

University of Illinois East Campus Cooling, Heating, and Power Facility

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Different Views of DE

- ☀ Renewable
 - Solar
 - Wind
 - Biomass
- ☀ **Cooling, Heating, and Power**
 - Commercial
 - Industrial
- ☀ Demand Side Management
- ☀ Energy Efficiency
- ☀ Grid Support

Renewable
Community

CHP
Community

Energy
Efficiency
Community

Electric
Community

Where Does CHP Fit With DE?

- ☀ High Thermal Loads
 - Cooling, Heating, or Dehumidification
 - Steam, Hot Water, or Direct Heat
- ☀ High Electric Loads
- ☀ Coincident Thermal and Electric Loads
- ☀ Extended Operating Hours
- ☀ Where the Rates and Regulatory Climate are Favorable
- ☀ Central HVAC System
- ☀ Access to Fuels (Natural Gas or Byproducts)

Why Is There An Opportunity?

- ☀️ DOE/EIA Project Over 360 GW of New Capacity
 - To Meet Growing Demand
 - To Compensate for Plant Retirements
- ☀️ Today's Central Station Plants Lose 23 Quads of Thermal Energy
- ☀️ Aging Electric Transmission/Distribution System
 - Difficult to Site New Lines
 - Capacity Constrained
 - Costly to Maintain

Why is There an Opportunity?

★ Rising Concerns Over

- Blackouts/Brownouts
- Power Supply Constraints
- Electricity Prices

★ Selected Power Outage Costs

| Industry | Avg. Cost of Downtime |
|--|-----------------------|
| Cellular | \$41,000 per hour |
| Communications Telephone Ticket Sales | \$72,000 per hour |
| Airline Reservations | \$90,000 per hour |
| Credit Card Operations | \$2,580,000 per hour |
| Brokerage Operations | \$6,480,000 per hour |

What is CHP?

- ☀ Integrated System
- ☀ Located At or Near A Building/Facility
- ☀ Provides a Portion of the Electrical Load
- ☀ Utilizes the Thermal Energy
 - ☀ Cooling
 - ☀ Heating
 - ☀ Dehumidification
 - ☀ Process Heat

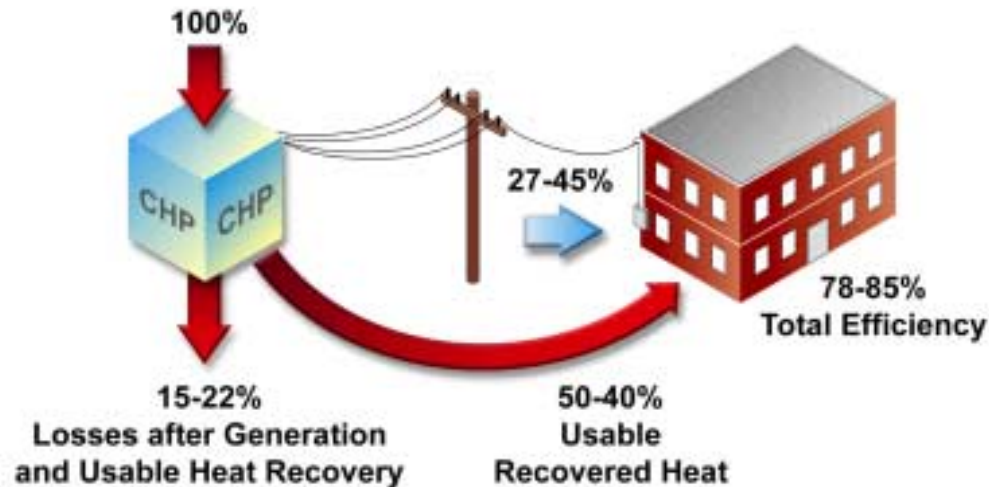
Why is CHP Better Than DE Alone?

- ★ High Efficiency – Up to 80%
- ★ Further Reduction on Summer Peak Grid Load
- ★ Significant Emissions Reductions
 - ★ 40% Less than Central Plants
- ★ Improved Indoor Air Quality

*CHP is an IMPORTANT Part of the BIG
Distributed Energy Picture!*



How CHP Saves Energy



East Campus Facility

- ☀ Meets the Electrical Demand of the East Campus
- ☀ Electrically Tied to West Campus with 69 KV Line
- ☀ 30 MMBTU/h Available to Offset the Heating & Cooling Demands of 3.8M ft² in 29 Buildings
- ☀ 8 MMBTU/h Available to Adjacent School and Church

