

# Reliable Integration of Inverter-Based DER

MADRI Meeting #47

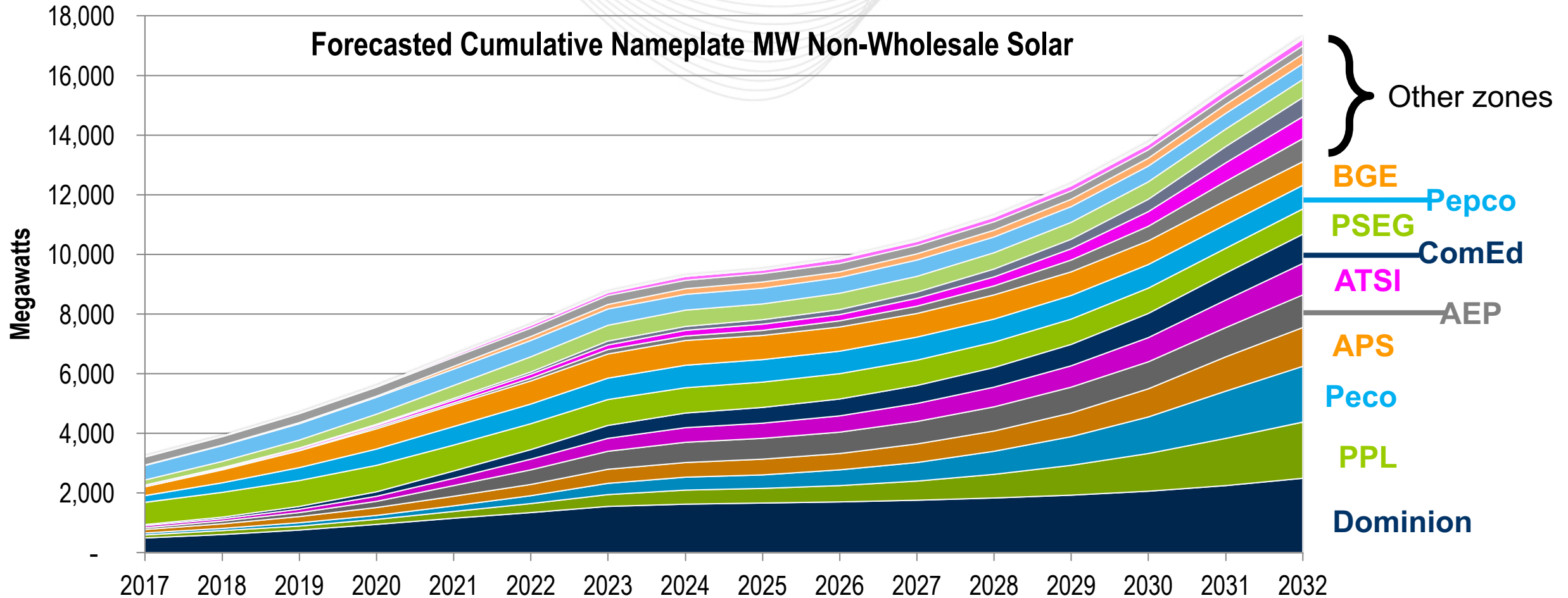
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Andrew Levitt

Senior Market Strategist, Emerging Markets



# Significant Solar Growth Projected: How to Integrate Reliably?



## Key DER Integration Topic: “Shall Trip” and “Ride Through”

### “Shall Trip”

- Immediately following a grid problem, DER must physically disconnect from the grid.
- **Purpose:** facilitate and simplify effective distribution system response to grid problems. Also simplifies controls for certain legacy and other non-inverter DER.

