District Energy – Combined Heat and Power as a Resource

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2007 ACEEE Conference on
Energy Efficiency as a Resource
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

Austin Energy's Virtual Power Plant: Energy Efficiencies + DSM

- ✓ 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

1. **Municipal Plan**. Makes all COA facilities, fleets and operations totally carbon-neutral by 2020.
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.
4. **Community Plan**. Develops a comprehensive plan for reducing GHG emissions from sources community-wide.
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.

Mounting Energy Challenges

- Fuel Scarcity
- Environmental Issues
- Energy Security
- Financial Performance
- Sustainable Design

We should demand. . .

Maximum possible energy efficiency

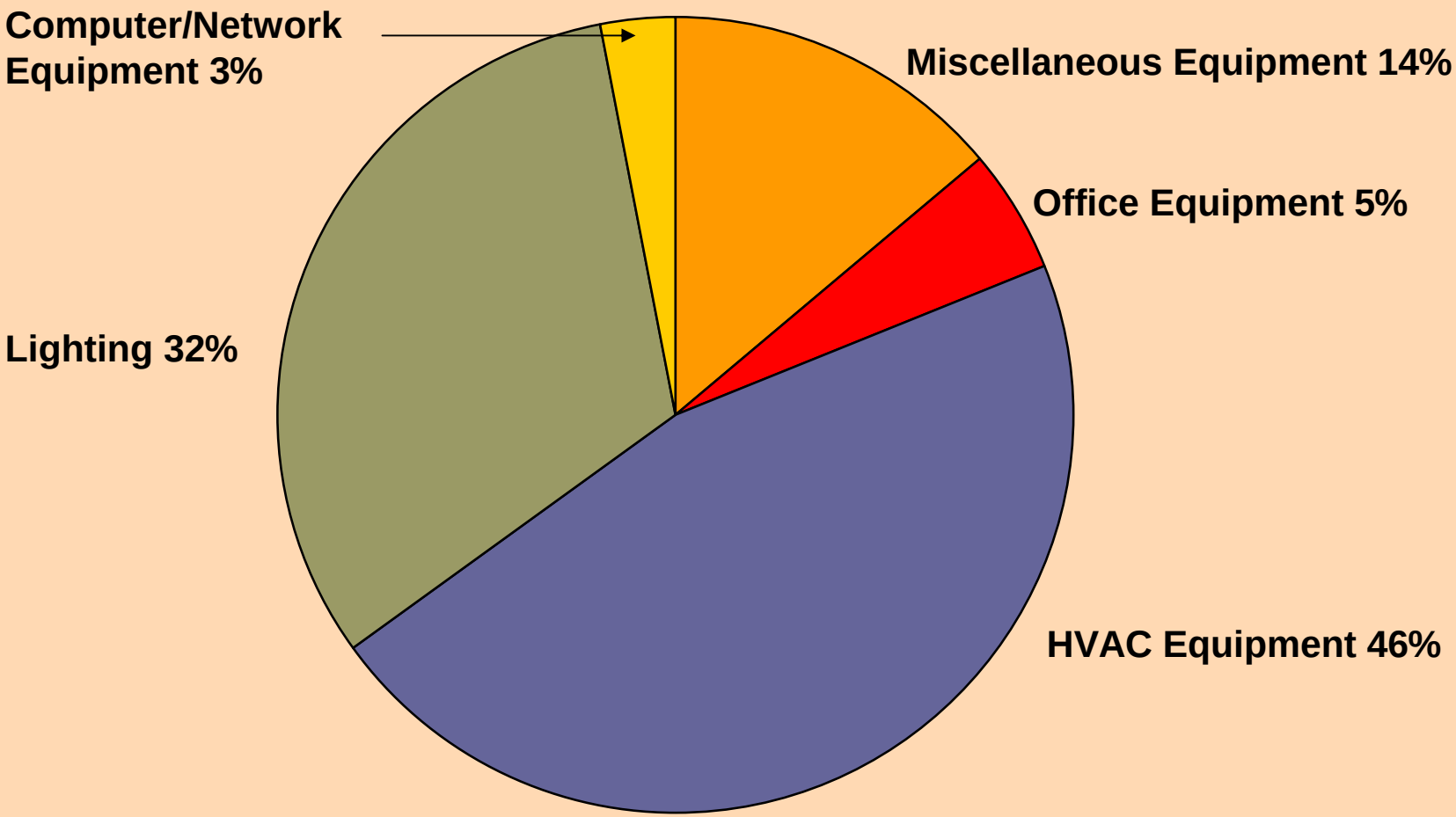
Significant reduction in emissions, Especially carbon

