Great Lake Symposium on Smart Grid and the New Energy Economy

Microgrid as a Platform: A Holistic Approach to Campus Energy Solution Design

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SAIC®

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A Quick Word on SAIC

Fortune 240

National Rankings 2013
Engineering News-Record

#23	Top 25 in Power
#6	Top 15 in Transmission & Distribution (T&D)
#8	Top 50 in Program Management
#46	Top 100 in Design Build
#34	Top 500 in Design
#8	Top 200 Environmental Firms

DesignBuild[SM] project delivery
- Commissioning and start-up
- Construction
- Pre-construction

Energy management
- Efficiency and conservation
- Energy-saving performance contracts
- Energy systems and dashboards
- Procurement
- Program management

Renewable and clean energy
- Combined heat and power and biomass
- Energy storage
- Geothermal
- Renewable/alternative fuels and chemicals
- Waste-to-energy

Microgrids
- Combined heat and power
- Energy management
- Energy-saving performance contracts
- Energy security
- Energy storage
- Smart grid as a service

Systems integration and controls
- Assembly management system
- Energy systems and dashboards
- Systems engineering

Transmission and distribution
- Distribution automation
- Power line design and engineering
- Power system protection
- Substation design and engineering
- System planning and analyses

R·W·BECK

BENHAM

PATRICK ENERGYSERVICES

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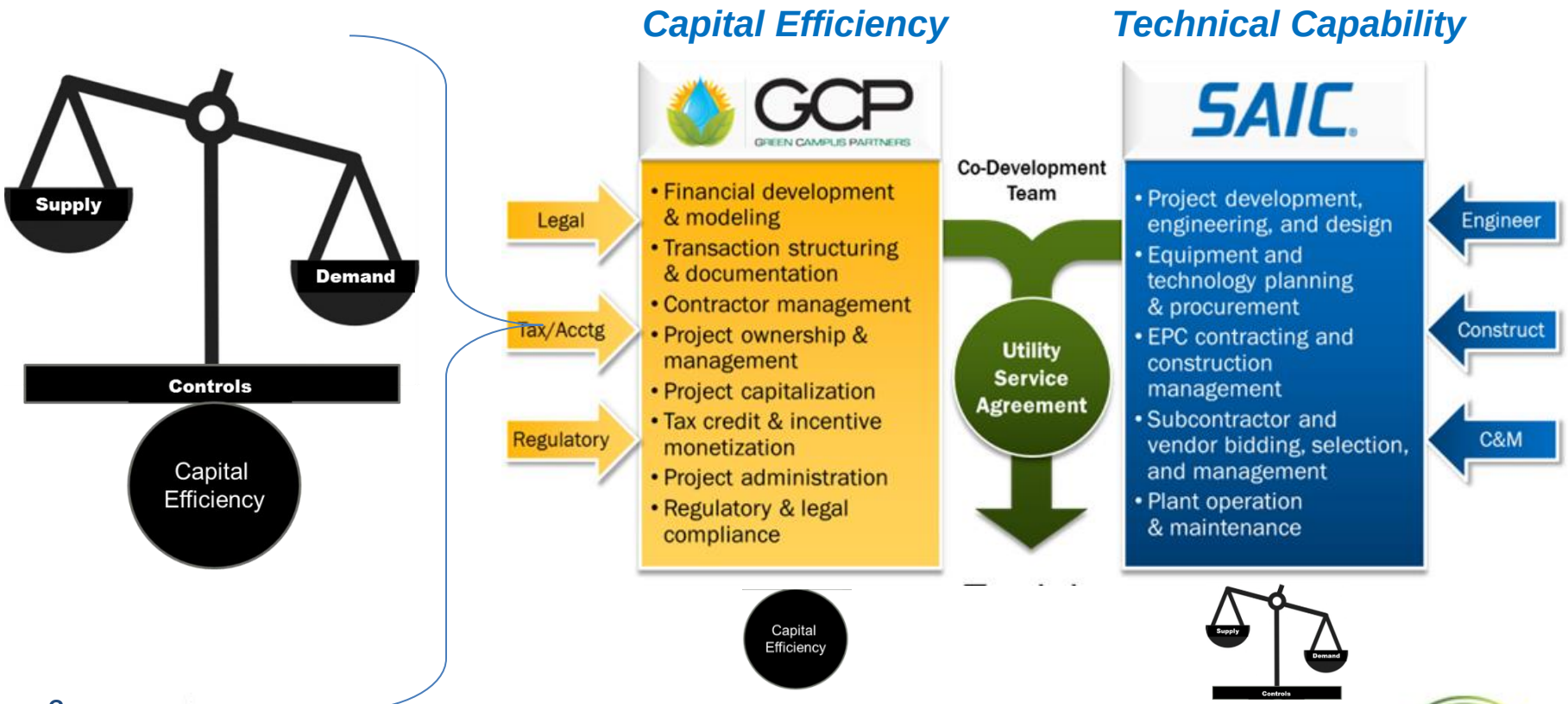
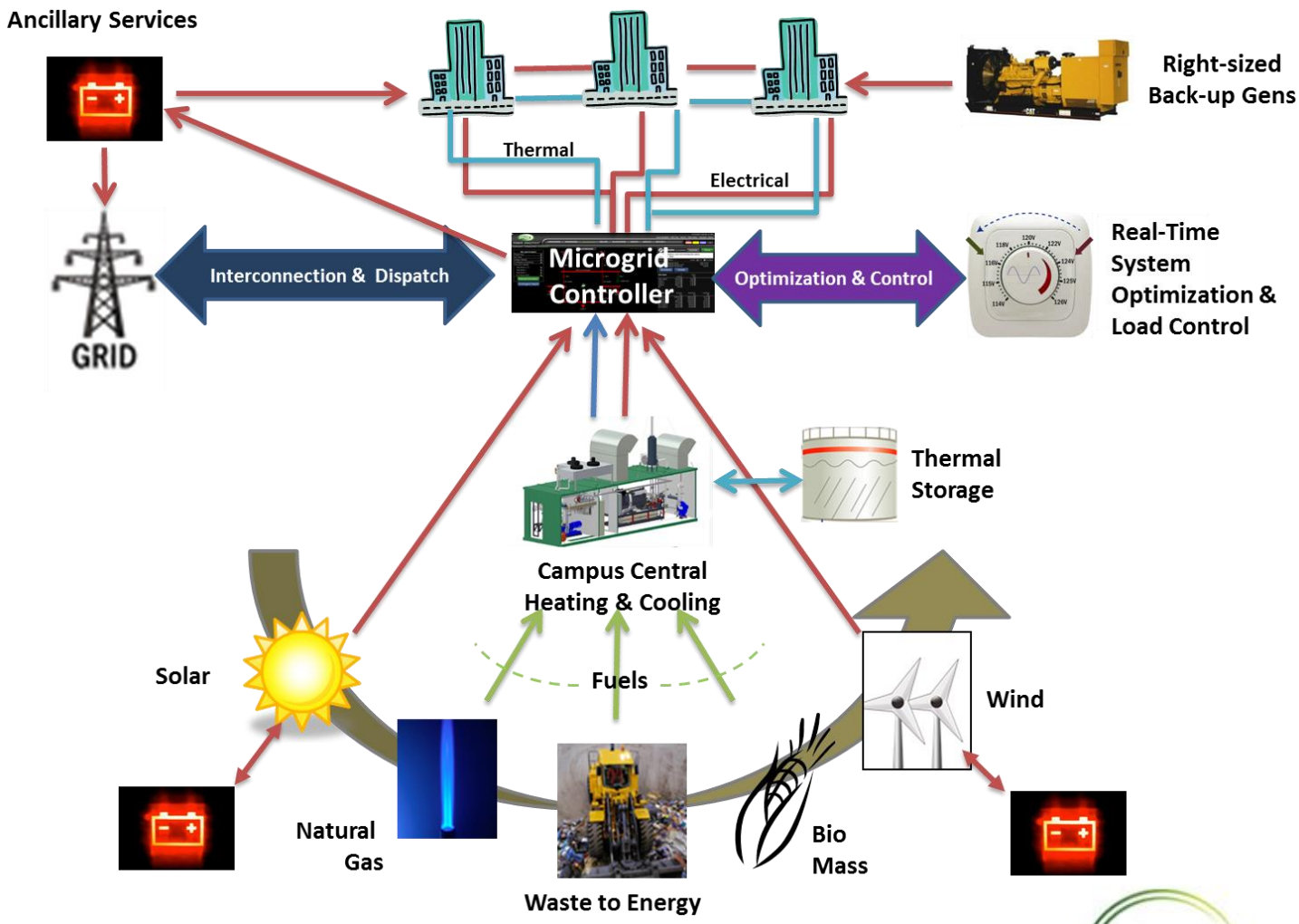
Starting Thought……..

