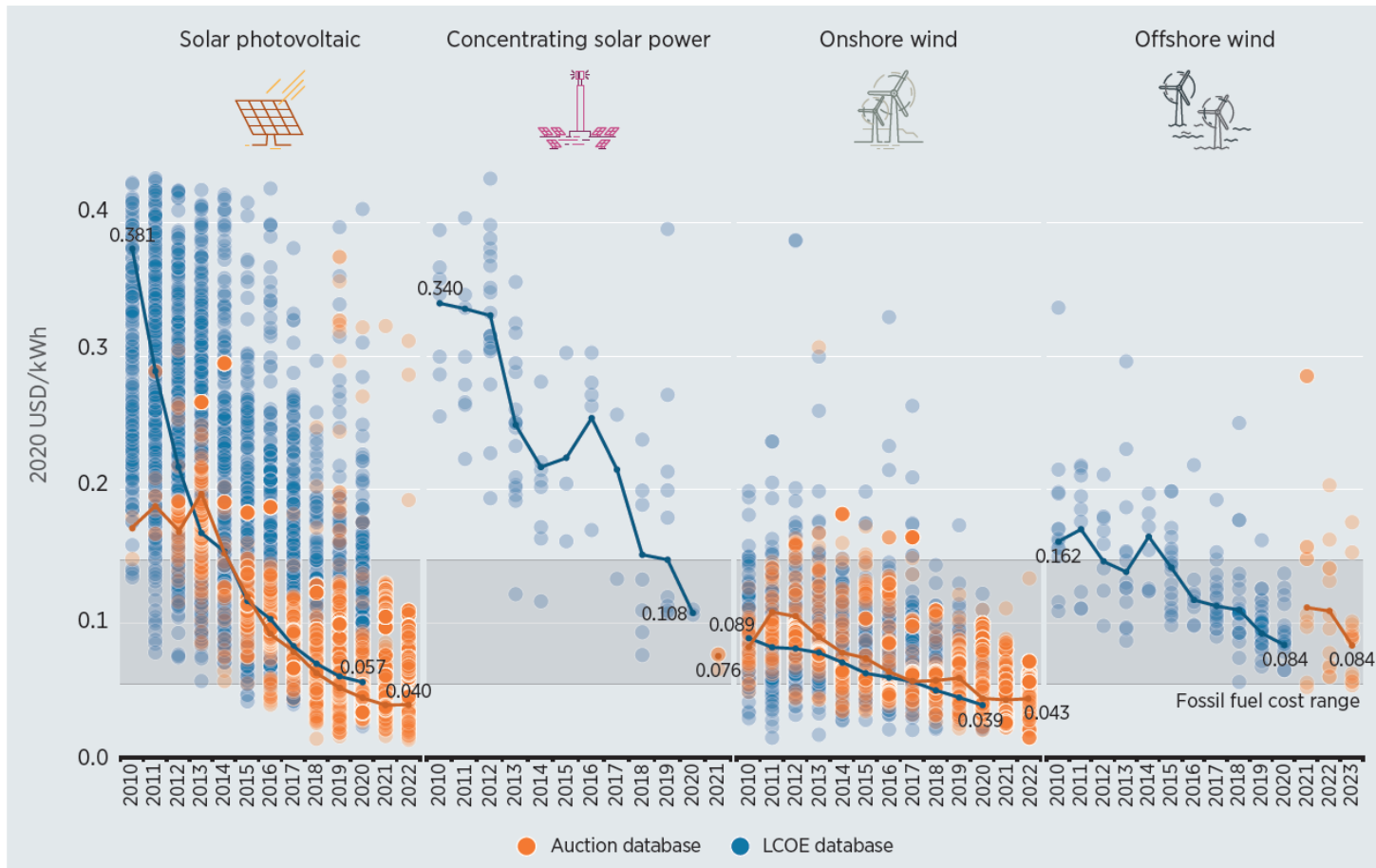


Renewables Economics in Times of Transition

Dolf Gielen
Director Innovation and Technology

Recent cost evolution



Source: IRENA Renewable Cost and Auction and PPA Databases

In most parts of world RE least-cost source of new electricity:

