ρυθμιστική αρχή ενέργειας κύπρου
cyprus energy regulatory authority

Presidents' Roundtable

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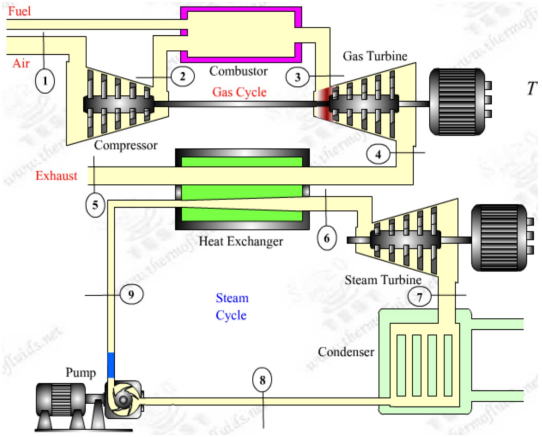
- **Cyprus current electricity and NG systems** – systems characteristics
- **Energy transition for island systems** – solutions to isolation
- **Short to medium term challenges** – large scale integration of RES
- **Medium to long term challenges** – the role of interconnections and hydrogen

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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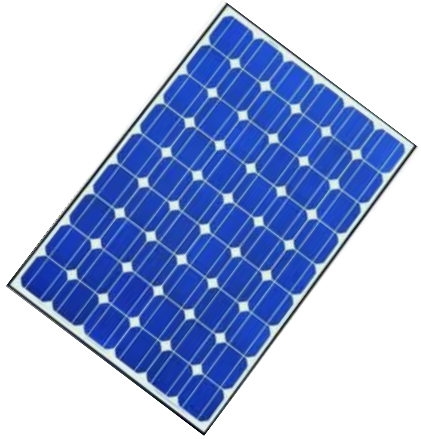
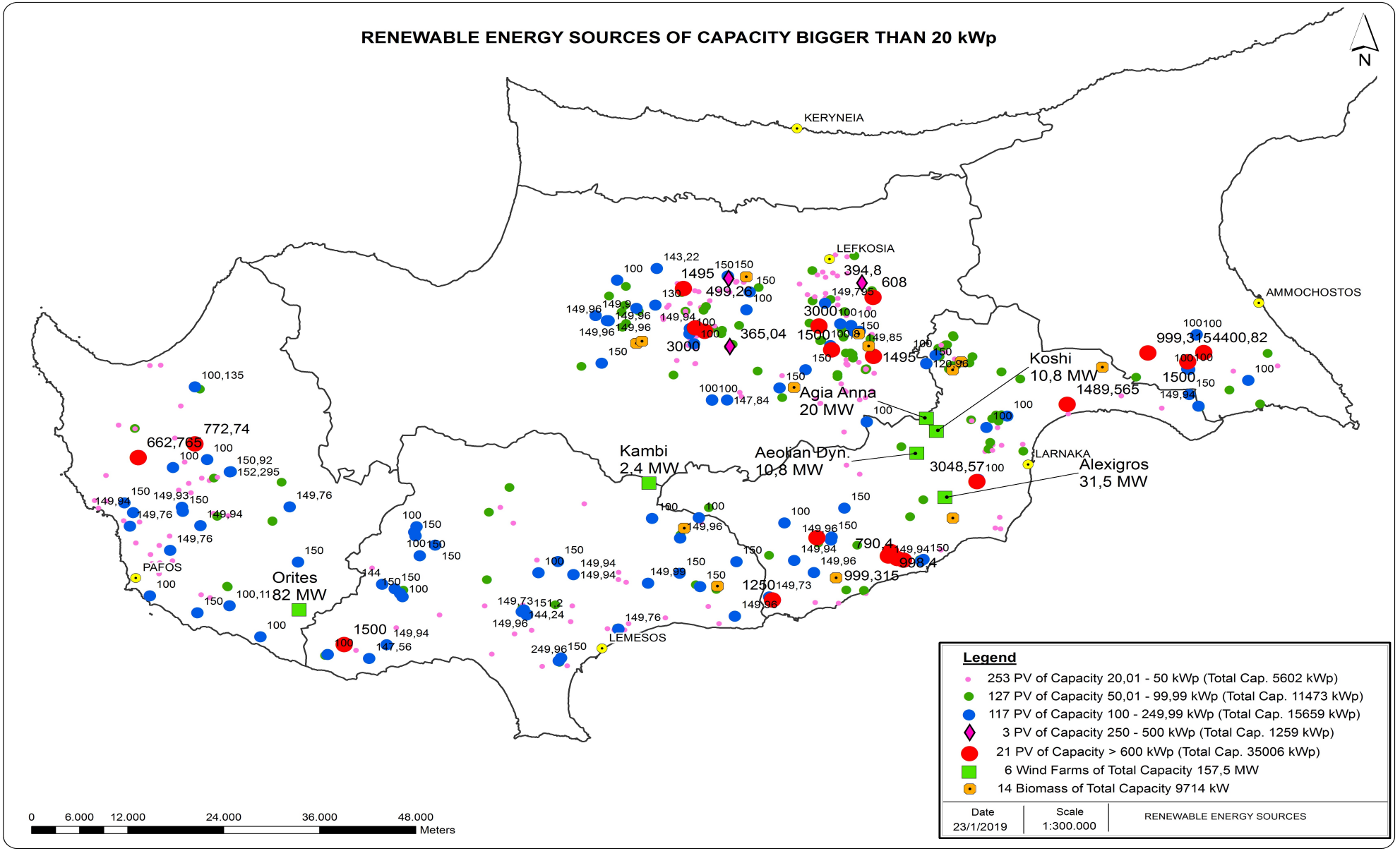
- **Renewables**
  - **PVs: 282MWe**
  - **Wind: 157MWe**
  - **Biomass: 13MWe**



- **Total installed capacity:**
  - **Conventional: 1483MWe**
  - **Renewables: 452MWe**

Distribution of RES-E



Existing natural gas system

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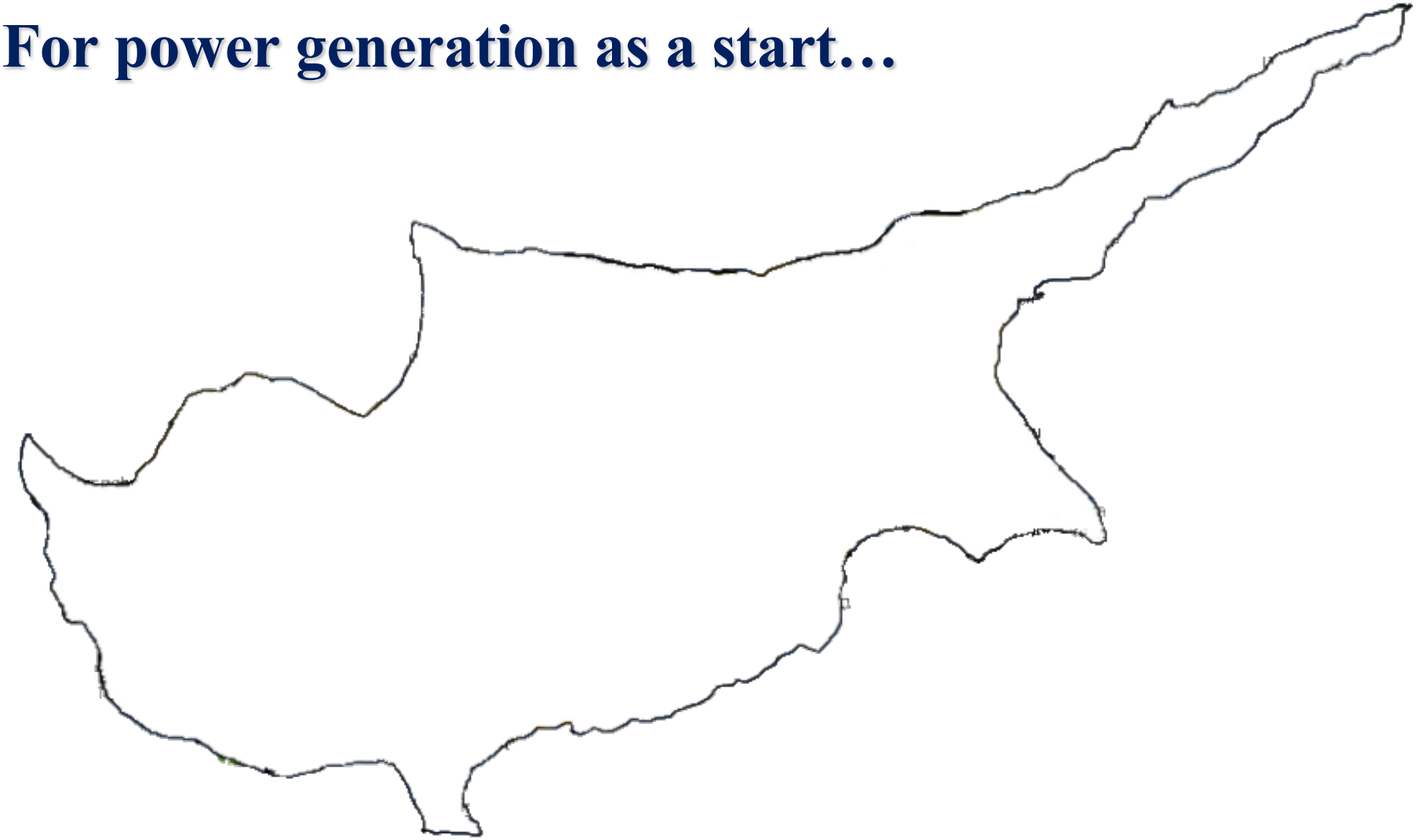
- **Under development !**
- **For power generation as a start…**



Energy transition for island systems

Solutions for isolated systems

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

Brent historic prices

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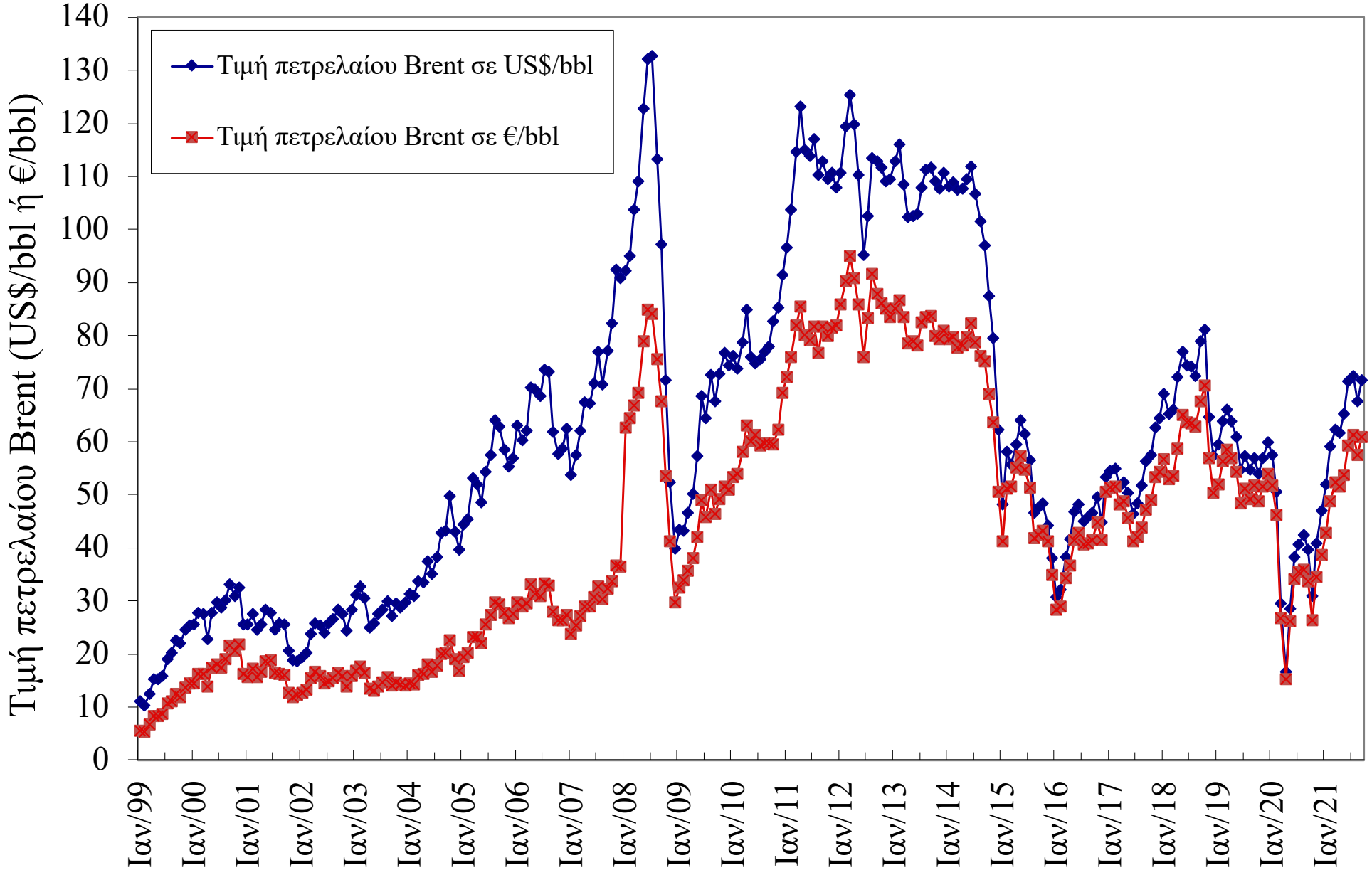

