ΣΥΝΔΕΣΜΟΣ ΥΔΡΟΓΟΝΟΥ ΚΥΠΡΟΥ
CYPRUS HYDROGEN ASSOCIATION

Πράσινο Υδρογόνο

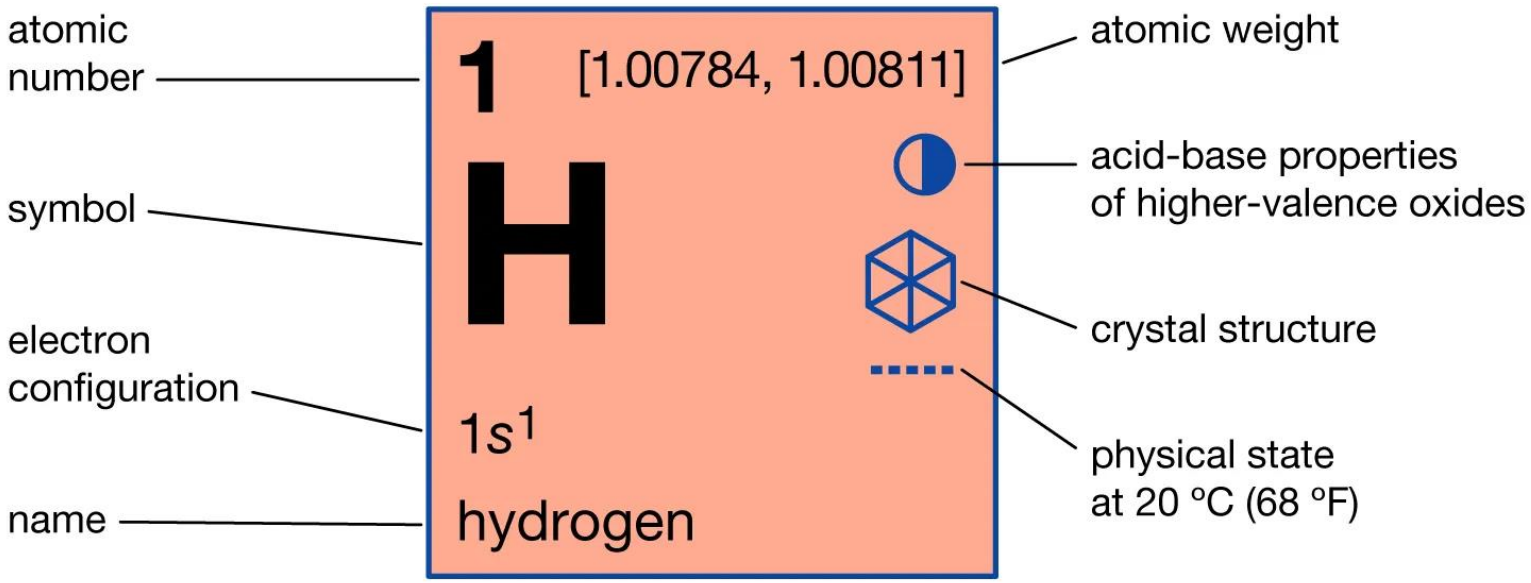
Εφαρμογές, πλεονεκτήματα, συνεισφορά στη μείωση των αέριων εκπομπών και η ετοιμότητα των επιχειρήσεων

Σύνδεσμος Υδρογόνου Κύπρου (ΣΥΚ)

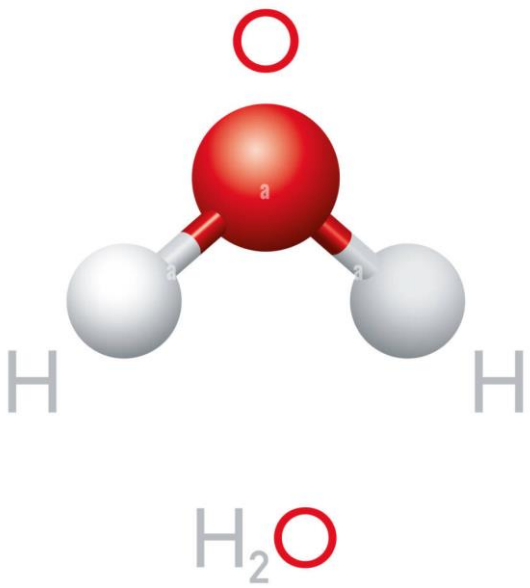
Πρόεδρος ΣΥΚ, Μάκης Κετώνης

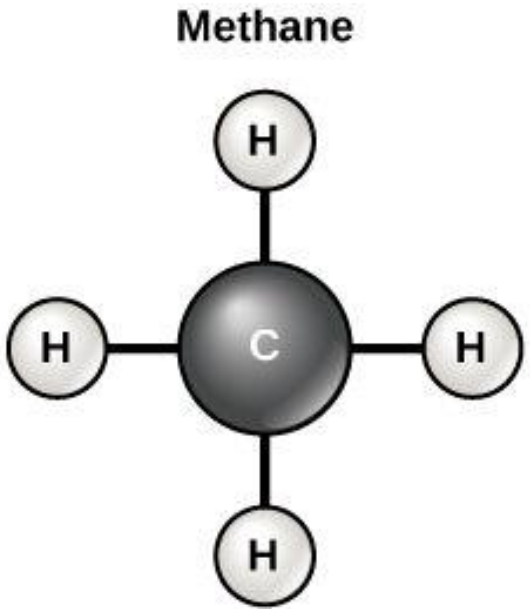
What is hydrogen ?

