



Free Cooling Case Study @ St. Elizabeth Hospital

In collaboration with Gary Kusnierz, Steve Kappell, Jeff Wyngard,
Iqbal Mian, Fred Betz, Scott Easton & Steve Carlson.

Ministry Health Care hospitals and the farmers market where employees interact with the community every weekend during summer seasons.



MINISTRY HEALTH CARE



AIM4EXCELLENCE

RESULTS:

Key Performance Indicators



RESULTS:

Key Behavior Indicators



“By empowering our culture, aligning systems and making continuous improvement part of daily activity, the person we care for is at the center of everything we do supported by behaviors and performance.”

– Gary Kusnierz, VP Performance Excellence

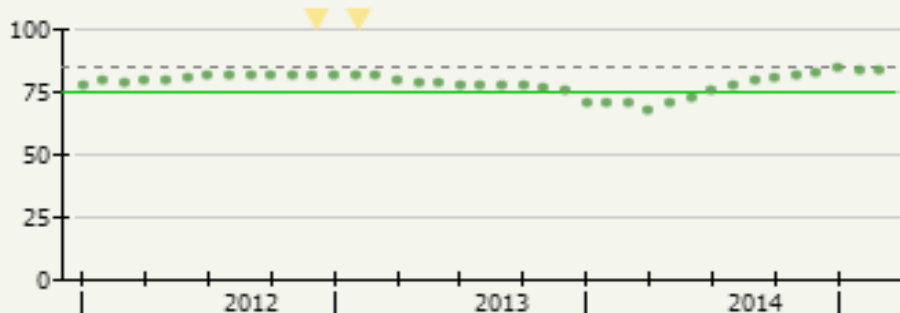
St. Elizabeth Hospital
1506 S. Oneida Street
Appleton, WI



Issue

St. Elizabeth Hospital, with growing patient needs, utilizes energy to keep up with services and demand in the community (e.g. the new ED patient volume after renovation increased by 20% in 2011).

ENERGY STAR® Ratings (12-month calculation)



ENERGY STAR® Scorecard

86

St. Elizabeth Hospital (Active)

Primary Function: Hospital (General Medical & Surgical)
Gross Floor Area (ft²): 992,696
Built: 1966

Property Address:
St. Elizabeth Hospital (Active)
1506 South Oneida Street
Appleton, Wisconsin 54915

On January 2015, the Fremont Tower, a 90 bed inpatient unit was open to patients in addition to a more efficient central utility plant. Between seven options for plant upgrades, a 90 ton heat recovery chiller (HRC) and cooling tower cooling strategy with a shoulder boiler was selected to enable free cooling and improve load performance during low load hours.



