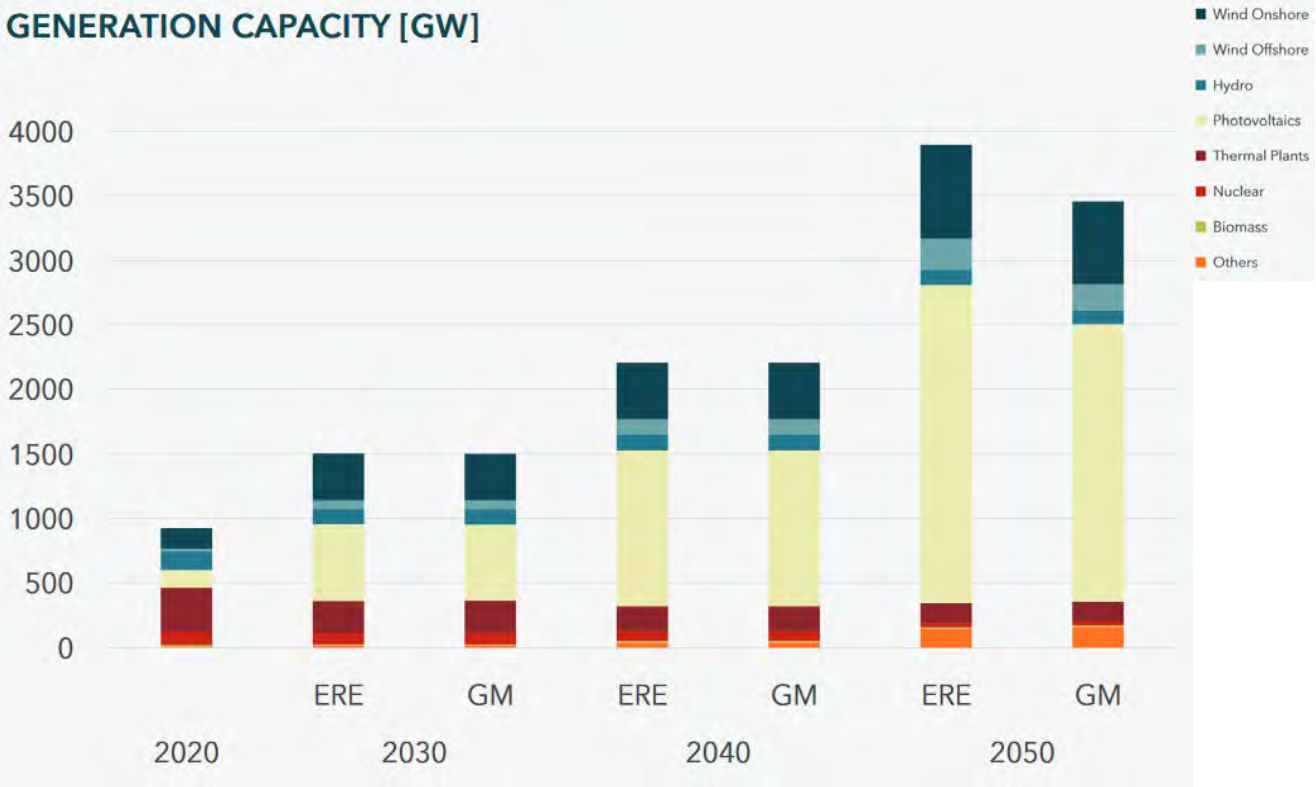
Panel debate: Reforming Electricity Marketsfor an Evolving Energy Landscape

Dogan Keles @ 2024 European Energy Policy Conference

What investments are needed?

