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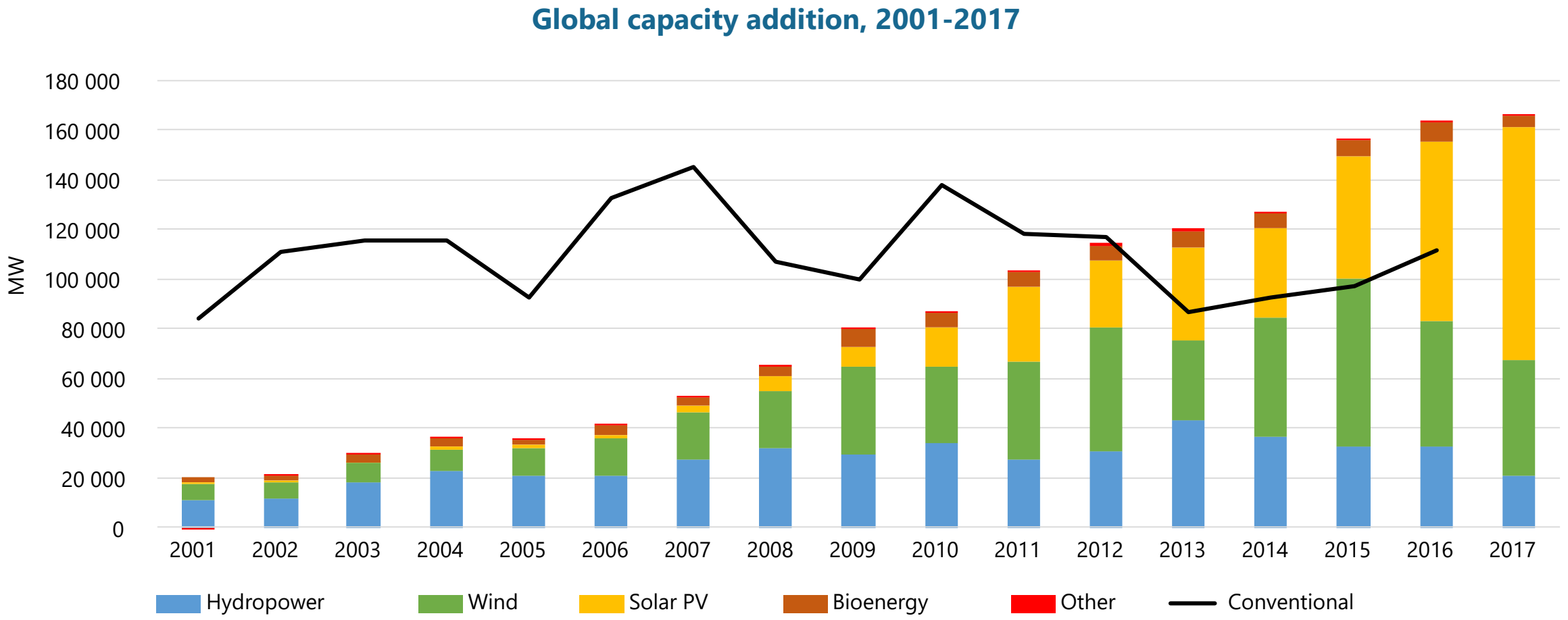
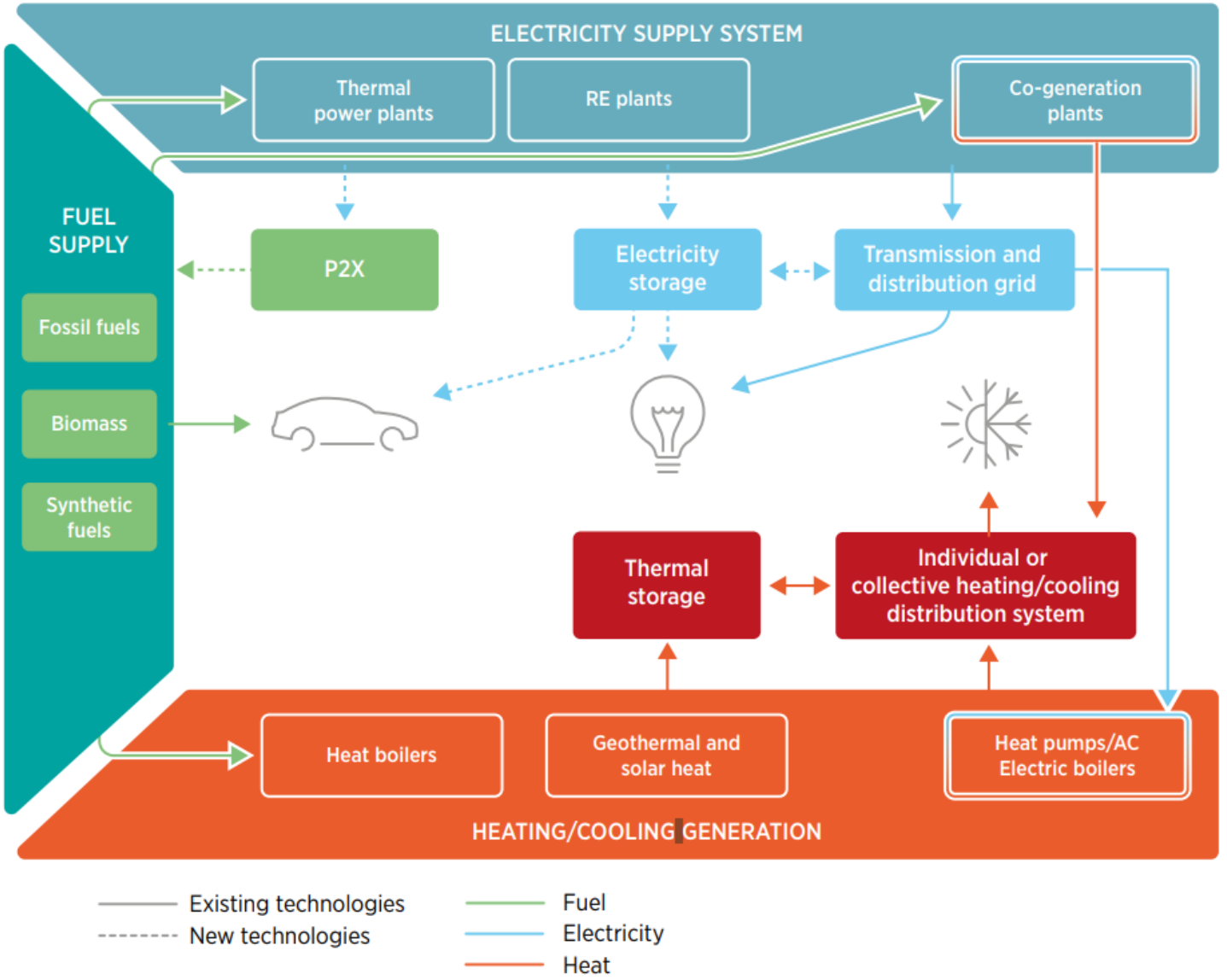
Market design for the uptake of VRE

