



# Energy Transition: The role of H<sub>2</sub> for Sustainable Cities

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

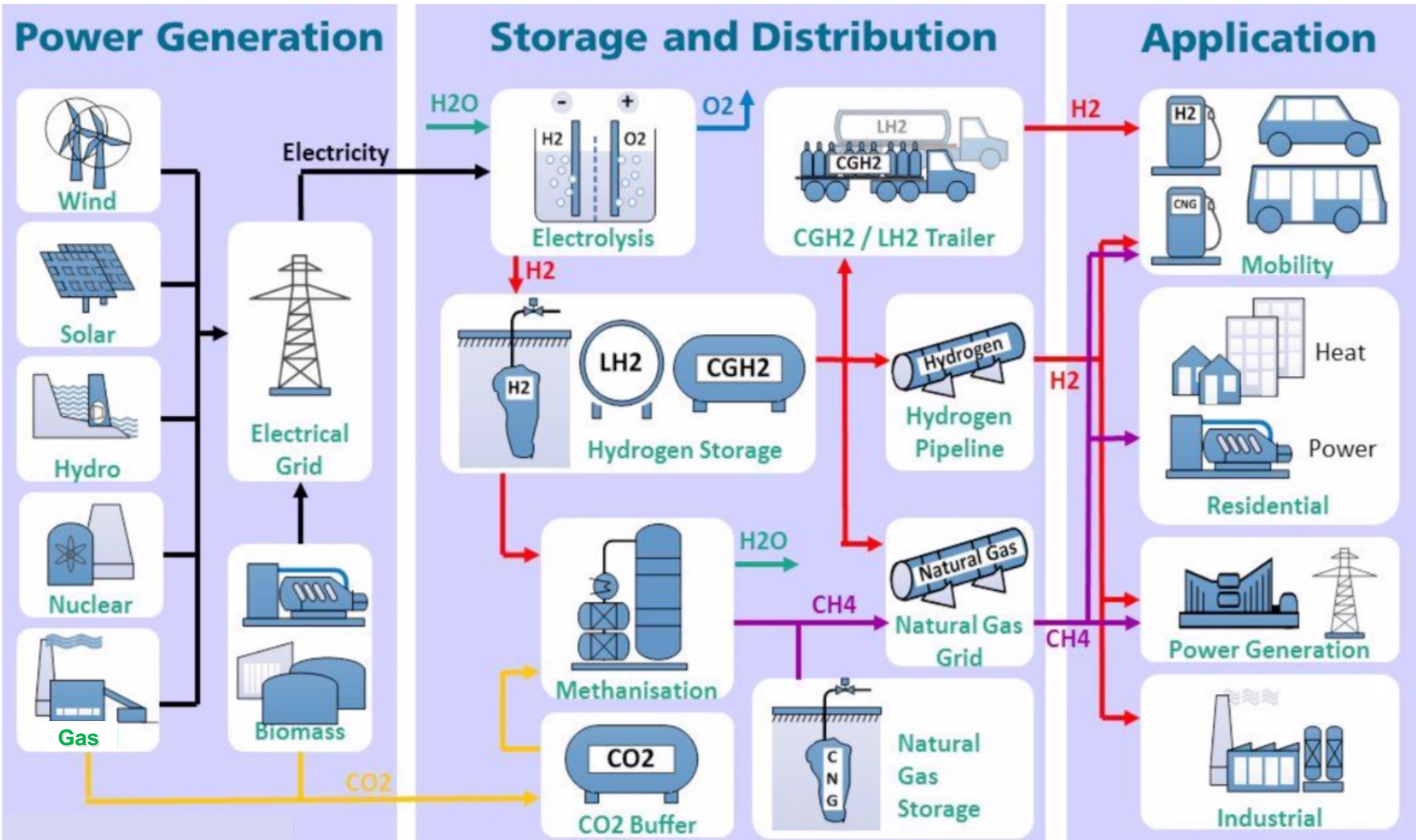
Long-term scenarios from carbon  
economy to hydrogen economy

