Climate Smart Communities Webinar

Telephone call-in number

• 1-866-394-2346

• Code: 1982360347#

• No audio signal will be transmitted over the Internet
Climate Smart Communities Webinar
October 9, 2014
Community Energy Options: Micro-Grids, CHP and Distributed Generation

This webinar will begin shortly. Please be considerate of your fellow attendees:

• Please mute your phone to reduce background noise

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• Please do not put your phone on hold at any time.

• To ask a question, please type your question or comment in the chat box feature.
Welcome

Kim Farrow
Environmental Program Specialist
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Climate Smart Communities
Webinar

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Climate Smart Community Webinars

Schedule: http://www.dec.ny.gov/energy/86246.html

- November 13, 10:30 a.m. Community Energy Options: Microgrids and Community Choice Aggregation.
- December 10 (Wednesday), 10:30 a.m. Best Practices in LED Streetlight Conversions
- January 8, 10:30 a.m. Getting to Net-Zero Homes

Coming Events

- October 17, 8:00 p.m. Preparing New York’s Communities for Climate Change. Kopernik Observatory and Science Center, Vestal, NY. www.kopernik.org.
NYSERDA

Public-Benefit Corporation - Established by the New York State Legislature

NYSERDA’s focus: Energy and it’s Environmental, Economic and Educational impacts on the state

Majority of Funding through System Benefits Charge
NY Electric Market

NYISO:
- 11,000 miles of circuits
- 300 Generators
- 34,800 MW peak
- 158,000,000 MWH

NY Utilities:
- 6 - IOU
- 2 - Public
- Municipals / Coops

Generation:
- Nuclear (26%)
- Natural Gas (31%)
- Hydro (18%)
- Imported (15%)
- Coal (5%)
- Other (5%)
What is a Microgrid?

Not New

Not Backup Generation

Microgrid - A group of interconnected loads and distributed energy resources that form a single controllable entity capable of operating continuously in both grid-connected and islanded mode.
Benefits

**Economic**

- *Direct*
  - Energy cost reductions
  - Reduced purchases of electric generation, transmission & distribution services
  - Reduced purchases of fuel for on-site thermal energy demand
  - Reduced purchases of ancillary services
  - Sales of excess electricity to the macro-grid
  - Participation in demand response programs
  - Provision of ancillary services to the macro-grid

- *Indirect*
  - Reduced electric T&D losses
  - Deferred electric T&D capacity investments
  - Utility option value for long-term planning purposes
  - Enhanced electricity price elasticity
  - Support for deployment of renewable generation

**Reliability & Power Quality**

- Reduced power interruptions
- Enhanced power quality

**Environmental**

- Reduced emissions of greenhouse gases
- Reduced emissions of criteria pollutants

**Security and Safety**

- Safe havens during power outages
Case Study – Urban

New York University (15 MW)

THE PROCESS
Natural gas 2 fuels twin high-tech gas turbines 3 which work very much like jet engines. As the turbines work, two things happen: hot exhaust from the turbine is directed to heat recovery steam generators 4 which make steam, and the rotation of the turbine is used to generate 11 megawatts of electricity. Once steam is created in the steam generators, it is piped to a steam turbine electrical generator 7 which produces an additional 2.4 megawatts of electricity. After the steam has passed through the steam turbine generator, it is still hot and makes hot water for the campus in two high-temp hot water heat exchangers 5 and it is used to operate a chiller that provides cool water and cold water for air conditioning 6.

SITE MAP

ENERGY KEY
- Natural gas
- Electricity
- Steam
- Hot, water
- Mechanical energy
- Hot turbine exhaust
- Cold water

HOW NYU’S NEW COGENERATION PLANT WORKS

GETTING GREENER: In 2007, NYU committed to building a new, state-of-the-art cogeneration (CoGen) plant, which simultaneously produces heat and electricity to serve the NYU campus. Because of the plant’s efficiency, greenhouse gases and regulated pollutants will be significantly reduced compared to meeting NYU’s energy needs with conventionally produced energy. When it becomes fully operational in 2010, it will permit NYU to achieve and surpass the public commitment it made in 2007 to reduce its carbon footprint by 30% by 2017.

