρισμού
- Παροχή οικονομικής στήριξης
- Σχέδια χορηγιών για αποθήκευση ηλεκτρικής ενέργειας
- Προώθηση αντλιών θερμότητας υψηλής απόδοσης
- Απλοποίηση και επιτάχυνση των διαδικασιών αδειοδότησης

## Ενεργειακή απόδοση

- Ενεργειακή Απόδοση σε διανομείς ενέργειας
- Ενεργειακές αναβαθμίσεις σε δημόσια κτίρια
- Ενεργειακές αναβαθμίσεις σε κατοικίες και επιχειρήσεις
- Μέτρα εξοικονόμησης ενέργειας στον τομέα των οδικών μεταφορών.
- Οδικός φωτισμός
- Υποδομή έξυπνων συστημάτων μέτρησης

# Προσχέδιο Αναθεώρησης Εθνικού Σχεδίου

ΠΟΛΙΤΙΚΕΣ ΚΑΙ ΜΕΤΡΑ  
(2/2)

## Μεταφορές

- Εφαρμογή Σχεδίων Βιώσιμης Αστικής Κινητικότητας
- Χρήση βιοκαυσίμων στις μεταφορές
- Προώθηση ηλεκτρικών οχημάτων

## Απόβλητα

- Προώθηση αναερόβιας χώνευσης για επεξεργασία κτηνοτροφικών αποβλήτων
- Απορρίμματα
  - Ορθή εφαρμογή του πλαισίου πολιτικής για τα απορρίμματα
  - Ανάκτηση βιοαερίου
- Βελτίωση διαχείρισης υγρών αποβλήτων

## Βιομηχανία/επιχειρήσεις

- Μείωση των εκπομπών αερίων του θερμοκηπίου από τις επιχειρήσεις
- Ανάκτηση ψυκτικών αερίων

## Χρήσεις γης

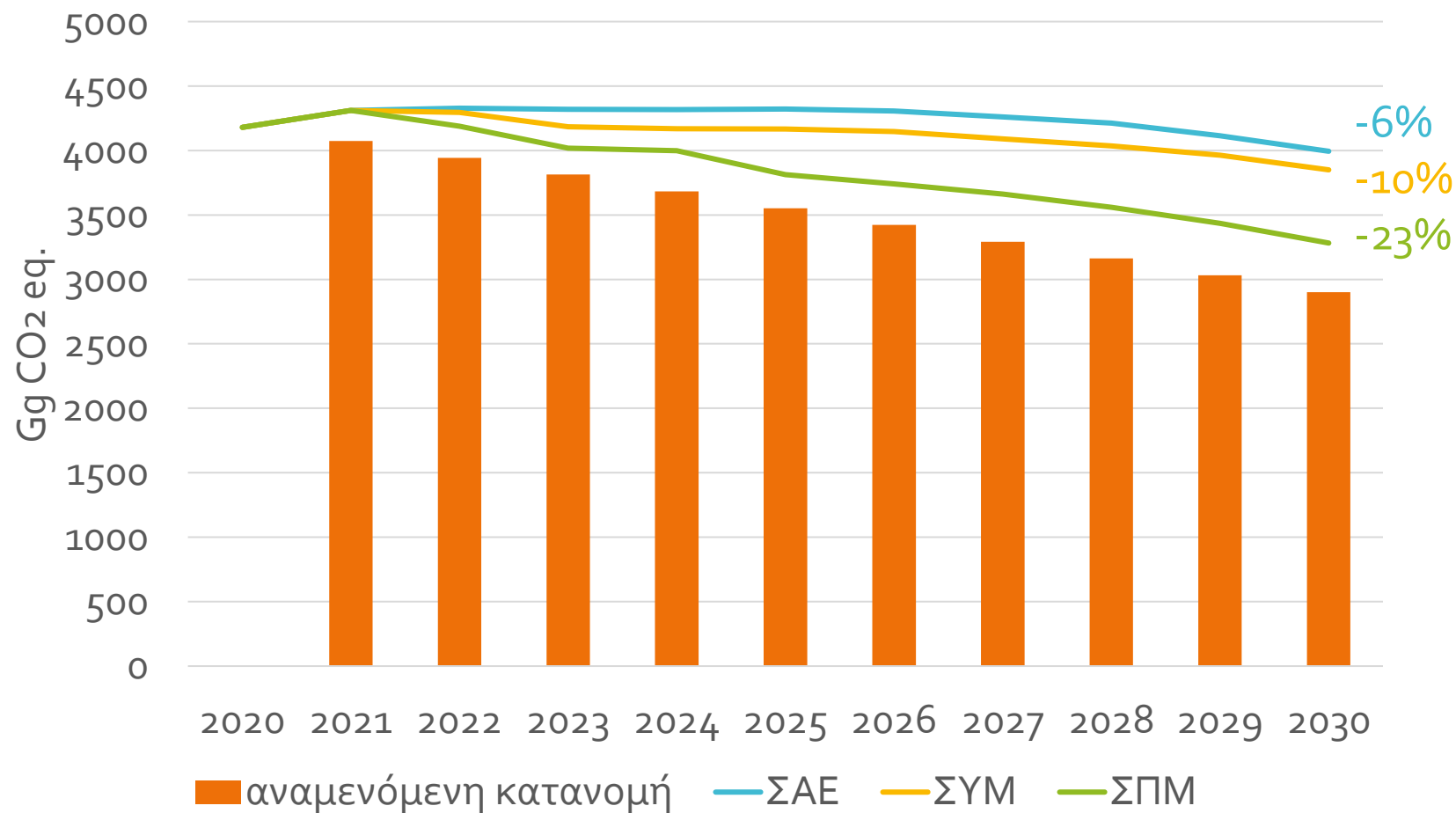
- Αύξηση απορρόφησης από τις χρήσεις γης

## Οριζόντια

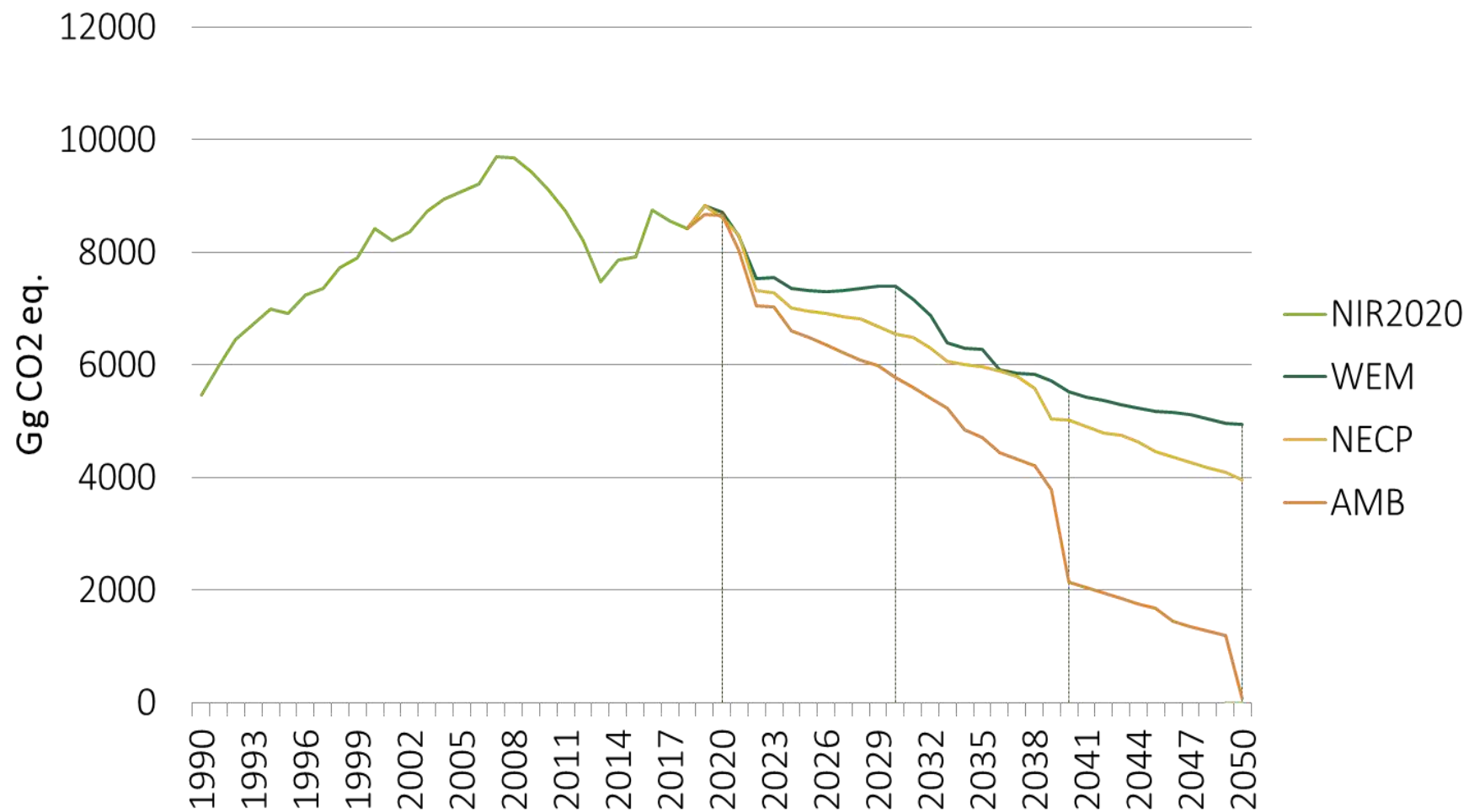
- Στοχευμένη Έρευνα και Καινοτομία (υπό αξιολόγηση)
- Φορολογική μεταρρύθμιση (υπό αξιολόγηση)

# Προσχέδιο Αναθεώρησης Εθνικού Σχεδίου

ΕΠΙΤΕΥΞΗ ΣΤΟΧΩΝ  
(% Vs 2005)

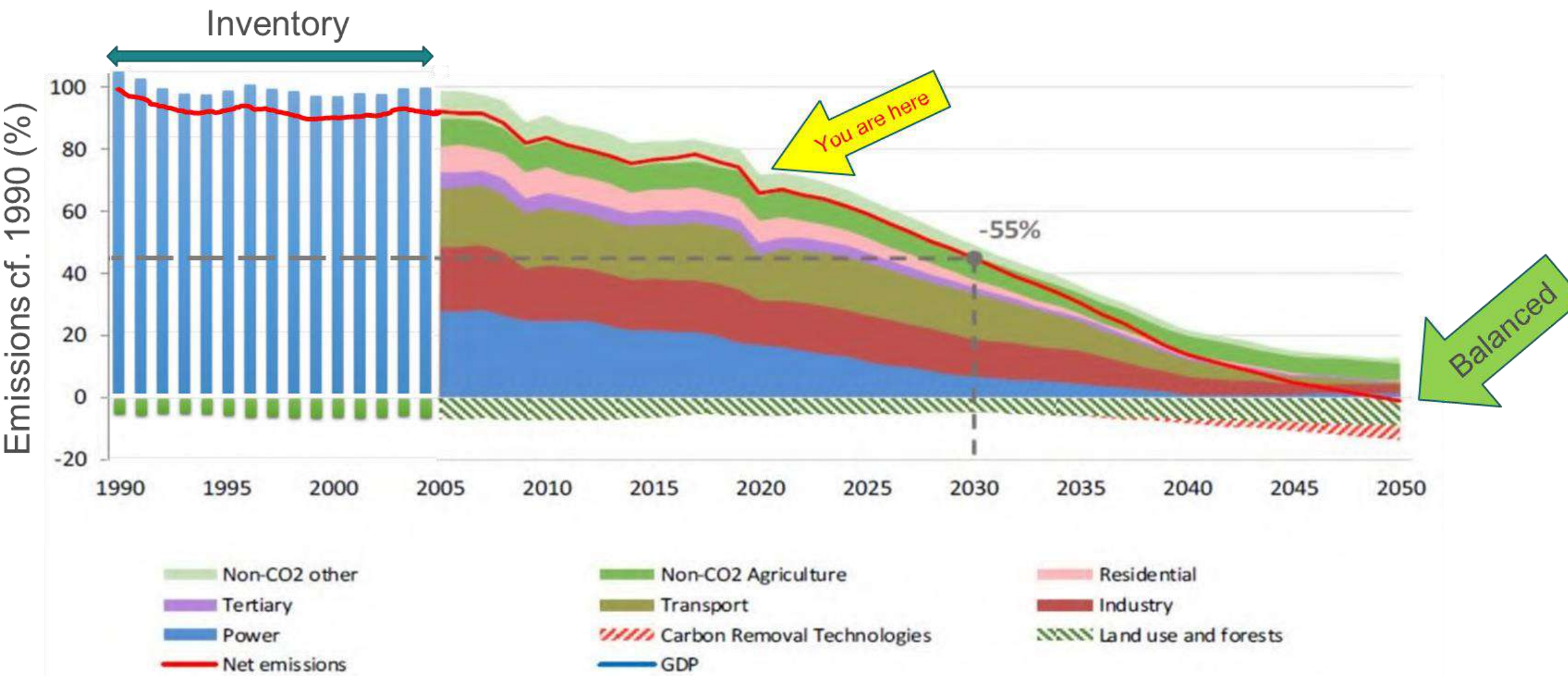


## Μακροπρόθεσμη Στρατηγική για Ανάπτυξη με Χαμηλές Εκπομπές (2022)



Επίτευξη κλιματικής ουδετερότητας μέσω

- Περαιτέρω εφαρμογή υφιστάμενων πολιτικών
- Συμπερίληψη νέων τεχνολογιών



# Συμπέρασμα

- Ανάγκη για καινοτόμες λύσεις/εφαρμογές τόσο για επίτευξη του εθνικού στόχου για το 2030, όσο και για επίτευξη κλιματικής ουδετερότητας το 2050.
- Το υδρογόνο προσφέρει πολύ μεγάλο δυναμικό μείωσης εκπομπών, ωστόσο αυτή τη στιγμή υπάρχουν σημαντικές προκλήσεις στην αδειοδότηση, υποδομές και αξιοποίησή του στην Κύπρο
- Υπάρχουν αρκετές ευκαιρίες και εργαλεία χρηματοδότησης της τεχνολογίας του υδρογόνου
- Στα πλαίσια διαμόρφωσης του τελικού σχεδίου για την Ενέργεια και το Κλίμα 2021-2030 μέχρι το Ιούνιο 2024, θα ληφθούν πολύ σοβαρά υπόψη εισηγήσεις για αξιοποίηση της τεχνολογίας

# ΕΥΧΑΡΙΣΤΩ

Δρ. Θεοδουλος Μεσημέρης

ΤΜΗΜΑ ΠΕΡΙΒΑΛΛΟΝΤΟΣ

[tmesimeris@environment.moa.gov.cy](mailto:tmesimeris@environment.moa.gov.cy) | 22408948





# Ms. Anthi Charalambous & Dr. Chryso Sotiriou, ideopsis Ltd

## Funding opportunities and prospects for Green Hydrogen in Cyprus

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# Funding Opportunities and Prospects for Green Hydrogen in Cyprus

Dr. Chryso Sotiriou, Energy Policy & Climate Change Senior Expert, ideopsis ltd

INFORMATIVE DAY: GREEN HYDROGEN IN CYPRUS

15 September 2023



# Cyprus on the Map of Innovation



Co-funded by  
the European Union

The GreenH2CY project is Co-funded by  
the European Union.

The Innovation Fund is 100% funded by  
the EU Emissions Trading System.



Decarbonising the transport sector in  
Cyprus.

01. COORDINATOR

**KETONIS HOLDINGS LTD**  
(Ketonis H.)



02. BENEFICIARIES

**MCK. FUTURE FUELS LTD**  
(Future Fuels)





# EU funding

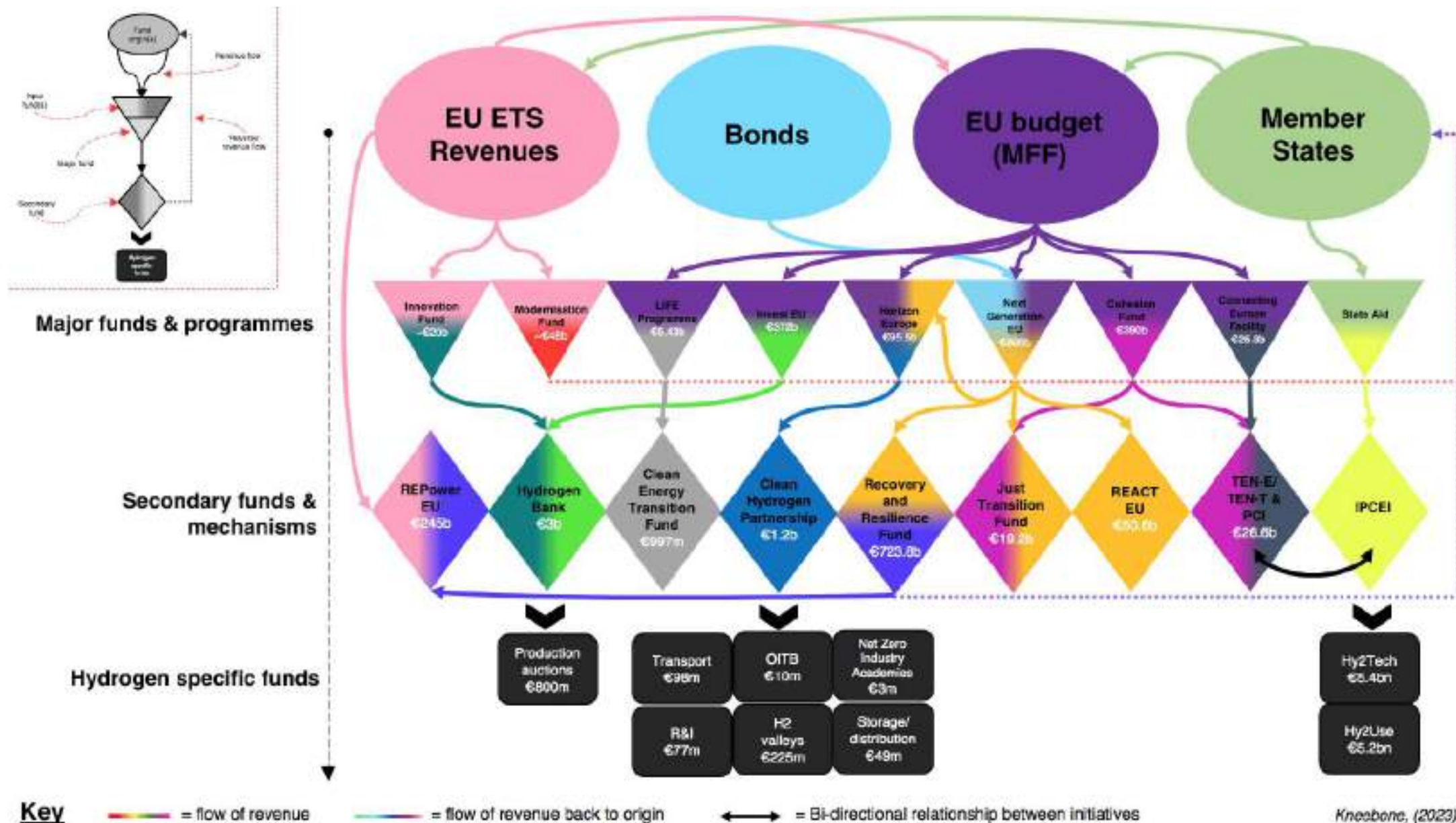
*Keyword: hydrogen*

# EU funding programmes and funds 2021-2027

*Keyword: hydrogen*

- 1 Connecting Europe Facility - Energy
- 2 Connecting Europe Facility – Transport
- 3 Cohesion Fund
- 4 Horizon Europe
- 5 Innovation Fund
- 6 InvestEU
- 7 Just Transition Fund
- 8 LIFE programme
- 9 Modernisation Fund
- 10 Recovery and Resilience Facility

# Hydrogen funding flows in the European Union 2023





# Financing your hydrogen activity

# Exploring the available funds



**Identify** the relevant programmes and funds



**Check out** the main elements of the programmes and funds identified



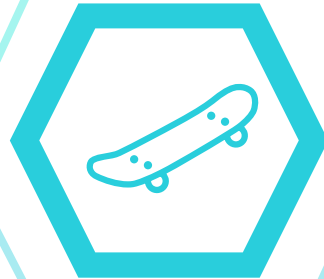
**Explore** in-depth the programmes and funds of most interest



