Decentralized Power Grids: Successfully Integrating Distributed Generation with Cyber Security

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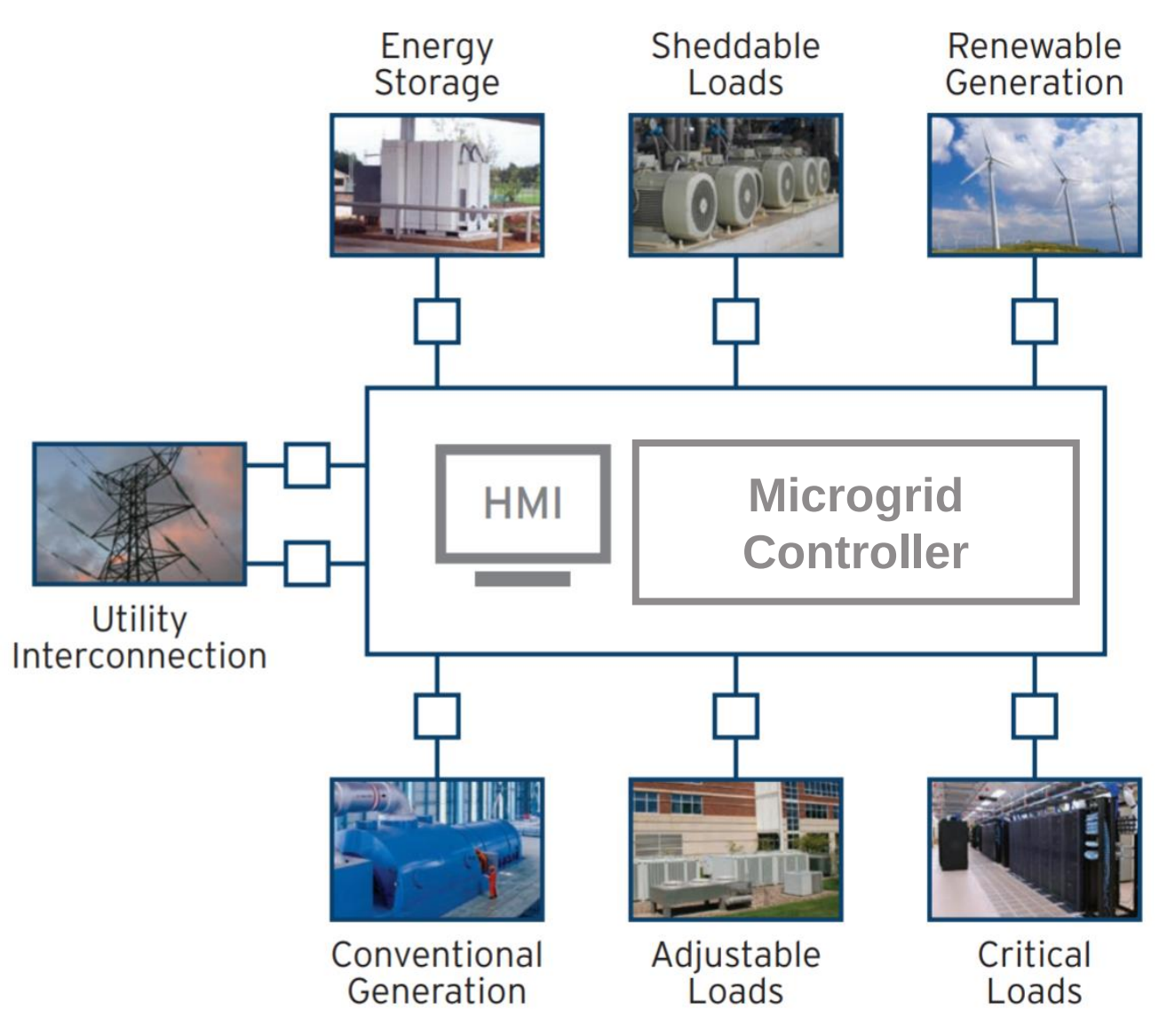
Decentralized Power Grids