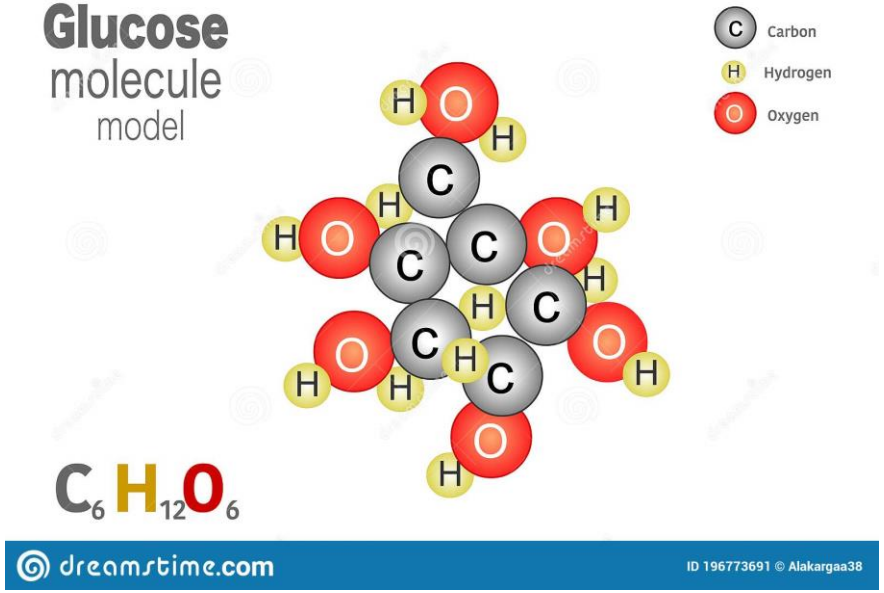
Hydrogen



Hydrogen in chemical compounds







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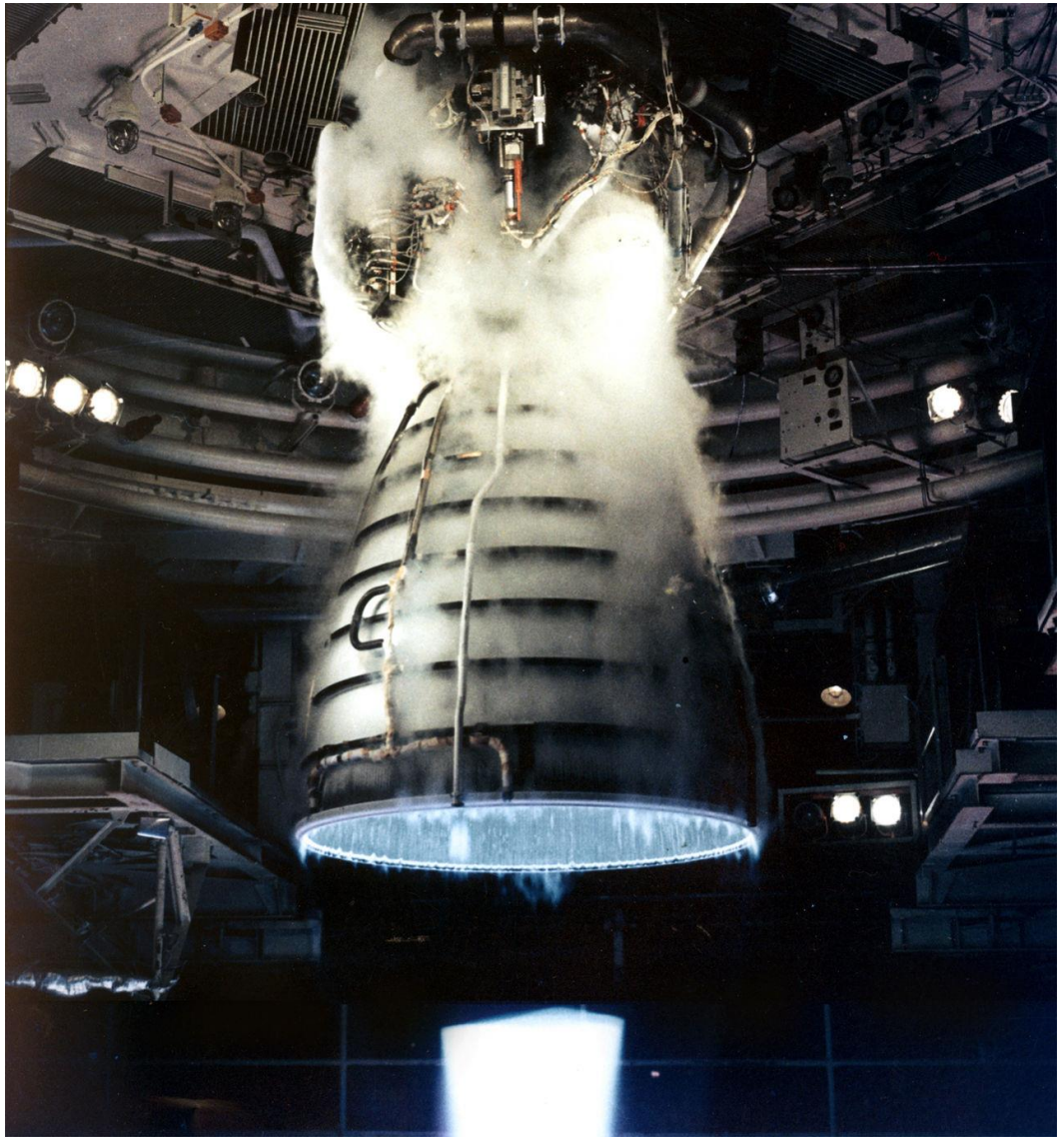
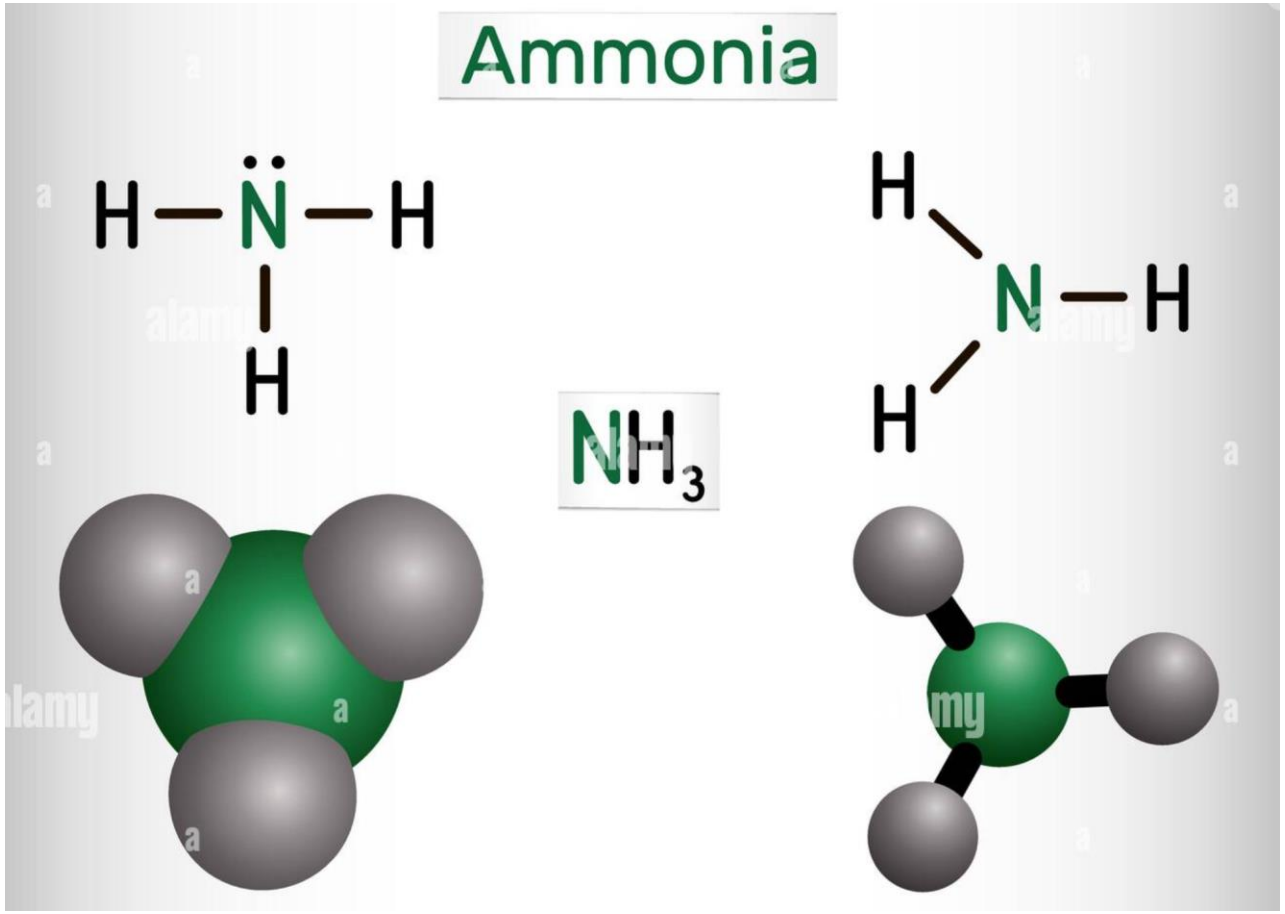
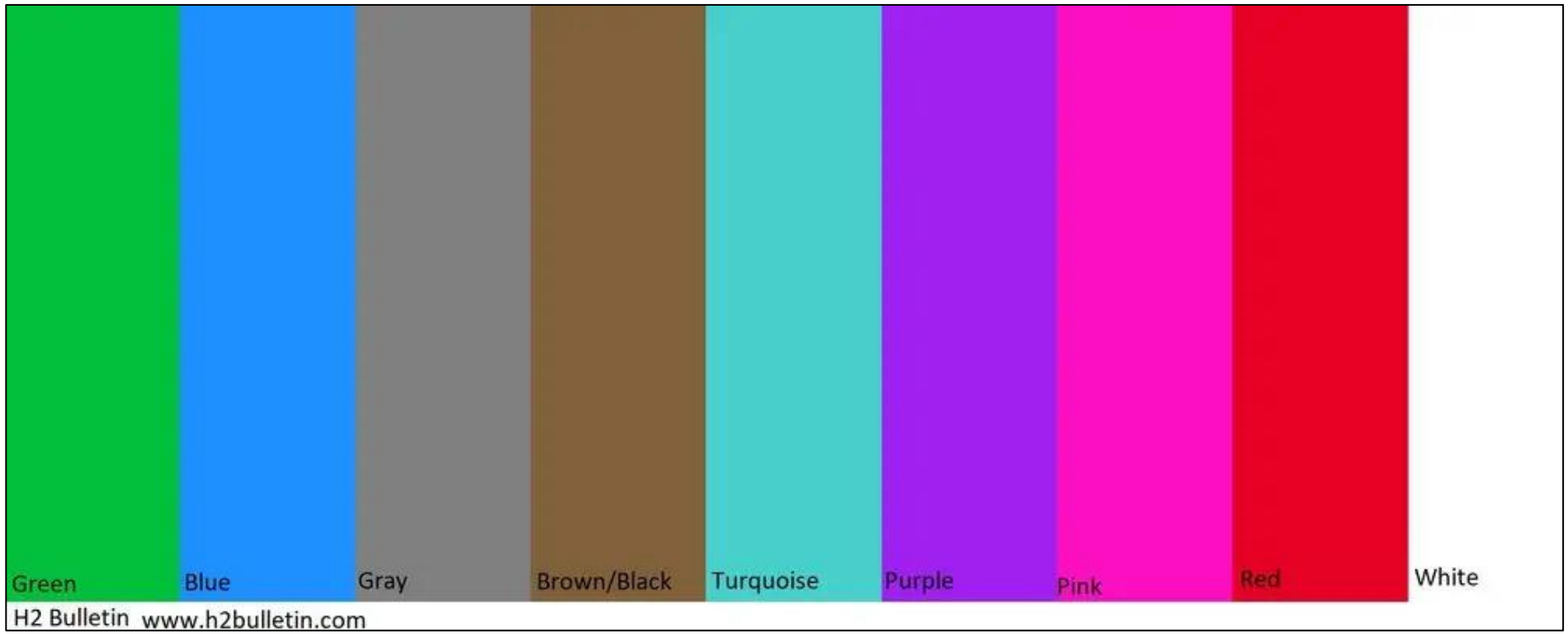
ICE (internal combustion engine)

