Program will start at 10:00 am

ETCC QUARTERLY MEETING:
CRUNCHING NUMBERS, SHRINKING MEGAWATTS: MAKING DATA CENTERS MORE ENERGY EFFICIENT

December 7, 2016
UC Davis, Activities and Recreation Center
HOSTED BY: Sacramento Municipal Utilities District

Wifi: ucd-guest WIFI code: Browser pops up to have you create a guest account.

Welcome, Safety and ETCC Updates

Jim Parks

Program Manager | Sacramento Municipal Utility District

WELCOME!

Before we get started….
housekeeping and safety

FOR OUR ONLINE MEETING PARTICIPANTS

- Quick logistics
  - Phone lines are muted
  - Please use question field to ask questions during Q&A or if any technical issues

HOUSEKEEPING FOR ALL PARTICIPANTS

- Please **turn off** or **silence** your phone, and **step outside** for any non-program conversations
- Audio recording today's session
  - Will be posted on www.etcc-ca.com
- Slides will be posted to www.etcc-ca.com
- Don't forget to fill out evaluations!

SAFETY MESSAGE

- In the event of an emergency:
  - Earthquake
  - Fire
  - Other evacuation
- Meeting point
- 911
- CPR

TODAY'S AGENDA

10:00 AM	Welcome, Safety & ETCC Updates
10:20 AM	**The Big Picture Behind Crunching Big Data**
11:30 PM	LUNCH (provided)
12:35 PM	**Concurrent Sessions:** **Enterprise Data Center Solutions** **Server Closet and Server Room Solutions**
1:55 PM	BREAK
2:15 PM	**What's Next? The Future of Data Centers**
3:30 PM	WRAP UP

EMERGING TECHNOLOGIES COORDINATING COUNCIL (ETCC)

The ETCC supports ETP efforts in the advancement of energy efficiency and demand response initiatives through its leadership, impact and influence in the emerging technology domain. It pursues this objective by strategically engaging with a wide range of external ET stakeholders and effectively and efficiently managing coordination among ETCC members.

Members include:

SOUTHERN CALIFORNIA EDISON®
An EDISON INTERNATIONAL® Company

Pacific Gas and Electric Company®

SMUD®

Southern California Gas Company
A Sempra Energy utility™

SDGE
A Sempra Energy utility™

LA DWP Los Angeles Department of Water & Power

EMERGING TECHNOLOGIES PROGRAM MISSION

"…to increase energy efficiency market demand and technology supply through evaluation of *emerging* and *underutilized* advanced technologies to increase customer savings…"

Emerging Technologies → **Programs** → **Codes and Standards**

Zero Net Energy

LED Lighting

HVAC

EE Rebates

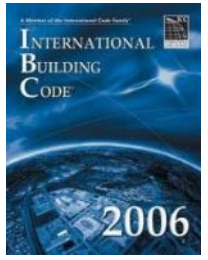
Home Energy Report

Retail and Manufacturer Strategy

Contractor Training and outreach

Appliance Standards

Building Codes



ET PROGRAM DESIGN

Technology Development Support

- Provide resources to transform early-stage technologies / concepts into saleable products
- Develop forward-looking product specifications
- Provide outreach to early-stage entrepreneurs, investors, and analysts (TRIO)

Technology Assessment

- Evaluate performance claims
- Generate energy savings and cost data required for regulatory approval of a new EE measures

Technology Introduction Support

- Conduct scaled field placements to foster market traction
- Build demonstration showcases to create visibility / market awareness
- Conduct third-party solicitations using competitive bidding (TRIP solicitation)

UPCOMING ETCC EVENTS

Date	Event	Location & Host
February 8, 2017	Q1 Meeting: Commercial	Energy Education Center, Southern California Edison
April 19-21, 2017	Emerging Technologies Summit	Ontario Convention Center, Ontario, California
September 20, 2017	Q3 Meeting: Industrial	Bay Area, PG&E

To sign up for the ETCC Insight newsletter, check the box on the sign-in / registration sheet or sign up online at: www.etcc-ca.com/subscribe

Check the ETCC website for updates: http://www.etcc-ca.com/events

THE BIG PICTURE BEHIND CRUNCHING BIG DATA

Ryan Hammond, Senior Energy Advisor, Commercial Services | Sacramento Municipal Utility District - *moderator*

Pierre Delforge, Director of High Tech Sector Energy Efficiency, Energy & Transportation Program | Natural Resources Defense Council

Arman Shehabi, Research Scientist, Energy Technologies Area | Lawrence Berkeley National Laboratory

Ryan Hammond
Senior Energy Advisor, Commercial Services
| Sacramento Municipal Utility District

SMUD Custom Incentive Program

R. Ryan Hammond, P.E.

Crunching Numbers, Shrinking Megawatts: Energy Efficiency of Data Centers
December 7th, 2016

Powering forward. Together.

SMUD

Overview of Incentable Measures

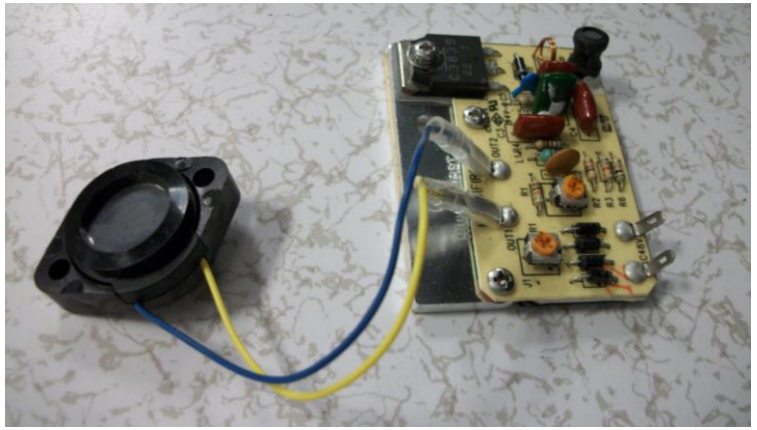
- Individual System Components
- Complete systems
- Controls upgrades
- Unique technologies

Incentive Structure Overview

- Paid on energy (kWh) and demand (kW) savings
- Capped
  - kWh & kW savings
  - 30% of Project Cost
  - $150,000

Data Center Humidifier Retrofit

- Existing System = Infrared
- Proposed System = Ultrasonic
- Incentive = $100,000
- Annual energy savings = 1,100,000 kWh from humidifiers and an additional 350,000 kWh from reduced load on the chiller
- Annual bill savings = $140,000



SMUD

Contact

Custom Incentive Program

R. Ryan Hammond, P.E.

Senior Energy Advisor

916-732-5647

Ryan.Hammond@smud.org

Pierre Delforge
Director of High Tech Sector Energy Efficiency, Energy & Transportation Program | Natural Resources Defense Council

BIO

PIERRE DELFORGE

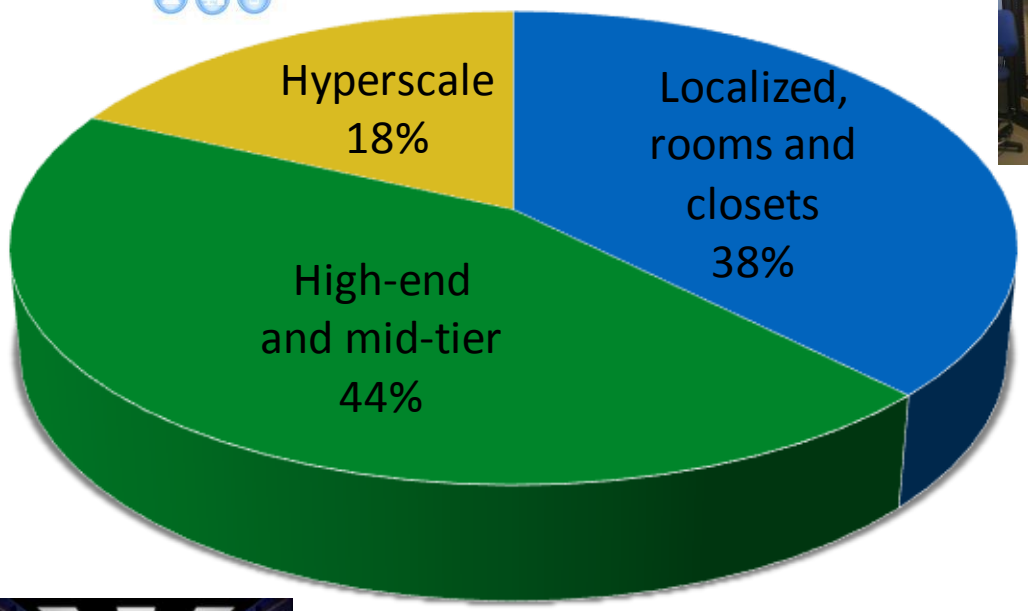
NATURAL RESOURCES DEFENSE COUNCIL (2010-Present)

IT industry (1989-2010)

Areas of focus:

- Information and Communications Technologies (ICT): Data centers, computers, game consoles...
- Plug loads, idle/standby
- Thermal decarbonization (heat pump space and water heating)
- Marathons…

Data Center Energy by Type (2014)



Shehabi A. et al., “United States Data Center Energy Usage Report”, 2016

NRDC

Data Center Efficiency Framework

Infrastructure efficiency

- PUE

IT equipment efficiency

- ENERGY STAR

IT operations efficiency

- Utilization

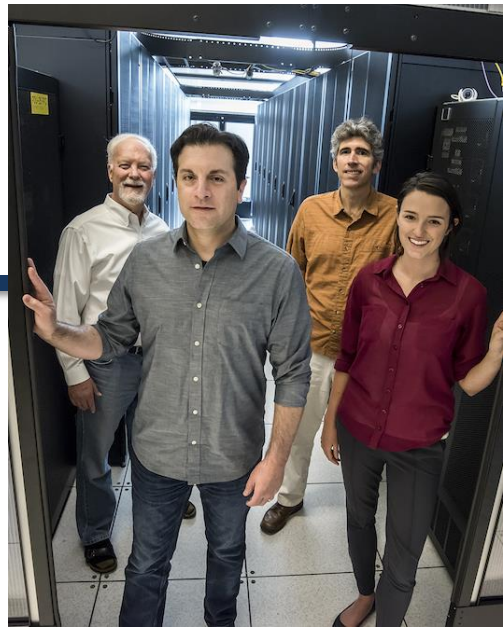
Cloud shift

- Hyperscale resource sharing

NRDC

Arman Shehabi
Research Scientist, Energy Technologies Area | Lawrence Berkeley National Laboratory

Arman Shehabi, Ph.D.