FAST FACTS:
- Approaching 15,000 heat 12,000 new school buildings
- Dilution cost savings
- 40% reduction of CO2 emission

NYU Green Energy Solutions.
Case Study – Suburban
Cornell University (30 MW)

Combustion Turbine with Heat Recovery Steam Generator

Combustion Turbine with Heat Recovery Steam Generator
Case Study - Rural

Town of Denning (1MW)
Critical Facilities Microgrid Study

Tasked Legislatively:

• What facilities in geographic regions impacted by extreme weather have interest in considering a microgrid?
  
  **NYC, Broome, Rockland, Nassau, Suffolk**

• What are potential regulatory structures under which microgrid would operate?

• How can operation of conform to/be compatible with current utility requirements?

• What type of configurations optimally supports critical services for extended grid outages?

• What technical and regulatory issues impact on interconnection to utility?

• What approaches are most appropriate for funding installation and O&M?
Results:

- Cost benefits was not economically feasible at the sites analyzed. This is primarily due to the robust backup generation available at most of the critical facilities and costs associated with communications, controls, and wiring.

- Microgrid designs are highly unique. It is difficult to compare or extrapolate benefits and costs from one site to another.

- The cost-effectiveness of a microgrid improves if the system can economically operate on a more frequent basis, rather than solely as back-up generation in the event of emergencies and can generate additional revenue from other sources.
Future Work

- Interconnections - Power Electronics
- Proposed Demonstrations
- NY Prize
Challenges

- Development
- Legal / Regulatory
- Interconnects
- Right of Ways
Lessons Learned

• Fundamentals First
• Economics Matter
• Use the Heat
• Remember O&M
• Renewable / Storage – Hybrid
• Every Site is Unique
Thank you

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NYSERDA
Northeast Combined Heat and Power Technical Assistance Partnership

CHP Opportunities in New York

Local and Regional Options for Energy and Climate Change Resiliency
CHP: Brief Background

- Currently there are approximately 82,000 MW’s of existing CHP in the U.S.

- Historically, CHP has mostly been in energy intensive industries:
  - 29% Chemicals
  - 18% Refining
  - 14% Pulp&Paper
  - 8% Food

- But, many of the NEW opportunities are in Commercial, Institutional, Hospital and University Campus settings
CHP (“cogeneration”) is an *integrated energy* system that generates electrical and/or mechanical power.

Located at or near a factory or building that can use the energy output, CHP:

- increases power reliability;
- improves efficiency;
- lowers operating costs; and reduces air emissions.
CHP Is Used at the Point of Demand

3,600 CHP Projects
81,700 MW
Saves 1.8 quads of fuel each year
Eliminates 241 M tons of CO₂ each year
CO₂ reduction equivalent to eliminating forty 1,000 MW coal power plants

Source: ICF International

CHP is an Underutilized Resource!!!
## CHP Technical and Economic Potential for the Northeast Region

<table>
<thead>
<tr>
<th>State</th>
<th>Technical Potential (MW's)</th>
<th>Existing CHP (MW's)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connecticut</td>
<td>1,400</td>
<td>713</td>
</tr>
<tr>
<td>Maine</td>
<td>900</td>
<td>900</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>2,800</td>
<td>1,571</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>600</td>
<td>58.5</td>
</tr>
<tr>
<td><strong>New York</strong></td>
<td><strong>9,500</strong></td>
<td><strong>5,585</strong></td>
</tr>
<tr>
<td>Rhode Island</td>
<td>500</td>
<td>114</td>
</tr>
<tr>
<td>Vermont</td>
<td>300</td>
<td>22</td>
</tr>
<tr>
<td><strong>Northeast Total</strong></td>
<td><strong>16,000</strong></td>
<td><strong>8,963.5</strong></td>
</tr>
</tbody>
</table>
## Northeast Commercial/Institutional CHP Technical Potential

