Modular/Container Data Centers Selection Guide: Optimizing for Energy Efficiency and Quick Deployment

- White paper sponsored by Federal GSA and prepared by LBNL.
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- Available at LBNL website:

http://hightech.lbl.gov/documents/data_centers/modular-dc-procurement-guide.pdf

Executive Summary

- Modular data centers, often in standard shipping container form factors, are being deployed by “utility scale” data center operators, and are marketed as an energy efficient and rapidly-deployable solution to enterprise customers, including federal government agencies.
- For users, specifying “second generation” modular data centers featuring air-side economizers will ensure not only significant energy and operational cost savings, but also lower deployment costs due to a reduced need for support infrastructure.
- This paper describes the key features of modular data centers, and guides potential users in selecting a feature set that best meets their operational needs.

Modular Data Centers

Oracle Sun Modular Data Center, Featuring a Unique IT Rack Layout

HP's POD Unit Featuring a Single Row of IT Rack Space. Cooling Design Uses Overhead Water-Cooled Coils

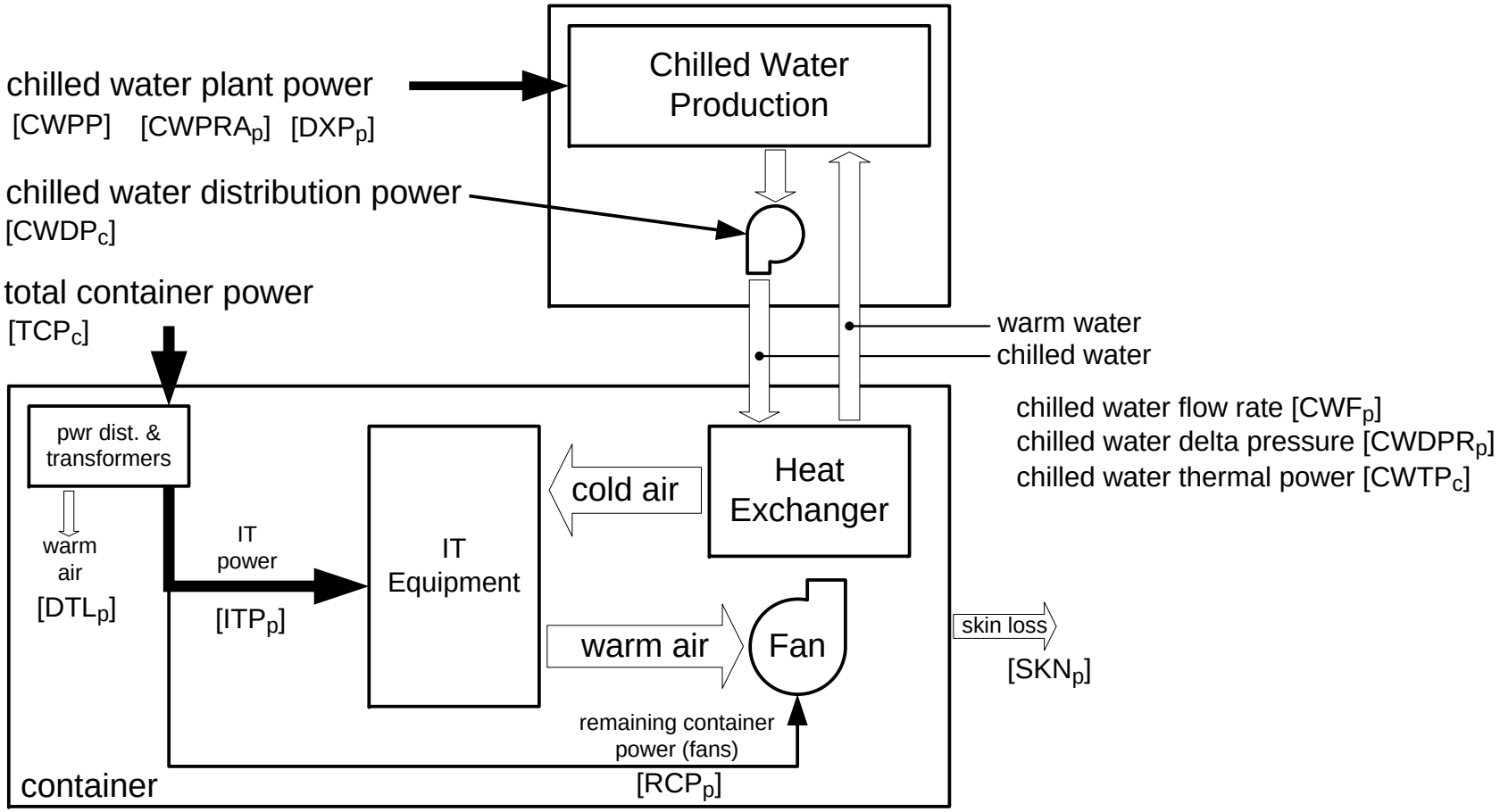
SGI Ice Cube Air Modular Data Center Featuring Air-Side Economizer Cooling