Energy transition for non-interconnected islands*

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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

CERA Energy Transition Regulatory Decisions

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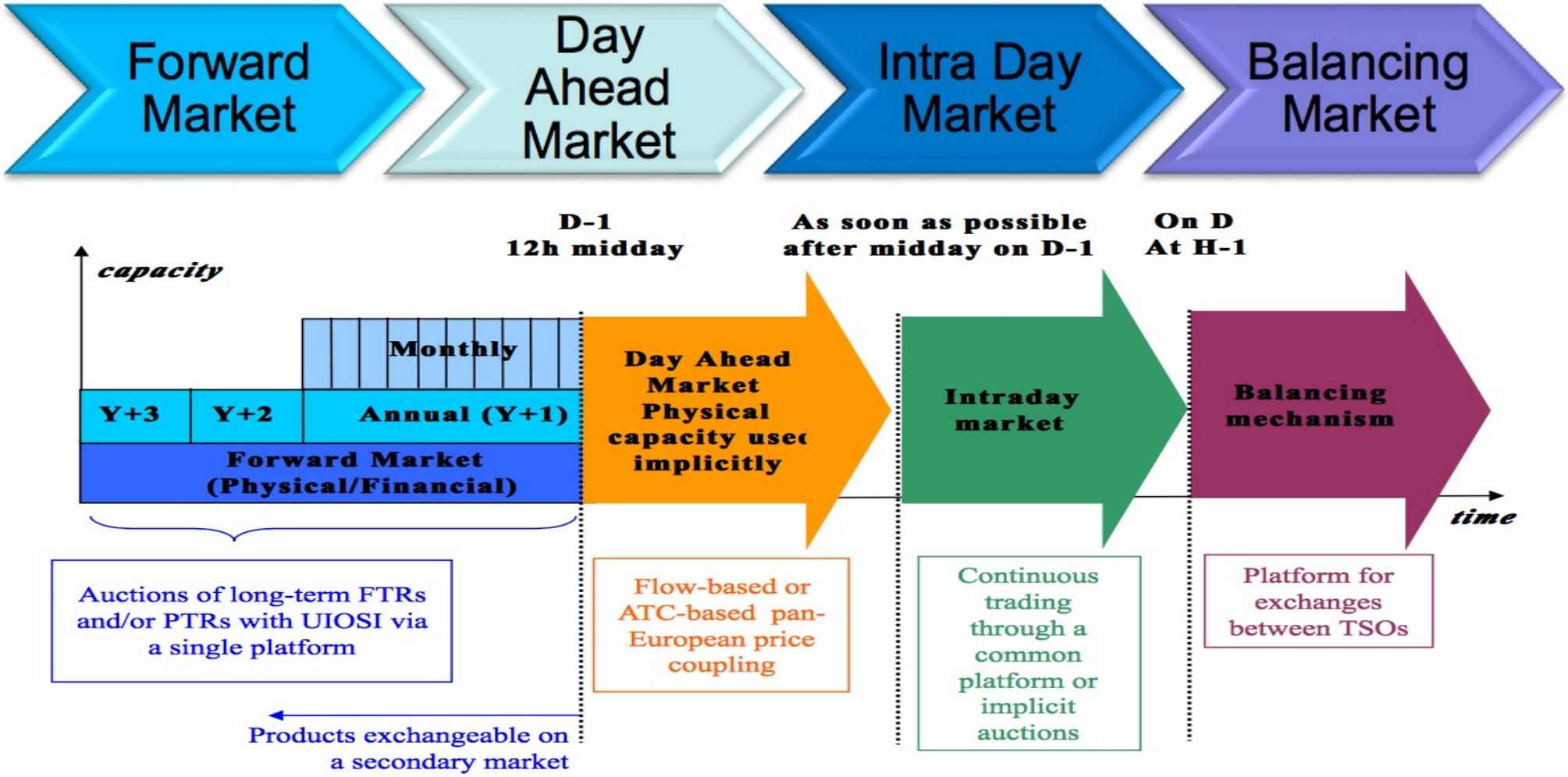
- **Regulatory Decision 01/2017 (ΚΔΠ 34/2017): A detailed schedule for the implementation of EU electricity market target model**
- **Regulatory Decision 02/2018 (ΚΔΠ 259/2018): The mass installation of an Advanced Metering Infrastructure including smartmeters to all electricity consumers**
- **Regulatory Decision 02/2019 (ΚΔΠ 204/2019): The establishment of basic principles of a regulatory framework for the operation of electricity storage systems in the wholesale electricity market**
- **Regulatory Decision 03/2019 (ΚΔΠ 224/2019): The redesign of the power grid to become smart and bi-directional in order to allow integration of large quantities of renewable energy sources in combination with energy storage systems**

Short to medium term challenges

Large scale integration of RES

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*

Daily load curve (the 'camel curve')*

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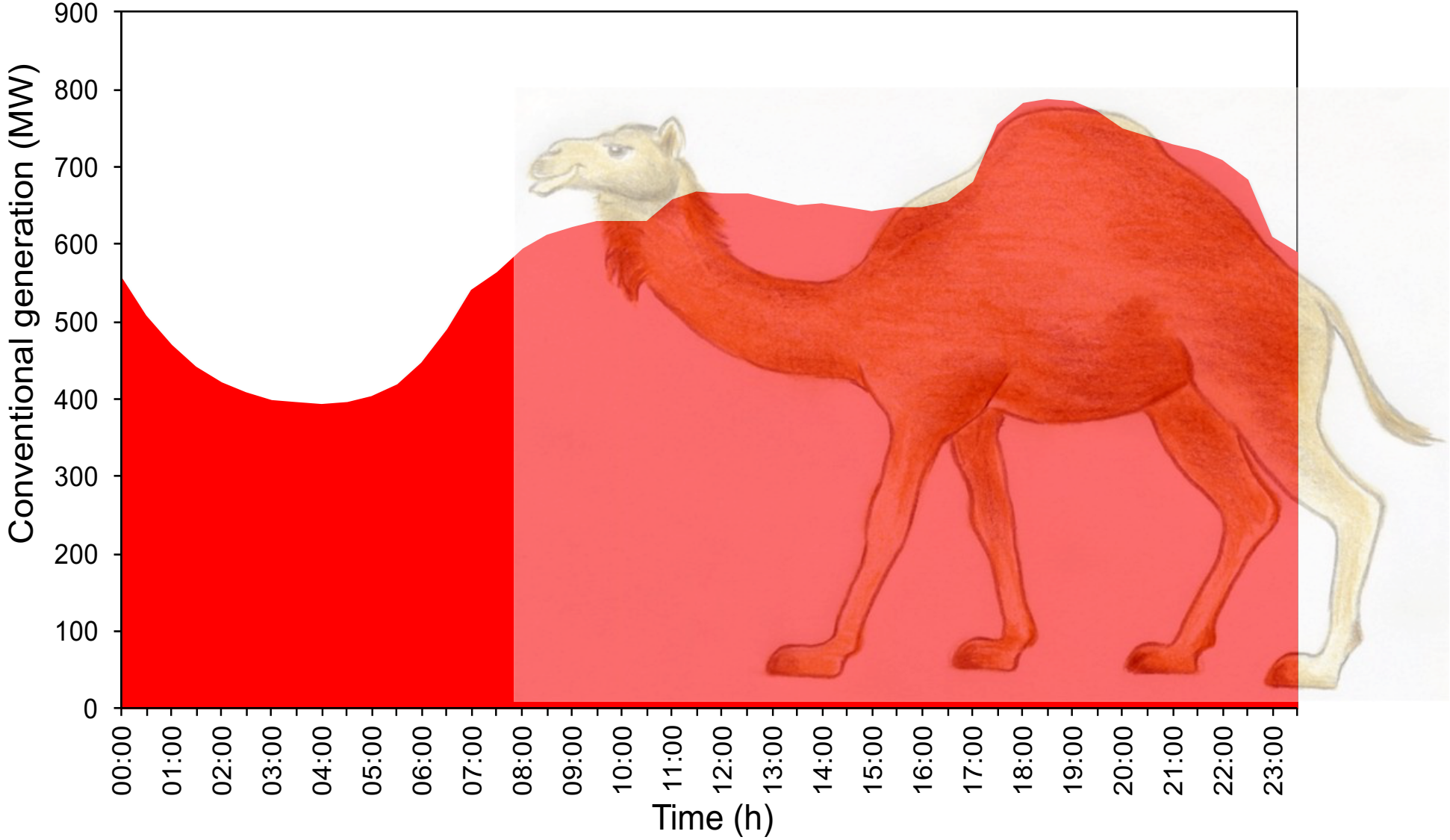
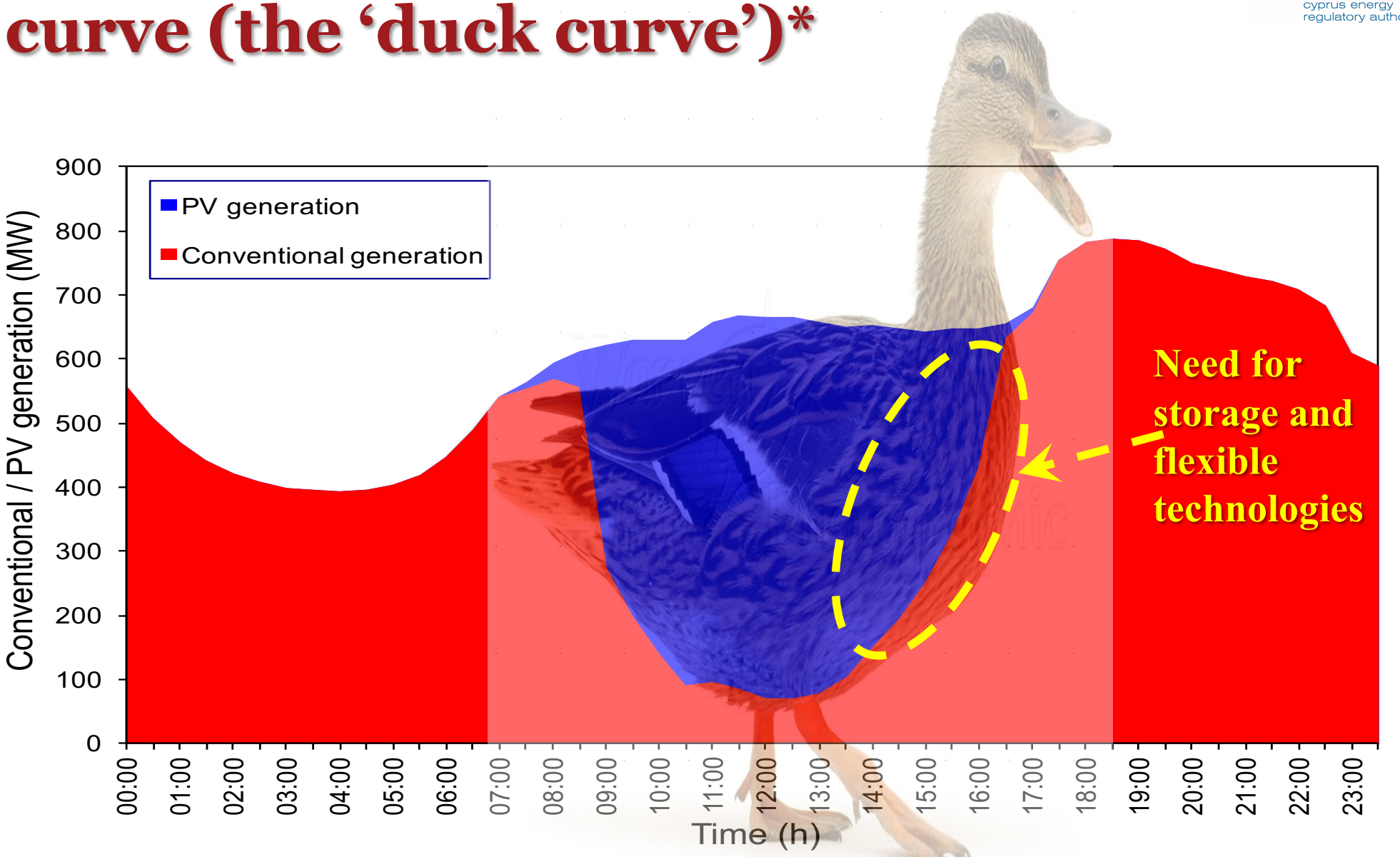