# 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...”



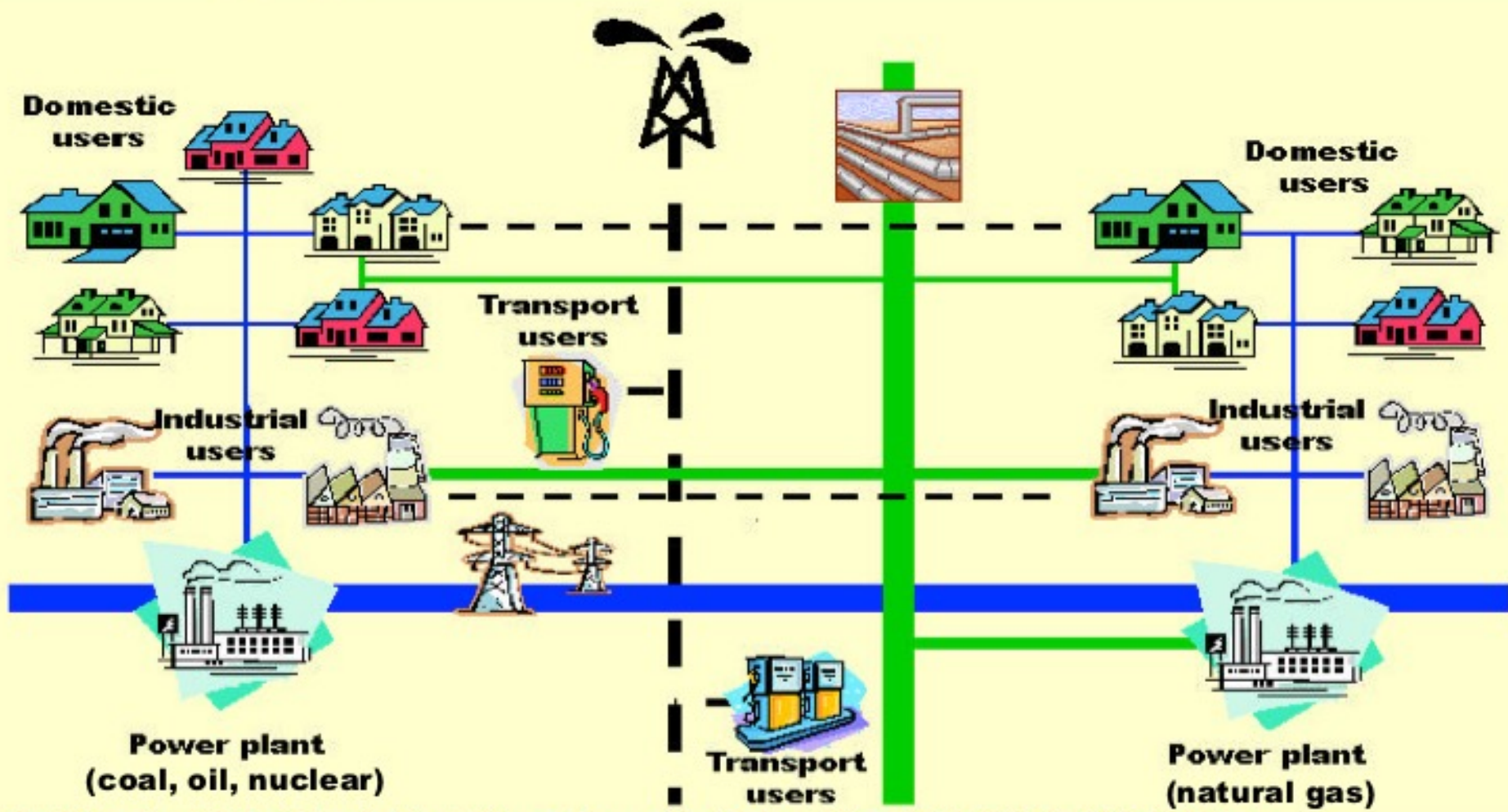
# Potential role of hydrogen in the energy transition\*



\* EU, 2019  
 Ενεργειακή εκδήλωση ΡΑΑΕΥ, 2<sup>η</sup> Διεθνής Έκθεση Κυκλικής Οικονομίας  
 Θεσσαλονίκη, Ελλάδα, 08 Μαρτίου 2024