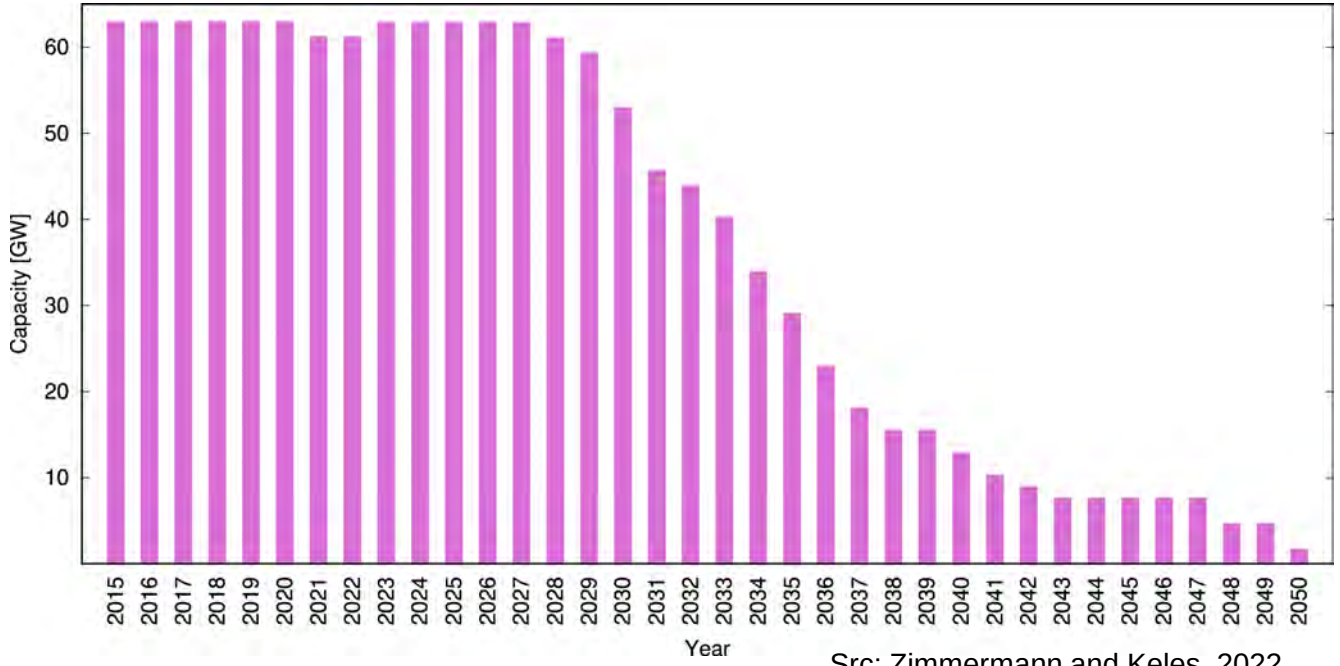


Src: Energy System 2050: Towards a decarbonised Europe, TransnetBW (2022), www.energysystem2050.net

- Electrification of transport, heat, and hydrogen increases the electricity demand.
- Needed annual growth of solar PV:
  55 GW/a by 2030 and 127 GW/a by 2050.
  (growth in 2022 was 44 GW/a)
  17 times the installed capacity by 2050
- More than 900 GW of offshore/onshore wind integrated into the energy system by 2050.
  (5 times the capacity we have today)
- Also need for ca. 300 GW flexible capacity (storage and thermal power plants)

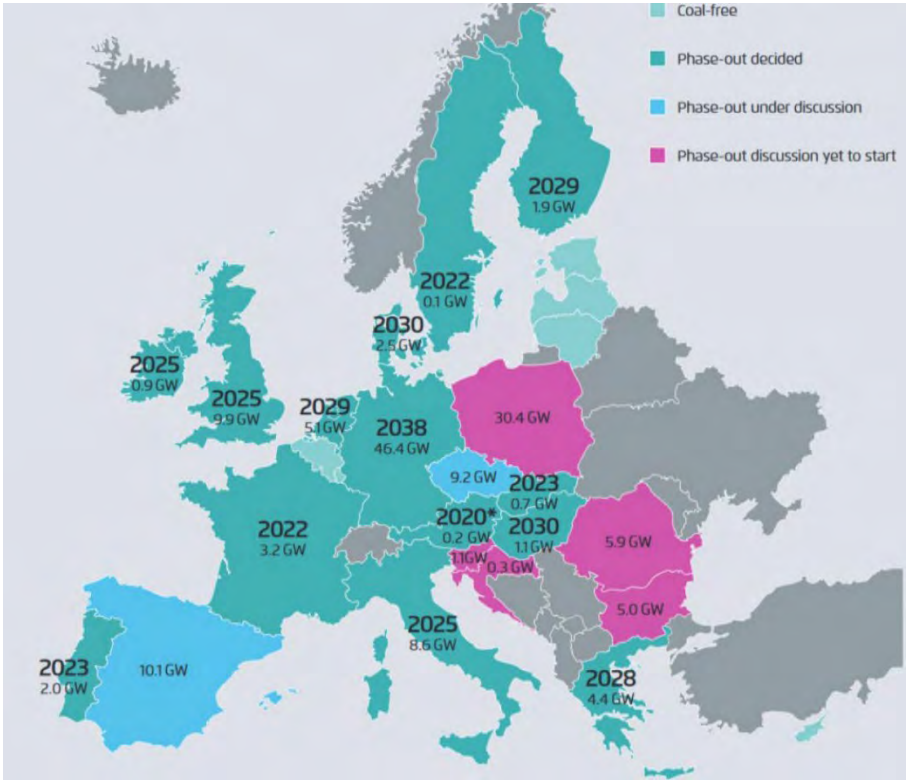
Challenges of the EU power system

Nuclear power capacity in France and shutdowns after lifespan of 50 ys.



