Possibilities and Perspectives of Biomass, Electricity and Gas Sectors Coupling in Croatia via Power-to-gas Hubs

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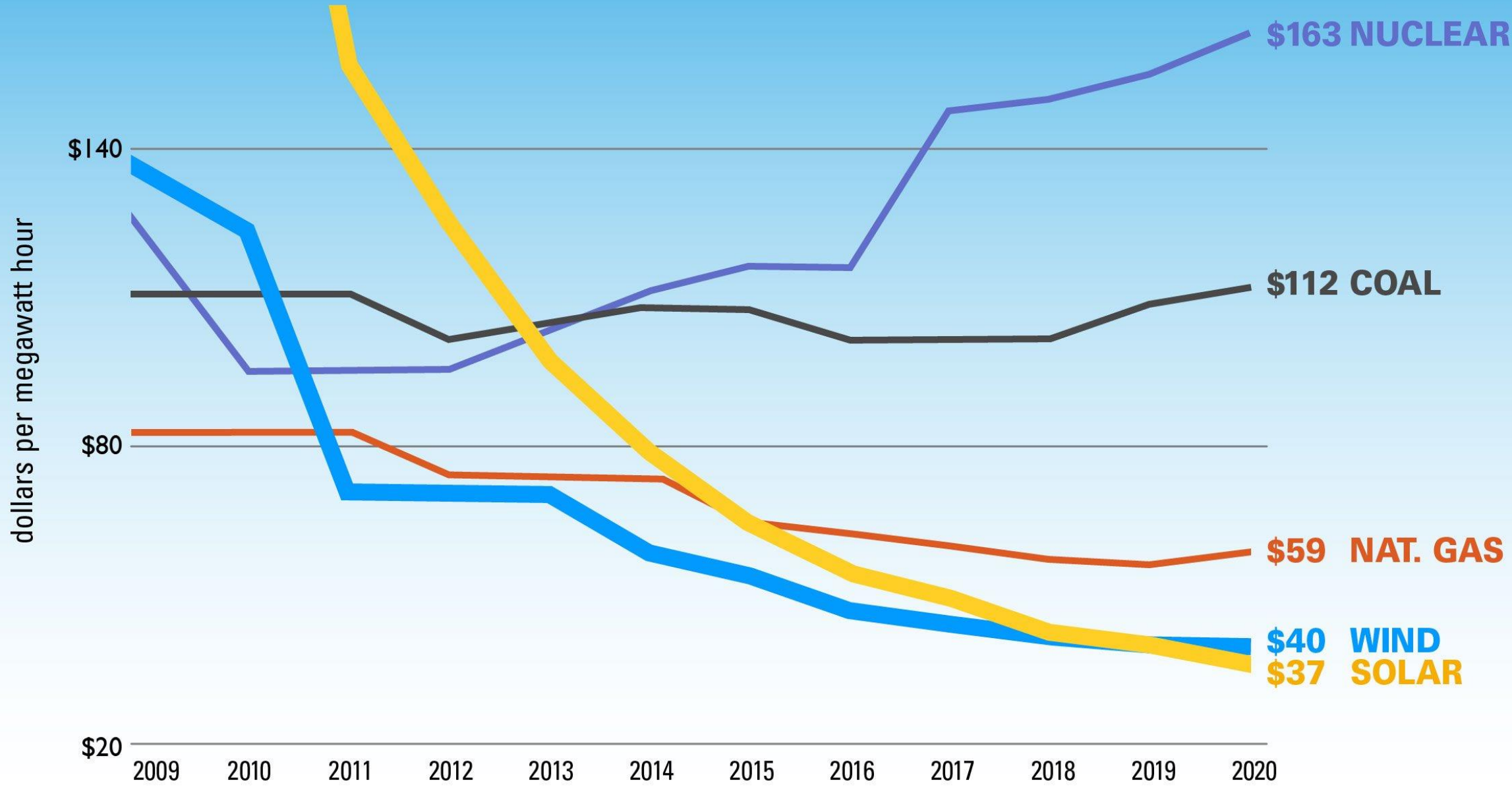
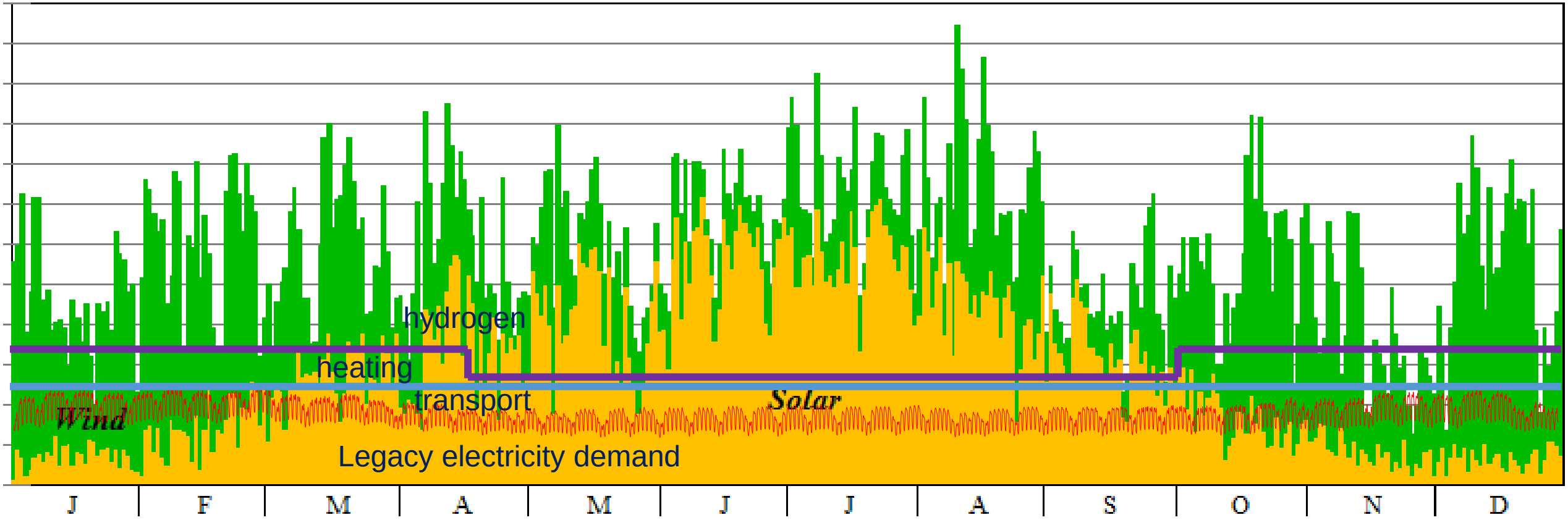
Lazard levelized cost of energy analysis: 2020



