Montana Wind and Transmission Working Group

November 15, 2012

Helena, MT

David LeMieux

Energy Engineer

Department of Environmental Quality

Presentation Overview

- Energy Use at Data Centers
- Data Center Consolidation
- SMDC Data Center Benefits
  - Airflow Control
  - Koyoto® Cooling
  - UPS System
  - Server Virtualization
- Trends and Advantages to Locating in MT

Energy Use

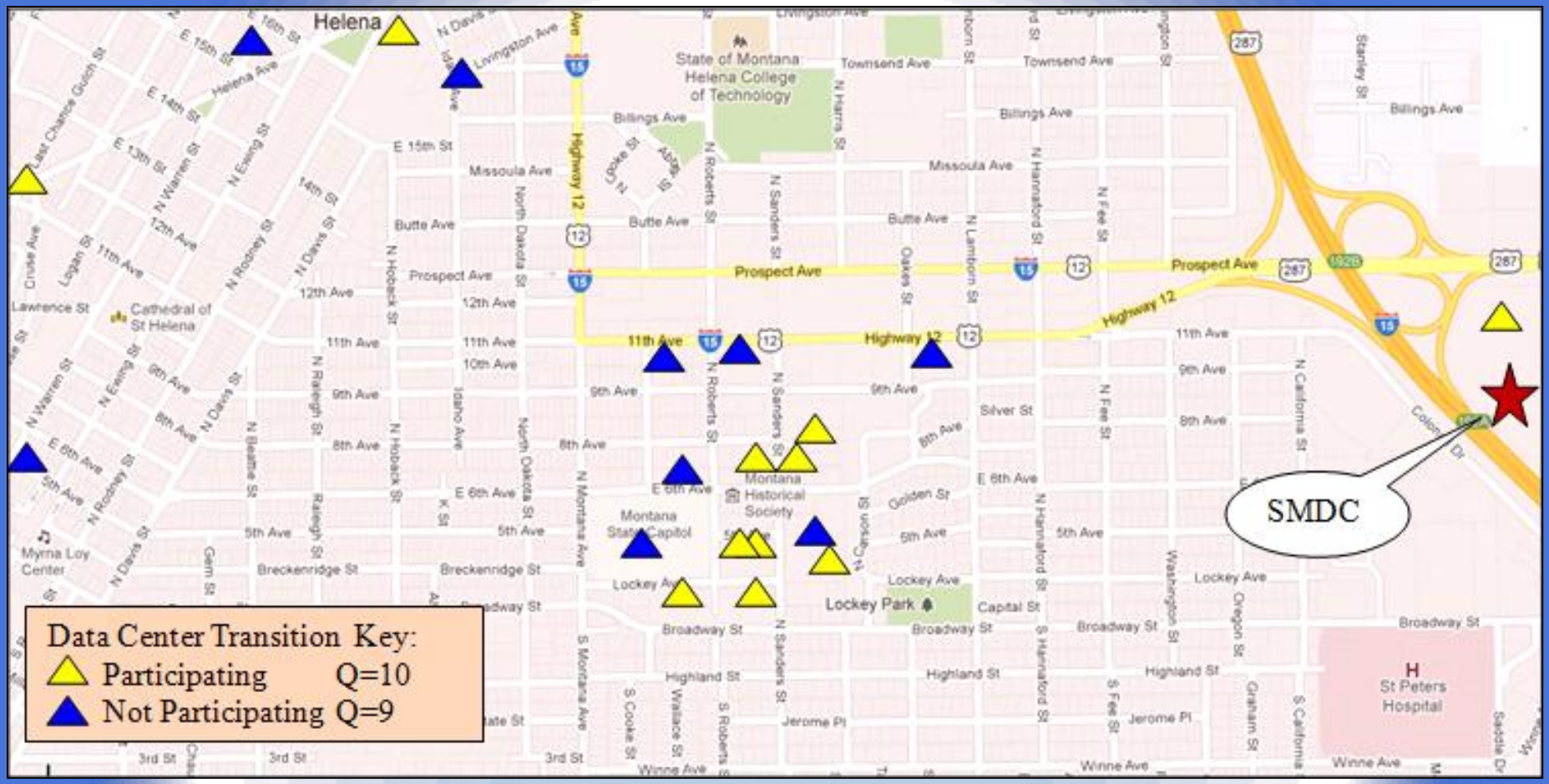
1. 30 billion watts electricity/yr ~30 nuclear pwr plants

1. 6-12% energy goes to performing computations
   1. Creating data
   2. Storing data
   3. Managing data

2. Nationwide data centers used 76 billion kwh in 2010 or about 2% of all electricity used in the country that year.

Source: NYTimes: http://www.nytimes.com/2012/09/23/technology/data-centers-waste-vast-amounts-of-energy-belying-in[illegible]y-image.html?pagewanted[illegible]r=2&nl=todaysheadlines&emc=edit_th_20120923

Data Center Locations



State MT Data Center (SMDC)

SMDC Benefits

1. Redundant Systems: UPS, Generator, Cooling
2. Security systems
3. Airflow Control → Improved equipment cooling
4. 24x7 Staffing
5. Clean Room
6. Energy Efficiency → Saves Money
   - UPS System →η =10% Improvement Typ.
   - Koyoto® cooling → η =85% Improvement