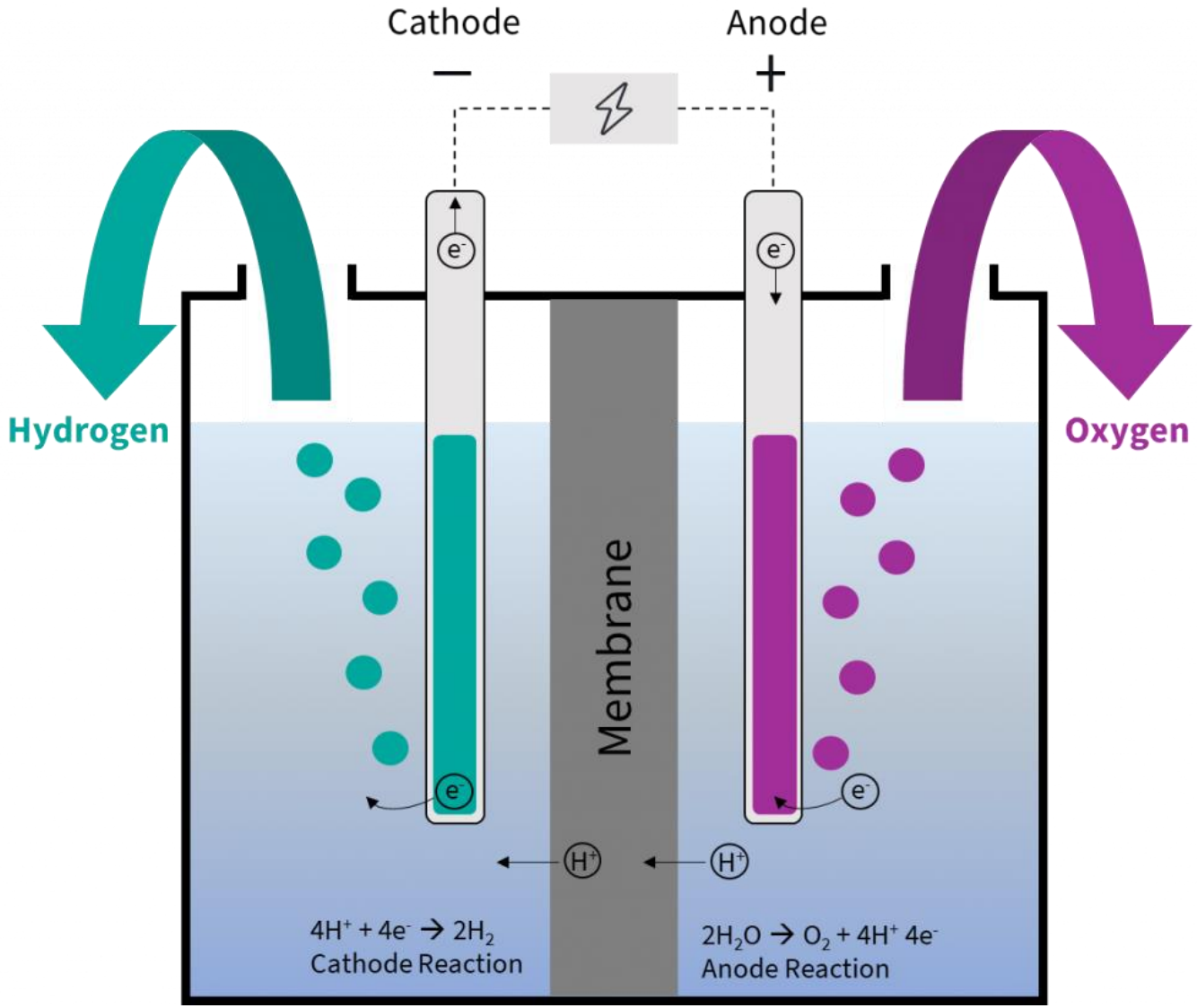



Ammonia
NH3

The colours of H_2

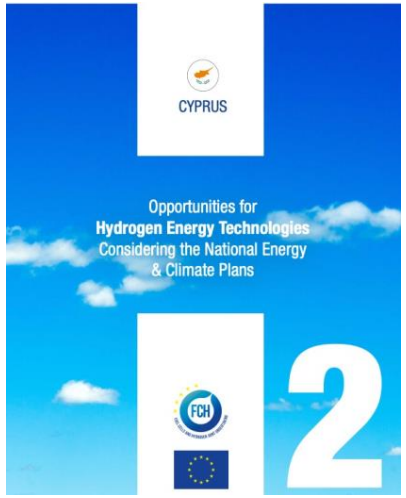


Electrolysis



Opportunities for Hydrogen Energy Technologies in Cyprus

Source:



