



International Context for RE Integration in Karnataka

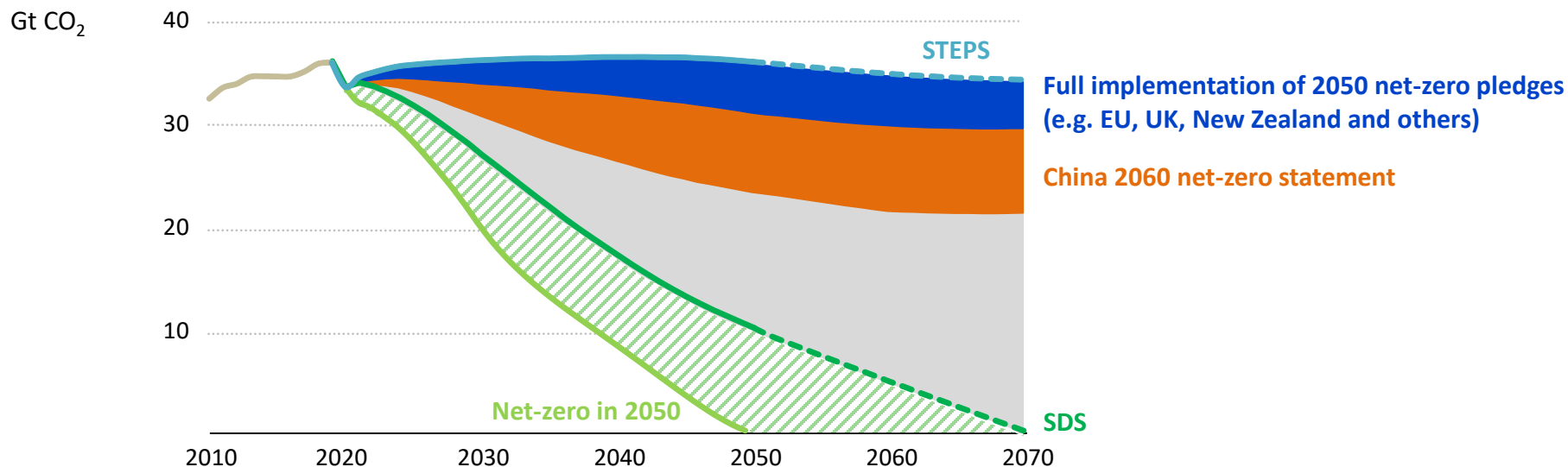
Szilvia Doczi – Renewables Integration and Secure Electricity

19 January 2021

Agenda

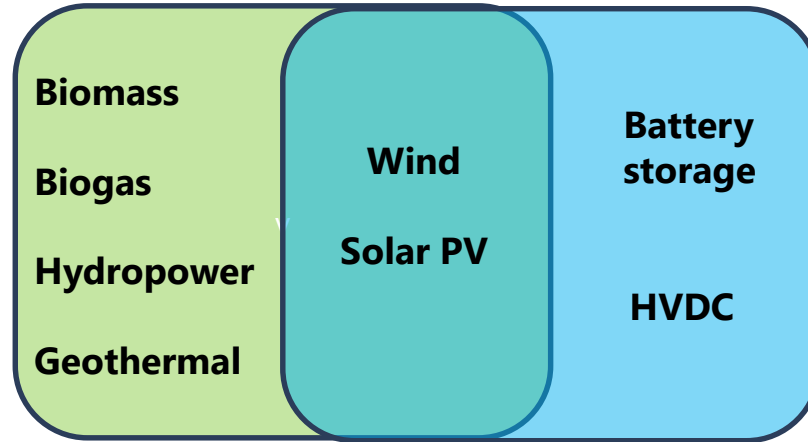
1. A Highlight from the World Energy Outlook 2020
2. IEA Framework of Renewables Integration with country examples
3. RE Integration in India – Karnataka Phase assessment
4. International solutions for system integration challenges
5. Further readings - relevant IEA publications

The world is still far from putting emissions into decline



Global emissions are set to bounce back more slowly than after the financial crisis of 2008-2009, but the world is still a long way from a sustainable recovery

Why do we use VRE (variable RE) and not RE?



