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NREL Transforming ENERGY

DISTRIBUTION UTILITY MEET DUM 2023

Session : Growth of RE and EV; and the plan for enhancing grid flexibility

Major Trends in Unlocking DER and Demand-Side Flexibility

Presented By

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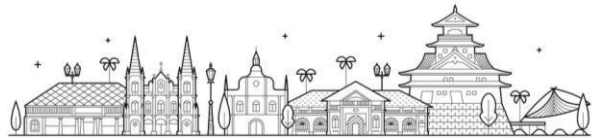
Distribution Utility Meet | 02 - 03 November 2023 | www.dumindia.in



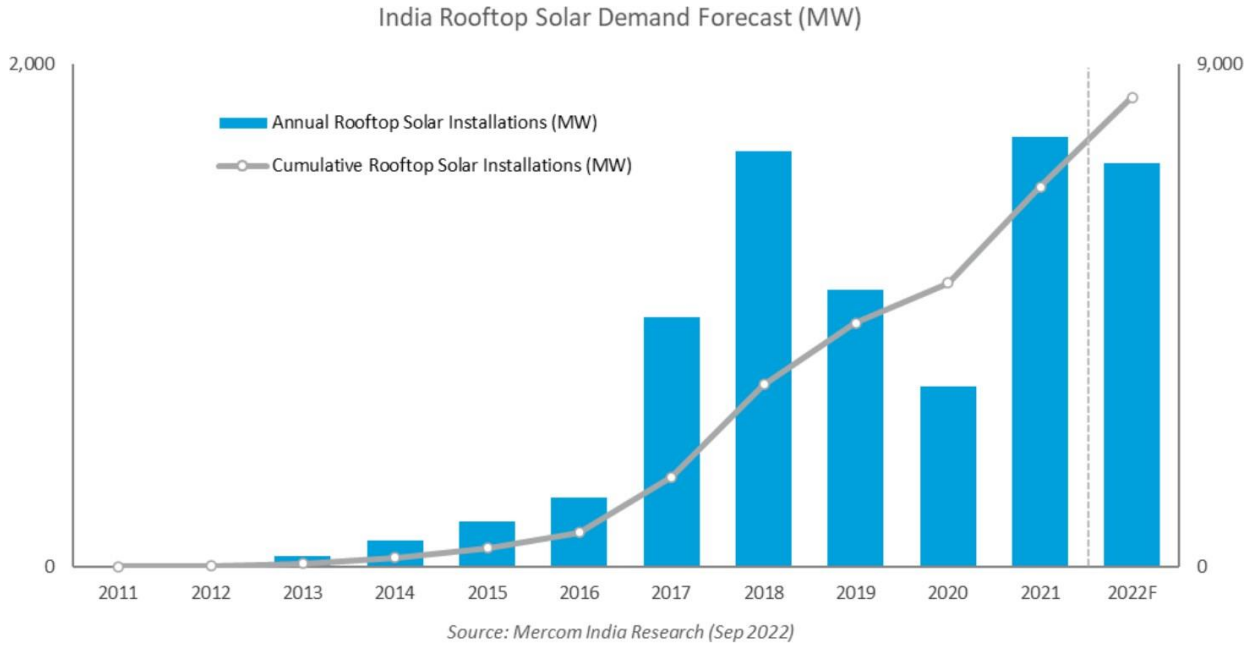


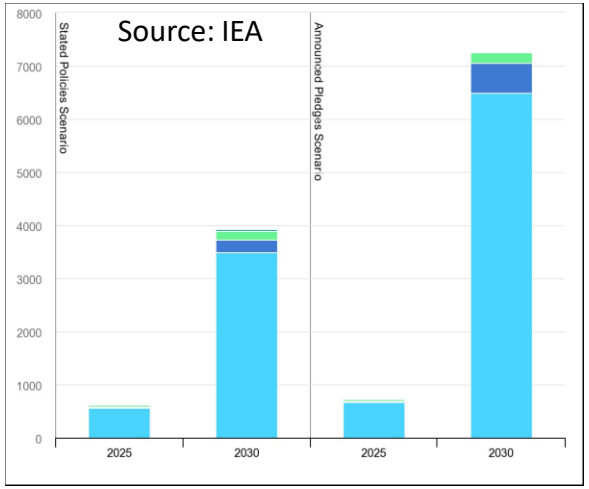
Solar and EV Growth

- India had installed close to **9 GW of rooftop** solar capacity by end of 2021, with targets for 40 GW of rooftop solar

- By March 2022 India had **>1M** EV's in India, with growth being led by 2W, 3W, and electric buses

- EV's and rooftop solar are expected to have significant growth rates. Flexibility is critical to the future power system





