

Προκλήσεις και στρατηγικές για αγορές ηλεκτρισμού και φυσικού αερίου

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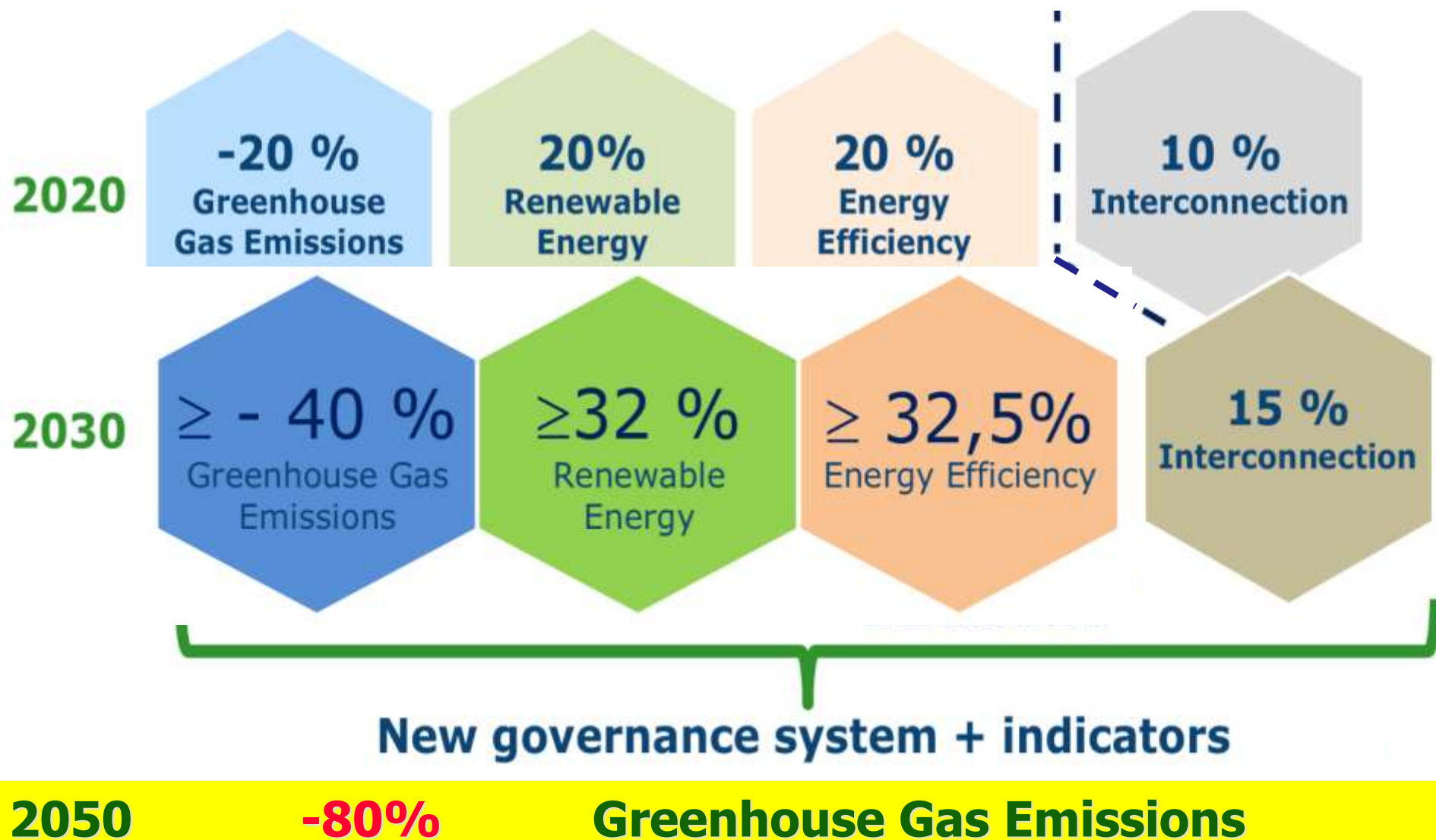
Contents