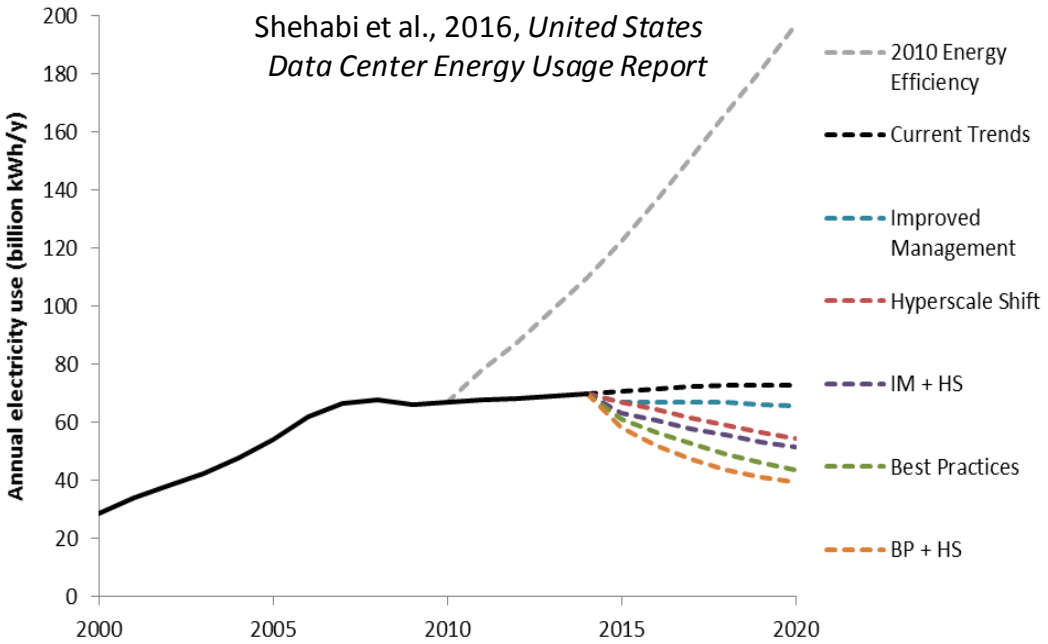
Research Scientist
Energy Analysis & Environmental Impacts Division
Lawrence Berkeley National Laboratory
1 Cyclotron Rd Building 90R2000
Berkeley, CA 94720
510-486-7818
ashehabi@lbl.gov

BERKELEY LAB

Data Center Energy Research

U.S. Data center energy usage

- Characterize growth and evolving ICT market



Target the inefficiencies:

- Lots of closet clunkers & other poorly operated data centers

Steer ICT towards greatest net energy benefits:

- Indirect effects of ICT across other economic sectors

Understand demand beyond 2020:

- Established efficiency measures to eventually hit upper limit, while computational/storage demand only increasing

BERKELEY LAB

DISCUSSION AND Q&A

THE BIG PICTURE BEHIND CRUNCHING BIG DATA

Ryan Hammond, Senior Energy Advisor, Commercial Services | Sacramento Municipal Utility District - *moderator*

Pierre Delforge, Director of High Tech Sector Energy Efficiency, Energy & Transportation Program | Natural Resources Defense Council

Arman Shahabi, Research Scientist, Energy Technologies Area | Lawrence Berkeley National Laboratory

LUNCH

Program will resume at 12:35 pm

SERVER CLOSETS – THIS ROOM
ENTERPRISE DATA CENTERS – NEXT DOOR

PLEASE FILL OUT EVALUATIONS!

SERVER CLOSET AND SERVER ROOM SOLUTIONS

Priscilla Johnson, Evaluation Measurement & Verification | Pacific Gas & Electric - *moderator*

Magnus Herrlin, Program Manager, High-Tech Group | Lawrence Berkeley National Laboratory

Bob Huang, Senior Associate | Cadmus

Priscilla Johnson
Evaluation Measurement & Verification | Pacific Gas & Electric

Small Data Center Market Characterization
CPUC ID: 2026

Priscilla Johnson, Ph.D., LEED O+M
Commercial/Water/Energy EM&V

ETCC Quarterly Meeting
December 7, 2016

Embedded Data Center Collaborative Partners

Contracted Support

CLEAResult

Mark Bramfitt

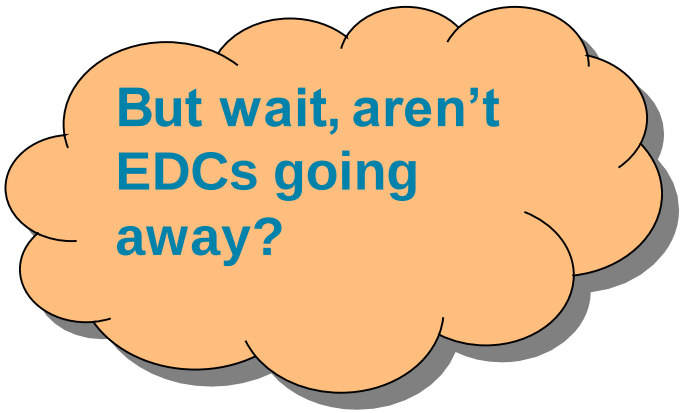
QDI Strategies, Inc.

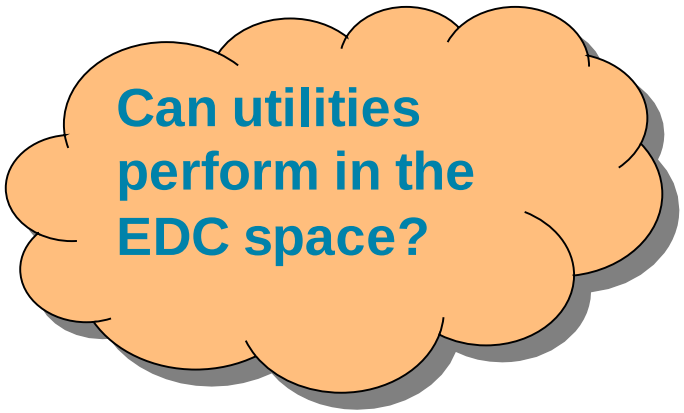
The Opportunity: Why EDCs?

- **US Data Centers projected to consume ~73 billion kWh in 2020 (LBNL, 2016)**
- **99.2% of all servers reside in embedded data centers (NRDC, 2014)**
- **Enterprise Data Centers already utilize the most efficient equipment, practices and infrastructure**
- ***Largest EE opportunity remains in Embedded Data Center space***

What happens in the absence of EE incentives?

- Older equipment, long life and The “Hodgepodge Effect”
- NO money, NO time to perform comprehensive upgrade
- Uptime and security are always key
- Energy efficiency is NOT a primary motivator





Outcome: Top Embedded Data Center (EDC) EE Interventions

- Website Clearinghouse
- Prescriptive/Deemed Measures
- ESCO (Shared Savings / Audits)

Cloud Panel Results

- Embedded Data Centers are not going away
- Hybrid IT solutions (Cloud + EDC) have the highest potential
- Applications with high privacy or seasonal needs are things firms would keep on premises
- “Forklifting” or moving IT resources to the cloud does not yield savings for a company
- Redesigning and then moving to the cloud does yield large savings, but it requires a higher order skill set
- Once companies migrate to the cloud, they migrate and STAY there

Next Steps

Integrate Findings into PG&E 2017 Business and Implementation Plans

Issue RFPs for 2017

Sustain engagement with supply chain to consider potential utility incentive products and programs aligned with study participant objectives and concerns

SUPPLEMENTAL SLIDES

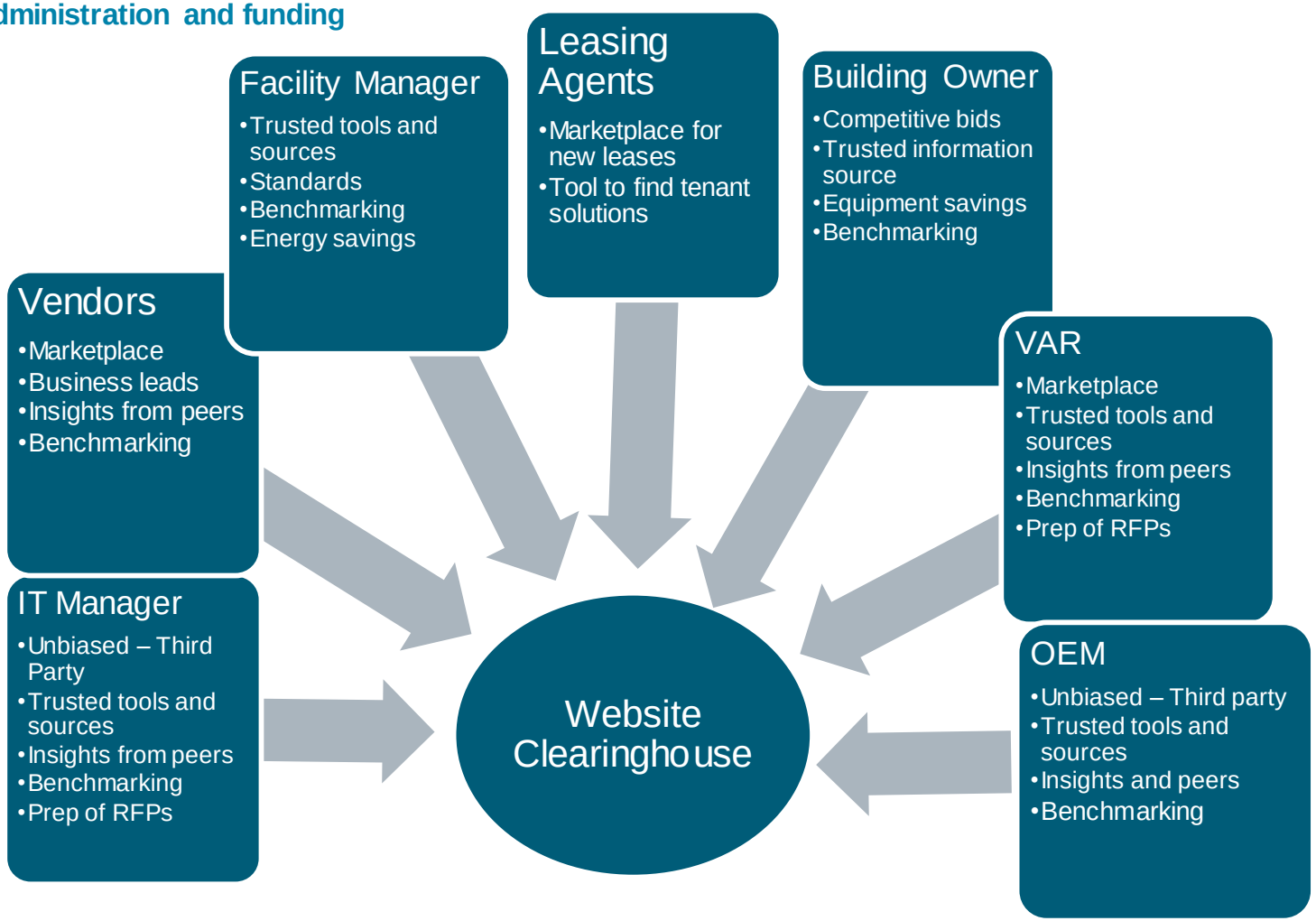
Outcome: Website Clearinghouse

Risks:

Maintain vendor neutrality

Long-term administration and funding

Purchase Process



Outcome: Deemed | Risks

Training/Programs

- DCEP-facilitated audits
- Enhanced audits (e.g. thermal imaging)
- PG&E DC Plus (Airflow Mgmt Program) for data centers (DCIM)

IT

- Efficient servers
- Storage optimization
- Server virtualization (reactivate for EDCs)

Equipment

- VFDs on CRACs/CRAHs
- Controls upgrades
- Efficient UPS
- Automated cooling

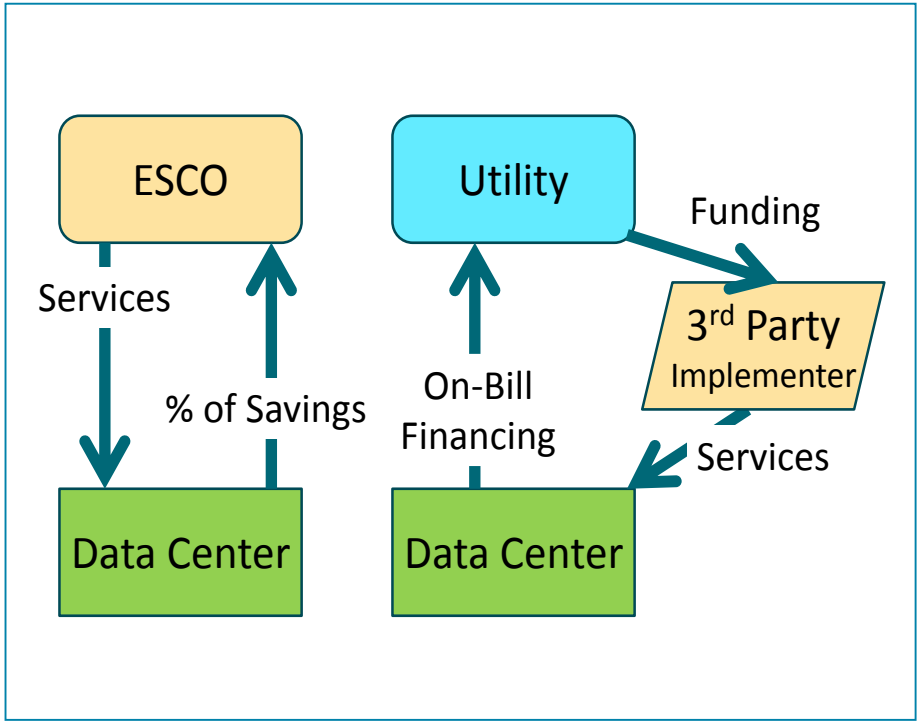
Outcome: Deemed | Risks

- Significant work to develop values & get approvals
  - Match utility specs to national standard
  - Incremental cost
- NTG (Free ridership) – EE is not industry standard practice for EDCs
- Technology shifts are rapid
  - Need to support platforms that don't change
  - Updating deemed values
  - Achieving Persistence of savings

Outcome: ESCO (Shared Savings)

What is it?

- ESCO model for data centers
- "Data centers as a service"
- Need to standardize the model
- Utility-approved audit methodology
- Support savings calculations
- Leverage existing frameworks



Risks

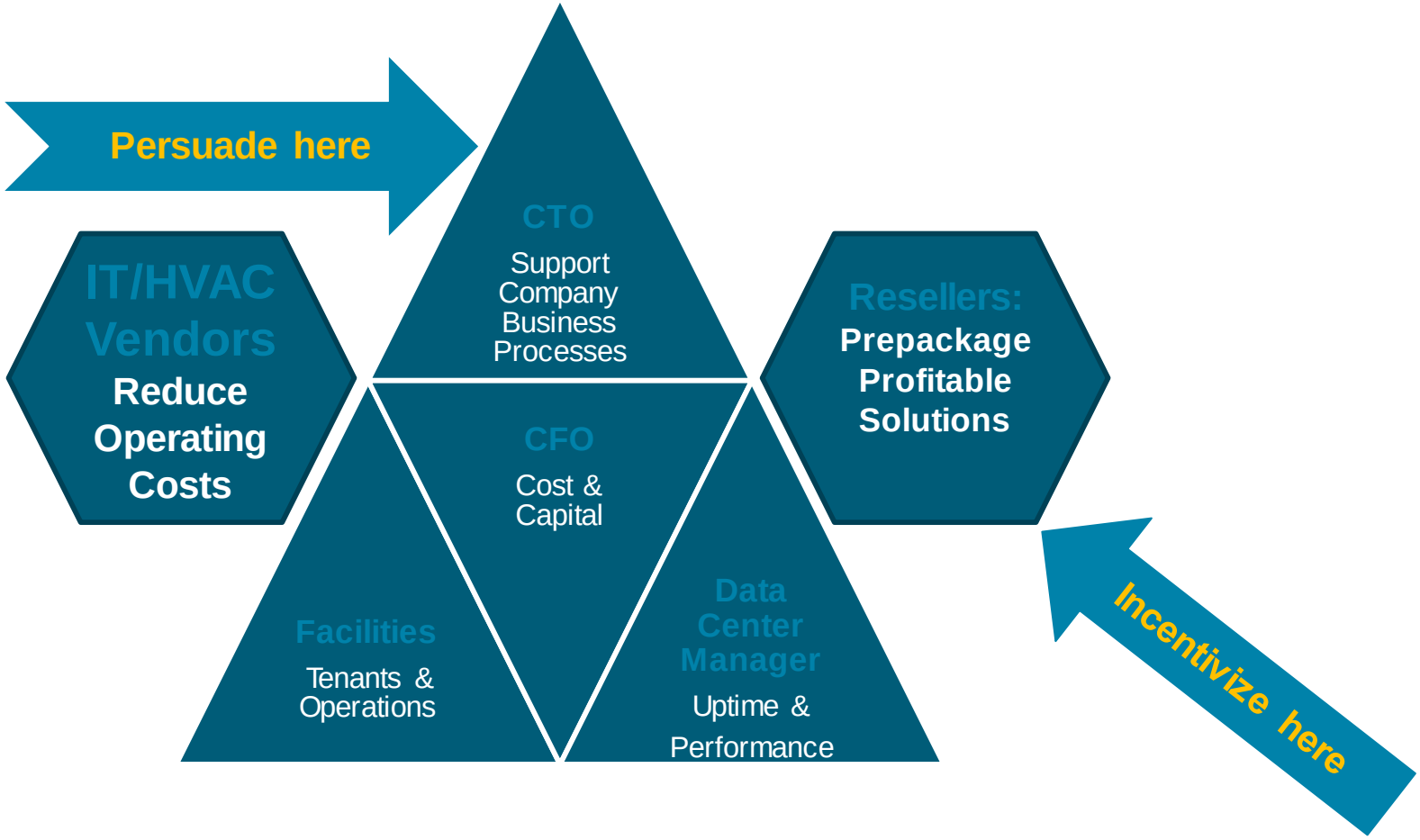
- Requires further discussion with ESCOs and utilities
- Need to understand savings potential
- What about M&V? Persistence?
- Multi-tenant buildings won't work
- Split incentive barrier

Chris

Outcome: Best Intervention Point for Incentive?

- **Midstream market best intervention point or "Reseller channel"**
- **Understand day-to-day operations of EDCs**
- **New tech > Market identification**

Embedded Data Center Market Map



Thank You

Priscilla Johnson, Ph.D., LEED O+M
EM&V Commercial, Water/Energy, Data Centers
415-973-2401
pxjj@pge.com

Magnus Herrlin
Program Manager, High-Tech Group |
Lawrence Berkeley National Laboratory

BERKELEY LAB
LAWRENCE BERKELEY NATIONAL LABORATORY

U.S. DEPARTMENT OF ENERGY

"Server Closets and Server Room Solutions" Panel

Magnus Herrlin, Ph.D.
Lawrence Berkeley National Laboratory (LBNL)
510-486-6515
mkherrlin@lbl.gov

December 7, 2016

The Challenge

- "Small data centers" are <5000 SF
- Houses 70%+ of all servers in data centers
- Majority of energy saving potential…
- … but a number of barriers:
  - Difficult to find (embedded)
  - Difficult to engage
  - Limited expertise
  - Limited resources
  - Limited savings for each individual data center.

Current Work at LBNL

- Focus on saving energy in small data centers
- Focus on air management
- Survey of portable air management monitoring tools (2016)
- Demonstration project for the portable tools (2017)
- Developing “packages” of air management measures (2016)
- Demonstration project for the packages (2017)
- Utility rebate program based on deemed savings.

U.S. DEPARTMENT OF
ENERGY

UNIVERSITY OF
CALIFORNIA

Bob Huang
Senior Associate | Cadmus

Robert Huang

- Leading EPA ENERGY STAR effort to promote EDC efficiency
- Characterized the EDC market for number of utility clients

nyserda
Energy. Innovation. Solutions.