- IEA EV projections have two 2030 scenarios, with between 3.9M-7.25M depending on national incentives
- 2022 KMPG report estimated 45-50M EV's by 2030

Mechanisms to Unlock DER and EV Flexibility

Utility Motivation for Unlocking Flexibility

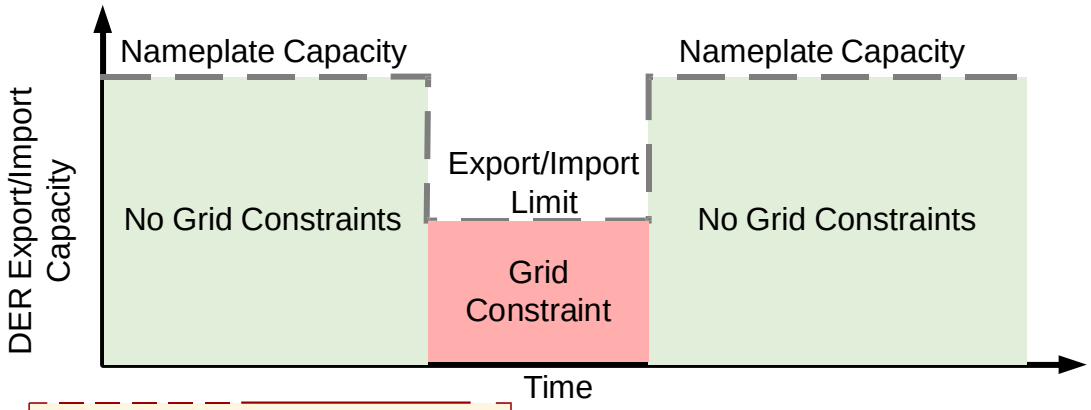
RE intermittency *Peak Load Shaving* *Grid Upgrade Deferrals*
Promoting Solar Self-Consumption *Energy Efficiency* *Ancillary Services*

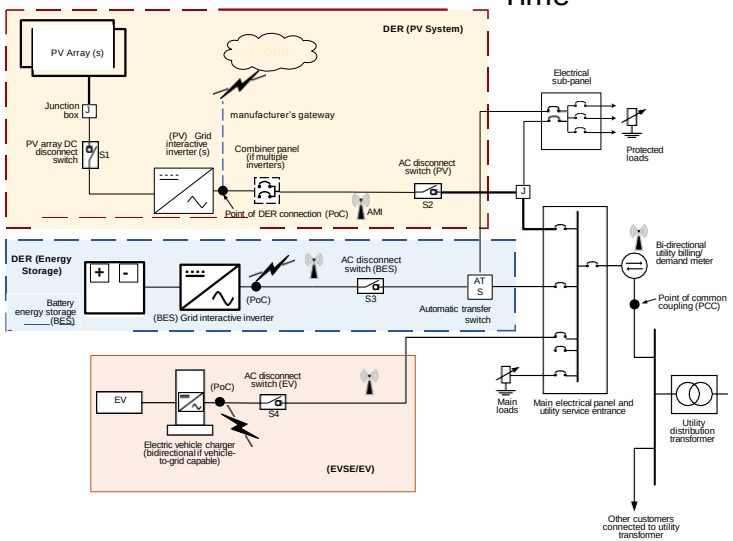
- How utilities can unlock flexibility:
  - **Interconnection** agreements/requirements
    - Interconnection standards
    - Flexible interconnection
  - **Customer Programs** and **Demand-Side Management**
    - Incentive driven customer programs
    - Smart tariffs
    - Aggregators/Virtual Power Plants (VPPs)/Distributed Energy Resource Management Systems (DERMS)

Utility Interconnection

- **Next-Generation Interconnection Process**
- *Hosting capacity maps:* For distributed generation and electrification.
- *Interconnection Screens:* Transition from conservative heuristics to comprehensive automated impact studies
- *Next generation interconnection:* Flexible interconnection and limited generation profiles

- **Flexible Interconnection**
- *Export/Import limited agreements (time-dependent)* as a *non-wire alternative / bridge-to-wires / DER/EV flexibility* solution





Increased complexity of interconnections with DER generation, storage, EVSE, metering and power control systems