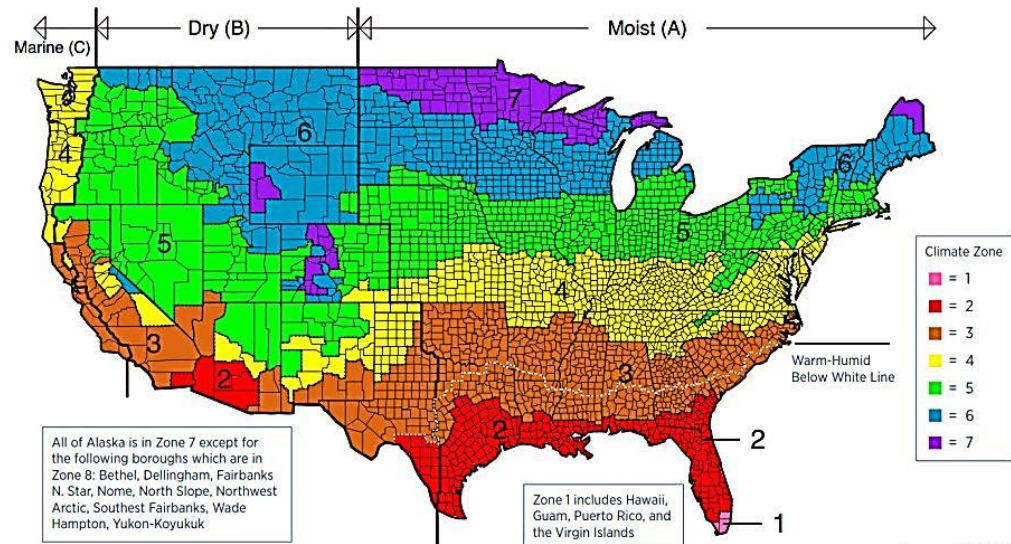
Background

Climate Considerations



“Free cooling is climate specific and is advantageous for regions like Wisconsin where a third of the year the operational performance is based on cooling loads and having enough run-time. It is not a one size fits all application. Taking into consideration the ASHRAE Climate Zone Map, regions 5-8 are appropriate with region 4 needing more assessment.”

