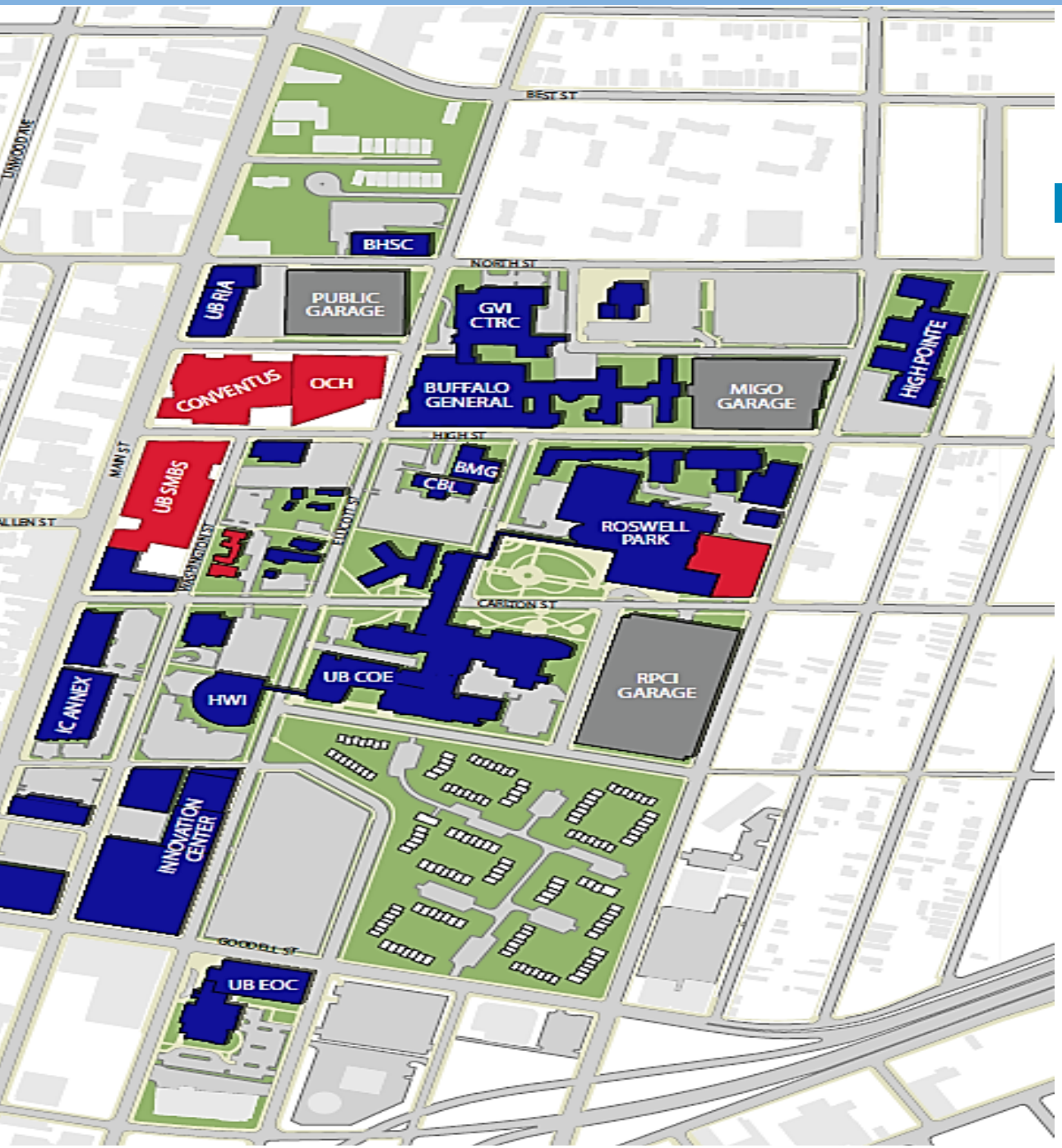
Buffalo Niagara Medical

part from an Economic Development
from National Grid



ENERGY

TRENDS:

NMC Strategy Stick ™

dernization and Power Quality Study by EPRI / National Grid and Thermal Load Optimization Study by the Gas Technology Institute / Natio

These two complementary studies provide the basis for the opportunities / strategies outlined below

NMC

Network Operations Center

- Smart meters, campus wide
- Data display/analytics
- Command and control
- Generation options/switching
- Market interface
- Optimization platform
- Island
- Demand response
- Dynamic management of a portfolio of distributed energy resources

Smart City_

Smo

Adding off grid elements

- Lighting (street, parking lot and walkways)

Storage elements

- Battery
- Ice

Campus utility / self-generation

- Duel-fuel / scrub existing diesel generators
- Gas turbine(s)
- District heating & cooling
- Solar
- Wind
- Fuel cell
- Digester / waste to energy

Community **Micro-**
Prize), completed S
Feasibility, have app
Stage 2 Detailed De

ldings

etro/continuous
ommissioning
ergy efficiency
onnected building systems

Smart Transportation

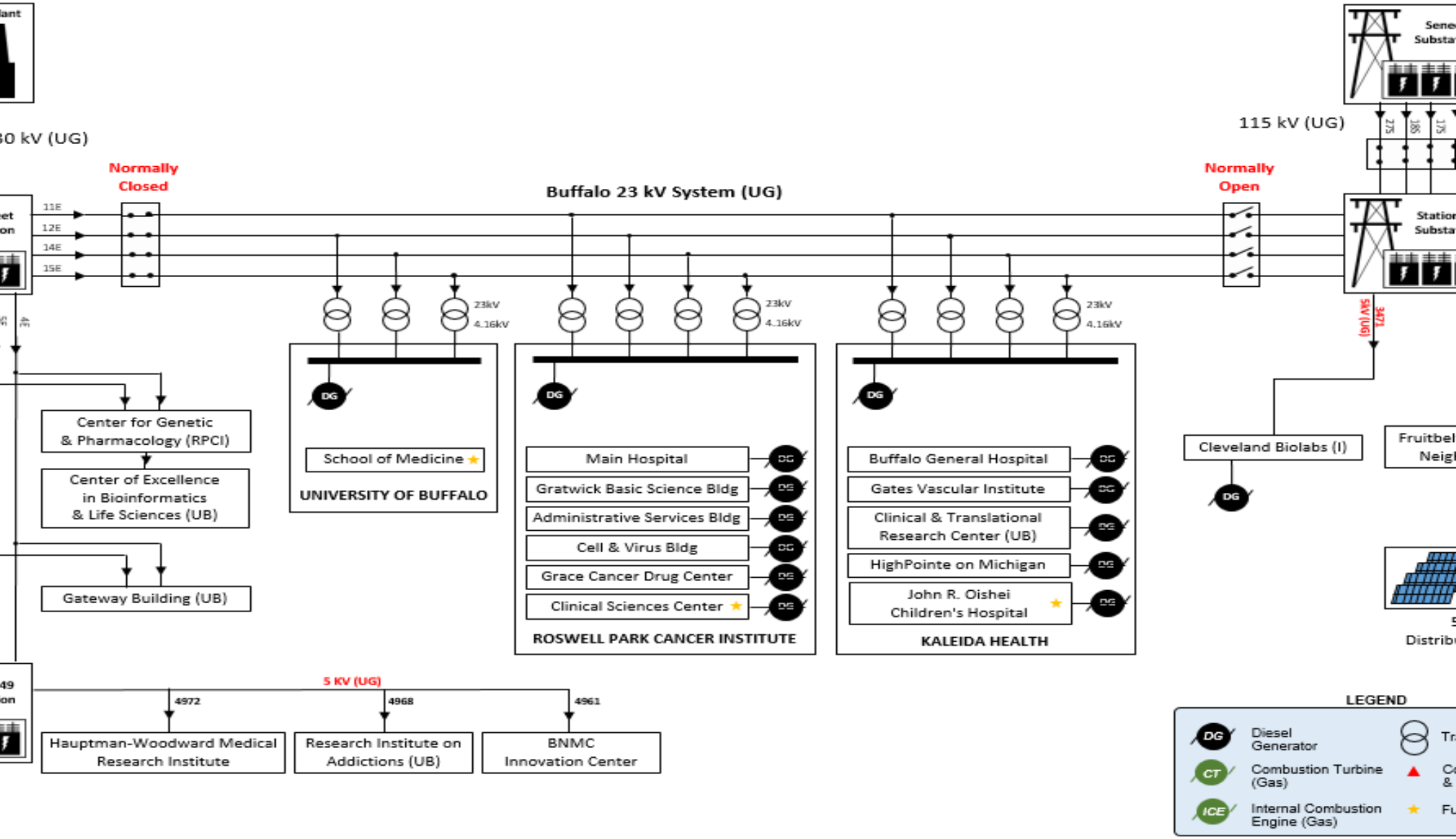
Incorporate alternative fuel transportation options