The transition in the power sector



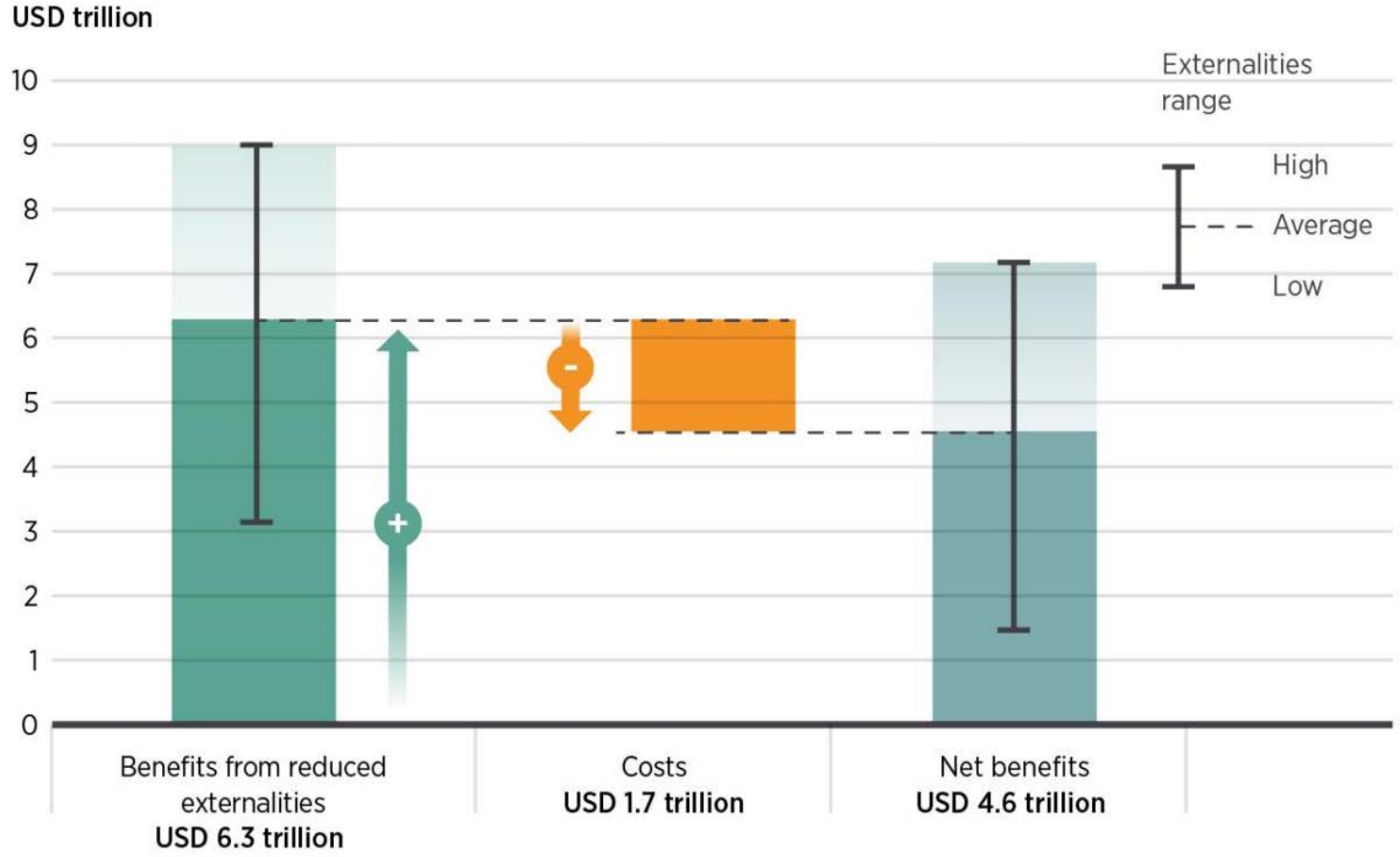
Source: IRENA data

The transition in the power consumption



The transition benefits

The benefits associated to the limiting of the global temperature rise to below 2°C, in terms of annual health and reduced externalities, outweigh incremental costs by a factor of 2 to 5 in 2050.



Source: IRENA (2018), Global Energy Transition, a roadmap to 2050

Updated renewable energy policy classification

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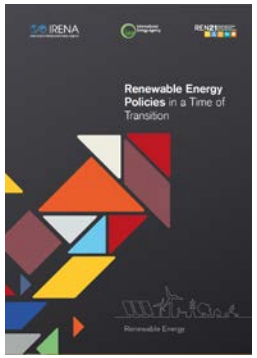


