



# Dallas/Fort Worth International Airport

## Low Temperature District Cooling with Thermal Energy Storage



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# DFW Airport – District Cooling with **TES**

## Presentation Outline

- **What is Thermal Energy Storage (TES)?**
- **Traditional Benefits of TES**
- **DFW Airport Background/Environment**
- **Traditional TES Usage**
- **ERCOT 4CP Approach**
- **ERCOT Demand Response (DR)**
- **Questions**



# DFW Airport – District Cooling with TES

## What is TES?

- Temporary storage of energy at high or low temperatures for use when needed
- Typically used in HVAC applications
- Considered by most to be cost management tool, not an energy conservation tool
- **This presentation will focus on chilled water storage in an HVAC application**



# DFW Airport – District Cooling with TES

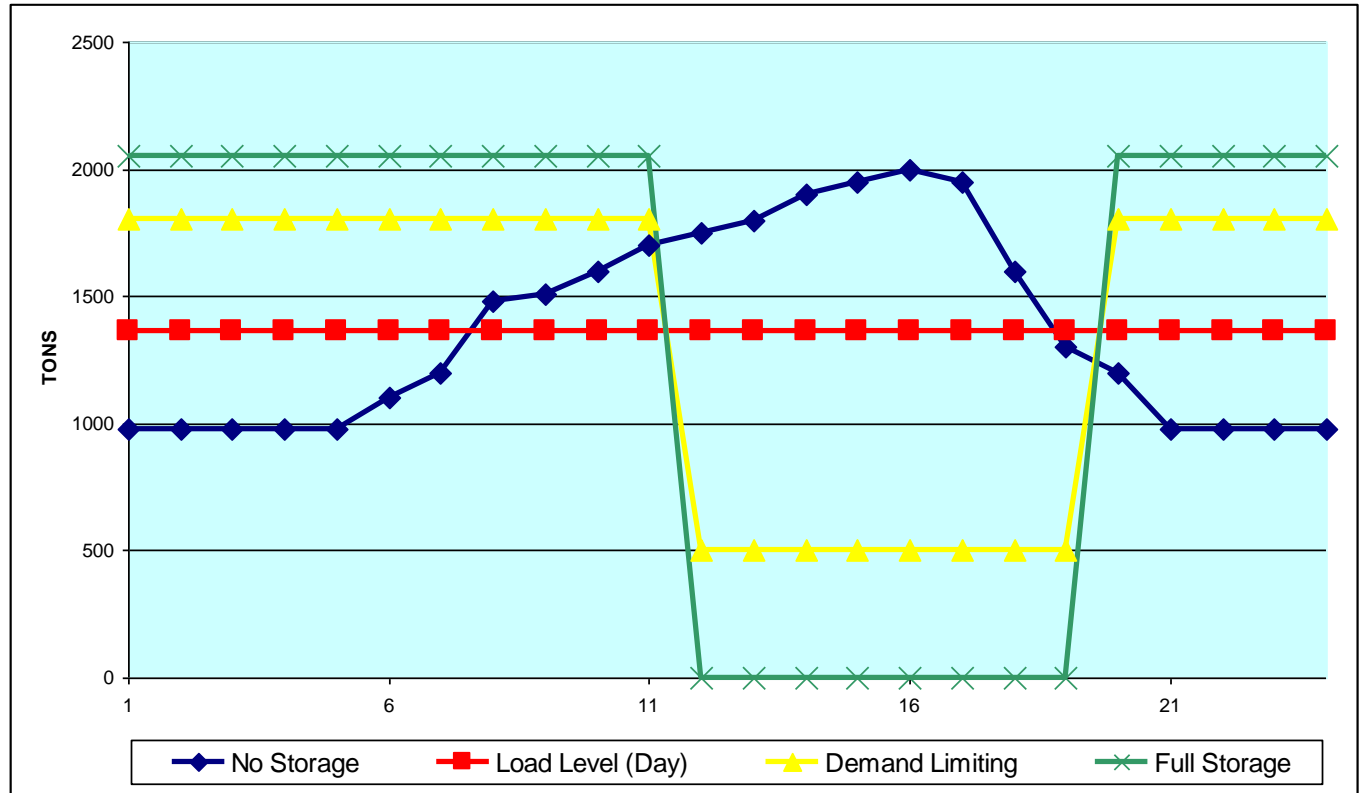
## Traditional Benefits of TES

- Energy cost savings
  - On-peak demand/energy reductions
  - Load shape control
- Capital cost savings
  - New construction
    - Reduce size of chillers, pumps, towers, switchgear
- Improve HVAC operations
  - Reliability, flexibility, backup capacity