"Technology without Finance is just a Science Project. You must be able to talk to both the Chief Technology Officer and the Chief Financial Officer at the same time."



High Level Microgrid Architecture Base Load Focused

- ✓ Works both supply and demand
- ✓ Ability to tune your campus
  - Economics
  - Sustainability
  - Resiliency
  - Critical Loads
  - Efficiency
- ✓ Resiliency via independent energy sources
- ✓ Electrical and thermal integration

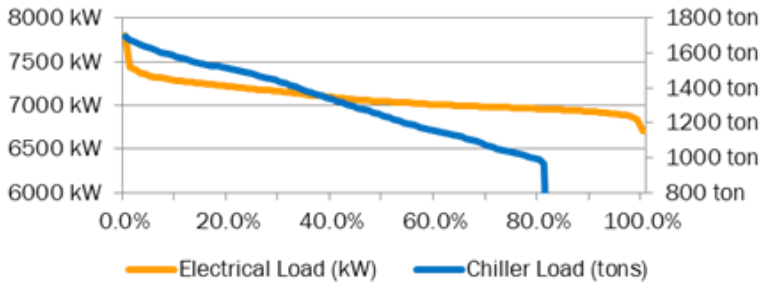


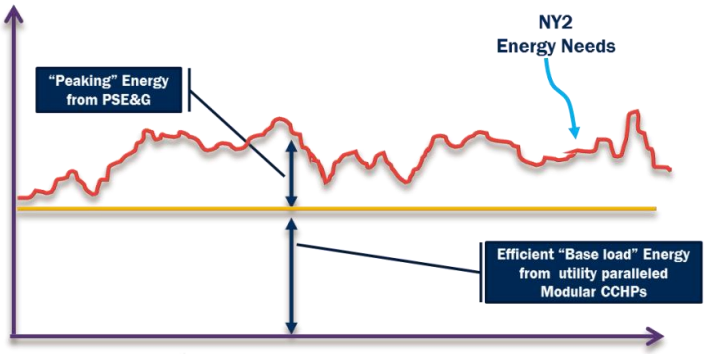
Supply Approach – Base-load Generation

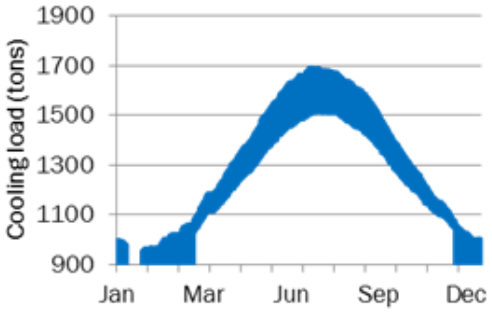
A comprehensive "8760" & Systemic Integrative Analysis is Vital

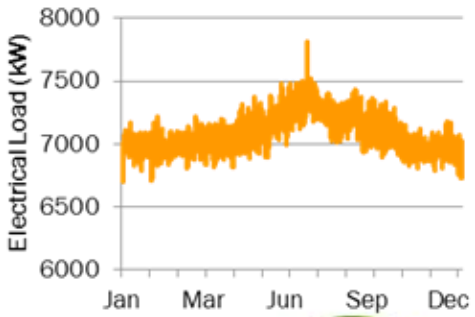
- Base-load generation and cooling
  - 6 MVA on-site generation: 3 x 2MVA reciprocating engine Combined Heat and Power (CHP) units
  - 1 x 1,000 ton absorption chiller
- System Operations
  - Normally parallel with utility system
  - Peaking energy supplied by utility
  - Solution provides "N+1" generation

