

SANDIA'S RED SKY

Energy Efficient

Power and Cooling

Design

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Red Sky

Energy Efficient Power & Cooling Design

Presented by:

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Distinguished Technologist

Computing Infrastructure & Support Operations

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000



Red Sky Decision Factors to Build

- ❖ Critical need for High Performance Computing
- ❖ Needed to be most accessible in DOE complex
- ❖ Had to be energy efficient



Red Sky Comparison to its Predecessor

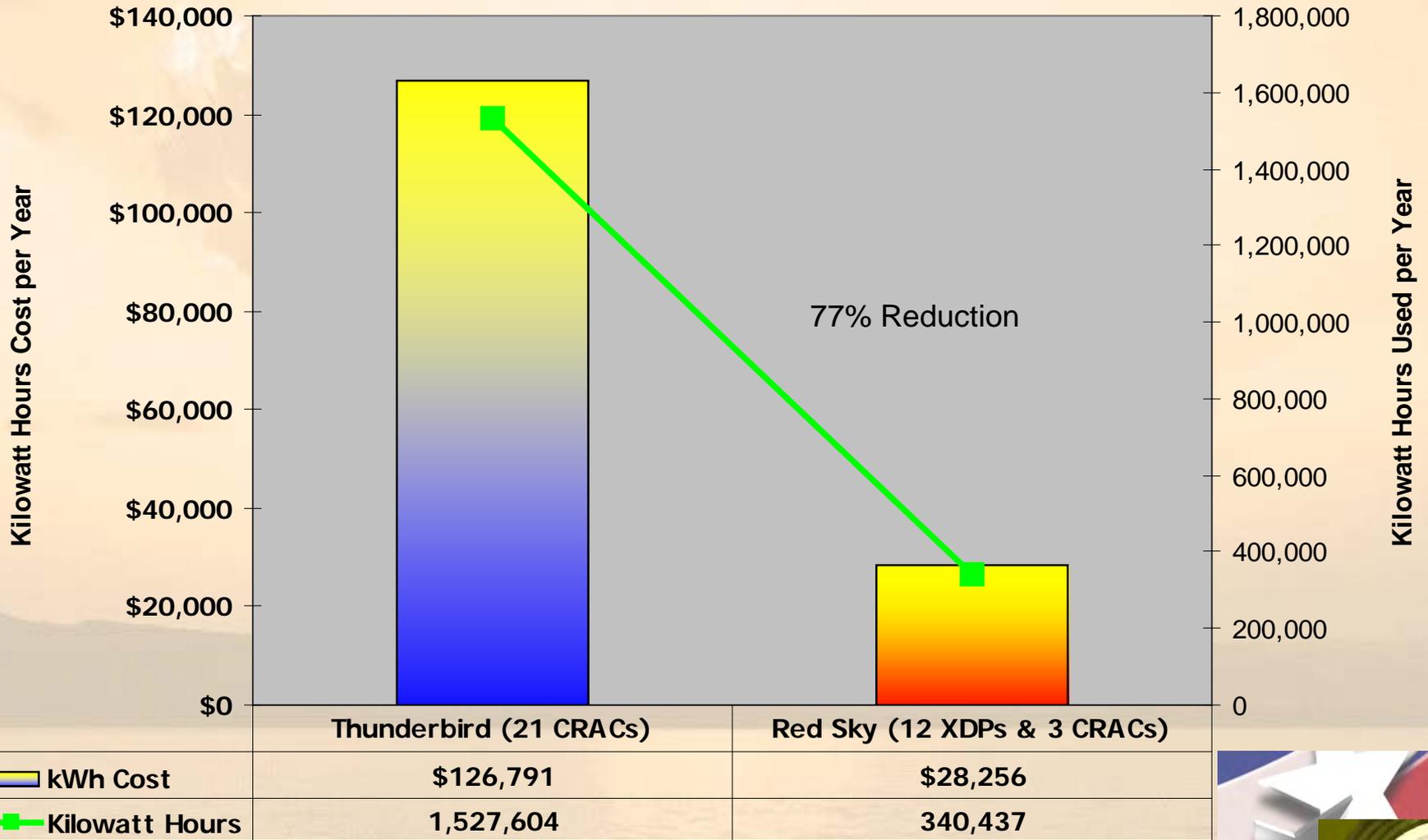
Thunderbird

Red Sky

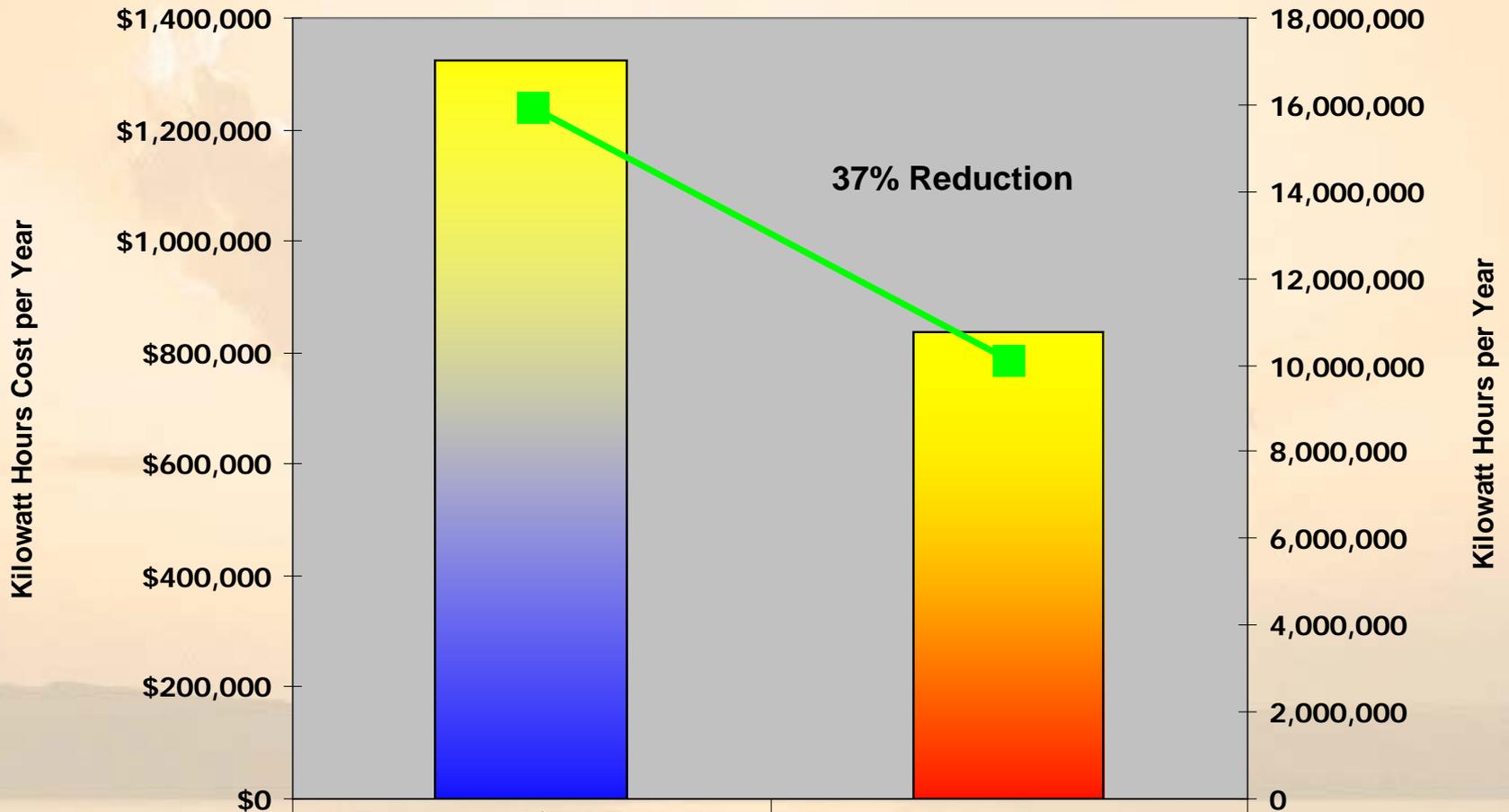
140 Racks - large footprint	36 Racks – small footprint
50 Teraflops <i>Entire System</i>	10 Teraflops per rack
~13 kW per rack - full load	~32 kW per rack - full load
518 tons cooling	328 tons cooling
12.7M gallons water per year	7.3M gallons water per year



Energy Consumption and Cost Comparison Indirect vs. Combined Direct/Indirect Cooling