Improved reliability even capable of grid independence

Investment grade financial returns

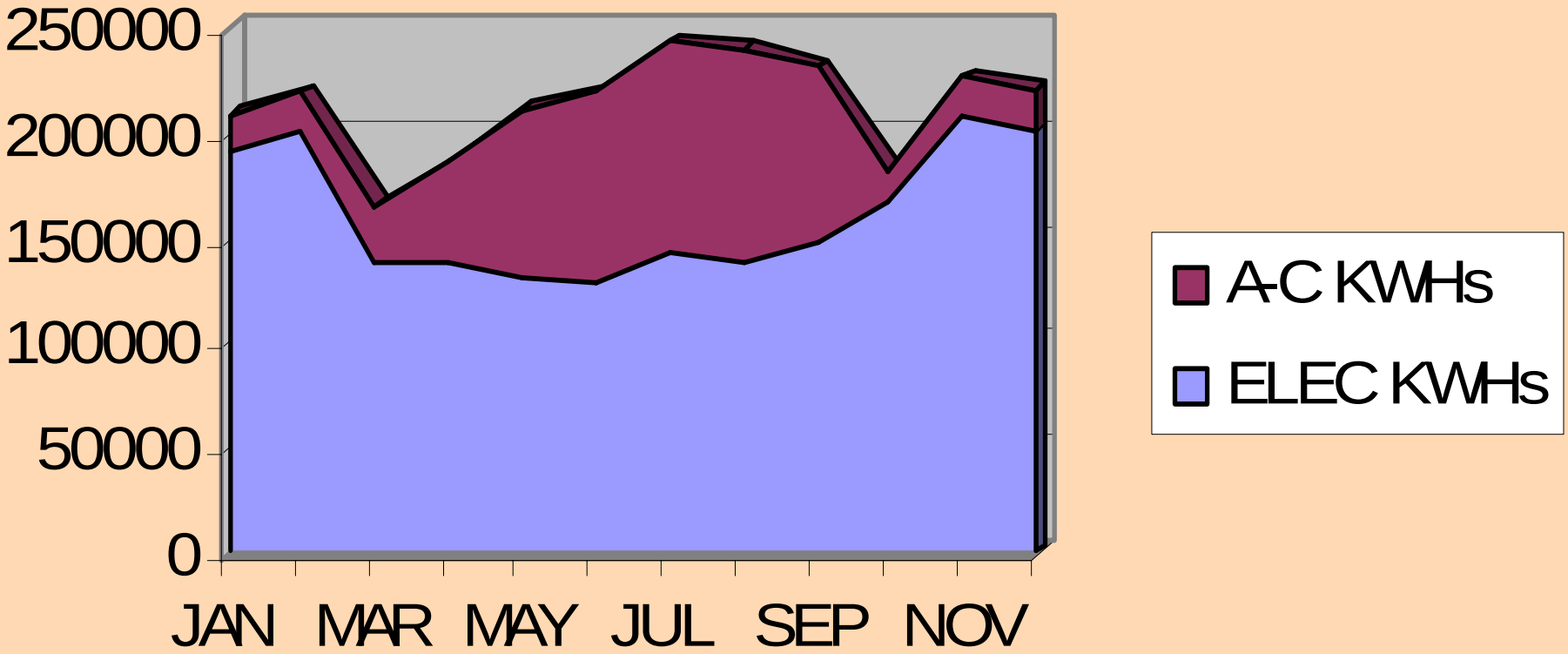
Green Building and LEED® points

Air Conditioning is a HUGE Energy Demand…



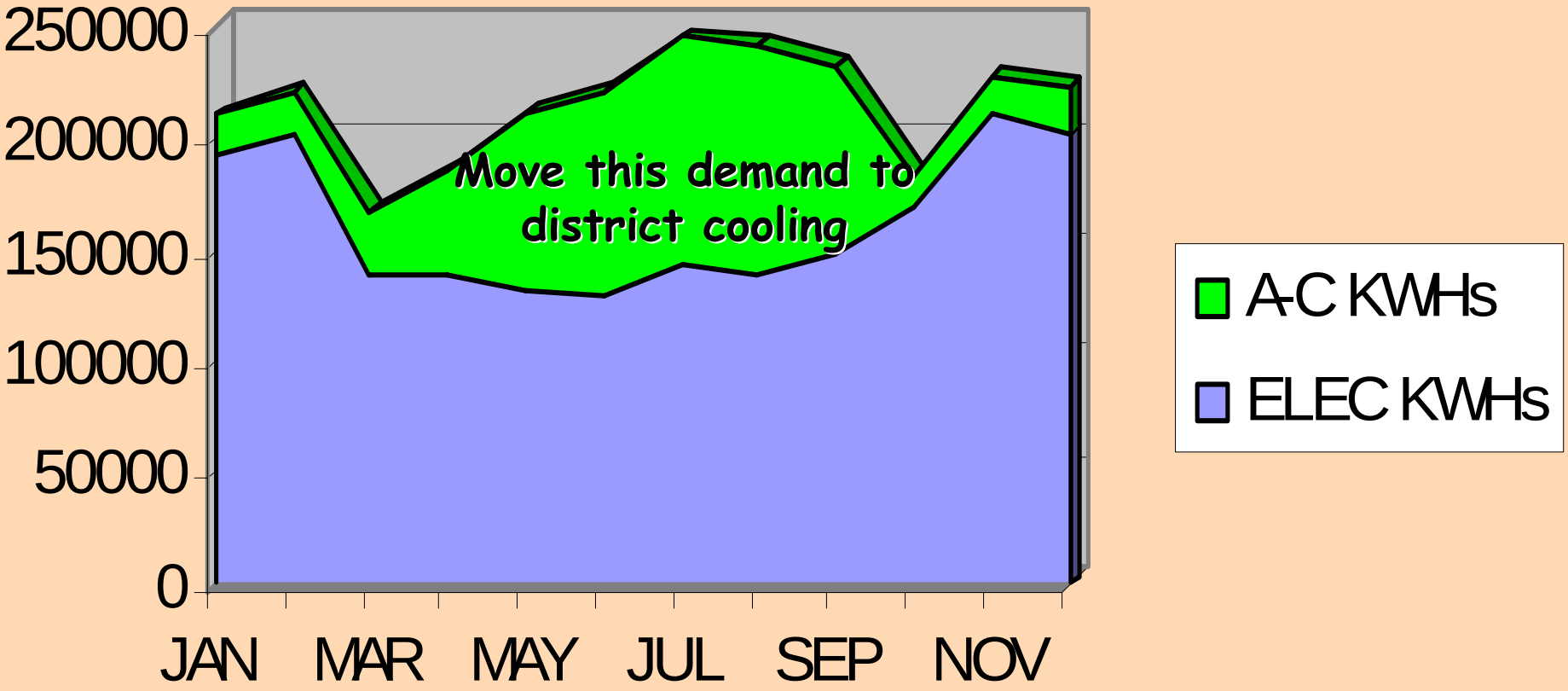
Electricity Consumption Profile Typical Campus

…and Air Conditioning Drives the Electrical Peaks.



350,000 sq. ft. Downtown Austin Building

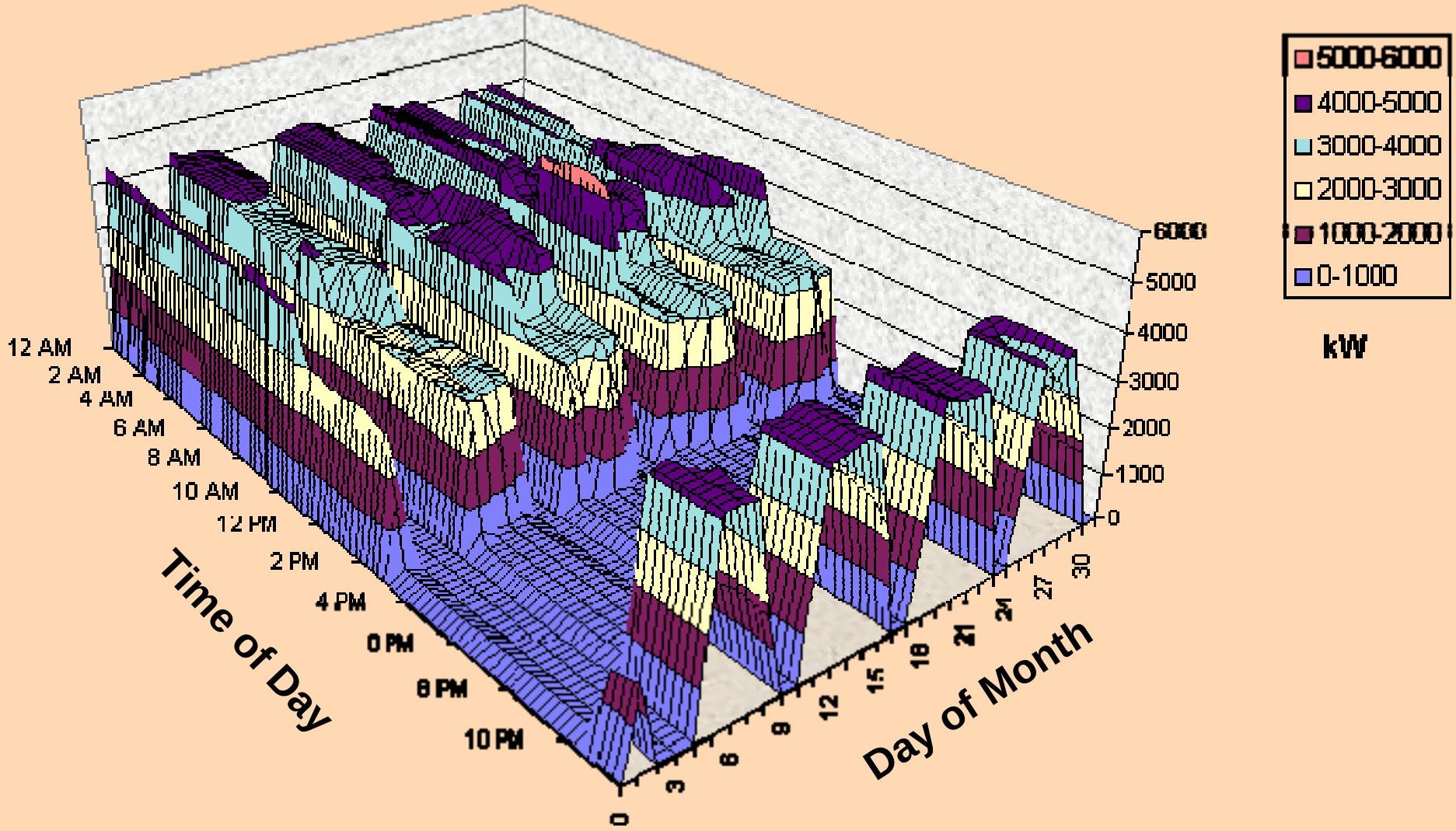
…What if we shift this “peak” to off peak?



350,000 sq. ft. Downtown Austin Building

Turning electric “peaks” into “negative peaks”

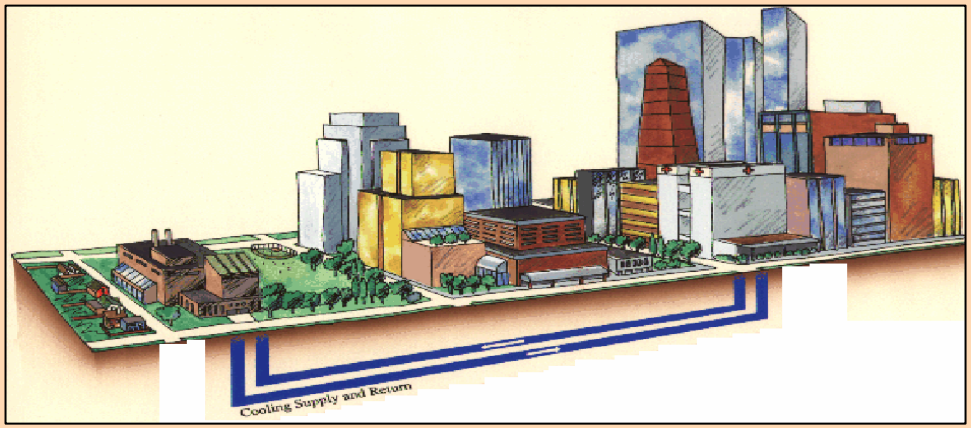
Paul Robbins District Cooling Plant Load Profile (July 2005)



Massive Ice Coils freeze water at night... to provide chilled water during day.

