

Addressing the key challenges for enhancing RE Integration

June 2022



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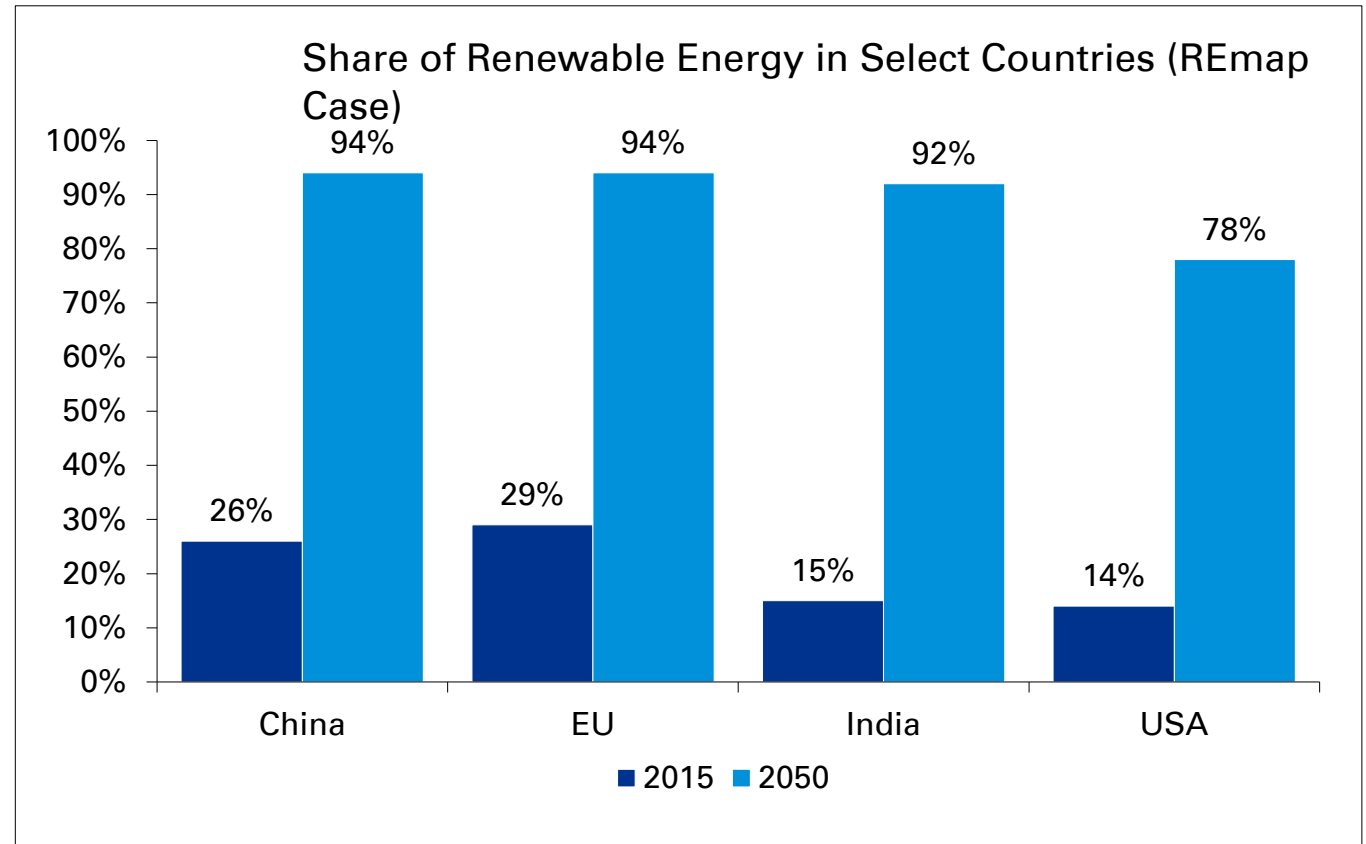
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Renewable energy to form ~95% of the power mix in select countries by 2050