Fred Betz @ Affiliated Engineers Inc. (AEI)



Source: US DOE

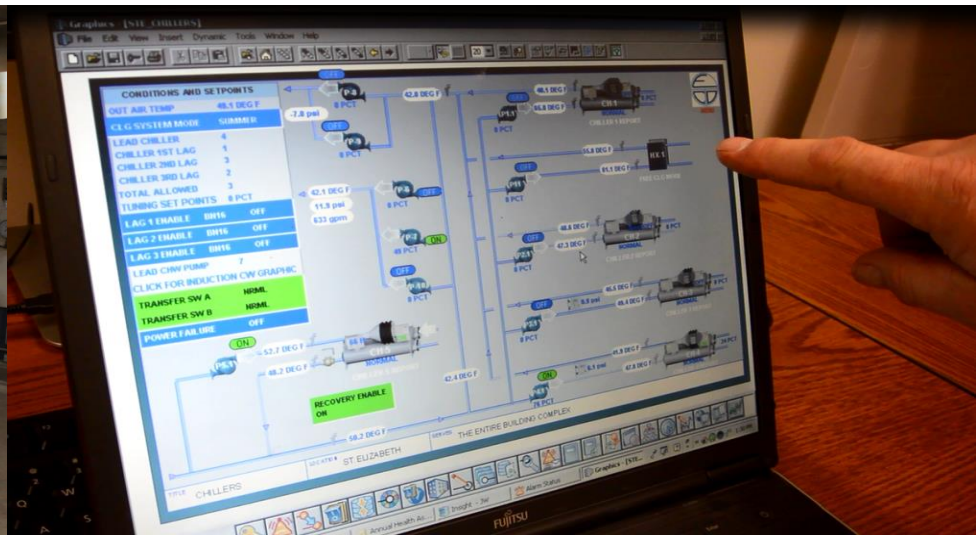


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Upgrades to the Central Utility Plant

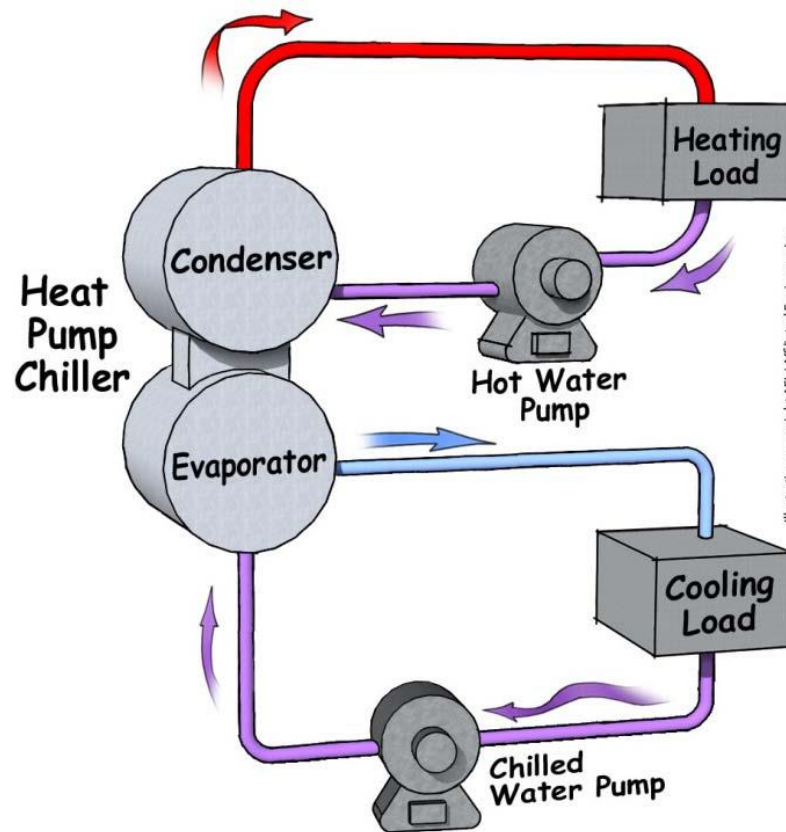
- 90/Ton Multi-stack DHRC
- 800/Ton York Chiller
- Two 700/Ton Daikin McQuay Chillers
- 300/Ton Bell Gosset Plate and Frame
- Variable Primary Secondary System
- Building Automation System Upgrade



