# ENERGY ECONOMIC PROSPECTS FOR GREEN HYDROGEN IN EUROPE

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# 1. INTRODUCTION

## Motivation:

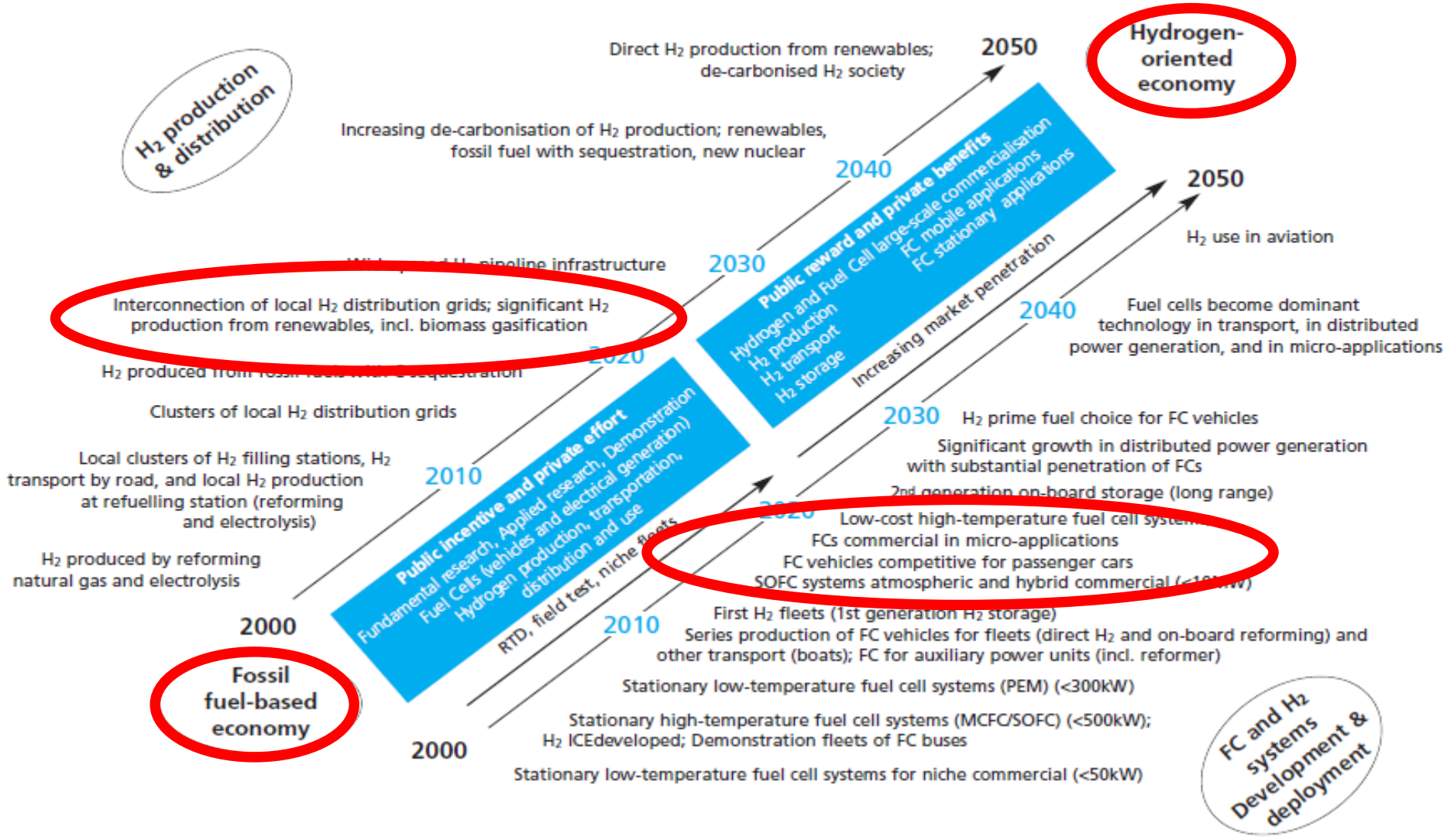
* Urgent needs for clean energy carriers

* It is not possible to force variable renewables into the system → storage needed 4