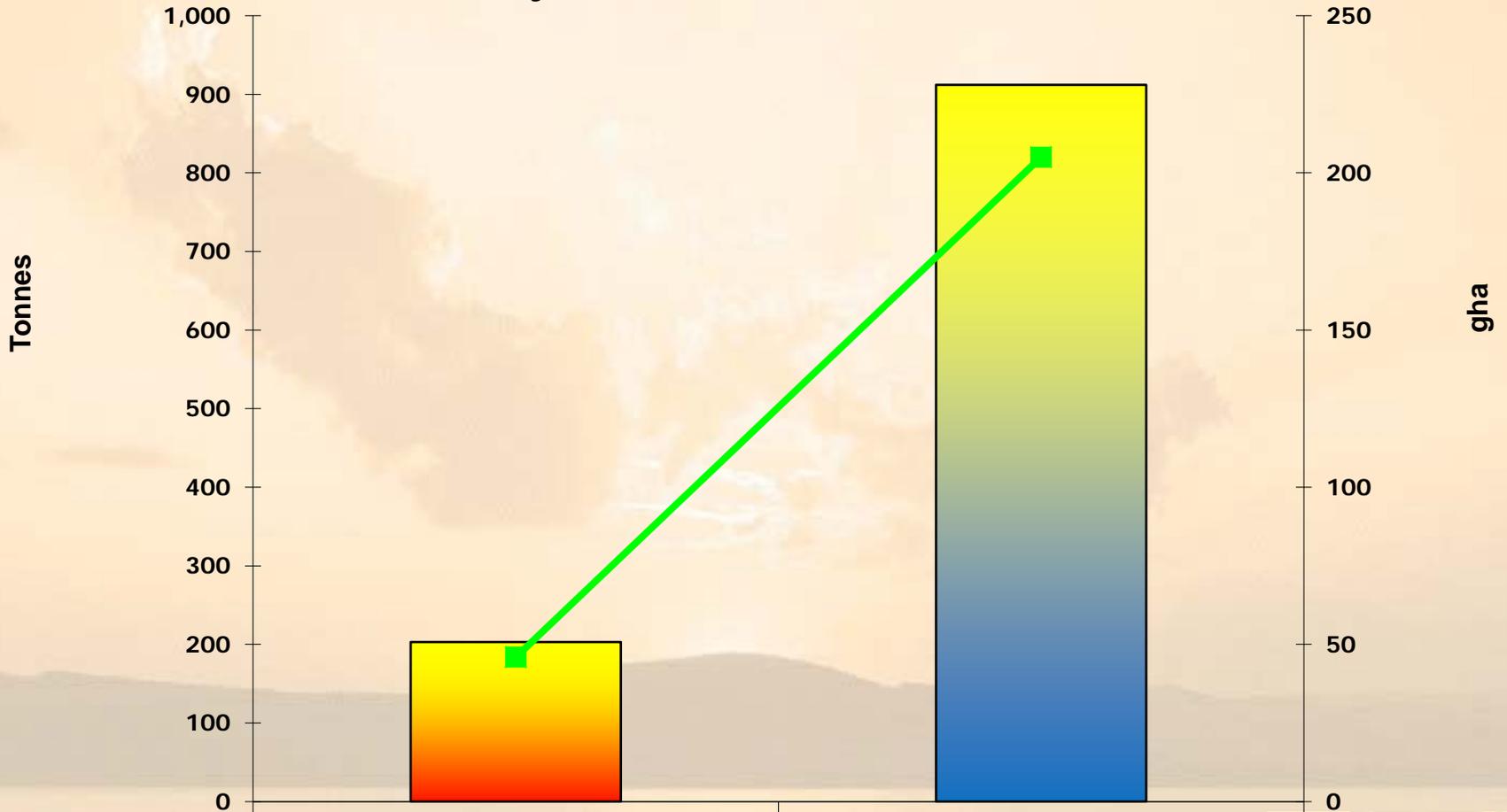
Chiller Plant Power Consumption and Cost Comparison



	Thunderbird (518 Tons of Cooling)	Red Sky (328 Tons of Cooling)
kWh Cost	\$1,324,222	\$838,504
Kilowatt Hours	15,954,483	10,102,452



Carbon Footprint - Resource Electricity Red Sky vs. Thunderbird



 CO2E
 Footprint

Red Sky

203

46

Thunderbird

912

205



Red Sky Getting the Facility Ready

3.5 months
Zero Accidents
0.5 miles copper
650 brazed connections
400 ft. carbon steel
140 welded connections