# Energy system in 2010

## EU energy system in 2010\*

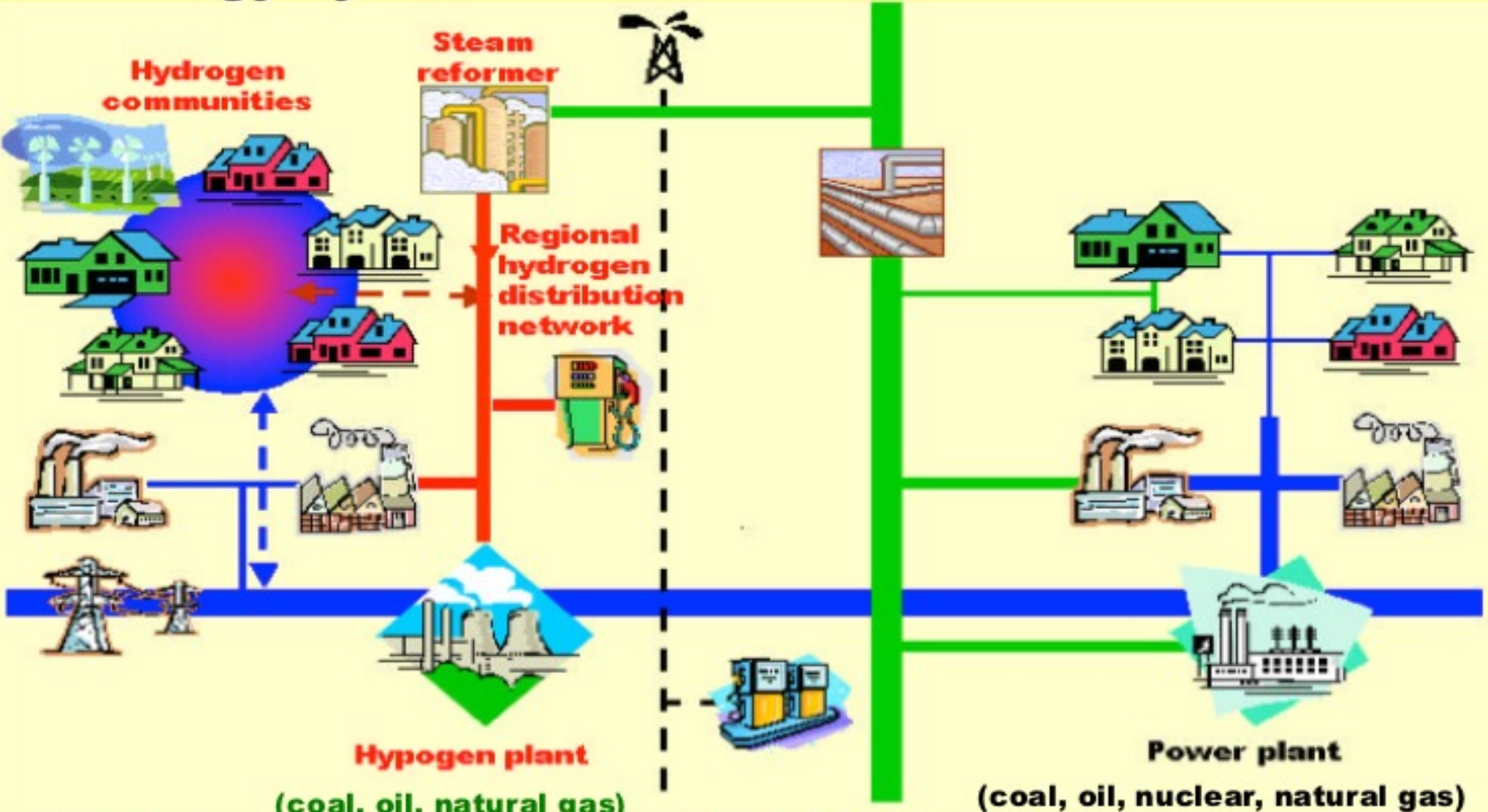


\* Poullikkas A., 2009, *Introduction to Power Generation Technologies*, ISBN: 978-1-60876-472-3