Utility consumption (current)		
Electricity	62,033,915 kWh	
Utility consumption (post-CHP)		**% of load**
CHP Electricity	49,932,000 kWh	86.6%[1]
Supplemental electricity[2]	7,736,011 kWh	13.4%
CHP Chilled Water	7,938,006 ton-h	71.9%[3]









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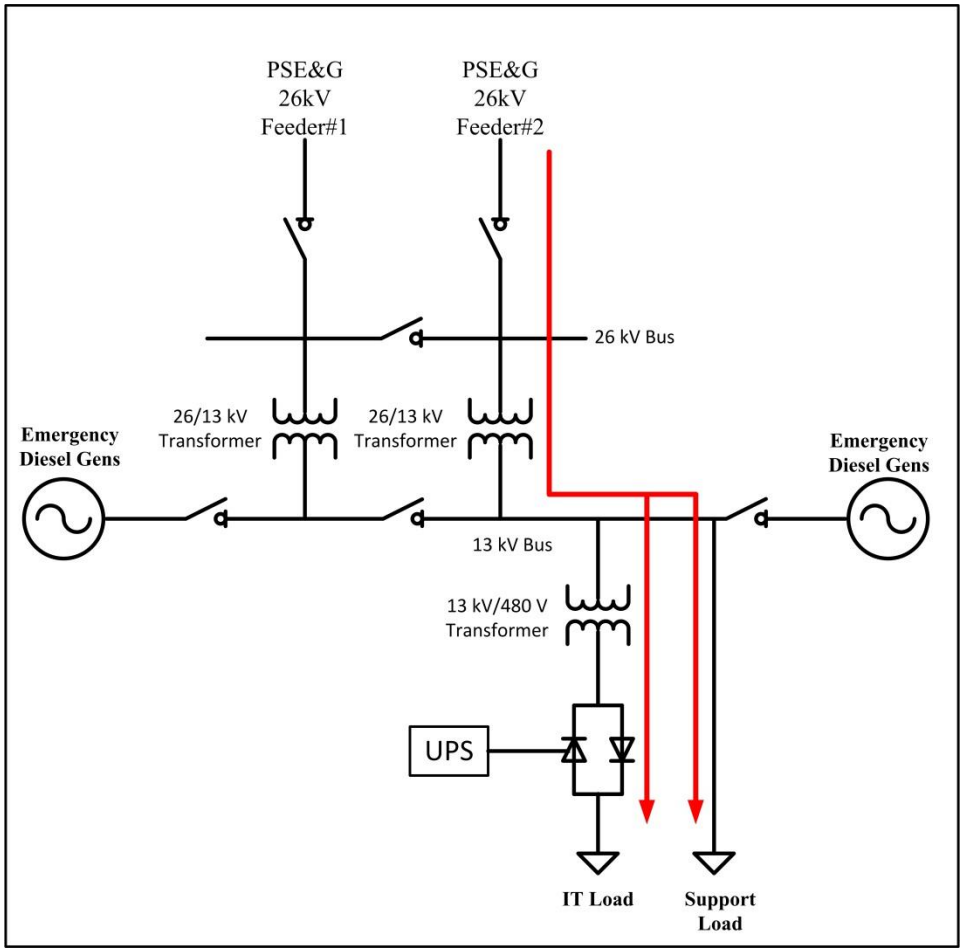
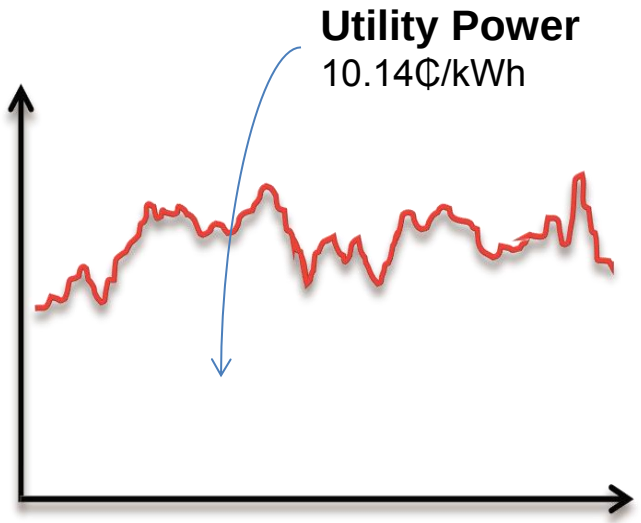
Supply Approach: Typical Existing Energy Feed