* **Poullikkas A., 2016, "From the 'camel curve' to the 'duck curve' on electric systems with increasing solar power", *Accountancy***

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*

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Medium to long term challenges

The role of interconnections and hydrogen

Main indigenous energy sources in Mediterranean region

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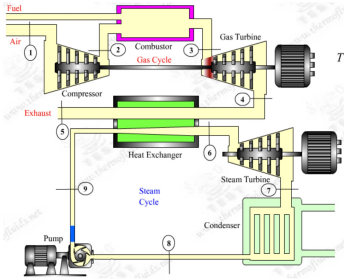
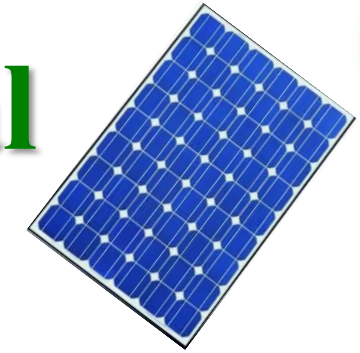
- Natural gas



- Wind potential

- Solar potential



hydrogen

The Super Smart Grid after 2050*
(may allow for 100% RES)

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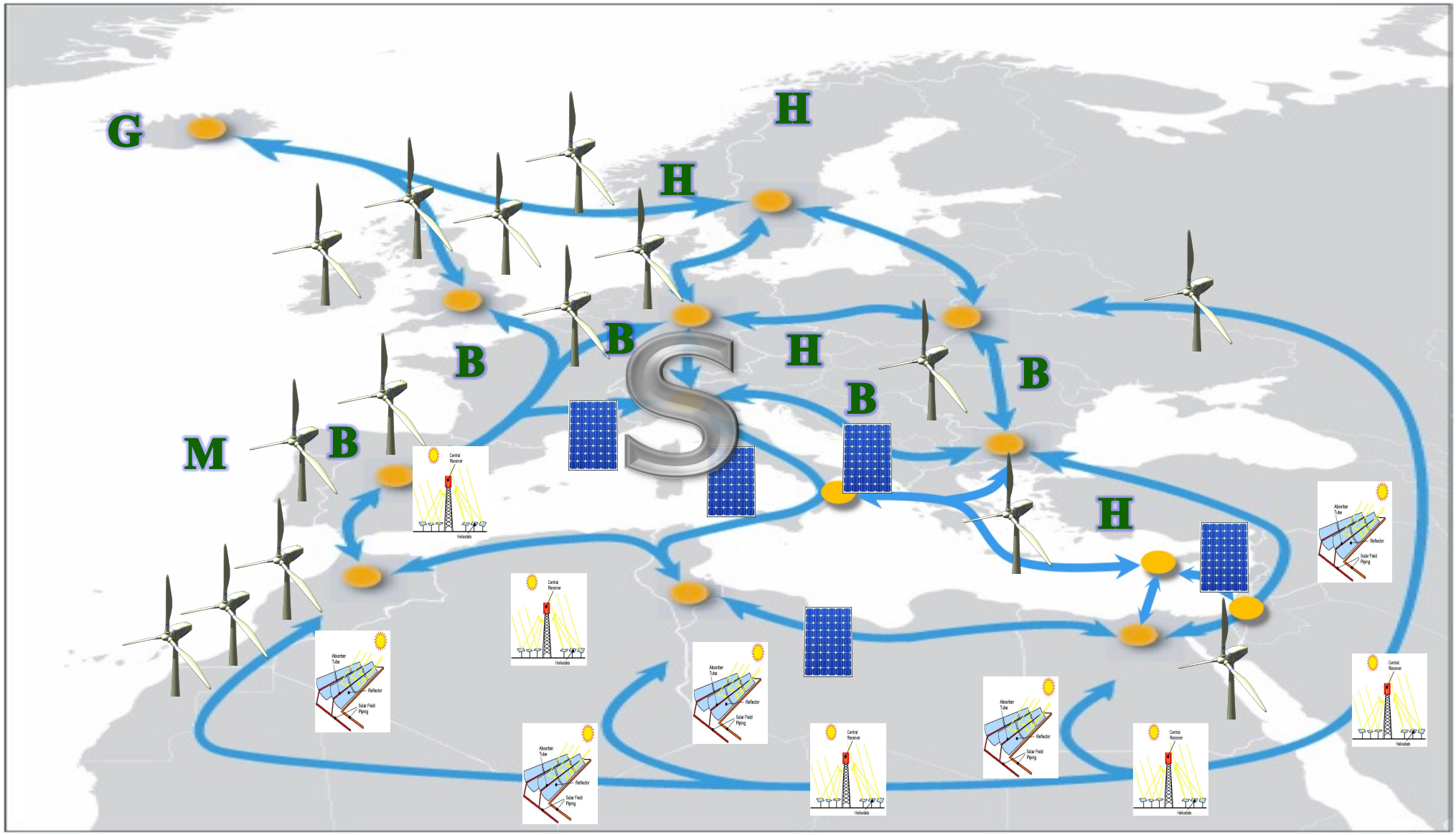

* Poullikkas A., 2013, *Sustainable Energy Development for Cyprus*, ISBN: 978-9963-7355-3-2

Long term scenarios in Europe

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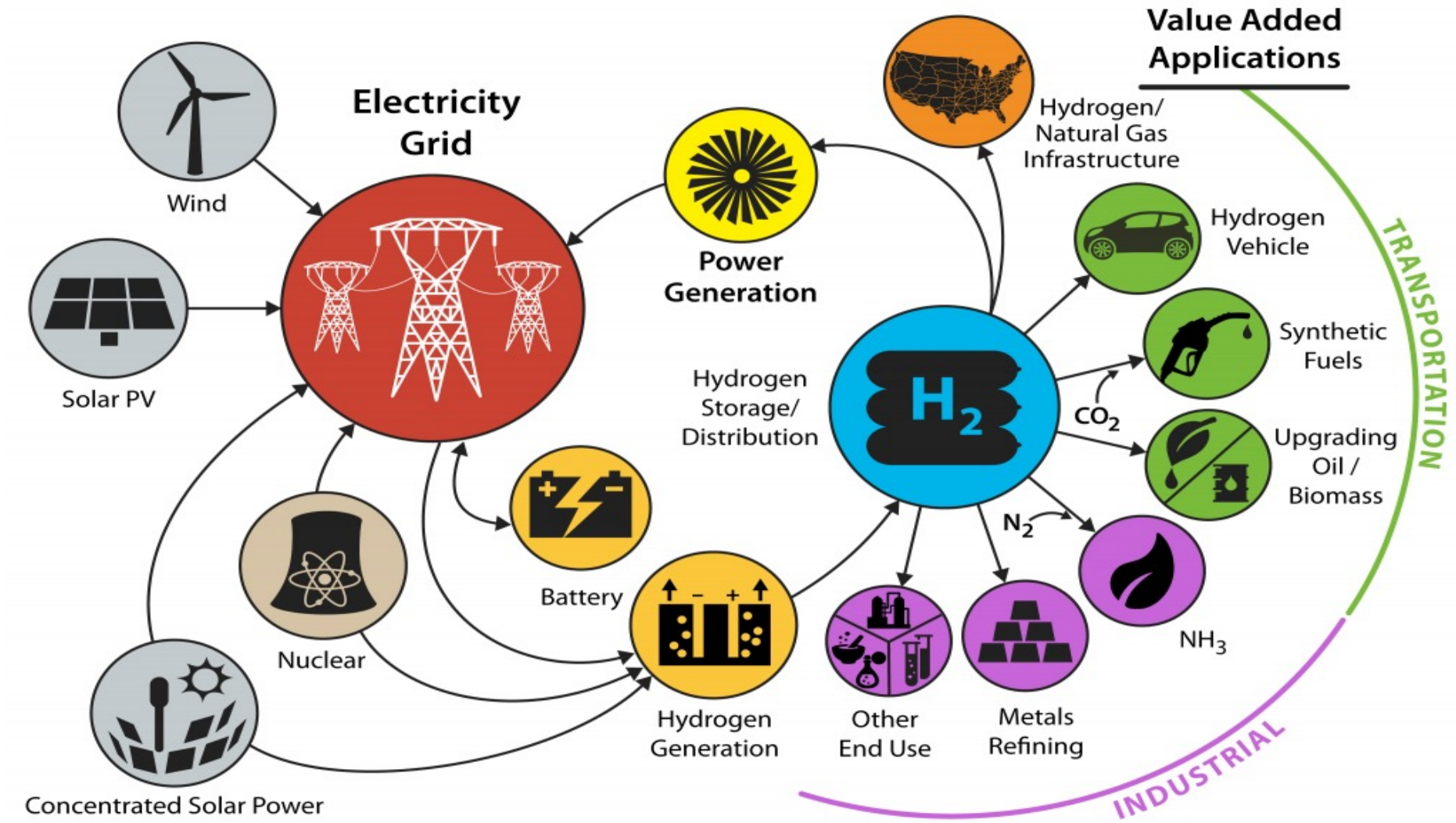
Moving from Carbon economy to Hydrogen economy



Target-setting for Cyprus' transition to hydrogen economy*

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Target	Year		
	2030	2040	2050
Greenhouse gases	-30%	-75%	-100%
Renewable energy sources	30%	75%	100%
Electrical interconnections	50%	65%	80%

Cyprus could set a long-term goal of reducing greenhouse gas emissions by 100% by 2050 !

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

Energy transition by 2050

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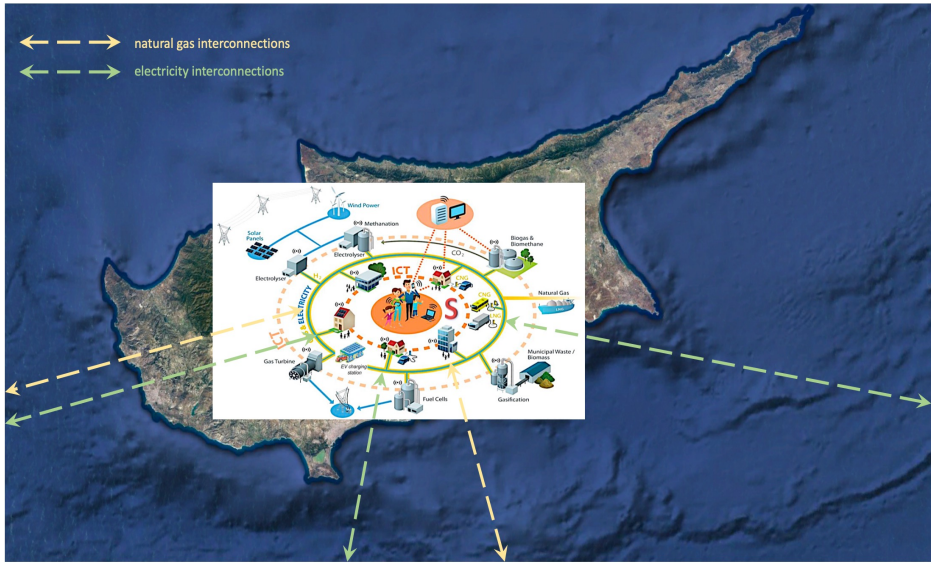
Cyprus' energy system:

- smart and digitised
- flexible
- decentralised
- electrically interconnected
- interconnected gas and/or hydrogen pipelines



Integration:

- hydrogen in all energy sectors
- renewable energy sources
- storage energy systems
- electric mobility

Transition of Cyprus from the current carbon economy to hydrogen economy by the year 2050

Development of regional energy strategy ?

