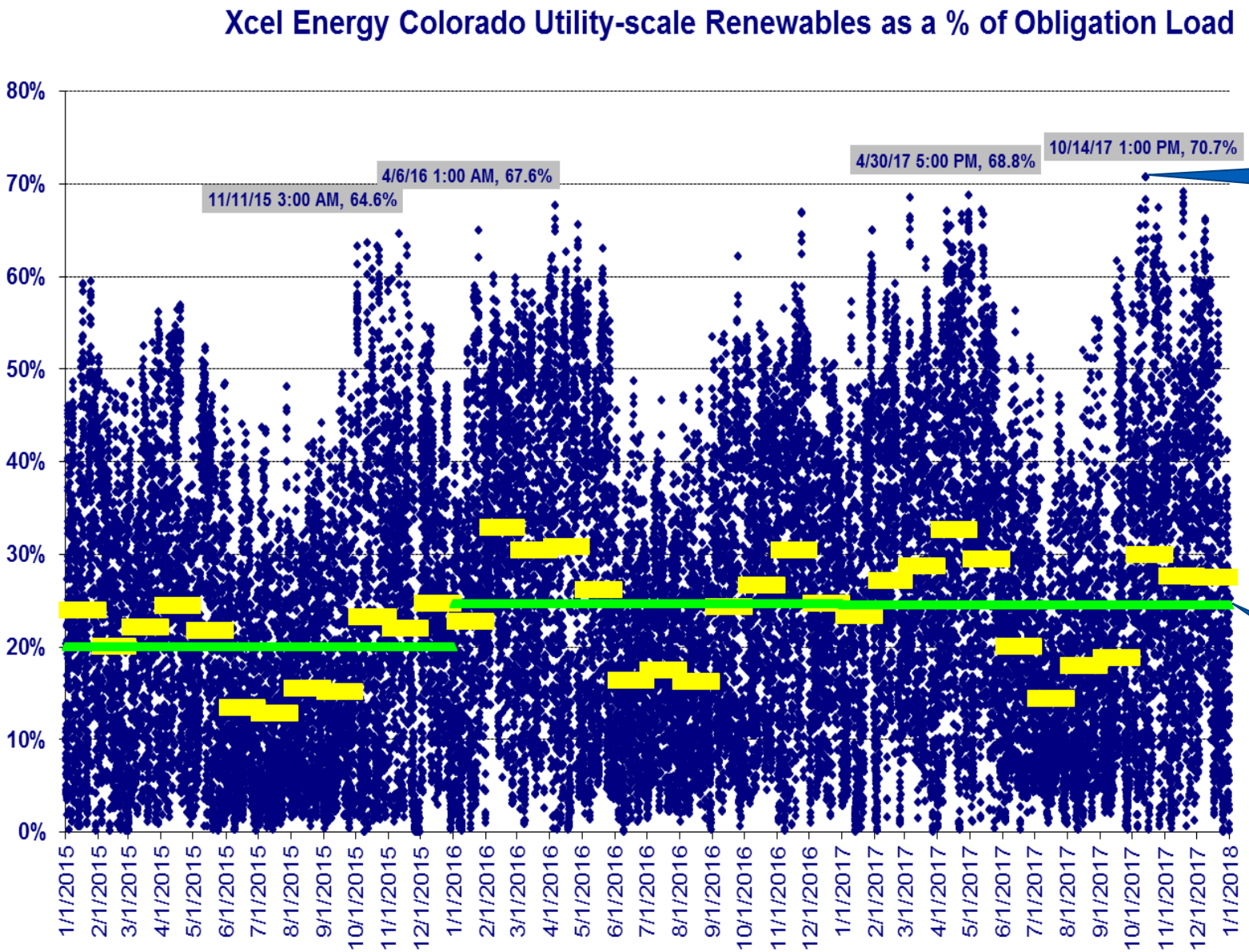

GridLAB
Expertise to Enable Grid Transformation

A paradigm shift: Inverter-based resources

Conventional synchronous resources

Inverter-based resources

Courtesy Nick Miller and Debbie Lew



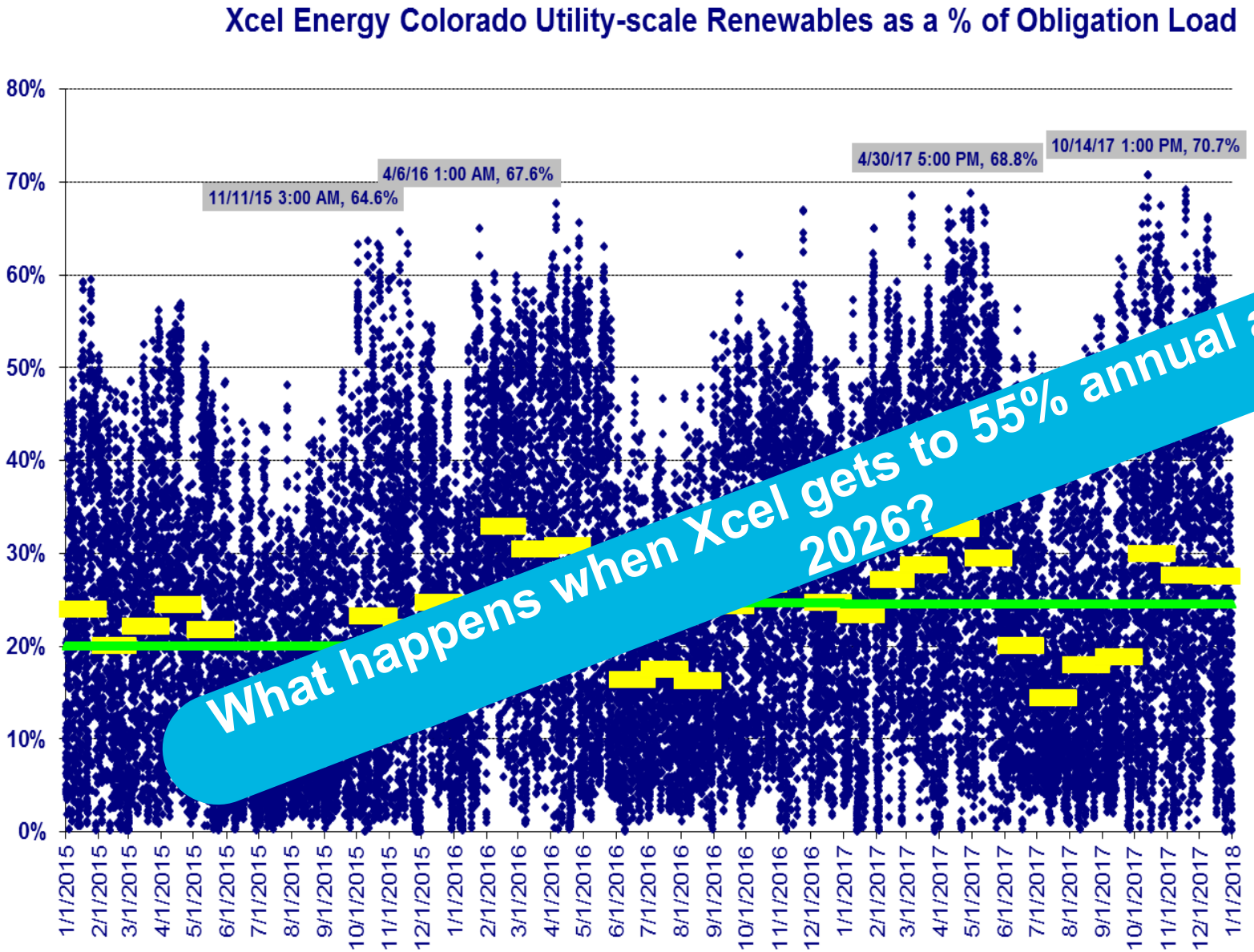