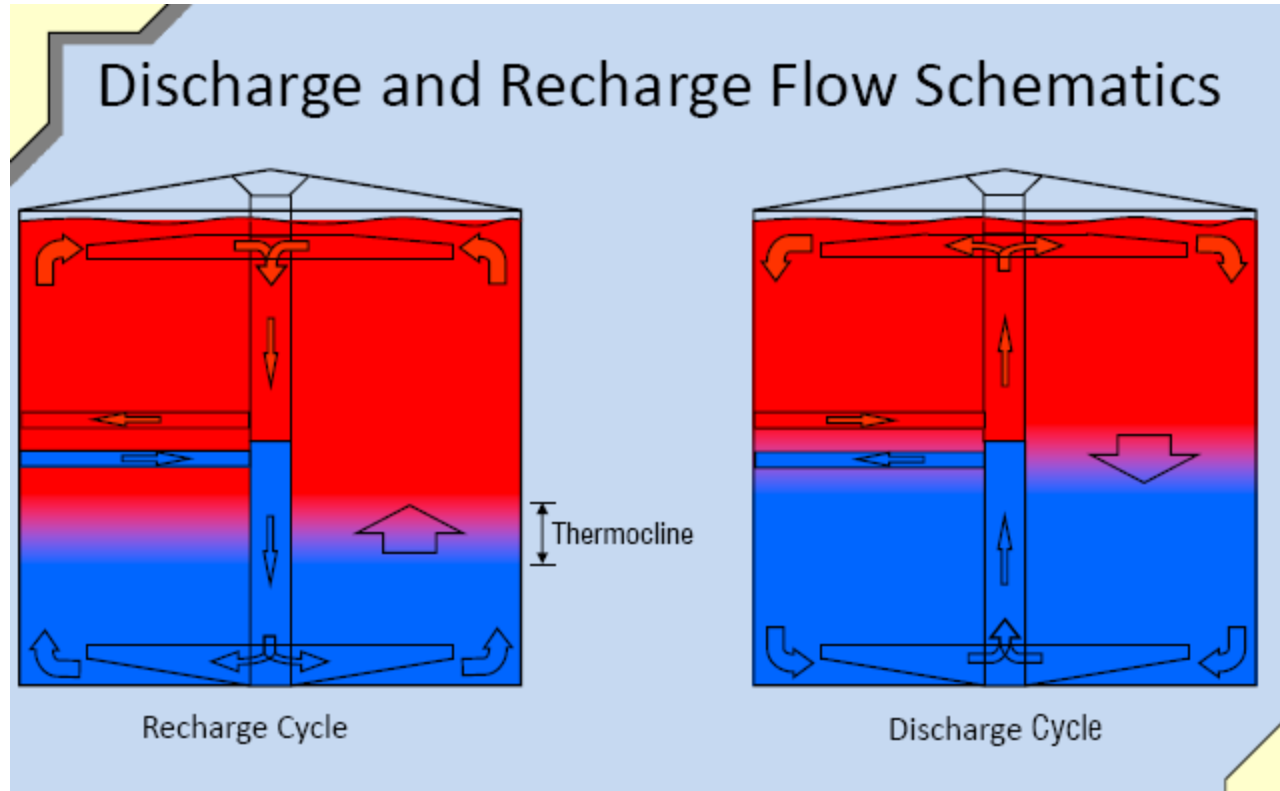
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## Traditional Benefits of TES



