District Energy – Combined Heat and Power as a Resource

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October 2, 2007
Berkeley, Ca.
Presentation Overview

- One Minute Overview of EE and DSM at Austin Energy
- 30 Second Overview of Austin’s Climate Protection Plan
- 12 Minutes about Distributed Energy and CHP as a Resource
1982 – 2002 Energy Efficiency
(about 450 MW equivalent)

RESIDENTIAL PROGRAMS:
1. Rebates for HVAC efficiency that beat Code
2. Duct repair and sealing
3. Weatherstripping, caulking, insulation, solar shading, radiant barrier
4. Power Saver Thermostat

COMMERCIAL PROGRAMS
1. Lighting
2. Motors and VFD’s
3. Energy recovery devices
4. Reflective roofing
5. Chillers
6. Window treatments
7. Thermal energy storage
8. Load co-op
9. Building Commissioning
10. Energy Misers
Efficiency and DSM will grow from less than 3% of total energy in 2006 to a goal of 15% (700 MW) by 2020

Renewable goal is 30% by 2020 (100 MW is solar)
Austin Climate Protection Plan

2. Utility Plan. Implements the most aggressive utility GHG-reduction plan in the nation through dramatic increases in conservation, efficiency and renewable programs; requirements for carbon neutrality on any new generation; and by early retirement of existing utility GHG emissions.
3. Homes and Buildings Plan. Makes Austin building codes for both residential and commercial properties the most energy efficient in the nation.
5. “Go Neutral” Plan. Provides mechanisms for all businesses and individuals to reduce their carbon footprint to zero.

Municipal Plan
- Power 100% of city facilities with renewable energy by 2012.
- Make entire city fleet carbon-neutral by 2020 through use of electric power and non-petroleum fuels (with alt fuel emissions offset through mitigation).
- Develop departmental climate protection plans, including: policies, procedures, targets and reporting for maximum achievable reduction of GHG emissions and energy consumption in all city departments.
- Develop a COA employee climate education campaign; and programs and incentives to help employees reduce personal carbon footprint and engage in community outreach for climate protection.

Utility Plan
- Achieve 700 MW in savings through energy efficiency and conservation by 2020.
- Meet 30% of all energy needs through renewable resources by 2020, including 100 MW of solar power.
- Achieve carbon neutrality on any new generation units through lowestemission technologies, carbon sequestration and offsets.
- Establish CO2 cap and reduction plan for all utility emissions.
We should demand.

- Maximum possible energy efficiency
- Significant reduction in emissions, especially carbon
- Improved reliability, even capable of grid independence
- Investment grade financial returns
- Green Building and LEED® points
Air Conditioning is a HUGE Energy Demand…

- HVAC Equipment 46%
- Lighting 32%
- Miscellaneous Equipment 14%
- Office Equipment 5%
- Computer/Network Equipment 3%

Electricity Consumption Profile Typical Campus
...and Air Conditioning Drives the Electrical Peaks.

350,000 sq. ft. Downtown Austin Building
...What if we shift this “peak” to off peak?

350,000 sq. ft. Downtown Austin Building

Move this demand to district cooling
Turning electric “peaks” into “negative peaks”

Paul Robbins District Cooling Plant Load Profile (July 2005)
Massive Ice Coils freeze water at night... to provide chilled water during day.
District Cooling and Heating…
How It Works

Produce chilled water (or heating) at a central plant and pipe that thermal energy to a number of buildings in the district to satisfy air conditioning needs. Individual buildings don’t need chillers and cooling towers of their own.

http://www.districtenergy.org/what_is.htm
Austin Energy
Downtown District Cooling Map

Legend:
- Existing Connection
- Stub outs
- Future

Downtown District Cooling
IDEA Member
District Energy Systems in the United States
District Cooling is Simple for the Customer

Which do you choose?

Cooling Towers & Chiller Plant…or

Heat Exchanger & District Cooling
District Energy Benefits

(Utility perspective)

- Defer peaking power plants
- Free up expensive “peaking” power
- Avoid power plant emissions during peak hours
- Greater energy efficiencies reduce air emissions
District Energy Advantages
(customer perspective)

- Favorable energy efficiencies
- Favorable economics
- Positive environmental impact
- Energy security
- Improved worker productivity
What if we add electric generation and use RECYCLED energy…
How the CHP works...

