ENERGY TRENDS:

• The emergence and viability of customer sited, in front of the meter distributed generation, renewables and storage.
• Intelligent loads; advances in building automation, enhanced connectivity to and communication with those loads, command/control infrastructure.
• Micro-grids and aggregated dynamically managed portfolios of distributed assets integrated with/contributing back to the larger grid, two way power flow management.
• Consortiums of service/technology providers, public/private financing responding to robust market animation.
These two complementary studies provide the basis for the opportunities / strategies outlined below.

**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

**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

**Buildings**
- Retro/continuous commissioning
- Energy efficiency
- Connected building systems

**Smart Transportation**
- Incorporate alternative fuel transportation options
  - CNG
  - EV stations
  - CNG / EV infrastructure

**Community Micro-Grid Prize**
- Completed Stage 1 Feasibility, have approved Stage 2 Detailed Design

**Reforming the Energy Value (REV) activity**
- Approaches unfunded demonstrations
  - Distributed Systems Platform
  - Fruit Belt Neighborhood Solar

These elements do not have to be sequential; they are concurrent, ongoing initiatives. They are informed / driven by the umbrella studies referenced above in parallel to activities and opportunities created by REV.
Why?
Niagara 2016 Symposium on Microgrids

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
$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 million

- 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
New 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 utilities
May present opportunities for ESCO’s to invest in local energy infrastructure
See Public-Private-Partnerships as a vehicle to move these projects forward

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 Million
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
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Tecogen Small Scale CHP Technology

Robert Panora,
President & COO
Induction Based CHP Technology Shortcomings

Early 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
Inverter-Based CHP Interface

- Natural Gas Engine
- To Exhaust After Treatment & Heat Recovery
- Amorphous Metal Generator
- Variable Frequency AC
- Rectifier
- DC
- Optional DC Input from Auxiliary Device (solar PV, Battery, Fuel Cell, etc.)
- Inverter
- High Quality 3-Phase, 50 or 60 Hz Power
- Graph showing Horsepower or Kilowatts vs. Engine-Generator RPM
Inverter-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…
The Consortium for Electric Reliability Technology Solutions (CERTS) was formed in 1999 to research, develop, and disseminate electric reliability technology solutions in order to protect and enhance the reliability of the U.S. electric power system under the emerging competitive electricity market structure. The founding members include four DOE National Labs (Lawrence Berkeley National Laboratory (LBNL), Sandia National Laboratory (SNL), Oak Ridge National Laboratory (ORNL), and Pacific Northwest National Laboratory (PNNL); NSF’s Power Systems Engineering Research Center; and the Electric Power Group.
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
Island Event (CERTS Phase I Test)

- **Initial Condition**
  - Three Units Grid Tie
  - \(~ 120 \text{ kW Load}\)
    - 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

- Solves Control Problems Inherent in Controlling Multiple Power Sources 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
- Extremely Stable/Rapid
  - With Fast Switch Can Serve UPS Function
  - Seamless Transfer/ Excellent Power Quality
  - Integrate With Other Technologies
- Applicable 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
Distributed System Implementation Plan (DSIP)

Engagement Groups

Distribution System Planning
- Interconnection
- Demand Forecasting
- DER Forecasting
- Probabilistic Planning
- Hosting Capacity
- NWA Suitability
- Load Flow Analysis

Grid Operations
- System Data
- Cyber Security
- Monitoring & Control
- ISO/DSP Roles, Responsibilities, Interaction

Market Operations
- Granular Pricing
- DER Sourcing - Procurement
- Customer Data
- Electric Vehicle Supply Equipment

Currently scheduled Engagement Group topics
- Interconnection Technical Working Group

Currently scheduled Advisory Group topics