Wind and solar are actually baseload with excess, which we can use for heating, driving and hydrogen for industry



➢How to solve renewables variability/intermittency problem?

- More grid interconnection
- Flexibilisation of thermal power plants
- Wholesale markets coupling
- Demand response and integration of power, heating, cooling, transport and water systems – power-to-X
- Dedicated electricity storage

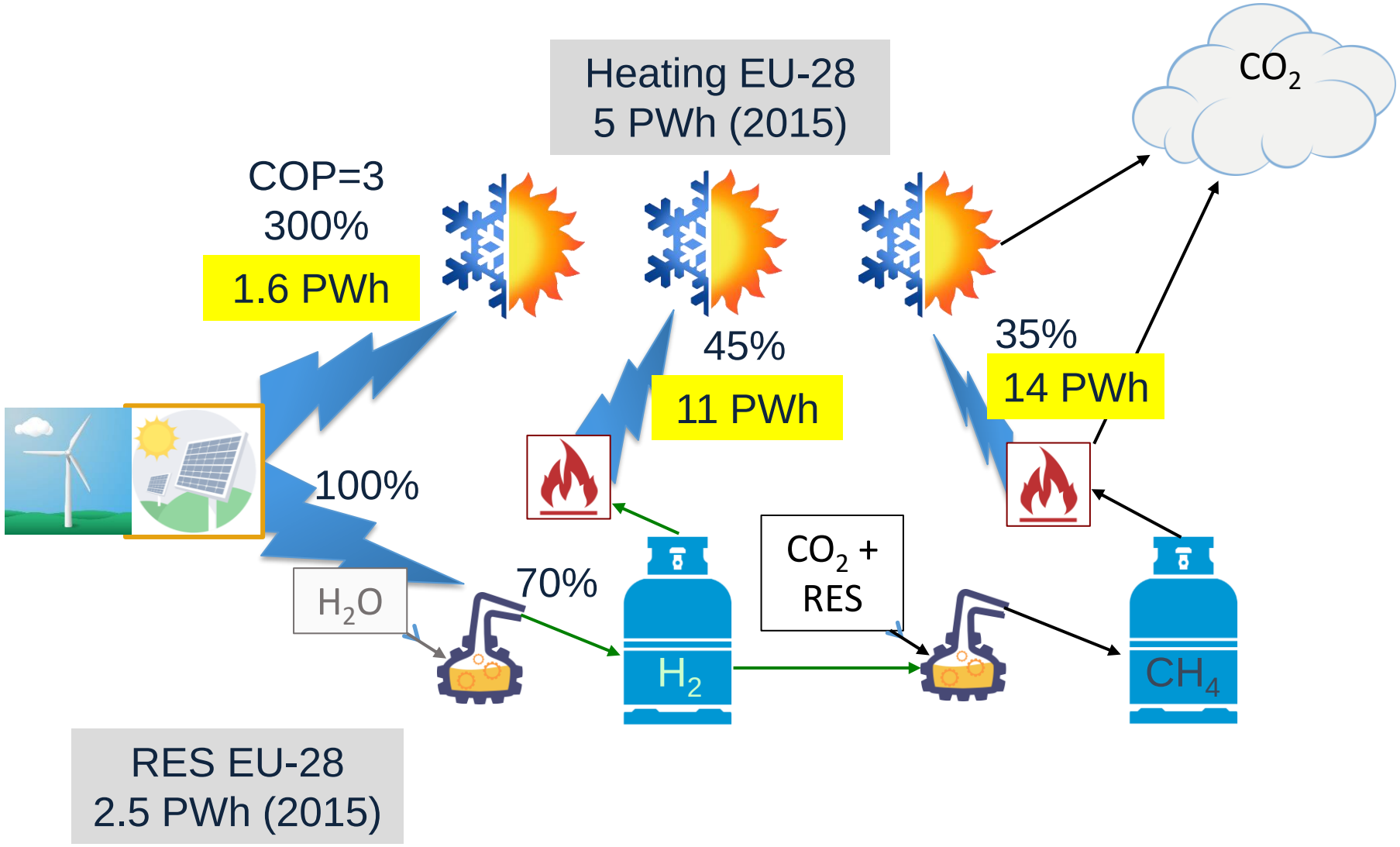
Demand response – power-to-X

- 20th century energy systems: supply follows demand
- 21st century energy systems: demand follows supply -> smart energy systems