Supplementary power source(s) to the existing centralized power grid

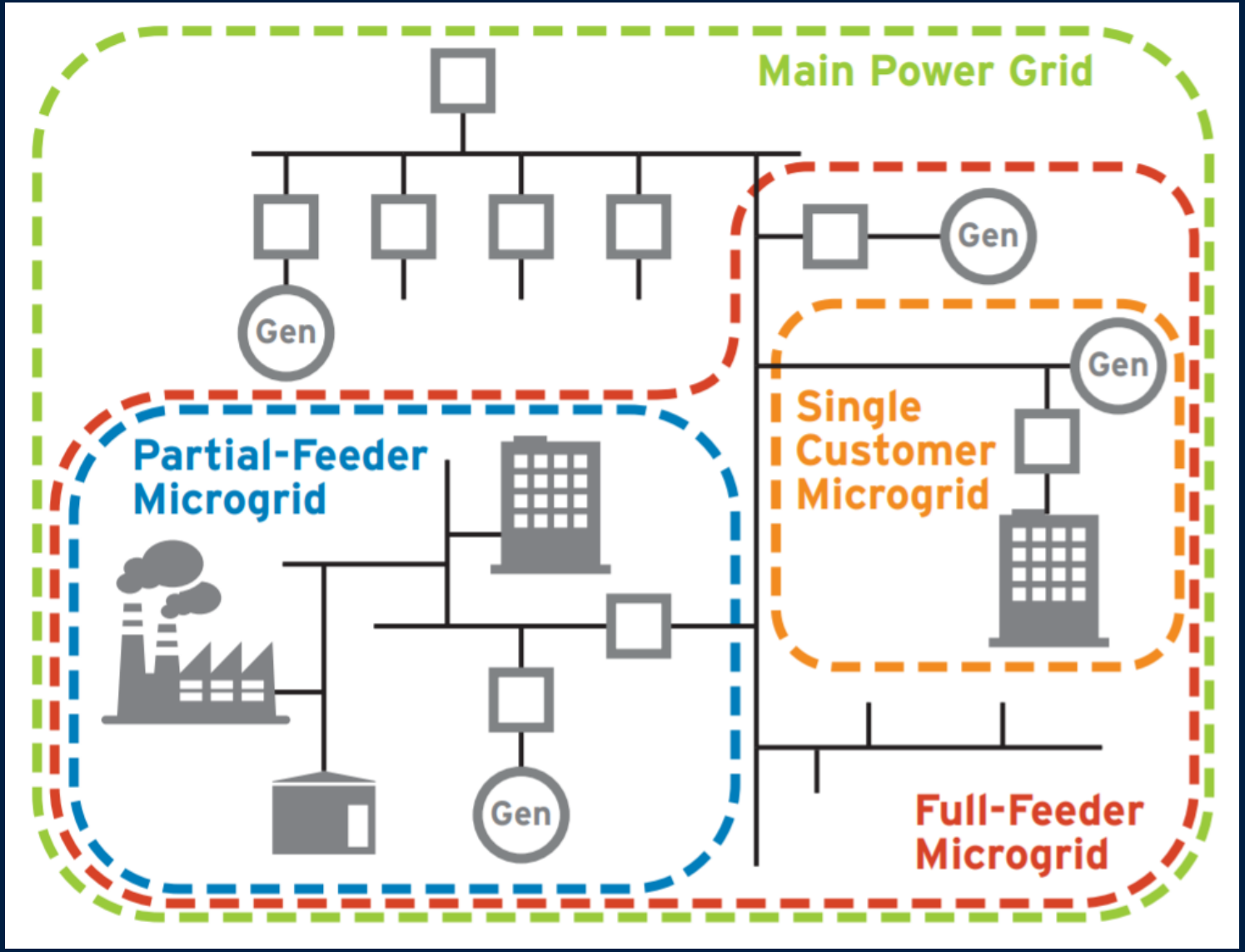
- Energy source(s) located closer to consumption
- Keep the lights on
- Enhance system user economics
- Facilitate renewable energy integration

Decentralize Systems Must:



- Decoupling
- Island Detection
- Maintain Inertia
- Frequency Control
- Load Shedding
- Load Restoration
- Communication