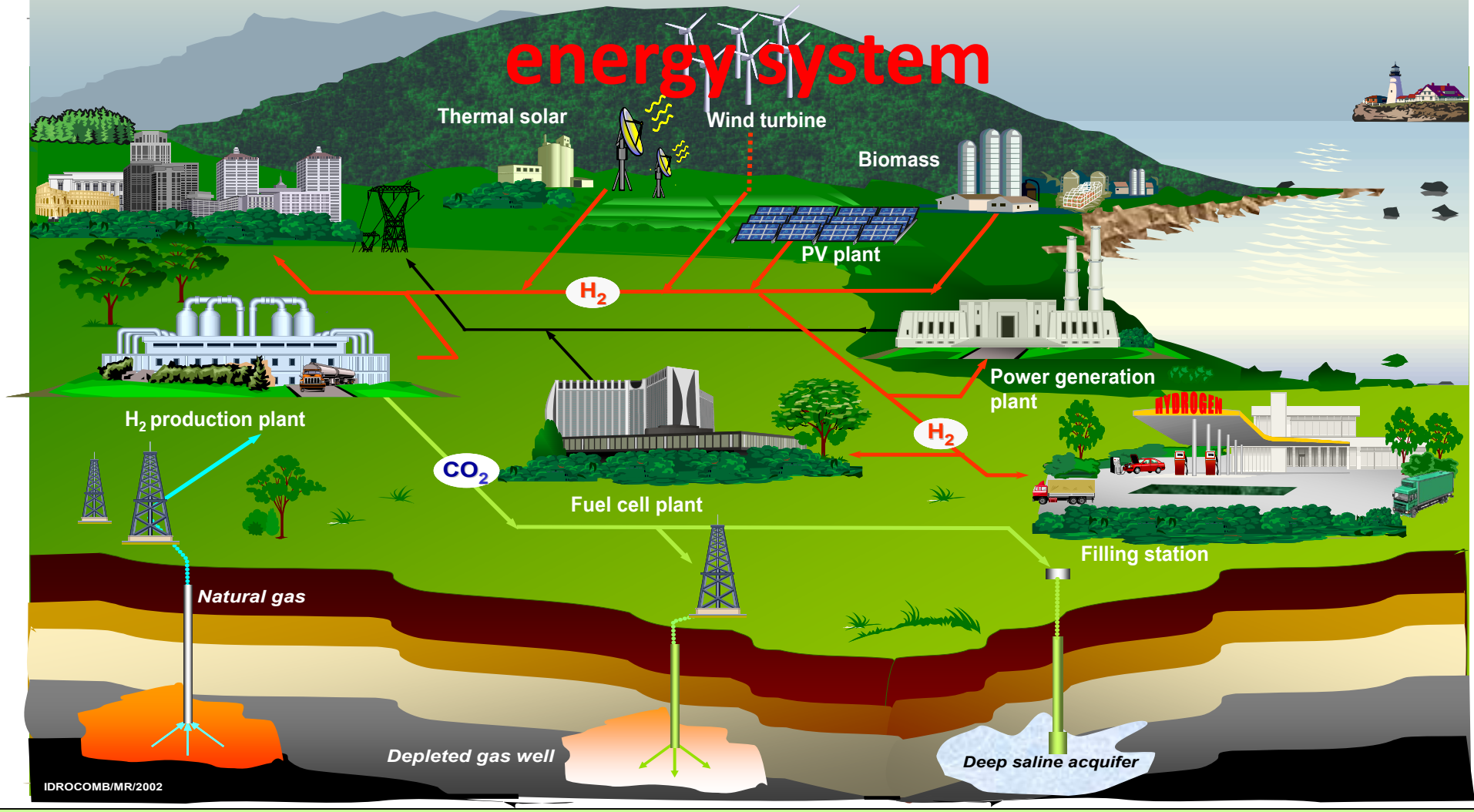
* Hydrogen is seen as such a clean energy carrier since decades