# I Identify the relevant programmes and funds



Who you are

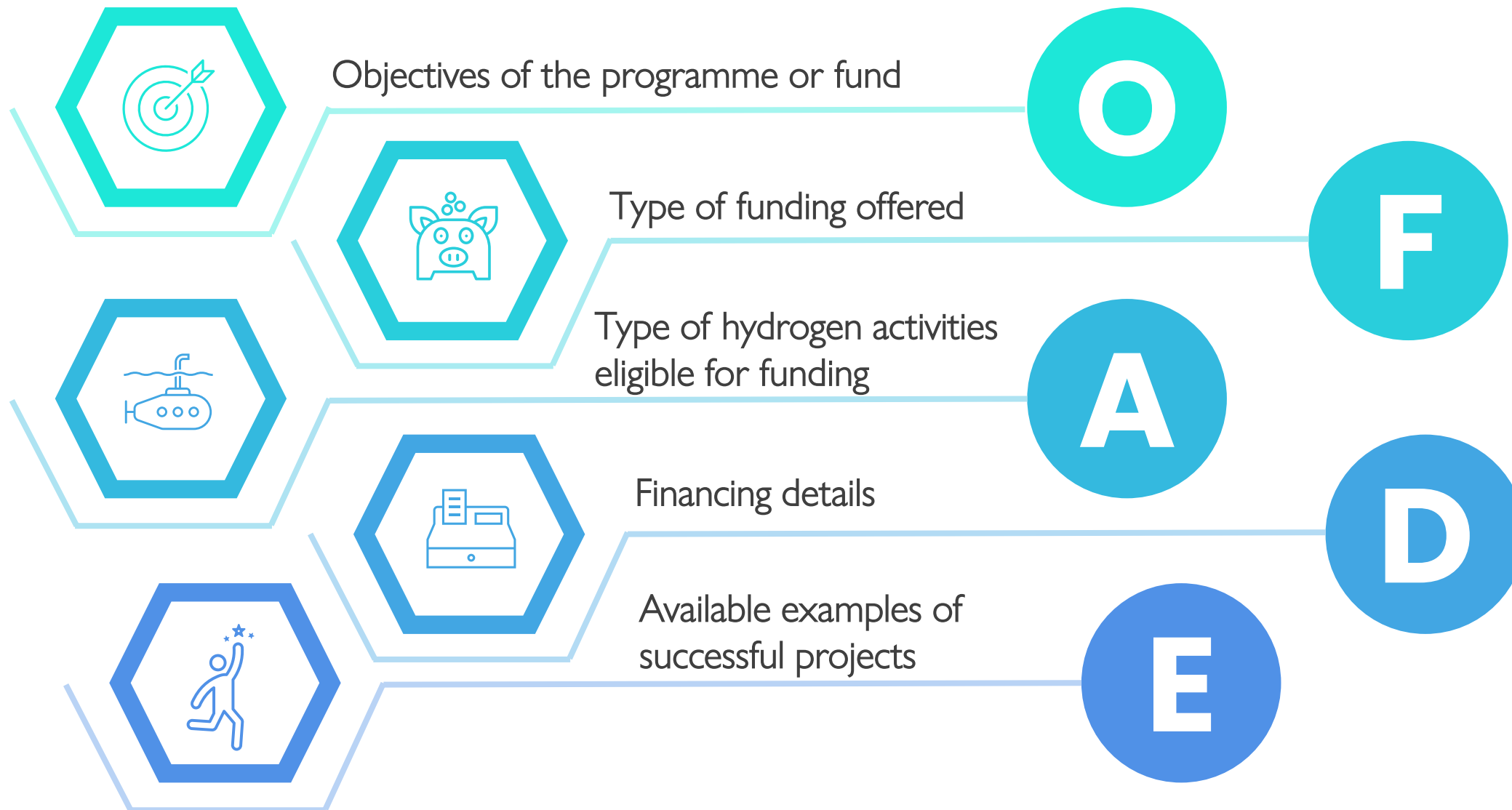


What type of activity you seek funding for



Which kind of funding you are looking for



**C****Check out the main elements of the programmes and funds identified**

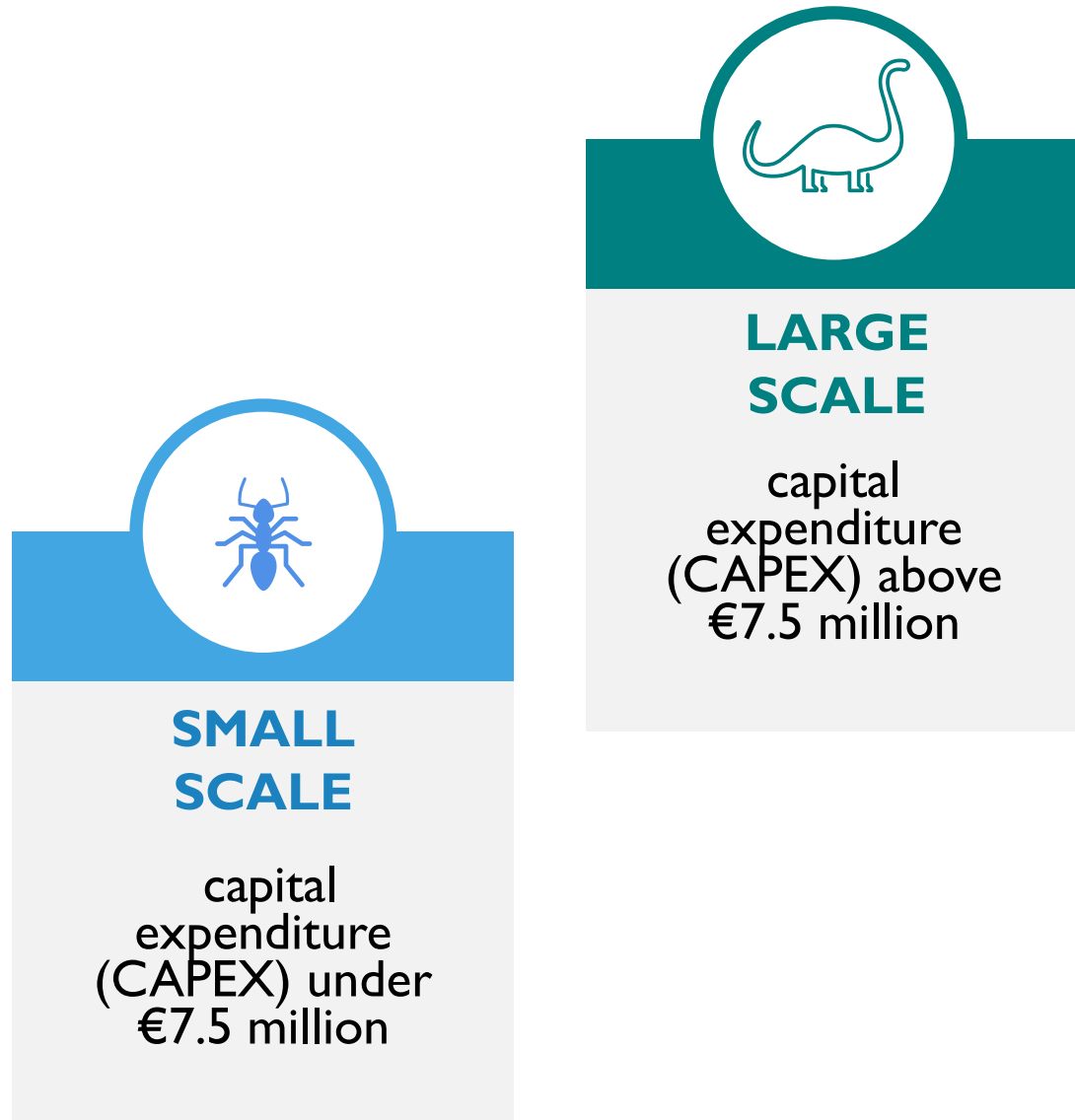
# Award procedure

Each project proposal is scrutinised before funding is granted.

1. Eligibility and exclusion criteria
2. Selection criteria
3. Award criteria
4. Award proposal




# **Innovation Fund in a Nutshell**



The Innovation Fund supports up to 60% of relevant costs of projects.

Relevant costs for small-scale projects are defined as the project's capital expenditure (CAPEX).

Relevant costs for large-scale projects are the net extra costs (CAPEX and OPEX) linked to the implementation during the 10 years after project's entry into operation.

Sufficiently mature projects in terms of  planning, business model as well as financial and legal structure.

## AWARD CRITERIA



### **Degree of innovation**

Innovation beyond  
state of the art at  
European and  
National level



### **GHG emission avoidance potential**

- Absolute emissions avoidance
- Relative emissions avoidance
- Quality and credibility of the calculation and minimum requirements



## Project maturity

- Technical maturity
- Financial maturity
- Operational maturity

Most critical criterion has been Project Maturity (Financial Maturity in particular)

## AWARD CRITERIA



## Scalability

- Scalability in terms of efficiency gains
- Scalability in terms of further technology or solutions deployment
- Quality and extent of the knowledge sharing



## Cost-efficiency

- Cost efficiency ratio (i.e., the EU contribution requested per tCO<sub>2</sub> avoided)
- Quality and credibility of the cost calculation



# Prospect of Hydrogen in Cyprus



# Accelerating the roll-out of renewable hydrogen

Project titled «Support REPowerEU, Country Report Cyprus» funded by the EU via the Technical Support Instrument

## Sectors

**High-T industries:** ceramics, cement, aluminium extrusion and processing, copper mining

**Medium-T industries:** publishing and printing, paper, plastic, textiles, food

**Buildings:** heating and cooling

**Road transportation:** passenger cars, buses, heavy-duty road transport

Airports and aviation

Shipping

Exports

## SCENARIOS

**Cautious:** Hydrogen is introduced usually at a later stage, and in sectors where it is projected to help with decarbonisation.

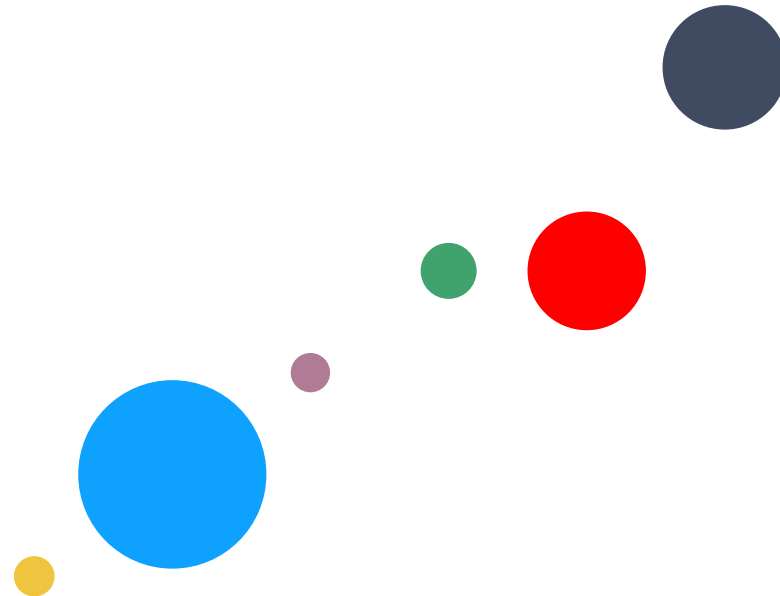
**Aggressive:** Hydrogen is seen as a primary decarbonisation option from early on, and its adoption is accelerated earlier and in more depth.

# Accelerating the roll-out of renewable hydrogen

Project titled «Support REPowerEU, Country Report Cyprus» funded by the EU via the Technical Support Instrument

## H2 demand by 2030 in the Aggressive Scenario

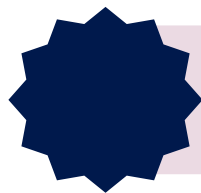
- Ceramics
- Cement
- Shipping / Ammonia
- Public Transportation
- Freight Road Transport
- E-Fuels & Aviation
- Export



End use	2030 (MWh)	2050 (MWh)
Ceramics	-	46,101
Cement	69,151	270,843
Shipping / Ammonia	1,507,850	7,799,822
Public Transportation	66,262	-
Freight Road Transport	132,449	474,161
E-Fuels & Aviation	597,800	3,416,003
Export	660,000	3,300,000

# Accelerating the roll-out of renewable hydrogen

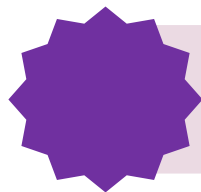
Project titled «Support REPowerEU, Country Report Cyprus» funded by the EU via the Technical Support Instrument



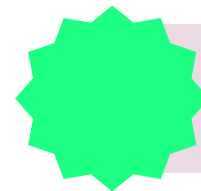
Cement industry, covering up to 10% of its energy needs if the infrastructure is available by 2030, and up to half of its energy needs by 2050.



Bricks and tiles (ceramics) industry after 2030.



Trucks and buses, accounting for about 4% of total energy consumption in road transport and up to over 15% in 2050.



Shipping and aviation, covering a very small fraction of fuel demand by 2030 and most of the fuel demand by 2050 (ammonia for shipping and e-kerosene for aviation).

# H2 Valley

## CY H2 VALLEY GROWTH VISION





# Thank you

[www.ideopsis.com](http://www.ideopsis.com)





## Dr. Efthymiou Venizelos, University of Cyprus “FOSS Research Centre”, Energy Sustainability Challenges

### Gold Sponsors



HELLENIC BANK



### Silver Sponsors



### Bronze Sponsors



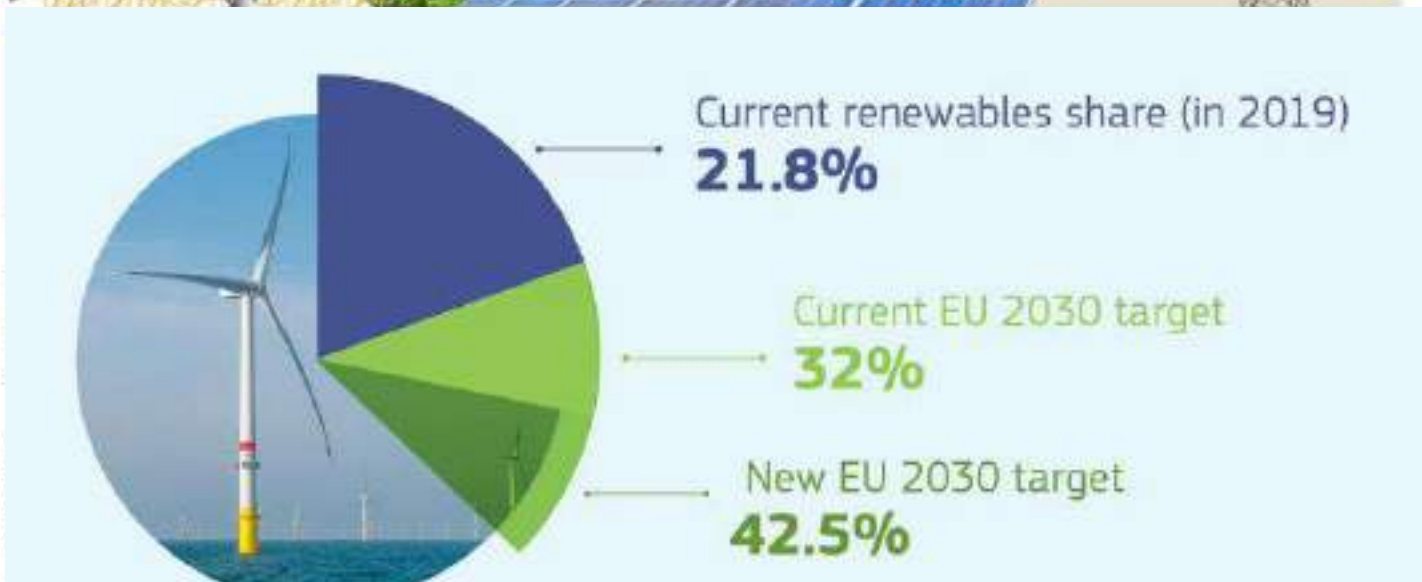
# Green Hydrogen in Cyprus

## Energy Sustainability

Dr Venizelos Efthymiou  
[Efthymiou.Venizelos@ucy.ac.cy](mailto:Efthymiou.Venizelos@ucy.ac.cy)



# Cleaning our energy system

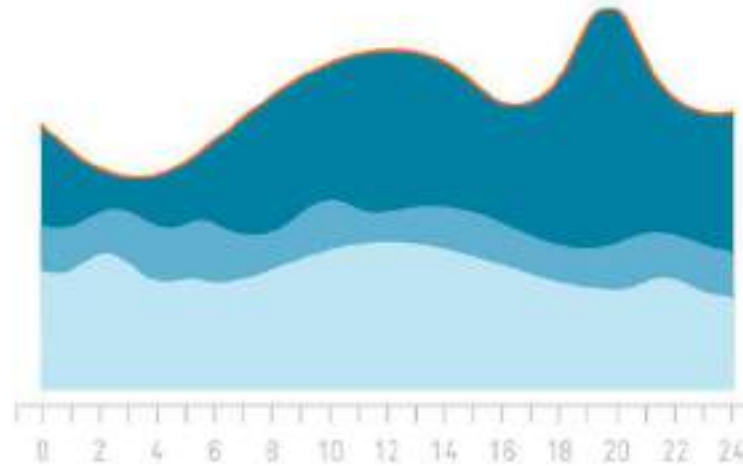


**The European Commission is proposing to cut net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels, up from our current target for 2030 of at least 40%.**

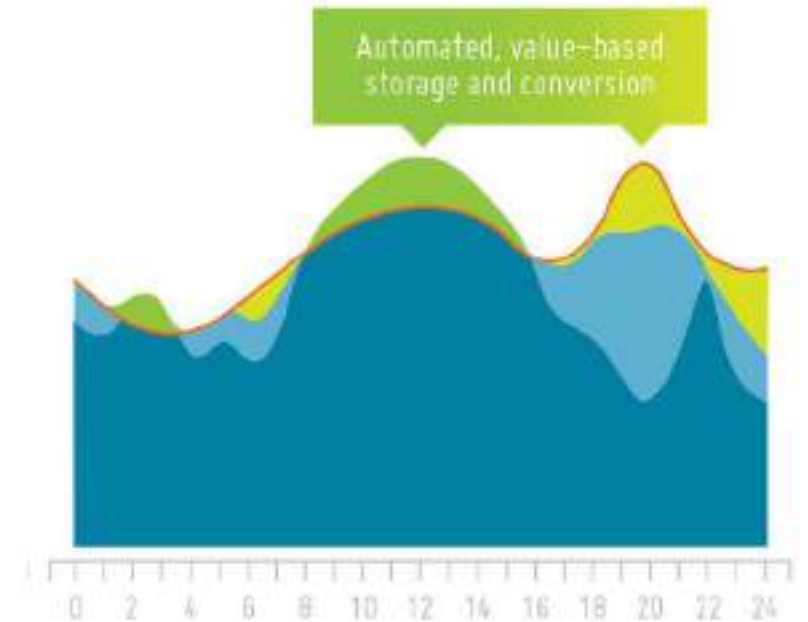


# Outcomes of the daily electricity market

A day in the past



A day in the future

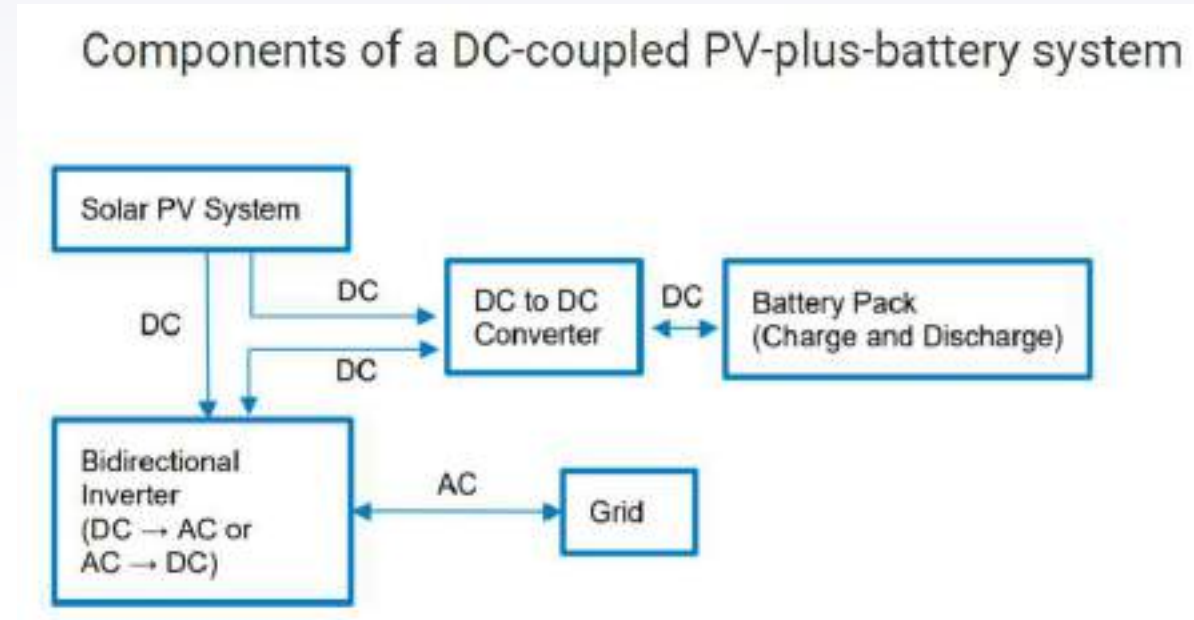


- Dispatchable non-renewable (nuclear, coal, gas, oil-fired power plants)
- Dispatchable renewable (biomass, hydro dams...)
- Variable renewables (wind, solar, hydro run of river...)
- Demand

This figure is provided for illustration purposes only: ratios between the different types of energy source not necessarily corresponding to the EU case; the demand profile should also be different in the future because of demand response measures that should be broadly implemented and possibly the massive roll-out of electric vehicles (EVs).

# DC coupled PV plus battery system

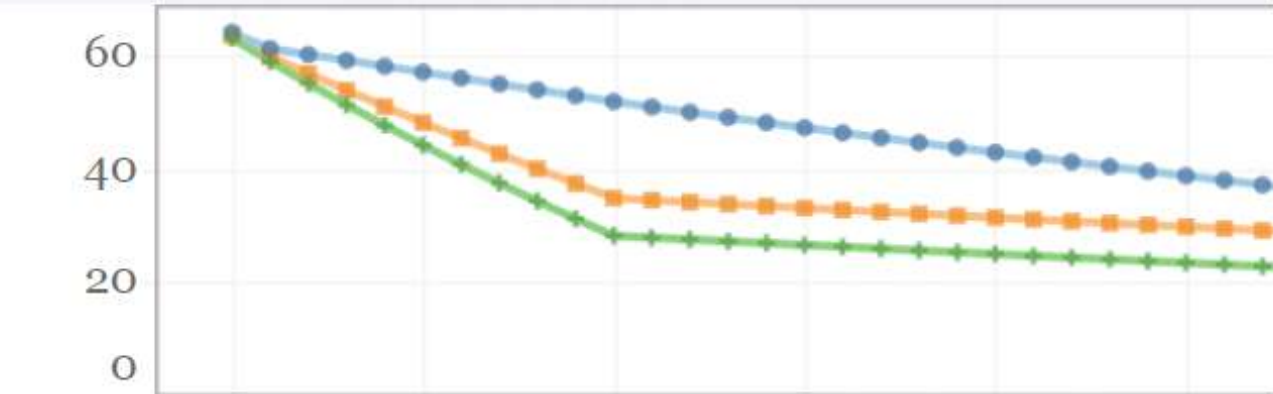
- The utility-scale PV-plus-battery technology represents a DC-coupled system in which one-axis tracking PV and 4-hour lithium-ion battery storage share a single bidirectional inverter.
- The PV-plus-battery technology is represented as having a 130-MW PV array, a 71.5-MW battery (with 4-hour duration), and a shared 100-MW inverter.
- The PV component has a DC-to-AC ratio (or inverter loading ratio [ILR]) of 1.3, which is slightly larger than that assumed for utility-scale PV (1.28) in the 2022 ATB.
- After accounting for state-of-charge and roundtrip efficiency constraints, the oversized battery component allows for 55-MW of usable stored power (or 220 MWh of usable stored energy).