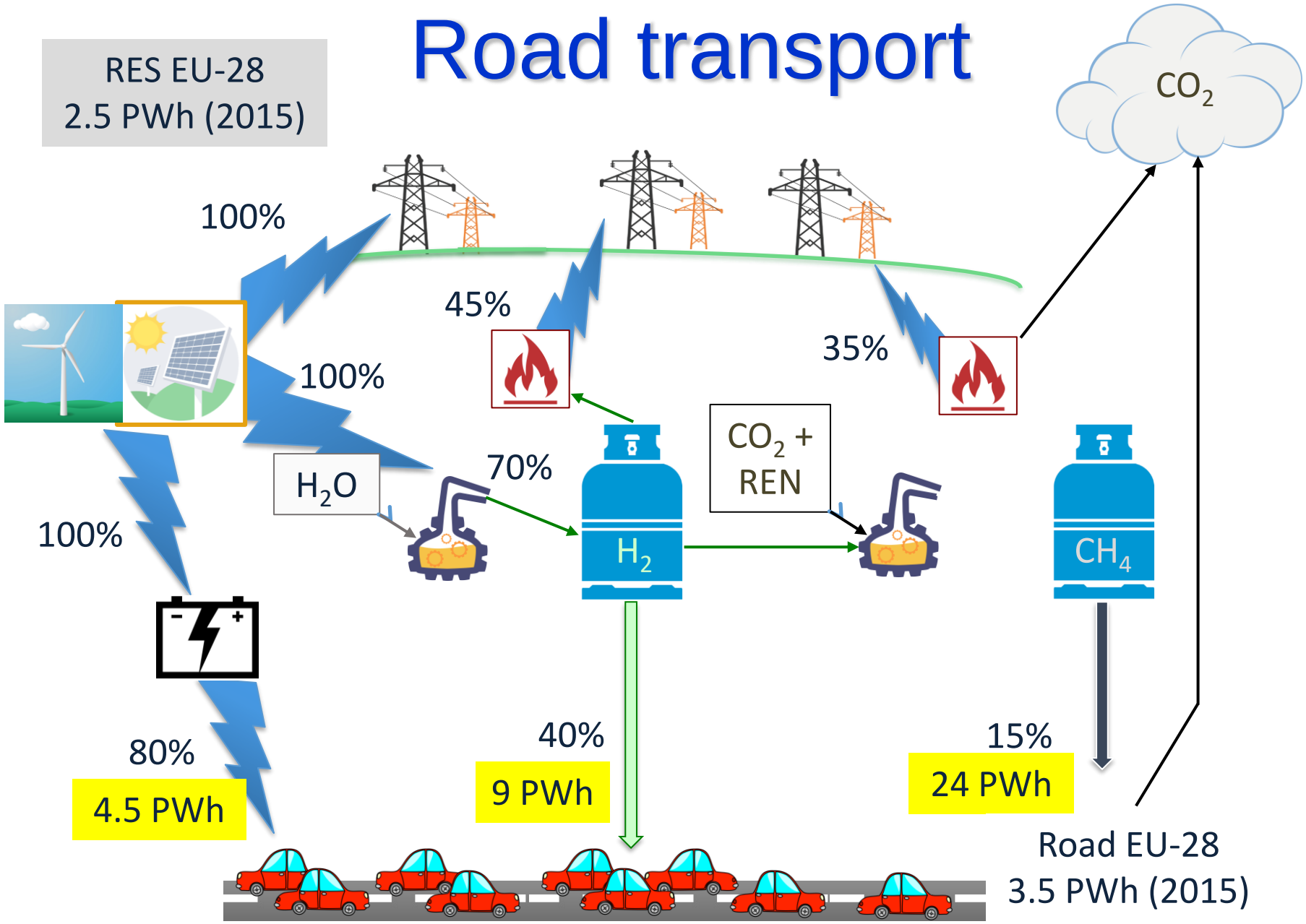
Which way H2way?

- Infrastructure way
  - Decarbonise gas and fuel by replacing it with hydrogen and synthetic fuels
- Efficient way
  - „hard-to-decarbonise sectors where other alternatives might not be feasible or have higher costs”