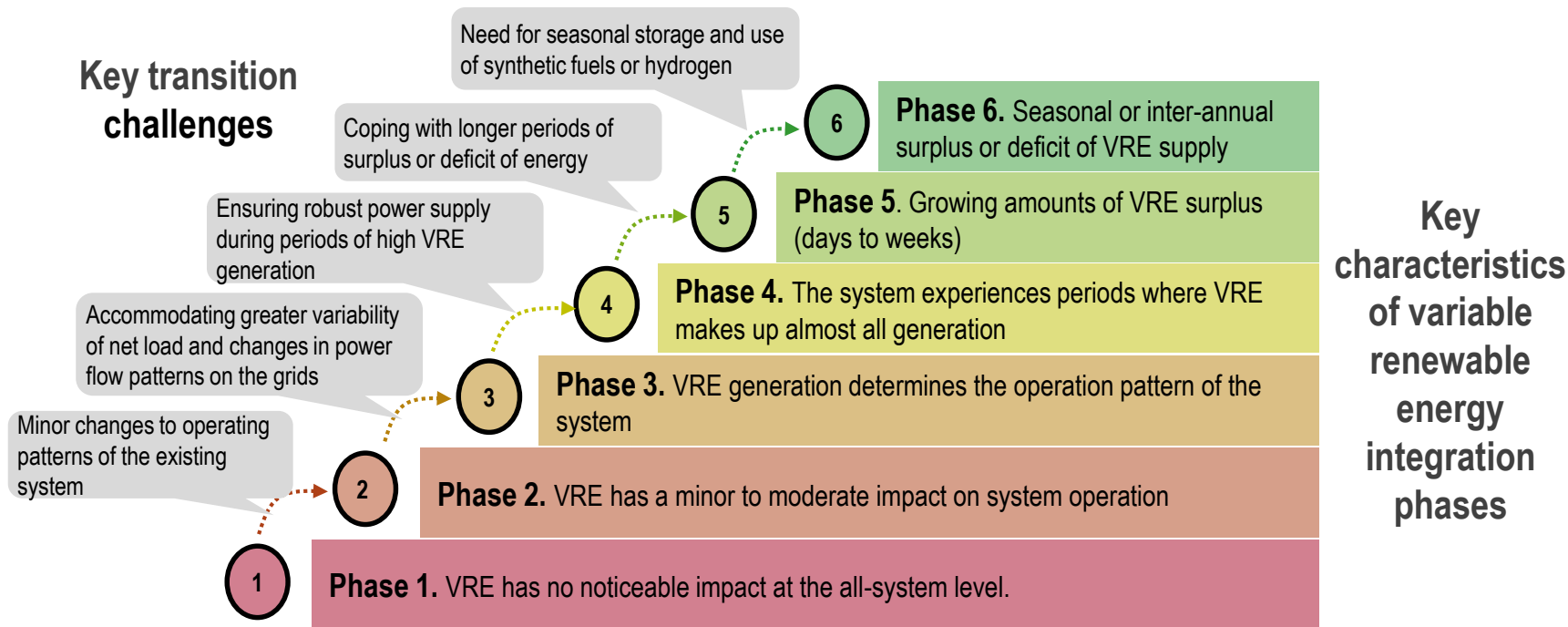
Renewables



Inverter-based resources

IEA RE integration work focusses on VRE and how the share of VRE increases in the power systems. High shares of VRE present system integration challenges. While hydro contributes to system flexibility.

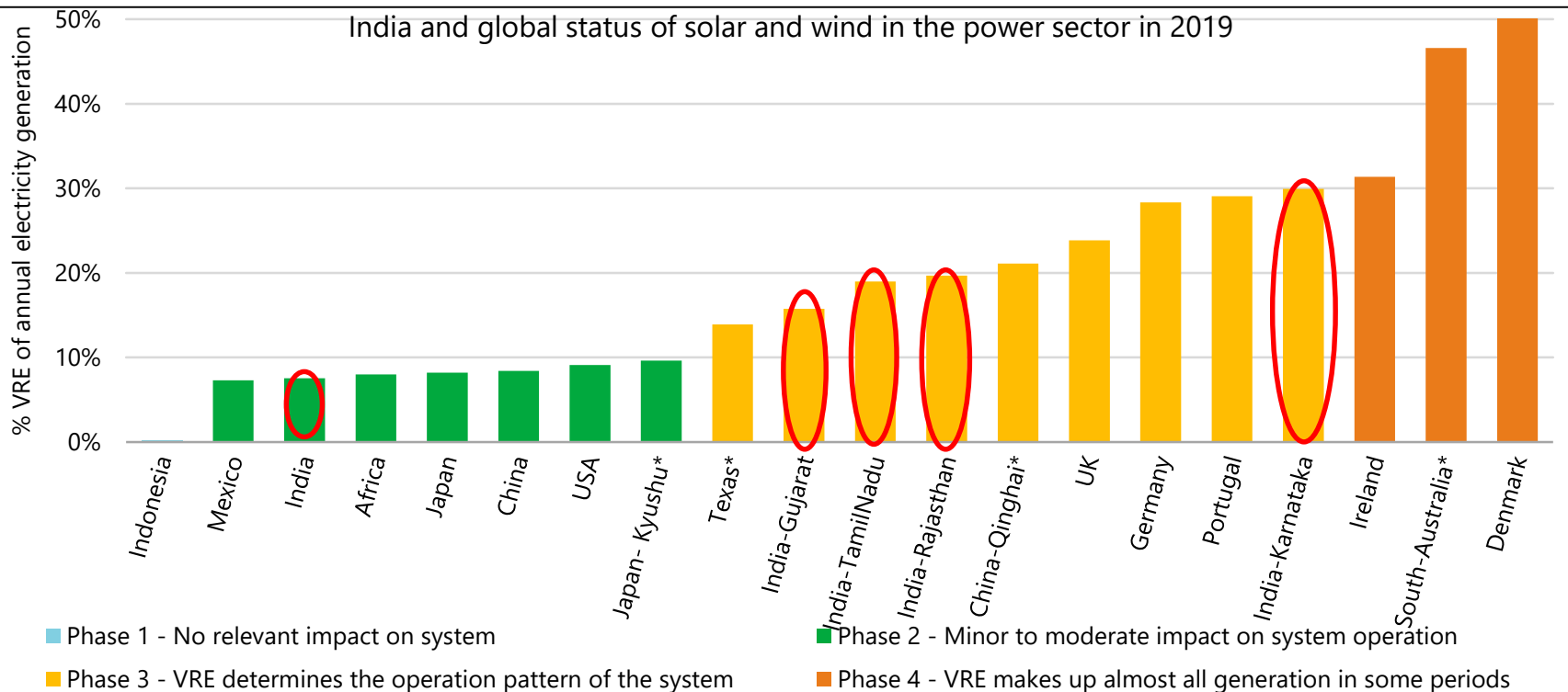
Six phases of VRE Integration help international knowledge exchange