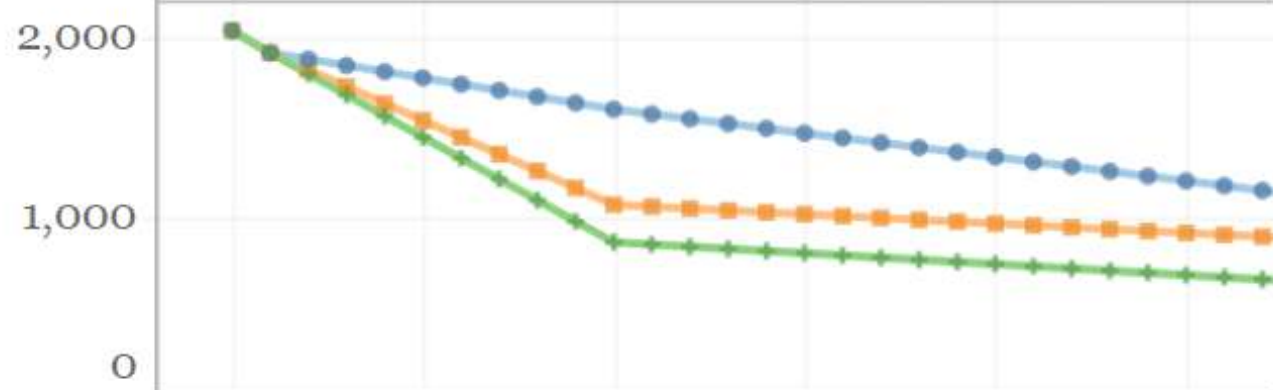
## Utility-Scale PV-Plus-Battery

R&D

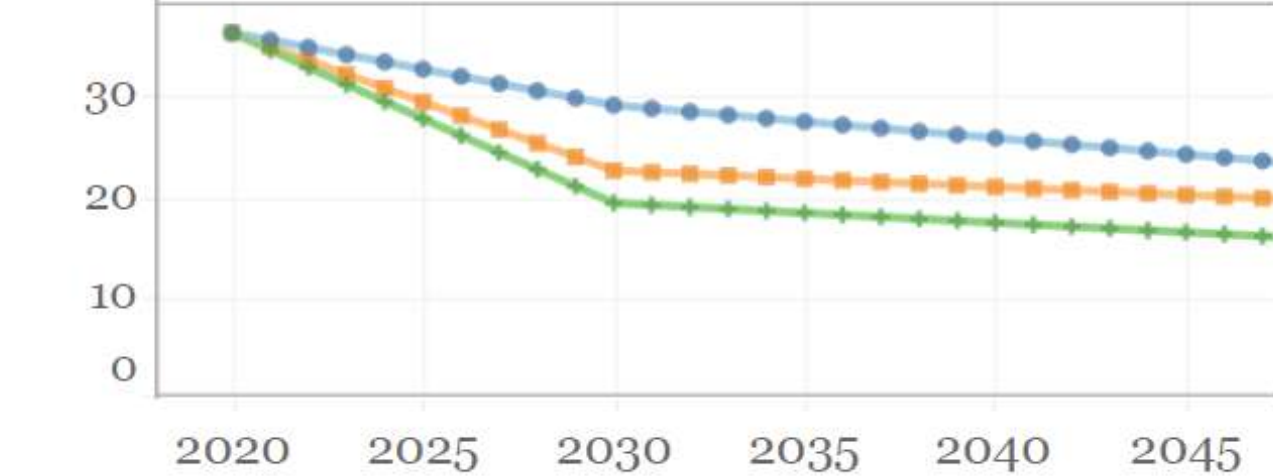
LCOE  
(\$/MWh)



CAPEX  
(\$/kW)

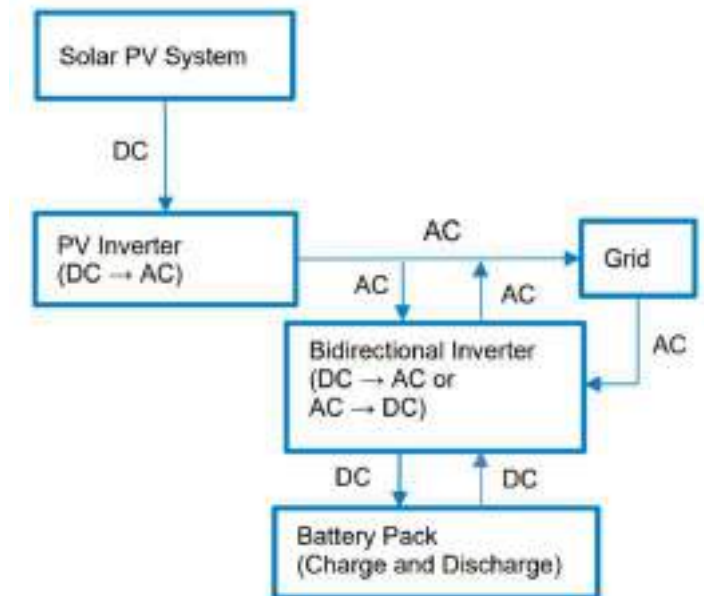


Fixed  
O&M  
(\$/KW-yr)



# Utility-Scale PV-Plus-Battery

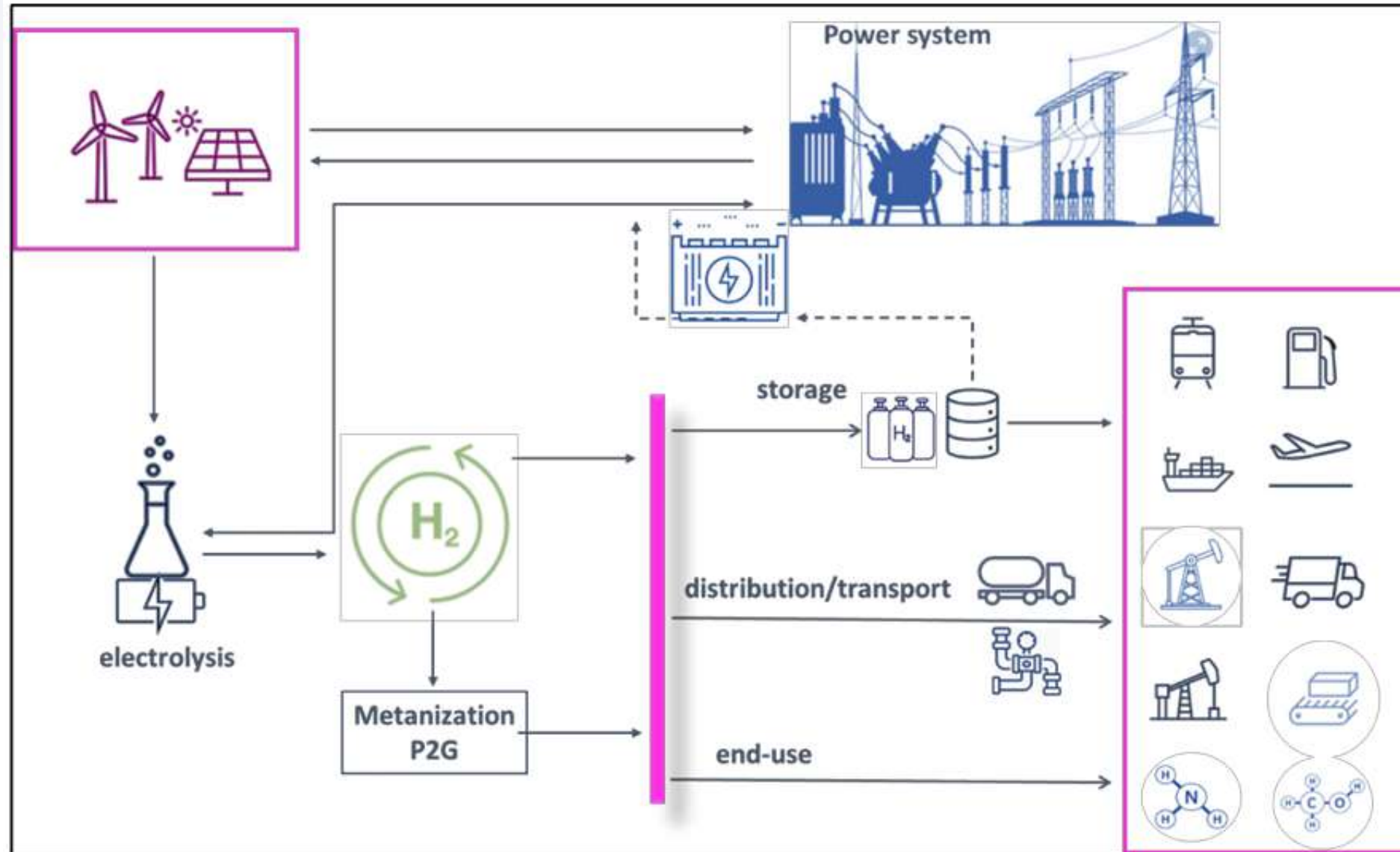
Components of an AC-coupled PV-plus-battery system



# The hydrogen economy

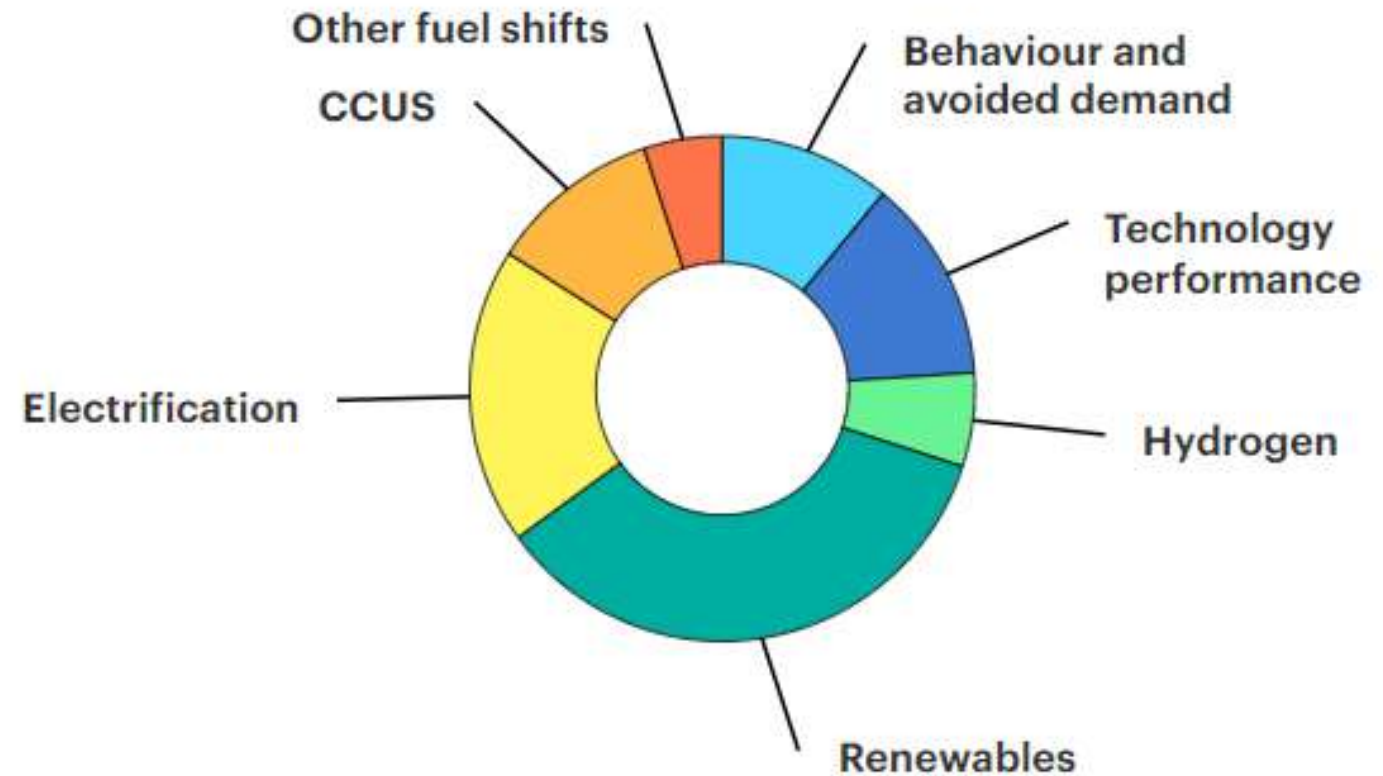
A simplified diagram of the hydrogen economy taking into account the Power to Gas (P2G) technology, assuming the production of hydrogen from renewable energy sources

Ref: Raport DISE/PSEW, Zielony wodór z OZE w Polsce, October 2021.



# Hydrogen is an increasingly important piece of the net zero emissions by 2050 puzzle

- ▶ The key pillars of decarbonising the global energy system are energy efficiency, behavioural change, electrification, renewables, hydrogen and hydrogen-based fuels, and CCUS. The importance of hydrogen in the Net zero Emissions Scenario is reflected in its increasing share in cumulative emission reductions. Strong hydrogen demand growth and the adoption of cleaner technologies for its production thus enable hydrogen and hydrogen based fuels to play a significant contribution in the Net Zero Emissions Scenario to decarbonise sectors where emissions are hard to abate, such as heavy industry and long distance transport.



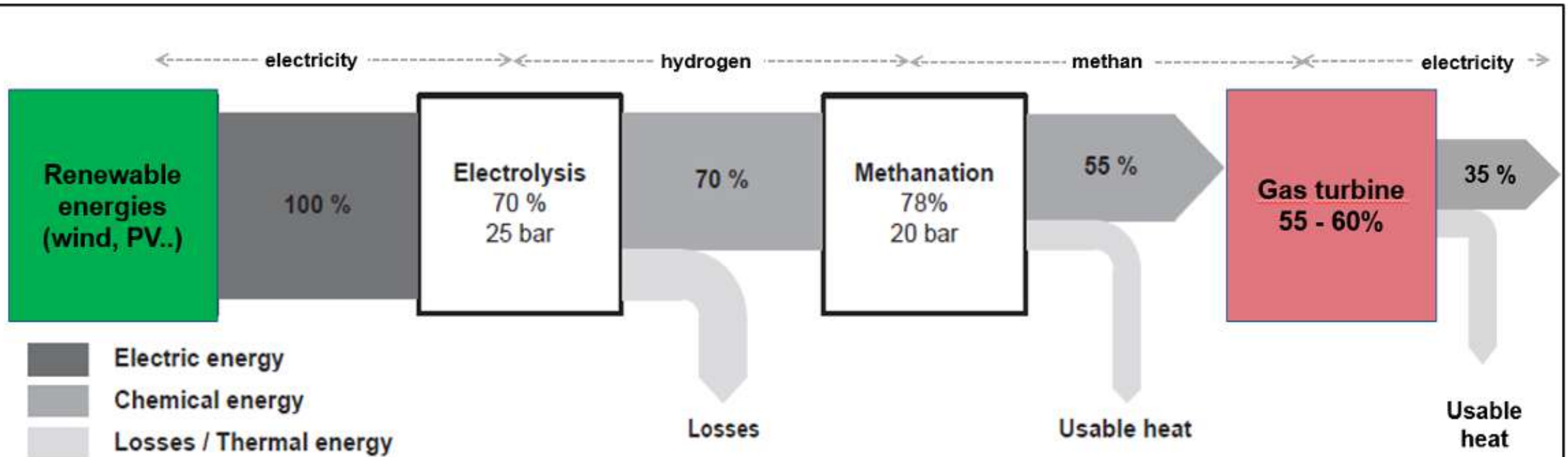
Ref: <https://www.iea.org/energy-system/low-emission-fuels/hydrogen>

# Flexibility options in the integrated grid

## Multiple energy conversions and associated losses

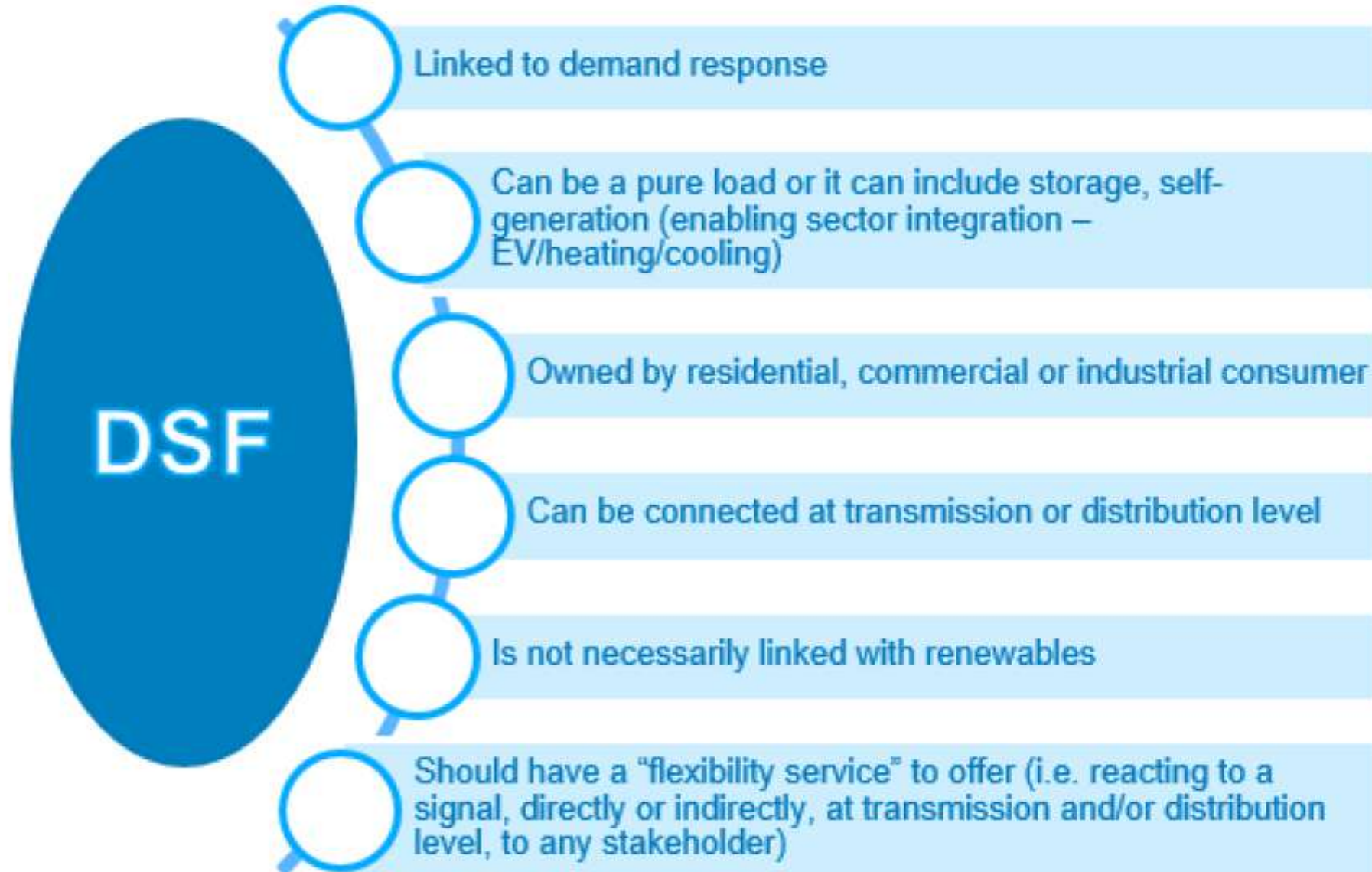
(Source: Hitachi Energy)

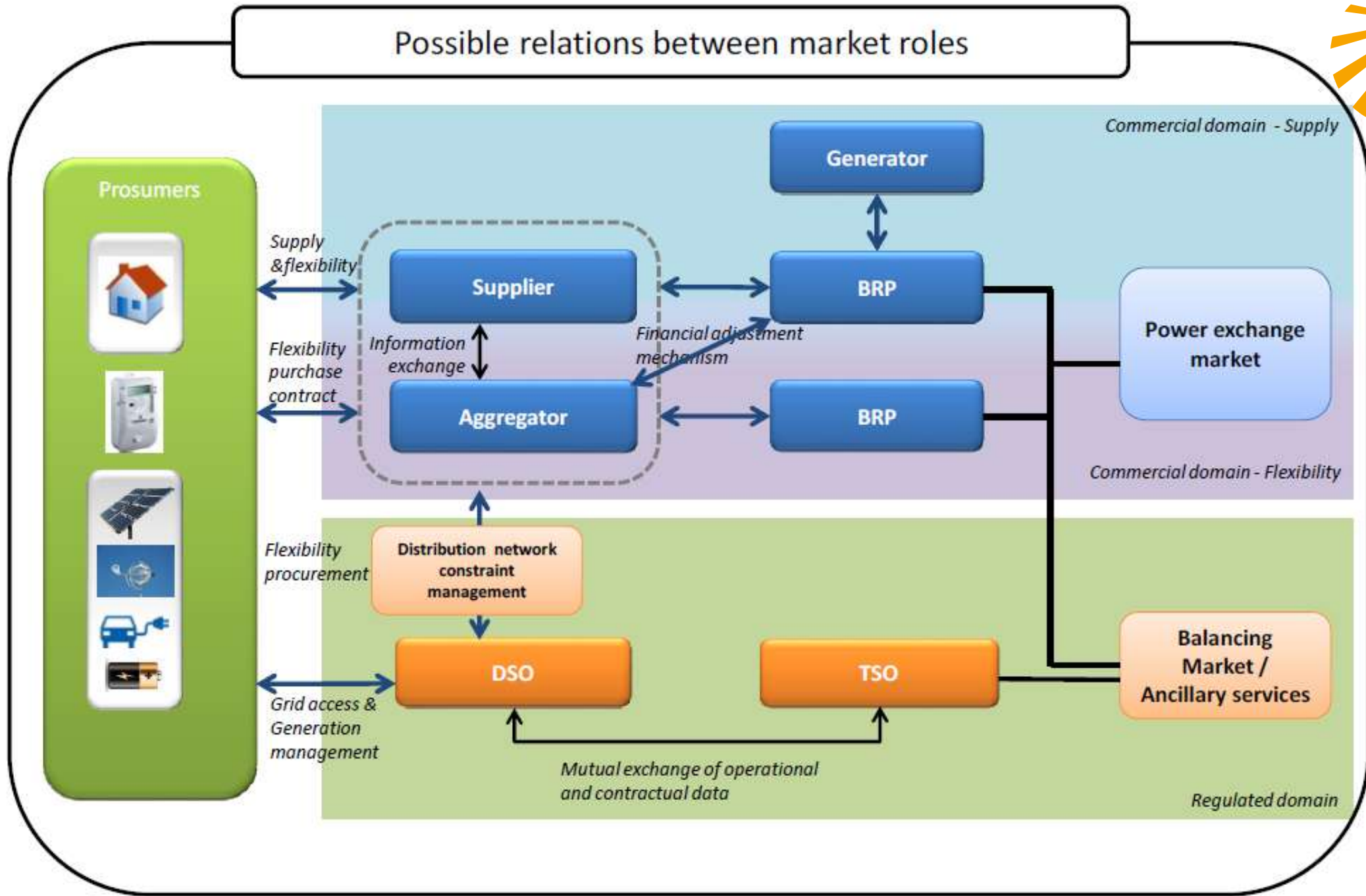
The power-to-X concept is basically a solution for absorbing/storing “excess” electricity (which cannot be directly used or stored in this clean form). Any conversion is associated/followed by energy losses.



If a double conversion is used (P2G + G2P), the overall electric efficiency is less than 35% (55% Methanation efficiency x 55%-60% CCGT efficiency).