Energy Efficiency Attributes

- All solutions offer the advantages of full airflow containment and close-coupled cooling
- First Generation units require chilled water supply, or use on-board DX
- Second Generation units feature air-side economizer, supplemented as needed by evaporative or other cooling system

Energy Efficiency Analysis

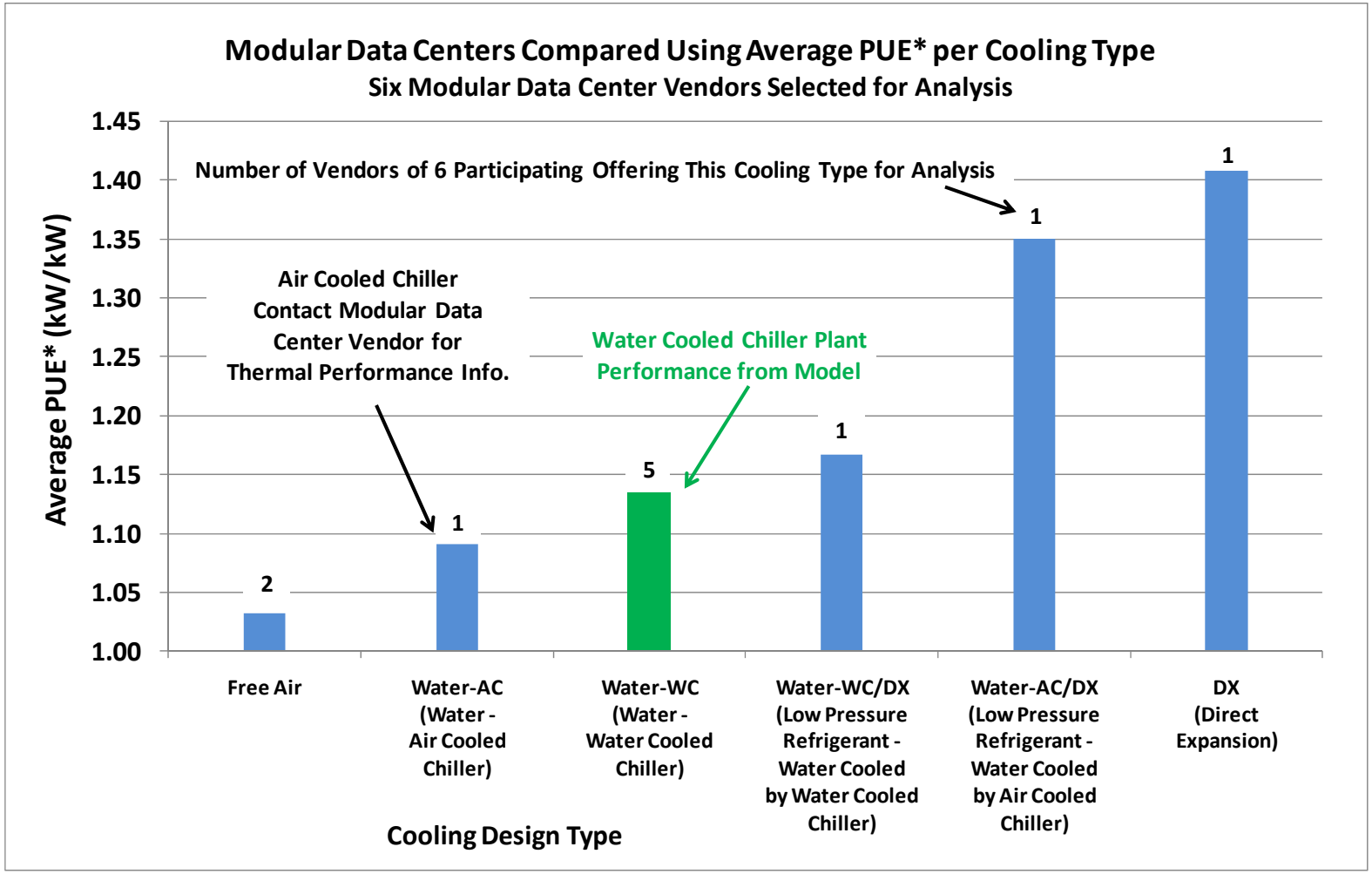
PUE = (total power supplied to the module + power to produce externally acquired chilled fluid) / IT power*



