ρυθμιστική αρχή ενέργειας κύπρου
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Cyprus' strategies towards decarbonization

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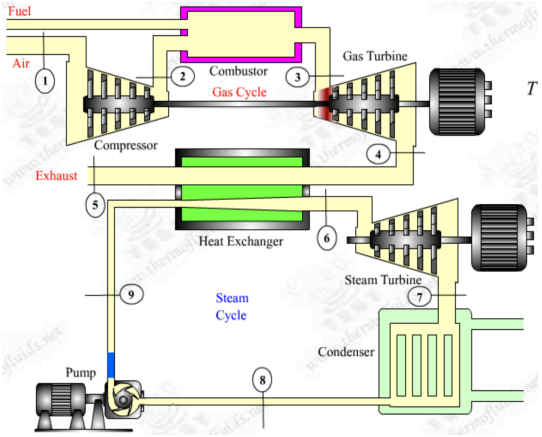
- **Cyprus current electricity and NG systems** – systems characteristics
- **Characteristics of island energy systems** – solutions to isolation
- **Short to medium term strategies** – towards sustainable energy system
- **Long term strategies** – sustainable future in SE Mediterranean region

Cyprus current electricity and NG systems

Systems characteristics

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**
  - Dhekelia power station 6x17.5MWe (HFO)



Existing power generation system (cont.)

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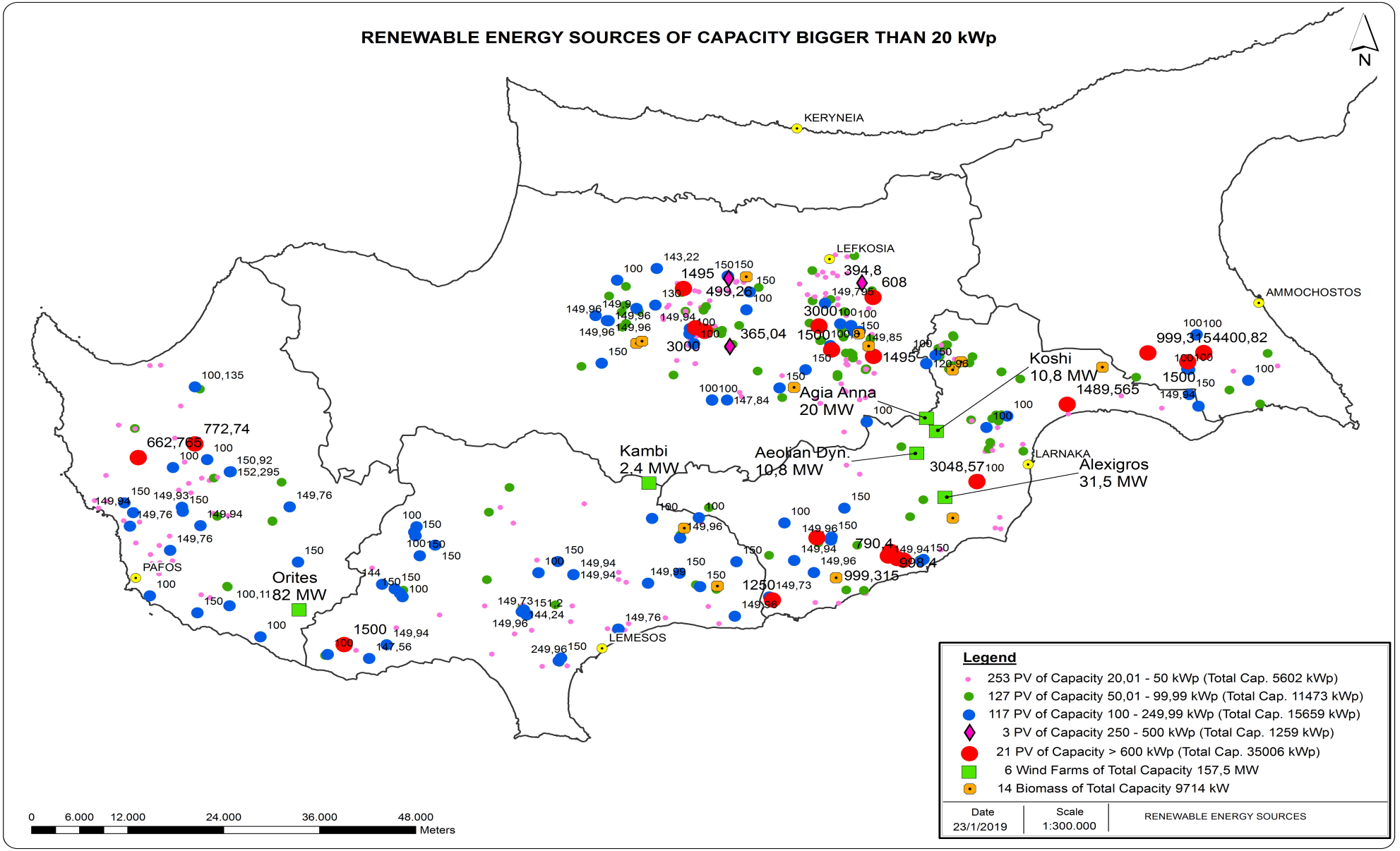
- **Renewables**
  - PVs: 217MWe
  - Wind: 157MWe
  - Biomass: 13MWe