- **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

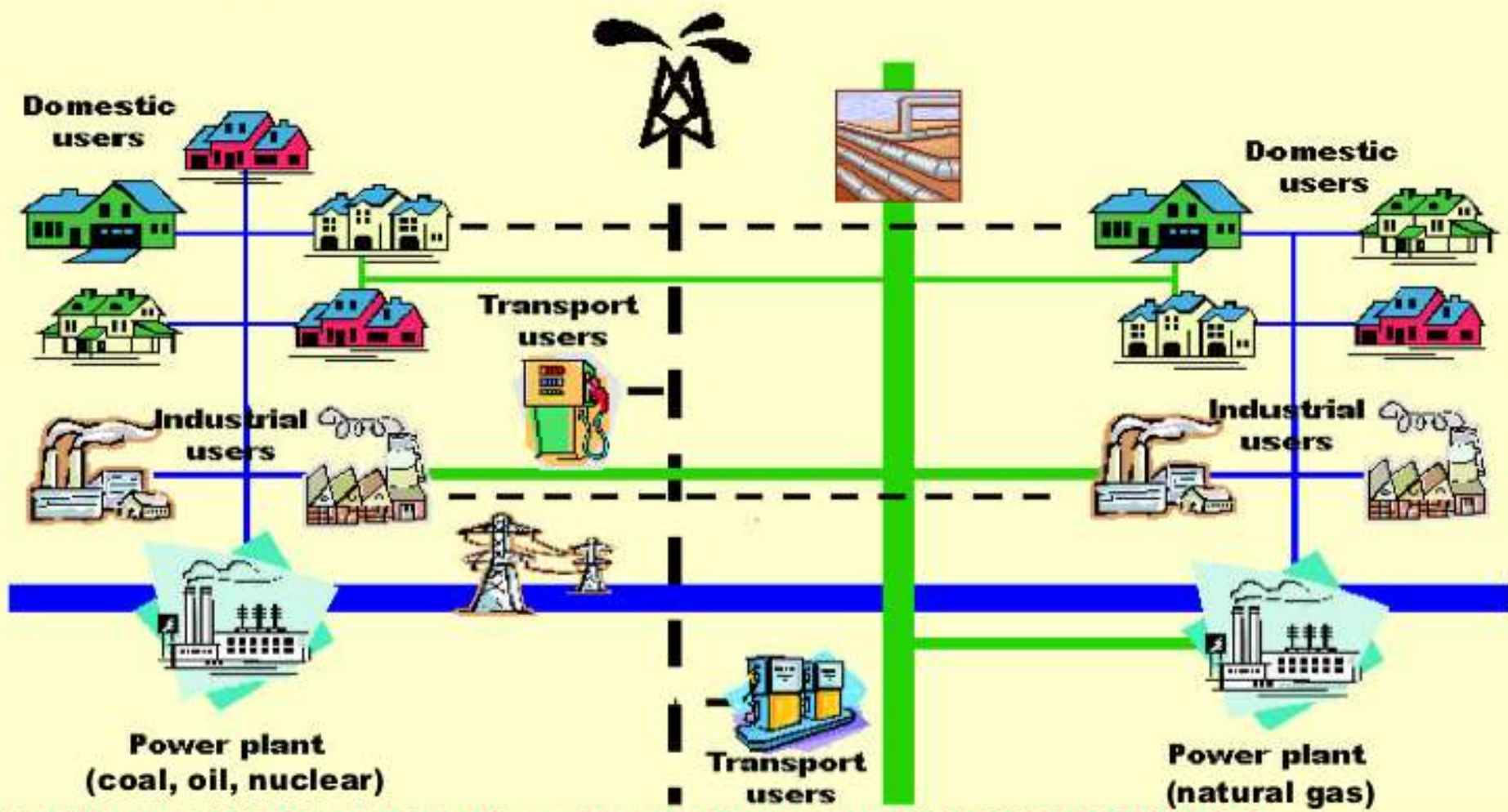
2020, 2030, 2050

EU medium and long term targets



Current energy system

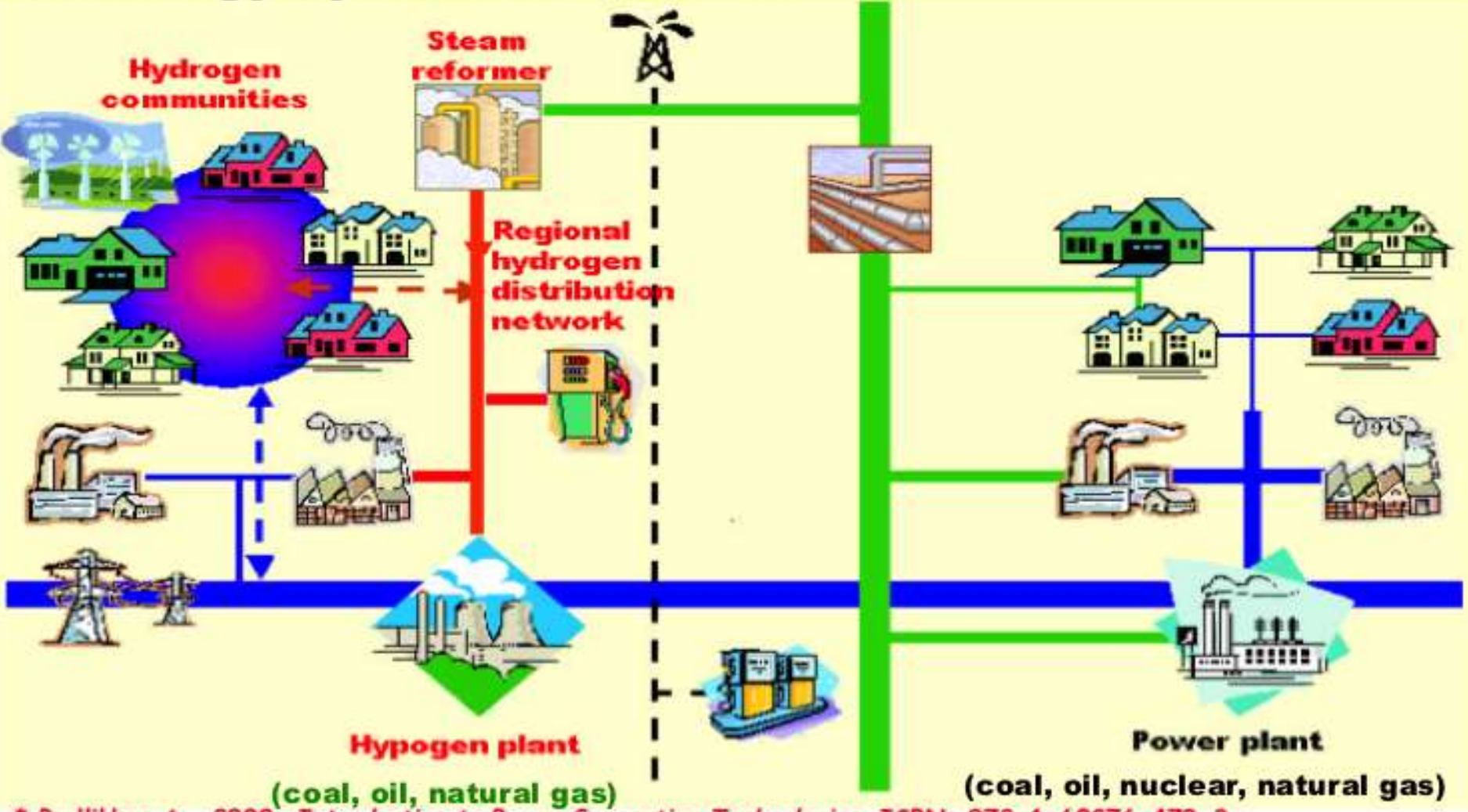
EU energy system today*



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

Future energy systems (optimistic scenario)