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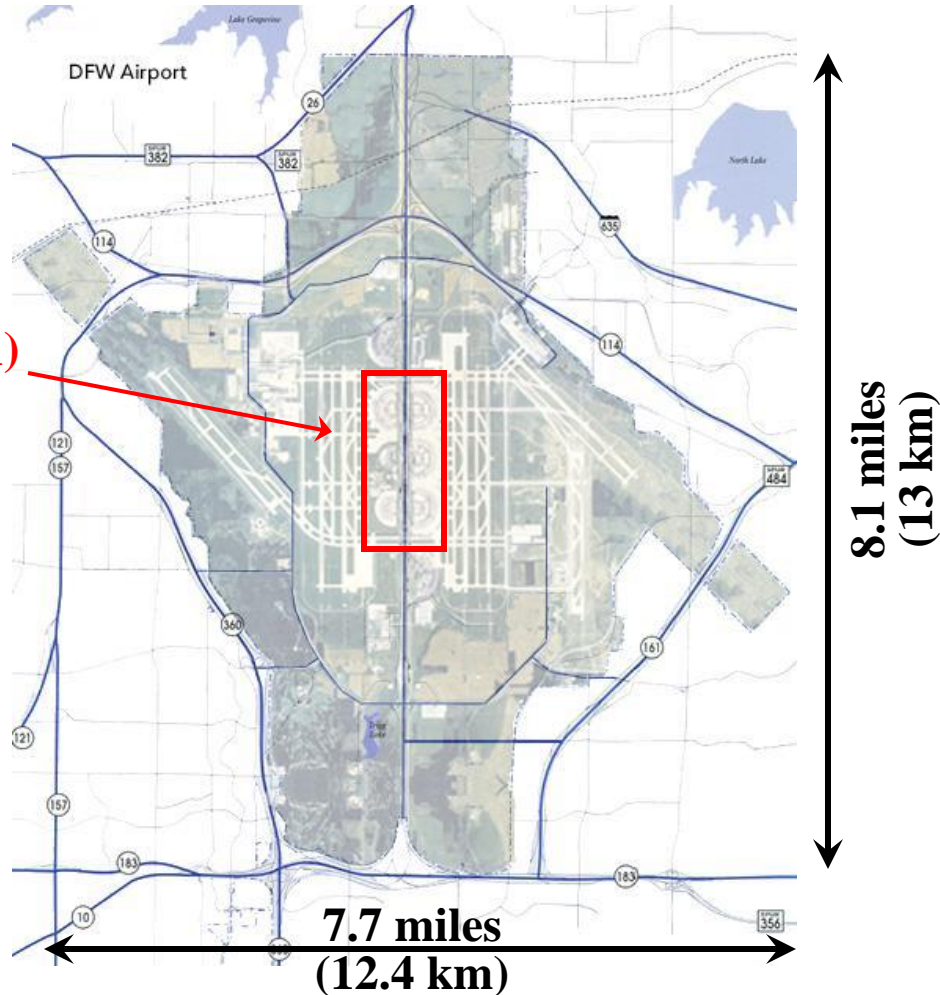
## Traditional Benefits of TES





# DFW Airport – District Cooling with TES Background/Environment

**Central Terminal Area (CTA)**  
~7 MSF of Conditioned Space

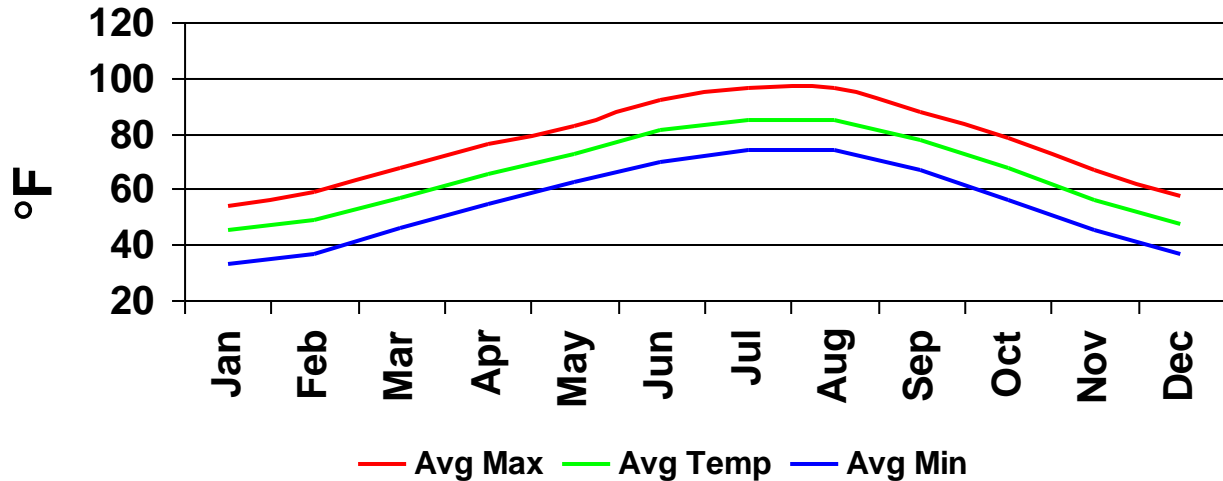




# DFW Airport – District Cooling with TES

## Background/Environment

### Weather Environment







# DFW Airport – District Cooling with TES Background/Environment

## 2005 CUP Upgrade Project (\$155 million)

### ■ Chiller Replacement

- Remove existing equipment (22,000 tons)
- Install 6 - 5,500 ton electric drive centrifugal chillers (33,000 tons)

### ■ Boiler Replacement

- Remove existing equipment - 405,000 lbs/hr (~100 PPM NO<sub>x</sub>)
- Install 5 new boilers - 222,000 lbs/hr @ 125 psig (~9 PPM NO<sub>x</sub>)
- 91% Reductions in Air Emissions