Key challenges in each phase that should be addressed for moving up to higher phases of variable renewable energy (wind and solar) integration

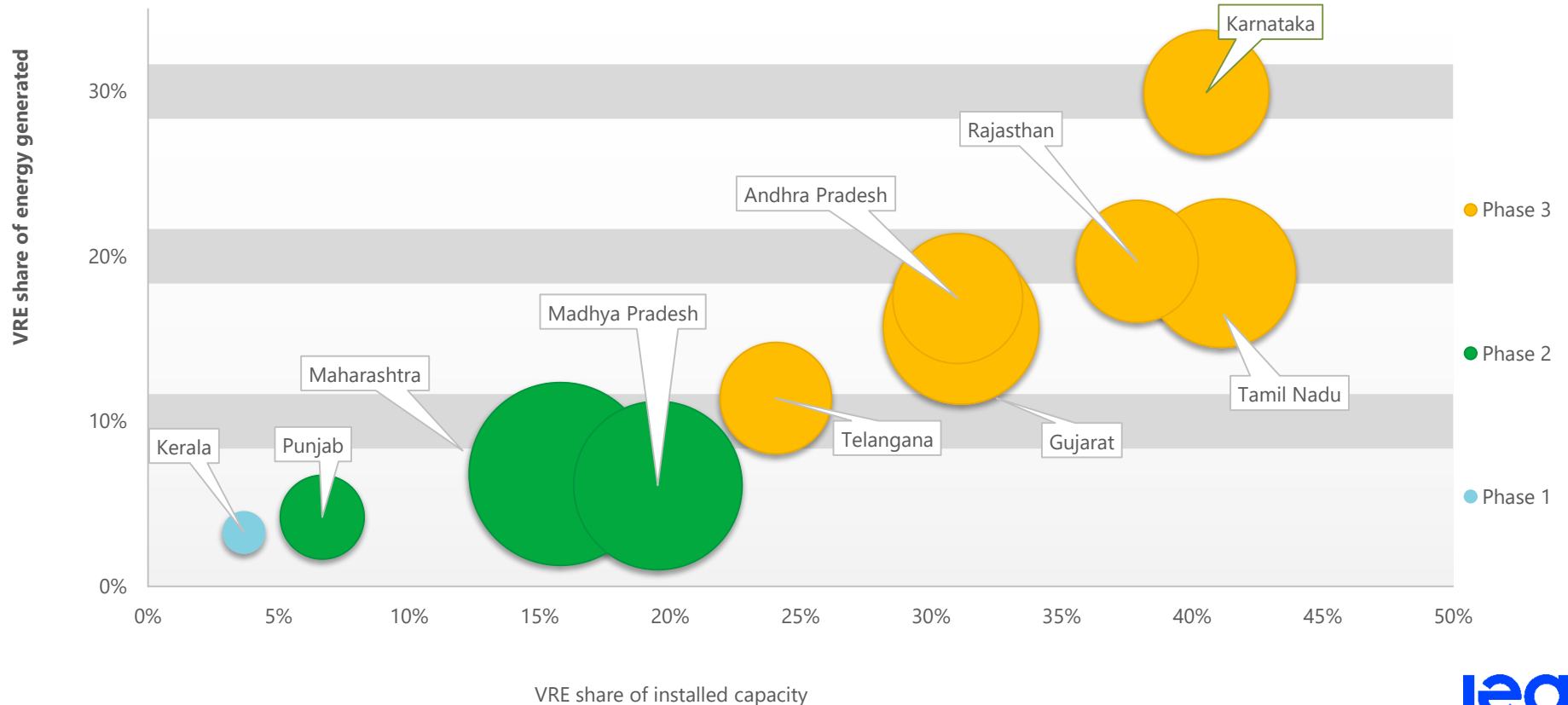
How do countries compare internationally?