- CNG
- EV stations
- CNG /EV infrastructure

Reforming the Energy
(REV) activity. Appro
funded demonstratio

- Distributed Sy
  Platform
- Fruit Belt Nei
  Solar

hese elements do not have to be sequential; they are concurrent, ongoing initiatives. They are informed / iven by the umbrella studies referenced above in parallel to activities and opportunities created by REV.


115 kV (UG)
Normally Closed
Normally Open
Buffalo 23 kV System (UG)
11E
12E
14E
15E
23kV
4.16kV
DG
Center for Genetic & Pharmacology (RPCI)
Center of Excellence in Bioinformatics & Life Sciences (UB)
Gateway Building (UB)
School of Medicine
UNIVERSITY OF BUFFALO
Main Hospital
Gratwick Basic Science Bldg
Administrative Services Bldg
Cell & Virus Bldg
Grace Cancer Drug Center
Clinical Sciences Center
ROSWELL PARK CANCER INSTITUTE
Buffalo General Hospital
Gates Vascular Institute
Clinical & Translational Research Center (UB)
HighPointe on Michigan
John R. Oishei Children's Hospital
KALEIDA HEALTH
Cleveland Biolabs (I)
5 KV (UG)
4972
4968
4961
Hauptman-Woodward Medical Research Institute
Research Institute on Addictions (UB)
BNMC Innovation Center
LEGEND
Diesel Generator
Combustion Turbine (Gas)
Internal Combustion Engine (Gas)

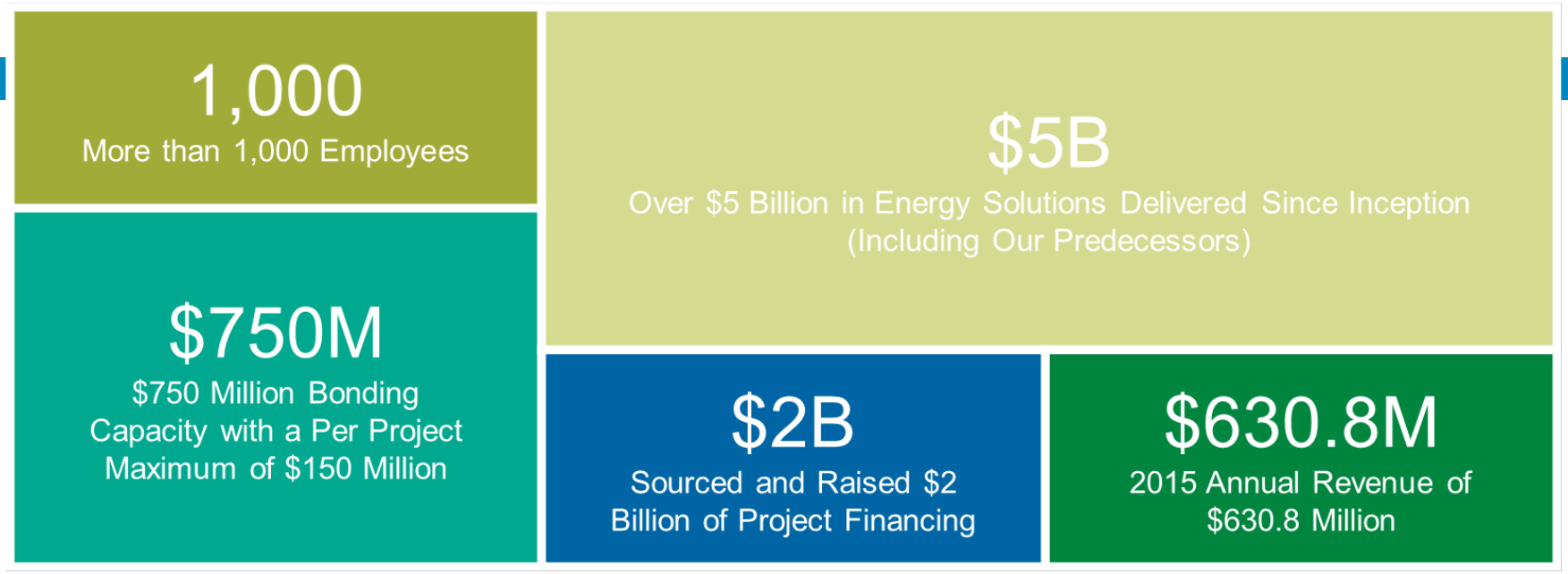
Why?