90/T Multi-stack DHRC

[How it Works](#)

(Click for video overview)



Graphics provided by Affiliated Engineers Inc. (AEI)

90/Ton Multi-stack

Application
Size



CHILLERS

Daikin McQuay
WME 700



800 Ton York

Equipment Feedback



“Oil-less chillers are part of the future. An advantage with the Daikin is better maintenance integrity (approximately \$3K preventable costs) and the components are lighter. The cost of construction to physically support two York Chillers is \$90K more than a single Daikin. Due to strong leadership, we identified synergies in equipment and resources.

Another advantage with Daikin is its ability to perform during power sags with minimal loss of RPMs in the compressor. The instance power is restored to normal levels, the chiller is 100%. It’s a quality piece of equipment and can start at extremely cold water because it isn't oil dependent giving more opportunity to use free cooling in the spring and fall.”

Jeff Wyngard, Maintenance Engineer @ Ministry Health Care

Free Cooling

- 300 Ton Bell Gosset Plate and Frame
- Fully Automated System





Cooling Tower



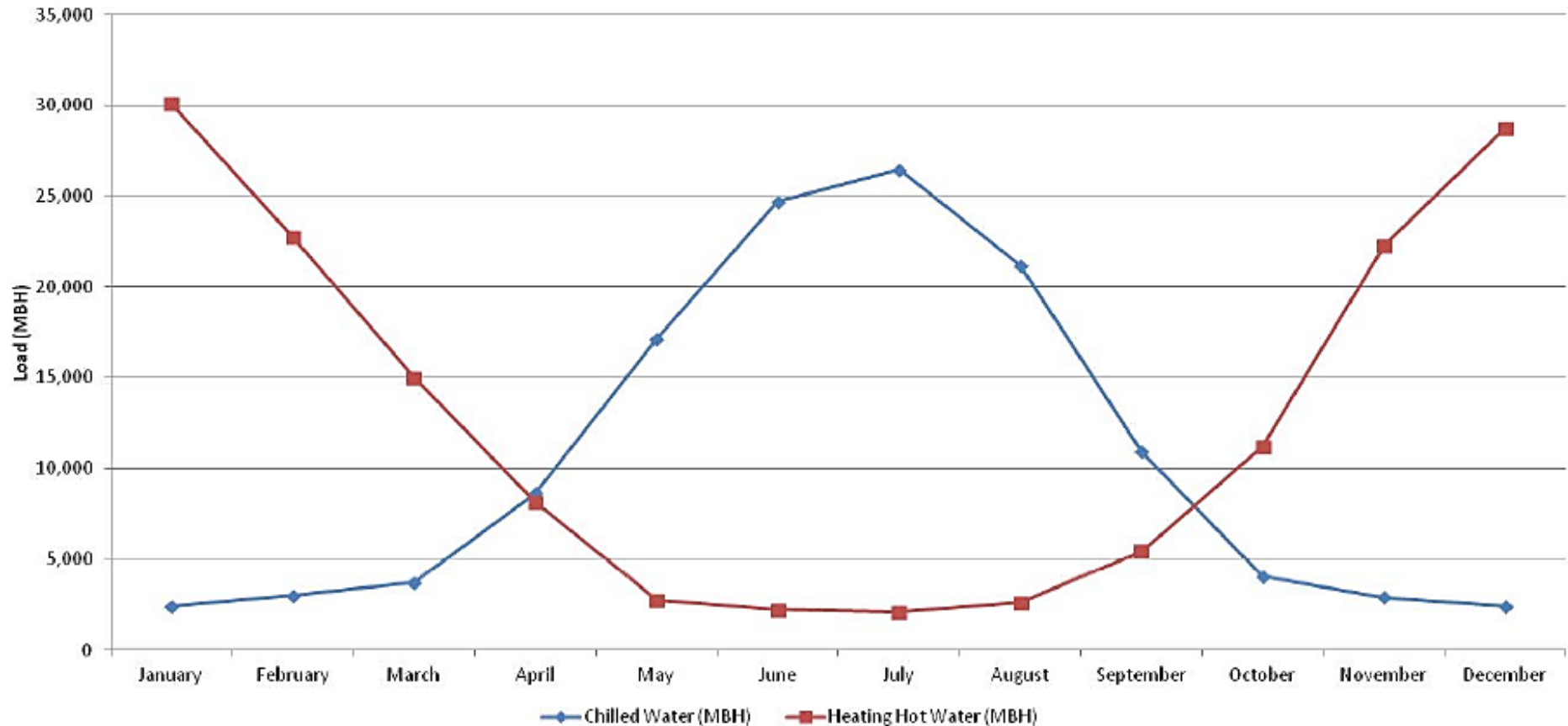
AMBULANCE

ENTRANCE

AirGuard

Performance

St. Elizabeth's Hospital: Chilled and Heating Hot Water Estimated Load Profiles



Based on the estimated load and operating hours, a total chilled water production of 64,668 MMBtu/year is estimated and a total of 113,873 MMBtu/year of hot water production.

