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*We never forget who we are working for®*

# INTELLIGENT MICROGRID SOLUTIONS™

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**EFFICIENTLY, SECURELY & RELIABLY  
MEETING ENERGY CHALLENGES**



# Current Power Infrastructure Challenges



## Operational

- **Logistics**
  - Transportation requirements and costs
    - Equipment size and weight
- **Fuel Expenses**
  - Skyrocketing fuel costs
  - Fuel convoys put soldiers' lives at risk
- **Inefficient energy generation**
  - Oversized, redundant generators support FOB loads
- **Legacy Equipment**
  - Lack of Renewable Energy sources
  - Modifications required to interface with an updated power infrastructure

## Fixed Installation

- **Current Infrastructure**
  - **High reliance on utility grid**
    - Blackouts/Brownouts
    - Expensive Utility demand charges
  - **Inconsistent/sporadic use of renewable energy**
  - **Inefficient Backup generators**
    - Legacy Equipment
    - Only used during emergencies
    - High capitol and operating costs
- **Major source of DoD's GHG emissions**
  - Contributing nearly 40% of DoD total
  - Driving DoD energy and environmental mandates



# Intelligent Microgrids



An integrated energy system intelligently managing interconnected loads and distributed energy resources, including renewables, that operates seamlessly with an existing power grid or in an independent mode

## Operational



Reduce fuel consumption in theater—reduce logistics, cost, and lives lost

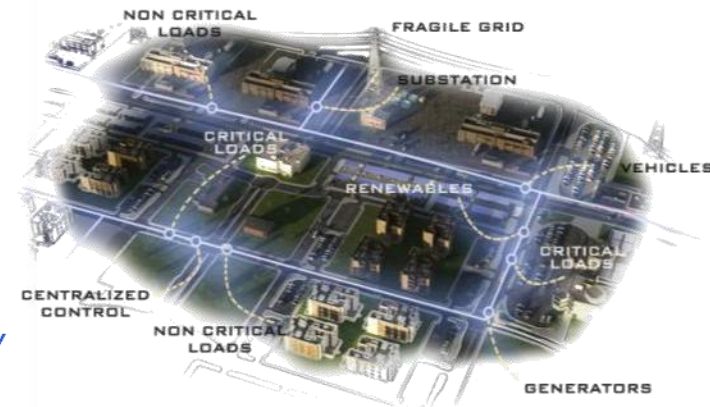
**Increases Efficiency**  
*Reduce fuel consumption*  
*Peak Shaving - Decrease cost*

**Increases Reliability**  
*Optimally manage resources*  
*Real-time monitoring/control*

**Provides Security**  
*Advanced cyber solutions*  
*Bulk grid independent capability*

**Reduces Carbon Footprint**  
*Easily integrates renewables*

## Fixed Installation



Enhance energy security:  
Surety, Survivability, Supply,  
Sufficiency, Sustainability