# DFW Airport – District Cooling with TES Background/Environment

## 2005 CUP Upgrade Project (cont.)

- **Install Thermal Energy Storage Tank**
  - 56' tall & 138' diameter
  - 6 million gallons
  - 90,000 ton-hours
  - Ability to shift up to 15 MW off-peak
- **Install Centralized Pre-Conditioned Air System**
  - 12,000 tons Cooling
  - 51 MMBtu Heating





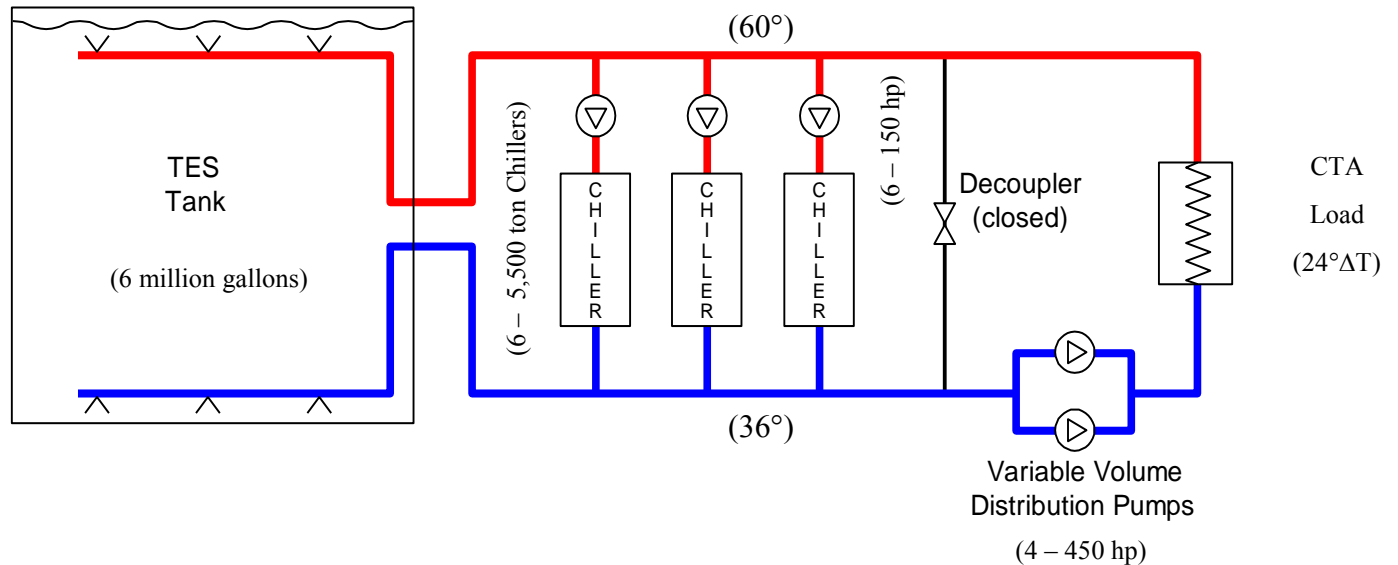
# DFW Airport – District Cooling with TES Background/Environment

## 2005 CUP Upgrade Project (cont.)

- **Electric Power**
  - Primary POD (redundant)
  - UPS for DCS & Critical Load Backup
- **Natural Gas**
  - Dual Feed (redundant)
  - Utilizes Jet Fuel as a Backup