Direct policies include:

- Targets, quotas and obligations
- Regulatory and pricing policies (e.g., administratively set tariffs, competitively set tariffs)
- Fiscal and financial instruments (e.g., tax incentives, subsidies, grants)

Integrating policies include:

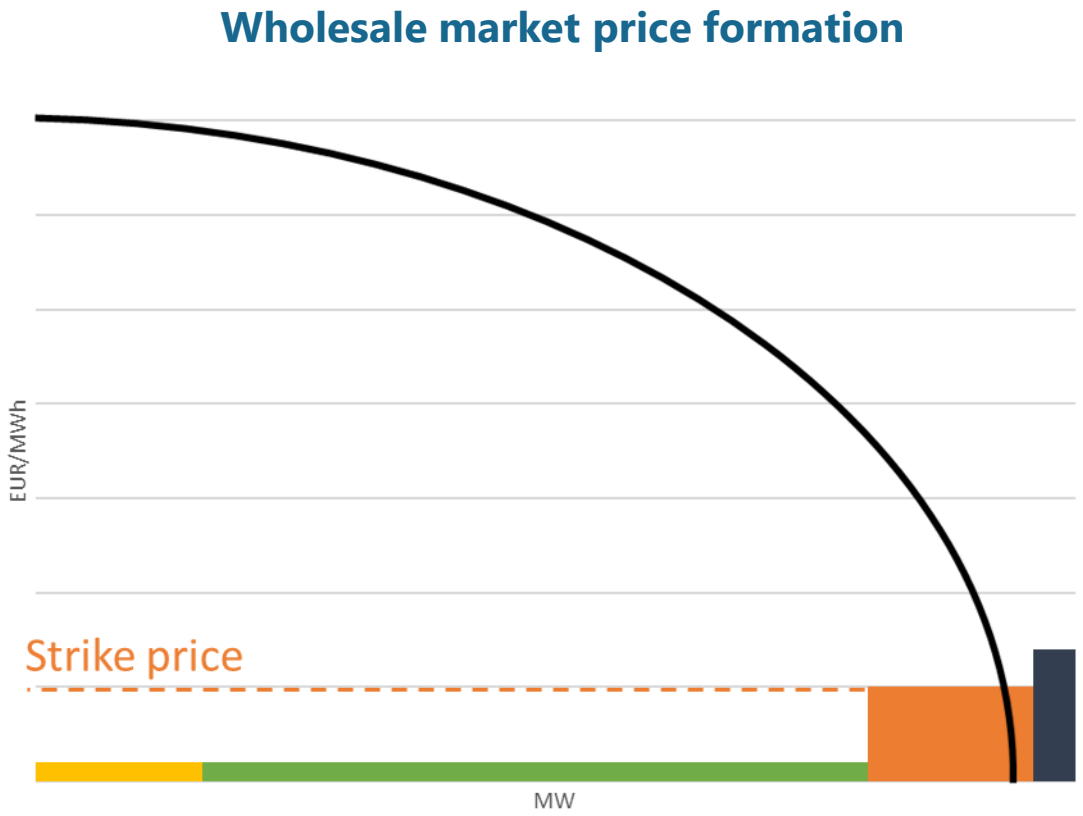
- Flexibility measures (e.g., support for storage, dispatch able supply, load shaping)
- Infrastructure development policies
- Policies for sector coupling
- Alignment of energy efficiency with renewable energy policies