India and global status of solar and wind in the power sector in 2019



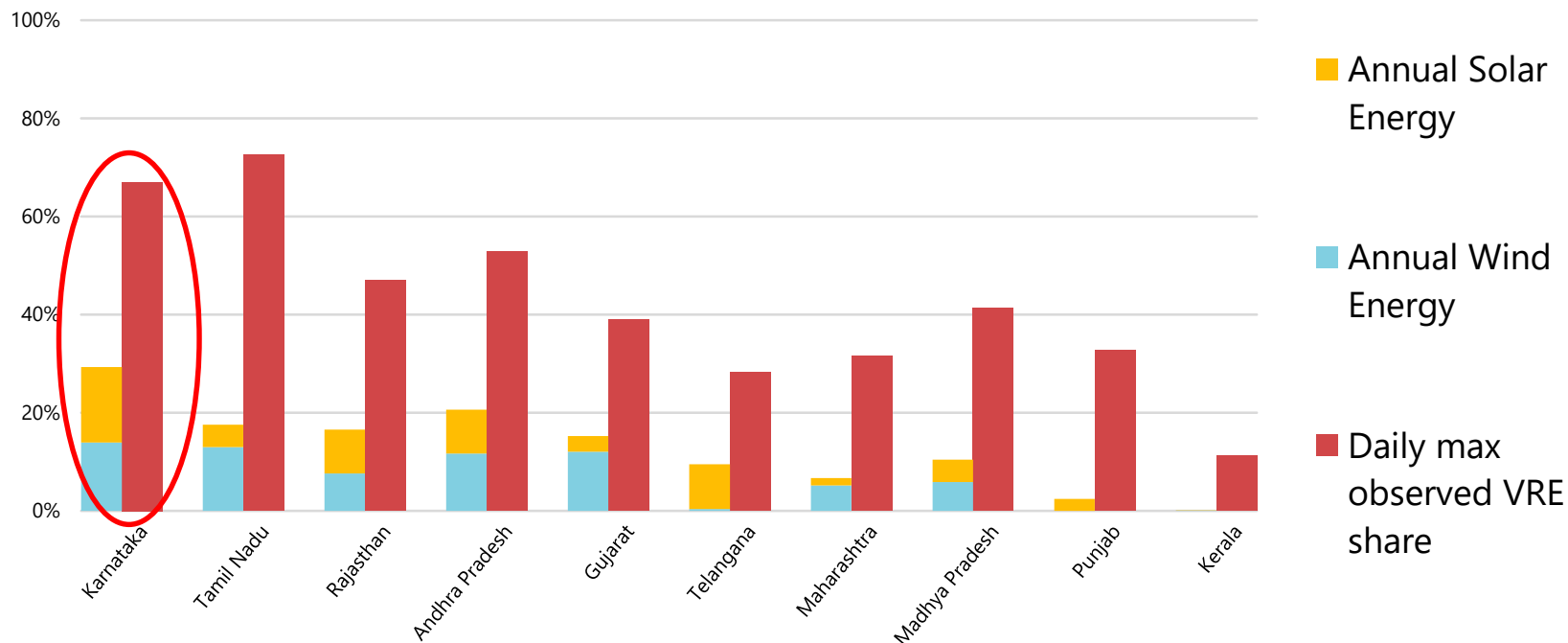
Globally most regions remain in phases 1 or 2. India's rapid energy transition already places some states in phases 2 or 3, while global examples in phases 3 and 4 already apply RE integration solutions to meet their challenges.