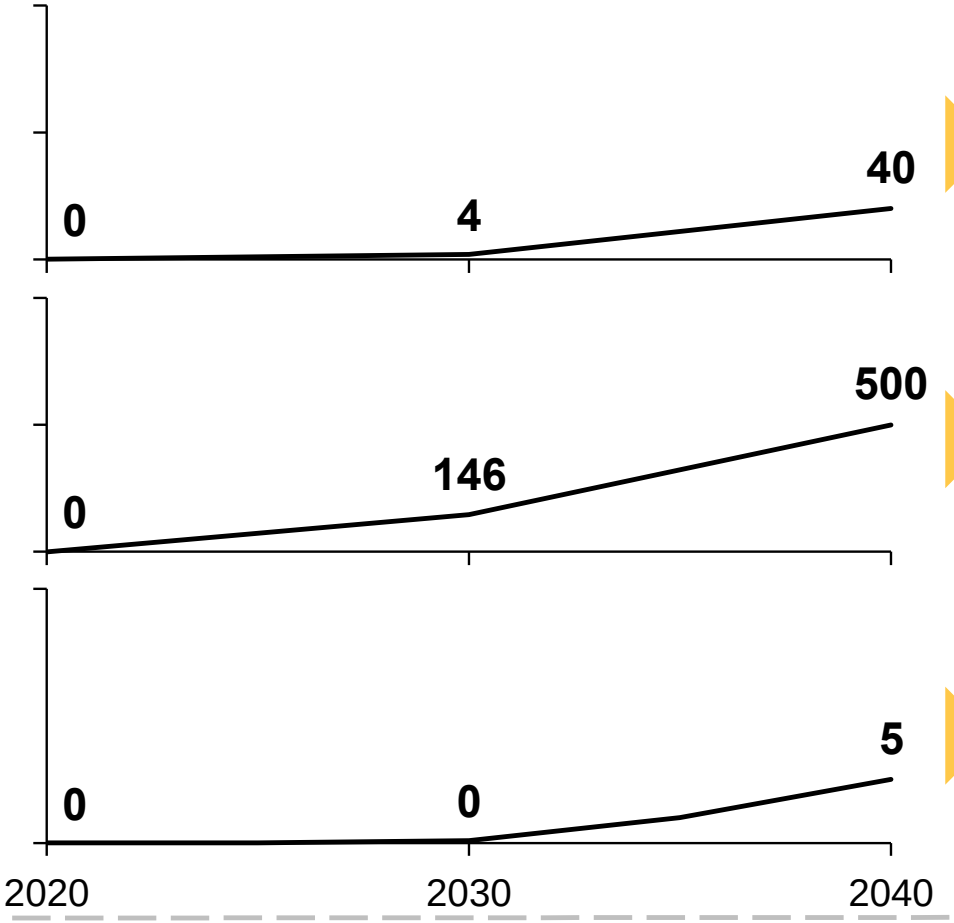
KEY FINDINGS

1. Main **consumption sectors** for hydrogen in 2030 are:
   - **transportation** (146 GWhH2 ≙ 3,705 tonnes of H2),
   - **industry** (4 GWhH2 ≙ 101.5 tonnes of H2) and
   - **buildings** (0.18 GWhH2 ≙ 4.6 tonnes of H2)
2. A **dedicated installed renewable electricity capacity** of **15 to 100 MW** is required to produce green hydrogen and cover its estimated hydrogen demand by 2030
3. The **NECP** of Cyprus estimates a production of about 1.5 TWh of renewable electricity in 2030 but **does not consider H2 deployment** for the period from 2021 to 2030
4. According to the estimated renewable electricity production in 2030, approx. **15 % of renewable electricity** will be used for **production of hydrogen** via electrolysis
5. **Annual costs** for green hydrogen production, development of its transport infrastructure and end-user applications in Cyprus are estimated to amount between **5 to 28 million Euro**
6. The deployment of hydrogen in Cyprus can add value to its economy e.g. by creating ≈ **600 potential jobs** in manufacturing, construction and operation of H2 technologies
7. The deployment of hydrogen in Cyprus can further **reduce greenhouse gas emissions (7-34 kt CO2/a)** and **fossil energy import dependence (0.03-0.14 TWh/a)** provided we reach our targets.
8. It is currently not possible to use an existing methane infrastructure to transport or distribute hydrogen in Cyprus, as there is **no gas natural network** available
9. **Neither salt cavern natural gas storage sites nor underground salt layers** that could provide **suitable storage** opportunities for hydrogen can be used or found in Cyprus

Cyprus roadmap until 2040

Source: 

H_2 demand development (GWh_{H_2})



Total

- Σ 0 GWh_{H_2}
- Σ 150 GWh_{H_2}
- Σ 545 GWh_{H_2}

Key assumptions / findings

- 4 GWh_{H2} industrial energy demand in 2030
- Limited level of opportunity for hydrogen use in industry (currently no natural gas use in Cyprus)
- Potential application: High-temperature process heat (>200°C) as industrial energy demand

- 146 GWh_{H2} demand for transport sector in 2030
- Hydrogen can be a suitable alternative to electric battery driven cars, trucks and buses
- On the medium to long run, hydrogen and derived fuels can be deployed to decarbonize the aviation sector

- 0.18 GWh_{H2} demand for heating and cooling in 2030
- Cyprus has no natural gas in its energy mix. However, space cooling is an important energy end-use for buildings
- Hydrogen-based technologies (reversible systems producing electricity and heating/cooling) can be an alternative e.g. for the services sector

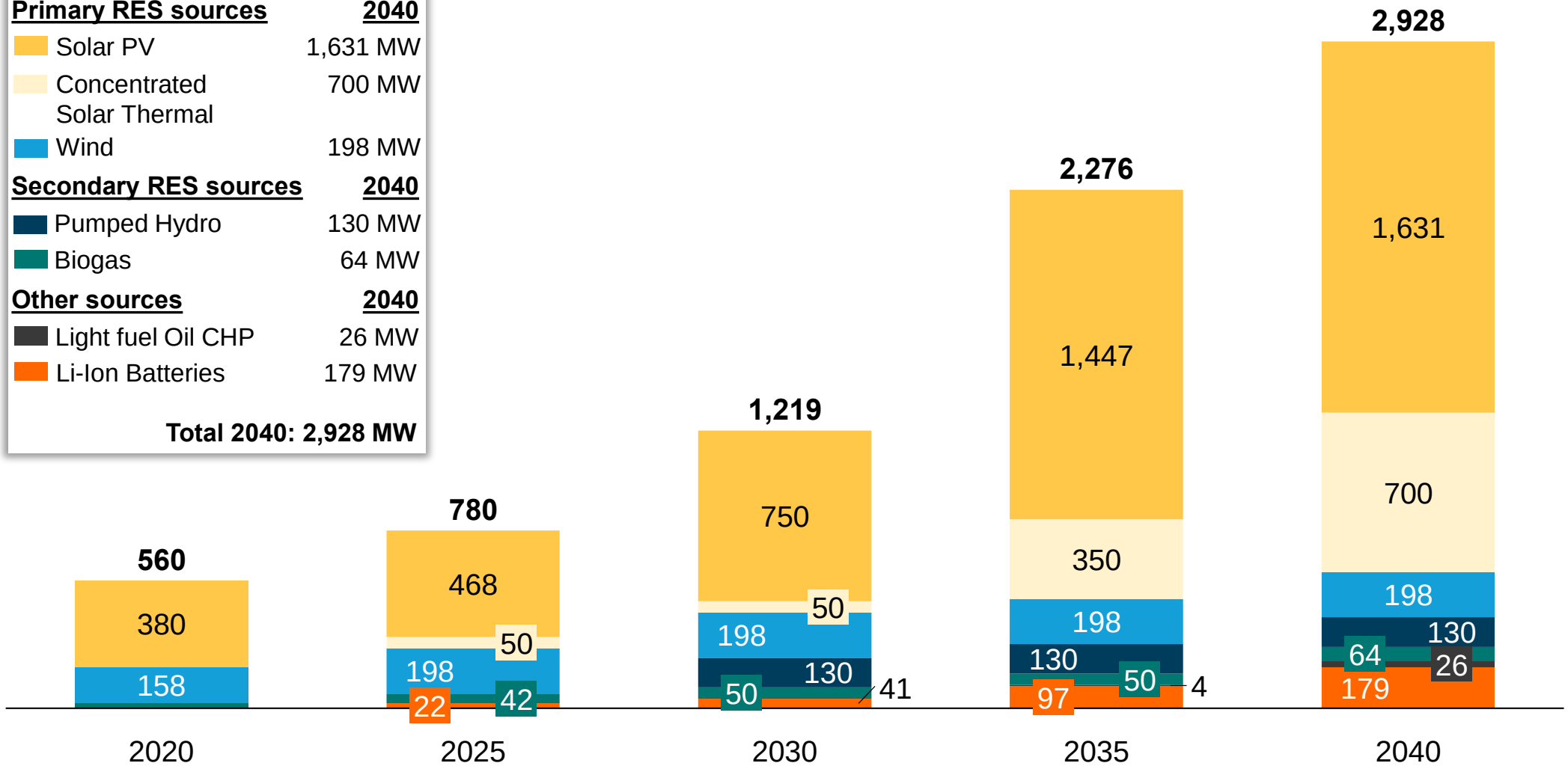
- **150 GWh_{H2} in 2030 (0.8% of 2030 final total energy demand)**
- **545 GWh_{H2} in 2040 (2.9% of 2030 final total energy demand)**

Green Hydrogen in Cyprus: RES Capacity in the electricity sector until 2040

The projected / planned RES capacity in Cyprus by 2040 is of 2,928 MW according to the NECP. These are:

Primary RES sources	2040
Solar PV	1,631 MW
Concentrated Solar Thermal	700 MW
Wind	198 MW
Secondary RES sources	**2040**
Pumped Hydro	130 MW
Biogas	64 MW
Other sources	**2040**
Light fuel Oil CHP	26 MW
Li-Ion Batteries	179 MW