- **Total installed capacity:**
  - Conventional: 1483MWe
  - Renewables: 387MWe

Distribution of RES-E



Existing natural gas system

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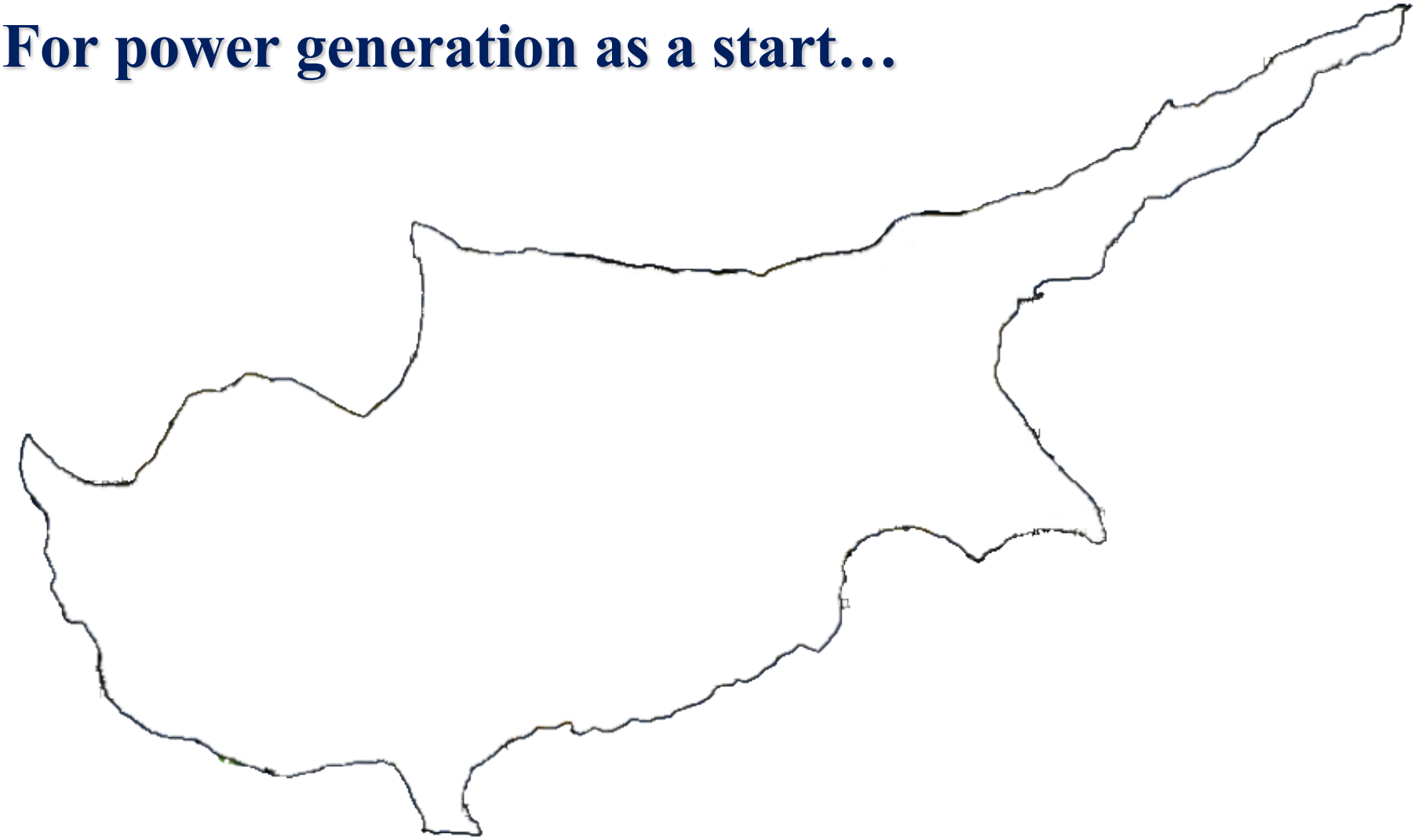
- **Under development !**
- **For power generation as a start…**



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Characteristics of island energy systems

Solutions to isolation

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

Energy transition for non-interconnected islands*

Need to:

- Reduce cost of security of supply
- Achieve market integration
- Increase socio-economic welfare benefits

* Poullikkas A., 2013, *Renewable Energy: Economics, Emerging Technologies and Global Practices*, ISBN: 978-1-62618-231-8

The solution*

- **Increase system flexibility**
  - ~ integrate RES into electricity market
  - ~ use natural gas, storage 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

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Short to medium term strategies