* Yet so far it has not delivered

# EU-Roadmap H2 (2003)



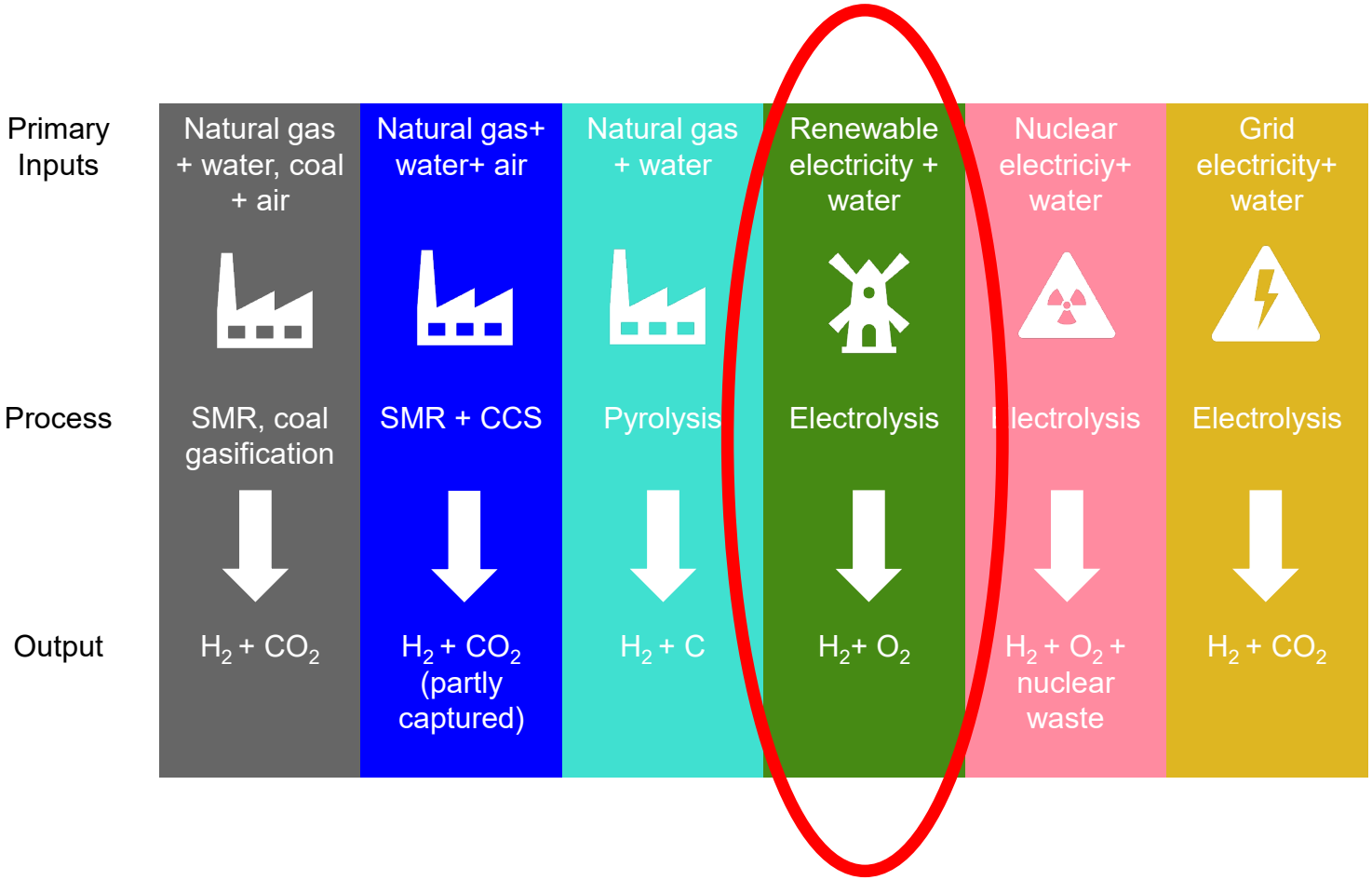
# The vision of a hydrogen–based energy system