Modular Data Centers

	Description	Provided	Calculated	Calculated	Calculated	Calculated	Provided	Calculated
Company	Cooling Type Server Air Inlet Temp.(F) Chilled Water Supply Temp.(F) Server Air Flow (cfm/kW)	IT Power [ITPp] (kW)	Remaining Container Power [RCPc] (kW)	Total Container Power [TCPc] (kW)	Chilled Water Pump Power [CWDPc] (kW)	Chilled Water Plant Power [CWPPc] (kW)	DX Power [DXPPp] (kW)	PUE*
HP	Water-WC, 72, 62, 112	580	17.4	603	5.20	44.7	NA	1.13
HP	Water-WC, 80, 70, 91	580	17.4	603	5.20	26.7	NA	1.09
HP	Outside Air, 72, NA, 112	1520	45.6	1581	NA	NA	NA	1.04
i/o Data Centers	Water-WC, 80, 60, 120	200	7.0	215	0.42	18.0	NA	1.17
i/o Data Centers	Water-WC, 80, 60, 120	1000	35.0	1076	2.55	90.0	NA	1.17
i/o Data Centers	Water-WC, 80, 60, 120	3200	112.0	3444	10.01	288.0	NA	1.17
i/o Data Centers	Water-WC, 80, 60, 120	6400	224.0	6889	25.22	576.0	NA	1.17
Liebert	Water-WC/DX, 75, 55, 120	300	2.1	317	0.02	33.4	NA	1.18
Liebert	Water-AC/DX, 75, 55, 120	300	2.1	317	0.02	88.4	NA	1.36
Liebert	DX, 75, NA, 120	200	2.1	212	NA	NA	72.0	1.42
Liebert	Water-WC/DX, 80, 60, 120	300	2.1	317	0.02	26.6	NA	1.16
Liebert	Water-AC/DX, 80, 60, 120	300	2.1	317	0.02	81.2	NA	1.34
Liebert	DX, 80, NA, 120	200	2.1	212	NA	NA	66.9	1.40
SGI	Outside Air, 77, NA, 120	280	4.0	287	NA	NA	NA	1.02
SGI	Water-WC, 77, 65, 120	750	9.5	767	2.29	48.58	0	1.09
PVD	Water-WC, 72, 58, 100	400	17.3	417	3.91	38.46	NA	1.15
PVD	Water-WC, 80, 68, 100	400	17.3	417	3.91	21.84	NA	1.11
PVD	Water-AC, 72, 58, 100	400	17.3	417	3.91	15.19	NA	1.09

Modular Data Center Thermal Analysis Results



Comparison Brick and Mortar to Modular

Primary Attributes	Traditional "Brick and Mortar" Data Center	First Generation Modular	Second Generation Modular
Time to Deployment	Long – typically two years from design to commissioning	Potentially short – perhaps in months depending on site conditions and available infrastructure	Same as First Gen. Modular with advantage that reduced cooling infrastructure is required
Capital Cost	Highest – generally thought to range from 10-$20 million per MW of IT capacity	Lower – though there is a lack of documented deployment costs	Lowest – marginal increase in cost of unit, made up for by reduced infrastructure costs
Operating Cost	Variable, with legacy data centers having PUE's exceeding 2.0 and best-in-class designs approaching 1.2 or lower if using outside air for cooling	Similar to traditional data center using the same cooling type. Pre-engineering and better system integration may provide some advantages.	Similar to best in class legacy data centers that use air-side cooling.

Presentation posted at www.markbramfitt.com

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