OLD vs. NEW

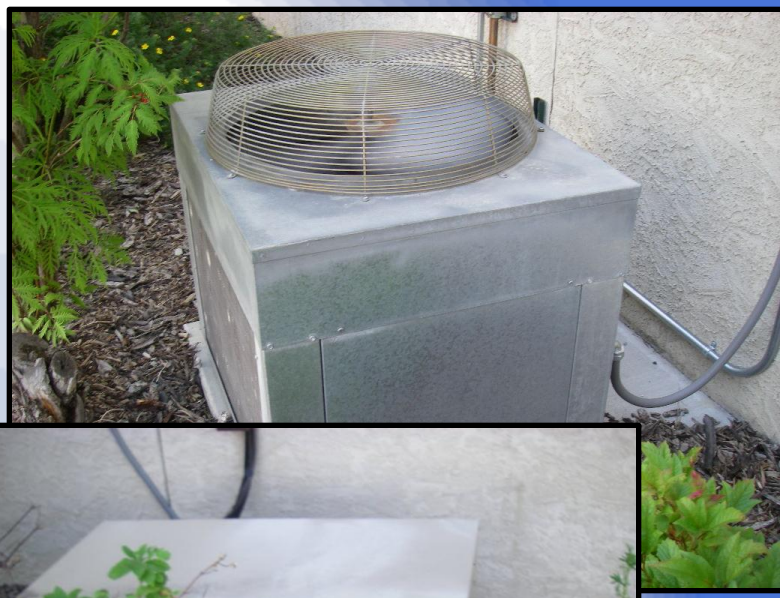
Typical Cooling

Condenser

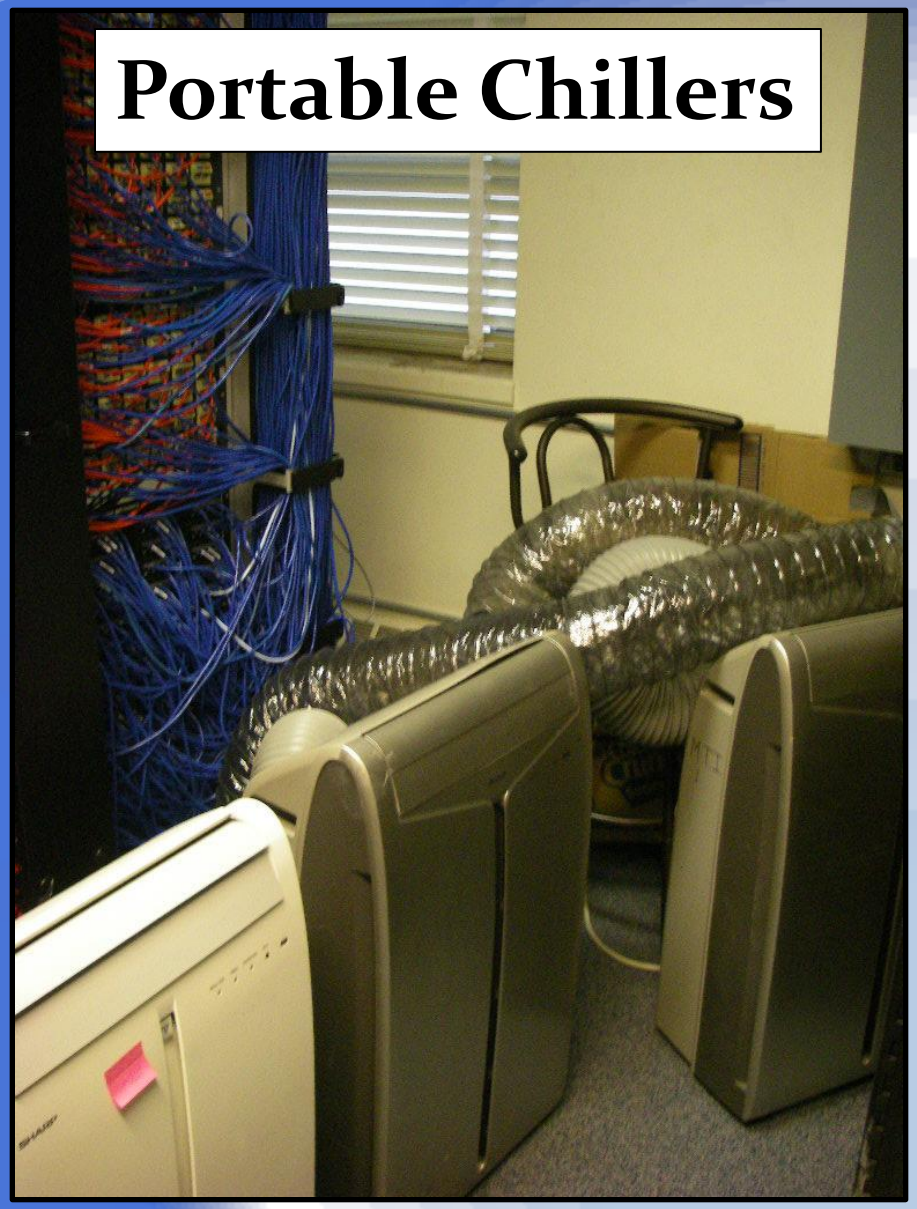
Elevated Floor

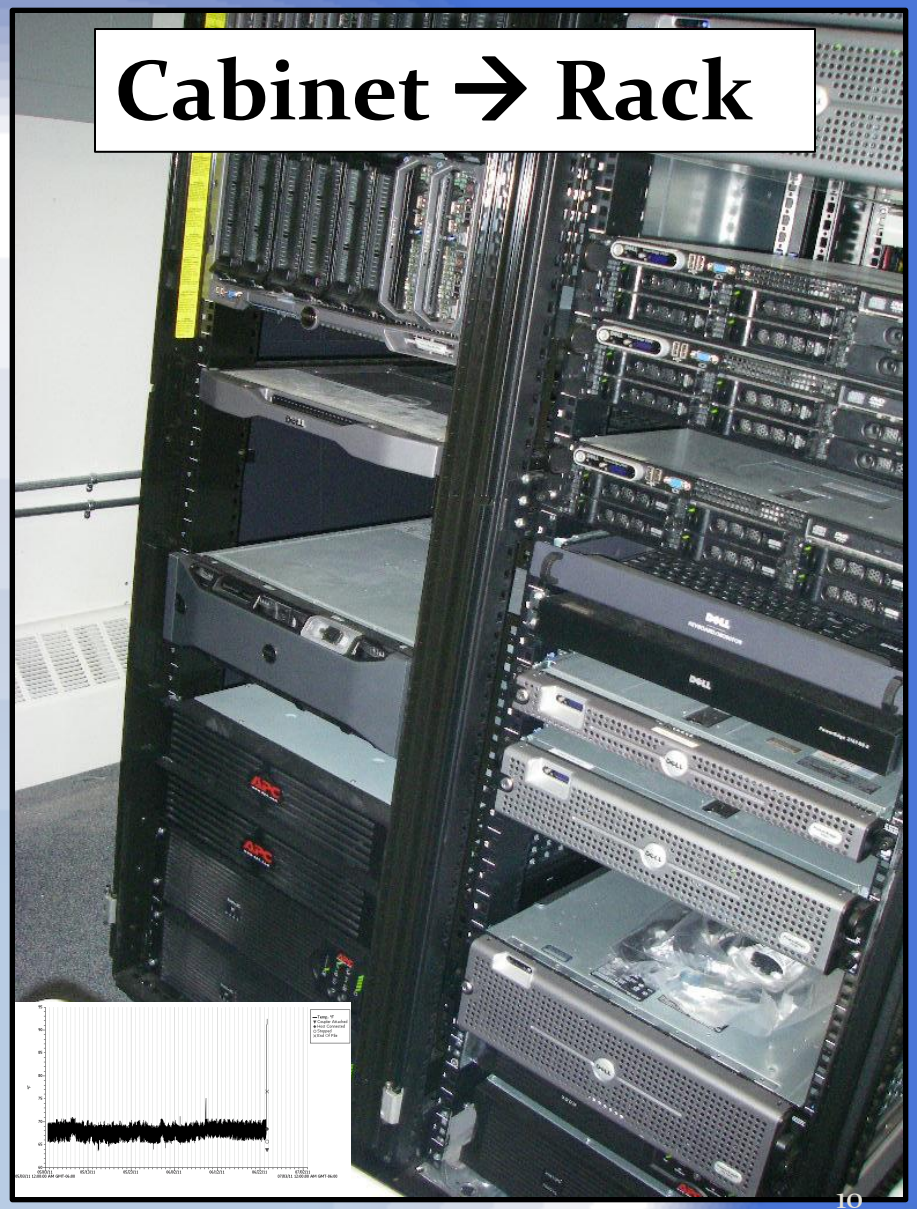
Typical Cooling

Condenser



Cooling Failure





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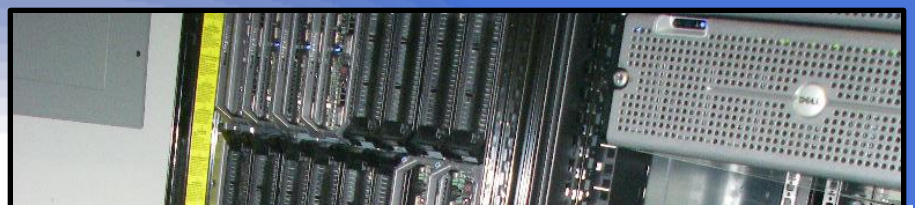
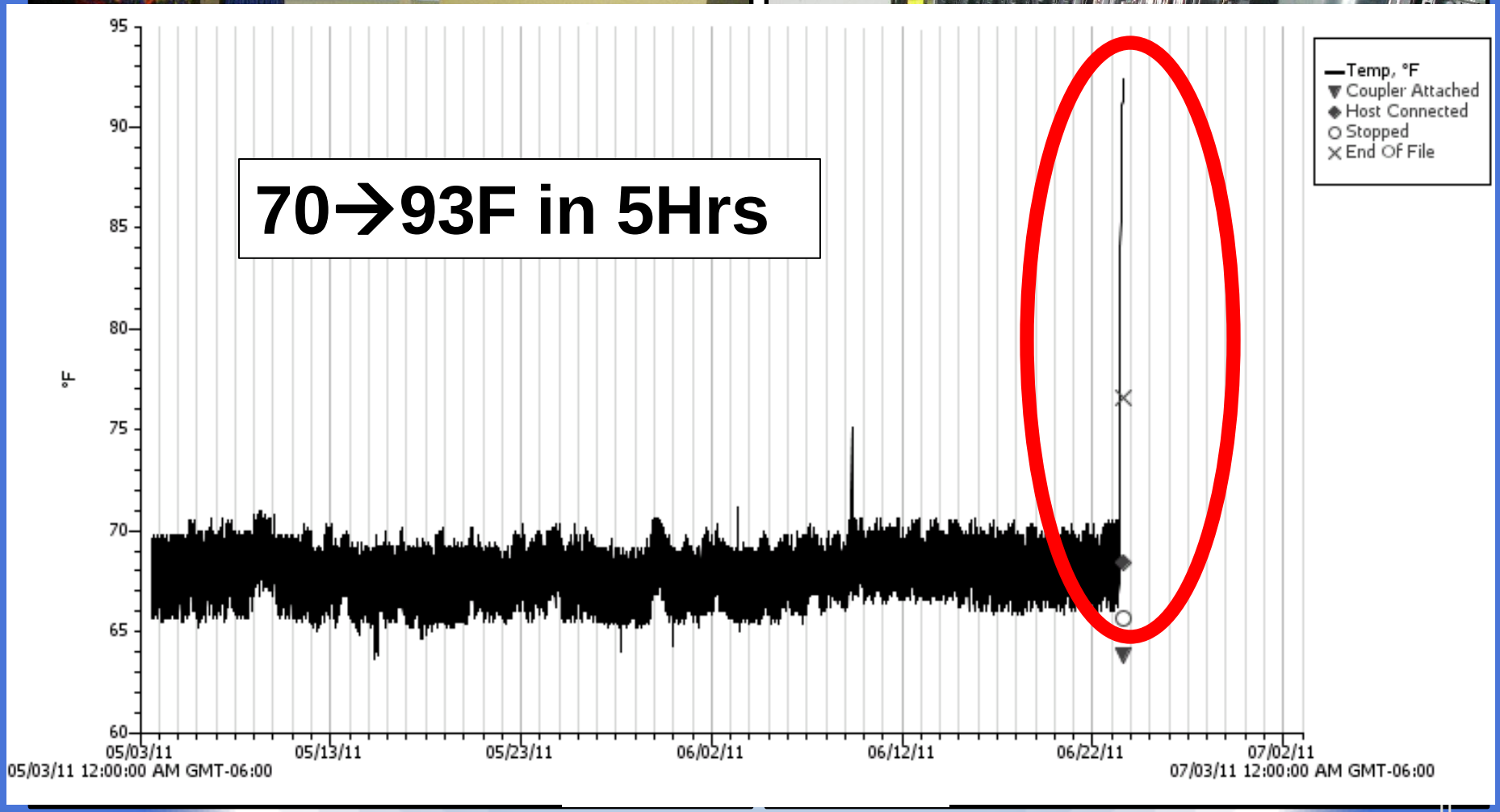
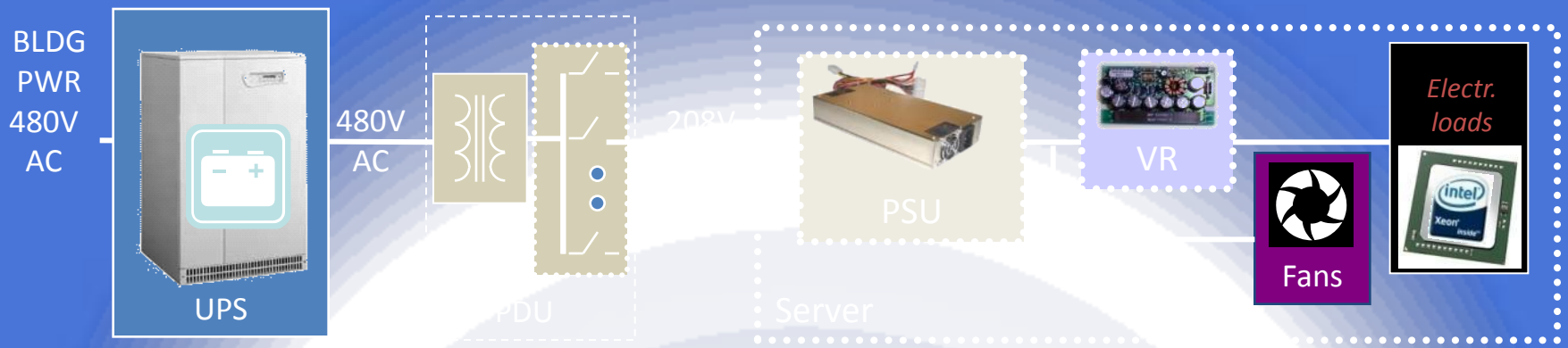
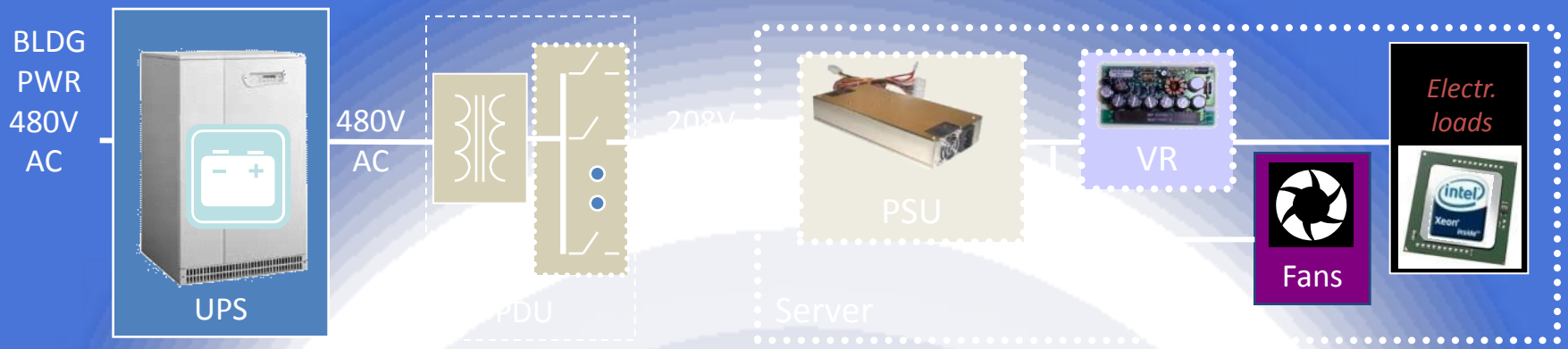




