500 MW for 5 Days – How Do We Get There?

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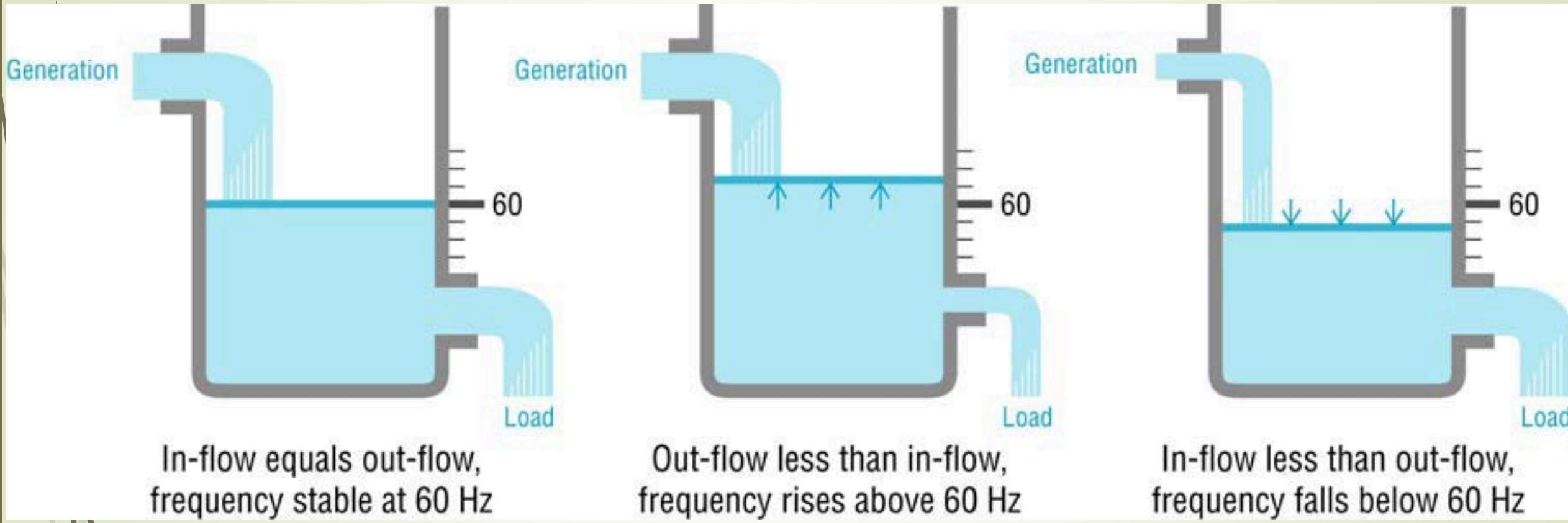
A Grid Fundamental



Energy Storage As a Grid Resource

- Has no inertia: Instantaneous response (almost!)
- Injects or absorbs energy
- Scalable: Kilo Watts to Mega Watts x 100s
- Siting flexibility

- Noise, emissions (at point of use)