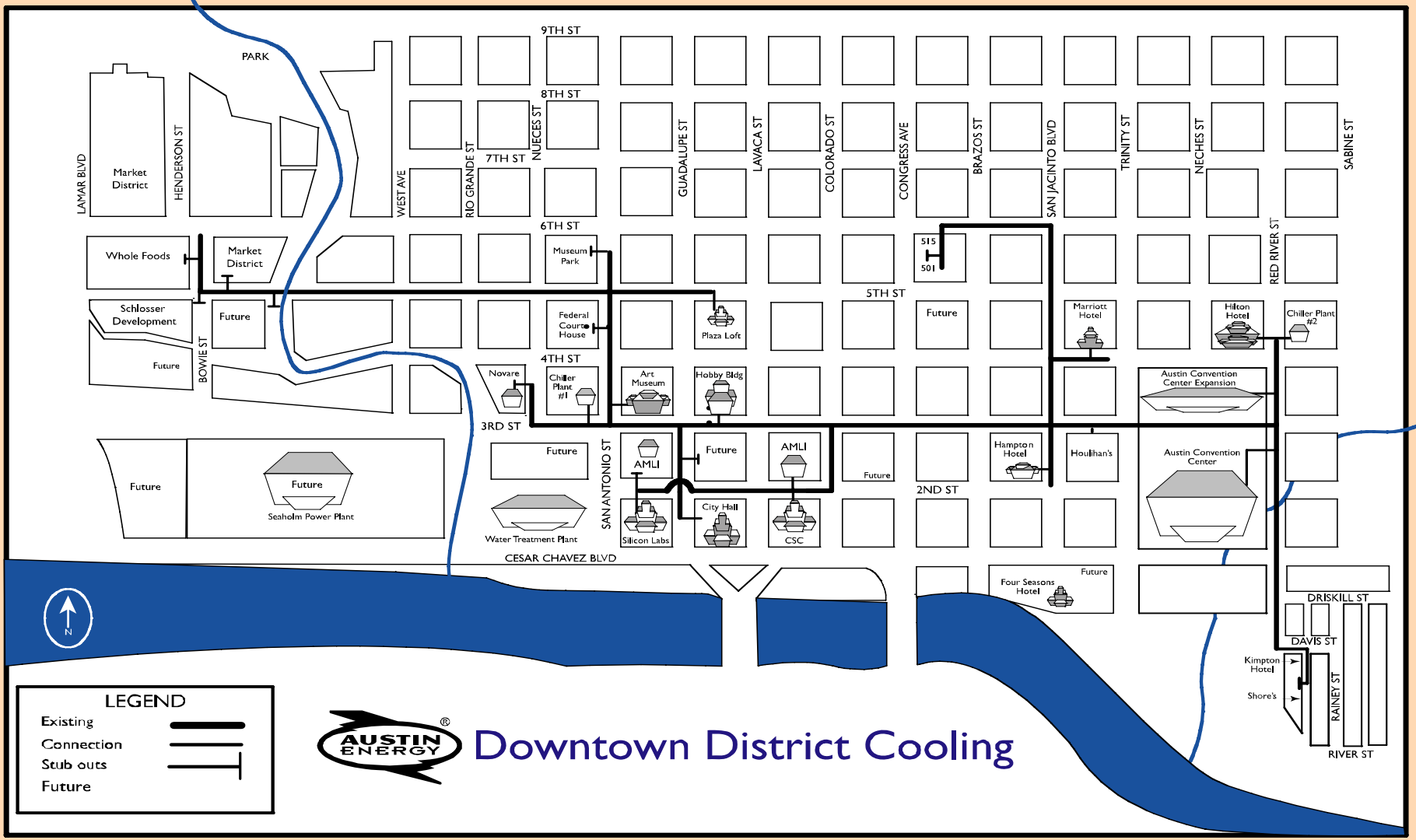
District Cooling and Heating… How It Works

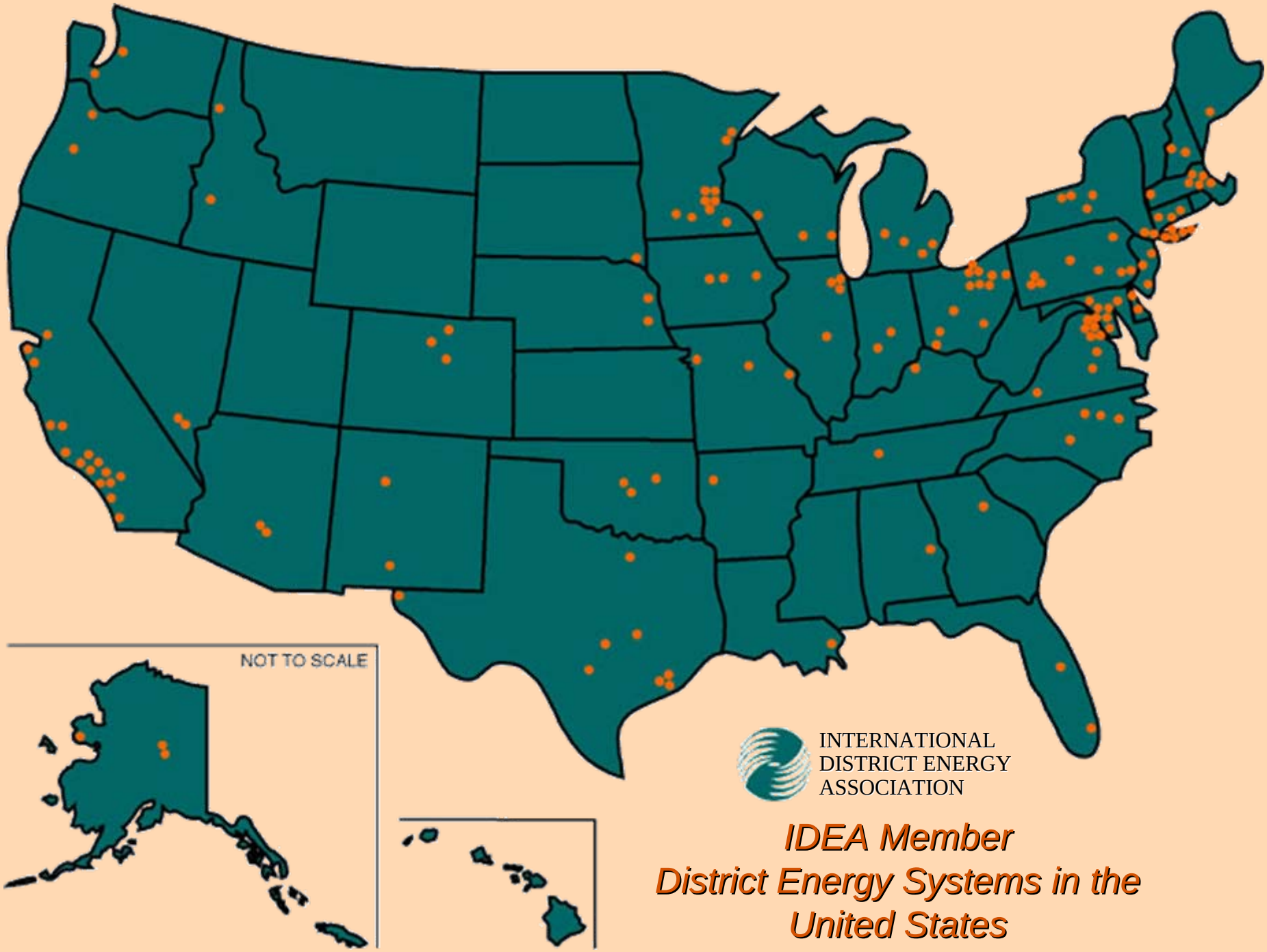
Produce chilled water (or heating) at a central plant and pipe that thermal energy to a number of buildings in the district to satisfy air conditioning needs. Individual buildings don't need chillers and cooling towers of their own.



http://www.districtenergy.org/what_is.htm

Austin Energy
Downtown District Cooling Map





INTERNATIONAL
DISTRICT ENERGY
ASSOCIATION

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

Whole Foods Headquarters and Store

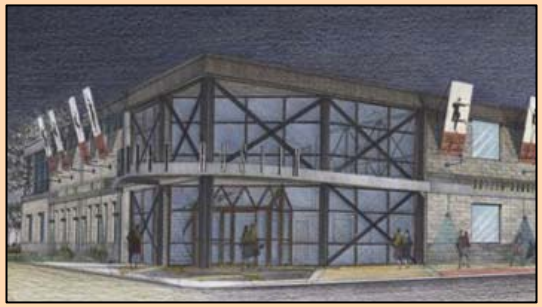
City Hall

Hilton Hotel & Five Fifty Five Condos

AMLI Residential

2nd Street Retail

Computer Science Corp.
Silicon Labs



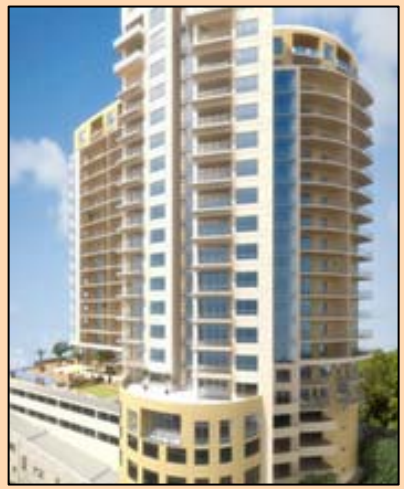
Ballet Austin

Hobby Office Bldg.