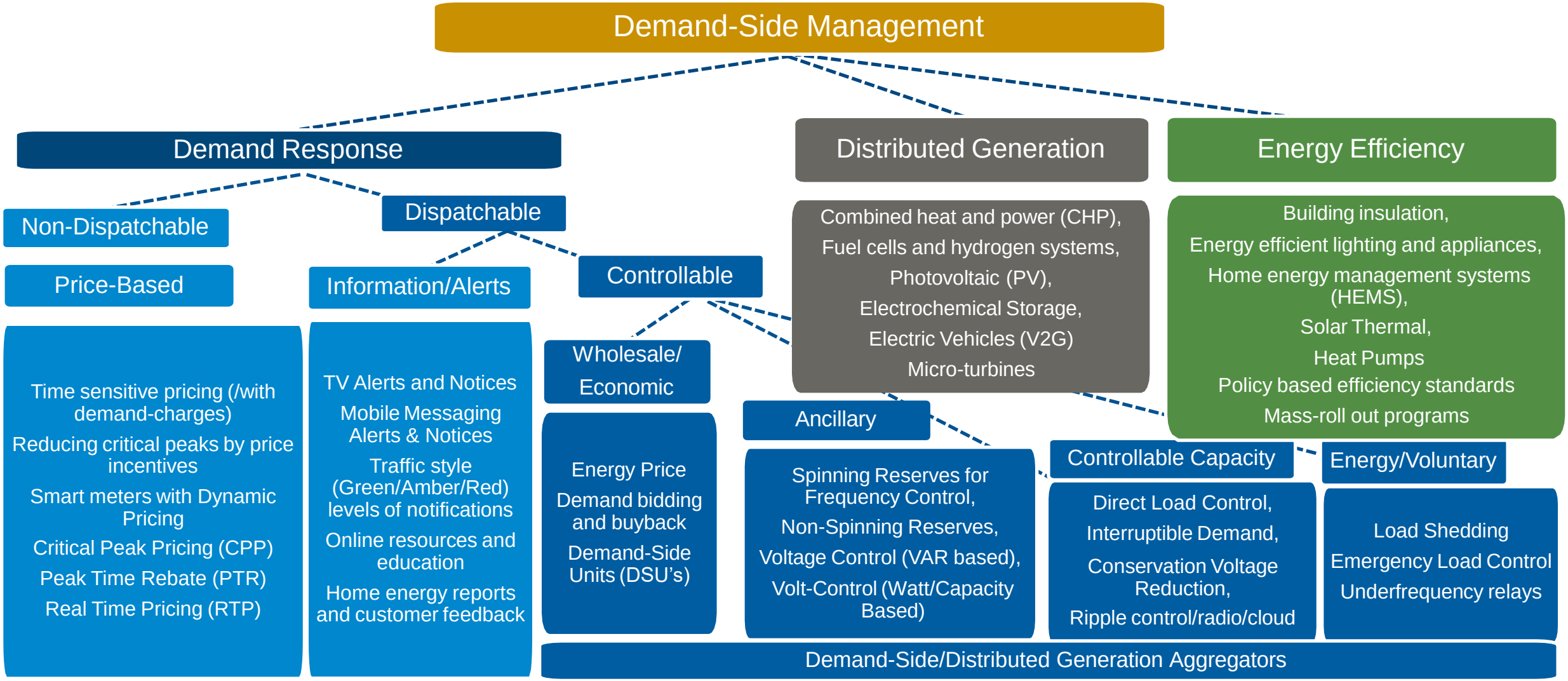
DER Connectivity Standards

- DER connectivity standards must make sure that these devices provide the necessary **grid support** to provide stability and power quality of both the **transmission** and **distribution system**
- As DER continue to displace bulk generation, the response of these devices is critical to the health of the overall power system
- As of 2021 there was over 9 GW of rooftop PV installed in India