71% instantaneous

25% Annual energy

Moderate annual averages translate to high instantaneous penetrations

Source: Drake Bartlett, PSCO, 2018

Courtesy Nick Miller and Debbie Lew



Courtesy Nick Miller and Debbie Lew

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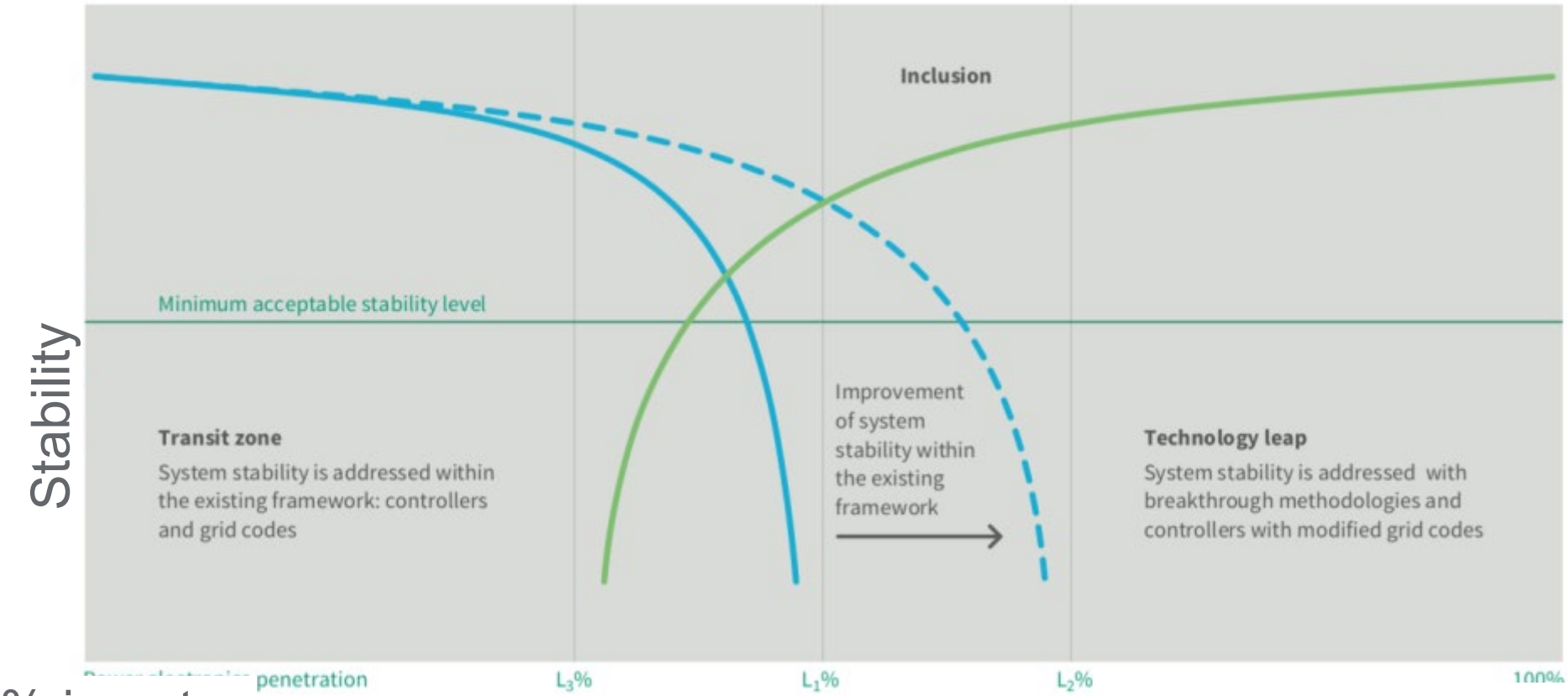
Source: Drake Bartlett, PSCO, 2018

You can’t get there from here without a paradigm shift



MIGRAT E, 2016

0% inverters

100% inverters

Today we are on the blue line and working towards the dashed blue curve.

