Resilient Energy Systems:
District Energy & Microgrids

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Senior Manager of Innovative Services
May 24, 2016
Climate leadership now also having the capacity to respond and adapt
• Carbon neutrality still a transformative component
• Also includes adaptation, preparedness - resilience

Goals for Commitments:
• Continue to provide visible and transformative leadership
• Proactive management of risks and opportunities; limit reactive response to unanticipated vulnerabilities
• Streamline implementation, demonstrate learning, understand progress, scale success
• Connect higher education to communities in order to enhance broader, coherent societal response

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Common Elements

• Made by Presidents and Chancellors on behalf of institution

• Climate Action Plans include actions to engage all students

• Sustainability Planning & Climate Action Guide
  o Digital, interactive, and linked to further resources

• One dues structure
Resilience Commitment

Broad Goal: Increase “ability to survive disruption and to anticipate, adapt, and flourish in the face of change” (definition of resilience)

Additional Goals:
• To avoid reactive and expensive decisions or unnecessary emergency management
• To have diverse and inclusive processes in climate actions
• To enhance the role of higher education in supporting community cohesion, innovation, smart design
• To contribute to cross-sector knowledge and progress

Key concepts of Resilience Commitment
• Increasing adaptive capacity
• Partnership with community
• Assessment, indicators, inclusivity

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1. Previous: Intro to Resilience & Energy Systems
   • Watch recording & download slides:
     http://secondnature.org/how-we-connect/webinars/


3. Upcoming: Resilient Energy Design:
   • Tue, Jun 14, 2016 2:00 PM - 3:00 PM EDT
   • Register:
     https://attendee.gotowebinar.com/register/3172158490825096964
Malcolm McLellan:

Malcolm McLellan is a partner with the law firm of Van Ness Feldman. He represents a wide array of participants in the electric power industry including owners of power generating facilities, transmission and distribution providers, wholesale power markers, and consumers. Malcolm has an intricate knowledge of the technical, legal, and business considerations facing the electric power industry.
Resilient Energy Systems: District Energy, CHP and Microgrids

Malcolm McLellan, Partner
Van Ness Feldman, LLP

May 24, 2016
Van Ness Feldman LLP

• Law firm that focuses on energy and use of natural resources
  – Government relations
  – Regulatory and transactional
  – Permitting
  – Land use and real estate

• Offices in Washington, D.C. and Seattle

• About 120 professionals
Planning checklist for District Energy and Renewable Energy Projects magazine:

**Planning for District Energy, CHP and Microgrids: A Checklist for Campus Administrators**

*(District Energy Magazine, 1st Quarter 2014)*

- *Written by my partners T.C. Richmond and David Yaffe*
Nomenclature

• District Energy
• Combined Heat and Power (CHP)
  – Topping Cycle
  – Bottoming Cycle
• Microgrids
District Energy
District Energy

District energy:

• **Is not** an energy source
  – It’s a **means** of moving energy

• Requires access to an energy source
  – A heating or cooling source
District Energy System

Water is utilized to move energy (in the form of heating or cooling) from where it is created to where it is consumed through pipes

Source: http://www.districtenergy.org/what-is-district-energy/
Ideal Conditions for District Energy

• Heat source closer to load
  – Water cools with distance
  – High demand density
  – A heat source that is unlikely to go away

• Requires water pipe infrastructure
  – Easier in new construction vs. retro-fit
District Energy Resources

- International District Energy Association
  - http://www.districtenergy.org/

- District-Scale Energy Planning: Smart Growth Implementation Assistance to the City of San Francisco, U.S. EPA (June 2015)
Combined Heat and Power (CHP)
<table>
<thead>
<tr>
<th><strong>CHP</strong></th>
<th><strong>Waste Heat Recovery</strong></th>
<th><strong>District Energy</strong></th>
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<tbody>
<tr>
<td>The sequential production of electric and thermal power from a single dedicated fuel source</td>
<td>Captures heat otherwise wasted in an industrial process and utilizes it to produce electric power. These systems may or may not produce additional thermal energy</td>
<td>Central heating &amp; cooling plants that incorporate electricity generation along with thermal distribution piping networks for multiple buildings (campus / downtown area)</td>
</tr>
</tbody>
</table>

Source: [https://www1.eere.energy.gov/femp/pdfs/fupwg_fall11_valentine.pdf](https://www1.eere.energy.gov/femp/pdfs/fupwg_fall11_valentine.pdf)
**Topping Cycle CHP**

1. **FUEL** → **PRIME MOVER** → **GENERATOR** → **ELECTRICITY** → **THERMAL ENERGY** → **FACILITY**

   *Internal Combustion Engine/Gas Turbine/Microturbine/Fuel Cell*

**Bottoming Cycle CHP**

1. **EXISTING PLANT PROCESS** → **HEAT RECOVERY UNIT** → **PRIME MOVER** → **GENERATOR** → **ELECTRICITY** → **THERMAL ENERGY** (optional) → **FACILITY**

   *Organic Rankine Cycle Turbine/Steam Turbine*

Source: [https://energycenter.org/self-generation-incentive-program/business/technologies/chp](https://energycenter.org/self-generation-incentive-program/business/technologies/chp)
Ideal Conditions for CHP

• Existing heat source closer to load
  – Bottoming cycle

• Desire to build a generating resource
  – Topping cycle
CHP Resources


• U.S. Dept. of Energy Combined Heat and Power Installation Database
  – https://doe.icfwebservices.com/chpdb/

Microgrids
Description

• “A microgrid is a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid.”