AMERESCO

Niagara 2016 Symposium on Microgri

Sal Prestano
Senior Project Developer
Asset Equity Group

Who is Ameresco?



- ✓ Independent Energy Services Co – Not a Utility or OEM Subsidiary
- ✓ Energy source (fuel) neutral
- ✓ Technology and equipment agnostic

What do we do?

Energy Efficiency

Renewable Energy

Energy Infrastructure

Energy Supply Management

Energy Information

Project Financing

Y Prize Experience – Town of Babylon

$100K award from NYSERDA for Stage 1 Report

- Ameresco consulting firm (AEG) lead energy consultant

Load Centers

- Village Hall (admin, EMS, police services)
- Department of Public Works
- Babylon Junior-Senior High School
- St. Joseph's School
- American Legion Hall

Distributed Energy Resources

- 2 x 500 kW natural gas fueled reciprocating engine-generators
- 275 kW of PV

Distribution

- 13.2 kV interconnection to all facilities in parallel with existing PSEG-LI distribution
- Facility can be interconnected w/out changes to PSEG-LI distribution service

NY Prize Experience – Town of Babylon

Town of Babylon – Project Economic Summary

Total estimated capital cost of about $4.6 million

Total NPV of capital and O&M costs about $4.9 million

Total estimated NPV of benefits from NYSERDA consultant analysis about $4.3 mil

- ✓ Included energy efficiency savings, capacity benefits, etc.
- ✓ Estimated NYSERDA benefits from DO NOT determine distribution of benefits or how they are monetized

Estimated NPV of revenues from benefits that can be monetized about $2.8 million

Estimated revenue shortfall = about $2.1 million

Project did not move to stage 2 due to poor economics

ew York Prize – ESCO View

Provides seed money for projects that may never have been explored

Promotes local energy infrastructure investments vs T&D investments by util

May present opportunities for ESCO's to invest in local energy infrastructu

See Public-Private-Partnerships as a vehicle to move these projects forwar

Potential ESCO roles:

- ✓Consulting
- ✓Development
- ✓Design/Build
- ✓Financing
- ✓Operations and Maintenance
- ✓Asset Ownership
- ✓***All of the above***

Ameresco Microgrid Experience

Portsmouth Naval Shipyard, Kittery, ME

- New power 14 MW CHP plant
- Steam and hot water distribution retrofits
- VSDs/pumps/compressed air
- Boiler system improvements
- Shipyard-wide lighting upgrades

Philadelphia Navy Yard Microgrid

- 3 MW CHP (data center)
- 6 MW Peak Reduction
- 1 MW Solar PV
- 600 KW Fuel Cell
- Energy Efficiency goal of 20% by 2022

