IPERC

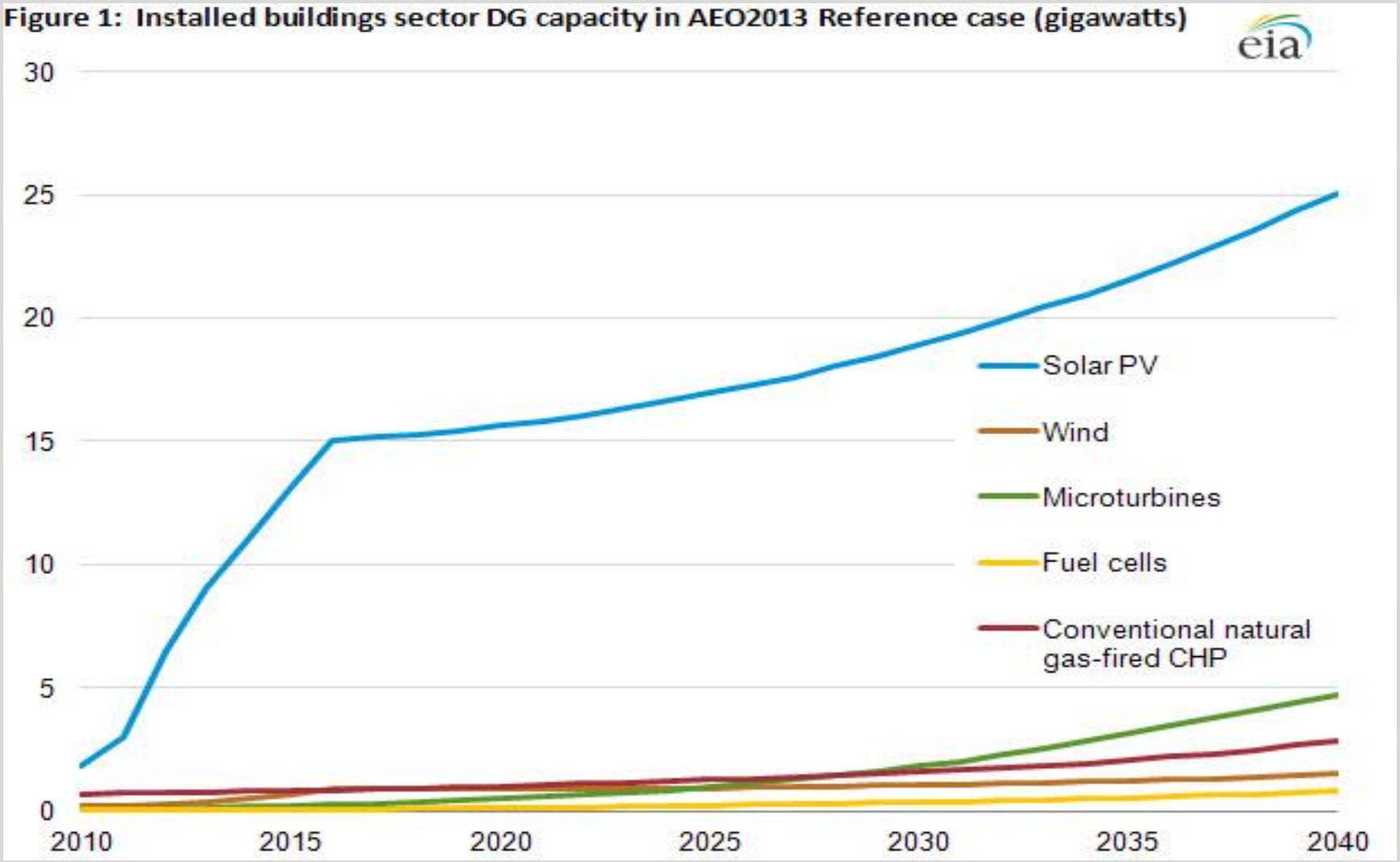
# *Maximizing Microgrids*

## The Top Issues Facing Development of the Ideal Microgrid

**ID # IDEA2016-37**

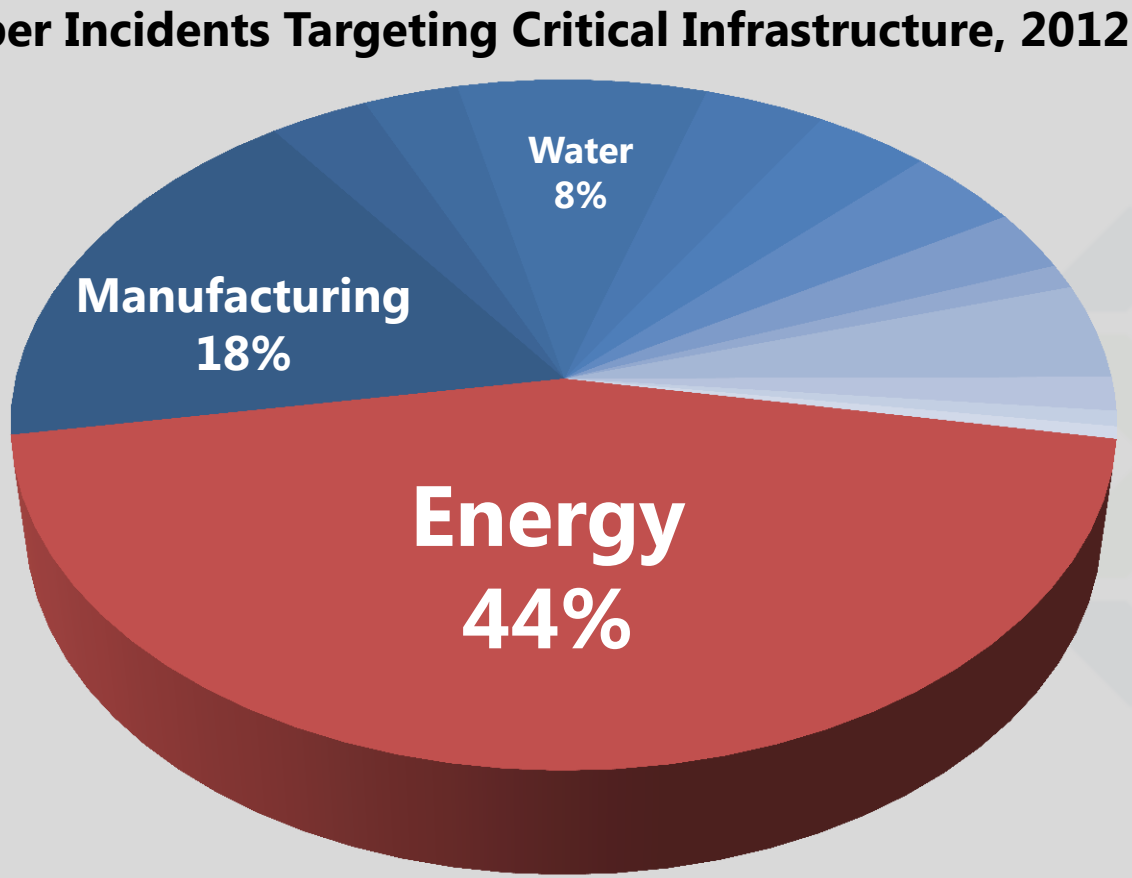
**John M. Carroll**

# Why Microgrids Now? Maximizing DER



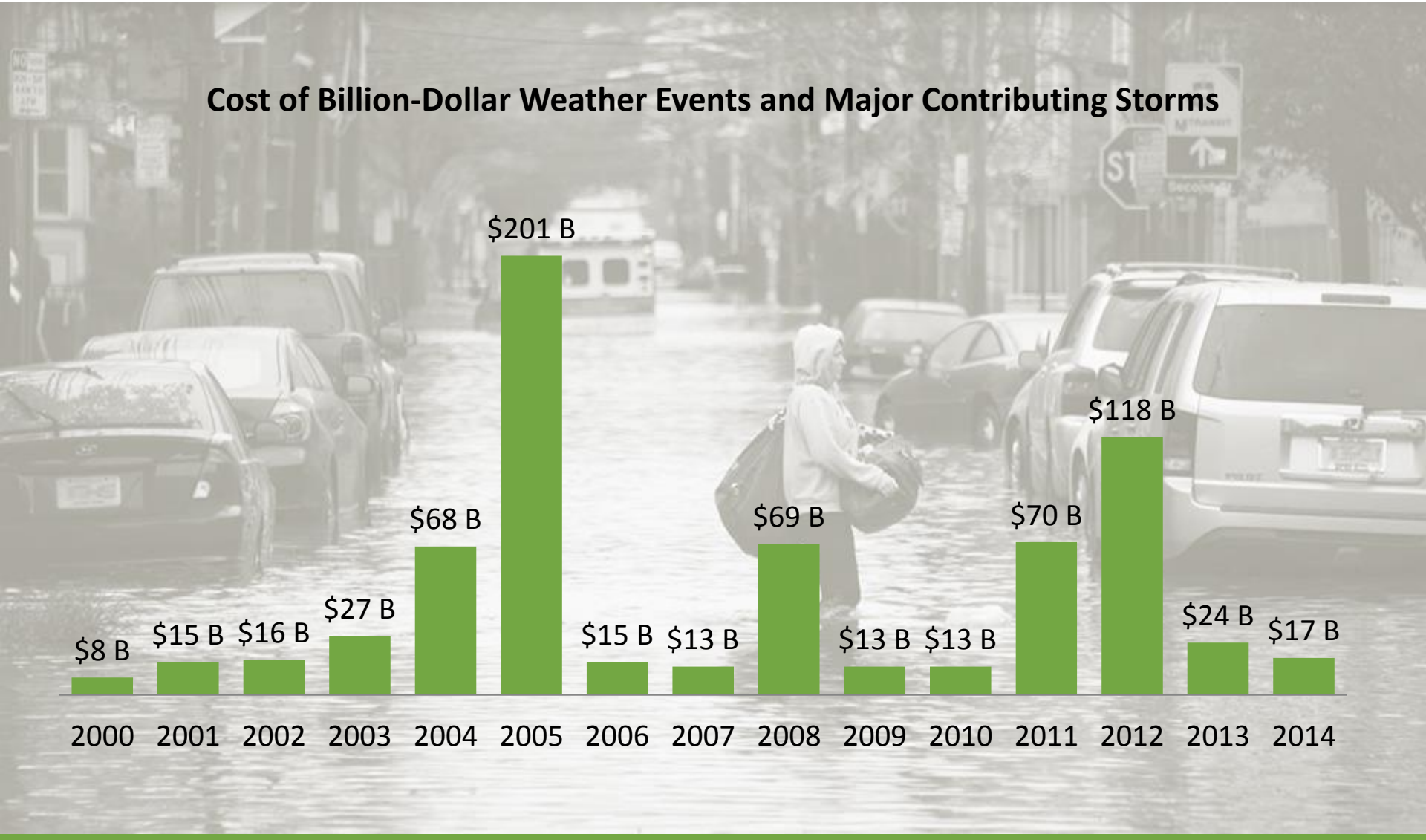

*** Courtesy of U.S. Energy Information Administration**

# Why Microgrids Now? Cybersecurity




*Voluntarily Reported. Source: ICS-CERT Monitor, October-December 2012; October-December 2013; October-December 2014*

# Not Once in a Century, but Twice a Decade



# Microgrid: Dept. of Energy Definition

"A group of interconnected **loads** and **distributed energy resources** with clearly defined electrical boundaries that acts as a **single controllable entity** with respect to the grid and can connect and disconnect from the grid to enable it to **operate in both grid-connected or island mode**."