<table>
<thead>
<tr>
<th>SIC</th>
<th>Application</th>
<th>50-1000 kW MW</th>
<th>1-5 MW (MW)</th>
<th>5-20 MW (MW)</th>
<th>20-50 MW (MW)</th>
<th>50-100 MW (MW)</th>
<th>Total MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>43</td>
<td>Post Offices</td>
<td>7</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>52</td>
<td>Retail</td>
<td>230</td>
<td>35</td>
<td>16</td>
<td>14</td>
<td>0</td>
<td>295</td>
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<tr>
<td>4222</td>
<td>Refrigerated Warehouses</td>
<td>8</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>4581</td>
<td>Airports</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>4952</td>
<td>Water Treatment</td>
<td>18</td>
<td>4</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>30</td>
</tr>
<tr>
<td>5411</td>
<td>Food Stores</td>
<td>308</td>
<td>78</td>
<td>36</td>
<td>26</td>
<td>0</td>
<td>447</td>
</tr>
<tr>
<td>5812</td>
<td>Restaurants</td>
<td>174</td>
<td>14</td>
<td>7</td>
<td>6</td>
<td>0</td>
<td>201</td>
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<tr>
<td>6512</td>
<td>Commercial Buildings</td>
<td>1,842</td>
<td>1,718</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3,560</td>
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<tr>
<td>6513</td>
<td>Multifamily Buildings</td>
<td>939</td>
<td>375</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1,313</td>
</tr>
<tr>
<td>7011</td>
<td>Hotels</td>
<td>304</td>
<td>89</td>
<td>193</td>
<td>57</td>
<td>21</td>
<td>664</td>
</tr>
<tr>
<td>7211</td>
<td>Laundries</td>
<td>24</td>
<td>7</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>34</td>
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<tr>
<td>7374</td>
<td>Data Centers</td>
<td>38</td>
<td>7</td>
<td>12</td>
<td>0</td>
<td>0</td>
<td>57</td>
</tr>
<tr>
<td>7542</td>
<td>Car Washes</td>
<td>6</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>7832</td>
<td>Movie Theaters</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>7991</td>
<td>Health Clubs</td>
<td>35</td>
<td>1</td>
<td>3</td>
<td>8</td>
<td>0</td>
<td>46</td>
</tr>
<tr>
<td>7997</td>
<td>Golf/Country Clubs</td>
<td>58</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>60</td>
</tr>
<tr>
<td>8051</td>
<td>Nursing Homes</td>
<td>257</td>
<td>33</td>
<td>47</td>
<td>0</td>
<td>0</td>
<td>338</td>
</tr>
<tr>
<td>8062</td>
<td>Hospitals</td>
<td>79</td>
<td>160</td>
<td>383</td>
<td>183</td>
<td>0</td>
<td>806</td>
</tr>
<tr>
<td>8211</td>
<td>Schools</td>
<td>383</td>
<td>21</td>
<td>19</td>
<td>0</td>
<td>0</td>
<td>423</td>
</tr>
<tr>
<td>8221</td>
<td>College/Univ.</td>
<td>121</td>
<td>104</td>
<td>386</td>
<td>473</td>
<td>238</td>
<td>1,320</td>
</tr>
<tr>
<td>8412</td>
<td>Museums</td>
<td>16</td>
<td>1</td>
<td>9</td>
<td>0</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>9100</td>
<td>Government Buildings</td>
<td>182</td>
<td>89</td>
<td>161</td>
<td>188</td>
<td>0</td>
<td>620</td>
</tr>
<tr>
<td>9223</td>
<td>Prisons</td>
<td>24</td>
<td>54</td>
<td>92</td>
<td>11</td>
<td>0</td>
<td>180</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total</th>
<th>Commercial Technical Potential</th>
<th>4,309</th>
<th>2,659</th>
<th>1,309</th>
<th>920</th>
<th>259</th>
<th>10,454</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>Commercial &amp; Industrial</td>
<td>5,284</td>
<td>3,952</td>
<td>2,597</td>
<td>1,951</td>
<td>1,088</td>
<td>15,870</td>
</tr>
</tbody>
</table>
CHP: What problems does it solve?

- Saves money, reduces operating costs
- More predictable, hedge against rising costs
- Greater efficiency
- Reduce GHG emissions (environmental performance)
- ..and following Superstorm Sandy, Hurricane Irene and October 2011 snowstorm – Resiliency, Business Continuity, Emergency Preparedness!
CHP Saves Money

- CHP was the single greatest opportunity to reduce utility costs at the NY Presbyterian Cornell Weill Campus
- UMass Medical Center Campus has expected payback < 3 years, $6.2 Mil. in annual savings
- South Oaks Hospital system saves nearly $540,000 annually (on $1.467 Mil energy bill)
- NY Presbyterian reports that by purchasing 10% more fuel (natural gas) they avoid purchasing 80% of their electricity requirements
CHP Markedly Improves Reliability