Power Conditioning Loads



Power Conditioning Loads



	UPS		PDU		PSU		VR		η
Typical	89%	x	93%	x	75%	x	81%	=	52%
Better	94%	x	94%	x	88%	x	87%	=	68%
Best?	96%	x	95%	x	94%	x	91%	=	78%

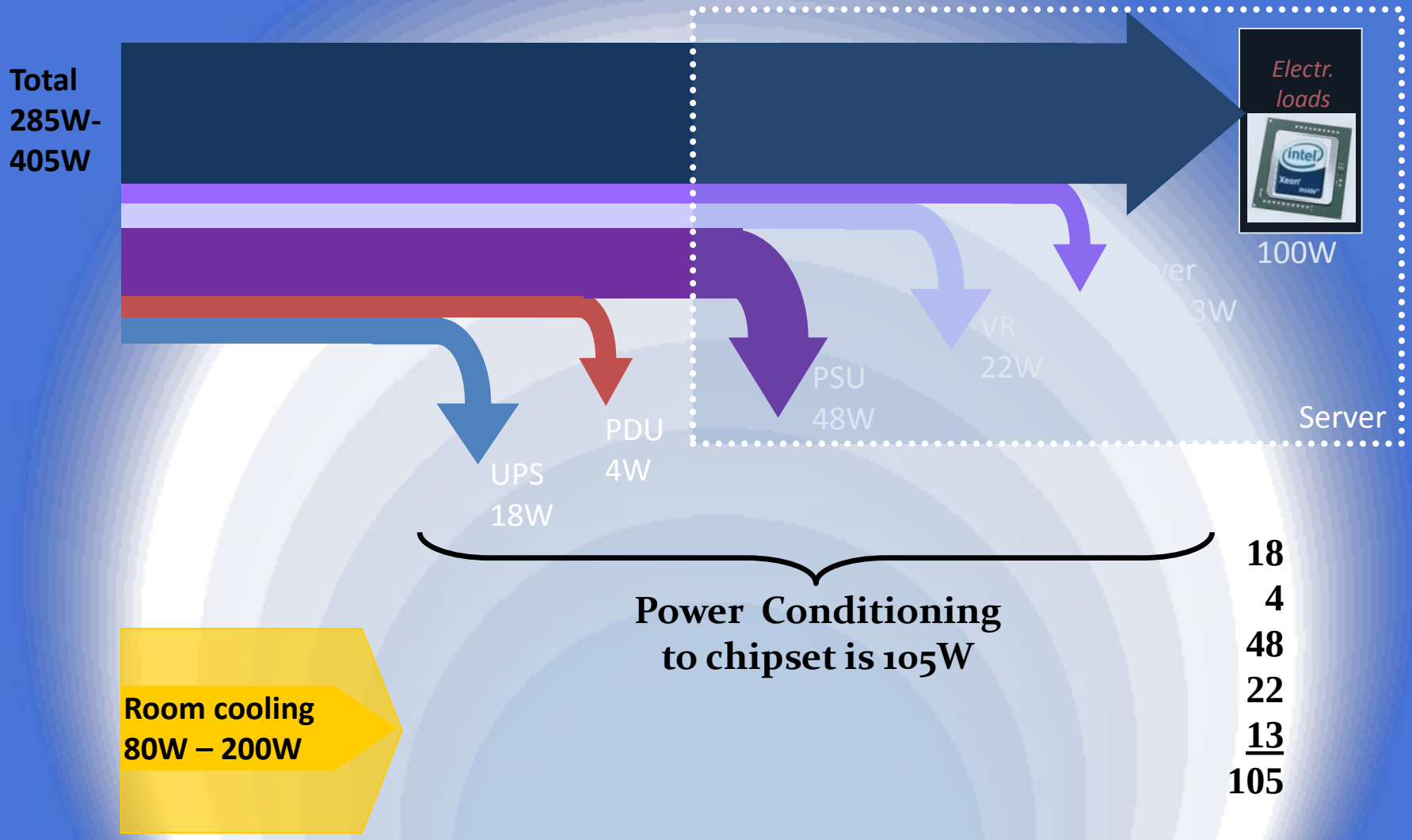
<u>Assume:</u>

- Rack mount Dual Processor server and centralized UPS
- PDU includes cable losses
- Heavy load efficiencies

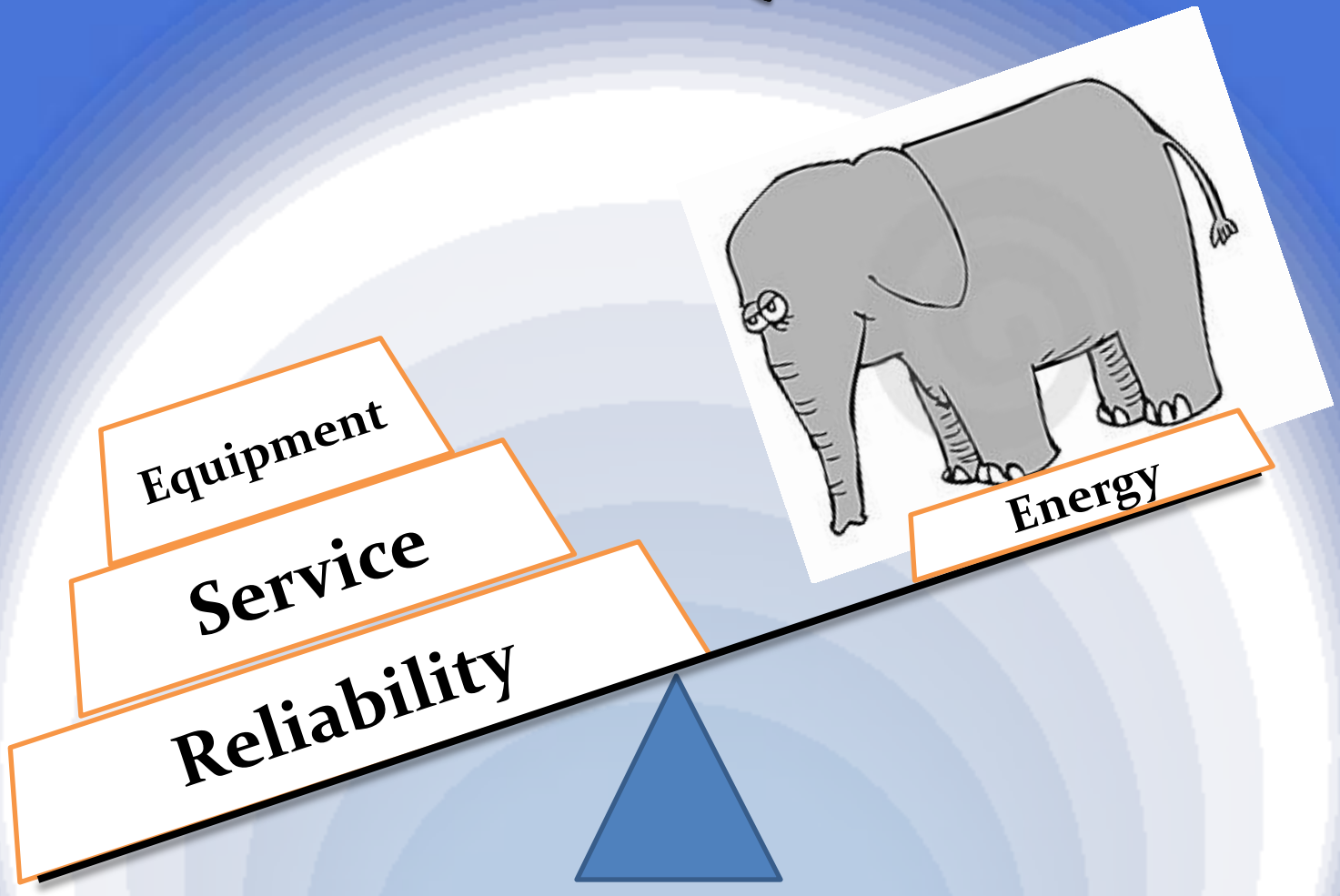
High efficiency components: reduce input power by 30%

