

Small Embedded Data Center (SEDC) Pilot Webinar

Conservation Applied Research & Development (CARD)

July 24, 2017

Presentation Preparation

- Attendees will be in listen-only mode
- Use the text box to ask questions or if there is a problem with the presentation visual or audio
- We will try to answer all questions during the presentation
- Presentation is being recorded and will be made available, along with the SEDC Final Report, to all participants.



Small Embedded Data Center (SEDC) Pilot Webinar

Conservation Applied Research & Development (CARD)

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Minnesota Applied Research & Development Fund

Purpose to help Minnesota utilities achieve 1.5 % energy savings goal by:

- Identifying new technologies or strategies to maximize energy savings;
- Improving effectiveness of energy conservation programs;
- Documenting CO₂ reductions from energy conservation programs.

Minnesota Statutes §216B.241, Subd. 1e.

CARD RFP Spending by Sector thru mid-FY2017



Project Team

- Center for Energy and Environment (CEE) with the following partners:
 - MnTAP = Minnesota Technical Assistance Program
 - WECC = Wisconsin Energy Conservation Corporation
 - Foundation Technologies
 - Packet Power

SEDC Program Pilot

- April-May, 2015: market characterization via an electronic survey (WECC)
- November 2015 February, 2017: field study (CEE/MnTAP)
- April 2017: final report (CEE)
- July 2017: pilot results (CEE/MnTAP/WECC)



- Overview
- Characterization
- Recruitment
- Field Study Findings
- Recommendations

LESTER SHEN, CEE

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- In 2016 data centers used about 70 billion kWh of electricity or about 1.8% of the total electricity in the U.S.
- About half of all the servers in the U.S. are located in small embedded data centers (SEDCs).
- As much as a third of the electricity used by SEDCs is unnecessary.

- SEDC typically occupy a room/rooms in a building.
 - Serve the host business or institution.
 - May have network closets (intermediate distribution frames) in several locations in the building.
- Small embedded data centers are one of the fastest growing end uses of electrical energy in commercial buildings.



SEDC server configuration

Flow of Electricity in SEDC



- Heat is generated from all server rack equipment
- ASHRAE recommends data center server rack inlet temperatures are maintained in the range of 64.4°F to 80.6°F.
- Dedicated cooling equipment can be used:
 - Rooftop units (RTUs)
 - Ductless splits
 - Computer room air-conditioning unit (CRAC)

- Pilot Project Tasks
 - Market Characterization Surveying
 - Site Recruitment Outreach + Scheduling
 - Field Study Monitoring, Data Collection, Measures
 - Findings Data Analysis and Recommendations
 - Dissemination Final Report and Final Presentation

JANET LYNCH-EISENHUT, WECC

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- 82 survey respondents were small embedded data centers (SEDC)
 - <1,000 sq. ft. area (server closets and rooms)
 - Majority of SEDCs (57%) were small server closets
 - Twenty-nine (35%) of participants were located in Twin city metro area







SEDC Survey Respondent Market Sectors

- 35% of survey respondents were a unitary business/building
 - 50% with 1 server rack
 - 38% with 2-4 server racks
 - 9% with 5-9 server racks



Monitoring

- 60% monitor server utilization
- 13% all respondents monitor power usage of equipment

- 66% had done server virtualization
- 48% both virtualization and cloud services



- Survey Respondent Equipment
 - Server industry average refresh rate is three years
 - 39% of 82 survey SEDC respondents had equipment over three years
 - 68% of respondents would upgrade servers to ensure dependability
 - 60% would upgrade based on planned upgrades



- Only 2% of respondents were aware of utility incentives
 - Over half of respondents were interested in free energy audit
- 52% identified equipment vendors as trusted source



Recruitment

JON VANYO, MNTAP

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Recruitment

Participant sites were recruited from:

- Electronic survey
- CEE and MnTAP contacts
- Utility customers

Recruitment

Site	Sector	Server Rooms	Server Room Racks	IDFs	Total SEDCs
Site 1	Architectural Design	1	10	3	4
Site 2	Architectural Design	1	3	0	1
Site 3	Healthcare	0	0	5	5
Site 4	Legal Services	1	2	0	1
Site 5	Municipality	1	6	0	1
Site 6	Non-Profit	1	2	2	3
Site 7	School District	1	5	2	3
Site 8	School District	1	9	2	3
Site 9	Manufacturing	1	4	0	1
Site 10	Manufacturing	1	4	0	1
Site 11	Manufacturing	1	2	0	1
	Total	10	47	14	24

Field Study

JON VANYO, MNTAP AND LESTER SHEN, CEE

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Site Assessment Process

- Meet with site contact.
- Explain project in more detail
- Collect information on IT and Cooling Equipment.
 - Perform inventory of IT equipment in the server racks.
- Install Meters
 - UPSs collect all energy data for IT equipment
 - HVAC collect energy data for cooling equipment