- NY Presbyterian System provides 100% redundancy to entire inpatient areas
- NYP system accounts for 100% of baseload and (2/3) of peak requirements
- UMass Medical Center system permits the Campus to operate with virtually no supplemental grid power
- UMass Amherst, ran through Oct 2011 storm
## CHP versus Backup Generation

<table>
<thead>
<tr>
<th></th>
<th>CHP</th>
<th>Backup Generation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>System Performance</strong></td>
<td>• Designed and maintained to run continuously</td>
<td>• Only used during emergencies</td>
</tr>
<tr>
<td></td>
<td>• Improved performance reliability</td>
<td></td>
</tr>
<tr>
<td><strong>Fuel Supply</strong></td>
<td>• Natural gas infrastructure typically not impacted by severe weather</td>
<td>• Limited by on-site storage</td>
</tr>
<tr>
<td><strong>Transition from Grid Power</strong></td>
<td>• May be configured for “flicker-free” transfer from grid connection to “island mode”</td>
<td>• Lag time may impact critical system performance</td>
</tr>
<tr>
<td><strong>Energy Supply</strong></td>
<td>• Electricity</td>
<td>• Electricity</td>
</tr>
<tr>
<td></td>
<td>• Thermal (heating, cooling, hot/chilled water)</td>
<td></td>
</tr>
<tr>
<td><strong>Emissions</strong></td>
<td>• Typically natural gas fueled</td>
<td>• Commonly burn diesel fuel</td>
</tr>
<tr>
<td></td>
<td>• Achieve greater system efficiencies (80%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Lower emissions</td>
<td></td>
</tr>
</tbody>
</table>
UMass Medical Center achieved a 19% decrease in net annual GHG emissions

NY Presbyterian reduced CO$_2$ emissions by 27,000 tons per year

South Oaks Hospital reduced their carbon footprint by >1,900 tons per year and NO$_x$ was reduced 95% in 2012 (removed hospital from Major Source site!)
CHP’s Higher Efficiency Results in Energy and Emissions Savings

<table>
<thead>
<tr>
<th>Category</th>
<th>10 MW CHP</th>
<th>10 MW PV</th>
<th>10 MW Wind</th>
<th>10 MW NGCC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Capacity Factor</td>
<td>85%</td>
<td>22%</td>
<td>34%</td>
<td>70%</td>
</tr>
<tr>
<td>Annual Electricity</td>
<td>74,446 MWh</td>
<td>19,272 MWh</td>
<td>29,784 MWh</td>
<td>61,320 MWh</td>
</tr>
<tr>
<td>Annual Useful Heat Provided</td>
<td>103,417 MWh</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Footprint Required</td>
<td>6,000 sq ft</td>
<td>1,740,000 sq ft</td>
<td>76,000 sq ft</td>
<td>N/A</td>
</tr>
<tr>
<td>Capital Cost</td>
<td>$20 million</td>
<td>$60.5 million</td>
<td>$24.4 million</td>
<td>$10 million</td>
</tr>
<tr>
<td>Annual Energy Savings, MMBtu</td>
<td>308,100</td>
<td>196,462</td>
<td>303,623</td>
<td>154,649</td>
</tr>
<tr>
<td>Annual CO₂ Savings, Tons</td>
<td>42,751</td>
<td>17,887</td>
<td>27,644</td>
<td>28,172</td>
</tr>
<tr>
<td>Annual NOx Savings</td>
<td>59.9</td>
<td>16.2</td>
<td>24.9</td>
<td>39.3</td>
</tr>
</tbody>
</table>

Source: Combined Heat and Power A Clean Energy Solution: August 2012: DOE and EPA
CHP Markets are Attractive in the Northeast

- Incentives available in northeast states, including:
  - CT CEFIA
  - MA Alternative Portfolio Standard and Mass Saves Program
  - NYSERDA’s suite of CHP Incentives
  - NJ’s $25 Million Allocation for CHP incentives
  - RI, ME, NH & VT all have incentives of some type
Top 4 States for new CHP Installations: 2007-2011

<table>
<thead>
<tr>
<th>State</th>
<th>Installations</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA</td>
<td>95</td>
</tr>
<tr>
<td>NY</td>
<td>92</td>
</tr>
<tr>
<td>CT</td>
<td>64</td>
</tr>
<tr>
<td>MA</td>
<td>44</td>
</tr>
</tbody>
</table>

Source: ICF/CHP database

CHP Markets are Attractive in the Northeast, particularly New York!
Factors Favoring CHP in Northeast