- ▶ 62% of utility-scale capacity added in cost less than cheapest new coal

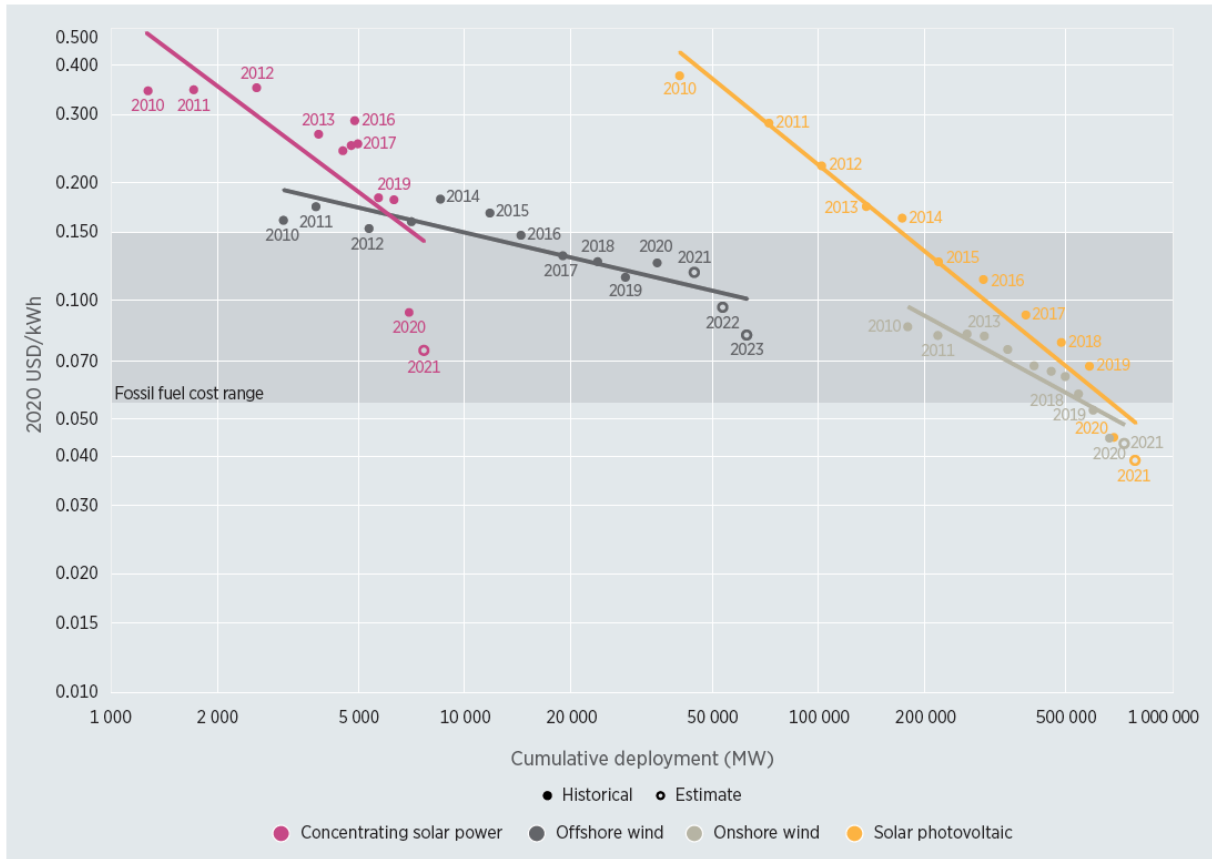
Will increasingly undercut even operating costs of existing coal

Low-cost renewable electricity to be backbone of electricity system:

- ▶ But also key to decarbonising the wider energy system

Learning rates

Quite remarkable rates of deflation for wind and, in particular, solar power technologies.