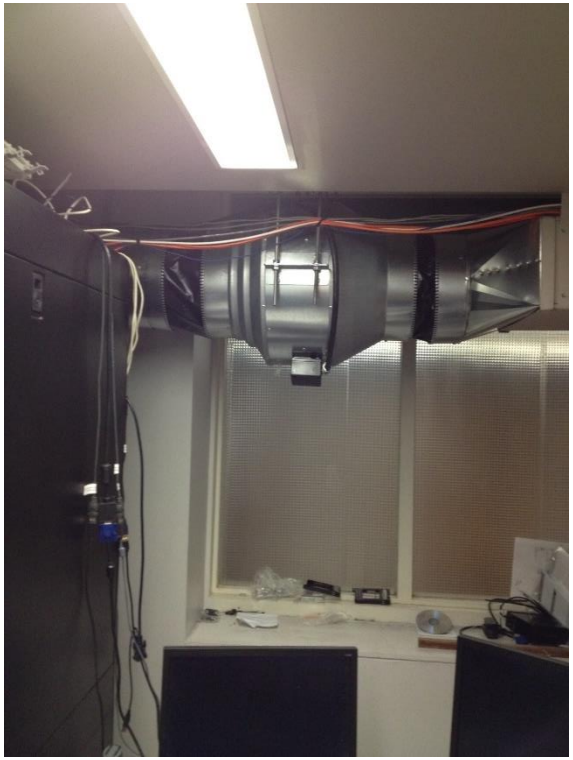
Northwest Power and Conservation Council

PG&E

Embedded Data Center Free Cooling

- EDC with 6.6 kW IT load
- Fitted with air side economizer
- Saves 2 kW of compressor load when free cooling
- Supply and return fans use 0.8 kW

Hot Aisle Return to Underfloor Plenum



DISCUSSION AND Q&A

SERVER CLOSET AND SERVER ROOM SOLUTIONS

Priscilla Johnson, Evaluation Measurement & Verification | Pacific Gas & Electric - *moderator*

Magnus Herrlin, Program Manager, High-Tech Group | Lawrence Berkeley National Laboratory

Bob Huang, Senior Associate | Cadmus

ENTERPRISE DATA CENTER SOLUTIONS

Mary Medeiros McEnroe, Public Benefit Program Manager | Silicon Valley Power - *moderator*

Nissim Hamu, Design Manager | Intel Corporation

Fred Rebarber, Manager, Technical Relations, North America | Vertiv

Mary Medeiros McEnroe
Public Benefit Program Manager |
Silicon Valley Power

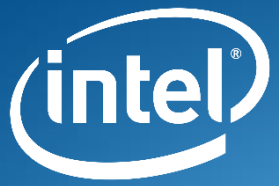
Mary Medeiros McEnroe
Public Benefits Program Manager
Silicon Valley Power
mmedeiros@svpower.com

- Manages utility energy efficiency, renewable energy, R&D and low income programs
- 22 years in the utility industry
- Working with data centers for 18 years

Data Centers in Santa Clara

- 19 square mile service territory
- 30+ large data centers
- 39% of electric load is data centers…and growing!
  - Excludes server rooms/closets
- Programs targeted at energy efficiency in data centers
- R&D effort on liquid cooling in data centers
  - Partnering with University of Washington

Nissim Hamu
Design Manager | Intel Corporation



ETCC QUARTERLY MEETING

Location – Davis, CA

Wednesday, December 7th | 9:00 AM – 3:30 PM

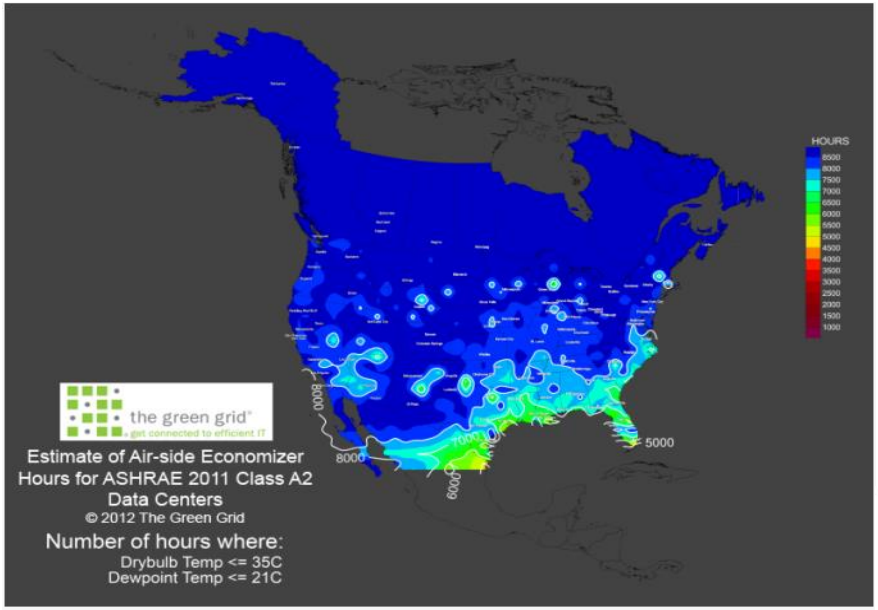
Chiller-less Cooling

Nissim Hamu, Intel Electronics

Nissim Hamu

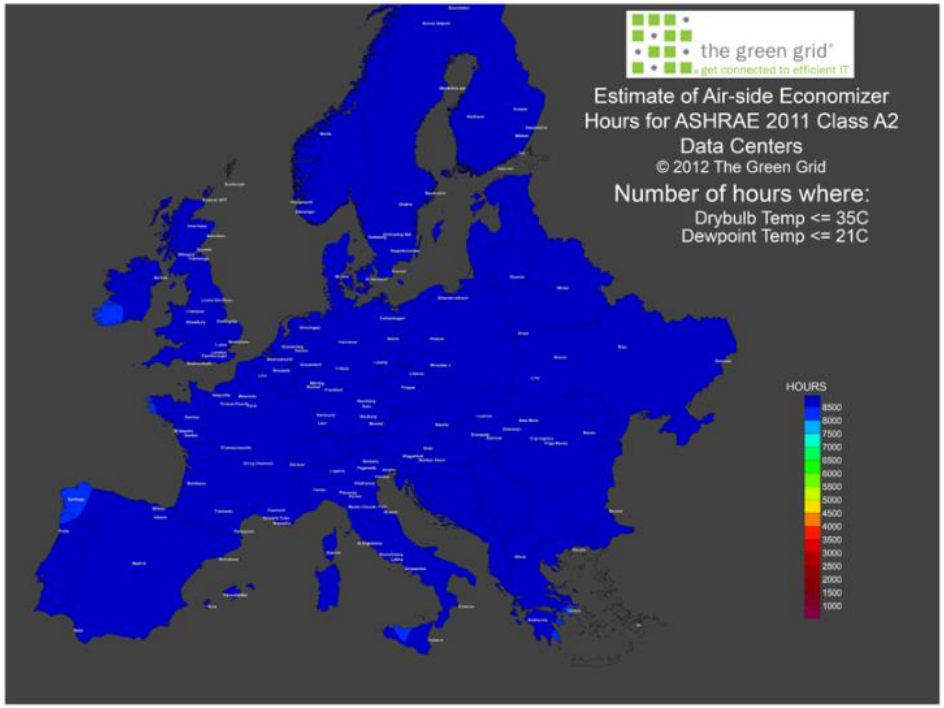
AMR Data Centers Design Manager

- B. Tech degree in Electrical Engineering, SCE College of Engineering, Israel
- Married + 3, Live in Chandler AZ
- 8 years Experience in Sustaining Electrical Systems in Intel Fabs
- 10 Years Experience in Design and Project Management in Intel
- Last 3 years – D2P3 Data Center Design Manager in Intel Santa Clara, CA
- Email: nissim.hamu@intel.com
- Cell: 1-480-3818077



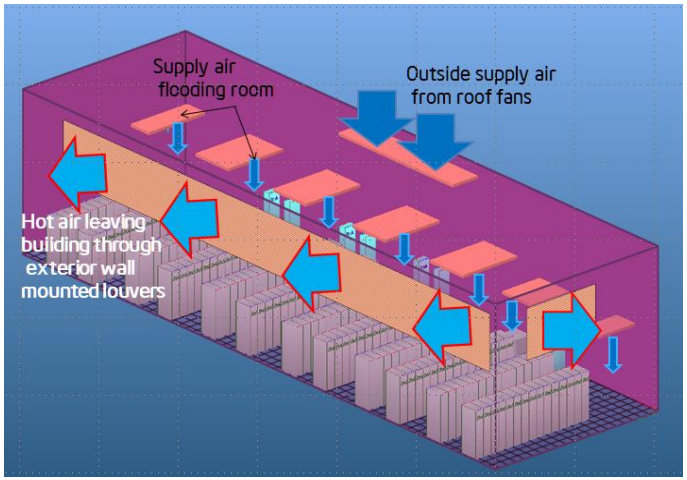
About 75% of North-America can use free cooling if the maximum inlet temperature is raised to 35°C (95 °F). In Europe, the situation is even better:

With outside air temperatures <95F/35C & Dew point <71F/21C
More of the world becomes available for airside economizers