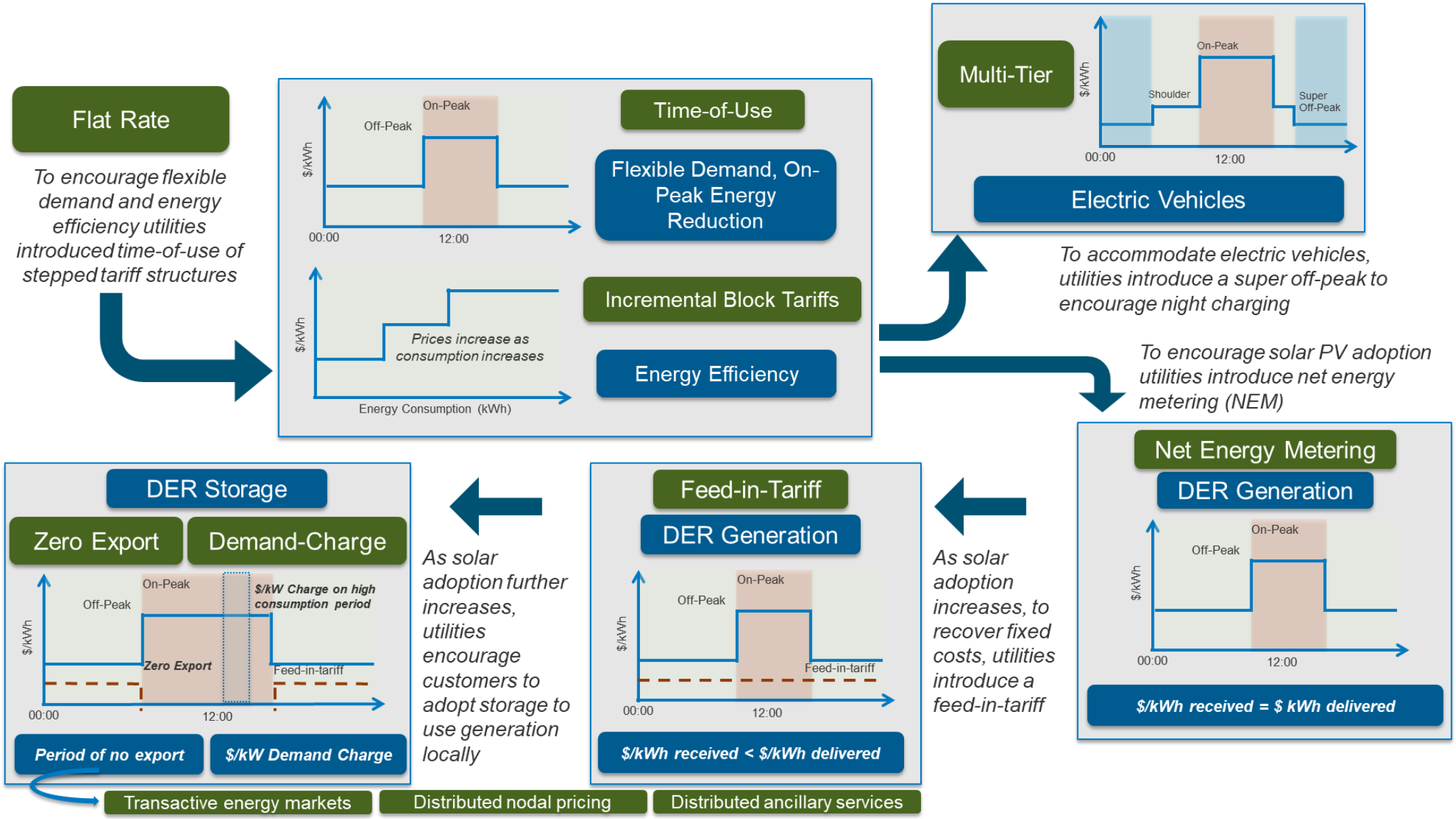
	Evolution of IEEE DER Standards	Evolution of CEA/MNRE Grid Codes
IEEE 1547-2003	• Shall NOT actively regulate voltage • Shall trip on abnormal voltage/frequency	• Shall trip on abnormal voltage/ frequency
IEEE 1547a-2014	• May actively regulate voltage • May ride-through abnormal voltage/frequency • May provide frequency response (frequency droop).	• Future Indian grid codes
IEEE 1547-2018	• Shall be capable of actively regulating voltage • Shall be capable of frequency response • Shall ride-through abnormal voltage/frequency • May provide intertial response	
Future Standards	• Potential greater inclusion of grid-forming capabilities • Potential greater consideration of inertial response • Potential inclusion of fault-current requirements	

NREL upcoming report: *Interconnection of Distributed Energy Resources in India: Consideration of IEEE 1547-2018 in a 50 Hz System and Grid Code Development*

