Economic Dispatch of DER Resources with VOLTTRON™

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MANAGING PARTNER
Cogen Power Technologies
• Who are we?
• Why work with us
• What we bring to the NYS Market Place
• How we became engaged in the dispatching of DER Assets Business
• What our DER Software Platform is
• What our expertise is
• Resiliency, DERs & Microgrids
Who Are We?

Cogen Power Technologies (CPT)

- Design Build CHP firm since 2006 located in Latham, NY
- A division of Bette & Cring, national construction firm, $250 M annual revenue
- Evolving from a MW-scale CHP Turnkey to a Hybrid Turnkey Supplier

Frontier Energy (FE) - formerly CDH Energy

- Long term partner for data analytics and automated economic dispatch
- Energy consulting firm with offices in NY, CA and TX
- NYSERDA Consultant

We serve the 1 MW – 20 MW market (hospital, university, industrial, etc.)
Why work with us?

- Our broad experience and domain expertise with generation assets, building load forecasting, real time prices, make us especially qualified as multiple components and systems are added together
- A tool box of vetted components available in VOLTTRON™ for PV, batteries, other plant components, etc.
- Our team has already implemented a FORMAL day-ahead optimization for CHP systems responding to day ahead prices. Including other technologies (solar, storage, etc.)
- We have successfully delivered 7 CHP Systems as the Design-Build contract holder
- We own and operate a Plant that has successfully dispatched multiple prime movers for over 10 years
### What we bring to the effort for NYS marketplace:

<table>
<thead>
<tr>
<th>Pre-Analytics to determine Size-mix of Technologies</th>
<th>Solar Equipment &amp; Installation</th>
<th>Storage Equipment &amp; Installation</th>
<th>CHP Equipment &amp; Installation</th>
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<th>Dispatching Algorithm, Signaling, Monitoring</th>
<th>Systemwide Responsibility (Interface to Customer)</th>
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### Audience-members we want to connect with to form a team in NYS:

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“We are flexible in the role we play”
In 2006, CPT Developed the St. Luke’s Hospital & Utica College Burrstone Energy Microgrid

UTICA, NY
The Optimization Problem
Maximize “profit” within constraints

Decision variables
(used to calculate control inputs)
Other decision variables
Provided forecasts
St. Luke’s Hospital/Utica College
Burrstone Energy Center Microgrid
UTICA, NY

WE FINANCED, OWN & OPERATE

Project Overview
- New 5,400 SF Building
- $15 Million Design-Build Project

Output
- 3.6 MW of 13.2 kV electricity,
- 7000 lbs/hr of 85 psig Steam
- 700 gpm of 200 degree hot water
- Output to Date:
  - Generated over 140 M kWh of Electricity
  - Exported over 10 M kWh of Electricity
  - Produced over 120 M lbs of Steam

Technology
- Three 1.1 MW and One 334 kW Lean Burn Natural Gas Reciprocating Engines
- 300 Ton Double Effect Steam Absorption Chiller, One 100 Ton Hot Water Absorption Chiller
- 750 kw Black Start Generator

KEY FEATURES:
- Multiple Gas Engines (3) 1.1 MW & (1) 334 kW
- Connection to Multiple Utility Services
- Load Management System
- Black Start Capability
- Campus Environment
We developed our own Automated Economic Dispatch System...

**EDA OUTPUT**
- Mode of Engine
- kW Level of Each Engine
- Peak Shave kW Level
- Base Load kW Level
- Export Level

Fixed Costs

Daily Price of Natural Gas
What is VOLTTRON™?

Pacific Northwest National Labs (PNNL) approached us to implement their open-source software platform developed with DOE funding.

- Provides a common, secure framework that runs on local, low-cost hardware or in the cloud (as needed)
- A robust library of agents to:
  - Gather and manage data from diverse sources (building system data, utility prices, weather data, etc.)
  - Forecasting tools (building loads, etc.)
  - Models of physical components (building equipment, solar arrays, inverters, batteries, chillers, boilers, thermal storage, etc.)
  - Send commands to control systems
  - Robust, formal optimization
  - Not dedicated to single technology/resource
Why use an Open Source Platform?

• It is open source like the programming languages FORTRAN or PYTHON are
• Someone still needs to know how to program the language to get the desired outcome... *we have that expertise*
• Proprietary programs are black boxes
• VOLTTRON has been Third Party Verified by a National Laboratory (PNNL)
• More transparency & more certainty it is doing the best thing
Why a new VOLTTRON™-Based Economic Dispatch System?

Enhancements that Address New (and Expected) Opportunities under NY REV

- Respond to new 24 hour day-ahead and hour ahead export pricing from National Grid DSP Pilot at Burrstone
  - Day ahead hourly pricing that includes value for both wholesale commodity AND distribution system benefits

- Provide better load forecasting to address wide range of “day ahead” price-response issues (demand limiting, energy storage, etc.)
Formulate Problem in VOLTTRON™ (Linear Programming)

- Define function to optimize
- Develop constraints in linear form
- Run optimization for each hour, looking 24 hours ahead

\[
\text{Load}_{f,h}^{\text{elec}} + \text{Commit}_{f,h} - \sum_{i} \text{Gen}_{i,h}^{\text{elec}} - \text{Import}_{f,h} = 0, \ \forall f, h
\]

\[
\text{Load}_{h}^{\text{steam}} + \text{Reject}_{h}^{\text{steam}} - \sum_{i} \text{Gen}_{i,h}^{\text{steam}} - \text{Boiler}_{h}^{\text{steam}} = 0, \ \forall f, h
\]

- Allows us to Optimize Value for Portfolio of DER Resources in facility
Data Exchange at Burrstone

VOLTTRON™

Economic Dispatch Agent

Server at Burrstone facility

National Grid

Day Ahead Import Electric Prices

Day Ahead Export Prices

Facility Load Data, Gas Price

Engine Commands (sent hourly)

24-hour Temperature Forecast

Weather Data

National Grid DSP Pilot
Since our collective Burrstone experience, we have...

CPT

- Completed 7 different CHP Projects as the Design-Build contract holder... of which 4 are at Level 1 Trauma Centers
- Produced over half-a-billion kWhs exported over 20 million kWhs
- Supported operations, maintenance, and troubleshooting at 2 Plants
- Implement islanding, Automatic Load Shed, and Black Start at 6 of the Plants

Frontier Energy

- Collects performance data from 500 different systems each night
- Run analytics and make recommendations to meet customer needs
- Developed a deep tool box to quickly interface to a wide variety of data streams from control systems, websites, etc. using Modbus, BACNet, OBIX, JSON, XMC, etc.

...AND
Frontier Energy built and operate this site presenting data for various DER
Resiliency

• 10 years of Plant Operations at our Hospital customer, plus 4 CHP Plants at Level 1 Trauma Centers has immersed us in why resiliency of reliable power is so critical.

DER Technologies

• The integration of DERs enables the developers much more flexibility to customize the solution(s) to meet the customer’s resiliency and financial needs.

Microgrids

• The inherent resiliency of microgrids will make them invaluable to their communities... however, there are still many obstacles to overcome (regulatory, DER Technology Performance, cost).

“This Audience will Solve this Problem”
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