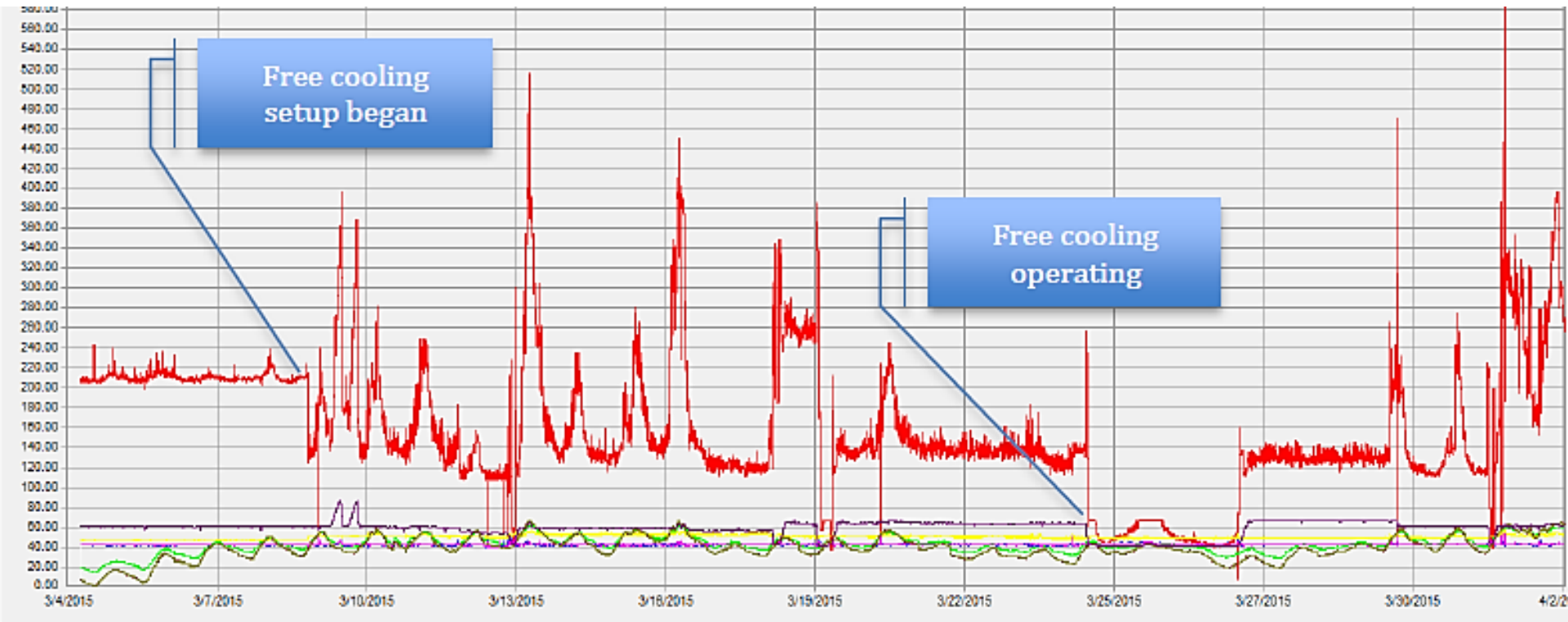
Performance



“Free cooling mode became available late in March 2015. It uses a single cooling tower, condenser water pump, primary pump and secondary pump to meet the cooling needs of the campus. Extrapolating the observed performance to the entire season suggests that the agreed cooling mode would have saved 312,000 kWh in the 2014/2015 winter season.”

Steve Carlson @ XRG Analytics

Performance



“The plant operated a chiller continuously drawing a constant 210 kW until March 9, 2015 when setup of the free cooling mode was started. During a setup period from March 9 to March 24 the logic of the free cooling mode was refined and a valve arrangement was updated. On March 24th free cooling mode was initially commissioned and allowed to operate until the weather warmed on the 26th. During free cooling the maximum power draw from the CUP is 67 kW with the cooling tower at full speed.”

Steve Carlson @ XRG Analytics

Free Cooling



“On March 10th, manual hand valves were used. Because of low dew points, we achieved 42 degree water with 45 degree air. Automatic run into free cooling occurred on March 25th. A fully automated system going in and out of free cooling is the goal based on outdoor air temp - no body is doing that!

Additionally, this process uses less chemicals, has better PH levels, utilizes less water and biocides for bacterial control, has less wear and tear on equipment due to downtime allowing us to be more competitive due to reduced fixed costs which benefits the patient. **Occupancy comfort is always part of our goal and patients need comfort for better quality healing.”**