Red Sky

New Power Technology & Implementation



APC InfraStruXure[®] Modular Power Distribution Unit

- Input 480V/Output 230V
- Small footprint – ½ floor tile!
- Load Capacity 266 VA
- Modular breaker



Red Sky New Cooling Technology & Implementation

Sun's Glacier Door

1st rack-mounted, refrigerant-based passive cooling system on the market



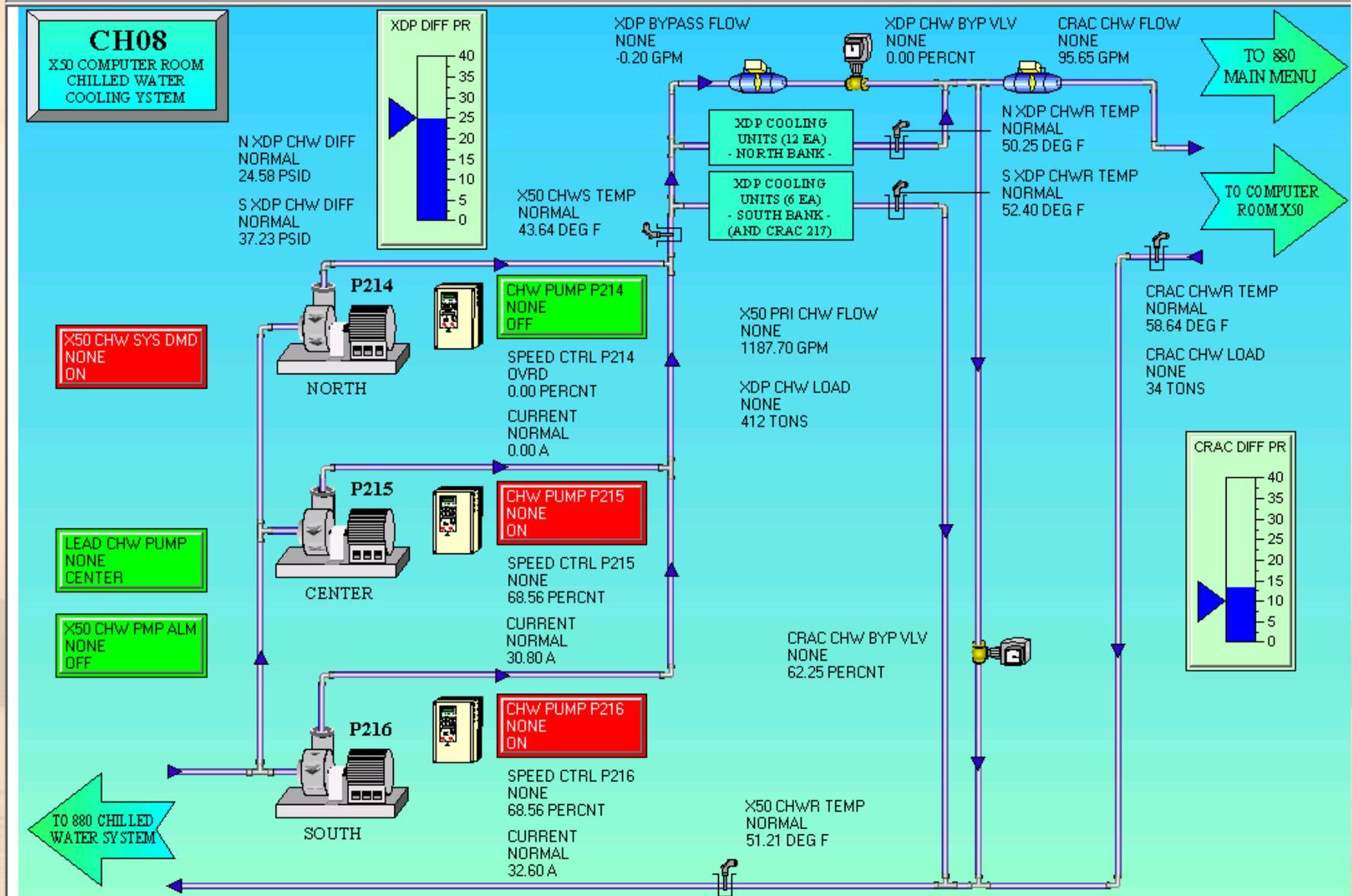
Liebert's XDP

A pumping unit that serves as an isolating interface between the building chilled water system and the pumped refrigerant (134A) circuit. Operates ~ 4 degrees above dew point. No compressor. Power used to cool computer not provide dehumidification.