Enabling policies include:

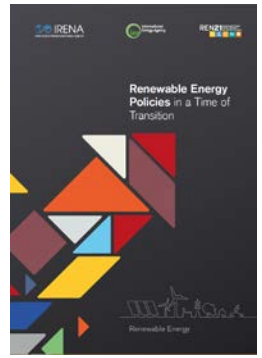
- Fossil fuel subsidy reforms
- Power market redesign
- Land use policies
- RD&D and innovation policies

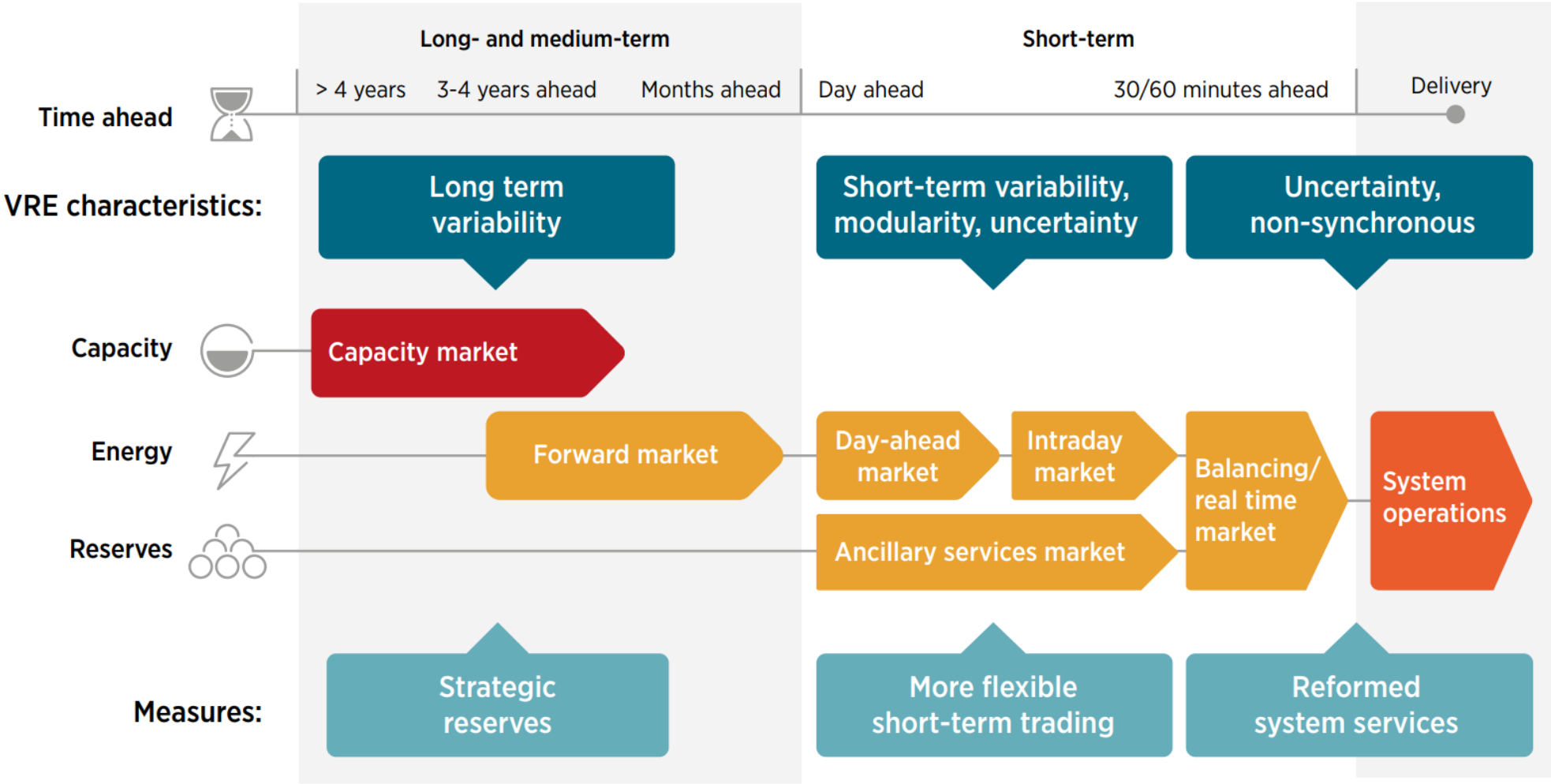
VRE low short-term costs

- In short-term wholesale markets, bids by generators and consumers are matched with the objective of determining who sells and who buys and market clearing prices for each time interval
- The supply curve is based on the marginal cost of each power plant (short-term costs)
- Under the classic power market setup, high shares of VRE displace dispatchable generators. The depressed prices disincentives further system expansion.