Portsmouth Naval Shipyard

Investment: $42.9 Million

Annual Savings: $5.3

efore you get started implement energy efficiency

Energy Audit's Identify Savings, Reduce Microgrid Overall Cost

Process

- Review site data
- Interview energy managers, planners, engineers and O&M staff
- Energy team site walk-throughs
- Review BAS operations
- Field measurements
- Building energy modeling

Results

- Energy conservation measures that reduce load, demand, current O&M cost and overall size and cost of proposed microgrid
- Without implementing an energy efficiency program for the end users, all elements of the microgrid will be oversized

Sal Prestano
SPRESTANO@AMERESCO.COM
+1 917 969 0989

AMERESCO

Your Trusted Sustainability Partner.

Tecogen Small Scale CHP Technology

Robert Panora,

President & COO

nduction Based CHP Technology Shortcomings

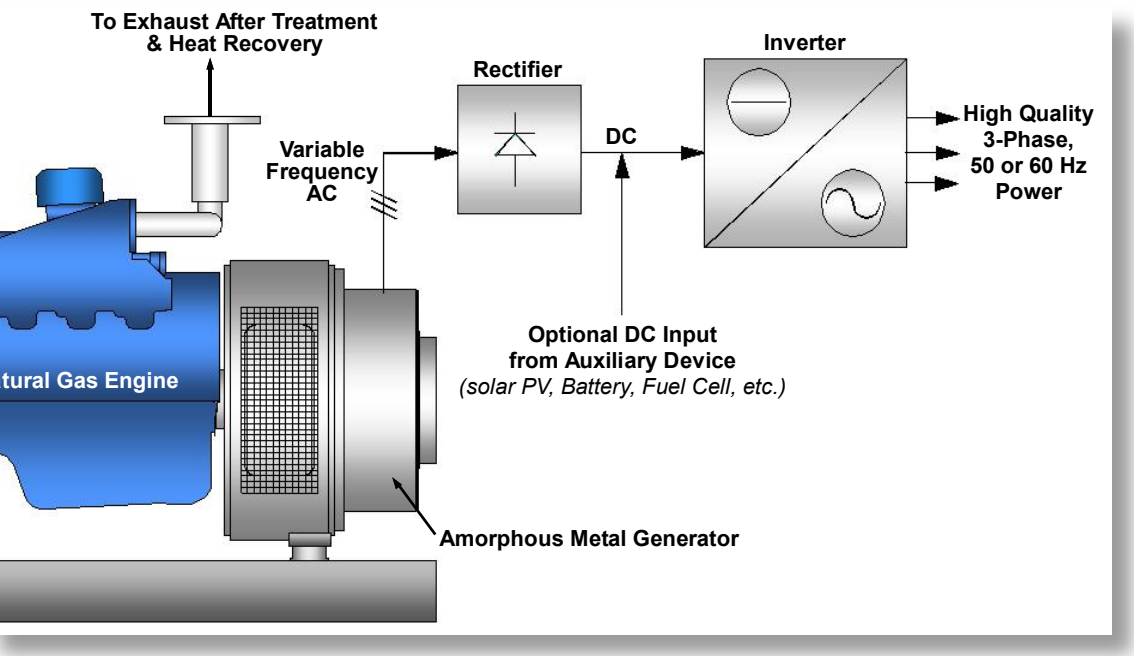
arly Decades of Small CHP

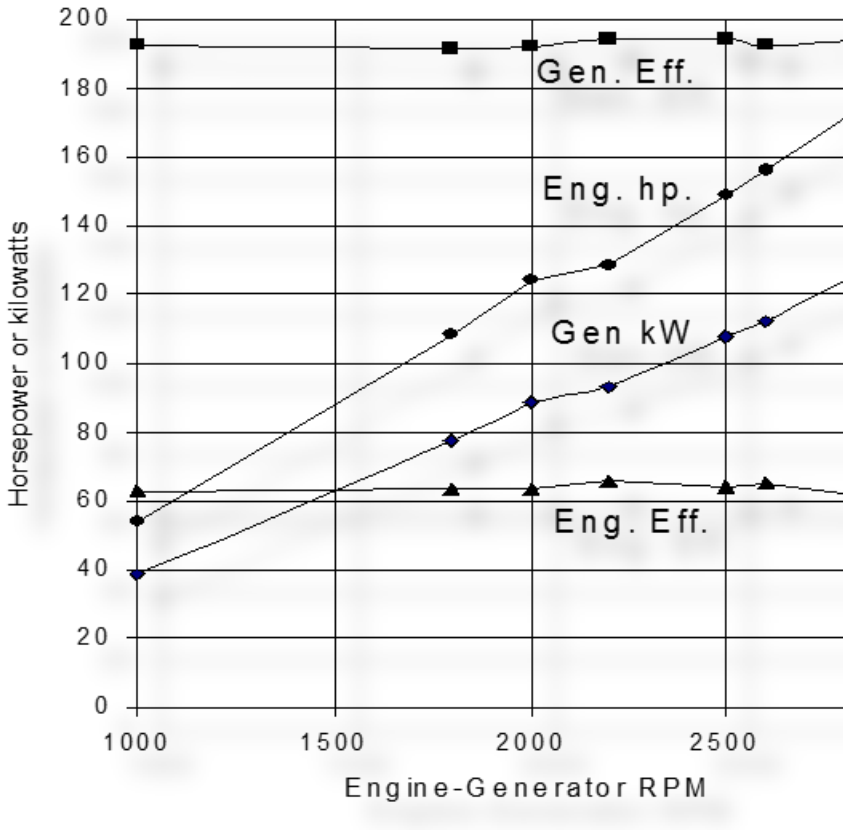
- Reciprocating Engines Highly Favored
  - Significant Advantages

Mounting Challenges Evident in Recent Years

- Tightening Emissions Standards
- Utility Interconnection Difficulties
  - Engines Precluded From Simplified Interconnection Rules/Certification
  - Certification Prerequisite to Net Metering/FIT
- Utility Outage Capability
  - Increasingly Valued Feature
  - Difficult to Implement

nverter–Based CHP Interface





nverter-Based Features

Qualifies for Standardized Interconnection

- UL1741 Certification
- Includes Anti-Islanding Feature
- Prerequisite to Qualify for Feed-In Tariffs/ Net Metering

Power Quality

- No Reactive Power Use

Power Boost for Demand-Side Response

- High RPM Operation

Enhanced Efficiency at Part Load (Patented)

Internationally Adaptable with Minor Changes

- 50/60 Hz

Potential for Outage Operation…

Incorporation of CERTS* Microgrid

he Consortium for Electric Reliability echnology Solutions (CERTS) was formed in 99 to research, develop, and disseminate electric iability technology solutions in order to protect and hance the reliability of the U.S. electric power system der the emerging competitive electricity market ructure. The founding members include four DOE National bs (Lawrence Berkeley National Laboratory (LBNL), Sandia tional Laboratory (SNL), Oak Ridge National Laboratory RNL), and Pacific Northwest National Laboratory (PNNL); F's Power Systems Engineering Research Center; and the ectric Power Group.

