IDEA Synopsis Submission

University of Minnesota 2017 IDEA Annual Energy Conference Abstract

Topic: District Cooling: A Heating Highway

Submitted by: Scott McCord, PE, University of Minnesota

Abstract 1: When the days shorten, the mercury drops, and Minnesotans begin to consider putting on a jacket, recapturing waste heat in district cooling systems seems like an idea worth warming up to. The concept has evolved into practice at several U of M cooling plants as the process picks up steam (load) in the North American District Energy industry. Using a unique business approach involving sales of both cooling and heating energy from the process has begun to provide mutual benefits to both Steam and Chilled Water businesses.

Background: The University of Minnesota has begun to deploy distributed heat recovery of chilled water in four various ways across its 41,000 ton, 16 decentralized cooling plant network using both existing assets in unique ways and specialized equipment. Energy production and distribution on the U of M's main Twin Cities campus operates as Independent Service Organization business units.

District Cooling:
A Heating Highway

Presented by Scott McCord, PE
University of Minnesota

District Cooling in Minnesota?

Doesn’t Nature do that?

Average Annual Temperature: *46.15 deg F*

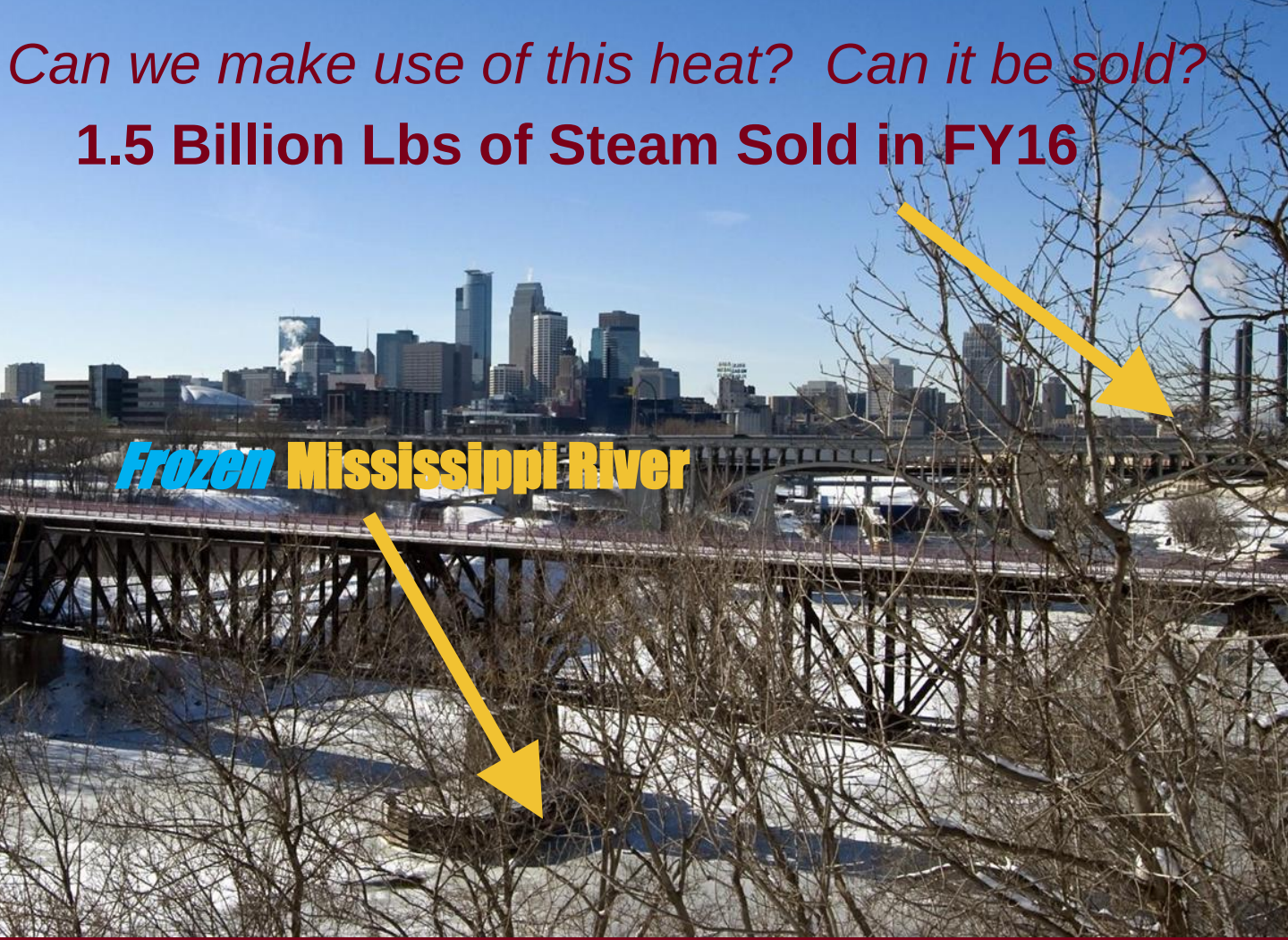

41,000 tons in the Summer


Only 760 tons in the Winter

Research parks, data centers and other process loads require year-round operations of the cooling plants.

Can we make use of this heat? Can it be sold?

1.5 Billion Lbs of Steam Sold in FY16



We need a business model to reuse this network of *low-grade heat* ….

Combined Heating and Cooling:
Thermal Utilities Campus Business Model

- District Cooling Business Unit Owns and Maintains Equipment

