Open. Together.
PUE 0.7, Data Center of the Future?

Michael Beatty
Data Center Consultant

*Data Center Dimensions*
Today’s Convergence

Sustainability
- Facebook commitment to reduce greenhouse gas footprint by 75%
- Microsoft commitment to cut carbon emissions by 10 million metric tons by 2030
- LEED Designs (Leadership in Energy and Environmental Design)

Internet of Things (IOT)
- Edge Data Centers, Remote Data Collection and Processing, 5G Rollout

Technology
- Liquid Cooling, Very Low PUE
- Advanced Modular Solutions

Cloud and Colocation Solutions
- Public
- Private
- Hybrid
Data Center Heat Recovery

Technology Exists for Practical Heat Recovery
LiquidCool (Dielectric Fluid Solutions)
Cloud & Heat Technologies (Water Based Solutions)

Liquid Cooling Much More Efficient than Air
Dielectric Fluid Options
Water Options

Technology Tested and Operational at 140°F (60°C) Exiting Temperatures From Server

Older Buildings Typically Use 180°F (82°C) Water for Heating

New Construction Buildings Typically Use 120°F – 140°F (49°C – 60°C) Water for Heating
(Condensing Boiler Technology)
Data Center Heat Recovery

No chiller required
Incoming “cool” fluid can be as high as 50°C (122°F)

Option 1: Direct External Heat Removal

Option 2: Heat Recovery for Building Heating

OCP SUMMIT
Open. Together.
Data Center Heat Recovery

Suggested Heat Recovery Adjusted PUE Calculation

\[
\text{(Total Facility Power – BTU Heat Recovered}/3.412) / \text{Total IT Power}
\]
Data Center Heat Recovery Simplicity

**Hardware Technology**
Liquid Cooling Server Technology Already Exists with Multiple Vendors
Longer Lasting IT Hardware, No Exposure to Dust and Environment

**Mechanical**
Very Few Moving Parts – Fluid Pumps and Drycooler Fans, Very Easy for Spare Parts
No Compressors, No Chillers, No CRACs, No Airflow Issues

**Electrical**
Consider UPS Options which function up to 100°F
EcoMode UPS Options for 99% UPS efficiency

**Water**
No Water Usage other than Potential Closed Loops
Data Center Heat Recovery

In a survey of 55,000 schools in the USA…

1. …that have a median size of 75,000 ft²,
2. …And an Annual Median Fuel Consumption of 114,000 BTU/ft²,
3. …Where 92% of Fuel Consumption goes to Building Heat and Hot Water (78,660 therms/year),
4. …Contributing 417 metric tons of CO₂ per year per School,
5. …Meaning 55,000 Schools Contribute 22,935,000 Metric tons CO₂ Every Year
6. …There are approximately 132,000 public and private schools in the USA
7. …An Estimated 1000-2000 New Schools are Built Each Year
8. Microsoft wants to cut 10,000,000 metric tons CO₂ by 2030, Heating 1500 Schools with Edge Data Centers could eliminate approximately 6,255,000 metric tons CO₂ over 10 Years

Source: Energy Star Data Trends, Energy Use in K-12 Schools, Jan 2015

<table>
<thead>
<tr>
<th>Power Capacity</th>
<th>Building Types</th>
<th>Carbon Emission Reduction Estimates</th>
<th>Estimated Heating Cost Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>500 KW</td>
<td>Small School, Small Office Building, Public Building</td>
<td>200-300 metric tons/year (2500 tons over 10 years)</td>
<td>$50,000/Year $1 million+ over 20 Years</td>
</tr>
<tr>
<td>1000 KW</td>
<td>Mid-Sized School, Museum, Mid-Sized Office Building, Warehouse</td>
<td>400-600 metric tons/year (5,000 tons over 10 years)</td>
<td>$100,000/Year $2 million+ over 20 Years</td>
</tr>
<tr>
<td>2000 KW</td>
<td>Large Office Building, Building Complex, Hospital, Industrial Applications</td>
<td>900-1200 metric tons/year (10,000 tons over 10 years)</td>
<td>$200,000/Year $4 million+ over 20 Years</td>
</tr>
</tbody>
</table>
Data Center Heat Recovery Possibilities

Source: University of Michigan Center For Sustainable Systems
Data Center Heat Recovery
Win – Win – Win Solutions

Potential Marketplace Clients
Cloud Providers, Colocation Providers
Cable/Telecom Providers

Win – Win - Win
Helping Corporate Clients and End Users Achieve Carbon Emissions Reductions
Helping the Environment
Free Heating in Exchange for Free Land/Space Use, No Property Taxes
Shared Generator and Generator Services
Shared IT Services
Potential Dedicated Private Cloud Opportunities, Security Benefits for On-Site Customer Location
Data Center Heat Recovery – Road Map to Success

Engineering Needs
- Capacity Needs Review
- Ideal Drycooler – 3-way valve – Building Heat Design/Control
- Energy Recovery PUE Calculation and Monitoring
- Rolling Virtual Workload Analysis/AI to Meet Heating Loads
- Redundancy Requirements
- Liquid Cooling for Network and Storage

Site Preferences
- Security Requirements
- Identify Ideal Target Markets
- Engineer Education
- EcoMode Options for 99% UPS efficiency

Service/Maintenance Planning and SLA’s
How do I get involved?

If you are interested in participating on a sub-committee to share ideas, information, and practical application for Data Center Heat Recovery Projects

Email Volunteer Leaders:

Michael.Beatty@datacenterdimensions.com
Brevan.Reyher@ocproject.com
Robert.Bunger@ocproject.com

https://www.opencompute.org/projects/data-center-facility

https://ocp-all-groups.io/g/OCP-DCF