Demand-Side Management – Breadth of Solutions

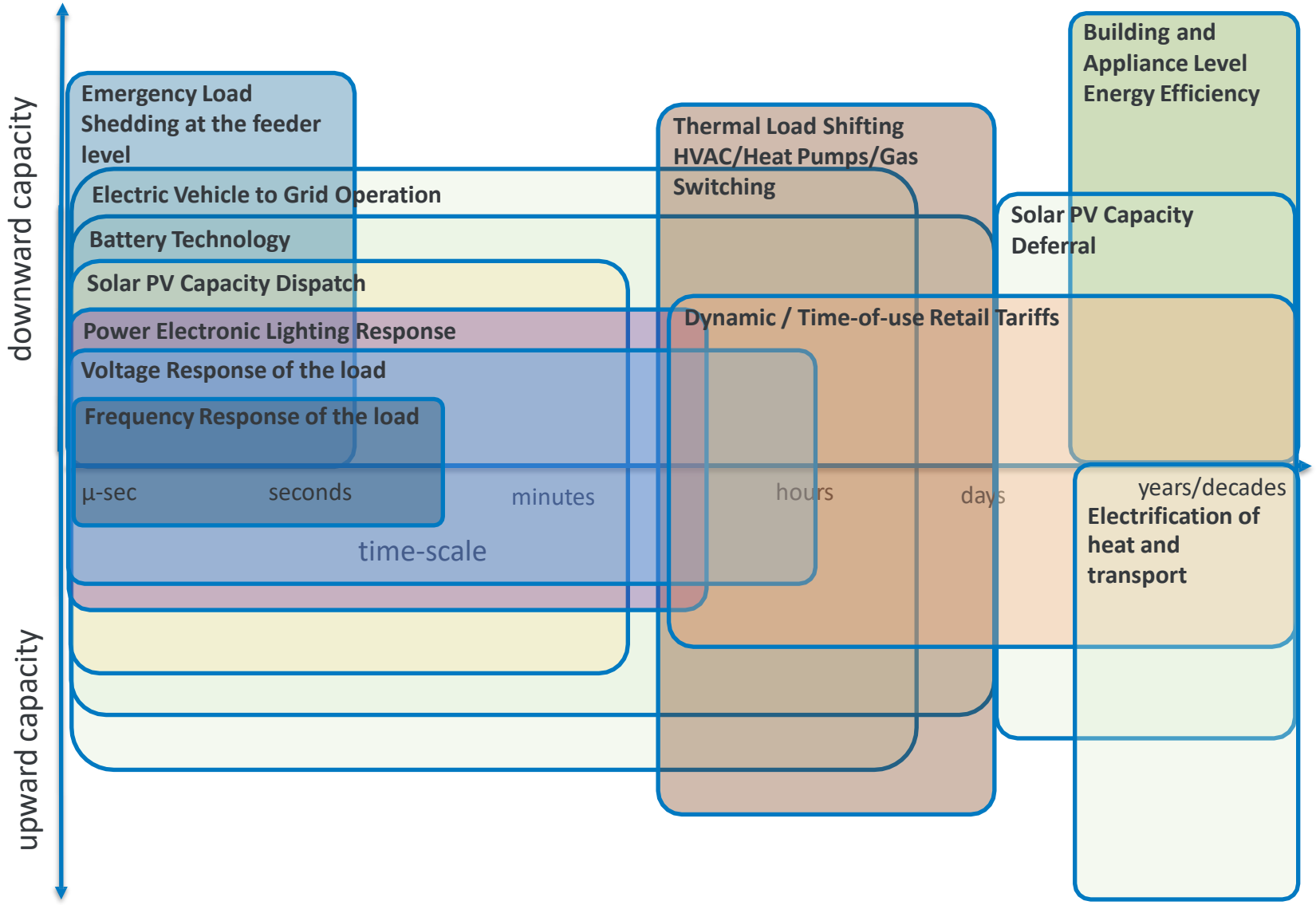


Evolution of Retail Tariffs



Potential of Load-Side Flexibility

- Loads can provide **upwards** or **downwards** capacity
- **Response** availability from **micro-seconds** to **years**
- **Low** to **high** levels of **capacity provision**
- Utilities need to customer programs, aggregators, and smart-tariffs are critical to unlocking demand-side flexibility