The India RE target of 450 GW will largely be achieved by 10 states



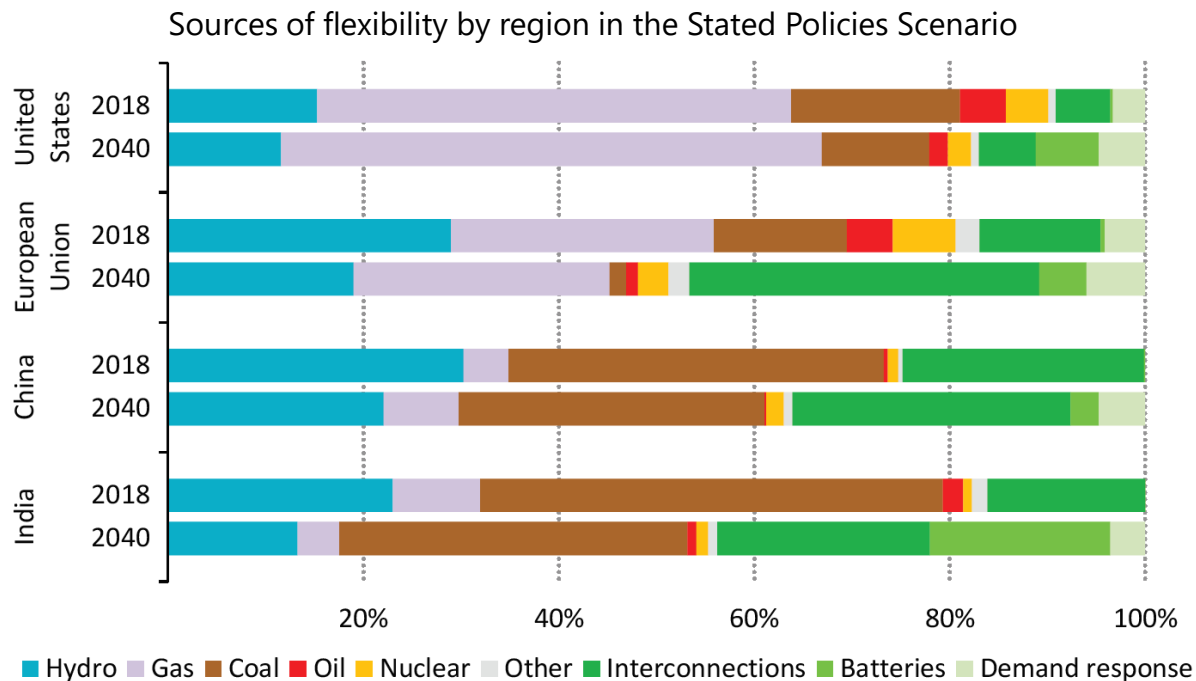
Solar and wind already reached challenging daily levels

Electricity generation from VRE as a percentage of all generation in VRE-rich Indian states, 2019/20



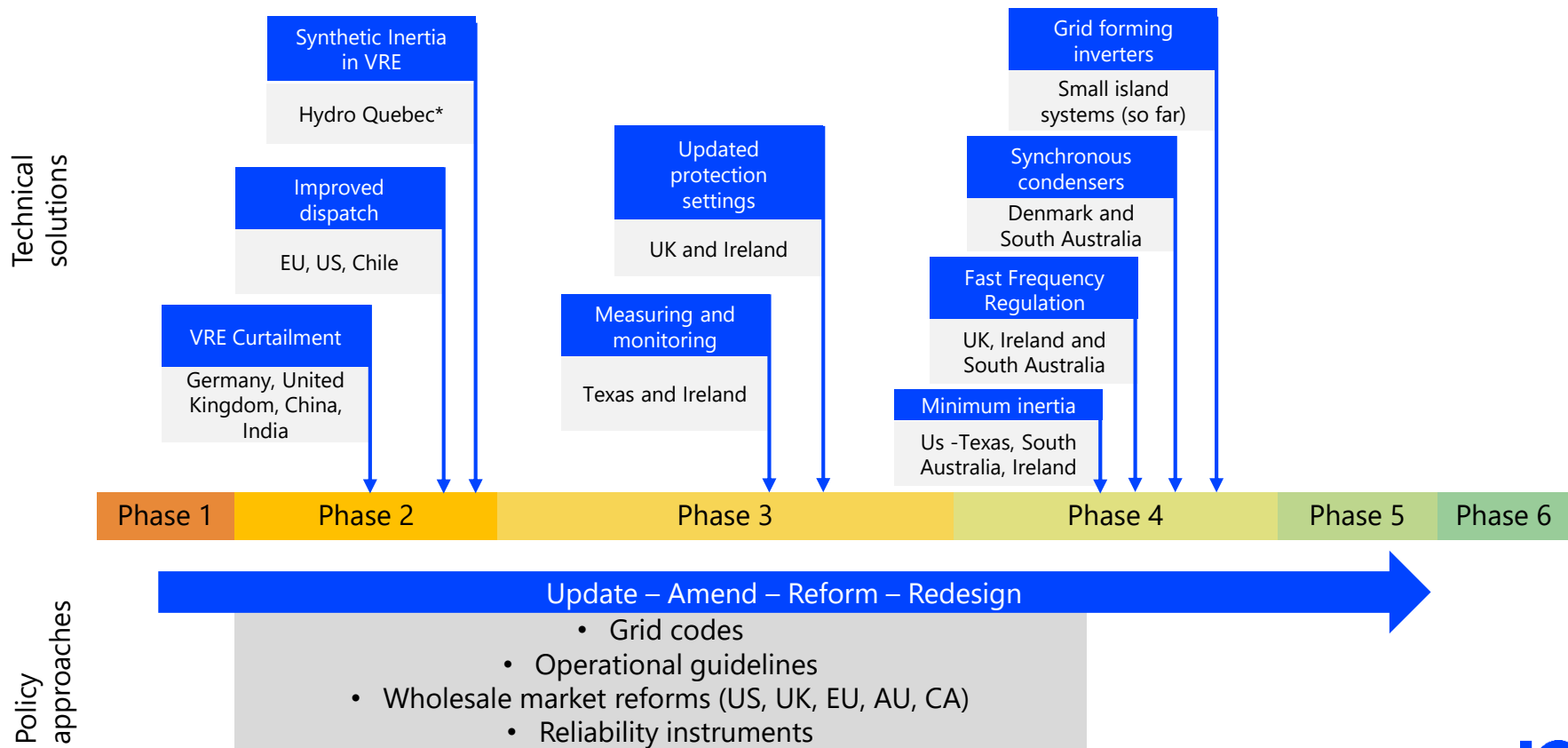
As the Karnataka Power system experiences periods when VRE makes up almost all generation, the state is set to enter Phase 4 in the near future.