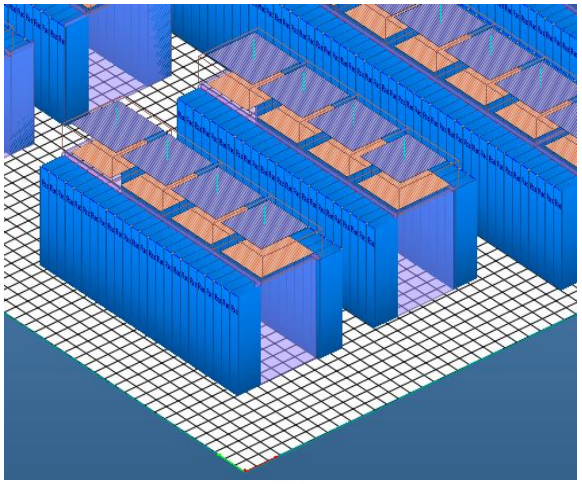
Intel Data Center Designs

Free Air- Air Side Economizer



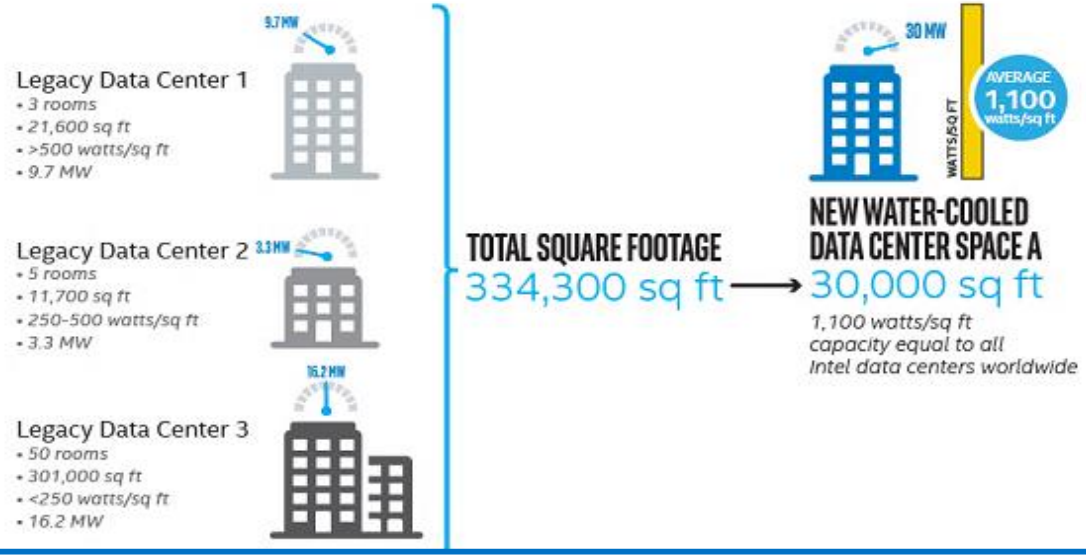
PUE ~1.07
Metered

Evaporative Cooling Wet Side Economizer



PUE <1.07
Design

:



World class designs feasible with very different cooling methods

Free Air- Air Side Economizer

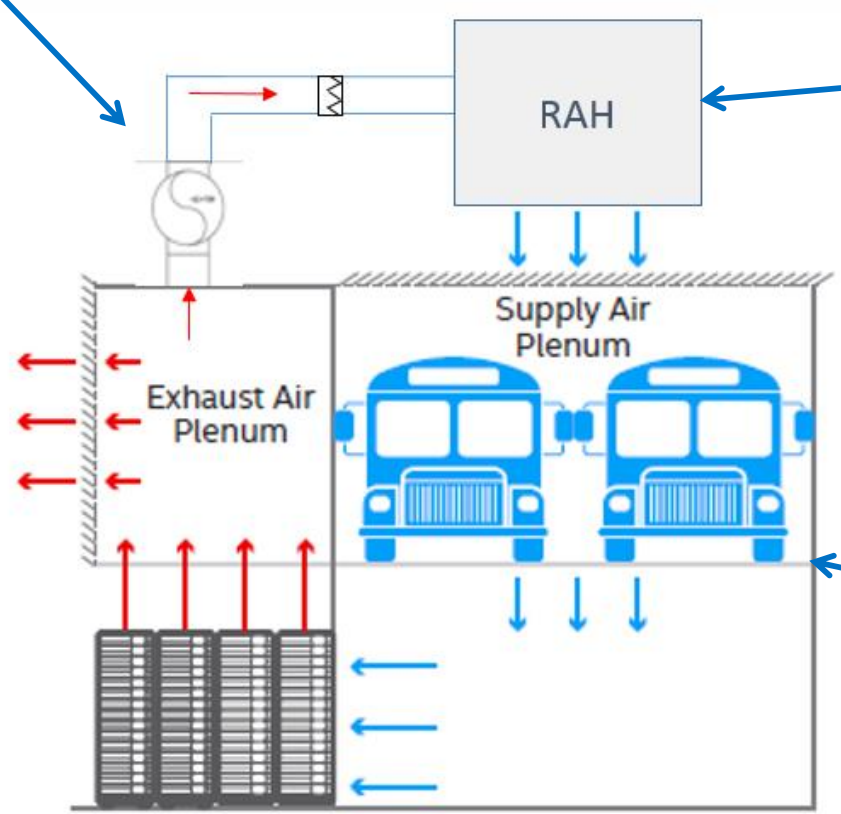
Chillers-less cooling

5MW DC: Traditional space ~43ksf

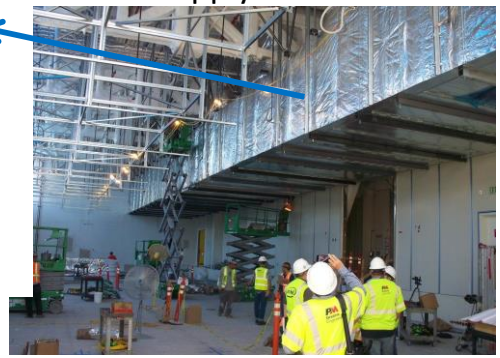
- ✓ **Intel new design required 5ksf**
- ✓ **Large Water & Electric savings**

Exhaust/recirculation Fan- mixing air

Exhaust louvers ~1400sf total



In room Supply Plenum



Evaporative Cooling Wet Side Economizer

Chillers-less cooling

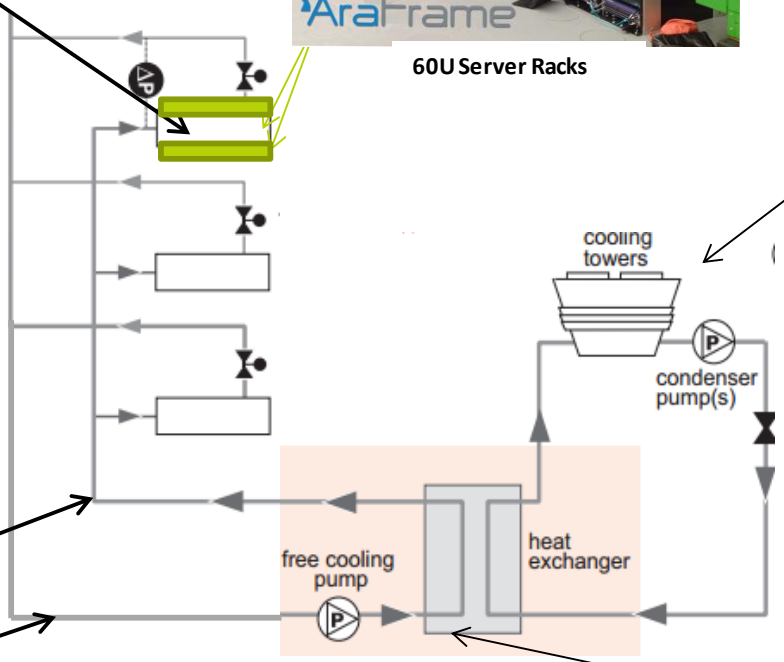
Hot aisle - Cooling coils in top of hot aisle

60U Server Racks

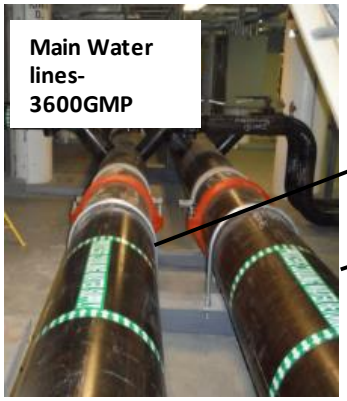
30MW DC:

Traditional space ~330k ksf

- ✓ **Intel new design required 33K**
- ✓ **Large Electrical savings**



Main Water lines- 3600GMP



Segregate cooling tower water from data center cooling coils

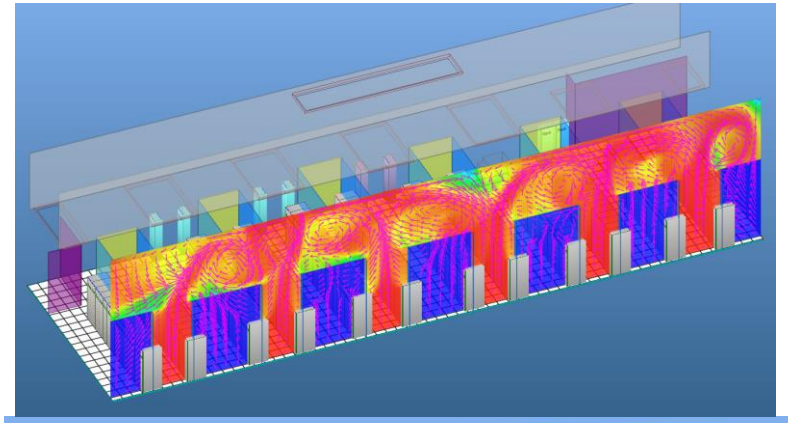
Plate heat exchanger

Designs and techniques to increase data center efficiency

Vision: Maintain Intel's position as being in the top three for most energy efficient DC in the industry

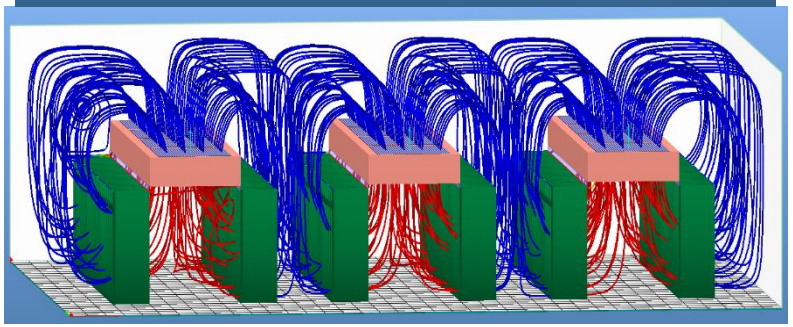
Air Segregation
- **No Raised Metal Floor**
- **Air segregation**
- **Chimney cabinets**

Air Management
- **Flooded supply air design**
- **Variable Frequency Drives**
- **Airflow** rate change from 160-200CFM /kW to 80-108CFM /kW



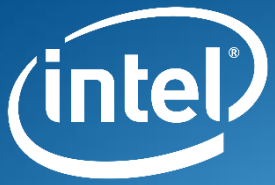
Cooling management
- **Evaporative cooling Wet side economization**
- **Free cooling Outside air Dry side economization**
- **Raise Return Air Temperature**
- **Raise Supply Air Temperature** (80 to 95F)
- **Raise Return Chilled Water Temperature**

Power Loss and Electrical Efficiency
- **12KV - 415/240 VAC systems (SS, TR's, Busways, racks…)**
- **High efficiency Transformers**
- **Utility as second source**



Room Design Efficiency
- **1100 watts /sf/ft. Power and cooling density**
- **Multi Tier room design**
- **Densification**

How will we measure: Use The Green Grid PUE Power Usage Effectiveness



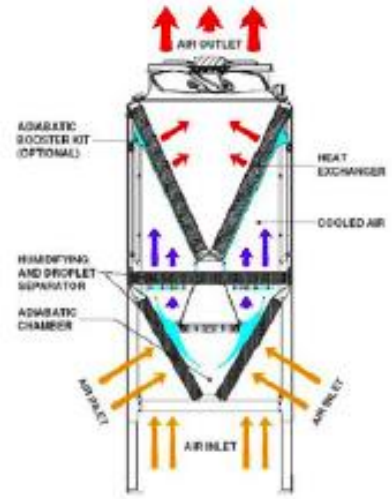
Thank You!