Spring
Condos

Hotel
Van Zandt

Austin Music Hall



The Shore
Condos

ZOM Residential

Plaza Lofts

Hampton

Marriott Residence Inn

Austin Convention Center

360 Condos

District Energy Benefits

(Utility perspective)

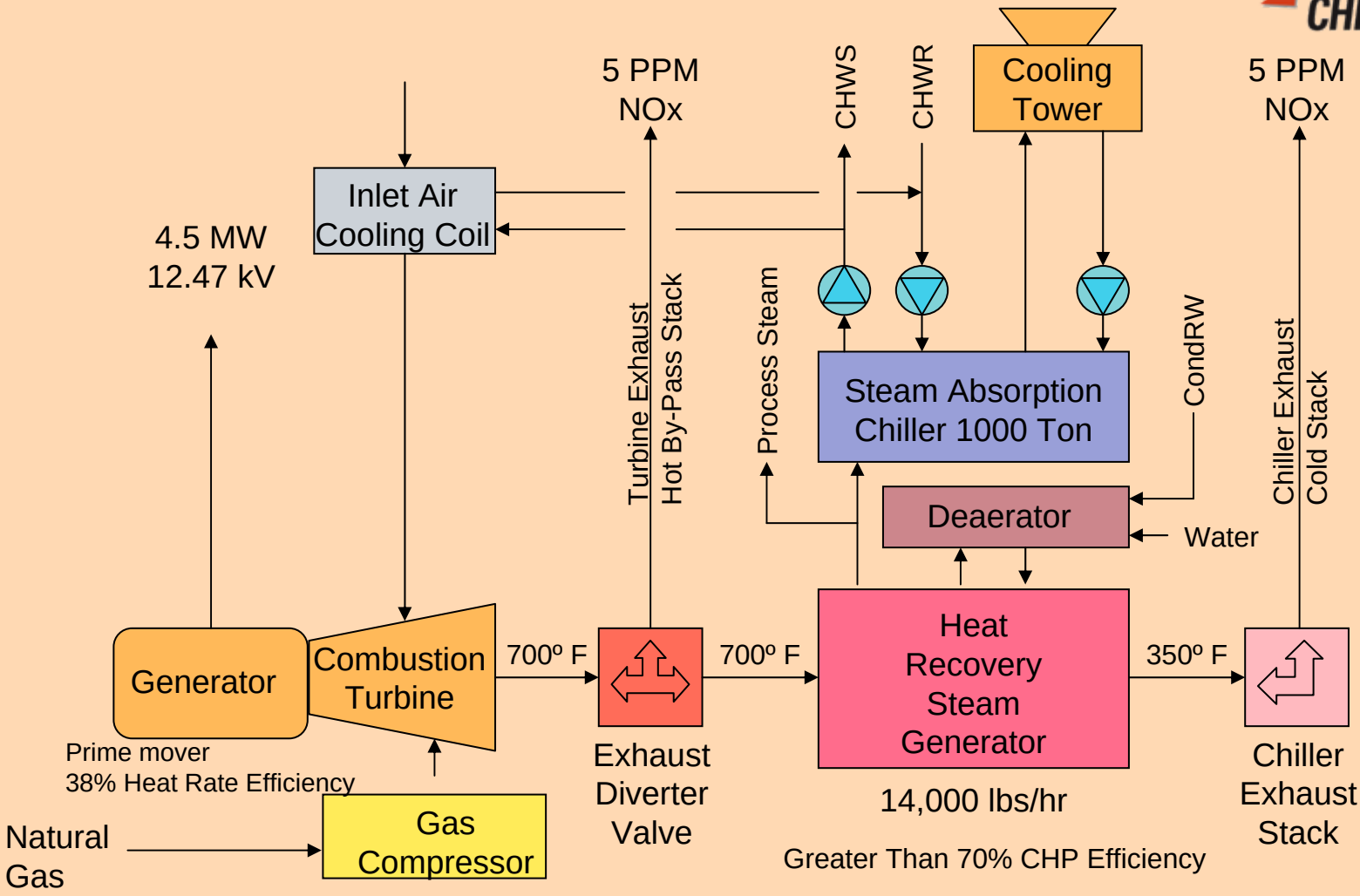
- **Defer peaking power plants**
- **Free up expensive “peaking” power**
- **Avoid power plant emissions during peak hours**
- **Greater energy efficiencies reduce air emissions**

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

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

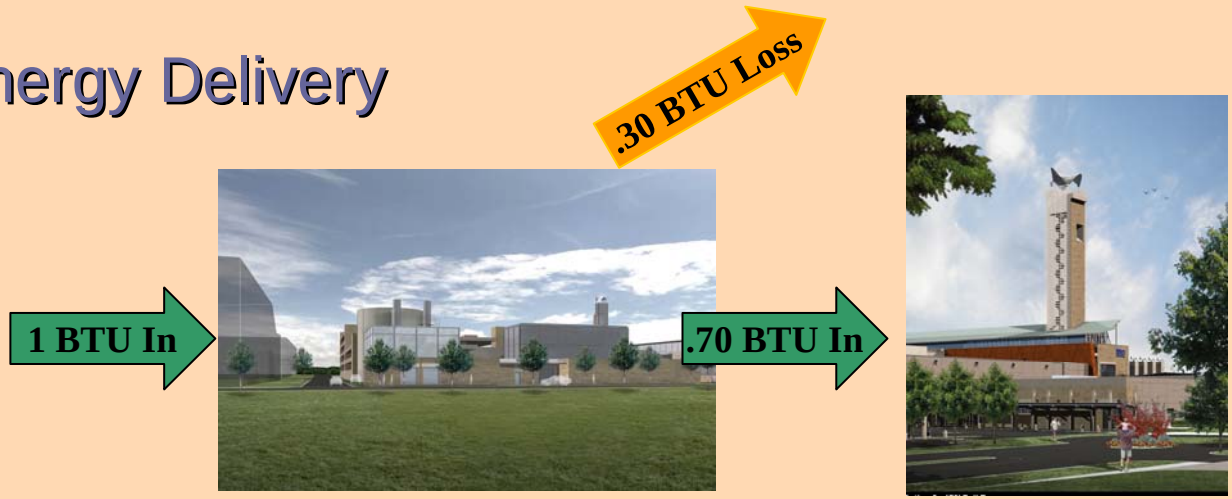
Transmission and distribution system loses about 6%.

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 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.