CERTS Test Facility at AEP's Dolan Lab

Technical Challenges of Utility Outage Operation

Requires Two Distinct Operating Modes

- Grid-Tie & Islanded Operation

Grid-Tie Common/Straightforward

- Utility Provides Foundation

Outage Operation More Difficult, Especially with Multiple Units

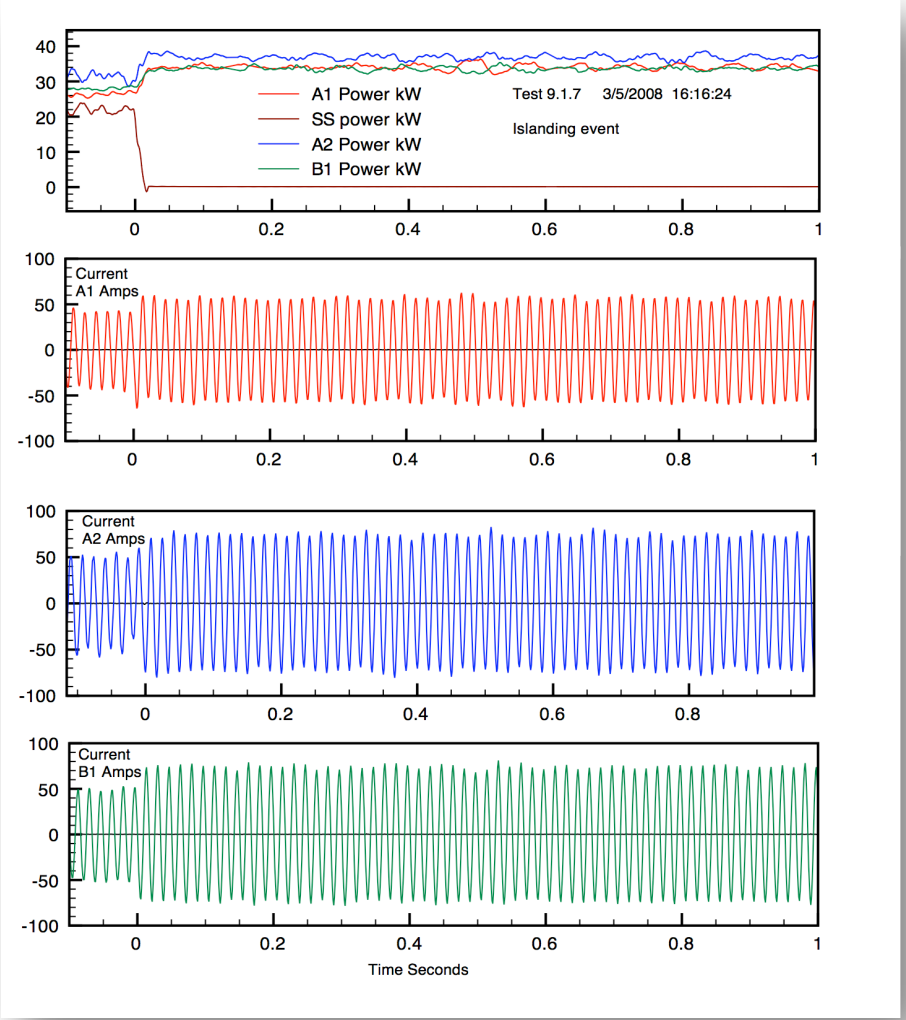
- Requires Control Basis for Establishing Frequency
- Real and Reactive Power Must be Shared
  - Not Inherently Stable
- Conventional Approaches Fairly Complex
  - Impractical in Small Module Applications

CERTS System Provides Solution…

Tecogen secured exclusive license from University of Wisconsin

sland Event (CERTS Phase I Test)

- Initial Condition
  - Three Units Grid Tie
  - ~ 120 kW Load
    - 30 kW/ Module
    - 30 kW Utility Import
- Intentional Island Imposed (t=0)
  - Utility Import Ceases
  - kW/kVAR Balanced
  - Stable in Several Cycles



CERTS Microgrid Features/Benefits

olves Control Problems Inherent in Controlling Multiple Power ources in Isolated Circuit