Towards sustainable energy future

EU electricity market target model*

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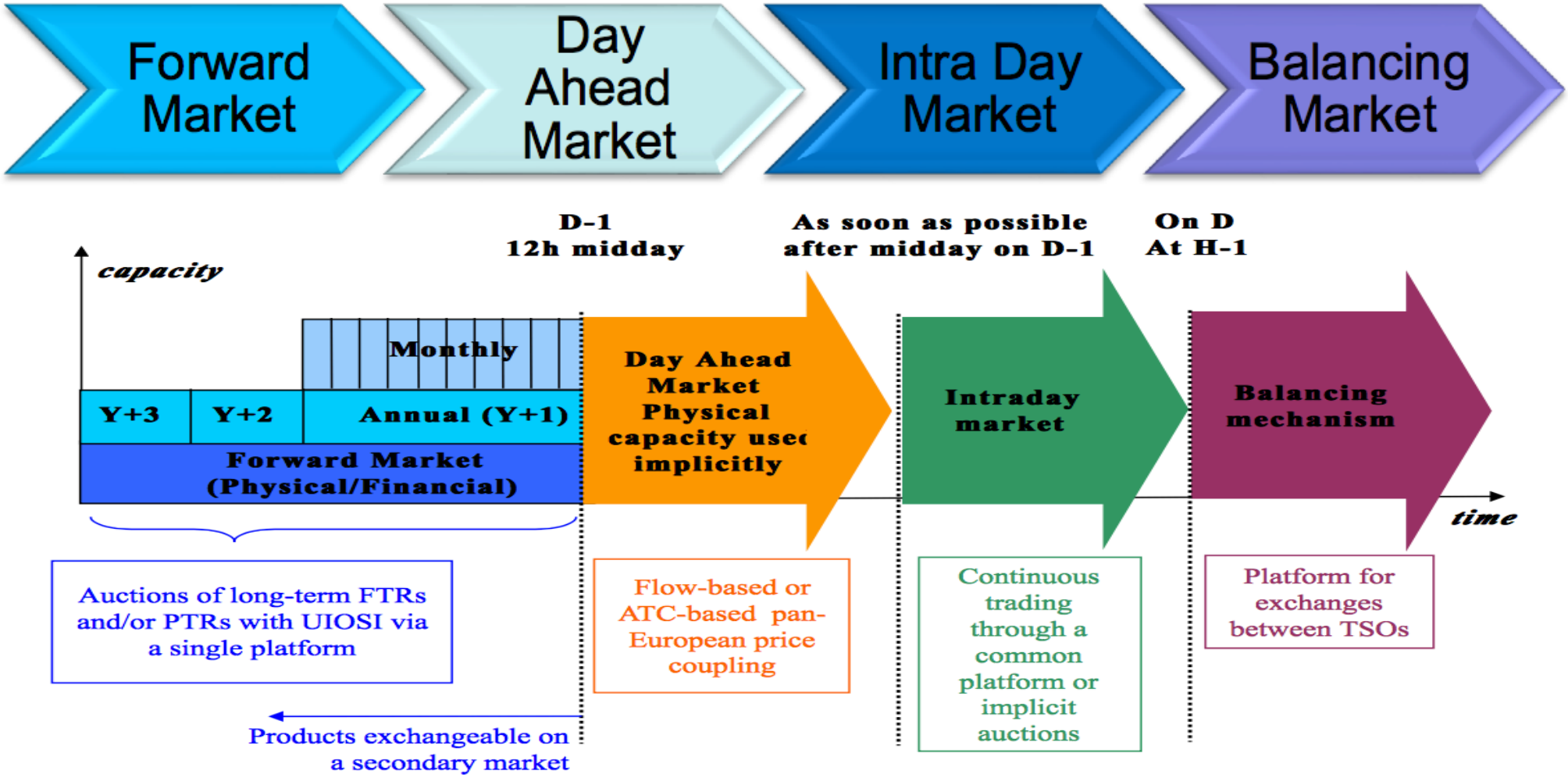
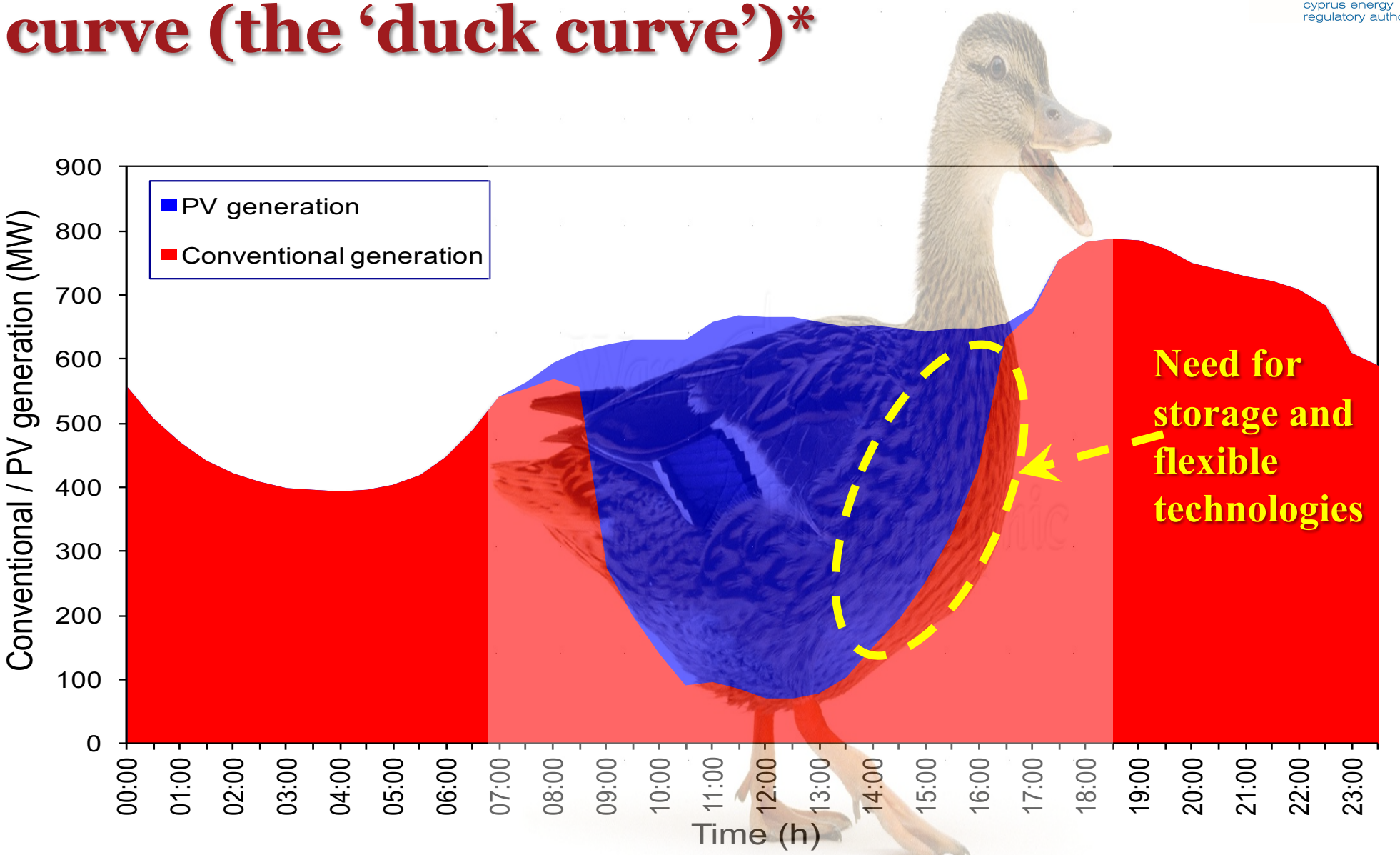


