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Centennial Campus Smart Grid Master Plan Presentation

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Centennial Campus Smart Grid Master Plan

NCSU Centennial Campus

- 1,000 Acre "Technopolis"
- Partnership of public/private entities
- Promote academic/research collaboration
- Now 4.0 mil gsf of 7.0 mil gsf @ build-out
- Evolving Thermal District Energy System
- 23kV distribution from a 230KV Substation
- Over 60 corporate and government partners including ABB and FREEDM Center

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Centennial Campus Growth

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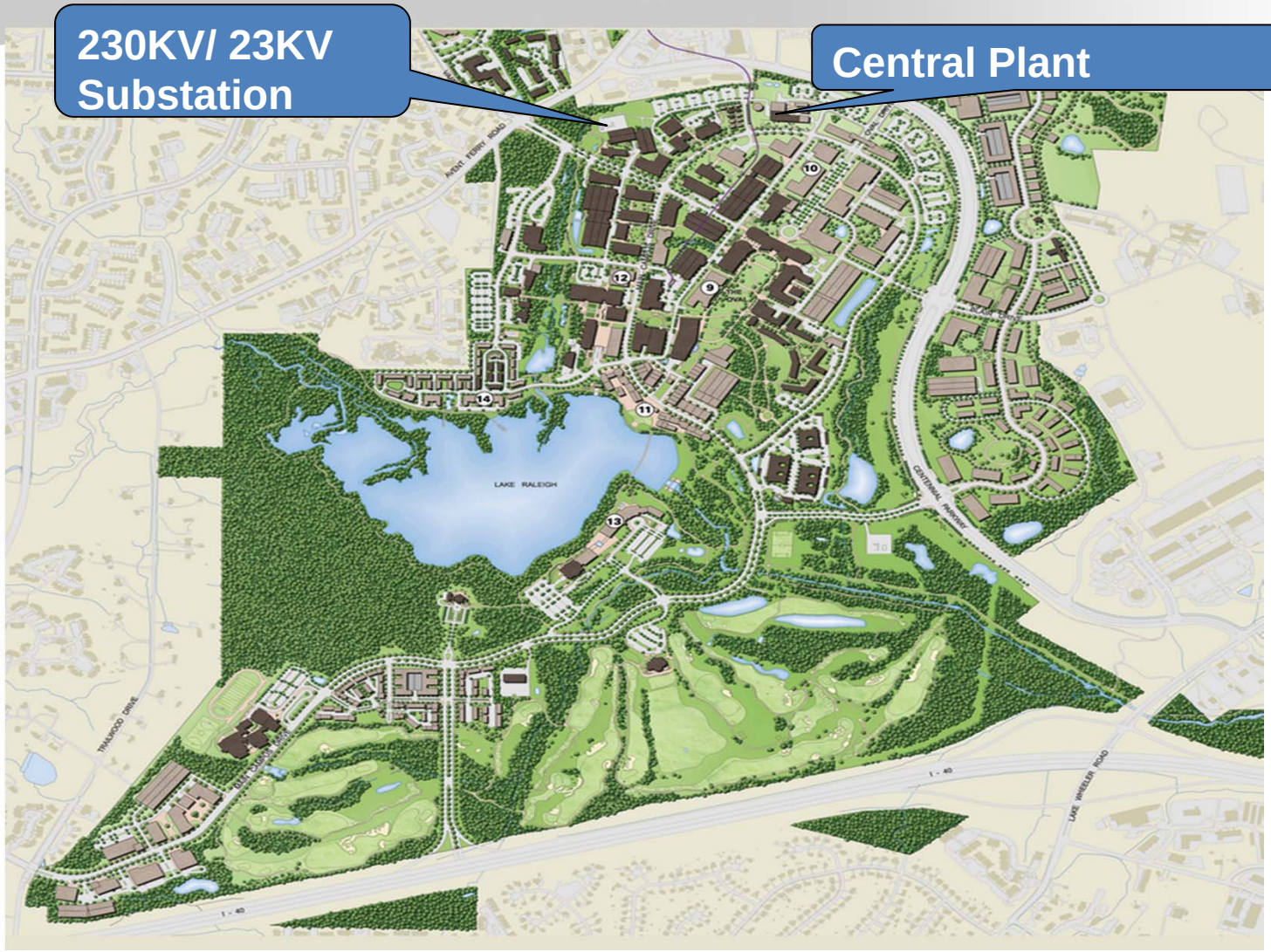

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Smart Micro-Grid Goals at Centennial

- **Reliability and Flexibility** - of the energy distribution infrastructure
- **Research** - Provide smart micro-grid infrastructure to promote/demonstrate R&D…….. “Proving Grounds”
- **Efficiency** - Reduce energy consumption and cost
- **Private Industry** – Attract Partners
- **Framework** - Develop a long term framework for expanding and refining the micro-grid.