# Future energy systems (optimistic scenario)

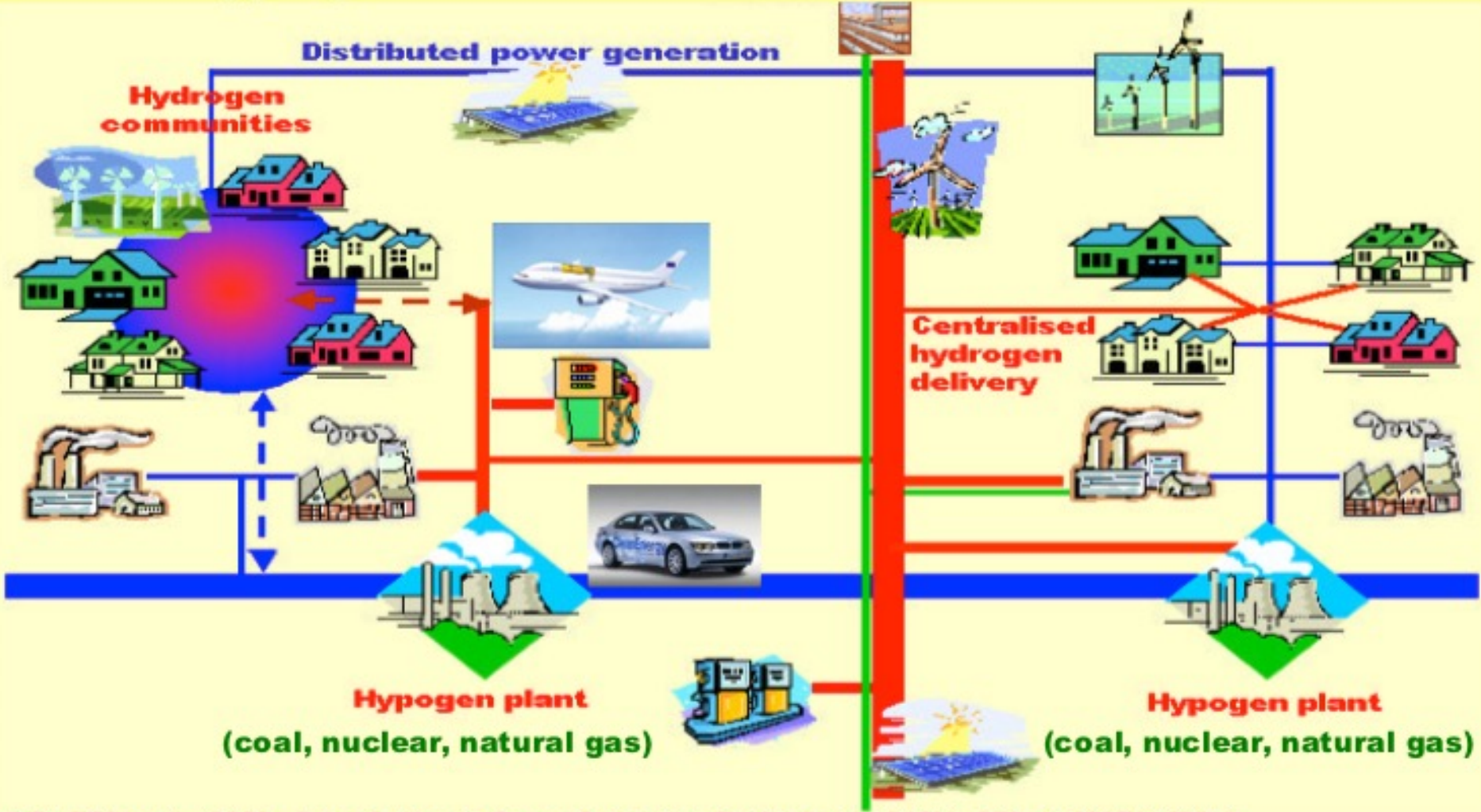
## EU energy system in 2020-30\*



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

# Future energy systems (optimistic