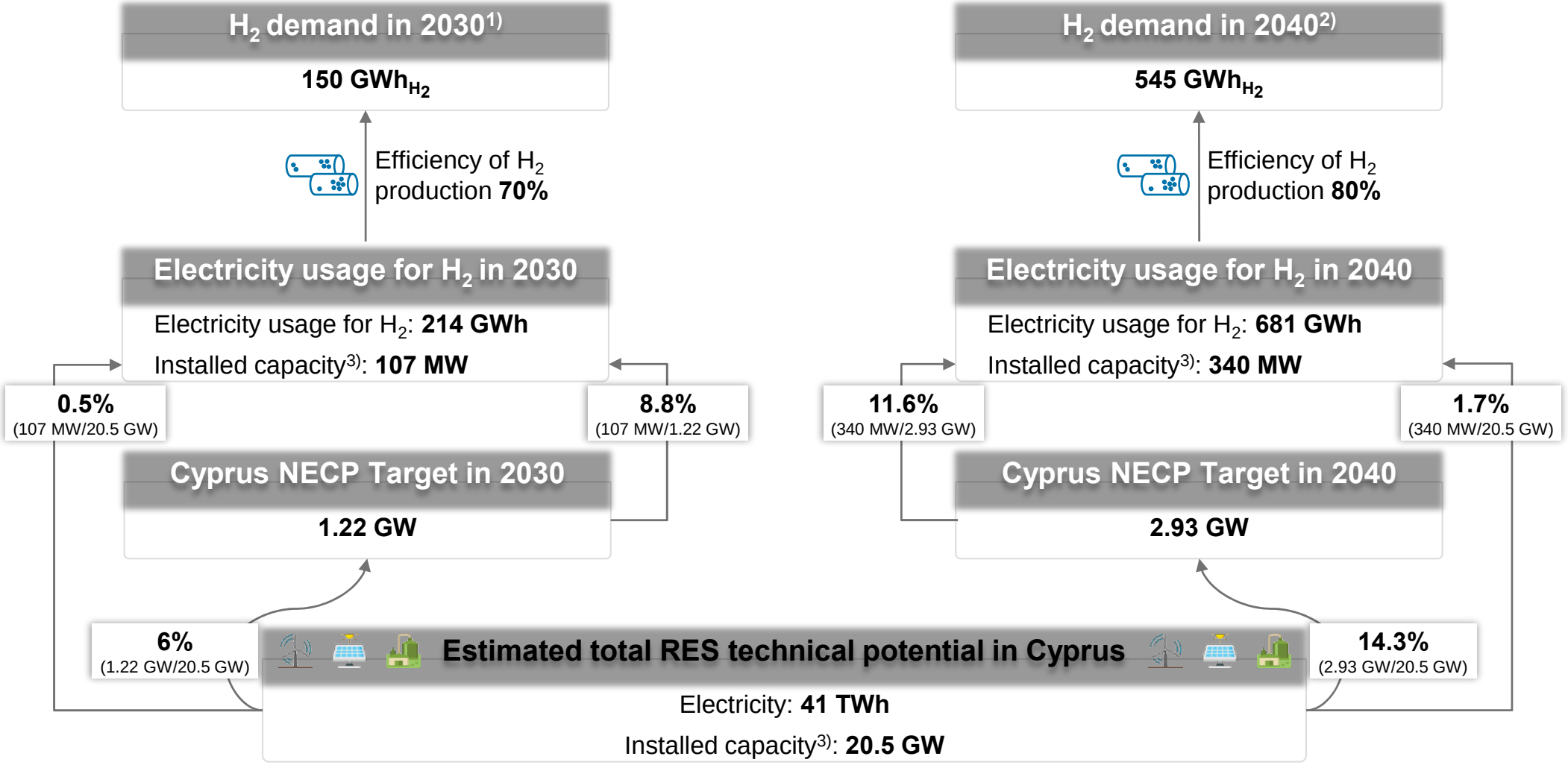
Total 2040: 2,928 MW



RES: Renewable Energy Sources | NECP: National Energy and Climate Plan | PV: Solar Photovoltaic Systems | CHP: Combined Heat and Power

Green Hydrogen in Cyprus: H2 production for Cyprus in 2030 and 2040

About 9% of RES installed capacity defined in the Cyprus NECP targets would be required to cover the hydrogen demand of Cyprus in 2030, whereas around 12% would be required in 2040



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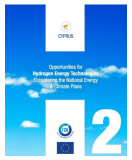

RES: Renewable Energy Sources | NECP: National Energy and Climate Plan

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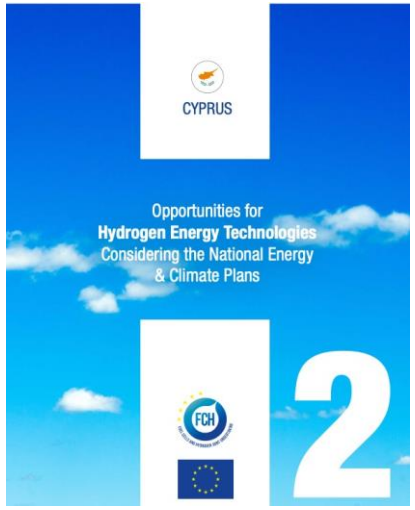
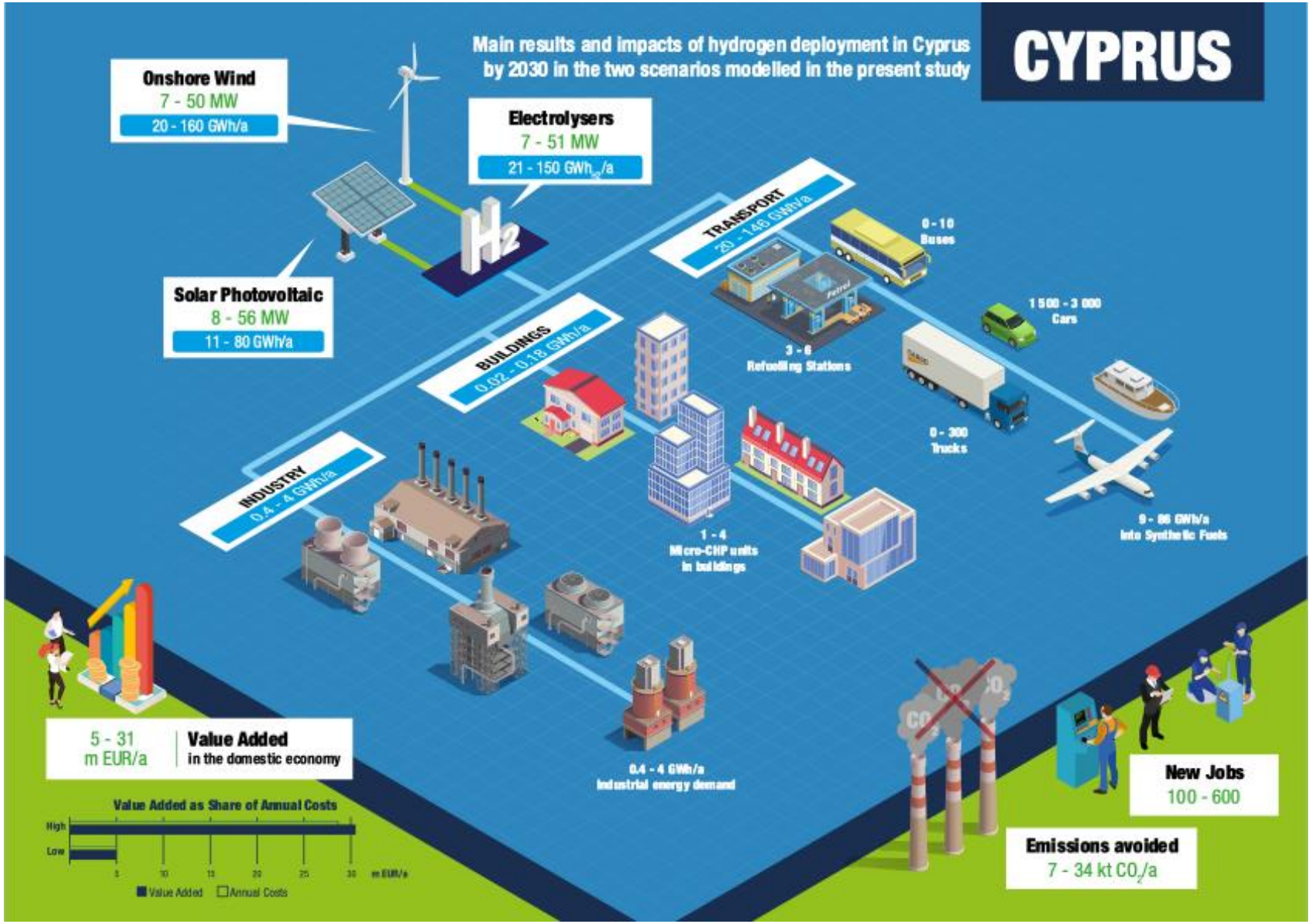
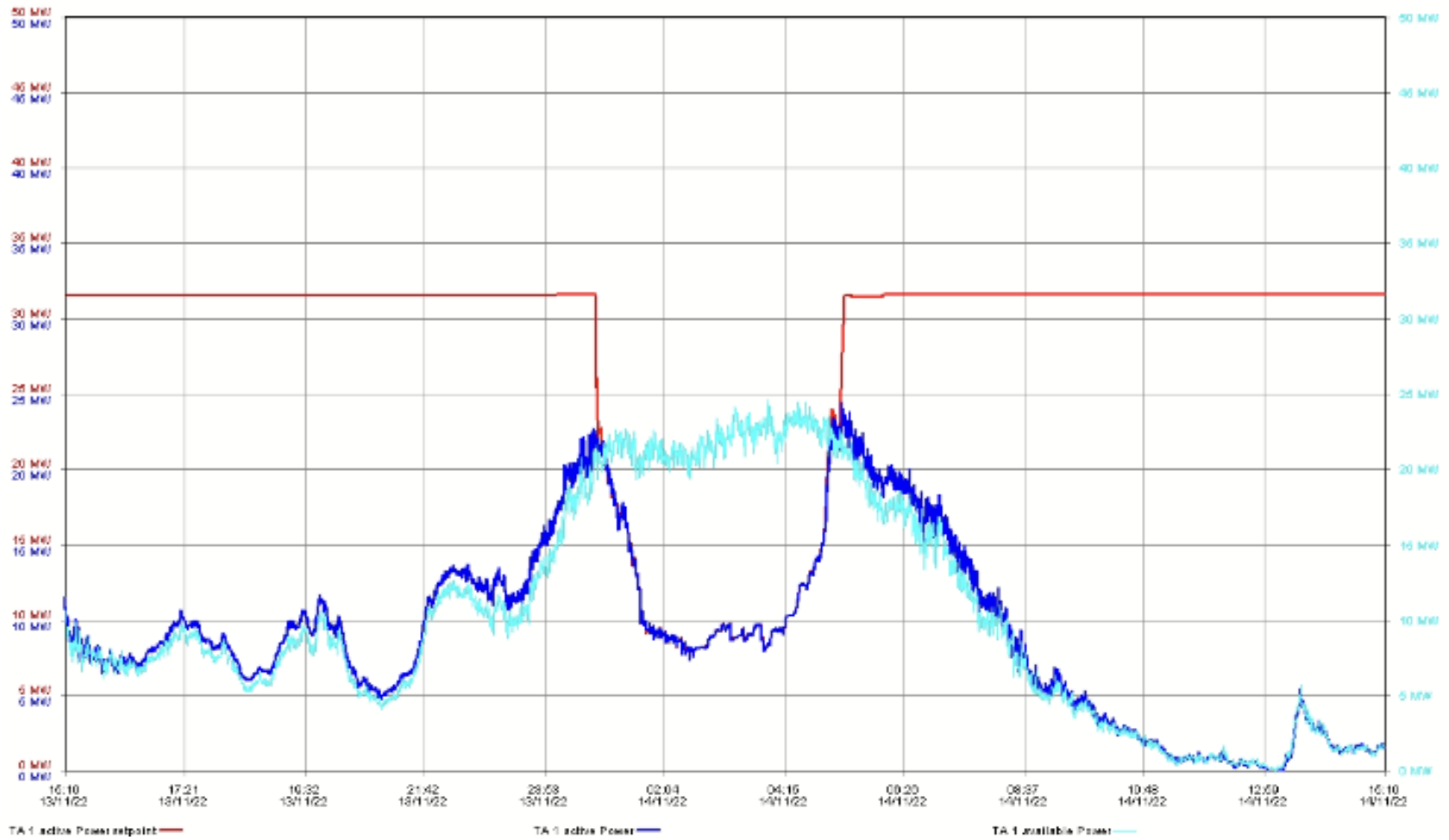


FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING



Curtailment of RES

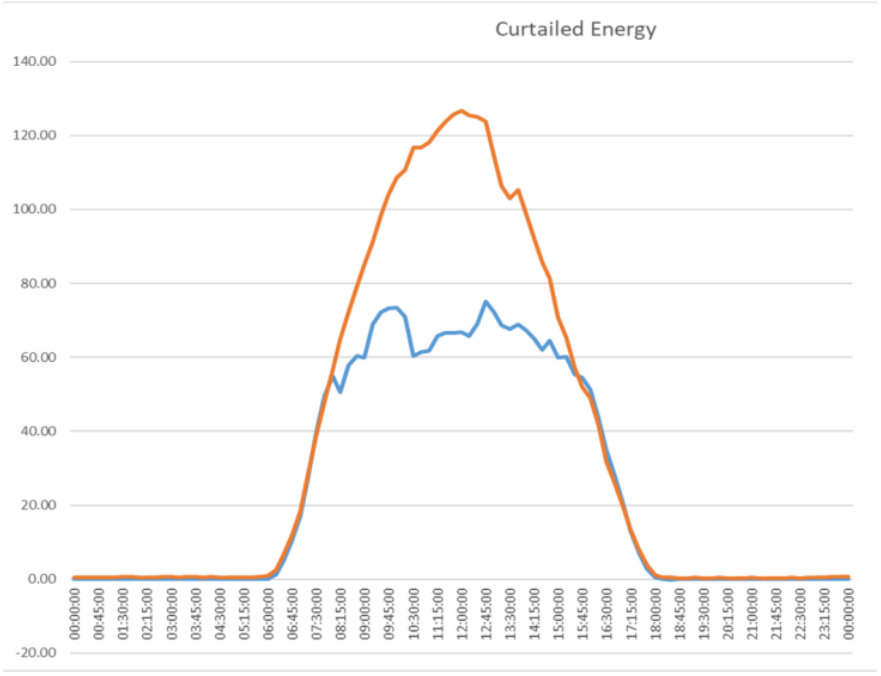


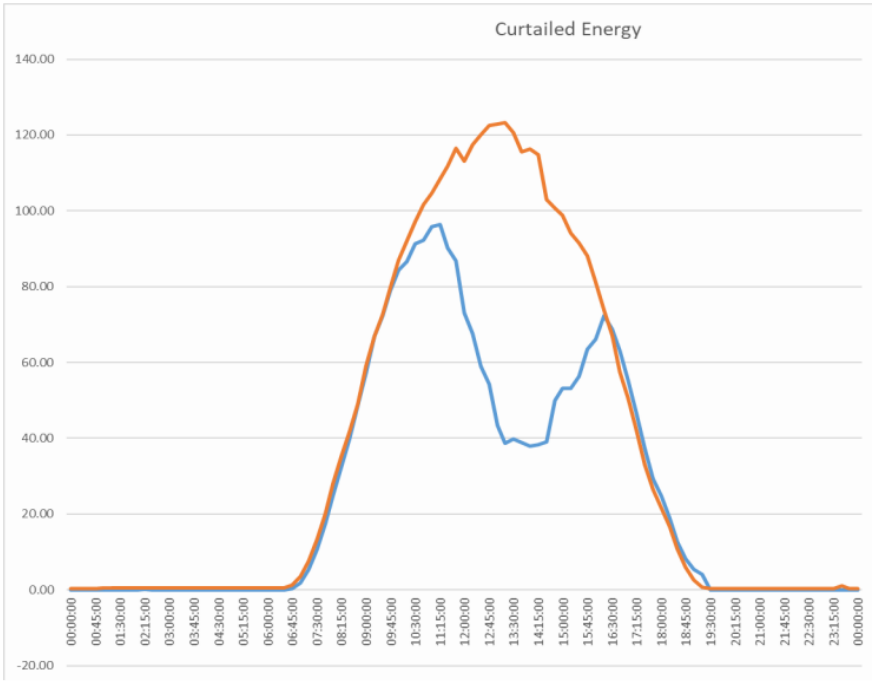
Curtailment Alexigros wind farm, 14.11.2022

Curtailment of RES

Examples of actual days with substantial PV Curtailment

ΔΣΜΚ
Διαχειριστής Συστήματος Μεταφοράς Κύπρου
Transmission System Operator - Cyprus





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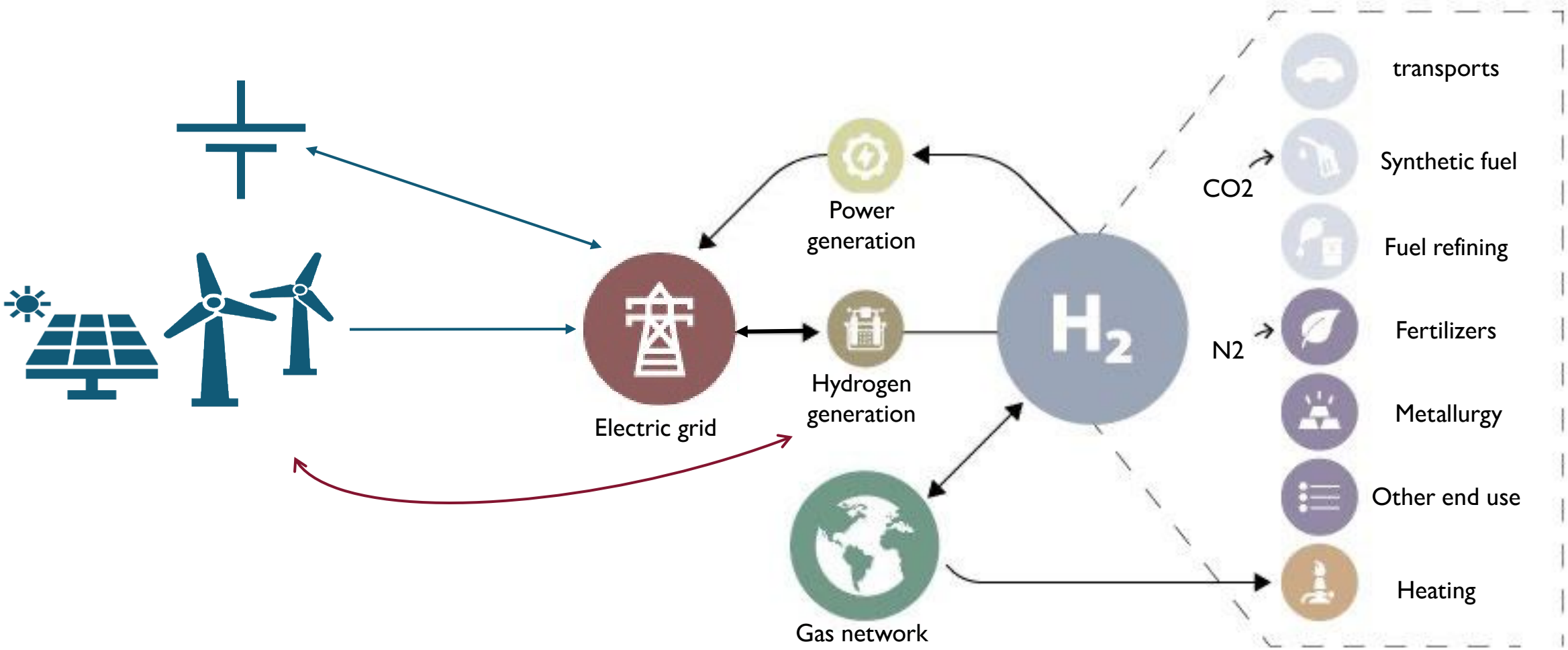
The value chains of green hydrogen