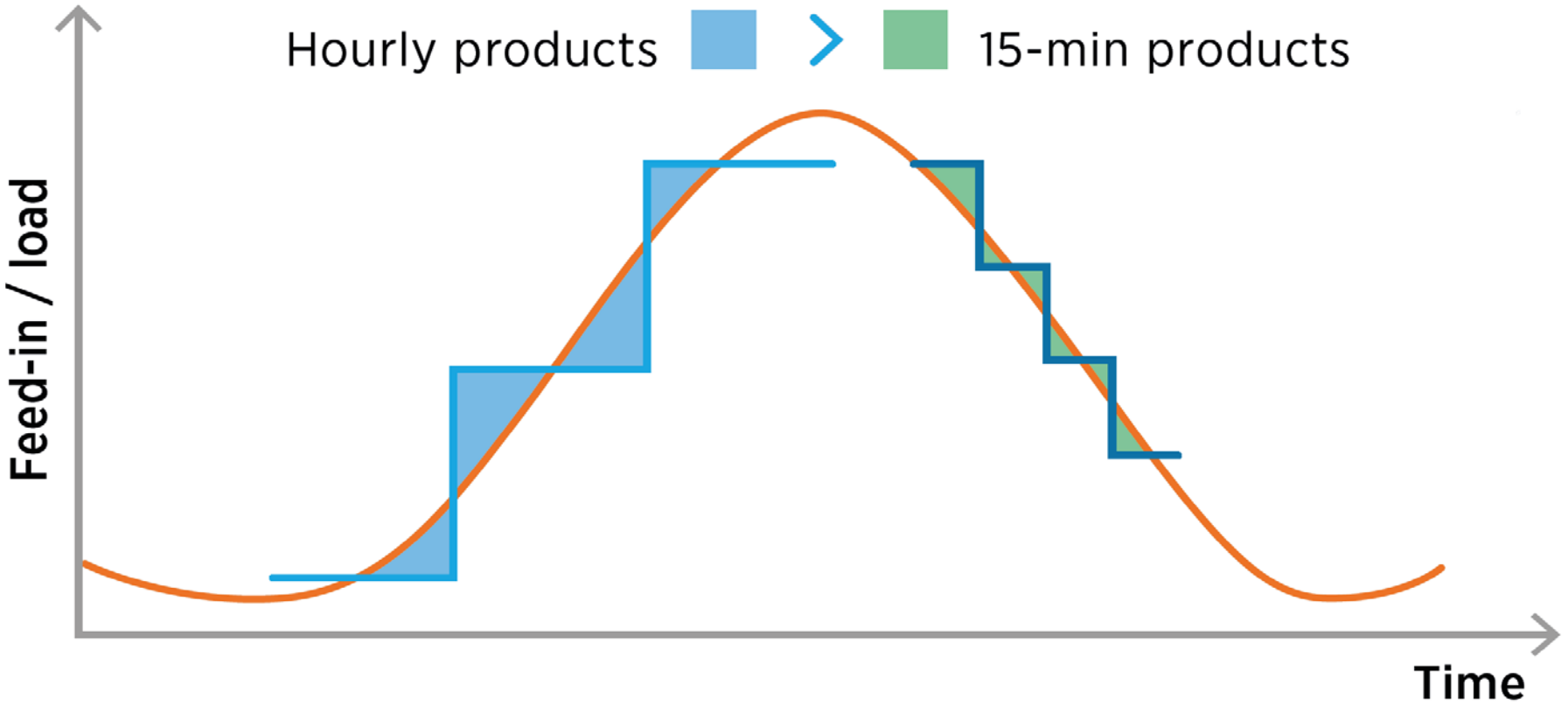
VRE properties and market measures (examples)





Source: IRENA/IEA/REN21 (2018), Renewable energy policies in a time of transition

More flexible short-term trading



VRE presence increase variability of the net load. The net load (orange line) is better represented by sub-hourly products (green) than hourly product (in blue) reducing the need for dedicated reserves