For PSU, can recoup higher cost of high efficiency unit in < 1 year

Load Summary



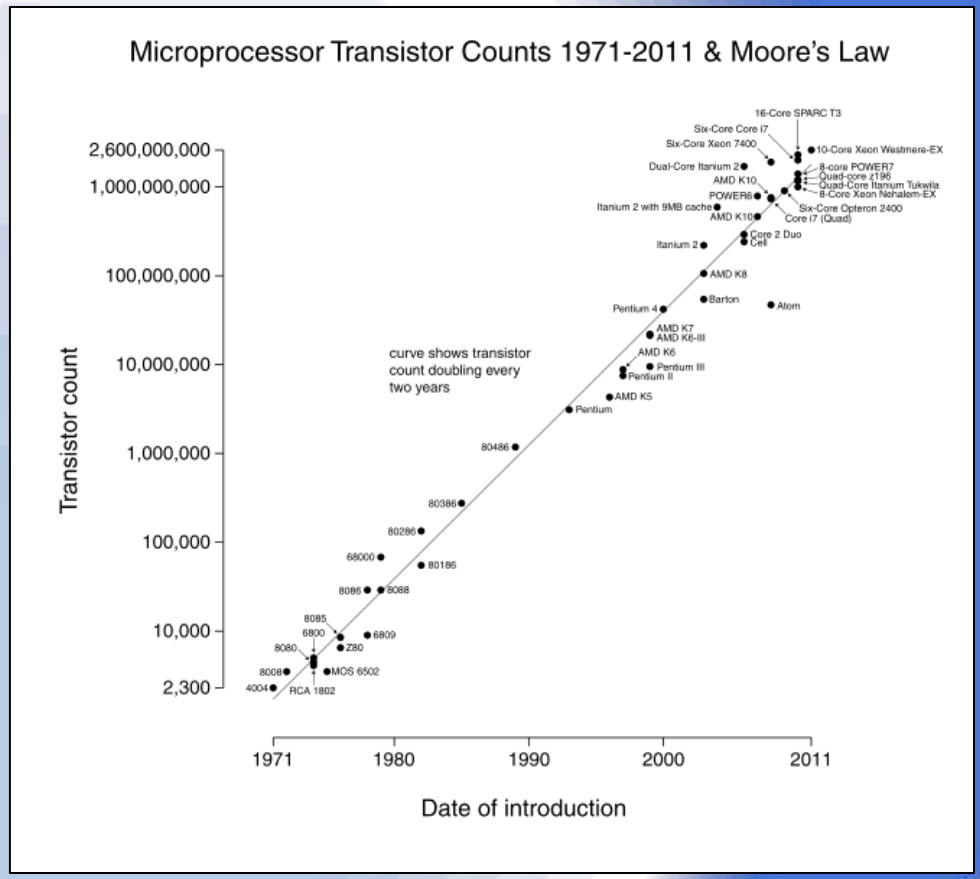
CTQ



"Servers use 60% of their maximum power while doing nothing at all."
Senior Analyst Eric Woods, Intel
http://software.intel.com/sites/datacentermanager/?cid=cim:ggl|ssg_us_datapower|ti20784|s

How to Save $$$?

1. Virtualize Servers
2. Replace Servers ~2-4yr cycle
   - Moore's law
3. Maintenance
   - Fewer Systems
4. Virtual Desktop
5. Server Hosting
6. Min. PUE factor



Power Usage Effectiveness (PUE)

$$PUE = \frac{Total\ Facility\ Power}{IT\ Equipment\ Power}$$

Compressor Cooling → PUE=2.0

National Avg. Cooling → PUE=1.9

Koyoto® Cooling → PUE=1.15

Ambient Cooling → PUE=1.08

Cooling Savings: → 85% Reduction

PUE

OLD:

1:1 Ratio

200kw IT Load | **200kw Dx Cooling**

400kw load @9-cents/kwh
$315,360/yr or ~$6.3MM in 20yrs.

NEW:

1:0.15 Ratio

30 kw Koyoto® Cooling

200kw IT Load

(85% reduction in cooling load)

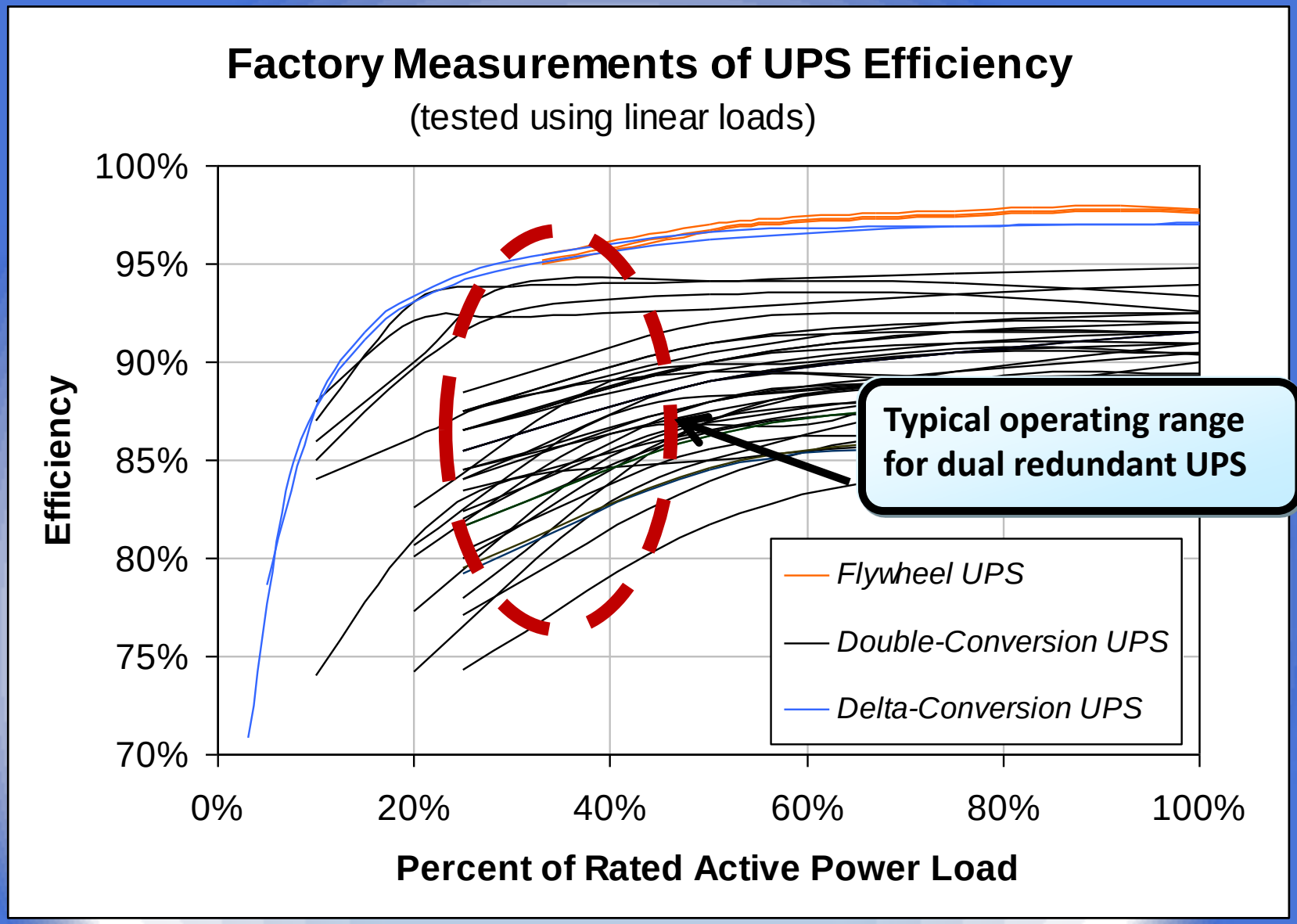
230kw load @9-cents/kwh
$181,332/yr or ~$3.6MM in 20yrs.
42.5% Savings