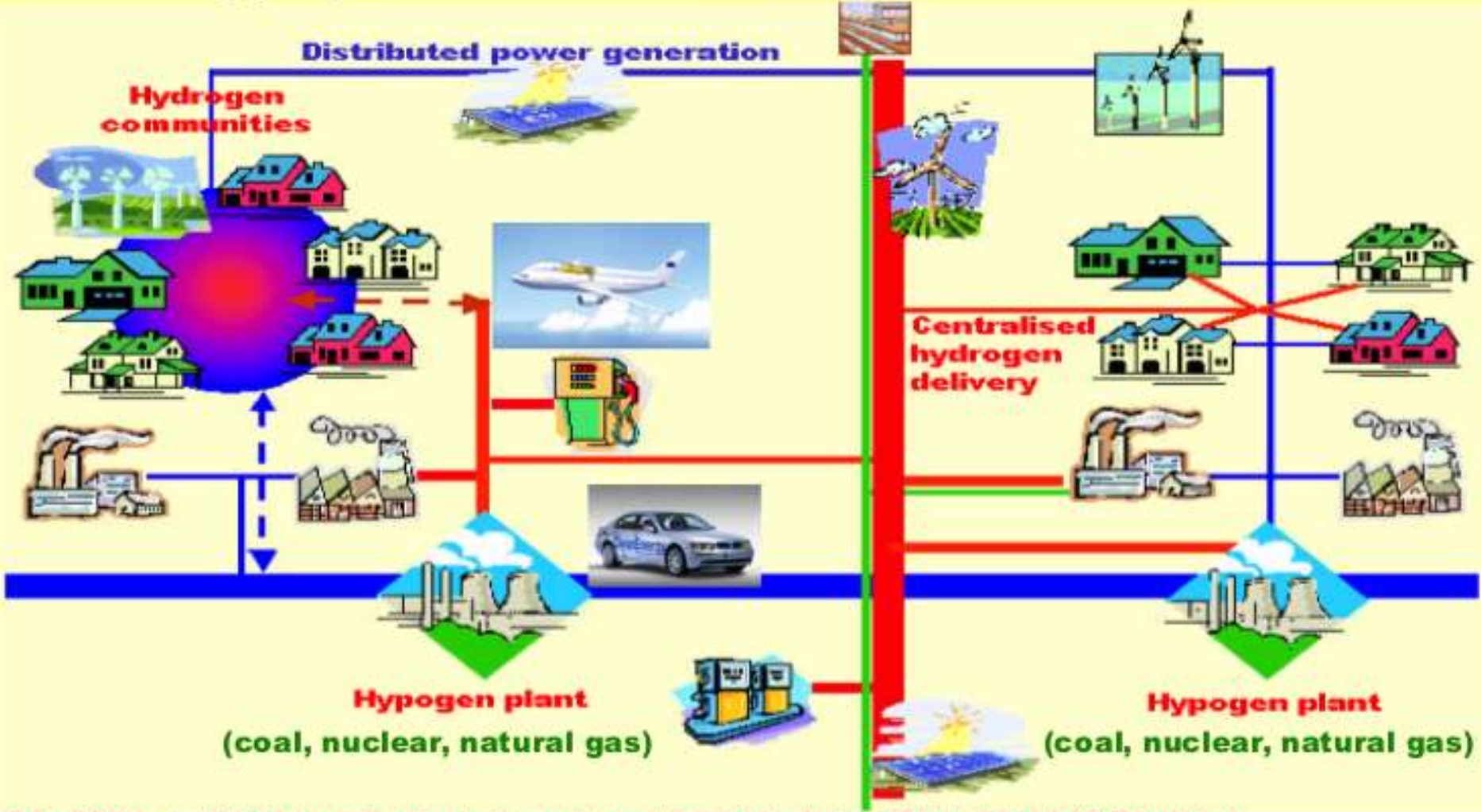
EU energy system in 2020-30*



* 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*



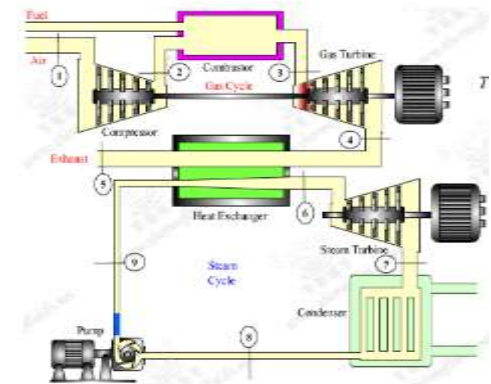
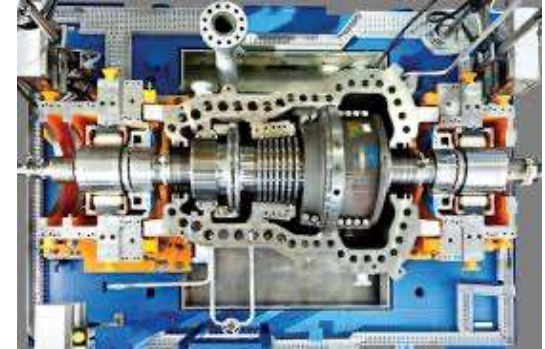
* Poulikkas A., 2009, *Introduction to Power Generation Technologies*, ISBN: 978-1-60876-472-3

