

Power market reform and integration of VREs

Matthew Wittenstein

Power Market Restructuring for Renewables Integration

January 27, 2020. Tokyo, Japan.

A bit about me

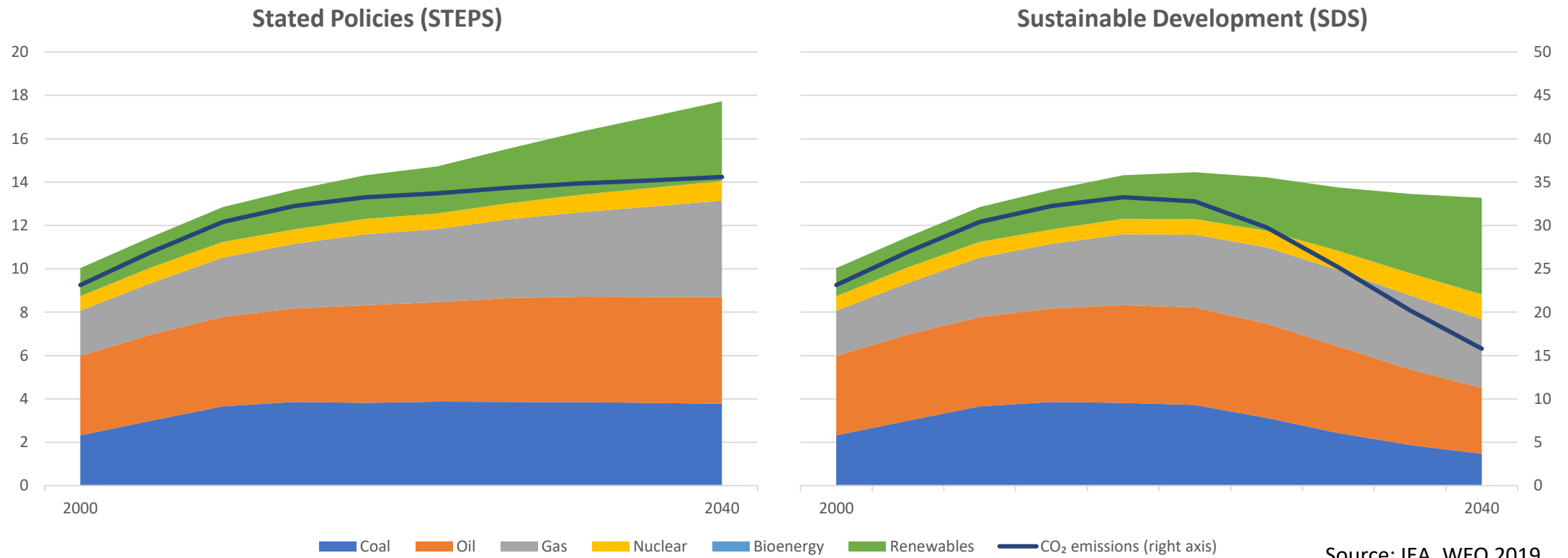
I am...

...formerly a Senior Electricity Analyst in the Gas, Coal and Power markets Division of the International Energy Agency (IEA).

...currently working as an energy analyst, both independently and through an affiliate consulting agreement with FTI Compass Lexecon (FTI CL).

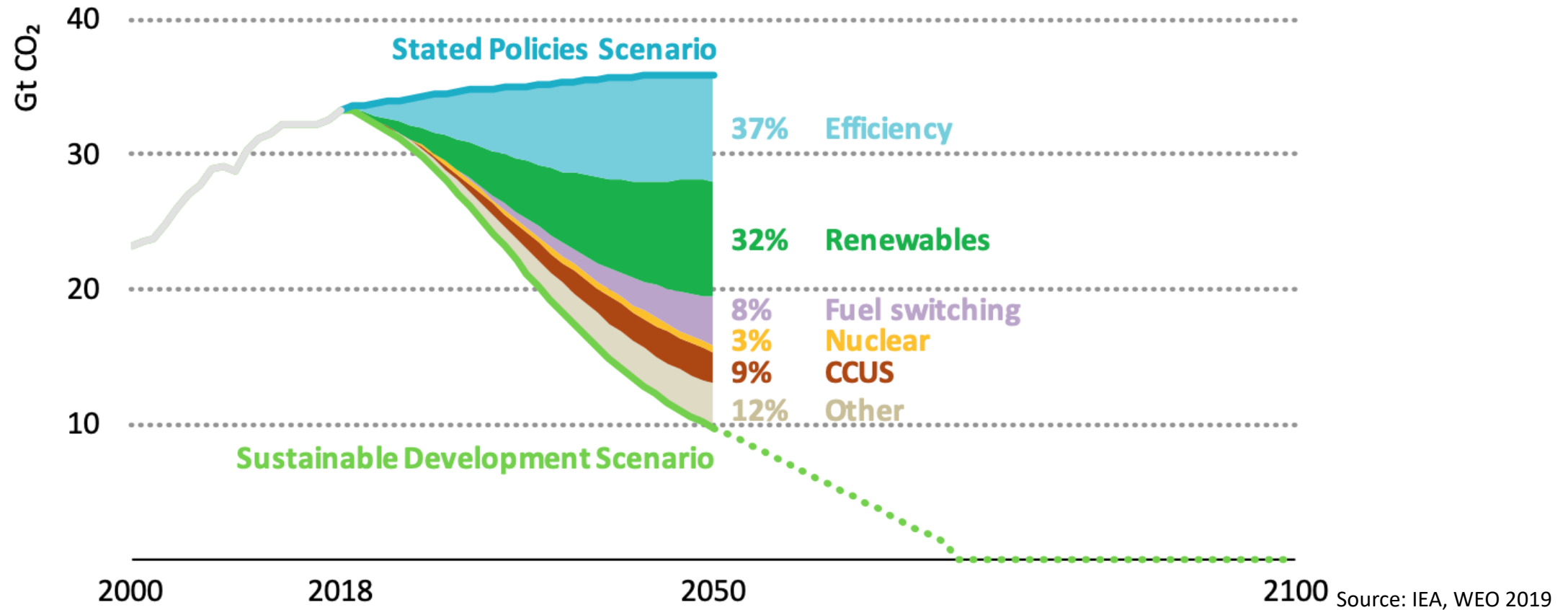
...speaking today on my own behalf. The thoughts and opinions I express here are my own, and not necessarily those of the IEA, FTI CL, or any other institution.