# Demand Side Flexibility



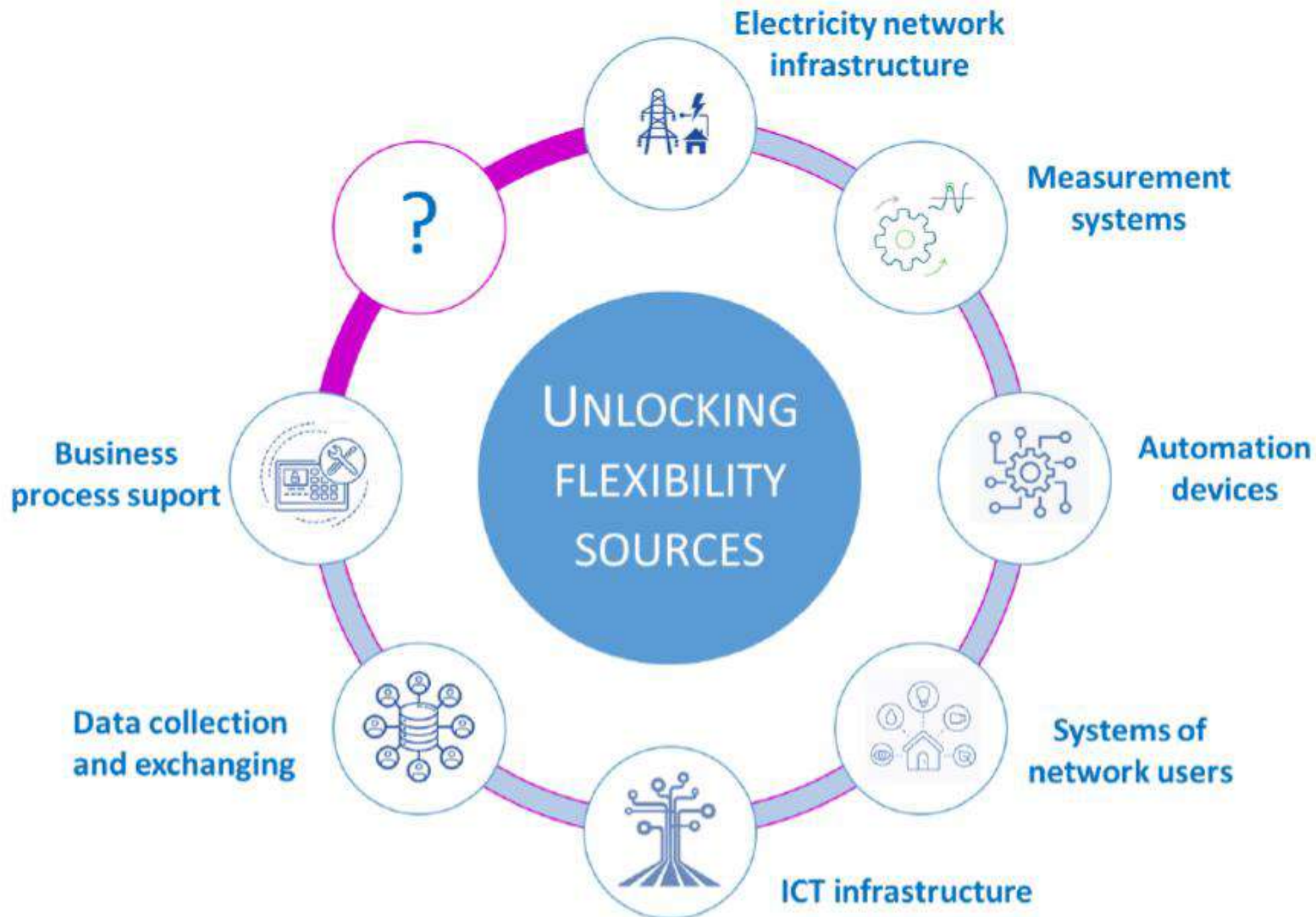


**Source:  
EG3  
Report**

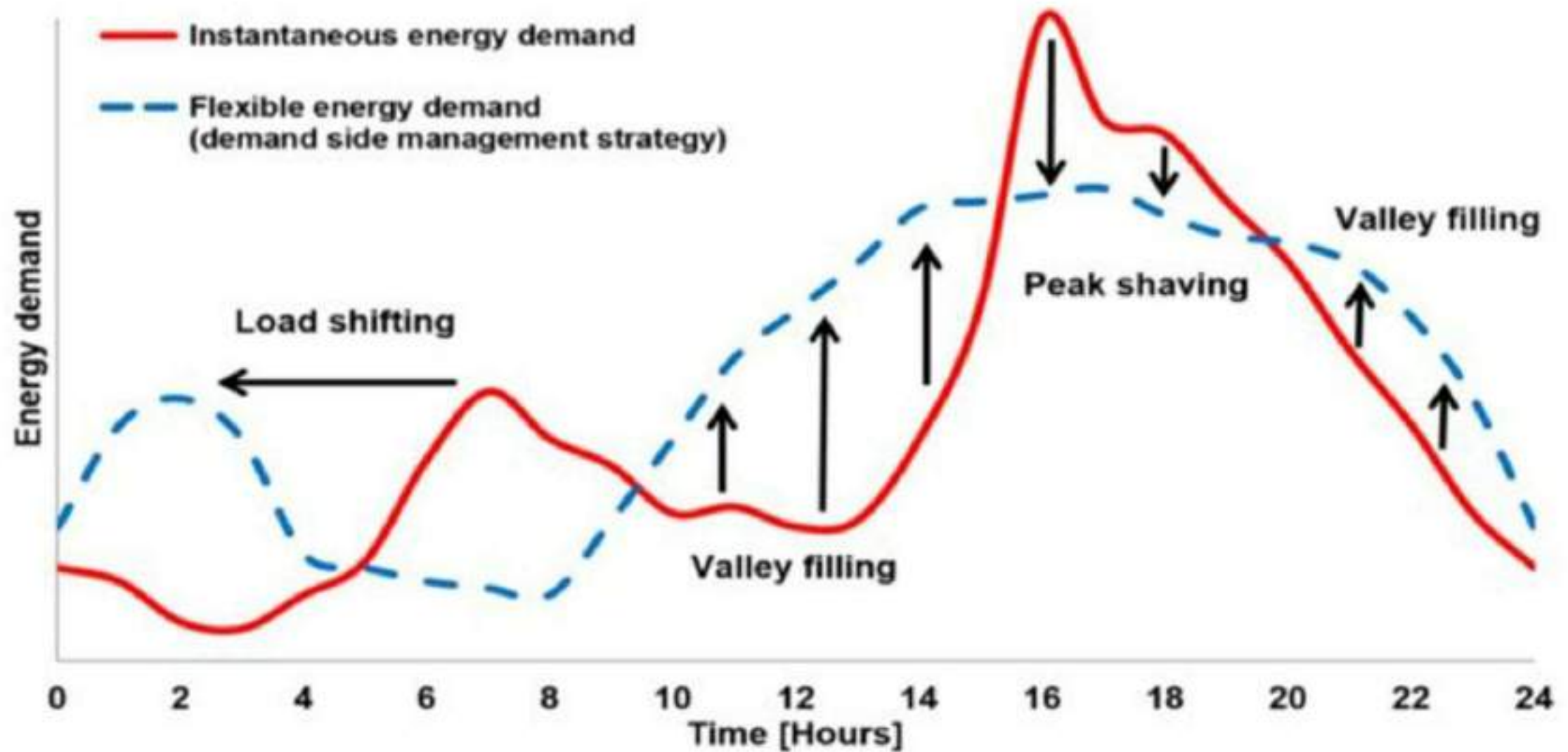


# Key Enablers

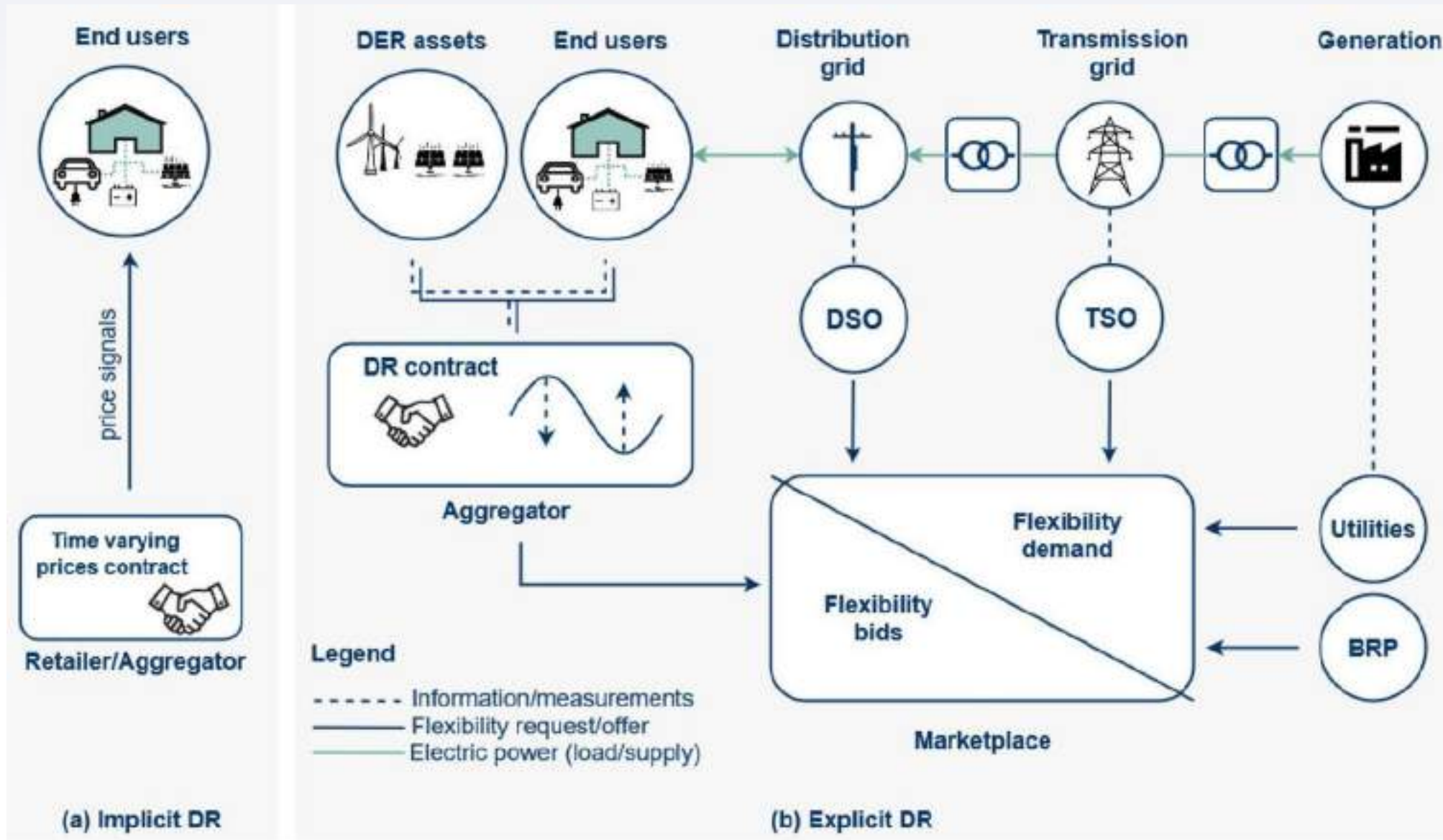
- ▶ At present, some of the required services cannot be offered by providers without the presence of enablers. A wide range of enablers can be implemented to encourage/facilitate participation in the market for flexibility services:
  - ▶ Regulation & codes
  - ▶ Market rules and processes
  - ▶ Grid and retail products & tariffs
  - ▶ ICT technology and standards
  - ▶ Smart appliances and smart meters



# Flexibility in support of system needs

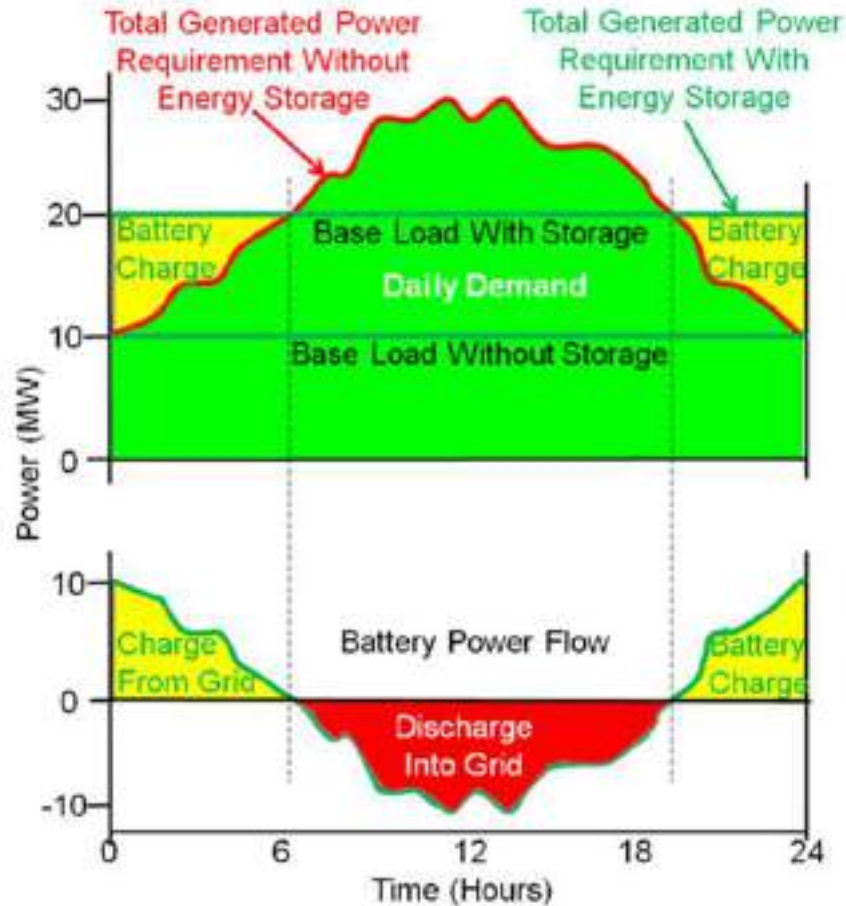


# FLEXIBILITY serving implicitly or explicitly



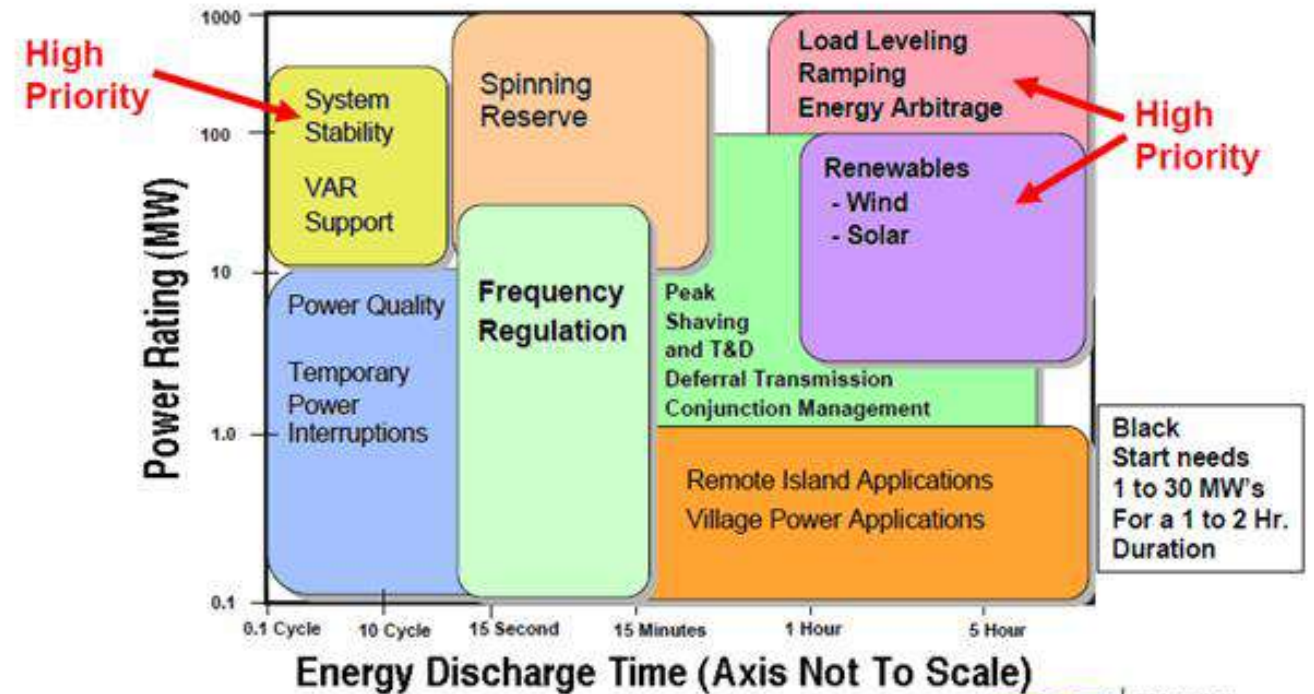
# The bi-directional nature of storage offers a wealth of flexibility but complex to regulate ...

**Load Levelling With Energy Storage**



## Electric Energy Storage Applications

(All Boundary Regions Displayed Are Approximate)



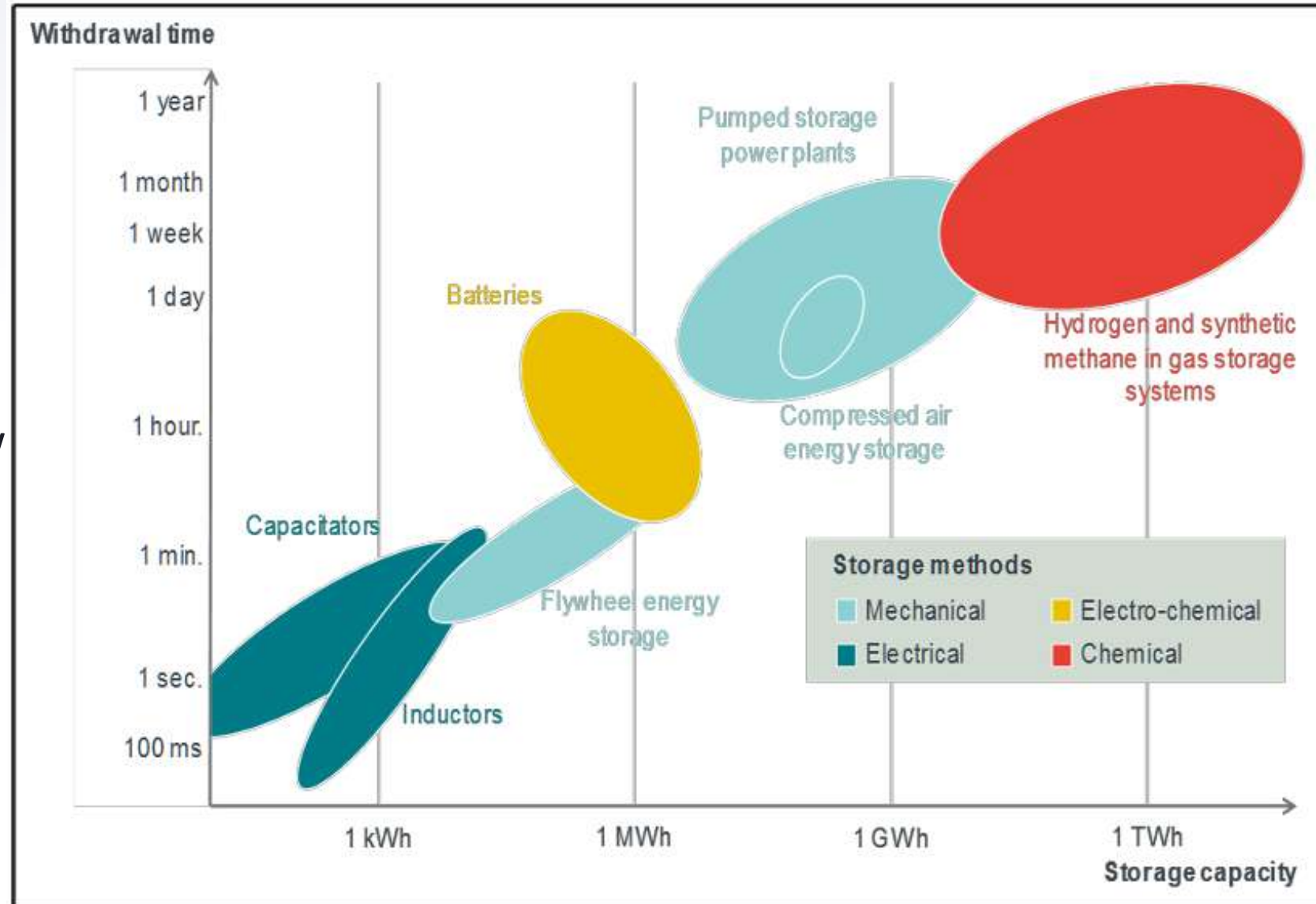
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2

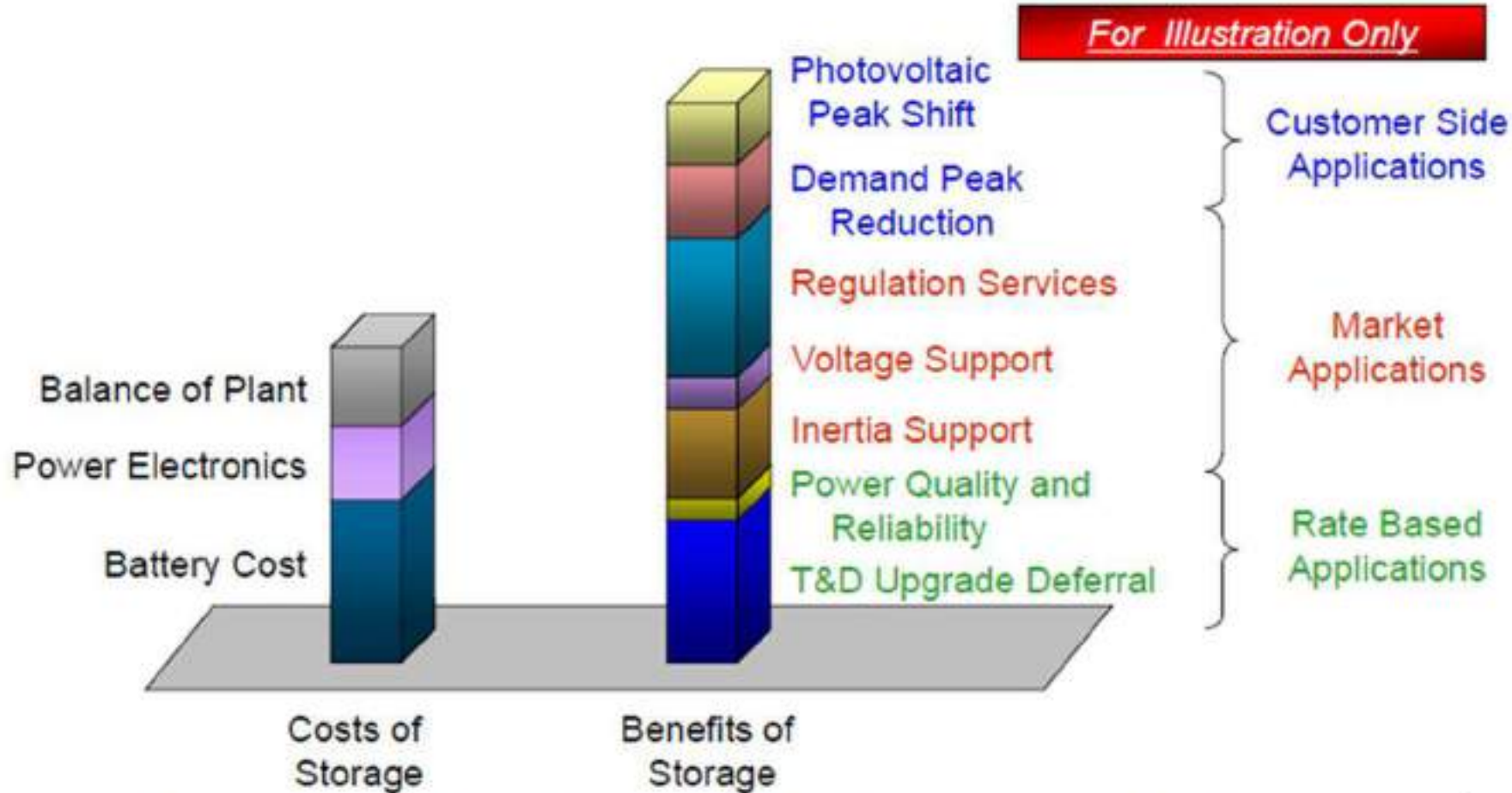
**EPRI** ELECTRIC POWER RESEARCH INSTITUTE

# Long duration flexibility options

- A plethora of technologies offering storage options that meet all operational needs of modern power systems!
- The features of hydrogen system to act as large and long duration storage show the advantages of hydrogen for complementing the other technical options, particularly valuable in the future System of Systems.