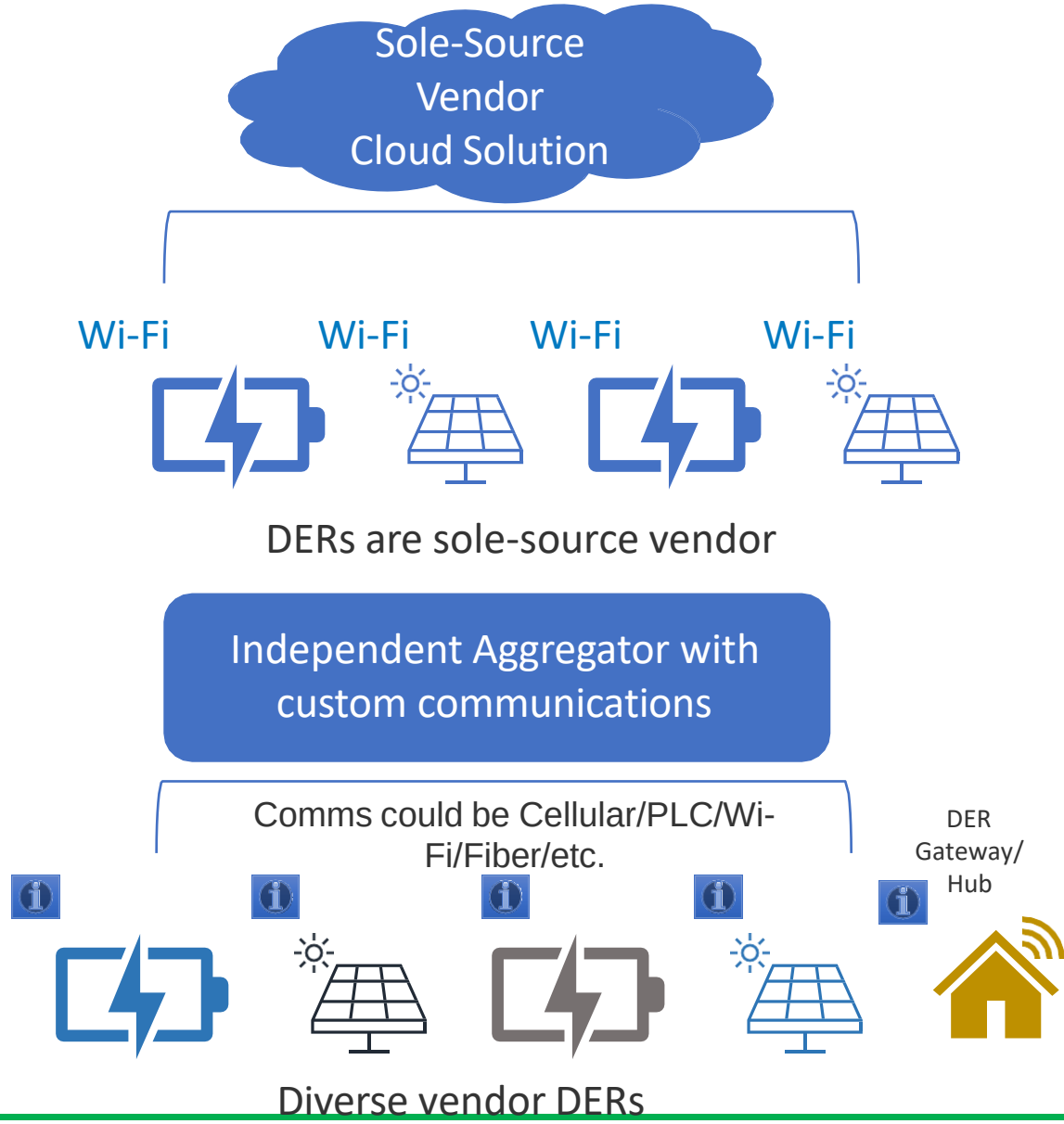


Aggregator Communication Structures

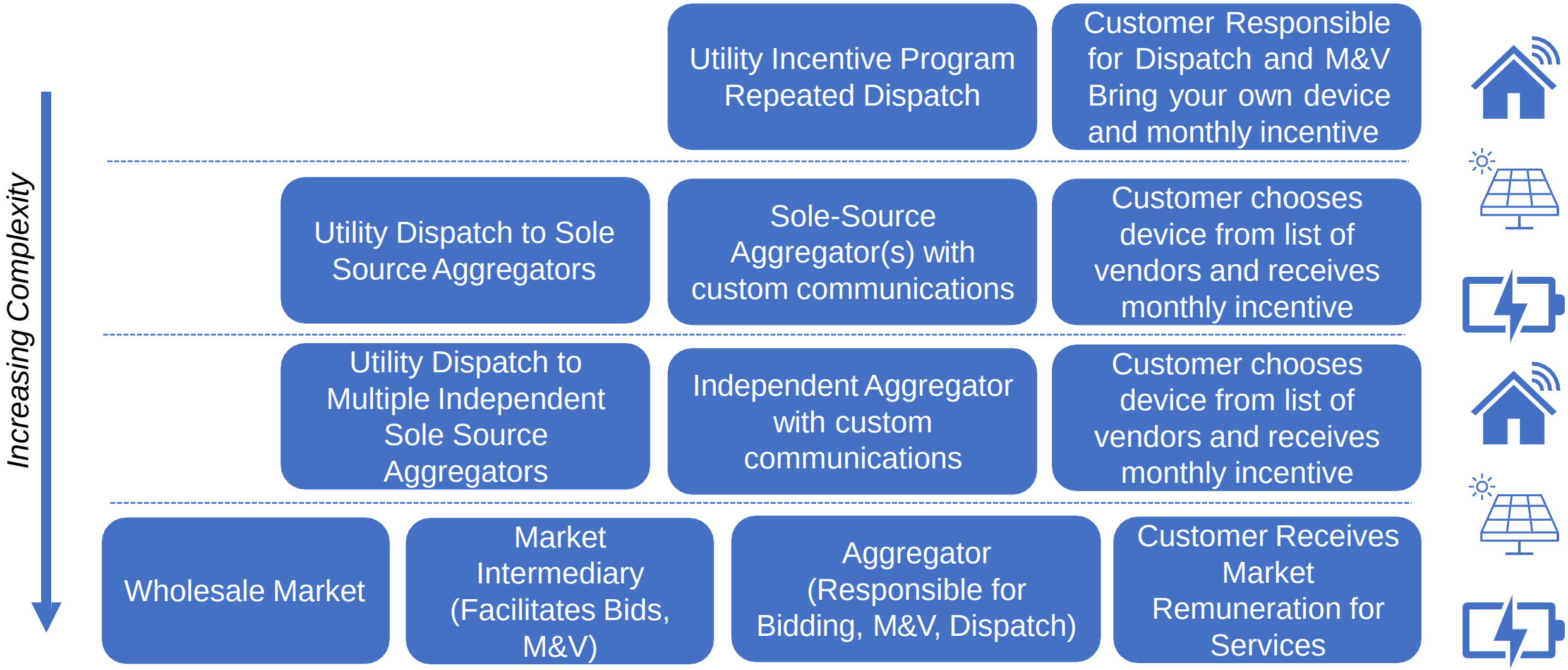
Sole source providers and vendor communication: Customer program for single vendor solution – rely on customer Wi-Fi.