We don’t know what the green curve looks like or how to get there.

Courtesy Nick Miller and Debbie Lew

Frequency Response

- What is Synchronous Inertial Response?
- Fast Frequency Response?
- Primary Frequency response?
- *As we move to an Inverter Based world, Frequency response is one thing that must evolve*

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Frequency after a Disturbance Event

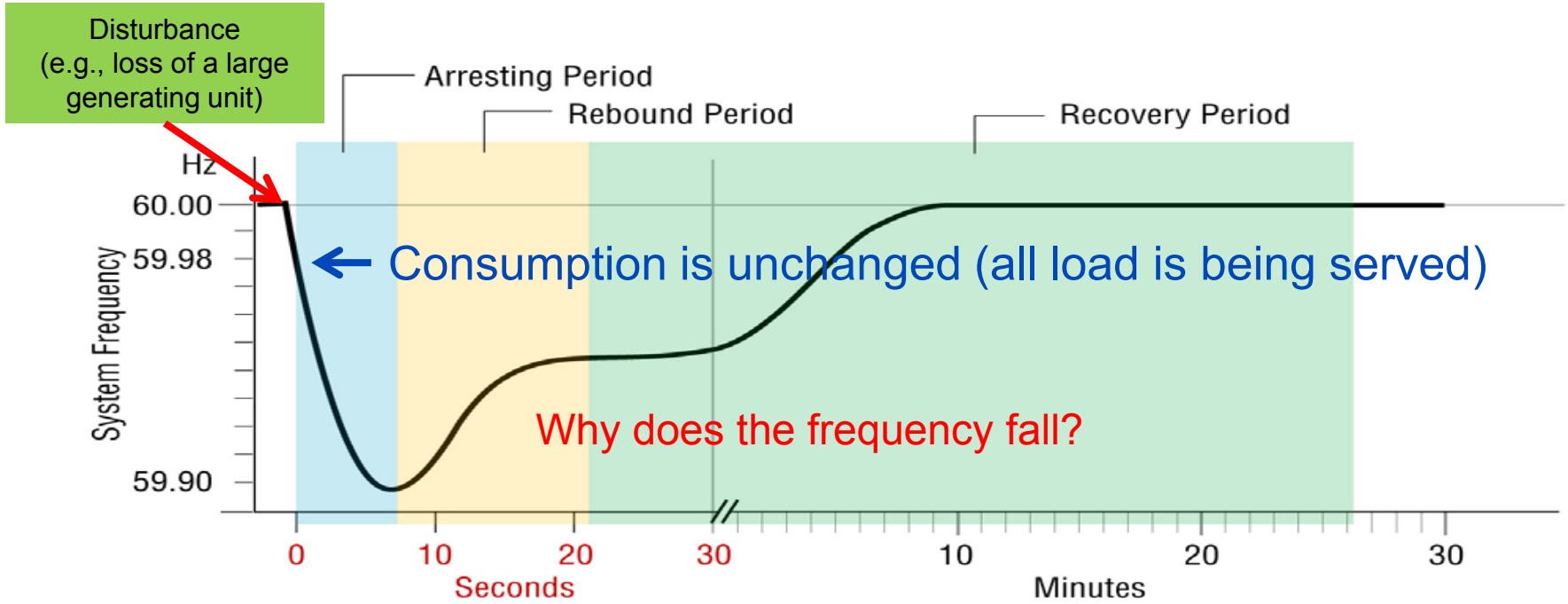

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Figure from J. Eto, LBNL,
https://www.ferc.gov/industries/electric/indus-act/reliability/frequencyresponsemetrics-report.pdf

