Data Center Energy Efficiency Workshop

PG&E Emerging Technology Case Study – Submersion Cooling for Data Centers

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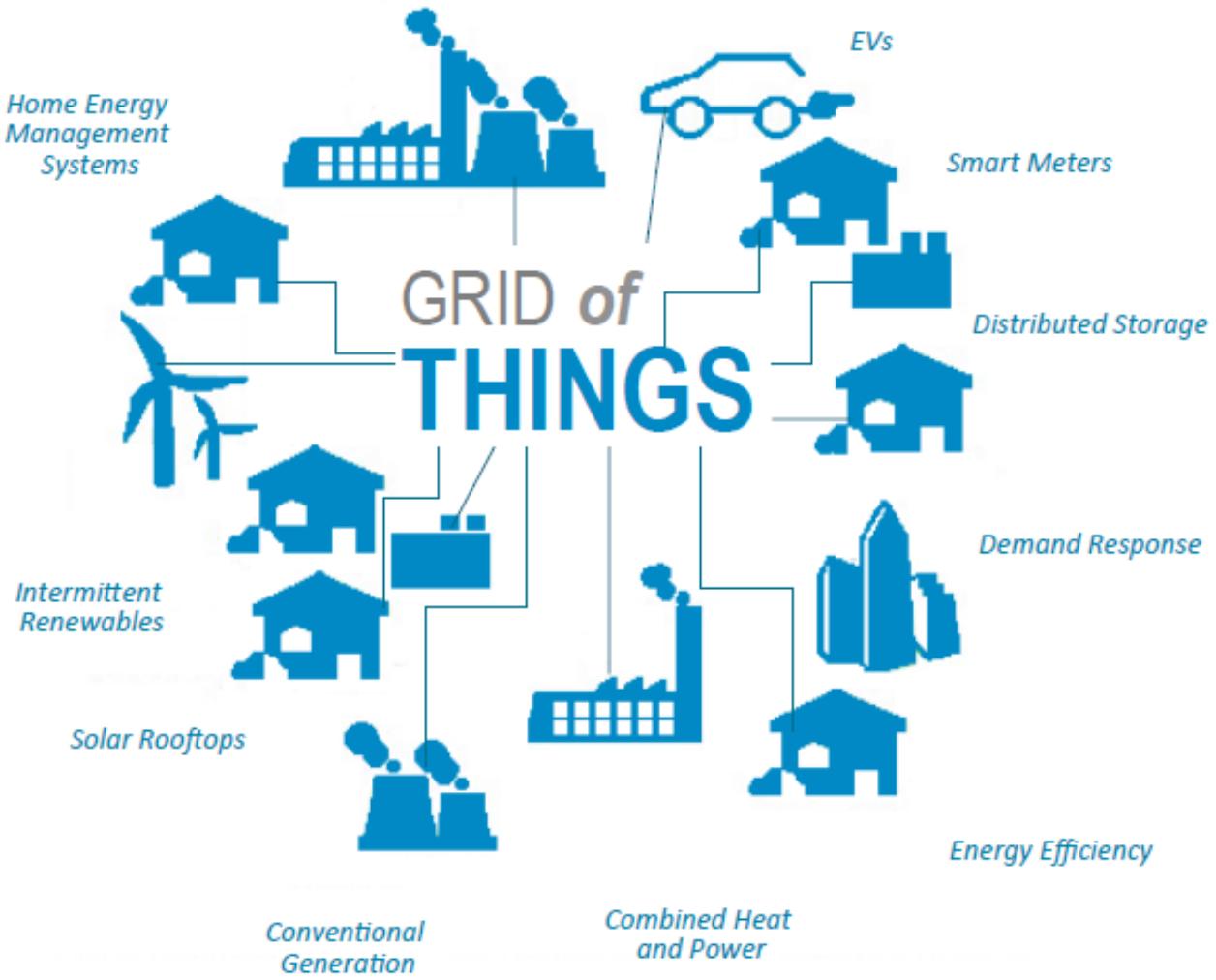
PRESENTATION OUTLINE

