

# Προκλήσεις και στρατηγικές για αγορές ηλεκτρισμού και φυσικού αερίου

**Δρ. Ανδρέας Πουλλικκός**

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

**Πρόεδρος Ρυθμιστικής Αρχής Ενέργειας Κύπρου**

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

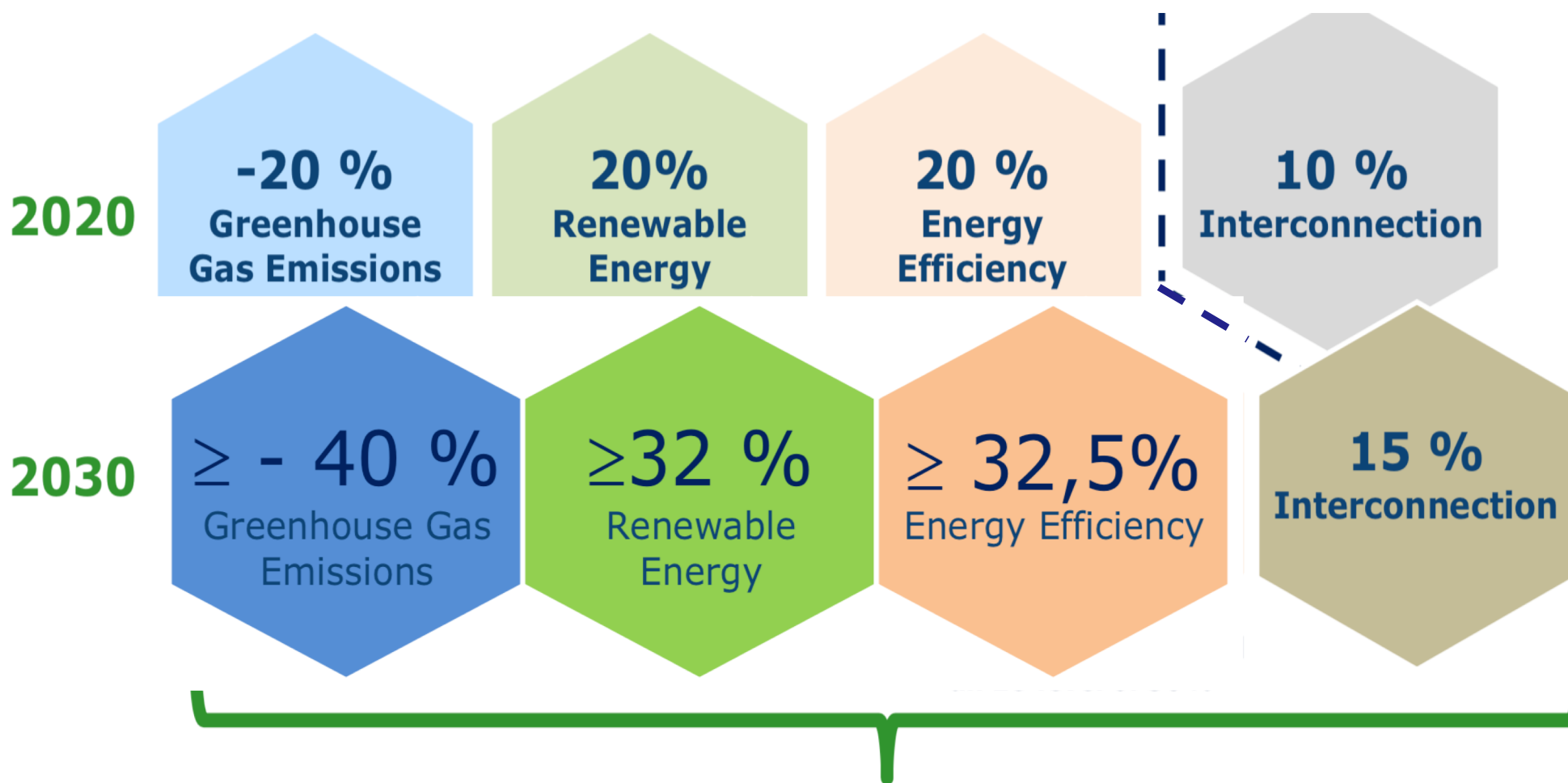
# Contents

- **EU energy strategy** – 2020, 2030, 2050
- **Cyprus electricity and NG systems** – characteristics and solutions to isolation
- **Short to medium term strategy** – large scale integration of RES and the role of natural gas and storage
- **Medium to long term strategy** – the role of interconnections and hydrogen for SE Mediterranean region
- **Next steps** – towards hydrogen economy