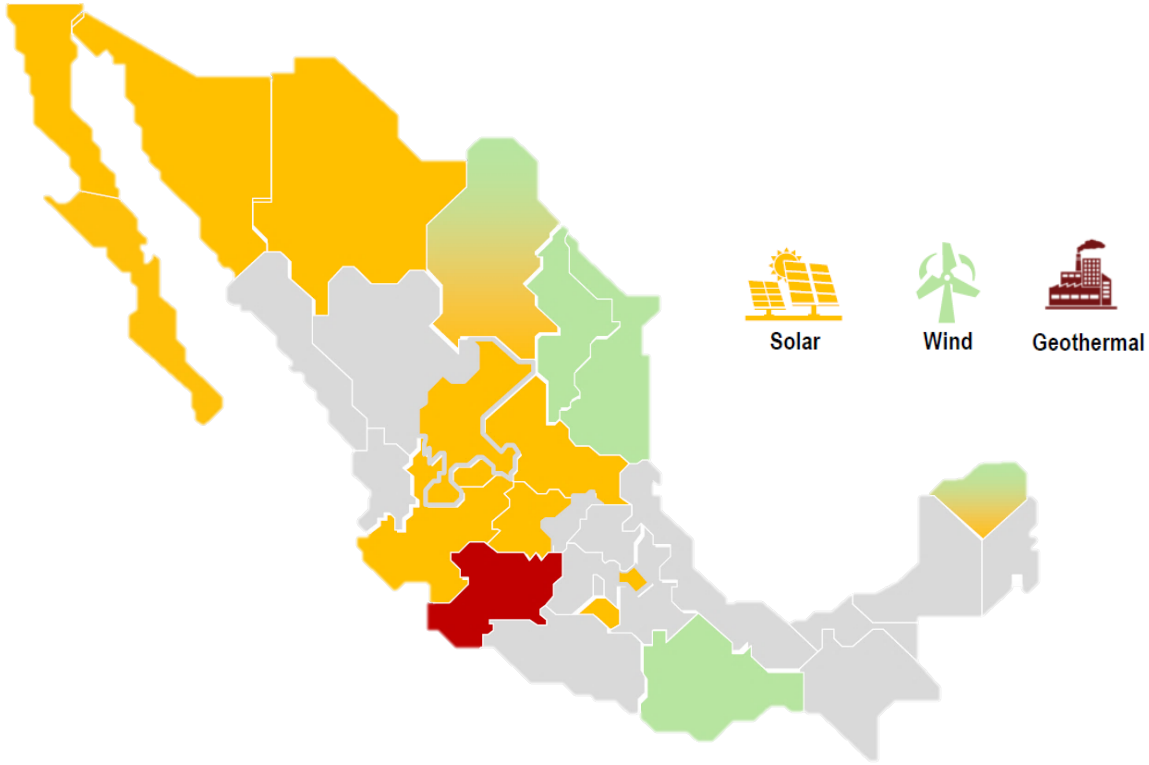
Source: IRENA (2016), Adapting market design to high shares of Variable Renewable Energy

Value-based auctions (Mexico)

Mexico's sophisticated energy auction design

- New auction scheme, adopted with the market liberalization
- Auctions are technology-neutral for clean energy options.
- Energy auctions design incorporates **time** and **locational** signals, to facilitate the deployment of higher value VRE plants
- Demand is set on load forecast (similarly to Brazil) by utilities and privates
- Average winning bids passed from 47.8 USD/MWh to 20.6 USD/MWh in 3 years, for a total of 7.3 GW added capacity.

Geographical diffusion



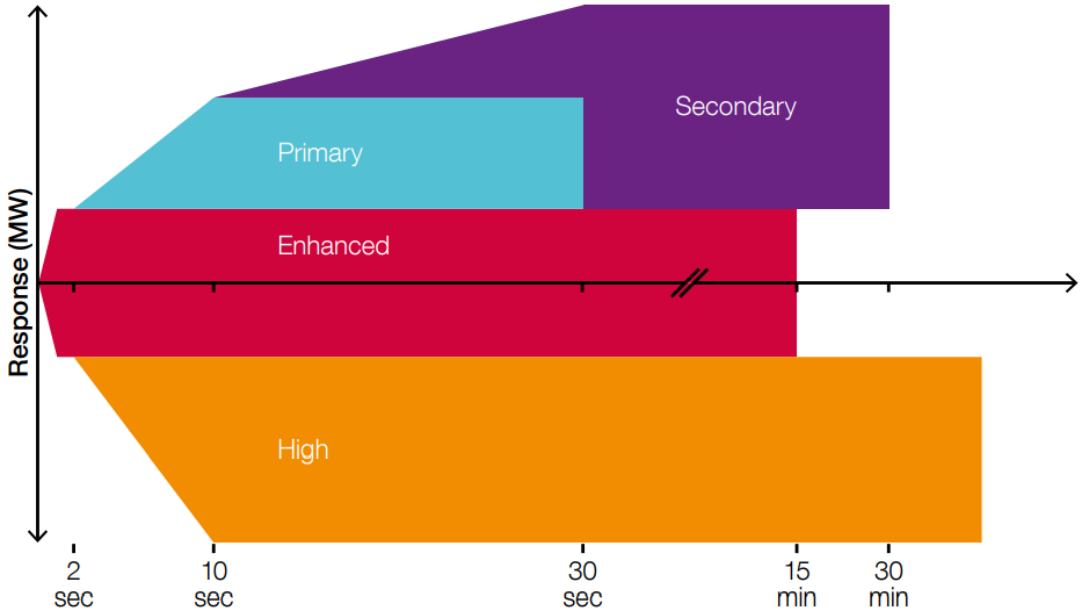
Source: Villareal (2018), *Value Based Auctions*

Enhanced Frequency Response (UK)

Enhanced Frequency Response (EFR) procurement

- With the rise of VRE and the gradual decommissioning of dispatchable power plants, power systems are becoming more susceptible to sudden variations in power generation or consumption.
- EFR which is capable of responding to grid fluctuations in less than one second, has been adopted in UK.
- Technology agnostic auctions have been held and 8 storage projects (201 MW) were selected for the provision of this service