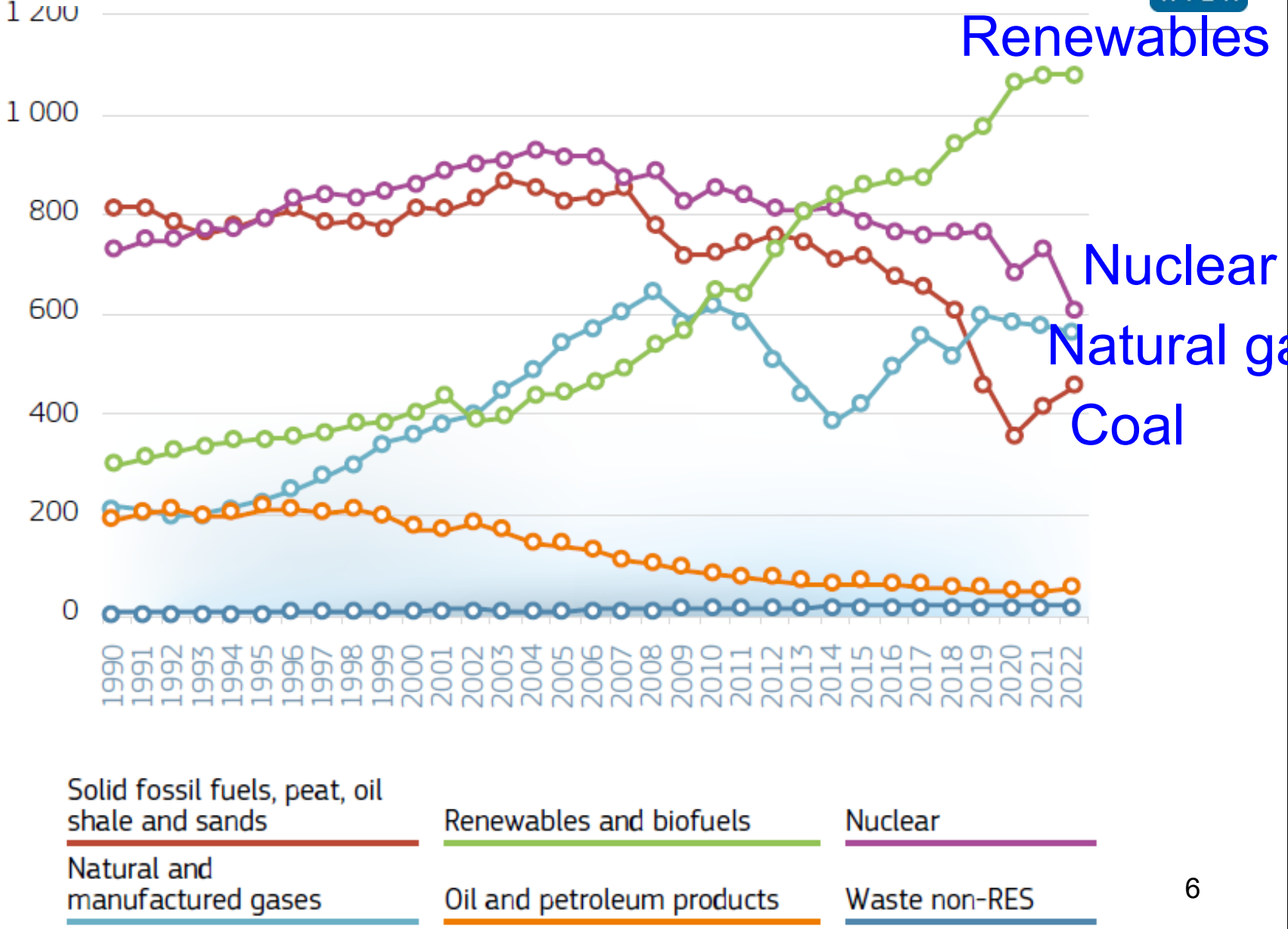

**This is how an integrated energy system of the future might look – combining large and small fuel cells for domestic and decentralised heat and electrical power generation. Local hydrogen networks could also be used to fuel conventional or fuel cell vehicles.**