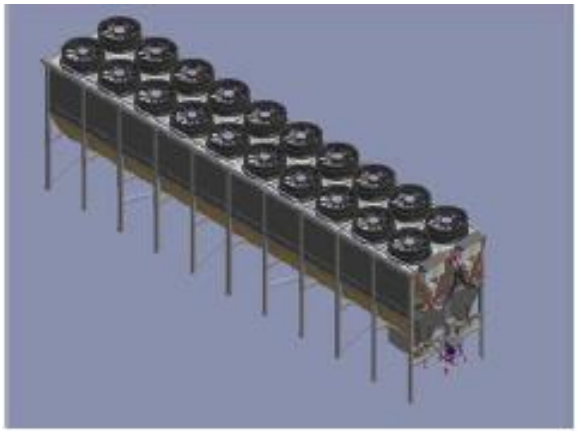
ABATIGO ABT – closed loop adiabatic liquid cooler System for Hydraulics Cooling

The **Abatigo ABT** is a dry-cooling modular system with high performance copper/aluminum finned pack heat exchangers and ventilated with axial fans. It cools the water by using the cooling capacity of ambient air. The system works as a "CLOSED CIRCUIT".

20 MW Cooling Systems

Parameter	Open Circuit (CT's)	Adiabatic
Pipe Loop Complexity	Double Loop	Single Loop
PCW Fluid	Water	25 % Glycol
Major Equipment Height w/Supports	35 ft.	26 ft.
Pump Quantity	3 PCW 3 CW	3 PCW 1 Glycol Mix
HX quantity	3 HX's	None Required
Sand Filter	CW	None Required
Energy Consumed (kWh/yr)	5,669,542	3,532,608
Energy Consumed cost/yr)	$566,954	$353,260
Water Consumed (gal/yr)	79,365,600	3,740,311
Water Discharged to sewer (gal/yr)	8,724,960	Near 0
Water In/Out (cost/yr)	$341,272	$16,083
Equipment cost		<25%
Energy and water costs	$908,226	$369,343
Energy consumed (kWh/yr per W)	0.27	0.2
Water consumed (gal/yr per W)	4.24	0.22
PUE	1.043	1.032
Normalized Footprint (sf/Kw)	0.3-0.4	0.9-1.6





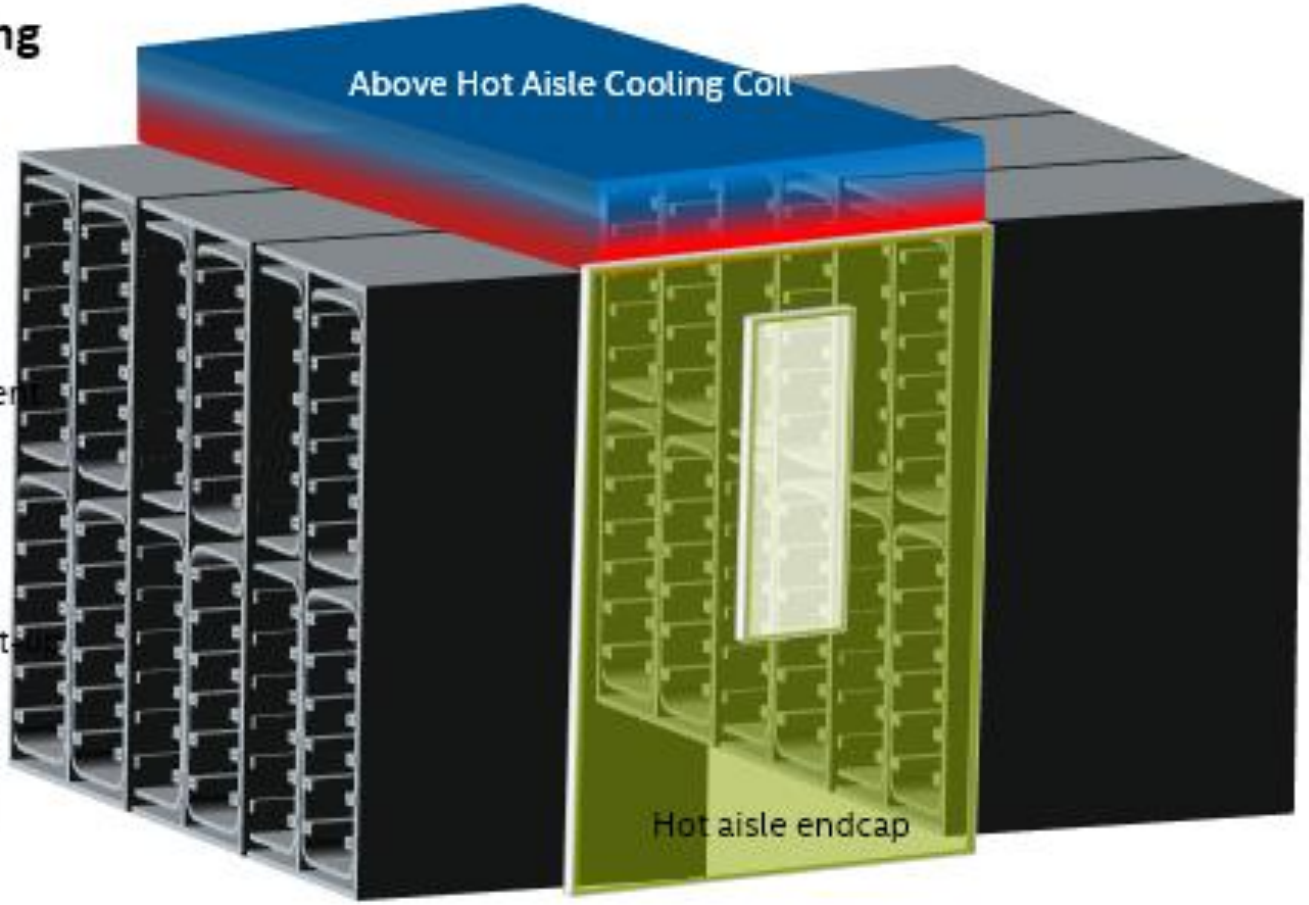
Close Coupled Cooling

Modular Build
10ft X 24ft Increments
from center cold aisle
to of center cold aisle

Server Racking
Sub 20in wide in 30u increment
30u, 60u and 90u elevation

Fit-Up Module
Insert provides on site
and offsite compute device fit-up

Close Coupled Cooling
Coil provides 330kW cooling
per twelve 60u racks



Closed Coupled Cooling

Fred Rebarber
Manager, Technical Relations, North America | Vertiv

ENTERPRISE PANEL

Fred Rebarber

Technical Relations Manager, North America

Vertiv, Thermal Management,

December 7, 2016

ETCC Meeting, Davis, CA

…"Big Data" Interactions Push Content Closer To the Edge and Closer To Users…

Centralized Data Centers

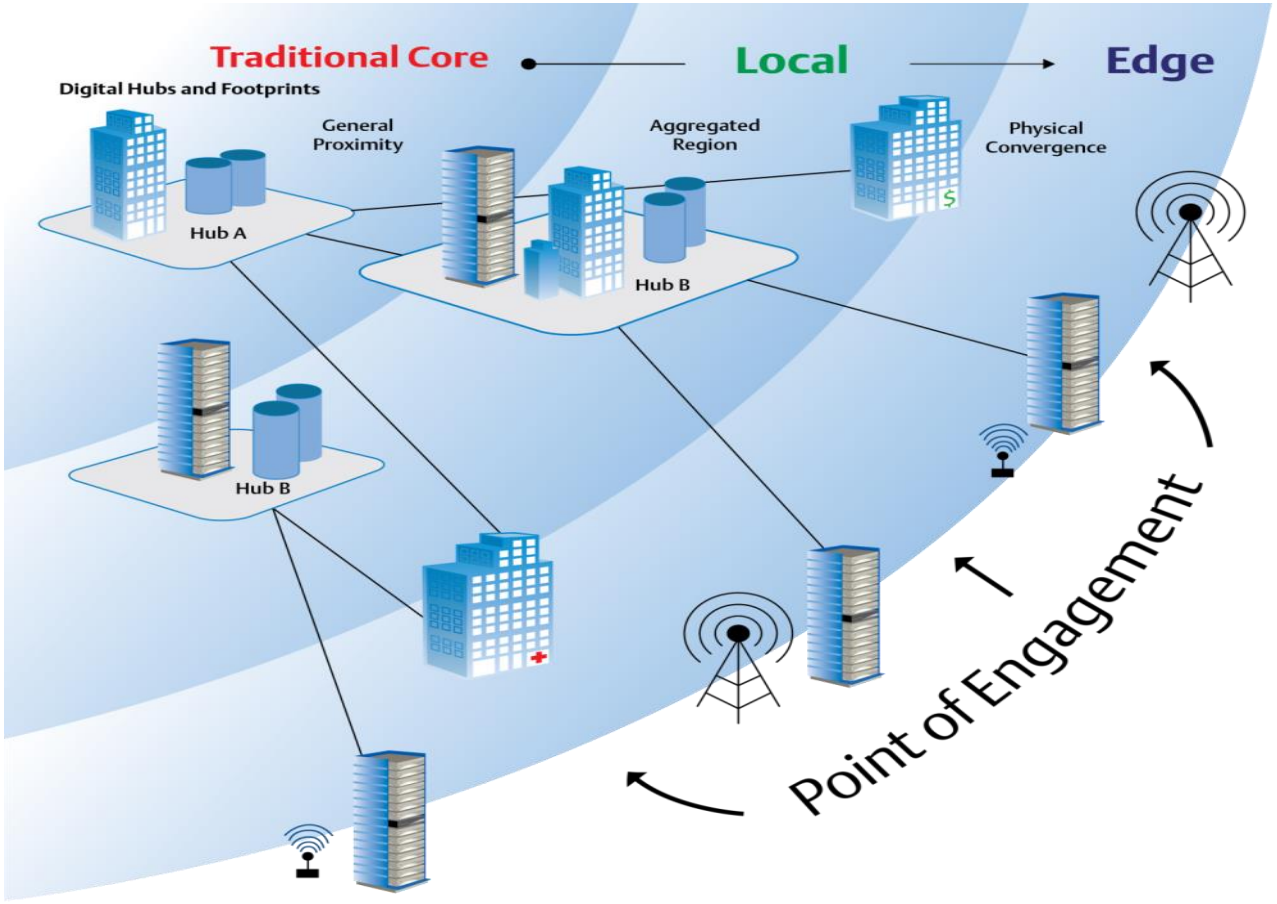
>500 m^2
1,000-1,000,000s Servers
8,000 Sites