# EU energy strategy

## 2020, 2030, 2050

# EU medium and long term targets

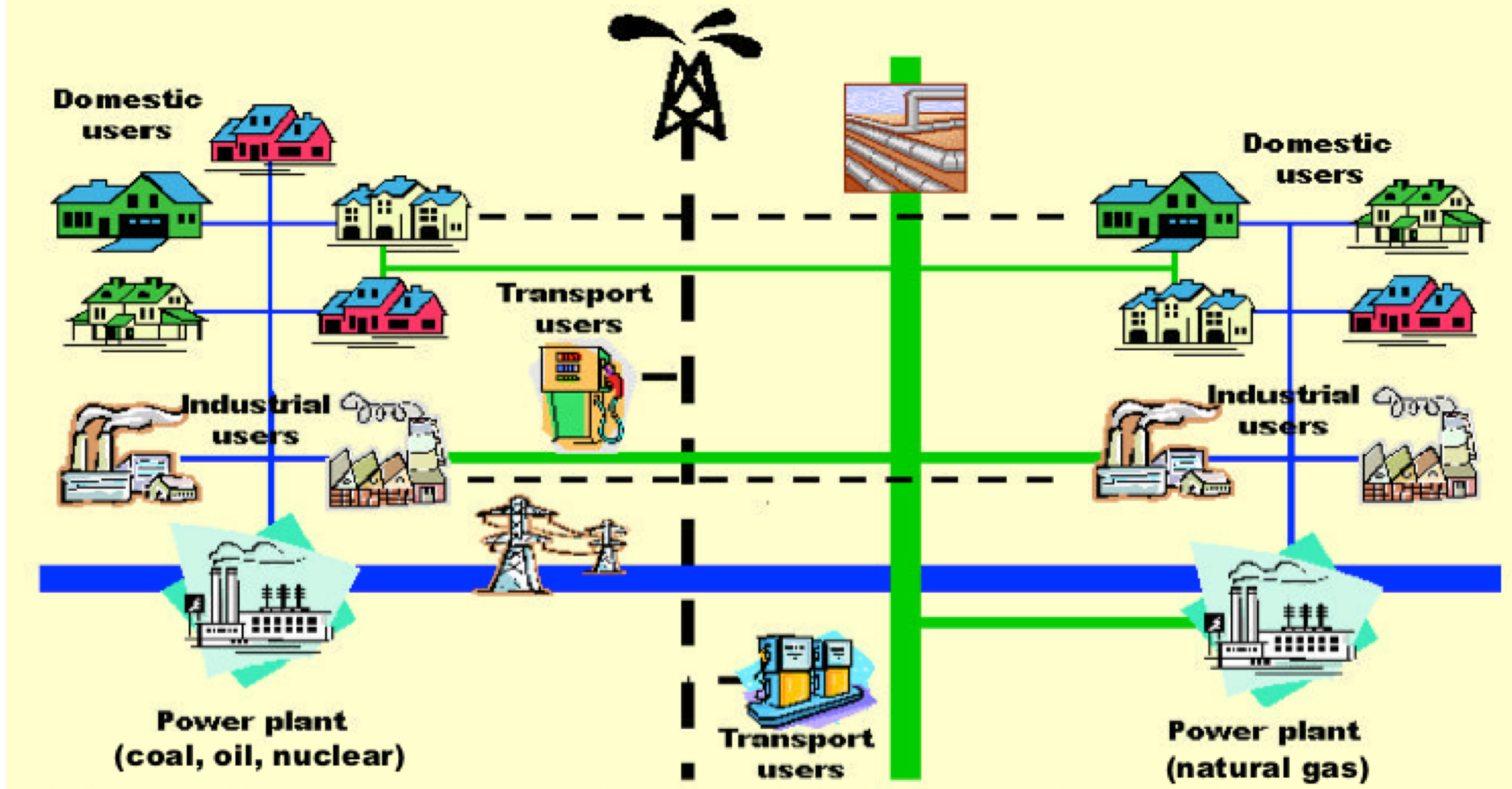


**New governance system + indicators**

**2050 -80% Greenhouse Gas Emissions**

# Current energy system

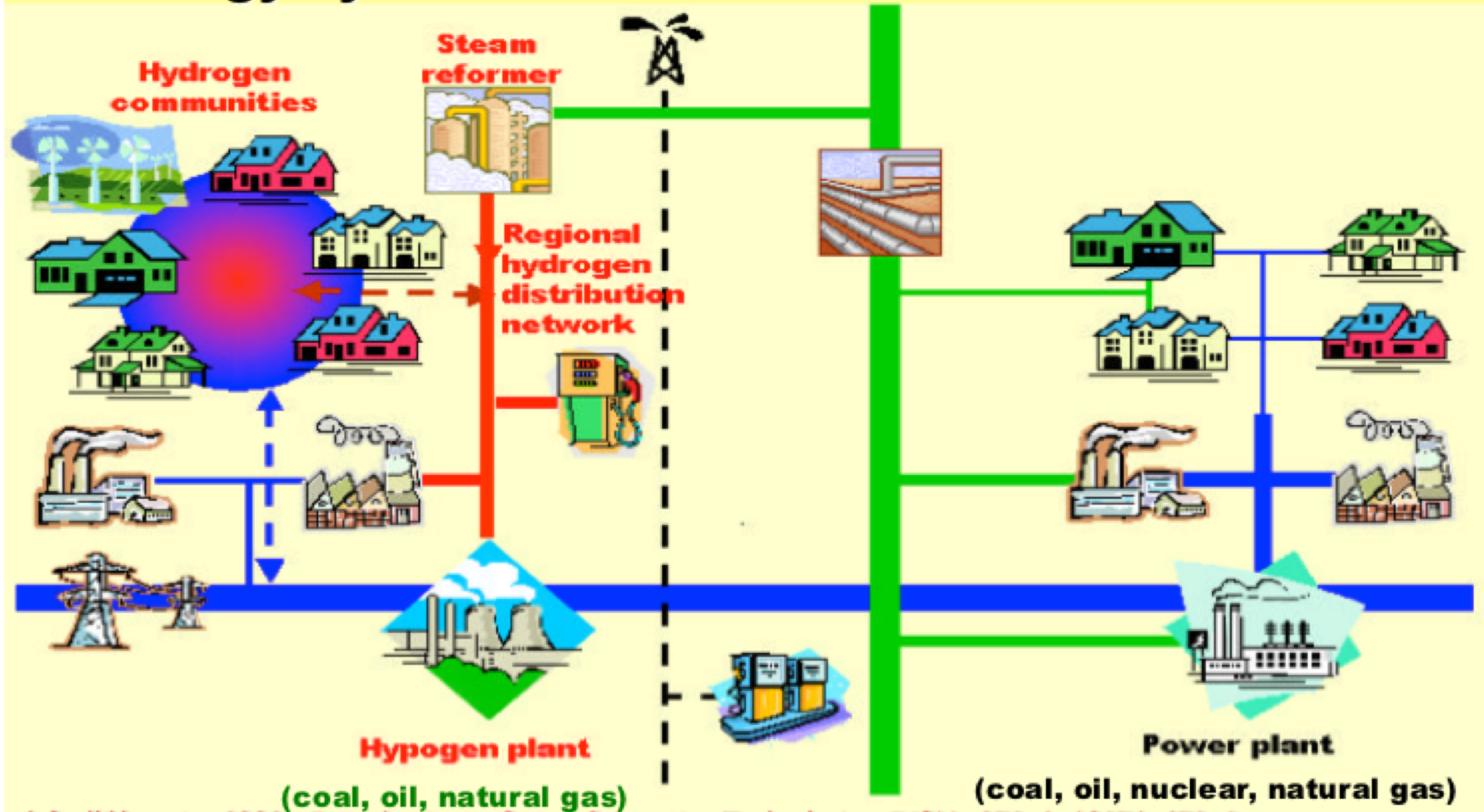
## EU energy system today\*



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

# Future energy systems (optimistic scenario)

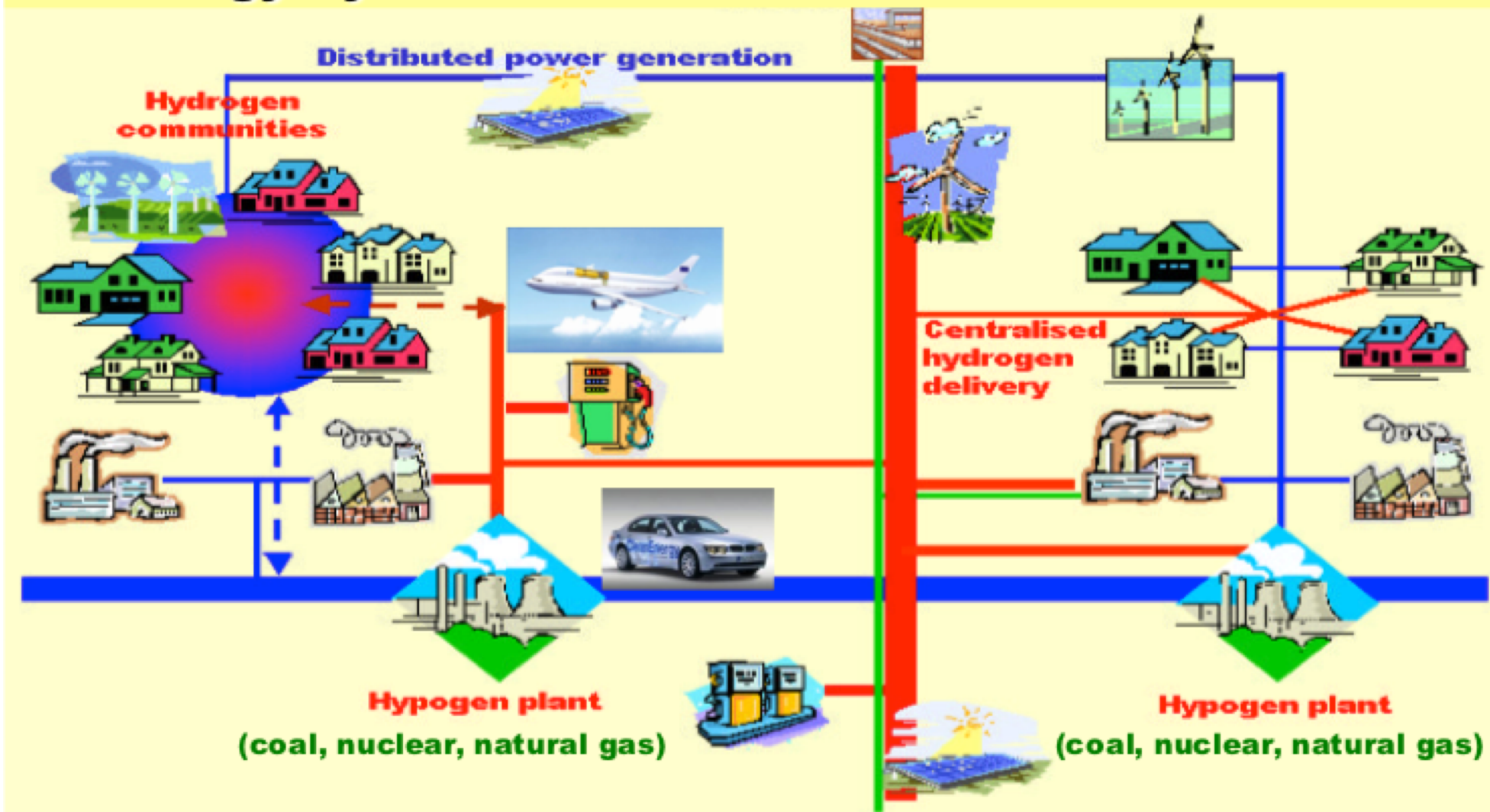
## EU energy system in 2020-30\*



\* 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

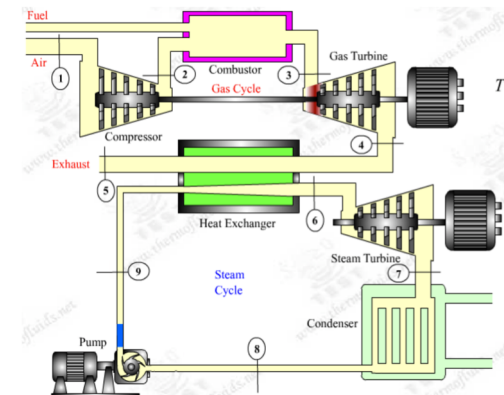
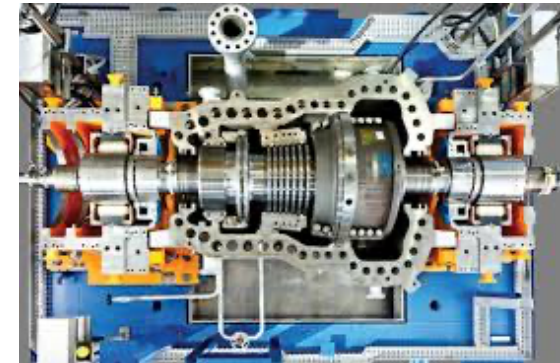
# **Cyprus current electricity and NG systems**

## **Characteristics and solutions to isolation**



# Existing power generation system

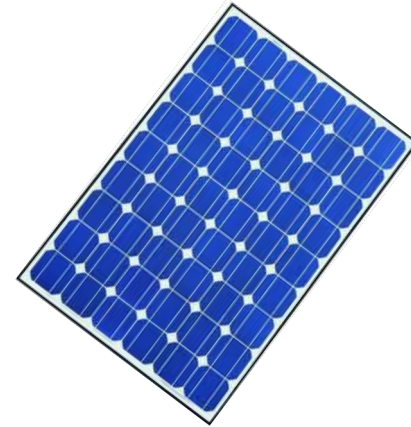