Islanding Possibilities



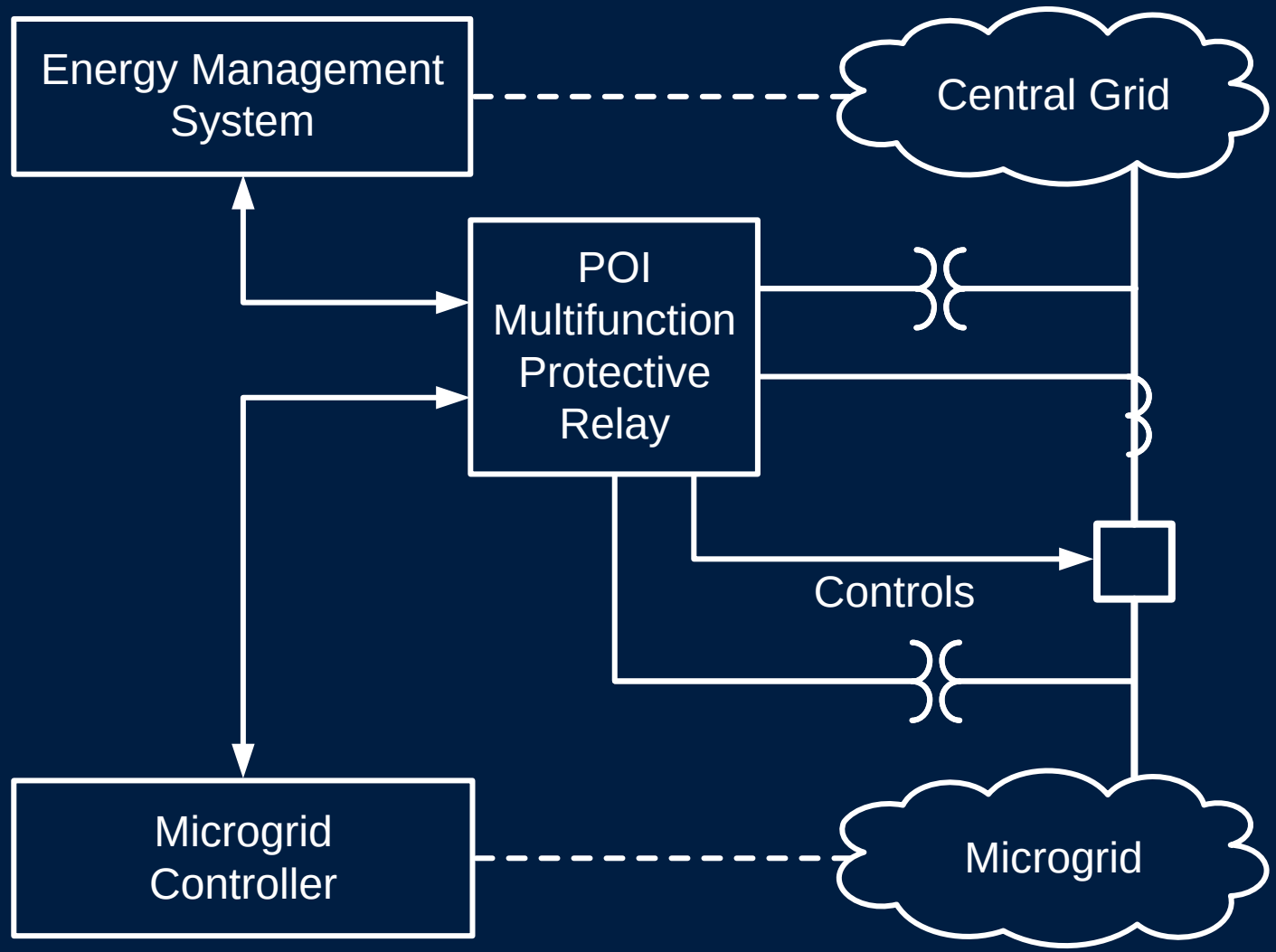
- Decentralized power to meet requirements
- Cybersecurity implications
- All generations need to maintain synchronization

Loads Will Have Different Requirements

	Residential	Industrial
Power Reliability	✗	✓
Energy Efficiency	✓	✗
Payback Period	Years	Days
Intermittent Energy Sources	✓	✗
Inverter-Based Generation	✓	✗