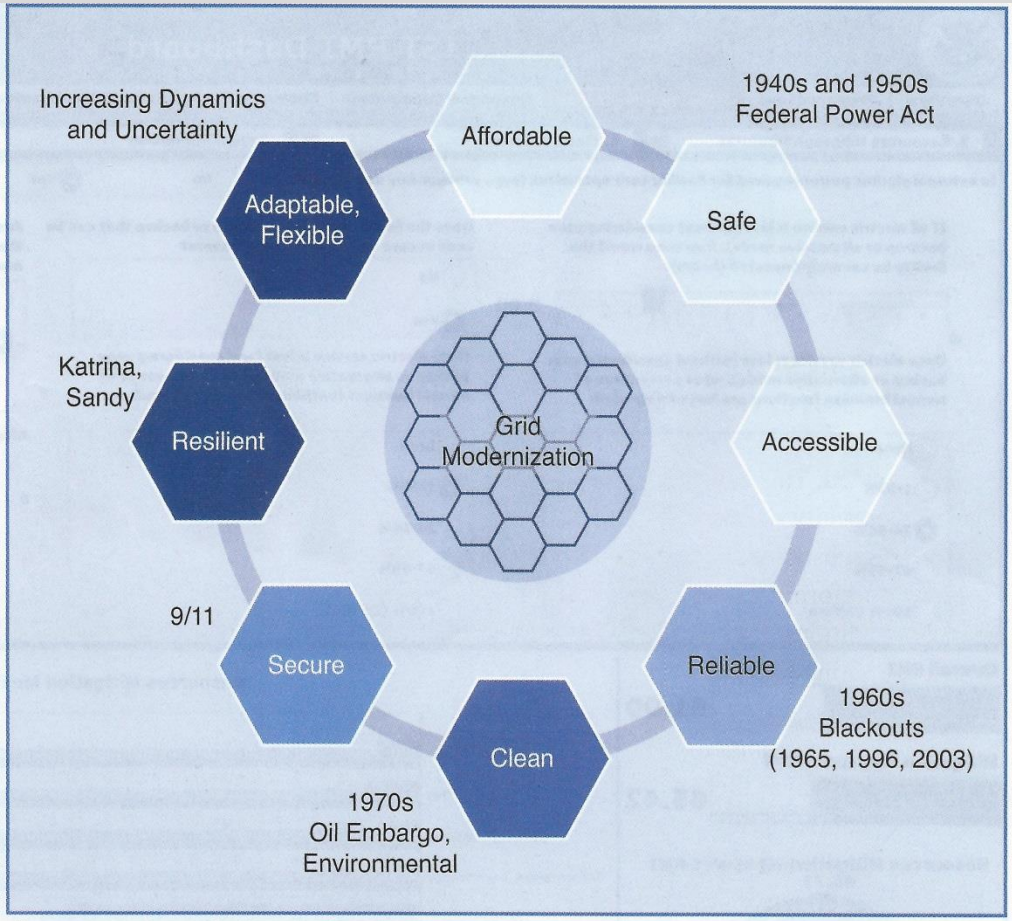
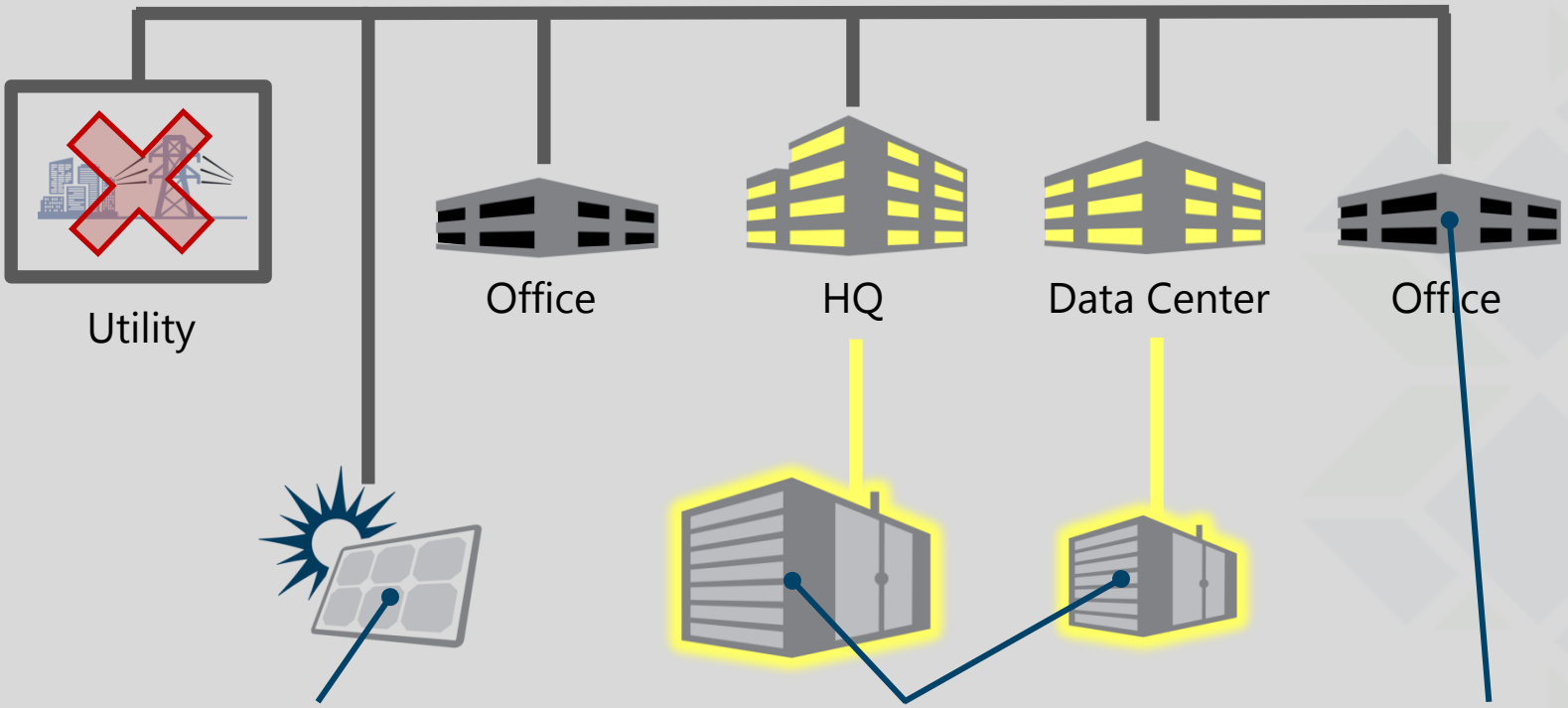