Cooling Loads

1. Avoid mixing hot and cold air
2. Supply at What Temperature?
3. Use 100% Outside Air (trend)

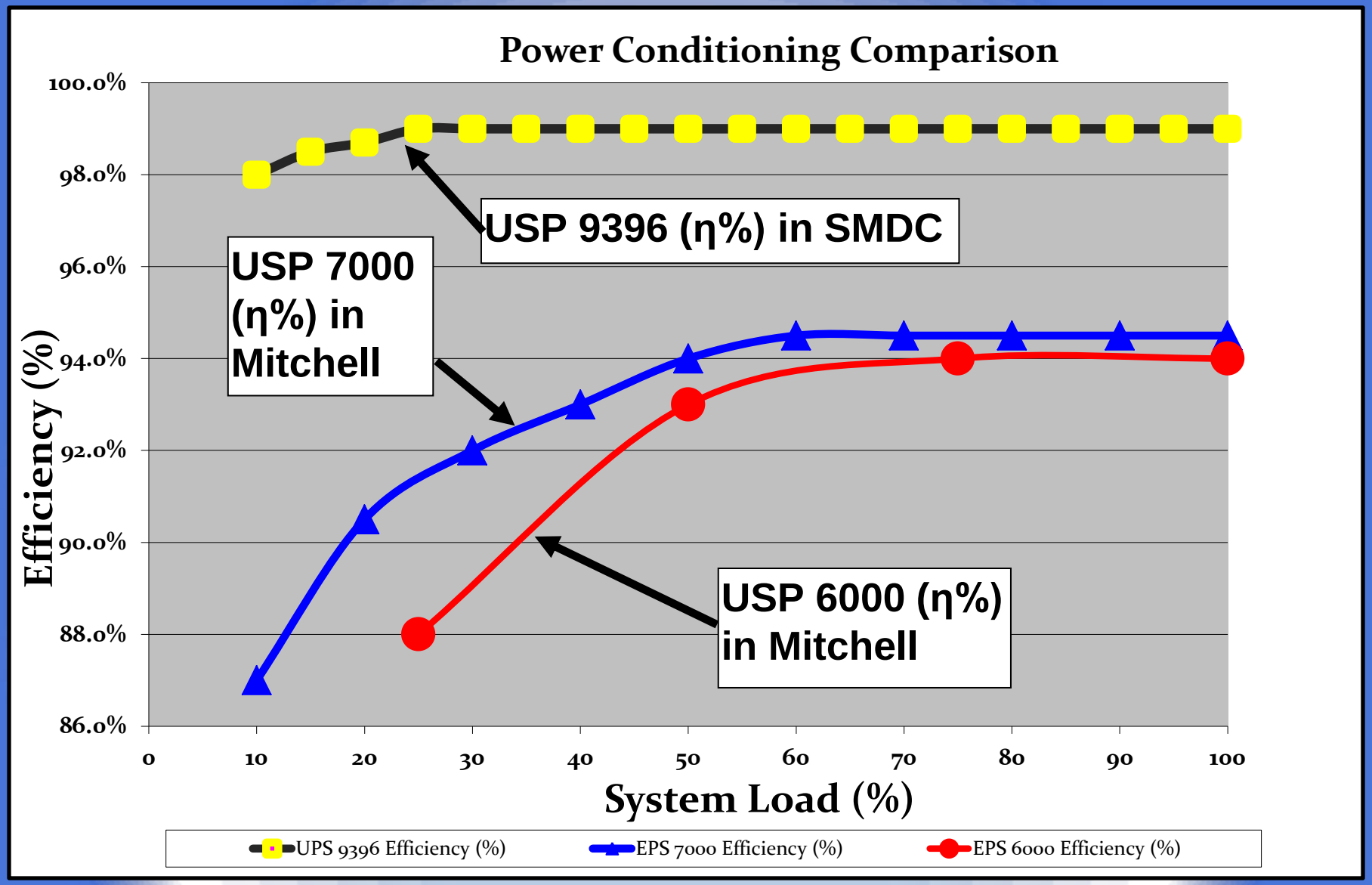
SMDC - UPS

UPS Efficiency



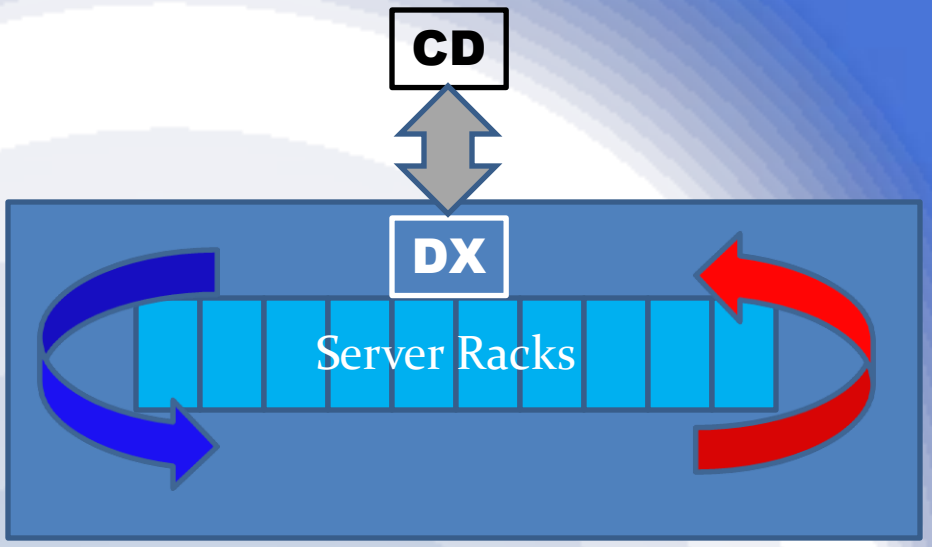
Source: US Department of Energy

SMDC UPS Efficiency

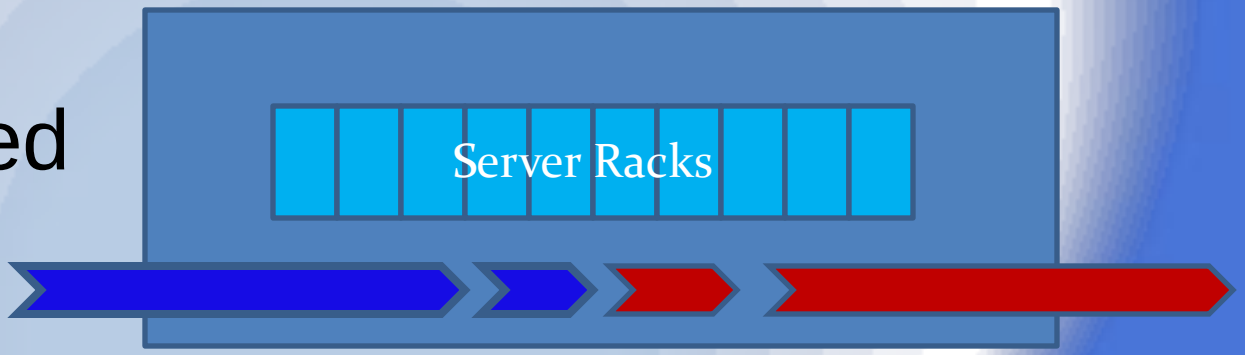


Cooling Methods

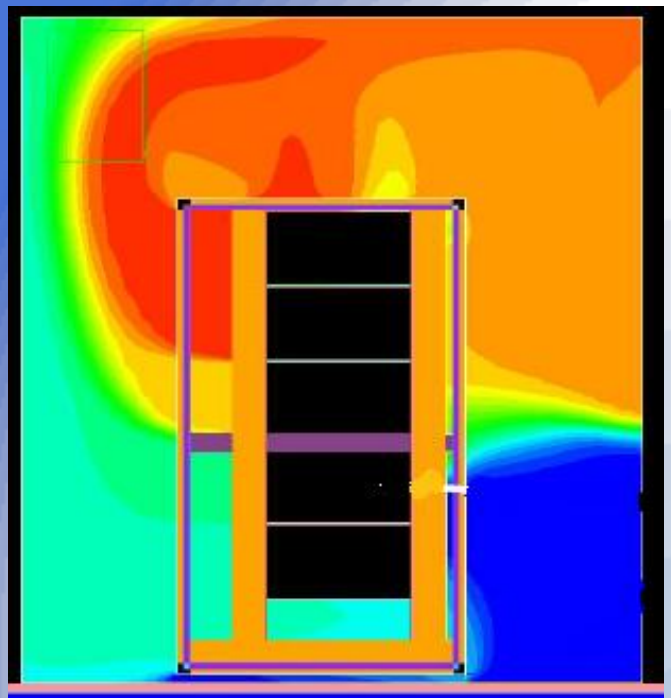
OLD :
Hot air is cooled and recirculated



