



Renewable Energy Challenges

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Traditional On Site Generation

- Combustion Gas Turbines & Diesel Generators
- Droop / kW / Baseload when Grid Connected
- Isochronous / Load Following when Islanded
- Typically Not Allowed to Export Power

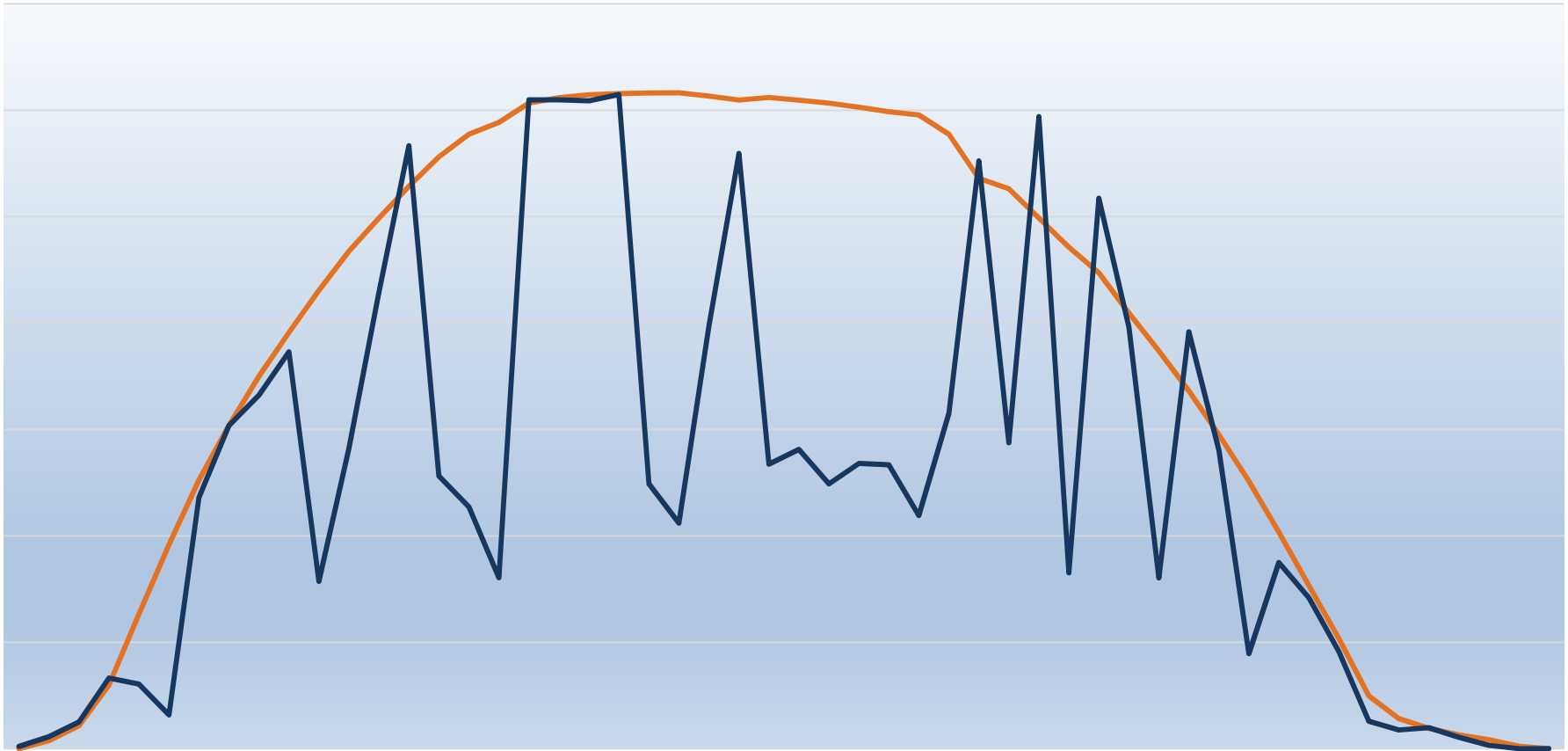


Typical Renewable Generation

- Vast Majority of Systems are UL 1741 Compliant
- Operate as a “Current Source” to the Grid
- Generates Electricity Solely Based on Availability of Resource