# Analyzing the Value of Storage

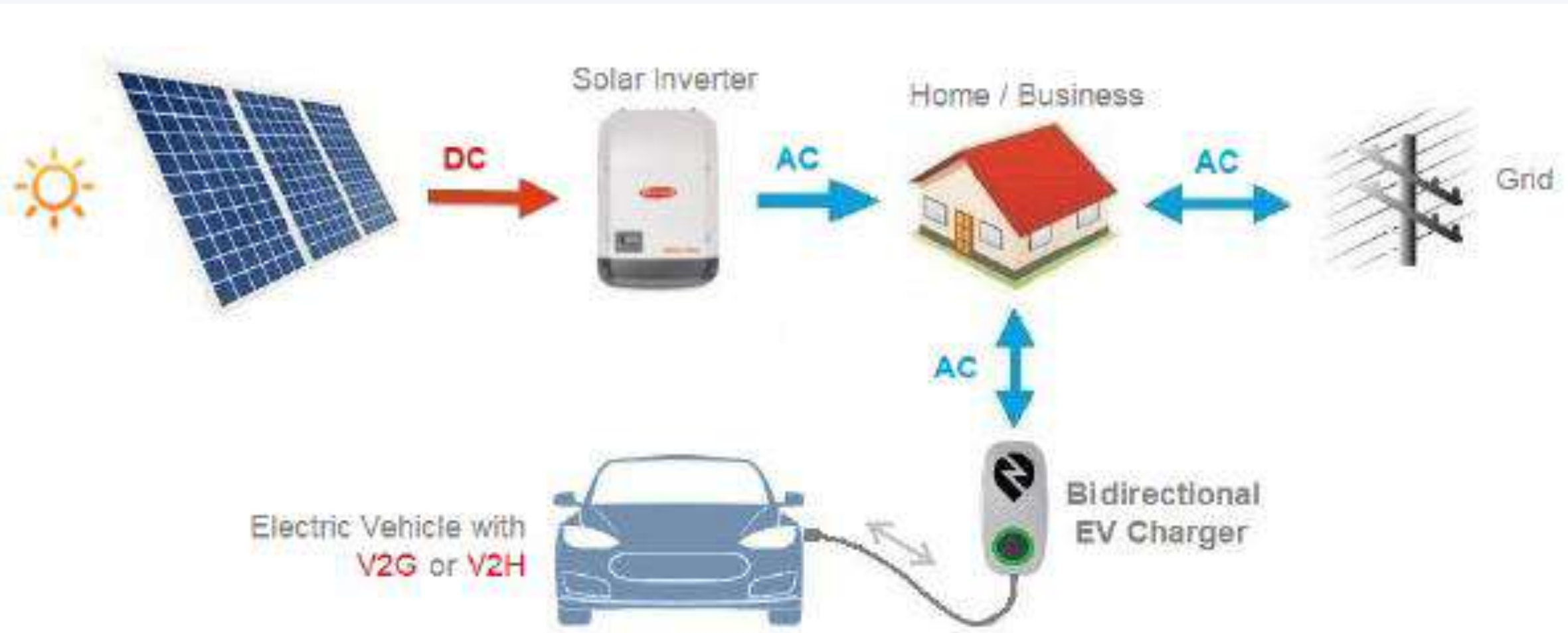


## Storage is fundamental

It is versatile with varied characteristics coming from a synthesis of technologies, to achieve the zero emissions economy and the evolution of the 100% RES energy system.

**Using storage for multiple applications can be effective, but is highly site-dependent**

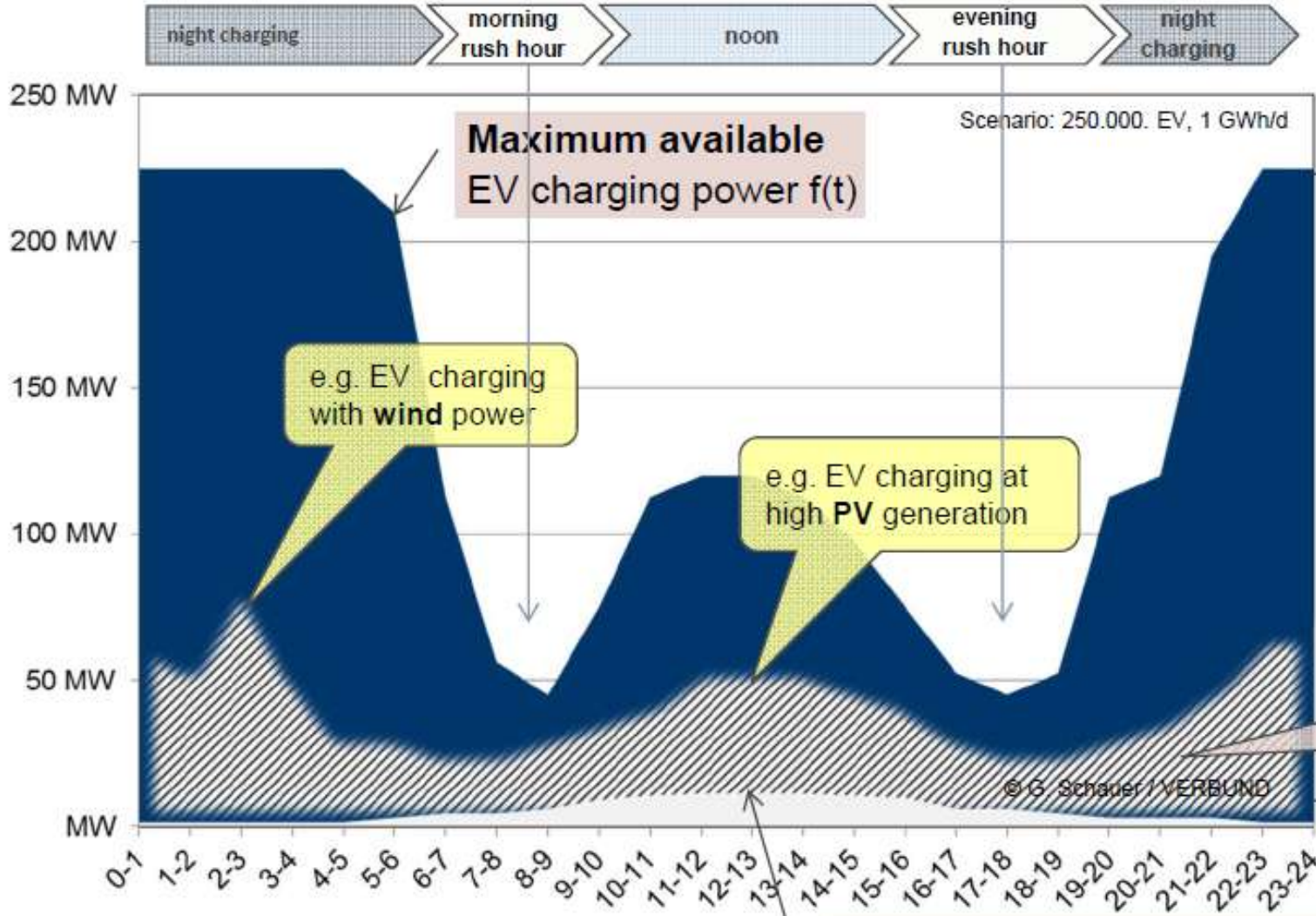
# EVs with bidirectional (two-way) charging capability can be used to power a home





# Potential Storage / charging power for 250.000 EV

(Charge on Demand, e.g. Austria 2020), frame for integration in Simulation Models



Usually bottom up aggregation of charging profiles ...

„Charging power bands“ offer flexibility for grid system operators to balance wind and PV power!

**Shaded area:** Example for load profile EV demand ~ 1 GWh/d

**Minimum required EV charging power**  
Fast charging, necessary during day

# Thank you very much!

## Questions?





## Mr. Heinz Eschner, Neuman & Esser, Electrolyser and Hydrogen Refuelling Stations

### Gold Sponsors



### Silver Sponsors



### Bronze Sponsors





**Solving The Hen And Egg Problem**

**H<sub>2</sub> Fuel Cell**

 **NEUMAN & ESSER**

# "THE GREEN HYDROGEN IN CYPRUS"

Short Company Introduction

Sector Coupling & The H<sub>2</sub> Value Chain

The Big Goal: Diesel Parity

Example: The H<sub>2</sub> Alliance for Mobility

Q&A

# NEUMAN & ESSER GROUP

Sequence of Company Owners



1830

Johann L. Neuman



J.L. Neuman & Cie.  
Maschinenfabrik in Aachen am  
Hirschgraben  
9/13/2023



## NEUMAN & ESSER

1831

Theodor Esser



# NEUMAN & ESSER GROUP

Almost 200 years experience in energy transitions



1891



Oscar Peters

1930



Wolfgang Peters

1965



Klaus Peters

seit 2008



Stefanie & Alexander Peters





# THE ROLE OF H<sub>2</sub> AS THE ENABLER OF SECTOR COUPLING NEUMAN & ESSER

## The Volatility Challenge – The Transportation Challenge

- In contrast to fossil power generation most renewable energy sources have a volatile pattern, PV is the most volatile, then onshore wind, then offshore with biomass and hydro the most stable.
- This volatility destabilizes the electric grid and can also lead to shortages and the lack of strategic reserves.
- To solve this problem a scalable energy storage with sufficient agility to be used as a grid stabilizer is required.
- Today more than 80% of the Energy comes in form of molecules and not electrons.
- The electric grid is already at its transportation limit.
- A natural gas pipeline can transport more than 30 GW of power.

# THE ROLE OF H<sub>2</sub> AS THE ENABLER OF SECTOR COUPLING NEUMAN & ESSER

Renewable Electricity & Hydrogen – The Milk & Cheese Analogy

**Whenever you can use the electricity directly & sensibly – Do it!**



Electricity is like milk with a shelf life of a few milliseconds



Hydrogen is like cheese, it stores temporal surplus energy for a long time and offers good transportation capabilities as well

# THE ROLE OF H<sub>2</sub> AS THE ENABLER OF SECTOR COUPLING NEUMAN & ESSER

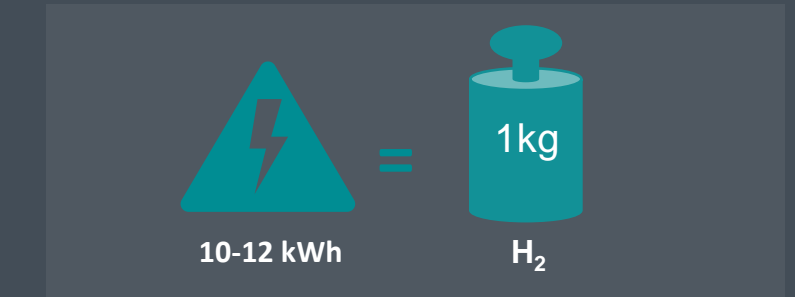
## Renewable Electricity & Hydrogen – The Milk & Cheese Analogy



CALORIFIC VALUE



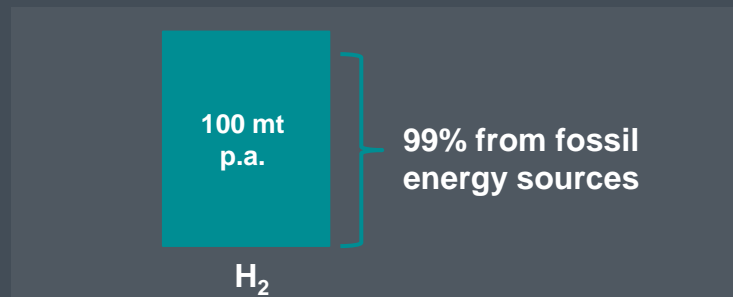
RESSOURCES



LIQUEFACTION



NATURAL GAS VS HYDROGEN

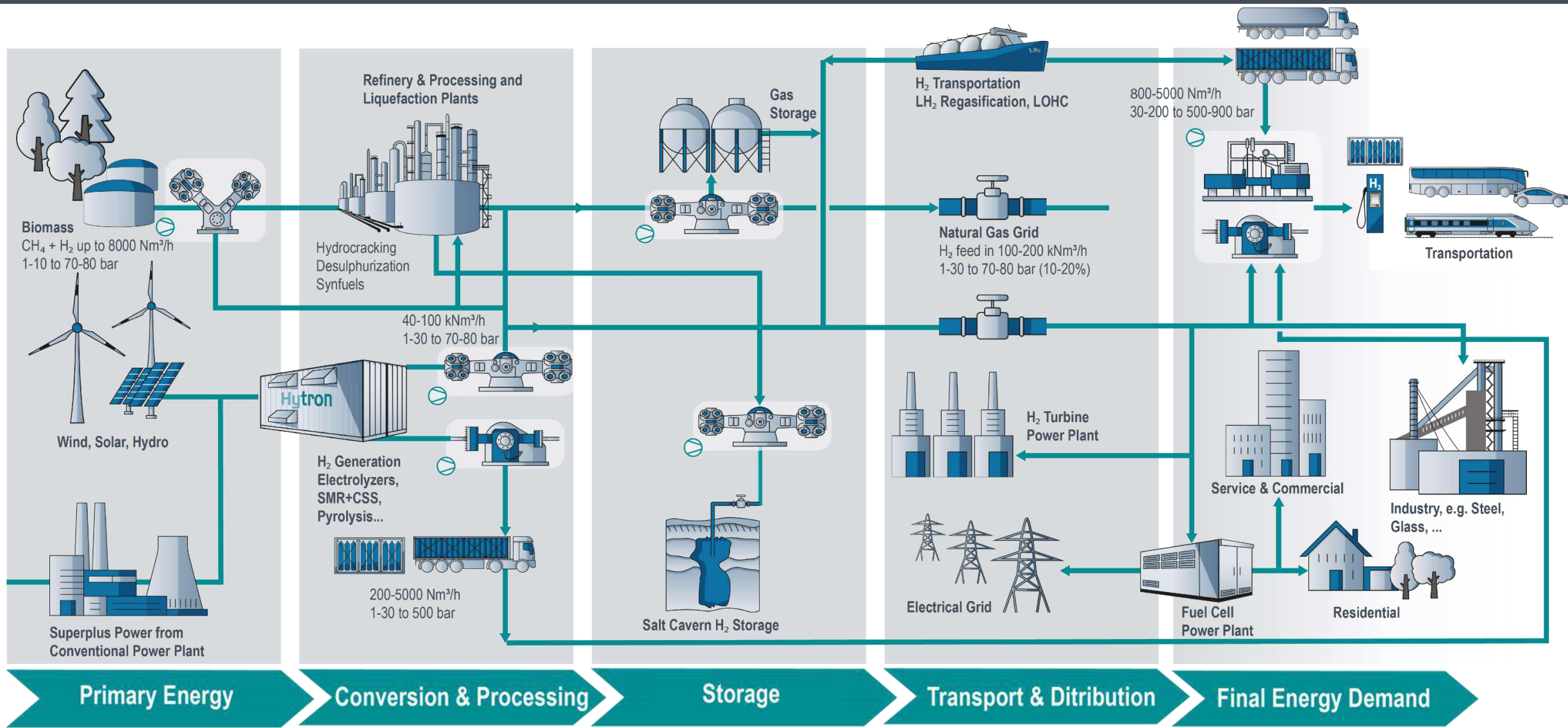


ANNUAL H<sub>2</sub> PRODUCTION



FUN FACT

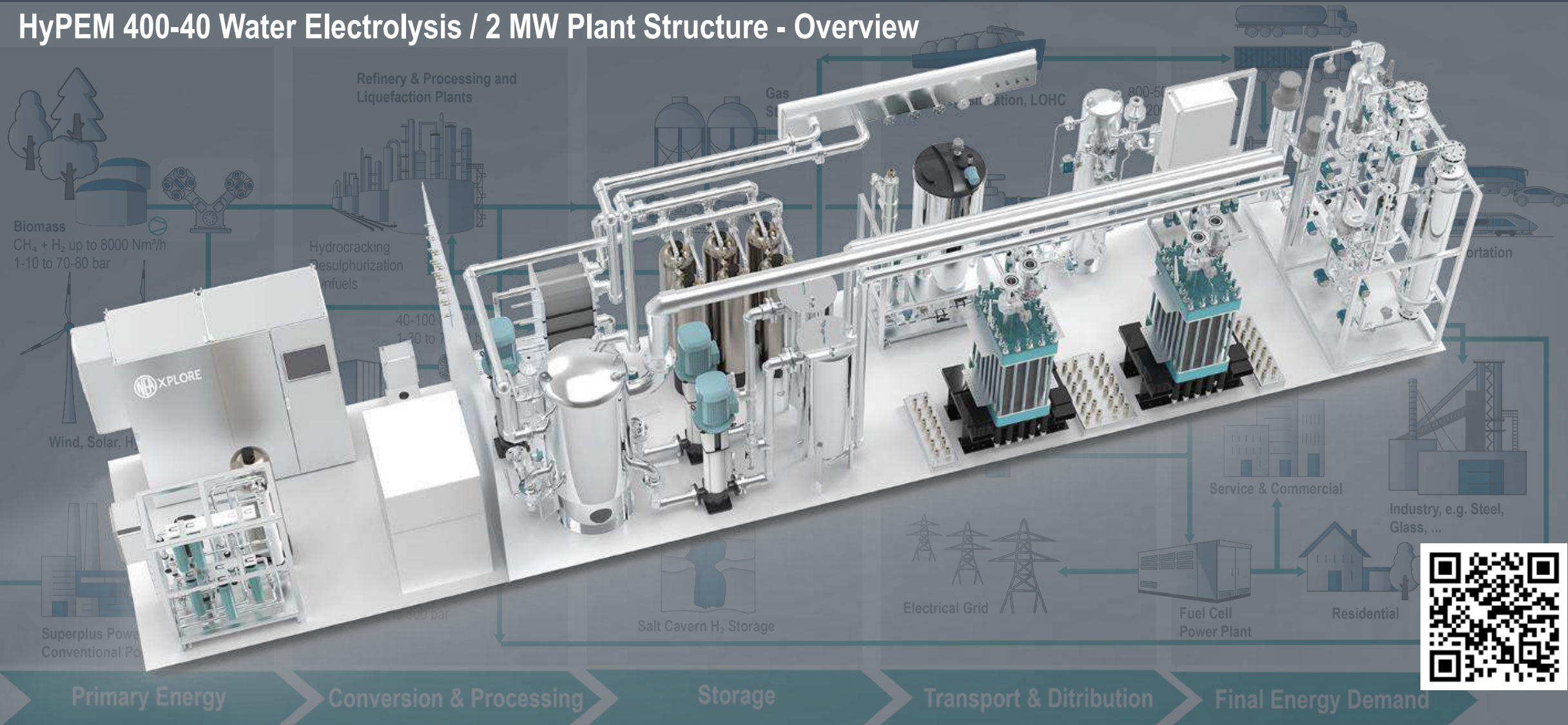
# HYDROGEN – KEYSTONE OF THE SOLUTION FOR THE VOLATILITY, STORAGE AND TRANSPORTATION CHALLENGES



# NEUMAN & ESSER – SOLUTIONS FOR H<sub>2</sub> PRODUCTION



## HyPEM 400-40 Water Electrolysis / 2 MW Plant Structure - Overview



# NEUMAN & ESSER – SOLUTIONS FOR H<sub>2</sub> PRODUCTION



## NEA BRASIL & HYTRON: 40' Container – ELECTROLYZER PACKAGE



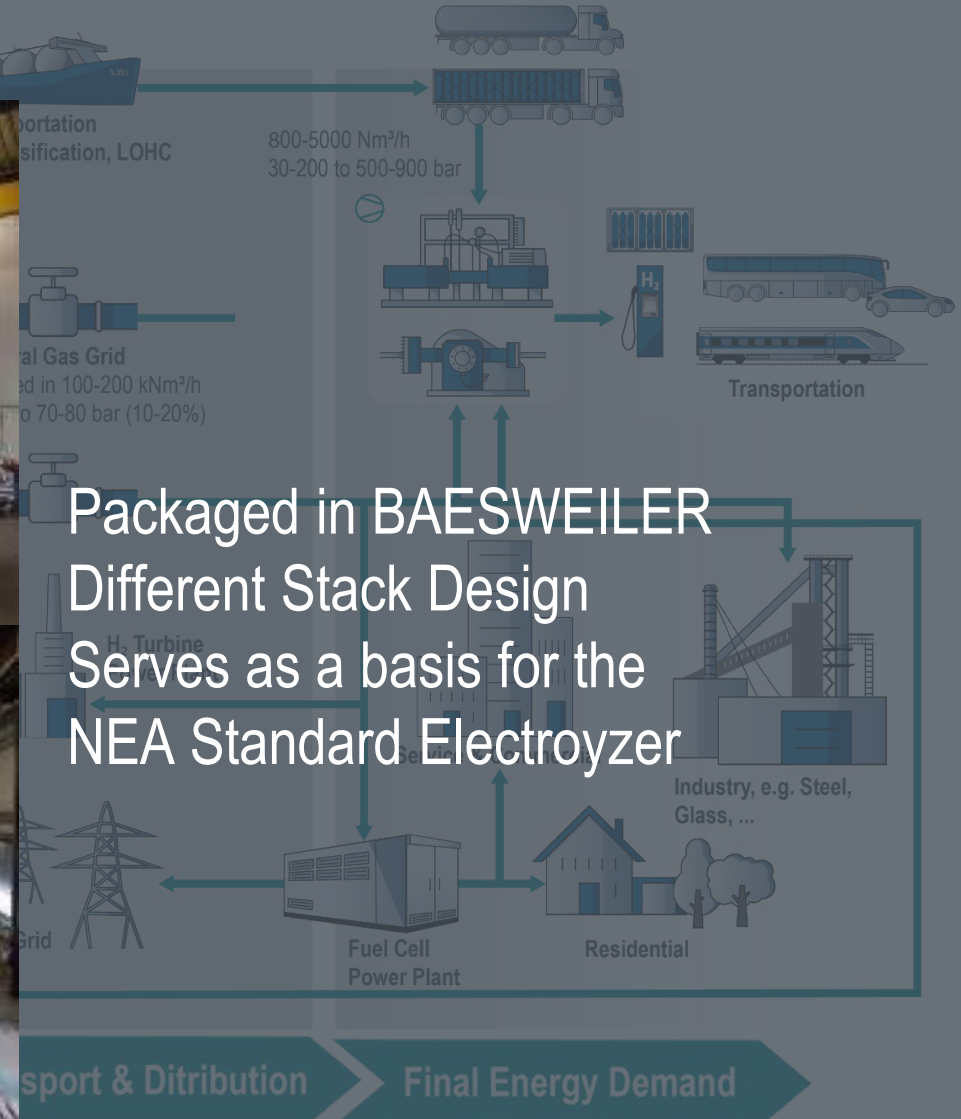
→ Packaged in BELO HORIZONTE  
Standard Stack Design  
→ Serves as a basis for the  
NEA Standard Electrolyzer



