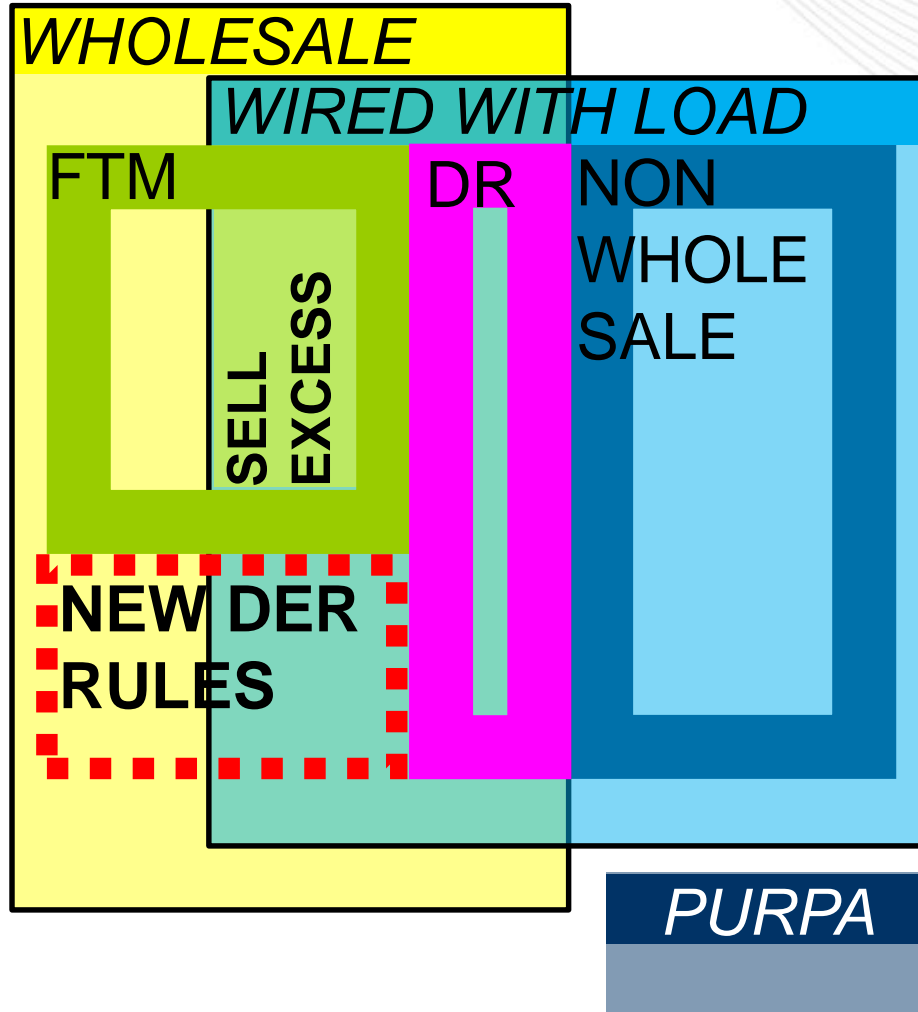


Distributed Energy Resources in PJM: Market Integration Considerations

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DER -- What are we talking about?



DER: devices capable of producing power and connected to the distribution system or behind a customer meter. E.g.:

- Rooftop and small utility solar, combined heat and power, small hydro, non-wires alternatives, peak shavers & back-up units
- For PJM: excludes load reduction and energy efficiency

WHOLESALE—participates in wholesale markets. E.g.:

- Small dedicated solar, landfill gas, and batteries
- Wholesale demand response

WIRED WITH LOAD—DER wired with load behind a load meter (commonly referred to as “behind the meter”).

FTM—“Front of meter” gen and storage: DER studied for injections by PJM and sells injections into wholesale market.

DR—PJM Demand Response from DER: offsets in load at a customer from generators and batteries that are wired with load.

Non-wholesale—DER w/ no explicit participation in wholesale markets.