Centennial Campus Smart Grid Proving Grounds

- **Objective** – Engage academics with the campus infrastructure program to provide a "Test Bed"
- **Goals**
  - »Protect Reliability of Electrical Service
  - »Collaboration between Utility Staff, Faculty, and Corporate Partners
  - »Next Generation Thinking and Tech Transfer
- **Physical Attributes**
  - »Medium Voltage Test Facility
  - »Low Voltage Lab
  - »DC Generation & Distribution

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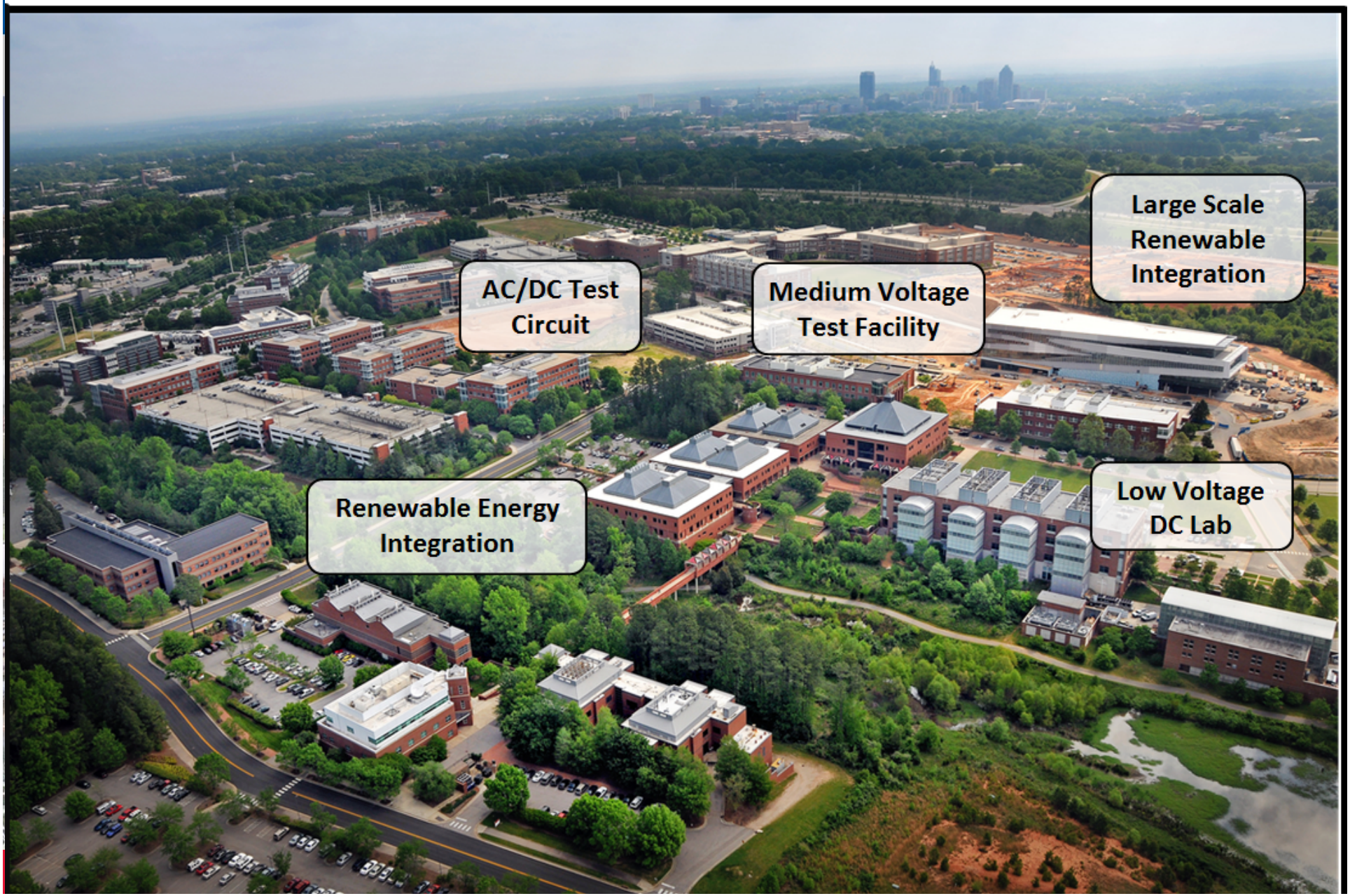
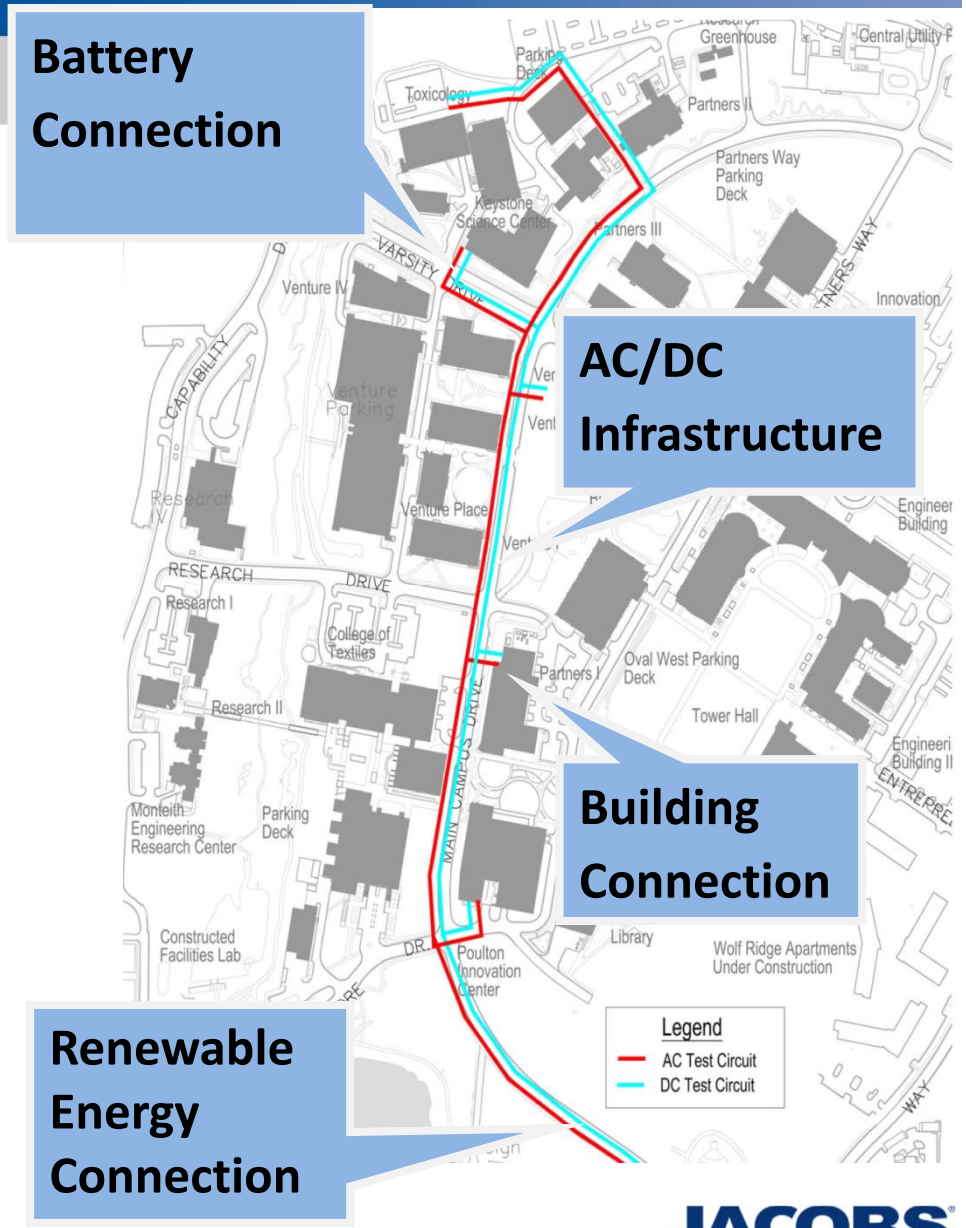
Smart Grid Proving Grounds - Research Support Infrastructure



