

**The Foodservice Distribution  
CONFERENCE & EXPO**  
OCTOBER 7-9, 2007  
LOUISVILLE, KY



# Reducing Occupancy Costs

## *It Pays to Conserve*

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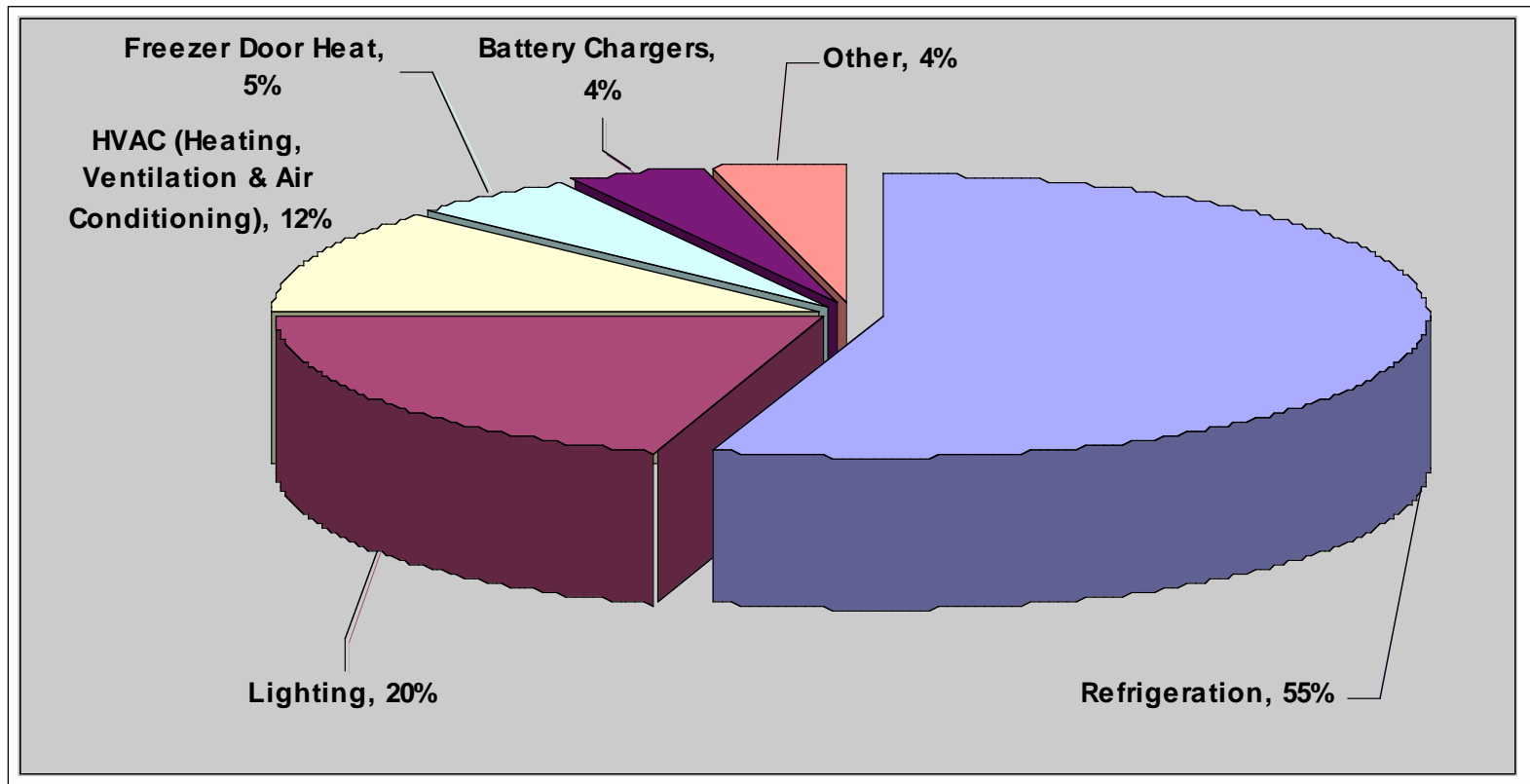
**SYSCO**



*People and Products*  
*You Can Count On®*



# “Typical” Energy Use By Sub-System





# Major Activities

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- 1. Commissioning & Follow-Up
- 2. Utility Tracking & Benchmarking
- 3. Real-Time Electric Meter Monitoring
- 4. Capital Upgrades
- 5. Efficient New Construction
- 6. Technical Support & Training



# Commissioning

- “Commissioning” is the in-depth, hands-on review and fine tuning of equipment, control setpoints, algorithms, light levels, and operational practices.
- Typically low or no-cost to implement.
- Typical savings of 5% to 15%.
- Typical payback is less than 1 year.
- Often accompanied by improvements in O&M.



# Commissioning Evaporator Controls

6/26/2006 15:06 SYSCO Hide Window

Penthouse #8  
-10° Freezer

INNOVATIVE REFRIGERATION SYSTEMS  
DESIGN BUILD SUCCESS

EVAPORATOR CONTROL  
LLS AUTO OFF FAN AUTO OFF  
FAN CYCLE YES NO

Enable Fan Cycling

Set Zone Temp.

Evaporator Temperature 1°F  
Evaporator Set Point 0°F  
Hours Between Defrosts 8 hrs  
Length of Defrost 15 min  
Hours Running Since Last Defrost 6 hrs  
Defrost Time Remaining  
Request Defrost

Adjust Defrosts

OK TO REFRIGERATE

Suction (HTRS)  
Hot Gas (HG)  
Liquid (HTRL)

EVAP #1	55° Cooler	EVAP #8	-10° Freezer	EVAP #15	-20° Freezer
EVAP #2	40° Cooler	EVAP #9	-10° Freezer	EVAP #15a	-20° Freezer
EVAP #3	34° Cooler	EVAP #10	-10° Freezer	EVAP #16	32° New Dock
EVAP #4	34° Cooler	EVAP #11	Dock	EVAP #17	34° Cooler
EVAP #5	50° Cooler	EVAP #12	Dock	EVAP #18	28° Cooler
EVAP #6	28° Cooler	EVAP #13	Dock		
EVAP #7	-10° Freezer	EVAP #14	Dock		

Close Window



# Commissioning Compressor Controls

6/26/2006 15:13 SYSCO Hide Window

MESSAGE SENT **IDLE** SCREW COMPRESSOR #2 350 HP SWING AUTO MAN MED TEMP

FES MODE STOP LOCAL REMOTE RUN PLC MODE AUTO MAN COMMS OK

**Compressor Sequencing** (Callout pointing to the sequencing table)

**Suction Set-Points** (Callout pointing to the 26 PSI MT Suct Setpoint)

**Medium Temperature Setpoints**

LEAD COMPRESSOR COMPRESSOR 2 Running			LAG COMPRESSOR COMPRESSOR 3 Running			LAG2 COMPRESSOR COMPRESSOR 4 Stopped		
Slide Valve Position	100 %		Slide Valve Position	48 %		Slide Valve Position	0 %	
	Run/Stop	Max Slide		Run/Stop	Max Slide		Run/Stop	Max Slide
1	Run	100%	1	Stop	0%	1	Stop	0%
2	Run	100%	2	Stop	0%	2	Stop	0%
3	Run	100%	3	Run	25%	3	Stop	0%
4	Run	100%	4	Run	50%	4	Stop	0%
5	Run	100%	5	Run	100%	5	Stop	0%
6	Run	100%	6	Run	100%	6	Run	50%
7	Run	100%	7	Run	100%	7	Run	100%
8	Run	100%	8	Run	100%	8	Run	100%
9	Run	100%	9	Run	100%	9	Run	100%
10	Run	100%	10	Run	100%	10	Run	100%