Power-to-e-fuels-to-heating?



Road transport



Based on slides by Marco Mazzotti, ETH Zurich, presented in Brussels – Feb 20th, 2018

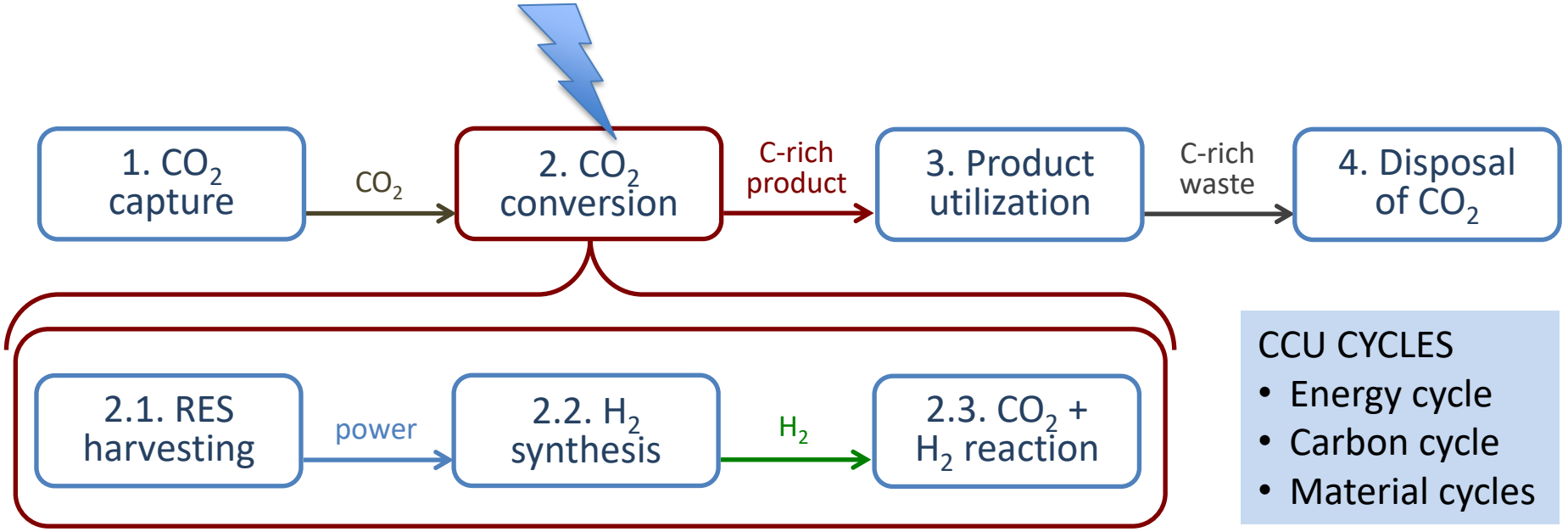
Electricity, hydrogen or e-fuels?