AC/DC Test Circuit

- Medium voltage AC/DC test loop
- Ability to test in real world scenario the technology being developed on campus
- Connection to PV and research with FREEDM Center



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Low Voltage DC Lab

- Showcase and test low voltage DC
- Abilities could include testing of the following:
  1. Consumer Electronics
  2. Lighting
  3. Renewable Energy Connection
  4. Data Centers or Server Hubs

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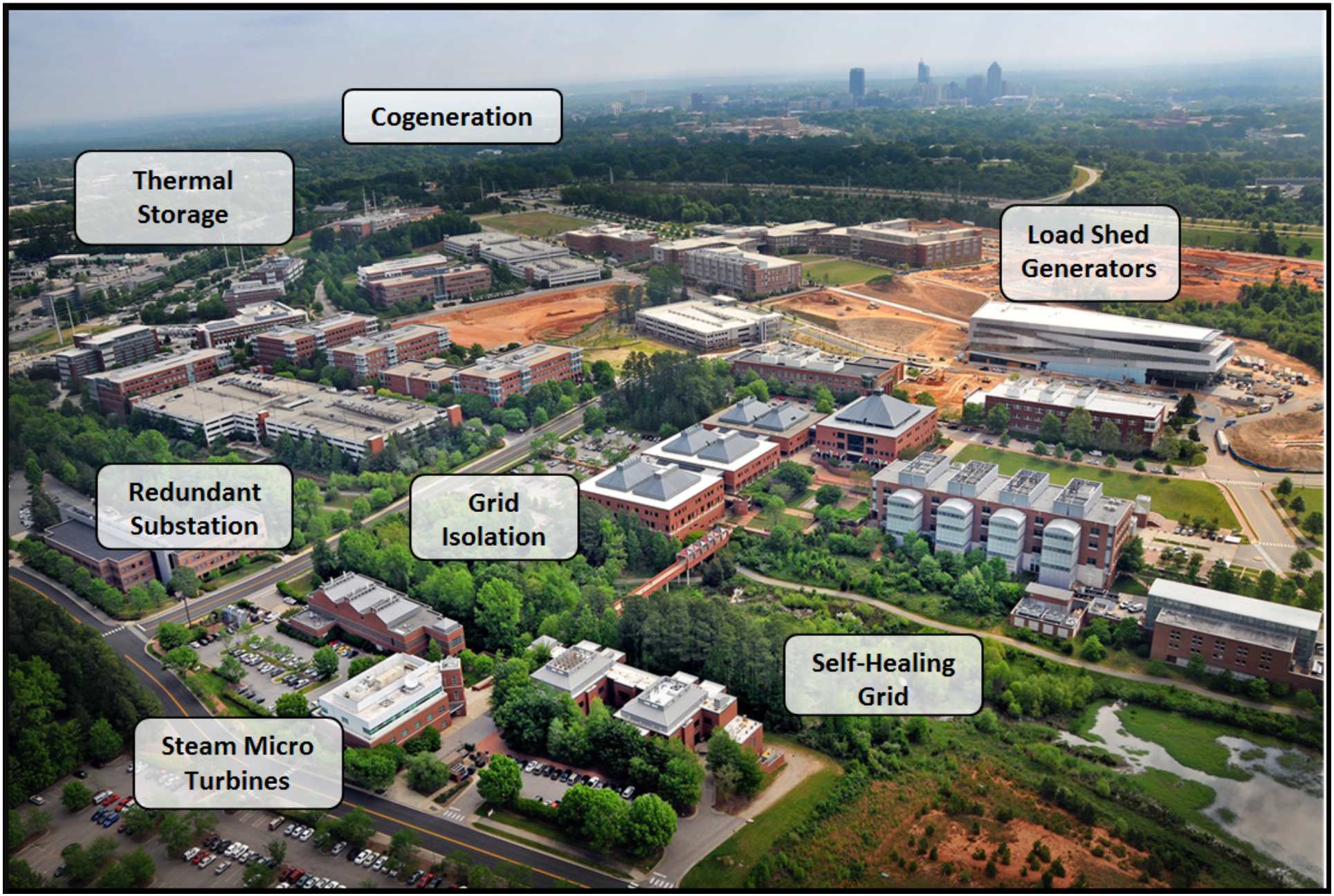
Smart Grid - Distributed Generation and Resiliency