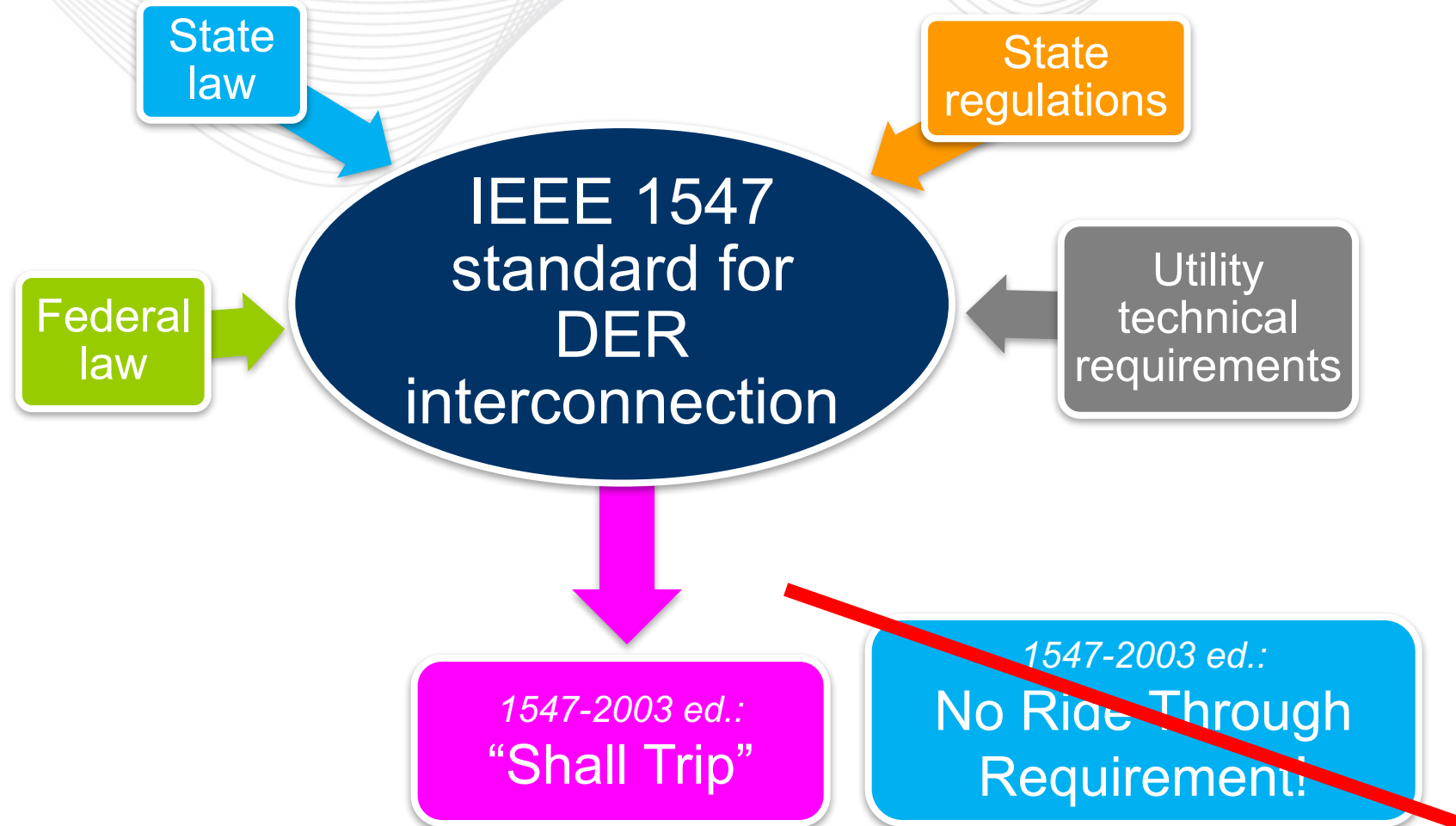
### “Shall Ride Through”

- Immediately following a grid problem, DER must continue to supply the grid. DER must NOT disconnect from the grid.
- **Purpose:** avoid regional stability problems due to loss of large numbers of DER.

***Under high DER deployment, both “Shall Trip” and “Shall Ride Through” are important!***

# The Role of IEEE 1547-2003 and “Ride Through”

***The national standard governing DER behavior does not require ride through.***



- **South Australia blackout** due (in part) to failure to ride through of consecutive voltage disturbances.
- **Western Interconnection:** frequency problems from trips on errors in ride through control circuits.
- **ERCOT:** Frequency problems due to inadequate ride through of consecutive voltage disturbances.
- **Germany blackout of 2006:** blackout and delayed restoration made worse to due lack of DER ride through.  
\$250 million spent to retrofit >300,000 solar units.