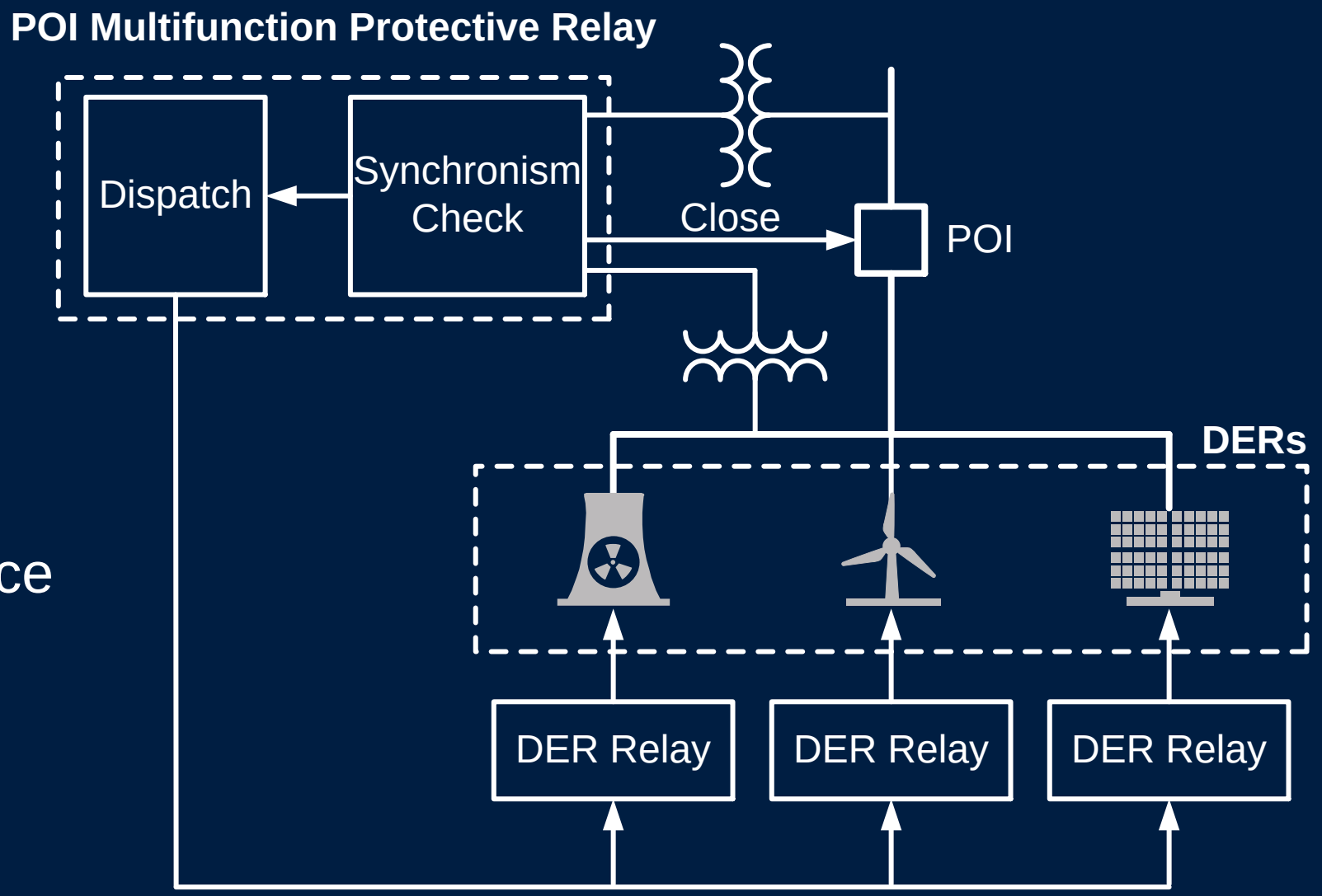
Microgrid Point of Interface (POI) Relay

- Grid reconnection
- Seamless islanding and load shedding
- Short- and open-circuit protection
- Power and Power Factor control at POI