Jeff Wyngard, Maintenance Engineer @ Ministry Health Care

Variable Primary Secondary



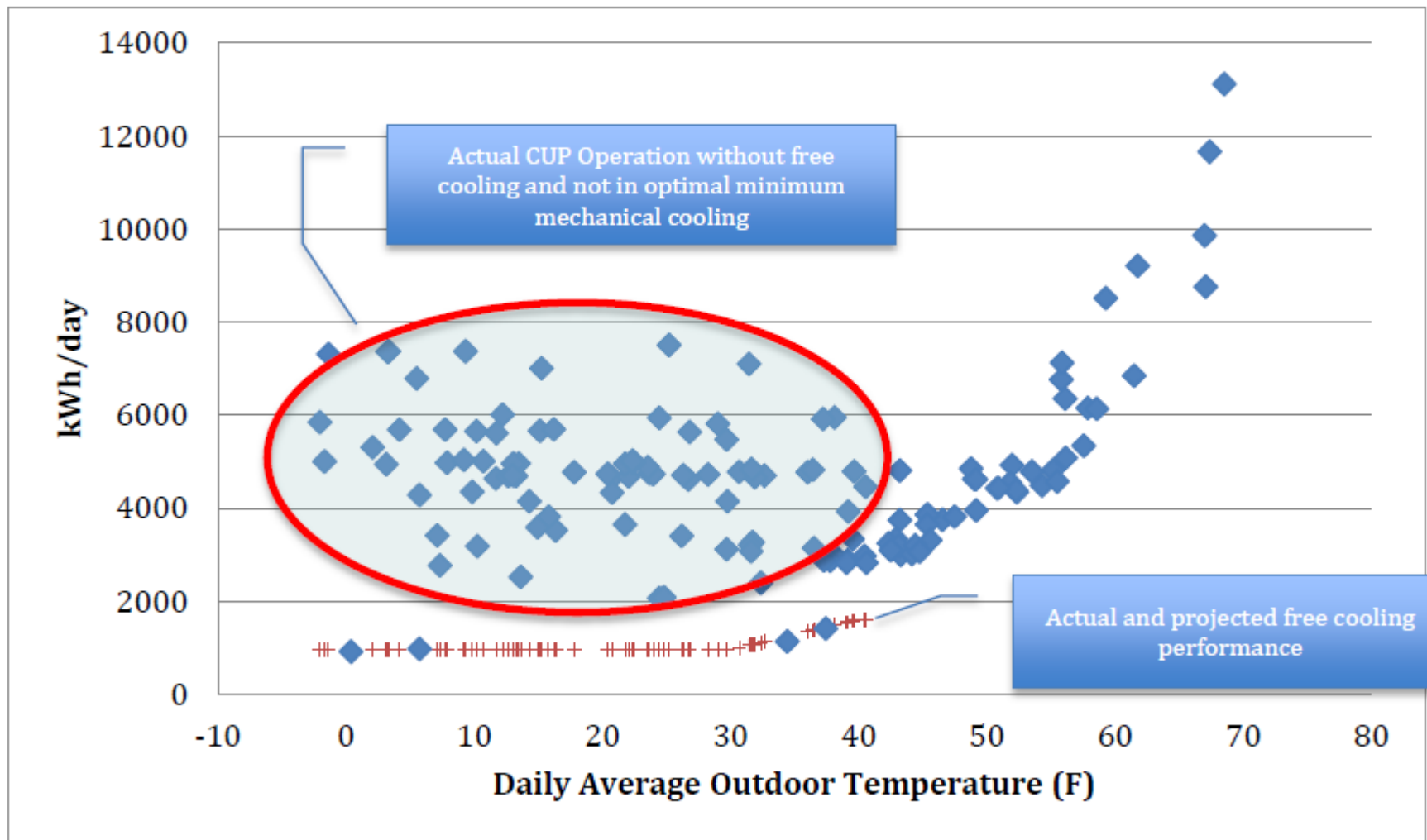
“What are we doing different and seeing different? Variable Primary Secondary immediately saw 35% energy savings on the pumps. We also have smoother staging of the chillers (i.e. reducing the peak loads). By reducing the air in the hydraulic systems, we slowed pumps down equating to 10-15% in savings.

The by-product is far less chemical usage. By keeping the cooling towers clean with screens and a preventative maintenance schedule, chemical reduction was observed by 33% while keeping bugs, debris, dust, bacteria, cottonwood out of the sump. Overall, we challenged the status quo.”

Jeff Wyngard, Maintenance Engineer @ Ministry Health Care



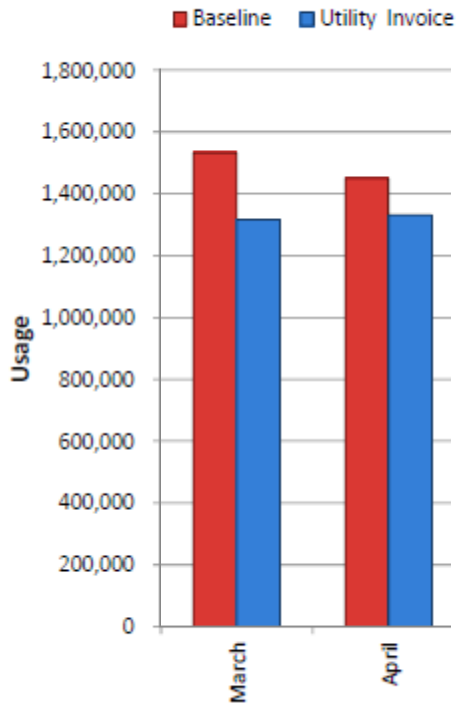
Figure 3. Daily CUP Electricity Use



“The performance noted above can be extrapolated to the entire season based on actual weather data for Appleton. During the 153 days with the mean temperature below 40F, the CUP would have used 165,000 kWh in free cooling compared to 477,000 kWh in minimal mechanical cooling. Free cooling would have saved 312,000 kWh in the 2014/15 winter season.”