- **Steam turbine units (HFO)**
  - Dhekelia power station 6x60MWe
  - Vasilikos power station 3x130MWe
- **Combined cycles (Diesel)**
  - Vasilikos power station 2x220MWe
- **Gas turbine units (Diesel)**
  - Moni power station 4x37,5MWe
  - Vasilikos power station 1x38MWe
- **Internal combustion engines (HFO)**
  - Dhekelia power station 6x17.5MWe



# Existing power generation system (cont.)

- **Renewables**

- **PVs 146MWe**
- **Wind 157MWe**
- **Biomass 13MWe**

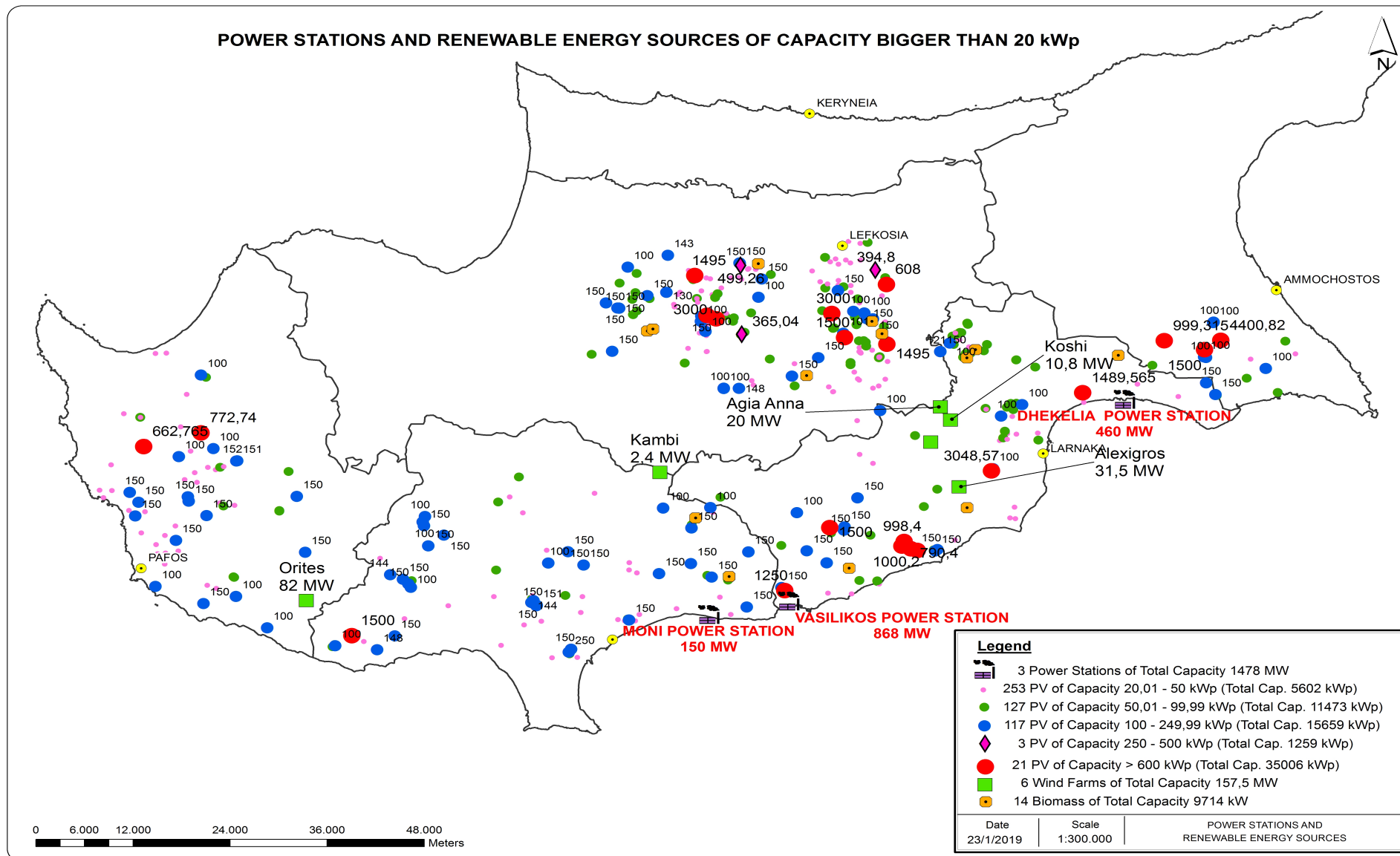


- **Total installed capacity:**

- **Conventional: 1483MWe**
- **Renewables: 316MWe**



# Distribution of RES-E



# Existing natural gas system

- Under development !
- For power generation as a start...