Integration of RES*: LCOE *vs* Reliability

* 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*)

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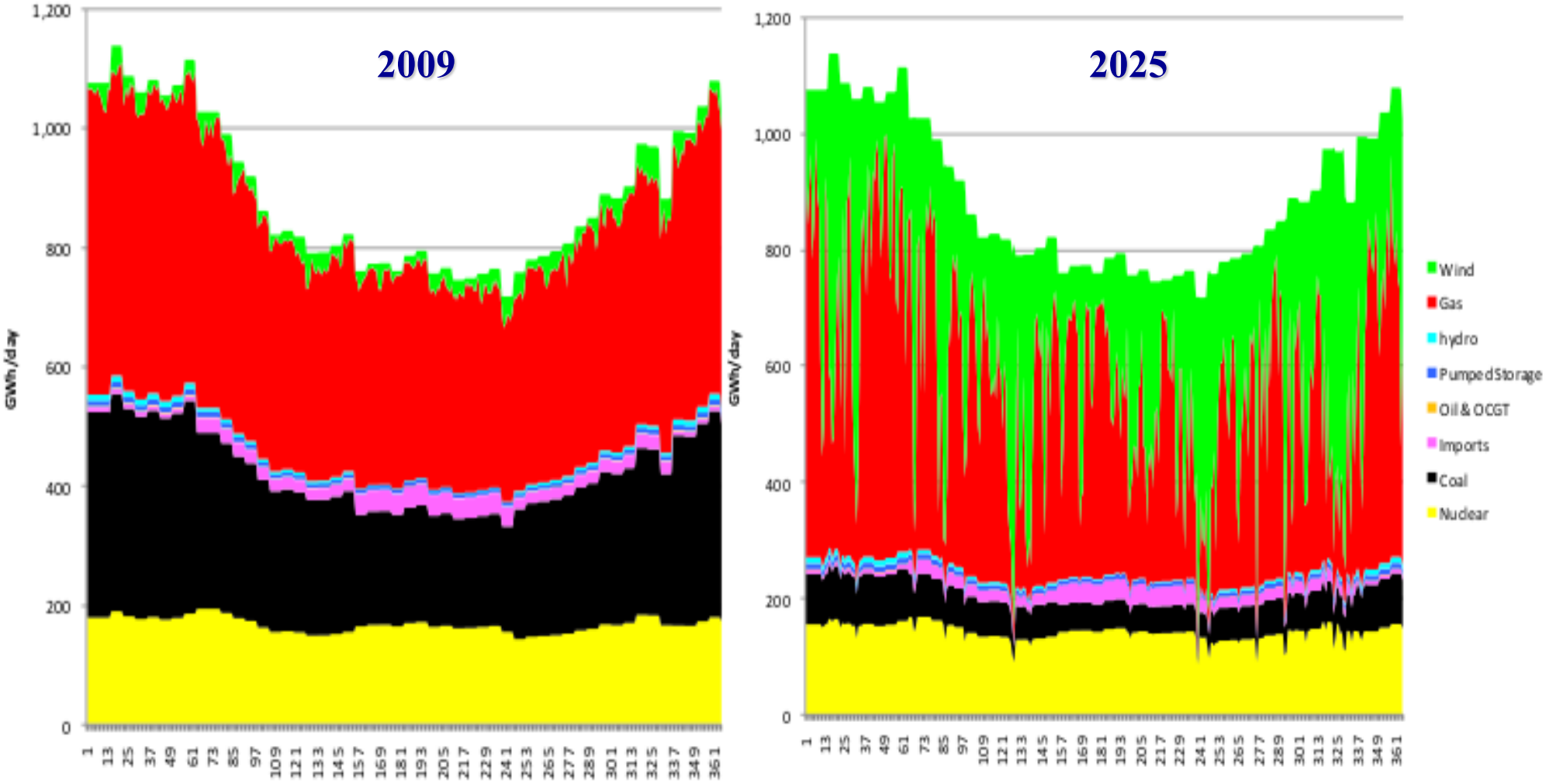