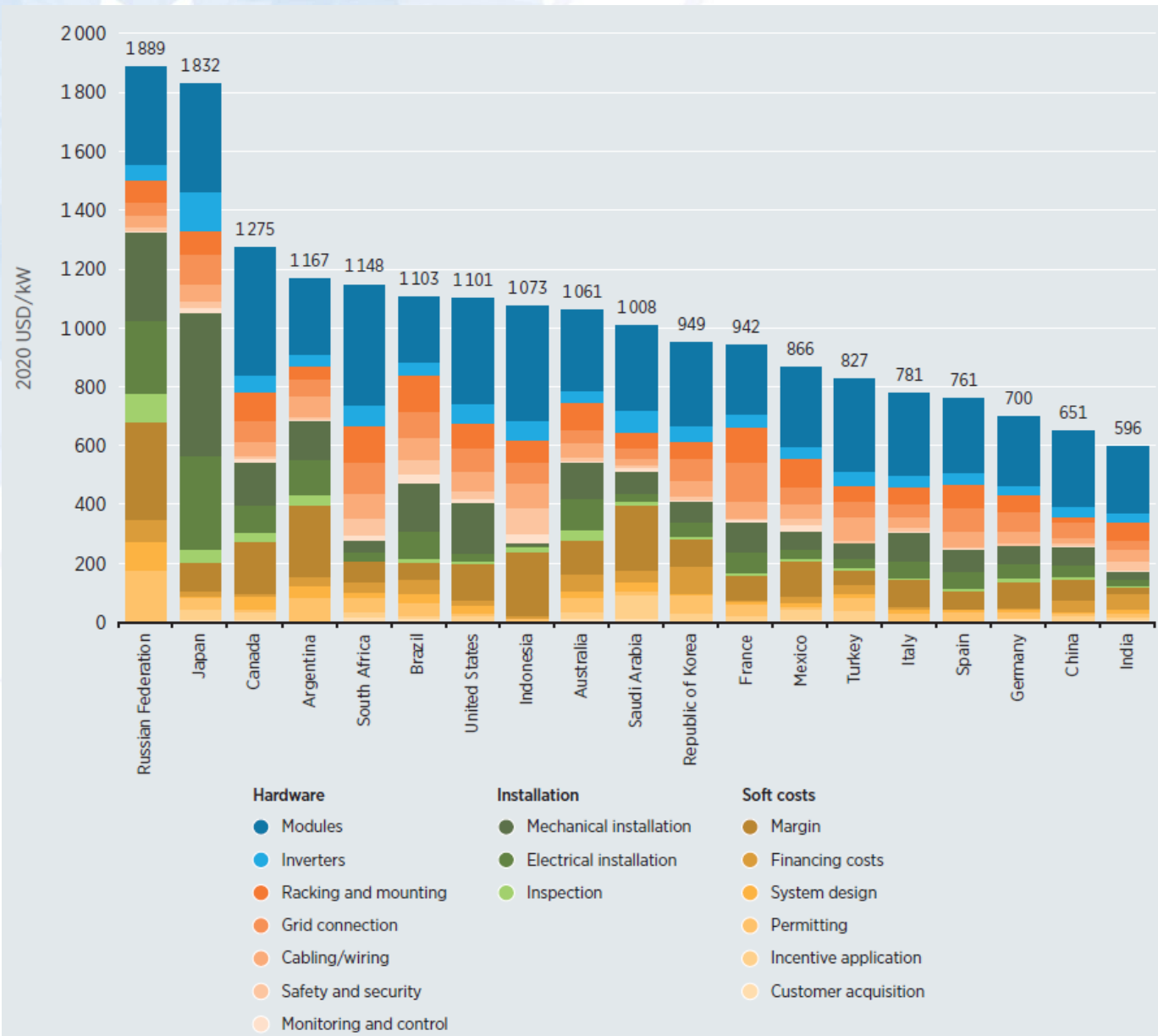
Source: IRENA Renewable Cost Database

Table ES2 Learning rates for solar PV, CSP, onshore and offshore wind, 2010-2020 and 2010 to 2021/3

	Learning rates	
	Total installed cost 2010-2020	LCOE 2010-2021/23
	(%)	(%)
Utility-scale solar PV	34	39
CSP	22	36
Onshore wind	17	32
Offshore	9	15