# Characteristics of isolated electricity systems\*



- **High fuel costs**
  - ~ use of oil derivatives
- **Economies of scale cannot be adequately exploited**
  - ~ generation units cannot exceed a certain size since the loss of a unit would mean the loss of a high percentage of the entire system
- **Need to maintain high reserve capacity to ensure power system reliability**

**The smaller the electrical system size, the more the expenses will be**

\* Poullikkas A., 2015, *Sustainable Energy Policy for Cyprus*, ISBN: 978-9963-7355-6-3

# The solution\*

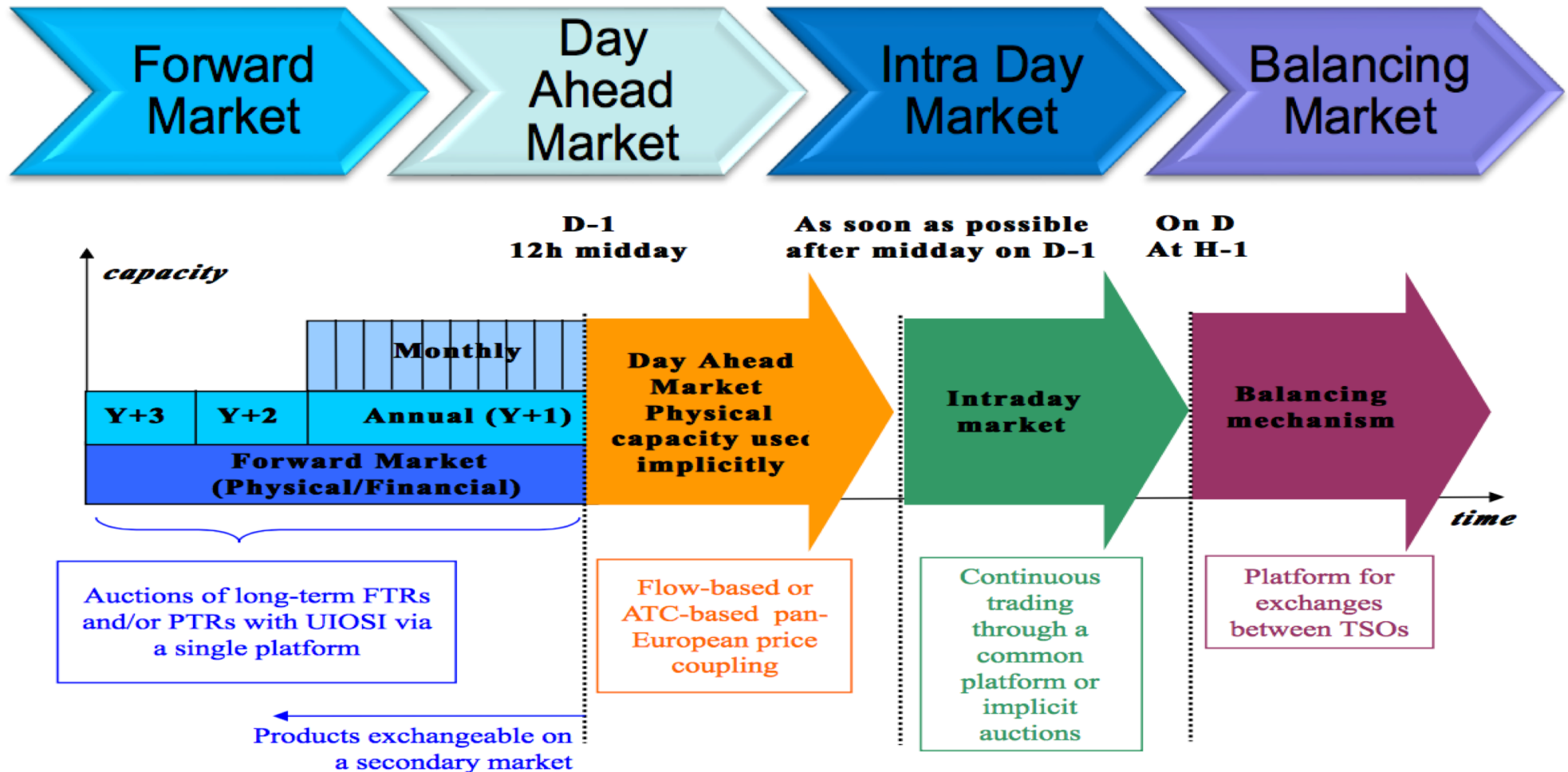
- **Increase system flexibility**
  - ~ integrate RES into electricity market
  - ~ use natural gas and RES for power generation
  - ~ promote e-mobility (V2G technology - bidirectional flow of electricity between the electric car and the grid)
- **Establish electricity interconnections**
  - ~ with EU internal electricity market (the island of Cyprus is the only non-interconnected Member State)
- **Production of hydrogen** (energy carrier)
  - ~ from RES and natural gas

\* Poullikkas A., 2016, *Fundamentals of Energy Regulation*, ISBN: 978-9963-7355-8-7