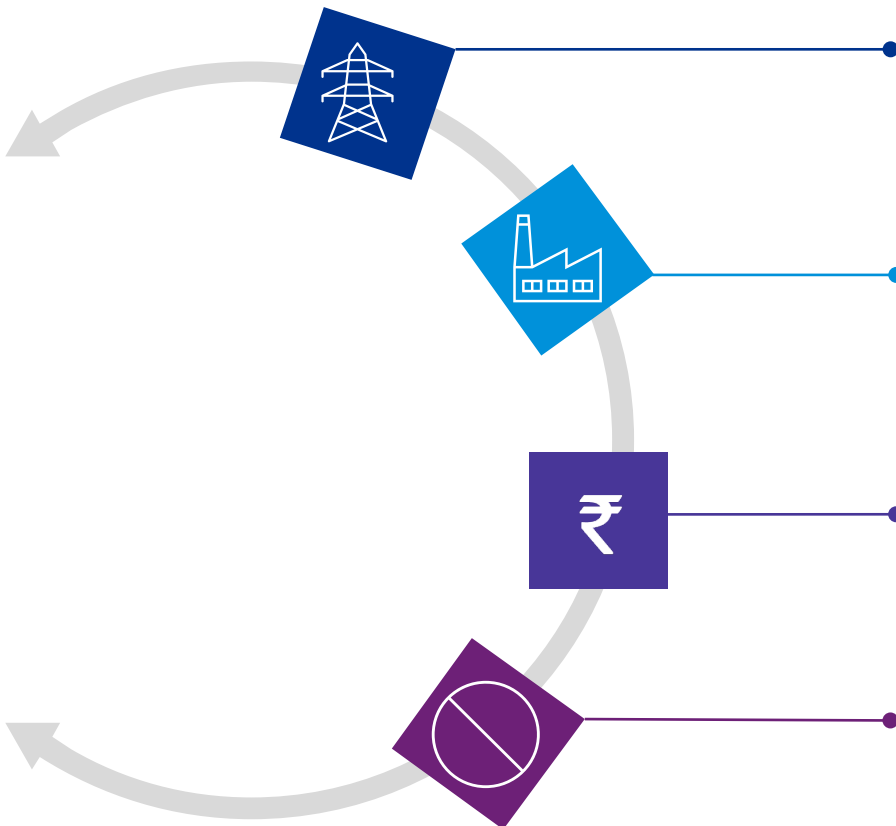


1. Globally RE capacity **has more than doubled over the last decade to 2,799 GW in 2020 up from 1,330 GW in 2011.** Growth led by solar and wind.
2. RE investments contributed to more than **20% of total energy investments in 2020.**
3. Globally, countries are driven by the need to **increase share of RE in the overall energy mix** while ensuring reliable, safe supply of power
4. **Decreasing costs and climate goals** are expected to lead to increasing adoption of clean energy sources



Source: IRENA: Global Energy Transformation

Increasing addition of intermittent energy sources such as Solar & Wind has technical and commercial consequences



Grid management constraints:

- Managing intermittency of RE sources –lack of historic data for accurate forecasting, lack of flexibility and standard operating procedures for existing coal fleet, lack of grid codes to ensure VRE plants support for system security

Decreasing utilization of existing assets:

- Energy from solar & wind are to be accompanied by backing down & ramping up existing power plants
- Reduced utilization of existing power plants and affects operating norms
- Sub-optimal utilization of transmission assets

Economic impact of market purchase:

- Intermittencies in generation is met through market purchase where significant price fluctuations are observed
- High cost of power purchase from open market during non-solar hours

Risk of curtailment:

- Surplus solar or wind generation will have to be curtailed in the absence of storage assets, resulting in inefficient utilization of these projects

Possible Framework for RE integration



Enhancing Power System Flexibility

- Flexible generation sources
- Battery Energy Storage Systems (BSES)/ bundling
- Pumped Hydro Storage (PHS)
- Green Hydrogen
- Smart Grids
- Demand response



Digital Solutions

- Accurate forecasting of VRE
- Optimum dispatch of generation sources
- Data analytics (Modelling and Analysis)



Deepening Power Markets

- Real time markets
- Wider balancing areas
- Strong interconnections
- Ancillary services
- RECs
- Capacity markets

Key Challenges:

- Upfront capital investment
- Limited power system flexibility
- Lack of regulatory and remuneration framework
- Absence of market signals for power system flexibility
- Lack of transmission capacity

Thank You

Anvesha Thakker

Partner & lead -Renewable energy

Energy Transition Co-Lead: Global Decarbonization Hub

KPMG India