- PG&E Energy Efficiency Emerging Technology (ET) Program
- ET Projects for Data Center (DC)
- DC Submersion Cooling Case Study Overview
- Case Study - Goals
- Case Study - Methodology
- Case Study - Results
- Questions

PG&E Corporate Strategy



ET Projects for Data Centers

- **Submersion Cooling for Data Centers**
- **Data Center Infrastructure Management (DCIM) of IT Systems**
- **Data Center Economizer Contamination and Humidity Study**
- **Efficient Power Supplies for Data Centers & Enterprise Servers**
- **Air Flow Management in High Density Data Centers**

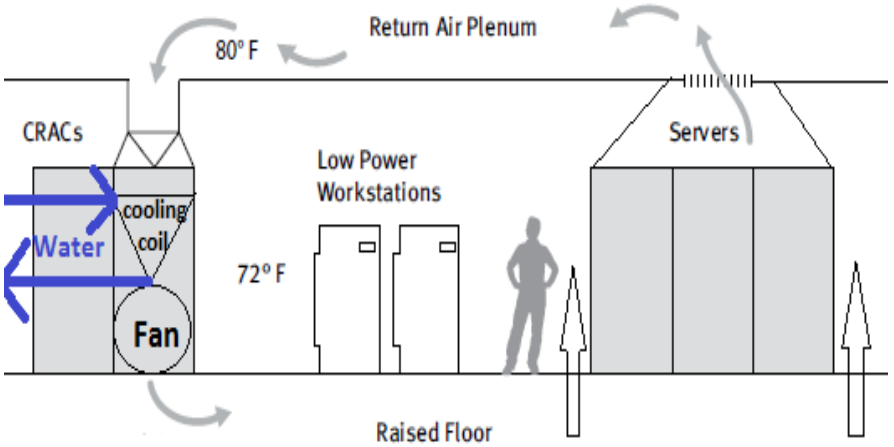
Note: http://www.etcc-ca.com/reports/submersion-cooling-data-centers-0

Submersion Cooling Case Study Overview

Technology – Mineral Oil GRC CarnotJet System (4 tanks)

Test Site – Telecom Data Center (Load Density = 17 kW/rack)

DC Configuration – Raised Floor, partial Hot/Cold aisle, Ducted Return Air Plenum and Chilled water CRAHs with VSD fans.



Submersion Cooling Case Study - Goals

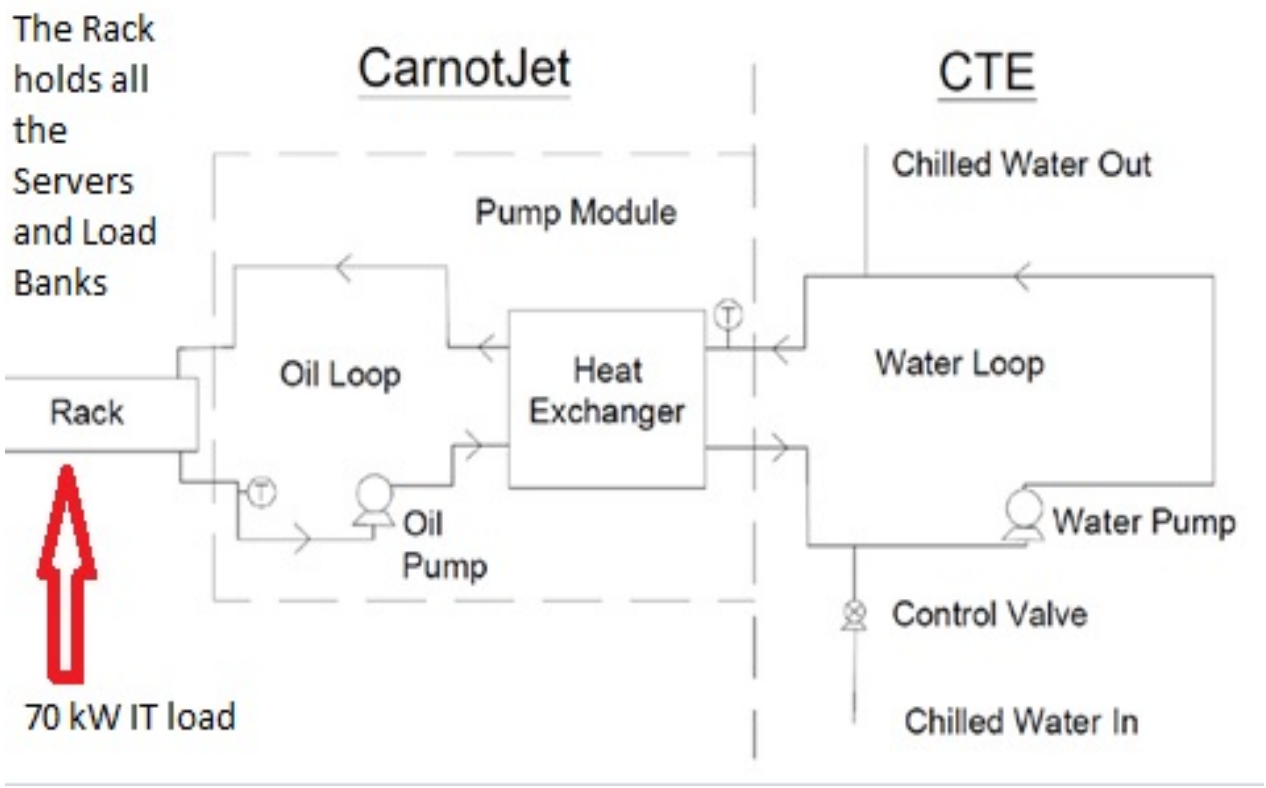
1. Technology Effectiveness – Does it work??
2. Estimate Energy Savings for PG&E EE Program