Lead Suction Cutout	10 psi	Lag Suction Cutout	12 psi	Lag Suction Cutout	15 psi
Lead Suction Cutin	28 psi	Lag Suction Cutin	35 psi	Lag Suction Cutin	42 psi
Lead Suction	OK	Lag Suction	OK	Lag Suction	OK

Discharge Press	153 psi	Discharge Press	26 PSI
Pump Diff Press	31 psi	Discharge Press	152 PSI
Suction Pressure	27 psi	Discharge Press	143 PSI
MT Suct Setpoint	26 psi	Discharge Press	4 PSI
Step Pressure	2 psi	Discharge Press	146 PSI
Next Step Time	600 sec	Discharge Press	7 PSI
Remain Until Next	600 sec	Discharge Press	175 °F
Previous Step Time	300 sec	Discharge Press	133 °F
Remain Until Prev	300 sec	Discharge Press	176 °F
Discharge Cutout	215 psi	Discharge Press	25 °F
Discharge Cutin	160 psi	Discharge Press	100 %
Discharge Press	OK	Discharge Press	278 AMPS
Pumpdown Cutout	-1 psi	Discharge Press	3 %
Pumpdown Cutin	1 psi	Discharge Press	124 VOLTS
Low Pump Diff SP	25 psi	Discharge Press	
Pump Differential	OK	Discharge Press	

Close

SOLENOID PULSE TIMES UNLOAD 12 / 4 SEC LOAD 8 / 4 SEC UNLOAD LOAD LINE VOLTAGE



# Commissioning Condensers

6/26/2006 15:14 SYSCO Hide Window

**Pump & Fan Set-Points**

View From Opposite Angle

INNOVATIVE REFRIGERATION SYSTEMS  
DESIGN BUILD SUCCESS

**Condenser Setpoints**

Condenser Setpoints	
Sump Pump On	140 psi
Sump Pump Off	130 psi
Lead Condenser Fan On	150 psi
Lead Condenser Fan Off	135 psi
Lag1 Condenser Fan On	160 psi
Lag1 Condenser Fan Off	137 psi
Lag2 Condenser Fan On	165 psi
Lag2 Condenser Fan Off	145 psi
Low Ambient Pump Cutout	40 °F
Low Ambient Pump Reset	40 °F

Lead/Lag rotation occurs at PLC midnight.

PLC Hour: 15  
PLC Minute: 18  
PLC Second: 53

Close

Level OK Float  
Level OK Setpoint  
Lo Level-Pumps OK  
Lo Level-Cooler OK  
Hi Suction-Pumps OK  
Pump1-Aux OK  
Pump1-Seal OK  
Pump2-Aux OK  
Pump2-Seal OK

Level OK Float  
Level OK Setpoint  
Lo Level-Pumps OK  
Lo Level-Cooler OK  
Hi Suction-Pumps OK  
Pump1-Aux OK  
Pump1-Seal OK  
Pump2-Aux OK  
Pump2-Seal OK

Med Temp 27 psi 40%  
Low Temp 5 psi 38%

Mechanical Room Temperature 84 °F  
Outside Temperature 75 °F

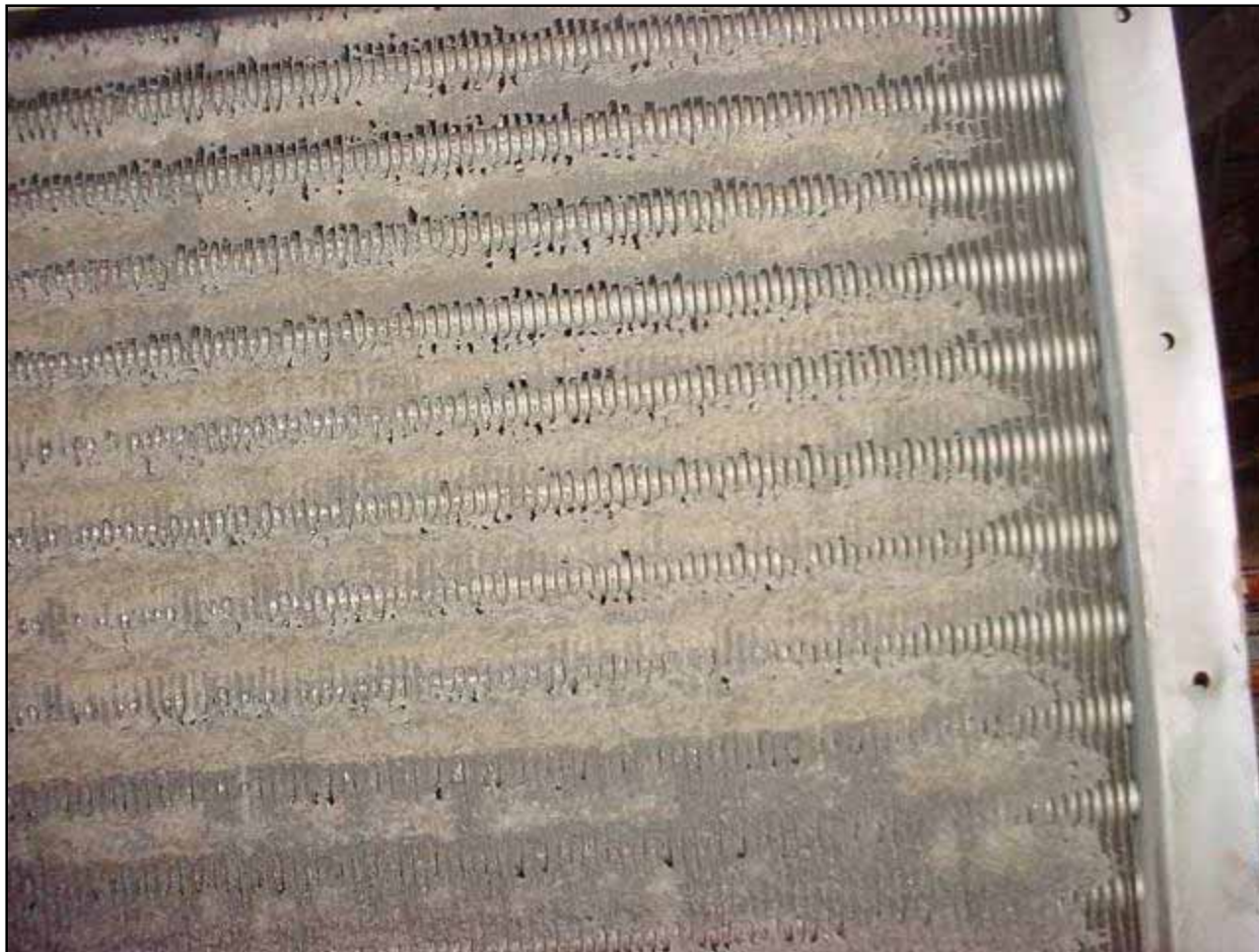
Mechanical Room Leak Detect 0 ppm  
Relief Stack Leak Detect 0 ppm

Mech Room Setpoints

Log  
Events  
Processor  
Ammonia  
Temperature  
Analog  
Evaporators  
Plan View  
Trending