Src: Zimmermann and Keles, 2022

Announced coal phase-out in the EU:

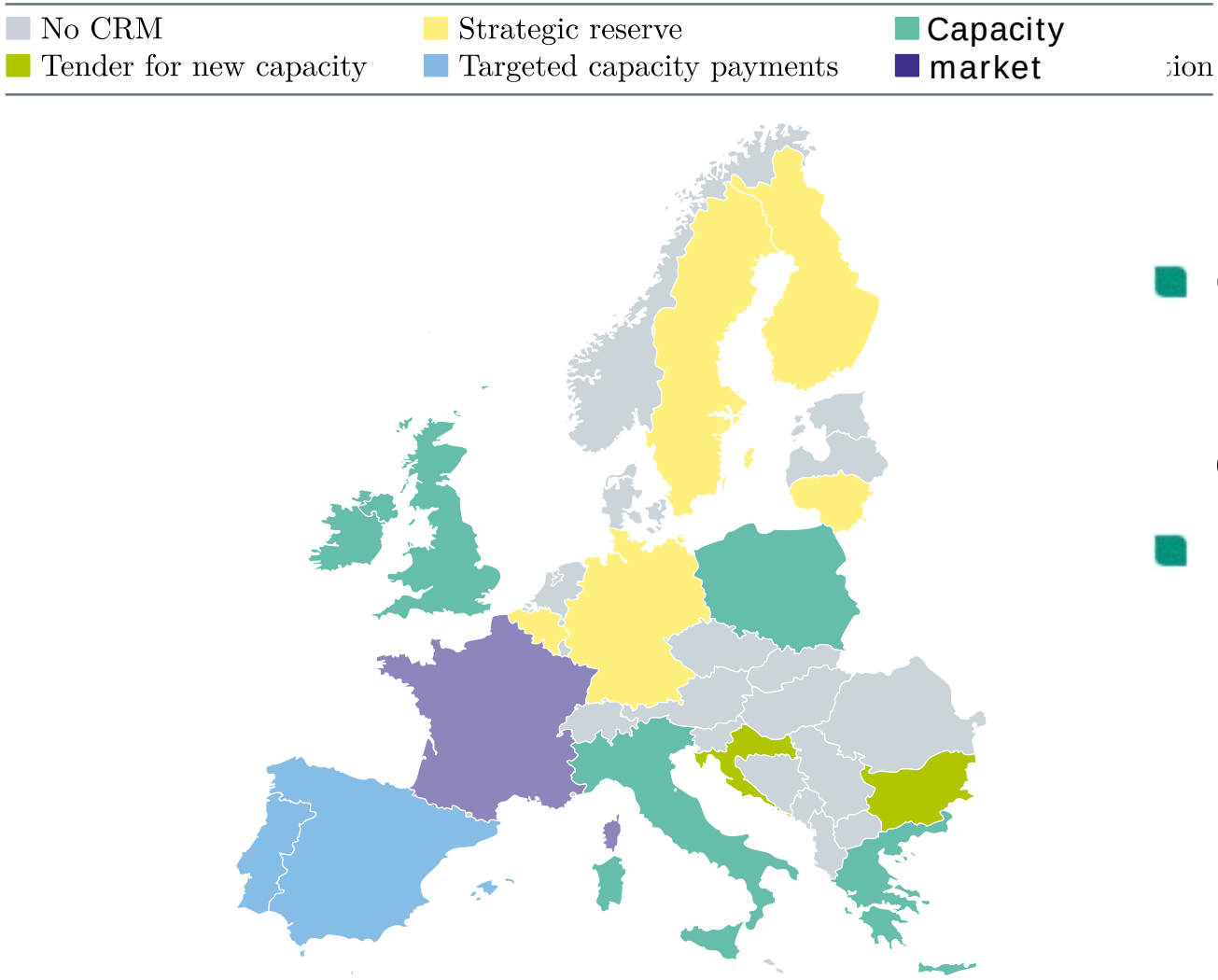


1. Large amount of dispatchabel capacities will be taken out of the EU power market
2. Increasing demand for electricity due to electrification (EU) and hydrogen for green fuels:

   from ca. 2500 TWh (in 2020) to probably 6000 TWh in 2050

→ **Missing capacities (also flexible ones)**

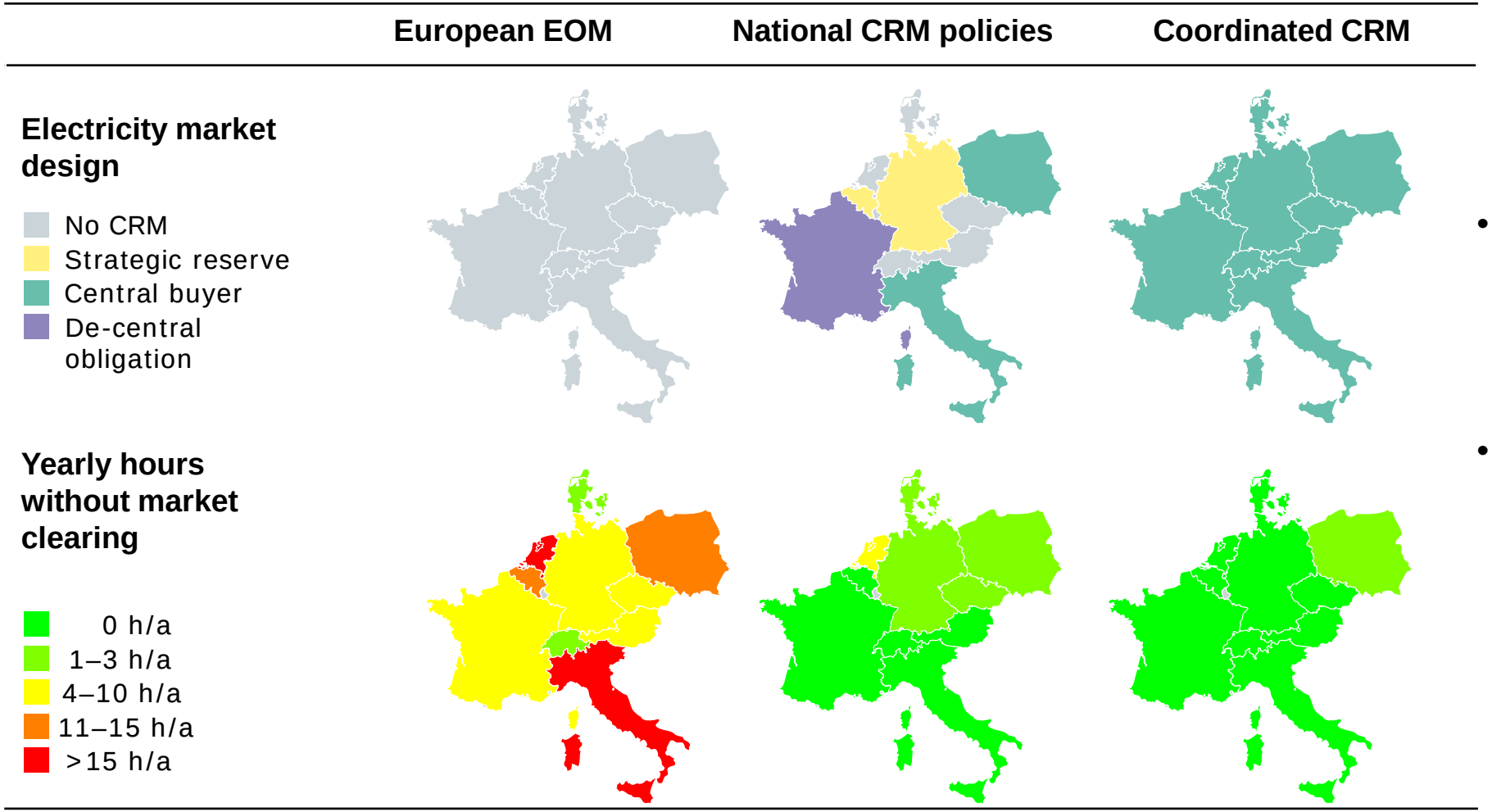
Cross-border effect of Market Design



- Capacity Remuneration Mechanisms (CRMs) remunerate provision of capacity
- **Impact on neighbouring markets without CRMs?**

Src: Bublitz, Keles, Fraunholz (2019)