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**

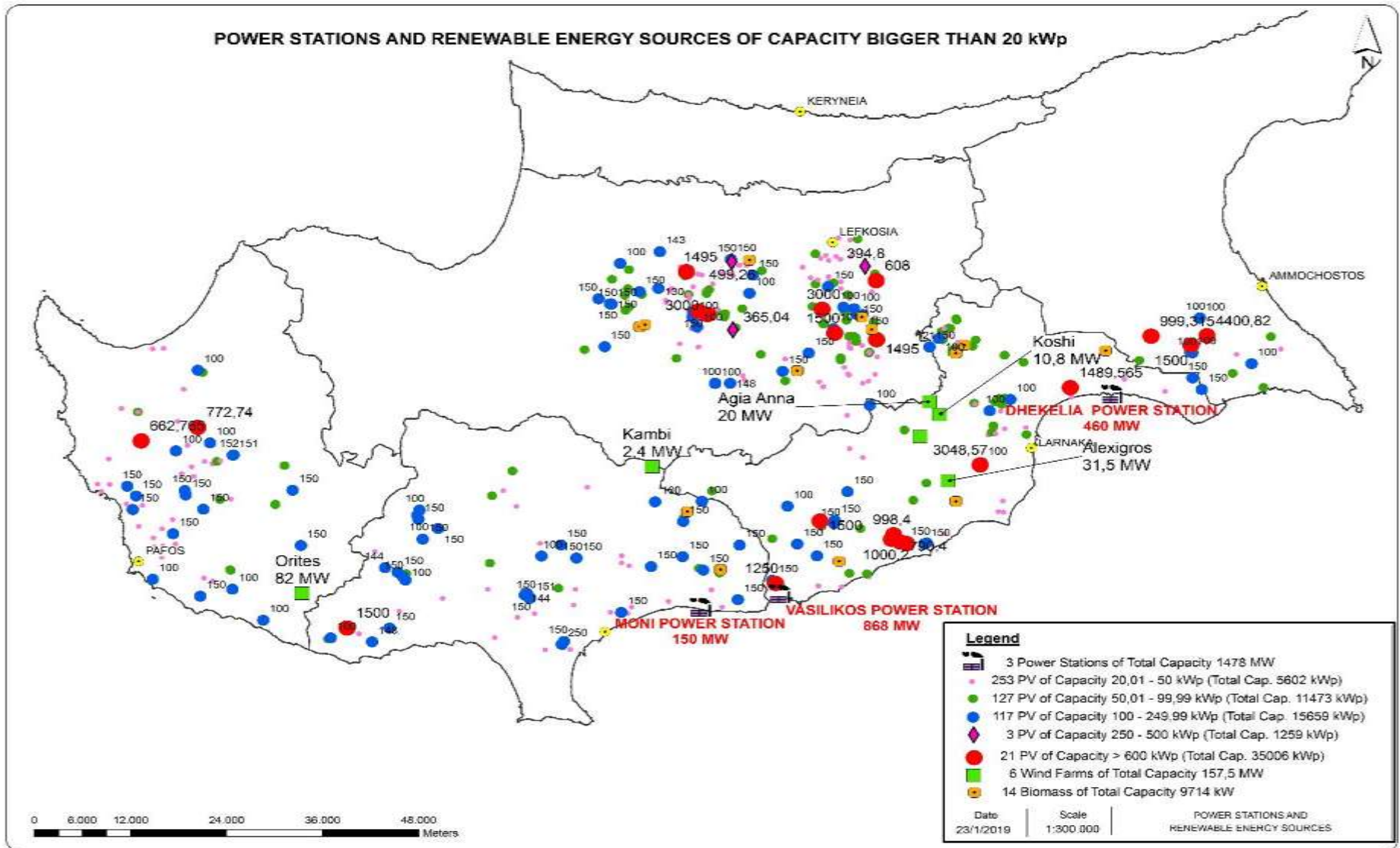


- **Total installed capacity:**

- **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**

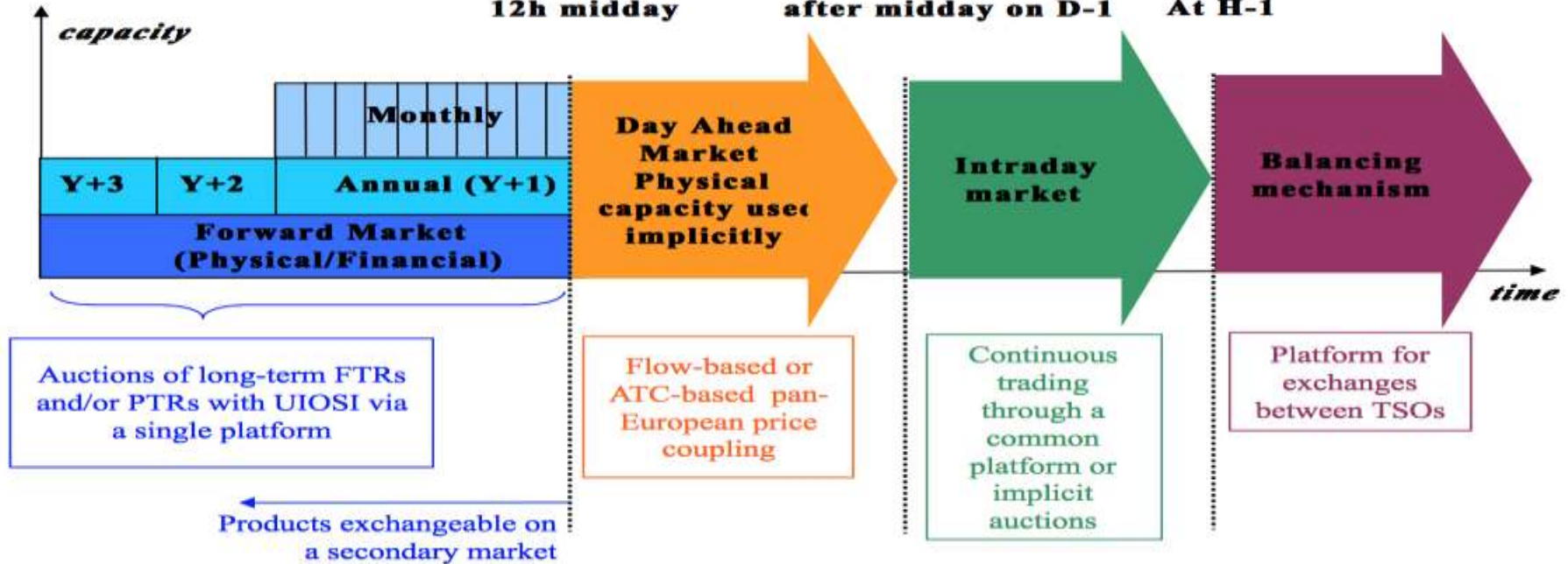
EU electricity market target model



**D-1
12h midday**

**As soon as possible
after midday on D-1**

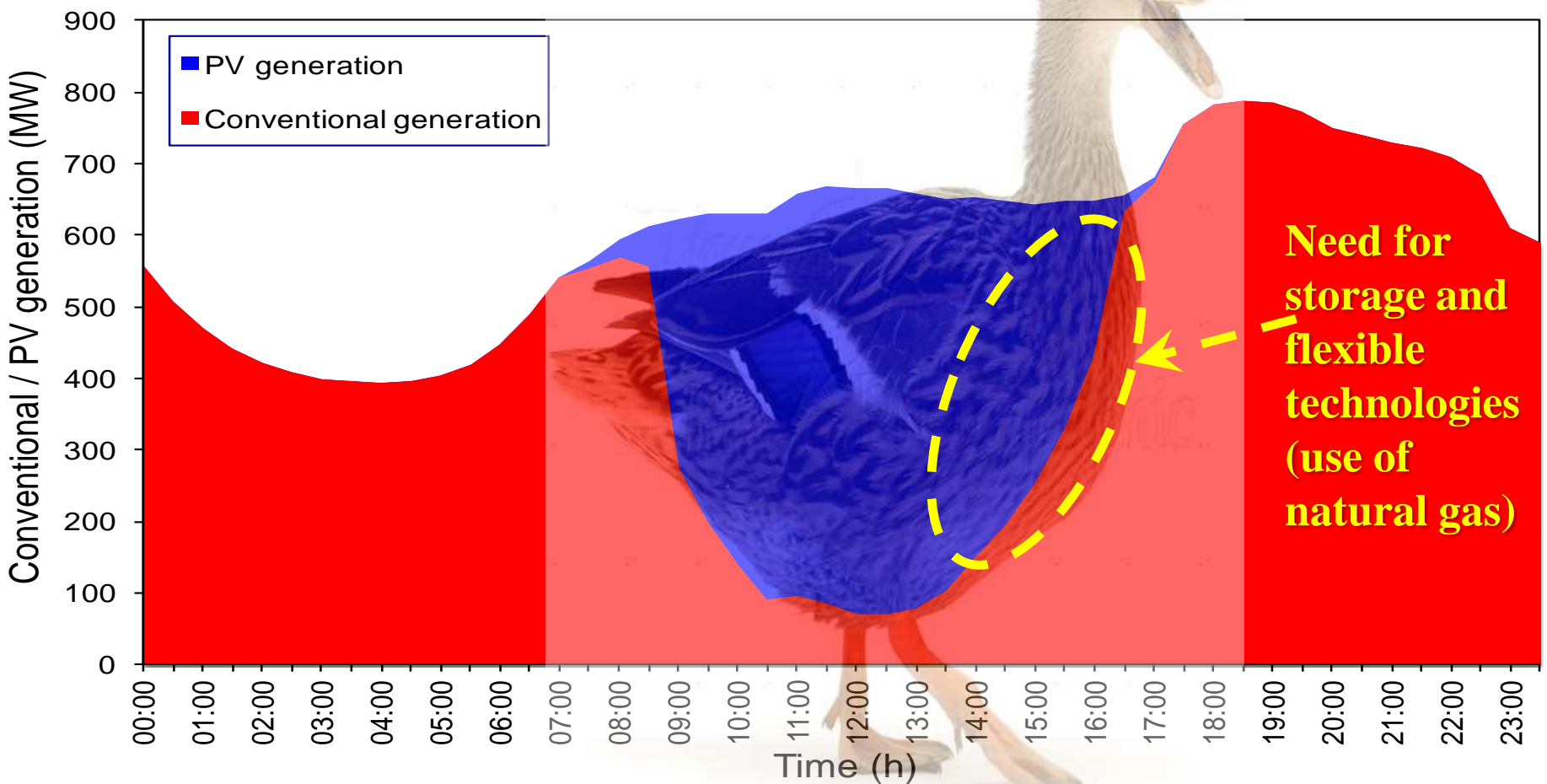