# **Short to medium term strategy**

**Large scale integration of RES and  
the role of natural gas and storage**

# EU electricity market target model

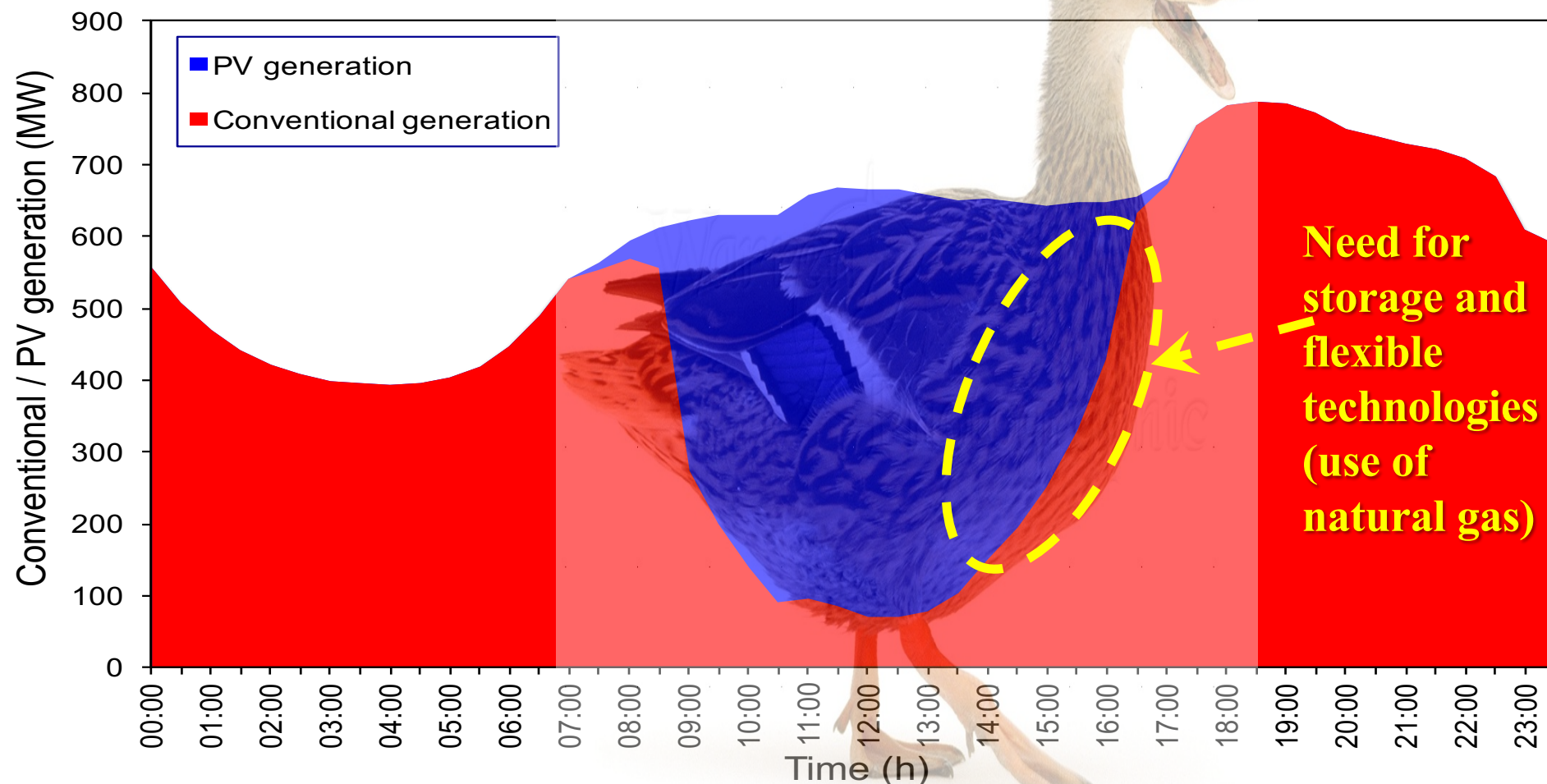


## Integration of RES\*: LCOE vs Reliability

\* Nicolaidis P., Chatzis S., Poullikkas A., 2018, "Renewable energy integration through optimal unit commitment and electricity storage in weak power networks", *International Journal of Sustainable Energy*

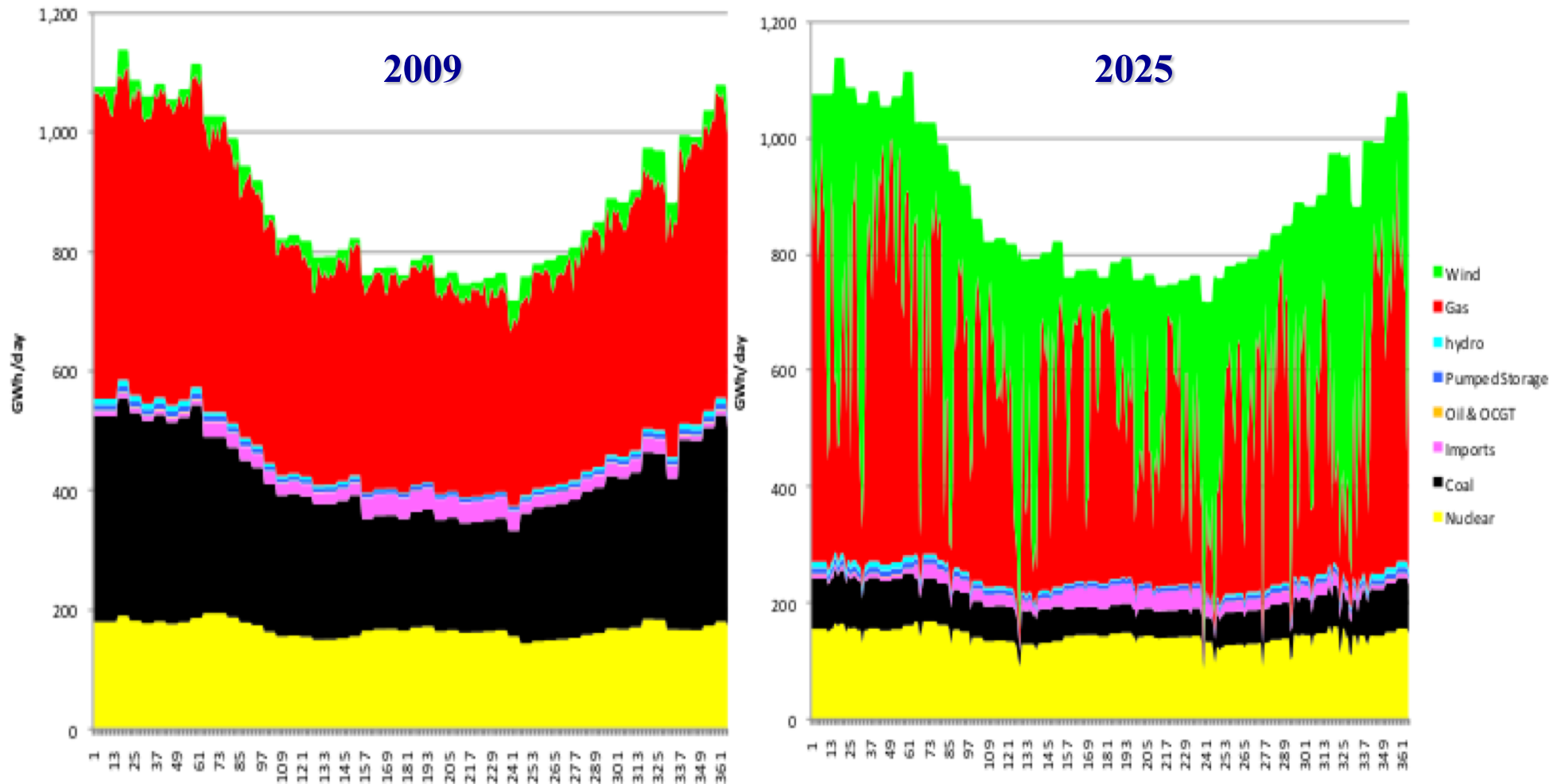


# Effect of PV generation on load curve (the 'duck curve')\*



\* Poullikkas A., 2016, "From the 'camel curve' to the 'duck curve' on electric systems with increasing solar power", *Accountancy*

# Gas is a pillar of renewable energy (power production in UK\*)



\* H.V. Rogers, 2011, *The Impact of Import Dependence and Wind Generation on UK Gas Demand and Security of Supply to 2025*, The Oxford Institute For Energy Studies

