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DESIGN BUILD CONSTRUCTION STREAMLINING DG & CHP BASED MICROGRIDS

Microgrid 2.0
Advancing Industry Growth

Introduction

How to BUILD a Microgrid that meets a facility's GOALS with their available MEANS

- Project Goals
- Contract Structures
- Managing Risk
- Example Projects

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Common Project Goals

- Resilient
- Energy Savings/Sustainability
- Minimal Capital Cost
- Increase Capacity
- Short Schedule
- High Quality Performance
- Minimum Impact on Operations

Goals need to be <u>DEFINED</u> & <u>PRIORITIZED</u> to create a successful project structure

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Contract Structures

- Design, Bid, Build
  - Facility owner or program manger is responsible for managing engineering, bid process (equipment & construction), and construction manager separately
  - Facility owns assets when project is complete
  - Long schedule, low first cost, high owner risk
- Traditional EPC (Engineering, Procurement and Construction)
  - Facility owner or program manger is responsible for defining project scope for bidding
  - EPC Contractor is responsible for detailed design, equipment procurement & construction
  - Facility owns assets when project is complete
  - Possible shorter schedule, more first cost for owner, less owner risk
- DBOOM (Design, Build, Own, Operate and Maintain)
  - Little owner involvement
  - DBOOM takes full responsibly of defining scope, detailed design, construction, asset ownership, operation and maintenance
  - Faster schedule, higher first cost or lower savings, lowest owner risk

Managing Risk

DESIGN, BID, BUILD

Safety Schedule Costs Performance

Facility Owner Separate Contractors

EPC

Safety Schedule Costs Performance

Facility Owner EPC Contractor

DBOOM

Safety Schedule Costs Performance

Facility Owner DBOOM Contractor

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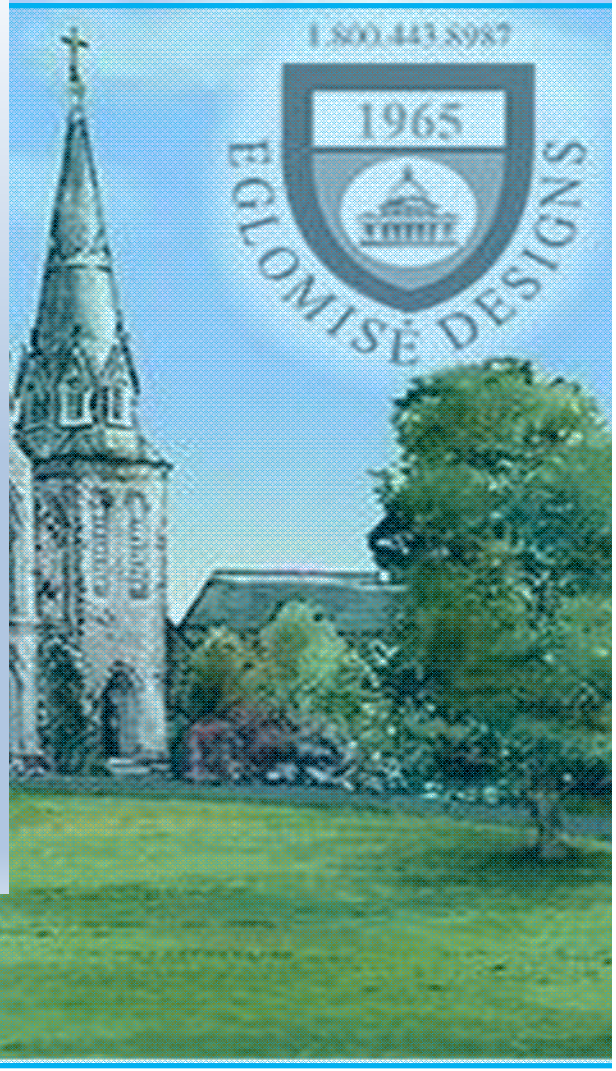
Villanova University

- Private Catholic University
- 10,000+ Undergraduate Students
- February 2014 Ice Storm
  - Campus completely lost utility power
  - Closed campus, sent students home
  - Major cost implications