We are not on track to meet Paris Agreement goals



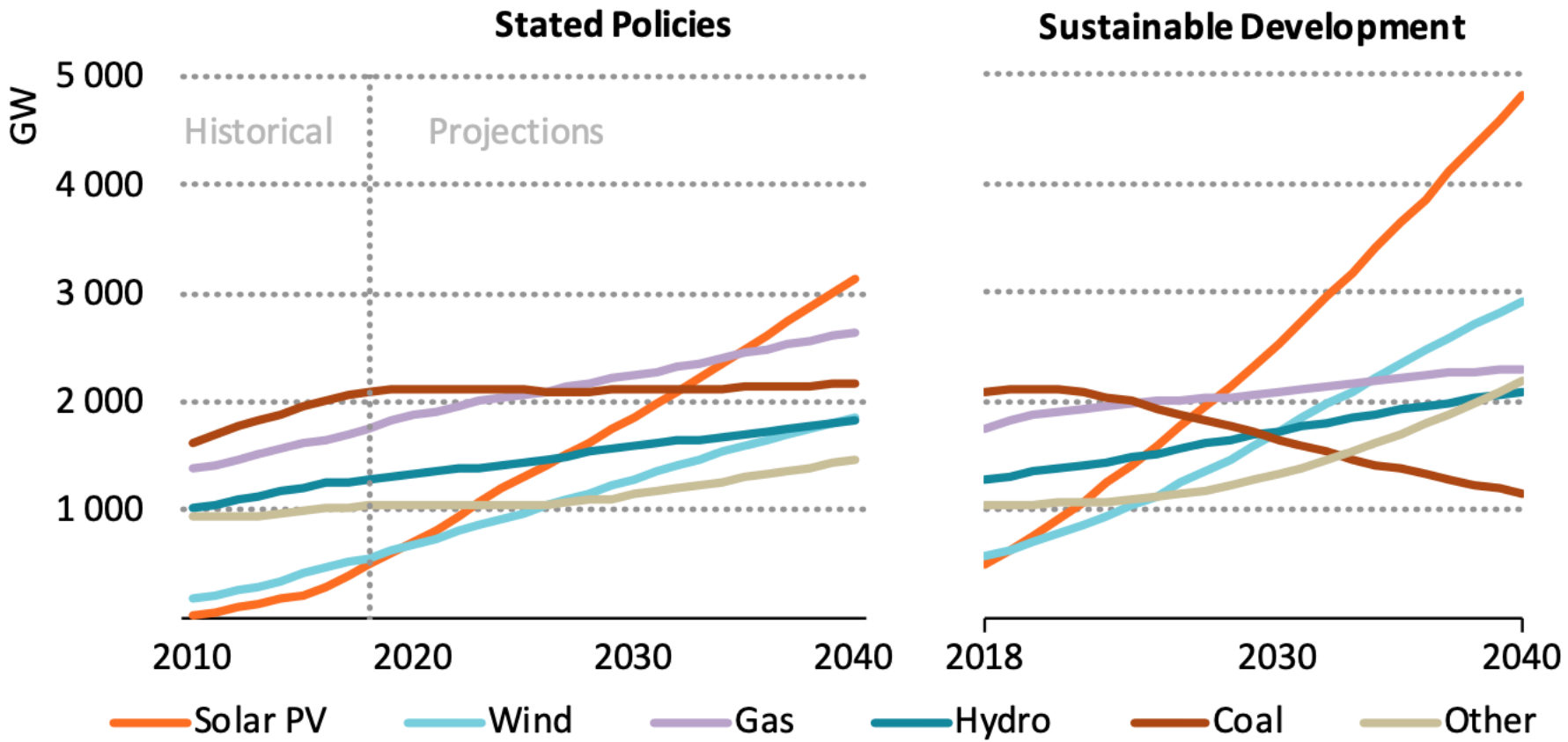
Under IEA projections, if existing policies and announced targets are maintained, global emissions will slow but not peak. To meet a “well-below 2-degree” target, a significant and rapid transformation is necessary.