Synchronous Generators

- Mechanical torque goes in (from the energy source - “prime mover”)
- Electrical torque is pulled out (the electrical power to the grid)
- When starting up, energy is applied to bring the generator up to speed and then it is synchronized (electro-mechanically coupled) with the electrical grid
- Thereafter, the plant controls try to maintain a “torque in = torque out” balance to generate the desired power output level

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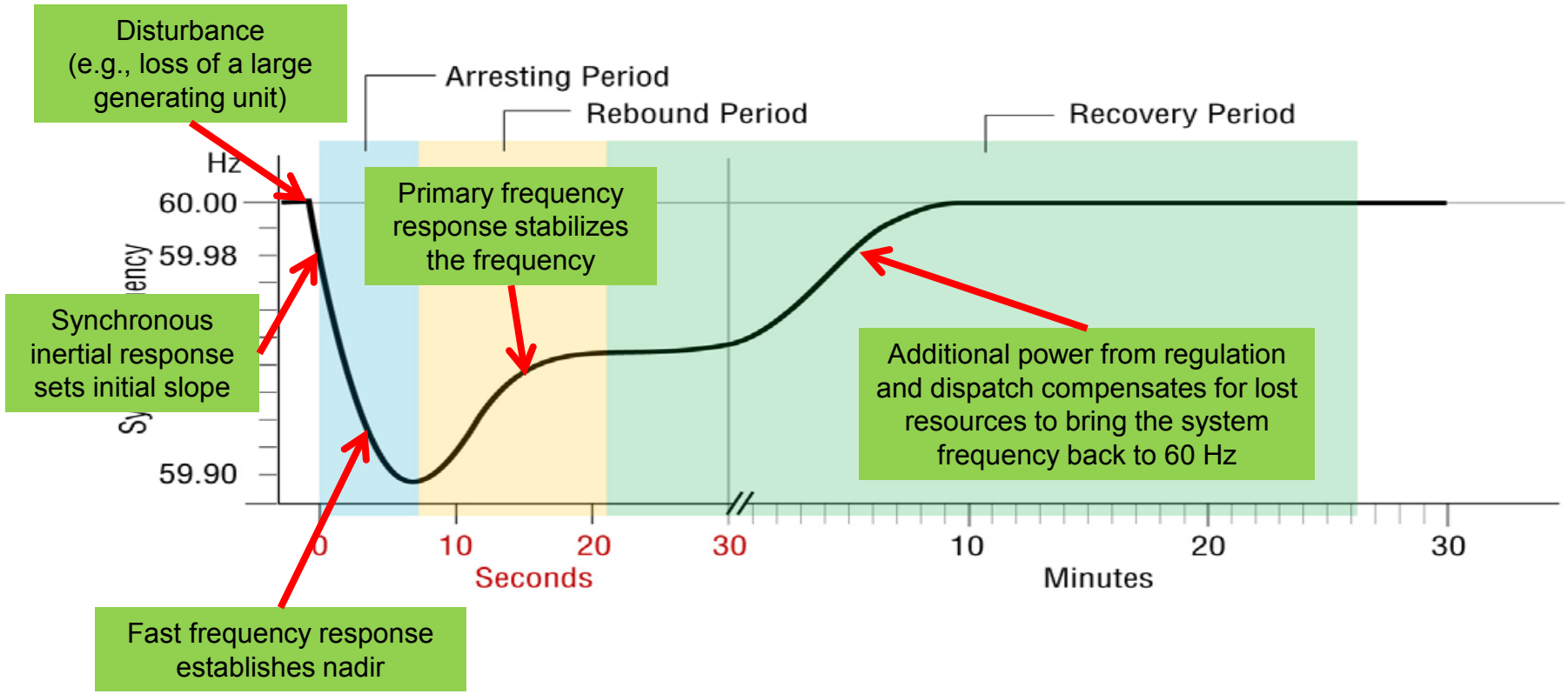
Putting it all Together: Frequency Response to an Event



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