# DFW Airport – District Cooling with TES Background/Environment

## Chilled Water System Configuration





# DFW Airport – District Cooling with TES

## Background/Environment

### Chilled Water System Utilization Drivers

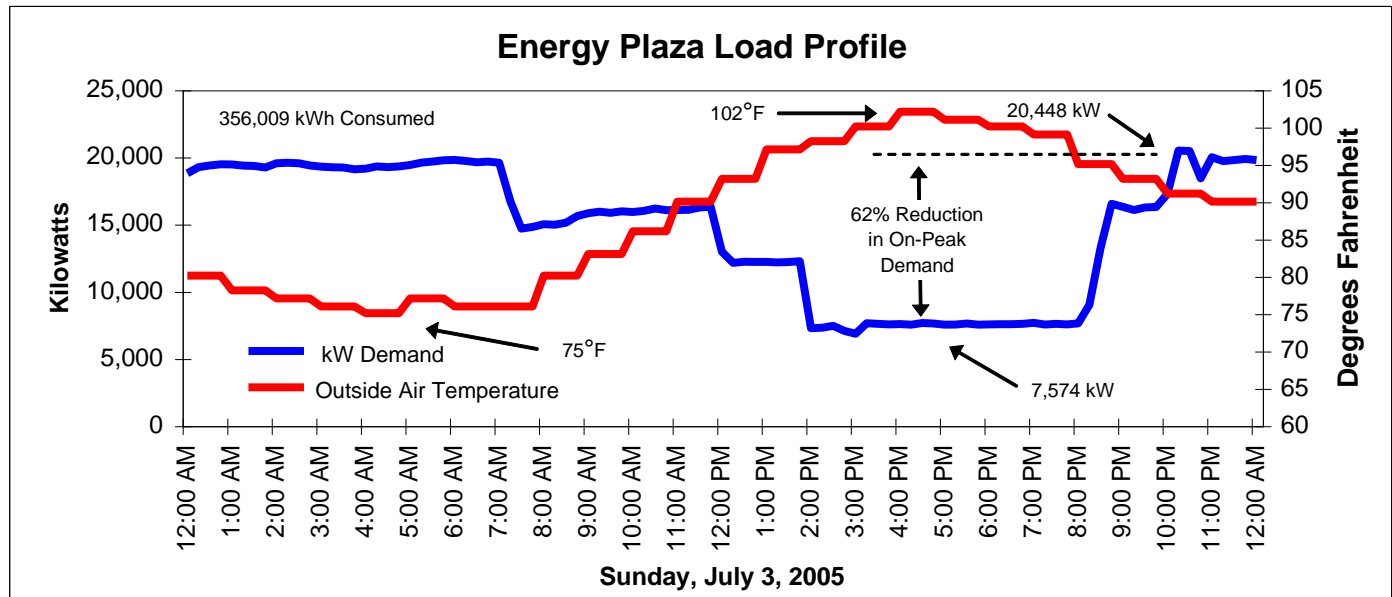
- **Thermal Load**
  - Summer Peak 18,000 tons
  - 4 of 6 Chillers Required to Meet Peak
- **Electric Rate**
  - Commodity – Peak Period
    - June – September, 12 noon to 8:00 pm
  - Transportation – Demand Charges
    - Distribution – Annual Peak (80% Ratchet)
    - **Transmission – ERCOT 4CP**



# DFW Airport – District Cooling with TES

## Traditional TES Usage

### Energy Plaza 2005 (1st Half) Operating Strategy





# DFW Airport – District Cooling with TES

## ERCOT 4CP Approach

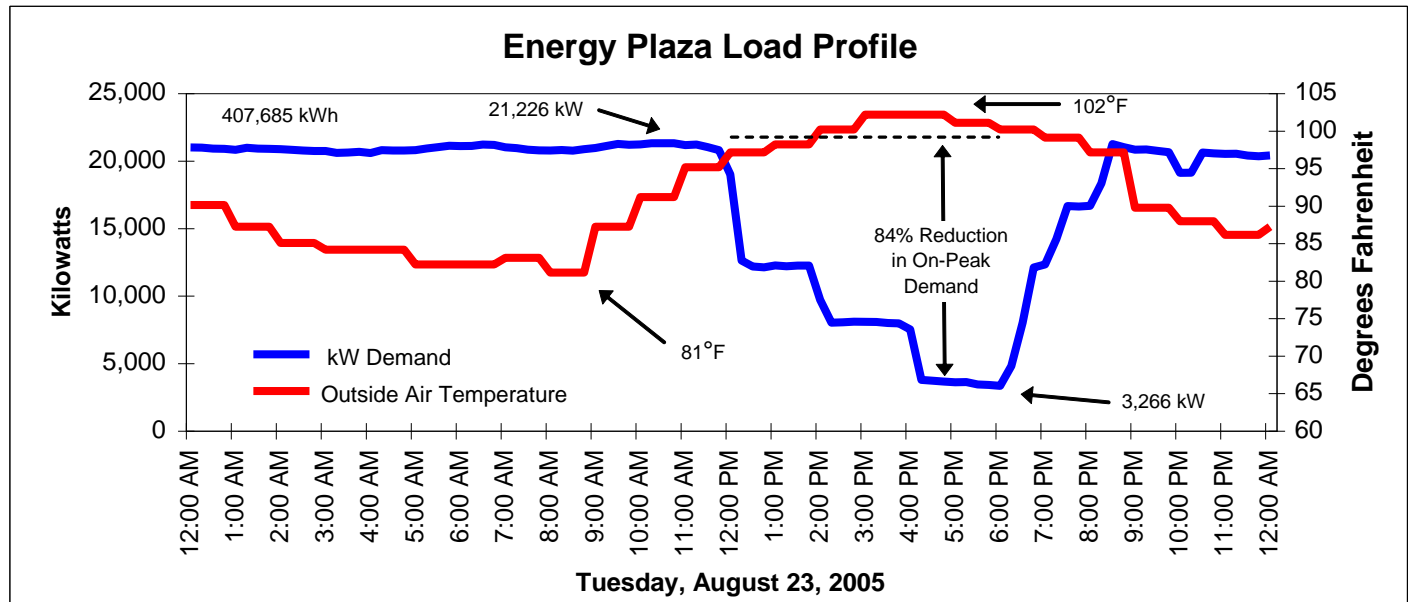
### ERCOT Peak Demand History

	2002	2003	2004
June	17:00	17:00	16:45
July	16:30	16:30	16:45
August	16:45	17:00	16:00
September	16:45	17:00	16:00
Earliest	16:30	16:30	16:00
Latest	17:00	17:00	16:45