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Villanova Goals

- Low Project Cost
- Increase Campus Resiliency
- Min. Impact on Campus Operations
- Fast Schedule
- Energy Savings

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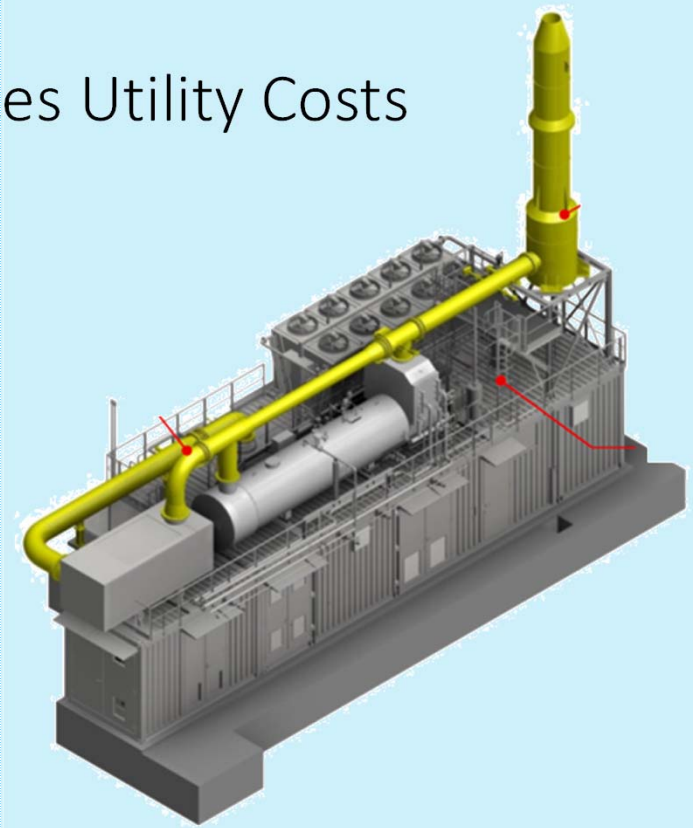
Low Project Cost

- Fully Financed By Developer Through Energy Savings
  - Villanova Did Not Fund Project - $0
  - Demand Management Strategy Reduces Utility Costs
  - Shared Energy Savings
  - CHP Grant for 1 Unit
- Simple Design
  - Prepackaged Units – Limit Field Labor
  - Limited Run Hours to Avoid SCR
  - Minimal Impact on Campus Utilities



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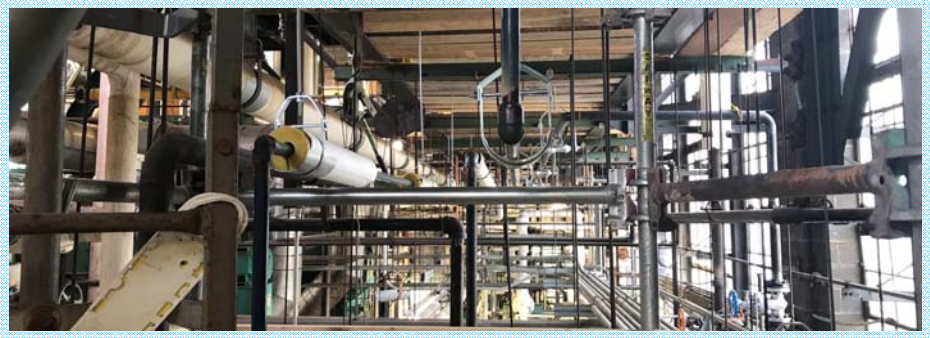
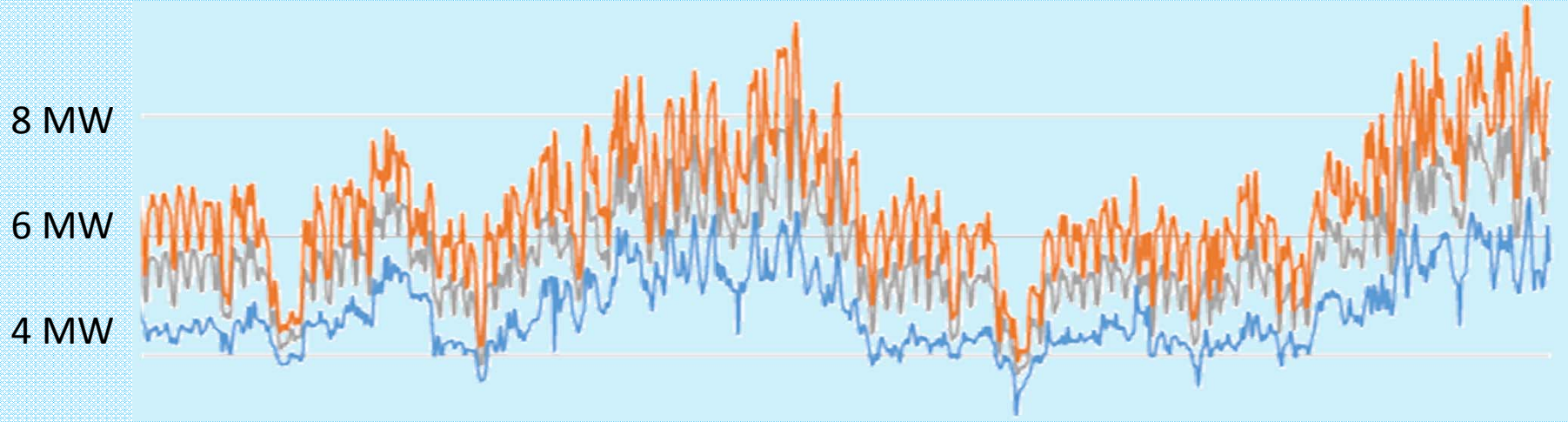
Increase Campus Resiliency