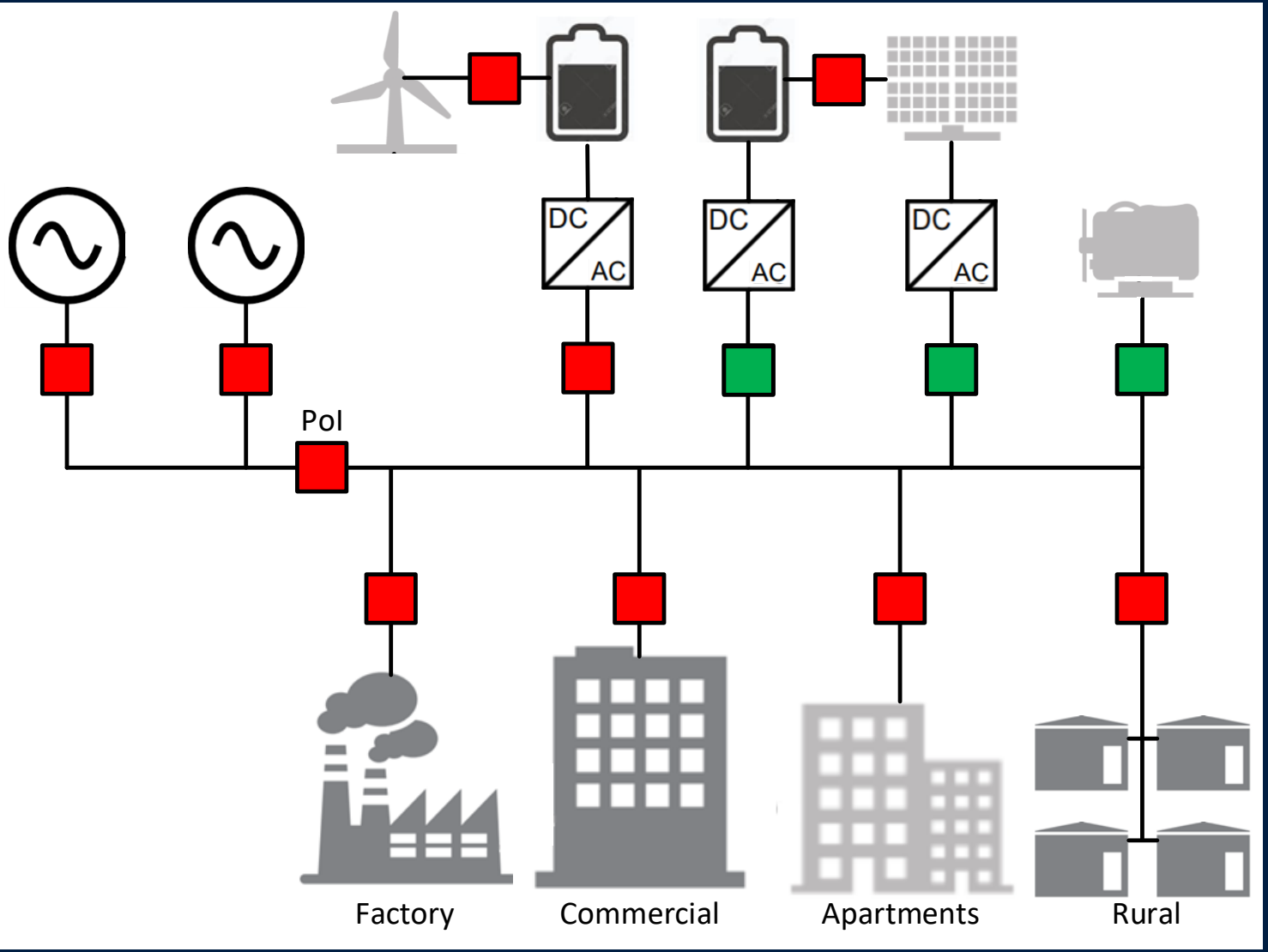


DER Relay Provides

- Protection
- Governor and exciter dispatch
- Inverter dispatch
- Parallel controls
- Distributed energy resource (DER) load sharing
- Voltage regulation
- Frequency regulation