Flexibility needs to improve globally, in India and in Karnataka



Karnataka already benefits from flexible agricultural demand and hydro resources. Going forward more flexibility of solar and wind, existing coal and new storage capacity will be increasingly important.

VRE integration solutions are already applied internationally

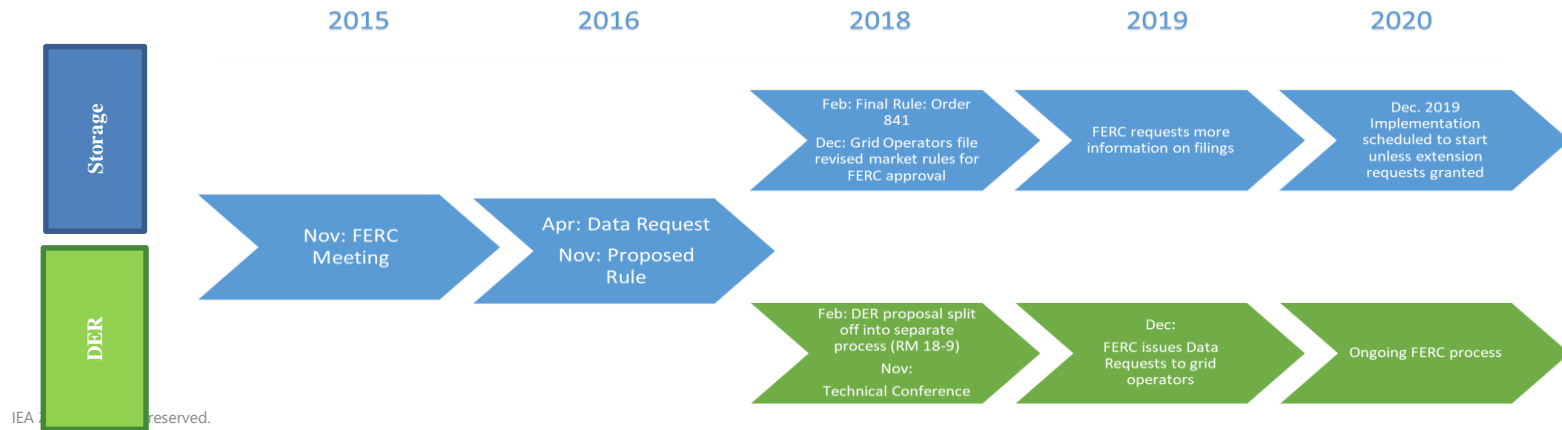


There are Barriers for New Storage Technologies in most countries

- Today in most countries still significant barriers exist for new storage technologies: **pumped hydro, batteries, EVs, flywheels, compressed air storage, hydrogen etc to access** multiple revenue streams including **energy, capacity and ancillary services** revenues.
- These barriers include:
 - Minimum size requirements tailored to conventional generation resources and not to small new technologies
 - Duration requirements: such as 10-hours can rule out battery storage (PJM)
 - Tension between jurisdictions of regulators (federal vs state) - inconsistency if connected to transmission or distribution level or behind the meter
 - Storage must register as both generation and demand side resource