- Installed 3 (2MWe) Reciprocating Engine Generators
  - Lean Burn Natural Gas
  - 1x CHP Unit Produces Steam
  - 2x Simple Cycle Unit



- Annual Electrical Demand (Daily Min. Average & Max.)



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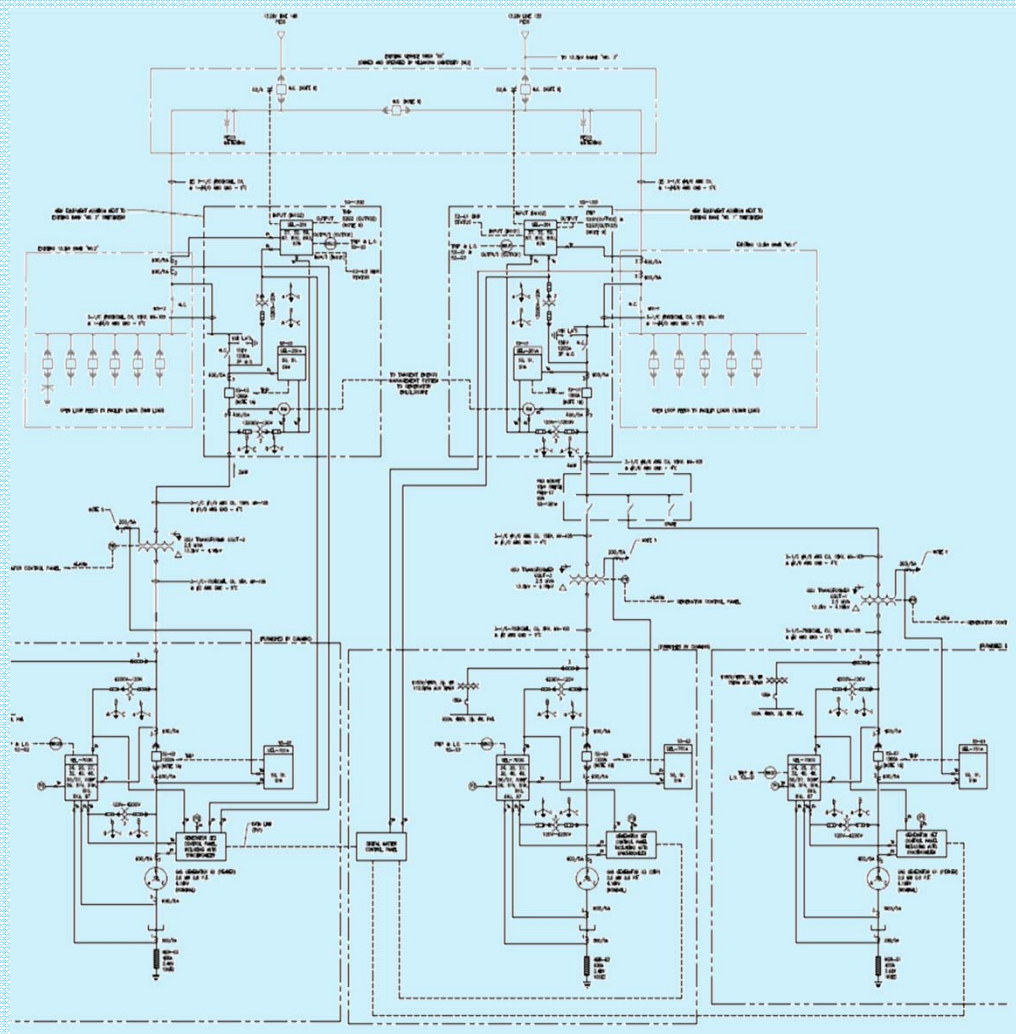
Increase Campus Resiliency