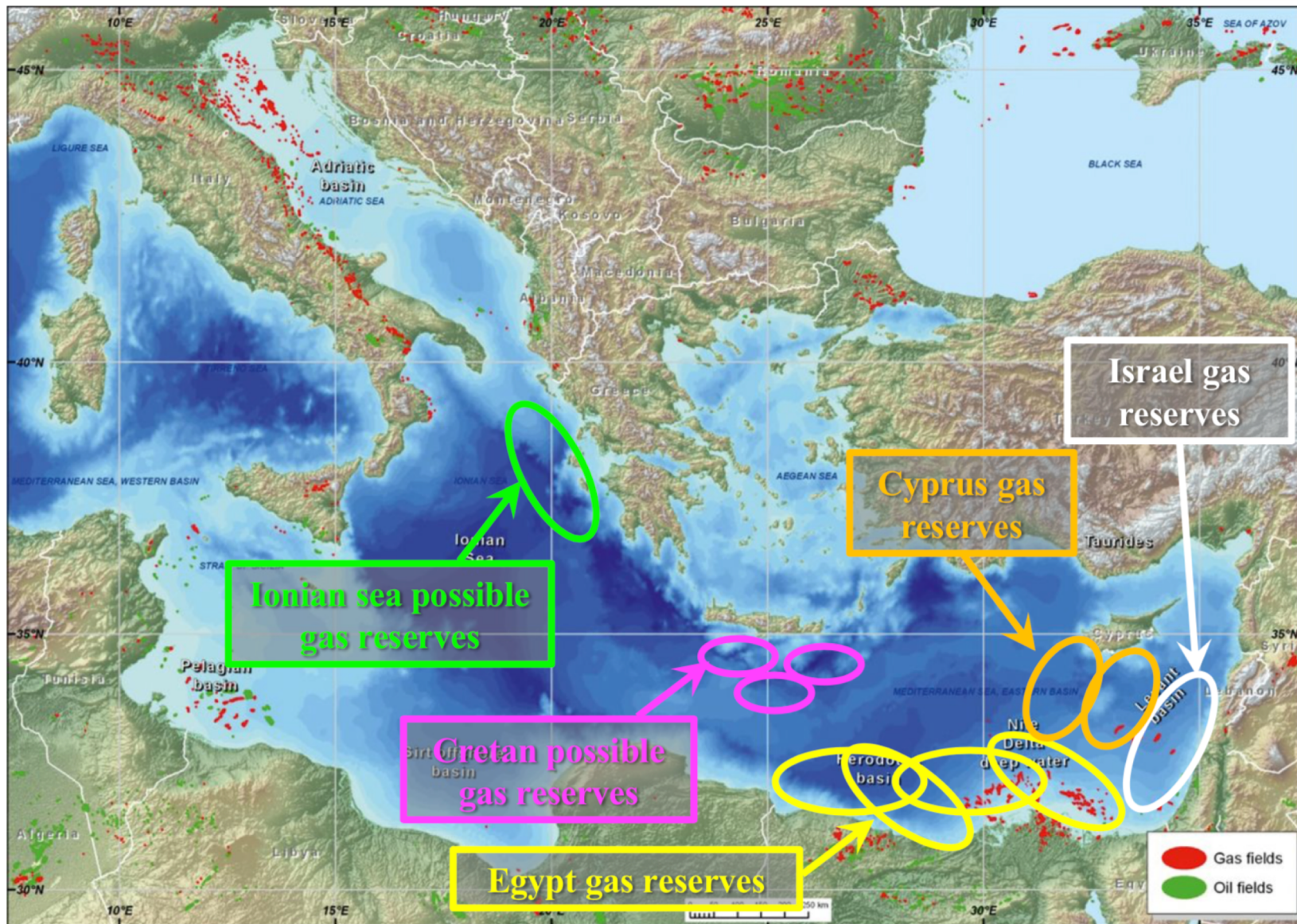
# Πρόσφατες σημαντικές Ρυθμιστικές Αποφάσεις

- **Ρυθμιστική Απόφαση 02/2018 (ΚΔΠ 259/2018)** «περί Εφαρμογής Δεσμευτικού Χρονοδιαγράμματος για τη Μαζική Εγκατάσταση και Λειτουργία από τον ΔΣΔ Υποδομής Ευφυών Συστημάτων Μέτρησης (Advanced Metering Infrastructure)» - εγκατάσταση έξυπνων μετρητών σε όλους τους καταναλωτές ηλεκτρισμού
- **Ρυθμιστική Απόφαση 02/2019 (ΚΔΠ 204/2019)** «περί Εκπόνησης εμπειριστατωμένης τεχνοοικονομικής μελέτης επανασχεδιασμού του Συστήματος Μεταφοράς και Συστήματος Διανομής 2021-2030» - ευέλικτο και αμφίδρομο ηλεκτρικό σύστημα για μεγάλη εισδοχή ΑΠΕ σε συνδυασμό με συστήματα αποθήκευσης ενέργειας πέραν του 2020
- **Ρυθμιστική Απόφαση 03/2019 (ΚΔΠ 224/2019)** «περί Θέσπισης βασικών αρχών Ρυθμιστικού Πλαισίου λειτουργίας εγκαταστάσεων αποθήκευσης ηλεκτρισμού ανάντη του μετρητή στη χονδρική αγορά ηλεκτρισμού» - λειτουργία εγκαταστάσεων αποθήκευσης ηλεκτρισμού στη χονδρική αγορά ηλεκτρισμού

# Medium to long term strategy

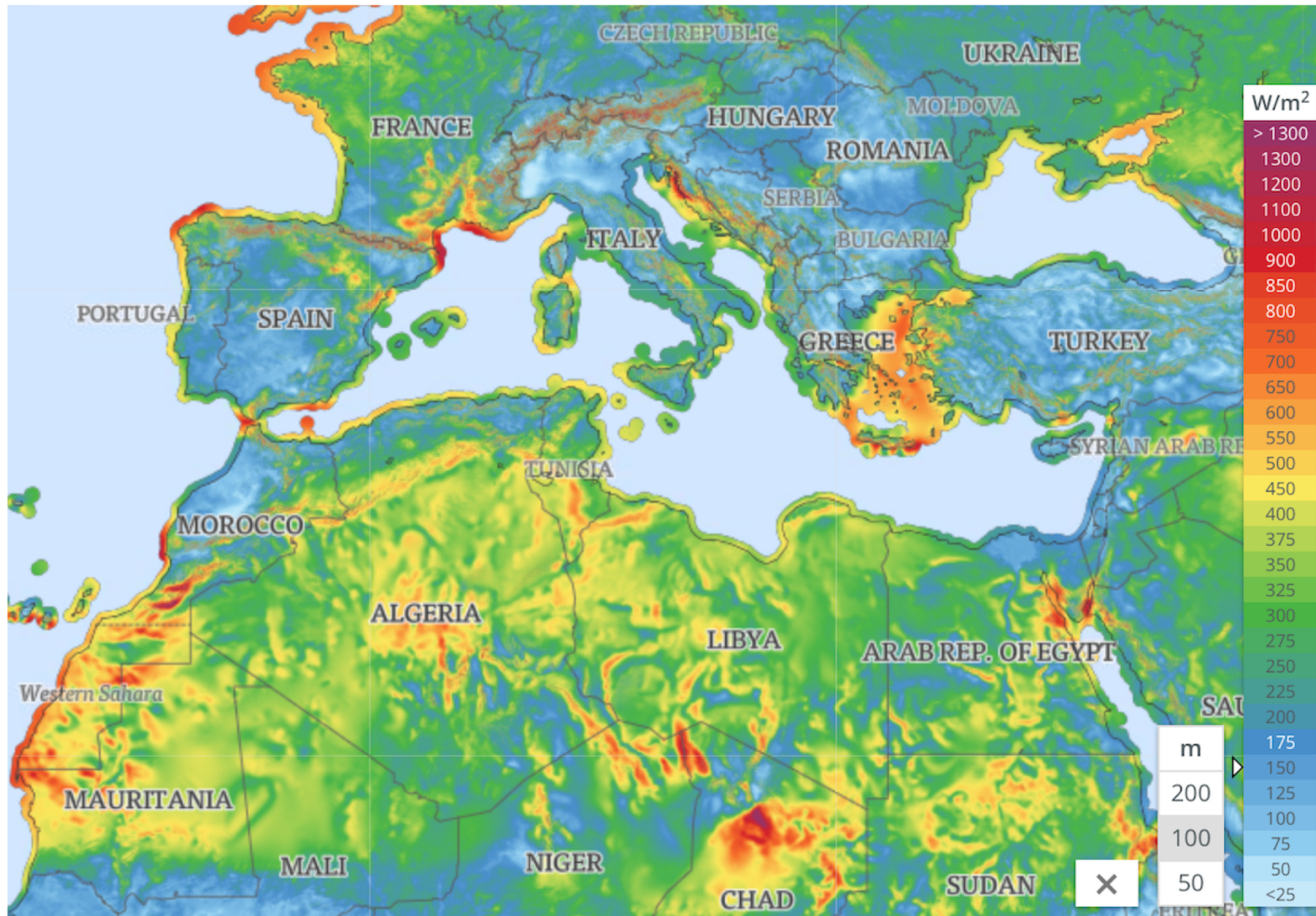
**The role of interconnections and hydrogen for  
SE Mediterranean region**