Source: EU, 2003

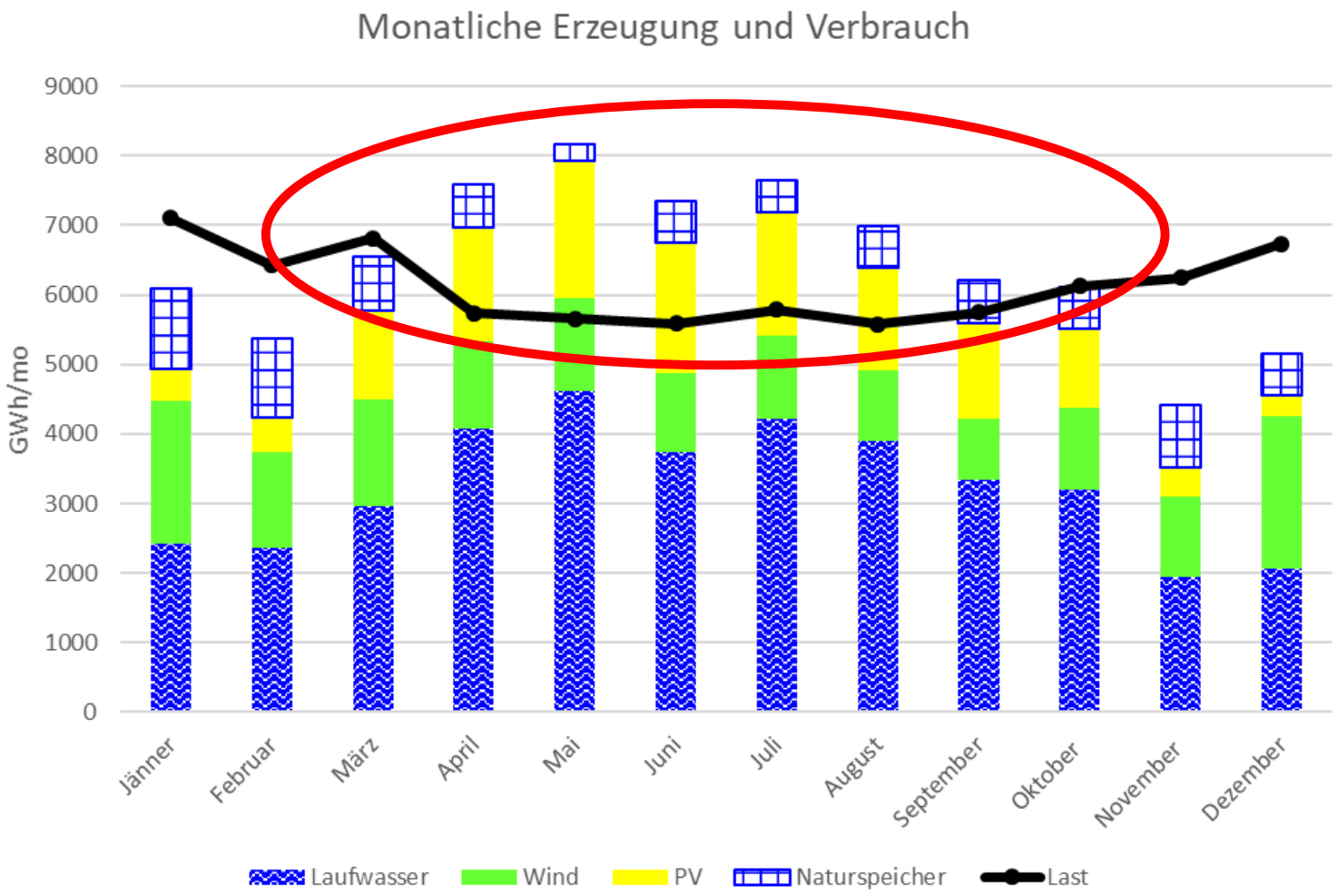
# Main colors of hydrogen



# 3. Renewable electricity generation

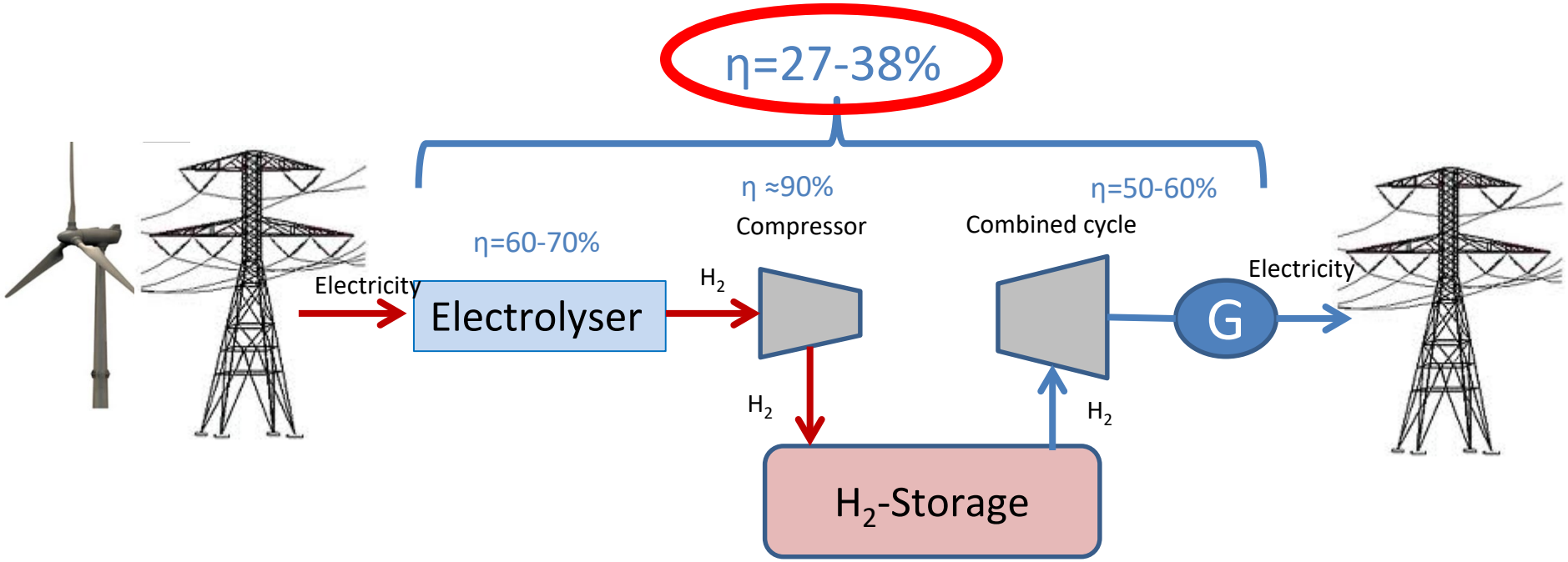


# Scenario monthly 2030

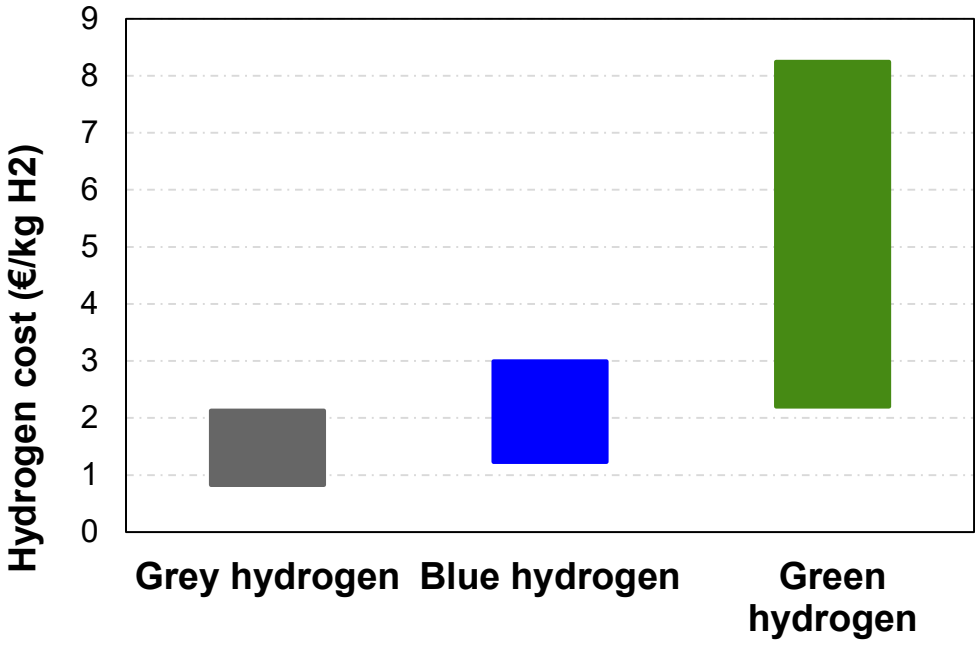