6 The learning rate is the percentage reduction in the price/cost for every doubling of cumulative installed capacity.

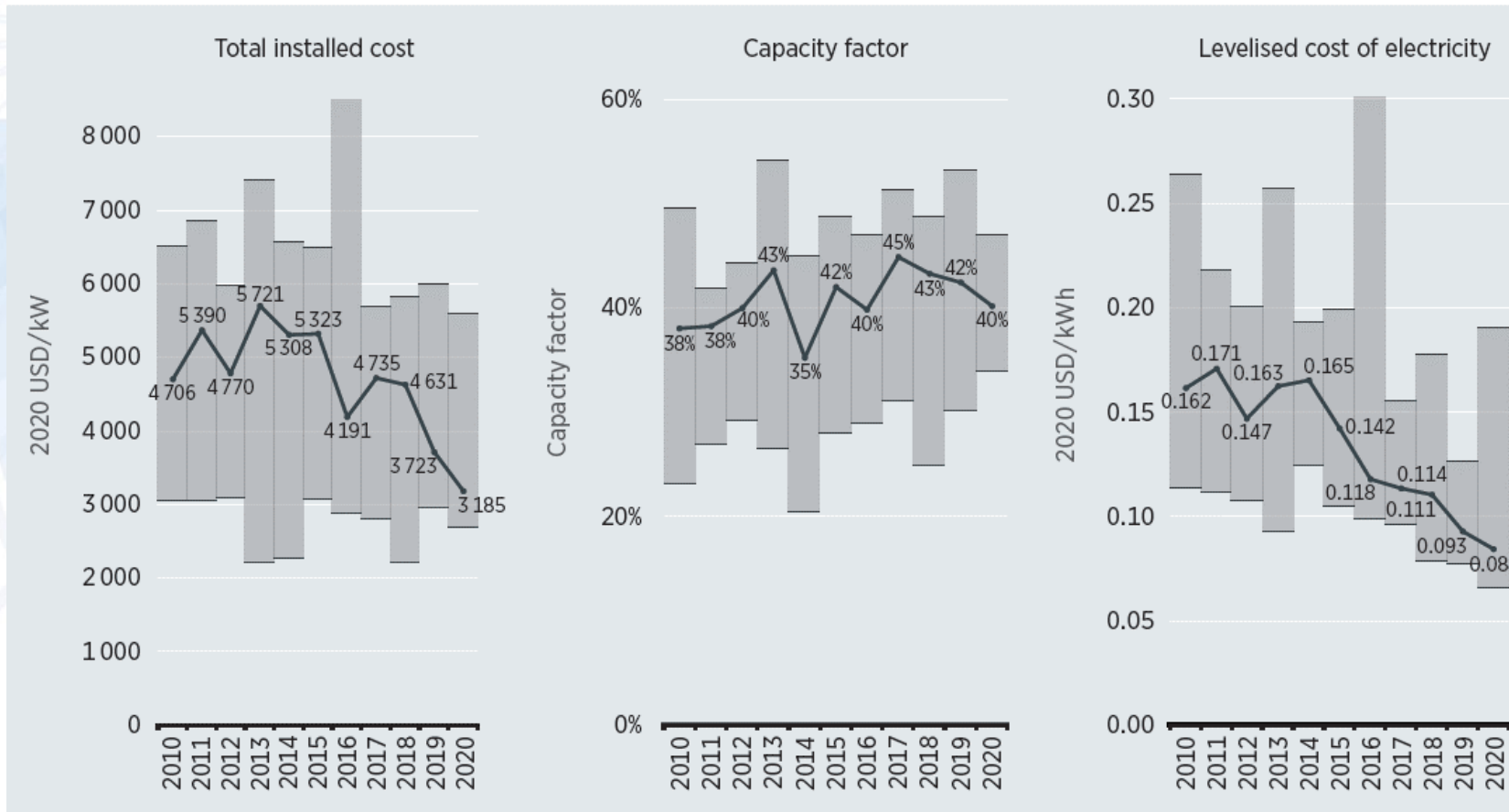
Solar PV cost trends



- 2010-2020, 61% of global weighted-average TIC decline due to modules. 39% due to BoS
- The highest cost average was 3x more than the lowest
- Despite convergence of installed costs in major markets in last 5 years, differences persist.