ID	Name	IT Load Density at Full Build-Out[B]		Design IT Load Density at Full Build-Out		Return Air Drybulb Temp. Setpoint	Oper-ating Supply Air Temp.	Oper-ating Airside Delta-T[C]	RH Setpoint and Tolerance[D]	Fan Airflow Effic-iency Metric[E]	Oper-ating CRAC/H Airflow Capacity[G]
		Min	Max	Min	Max						
		W/sf	W/sf	kW/ rack	kW/ rack	F	F	F		cfm/kW[F]	cfm
I	Hot Aisle/Cold Aisle, Open	0	100	0	10	74	64	10	50% +/- 10%	1,536	16,800
II	Hot Aisle/Cold Aisle, Ducted Return	101	220	0	10	78	65	13	50% +/- 10%	1,508	15,800
III	Hot Aisle/Cold Aisle, Fully Enclosed[A]	221	400	0	10	85	67	18	50% +/- 10%	1,482	13,875
IV	In-Row Cooling Solution			10	30						

Notes

Case Study - Methodology

1. Eight tests were run within two weeks
2. Various combinations of server loadings, rack temp setpoint, and cooling water temp setpoint were tested.



Case Study - Results

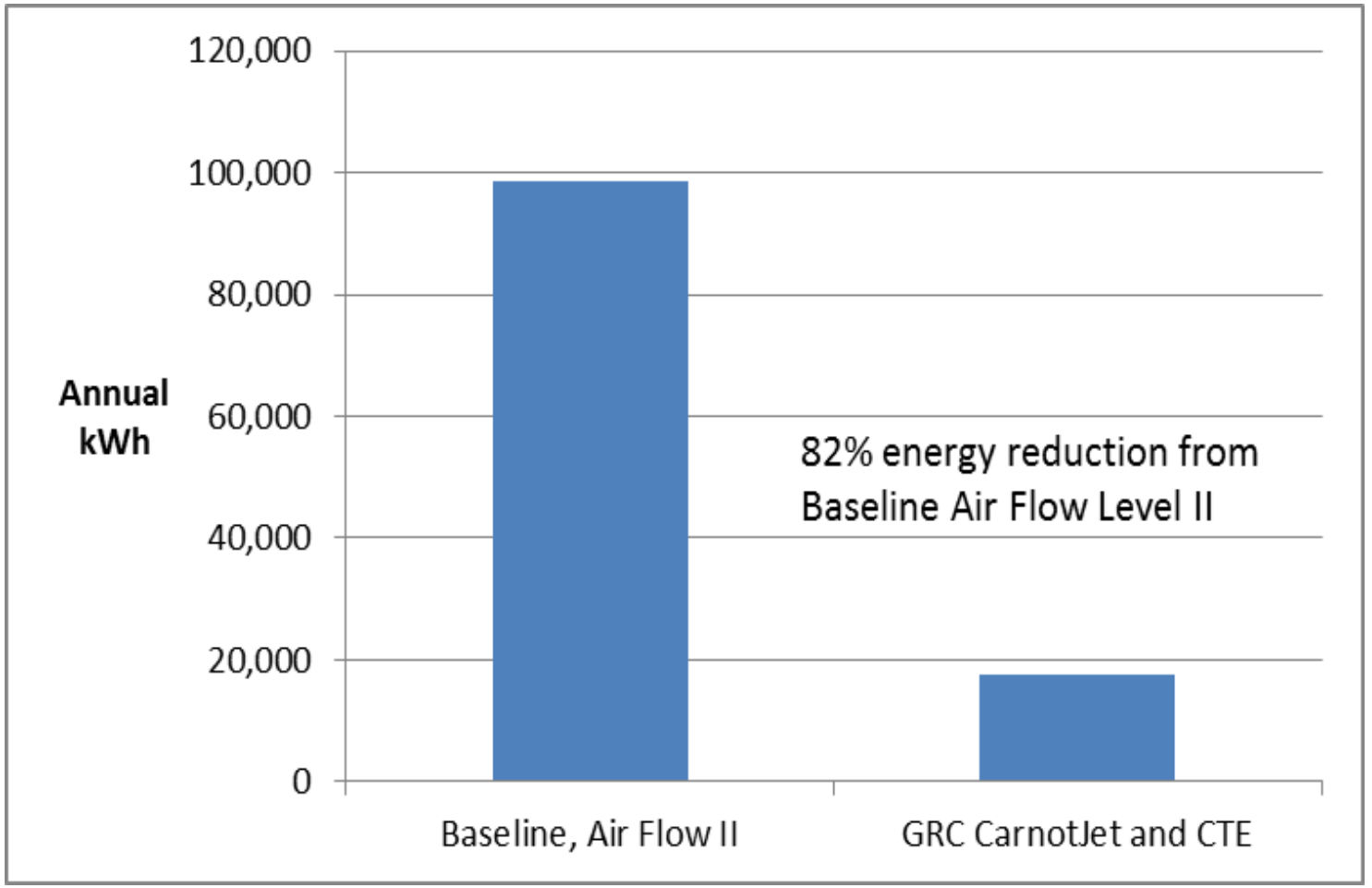
Goal (1) – Does it work?? YES

* The system was capable of maintaining the rack coolant temp at setpoint for all manufacturer test conditions (i.e., Test #1 and #4 through #8)

* Test #2 and #3 failed. They were "Extreme Test" using operating conditions beyond manufacturer recommended temp.