Aggregators and DER gateways: Aggregator responsible for communications, likely through hub/gateway and works with DER vendors to establish communications.

Importance of interconnection standards/ protocols: In the utility connection process, it is critical to ensure DERs are compliant with future communication standards to enable DERMS (IEEE 2030.11) and IEEE 1547-2018 compliant protocols (DNP3, SEP 2.0, SunSpec Modbus, TCP/IP)

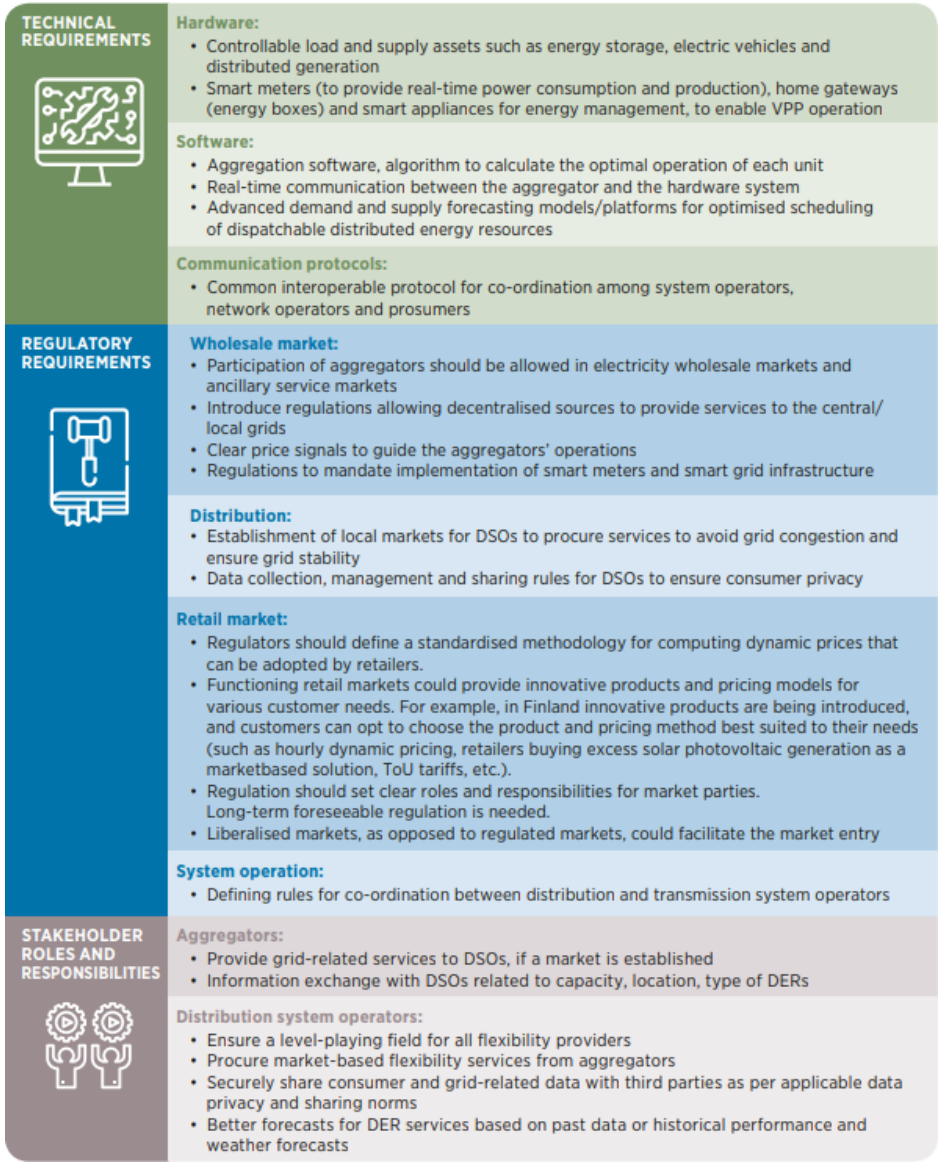


Aggregator Utility Models