# Gas reserves in SE Mediterranean region\*



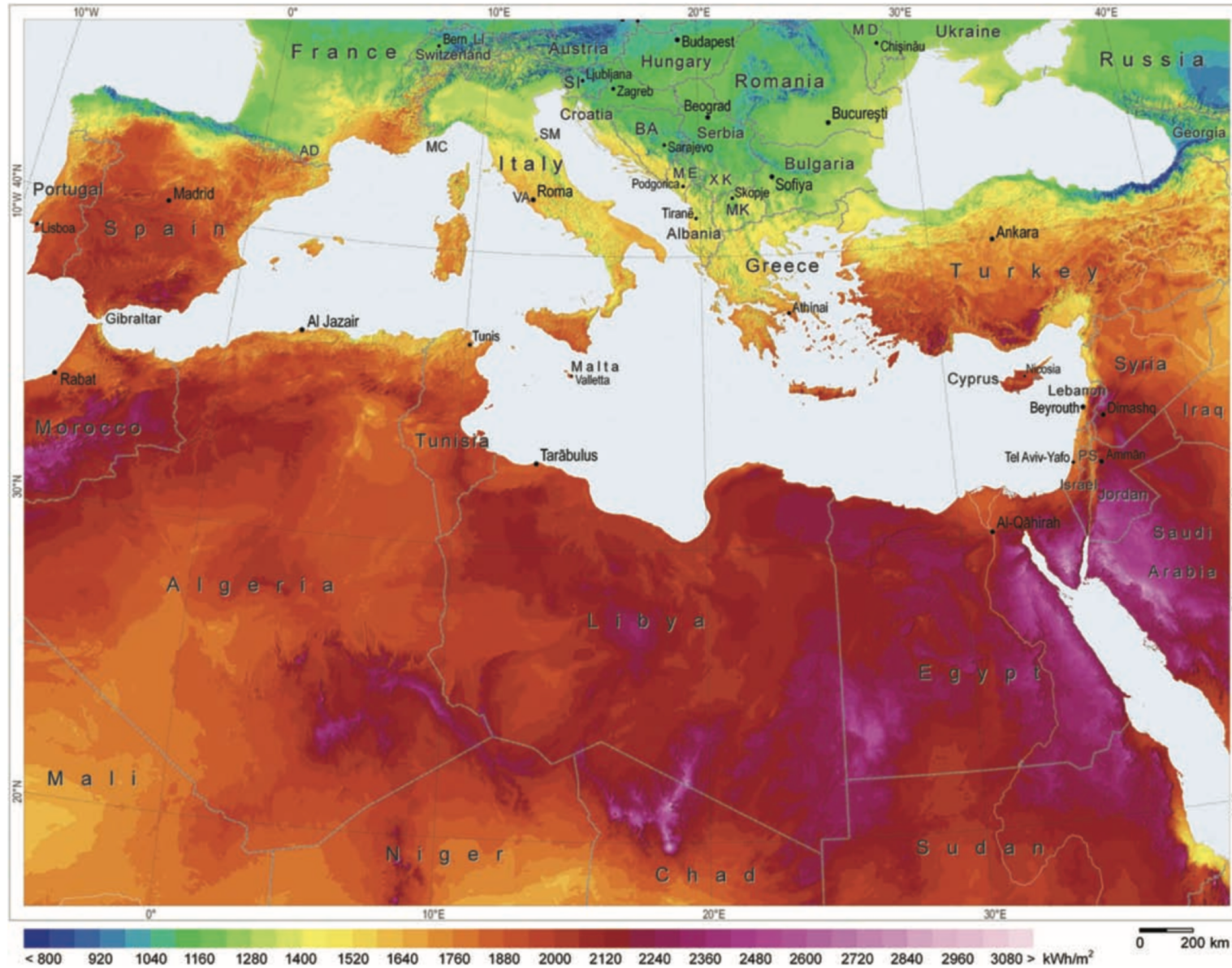
\* A. Belopolsky, et al., 2012, "New and emerging plays in the Eastern Mediterranean", *Petroleum Geoscience*

# Wind potential in SE Mediterranean region\*



\* The Global Wind Atlas (<https://globalwindatlas.com>)

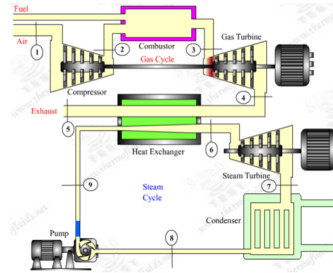
# Solar potential in SE Mediterranean region\*



\* Easac & Pihl, Erik. (2011). Concentrating Solar Power: Its potential contribution to a sustainable energy future