* H.V. Rogers, 2011, *The Impact of Import Dependence and Wind Generation on UK Gas Demand and Security of Supply to 2025*, The Oxford Institute For Energy Studies

Use of natural gas as a transition or bridge fuel*

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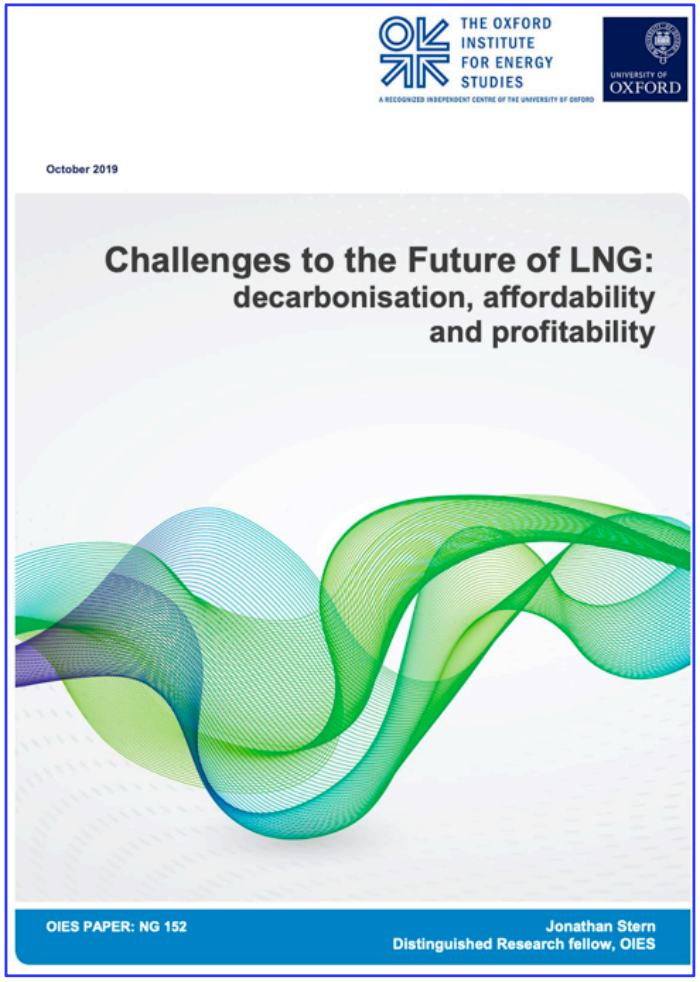
- switching from coal to gas
- using gas and storage to back up intermittent renewables
- the quickest, easiest and lowest cost decarbonization path



* Sterm J., 2019, *Challenges to the future of LNG: decarbonisation, affordability and profitability*, The Oxford Institute For Energy Studies