**figure 3.** The eight key attributes of a future electricity system, defined by the DOE GTT.

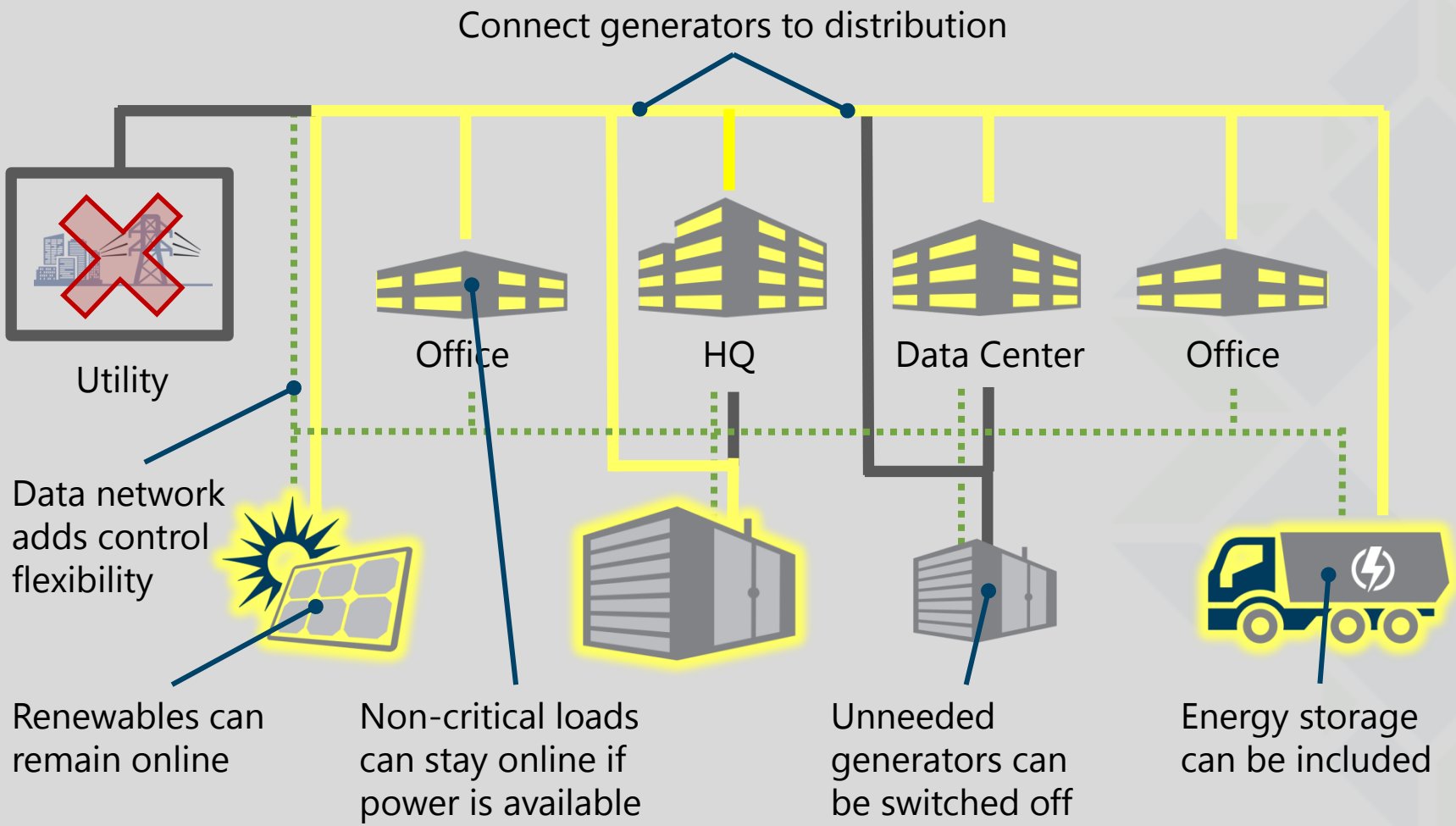
# Traditional Back-up Power Has Weaknesses