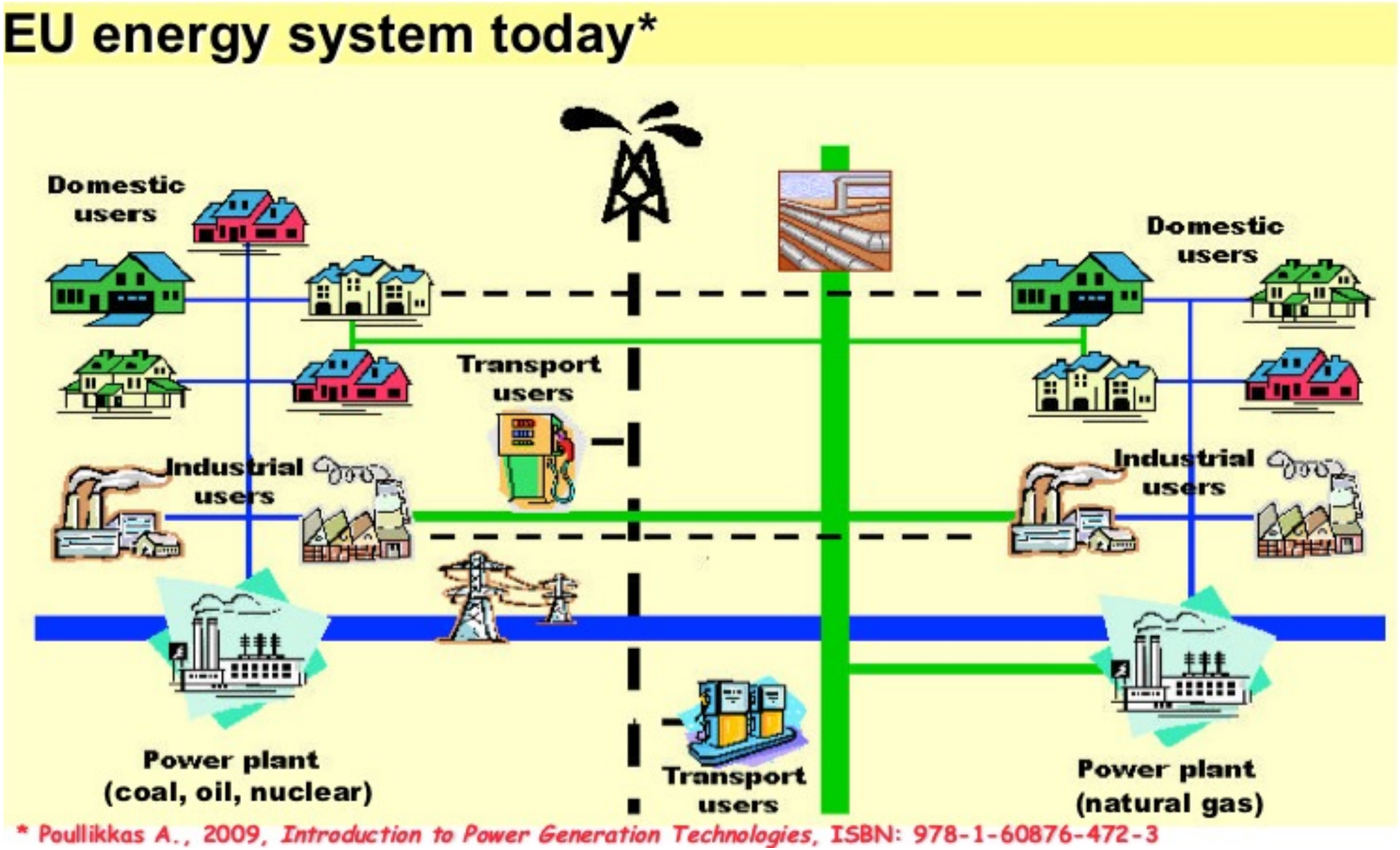
- **Horizon up to 2060**
- **Development of strategic plan for the region:**
  - ~ **Electrical interconnections**
  - ~ **Pipeline interconnections (or virtual pipelines)**
  - ~ **Integration of sustainable technologies and storage**
  - ~ **Use of hydrogen after 2030**
  - ~ **Hydrogen production**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

Additional Slides

EU energy strategy

towards 2050

Current energy system



Future energy systems (optimistic scenario)

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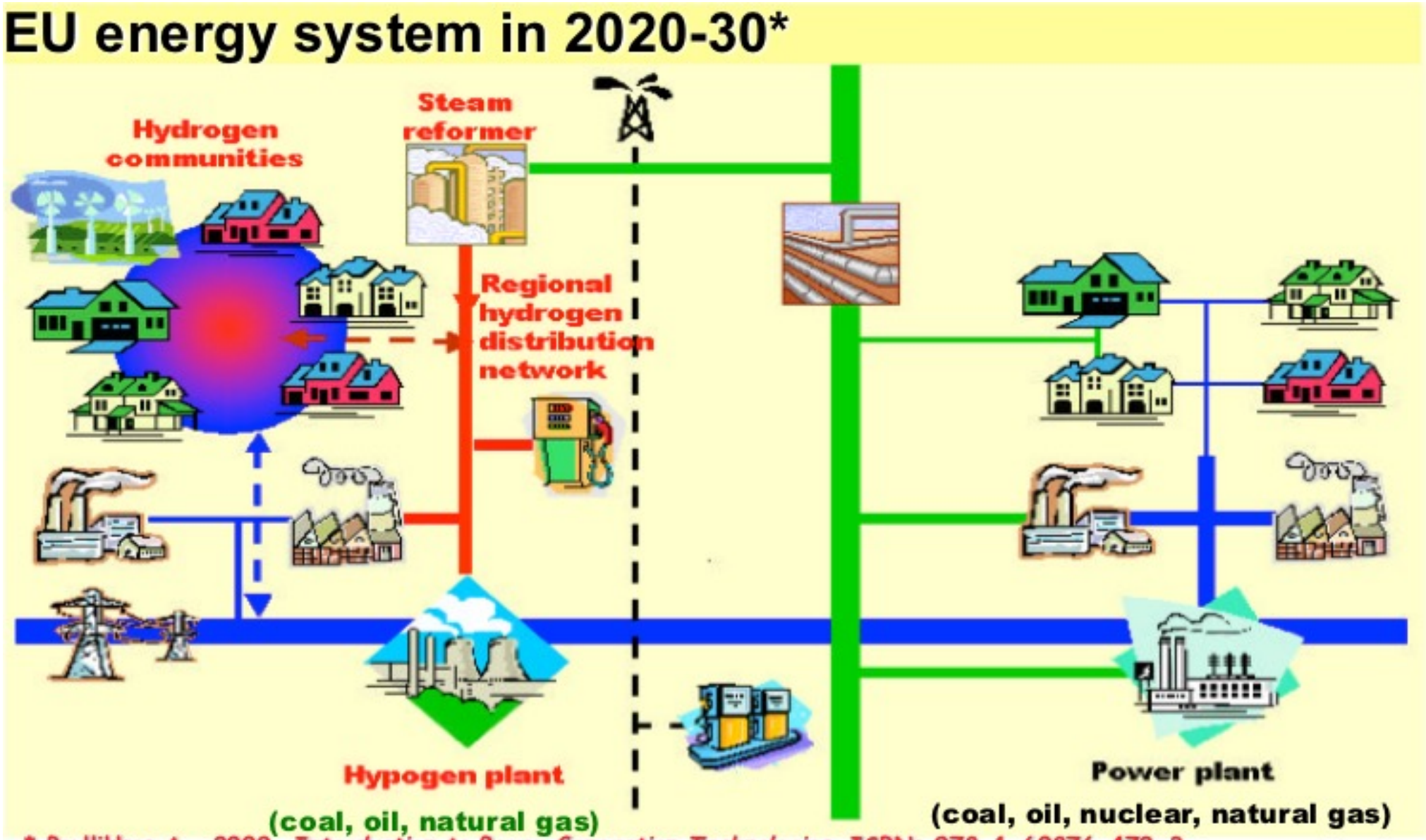

Future energy systems (optimistic scenario)