# Hydrogen as storage for re-electrification

*Very low roundtrip efficiency for electricity!*

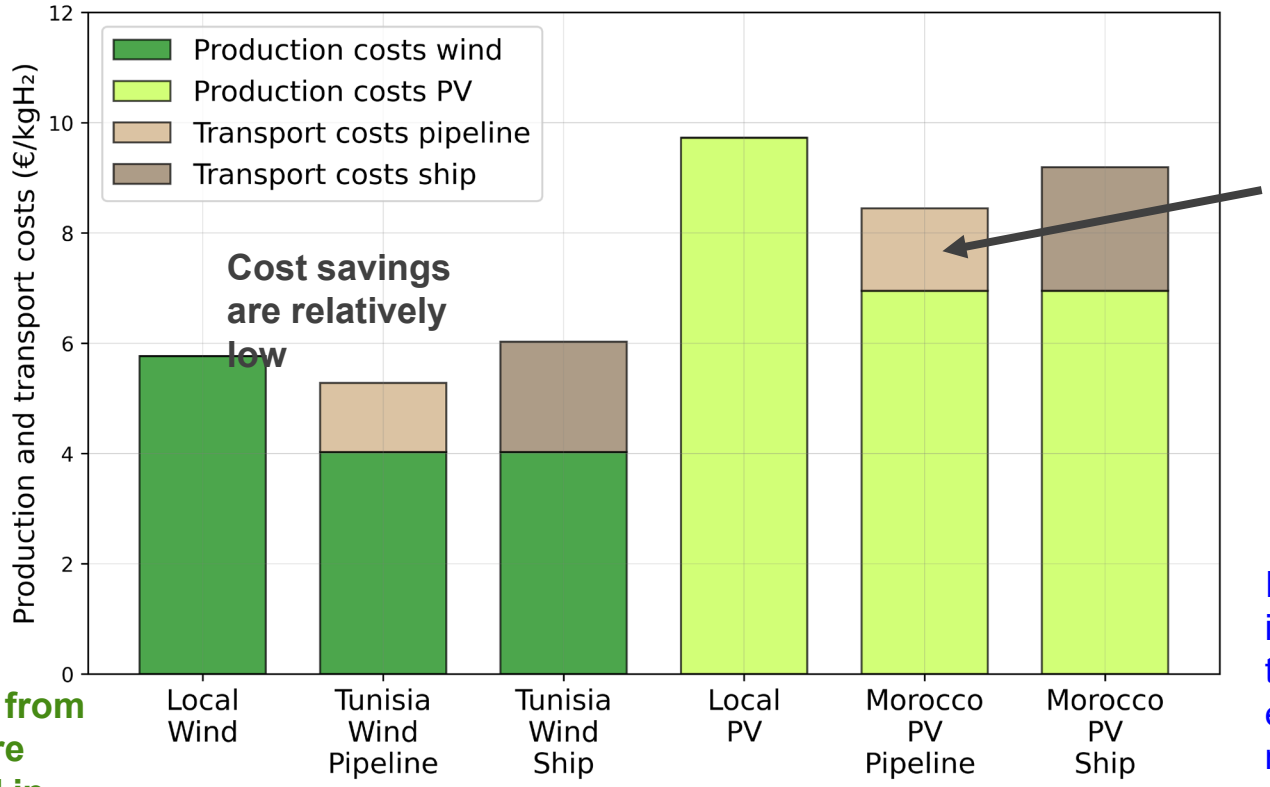


# Hydrogen production costs for the main colors




The following studies are included in the analysis:
BNEF, 2020; Hydrogen Council, 2020; IEA, 2018; Ji and Wang, 2021; Kayfeci et al., 2019; Longden et al., 2022; Midilli et al., 2021; Noussan et al., 2021