Site Development

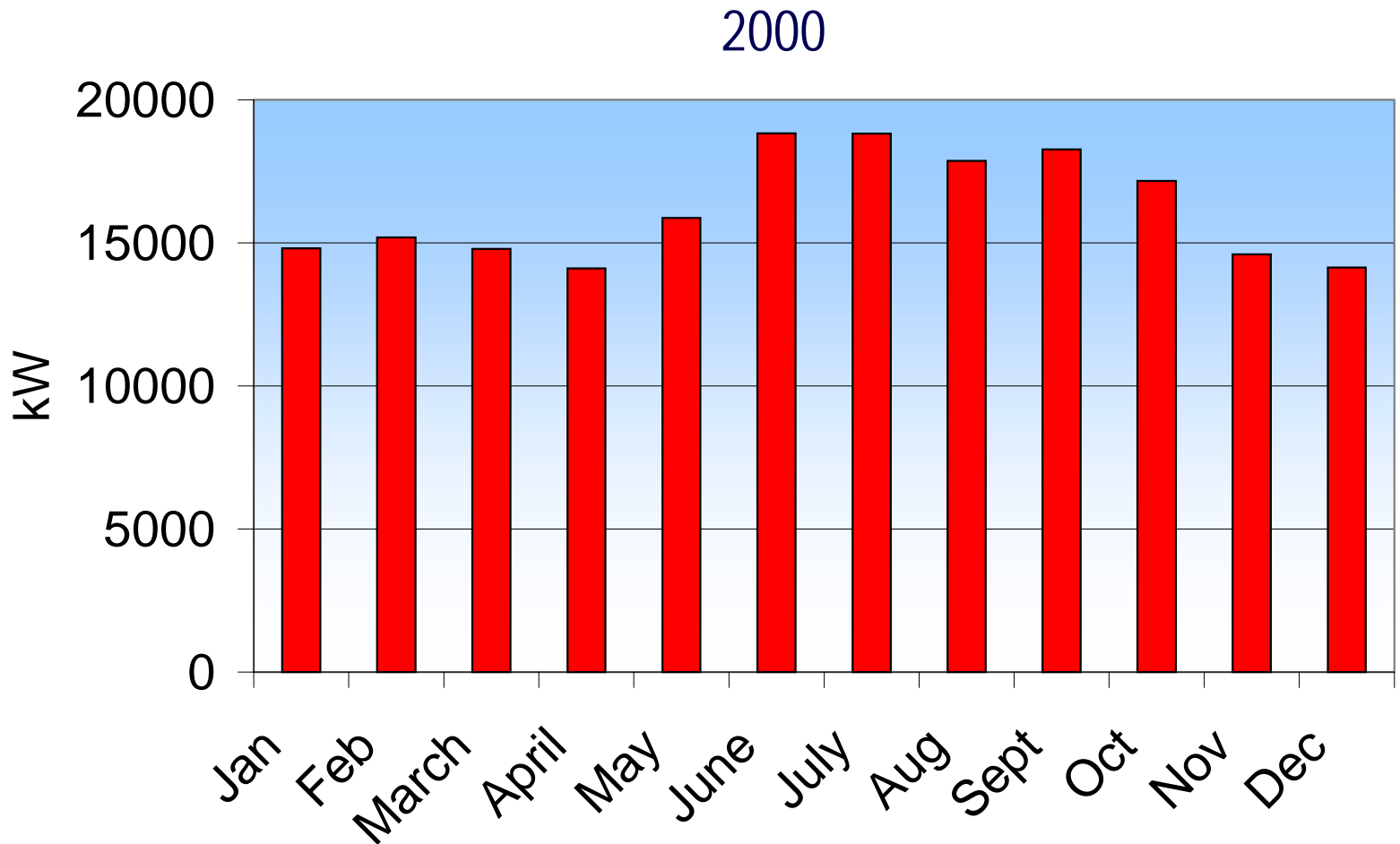
☀ Initial Site

- 12.6 MWe
- Hot Water Heating

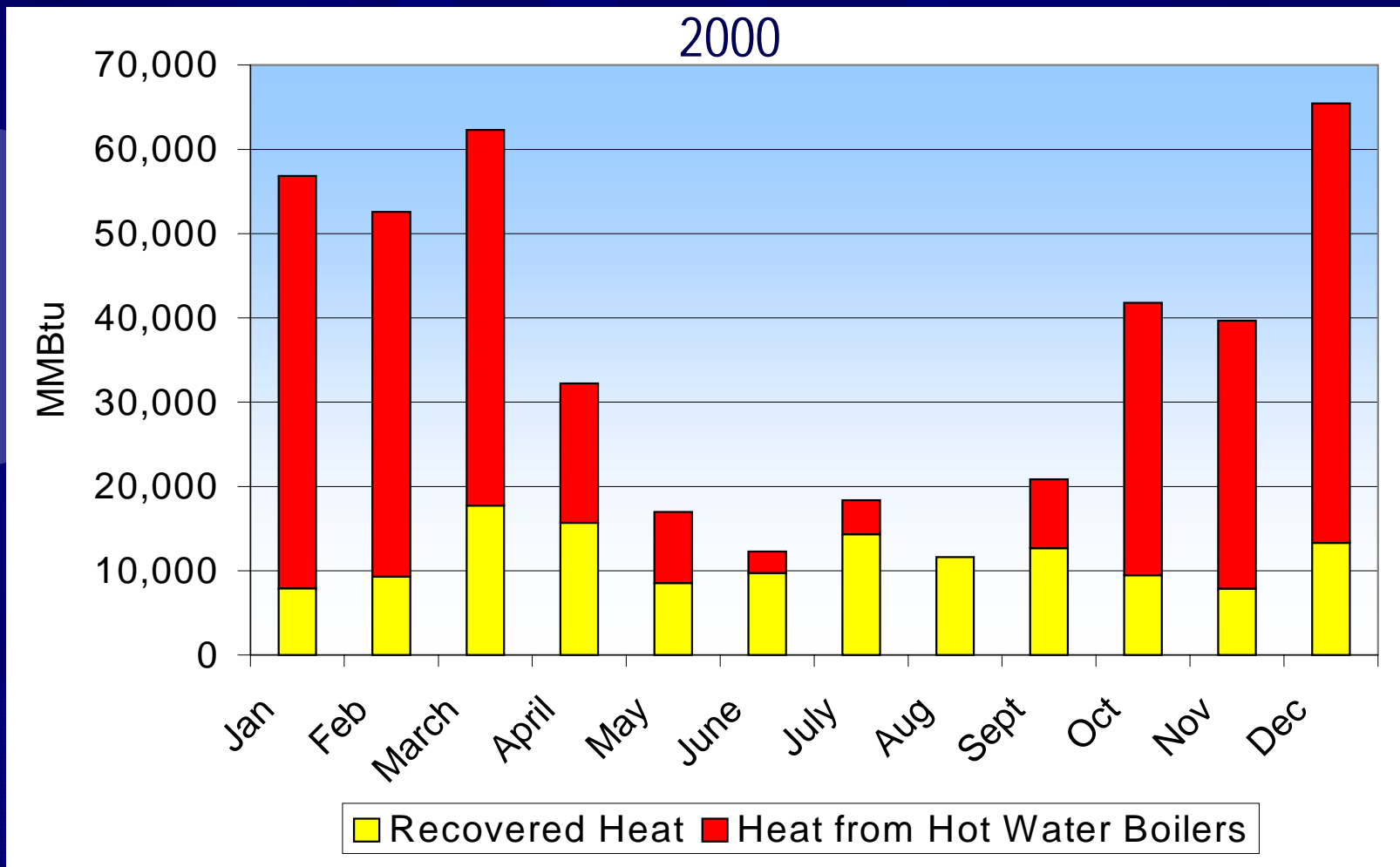
☀ Today

- 20.2 MWe
- Hot Water Heating
- Absorption Cooling
- Electrically Cross Connected to New West Campus Facility
 - Additional 37.2 MWe

Electric Demand Profile



Annual Thermal Energy Profile



Financial Statistics

☀ Original 12.6 MW East Campus Plant *(Operational in 1993)*

- Total Cost: \$15M
- Original Goal: Payback in 10 years
- Actual Performance: Payback in 7.5 years
- Operating Savings: Approximately \$2M/yr

Financial Statistics

★ Additional 7.6 MW East Campus Plant *(Operational in Mid-2000)*

- Total Cost: \$10.7M
- Original Goal: Payback in 10 years
- Actual Performance: First Full Year 2001
- Operating Savings: \$1.9M for 2000*

* *(With only 6 months of operation with the additional 7.6 MWe and all time high gas prices.)*

Gas Price Sensitivity

| Natural Gas Average Price [\$/MMBTU] | Savings | |
|--------------------------------------|---------------|--------------------|
| 2.5 | 36.18% | \$3,349,512 |
| 3.0 | 31.80% | \$3,029,657 |
| 3.5 | 27.66% | \$2,709,802 |
| 4.0 | 23.74% | \$2,389,947 |
| 4.5 | 20.03% | \$2,070,093 |
| 4.68 | 18.62% | \$1,931,518 |
| 5.0 | 16.50% | \$1,750,238 |