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Minimal Impact on Campus Operations

- Equipment is Owned by Project Developer
  - Villanova is Not Responsible for O&M
  - Automatic Engine Dispatch
- Minimal Boiler Plant Impact
  - Simple Operation

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Fast Schedule

- Financing Required Summer 2018 Startup
- Contract Signed November 2017
- Long Lead Items (Long Tent Poles)
  - Major Equipment Fabrication
  - Utility Interconnect Agreement
  - Air Permit
  - Engineering
  - Installation

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Very Fast Schedule

- Design-Build Approach
  - Engineering
  - CM at Risk
  - Start-Up, Cx

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Energy Savings

- 6 MW Demand Management
  - Capacity Savings
  - Transmission Savings
- 2 MW CHP Unit Operates 24/7
  - 3,250 pph Steam Capacity
  - 120 psig

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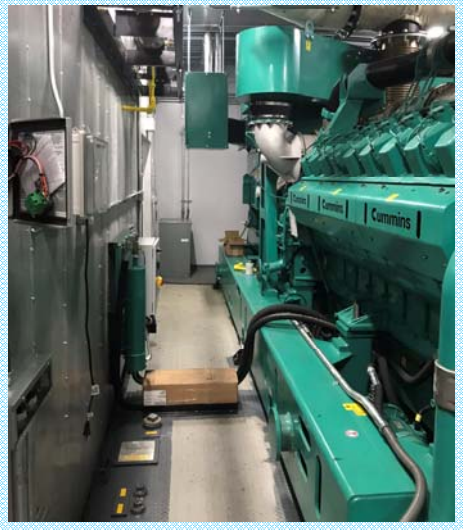
Lessons Learned

- Understanding Project Goals is Key
- Include Operations Staff Early in Process
- Identify & Plan for Construction Unknowns
- QA/QC is Vital Throughout Project
- Testing



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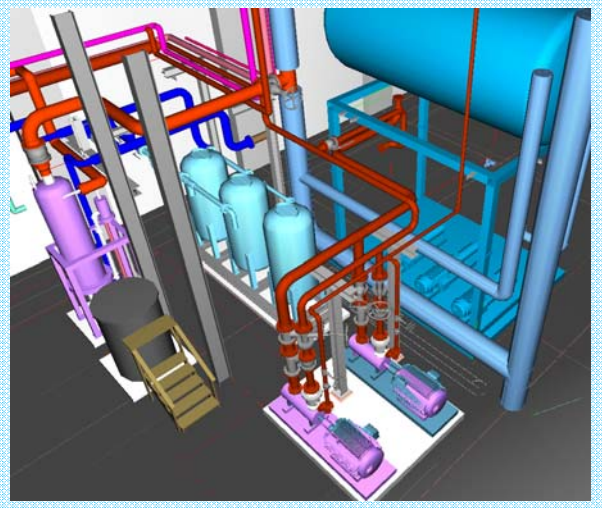
Closing Remarks

Questions



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