# Comparison of hydrogen transportation cost and renewable hydrogen production



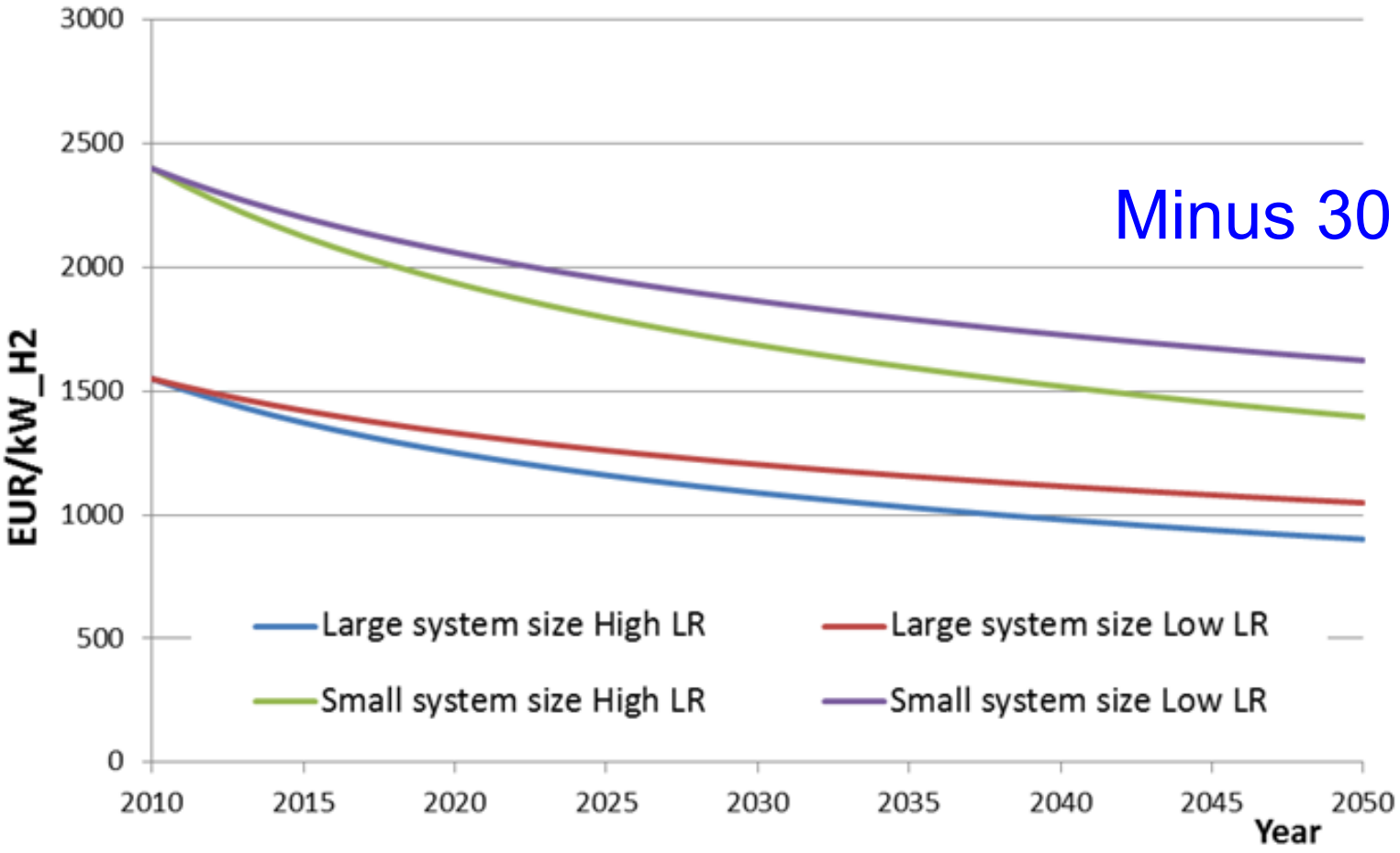

**Pipeline transport is cheaper**

**Generally very location specific**

**Production from wind is more economical in general**

In Morocco, 19% and in Tunisia, only 3% of the generated electricity comes from renewable sources (as per 2021)

# 6. SCENARIOS : TL EXPECTED



# 9. CONCLUSIONS

- A hydrogen economy in the energy system will never emerge
- Electricity is more efficient → electrify what is easily possible
- Unlikely for passenger car transport or heating
- However, green H2 to use excess electricity from variable renewables
- Important to force H2 in processes that cannot be decarbonized in any other way
- How to produce huge quantities of renewable electricity? Or will Western countries rely on H2 imports? From which countries?
- A planned economy or a market?

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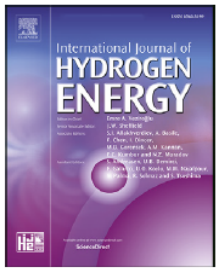

# The economics and the environmental benignity of different colors of hydrogen

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HIGHLIGHTS

- Technical, economic
- Different colors of h
- To date, grey hydrog
- With technological l
- Green hydrogen cou

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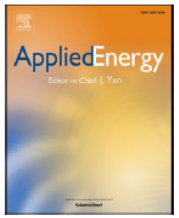

## On the future relevance of green hydrogen in Europe☆

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HIGHLIGHTS

- Hydrogen might have potential in the European energy system, yet a hydrogen-based energy system stays visionary.
- Green hydrogen from renewable electricity via electrolyzers is key for environmental benefits and decarbonization.
- Hydrogen should be prioritized for uses where electrification is not feasible.

ARTICLE INFO

ABSTRACT

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