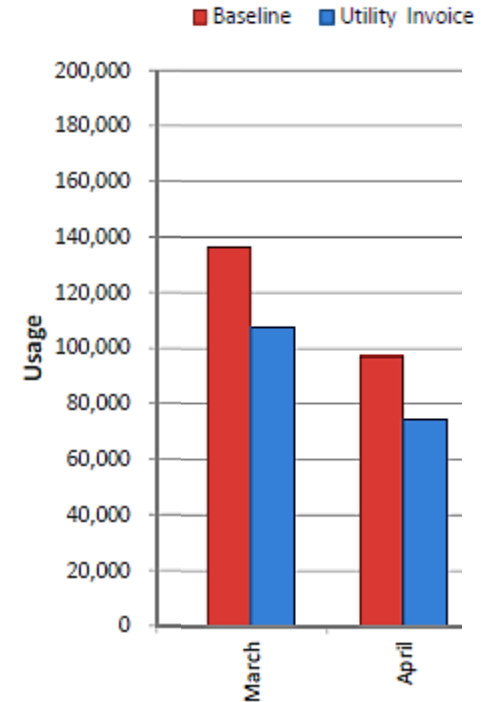
Steve Carlson @ XRG Analytics

Energy Trends



ELECTRIC

GAS



Thanks to the efficient Central Utility Plant that is capable of free cooling while undergoing retrocommissioning (RCx), St. Elizabeth Hospital in March and April used 6,230 fewer MMBtus than the previous year while saving \$49,782 from the utility (weather normalized data via regression analysis).

Return on Investment

Projected annual savings from free cooling is **\$48,813** from electrical and natural gas at seven cents per therm and seven cents per kWh with additional savings in humidification due to less steam.

90 ton Heat Recovery Chiller (HRC) and Cooling Tower Cooling cost estimates in LCCA:

First Cost = \$607,850

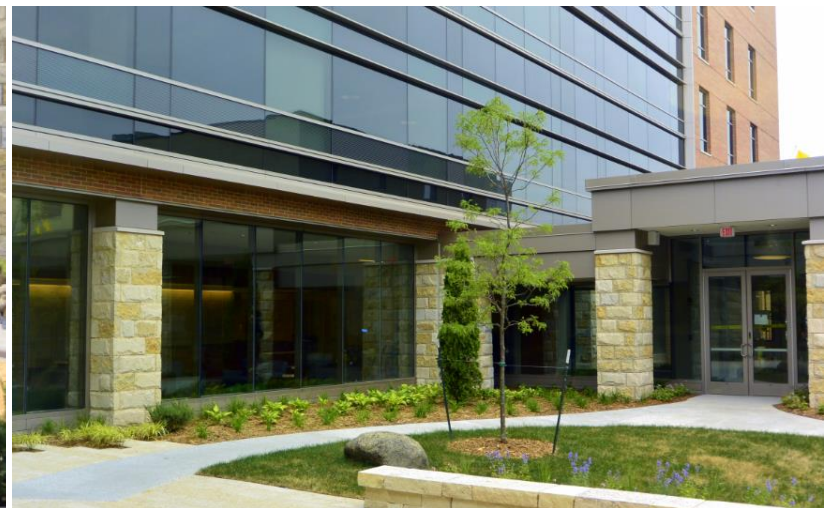
Maintenance Cost = \$4,200

Electric cost = \$304,000

Gas Cost = \$982,000

Water Cost = \$56,000

The secondary benefit to the HRC is it can delay the use of a chiller while in free cooling by meeting a portion of the cooling load thus, allowing the plant to operate at its lowest kW/ton for more hours of the year.



Person-Centered Care



“With a long history of environmental stewardship, the free cooling application at St. Elizabeth Hospital reflects how Ministry Health Care continues to push energy conservation measures with positive benefits to our community and to our patients.”

– Gary Kusnierz, VP Performance Excellence