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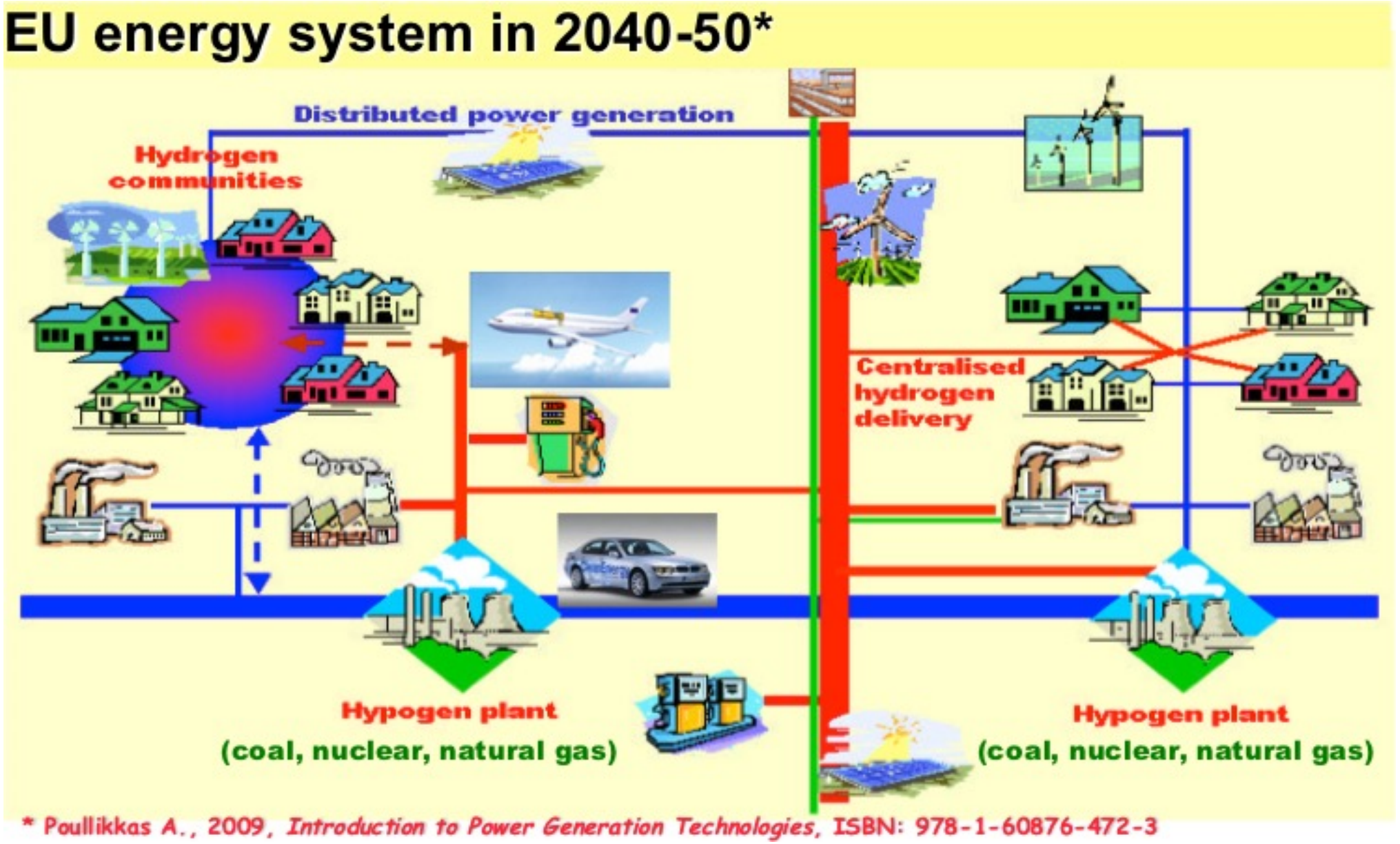
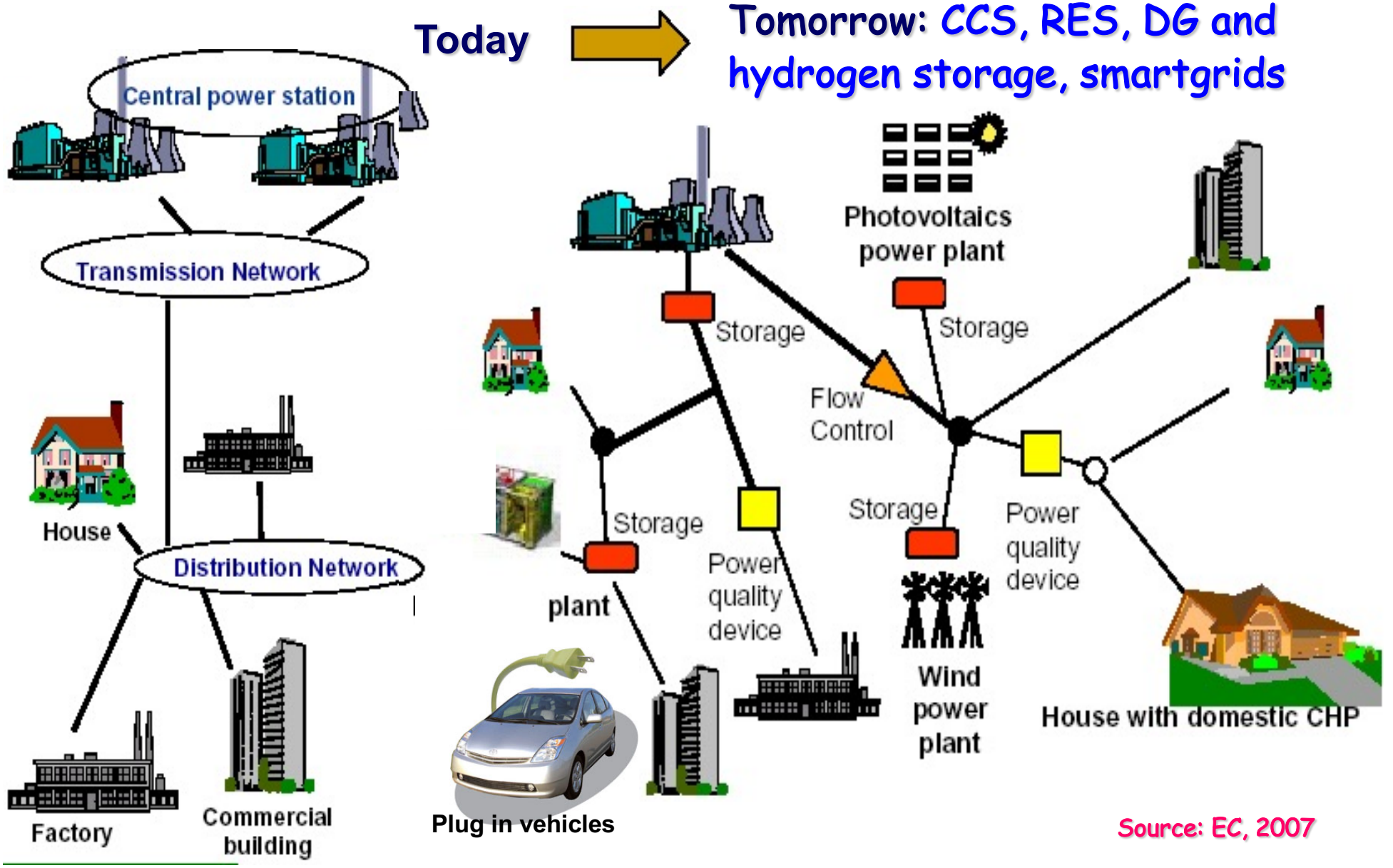
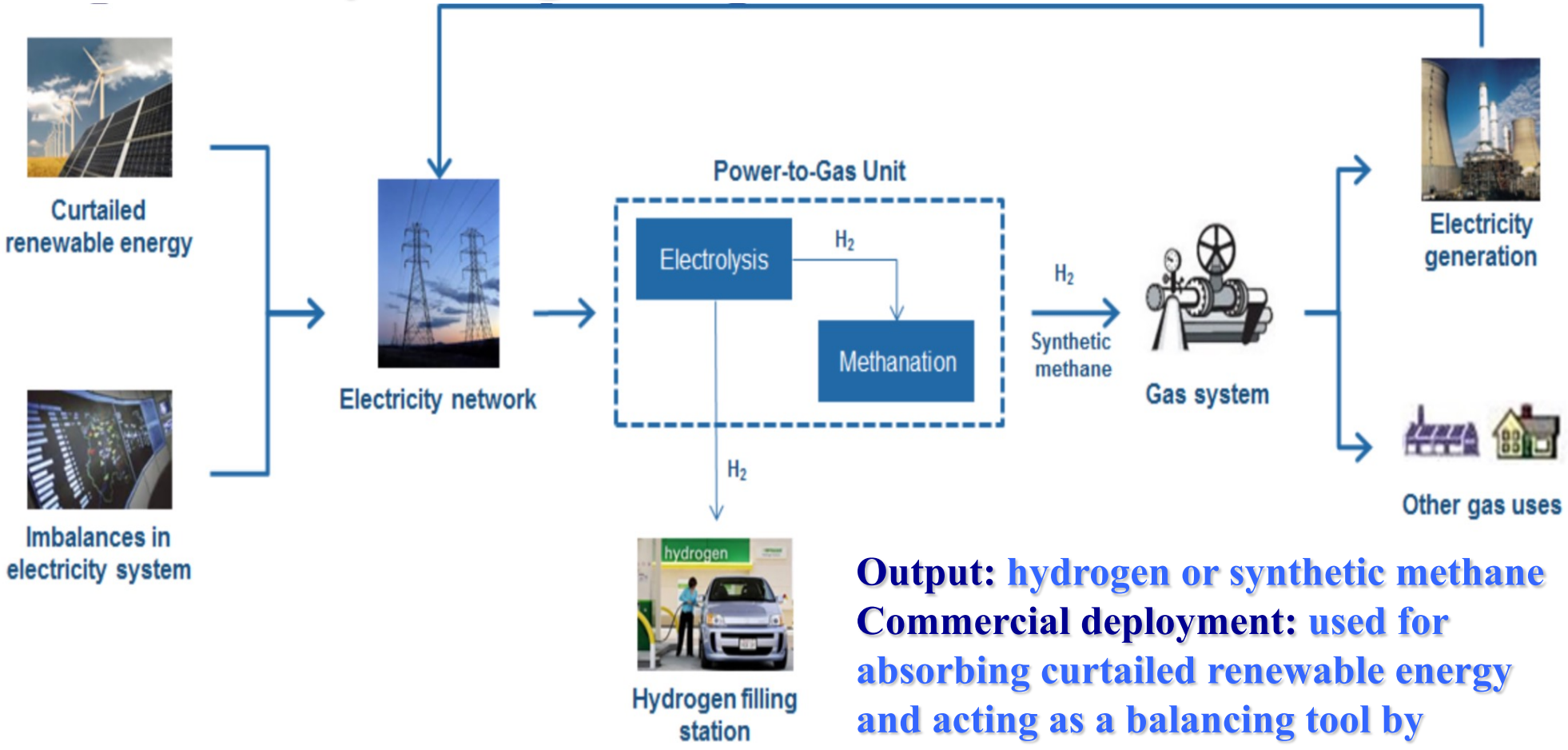


Future power systems



Power-to-Gas (P2G)*

- **energy storage technology linking the electricity and gas infrastructure**



Output: hydrogen or synthetic methane
Commercial deployment: used for absorbing curtailed renewable energy and acting as a balancing tool by electricity TSOs

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

Introduction of H2 in Cyprus's by 2030*

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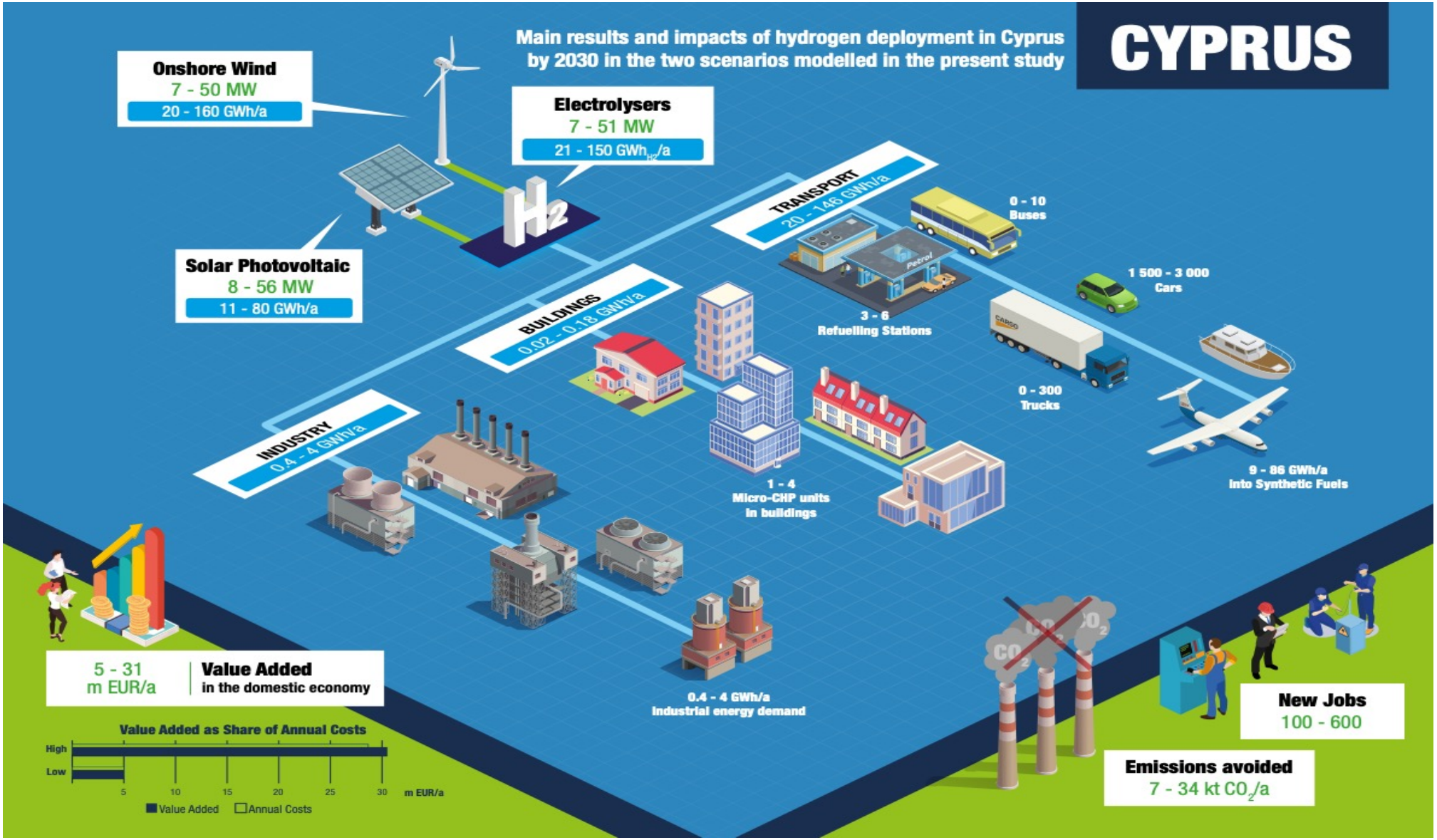

* FCH, EU, 2020

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Southern Regulators' Empowerment within European and regional Organisations

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Differences in ACER/CEER and MEDREG countries

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- **South *vs* North member states *vs* MedReg countries**
  - ~ **Differences in legal frameworks**
  - ~ **Level of NRAs' independence**
- **Enhancement of the cooperation**
  - ~ **empower the consumers in becoming active energy market participants**
  - ~ **benefit from the energy transition**

SRIG members cooperation

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- **Cooperation through the alignment of policies on issues of mutual interest**
- **Development of "Common Strategic Policy" orientation paper**
  - ~ **better harmonisation of regulatory frameworks for electricity and gas**
  - ~ **promotion of projects of mutual interest such as interconnections (PCIs) and joint projects with regard to the production of electricity, heating or cooling from renewable sources**
  - ~ **security of supply and mitigation measures**
  - ~ **certain actions for the promotion of EU green deal policies**
  - ~ **…**

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Crisis in power and gas prices

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- **Electricity prices** – historic data
- **Measures** – from short to medium and long term

Electricity prices

Historic data

Participants in electricity market

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- **Electricity Authority of Cyprus (state utility)**
  - ~ **Owner of transmission and distribution systems**
  - ~ **DSO**
  - ~ **Generation**
  - ~ **Supply**

Functional unbundling

- **TSO (legal unbundling since Oct 2021)**
- **RES IPPs (PPAs with EAC) but no conventional IPPs**
- **Two independent suppliers since 1st Jan 2021**

Status of electricity market

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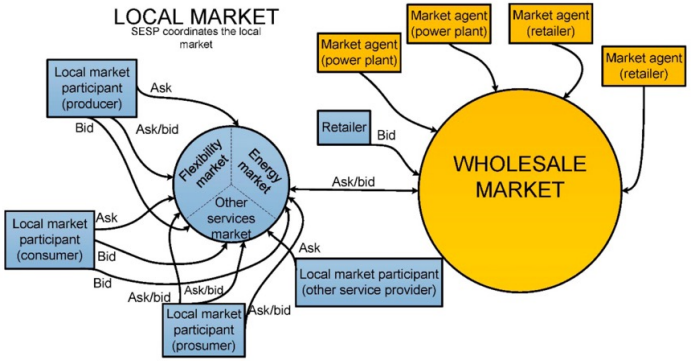
- **EU target model for market integration**