2 – 26 kV Utility Feeders



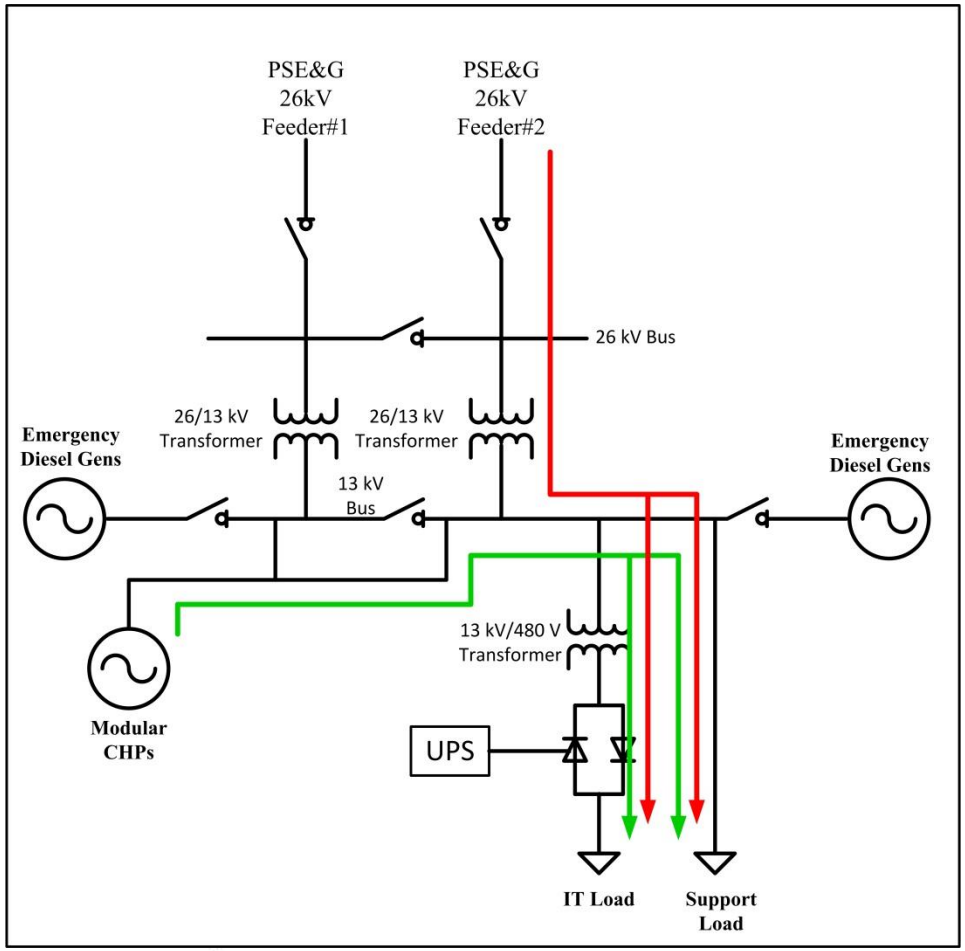


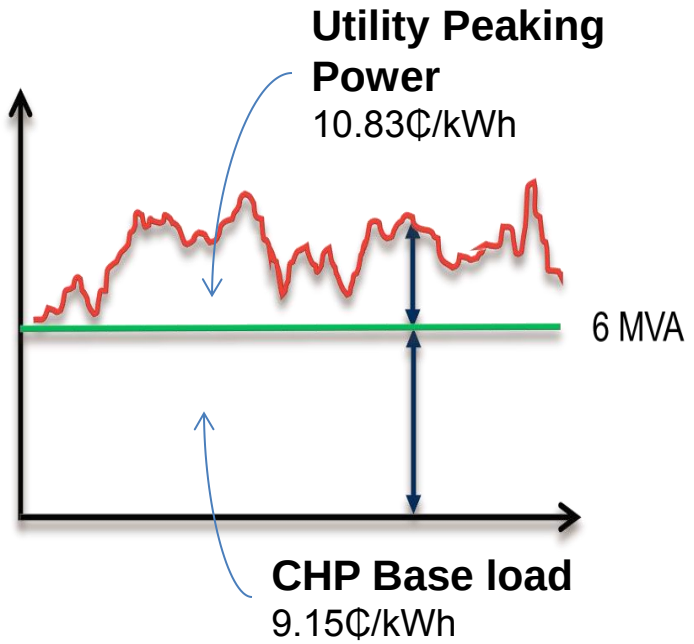
Existing Condition:

- ✓ No potential for energy savings
- ✓ Energy is totally contingent upon utility electrical supply. Constrained energy assurity and resilience

Supply Approach: Normal System Operations

Paralleled with the Utility



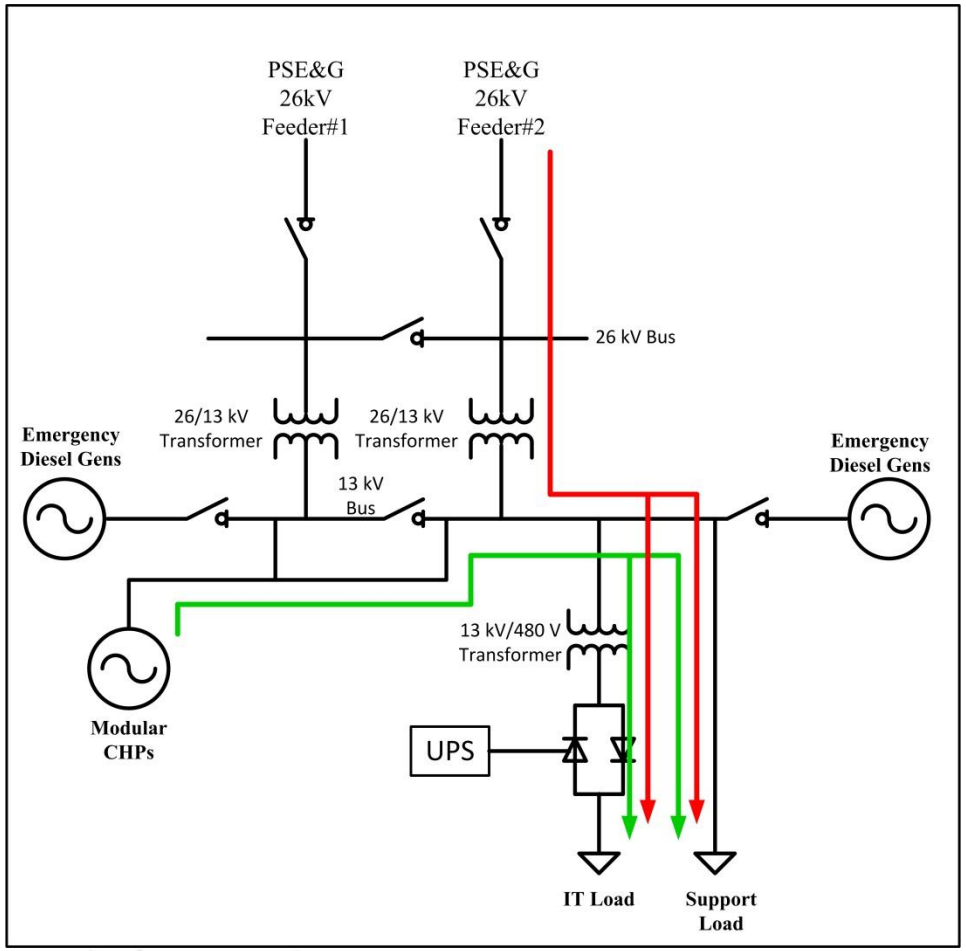


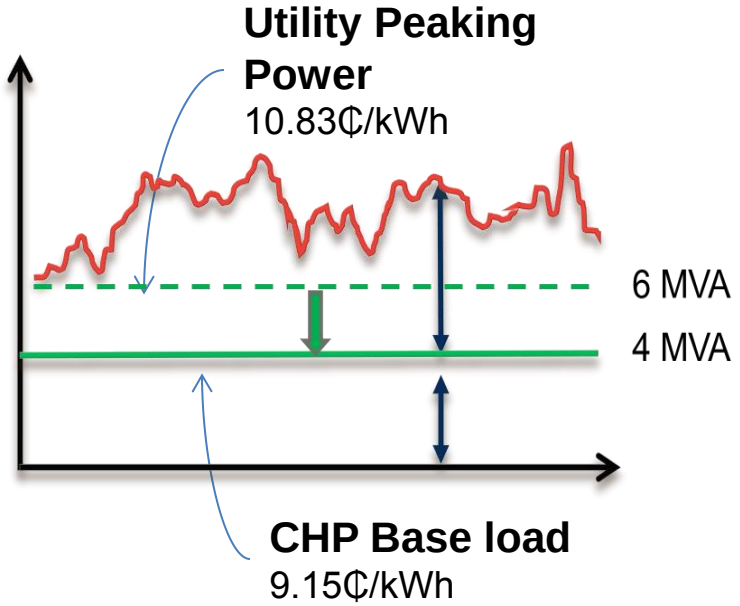
Improvements:

- ✓ Estimated savings of ***$400K per year***, or ***4.6% reduction*** in energy cost
- ✓ Data center **energy supply is now diversified** via the totally independent natural gas system

Supply Approach: Contingency System Operations

Loss of Single CHP: Maintenance – Utility Supply Compensation Until Campus Generation Reintegration



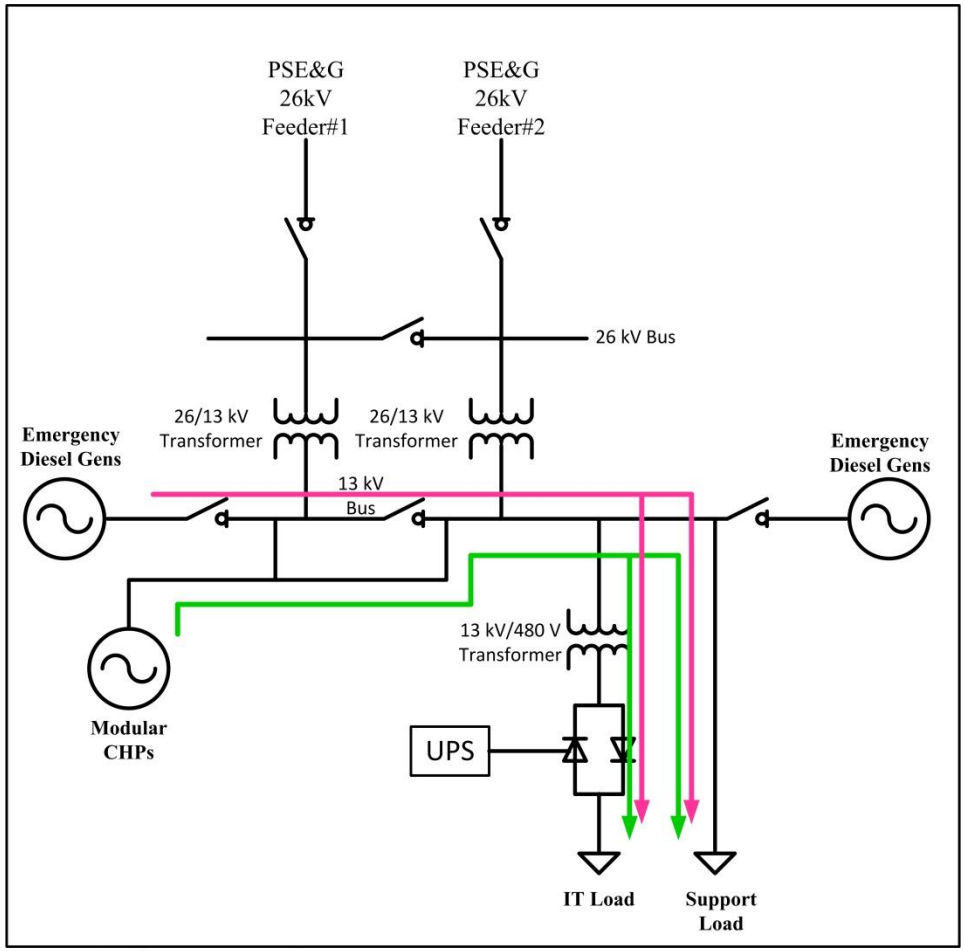


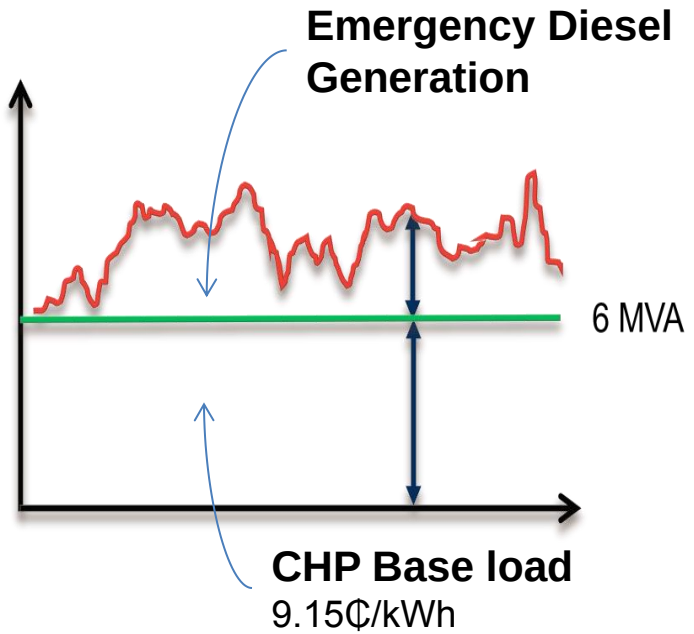
Improvements:

- ✓ ***Electric utility acts as "N+1" energy source***
- ✓ Modular approach allows lower cost power to be generated upon loss of one (or two) CHPs for either planned or un-planned outages

Supply Approach: Contingency System Operations

Total Loss of Utility Supply – Emergency Diesel Generation Compensation Until Utility Restoration