Offshore wind cost and performance trends

Between 2010-2020, the global weighted average:



Source: IRENA Renewable Cost Database.

- Total installed cost reduced by **32% from USD 4 706 to USD 3 185/kW**
- Capacity factor increased **from 37% to 40%**
- LCOE reduced **by 48% from USD 0.162/kWh to USD 0.084/kWh**
- **China accounted for half of new capacity in 2020**
- **Leases for 15 GW floating offshore wind allocated in Scotland**

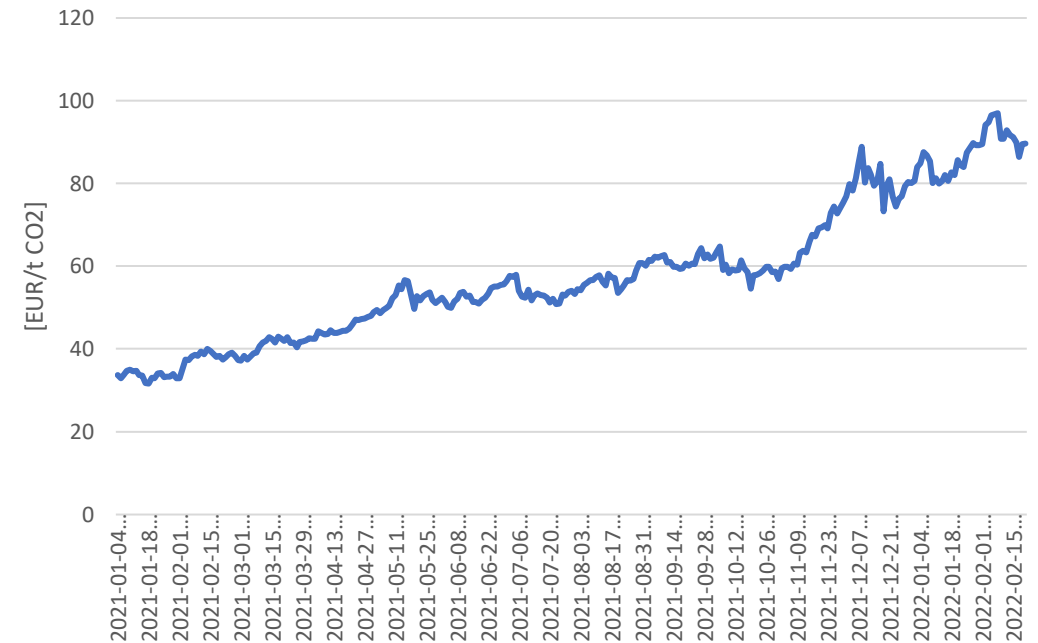
Electrification with renewables can help making energy more affordable – rising fossil fuel prices also help !