# NEUMAN & ESSER – SOLUTIONS FOR H<sub>2</sub> PRODUCTION



## 40' Container – ELECTROLYZER PACKAGE



Packaged in BAESWEILER  
Different Stack Design  
Serves as a basis for the  
NEA Standard Electrolyzer

# NEUMAN & ESSER – SOLUTIONS FOR H<sub>2</sub> COMPRESSION



## Diaphragm Compressor for H<sub>2</sub> - Size S

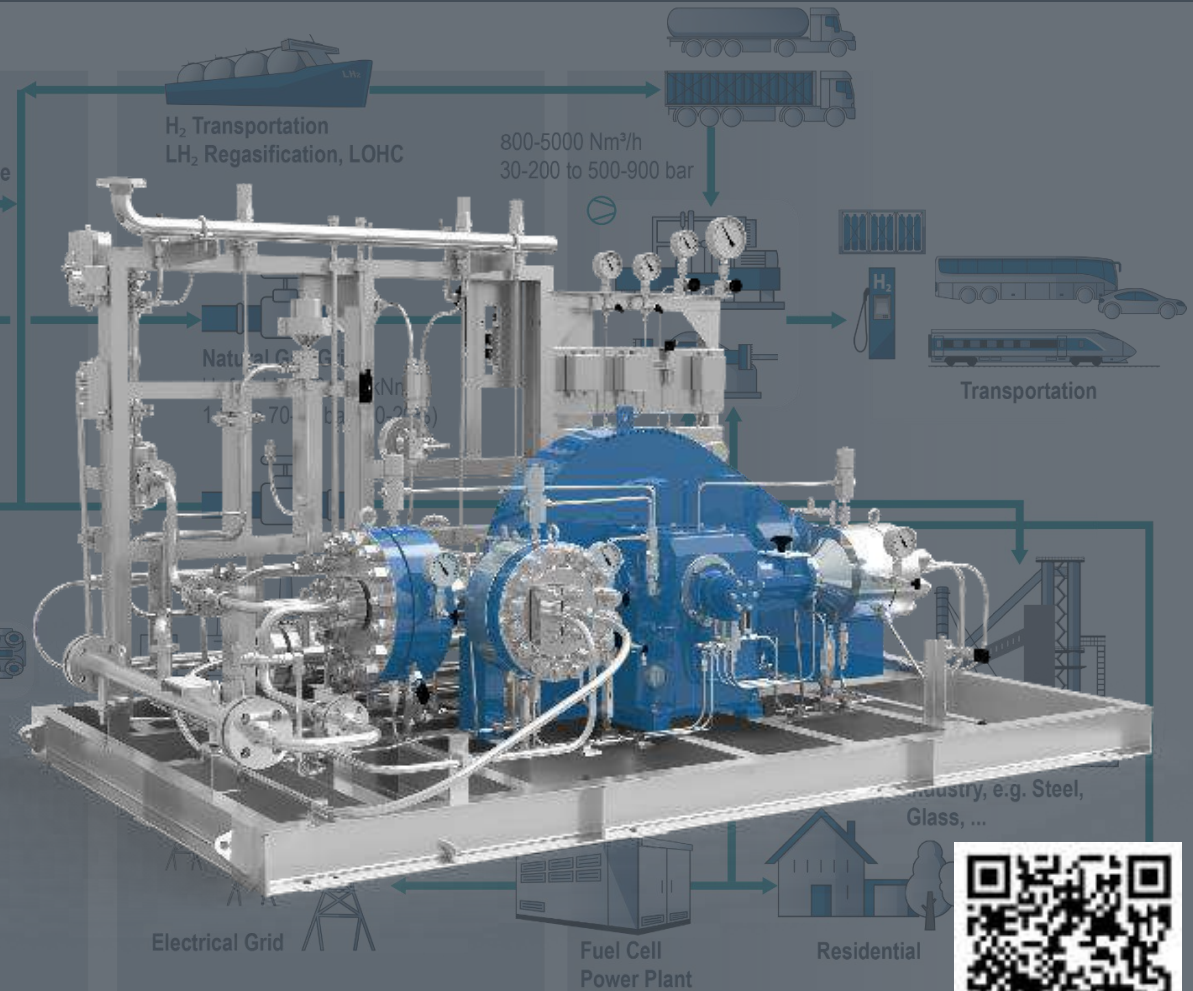
### Features

- for more continuous operation
- oil-free, abrasive-free, leakage-free up to 10-6 mbar l/s
- for demands of high purity and gas-tightness
- up to 3,000 bar (45,000 psi), 1 to 4 stages,
- mostly 1000 bar is enough
- ratio per stage 5 to 10
- H<sub>2</sub> -Flow rate: ~110 kg/h from 30-1000 bar.

### Applications

- H<sub>2</sub> trailer filling and large refueling station
- Laboratories with highest pressures

Video of working principle: <https://youtu.be/WvYbKMAHz54>



Primary Energy

Conversion & Processing

Storage

Transport & Distribution

Final Energy Demand



# NEUMAN & ESSER – SOLUTIONS FOR H<sub>2</sub> COMPRESSION



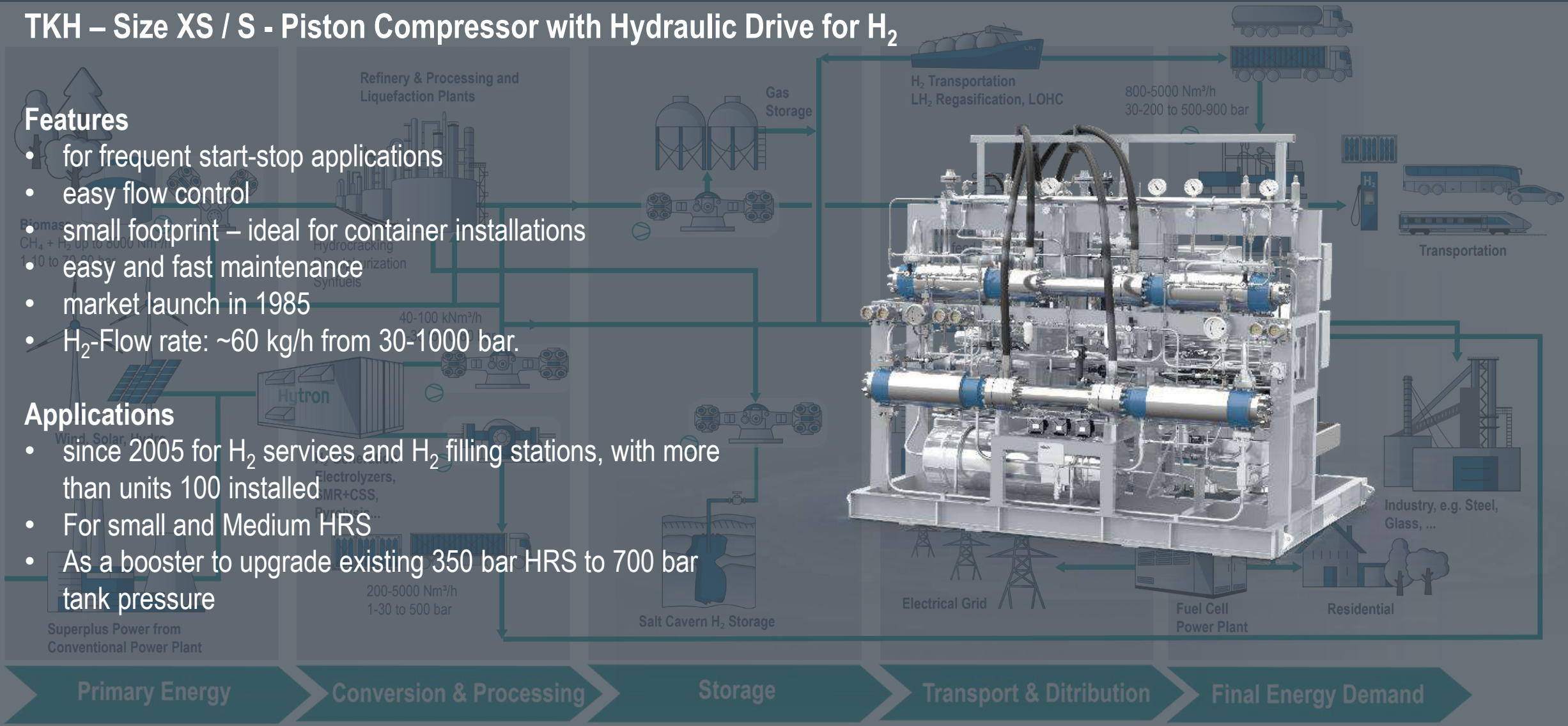
## TKH – Size XS / S - Piston Compressor with Hydraulic Drive for H<sub>2</sub>

### Features

- for frequent start-stop applications
- easy flow control
- small footprint – ideal for container installations
- easy and fast maintenance
- market launch in 1985
- H<sub>2</sub>-Flow rate: ~60 kg/h from 30-1000 bar.

### Applications

- since 2005 for H<sub>2</sub> services and H<sub>2</sub> filling stations, with more than units 100 installed
- For small and Medium HRS
- As a booster to upgrade existing 350 bar HRS to 700 bar tank pressure



# THE BIG GOAL - DIESEL PARITY

Energy Densities & CO2 Footprint (local) – Values for Diesel, LNG & H<sub>2</sub> for Mobility

Energy Carrier	LHV [kWh/kg]	Density [kg/m <sup>3</sup> ]	LHV/m <sup>3</sup> [kWh]	Local CO <sub>2</sub> /kg [kg]	Local CO <sub>2</sub> /kWh [kg]
LH <sub>2</sub> atmospheric - 253°C	33.60	70.79	2378.8	0	0
H <sub>2</sub> 350 bar 25°C	33.60	23.16	778.2	0	0
H <sub>2</sub> 700 bar 25°C	33.60	37.84	1271.5	0	0
H <sub>2</sub> 2350 bar 25°C	33.60	70.8	2378.9	0	0
CNG (H-Gas) 250 bar 25°C	13.89	218.77	3038.5	2.75	0.198
Diesel 25°C	12.06	820	9885.6	3.15	0.261
Gasoline 25°C	12.97	740	9599.4	3.3	0.254
Ammonia liquid 10 bar, 25°C	5.18	600	3107.7	0	0
Methanol 25°C	5.54	780	4318.2	1.37	0.247
LPG	13.7	540	7398.0	3.01	0.220
LNG -160°C	13.5	430	5805.0	2.6	0.193
Battery Lithium-ion cells	0.20	1600	320	0	0

# THE BIG GOAL - DIESEL PARITY

Range Demands Road & Rail

Range Requirements for some typical Use Cases:

- Light Cargo Vehicles: 400 – 800 km => 6-12 kg H<sub>2</sub>
- Semitrailer / Overland Bus: 1000 - 1500 km => 50-120 kg H<sub>2</sub>
- Municipal Buses: 200 – 400 km => 20-40 kg H<sub>2</sub>
- Railway Passenger Trains: 600 – 1000 km => 150-200 kg H<sub>2</sub>
- Railway Diesel Freight Train: 1000 km => 500-1000 kg H<sub>2</sub>

Cost Requirements Road Bound:

- 1kg of H<sub>2</sub> replaces around 4 liters of Diesel => 1.8€/l <=> 7.2€/kg
- But don't forget the CO<sub>2</sub> certificate pricing! Semi: 100-150 tons p.a.



<https://www.alstom.com/>



AS Operail

# EXAMPLE: H<sub>2</sub> ALLIANCE FOR MOBILITY

QUANTRON with Full Range Vehicle Portfolio

**100% zero emission since inception**

BEV & FCEV: the right technology for individual use case requirements



**FCEV**  
Available for orders TODAY  
SOP Q2/2023  
(4.25 – 7.2 t)

**BEV**  
Available TODAY  
(4.25 – 7.2 t)

**BEV**  
Available TODAY  
(6x2 28t)

**BEV**  
Available TODAY  
(4x2 44t / 6x2 65t)

**BEV**  
Available TODAY  
(12m low floor, city)

**BEV**  
Available TODAY  
(4.25t)

**FCEV**  
Available for orders TODAY  
SOP Q3/2023  
(4x2 44t / 6x2 65t)

**FCEV**  
Available on demand  
(12m low floor, city)

**FCEV**  
Available Q1/2024  
(to follow)

# EXAMPLE: H<sub>2</sub> ALLIANCE FOR MOBILITY

QUANTRON Vehicles – Light Cargo Solutions- QLI FCEV



- One of the first **road-ready** light commercial FCEVs
- More than **2x the range** vs. similar BEVs
- Integrated package provides **convenience** and **familiarity** for drivers
- Similarly **high variant matrix** as base vehicle possible

# EXAMPLE: H<sub>2</sub> ALLIANCE FOR MOBILITY

QUANTRON Vehicles – Heavy Duty Solutions - QHM FCEV AERO



- All components **fully chassis-integrated** – no H<sub>2</sub> backpack
- First and only FCEV tractor in EU that **requires no special approvals** for on-road use
- **Best-in-class real range** of 600-700 km (up to 1500 km possible in Nordics version) 🇳🇴
- **Same payload capability** as diesel tractors
- Further **20% drag reduction** with Aero Package



# INFRASTRUCTURE: „RIGHT-SIZING“ THE SOLUTION

## HRS (Hydrogen Refueling Station) Tool

**Dispenser 3**  
 Busses/Trucks/Train... | v

Pressure Ramp Setpoint (MPa/min) **5**

Precooling Temperature (°C) **-20**

Ave. Precooling COP **2**

Processing Time (s) **240**

Vehicles per hour  
 Manual  CSV

Time [h]    Vehicles Per Hour [ ]    Back2Back [ ]