**On D
At H-1**



Integration of RES*: LCOE vs Reliability

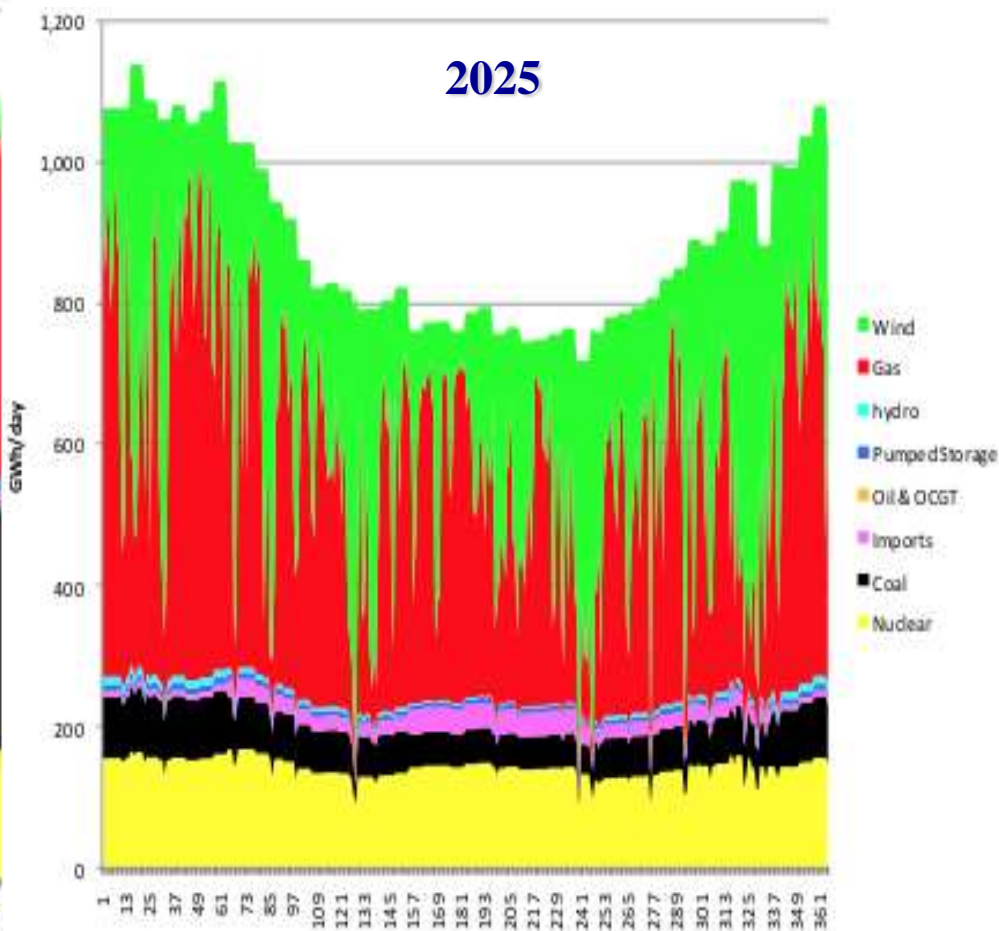
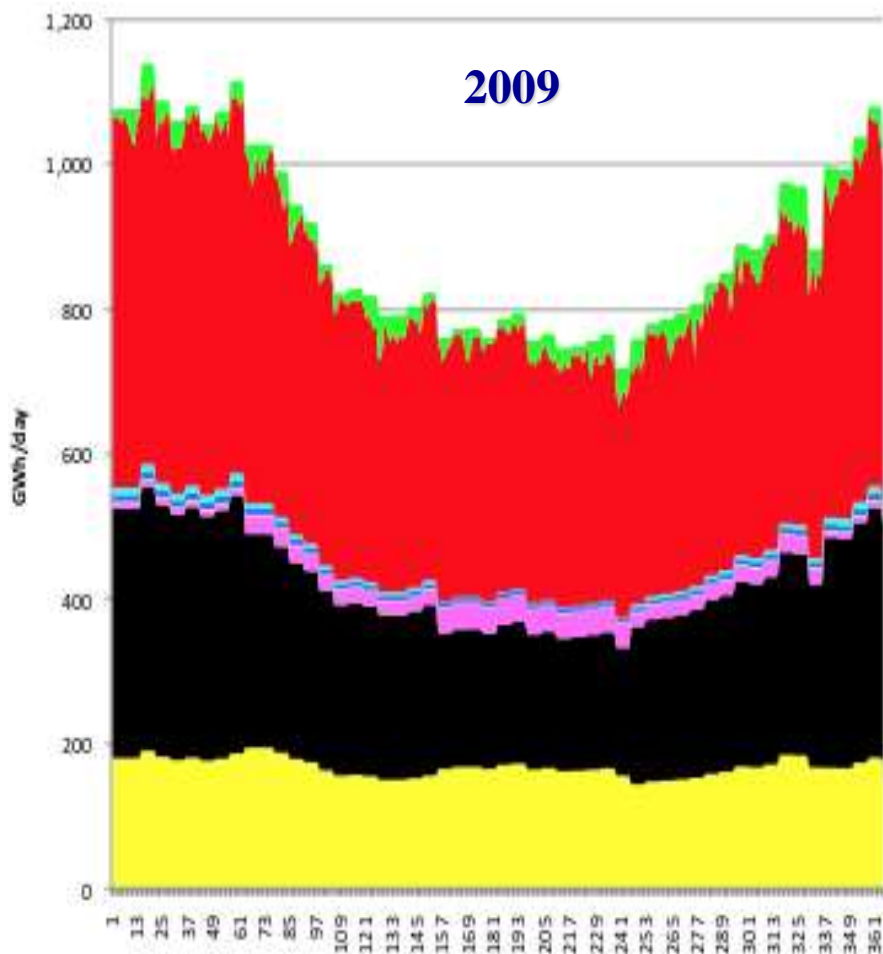
* Nicolaidis P., Chatzis S., Poullikkas A., 2018, "Renewable energy integration through optimal unit commitment and electricity storage in weak power networks", *International Journal of Sustainable Energy*