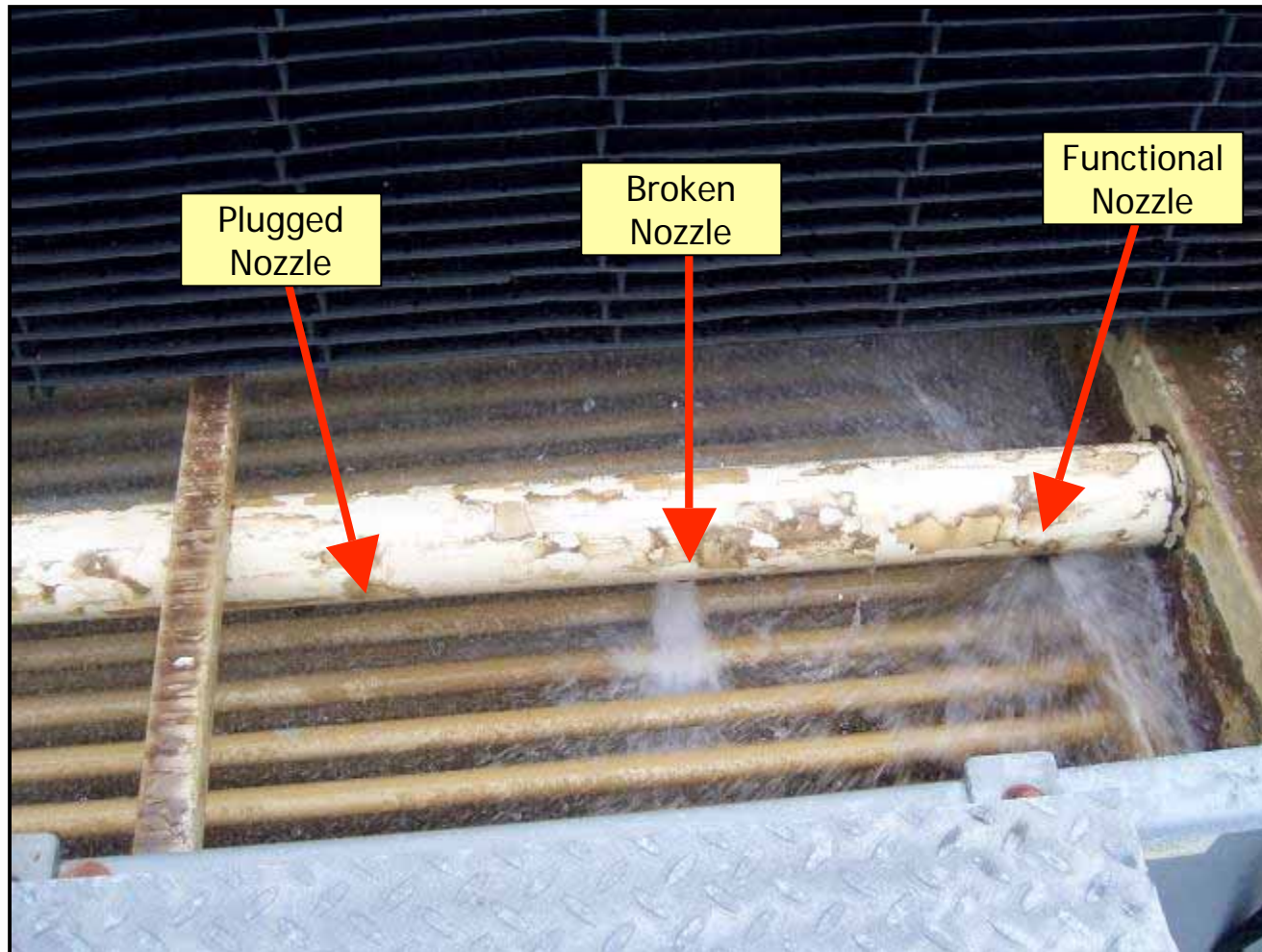


# Evaporator Coil Inspection





# Condenser Coil Inspection





# Dock Door Inspection





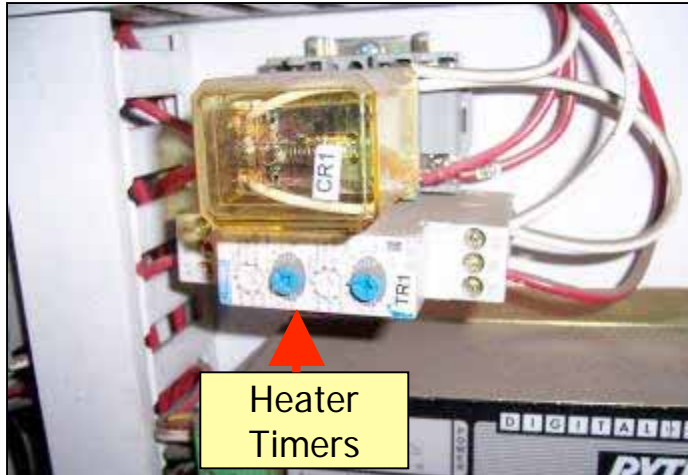
# How Much Can Door Operating Habits Really Cost?

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- **Open Dock Doors**
- \$6000+ per door, per year
- 6 inch gap: \$400+ per door, per year
  
- **Open Freezer Doors**
- \$35,000+ per door, per year
- 4 inch center gap: \$1200+ per door, per year