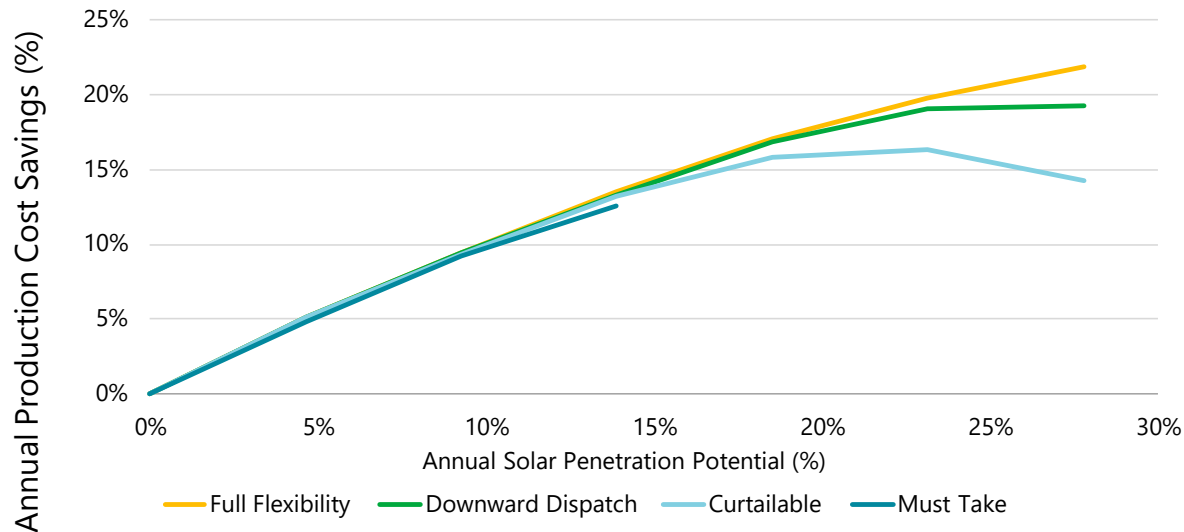
US regulation opens all markets for all storage technologies

- **All wholesale markets:** energy, capacity and ancillary services markets in 1 process
- **All storage technologies:** pumped hydro, battery, flywheel and compressed air...
- **All power sector levels:** transmission, distribution and behind the meter
- Removing barriers to entry is the first step and it is a lengthy process, ongoing for more than 5 years



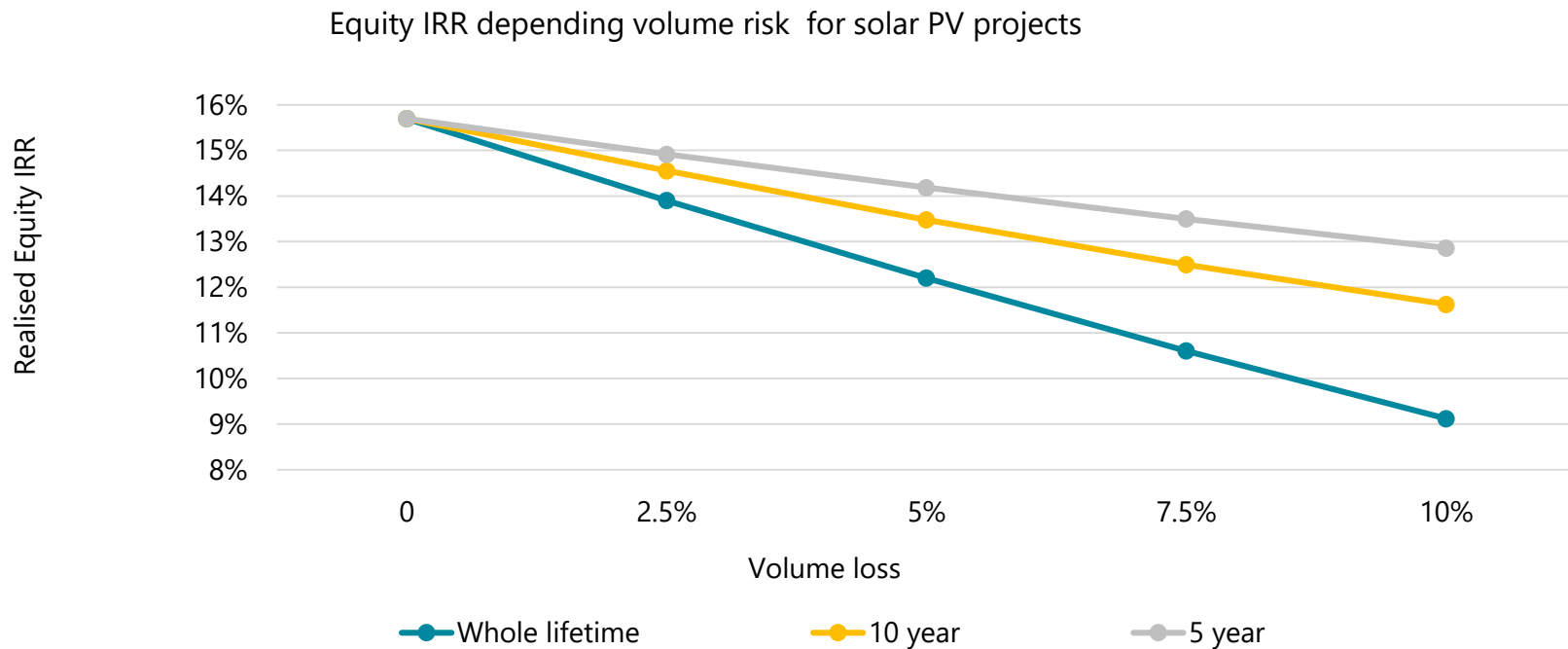
UK, US, Ireland & Australia benefit from flexibility of solar and wind