**DISPENSER**

- Dispenser 1
- Dispenser 2
- Dispenser 3**

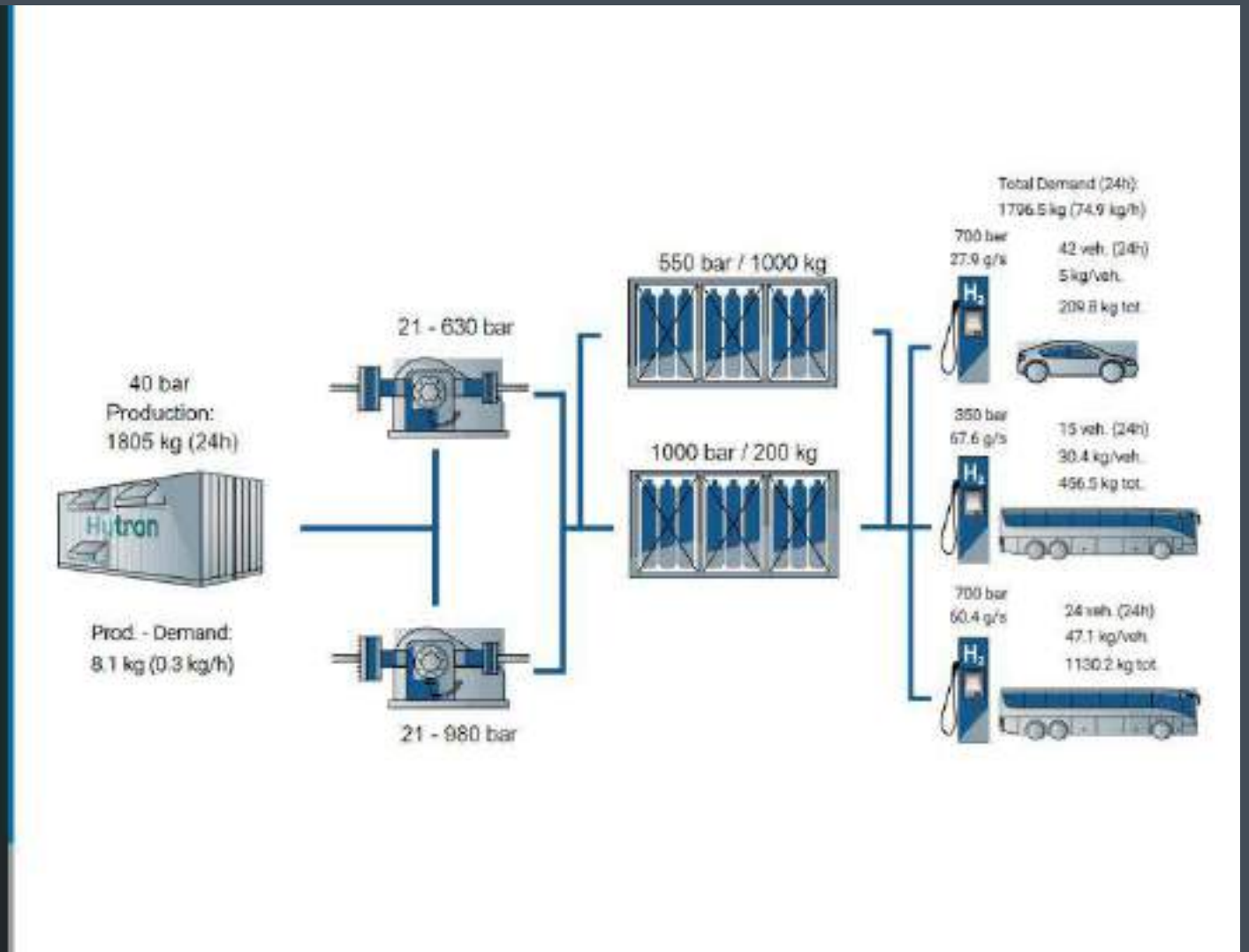
**PASSENGER CAR**

**BUS-TRUCK-TRAIN MED-P**

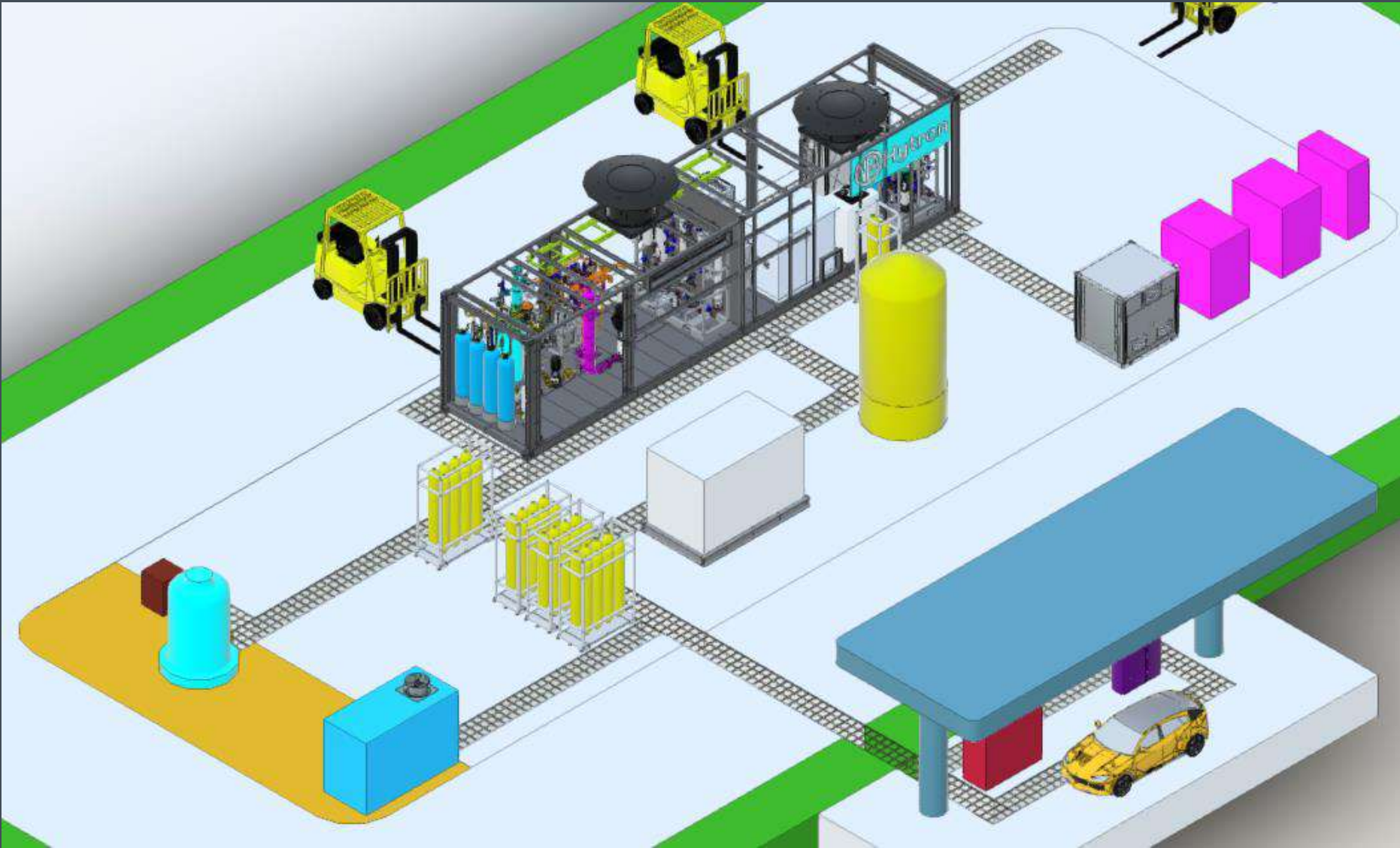
**BUS-TRUCK-TRAIN HIGH-P**

▶ START SIMULATION

↶ BACK TO DASHBOARD



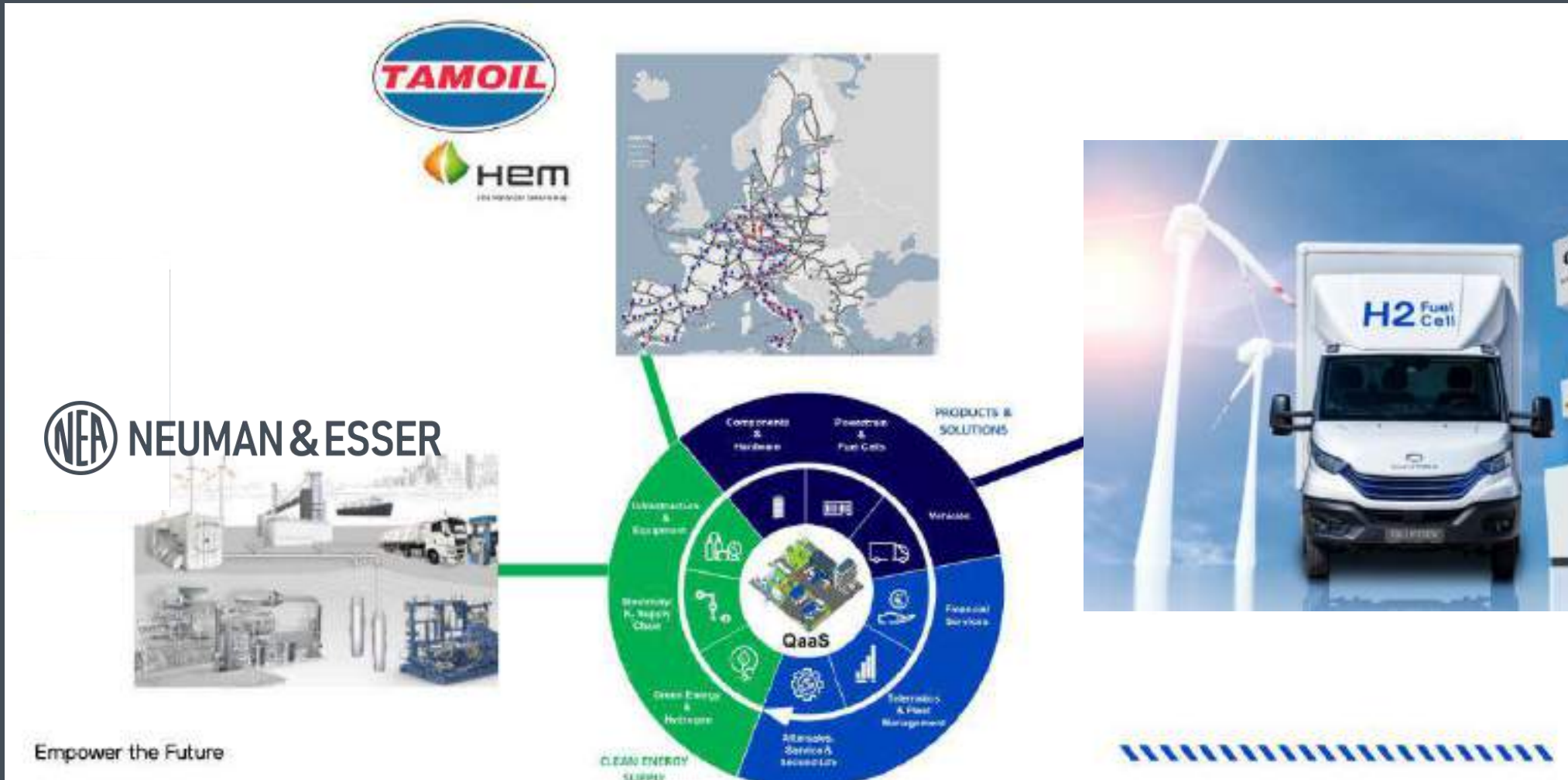
# INFRASTRUCTURE: HRS SAMPLE





# STRATEGIC PARTNERSHIPS TO SIMPLIFY RAMP-UP

H<sub>2</sub>-Alliance for a Green Mobility Infrastructure – Hen, Egg & Rooster



# ZERO-EMISSION TRANSPORT SOLUTIONS

3 Major Customer Challenges to Be Solved

Hen-and-Egg-Problem 

No refueling



No vehicle

New technology acceptance 



High initial investment 



QaaS as Solution

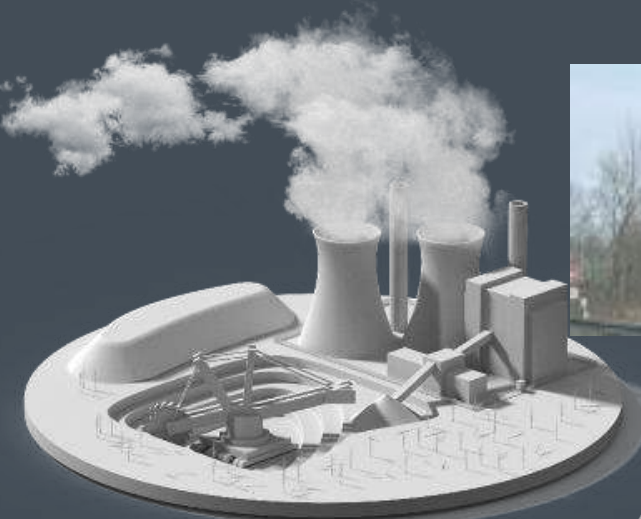


**QaaS platform with pay-as-you-go model (pay-per-km)**

# NEUMAN & ESSER



What we do and need to do....



The transition from a fossil...

...to a sustainable & renewable energy infrastructure!



# NEUMAN & ESSER



Time to transform

NEUMAN & ESSER on YOUTUBE

<https://www.youtube.com/watch?v=YBtjTYU3V88>

<https://www.youtube.com/watch?v=E3jHyRLLMUK>

<https://www.youtube.com/watch?v=Zz8NMrKJ3Os&t=2s>

<https://www.youtube.com/watch?v=0FAtmmVGX2I>

<https://www.youtube.com/watch?v=WvYbKMAHz54>



Thanks for your time! – Feel free to shoot your questions!



## Mr. Armin Offermann, Toyota Tsusho Europe, H2 Ecosystems by Toyota Tsusho (online)

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### Bronze Sponsors





# „H2 Ecosystems by Toyota Tsusho“

---

15.09.2023

Armin Offerman  
Toyota Tsusho Europa SA - Next Mobility

Toyota  
Group

16  
Corporations



 <b>TOYOTA</b>	Toyota Motor Corporation
 <b>TOYOTA</b>	Toyota Industries Corporation
	Hino Motors
 <b>DAIHATSU</b>	Daihatsu Motor
 <b>TOYOTA CENTRAL R&amp;D LABS, INC.</b>	Toyota Central R&D labs
	Toyoda Gosei
 <b>TOYOTA HOME</b>	Toyota Home Corporation
 <b>AISIN</b>	Aisin
	Towa Real Estate
	Toyota Motor East Japan
 <b>TOYOTA BOSHOKU</b>	Toyota Boshoku Corporation
 <b>DENSO</b>	Denso Corporation
 <b>TOYOTA TSUSHO</b>	Toyota Tsuho Corporation
 <b>TOYOTA AUTO BODY</b>	Toyota Auto Body
 <b>JTEKT</b>	Jtekt Corporation
 <b>AICHI STEEL</b>	Aichi Steel Corporation

TOYOTA

## Part of TOYOTA GROUP...

- Major shareholders:  
**Toyota Motor Corporation (22%),**  
**Toyota Industries Corporation (11%)**



## ...but an INDEPENDENT GLOBAL COMPANY

- Established in **1948** in Japan
- Publicly listed in **Tokyo Stock Exchange**
- Over **150 offices, 900 subsidiaries**
- About **60.000 employees**
- Turnover: **64.3 B€**  
 FY 2021 (April 2021 – March 2022)



*Business networks throughout the main cities in the world*



## Group Divisions in Europe



### Global Parts & Logistics

- Global production parts
- Inbound supply chain
- Logistics business



### Metal

- Automotive steel materials
- Steel products
- Non-ferrous metals
- Total waste management



### Machinery, Energy & Project

- Production lines
- Machines
- Relocations
- Spare parts



### Chemicals & Electronics

- Plastic and chemical
- Next generation vehicle materials
- Electronics

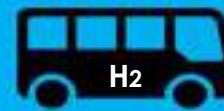


### Food & Consumer Services

- Feed
- Ingredients
- Processed food
- Medical services
- Insurance

### Next Mobility

- FCEV Infrastructure
- BEV/PHEV Infrastructure
- 3R (Rebuild, Reuse, Recycle)
- CO2 Reduction



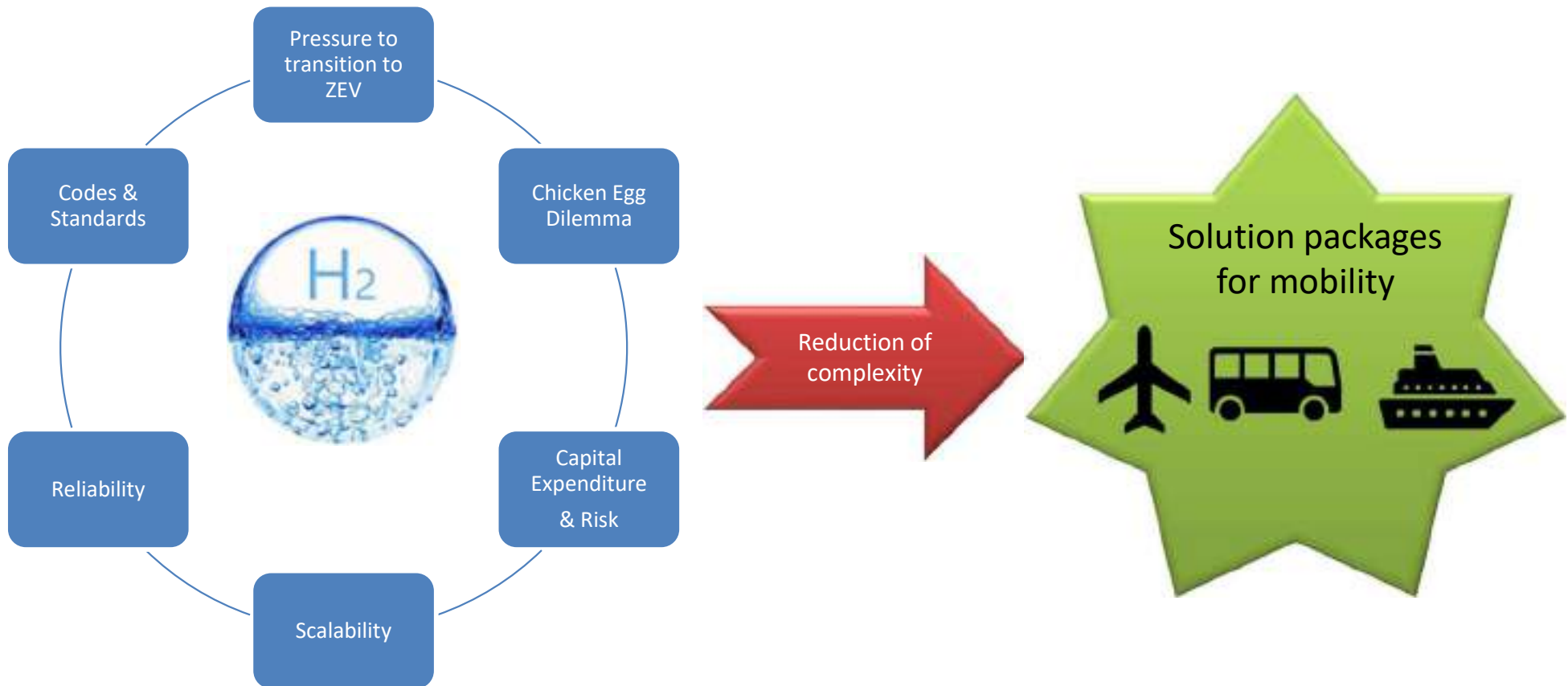


## Toyota Tsusho H<sub>2</sub> Track Record

- Operator of Hydrogen refuelling stations since 2014 in Japan
- Ongoing feasibility Studies for Ports in Japan, US, and the UK
- Eurus Energy is a 100% subsidiary of the Toyota Tsusho Group operating over 3142 MW of wind & solar farms



## Challenges surrounding H2-mobility



## Mobility example: “H2 One stop shop”

### Target customers: *Bus operators*

- **Turnkey solution** for bus operators covering the entire value chain
- Predictable TCO with **pay per use** model
- Clear commitment to H<sub>2</sub> technology through Toyota Group
- Long-term Partnership and Engagement with a strong financial partner



## Bus: Turnkey solution



**Capital**  
 Toyota  
Financial Services

**Fuel-Cell Electric Vehicles**  
 TOYOTA Cartanobus

**Fleet services**  
 TOYOTA TSUSHO EUROPE

**Hydrogen supplies  
& filling infrastructure**  
 MESSER  
Gases for Life

Price per €/km or CO2e Savings

## Why „H2 One stop Shop“



- Customer can focus on core business
- Customer pays per km. Incentive to supplier to keep everything running.
- Pay per km → Predictable TCO
- High availability solutions
- Long-term reliable partnership
- Optimized Cash flow -> Faster rollout



## Questions

Feel free to contact me

[Armin.Offermann@ttesa.net](mailto:Armin.Offermann@ttesa.net)

+49 171 8127271





## Mr. Andreas Demetriades & Miguel Angel Alonso Julia Cyprus Public Transport, The Spanish experience in decarbonisation of public transport

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### Bronze Sponsors



alsa 100 años

**Alsa, moving in green.**

***Green H2 -The Spanish experience.***

Miguel Ángel Alonso

Engineering & European Funds Office Director.

15.09.2023



Alsa, moving in green.  
Sustainability.



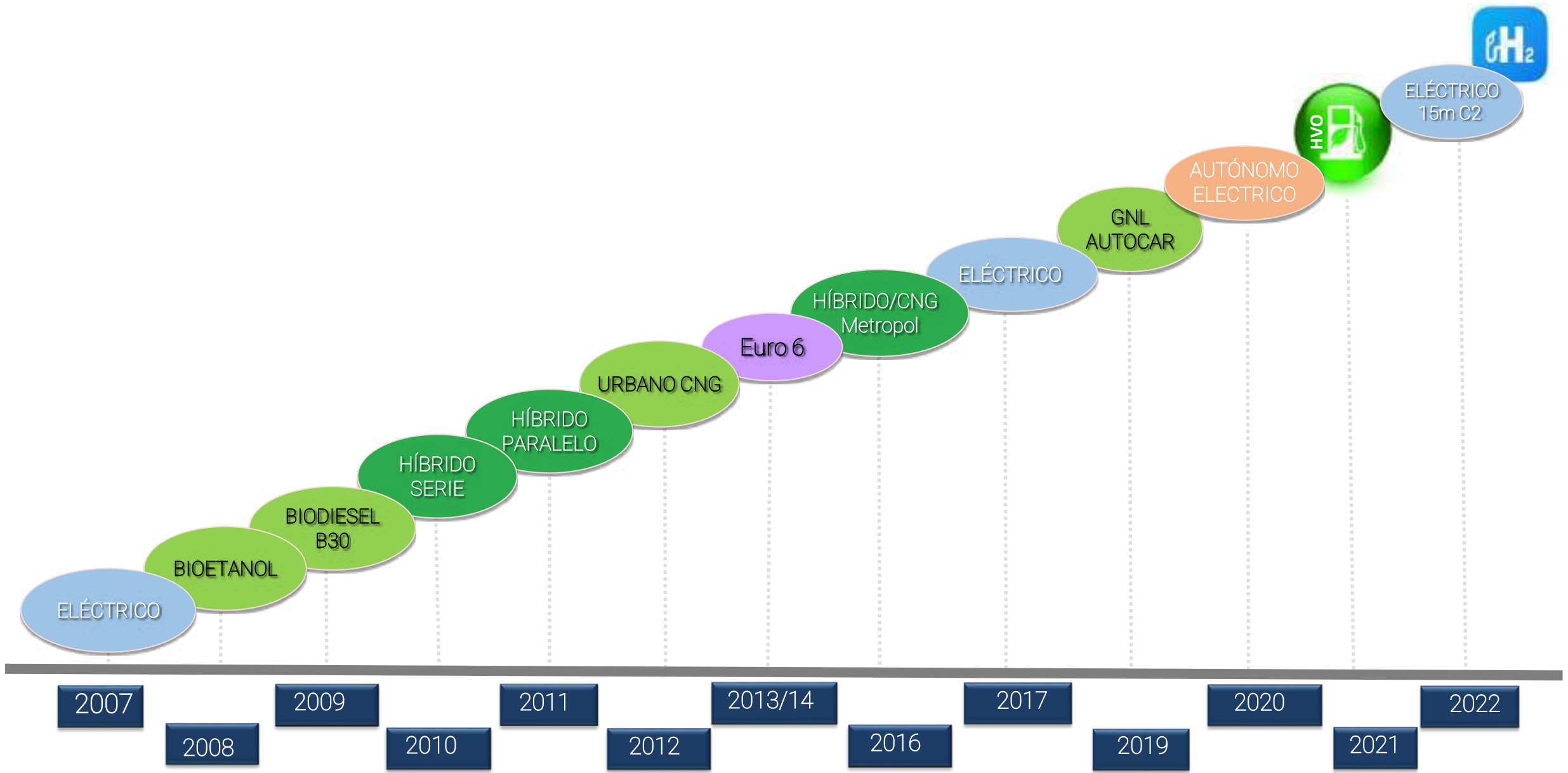
Social Environmental Economic



Regulatory framework  
Climate change

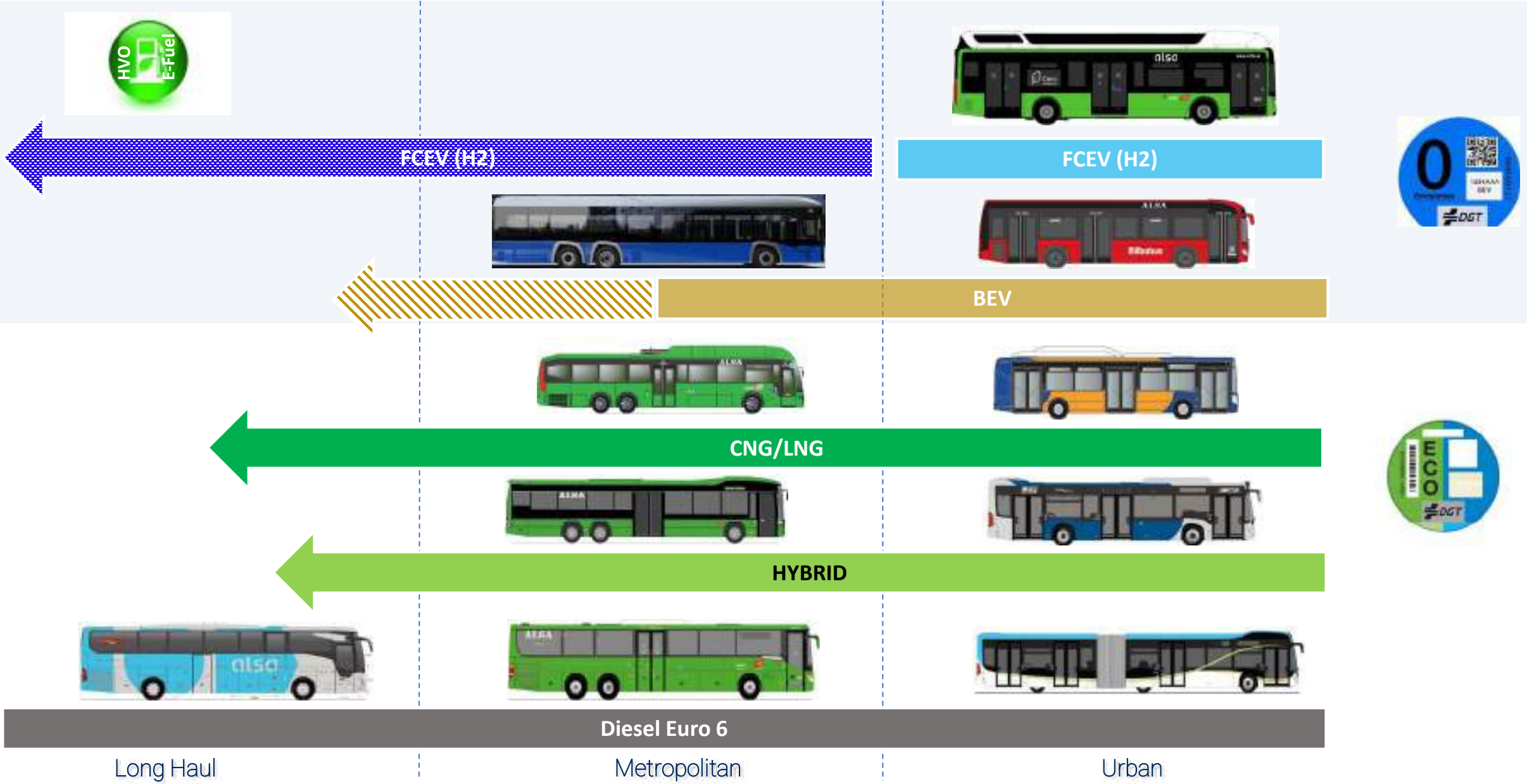
Sustainable solution

**Alsa, moving in green.**  
Bus propulsion Timeline.



Alsa, moving in green.

Roadmap towards zero emissions.



Partnership



**Alsa H2 Roadmap.**



Alsa, moving in green.  
Our FCEV fleet.

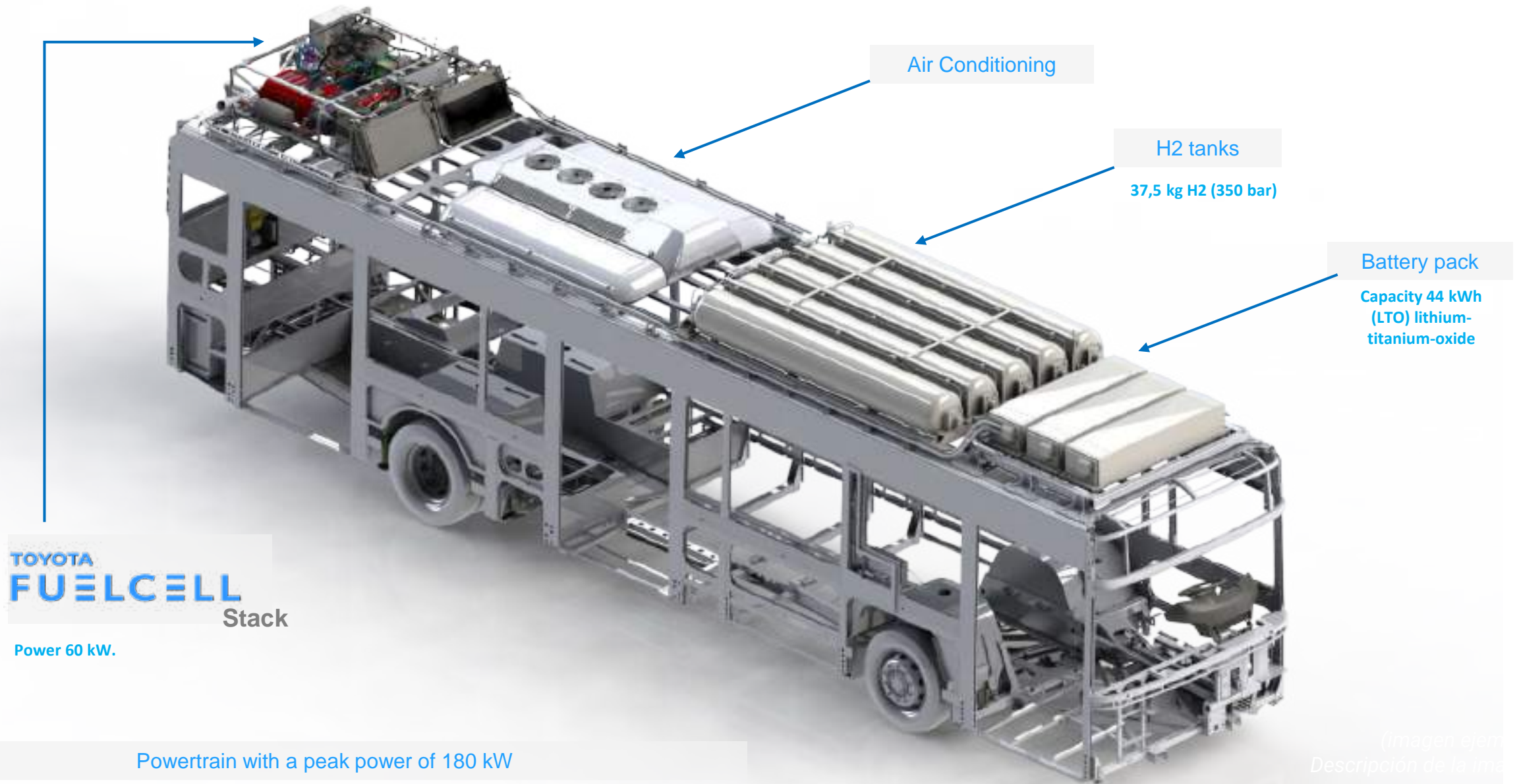


2<sup>nd</sup> FCEV bus in operation since March 2023.  
CAF-Solaris



1st FCEV in operation in Spain since January 2022.  
Toyota-Caetano

Alsa, moving in green.  
FCEV powertrain.