What Market Design? Security of electricity supply

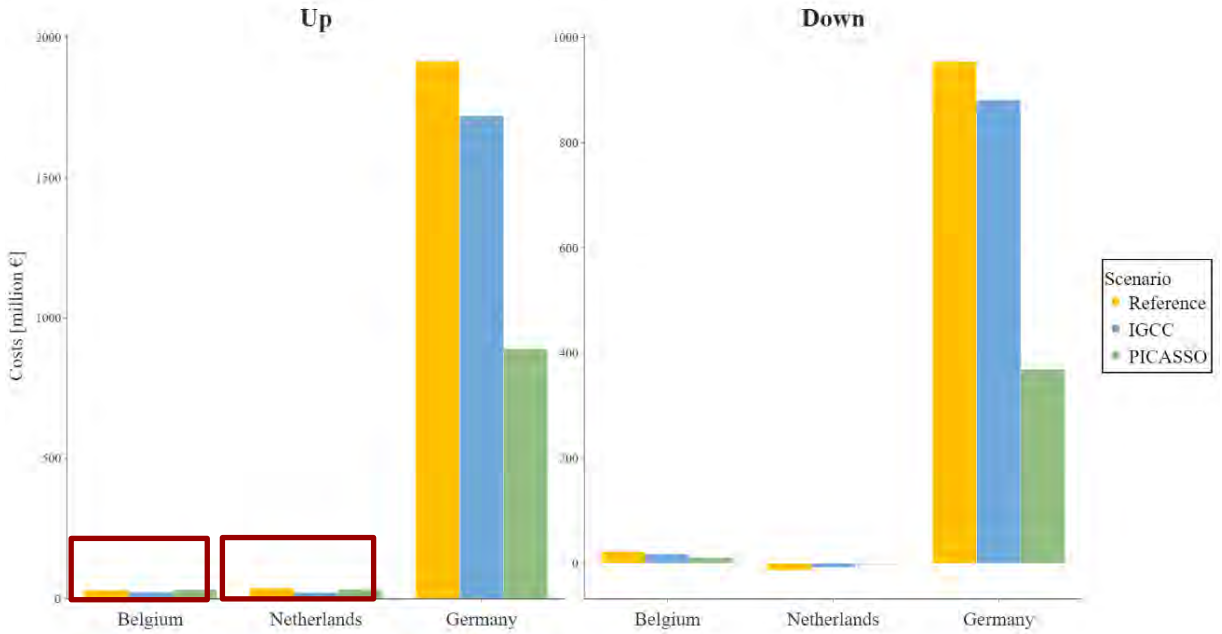


- **Capacity remuneration mechanisms (CRM)** help to increase security of supply (less market failures)
- Coordinated mechanisms in the EU would be even more effective and less costly

Src.: Fraunholz, Keles, Fichtner (2020)

European market coupling – example of PICASSO collaboration

Total Costs



	PICASSO - reference	PICASSO - IGCC
Δ Consumer Surplus	+1,634	+1,342
Δ Producer Surplus	- 1,140	-949
Δ Congestion Rent	+53	n\a
Total Econ. Surplus	**547**	**393**

*values in million €

- Cost reductions in Germany, without large effect on activation costs in Netherlands + Belgium
- Producer rent declines in Germany, producers in Netherlands + Belgium win, consumers benefit

Src.: Backer, Keles, Kraft (2023)

References

[1] Kountouris, Madsen, Bramstoft, Münster, Keles (2023): A unified European hydrogen infrastructure planning to support the rapid scale-up of hydrogen production, working paper, Resereach square

[2] TransnetBW (2022): Energy System 2050: Towards a decarbonised Europe, www.energysystem2050.net

[3] Zimmermann and Keles (2022): State or market: Investments in new nuclear power plants in France and their domestic and cross-border effects, Energy Policy (173)