  ~ **Expected Oct 2022**



- **Transitory regulation**

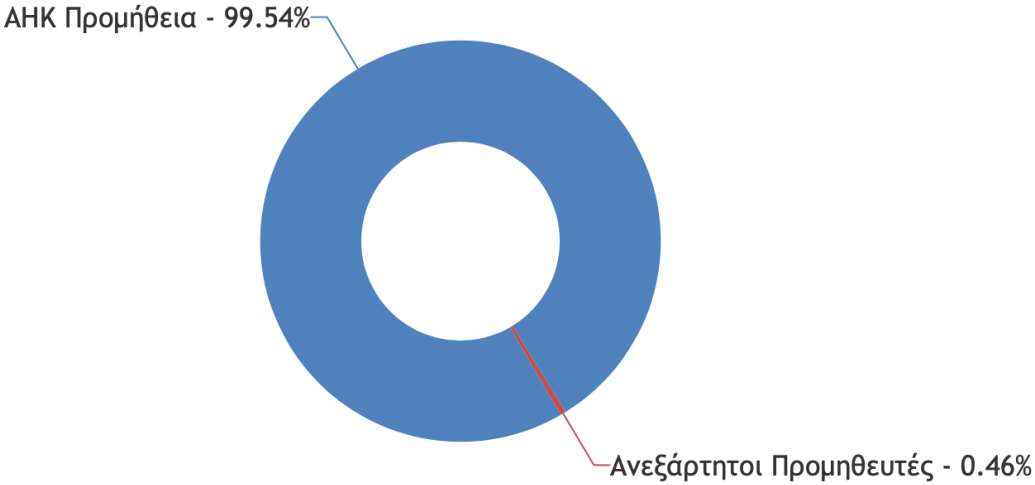
  ~ **PV parks (kWh clearance on a monthly basis)**

  ~ **Bilateral contracts between PV owners and independent suppliers**

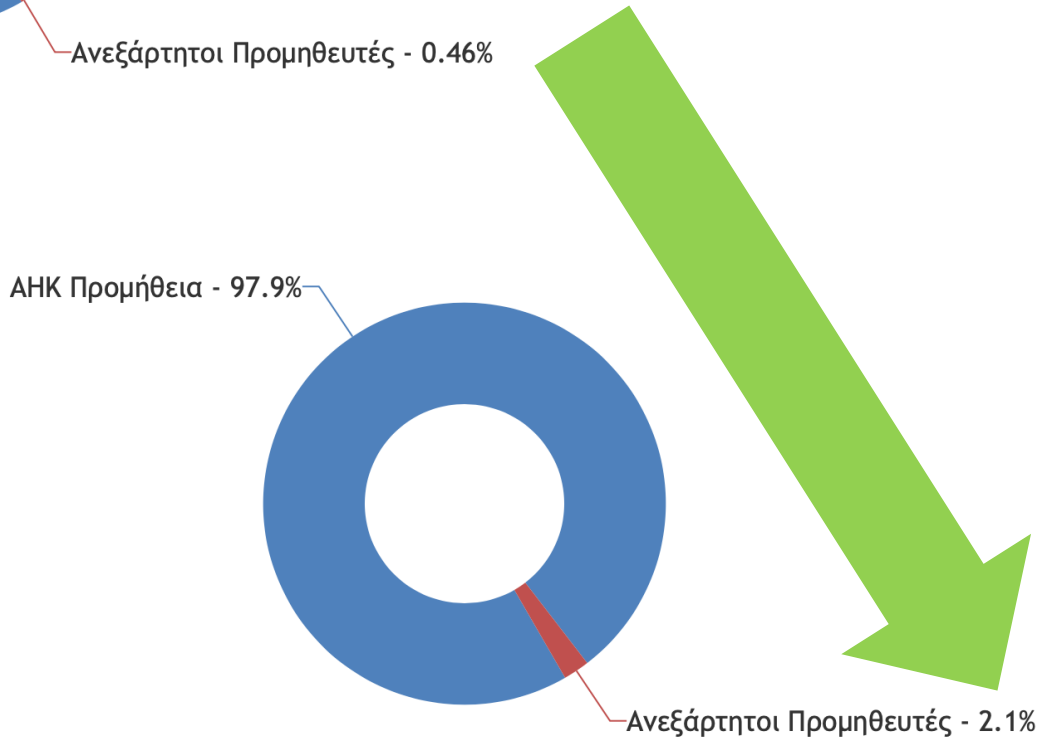
  ~ **Two independent suppliers since 1st Jan 2021**

Interim Regulation - Supply

Ιανουάριος 2021

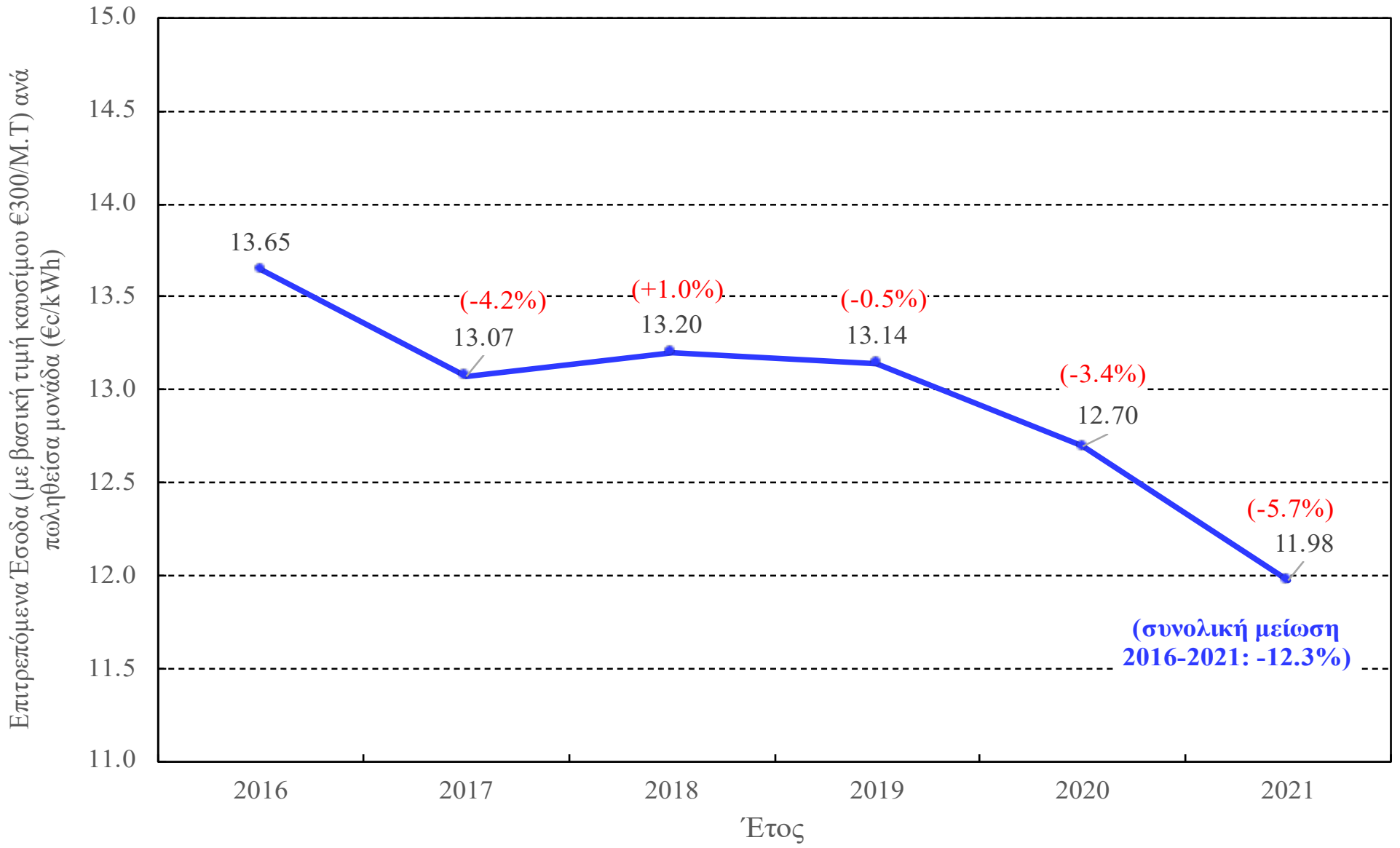


Ιούνιος 2021

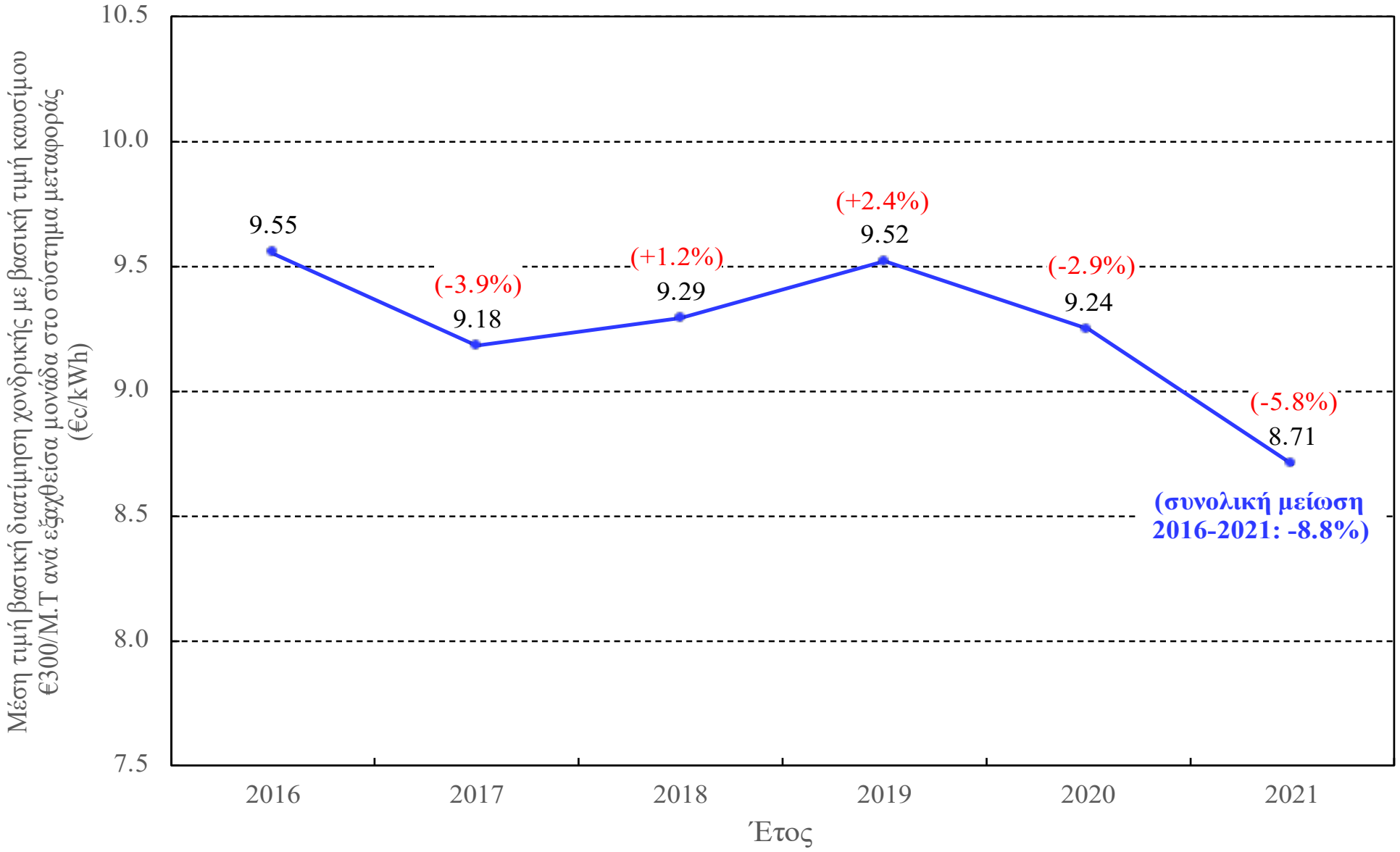


Revenue requirement (or allowable income)