Getting to below 2 degrees requires a full transformation of the global energy system



Sticking again with the IEA projections, it is clear there is no magic bullet for decarbonization. Globally, all low- and zero-carbon technologies will play a role. But, renewables and efficiency make up most of the solution.

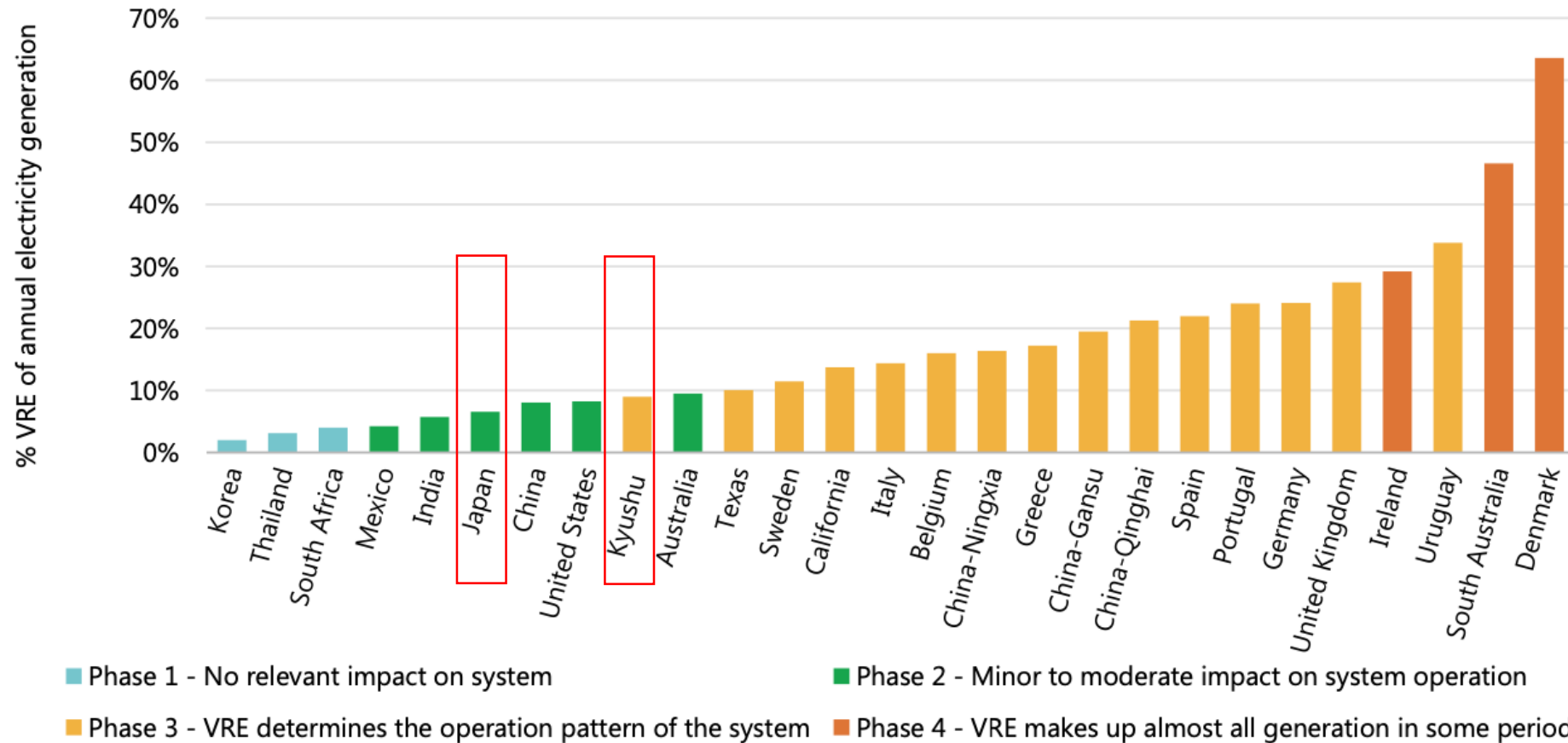
Renewables: nowhere to go but up



Source: IEA, WEO 2019

Even under the IEA's Stated Policies scenario the penetration of VRE increases significantly, with solar PV becoming the largest deployed technology in capacity terms. Under SDS, VRE technologies become dominant.