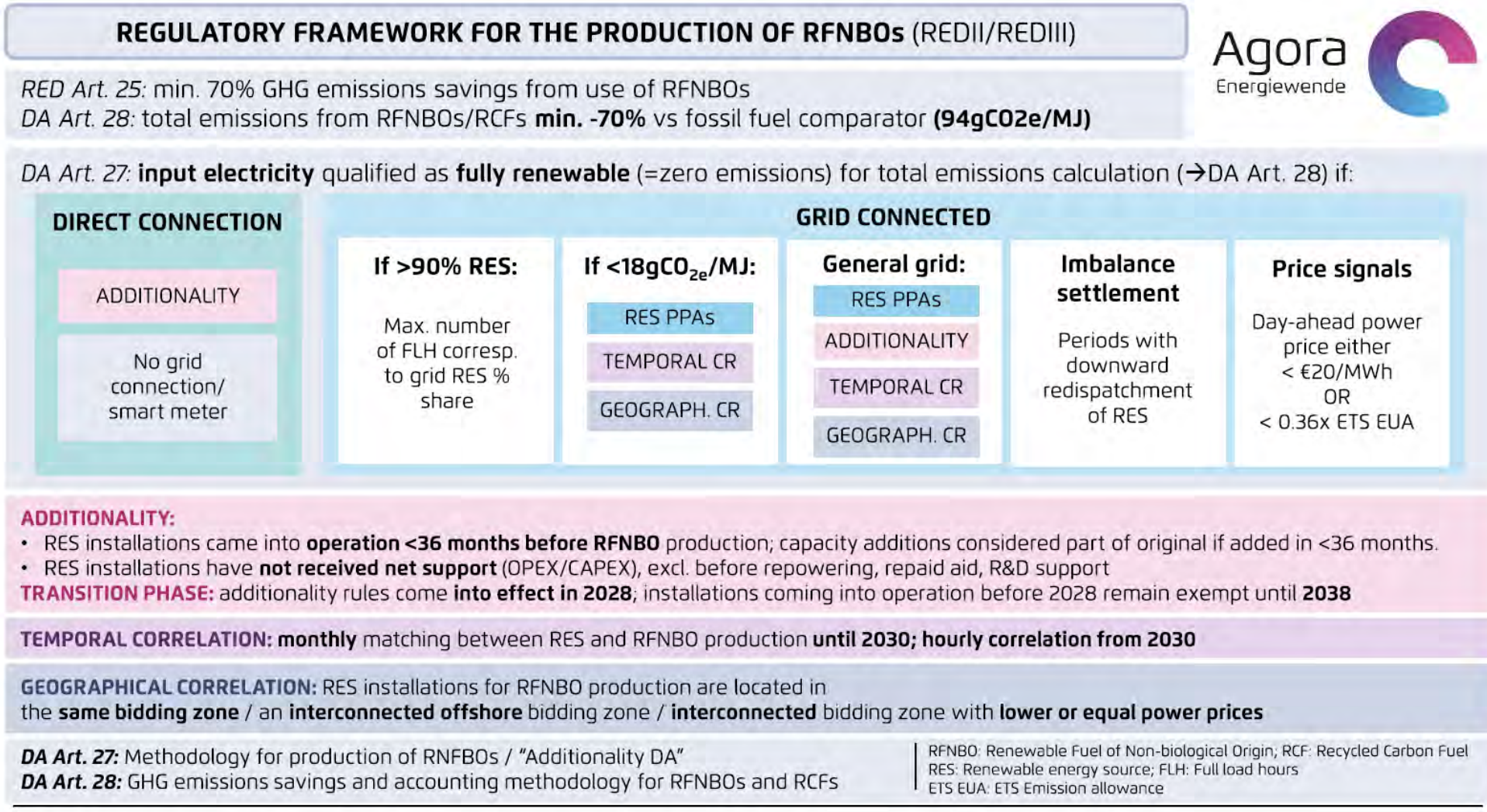
[4] Fraunholz, Keles, Fichtner (2020): Impact of electricity market designs on investments in flexibility options, in: The Future European Energy System: Renewable Energy, Flexibility Options and Technological Progress

[5] Backer, Keles, Kraft (2023): On the economic impacts of European balancing market integration: the case of the newly-installed aFRR market coupling platform PICASSO, under Review, Energy Economics.