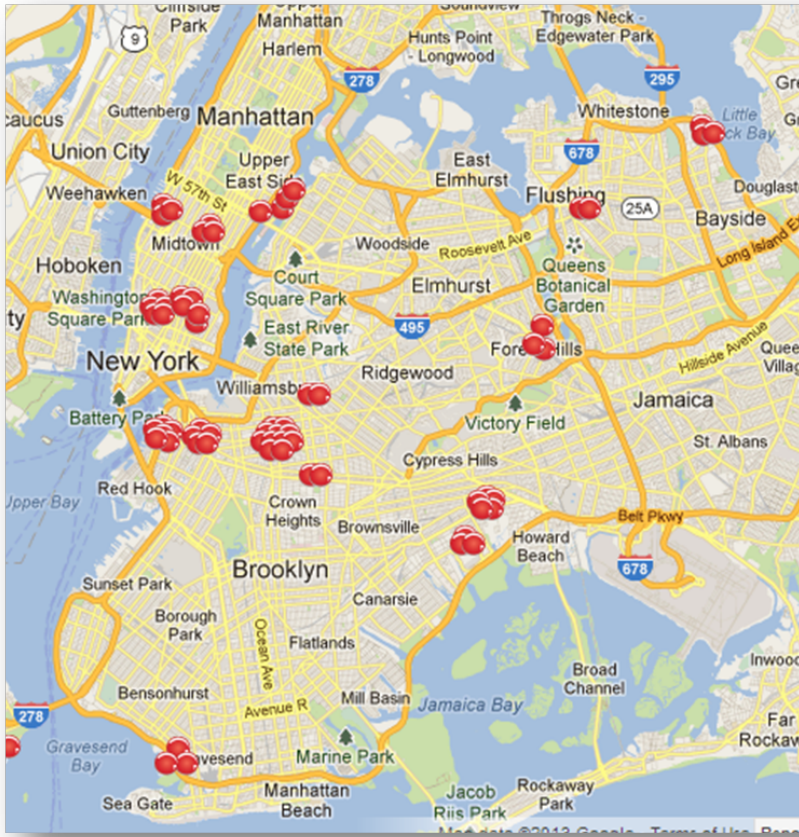
- No External Controllers Required
- Control Resides Within Factory Firmware
  - No Field Set-up/Tuning (Plug and Play)
- Each Module is Entirely Autonomous
  - No single Point Failure
  - Units are Truly Modular…Future Machines Have No Control Impact on Others

xtremely Stable/Rapid

- With Fast Switch Can Serve UPS Function
  - Seamless Transfer/ Excellent Power Quality
- Integrate With Other Technologies

pplicable to Simpler Standby Schemes

- Non-Seamless Transfer (Common Tecogen Application)



Second Generation Model InVerde e+

Demand Response

- High RPM 125% (125 kW) operation

Supplemental Battery Utilization

- 2- hour/ 100 kW system example
  - 2-hour window to complete service
    - Cover routine service events
    - Allow reset of unit (or site load shed)
- Seamless power transfer in outage
  - Provide time to prepare for power transfer

Supplemental Solar PV

- Curtail engine kW contribution during Active PV periods
- Allow PV contribution in outage

NIAGARA 2016 SYMPOSIUM ON MICROGRIDS
"NY PRIZE"

Dennis Elsenbeck
Director, Stakeholder Engagement and Policy

National Grid and NY Prize

Project Volume

- Upstate NY – 21 projects Submitted via Stage I

Projects Took Various Forms

- Utilize Utility Feeders for Distribution
- Vendor Constructed & Owned Distribution Feeders
- Hybrid Distribution Ownership
- Existing Backup and/or New Generation
- Existing Electrical Stress

Evolution to Stage II – Winter 2016/17

- NG to Assist in Detailed Design Plans

Lessons Learned

Joint Utilities

- Create Microgrid Policies

What is a "Good" Microgrid?

- Ease of Coordination & Connectivity
- Voltages are Consistent
- Isolation Equipment Kept at a Minimum
- LMI Customers Engaged in Some Manner
- Maintain or Improve Reliability
- Addresses an Electrical System Need and/or Resiliency
- Regulatory Barriers Kept to a Minimum

stributed System Implementation an (DSIP)

gement oups

cs

Distribution System Planning		Grid Operations		Market Operati	
Inter connection	Hosting Capacity	System Data	Monitoring & Control	Granular Pricing	Custon
Demand Forecasting	NWA Suitability	Cyber Security	ISO/DSP Roles, Responsibilities, Interaction	DER Sourcing - Procurement	Electri Supply E
DER Forecasting	Load Flow Analysis				
Probabilistic Planning					

Interconnection Technical Working Group

Currently scheduled Engagement Group topics

Currently scheduled Advisory Group topics