scenario)

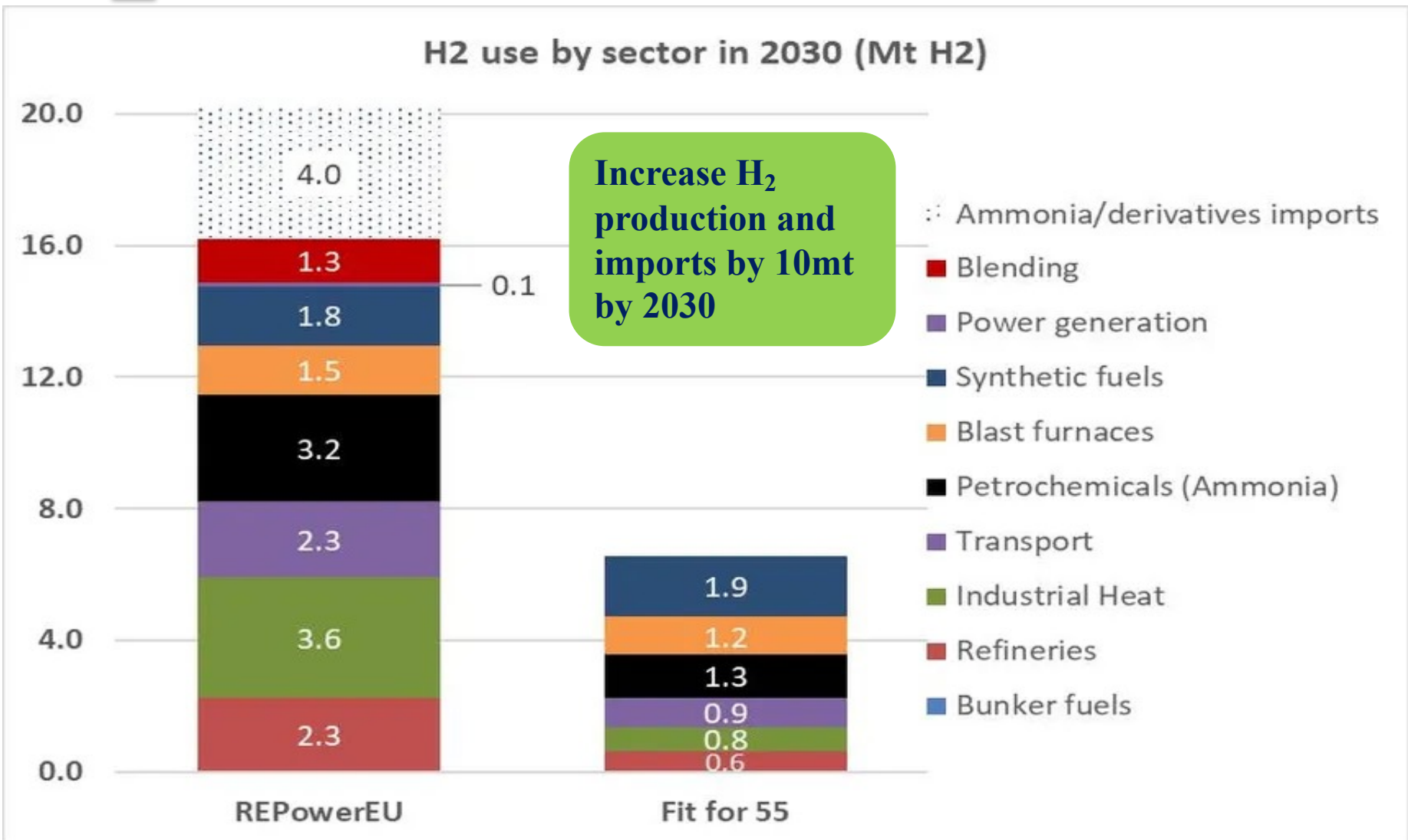
## EU energy system in 2040-50\*



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



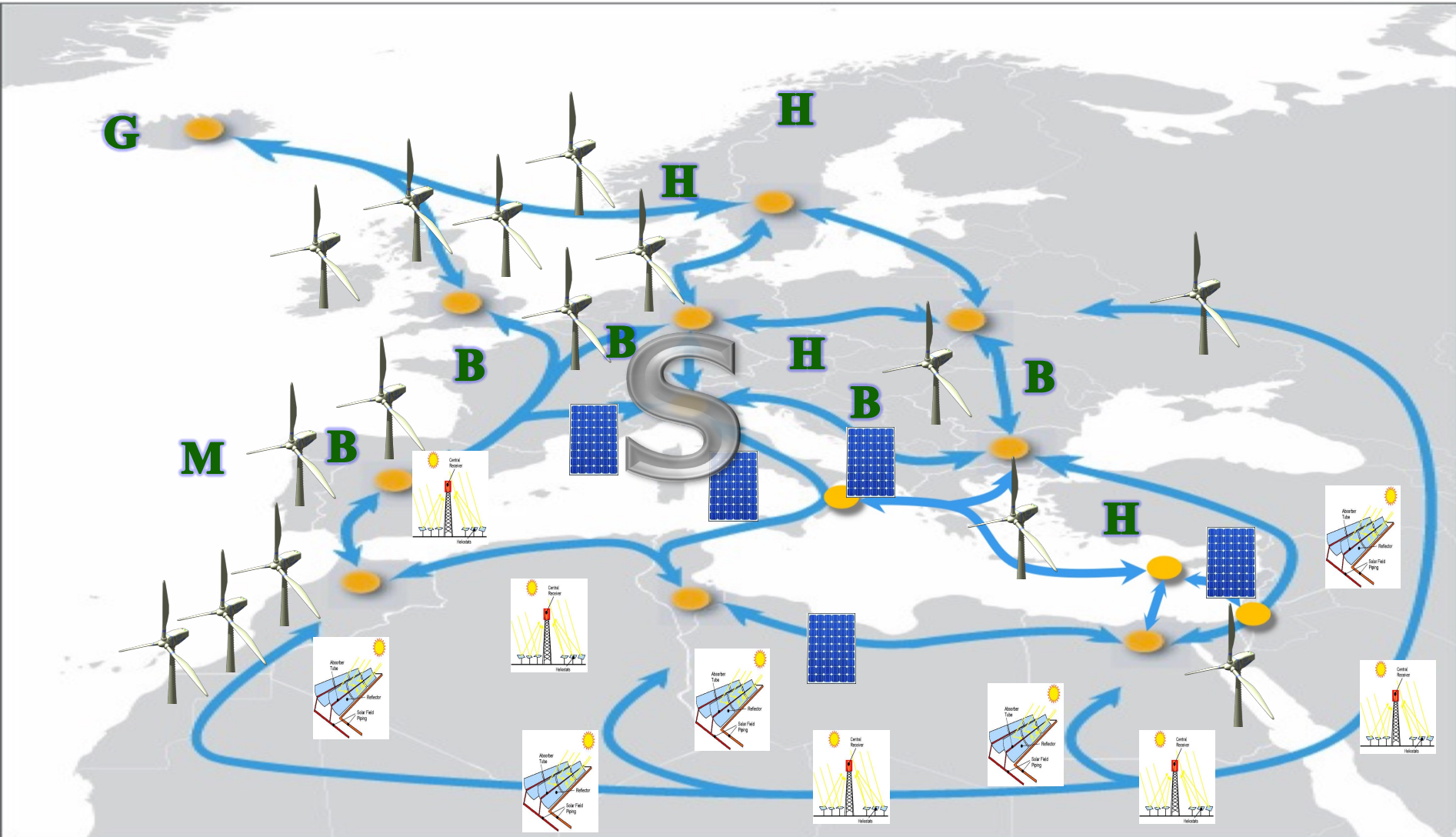
# H<sub>2</sub> accelerator\*



\* RePowerEU Plan, EU, 2022