Long term strategies

The role of interconnections and hydrogen for SE Mediterranean region

Long term strategy for energy exports from SE Mediterranean region

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Indigenous energy sources

Gas reserves in SE Mediterranean region*

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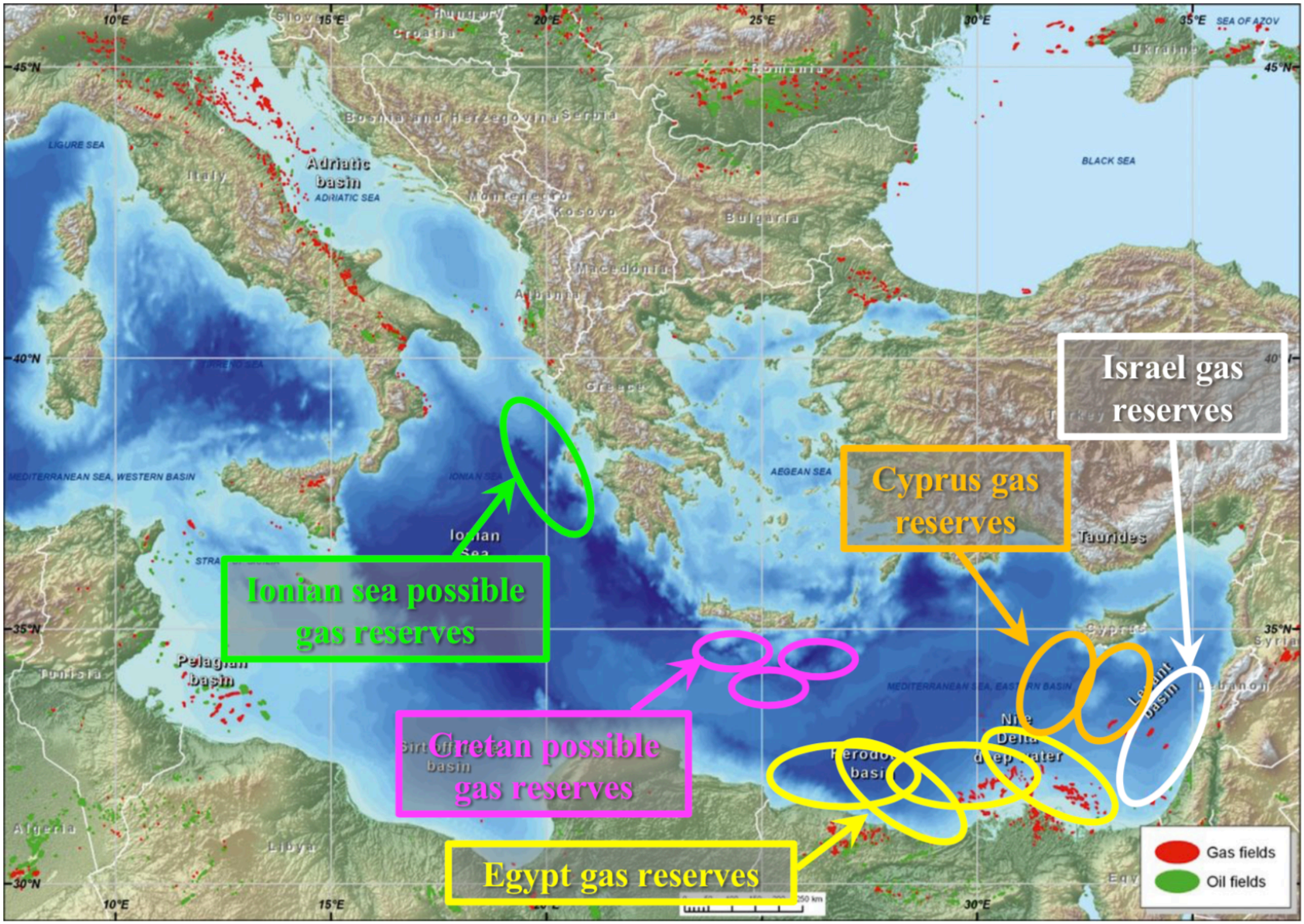

* A. Belopolsky, *et al.*, 2012, "New and emerging plays in the Eastern Mediterranean", *Petroleum Geoscience*

Wind potential in SE Mediterranean region*

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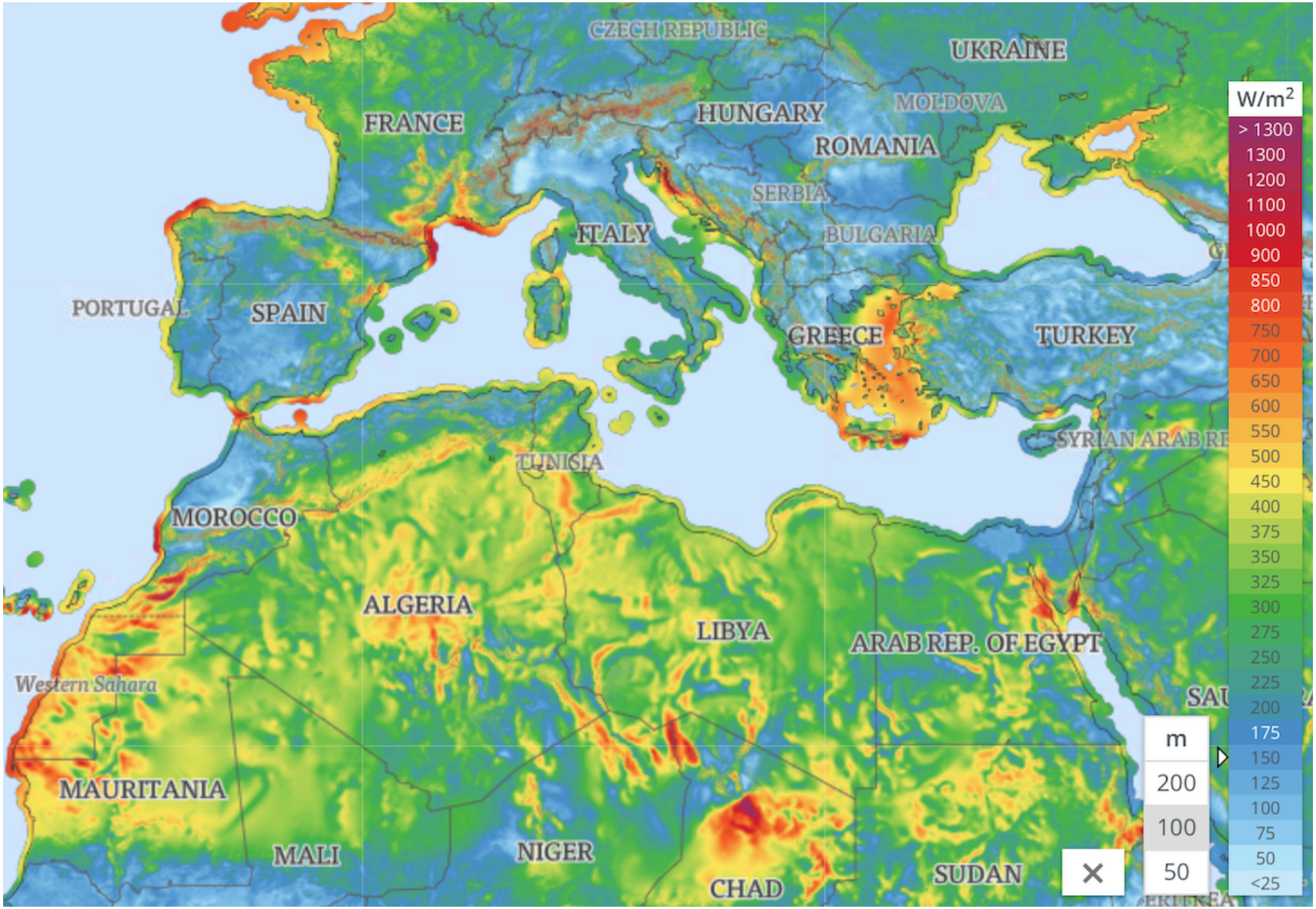