- Road freight – maybe electrified roads, maybe hydrogen, or e-fuels (e-LNG, e-DME, e-methanol)
- Long distance shipping – ammonia or e-LNG or e-DME
- Long distance aviation – SAF for current fleet, and later who knows …
- High temperature processes which cannot be electrified - hydrogen
- Winter windless weeks backup – hydrogen …
- It all makes up to 20% of energy demand
- If biomass is used only for the above it could cover half of the missing demand
- And the rest? Synthetic or e-fuels?

Role of biomass?

- It would be preferable to use waste biomass …
- Slowly moving it from heating towards transport
- SAF – waste edible oils
- Biogas as feedstock, backup, bio-LNG etc.

The CCU system

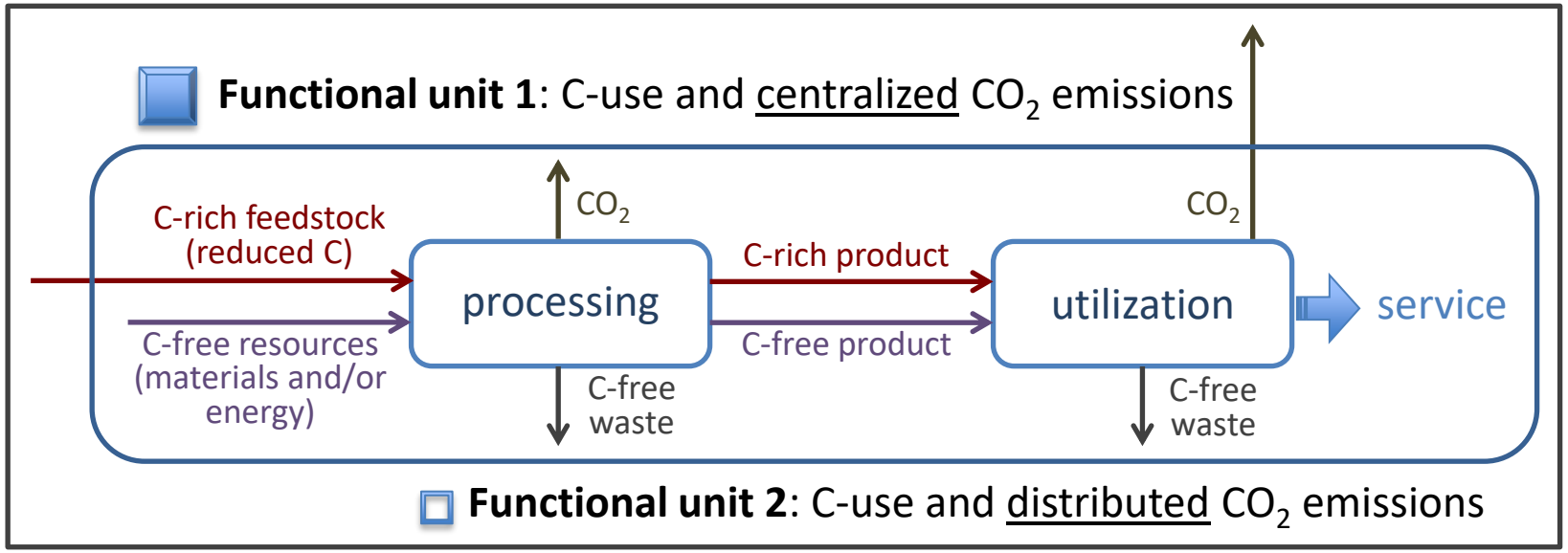


CCU CYCLES
- Energy cycle
- Carbon cycle
- Material cycles

WG VIEW: SOCIETAL SERVICES
- power generation and distribution;
- fuels (and power) for transport;
- long-term long-range RES storage;
- industrial products and materials.