- District Heating Business Unit *Reimburses* District Cooling Business for "incremental energy" of operating Heat Recovery Chiller vs. Business as Usual as part of "*Fuel*" budget

- Dedicated Heat Recovery Chillers: District Heating unity pays for compressor power via power meter.
- Combination Conventional-Heat Recovery Units: Empiracle rate determined (typically 80-120 kWh/MMBtu) *Reimbursed* to District Cooling from District Heating

Deployment of Heating w/ District Cooling Grid @ U of M:

- Cooling Plant & Electrical Switch Station Heating
- Research District w/ High Reheat Load
- Heat-Load-Following Heat Recovery Chiller w/ Free Cooling
- Heat Recovery using Existing Chiller Plant Assets

Chiller Plant and Switch Station Heating:

Fitch Avenue Utility Building

- 30 Ton Water to Water Heat Pump used to heat facility
- $400k First Cost Savings vs. Installing District Heating
- 20% Annual Savings vs. District Heating or Stand Alone Natural Gas Units
- Avoids ASHRAE 15 Conflict between Refrigerating Machine Room and Open Combustion Flame

Research District w/ High Reheat Load

- Catalog Packaged Heat Recovery Chiller Systems:
  - *Cooling Energy* << *Heating Energy*
  - *Control on CHWS Temp Set Point*
- District Designed around 120-140 deg F Low-Temp Hot Water Supply Temperatures
  - Economical COP
- Positive Displacement Heat Recovery Chillers
- Preferential preheat coil return water to unit during winter for improved COP and capacity recommended.

Heat-Load-Following Heat Recovery Chiller w/ Free Cooling

- Custom Packaged Heat Recovery Chiller System:
  - *Cooling Energy* >> *Heating Energy*
  - *Control on HWS Temp Set Point w/ Floating CHWS*
- District Designed around 115 deg F Low-Temp Hot Water Supply Temperatures
  - Economical COP
- Centrifugal Heat Recovery Chiller
- Cooling Load >> Year-Round Heating Load = Challenging Deployment and Control
  - *Recommend Heat Recovery Chiller & Free Cooling in Series-Configuration for simplified control*