Field Monitoring



Protocol for Site Field Studies

- Collect data characterize baseline use
- Analyze and identify energy savings measures
- Collect data to measure energy savings
- Uninstall Meters

SEDC IT Equipment

- Servers
- Switches
- Storage
- UPS

SEDC Cooling Equipment

Site	Dedicated Air Conditioning			
Site 1	CRAC with under floor air delivery			
Site 2	In-Row			
Site 4	RTU			
Site 5	Three ductless splits			
Site 6	Exhaust fan			
Site 7	RTU			
Site 8	Two ductless splits			
Site 9	RTU			
Site 10	Three ductless splits			
Site 11	CRAC			

Findings

- Average server room power draw of 4,520 watts
 - \$3,960 per year (39,600 kWh per year)
- Average Intermediate Distribution Frame (IDF) had an average load of 882 watts
 - \$770 per year (7,726 kWh per year)
- No site had 24/7 business operation, but most IT equipment is left on 24/7

IT Energy Savings Opportunities



Predicting IT Power Load



Typical UPS Efficiency Curve



Servers



- Turn off dormant or "comatose" servers
- Consolidate physical servers through virtualization
- Schedule server power through distributed power management ("Live Migration")

Network Switches, Data, & PoE Devices



Cooling Energy Savings Opportunities





SEDC Thermostat Settings



Air Flow Management



	UPSs	Servers	Switches	Power
Server room	3	11	7	4520 W

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Live Migration		-172 W		2426 W	46%

Recommendations

LESTER SHEN, CEE

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Recommendations for IT Staff

- Rely on equipment vendors for support of operation and replacement options
- Usage data (monitoring, UPS power loads, server inlet temperatures)
- Operational efficiency measures (baseload, phantom loads, set back)
- Equipment purchases (ENERGY STAR[™], proper sizing)
- Cloud services / collocation (PUE from ~2.0 to 1.1?)

Recommendations for Utility Programs

- Raise awareness of incentives and rebates
- Measured and deemed savings (Pay for Performance and TRM)
- Develop midstream approaches through vendors service providers.
- Design assistance (server room design and engineering)
- Recommissioning (HVAC)



QUESTIONS?

CARD Project Resources

Conservation Applied Research and For Reports use **Development Industries & Agencies CARD Search** Funds projects to identify new technologies or strategies Energy **Quick Link** RESOURCES to maximize energy savings, improve the effectiveness of Solar Industry Wind Industry energy conservation programs, or document the carbon **Bioenergy Industry** dioxide reductions from energy conservation projects. CARD Webinars & Videos Energy Environmental Review & Analysis Energy Efficiency Background Request for Proposals Distributed Energy Resources The Next Generation Energy Act of 2007 (the Act) established energy Proposals & Evaluations For Webinars use Financial Assistance conservation as a primary resource for meeting Minnesota's energy needs Technical Assistance while reducing greenhouse gases and other harmful emissions. The Act also **CARD Webinars &** Commercialization Assistance established a savings goal of 1.5 percent of annual retail electricity and QUESTIONS? Utilities Videos Quick Link natural gas sales for all utilities in the state. The utilities may reach this annual goal directly through its utility Conservation Improvement Program For questions related to the CARD program, Annual Reporting (CIP) and, indirectly, through energy codes, appliance standards, behavioral upcoming events, or if you'd like to provide Rate Cases feedback or suggestions, contact: and other market transformation programs. Conservation Improvement Programs To help utilities reach their energy savings goal, the Act authorizes the Department of Commerce Technical Reference Manual Mary Sue Lobenstein | R&D Program commissioner to assess utilities \$3,600,000 annually for grants for applied Administrator Applied Research & research and development projects: > Development E-mail: marysue.lobenstein@state.mn.us \$2,600,000 for the Conservation Applied Research and Development Projects & Rates (CARD) program through which Commerce awards grants in a Service Providers competitive Request for Proposal (RFP) process. **Financial Institutions** \$500,000 for the Center for Sustainable Building Research to coordinate activities related to Sustainable Building 2030 (SB2030) Insurance • \$500,000 for the Clean Energy Resources Teams (CERTs) for community energy technical assistance and outreach. Unclaimed Property Link to Securities, Franchises & Program Updates Project Info Stakeholder Info Subdivided Lands Grantee Info **SEDC Final Report** Fuel CARD Program Updates Scales & Meters FY 2017 CARD RFP Retailers Two CARD Request for Proposals (RFPs) have been posted for fiscal year 2017: Telecom Provider

CARD Web Page (https://mn.gov/commerce/industries/energy/utilities/cip/applied-research-development/)



Thanks for Participating!

Upcoming CARD Webinars:

- July 26: Statewide Commercial Behavior Segmentation & Potential
- August 17: Expanding New Construction Design Assistance Statewide

If you have questions or feedback on the CARD program contact: Mary Sue Lobenstein marysue.Lobenstein@state.mn.us 651-539-1872