TOYOTA  
**FUELCELL**  
Stack  
Power 60 kW.

Air Conditioning

H2 tanks  
37,5 kg H2 (350 bar)

Battery pack  
Capacity 44 kWh  
(LTO) lithium-  
titanium-oxide

Powertrain with a peak power of 180 kW

(imagen ejemplar)  
Descripción de la imagen



Alsa, moving in green.

HRS in Torrejón (Madrid). Air Products



- HRS + compresor
- Tube trailer: 200 bar
- Compression and storage: 1000 bar
- Refuelling pressure 350 bar
- 50Kg. /day

Alsa, moving in green.

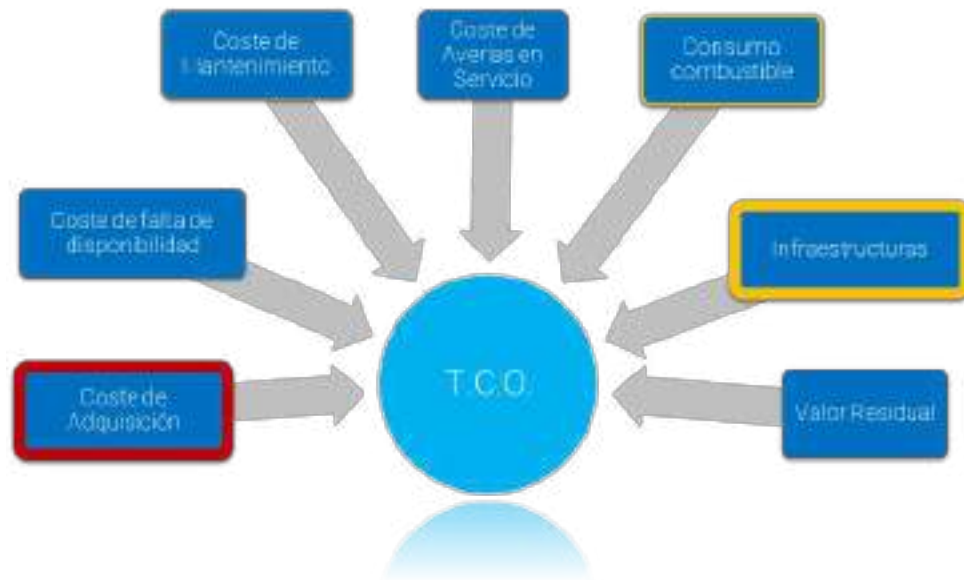
Exolum facilities in Torrejón (Madrid).



Pioneer Technology from Fusion Fuel: on-site & off-grid H2 production

## Alsa, moving in green. Learned lessons.

- ✓ Zero emissions.
- ✓ Silent.
- ✓ Range.
- ✓ Refuelling time.
- ✓ Reliability.
- ✓ Dynamic behaviour.
- ✓ Coach solution will be key
- ✓ Scalability with demand aggregation.
- ✓ EU and Spain H2 Roadmap.



alsa 100 años



- × Limited bus offer (only urban).
- × T.C.O. (Total cost of ownership)
  - × Bus price.
  - × Cost of the charging infrastructure.
  - × Price of green H2.
- × No production and distribution network.
- × Dependent on European Funds

## Alsa, moving in green.

### H2 Sustainability.

1. Development of **Coaches** and Trucks.
2. Focus on the **aggregation of demand** from the different sectors, to achieve economies of scale.
3. **Balanced distribution** of funds between the different transport modes and between public companies and private companies.
4. Coordinated **structuring in time and form** between different components of the NG EU funds, with homogeneous grants for the entire value chain.
5. Comprehensive and coordinated vision between the **different administrations**, to adapt and develop the necessary infrastructures, ensuring sustainability.
6. H2 **Key vector to decarbonize**: use for Fuel Cell, engines and eFuel.



Thank you!

[miguelangel.alonso@alsa.es](mailto:miguelangel.alonso@alsa.es)

alsa

HydrogenIN





## Ms. Sharon van Beek, Quantron, Hydrogen Electric Vehicles and Retrofitting (online)

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Sustainability becomes Reality



Zero Emission Solutions for a better Future

September 2023

Empower the Future



# QUANTRON IMAGEVIDEO

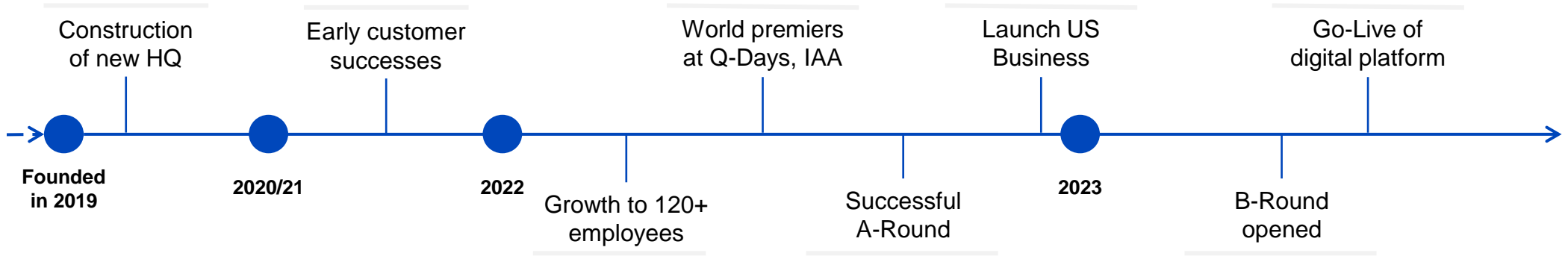




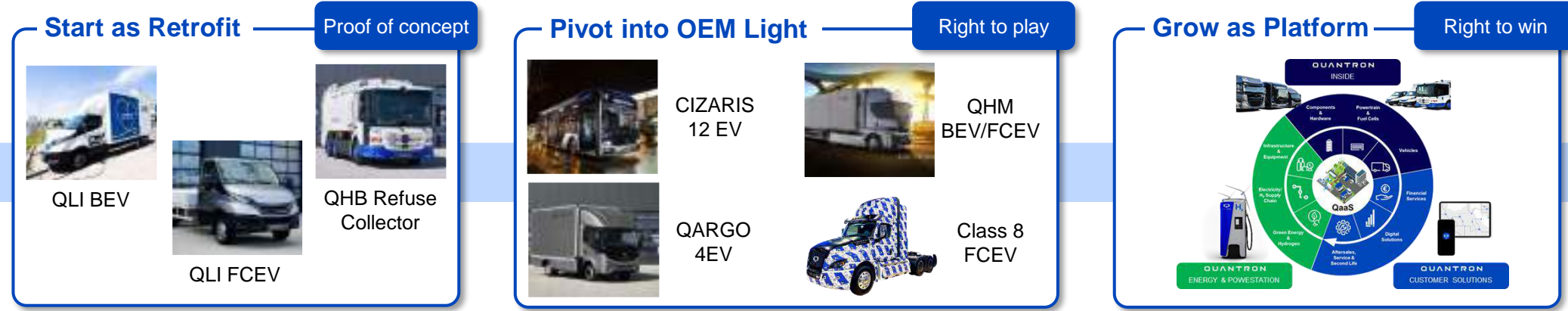
# QUANTRON's Evolution From Retrofit to Zero Emission Platform Provider



Corporate journey



Proactive product & business model evolution



Moving from a retrofit business which served as proof of concept towards a platform offering enabling clients to have all their zero emission mobility and logistics needs met via QUANTRON. Our recent FCEV truck reveals demonstrate that we are well-positioned to serve our clients with sustainable hydrogen transportation.

# Businesses evolve from physical products to disruptive platforms



**Ecosystems and digital platforms disrupt entire industries. The age of platform economy has started.**

Note: The companies shown above are only illustrative examples representative of the companies in that industry/sector.

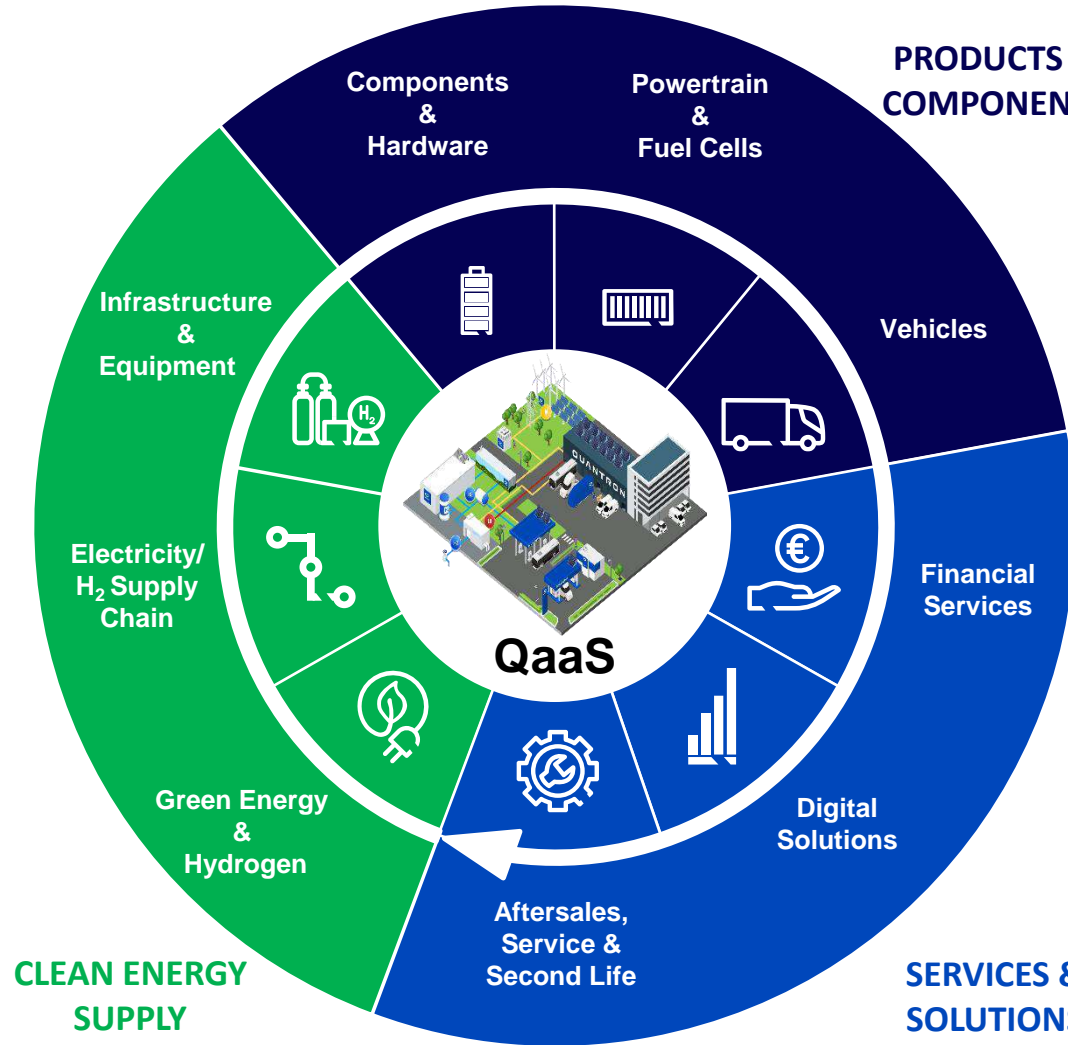
# QUANTRON's comprehensive 360° ecosystem offer

## QUANTRON ENERGY & POWER STATION

Production and distribution of green energy and hydrogen



H<sub>2</sub> refilling & electricity charging infrastructure network and equipment



## QUANTRON INSIDE

Fuel cell and battery electric commercial vehicles and components

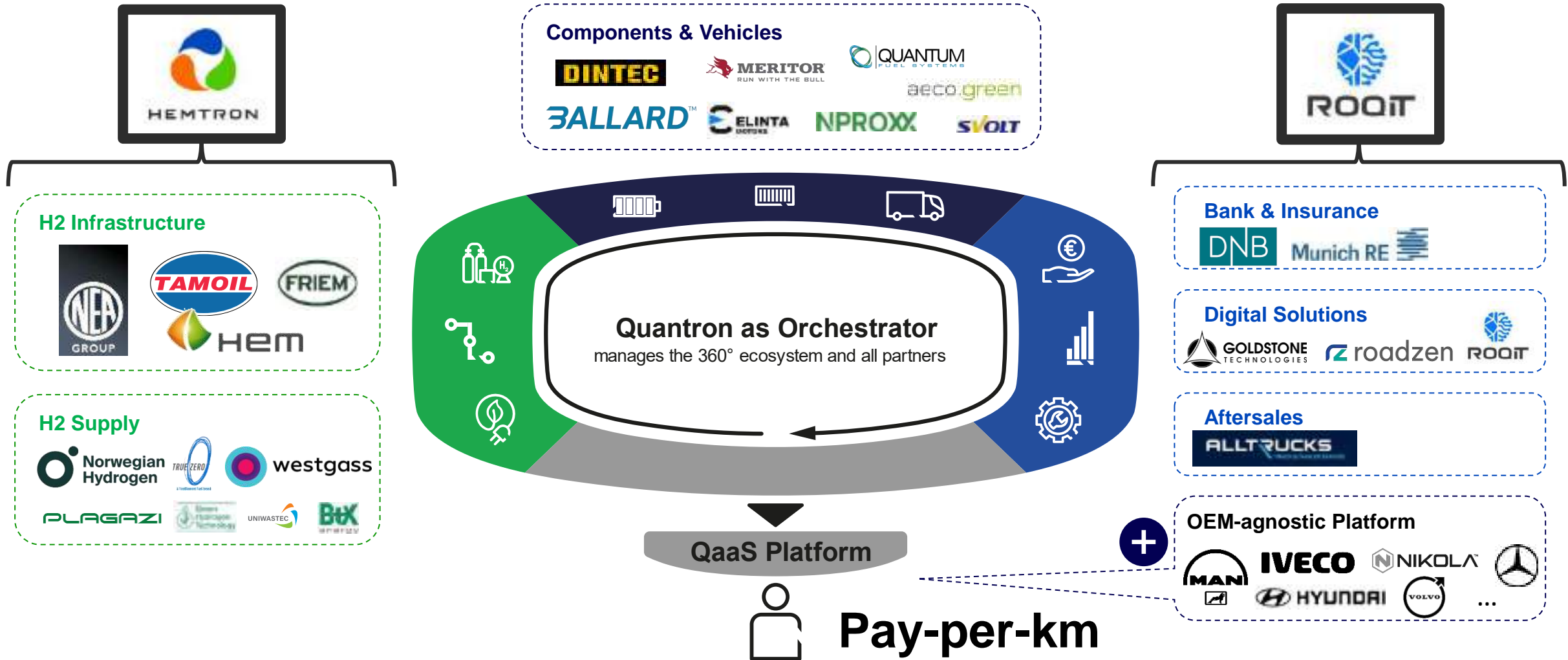


## QUANTRON CUSTOMER SOLUTIONS

Physical and digital solutions for sales aftersales, financing and 2<sup>nd</sup> life



# Clean Transportation Alliance: Network of strategic partners enabling the QaaS platform



# QUANTRON with full range vehicle portfolio

**100% zero emission since inception**

BEV & FCEV: the right technology for individual use case requirements



**FCEV**  
**Available for orders TODAY**  
**SOP Q2/2023**  
 (4.25 – 7.2 t)

**BEV**  
**Available TODAY**  
 (4.25 – 7.2 t)

**BEV**  
**Available TODAY**  
 (6x2 28t)

**BEV**  
**Available TODAY**  
 (4x2 44t / 6x2 65t)

**FCEV**  
**Available for orders TODAY**  
**SOP Q3/2023**  
 (4x2 44t / 6x2 65t)

**BEV**  
**Available TODAY**  
 (12m low floor, city)

**FCEV**  
**Available on demand**  
 (12m low floor, city)

**BEV**  
**Available TODAY**  
 (4.25t)

**FCEV**  
**Available Q1/2024**  
 (to follow)



# QUANTRON QLI FCEV USPs & Highlights

Available as  
4.2t

Range up to  
450km (WLTP)

> 8kg H<sub>2</sub> + 37kWh HV-  
Battery

up to 150 kW max.  
motor power



Powered by Ballard's  
FCmove™-MD Fuel Cell



Diesel analog tank refilling  
times. Can be refueled at  
any H2 station (>100 POI)

Chassis integrated packaging for  
unrestricted body solutions

Highest range, fast refilling times and fully integrated packaging!



# Our technology leadership showcased by the QLI FCEV



- One of the first **road-ready** light commercial FCEVs
- More than **2x the range** vs. similar BEVs
- Integrated package provides **convenience** and **familiarity** for drivers
- Similarly **high variant matrix** as base vehicle possible

# QUANTRON QHM FCEV USPs & Highlights

600-700 km real range  
(max. load)  
(up to 1500km in Nordic version)

Long sleeper cabin and standard  
ISO-trailer possible

Optimized aerodynamics  
with AERO package

Worlds 1<sup>st</sup> dedicated  
Fuel Cell for Heavy Duty  
applications:  
**FCmove™-XD**



Capable to refuel  
@350 or 700 bar

Almost no changes in payload

Best in class tank-capacity for  
maximum range

Tractor unit & chassis with  
different configurations - from  
3600+ mm wheelbase

Maximum range without restrictions in cabin and trailer length!



ZERO EMISSION - FULL H<sub>2</sub> POWER

H<sub>2</sub> Range  
Champion

1

Maximum efficiency

Improved aerodynamics with the new design, reaching 20% drop in the drag coefficient, resulting 10% increase in the overall range!



Interior

Sustainability is not just about our zero emission vehicles, but also about our recycled textiles and sustainable materials used in the interior.



FCEV truck platform

QHM with its unique „package“ – utilizes renowned international partners to ensure high-quality equipment and safe technology are integrated in all its vehicles.

Features

 Zero Emission range champion  
700 - 1500 km

 ISO Trailer compatible and standard length possible

 H<sub>2</sub> Tank volume  
54 - 116 kg H<sub>2</sub> @700 bar

 Axle config.  
4x2 tractor  
6x2 tractor  
4x2 chassis  
6x2 chassis

 Refueling time  
15 minutes

Fuel Cell

240 kW (2 x 120 kW FCmove™-XD fuel cell) from the world's leading hydrogen expert Ballard Power Systems.



QUANTRON QHM FCEV AERO

 QUANTRON

# 5 KEY TAKEAWAYS – QUANTRON right to win

140 years commercial vehicle expertise & DNA



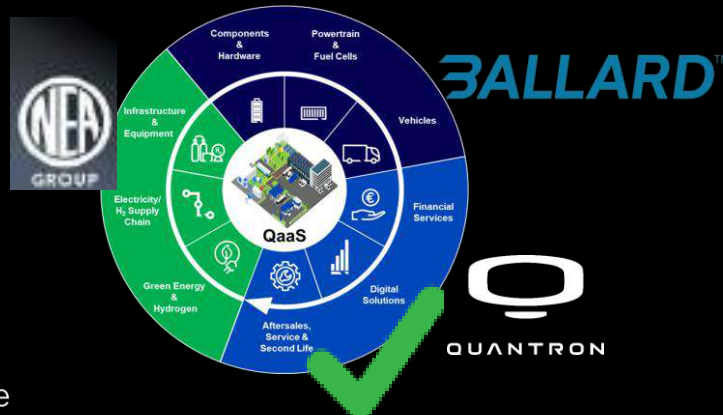
Full light & heavy BEV & FCEV portfolio as OEM - already today



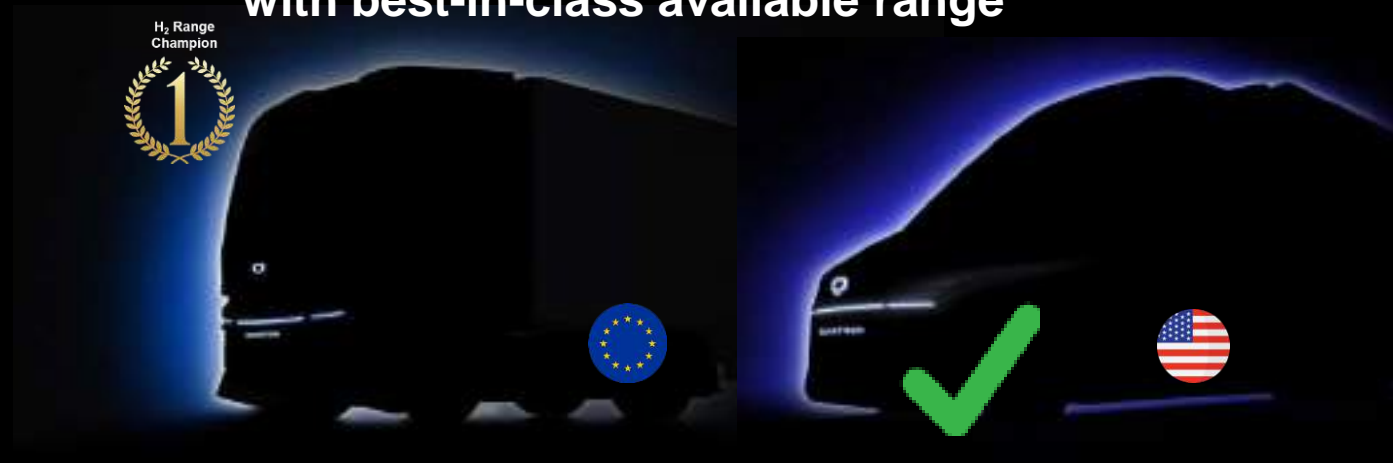
Strong Market Demand for sustainable transport solutions



QaaS 360° Ecosystem enabling the Clean Transportation Alliance



World class H<sub>2</sub> & BEV vehicles with best-in-class available range





Thank you!

  
QUANTRON

Empower the Future

September 2023





# THANKS FOR JOINING US!

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**Bronze Sponsors**