**CONCLUSION: “RIDE THROUGH” is critical (in addition to “SHALL TRIP”)**

# PJM Simulation of Benefit From Ride Through

**Many DER  
Ride Through:  
OFF**

**No DER**

**Many DER  
Ride Through:  
ON**

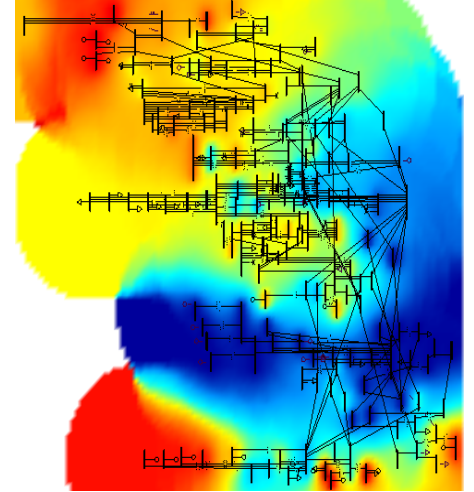
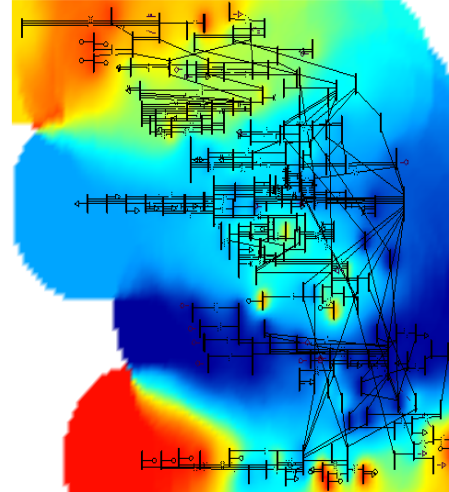
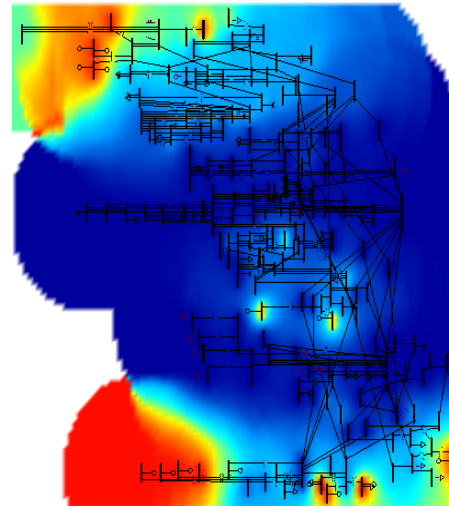
**LOAD AT RISK FROM  
GRID EVENT**