# The Super Smart Grid after 2050\*

(may allow for 100% RES)



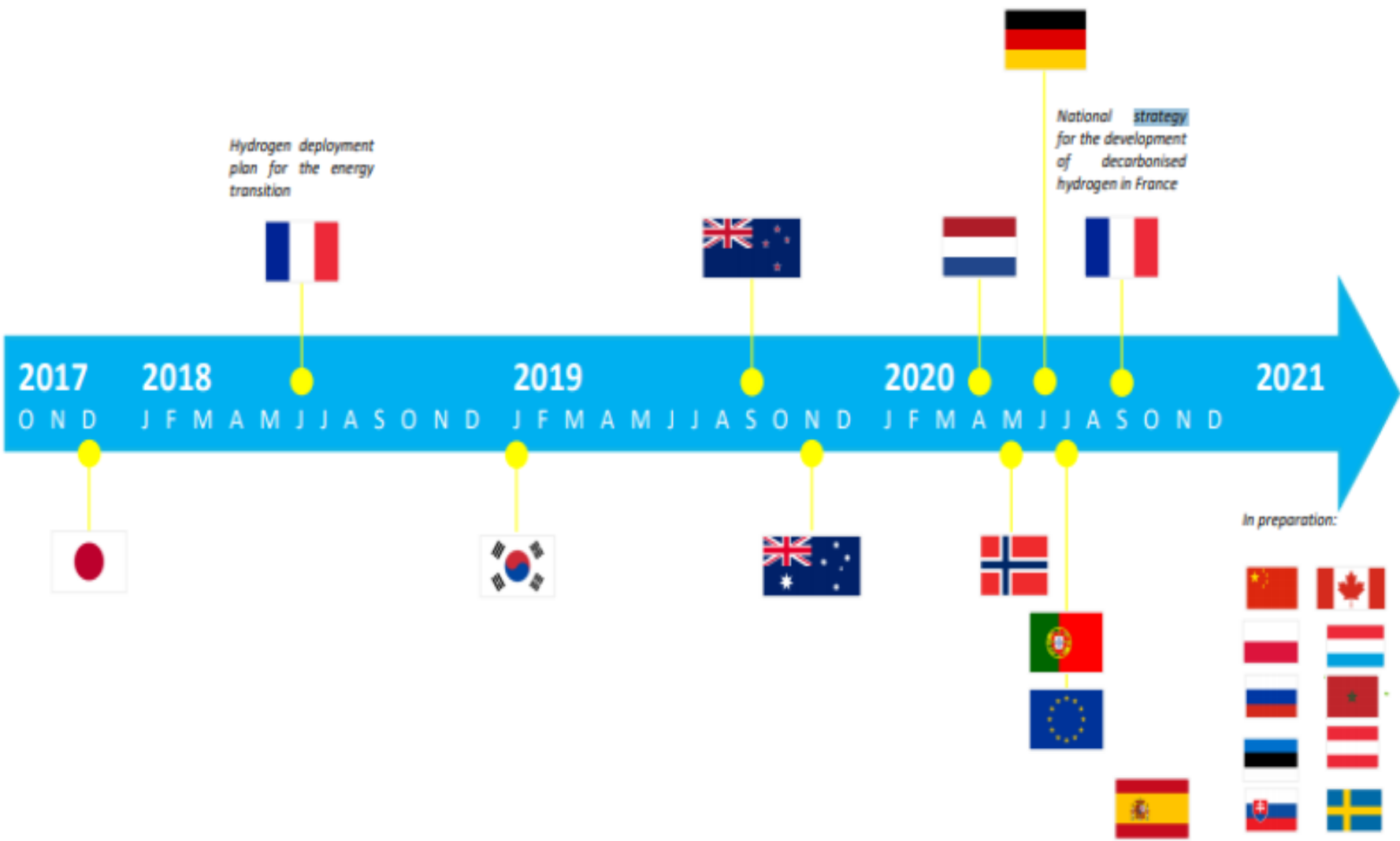
\* Poulikkas A., 2013, Sustainable Energy Development for Cyprus, ISBN: 978-9963-7355-3-2