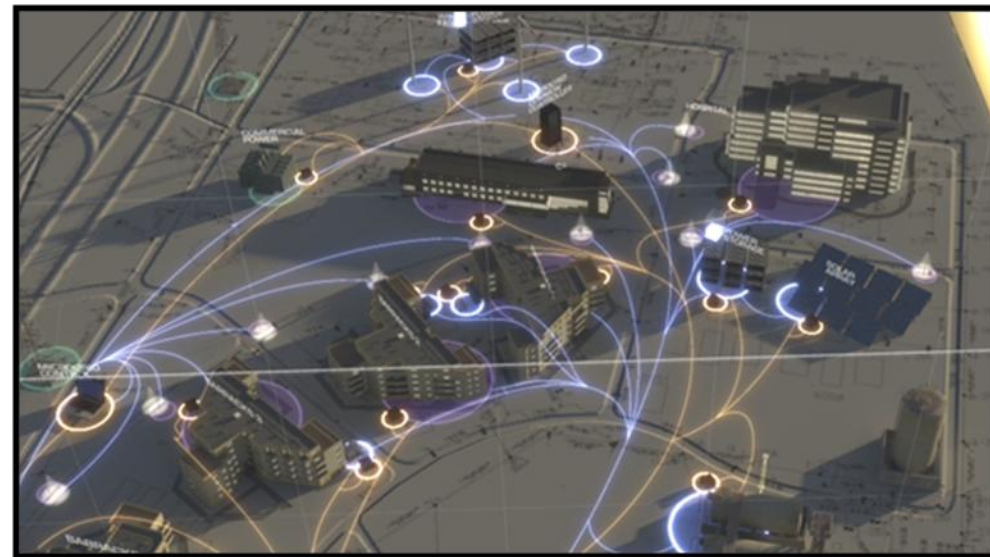




# Key Characteristics of an Intelligent Microgrid

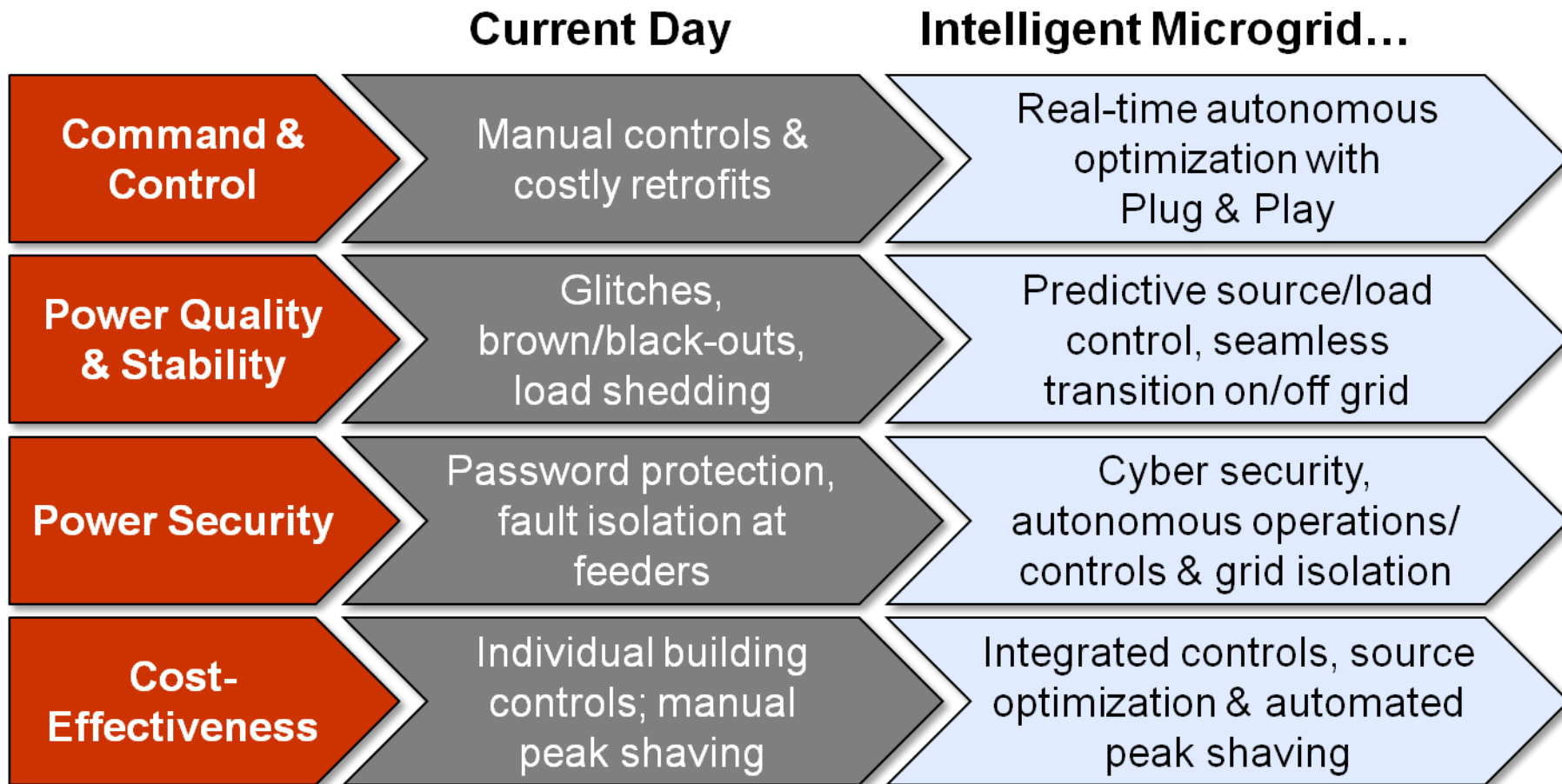


- Intelligent centralized and distributed control
- Algorithms to optimize operation
- Fast and secure communications
- Resilient fault coordination and recovery
- Plug-and-play integration of sources and loads
- Multi-mode operation based on customer requirements