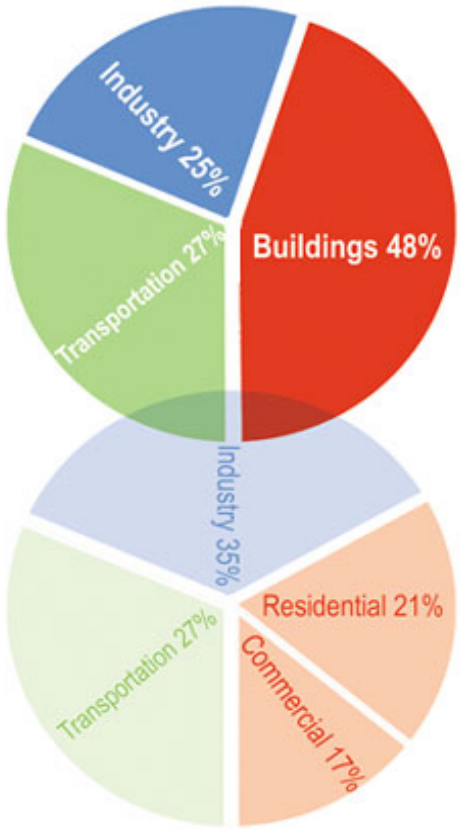
Using Utility Lingo…

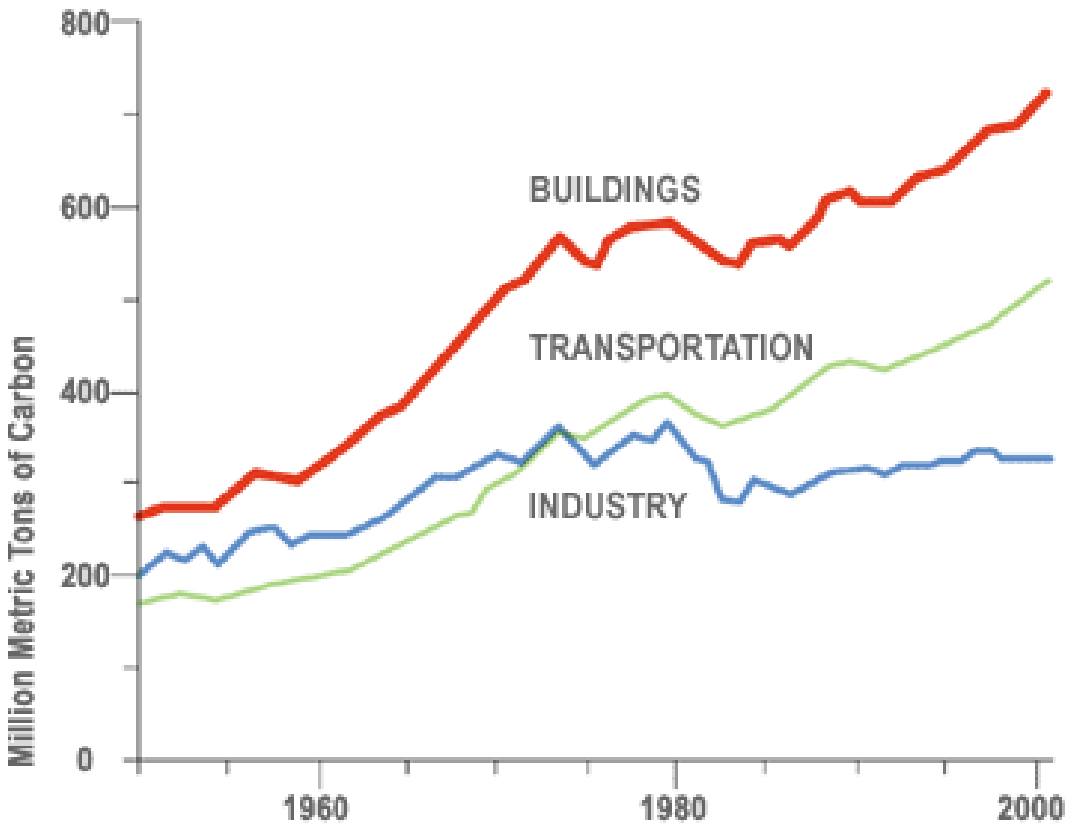
- CHP efficiency compares favorably with best in class combined cycle power plant heat rates (i.e. less than 7,000 BTU/KWH)
- CHP is firm capacity and is dispatchable
- Thermal energy may be more profitable than electrical output
- Power factor on feeder can be improved

Note: Heat Rate calculation includes electrical equivalent of recycled thermal energy)

Carbon Emissions Reduction: Where's the biggest opportunity?

www.architect2030.org



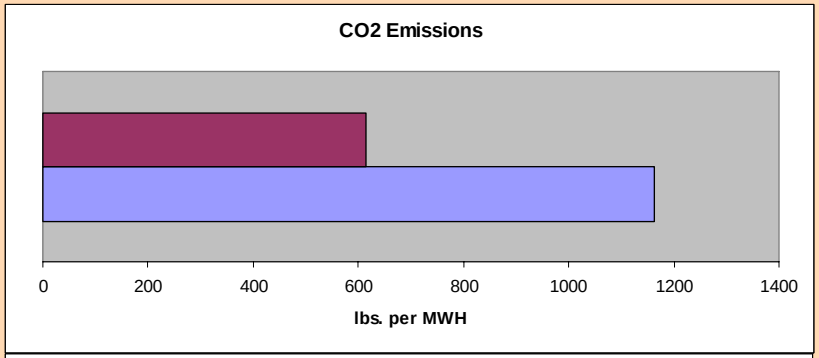


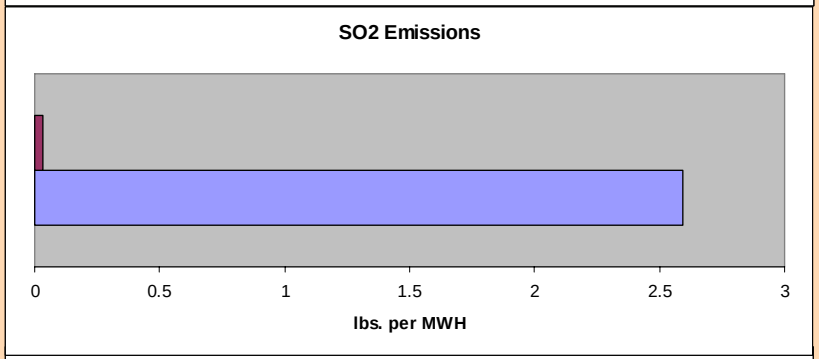
Environmental Impact…

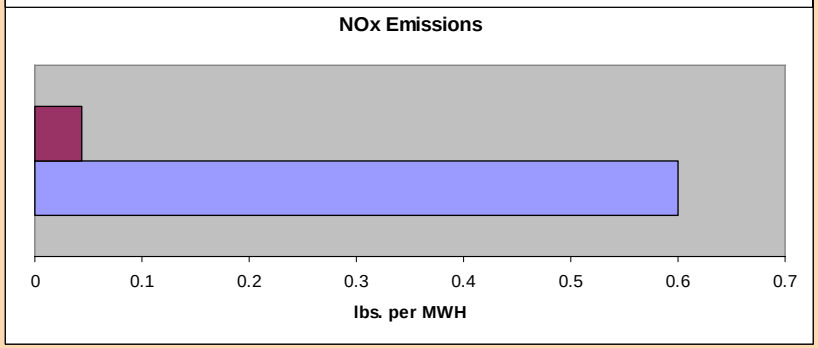
Isn't CHP a better way?

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

CO2 1162 lbs/MWh
SO2 2.33 lbs/MWh
NOx 0.6 lbs/MWh







CHP Plant

CO2 615 lbs/MWh
SO2 0.003 lbs/MWh
NOx 0.043 lbs/MWh

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

CO2	1162 lbs/MWh
SO2	2.33 lbs/MWh
NOx	0.6 lbs/MWh

CO2	615 lbs/MWh
SO2	0.003 lbs/MWh
NOx	.043 lbs/MWh

Positive Impact to the Environment…

(Coal vs. CHP)

Typical COAL Plant

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

VS.