Dutch TTF Gas Mar '22 (TGH22) - Barchart.com

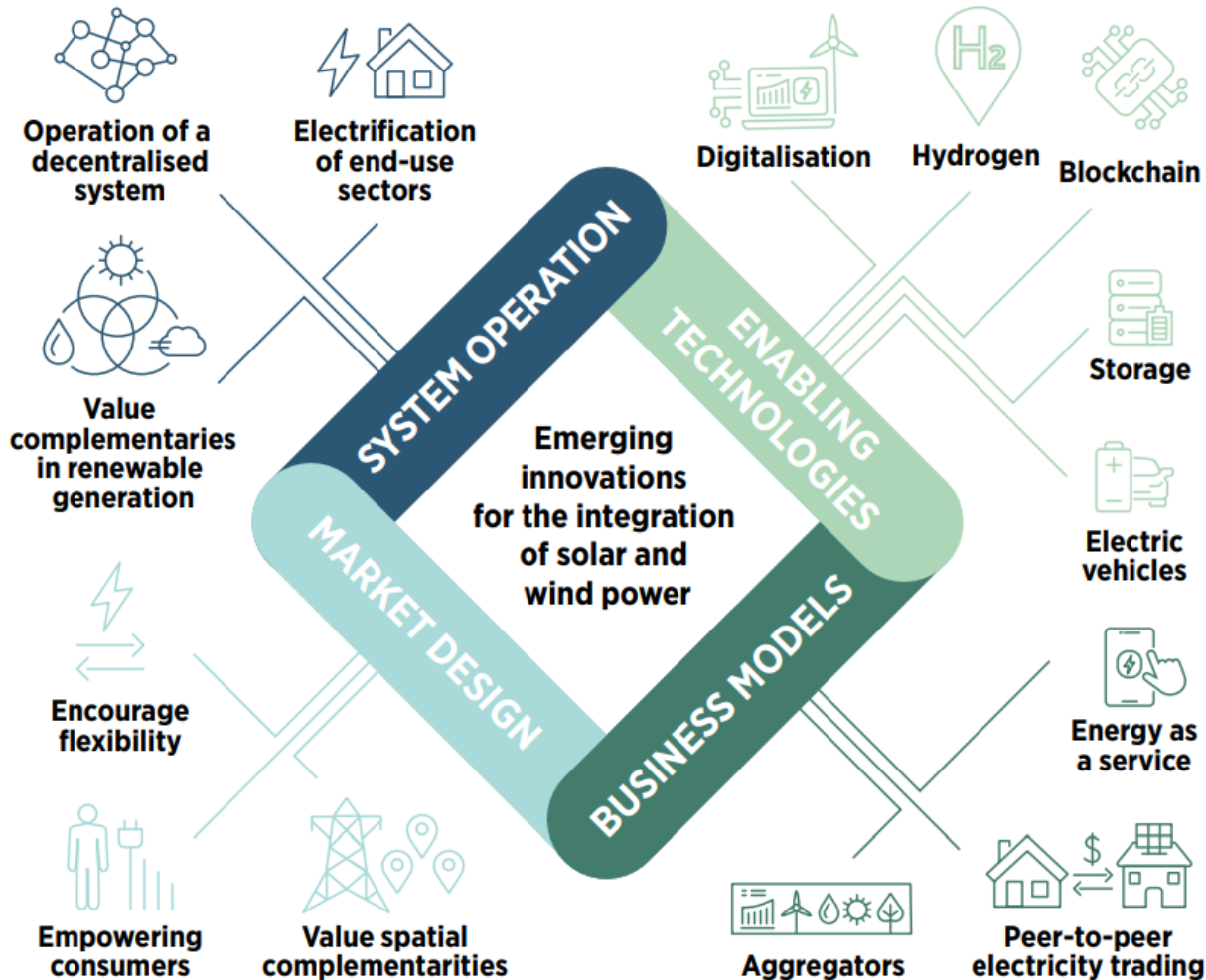
Gas prices quadrupled in Europe



EU ETS price



Need for a systemic innovation approach



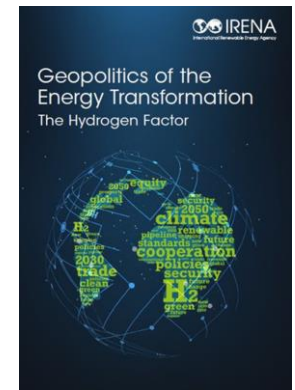
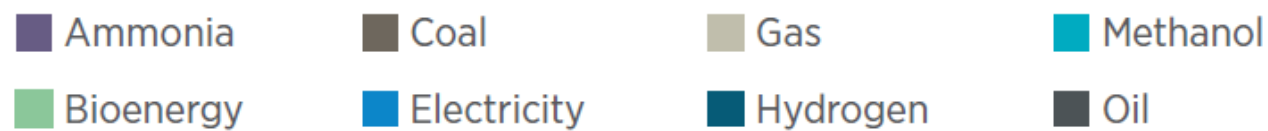
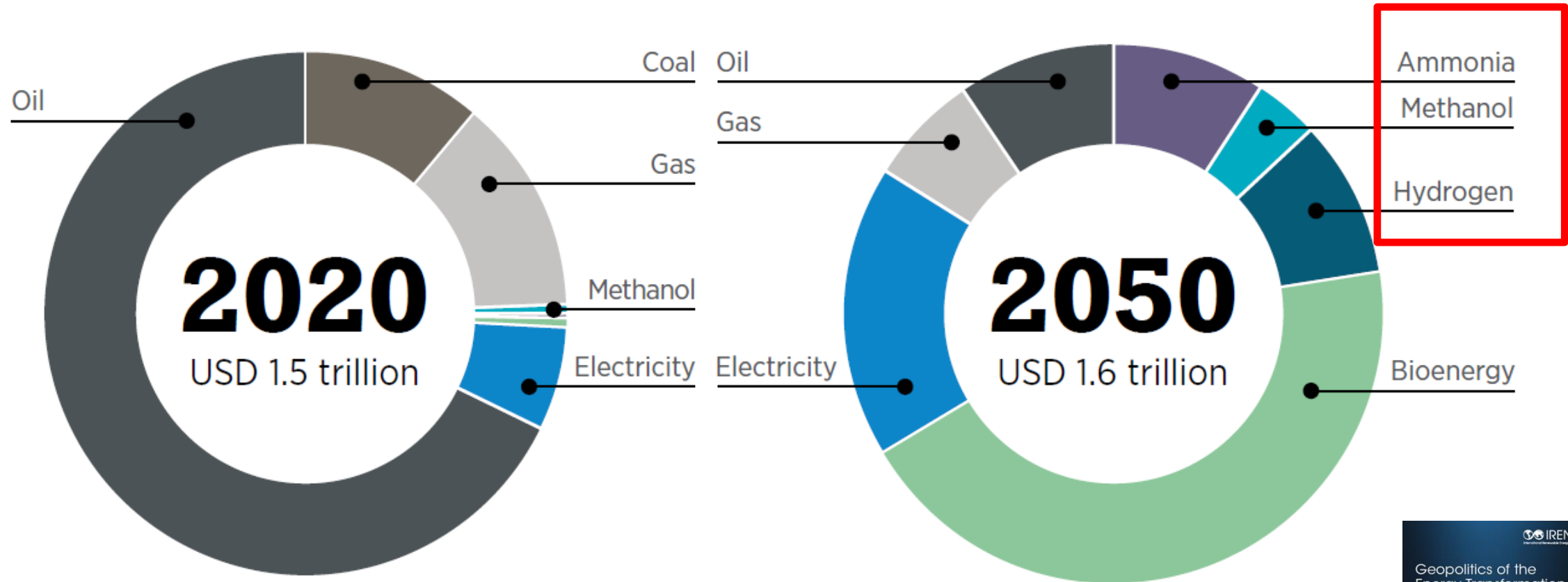
Source: IRENA (2021)

Increasing flexibility through:

- Governments to create the enabling infrastructure (grids, EV recharging etc.)
- A key role for digitalisation and smart systems
- Changing supply and demand patterns and more variable electricity pricing create new business cases
- More attention for demand side flexibility
- New ongoing IRENA analysis Innovation Landscape Report for electrification of end use
- Unlocking existing flexibility is the first action to be taken: restructuring of market and operations is key. Regulation can be a barrier and needs attention

Shifts in the value of trade in energy commodities, 2020 to 2050

20% hydrogen and its energy derivatives



Green commodities

- Hydrogen as feedstock for steel making
 - Approximately 20 pilot projects worldwide
 - Hydrogen at 1.5 USD/kg offers a prospect of low cost green steel (120 USD/t energy cost for crude steel)
 - DRI/HBI can be shipped and used in blast furnaces or EAF
 - DRI is an established commodity >100 Mt/yr, approx. 8% of global primary steel production
 - Produce in ore mining countries with low RE power cost
 - “Green” leakage
-
- Similar strong trend for green ammonia – new IRENA study upcoming soon