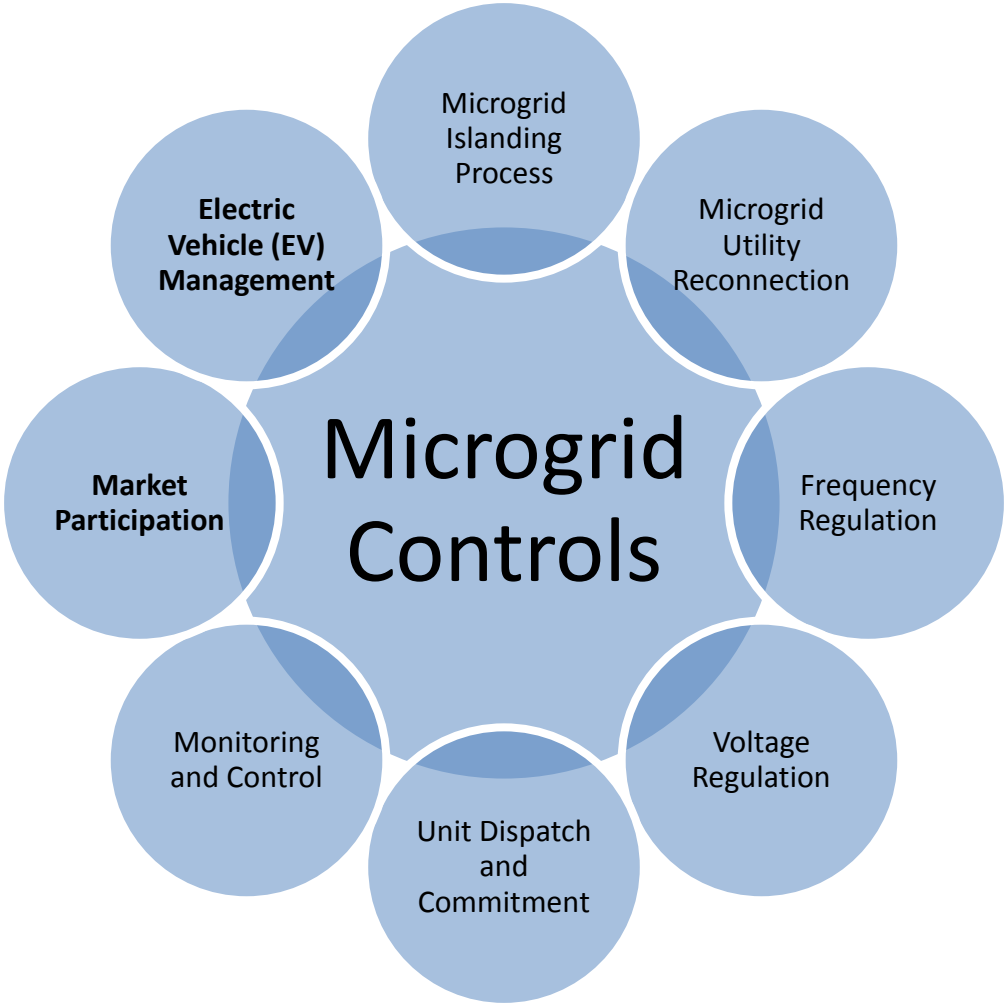




Improvements:

- ✓ Islanded micro grid condition allows **normal operations during total utility outage**
- ✓ On-Site CHP "stretches" existing data center back-up diesel supply **up to 6.7 times**

The Ideal Controller

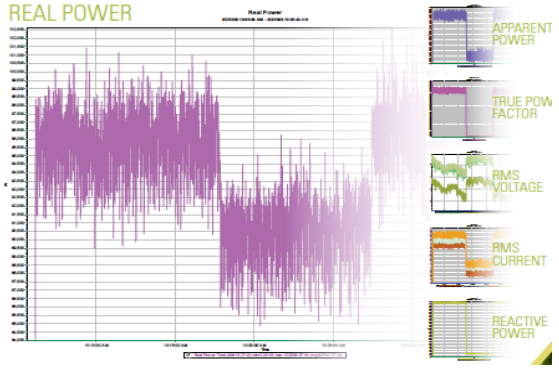


Load and System Optimization

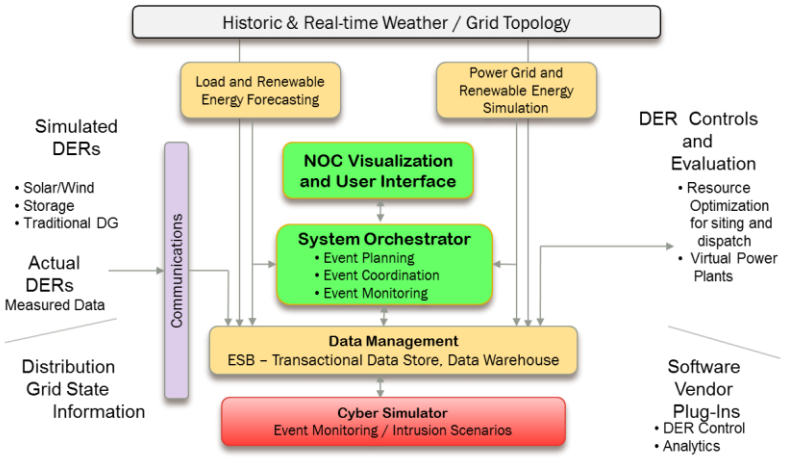
Campus Conservation Voltage Reduction

Inductive Load Optimization

1. **Magnetic phase balancing** of voltage and current to reduce waste, demand, friction and heat in loads;
2. **Passive resonance-free power factor correction** to reduce the demand of reactive non-power currents;
3. **Harmonic filtering of non-power currents** to reduce the billed kWh consumption;
4. **Transient energy conversion** through the surge protections self-healing magnetic chokes – energy above and below the operational voltage of a facility is absorbed, re-constituted, and returned to the customer as usable power;
5. **Proprietary chokes** generate a current from each phase that is injected into the adjacent phases as usable power, reducing magnetic fields.