- High electricity prices in Northeast improve the economics of CHP investments
- Low gas prices and expectations for future low prices
- Additional incentives such as preferential gas rates for gas used in CHP
Favorable Characteristics for CHP Applications

- Concern about energy costs
- Concern about power reliability
- Concern about sustainability and environmental impacts
- Long hours of operation
- Existing thermal loads
- Central heating and cooling plant
- Future central plant replacement and/or upgrades
- Future facility expansion or new construction projects
- EE measures already implemented
- Access to nearby renewable fuels
- Facility energy champion
Emerging Drivers for CHP

- Benefits of CHP recognized by policymakers
  - President Obama signed an Executive Order to accelerate investments in industrial EE and CHP on 8/30/12 that sets national goal of 40 GW of new CHP installation over the next decade

- Favorable outlook for natural gas supply and price in North America

- Opportunities created by environmental drivers

DOE / EPA CHP Report (8/2012)


CHP Technologies

- Electric Generation Equipment
  - Reciprocating Engines
  - Turbines / Microturbines
  - Steam Turbines
  - Fuel Cells
- Heat Recovery Systems
  - Hot Water
  - Steam
  - Exhaust Gases
- Thermally Activated Technologies
  - Absorption Chillers
  - Desiccant Dehumidification
  - Thermal Storage
Grid Interconnection

Any CHP interconnection MUST address:

- Safety of customers, line workers, general public
- Integrity of the grid & quality of service
- Protection of equipment
- System Control by the utility

Consult with your electric utility EARLY
Federal Business Energy Investment Tax Credit

- A 10% ITC is available for qualifying CHP systems, with a 30% ITC for fuel cells.
- Value of an ITC can be passed to Non-Taxable entities via 3rd party arrangements and leases.
- Eligible if significant physical work begins on project or 5% of project costs incurred before 12/31/2016.
ITC: Non-Taxable Entities and Qualifying Projects

- Microturbines up to 2MW in size are eligible for a 10% ITC, capped at $200/kW.
- Fuel Cell projects are eligible for a 30% ITC with no maximum credit limit expect that the payment shall not exceed $3000/kW.
- CHP projects are eligible for a 10% ITC with no maximum credit limit. Eligible systems must exceed 60% system efficiency, or use 90% biomass.
ITC: Non-Taxable Entities and Qualifying Projects

- Microturbines up to 2MW in size are eligible for a 10% ITC, capped at $200/kW.
- Fuel Cell projects are eligible for a 30% ITC with no maximum credit limit except that the payment shall not exceed $3000/kW.
- CHP projects are eligible for a 10% ITC with no maximum credit limit. Eligible systems must exceed 60% system efficiency, or use 90% biomass (with lower efficiency allowed).
Modified Accelerated Cost Recovery System (MACRS)

- Provides favorable depreciation recovery for investment in eligible capital equipment
- CHP, fuel cells, and microturbines for purposes of MACRS are classified as 5 year property, absent MACRS it would be 15 years
- Biomass is typically classified as a 7-year property.
Clean Energy Application Centers (CEAC)

DOE Clean Energy Application Centers: Locations, Contacts, and Web Sites

NORTHWEST
www.northwestcleanenergy.org
Dave Spading
Washington State University
Tel: 360-956-2004
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MID-ATLANTIC
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Mississippi State University
Tel: 662-325-6602
mago@ee.msstate.edu

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www.districtenergy.org
Rob Thornton
President
Tel: 508-366-9339
rob.idea@districtenergy.org

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Katrina Pieli
Office of Energy Efficiency and Renewable Energy
U.S. Department of Energy
Phone: 202-287-5850
E-mail: katrina.pieli@ee.doe.gov

Joe Renk
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Economic and Financial Analysis

Providing Resources to interested communities including:

* Assessing economic viability and technical feasibility
* Approaching interconnection issues
* Navigating legal and regulatory matters
* Understanding tariffs and standby charges
CHP Assistance from CEACs

CEAC Capabilities
- Qualification through Feasibility Analysis
- CHP Expertise thru all Steps
- Bringing customers and CHP engineering community together

CEAC Project Support
- Over 225 assessments & 700 tech support activities
- Represents over 1.5 GW installed or in development
Thank You

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http://www1.eere.energy.gov/manufacturing/distributedenergy/ceacs.html
Climate Smart Communities Webinar

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