Solar Turbines Mercury 50 with Heat Recovery Steam Generator and Steam Absorption Chiller
Services Provided by the District Energy CHP Plant…

- Chilled Water Cooling
- Steam Heating
- Electric KW Capacity (grid independent capable “Premium Power”)
- Life Safety “emergency” power
Why Choose CHP – District Energy…

**Fuel Scarcity drives energy efficiency**

**Typical Power Delivery**

1 BTU In → .65 BTU Loss

**Power Plant:** About 35% of BTU input converts to electricity (65% wasted!!)

.35 BTU In → .06 BTU Loss

**Transmission and distribution system loses about 6%**.

.29 BTU In → About 29% of all power input at the power plant is delivered to the customer.
A better solution:

CHP Energy Conversion & Delivery…

CHP Energy Delivery

CHP Plant

End User

30 BTU Loss

1 BTU In

.70 BTU In

CHP has **70% greater efficiency** at conversion of primary fuel to useful energy.

Emissions are greatly reduced – handily beating the Texas Commission on Environmental Quality requirements.
Using Utility Lingo…

- CHP efficiency compares favorably with best in class combined cycle power plant heat rates (i.e. less than 7,000 BTU/KWH)
- CHP is firm capacity and is dispatchable
- Thermal energy may be more profitable than electrical output
- Power factor on feeder can be improved

Note: Heat Rate calculation includes electrical equivalent of recycled thermal energy)
Carbon Emissions Reduction: Where’s the biggest opportunity?

www.architect2030.org
Environmental Impact…

Isn’t CHP a better way?

Austin Energy’s Fleet
Central Power Plants
(Including nuclear)

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<th>CO2</th>
<th>SO2</th>
<th>NOx</th>
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<tr>
<td>CO2</td>
<td>1162 lbs/MWh</td>
<td>2.33 lbs/MWh</td>
<td>0.6 lbs/MWh</td>
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CHP Plant

<table>
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<td>615 lbs/MWh</td>
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Positive Impact to the Environment…

Austin Energy’s Fleet Central Power Plants (Including nuclear) VS. CHP Plant

Carbon Dioxide: 47% reduction
Sulphur Oxide: 99% reduction
NOx: 93% reduction

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<th></th>
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<td>CHP</td>
<td>615 lbs/MWh</td>
<td>0.003 lbs/MWh</td>
<td>.043 lbs/MWh</td>
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Positive Impact to the Environment…
(Coal vs. CHP)

Typical COAL Plant

- Carbon Dioxide: 72% reduction
- Sulphur Oxide: 99% reduction
- NOx: 99% reduction

CO2 2179 lbs/MWh
SO2 8 lbs/MWh
NOx 5 lbs/MWh

VS.

CHP Plant

- Carbon Dioxide: 72% reduction
- Sulphur Oxide: 99% reduction
- NOx: 99% reduction

CO2 615 lbs/MWh
SO2 0.003 lbs/MWh
NOx 0.043 lbs/MWh
Recycled energy could displace a boiler…

**Typical boiler**

CO2: 1502 lbs/hr reduction  
SO2: .007 lbs/hr reduction  
NOx: 1.25 lbs/hr reduction

* Assuming 10 mmbtu/hr output

**IES Plant**
Why Choose CHP:
Energy Security and Reliability

The Grid Dilemma: Decoupling of transmission & generation investment

CHP Distributed Generation Could Transform the Electric Grid…

Bulk Power

Remote Power and CHP

Energy Management, Future CHP and Sell to Grid

Grid Ancillary Services

Base-load, and Industrial Cooling, Heat and Power

Power Quality and CHP

Back-up Generation For Critical Services
**Why Choose CHP...**

**A smart INVESTMENT!!**

Attractive IRR's and NPV's - beating other long term investments)