# DFW Airport – District Cooling with TES ERCOT 4CP Approach

## Energy Plaza 2005 (2<sup>nd</sup> Half) Operating Strategy







# DFW Airport – District Cooling with TES ERCOT 4CP Approach

## Current Electric Charges Detail

32 Day Billing Period From 08/23/2006 To 09/24/2006

### State Power Program - Monthly Gas Index

TDSP Pass Through chgs		From 08/24/2006 To 09/24/2006
Transition Charge	23,803 KW @ \$0.208000/KW	4,951.02
Transmission Cost Recov Factor	6,081 KW @ \$0.242577/KW	1,475.11
Delivery Point Charge		41.56
Transition Charge	23,803 KW @ \$0.336000/KW	7,997.81
System Benefit Fund (SBF)	9,265,316 KWH @ \$0.000637/KWH	5,902.01
Nuclear Decommissioning (NDF)	23,803 KW @ \$0.045000/KW	1,071.14
Transmission Charge (TUOS)	6,081 KW @ \$1.430000/KW	8,695.83
Distribution Charge (DUOS)	23,803 KW @ \$2.960000/KW	70,456.88
<b>Total TDSP Pass Through Charges</b>		<b>100,591.36</b>

4CP Demand + PF Adjustment

$$(5434.5 \text{ KW} \times 95\%) / 84.9\% = 6081 \text{ KW}$$

\$355,697 Annual Savings



# DFW Airport – District Cooling with TES ERCOT 4CP Approach

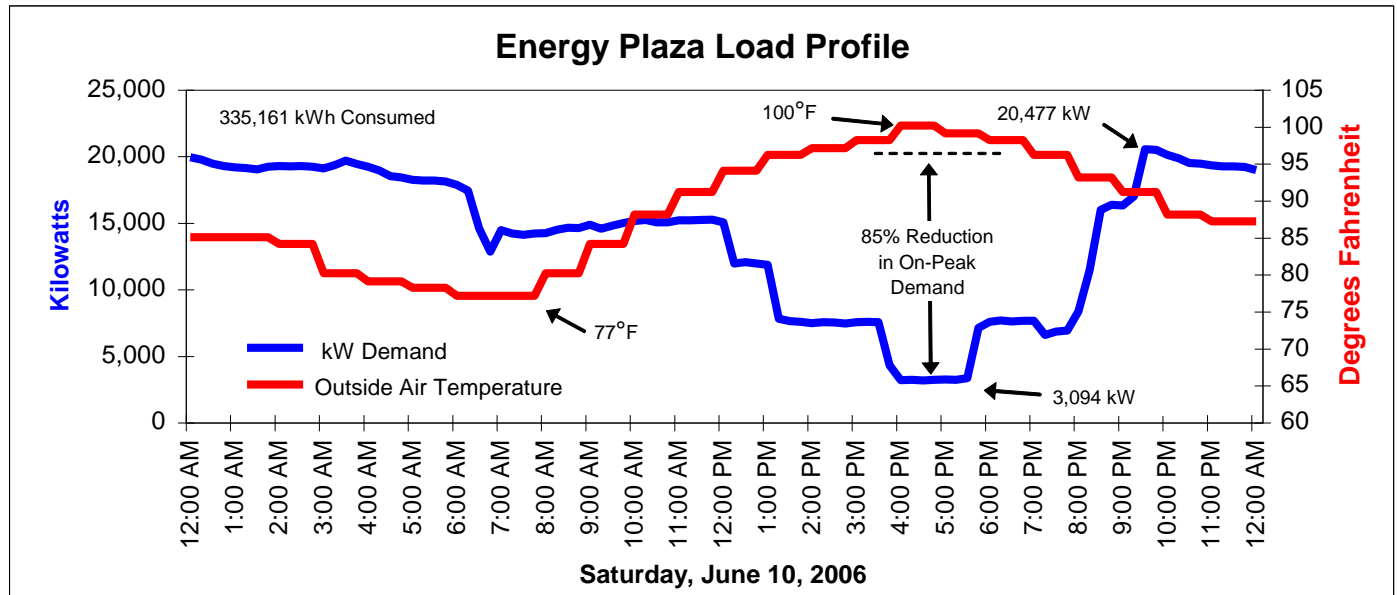
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# DFW Airport – District Cooling with TES ERCOT 4CP Approach