**2,600 MW**

**1,600 MW**

**750 MW**

← Grid event worsened —●— Grid event improved →



*Blue, teal, and green are abnormally low voltage, which puts load at risk.*



***Problem/opportunity:*** no “ride through” in the national standard.

***Solution:*** change the national standard to require both “Shall trip” and “Ride through”.

***How do you do require both tripping and ride through?***

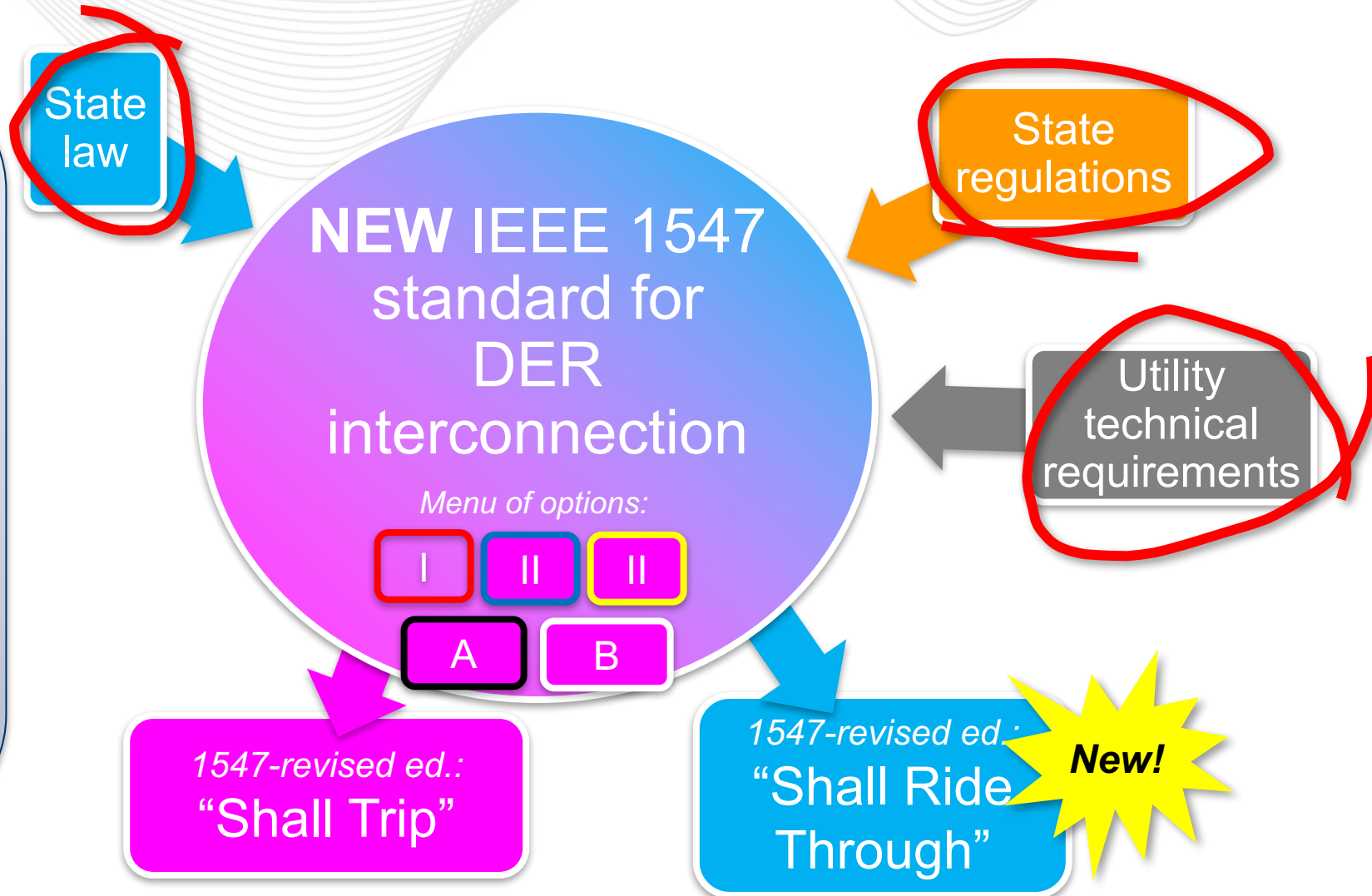
It’s a little complicated, that’s why it took engineers at IEEE Working Group 2 years to make the new standard!

***What next?*** Incorporate the new standard into rules and laws.

***New IEEE 1547 revision with ride through expected early next year!\****

*\*Mass-market DER hardware that meets the revised standard expected in the 2019-2020 timeframe.*

***Utility requirements, state regulations, and/or state law may need to be updated to 1) reflect the new DER interconnection standard and 2) specify options.***





***PJM seeks to facilitate regional consistency in ride through settings for state jurisdictional retail DER.***

- Interconnection requirements for retail DER, including ride through, are under state jurisdiction.
- A ride through requirement for retail DER is a cost effective way to integrate large deployments of DER while maintaining bulk electric system reliability.
  - DER with ride through can improve problem events.
  - DER without ride through can make problem events worse.
  - Ride through is now required for retail DER in California and Hawaii.
- Without DER ride through, it would be costly to maintain bulk electric system reliability while integrating large deployments of DER.



## PJM is Looking for Opportunities to Engage Distribution Utilities By:

***PJM seeks to engage directly with utilities and in local interconnection Working Groups***

***PJM to host a dialogue with distribution utilities on the new 1547 standard.***

***Look for technical reports.***

- Direct discussions with distribution utility engineers regarding ride through settings.
- Hosting an open dialog event with distribution utility engineers to discuss ride through settings.
- Supporting local regulators in discussions of ride through requirements for retail DER.
- Participation in local regulatory interconnection Working Groups.
- Issuing technical reports on the results of inverter simulations and real-world studies.
- Interested in a possible joint report that describes desirable ride through settings and related considerations.