• “A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island-mode.”

Source: https://building-microgrid.lbl.gov/microgrid-definitions
The UCSD microgrid project supplies electricity, heating, and cooling for a 450 hectare campus with a daily population of 45,000. It consists of two 13.5 MW gas turbines, one 3 MW steam turbine, and a 1.2 MW solar-cell installation that together supply 85% of campus electricity needs, 95% of its heating, and 95% of its cooling.

Source: https://building-microgrid.lbl.gov/ucsd
Ideal Conditions for Microgrid

• Groups of buildings
• Buildings are operated on a common circuit(s)
• Energy source proximate to the grouping and electrically interconnected
Microgrid Resources

• U.S Dept. of Energy

• Berkley Labs – Example Microgrids
  – [https://building-microgrid.lbl.gov/examples-microgrids](https://building-microgrid.lbl.gov/examples-microgrids)
The Checklist
A. What are the objectives and priorities of your institution that will guide decision-making on the district energy/CHP/microgrid project?

- Combined heat and power + district energy
  - Fuel savings
  - Greenhouse gas emissions savings

- Microgrid
  - Allows critical facilities to remain operational during electricity blackouts and/or natural gas supply outage
  - Hedge for power purchase expenses
B. What is the **current state of your campus’s energy resilience and greenhouse gas emissions?**

- Assess energy use and inefficiencies at existing structures.
- Know the context for decision-making at your institution.
  - Should your institution attempt to achieve reduced or net zero emissions?
- What is a realistic time period for achieving the stated goal?
C. What are the potential savings in dollars, energy/water usage and emissions that you could achieve by implementing district energy, CHP and/or a microgrid?

• Assess heating/cooling and electricity usage characteristics of campus facilities
  – Determine the availability, cost and desirability of utilizing renewable fuels
  – Assess potential for and sale of electricity outside of the campus or microgrid
Cost Analysis

**Beware:** Cost analysis of innovative energy ideas may be deceptively complicated.

- What benefits are considered?
  - How are the benefits described?
- How are benefits quantified?
- What is the methodology of comparing the benefits/costs to status quo?
Possible Benefits/Costs

• Avoided cost of second heat source
• Avoided carbon from second heat source
• Incur a cost to build and operate the heat transfer system.
  – Avoid the cost of building and operating internal heating system and purchasing the fuel
• What’s the back-up if the heat source goes away.
  – How often will access be interrupted in comparison to status quo?
D. What are your design and engineering parameters and your process for selecting district energy, CHP and/or microgrid options?

• Conduct outreach to campus constituencies to explain and engage in project scoping
  – Administration, faculty, staff, and students
  – Special energy needs - researchers and hospitals

• Conduct preliminary outreach to potential vendors and partners
E. Do you have adequate space on campus for a district energy/CHP project?

- Coordinate with campus master planning process:
  - Identify master plan amendment requirements and timing
  - Plan to incorporate energy needs and district energy/CHP locations on campus into campus master plan

- Identify any necessary real estate acquisition or parcel consolidation

- Review water rights and availability for project and potential impacts of project on local water resources
F. Is there an environmental review process such as the NEPA or state equivalent that will guide the planning and review process for the project?

• Begin assembling the lists of potential environmental impacts of the project
• Begin to identify benefits, mitigation measures or credits that can be claimed for this project
• Will district energy simplify environmental review for individual building projects and can environmental benefits be claimed that will assist in the permitting of those projects?
G. What are the applicable state and local siting and zoning requirements for the project?

• Do local zoning authorities encourage district energy, CHP or microgrids?
• Do any local covenants or land use restrictions adversely affect the project?
• For microgrids, are there franchise requirements of local utilities and will facilities cross public streets?
H. What **air permits** will be required and what is the process and timing for the district energy project?

- What permit will be triggered when there is a new heat/power source?
  - Determine the period of operation and emissions

- Are you located in an air containment zone?
I. Are there other federal, state or local regulatory requirements for the project?

- Requirements to interconnect the generating unit or microgrid to the power grid
- If selling power back to the utility
  - Qualifying facility under the Public Utility Regulatory Policy Act
  - Net metering
- If selling power to anyone other than yourself or the utility, are you a public utility subject to state retail jurisdiction?
J. What are the **financing and procurement** opportunities and requirements for the project?

- Grants
- Utility programs
- Bonds
- Leasing or lease/purchase
- Public private partnerships
- Energy savings performance contracts
Questions . . .

Contact information

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