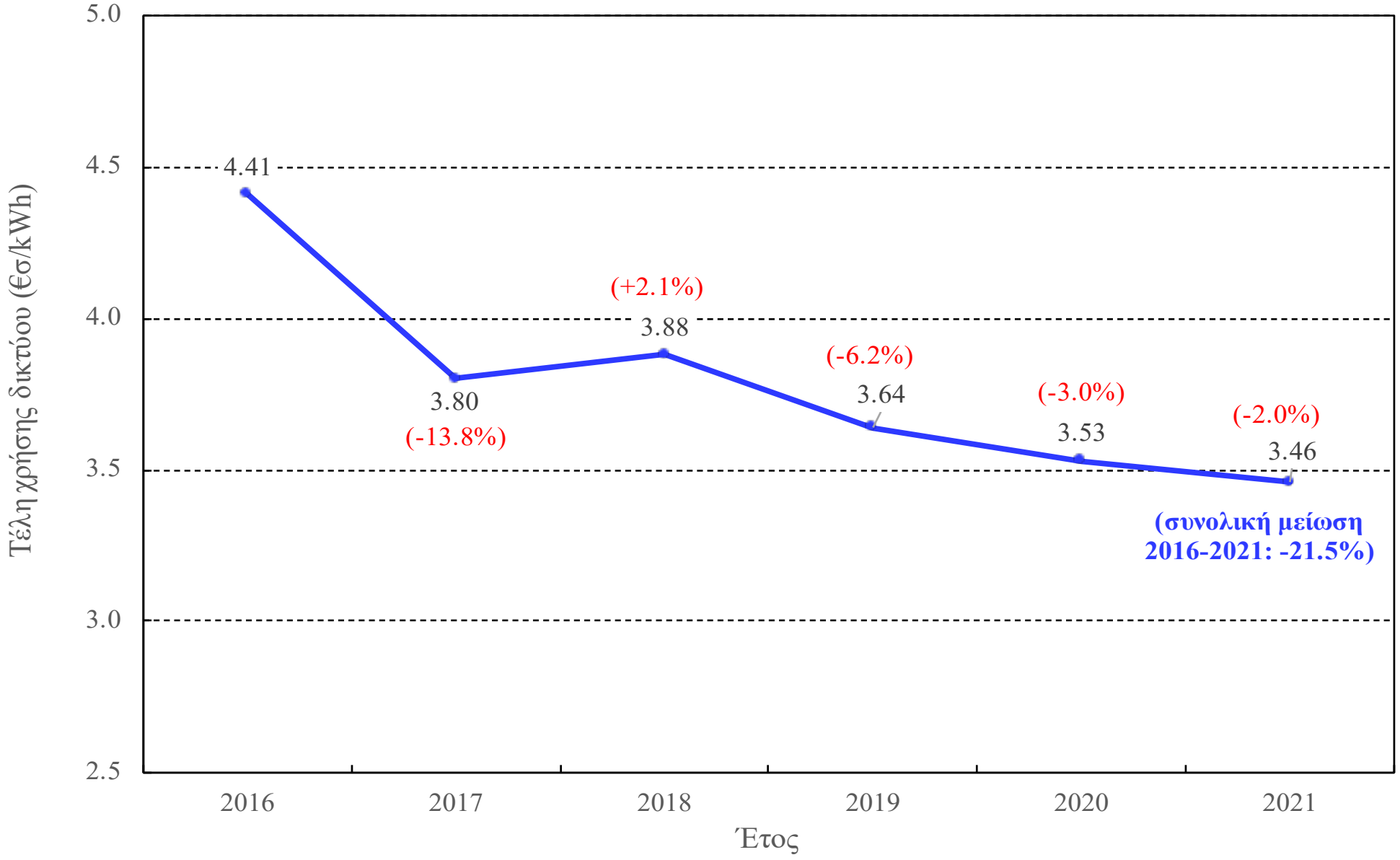
(fuel reference price €300/MT = Basic tariff)



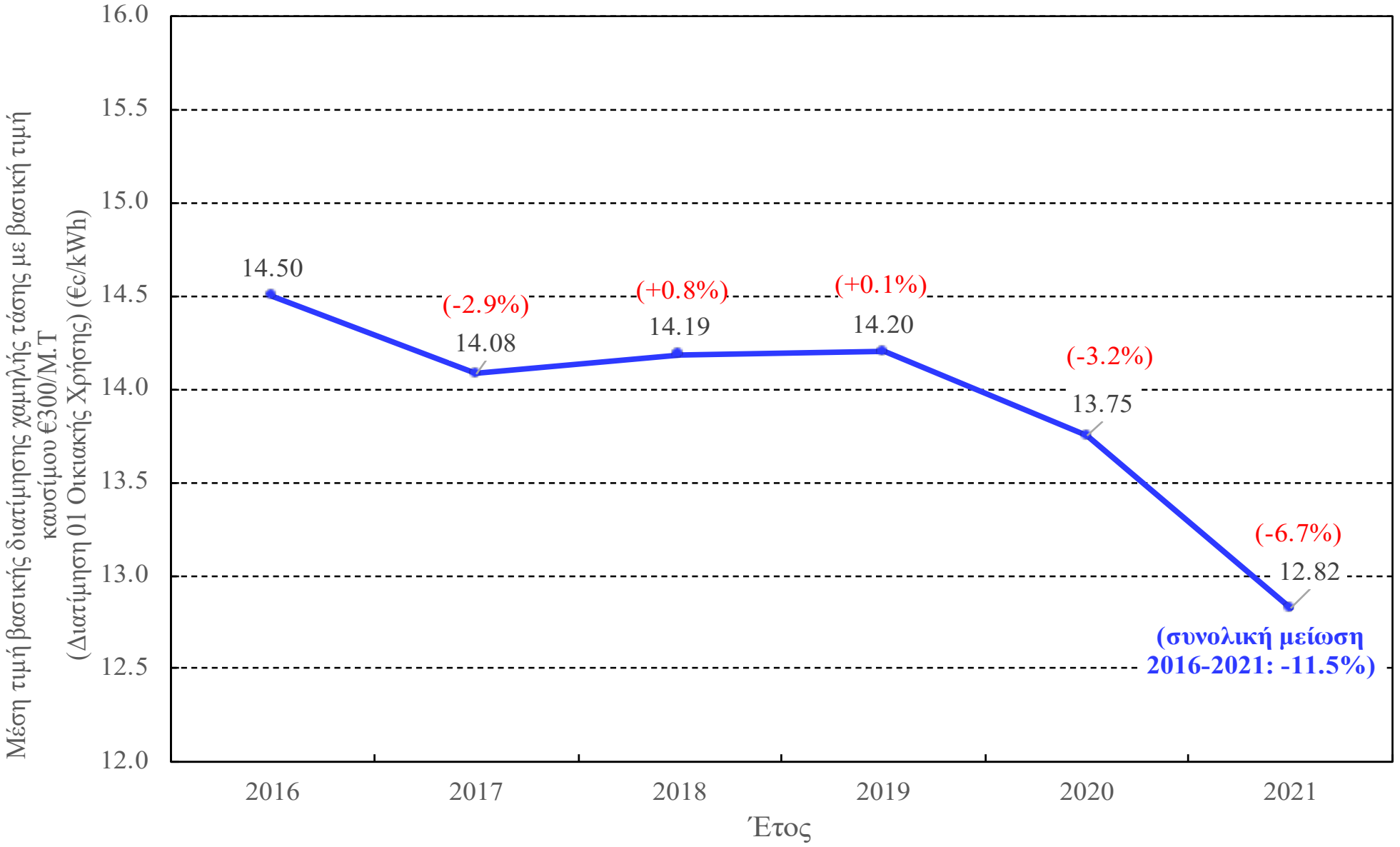
Basic wholesale tariff
(fuel reference price €300/MT)



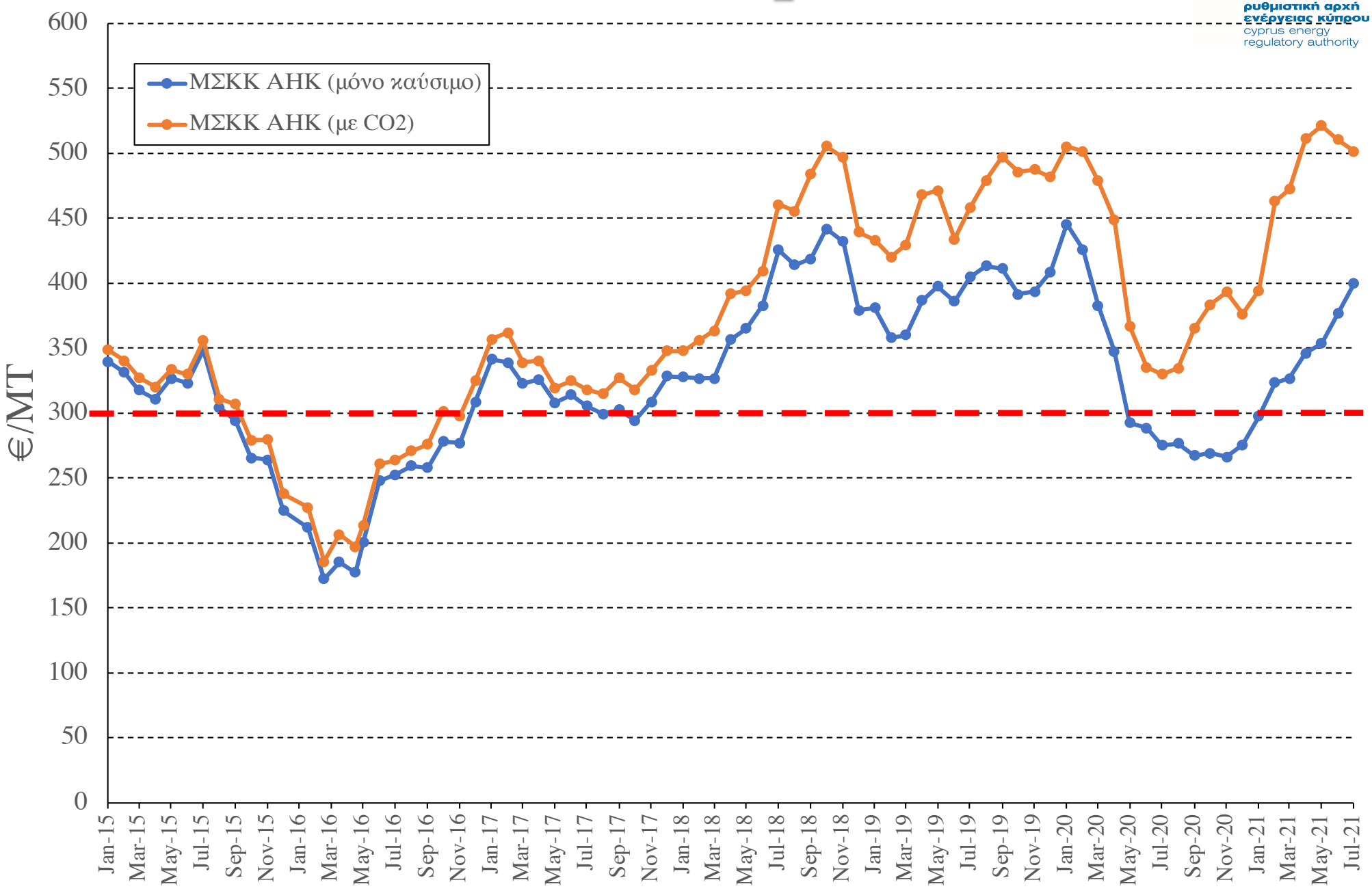
Network charges



Basic residential retail tariff
(fuel reference price €300/MT)



Cost of fuel cost and and CO_2 allowances



Brent historic prices

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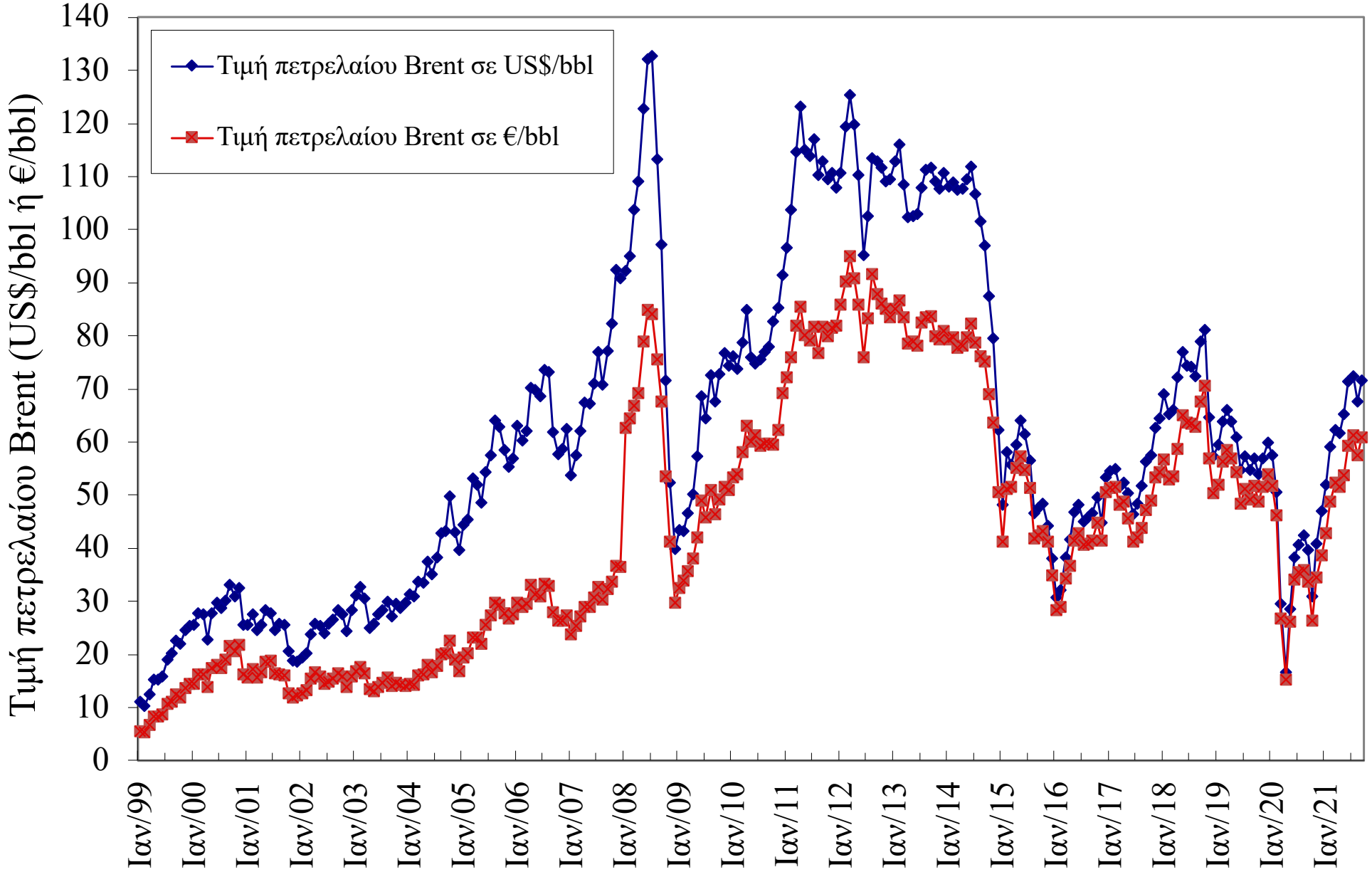