“SELL EXCESS”—DER wired w/ load selling excess energy at wholesale.

PURPA—DER selling output directly to interconnected utility under state-administered avoided-cost rate. No interaction with PJM.

1.3 GW DER

Wholesale DER as Demand Response

Behind-the-meter generation: Offers into capacity, energy and/or ancillary services markets

74% Diesel | 24% Natural Gas

Remaining ~8,000 MW DR is load modification without any generation (e.g., Industrial process management)

~6.6 GW DER

Non-Wholesale DER

Solar PV DER: Retail / rooftop solar

Municipal DER: Municipal electric company distribution-level generators

Process DER: Industrial generators, combined heat and power

Resiliency DER: Emergency back-up

Qualified Facilities: Direct sales to distribution utilities

Visibility

Forecast
and
Measure

Incent

DER that choose to participate in wholesale markets respond to market **incentives** to enhance efficiency.

Visibility

Forecast and Measure

Incent

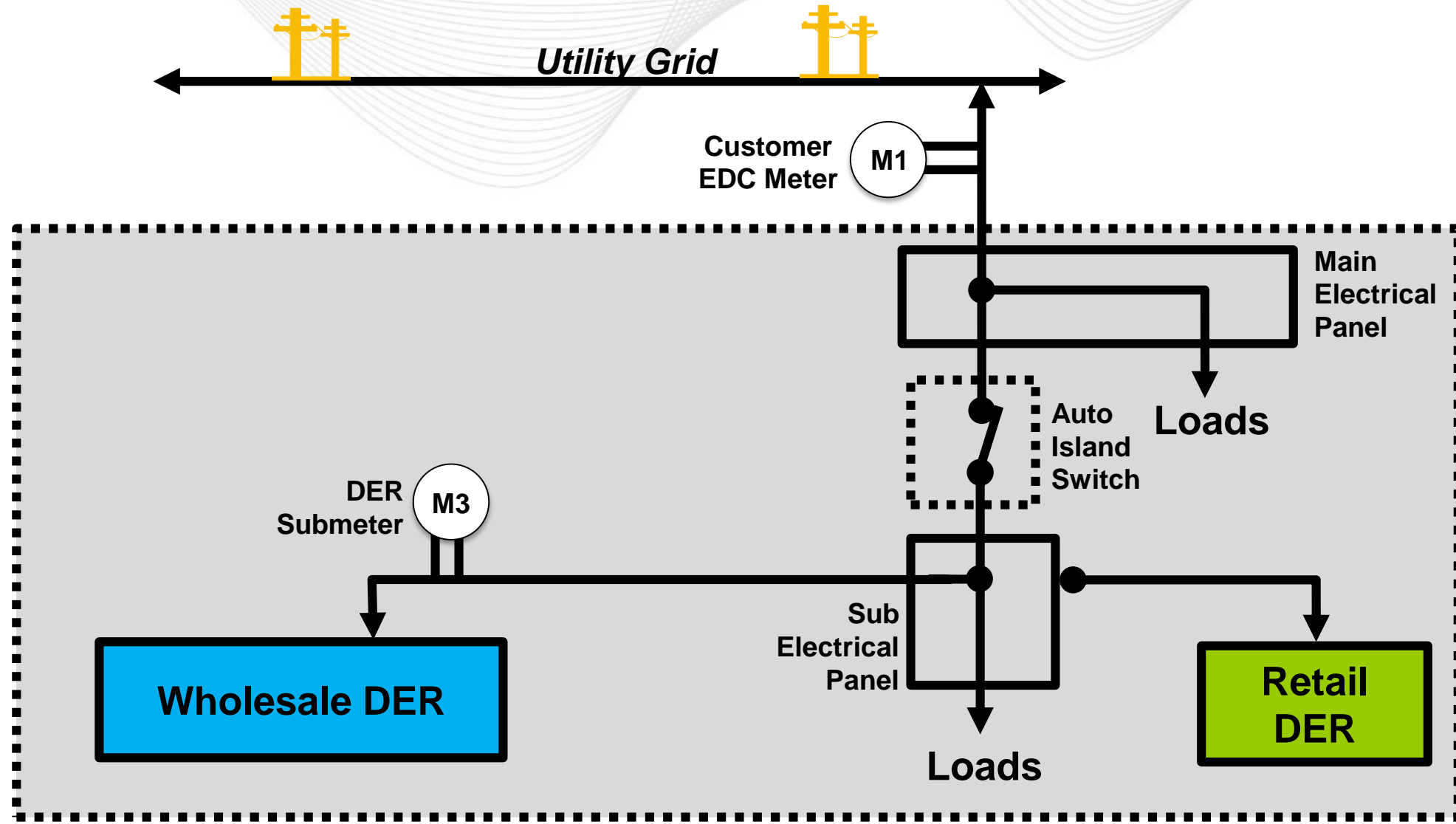
Key Issues

1. *Interconnection* and relaying requirements
2. Proper accounting: *avoiding double counting*, respecting jurisdiction, metering configurations
3. Preserving reliability, efficiency, and incentives while *allowing aggregation*



Market Rules for Wholesale DER

- Visibility
- Forecast and Measure
- Incent

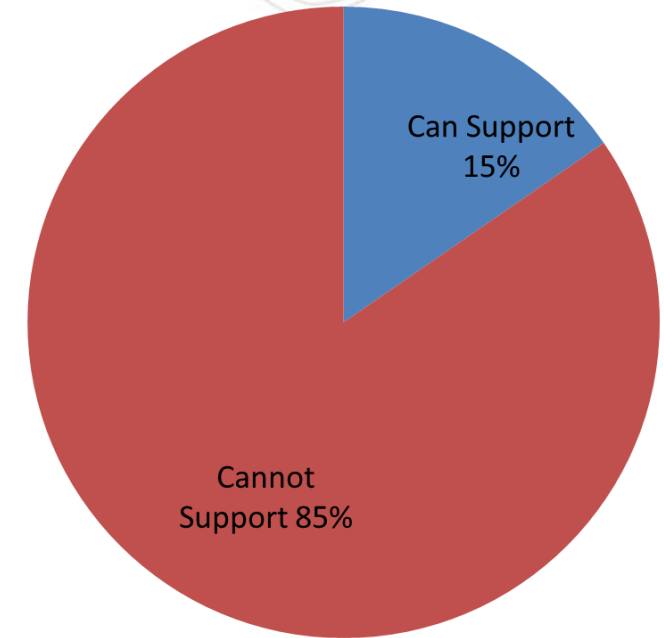




Market Proposal: Aggregation, Energy, & Ancillary Services