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 Ευφών 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

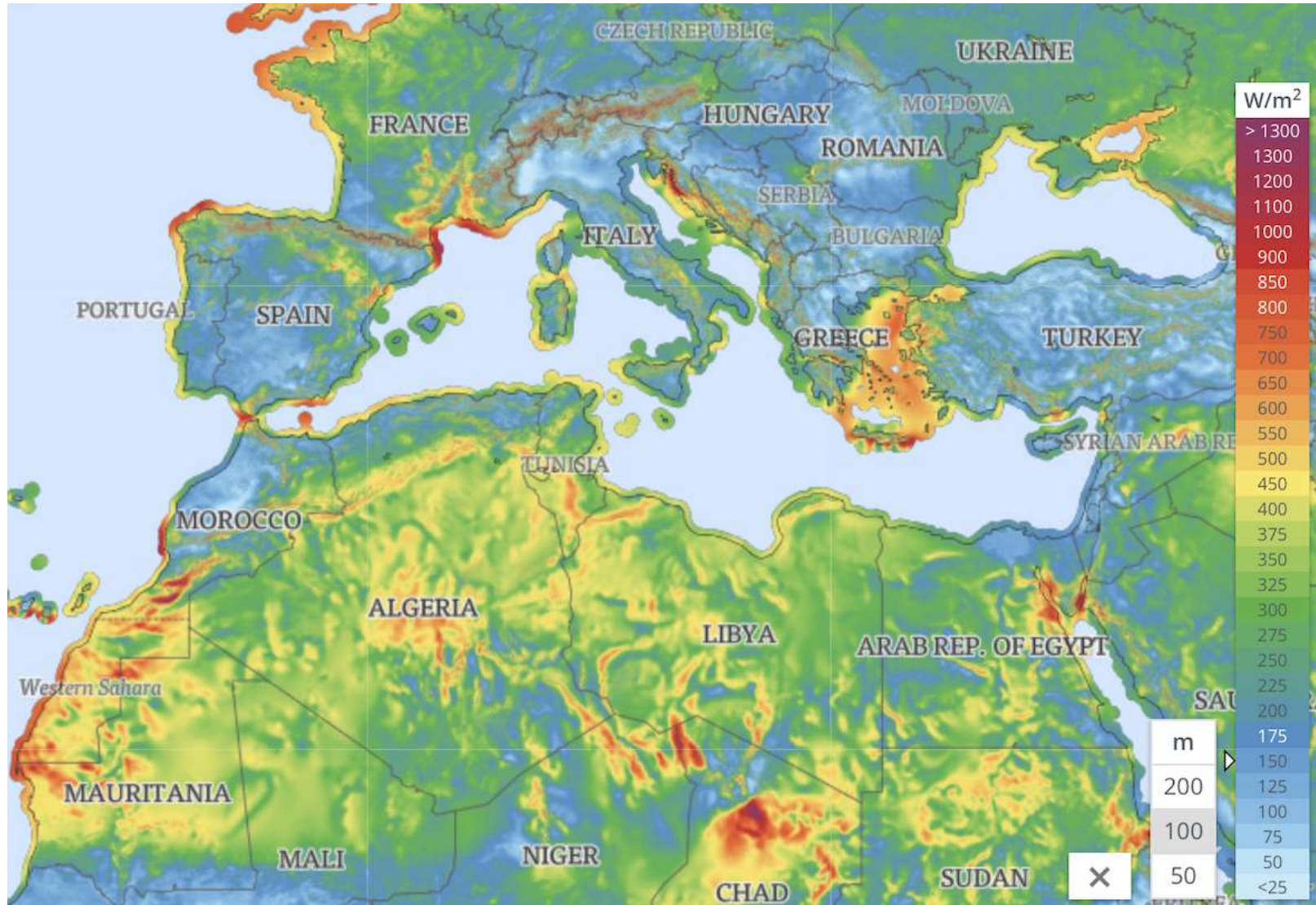
**The role of interconnections and hydrogen for
SE Mediterranean region**