# Freezer Door Heating, Maintenance & Performance



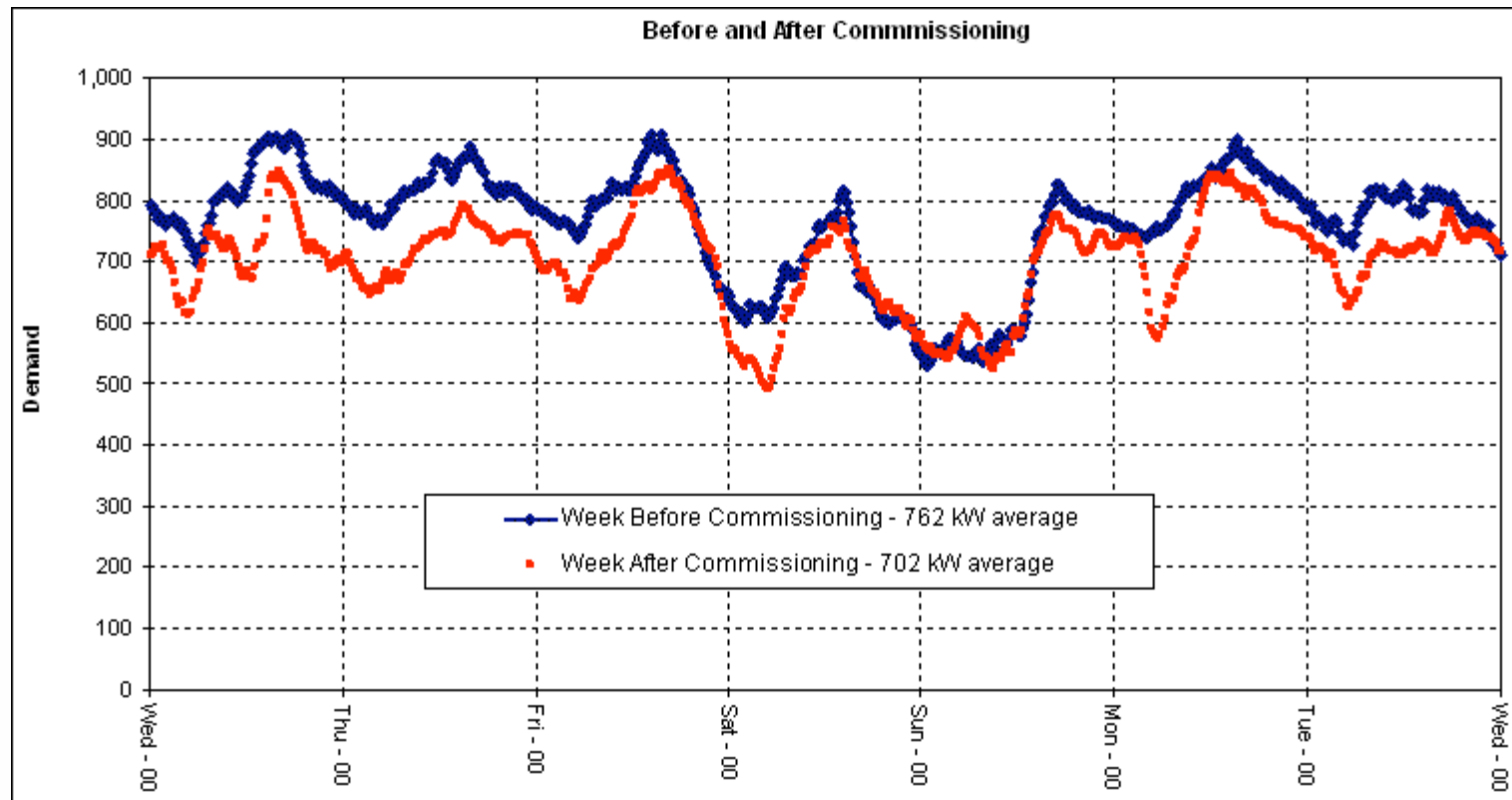


# How Much Can Door Heat Really Cost?

- Typical Range of Freezer Door Heat:
  - 5 to 30 kW per door, sometimes more!
- Typical Door Heat Operation
  - Continuous
- Typical Door Heat Cost: \$34,000 per year
  - 4 doors
  - 12 kW heat per door, continuous
  - 6.5¢ per kWh energy cost (SYSCO average)
  - Refrigeration penalty: 25%
- How To Save?
  - Use door control panel or install timers to cycle the door heat. Only use enough to keep door frost free!
  - Pay attention to door heat when selecting new doors!



# Impact of Commissioning an Existing Facility



- 34 kW average savings was claimed in the commissioning report.
- 60 kW average saving seen in this comparison.

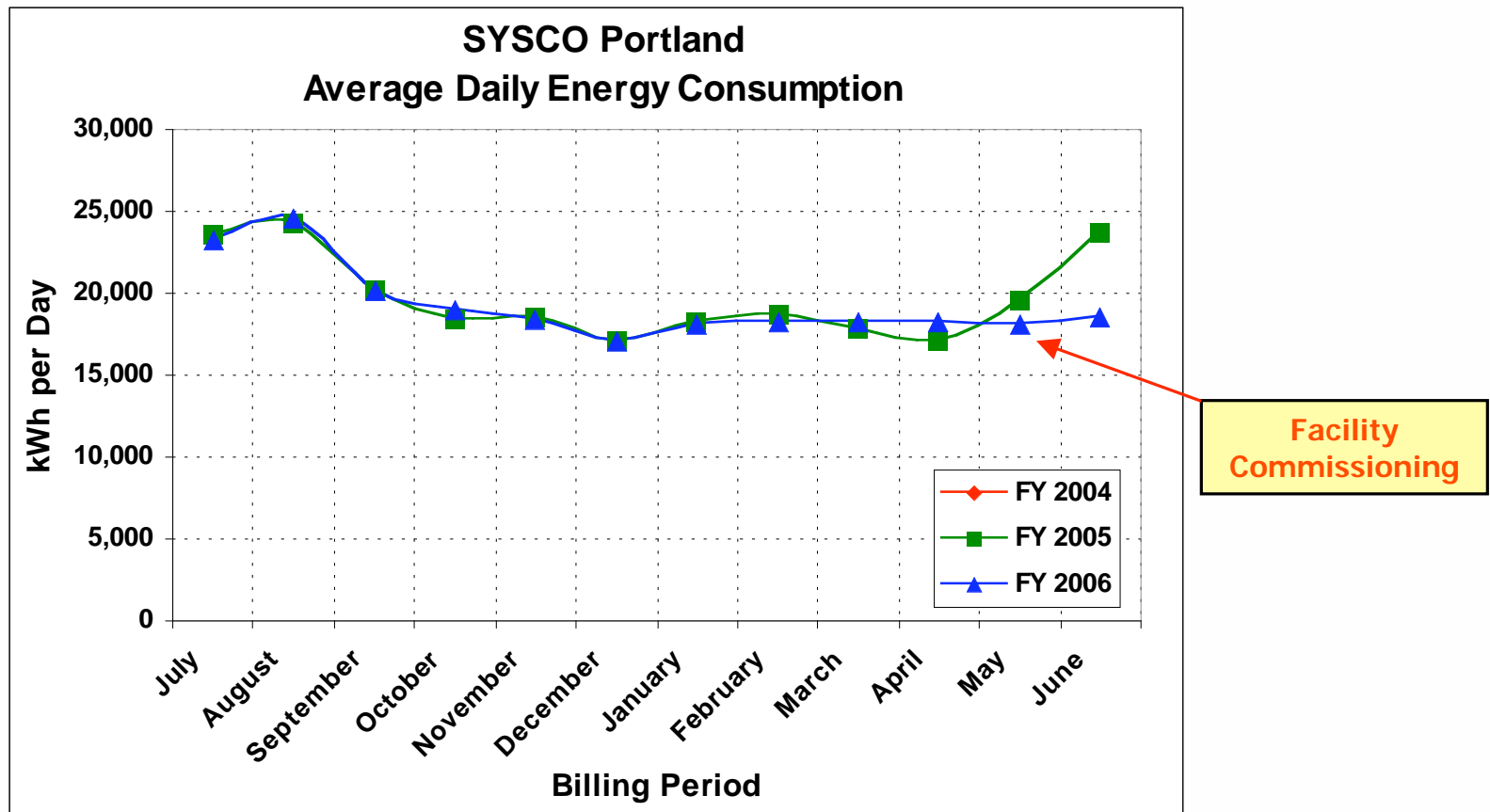


# Changes Made During Commissioning

- Increased Freezer Suction.
- Increased Cooler Suction.
- Reduced Minimum Condensing.
- Changed Condenser Sequencing Strategy from pumps first, fans second to pump then fan, pump then fan.
- Increase Hot Gas Regulator Pressure in Heated Zones (to make heating more effective)
- Reduce freezer door supplemental heat