# Paradigm Shift



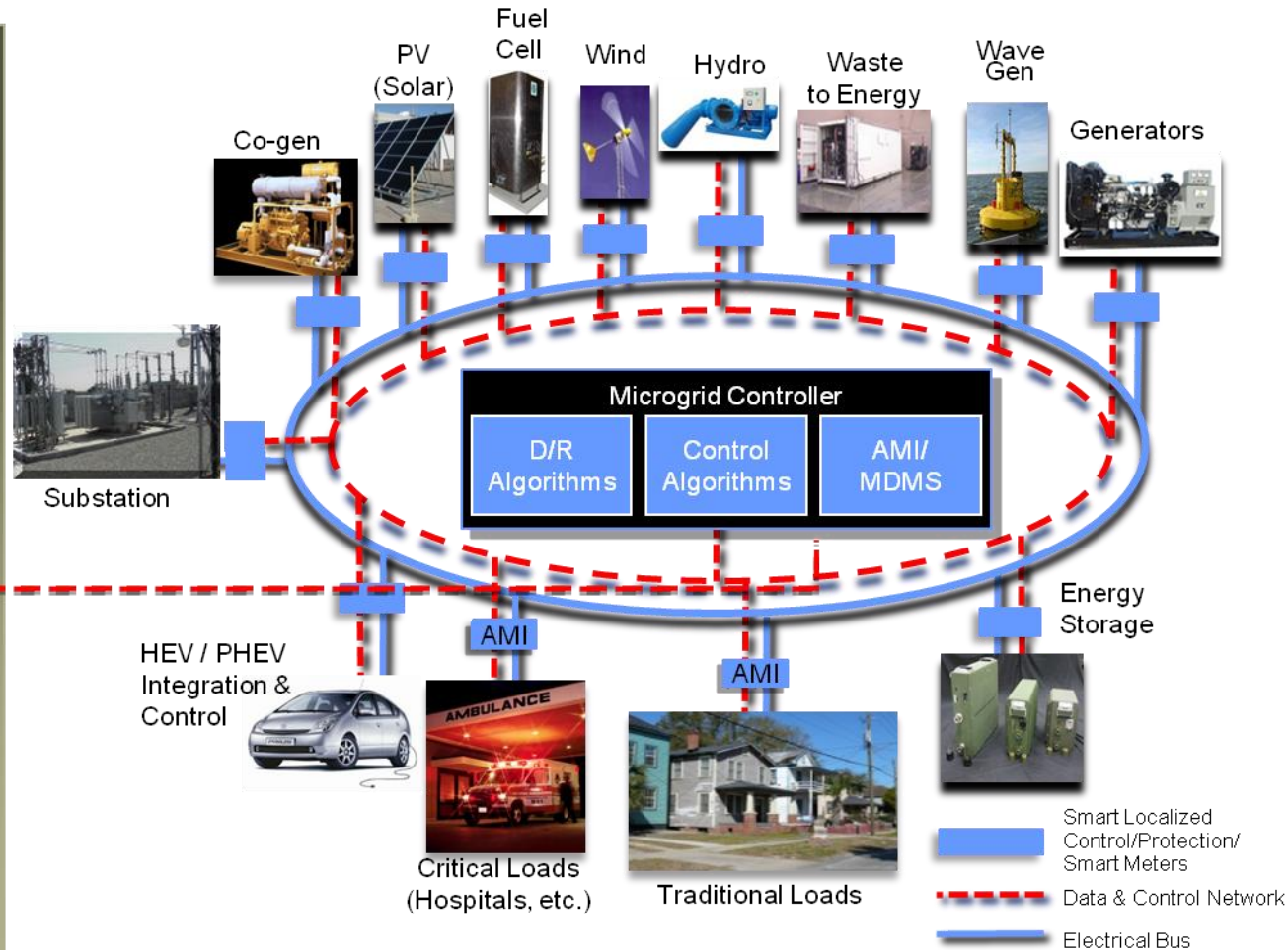
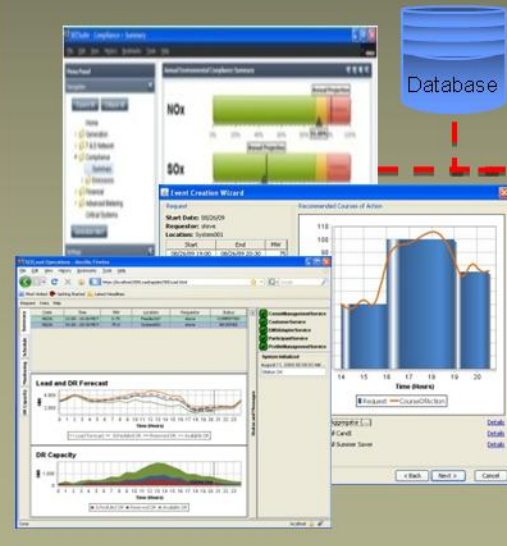