Sunny vs Cloudy PV Output



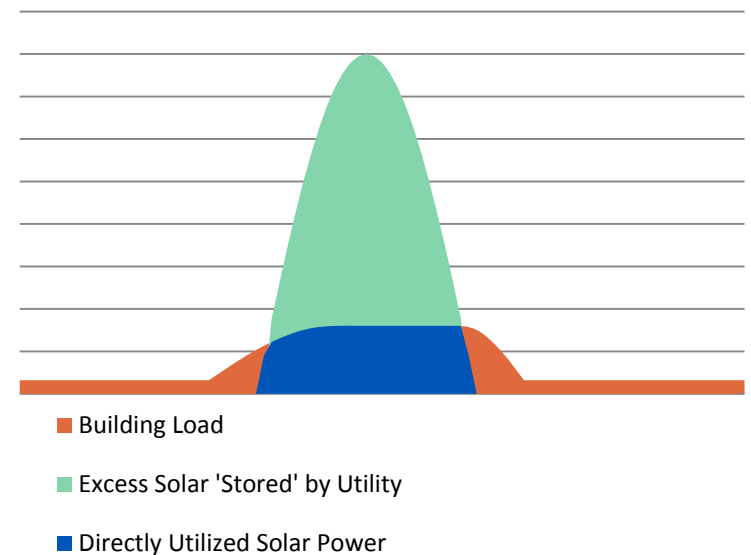
California Rule 21 Inverters

- Emerging Technology
- Limits kW Output Autonomously Based on Grid Frequency
- Produces / Consumes VARs Autonomously Based on Grid Voltage
- More Features to Come



Net Zero Facilities

- Renewable Generation Equals Consumption on “Typical” Day
- Daily Energy Export to Distribution System
- Utility Serves as 100% Efficient Battery



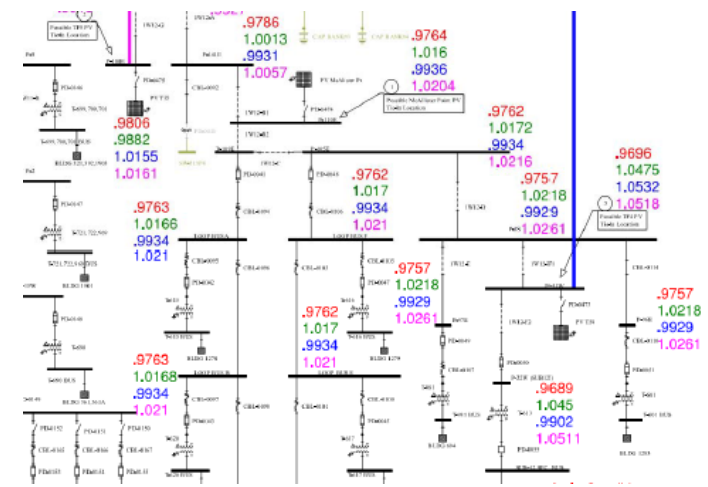
What Happens to Excess Power?

- Net Metering vs Avoided Cost Rates
- Reshape Your Load Profile
- Disable / Limit Inverters When Needed
- Energy Storage