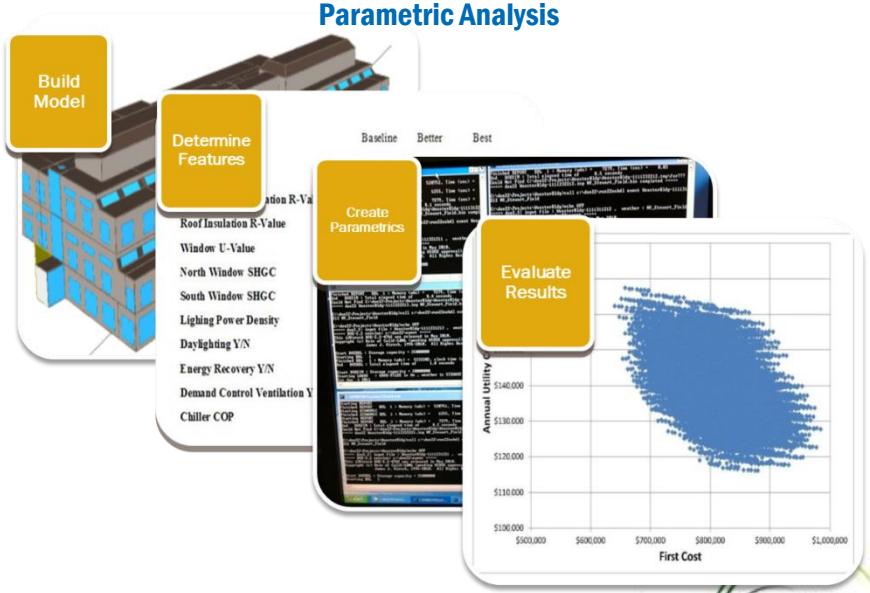


Simulated Network Operations Center for Advanced DER Planning and Operations



Conceptual functional design of the simulated NOC.

Parametric Analysis



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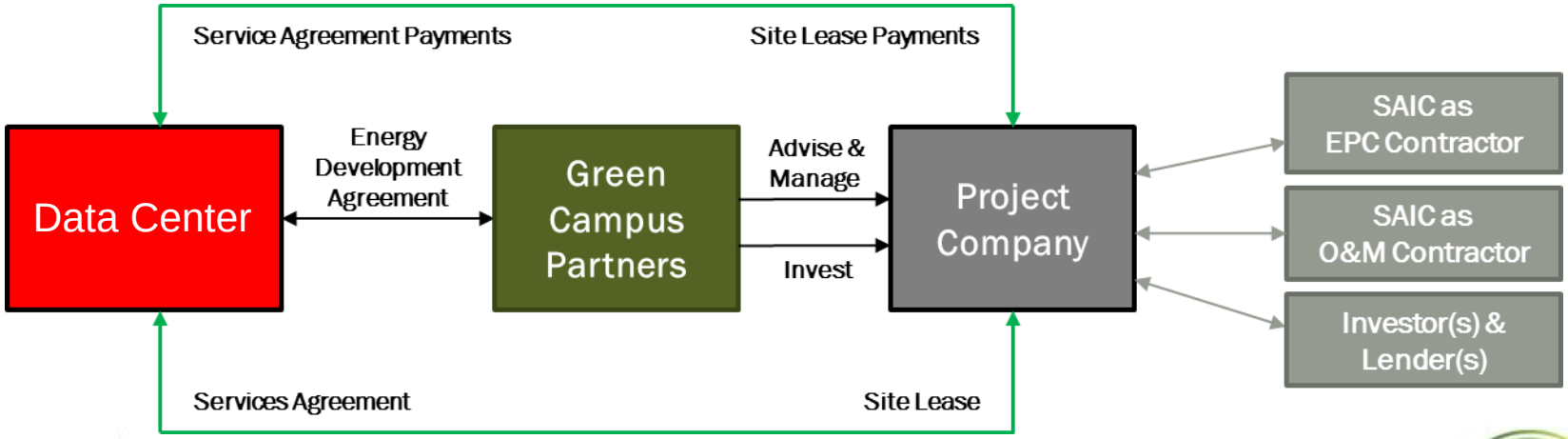
Financial Approach

- **Utility Service Agreement Approach**
  - No capital investment by customer
  - Off-balance sheet accounting treatment
  - Lays off risk (construction, load, performance) to third parties
  - No fixed payment or minimum take-or-pay provision: pay only for what is used

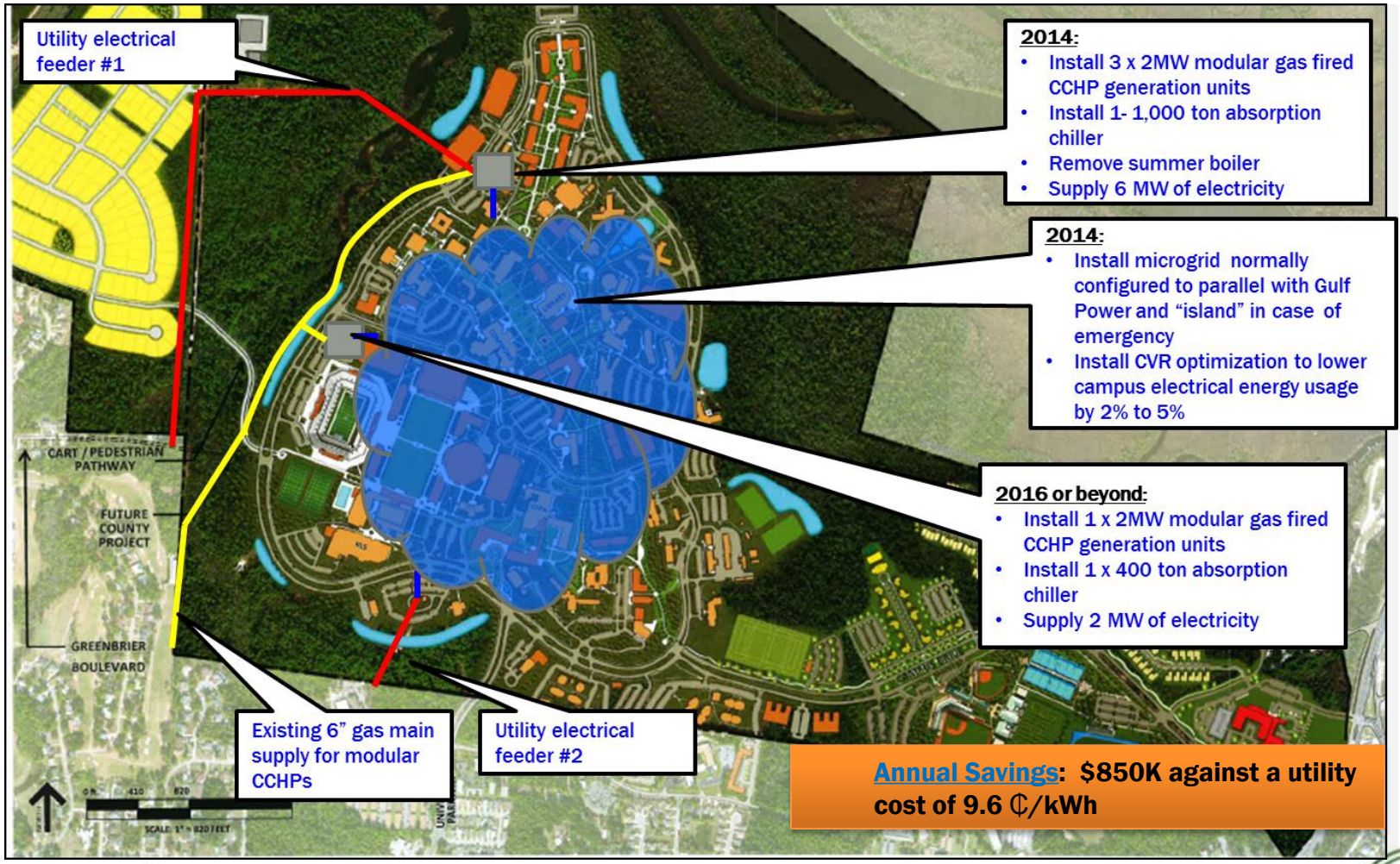
Financial Benefits:

- ✓ Estimated $400K per year, or 4.6% reduction in energy cost
  - *$4.6M NPV savings over the term of services agreement*
- ✓ No capital investment while benefitting from reduced utility costs
- ✓ Plant can continue to provide discounted utilities to the facility well beyond the end of service agreement



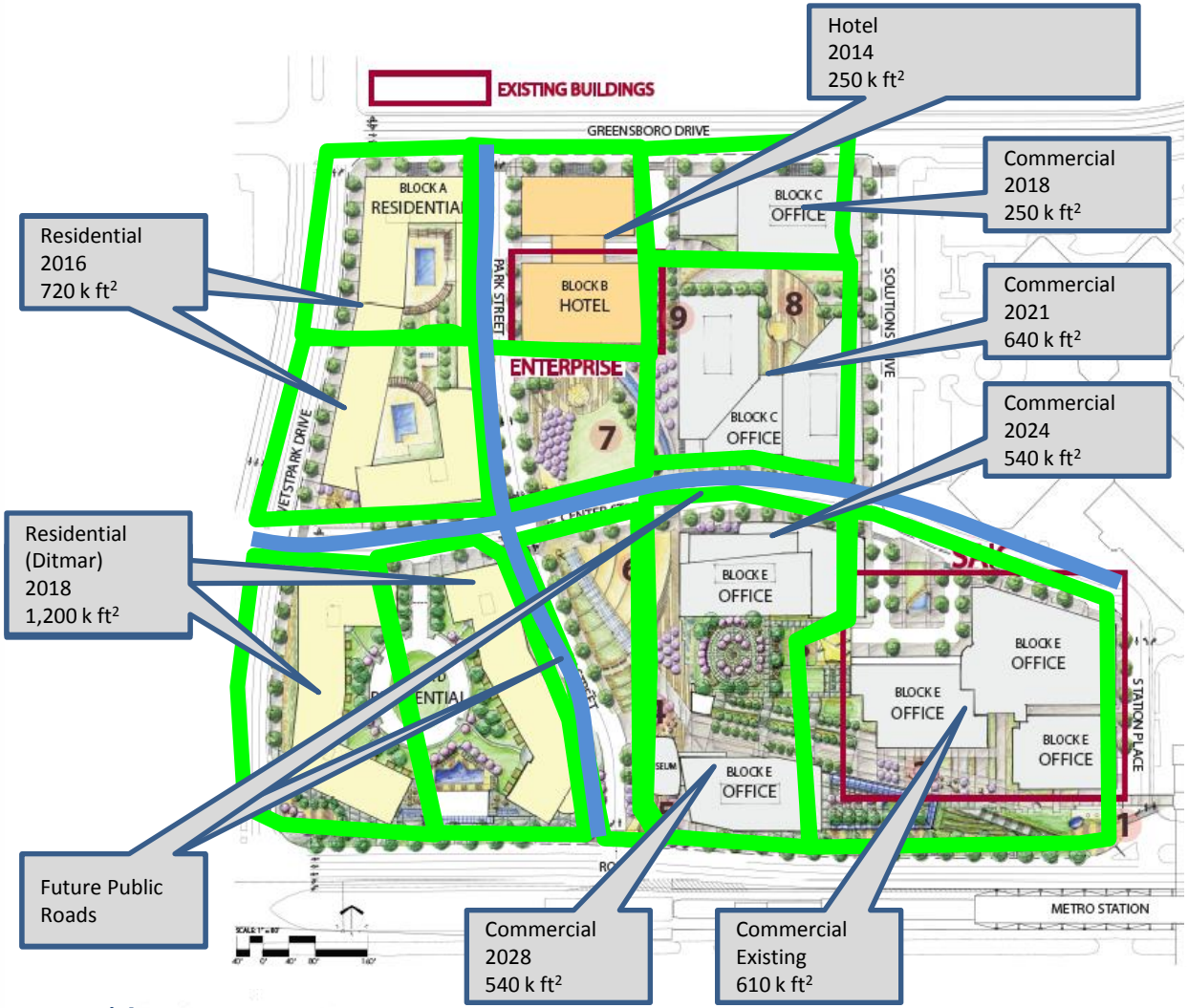
Real world Example 1:

Mid-sized 10 MVA University



Real world Example 2:

Urban Re-development Microgrid



- ✓ 11-parcel microgrid
- ✓ 4.9 million square feet
- ✓ Loads
  - 35 MVA winter
  - 28 MVA summer
- ✓ Mixed use
  - Corporate Headquarters
  - High-rise residential
  - Commercial
  - Hotel
- ✓ Electric and thermal microgrid components

Project suspended: Local spark spread using natural gas as the generation fuel did not support the microgrid economic model.

Revisiting with Municipal Solid Waste as fuel via Waste to Energy.

MVA = mega volt ampere k ft = kilofoot

Thank You

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