Emissions Reductions

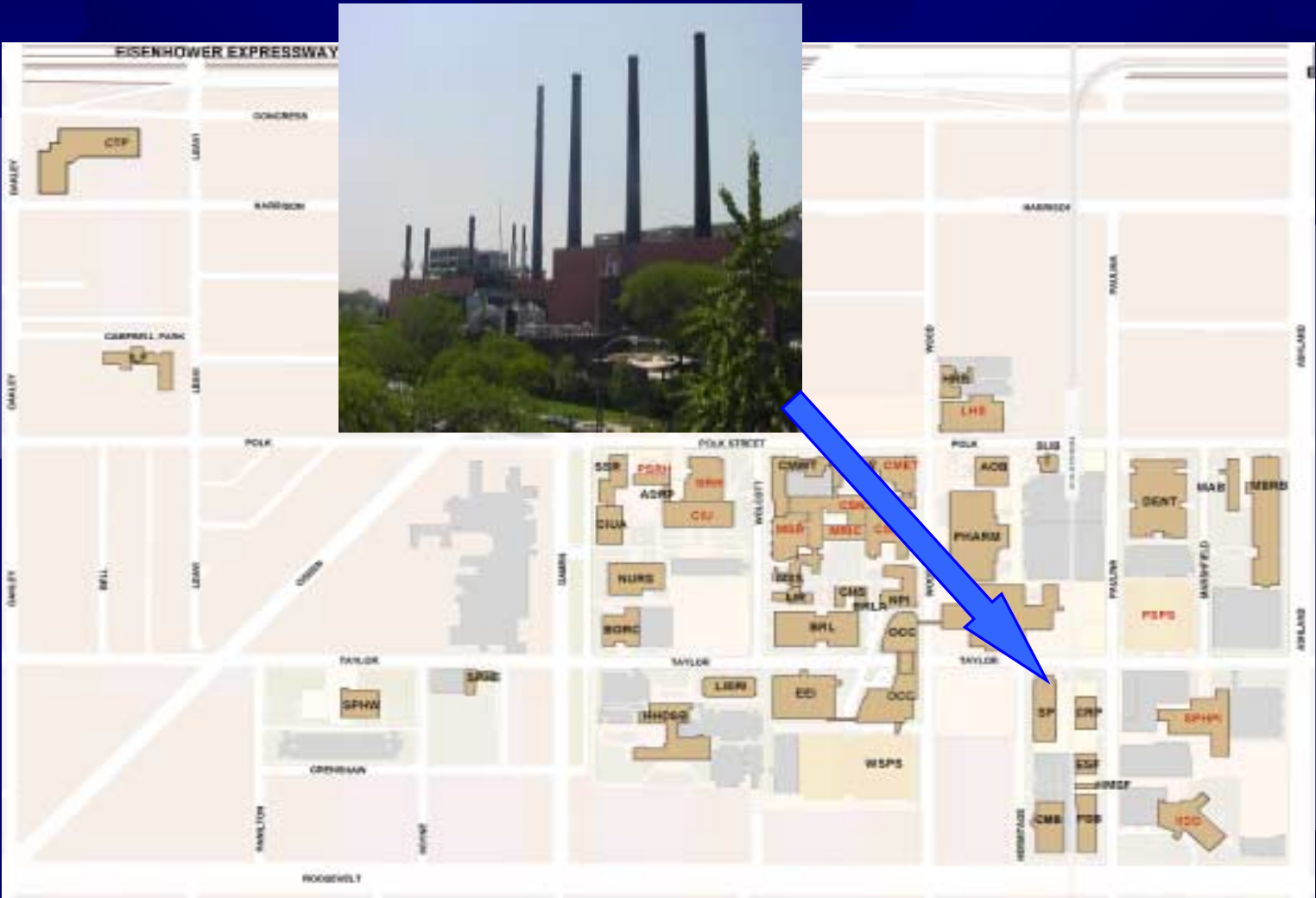
☀ Overall Source Energy Reduction

- 14.15% (236,856 MMBTU/year)

☀ Emissions

- CO₂
 - 28.5% (236,856 Tons/Year)
- NO_x
 - 52.8% (126 Tons/Year)
- SO₂
 - 89.1% (551 Tons/Year)

West Campus Facility



Cooling, Heating and Power Systems West Campus

3 Wärtsilä Reciprocating Engine-Generators

- Natural Gas
- 5.4 MW_e each



Cooling, Heating and Power Systems West Campus

3 Solar Taurus Turbines

- Natural Gas
- 7.0 MW_e each



Cooling, Heating and Power Systems West Campus

3 Exhaust Gas Systems with Duct Burners

- Solar Taurus Turbines Only
- Total Capacity 90,000 lb/hr to 360,000 lb/hr of Steam



Cooling, Heating and Power Systems

West Campus

2 Boilers

- Natural Gas or #6 Fuel Oil



Cooling, Heating and Power Systems

West Campus

Remote Absorption Chillers

- Activated by Steam Loop
- University of Illinois Hospital
Outpatient Building
 - 3 Carrier Units (Total of 2000 RT)
 - 2 @ 500 RT
 - 1 @ 1000 RT

Financial Statistics

☀ New 37.2 MW West Campus Plant *(Operation Expected in Late 2001)*

- Total Cost: \$38M
- Original Goal: Payback in 7 years
- Actual Performance: First Full Year 2002
- Operating Savings: Estimated \$7M