# Site-Specific Energy Needs



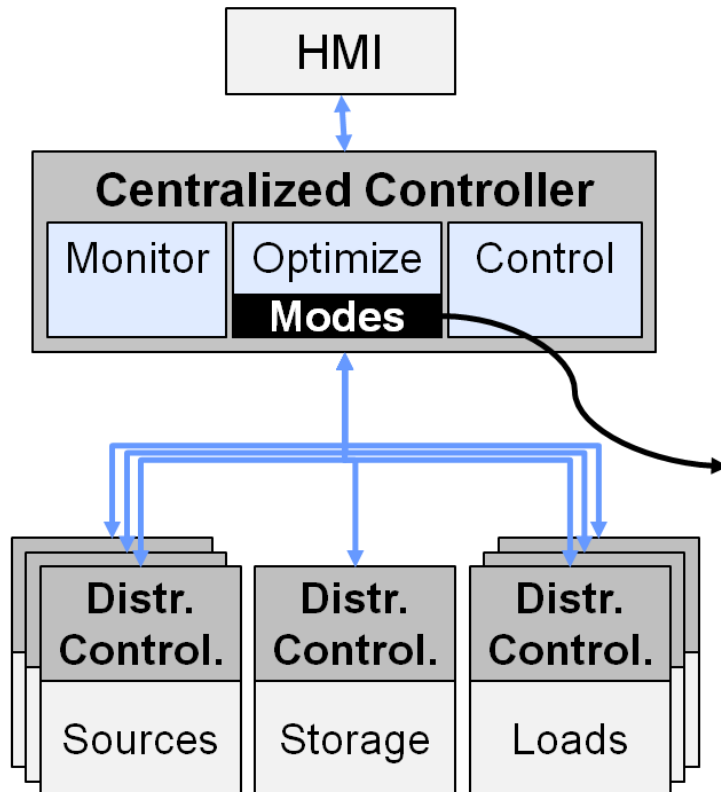
## Microgrid Control

- Real-time monitoring and control
- Continuous cost and efficiency analysis
- Protection and control status





# An Intelligent Architecture



- **Centralized controller**

- Optimizes source/load based on mode
- Provides interface to external systems

- **Distributed Controllers**

- Monitor/control sources, loads & storage
- Real-time response & fault protection
- Can run without centralized controller

Ex: Modes	When	Goal
Economizing	Normal operation	Minimize cost/fuel
Surety	Emergency event	Power to critical loads
Increased Optempo	Customer-defined	Pre-set reprioritization of sources/loads





# Distributed Resource Controllers (DRCs)



- **DRCs communicate with Power Sources and Loads**
  - Via real-time comms utilizing various industrial protocols and discretes
    - Perform device data acquisition
    - Send device commands
- **DRCs communicate with the Microgrid Centralized Controller (MCC)**
  - Provide data to MCC for Cost/Fuel Optimization and HMI reporting
  - Process MCC requests to modify source/load operation
- **Additional DRC functionality**
  - Provide device fault handling and protection
  - Run autonomously during loss of centralized control
  - Ensure secure communications to other devices
  - Run algorithms and process complex calculations





# NI Products in Microgrid Applications

- **NI's Compact RIO (cRIO) platform supports a versatile list of**
  - Widely used comms protocols
  - C Series I/O modules for monitoring discretes
  - VxWorks Real-Time processor
  - FPGA options
  - Functions and Algorithms (NI code base)
  - Packaging options
  - Industrial HW and SW standards (IEEE, UL, etc.)
- **Other important Microgrid-related cRIO features:**
  - Processing capability
  - Ruggedness for harsh environmental conditions
  - SW and HW scalability
  - Expandability