H2 filling station

Refueling with Hydrogen

H2 filling station

https://www.weh.se/refuelling-components-hydrogen/h2-car-dispensers.html

https://www.fiedlergroup.com/architecture-engineering-project-recaps/shell-opens-san-franciscos-first-hydrogen-stations/

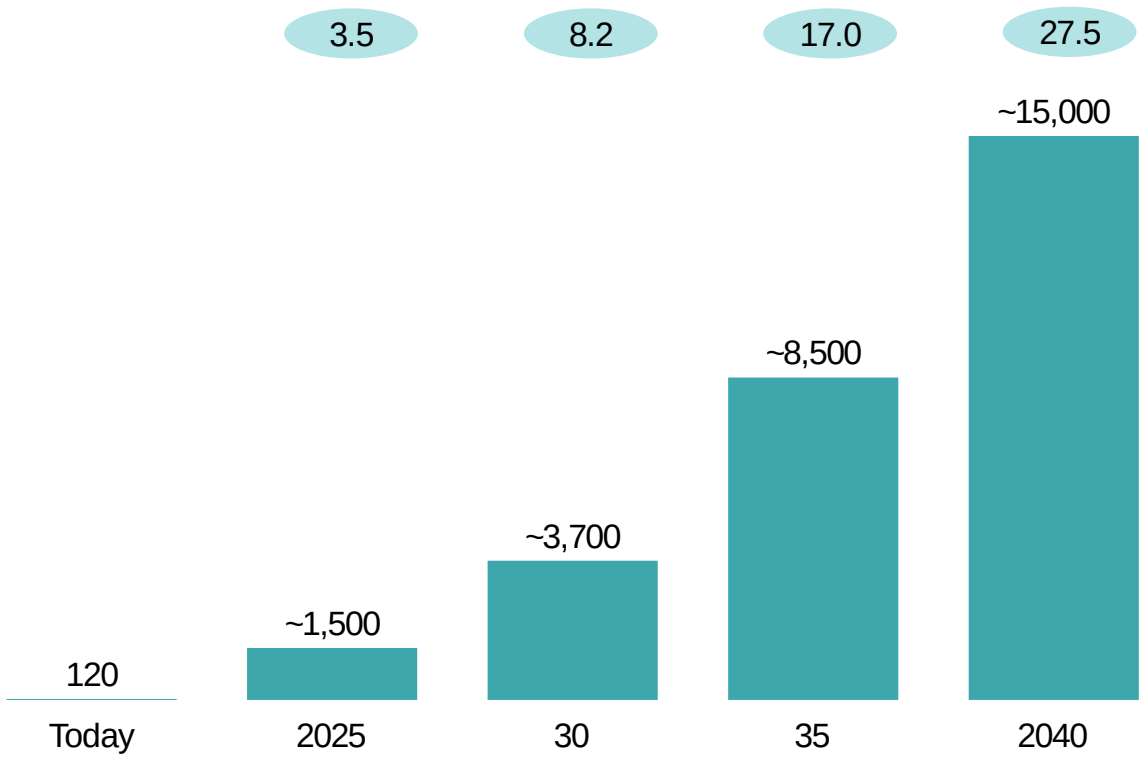
Forecast – Future Hydrogen Refueling Stations [HRS] in Europe

THE EQUIVALENT OF ~3,740 REFUELING STATIONS WOULD BE REQUIRED BY 2030, IMPLYING INVESTMENT NEEDS OF EUR ~8.2 BN

Required large HRS[1], number

XX Cumulative investment need, EUR billions

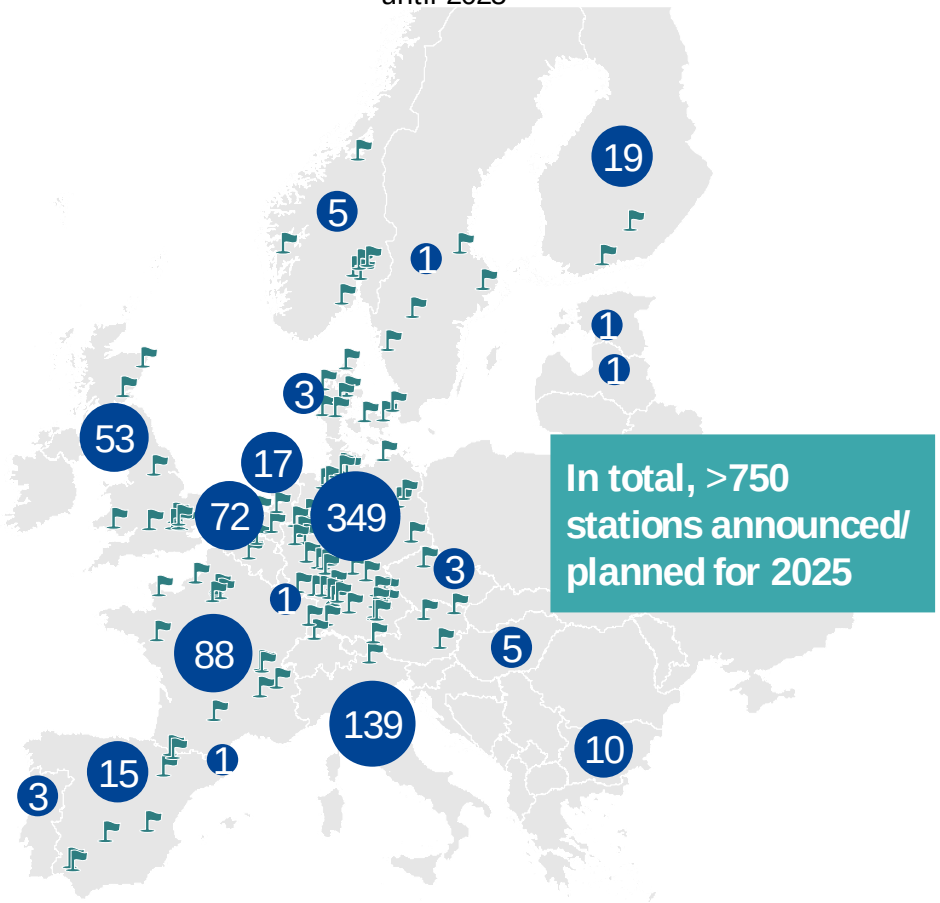
AMBITIOUS SCENARIO



Current and planned HRS in Europe

HRS in operation[2]

Number of HRS announced and/or planned until 2025



In total, >750 stations announced/ planned for 2025

1 Equivalents of medium HRS (1,000kg daily capacity); utilization relative to steady-state 2 Indicative position

SOURCE: European Commission (2017); H2stations.org; press research; Hydrogen Roadmap Europe team