# Main indigenous energy sources in SE Mediterranean region

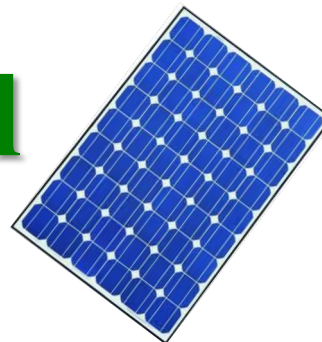
- **Natural gas**



- **Wind potential**

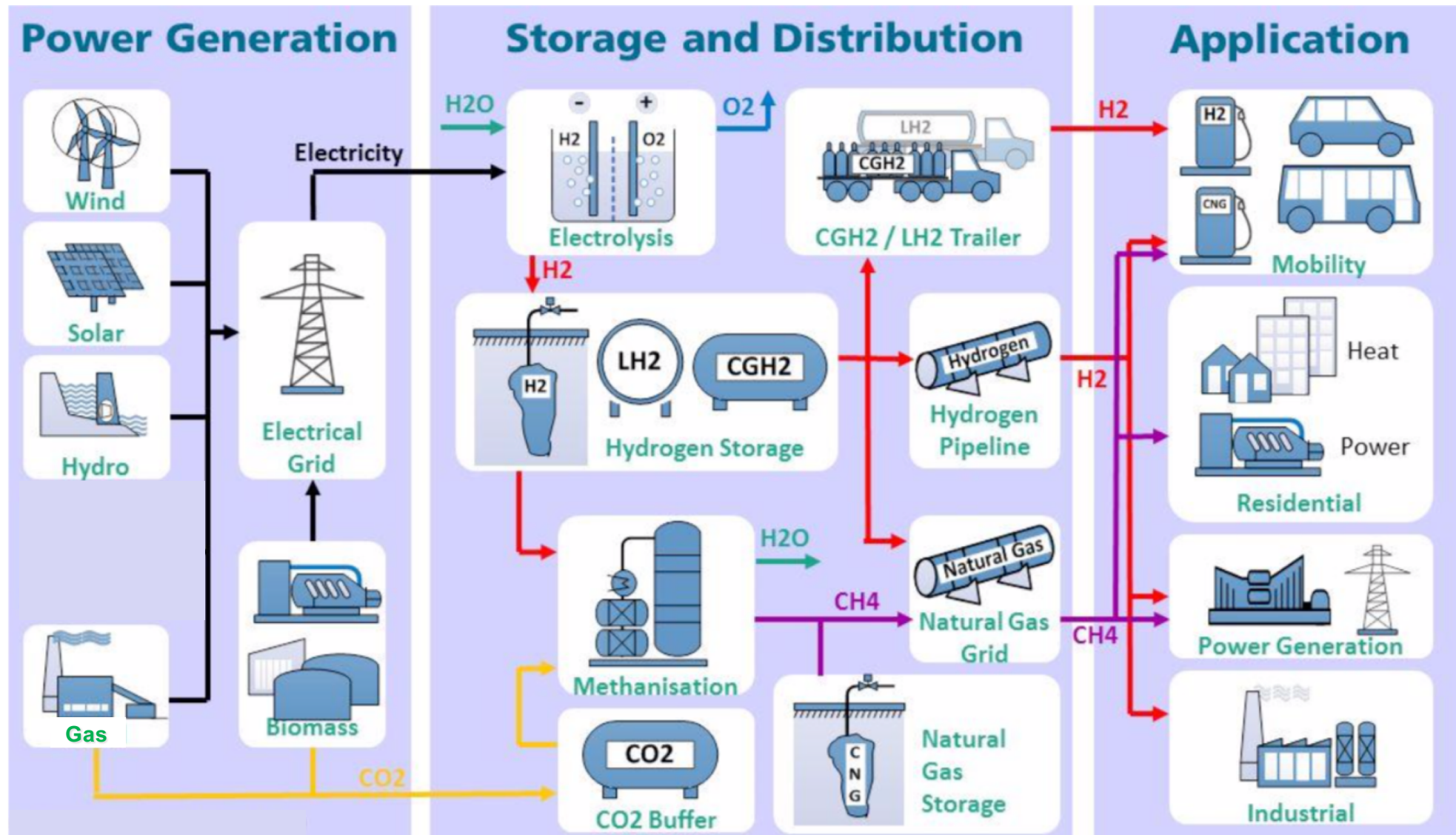


- **Solar potential**



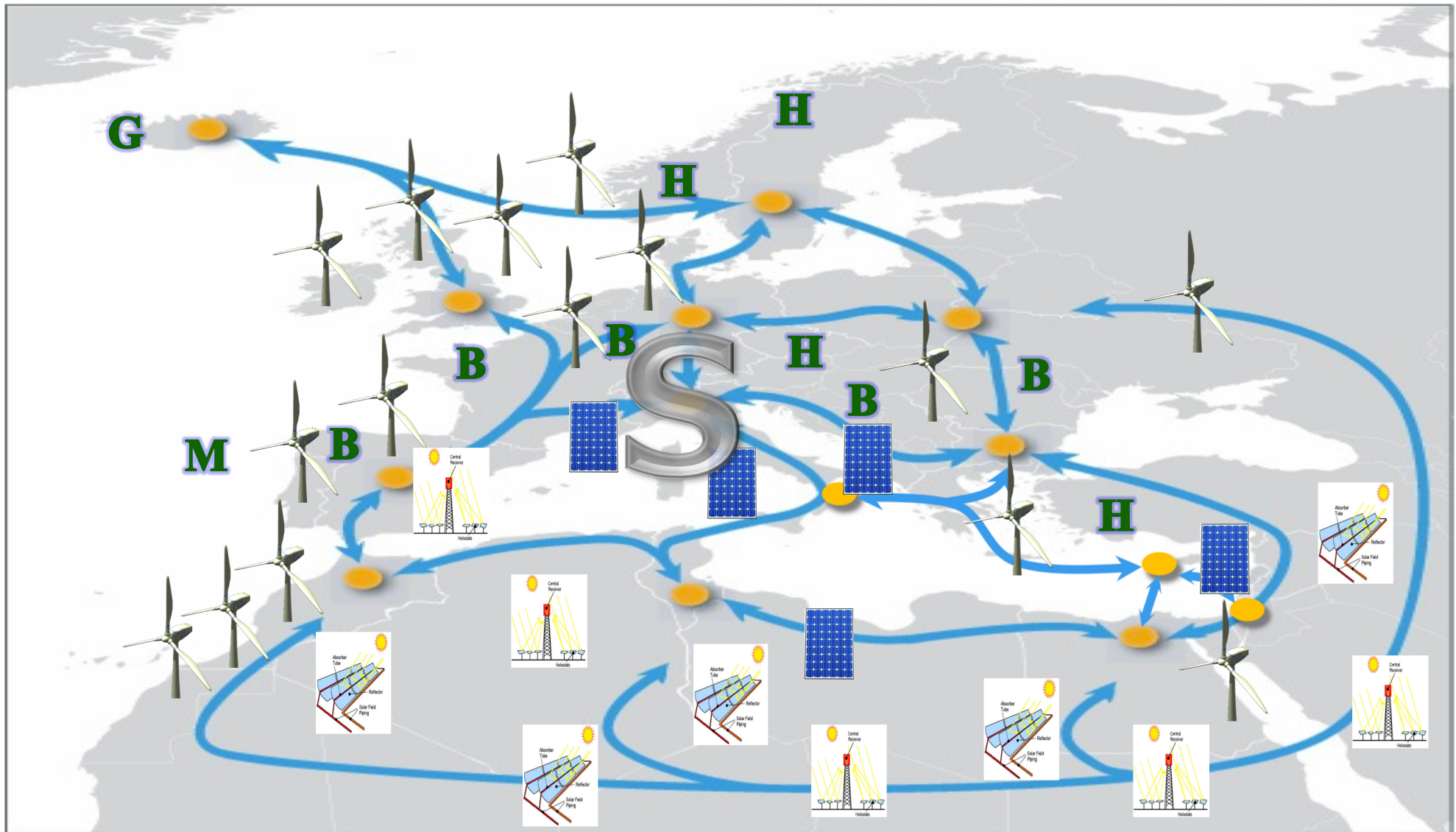


# Potential role of hydrogen in the energy transition



Source: EU, 2019

# 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

# Next steps

## Towards hydrogen economy

# Next steps

## First steps towards the development of sustainable energy strategy

- **Horizon up to 2060**
- **Development of strategic plan:**
  - ~ **Electrical interconnections**
  - ~ **Integration of sustainable technologies and storage**
  - ~ **Pipeline interconnections (or virtual pipelines)**
  - ~ **Use of hydrogen after 2030**
  - ~ **Hydrogen production**
    - From natural gas
    - From renewables
- **Energy exporters to EU**