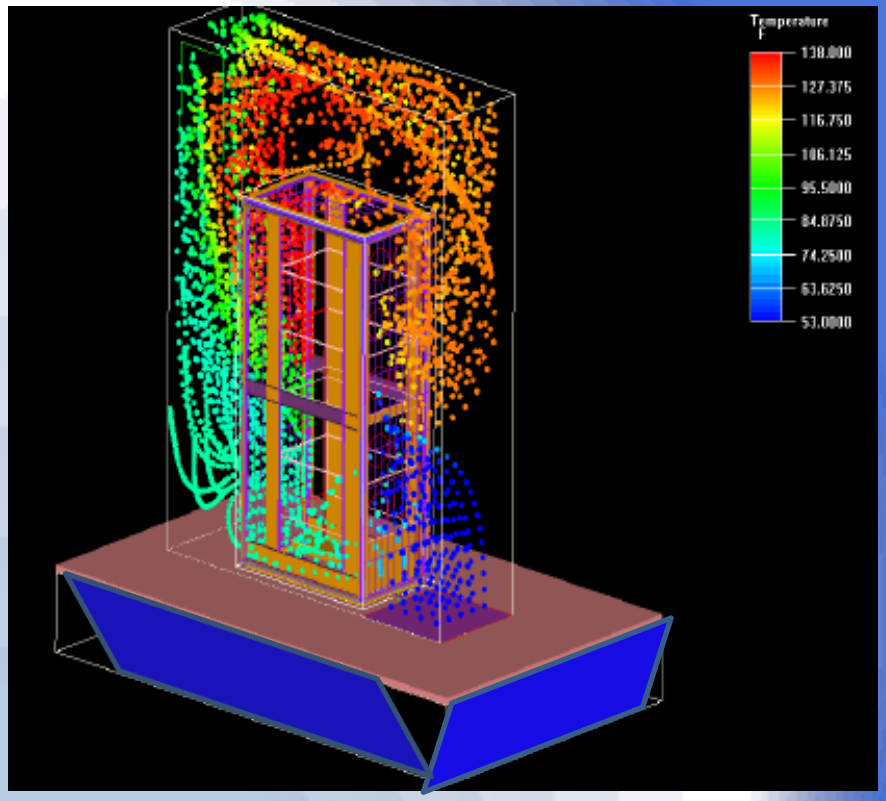
NEW:
Hot air is purged outside



Thermal Mixing

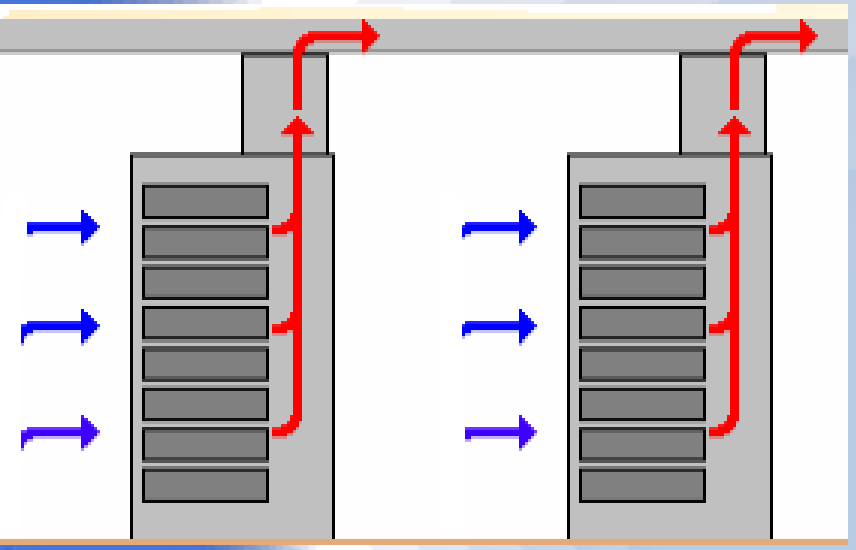


Elevated Floor = “Cold Deck”



Chatsworth Products, Inc.
FLUENT INCORPORATED
800-834-4969
www.chatsworth.com

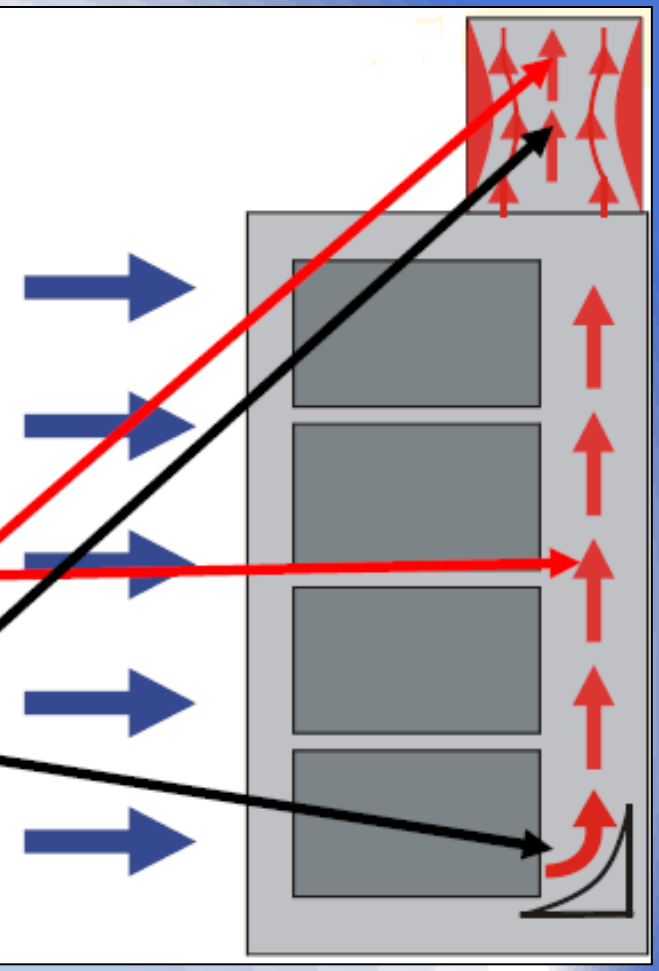
Air Control

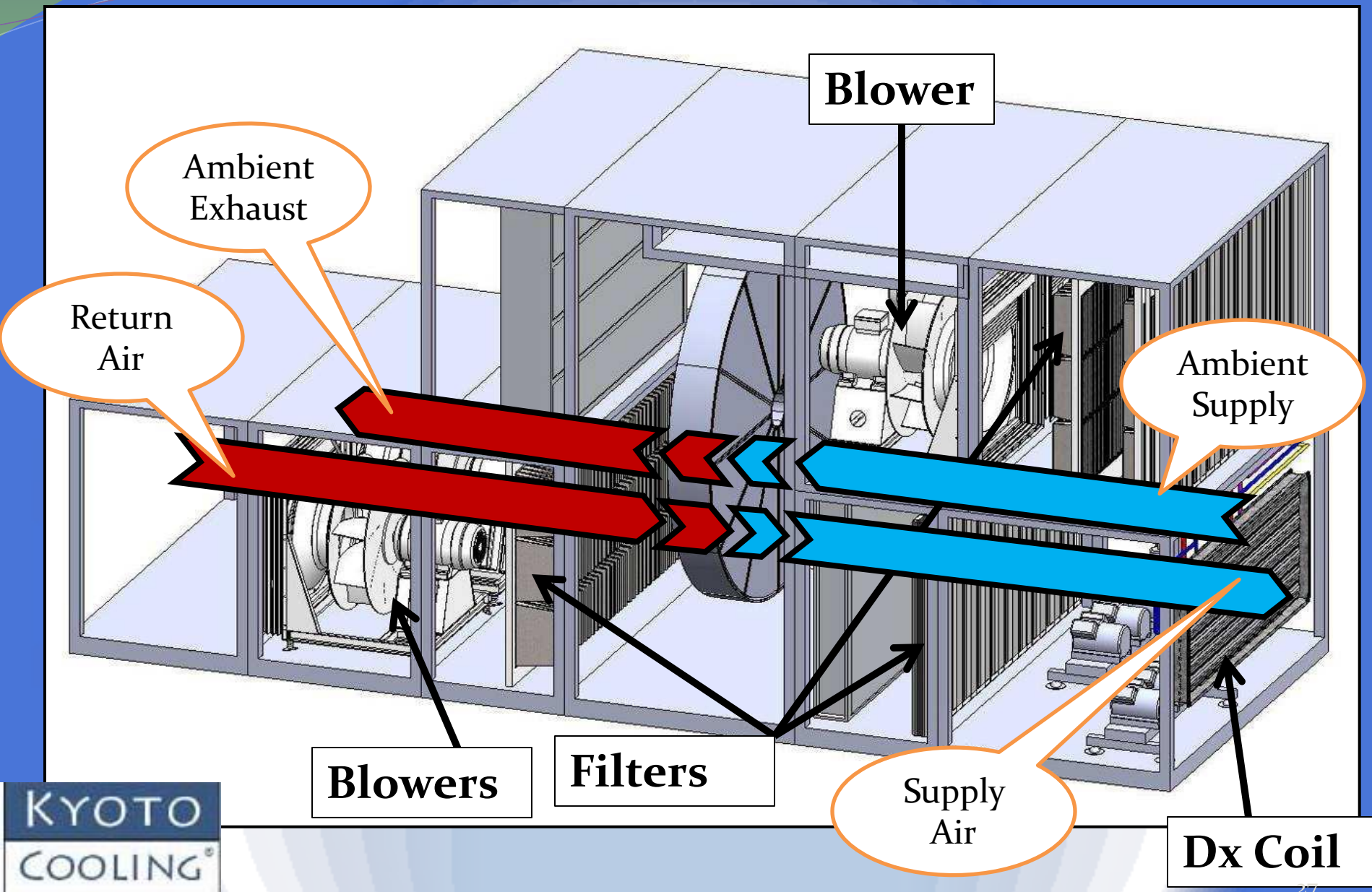


Thermal Isolation

Inverse relation between air velocity and pressure

(Bernoulli Equation)