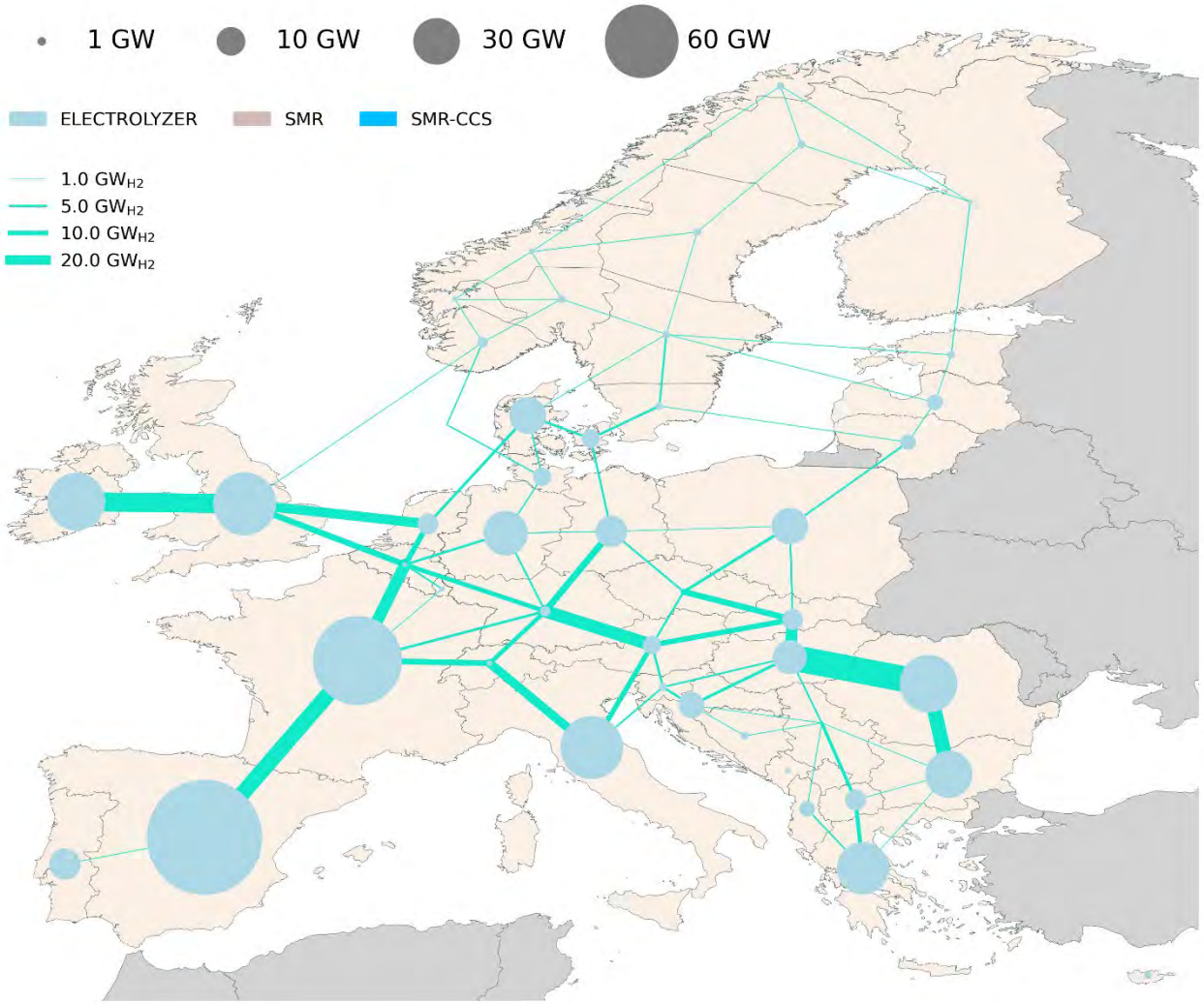
[6] www.epexspot.com, Market Results

THANK YOU!