Carbon Dioxide: 72% reduction

Sulphur Oxide: 99% reduction

NOx: 99% reduction

CHP Plant

CO2	615 lbs/MWh
SO2	0.003 lbs/MWh
NOx	0.043 lbs/MWh

Recycled energy could displace a boiler…

Typical boiler *

VS

CO2: 1502 lbs/hr reduction

SO2: .007 lbs/hr reduction

NOx: 1.25 lbs./hr. reduction

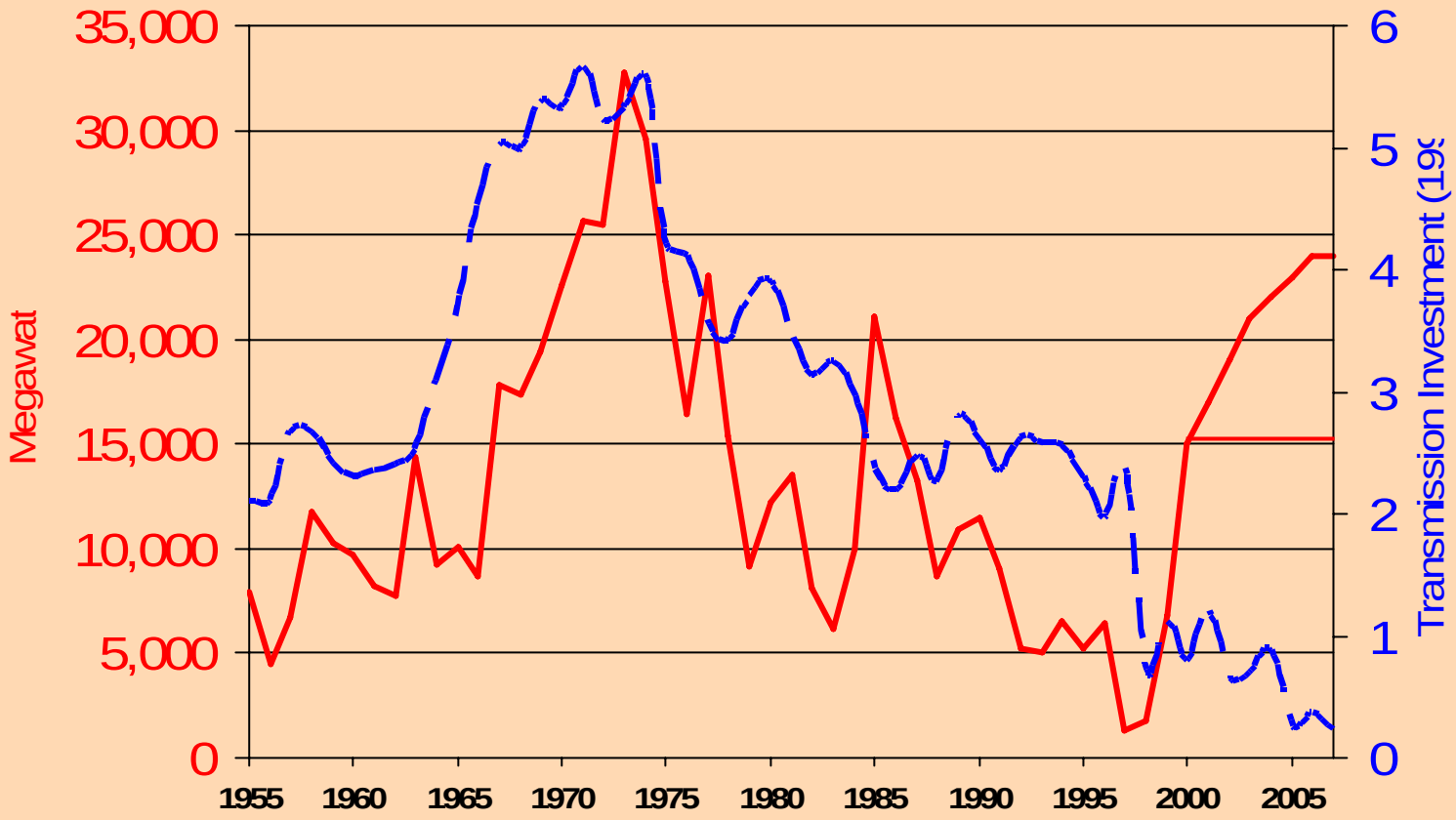
IES Plant

* Assuming 10 mmbtu/ hr output

Why Choose CHP:

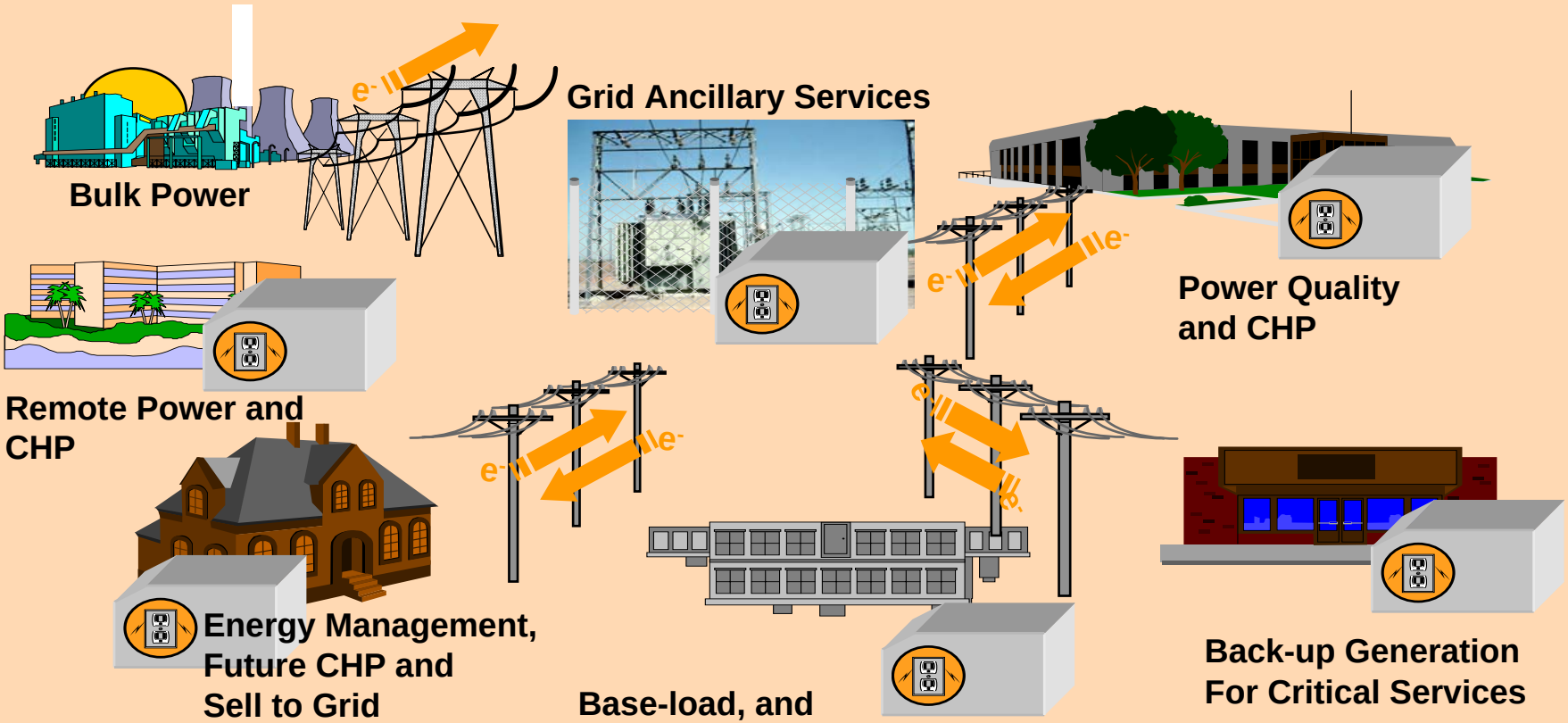
Energy Security and Reliability

The Grid Dilemma: Decoupling of transmission & generation investment



Source: Cambridge Energy Research Associates, Electric Transmission Advisory Service, 2000

CHP Distributed Generation Could Transform the Electric Grid…



Why Choose CHP...

A smart *INVESTMENT!!*

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

SAMPLE IES PROFORMA

Year	0000	0001	0002	0003	0004	0005	0006	0007	0008	0009	0010
REVENUES											
Electricity to GRID		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Electricity to Customer		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Premium Power / Standby fee		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Profit on Electric Service to CUP											
CW Revenue		$0	$0	$0	$2,597,340	$2,597,340	$2,597,340	$2,597,340	$2,597,340	$2,597,340	$2,597,340
Steam revenue		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Hot Water revenue											
Total Revenue	**$0**	**$0**	**$0**	**$0**	########	**$2,649,287**	########	#######	**$2,811,444**	########	########
OPERATING EXPENSES											
FTE		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
O&M: Generator		$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
O&M: ABS Chiller		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
O&M: Electric Chiller		$0	$0	$0	$43,362	$43,362	$43,362	$43,362	$43,362	$43,362	$43,362
O&M: HRSG		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
O&M: Boiler		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Electric Chiller Utility (elec, H20, chem) Cost		$0	$0	$0	$361,350	$361,350	$361,350	$361,350	$361,350	$361,350	$361,350
ABS Chiller Utility Cost		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
purchase GRID power - TES		$0	$0	$0	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000
Fuel or Electric Cost (Boiler)		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Fuel Cost (Generator)		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Insurance Cost		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Property Lease Cost		$10	$10	$10	$10	$10	$10	$10	$10	$10	$10
Admin/Overhead Costs		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total O&M Expenses	**$0**	**$10**	**$10**	**$10**	**$444,723**	**$453,617**	**$462,689**	**$471,943**	**$481,382**	**$491,010**	**$500,830**
NET INCOME											
	$0	**($10)**	**($10)**	**($10)**	**$2,152,617**	**$2,195,670**	########	#######	**$2,330,062**	########	**$2,424,197**
Net Profit Margin		#DIV/0!	#DIV/0!	#DIV/0!	83%	83%	83%	83%	83%	83%	83%
CAPITAL EXPENSES											
Equipment, Installation, Engineering	$0	$0		$450,000				$0			
Building	$0										
Land	$0										
Pipe and connection	$0			$1,000,000				$0			
Pollution Control		$0									
Total Capital Cost	**$0**	**$0**	**$0**	**$1,450,000**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
CASH FLOW											
Annual Cash Flow	$0	($10)	($10)	($1,450,010)	$2,152,617	$2,195,670	$2,239,583	$2,284,375	$2,330,062	$2,376,664	$2,424,197
Cumulative Cash Flow	**$0**	**($10)**	**($20)**	**($1,450,031)**	**$702,587**	**$2,898,257**	########	#######	**$9,752,277**	########	########