Energy Storage Applications

Seconds to Minutes

Frequency Regulation
Spinning Reserve

Batteries
Flywheels
Super Capacitors

Minutes to Hours

Spinning Reserve
Renewable Support
Load Leveling
Arbitrage

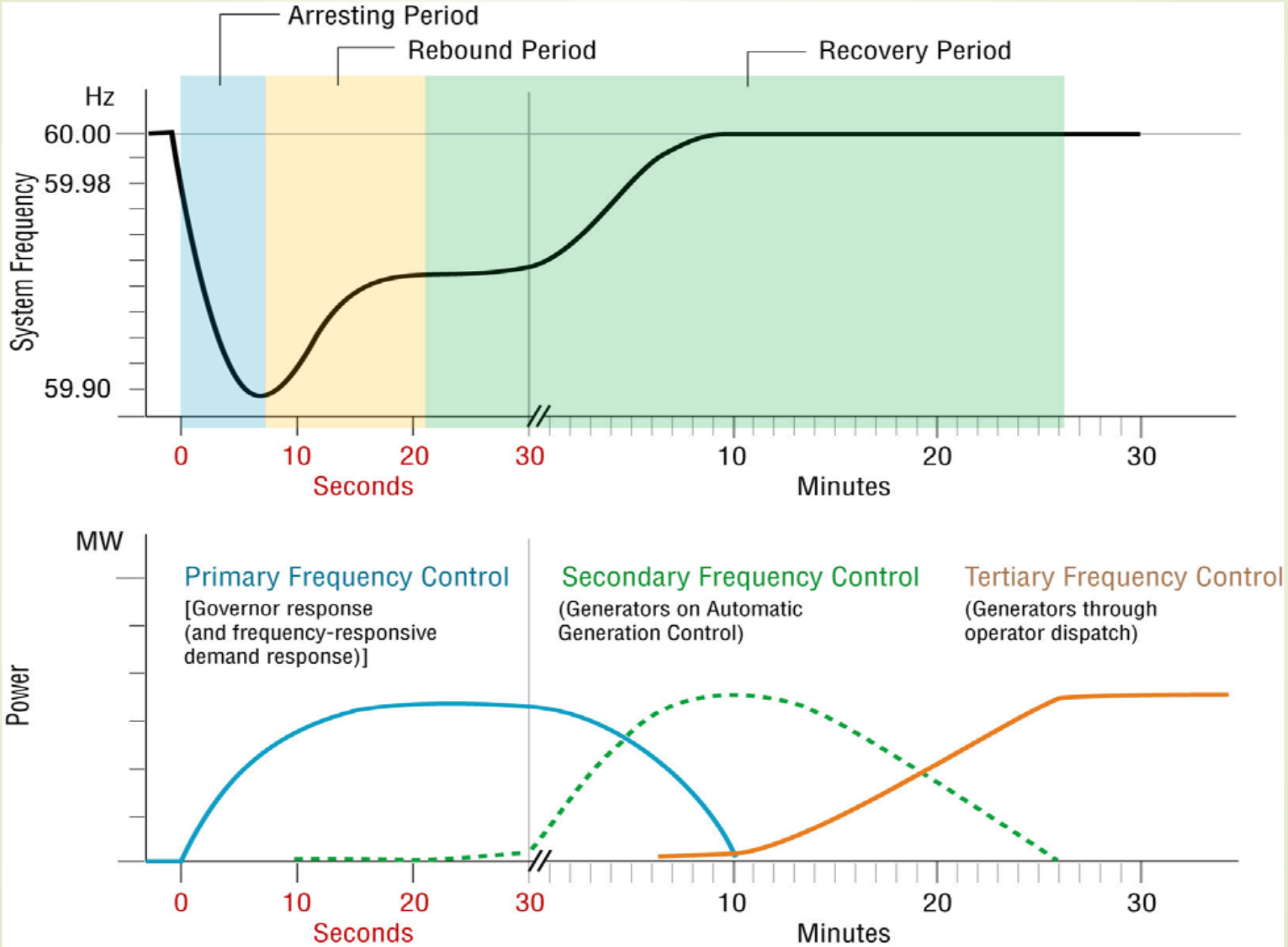
Batteries
Pumped Storage
CAES

Days to Weeks

Renewable Support
Arbitrage

Pumped Storage
Ultra Long Duration Storage

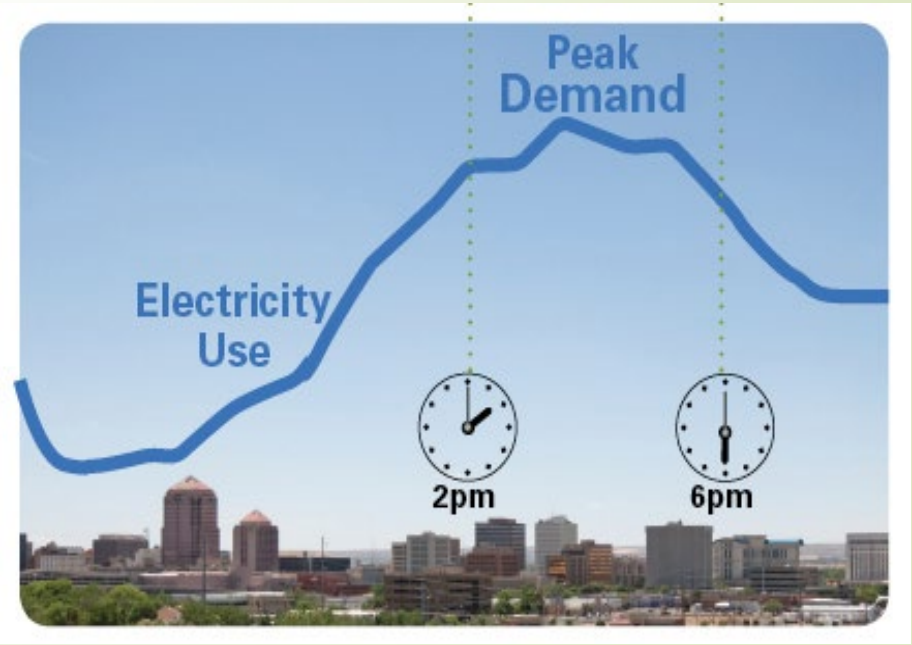
Short Duration Storage



Long Duration Storage

The best solar production occurs ~ 2 to 8 hours prior to:

when the most power is needed on the grid



Storage Technologies (Stationary Applications)

Batteries:

Pb-acid

1987: First use by Crescent Electric Co-op (now Energy United)
500 kW/500 kWh
1987: BEWAG – Germany
1988: Southern California Edison
1994: Puerto Rico Electric Power Authority
New Mexico use: PNM – Prosperity Project, near Mesa del Sol

NiCd

2003: First (and only??) use by Golden Valley Electric Co-op, Fairbanks, AK
4 stacked applications

Storage Technologies (Stationary Applications)

Batteries (Contd….):

NaS: High temperature; longer duration:
Japanese developers: Hitachi, NGK
New Mexico use: Los Alamos County

ZnBr:
Johnson Controls

Technology Evolution

Late 1990's: On-site construction to smaller, containerized system

AC Battery to PQ2000: Short duration backup: 1- 2 MW for 30 seconds

New Mexico use: Intel, Rio Rancho

Pb-acid to Lithium: Significantly higher energy density:

1.2 kWh/Sq ft to 10 kWh/sq ft: smaller footprint

Improved utility-scale modeling tools: PROMOD, PLEXOS, PowerSimm

HOMER for smaller applications

Regulatory side: Rulings by FERC and state PUC's in late 1990/2000 recognizing storage benefits: Storage applications move into the mainstream:

No longer pilot or demo projects

New Mexico Energy Storage Perspectives

New Mexico has:

- ETA carbon-free goal by 2045
- Best wind and solar resources: Variability needs energy storage: short and long duration
- Rural and tribal communities: Storage is vital for resiliency and energy independence

- NM RETA: Transmission ***and*** Storage
- State Land Office – leader in wind farm development

- Sandia Labs is the lead lab for DOE's utility energy storage since mid-1970's:

  world-class experts in our backyard

One-size Does Not Fit All

New Mexico has:

- Three IOUs and sixteen Co-ops

- Different application needs:
  - Two approaches: Centralized and Distributed
  - Two tech solutions: Batteries for short duration and other technologies for long duration needs

Centralized and Distributed Storage

Centralized energy storage

- Serves utility-scale needs; gets more attention

Distributed energy storage

- Residential, small commercial and substation applications; Community Solar
- Offers equally significant opportunities for deployment

Centralized Storage

Technologies:

- Batteries – 4 to 6 hours
- Pumped hydro – 10 to 14 hours
- Compressed Air Energy Storage (CAES) – 10 to 14 hours

Pumped hydro constraints:

- Water use, size and environmental impact

CAES:

- Limited operational experience, difficult siting

Distributed Storage

Technologies:

- Batteries – 2 to 4 hours

Residential needs state and federal incentives and regulatory support:

- Solar + storage; stand-alone; electric vehicles
- Legislation in 2023 for incentives

Utility-owned substation applications

- Substation deferral, greater PV penetration

Questions?