Gas reserves in SE Mediterranean region*



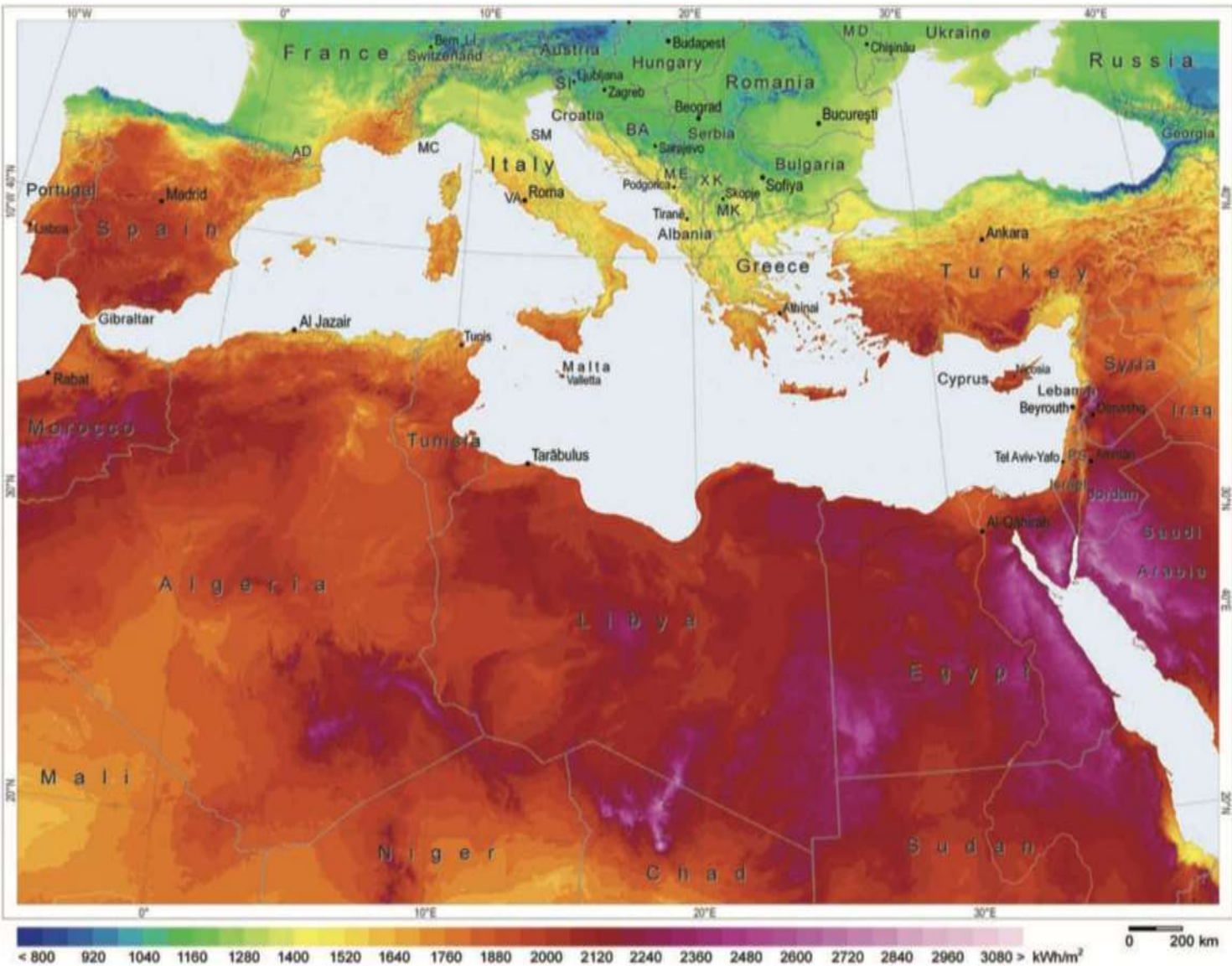
* A. Belopolsky, *et al.*, 2012, "New and emerging plays in the Eastern Mediterranean", *Petroleum Geoscience*

Wind potential in SE Mediterranean region*



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

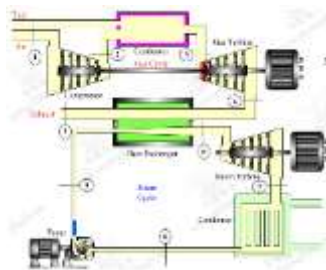
Solar potential in SE Mediterranean region*