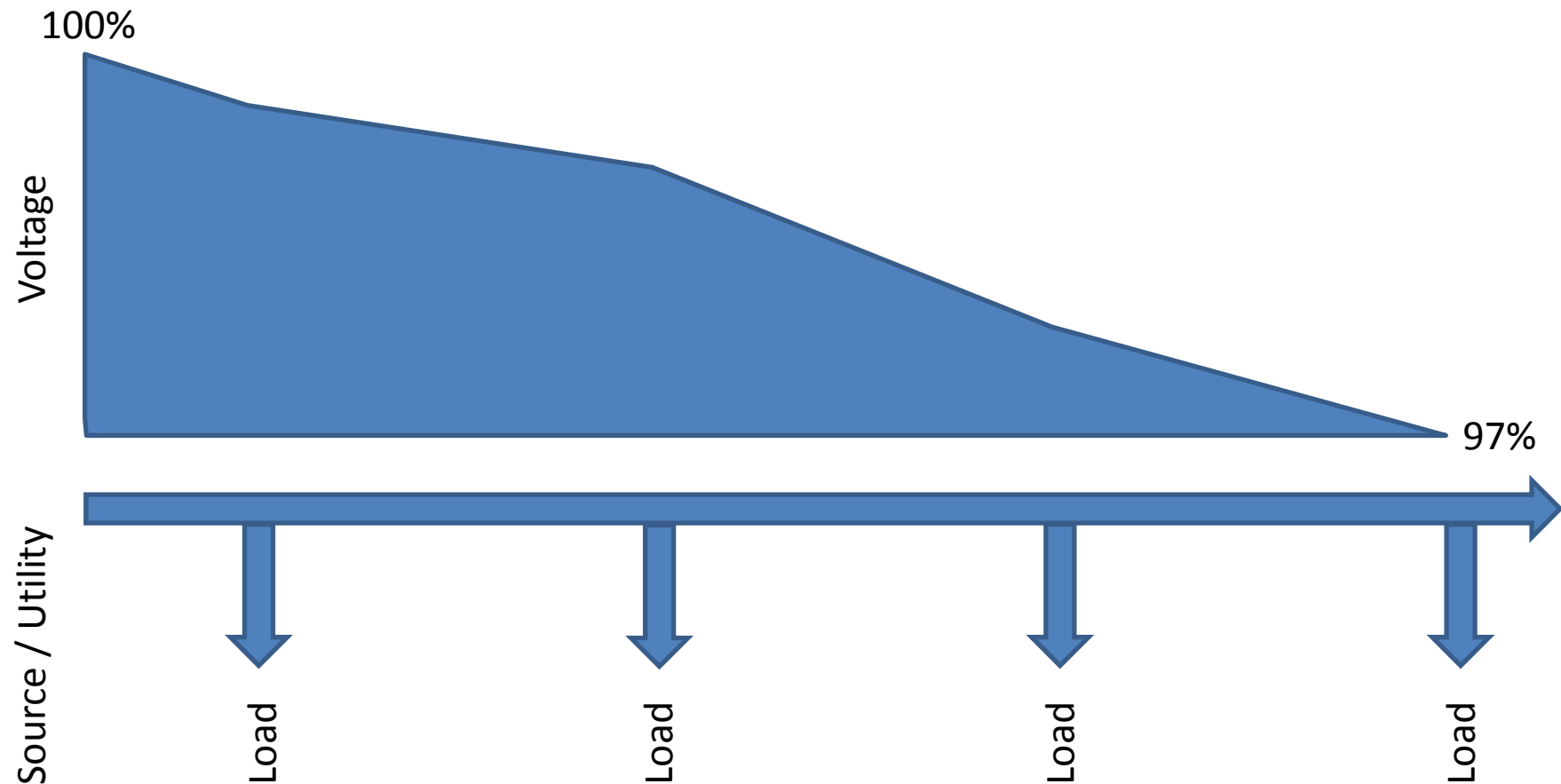


Voltage Profile Concerns

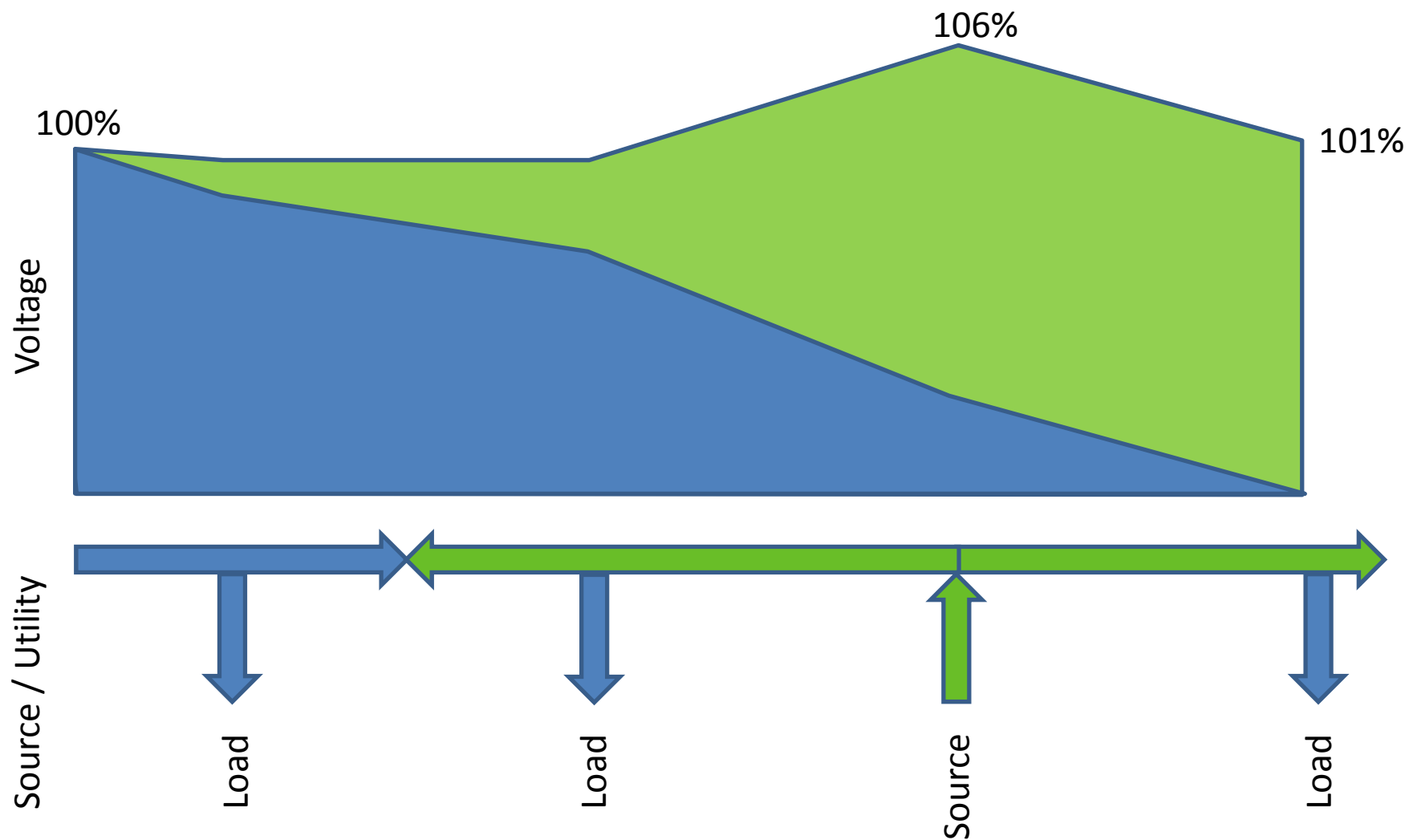
- Renewable Generation can Invert Voltage Profile of Feeders
- Need to Evaluate Profile in All Conditions
- May Need to Reset Voltage Setpoints of Dispatchable Generation, Tap Changers, and Capacitors