Design of UK's frequency response



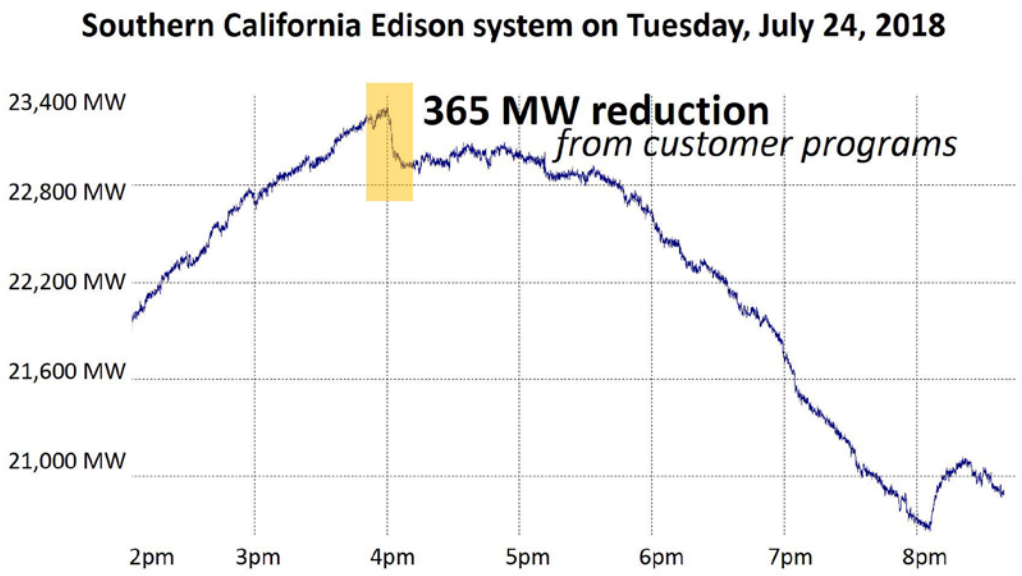
Source: National Grid (2016), *System operability framework*

Demand response (California)

Southern California Edison 's Demand response program

- In August 2015, SCE announced the integration of approximately 1,118 MW of demand response resources into wholesale energy markets managed by the California Independent System Operation (CAISO).
- The demand response programs include 320,000 customers who, in return for a bill credit, reduce energy consumption when requested by the utility.
- Individually these customers would be too small to participate in wholesale markets