* The Global Wind Atlas (https://globalwindatlas)

Solar potential in SE Mediterranean region*

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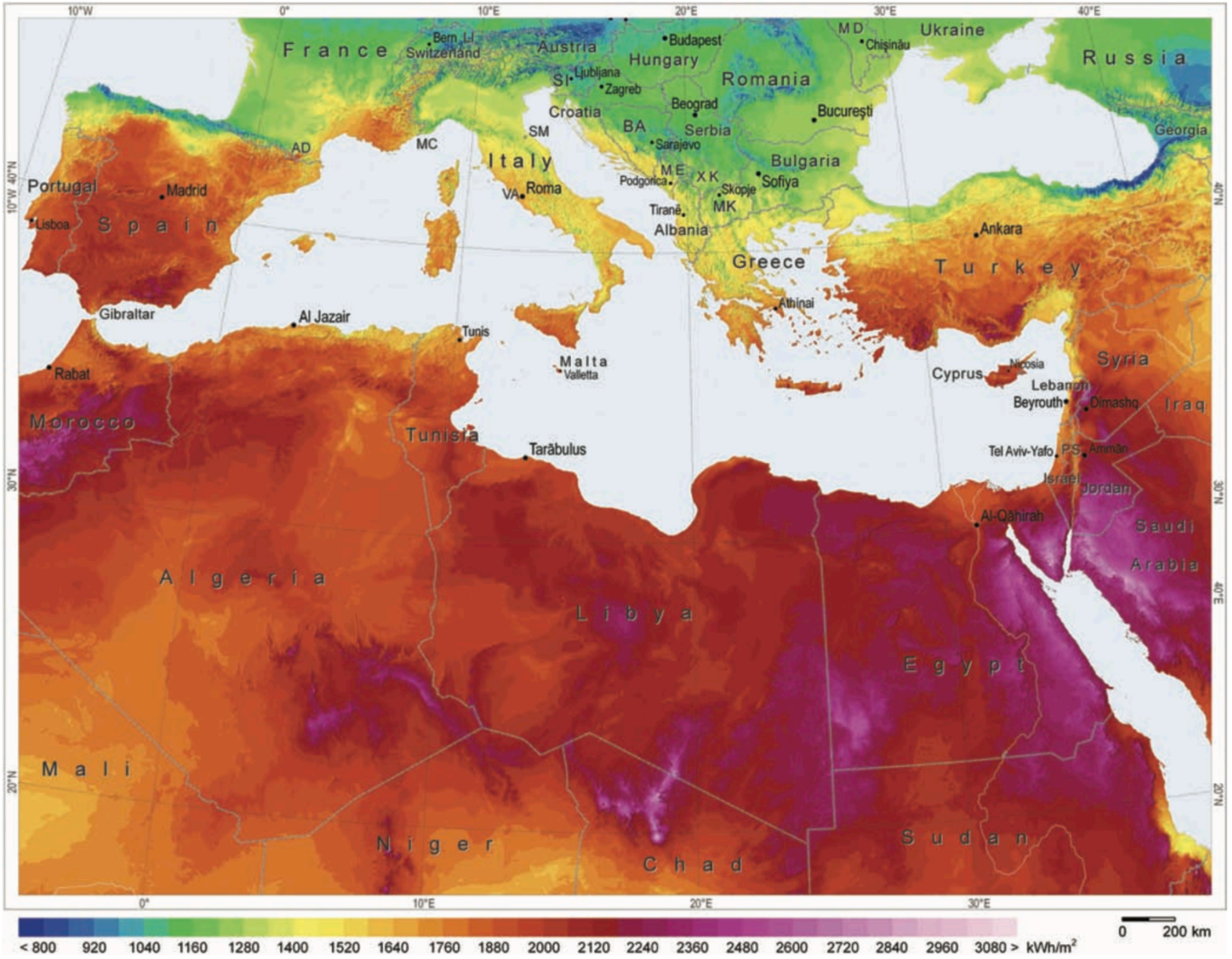