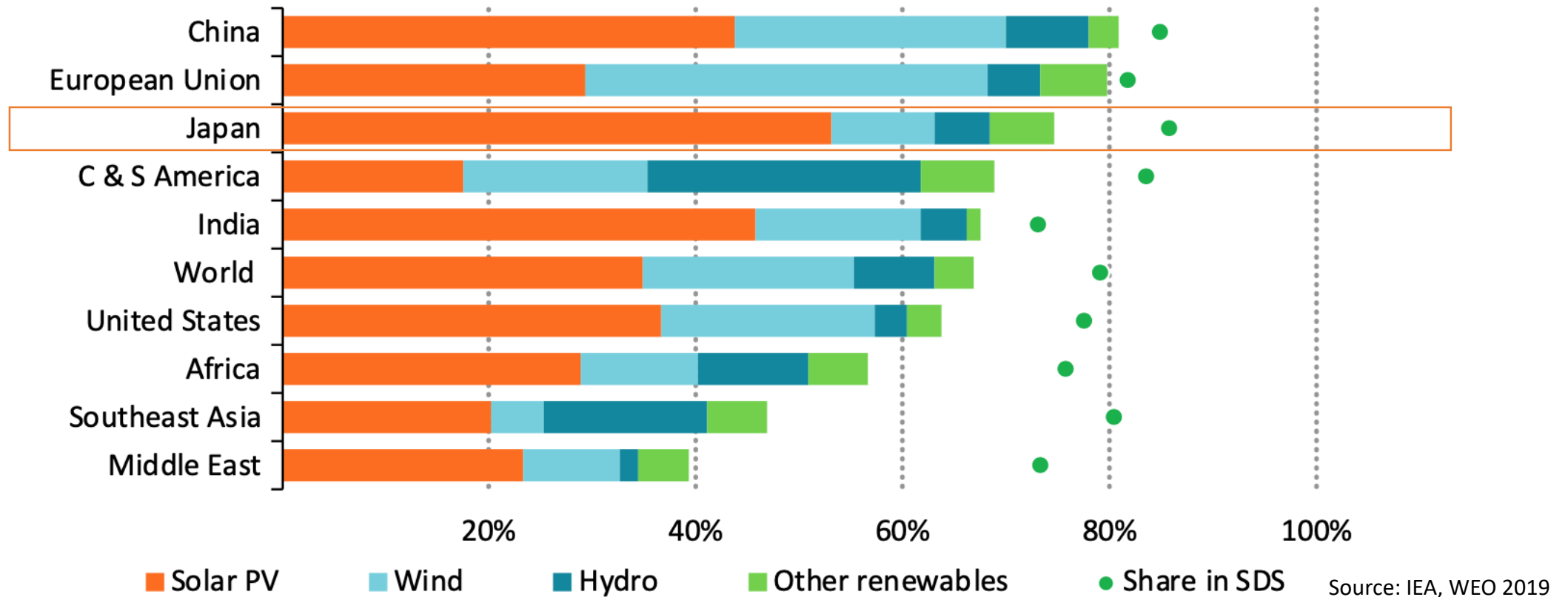
Higher shares of renewables are already a reality in many parts of the world



Source: IEA, Renewables 2019

A growing number of countries and jurisdictions now find that the level of renewable in their power systems guides power system operations. This is already the case in Kyushu.

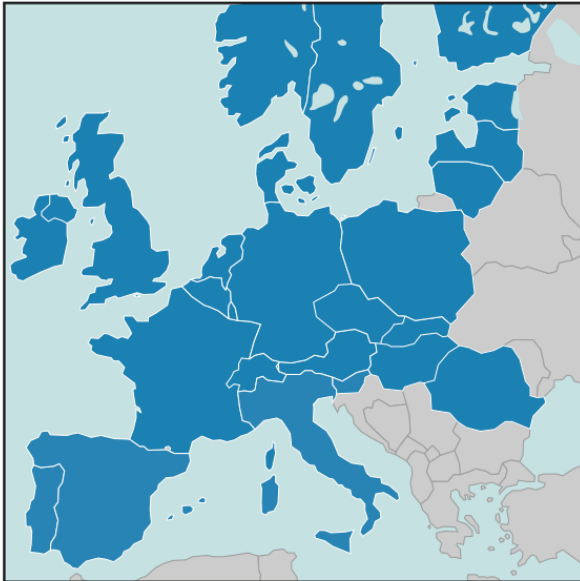
High shares of VRE are set to become the default around the world