# Impact of Commissioning a Facility w/ Existing Efficient Features & Equipment



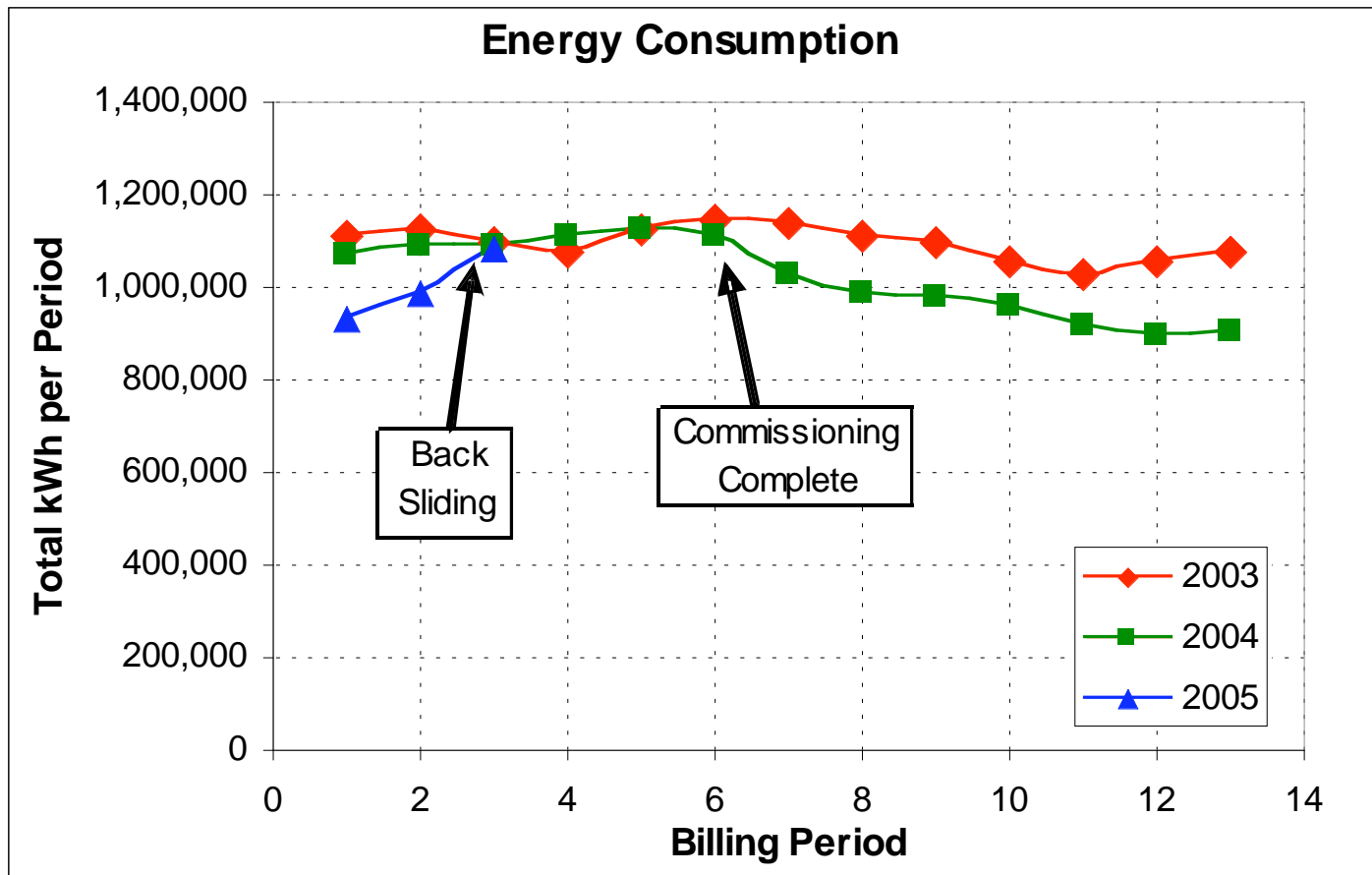


# Changes Made During Commissioning

- Evaporator Hot Gas Defrost Changes
  - Increase time between defrosts
  - Increase pump-down times
  - Shorten hot gas times
- Evaporator Fan Speed Control
  - Lower maximum fan speed from 100% to 90%
  - This reduces coil capacity by 5-7% while reducing fan power consumption by 22%.
- Increase High Stage Suction
- Implement Office Temperature Set-backs during Unoccupied Time
- Improve Condenser Staging
  - All pumps then all fans strategy. (old school)
  - Pump fan, pump fan strategy.



# Importance of Energy Management Following Commissioning





# Energy Management Sites

## Tools

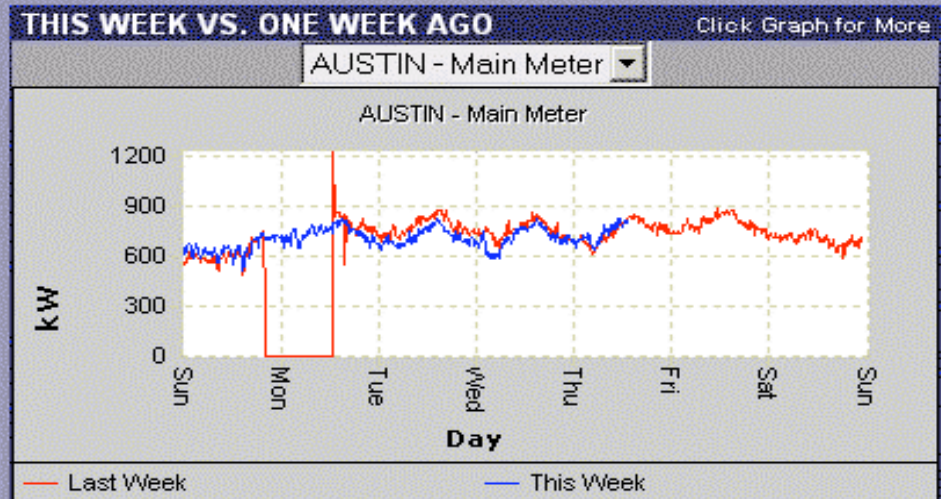
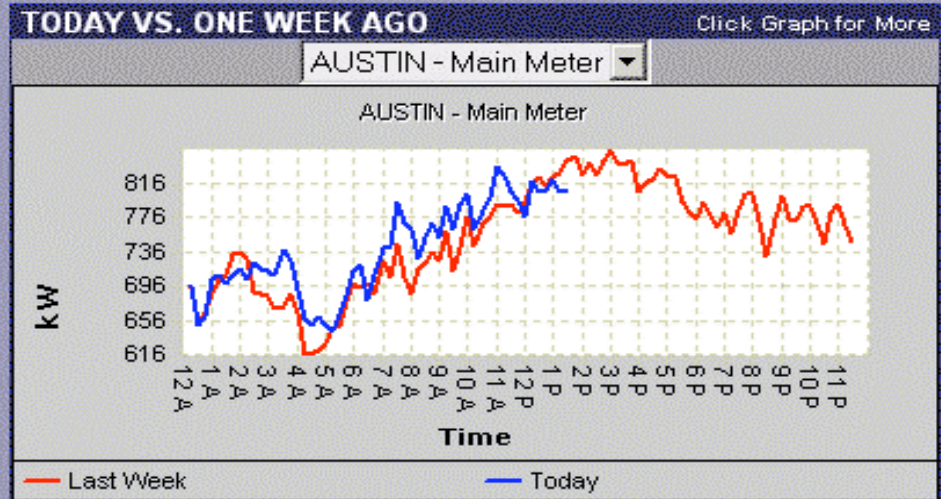
- [Facility Data](#)
- [Meter Monitoring](#)
- [Benchmarking](#)
- [Questionnaire](#)
- [Action Items](#)
- [Utility Bill Analysis](#)

## Resources

- [Document Manager](#)
- [Links](#)

## Administration

- [Manage Worksite](#)