Source: "Hydrogen Roadmap Europe", FCH

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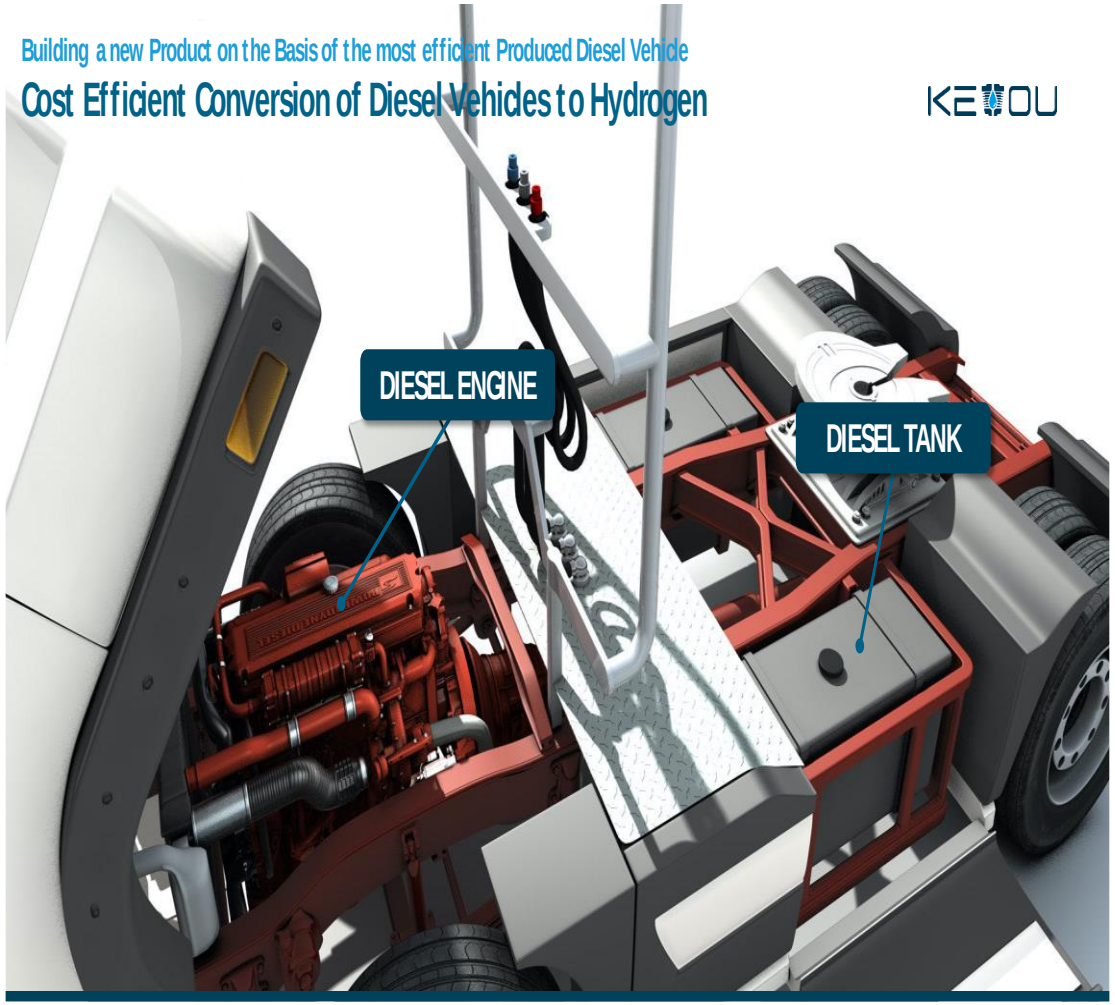
KEYOU
Hydrogen Moves Webinar, September 15, 2022 | Markus Schneider, COO & Co-Founder, KEYOU GmbH
The Hydrogen Engine for Commercial Vehicles
Co-funded by the Horizon 2020 programme of the European Union
Federal Ministry for Digital and Transport
Sponsored by
Bavarian Ministry of Economic Affairs, Regional Development and Energy

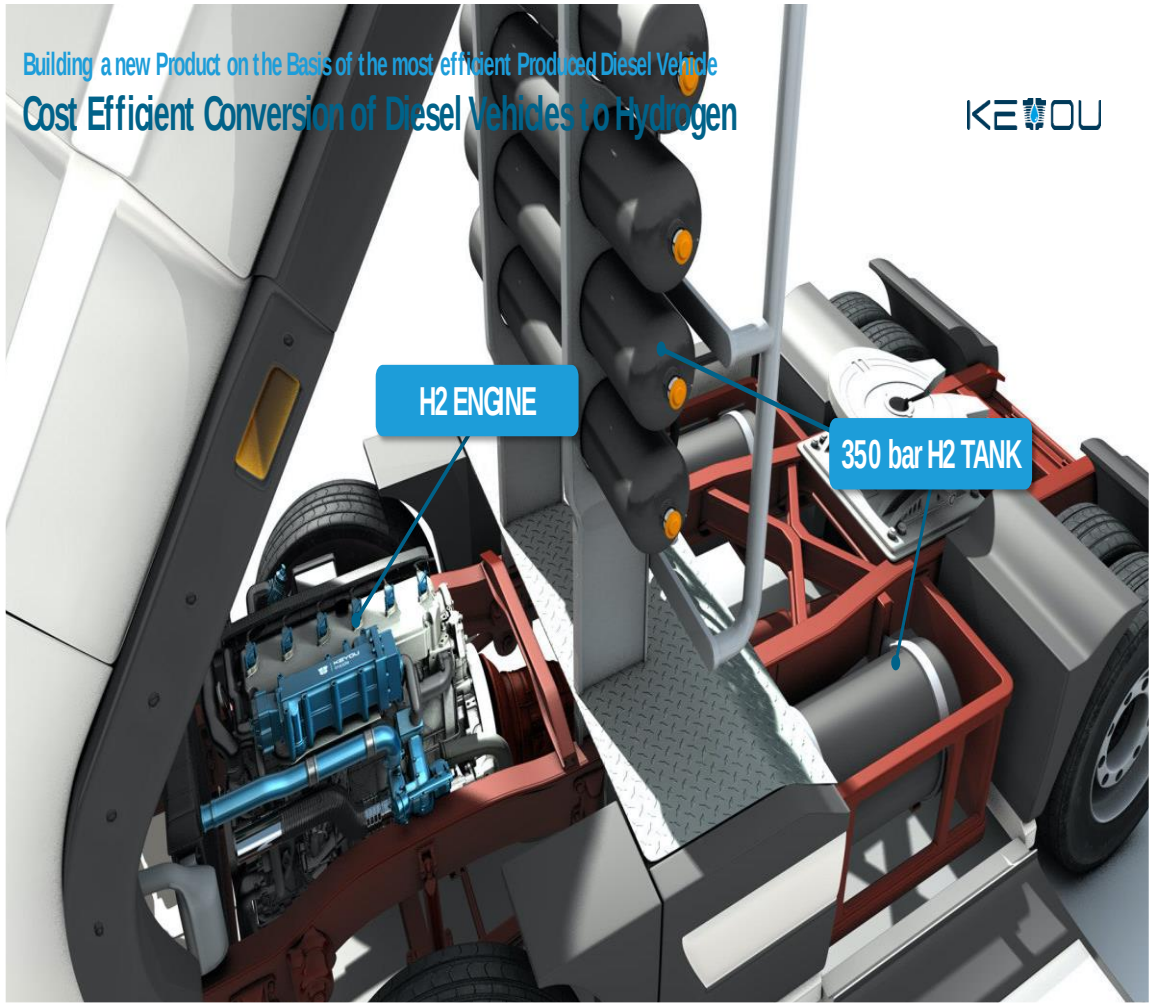
Building a new Product on the Basis of the most efficient Produced Diesel Vehicle

Cost Efficient Conversion of Diesel Vehicles to Hydrogen



Building a new Product on the Basis of the most efficient Produced Diesel Vehicle

Cost Efficient Conversion of Diesel Vehicles to Hydrogen



Fuel cell vehicle applications

Passenger vehicle

Hydrogen logistic vehicle

Hydrogen heavy duty truck

Hydrogen bus

Hydrogen bin truck

Hydrogen forklift

FCEV Passenger cars

Hyundai ix35

Hyundai NEXO

Toyota MIRAI

Honda Clarity Fuel Cell

Mercedes-Benz GLC F-CELL

FCEV Range Extended Vans

Renault Master Z.E. Hydrogen

Cost to purchase new: ~50.000 €

Cost to purchase new: ~55.000 €

Nissan e-NV200

Cost to purchase new: ~50.000 €

FCEV Heavy Duty Vehicles

Hyzon Hydrogen Heavy Truck

Toyota Hino Profia FC

Cost to purchase new:
~450.000 €

Hyundai Xcient Fuel Cell

Thank you very much for your attention

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President of CHA,
Makis Ketonis