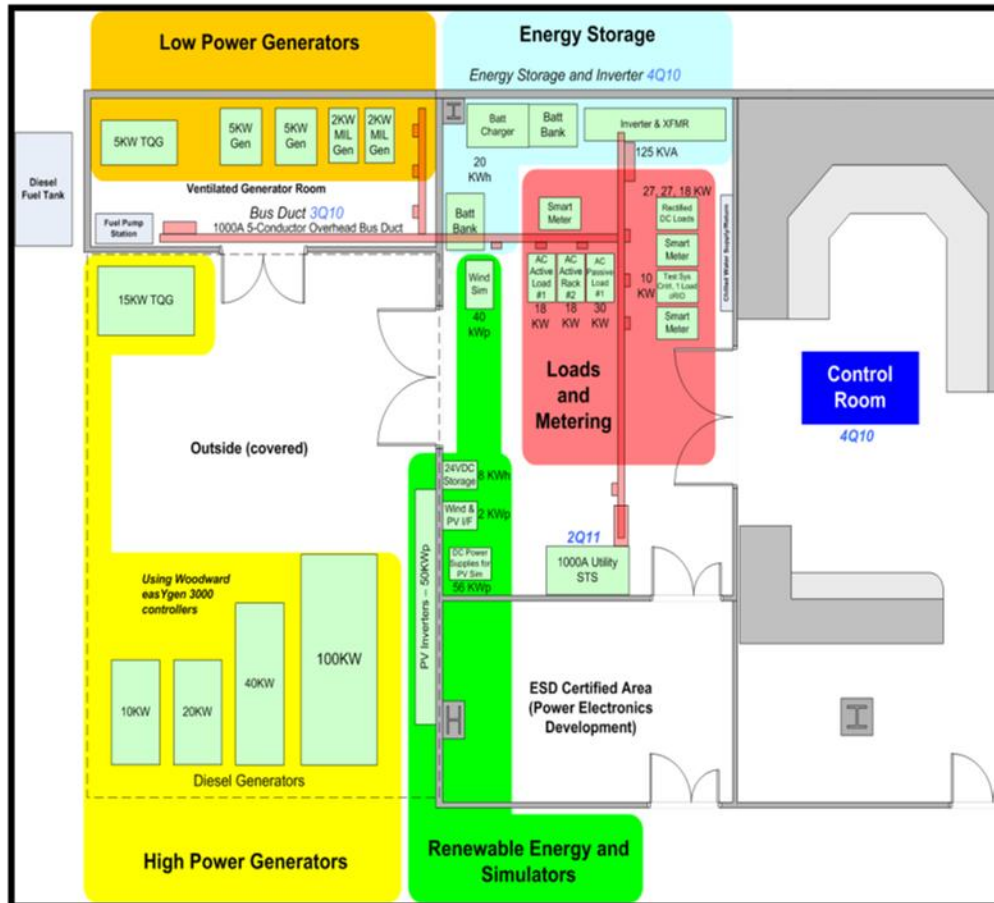
## DRC Example: Energy Storage

- **Energy Storage System includes**
  - Energy Storage (e.g. Lead Acid Batteries)
  - Charger
  - Inverter
- **Multiple Communications Interfaces**
  - Modbus TCP/IP
  - CAN
  - Analog I/O
- **Device Data Acquisition**
  - Polling data (~milliseconds)
- **Fault Identification/Handling**
  - Reporting Alarms that require Human In the Loop
  - DRC Control Logic/Algorithms
- **Device Control**
  - Sending commands to individual devices to ensure
    - System/Device Optimization
    - System/Device Surety





# Microgrid Development Center



- Diverse set of prog. sources & loads
- Renewables & energy storage
- Real-time monitoring & control
- Integrated with simulation