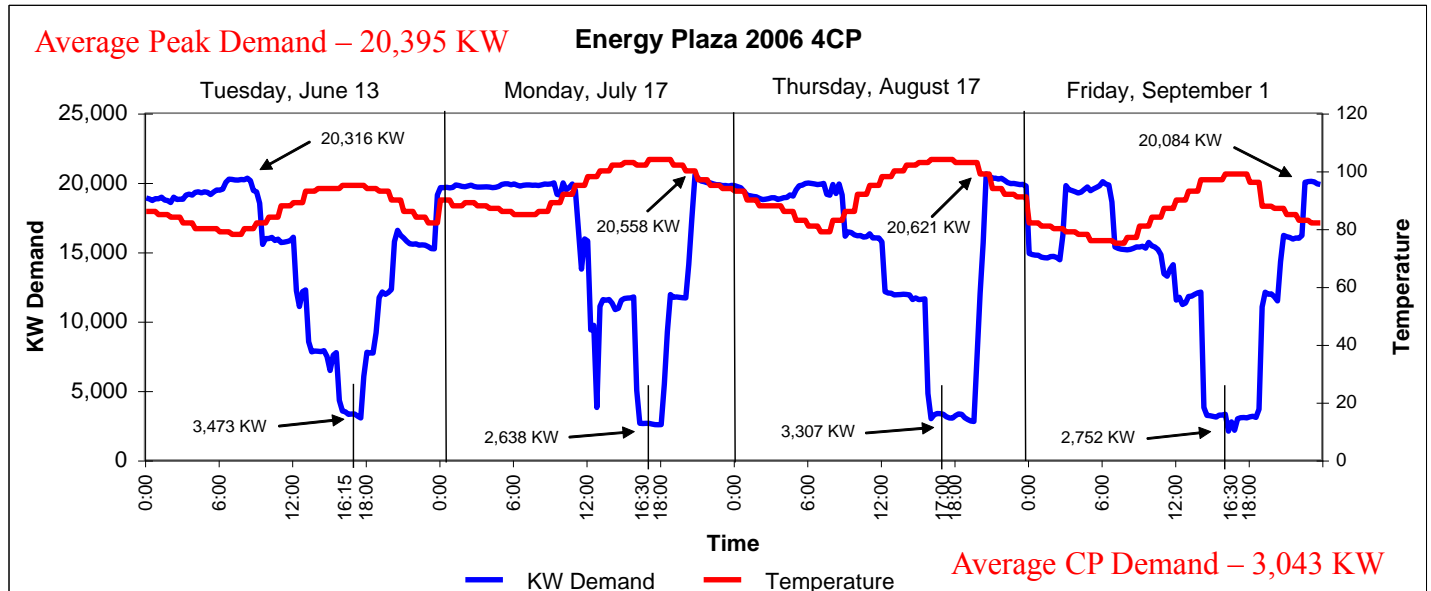
## Energy Plaza 2006 Operating Strategy





# DFW Airport – District Cooling with TES ERCOT 4CP Approach

## Energy Plaza Performance VS ERCOT 4CP





# DFW Airport – District Cooling with TES ERCOT 4CP Approach

## Thermal Storage – Simple Payback

Construction Cost            \$3,300,000 (\$0.55 per gallon)

Energy Cost Savings

Commodity                      \$426,400 Annually

Transportation                 \$389,249 Annually

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\$815,649 Annually

Simple Payback

4 Years



# DFW Airport – District Cooling with TES ERCOT 4CP Approach

Meter	Type	Dates	Current Meter Read	Previous Meter Read	Multiplier	kWh Usage	kW Demand	Power Factor
004452563WE	ACT	07/25 - 08/24	55966.6	53764.2	720	1,585,703.52		0.857
004452565WE	ACT	07/25 - 08/24	14497.5	11867.1	720	1,893,857.76	18,841.00	0.857
004452564WE	ACT	07/25 - 08/24	19308.6	16302.2	720	2,164,608.00		0.857
004452566WE	ACT	07/25 - 08/24	6994.85	372.664	720	4,767,975.36		0.857