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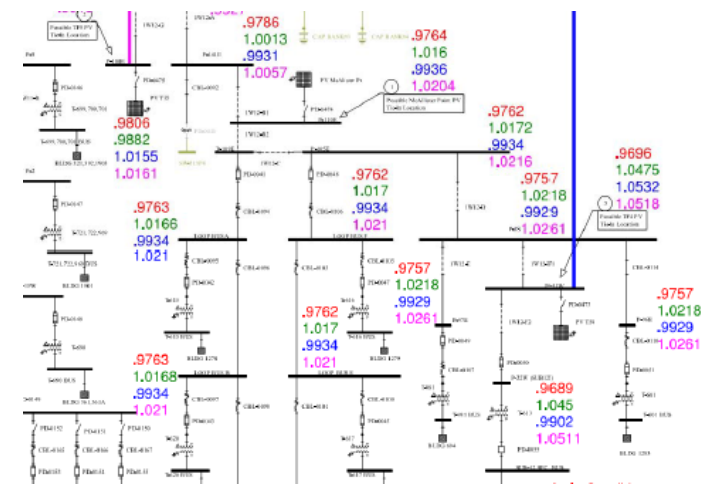


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Renewable Energy and Energy Security

- Without a Grid Reference, UL1741 Equipment Generates NO Power
- Microgrids Enable Renewable Energy When the Utility has Failed
- Microgrids Magnify the Challenges of Renewables



Thank You