100% sensible at 0.13 kW per kW cooling



Red Sky Pumping Solution



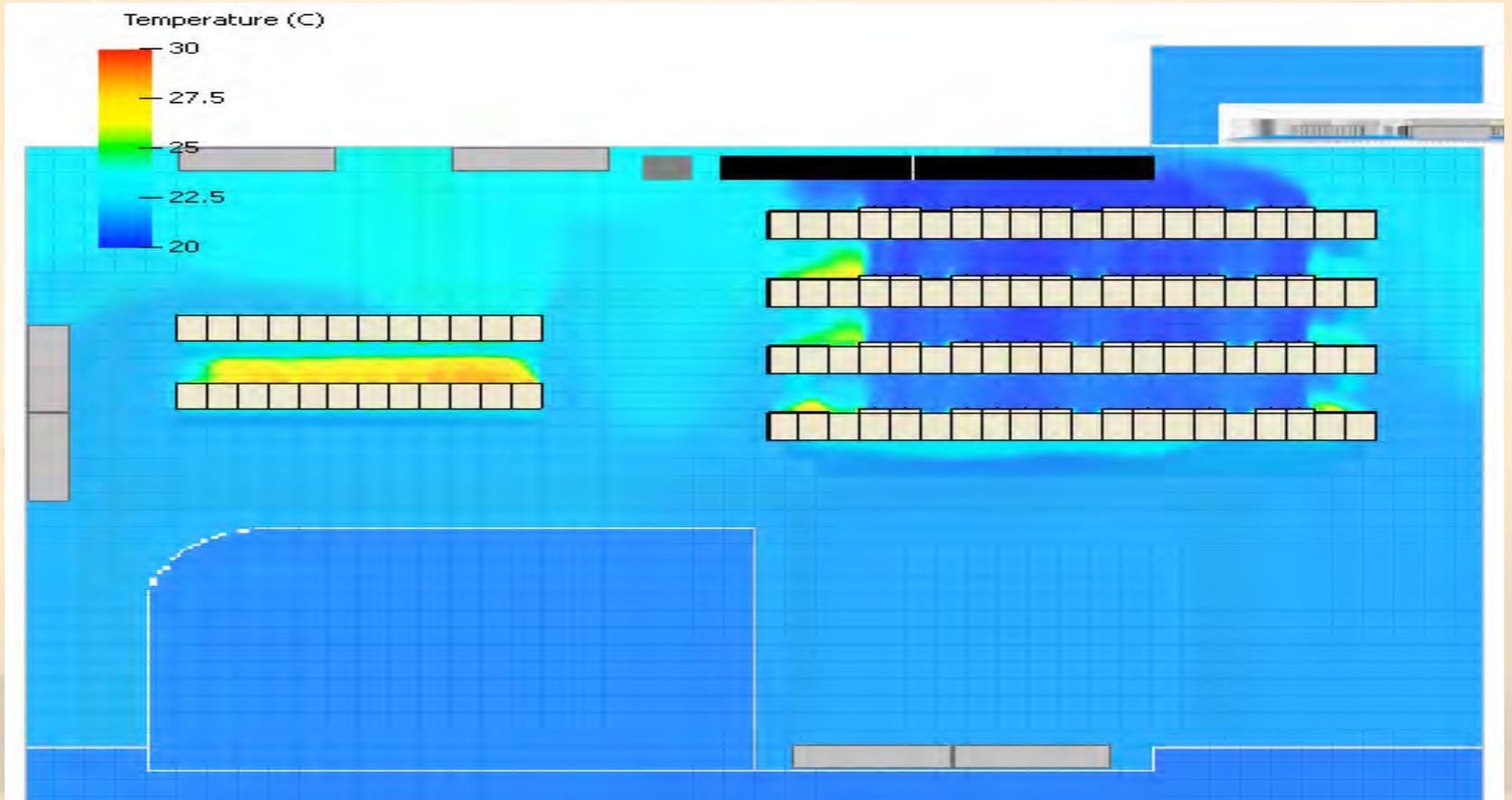
Red Sky Cooling Solution Overview

90% heat load removed with the XDP/Glacier Doors

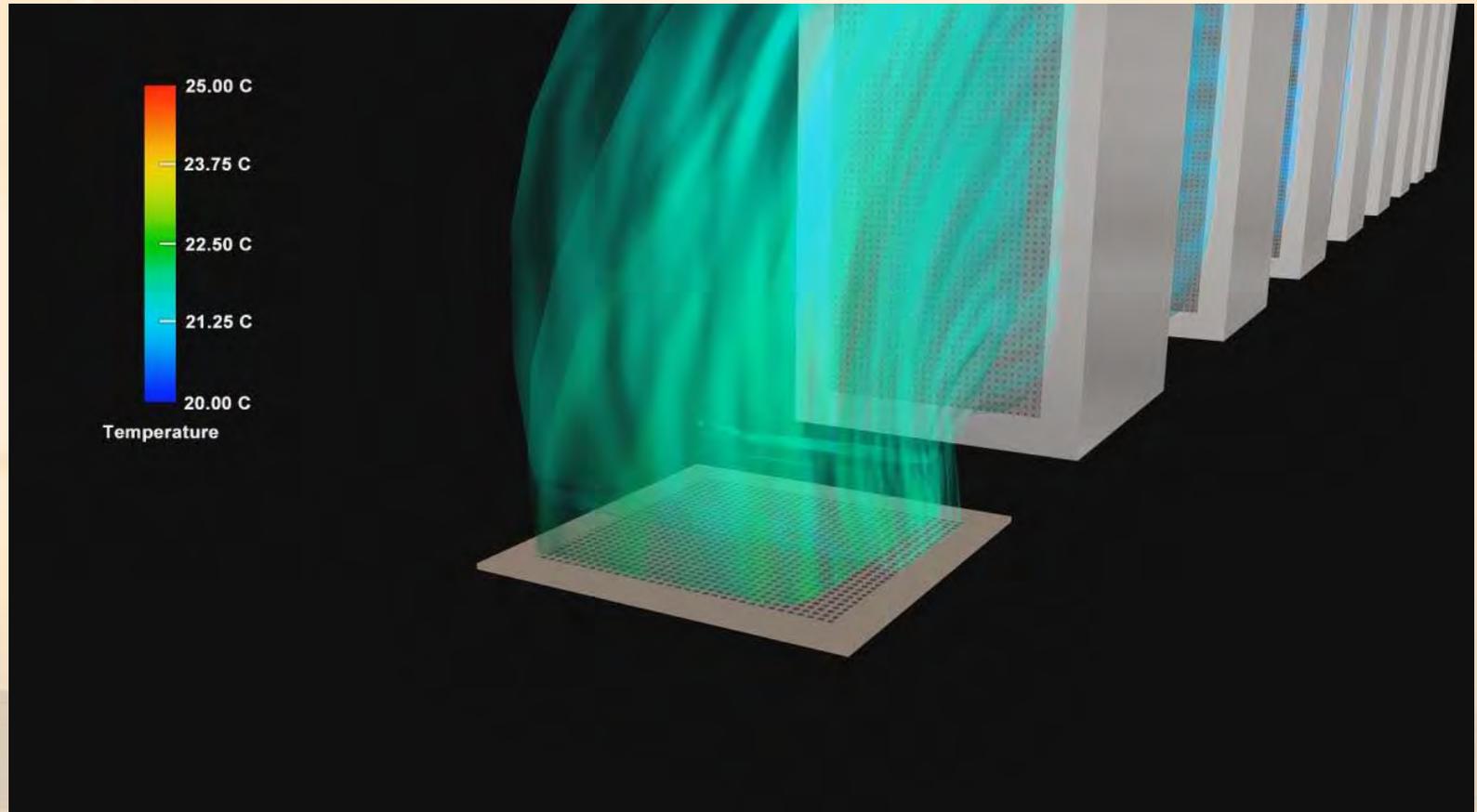
- Works on Laminar air flow concept
 - CFM delivered in front of the 1st row
 - Passes through rack
 - Passes through Glacier door (passive)
 - Cools air
 - Passes cool air to next row
- Perforated tiles are only needed in the 1st row