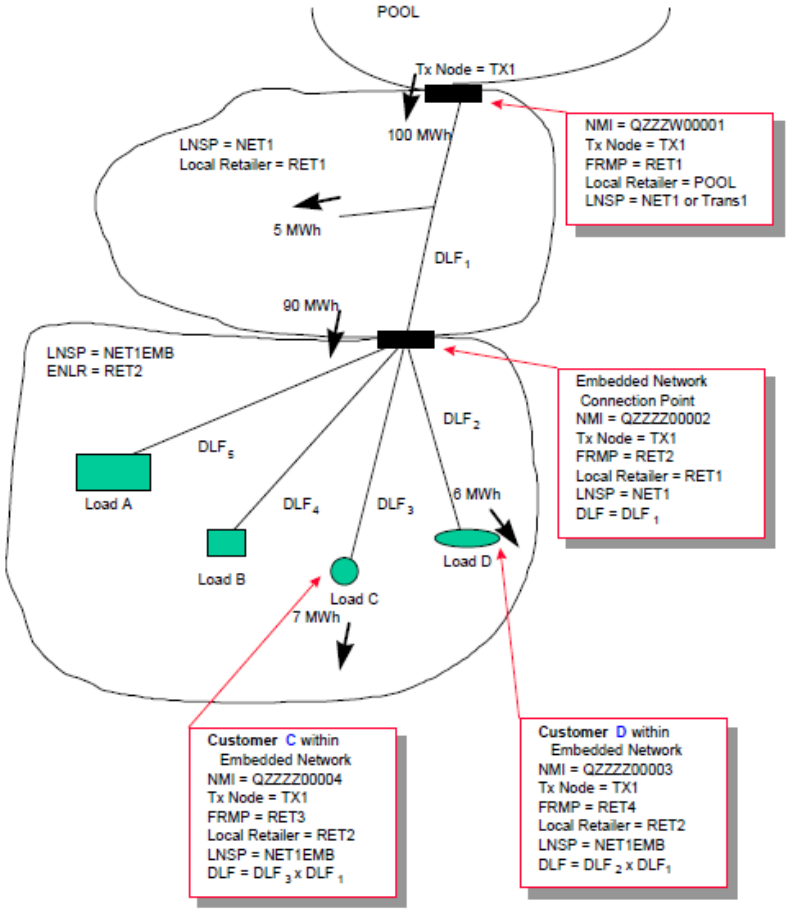
Results



Source: Jill Anderson, SCE, @JillEnergy

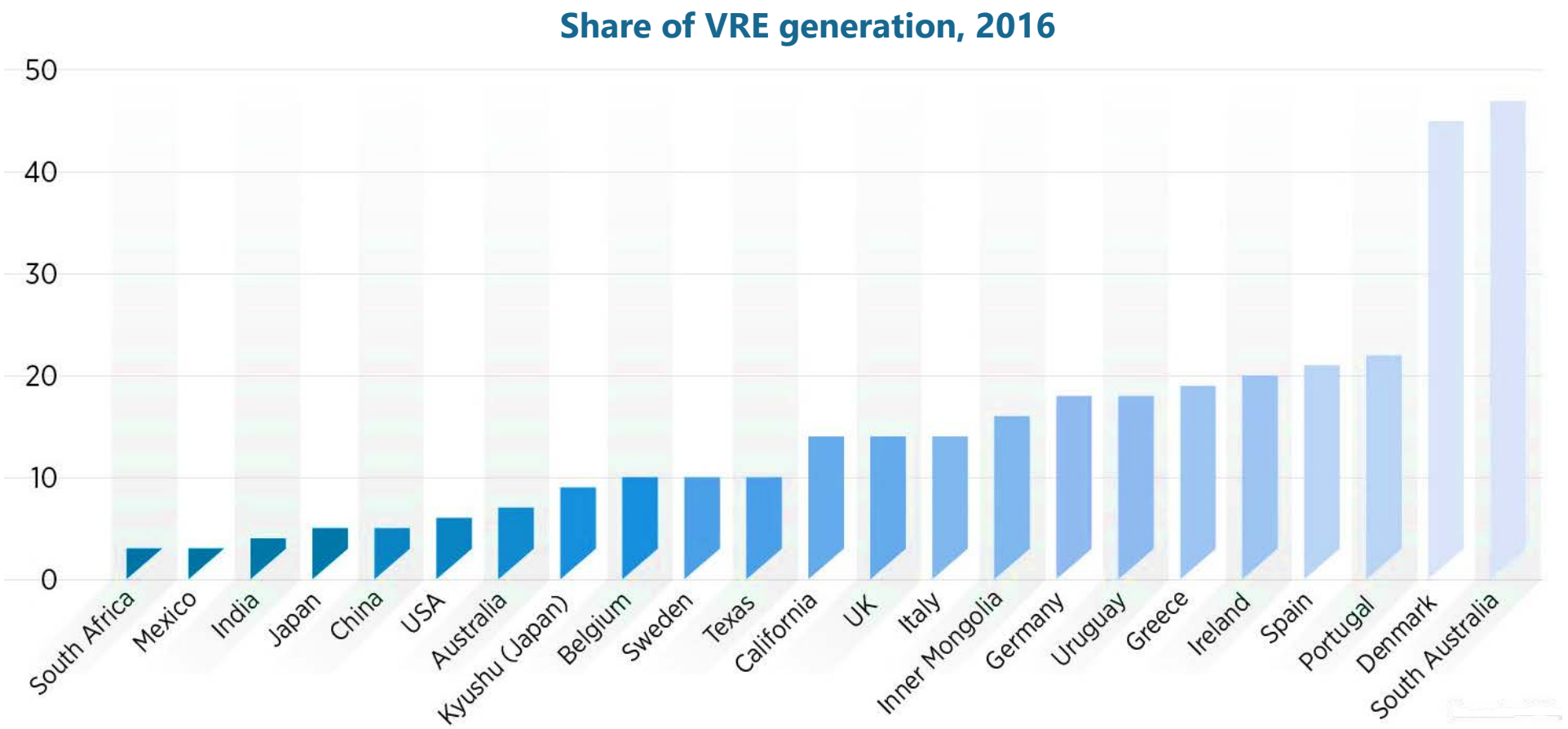
Embedded Network (Australia)

- In some sites, the electrical wiring is configured in such a way as to enable the owner to sell energy to all the residents. This is known as an **Embedded Network (ENs).**
- ENs Managers can perform tariff arbitrage, demand reduction and PV self consumption for the benefit of its end users.
- EN Managers can participate in the ancillary service markets. ENs can provide frequency control services, voltage regulation services and demand response services to the grid.
- ENs can help networks with congestion relief and with grid infrastructure deferment.
- Over 4000 Embedded Networks have come online in the past 5 years.



Source: Martell (2018), *Embedded Network*

The gradual challenge



Experience shows that challenges emerge gradually. A focus on the right set of issues will allow to continue progress, giving time to adopt comprehensive approaches

Source: IRENA/IEA/REN 21 (2018), Renewable energy policies in a time of transition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Gender and Renewable Energy survey

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Complete the survey and contribute to address the data and knowledge gap on gender in renewable energy!

The findings from the survey will contribute to, and will provide quantitative and qualitative insights on the current status of women's participation in the renewable energy sector, existing challenges and potential solutions to improve gender diversity.

www.irena.org/gendersurvey