# National hydrogen strategies

## towards 2030-2050

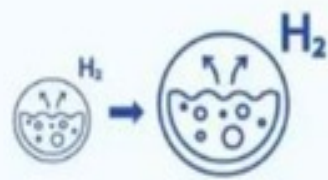


# National Hydrogen Strategies\*



\* 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 H<sub>2</sub> 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

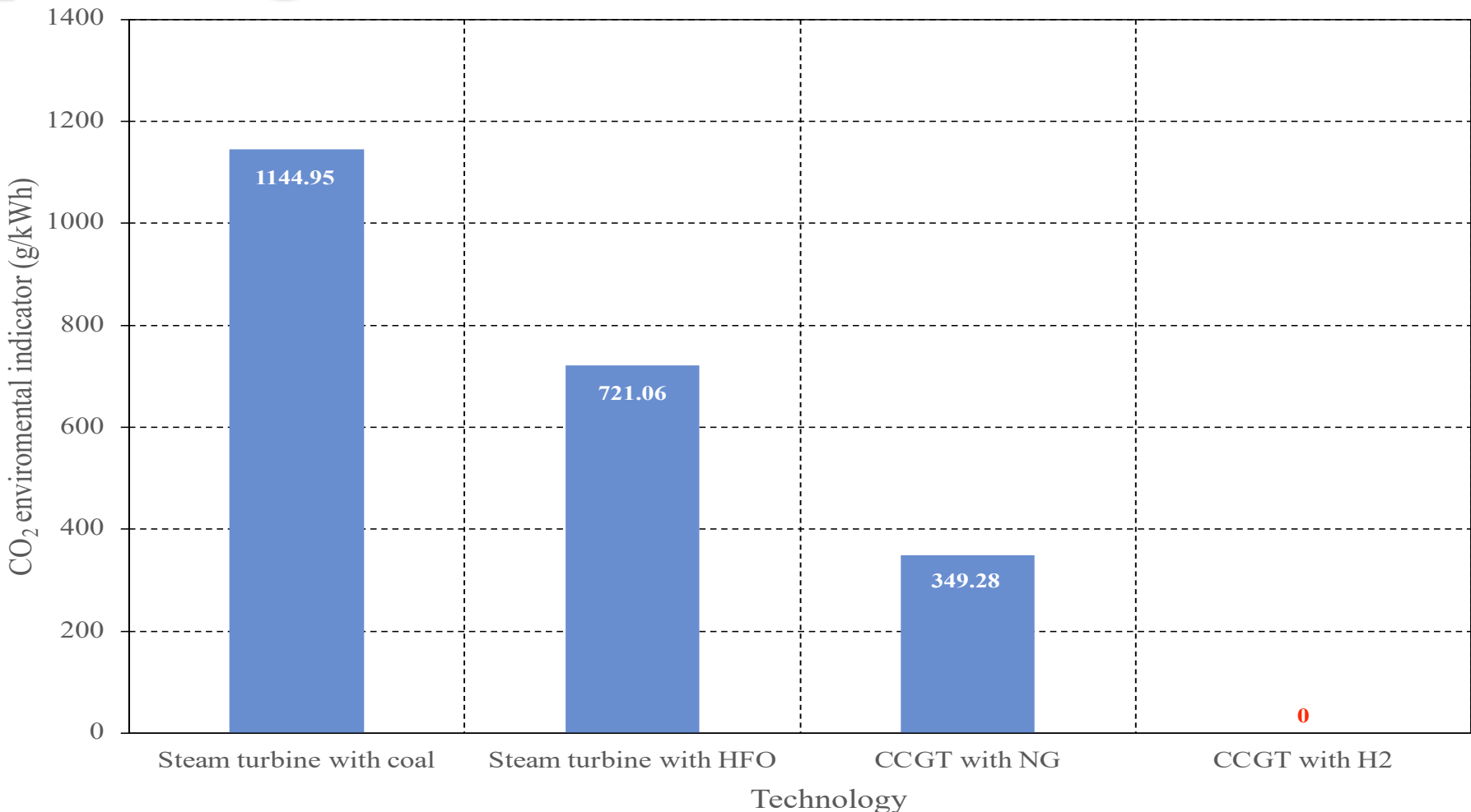




# Green H<sub>2</sub> economics

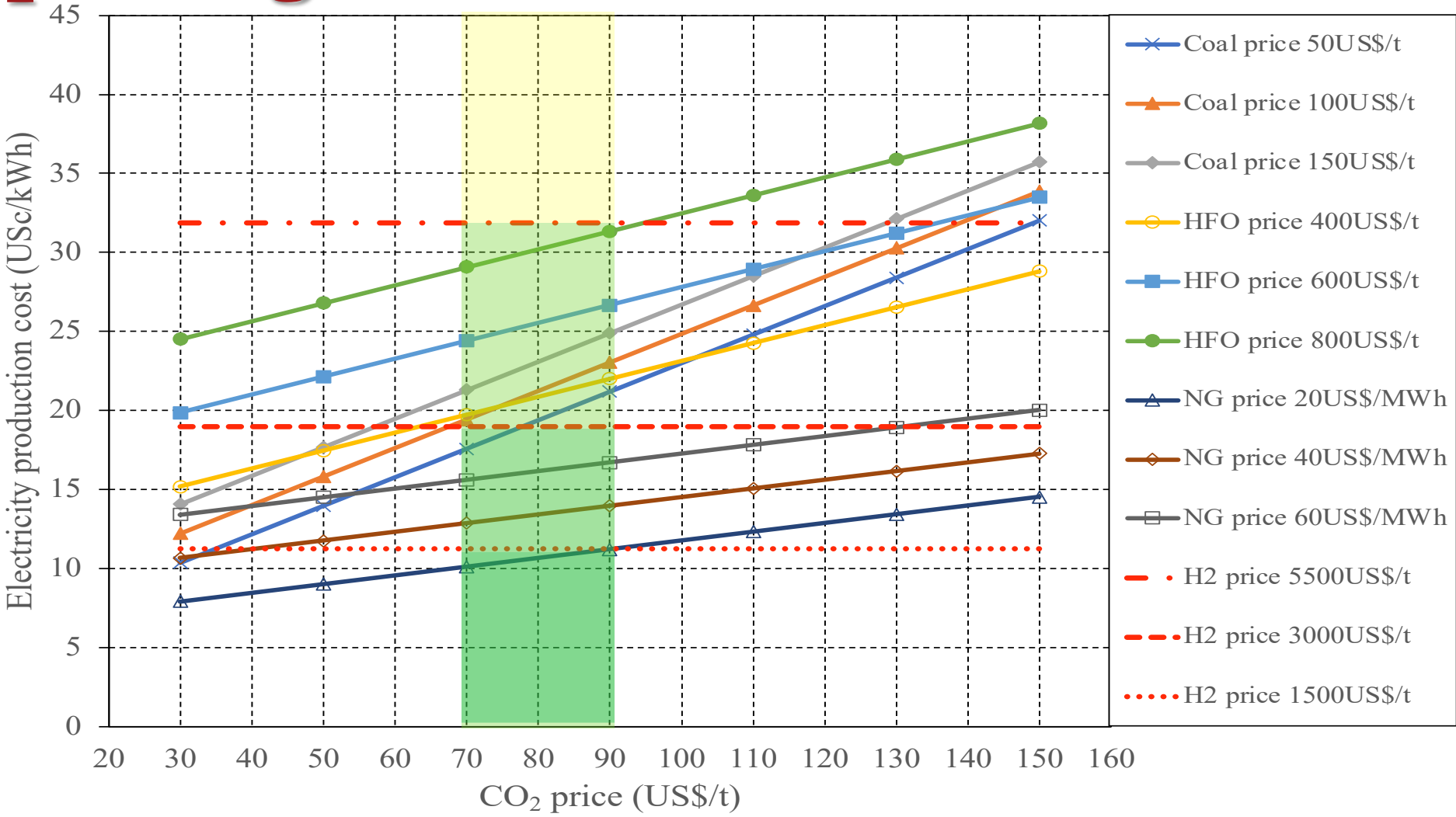
## The effect of carbon price

# Carbon price vs green hydrogen power generation\*



\* Nicolaidis P., Poullikkas A., 2023, "Power-to-hydrogen concepts for 100% renewable and sustainable energy systems", *Hydrogen Economy*

# Carbon price vs green hydrogen power generation\*



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