Why Choose CHP... Financial

- 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

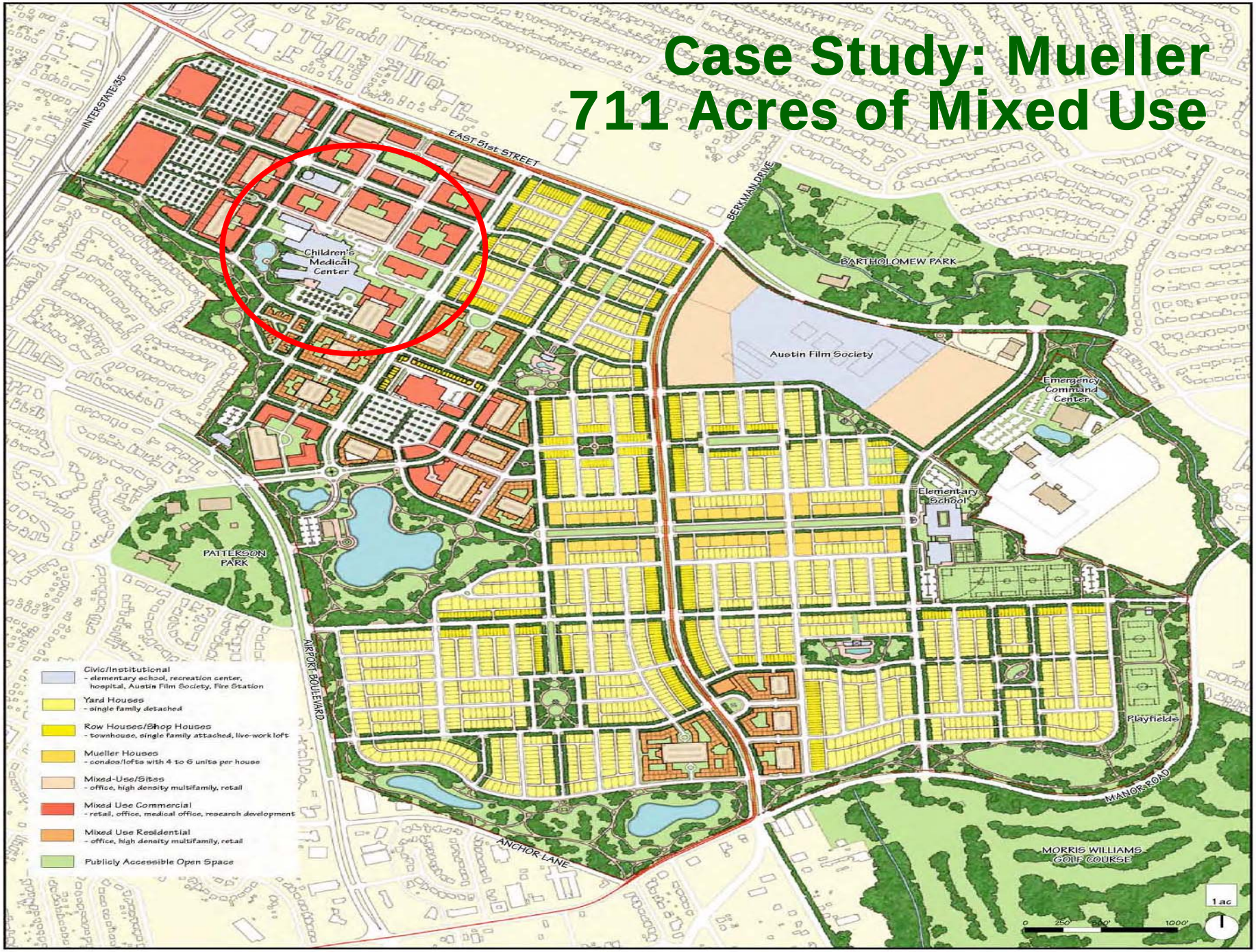
- USGBC recognizes CHP as an alternative means to meet energy needs of buildings
- Eight to 10 LEED points can be attributable to the positive impact of a CHP plant
- The Dell Children's Hospital in Austin is on track to be the first healthcare in the world to receive LEED ***Platinum*** rating
- The 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



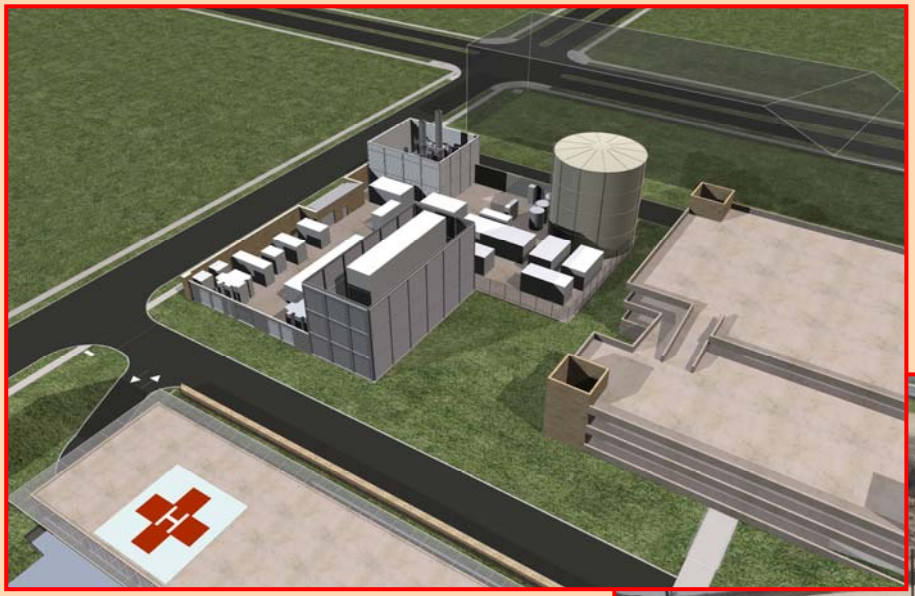
The Mueller Energy Center (MEC) is located in an urban "brownfield redevelopment site…