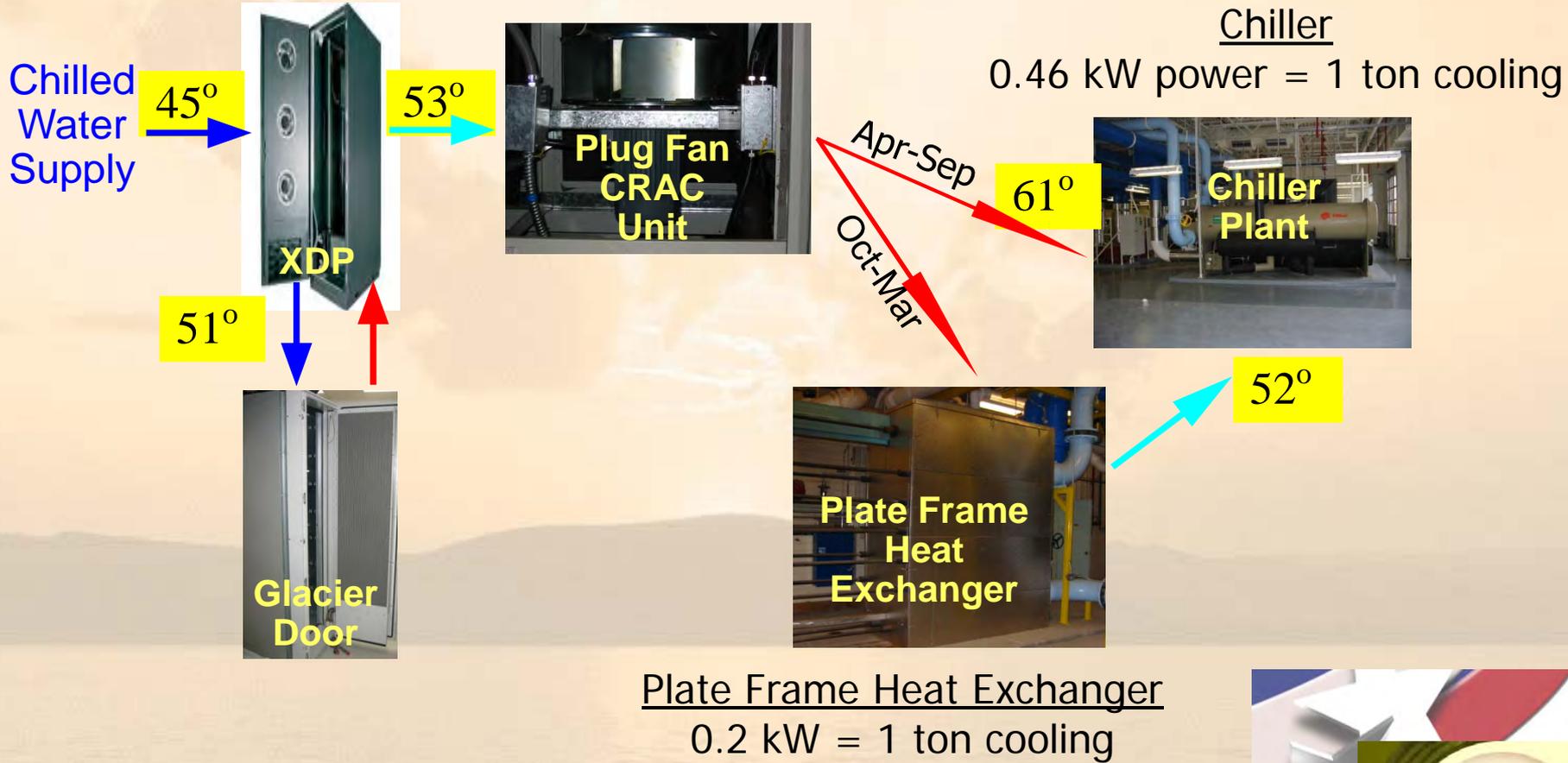
Red Sky CFD Analysis



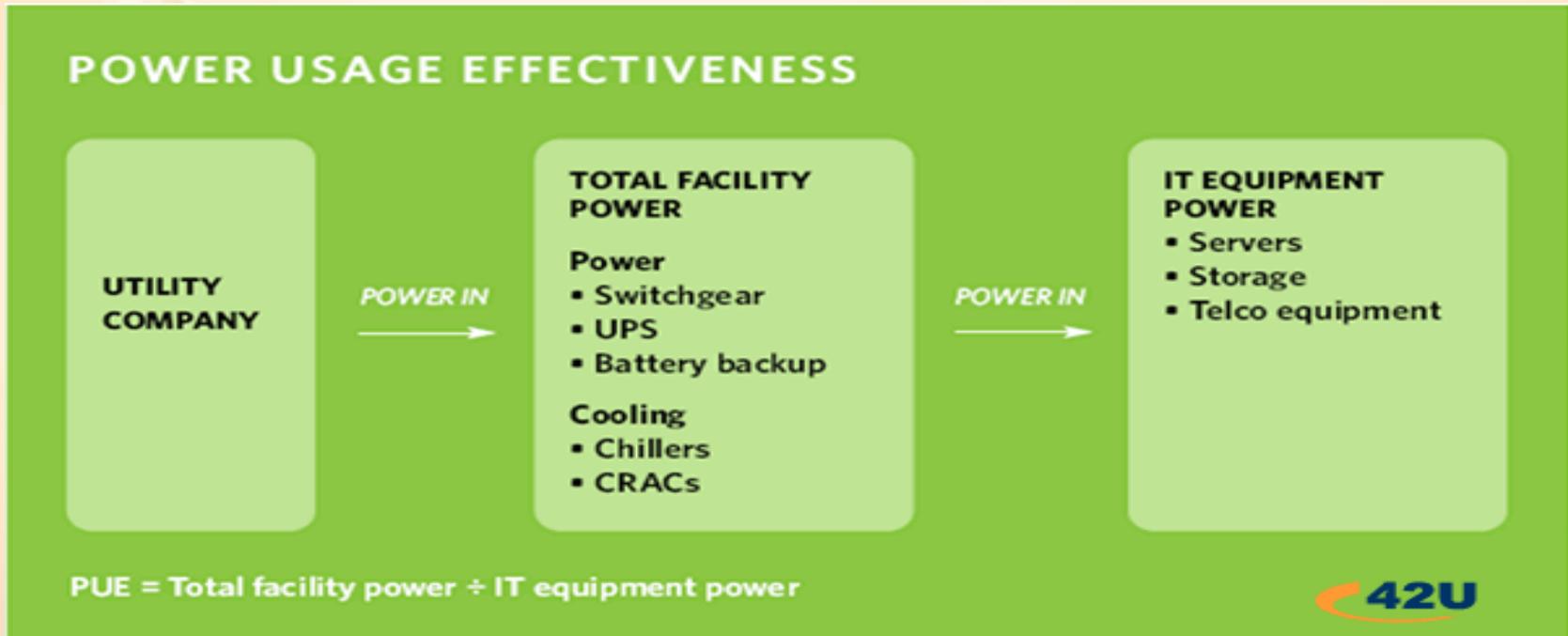
Red Sky Cooling Using Laminar Air Flow



Red Sky How the Cooling Solution Comes Together



Red Sky



Red Sky CCF Room X50 PUE Calculation

Total Power Used	2275 kW	Current State for all of X50 with: 33.4 kW per Rack ▶ 0.510 kW per ton Chiller Efficiency
IT Equipment Used	1794 kW	
<u>Power Usage Effectiveness</u>	1.27	

Total Power Used	2231 kW	Current State with the following changes: 0.434 per ton Chiller Efficiency 60% per day Lights Out
IT Equipment Used	1794 kW	
<u>Power Usage Effectiveness</u>	1.24	

Total Power Used	2138 kW	Current State with the following changes: 0.434 kW per ton Chiller Efficiency 60% per day Lights Out 0.2 kW per Plate Frame Heat Exchanger utilized 4.5 months per year
IT Equipment Used	1794 kW	
<u>Power Usage Effectiveness</u>	1.19	

Total Power Used	1803 kW	Current State with the following changed: Removed non-Red Sky IT Equipment Removed all outside utilities except chilled water pump
IT Equipment Used	1694 kW	
<u>Power Usage Effectiveness</u>	1.06	



Red Sky Utilizing CRACs vs. XDP Units

Additional 30-Ton CRAC

# Racks	kW per Rack	Tons	GPM	# CRAC	CFM
48	32	440	874	15	225,000

Additional Footprint

# Racks	Tons	Rack CFM	Total CFM	Grated Tiles	+ Sq. Ft.
1	9	400	3600	3	748
10 CRACs 600 sq. ft. – XDPs 120 sq. ft. =					480
Total					1228

Additional Power

	Unit Amps	# Units	Total Amps	kW
XDPs	1.2	12	14.4	12
CRACs	10	15	150	125

¹Computer Room Air Conditioning Units



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Questions?

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