1. Multi-nodal aggregation within single distribution utility to meet 100kW min market size
2. Energy: compensation at LMP for excess sales at Point of Interconnection.
 - a) No compensation for load offsets from W-DER (however, open to stakeholder discussion). Proposal for co-located curtailments in Demand Response.
 - b) Scheduling will be on entire W-DER output, including load offsets.
 - c) Working internally on quantifying wholesale stored energy for storage with pigtail.
 - d) Option for PJM wholesale Ancillary-Services Only—no wholesale energy settlement (e.g., if customer sells energy output under PURPA or net metering).
3. Ancillary Services can be measured at POI or at DER with submeter.
4. Coordinate W-DER operations w/ distribution utility: day ahead schedules, etc.
5. Capacity market rules to be developed later in 2018.
6. Submeter (can be 3d-party owned) required for all W-DER > 25 kW, with “gross load” measurement used for PJM planning purposes and possibly other purposes.

- Too little coordination with EDC
- Too much coordination with EDC
- EDCs: reliability concerns
 - Will aggregated DER operate to the detriment of distribution system reliability?
- 3rd party owned submeters
- Overarching concern: Are we moving too fast?
 - No mandate from FERC; Distribution systems not built to handle growing DER



Question regarding various aspects of EDC review and approval of DER aggregations