CCU POTENTIAL IN EU TO SUPPORT:
- climate change objectives;
- circular economy (O- vs. L-economy);
- energy security and RES deployment;
- evolution of CO_2 capture systems.

Generic functional unit



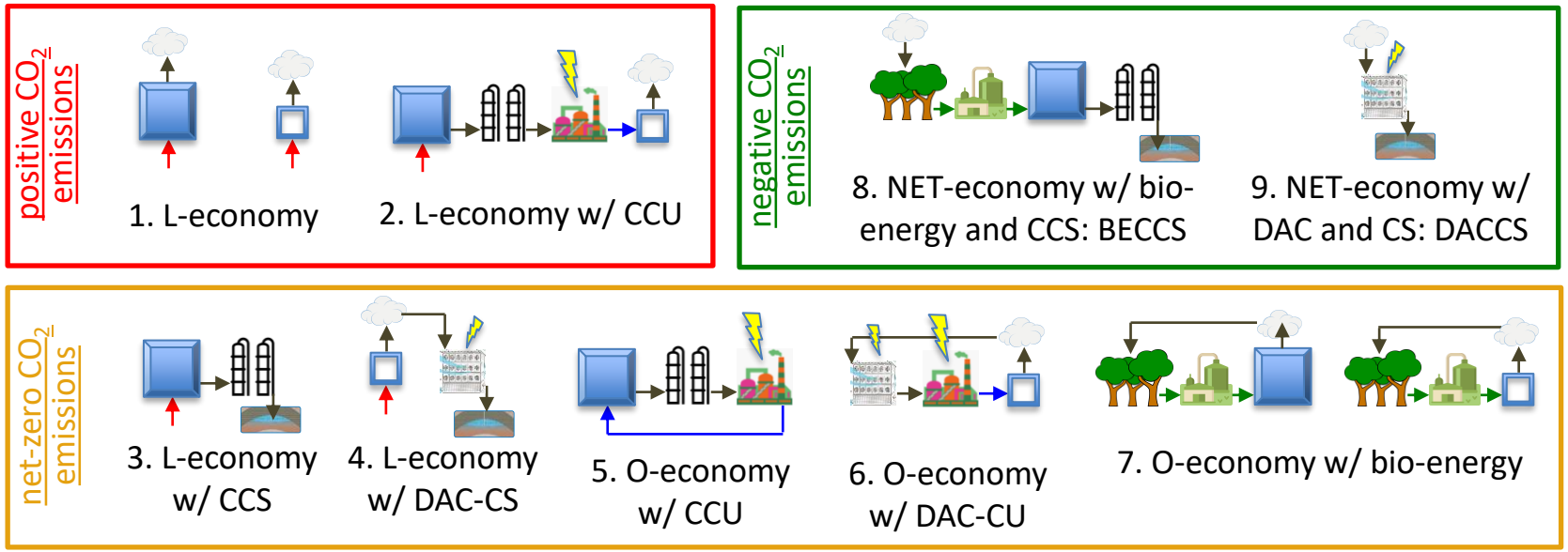
Functional unit 1:

- fossil-fuel-fired power plant
- large-scale industrial boiler for heat generation
- chemical plant coupled to incinerator for C-rich waste disposal (polymeric materials)