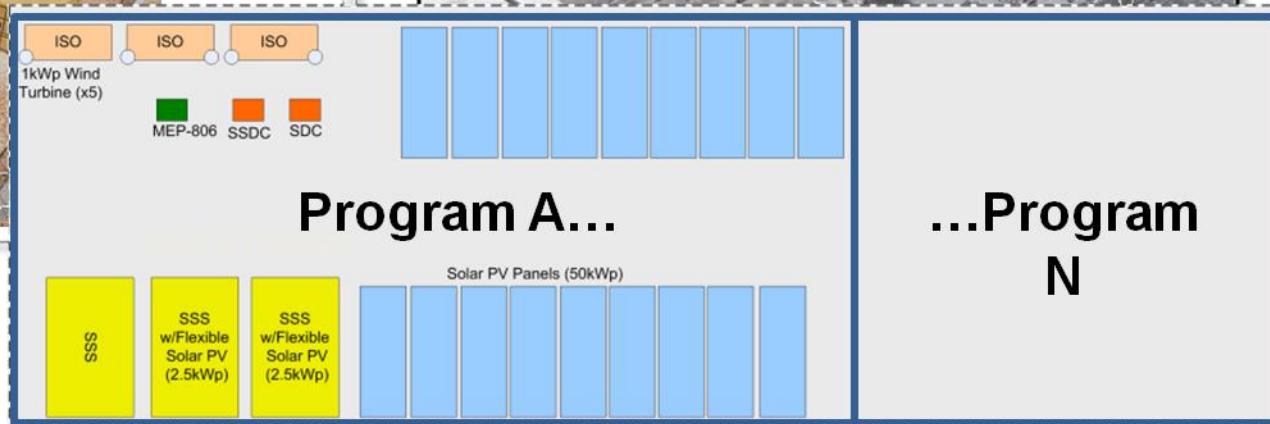
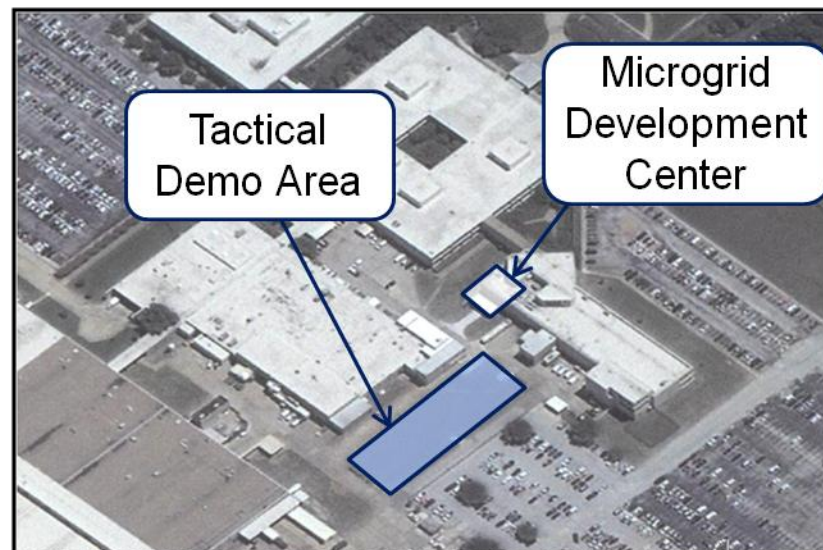




# Tactical Demonstration Area



- Dedicated, fenced, secured area
- 100' X 300' high voltage area
- Easily reconfigurable
- Integrated with MDC







# Current Microgrid Projects



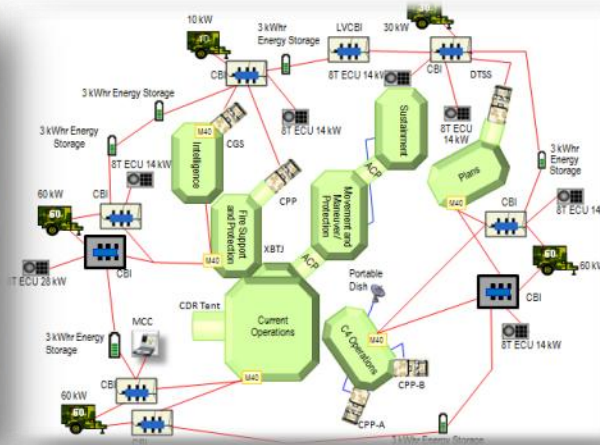
Intelligent Source and Load Management to Enhance Energy Security, Surety, Survivability, Supply, Sufficiency, Sustainability

## Ft. Bliss BCT Microgrid



- Renewable integration
- Peak shaving
- Energy storage
- Reduce Carbon, Costs
- Enhance energy security

## Army HI-Power



- Reduce fuel consumption
- Reduce weight & logistics
- Integrate energy storage
- Renewable energy capable
- Flexible/Scalable - PnP

## Air Force ISBPS



- Reduce fuel consumption
- Renewable integration
- Flexible/Scalable/Modular
- Improved reliability
- Expeditionary design

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