Distributed Generation

- Cogeneration
  - » 5.7MW combustion turbine & 900kW steam turbine with 50,000lb/hr HRSG with duct burner
- Thermal Storage
  - » 4 million gallon storage tank. Provide load shedding and redundancy
- Steam Micro Turbines
  - » Replaces pressure reducing stations at the buildings
  - » Needs a minimum of 4,000lb/hr year round to be successful

Grid Resiliency

- Grid Isolation
  - » Full Isolation – Isolate from the grid at anytime
    - Isolate due to high electric cost or reliability issues (Requires 15-30MW)
  - » Emergency – Provide campus generation during long term power outages
    - Only to run essential buildings and equipment (Requires 5-20MW)
- Self Healing Grid
  - » Utilize intelligent control system to automatically detect and isolate faults
  - » Currently implementing a sectionalized self-healing grid

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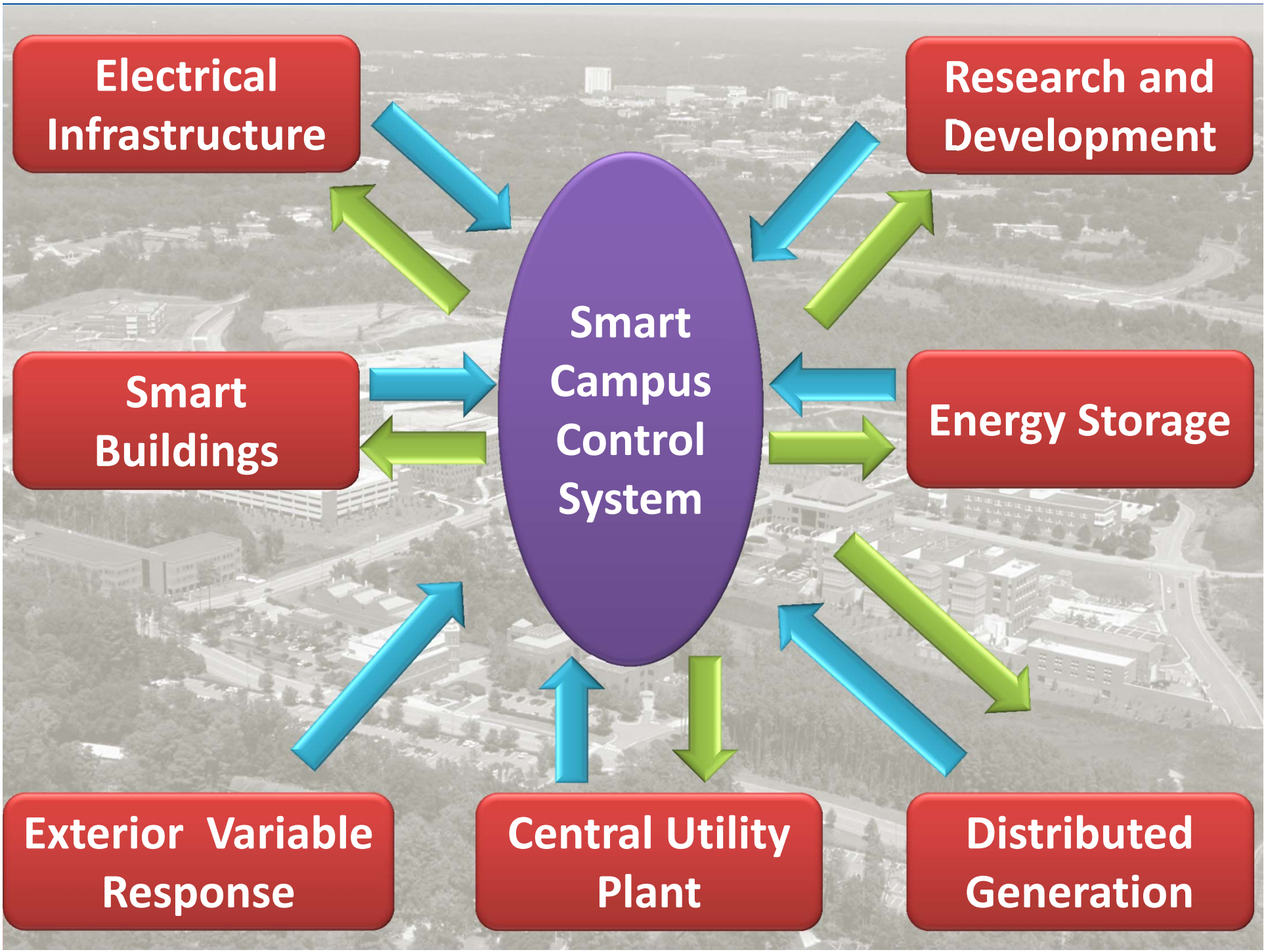
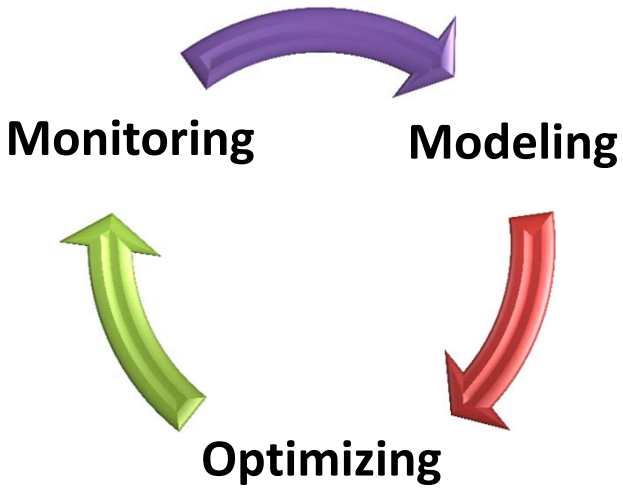
Smart Grid – Energy Optimization