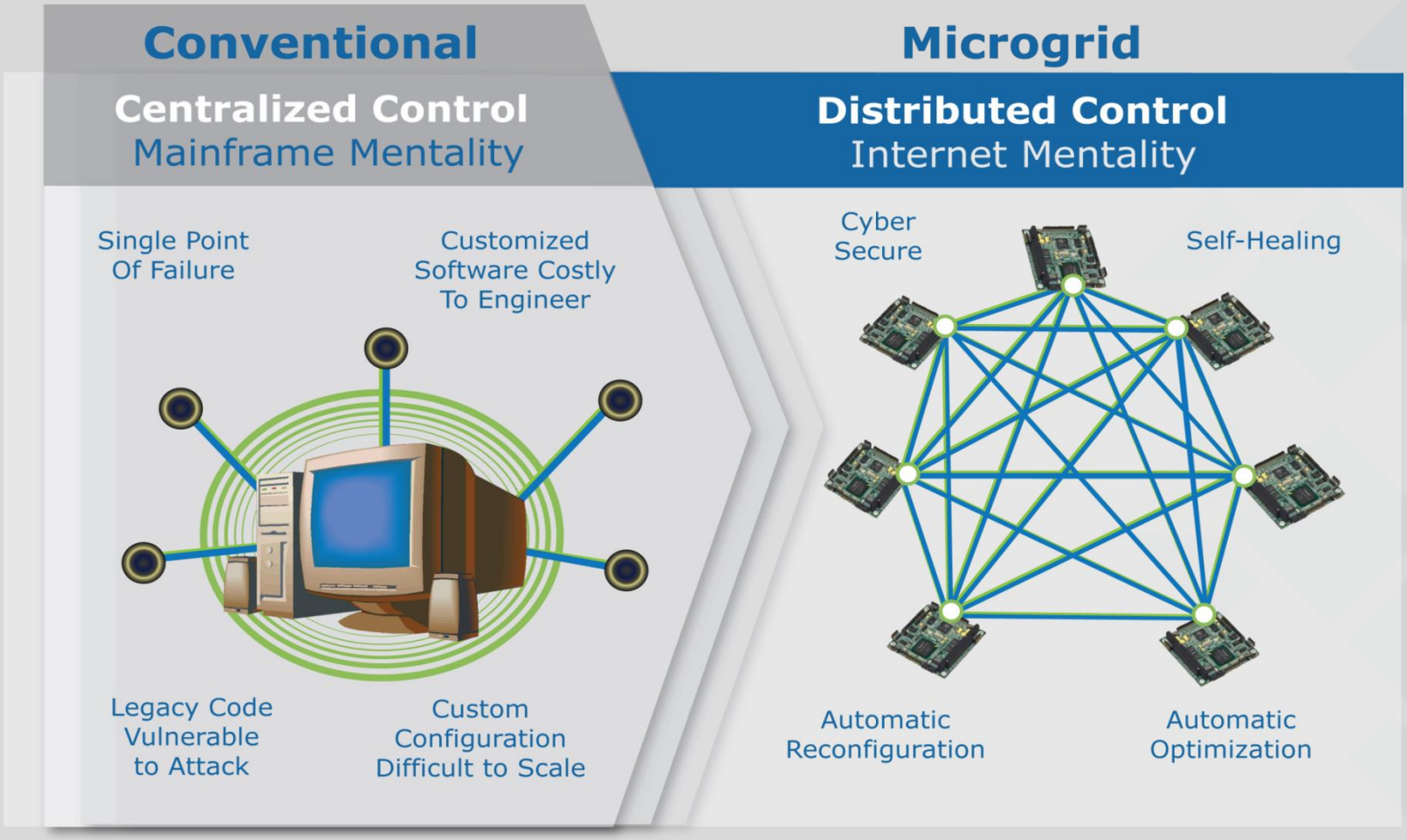
# Why Microgrids?