DER – Normal Morning



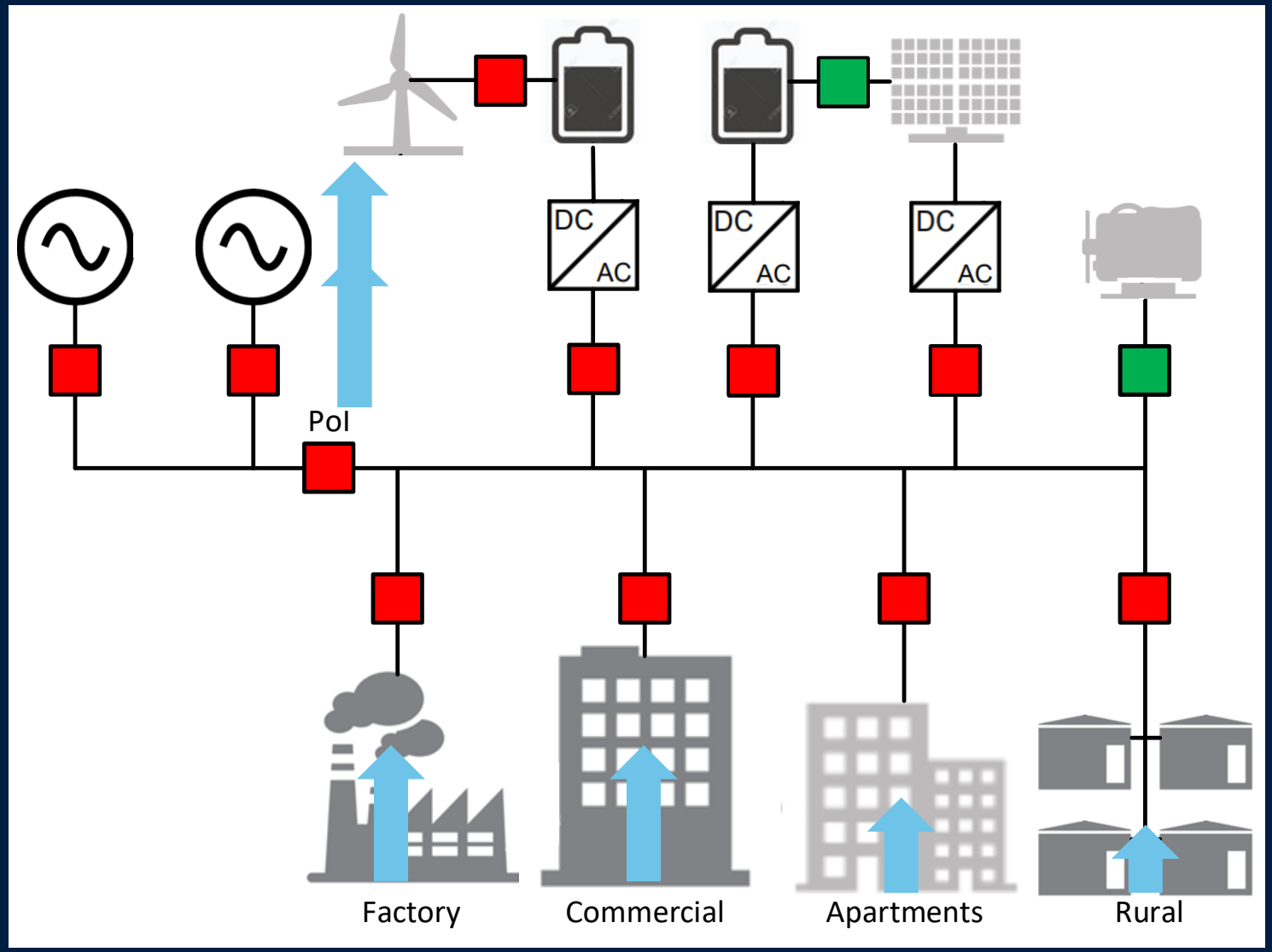
7:00 AM

Batteries partially drained from lack of solar

Power = Central Grid + Wind

Solar charging batteries

DER – Peak Shaving (Economic)