Average residential electricity price
(including taxes)

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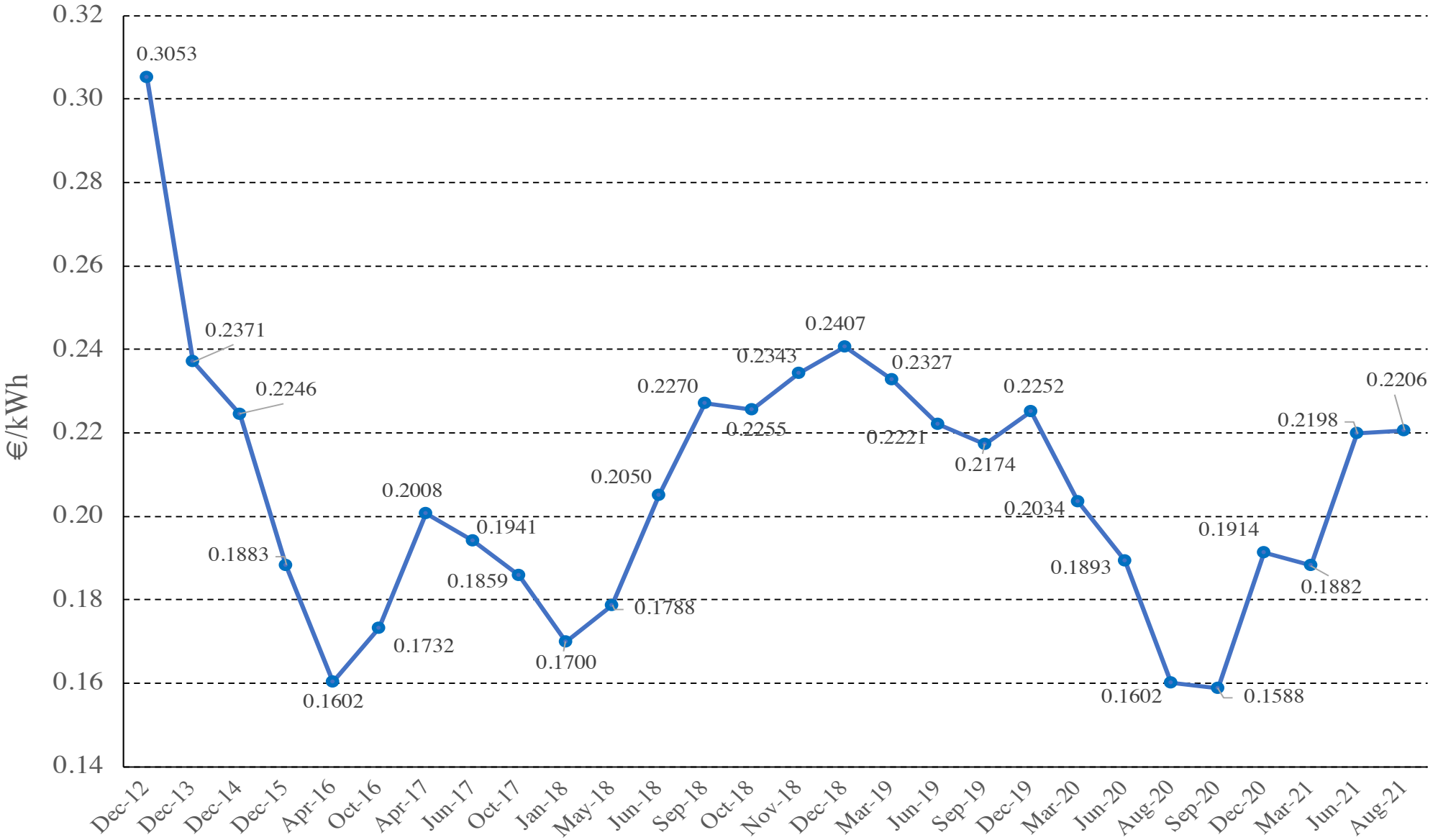

Measures

From short to medium and long term

Short term measures

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- **CERA with Decision No. 294/2021:**

Medium to long term measures

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- **Cyprus' Government (agreed with CERA):**
  - ~ **less dependent on fossil fuels**
  - ~ **more RES and storage**
  - ~ **support schemes for net-metering, energy efficiency (e.g., insulation, change of a/c and domestic appliances)**
- **Revenue generated from the auctions of the EU ETS allowances**
- **European Commission 'toolbox' of measures**
- **Transitory regulation and EU target model**
- **Electricity interconnections**

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Security of Supply and Systems' Resilience in cases of emergency and climate crisis

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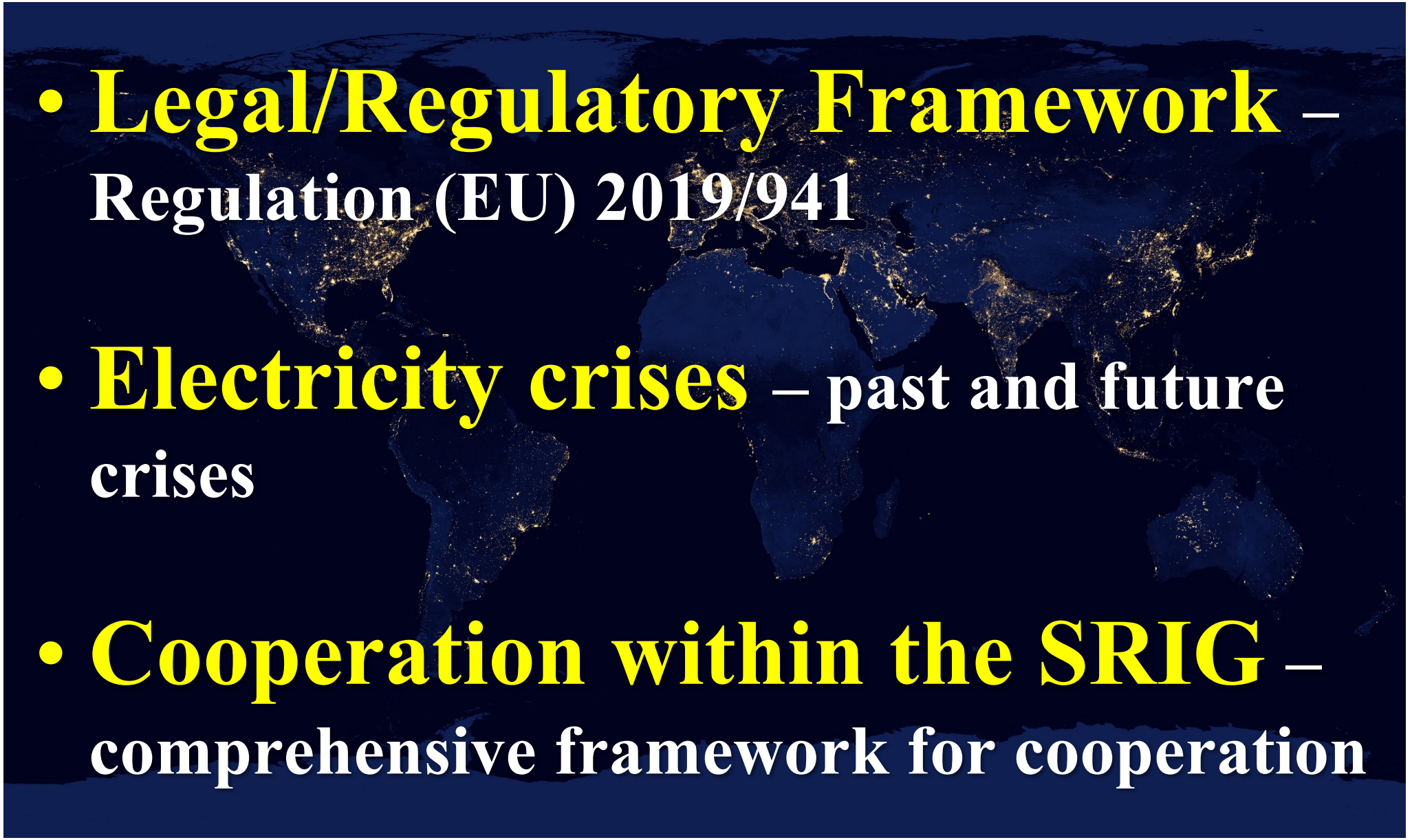

- **Legal/Regulatory Framework** – Regulation (EU) 2019/941
- **Electricity crises** – past and future crises
- **Cooperation within the SRIG** – comprehensive framework for cooperation

Legal/Regulatory Framework

Regulation (EU) 2019/941

National electricity crisis scenarios

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- **CERA is the competent authority for implementing and carrying out the tasks provided in the Regulation (EU) 2019/941**
- **Categories of electricity crisis scenarios**
  - ~ **rare and extreme natural hazards**
  - ~ **accidental hazards going beyond the N-1 security criterion and exceptional contingencies**
  - ~ **consequential hazards including the consequences of malicious attacks and of fuel shortages**
- **Measures to mitigate the consequences of crisis scenarios**

Electricity crises

Past and future crises

Prevention of electricity crisis in the Republic of Cyprus

- **Summer 2020**
- **Due to COVID-19 delays in generation units' work plan of EAC**
  - **~ installation of emissions abatement technologies at Vasilikos PS steam units**
  - **~ measures taken for the installation of temporary units delayed as well**
- **Inadequacy in electrical system**
  - **~ 130-180MW**

Prevention of electricity crisis in the Republic of Cyprus (cont.)

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- **Decision No.174/2020 'Early warning and measures to prevent electricity crisis'**
  - ~ **"…EAC shall ensure that the conventional production units which are in operation and are connected to the system are technically available for the period 1 June 2020 to 15 September 2020 and shall be made available to the TSO for operation whenever this is required for ensuring that electricity demand is met and the reserve margin of installed capacity for the electricity system of Cyprus…"**
  - ~ **"…TSO shall, whenever it deems it necessary carry out an Emergency Action Plan for the summer period 2020 concerning the adequacy of the electricity generation and electricity transmission…"**

Prevention of electricity 2022 crisis

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- **Dhekelia PS steam units derogation (IED)**
  - ~ In operation only 18000h between 2020-2023
- **The problem**
  - ~ Natural gas not available yet to the island
  - ~ Delays due to COVID-19 for the installation of emissions abatement technologies at Vasilikos PS steam units
  - ~ Use of Dhekelia PS 24/7, 18000h will expire Jan 2022
- **Inadequacy in electrical system**
  - ~ 180-220MW
- **Under examination by CERA**

Cooperation within the SRIG

Comprehensive framework for cooperation

Comprehensive framework for cooperation

ρυθμιστική αρχή ενέργειας κύπρου
cyprus energy regulatory authority

- **MoU**
- **Need set the rules**
- **Agree on a comprehensive framework for cooperation on security of supply**

  ~ robust enforcement of risk preparedness rules

  ~ protection of consumers