Local and Regional Data Centers

> 500 m^2
50-100s Servers
85,000 Sites

Network Closets & Server Rooms

< 500 m^2
1-50 Servers
2,800,000 Sites



Source: Gartner, Blue Canyon

Market Trends In Large Data Centers

High Efficiency – Low PUE

SLA's still written around 66–75°F (19-24°C) Supply Temps / Conservative Humidity Ranges

Scalable Deployments

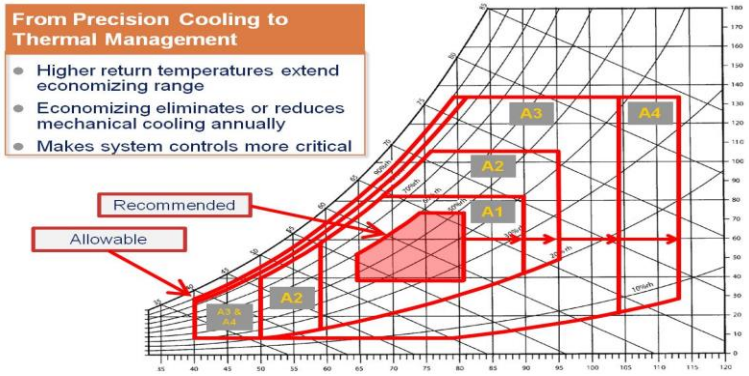
Larger building blocks

Minimal Water usage

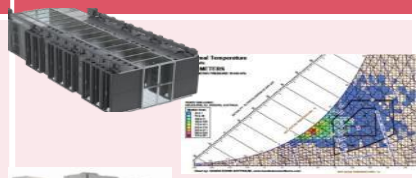
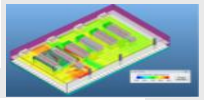
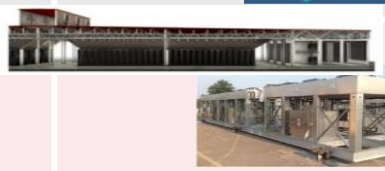
Low Max kW/Peak Power

Greater use of containment

Maximize rack count / External deployments



Thermal Management System Keys to a Successful Data Center Design

	Resiliency SLA	OP EX Cost	CAP EX Cost	Why?	How !!!
Containment enabling Higher Operating Temperatures	✓	✓	✓	Reliable control of supply air temperatures **PUE** ↓ 20% to 35% Unit capacities ↑ Unit count ↓ Lower Max kW => more Power allocated to IT	
Economization		✓	✓	Sustainable control of operating costs Mechanical refrigeration ↓ **PUE** 15% to [illegible]% Improved life (MTBF)	
Control	✓	✓	✓	Networking for optimization & fault tolerance Adjust/Optimize the cooling to the IT load One control platform for the whole critical space	
Intelligent Monitoring (DCIM)	✓	✓	✓	Means to verify optimal performance Anticipating / predicting critical issues Planning change and growth	 
Scalable Design		✓	✓	Deploy latest technology as developed Time value of money, reduced excess capacity Speed of deployment	

Economization Technology Available

Pumped Refrigerant – Turns off compressors and pumps refrigerant around to reject the heat outdoors

Evaporative – Indirect and Direct – uses water evaporation to lower the temperature of the air for better heat transfer

Outside Air – replaces mechanical refrigeration

Chilled Water Economization – uses cool cooling tower water to cooling the chilled water loop to reject the heat

Climate impacts the available hours for economization modes

Department of Energy (DOE)

Requires manufacturers to test and register on DOE web site

Liebert submitted SCOPs to be in compliance by January 1, 2016

www.regulations.doe.gov/certification-data/

U.S. DEPARTMENT OF ENERGY

Requirement currently applies only to DX units in Upflow & Downflow configurations

Pumped Refrigerant Economization – Liebert DSE

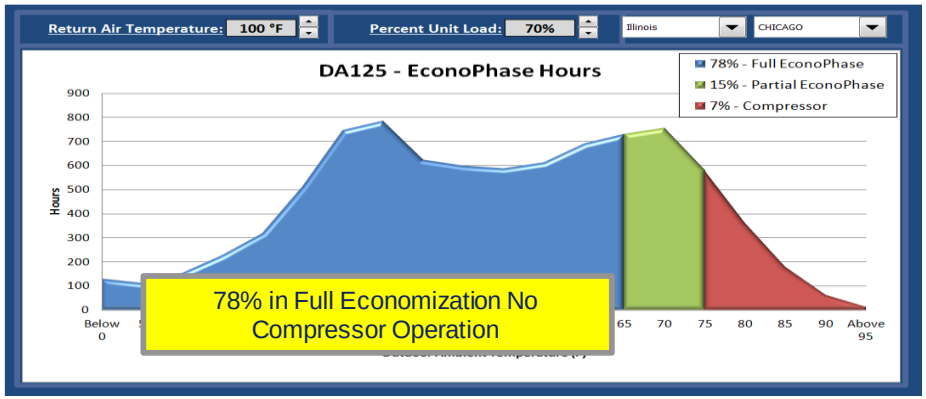
Larger building blocks 50 to 165 kW for sites up to 5 MW

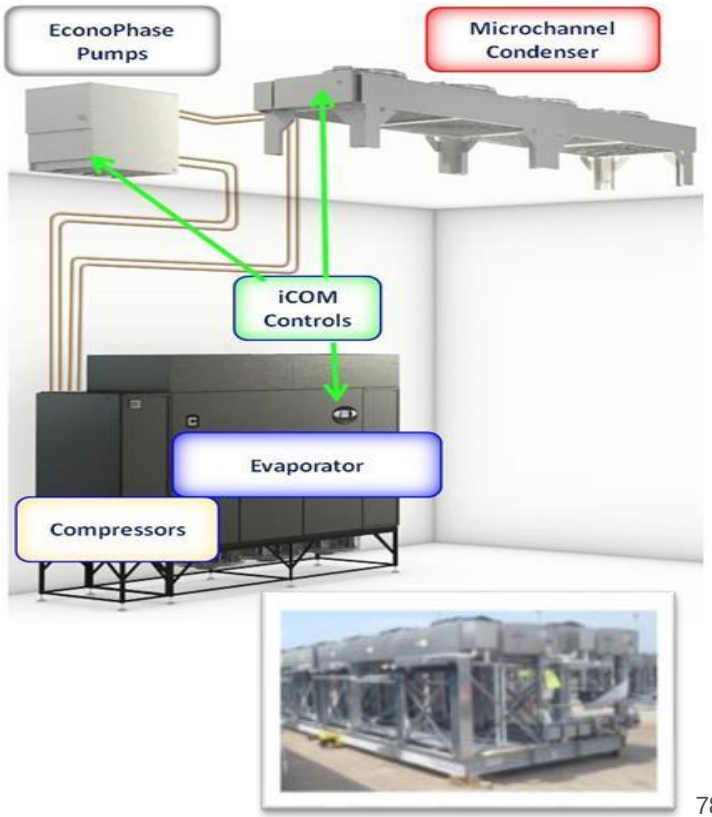
- Effective on Modular build outs
- Quick Deployment
- Global Deployments