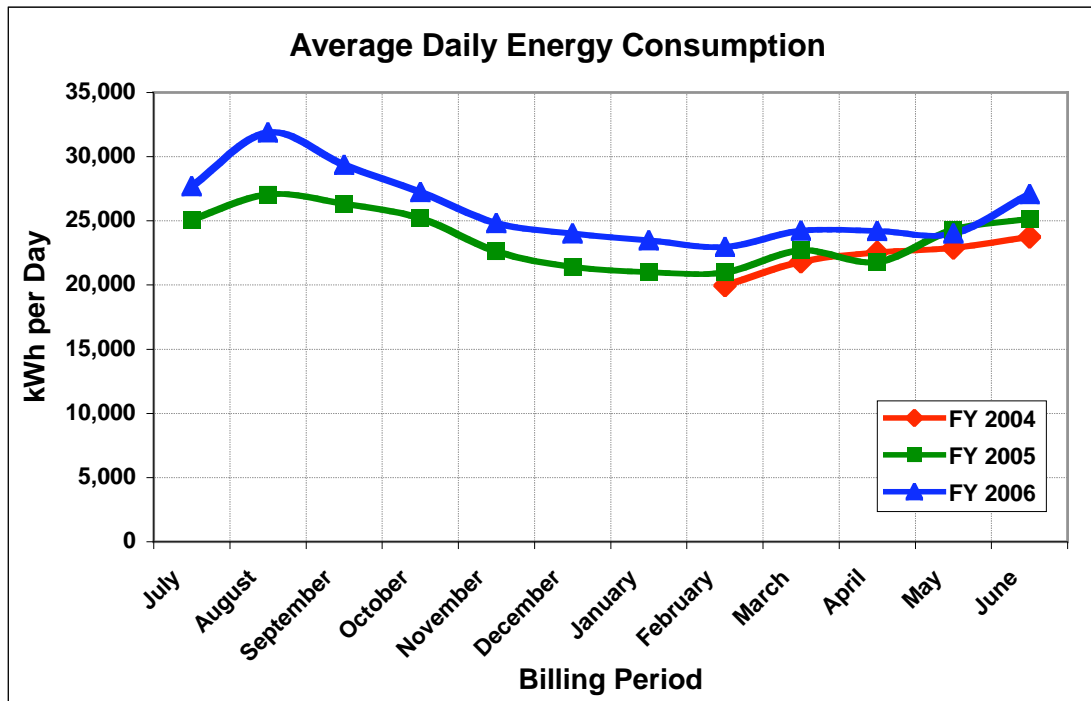




# Energy Consumption kWh/day

## GRAPHICAL

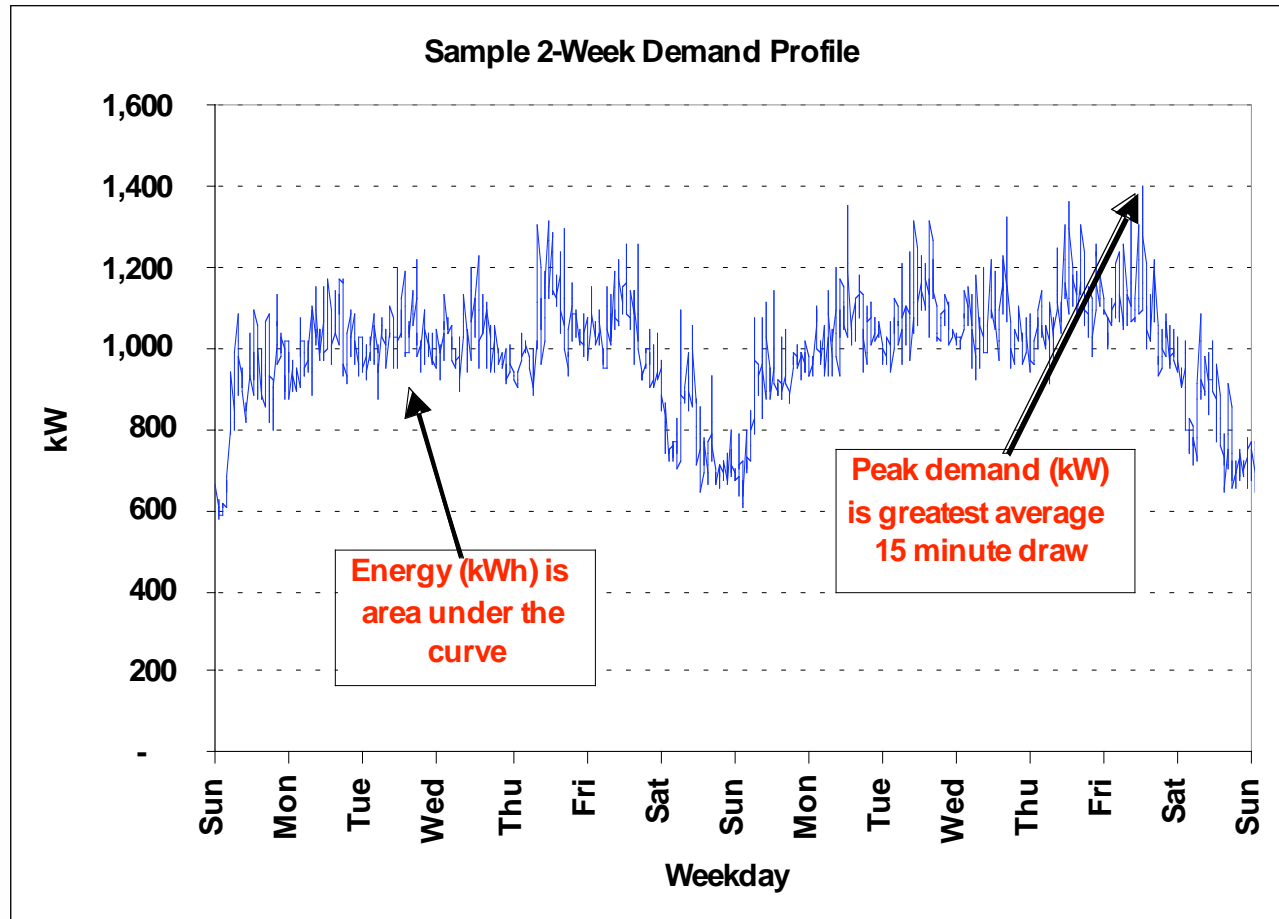
- |   |   |   |
|---|---|---|
| <input type="checkbox"/> Normalized per cu-ft | <input type="checkbox"/> kWh            | <input type="checkbox"/> All                      |
| <input type="checkbox"/> All                  | <input type="checkbox"/> kWh per day    | <input type="checkbox"/> Electric                 |
| <input type="checkbox"/> Meter 1: Main Meter  | <input type="checkbox"/> Peak kW or kVA | <input type="checkbox"/> Natural Gas              |
| <input type="checkbox"/> Meter 2: Addition    | <input type="checkbox"/> \$             | <input type="checkbox"/> Water, Propane, etc. . . |
|   | <input type="checkbox"/> ¢ per kWh      |   |



- 2006 higher than 2005. What changed?



# Sample Electric Meter Data





# New Construction / Retro-fits

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- Lighting
- Hi-Speed doors
- Roofing
- Design
- Refrigeration
- Dock / Pit