	Qty	Rate	Amount
<b>Current Charges</b>			
<b>Champion Energy Charges</b>			
CKWH : Commercial Energy.....	10,412,144.64	0.04318	\$449,596.41
TDU Delivery Charges.....			\$84,519.48
<i>BAS001:Basic Customer Charge</i> .....	1.00	14.95000	\$14.95
<i>BAS003:Delivery Point Charge</i> .....	1.00	24.69000	\$24.69
<i>DIS001:Distribution Charge</i> .....	20,885.00	3.37000	\$70,382.45
<i>MSC054:Rate Case Expenses Surcharge 2</i> .....	20,885.00	0.00617	\$128.78
<i>TRN002:Firm Point to Point Transmission Service Charge for long term or short term firm</i> .....	4,200.00	3.32586	\$13,968.61
TDU Delivery Charges Non Taxable.....			\$8,855.25
<i>MSC025:Nuclear Decommissioning</i> .....	20,885.00	0.04500	\$939.83
<i>MSC029:Recovery of securitized portion of stranded assets and costs</i> .....	20,885.00	0.15400	\$3,216.29
<i>MSC036:Recovery of securitized regulatory assets - stranded costs (TC2)</i> .....	20,885.00	0.22500	\$4,699.13
TDU Surcharges.....			\$6,938.82
<i>MSC041:Energy Efficiency Cost Recovery Factor (EECRF)</i> .....	10,412,143.00	0.00065	\$6,757.48
<i>MSC049:Rate Case Expenses Surcharge</i> .....	20,885.00	0.00868	\$181.34
<b>Taxes</b>			
Gross Receipts Reimb.....			\$10,804.86
PUC Assessment.....			\$901.94
<b>Total Current Charges</b> .....			<b>\$561,616.76</b>

AAAE Energy Efficiency Forum  
April 21, 2015

4CP Demand + PF Adjustment

(3789 KW x 95%) / 85.7% = 4,200 KW

20,885 KW x \$3.32586 = \$69,461

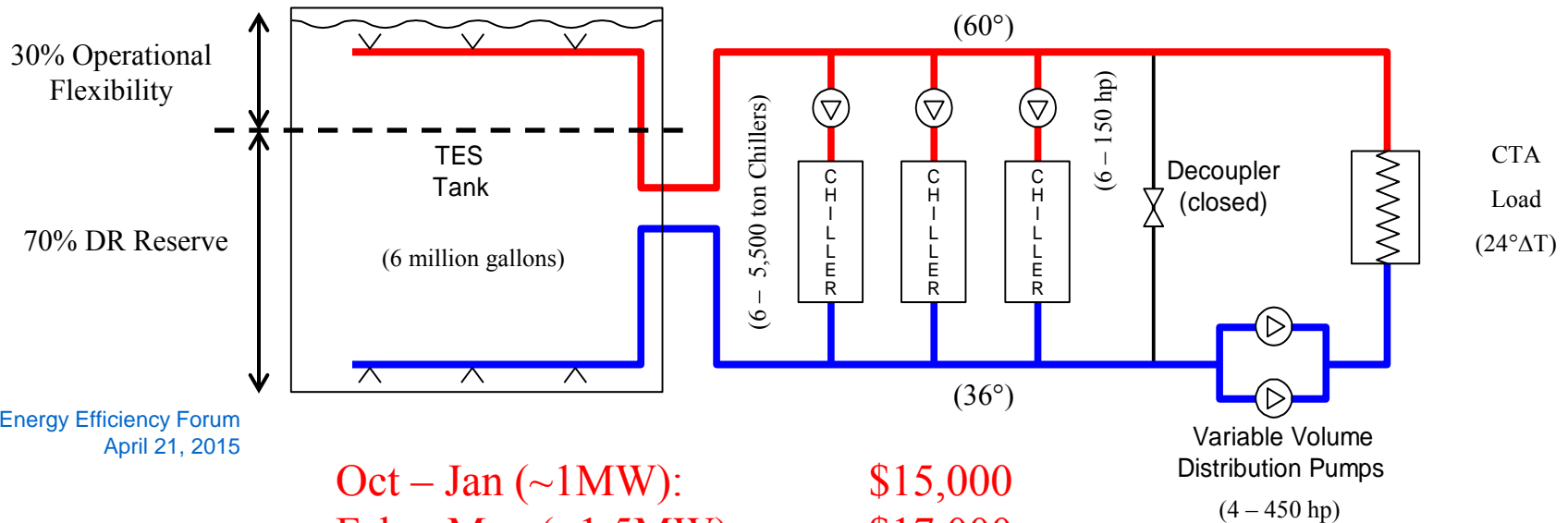
\$55,492 Monthly Savings

\$665,904 Annual Savings



# DFW Airport – District Cooling with TES Demand Response

## Chilled Water System Configuration



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Oct – Jan (~1MW):	\$15,000
Feb – May (~1.5MW):	\$17,000
ERCOT Rebate	\$32,000



# DFW Airport – District Cooling with TES

## Questions