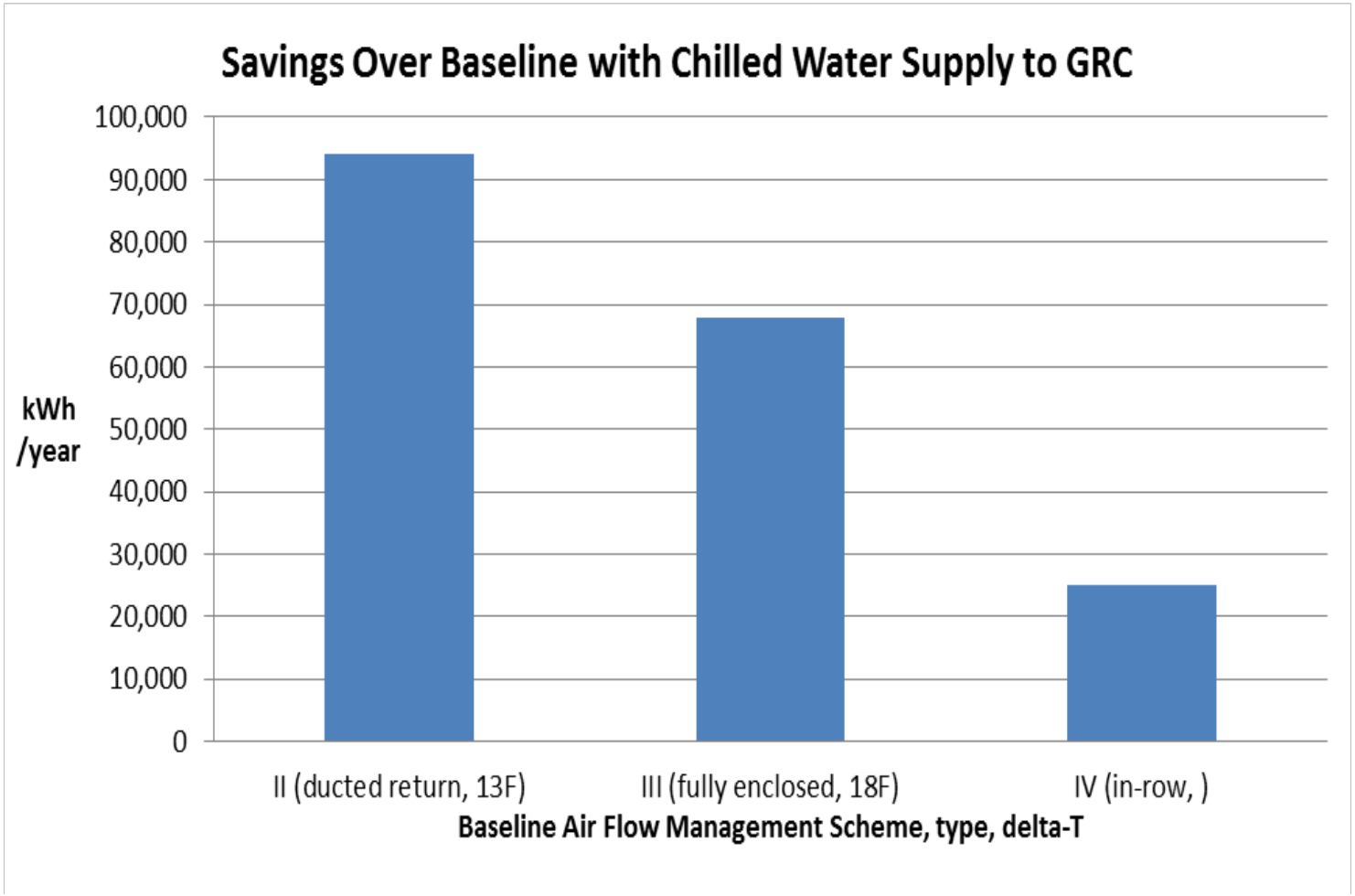
Test No.	Server Power (kW)	Oil Temp (°C)	Water Temp (°C)	Coolant Oil Pump Power (kW)	CTE Flow (GPM)	CTE Pump Power (kW)	LMTD (°C)	Oil Pump (kW/ton)	CTE (kW/ton)	Total GRC Power (kW)	Total GRC (kW/ton)
1	69.81	45.1	29.0	0.61	121.6	2.04	10.34	0.031	0.103	2.65	0.134
2	69.80	46.8	32.0	0.80	128.2	2.39	9.45	0.040	0.120	3.19	0.161
3	69.77	35.1	18.0	0.86	128.5	2.40	10.93	0.043	0.121	3.26	0.164
4	69.78	40.1	24.0	0.83	127.8	2.37	10.40	0.042	0.119	3.20	0.161
5	69.82	45.1	24.0	0.29	91.3	0.88	13.48	0.015	0.044	1.17	0.059
6	69.84	45.1	18.0	0.15	72.5	0.45	17.53	0.007	0.022	0.59	0.030
7	69.84	40.2	18.0	0.33	93.5	0.96	14.34	0.017	0.048	1.29	0.065
8	44.83	40.0	18.0	0.08	54.4	0.19	14.35	0.006	0.015	0.27	0.021

Case Study – Results (As-Installed)



Case Study - Results

Goal (2) – Theoretical Energy Savings Estimates



Questions?

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