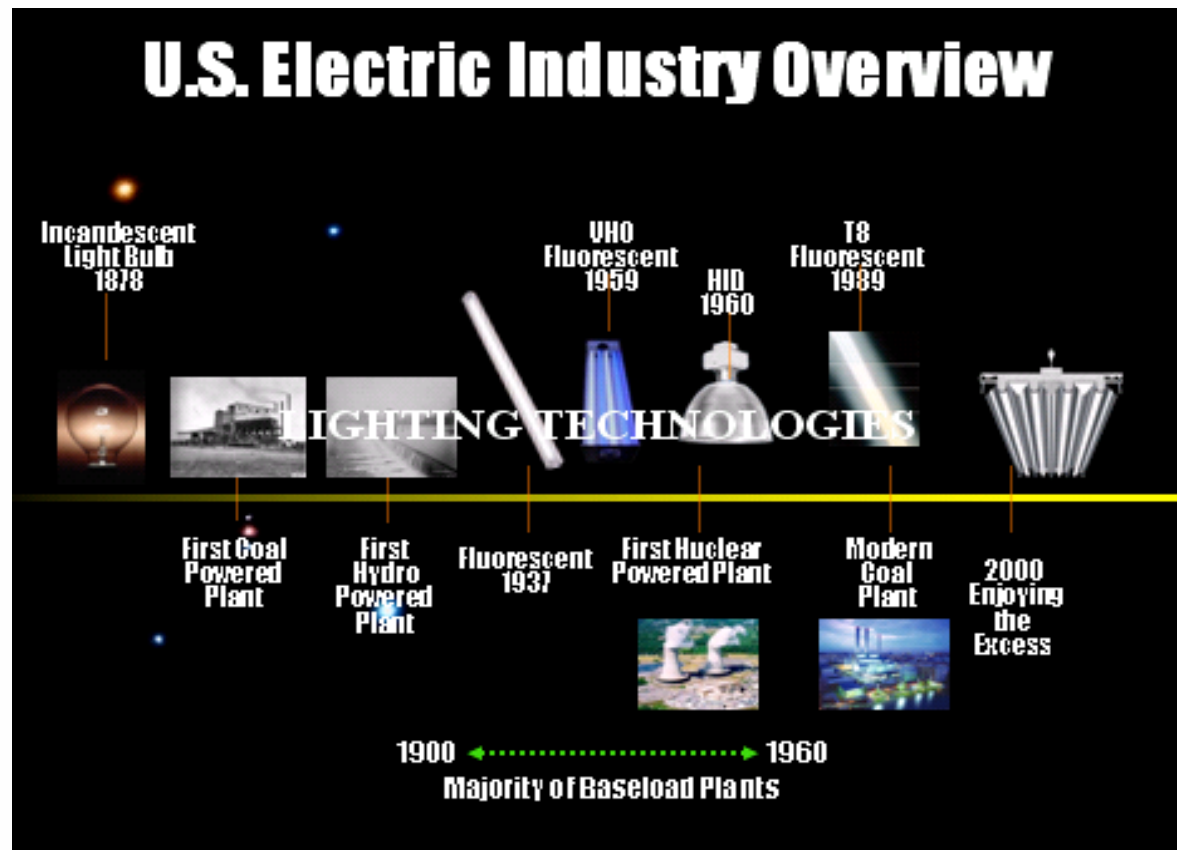


# Warehouse Lighting





# Lighting Technologies





# Physics of Lighting

Throughput Energy is Consumed as

1) Heat

2) Vibration

3) Work

**Input vs. Throughput:  
Lumens vs. Footcandles**



Input

vs.



Throughput

Delivered Footcandles



# Physics of Lighting

Throughput Energy is Consumed as

1) Heat

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**Input vs. Throughput:  
Lumens vs. Footcandles**



Input

vs.

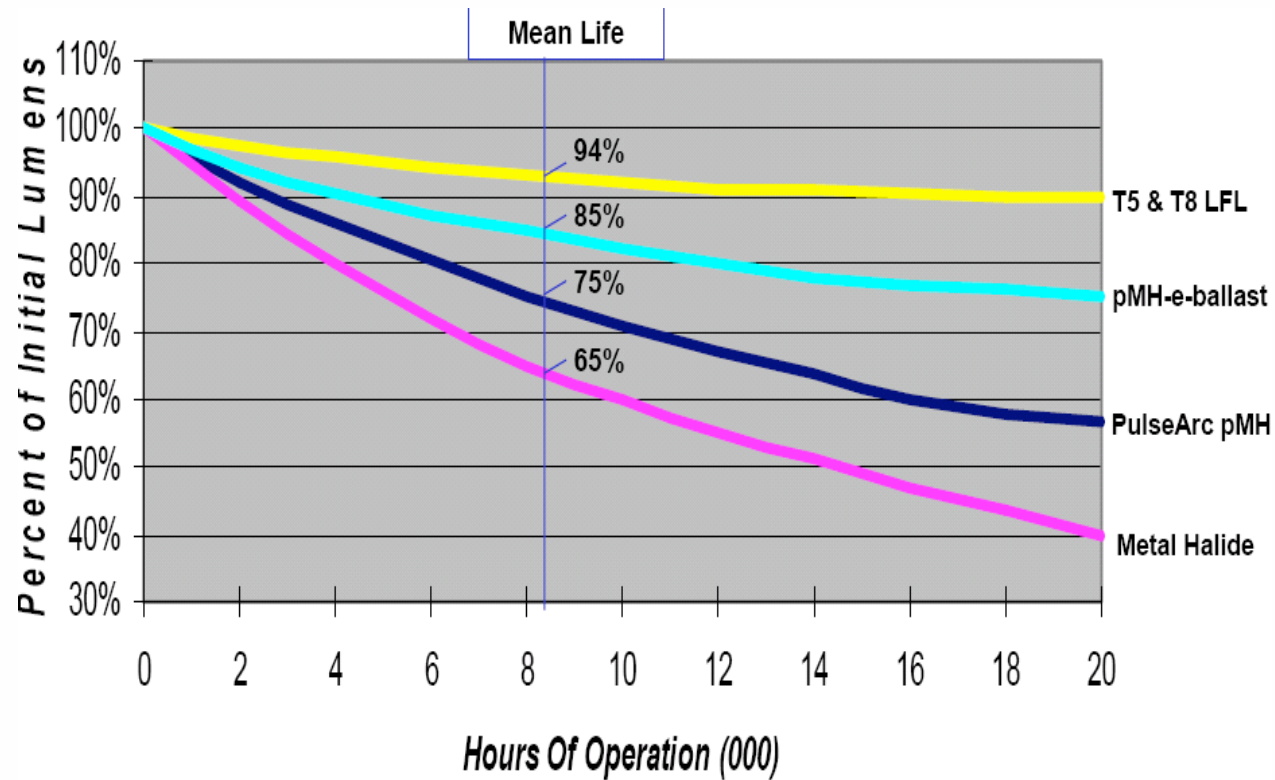


Throughput

Delivered Footcandles



# Physics of Lighting



T5 LFL Lamp Technology Provides The Best Lumen Maintenance / Maintained Light Output

- Courtesy of GE Lighting Systems, Inc.



# Color Rendition Index



**CRI 22**

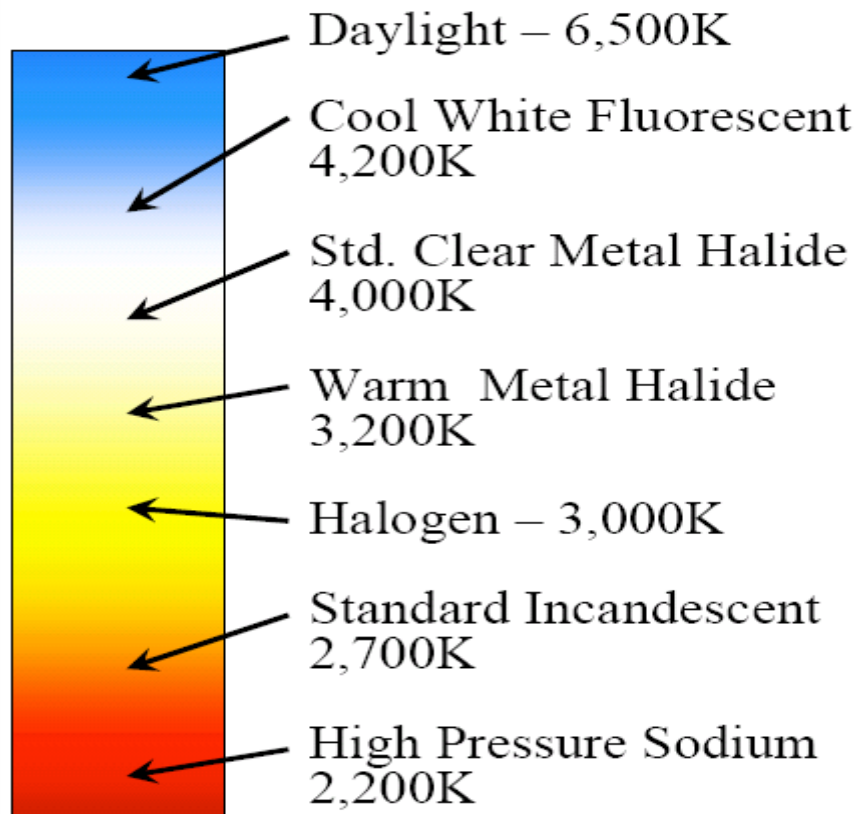


**CRI 82**

- Measure of how a lamp influences the color appearance of the objects being illuminated
- The greater the CRI, the more accurate the color rendered
- CRI of 100 = Sunlight
- CRI of 80 to 86 = Fluorescent and Induction
- CRI of 22 = High Pressure Sodium