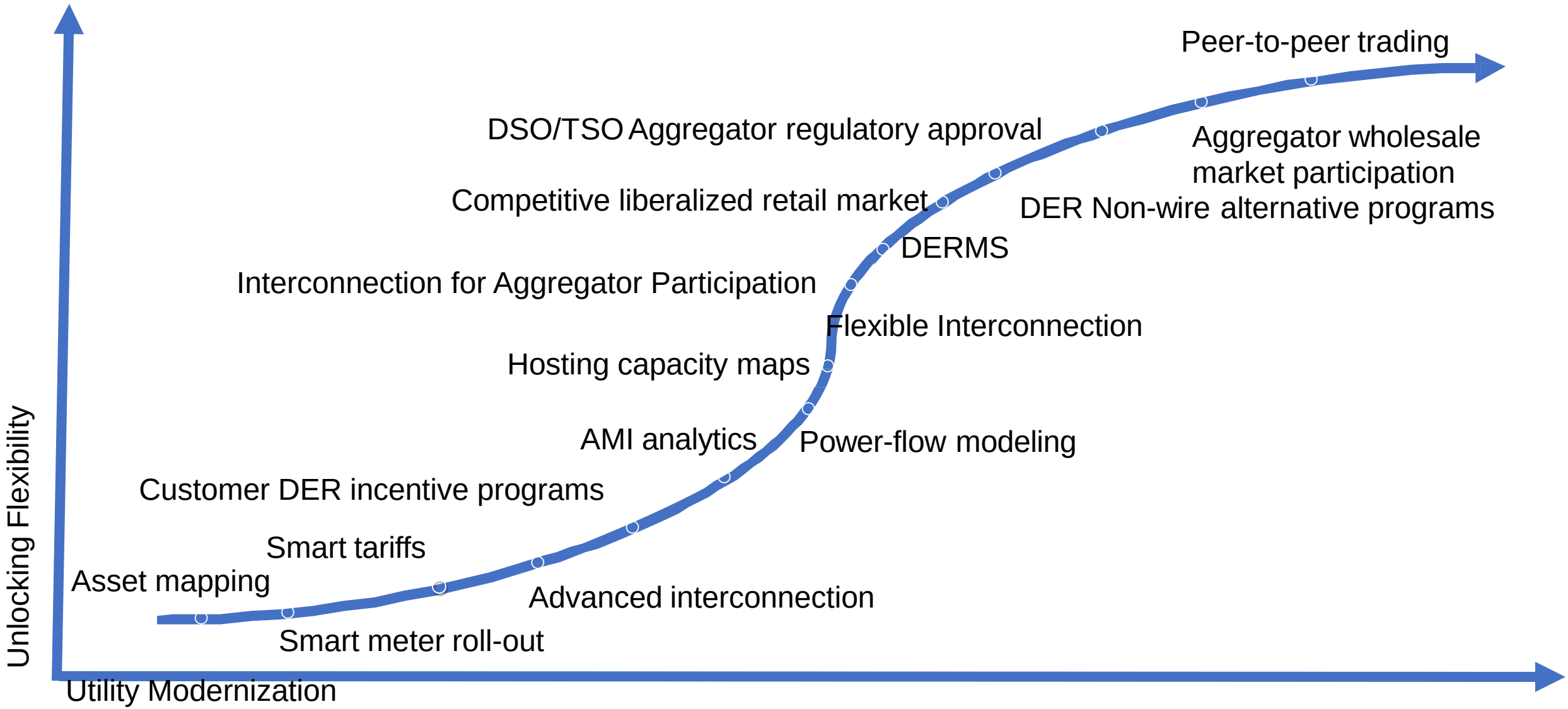
Wholesale Aggregators – A Long-term Path

- Complex aggregator models have many technical, regulatory, and stakeholder requirements that need to be met (e.g., FERC 2222)
- However, more simple aggregator models do exist and are being practiced



Source: IRENA (2019)

Unlocking Flexibility: Evolution *not* Revolution



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Links/References (If any)

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