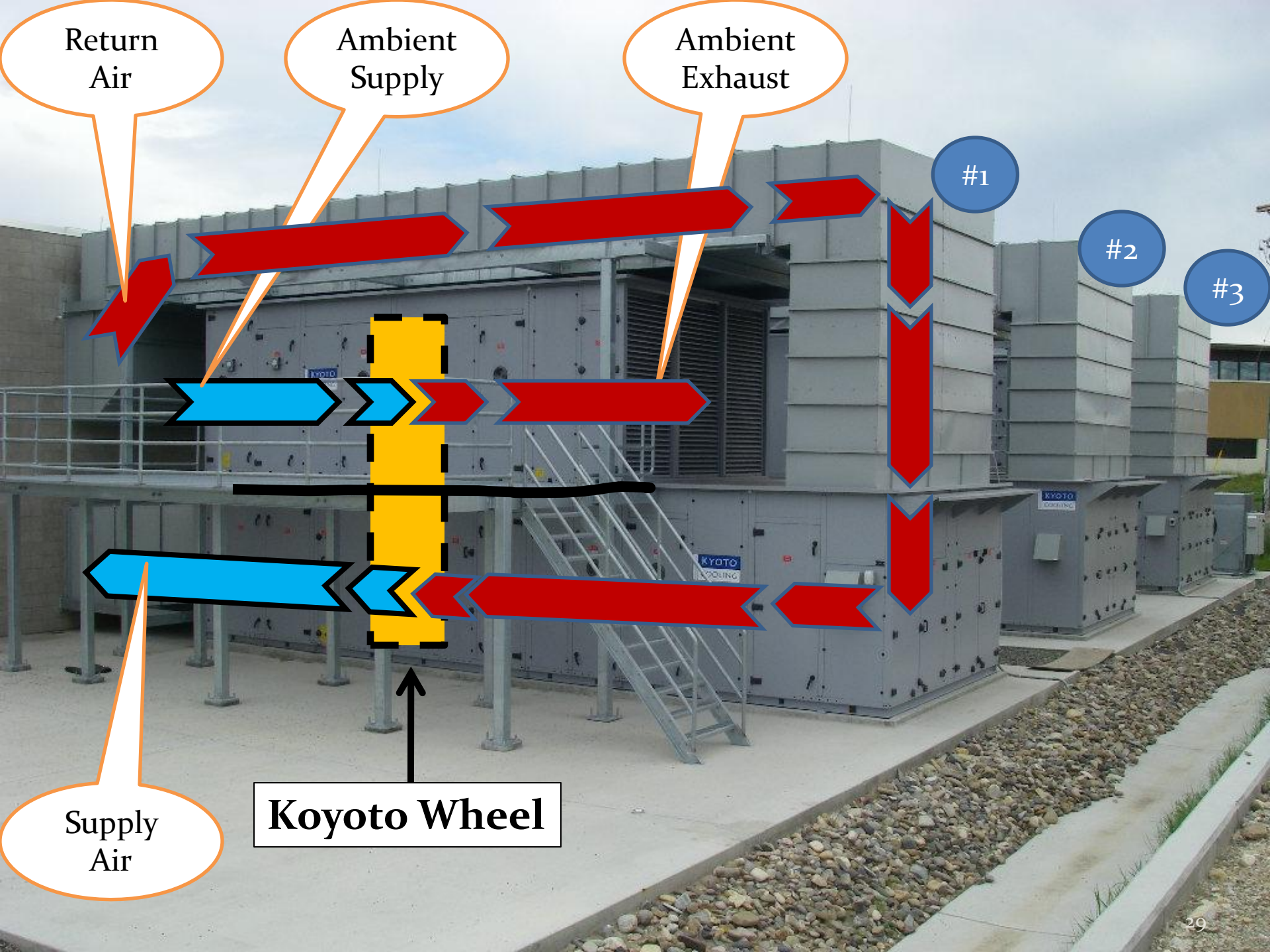




KYOTO COOLING®

>5 Acres Aluminum fin

KYOTO COOLING®

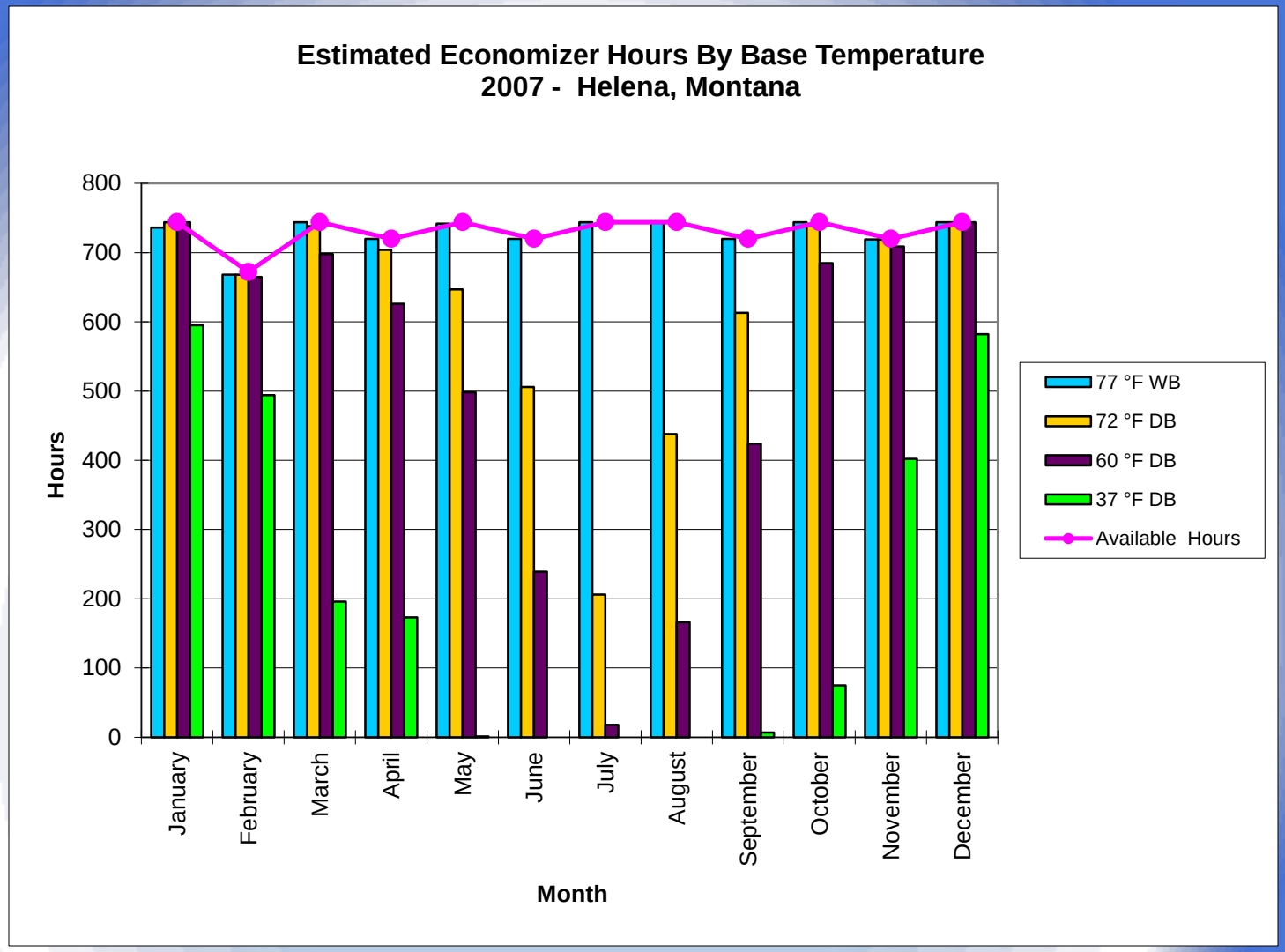

Return Air
Ambient Supply
Ambient Exhaust
#1
#2
#3
Supply Air
Koyoto Wheel

Koyoto Cooling

Estimated Annual Economizer Hours For Helena, Montana							
				Scenario*			
				A	B	C	D
		Available	Available	Number of Hours Temperature** Is Under			
Month	Year	Days	Hours	37 °F DB	60 °F DB	72 °F DB	77 °F WB
January	2007	31	744	595	744	744	736
February	2007	28	672	494	665	668	668
March	2007	31	744	196	698	738	744
April	2007	30	720	173	626	704	720
May	2007	31	744	1	498	647	742
June	2007	30	720	0	239	506	720
July	2007	31	744	0	18	206	744
August	2007	31	744	0	166	438	743
September	2007	30	720	7	424	613	720
October	2007	31	744	75	685	738	744
November	2007	30	720	402	709	719	719
December	2007	31	744	582	744	744	744
Total Hours			**8760**	**2525**	**6216**	**7465**	**8744**
Total Days (Total Hours/24)* **			**365**	**105**	**259**	**311**	**364**
Percentage of Total Hours			**100.0%**	**28.8%**	**71.0%**	**85.2%**	**99.8%**