# Color Temperature



## Correlated Color Temperature (CCT)

- **Warm** - 3500 Kelvin or less
- **Neutral** - 3500 to 4000 Kelvin
- **Cool** - 4000 to 6000 Kelvin
  
- **Daylight** = 6500 Kelvin
- **Fluorescent** – Available from 3,000 to 6,500 Kelvin

## Economics of Lighting

	HID	FLUORESCENT
Watts Consumed	465	221
Electric Rate	\$.06	\$.06
Annual Hours of Operations	8760	8760
Annual Operating Cost per Fixture	\$244	\$116
Annual Operating Cost for 500 fixtures	\$122,000	\$58,000

**One Fixture x .244 Kw x \$06/Kwh x 8760 = \$128 / year**

**500 fixtures x \$128 = \$64,000 annual savings**

**200,000 sq. ft. facility**

# Daylight Sensor



## Types of Doors for:

- Food Distribution – Cooler and Freezer
- Interior Warehousing
- Loading Docks

## Low traffic (less than 20 cycles/8 hour shift):

- Sectional door, rolling steel door, hard slider



## Moderate to heavy traffic (more than 20 cycles/ 8 hour shift):

- High speed rolling, folding and sliding doors



## Reasons to Use A High Speed, High Performance Door

- High Speed: Reduce idle time improving traffic flow and productivity
- High Cycle, Low Maintenance:
  - Normal overhead doors are notorious for their high costs of maintenance (parts, labor, downtime).
  - High speed doors are designed and built to handle the rigors of opening and closing thousands of times a day, day after day.
  - Designed to handle millions of cycles with little maintenance. Up to 2,500 cycles per day depending on model.
- High security
- High wind loads
- Vehicular and personnel safety
- Custom-sized for each application
- Energy savings





# Why Are High Performance Doors Energy Efficient?

High opening and closing speeds minimize air movement between interior and exterior environments, reducing heating and cooling costs.

Tight weather seals around the full perimeter of the door and insulated panels increase energy efficiency.

In refrigerated areas, less air infiltration leads to lower energy costs, which alone can provide a return on the investment.

Simply put, the less time a door is left open, the less expensive your heating and cooling costs will be.





# High Performance Doors

## **Energy Audits and Utility Incentives**

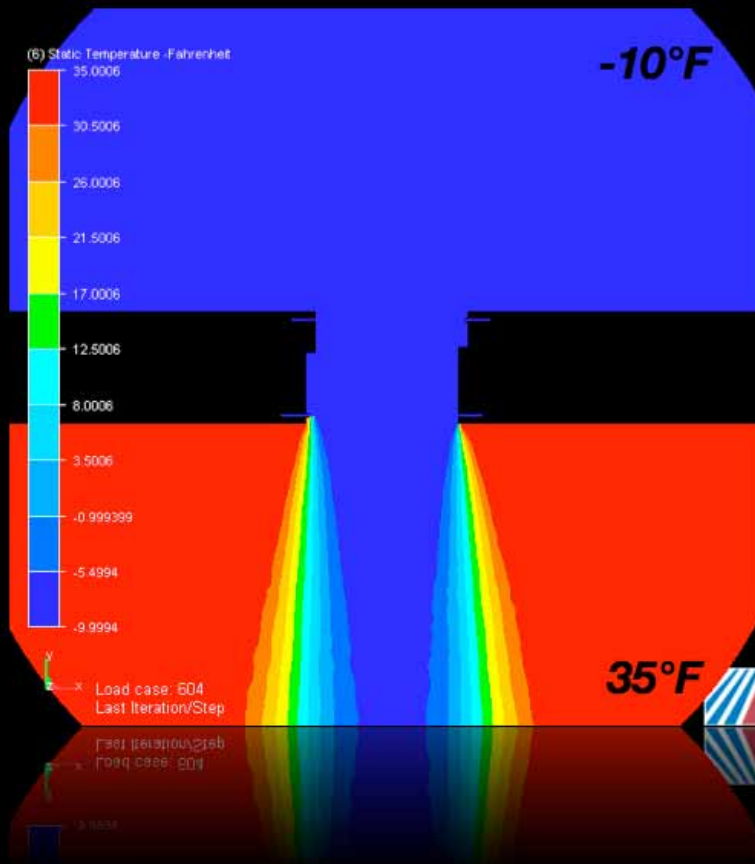
- Some door manufacturers, as well as local utilities in some areas, offer energy audits, whereby energy use is documented prior to purchasing a door and an estimate is made as to potential savings based on the door's traffic volume, local weather and heating and cooling needs for the space.
- Great tool for helping to evaluate the payback on a high speed door investment.
- Some utilities will even offer financial incentives for purchasing a high speed door based on the energy savings.
- Check with your local utility regarding these conservation programs.

# Recirculatory Air Doors

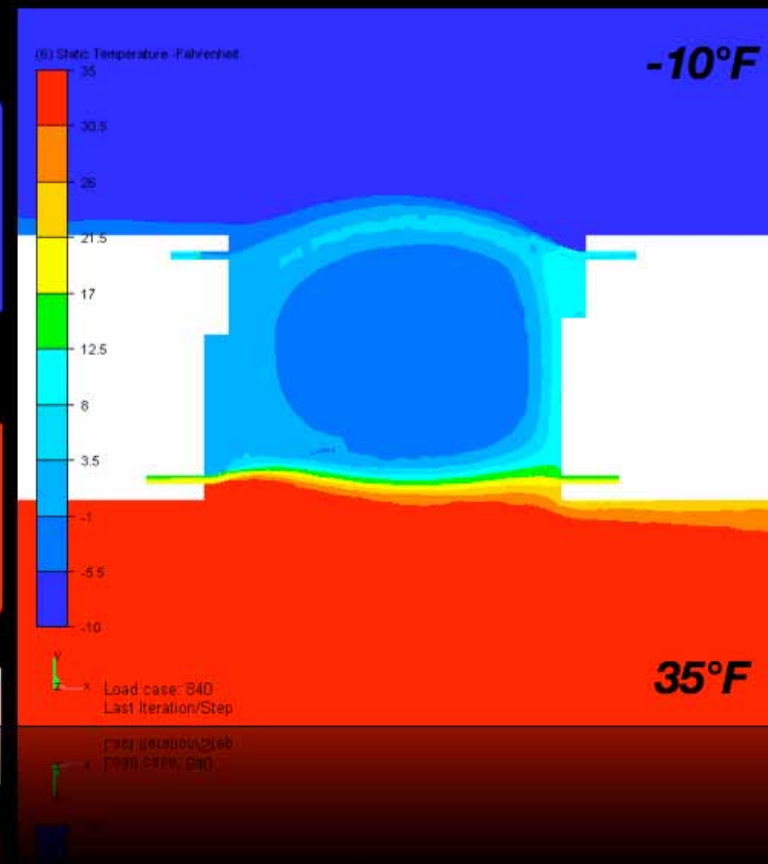


- Address the problems of open doorways.
- Conditions the air to a non-fog, non-frost state
- Provides an air block to significantly reduce refrigeration loss.

# Unprotected Doorway



# Protected Doorway



Thermal profile at the bottom of the doorway



# Construction Design

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- Design
- Individual pit vs. continuous pit
- White TPO roof vs. black EPDM roof
- Refrigeration



# Refrigeration

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- Dedicated hot gas compressors for defrost and heating
- Condenser VFD's
- Evaporator VFD's
- Compressor VFD's
- Two stage vs. single stage



# Refrigeration

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- Compressor Motor Efficiency
- Condenser wet bulb / approach
- Box temp.
- Suction pressure
- Discharge pressure



# Refrigeration

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- Auto Purgers
- Thermosyphon oil cooling vs. liquid injection
- Refrigeration control systems
- Water treatment and scaling impacts on energy

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# The End

- Questions?
- Comments?
- Thank You!!!!

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