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**SAMPLE IES PROFORMA**

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| **OPERATING EXPENSES** | | | | | | | | | | | |
| FIT | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| O&M Generator | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| O&M Backup Diesel Gen | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| O&M ABS Chiller | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| O&M Electrical Chiller | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| O&M Boiler | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Electric Chiller Utility (elec, H2O, chem) Cost | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Purchase GPD power - TES | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Fuel or Electric Cost (Boiler) | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Fuel Cost (Generator) | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Insurance Cost | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Property Lease Cost | $10 | $10 | $10 | $10 | $10 | $10 | $10 | $10 | $10 | $10 | $10 |
| Admin/Overhead Costs | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Total O&M Expenses | $0 | $10 | $10 | $10 | $10 | $10 | $10 | $10 | $10 | $10 | $10 |

| **NET INCOME** | $0 | ($10) | ($10) | ($10) | $2,152,617 | $2,166,670 | $2,315,018 | $2,394,562 | $2,394,562 | $2,394,562 | $2,394,562 |
| **CAPITAL EXPENSES** | | | | | | | | | | | |
| Equipment, Installation, Engineering | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Building | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Land | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Pipe and connection | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Pollution Control | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Total Capital Cost | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |

| **CASH FLOW** | | | | | | | | | | | |
| Annual Cash Flow | $0 | ($10) | ($10) | ($10) | $2,152,617 | $2,156,670 | $2,233,563 | $2,284,375 | $2,336,662 | $2,376,664 | $2,424,187 |
| Cumulative Cash Flow | $0 | ($10) | ($20) | ($30) | $2,152,617 | $2,156,670 | $2,233,563 | $2,284,375 | $2,336,662 | $2,376,664 | $2,424,187 |
Customers experience lowest life-cycle costs
(avoid initial capital, predictable pricing, increased productivity)

Utilities get a cheap source for new generation capacity (OPM is paying for infrastructure, most o&m costs – including fuel)

New source of revenue and profit for the CHP provider (thermal and premium power sales)

OPM = Other People’s Money
Why Choose CHP…

CHP Maximizes LEED Recognition

- USGBC recognizes CHP as an alternative means to meet energy needs of buildings
- Eight to 10 LEED points can be attributable to the positive impact of a CHP plant
- The Dell Children’s Hospital in Austin is on track to be the first healthcare in the world to receive LEED Platinum rating
- The project will attain award from Austin Energy’s “Green Building” Program
Why Choose CHP…
LEED Recognition

“I was fortunate to personally meet with the team from the Austin Energy/Seton Healthcare Network and came away amazed by what I experienced. In particular, the low emissions and the high energy conversion efficiencies predicted for the Dell Children's Medical Center of Central Texas (DCMCCT) combined cooling, heating and power plant, make it quite possible for this project to be awarded the maximum 10 points allowable under Credit EA-1 and that will, in turn, allow the DCMCCT to become the first LEED Platinum Hospital in the World.”

Rick Fedrizzi - President, CEO and Founding Chairman
United States Green Building Council
April 14, 2005
Case Study: Mueller
711 Acres of Mixed Use
The Mueller Energy Center (MEC) is located in an urban “brownfield redevelopment site…”

IN TUNE AND IN TOUCH WITH AUSTIN.

Welcome to Mueller, the new mixed-use urban village in the heart of Austin, Texas. The result of unprecedented community collaboration, Mueller is a model for responsible planning and sustainability. In every way, Mueller breaks the mold and offers a variety of homes, shops, services, schools and places to work and play in a setting that’s vibrant, pleasing and downright friendly.
Mueller Energy Center…
Modular Packaged CHP
CHP is quick to build…

From concept to reality in less than twelve months
The Plant...
Awards...

“Little Big Man of the State’s Generation Sector”

For looking good and being clean...

2007 award winner “industrial” category
Here’s why anyone might choose CHP…

✓ **Energy Efficiency:** Best use of natural gas
✓ **Environmental:** Huge emissions reduction
✓ **Energy Security:** Improved reliability
✓ **Financial:** Lowest life cycle costs
✓ **LEED Scoring**
Replication potential is limited...

Only Customers Who Fit One or More of These Conditions:

- Large cooling or heating load?
- Large user of natural gas?
- Willing to pay a small premium for extraordinarily reliable power?
- Need new back up generators, chillers, boilers?
- Need to reduce site emissions?
- Capital constrained for energy upgrades?
- Desire to reduce risk by outsourcing?
- Need stable, long-term pricing?
- Exploring new energy supply options
The Time Is NOW For the CHP & District Energy TEAM To Win!