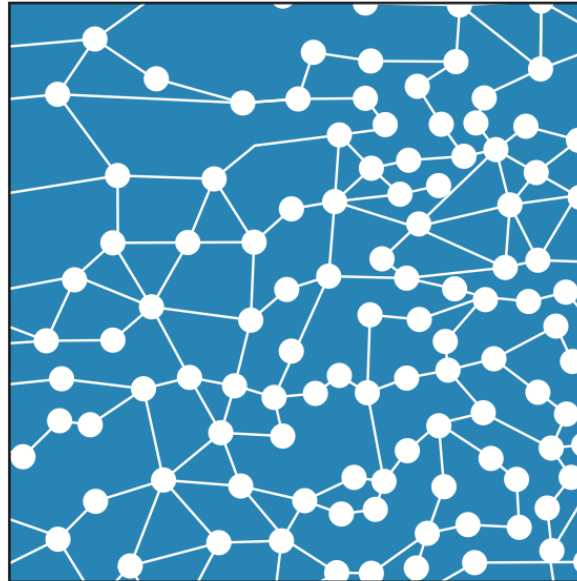
By 2040, shares of VRE above 50% (and even reaching 80%) will become the norm. This will dramatically transform the way our power systems function. Japan is on track to become a leader in this regard.

The future is ~~centralized~~ ~~distributed~~ integrated

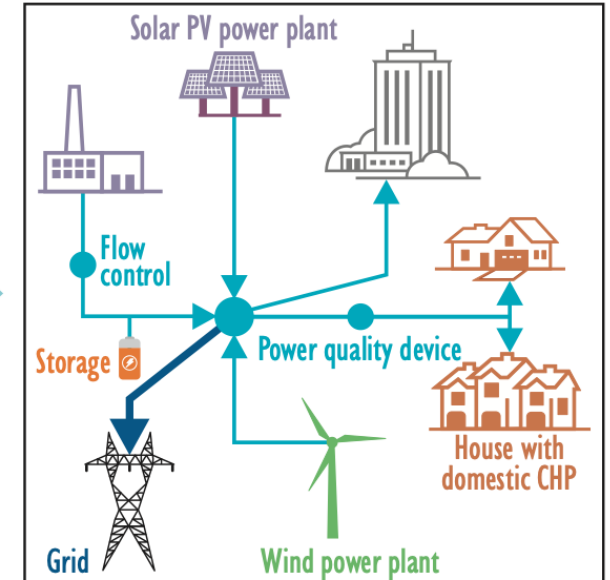
Continental markets



Locational markets



Local, distributed market

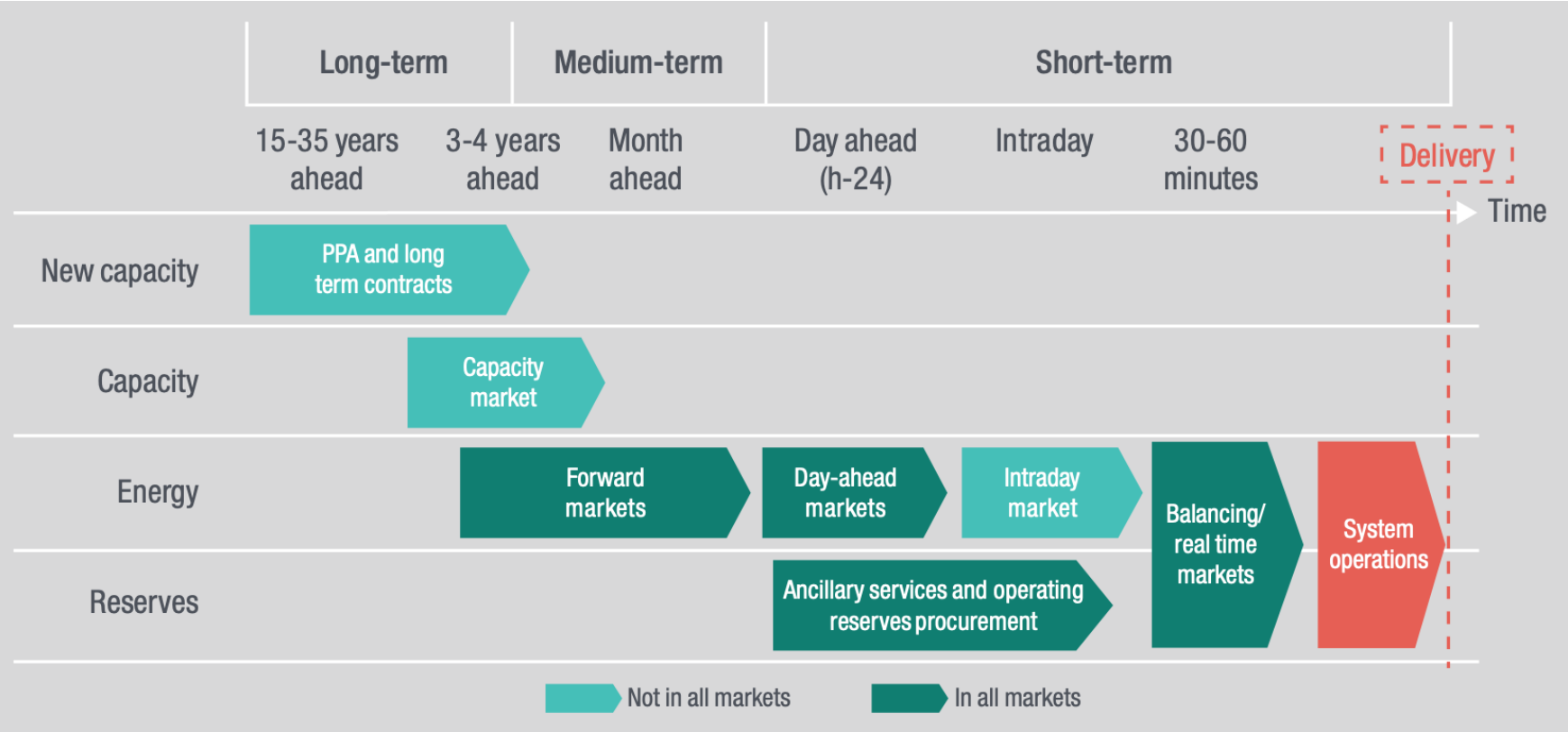


This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Source: IEA, Repowering Markets

The debate over the future of the power system has often been divided into two camps: large-scale centralized vs small-scale distributed. In fact, we need a mix of both, and some way to coordinate it all.

How to coordinate? Markets



Source: IEA, Repowering Markets

There is no single “power market.” Instead different markets that serve different, inter-related, purposes. Long-term markets support investments in capacity, short-term markets ensure supply meets demand in real-time.

Markets and decarbonisation