Example: Tampa Electric Company (USA) study on system integration of PV



A move from must-run mode to dispatchable solar and wind can minimise curtailment. Redefining grid codes, ancillary services and remuneration are needed to tap into this flexibility potential.

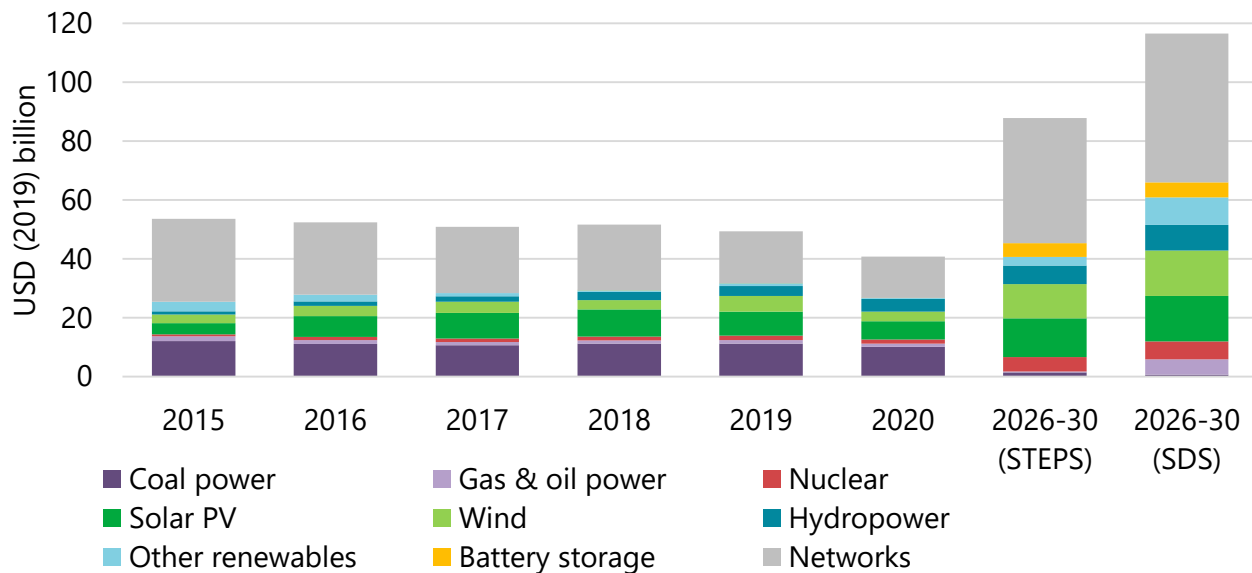
Volume risk (curtailment) is a key downside risks for investors in India



Small negative variations can create considerable deviations between *realised* and *expected* returns—according to a sensitivity analysis exercise included in the IEA India Investment Trends report.

Power investment in India was strongly hit in 2020

Investment trends vs investment needs in IEA Stated Policies and Sustainable Development Scenarios



Note: Investment is measured as the ongoing capital spending in power capacity.

Source: World Energy Outlook 2020.

Power investments slumped by 17% in 2020 as a result of Covid-19, with impacts across sectors. Spending needs would need to double under the stated policies & triple to meet sustainability goals.

More RE Integration related IEA content for further reading

Power Systems in Transition 2020 - Electricity Security

<https://www.iea.org/reports/power-systems-in-transition>

India Clean Energy Investment Trends 2020

<https://webstore.iea.org/clean-energy-investment-trends-2020>

India Energy Policy Review 2020

<https://www.iea.org/reports/india-2020>

Gujarat Power System Transformation Workshop

<https://www.iea.org/events/power-system-transformation-workshop-2-state-of-gujarat>

Upcoming publications:

January 2021: India Energy Outlook

First half of 2021: India Power System Transformation

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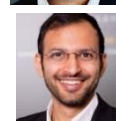
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