30days=720hrs

Koyoto Cooling



Cooling Loads

Yahoo's new 100% outdoor air Data Center, NY

INTEL pilot test - 100% outside air for 1-yr, AZ

MT Data Center Location

Climate

- High HDD; Low CDD
- Geography

Power

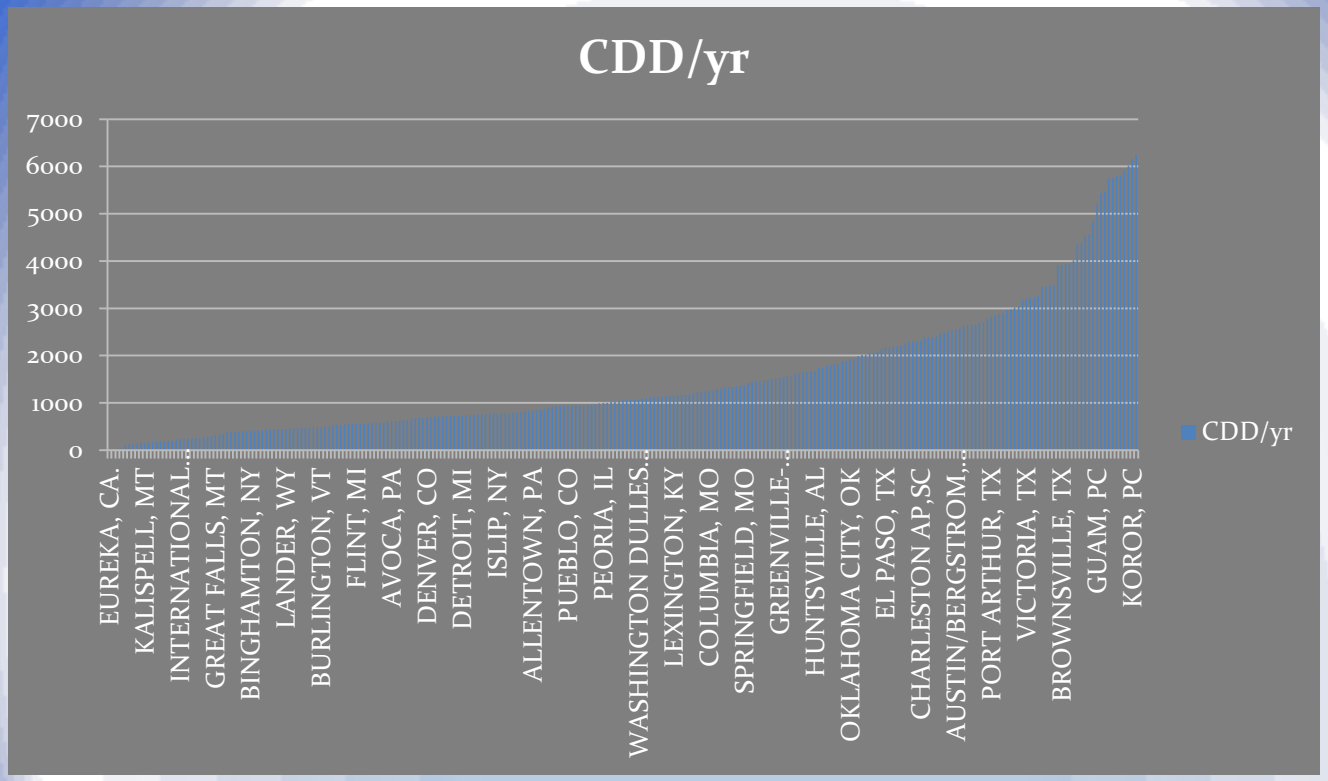
- Base-load Hydroelectric
- Wind and Solar Resources

Fiber

- FO Infrastructure

Locate by Climate

- 30-year avg. CDD/yr NOAA Data Set (1971-2001)
- 250 cities across USA (lower 48-states)
- Ranked by CDD/yr (base 65F)

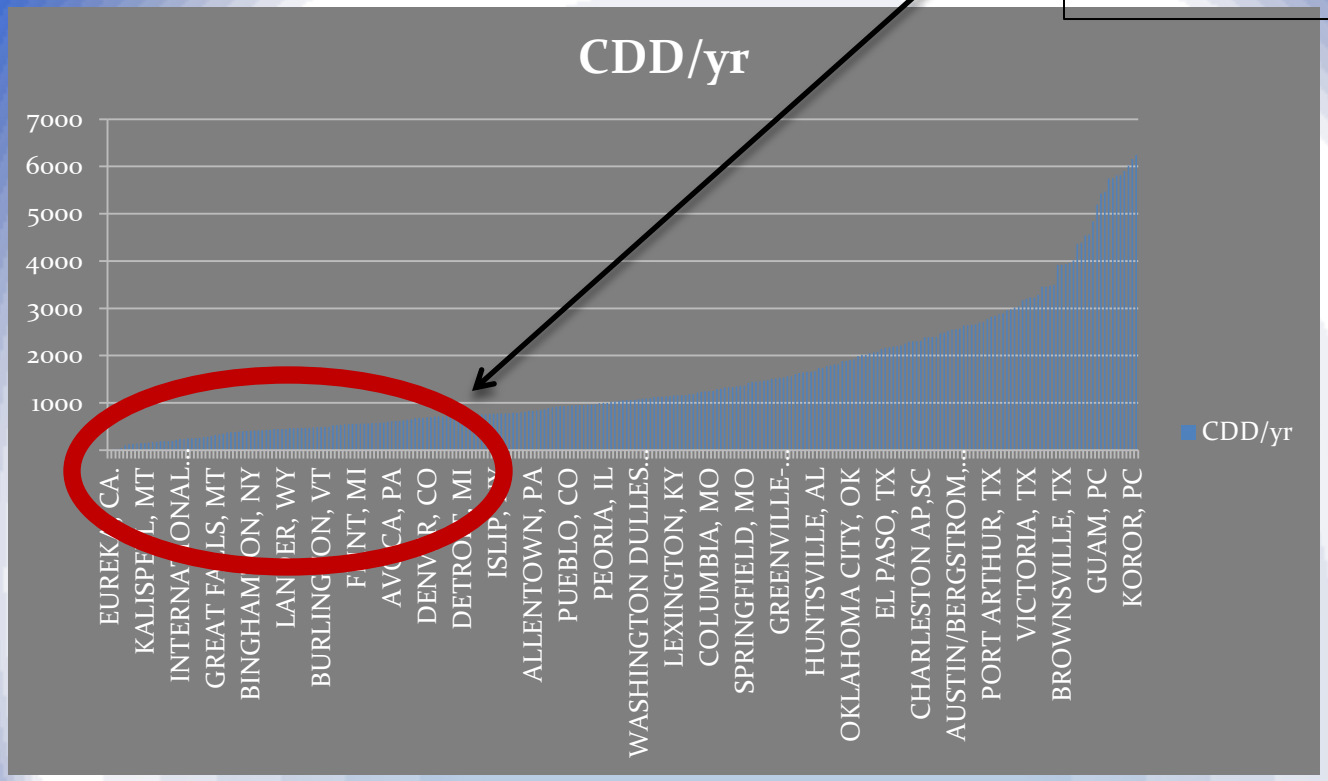


Source: NOAA http://www.ncdc.noaa.gov/oa/climate/online/ccd/nrmcdd.html

Locate by Climate

- 250 cities across USA (lower 48-states)
- Ranked by CDD/yr (base 65F)

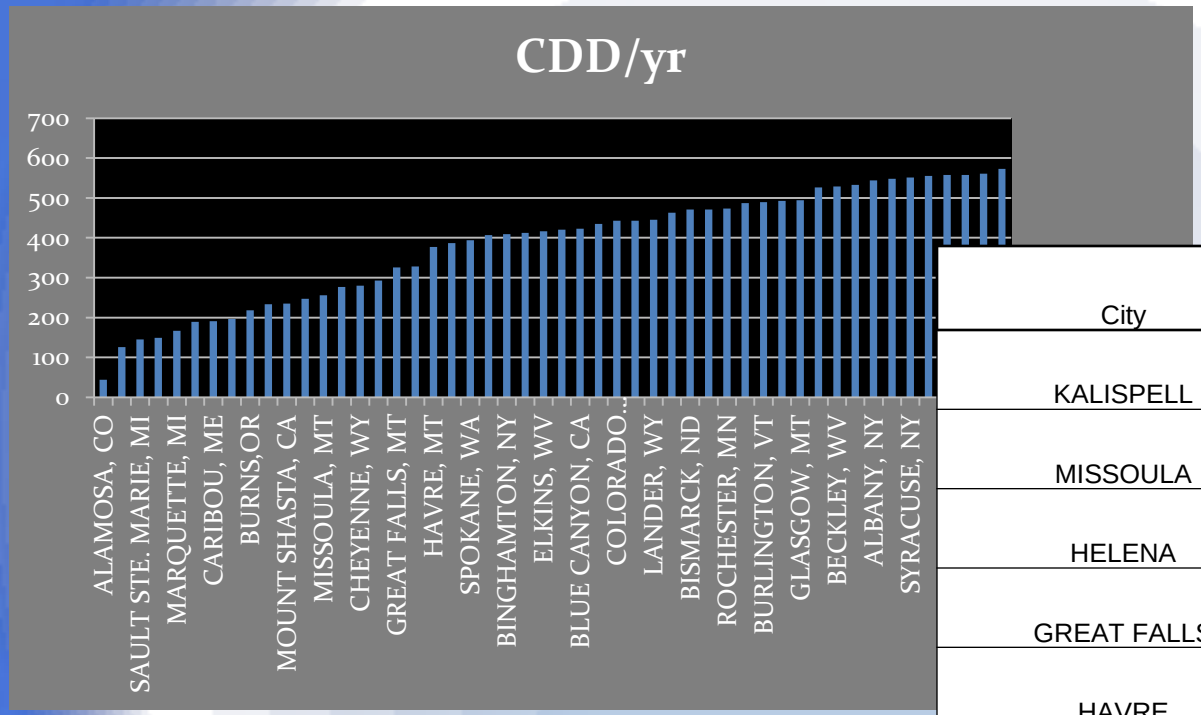
Filter:
Top 100 Cities
<770 CDD/yr
Remove coastal cities



Source: NOAA http://www.ncdc.noaa.gov/oa/climate/online/ccd/nrmcdd.html

Locate by Climate -Coastal

Filter:
Top 50 Cities
(Billings MT #53)



City	CDD	Rank
KALISPELL	149	4
MISSOULA	256	13
HELENA	277	14
GREAT FALLS	326	17
HAVRE	377	19
GLASGOW	494	39

Source: NOAA http://www.ncdc.noaa.gov/oa/climate/online/ccd/nrmcdd.html

Locate by Climate -Coastal +Hydro

Filter:
Within 200mi. Radius of Hydro Source

City	State	CDD/yr	Rank
KALISPELL, MT	MT	149	1
MISSOULA, MT	MT	256	2
HELENA, MT	MT	277	3
GREAT FALLS, MT	MT	326	4
HAVRE, MT	MT	377	5
POCATELLO, ID	ID	387	6
SPOKANE, WA	WA	394	7
WILLISTON, ND	ND	471	8
GLASGOW, MT	MT	494	9

Source: NOAA http://www.ncdc.noaa.gov/oa/climate/online/ccd/nrmcdd.html

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