Markets can support decarbonisation in two main ways:

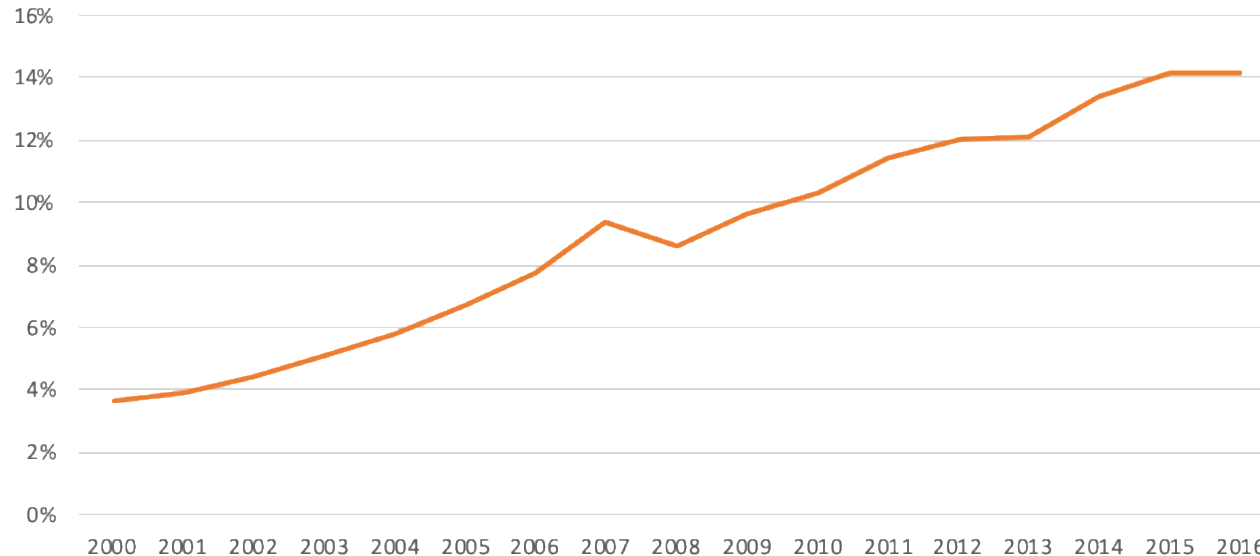
- 1) Incentivise new investment at least cost
 - Auctions (PPA and long-term contracts)

- 2) Enable the optimal use of a low-carbon generation mix
 - Wholesale markets (day-ahead and real-time balancing)

Feed-in-tariffs: a victim of their own success

- Historically, direct subsidies like feed-in-tariffs had been the most popular way of supporting VRE deployment
 - FiTs have been successful, but expensive

Share of wind and solar PV in Germany's power system



Source: IEA

**Between 2000 and 2015,
Germany deployed 97 GW
of solar PV and wind (on-
and offshore) at a cost of
EUR 125 billion**

Source: Ander, Frondel and Vance, 2017

Auctions: using market forces to lower costs

- Auctions have proven successful at reducing the cost of investment, and even eliminating the need for subsidies all together
- Germany has held two auctions for offshore wind to determine the amount of subsidy (premium above wholesale price) they would receive. Both resulted in some zero-subsidy bids:

	Capacity (MW)	Average price	High price	Low price
2017	1,490	0.44 ct/kWh	6.00 ct/kWh	0.00 ct/kWh
2018	1,610	4.66 ct/kWh	9.83 ct/kWh	0.00 ct/kWh

Source: BNetzA

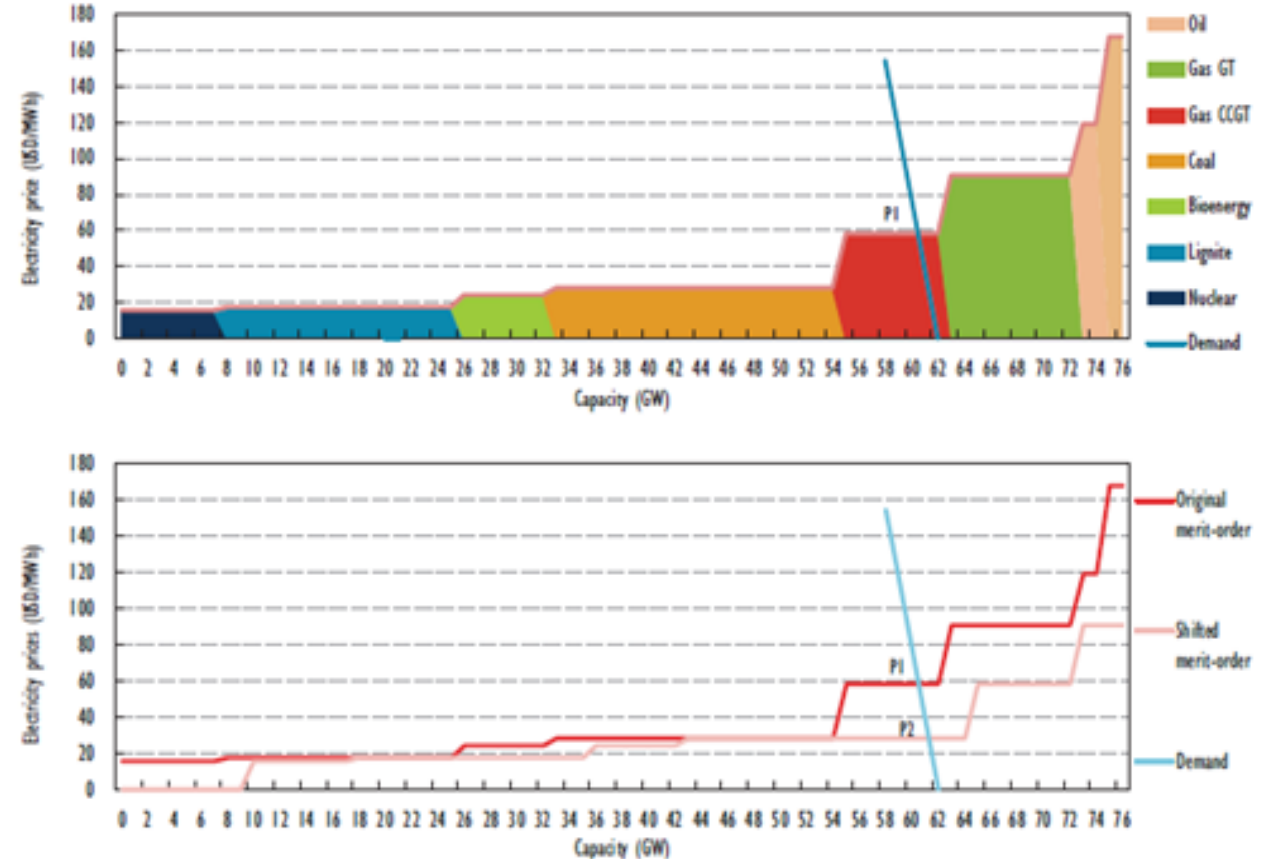
- FiT's use market forces to maximize deployment; auctions use market forces to minimize costs

Wholesale markets: why introduce them?

- Wholesale markets improve operational efficiency
 - Competition among generators creates incentives to reduce costs and improve plant operations
- Regulated utilities have little incentive to invest in lower-cost or innovative technologies
 - Utilities earn higher returns when they invest in more expensive assets
 - If innovative technologies fail, utilities must bear the costs.
- Regulated markets focus less on the demand-side
 - Revenues come from delivering electricity, therefore energy efficiency and distributed generation undermine revenues
- Wholesale markets are open to a wider range of participants