Reliable and Low Maintenance Operation

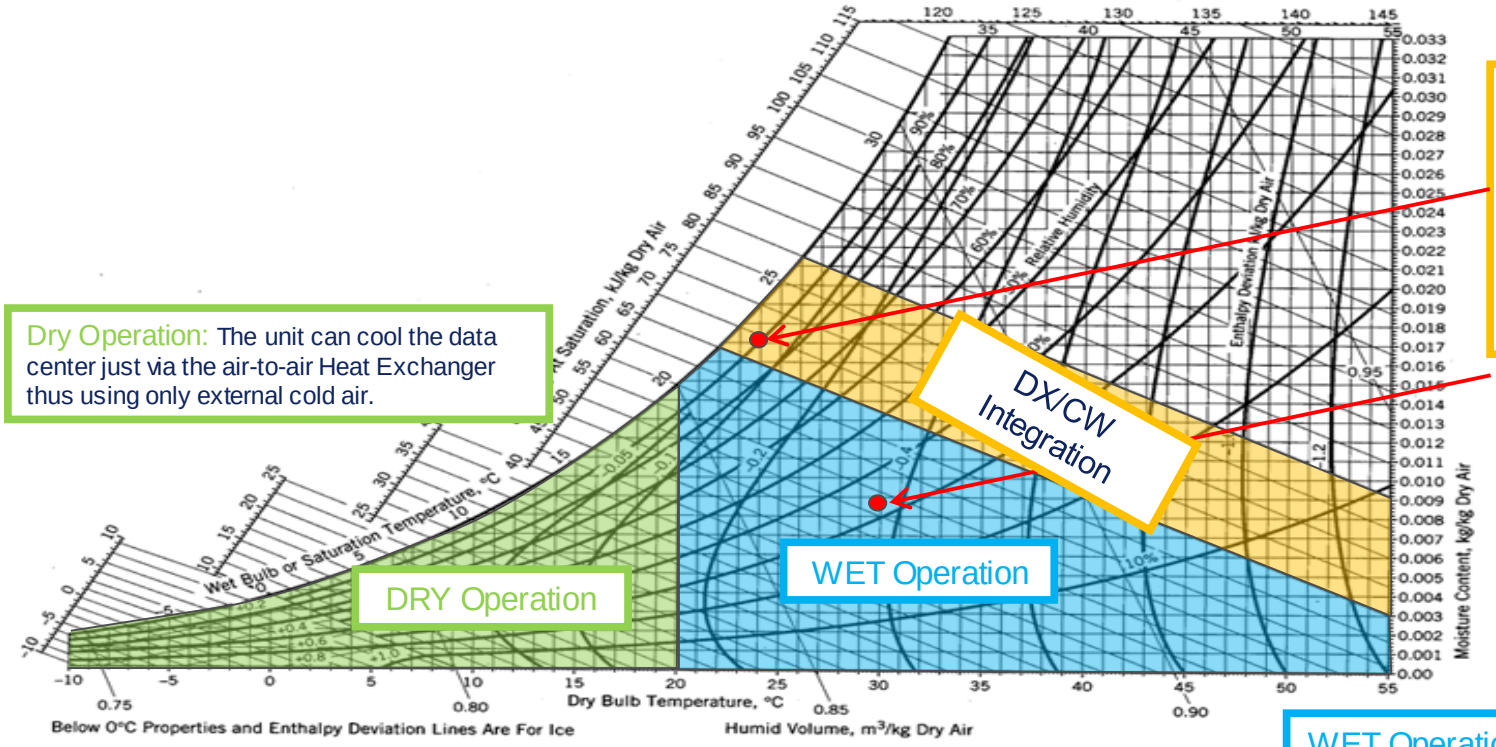
- No Water usage or treatment
- No Outside Air or damper maintenance
- Instant automatic economizer changeover

Approved as a prescriptive alternative to California CEC Title 24 for DC





Indirect Evaporative AHU - Liebert EFC



Dry Operation: The unit can cool the data center just via the air-to-air Heat Exchanger thus using only external cold air.

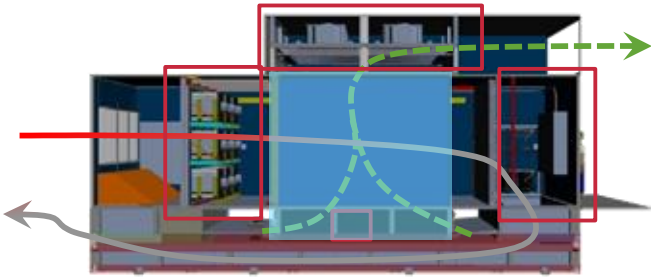
DX/CW Integration:

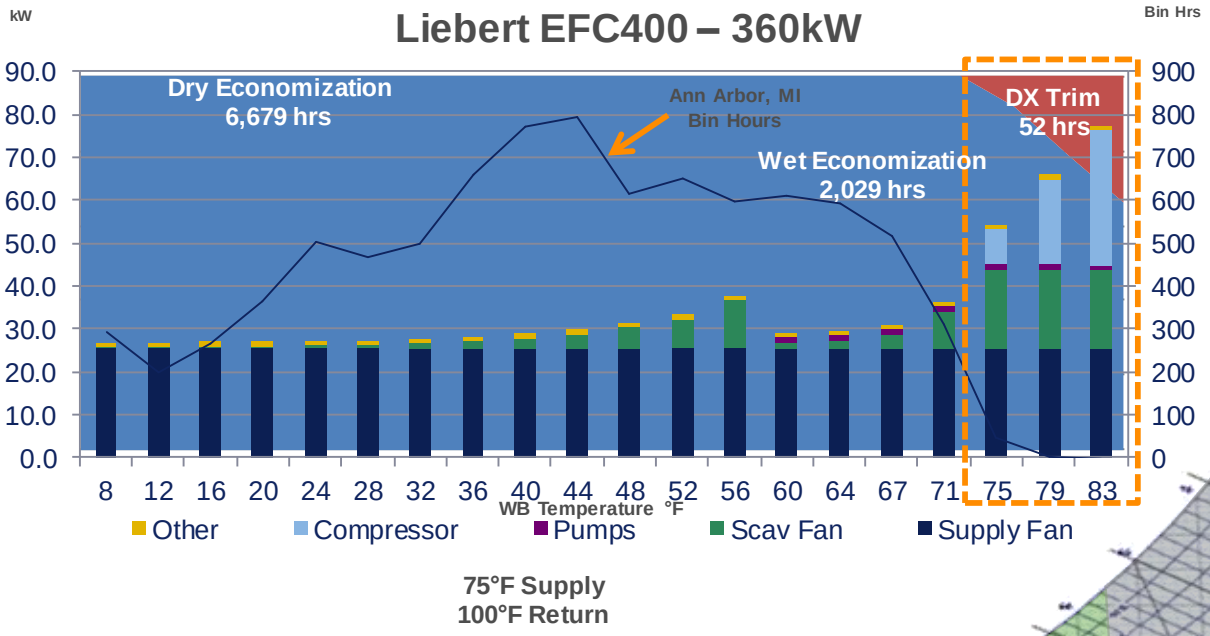
- At 24°C and 90% relative humidity, the unit might require DX/CW integration.
- But, at 30°C *(higher temperature) and* 35% *(lower relative humidity)* the unit can work just with the adiabatic.

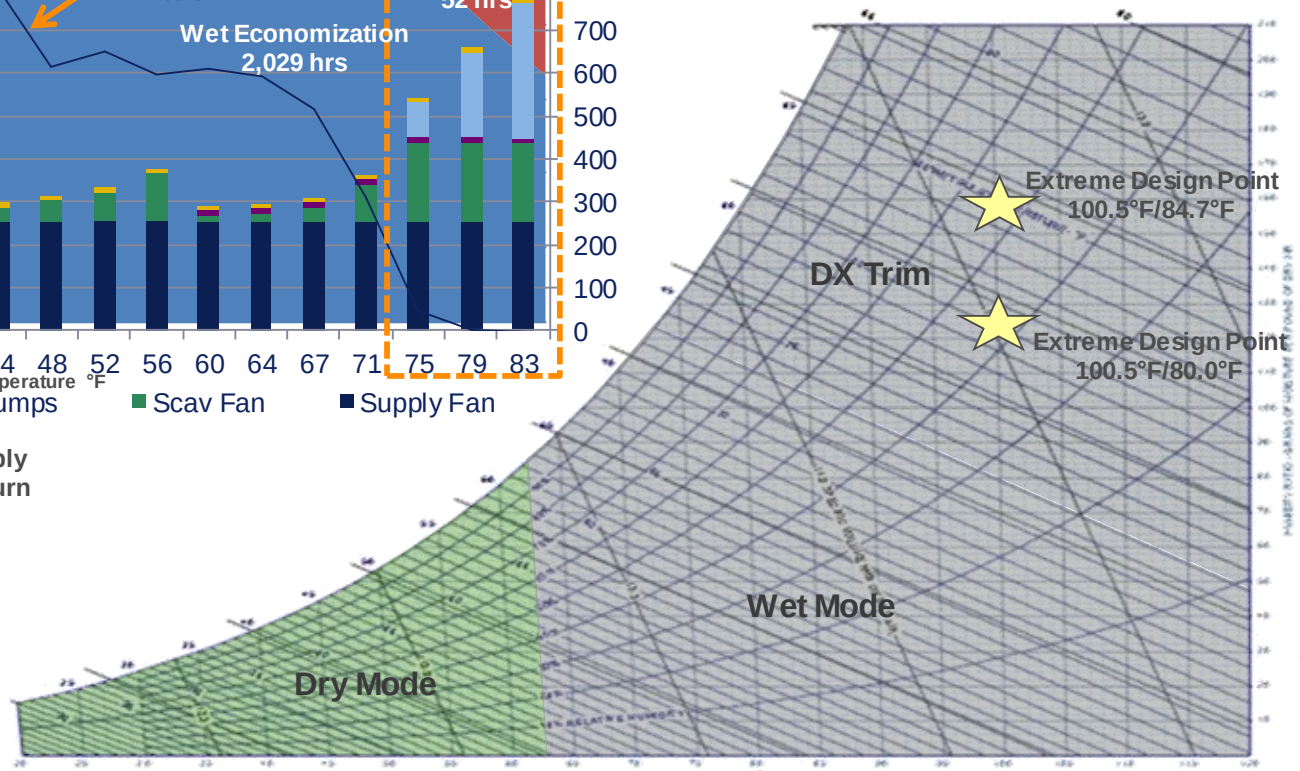
WET Operation: The unit can here exploit the adiabatic effect via humidification.

Assumptions:
- Data Center 36°C → 24°C
- 100% of Full Load per Unit

Liebert EFC400
Wet + DX Trim Operation







DISCUSSION AND Q&A

ENTERPRISE DATA CENTER SOLUTIONS

Mary Medeiros McEnroe, Public Benefit Program Manager | Silicon Valley Power - *moderator*

Nissim Hamu, Design Manager | Intel Corporation

Fred Rebarber, Manager, Technical Relations, North America | Vertiv

BREAK

Program will resume at 2:15 pm

PLEASE FILL OUT EVALUATIONS!

WHAT'S NEXT? THE FUTURE OF DATA CENTERS

Mark Modera, Director, Western Cooling Efficiency Center | UC Davis - *moderator*

Mukesh Khattar, Technical Executive, Data Centers | EPRI

Jeff Stein, Principal | Taylor Engineering

Jim Hanna, Director, Datacenter Sustainability | Microsoft

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ETCC EMERGING TECHNOLOGIES COORDINATING COUNCIL

DISCUSSION AND Q&A

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SESSION WRAP-UP

PLEASE FILL OUT EVALUATIONS!

UPCOMING ETCC EVENTS

Date	Event	Location & Host
February 8, 2017	Q1 Meeting: Commercial	Energy Education Center, Southern California Edison
April 19-21, 2017	Emerging Technologies Summit	Ontario Convention Center, Ontario, California
September 20, 2017	Q3 Meeting: Industrial	Bay Area, PG&E

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