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

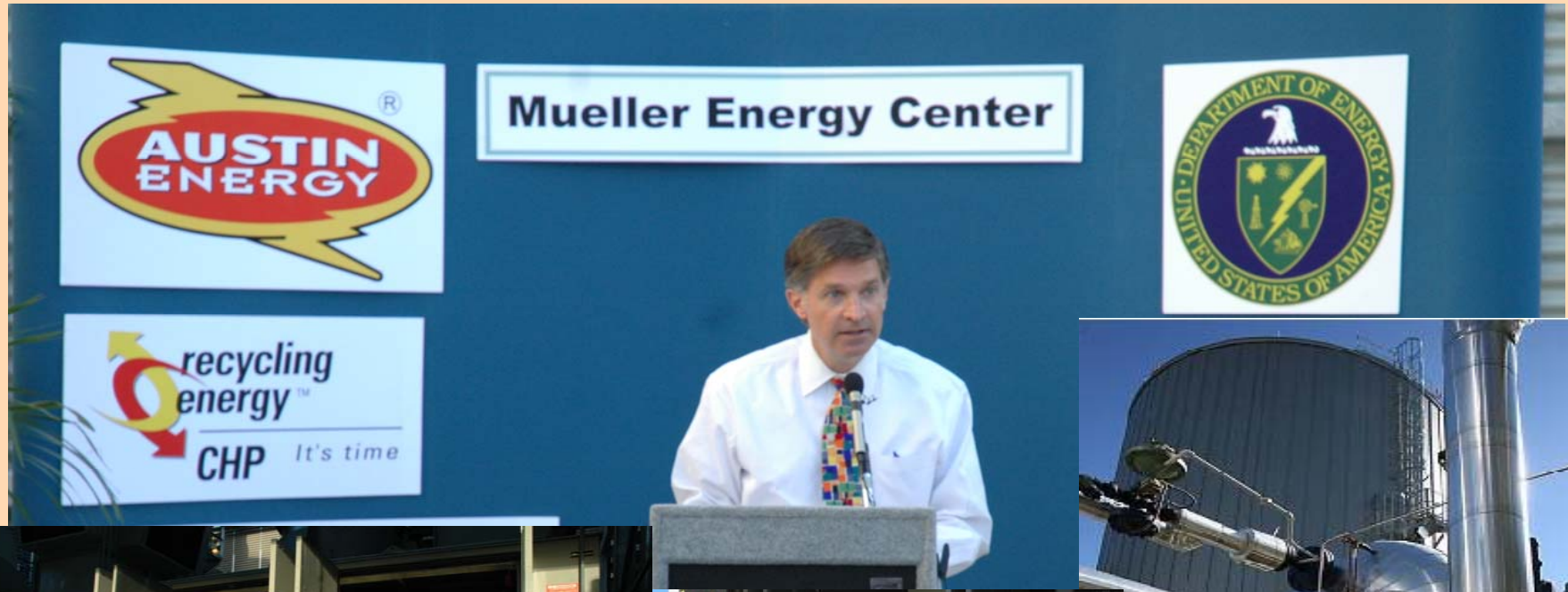
CHP is quick to build…

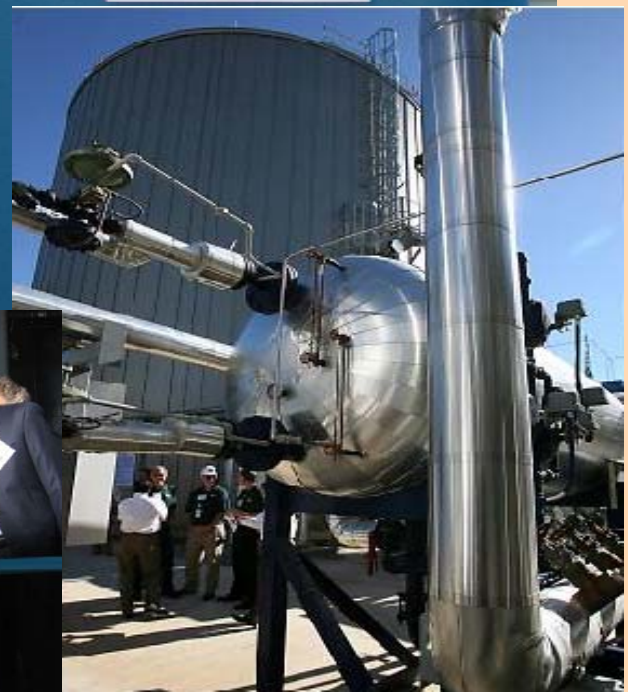


From concept to reality in less than twelve months

The Plant...

Mueller Energy Center Ribbon Cutting and Dedication Ceremony: 10/17/2006





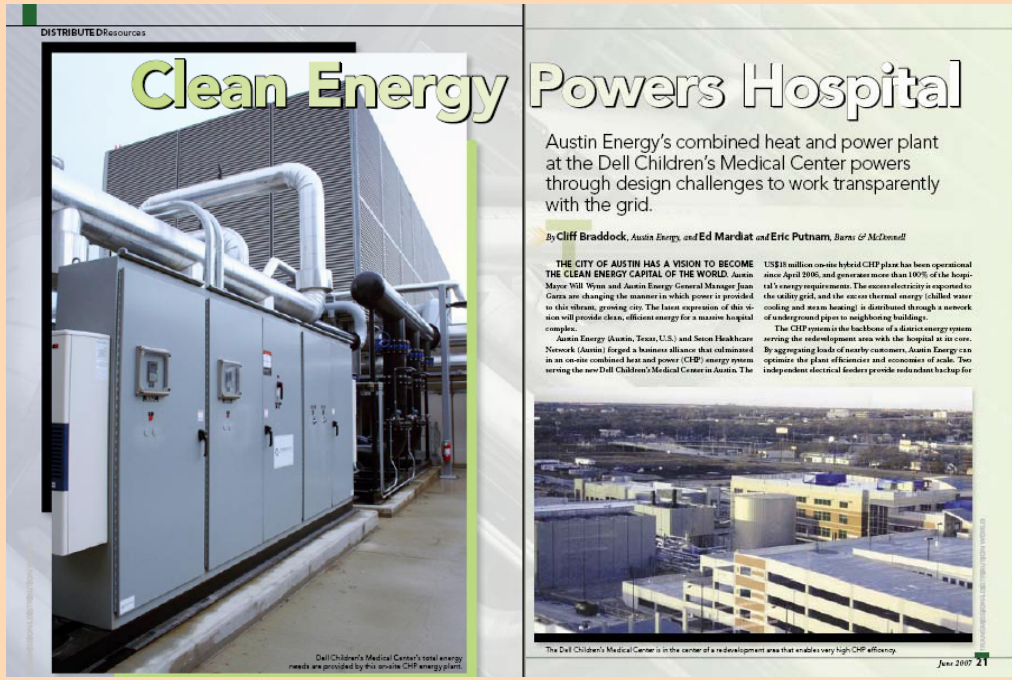
And More Recognition…

HEATING/PIPING/AIR CONDITIONING
HPAC ENGINEERING
Meeting Today's Energy Challenges with
On-Site Energy Systems

TRANSMISSION & DISTRIBUTION WORLD

ES
Engineered Systems

PRACTICAL APPLICATIONS FOR INNOVATIVE HVAC MECHANICAL SYSTEMS ENGINEERS


DISTRIBUTED Resources

Clean Energy Powers Hospital

Austin Energy's combined heat and power plant at the Dell Children's Medical Center powers through design challenges to work transparently with the grid.

By Cliff Braddock, *Austin Energy*, and Ed Mardiat and Eric Putnam, *Burns & McDonnell*

THE CITY OF AUSTIN HAS A VISION TO BECOME THE CLEAN ENERGY CAPITAL OF THE WORLD. Austin Mayor Will Wynn and Austin Energy General Manager Juan Garza are changing the manner in which power is provided to this vibrant, growing city. The latest expression of this vision will provide clean, efficient energy for a massive hospital complex.

Austin Energy (Austin, Texas, U.S.) and Seton Healthcare Network (Austin) forged a business alliance that culminated in an on-site combined heat and power (CHP) energy system serving the new Dell Children's Medical Center in Austin. The US$18 million on-site hybrid CHP plant has been operational since April 2006, and generates more than 100% of the hospital's energy requirements. The excess electricity is exported to the utility grid, and the excess thermal energy (chilled water cooling and steam heating) is distributed through a network of underground pipes to neighboring buildings.

The CHP system is the backbone of a district energy system serving the redevelopment area with the hospital at its core. By aggregating loads of nearby customers, Austin Energy can optimize the plant efficiencies and economies of scale. Two independent electrical feeders provide redundant backup for

Dell Children's Medical Center's total energy needs are provided by this on-site CHP energy plant.

The Dell Children's Medical Center is in the center of a redevelopment area that enables very high CHP efficiency.

June 2007 21

July 2007

A MONTHLY JOURNAL OF AUSTIN STORIES
the good life
getta life…getta good life

Dell Children's Hospital :
A Prescription for Energy Efficiency (July, 2007)

Awards...

COMBINED CYCLE Journal

2007 Pacesetter Plant Award

"Little Big Man of the State's Generation Sector"

For looking good and being clean...

kab
KEEP AUSTIN BEAUTIFUL

2007 award winner "*industrial*" category

STEEL TANK INSTITUTE
STEEL PLATE FABRICATORS ASSOCIATION
DIVISIONS OF STI/SPFA

Steel Tank of the Year - Special Storage
Dell Children's Medical Center in Austin, TX
Built by CB&I Constructors Inc.,
The Woodlands, TX

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 <u>NOW</u> For the CHP & District Energy TEAM To Win!