BACKUP

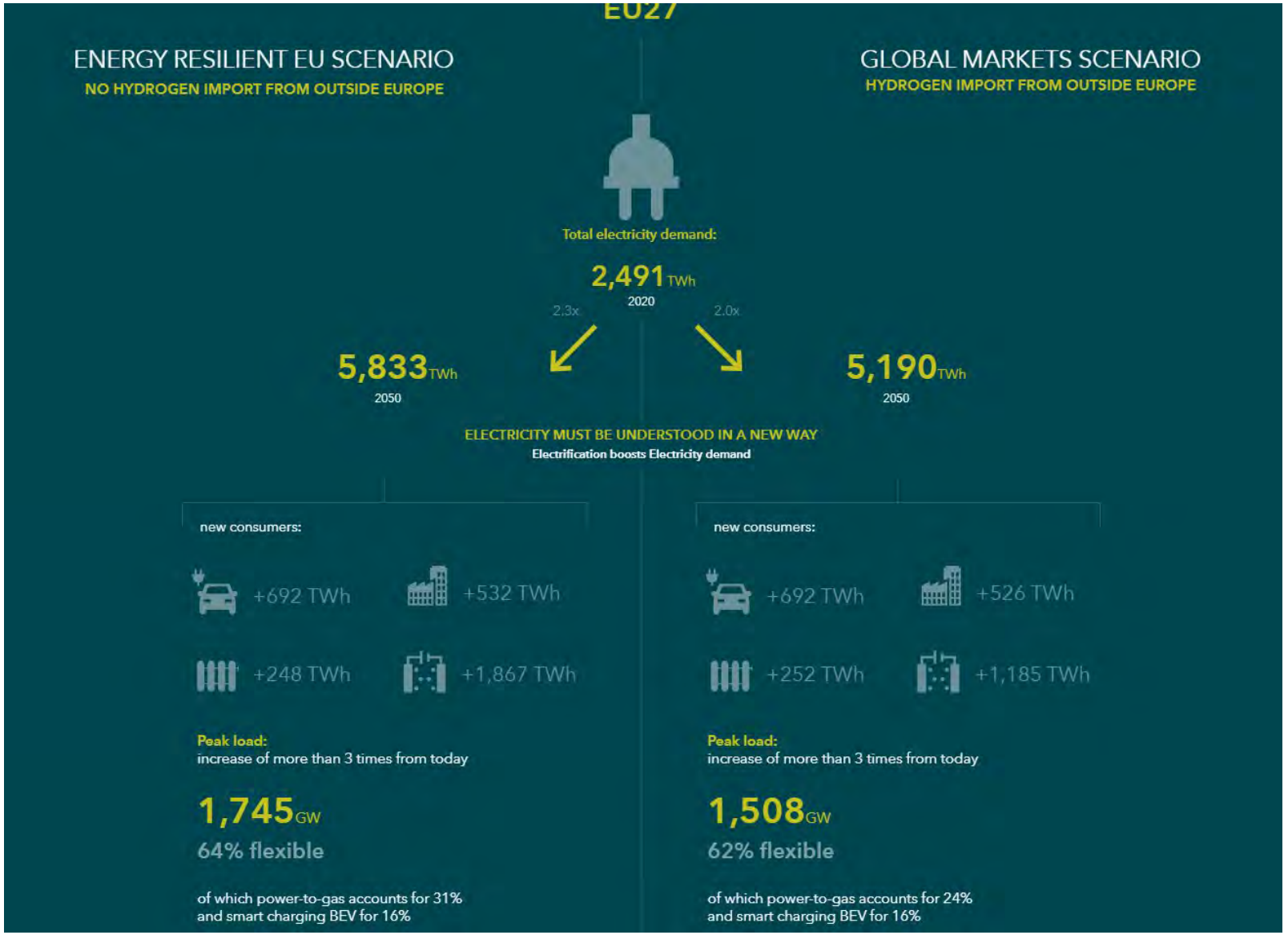

REGULATORY FRAMEWORK FOR THE PRODUCTION OF RFNBOs (REDII/REDIII)
Agora Energiewende
RED Art. 25: min. 70% GHG emissions savings from use of RFNBOs
DA Art. 28: total emissions from RFNBOs/RCFs min. -70% vs fossil fuel comparator (94gCO2e/MJ)
DA Art. 27: input electricity qualified as fully renewable (=zero emissions) for total emissions calculation (→DA Art. 28) if:
DIRECT CONNECTION
ADDITIONALITY
No grid connection/ smart meter
GRID CONNECTED
If >90% RES:
Max. number of FLH corresp. to grid RES % share
If <18gCO2e/MJ:
RES PPAs
TEMPORAL CR
GEOGRAPH. CR
General grid:
RES PPAs
ADDITIONALITY
TEMPORAL CR
GEOGRAPH. CR
Imbalance settlement
Periods with downward redispatchment of RES
Price signals
Day-ahead power price either < €20/MWh OR < 0.36x ETS EUA
ADDITIONALITY:
• RES installations came into operation <36 months before RFNBO production; capacity additions considered part of original if added in <36 months.
• RES installations have not received net support (OPEX/CAPEX), excl. before repowering, repaid aid, R&D support
TRANSITION PHASE: additionality rules come into effect in 2028; installations coming into operation before 2028 remain exempt until 2038
TEMPORAL CORRELATION: monthly matching between RES and RFNBO production until 2030; hourly correlation from 2030
GEOGRAPHICAL CORRELATION: RES installations for RFNBO production are located in the same bidding zone / an interconnected offshore bidding zone / interconnected bidding zone with lower or equal power prices
DA Art. 27: Methodology for production of RNFBOs / "Additionality DA"
DA Art. 28: GHG emissions savings and accounting methodology for RFNBOs and RCFs
RFNBO: Renewable Fuel of Non-biological Origin; RCF: Recycled Carbon Fuel
RES: Renewable energy source; FLH: Full load hours
ETS EUA: ETS Emission allowance

How large investments: The case of hydrogen



Source: Kountouris, Langer, Bramstoft, Münster, Keles (2023)

- 500GW of electrolysis capacity needed by 2050
- Hydrogen network composed of new and repurposed nat. gas pipelines (255 TWkm),
- Large share of renewables for green hydrogen


EU27
ENERGY RESILIENT EU SCENARIO
NO HYDROGEN IMPORT FROM OUTSIDE EUROPE
GLOBAL MARKETS SCENARIO
HYDROGEN IMPORT FROM OUTSIDE EUROPE
Total electricity demand:
2,491 TWh
2020
2.3x
2.0x
5,833 TWh
2050
5,190 TWh
2050
ELECTRICITY MUST BE UNDERSTOOD IN A NEW WAY
Electrification boosts Electricity demand
new consumers:
+692 TWh
+532 TWh
+248 TWh
+1,867 TWh
Peak load:
increase of more than 3 times from today
1,745 GW
64% flexible
of which power-to-gas accounts for 31%
and smart charging BEV for 16%
new consumers:
+692 TWh
+526 TWh
+252 TWh
+1,185 TWh
Peak load:
increase of more than 3 times from today
1,508 GW
62% flexible
of which power-to-gas accounts for 24%
and smart charging BEV for 16%

Energy trading and consumption