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

Main indigenous energy sources in SE Mediterranean region

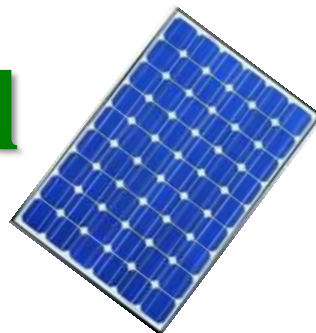
- Natural gas



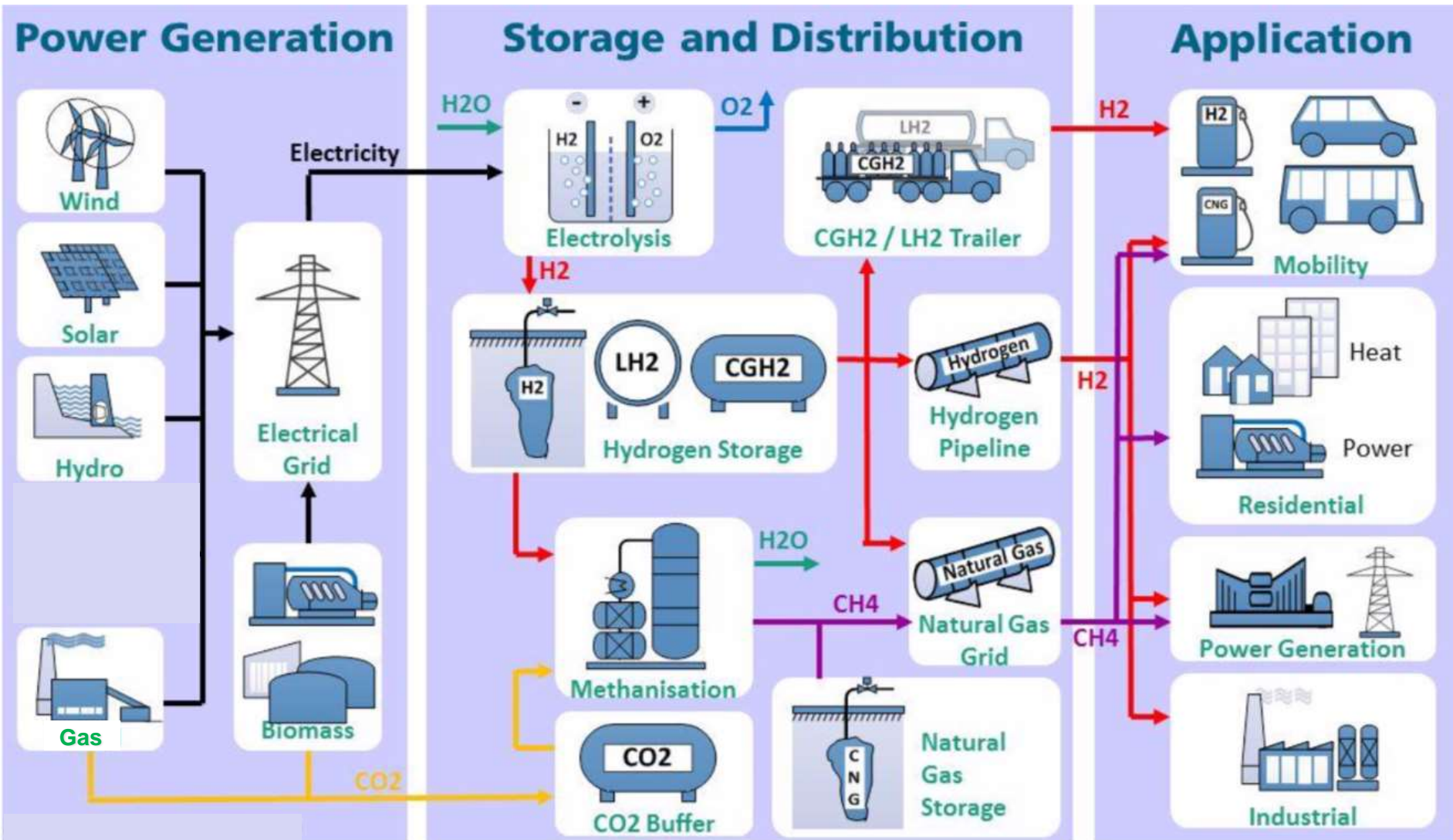
- Wind potential



- Solar potential



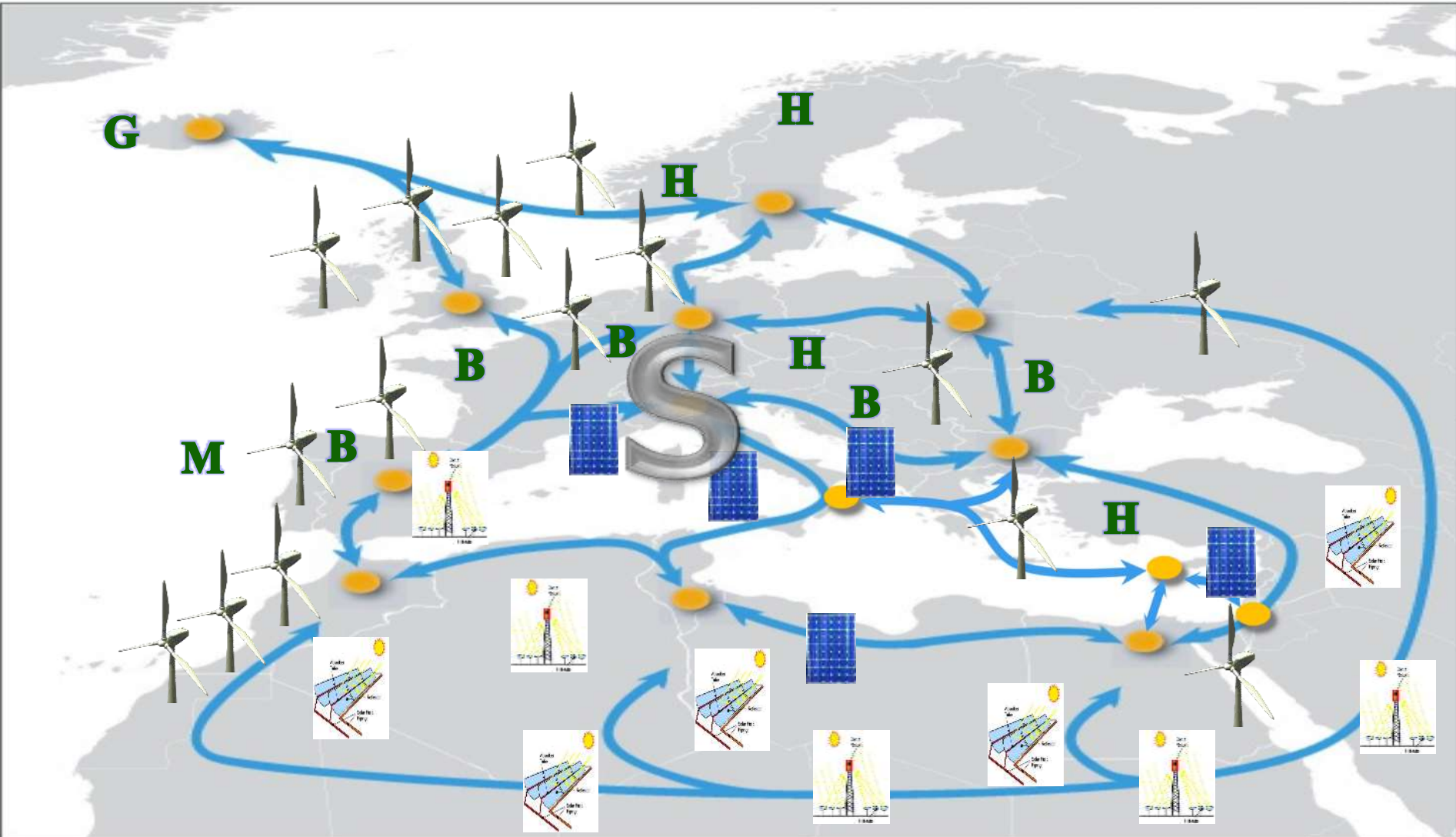
Potential role of hydrogen in the energy transition



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**