* Easac & Pihl, Erik. (2011). Concentrating Solar Power: Its potential contribution to a sustainable energy future

Main indigenous energy sources in SE Mediterranean region

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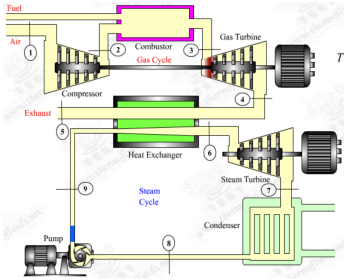
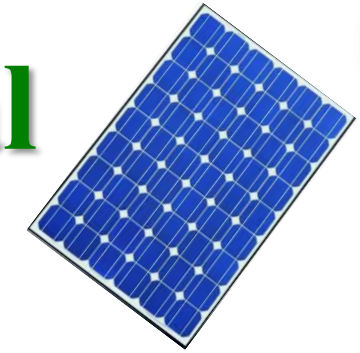
- Natural gas



- Wind potential

- Solar potential



hydrogen

Long term scenarios in Europe

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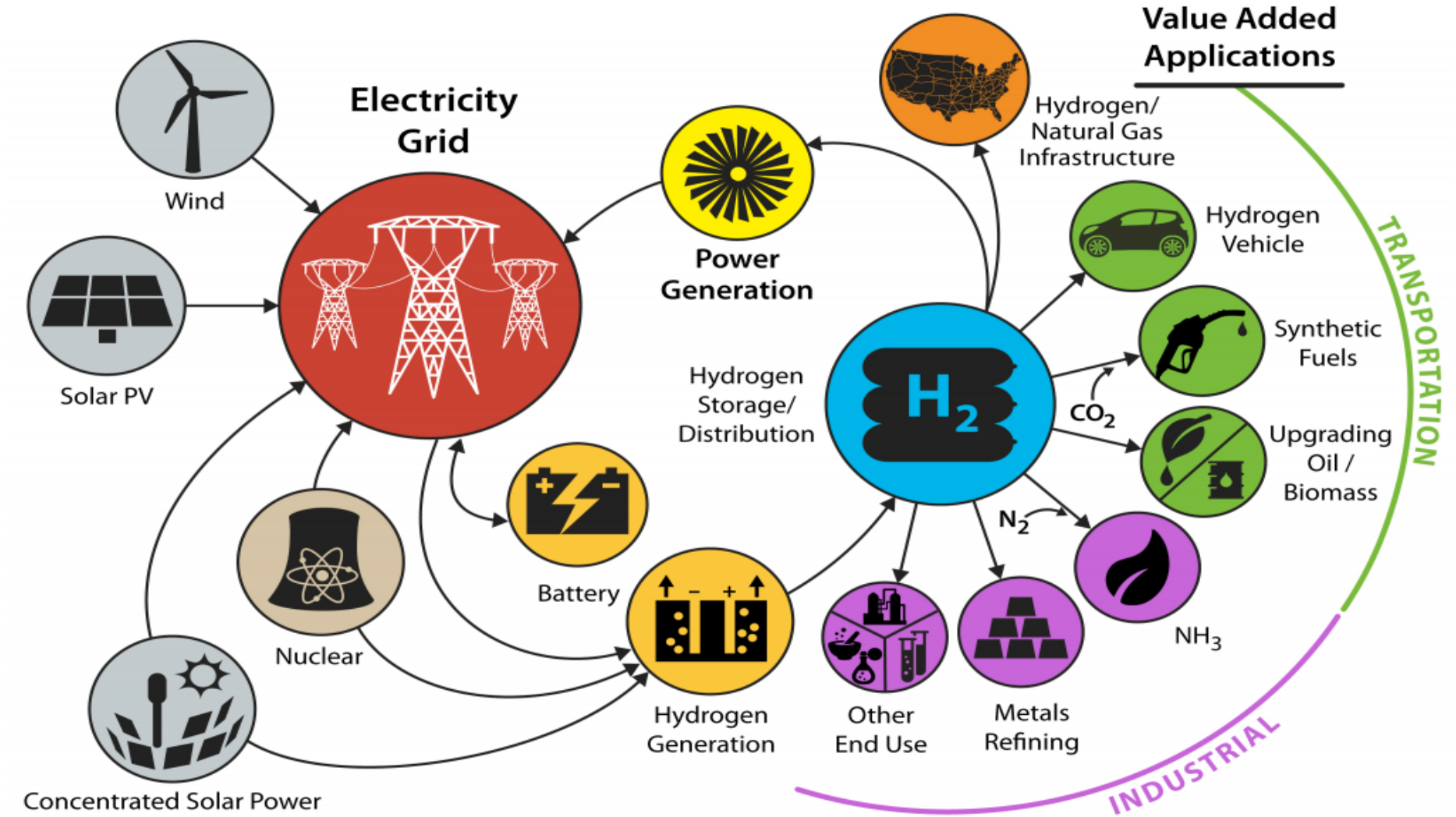
Moving from Carbon economy to Hydrogen economy



Next steps towards the development of sustainable energy strategy*

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

* Poullikkas A., 2020, *Long-term Sustainable Energy Strategy: Cyprus' Energy Transition to Hydrogen Economy*, ISBN: 978-9925-7710-0-4