Electrical Infrastructure
Research and Development
Smart Campus Control System
Smart Buildings
Energy Storage
Exterior Variable Response
Central Utility Plant
Distributed Generation

Smart Campus Control System

- Implement enterprise level system to connect to existing plant and buildings control systems to create an integrated energy system
- Develop a unified energy strategy for the campus to enhance total efficiency and not just local efficiency
- By leveraging existing equipment and economy of scale the economics of system implementation are advantageous



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Smart Campus Control System Components

- Smart Metering
  - » Energy Engagement Dashboard and Building Benchmarking/Monitoring
- Continuous Commissioning
  - » Monitor key pieces of equipment against a set of algorithms and rules to determine if the equipment is functioning properly
  - » Develop a prioritized list of equipment faults based on estimated energy cost
- Energy Optimization
  - » Develop a daily energy operating strategy for the campus thermal systems to reduce peaks and optimize energy consumption

Smart Campus Control System Components

- Demand Response
  - » Supply Air/ Space Temperature/ Chilled Water Demand Response
  - » Campus wide implementation allows for real savings
- Automated Set Point Control
  - » Define a set of rules for spaces and equipment and if set points are outside the parameters of rules the system will reset set points
  - » Prevents temporary fixes from becoming permanent energy problems
- Campus Data Access
  - » Allow researchers to mirror the system to complete smart grid research via simulations of the campus systems with impacting campus operations

Next Steps for Smart Micro Grid

- Establish SCADA and Monitor Switching of electrical grid to improve resiliency
- Integrating BAS, central plants, substation, and other control systems for both the supply and demand
- Distributed Generation and Storage
- Organizational Structure to Develop and Operate the Micro Grid

Lessons Learned

- Plan So You Can Plan!
- Create a Tool to Tell the Story & Make the Case
- Look for Opportunities/ Partnerships – Build It and They Will Come
- Understand the Complexity of Integration
- People Make It Happen – Hire Good.
- Build for the New Grid Economy

Questions

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