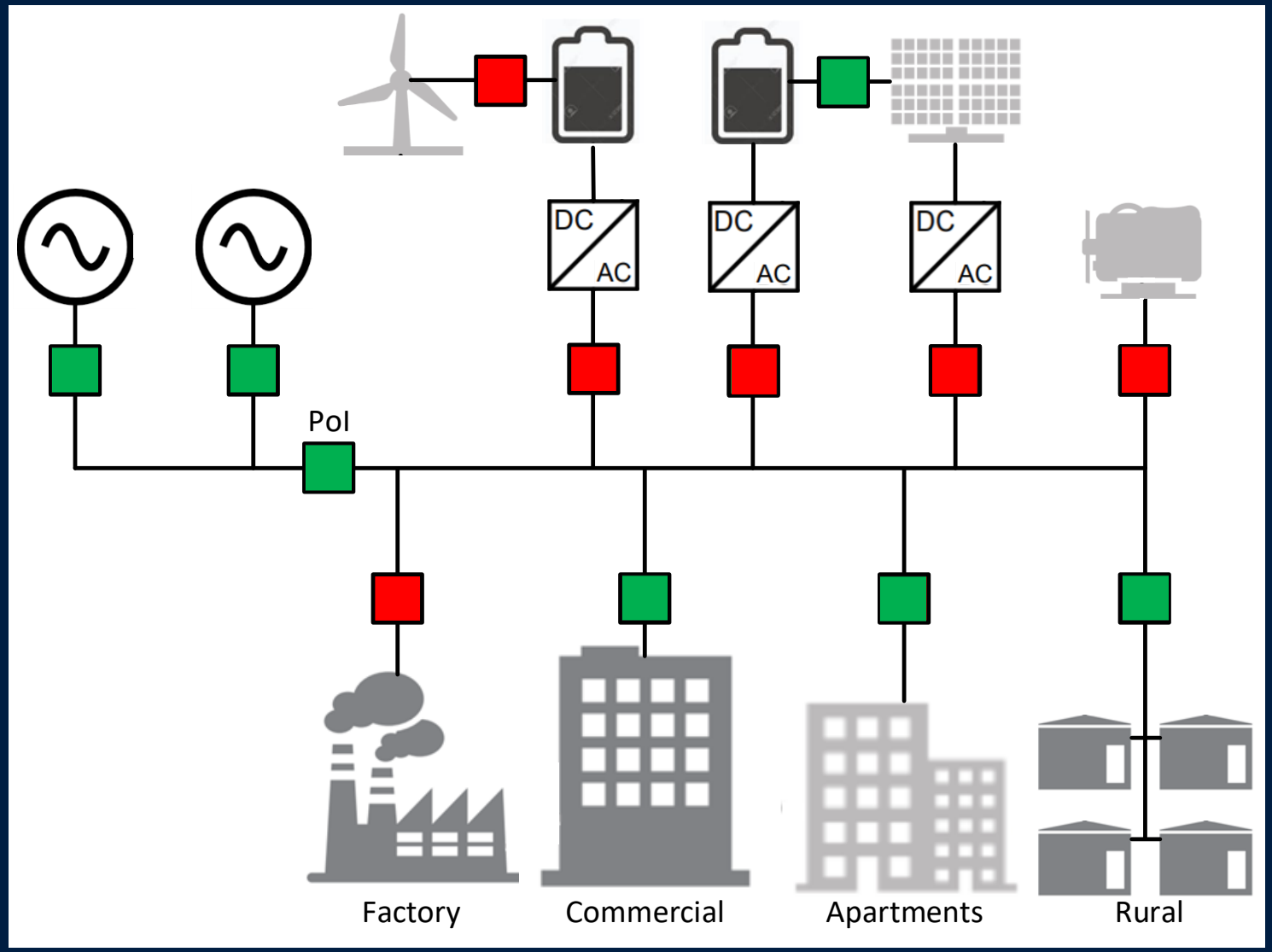
1:00 PM

High Demand on Central Grid

Disconnect battery charging

Connect batteries and solar into system

DER – Loss of Central Grid



Power Event / Islanding

Shed Load based on priority

Switch Distributive Energy Sources

Wait for generator to start and provide inertia

Bring additional load back on based on generation priority

Balancing Risks

Complicated in energy systems with multiple owners

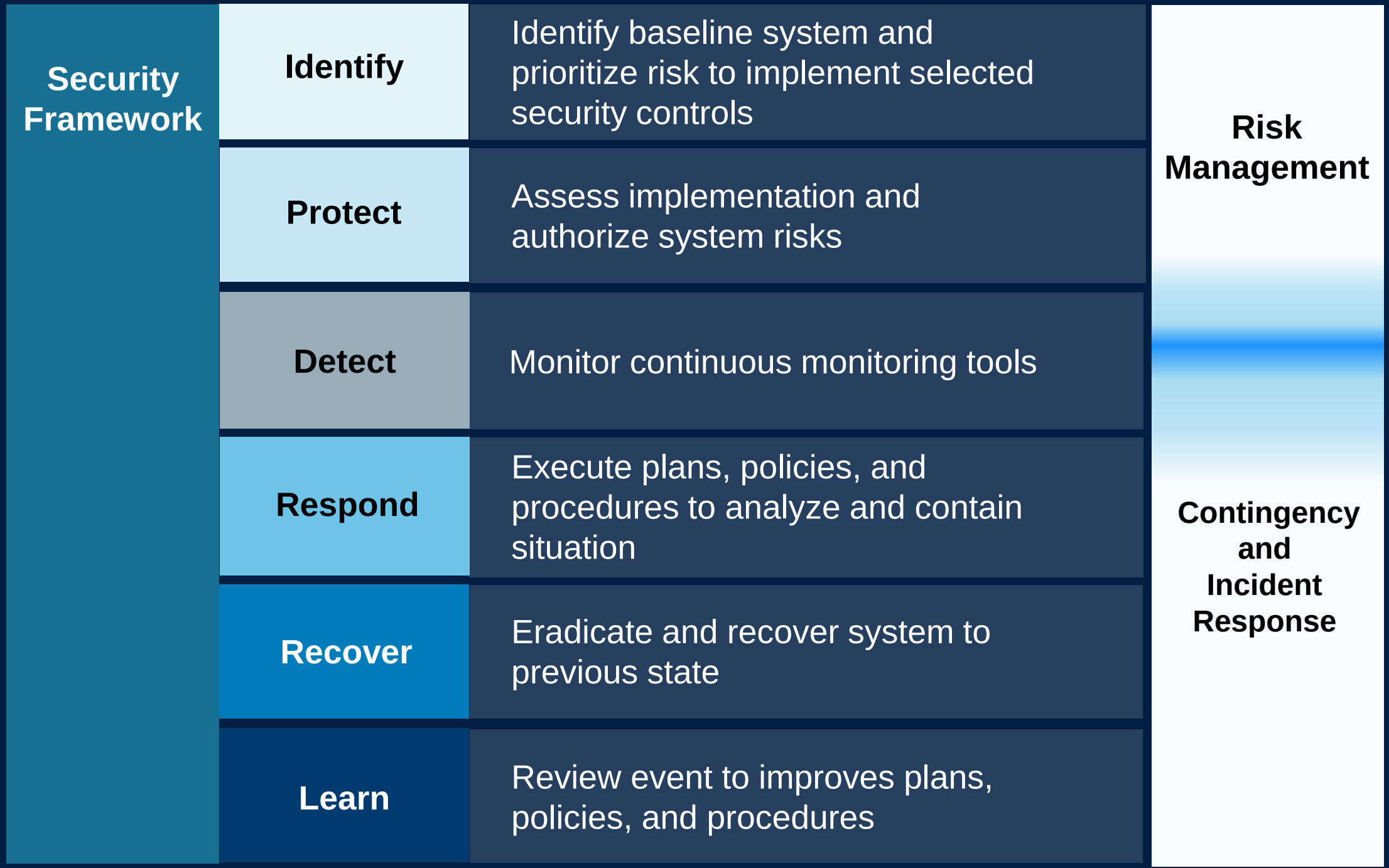
Important discussion for distributive generation

Not just cyber!

Framework

- National Institute of Standards and Technology (NIST)
- NIST Cybersecurity Framework (CSF)

The Cybersecurity Framework's prioritized, flexible, and cost effective approach helps to promote the protection and resilience of critical infrastructure and other sectors important to the economy.


Security Framework
Identify
Identify baseline system and prioritize risk to implement selected security controls
Protect
Assess implementation and authorize system risks
Detect
Monitor continuous monitoring tools
Respond
Execute plans, policies, and procedures to analyze and contain situation
Recover
Eradicate and recover system to previous state
Learn
Review event to improves plans, policies, and procedures
Risk Management
Contingency and Incident Response

Questions?