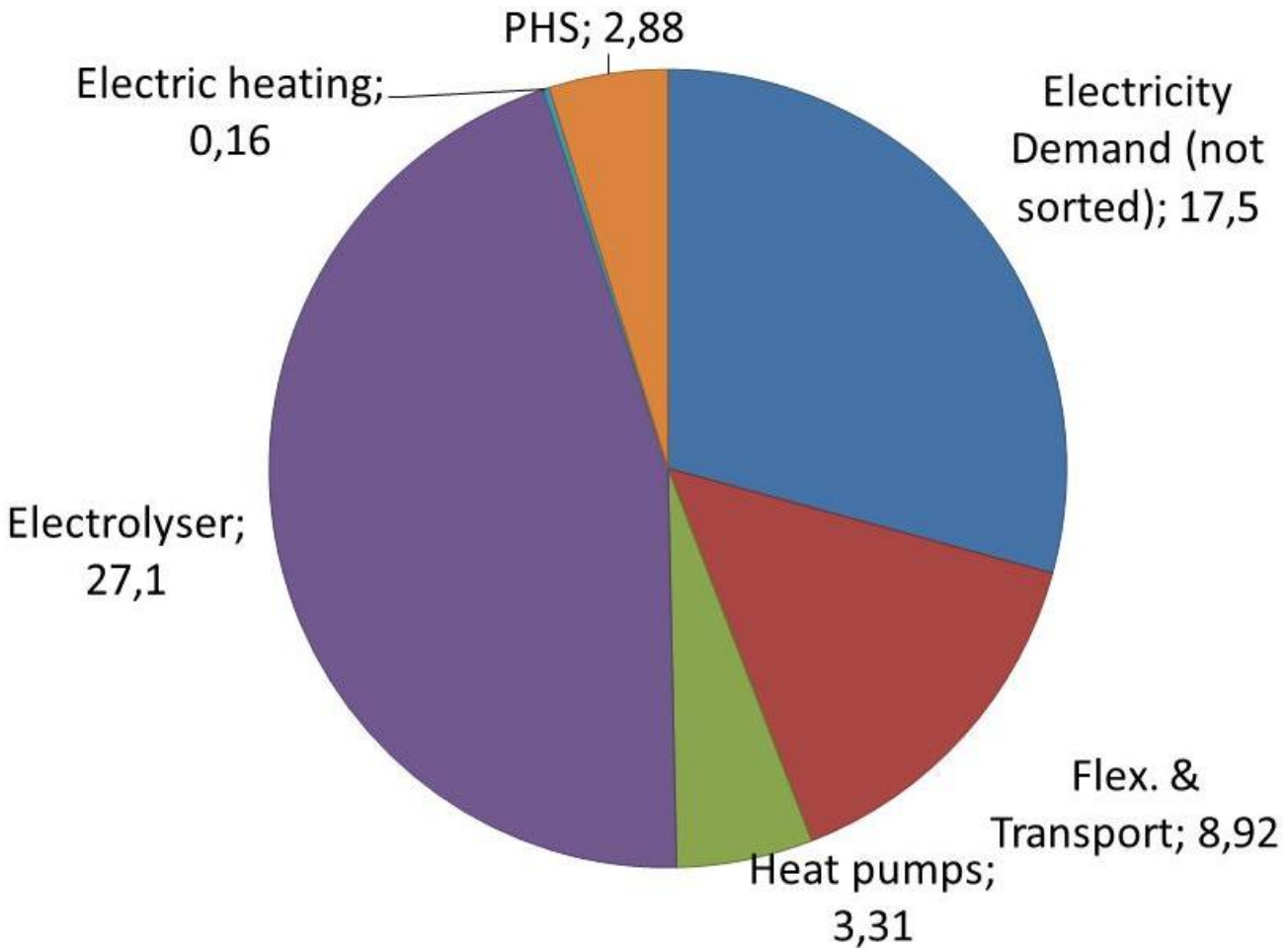
Functional unit 2:

- urea production and use
- fuels (cars, ships, planes) synthesis and use
- chemical plant not-coupled to incinerator, or to incinerator without CO_2 capture

Carbon economy



Electricity demand in Croatia 2050 (TWh)



Conclusions

- Wind and solar are coming, but difficult to integrate
- Integration of power, heating, cooling, water and transport system necessary
- In the end we will need some kind of synthetic fuel, and not really in small quantities, it may be hydrogen, ammonia, or carbon-based synthetic fuels, or most probably all
- Due to high marginal abatement cost, CCU of fossil fuels does not make generally much sense
- Total cost of abatement should be used to find the best fuels for tomorrow
- It is difficult now to build hubs before industry decide on fuels – SAF is decided … but most probably it will be multifuel
- It would be great to find which would be cost and benefits of each of the fuels

5th Southeast European SDEWES Vlore, May 2022
3rd Latin American SDEWES São Paolo, July 2022

THANK YOU FOR YOUR ATTENTION!

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