- Centralized power vulnerability
- Increased deployment of DERs
- Power for autonomous, intelligent communities
- Power resiliency under all circumstances
- Existing and Emerging threats (weather, cyber, etc.)
- 24/7/365 support for emergency services
- Increased energy efficiency and cost reduction

# Microgrids Improve Resilience & Flexibility



# The Future of Microgrid Controls Design



# GridMaster™ Microgrid Control System

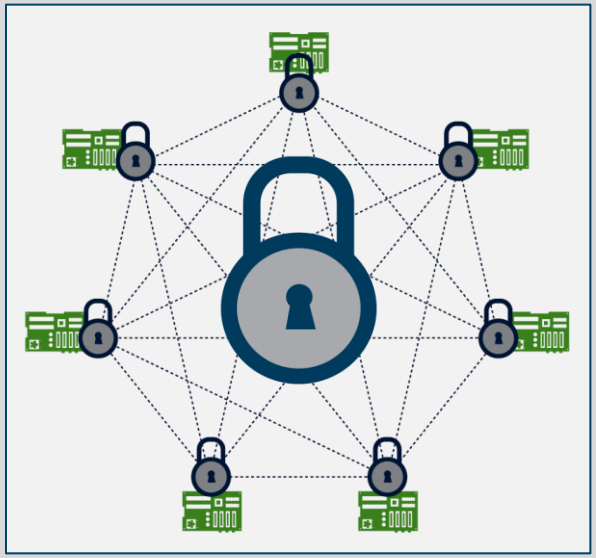
- **Characteristics**
  - Intelligent distributed controls
  - Peer-to-peer architecture;  No master-slave
  - Automatic self-healing and configuration
  - Autonomous balancing of generation and loads
- **Advantages**
  - Works with existing infrastructure and new power generation sources
  - Component vendor-agnostic
  - Dynamic adaptation to resource behavior
  - Graceful degradation
  - Components capable of isolated operation
  - Allows rapid inclusion of new technologies


***Distributed control means no master-slave and no single point of failure***

# Effective Cybersecurity = Defense in Depth

- Constantly moving target: Defenses must continually evolve
- No fixed solutions: Only robust processes for deep, multi-layered defenses
- Baseline assumption: Firewalls and intrusion detection will be defeated

- Applicable frameworks:
  - **NIST 800-82**, Guide to Industrial Control System Security
  - **NIST 800-53**, Risk Management Framework; App I Security Controls, Enhancements, and Supplemental Guidance
  - **DoDI 8500.2**, DoD IA Certification and Accreditation Process
  - **CNSSI 1253 App I**, ICS Security Overlay



***The control system must function with attackers inside***

# Cybersecurity Defense in Depth


Policies, Procedures, Training & Awareness

Physical Security


Perimeter Protection


Monitoring, Forensics

Encryption

Host Based Security

Access Control


Recovery, Patching

***GridMaster is the only control system with Approval to Operate (ATO) and Type Accreditation from DoD***

# Sites Seeking Microgrids for Energy Assurance

Electric Utilities

Military

Municipalities

Airports & Mass Transit

Water Treatment

Medical & Laboratory

Commercial & Industrial Campuses

Islands & Developing World

# Challenges Facing Microgrid Growth

- Microgrids are inherently complex
- Users want resilient power, but hesitate to build, own, operate
- Buyers don't have a microgrid mentality (yet)
- Limited experienced system integration vendors
- Business model definition for utilities & ownership
- Policy/regulatory restrictions

# Take-Aways

- Communities require rapid response & automatic optimization
- Redundancy increases resiliency; Self-healing mitigates contingencies
- Optimizing energy sharing saves cost & improves efficiency (when grid connected & islanded)
- Distributed architecture provides highest degree of scalability & flexibility
- Controls technology must support multiple generation types
- Communication flexibility is key! Fiber, ethernet, wireless, PLC, etc.
- Cybersecurity? Investment in critical infrastructure…why not secure it?

The value add of backup generation is measured in risk mitigation

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# THANK YOU


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