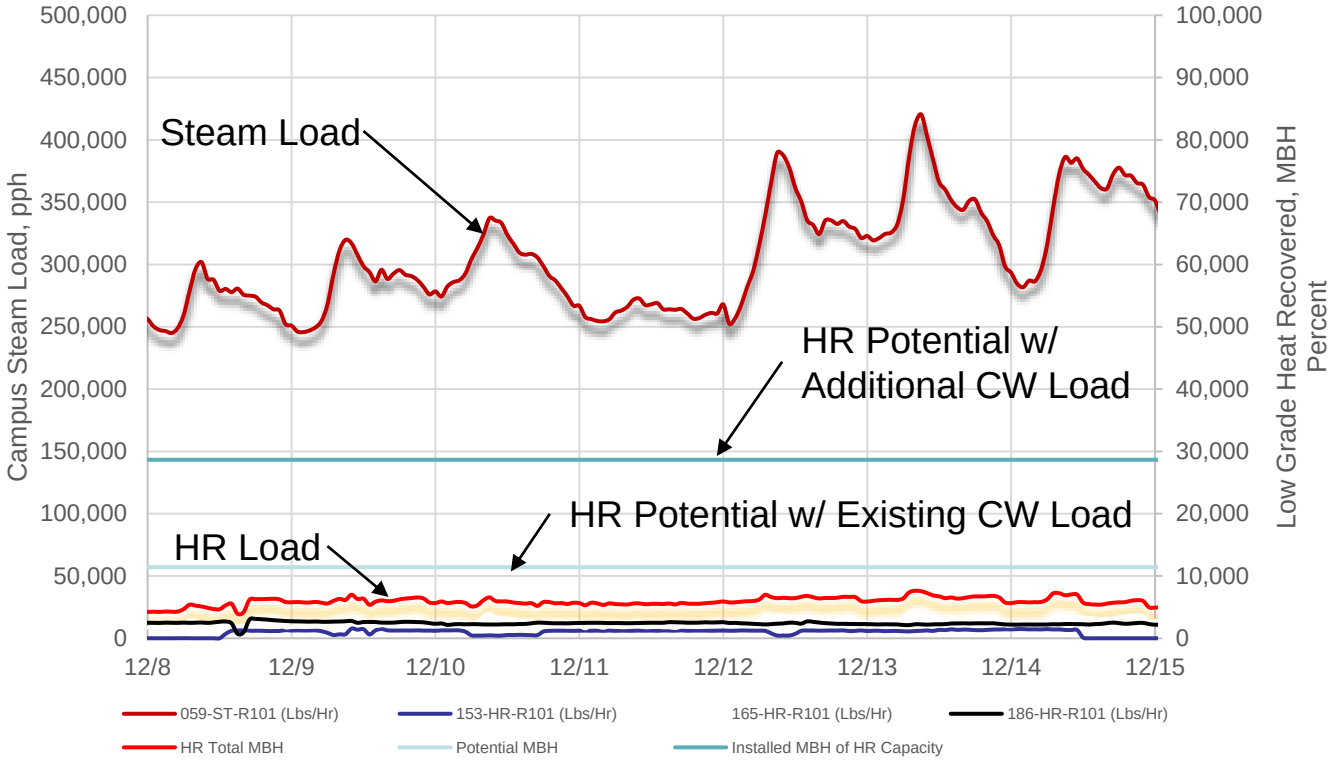
Heat Recovery: Adapting Existing Plant Capacity

- Plate & Frame HX Added to Condenser Water Return
- Add Tower Hot Deck to Sump Bypass
- “Passive” Recovery to 75 F Ultra-Low Temperature Heating Water serving 100% OA Preheats
  - Adapted CHW Coils to a 2-pipe changeover system to achieve ultra-low temp performance
- Unused Heat Rejected in Cooling Tower
- Simple, Reliable Deployment Guarantees Use and Buy-In by Operators

The Numbers

- 3% Shift in Campus Heating Load to Recovered Energy
  - 45,000 MMBtu
- 8% Potential w/ Existing Equipment
  - 120,000 MMBtu
  - Need more connected “process” load to achieve

University of Minnesota: Typical Winter Week
Campus Steam and Heat Recovery Load




Thank You!
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