Wholesale markets and VRE: price disruption

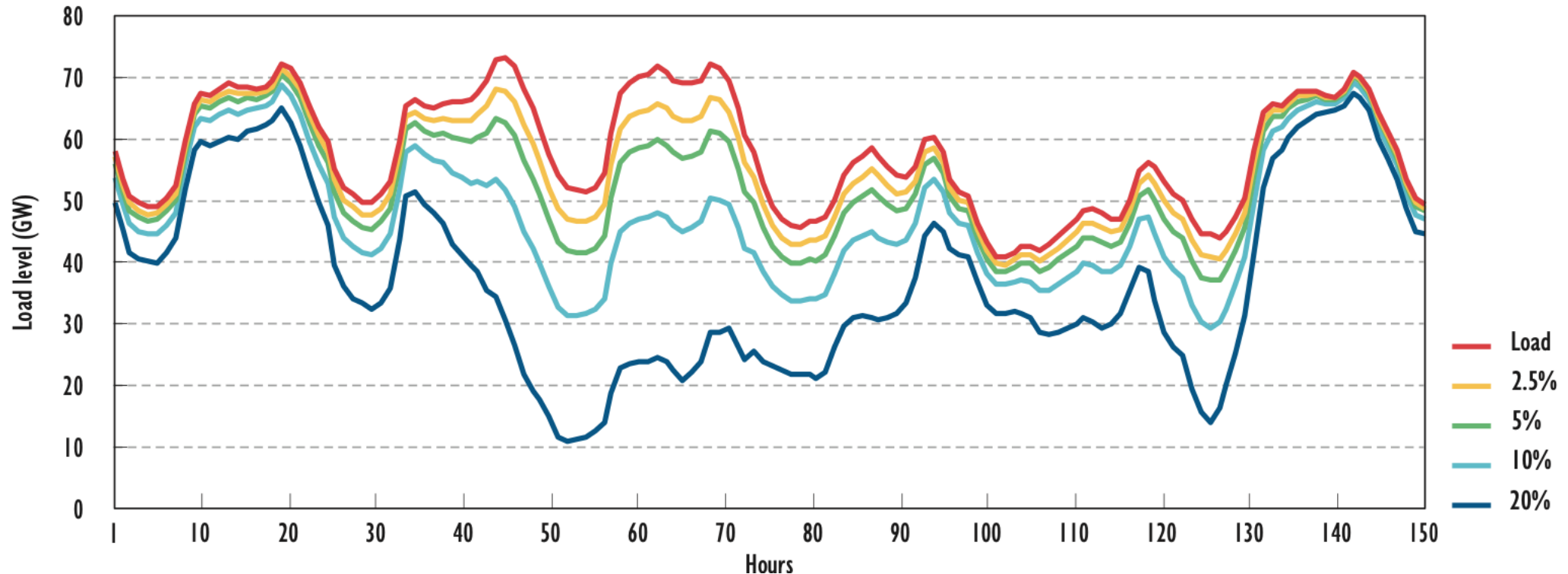
- At even low shares, VRE can impact wholesale prices
 - VREs have low- or zero-marginal cost, and so are the first to be dispatched when available
 - This displaces higher cost generation – the so called “merit order effect”
- This can lead to earlier than expected exits of high cost (often carbon intensive) generation



Notes: CCGT = combined-cycle gas turbine; GT = gas turbine; GW = gigawatt; P1 = price without additional generation; P2 with additional generation.

Wholesale markets and VRE: flexibility

Evolution of net load for different shares of variable renewables



Source: IEA, Repowering Markets

At higher penetrations of VRE, system needs change quickly. Markets can provide flexibility by incentivizing the correct behavior across a wide and diverse range of stakeholders.

What about reliability?

- VREs dramatically change the way power systems operate.
 - But, countries like Denmark and Ireland have shown that it is possible to integrate high shares of VRE without impacting security.
- How?
 - Leverage all flexibility measures. Markets help by providing signals to flexible resources; this includes balancing and ancillary services markets.
 - Regional integration. Larger power systems can balance more renewables.
- Benefits of distribution: resilience to unexpected events.
 - But full benefits come when local resources are integrated into the larger grid.

Renewables and capacity markets

- Many regions that have introduced wholesale markets have also introduced capacity markets
 - Power systems have “reserve margin” targets defined as **X% above peak load**
 - E.g. PJM (United States) has a target of 15% above peak load
 - Capacity markets seek to ensure that capacity never falls below the reserve margin requirement
 - “Energy-only” markets like Texas (ERCOT) cost consumers less. But, must be willing to tolerate periods with low reserve margins (currently **10.5%** compared to 13.75% target).
- Challenges to capacity markets:
 - Tend to over-procure. PJM reserve margin is **27.5%** and expected to rise.
 - Renewable subsidies rapidly transform capacity mix; may displace generation without replacing them 1-to-1 from a reserve margin perspective.

Some final thoughts on power markets

- Markets mean giving up control – moving decisions from one central entity to dozens, hundreds, or thousands of participants.
 - Can't predict how things will evolve!
 - Need to be willing to accept the possibility that markets will lead to unexpected results.
 - As such, it is important not to over promise (cost savings, etc).
- But policy matters, too
 - Policy shapes market outcomes and investment decisions.
 - Clear and enforceable/believable targets (RE deployment, CO₂ reductions) and tools (RE auctions, CO₂ pricing) can push market outcomes in a particular direction.

Thank you

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