Case Study

A Systematic Approach to Smart Conservation at Grand River Hospital

November 2018
Grand River Hospital

Kitchener Waterloo Main Hospital

- Acute & continuing care services
- 663,000 square feet
- 232 beds

Freeport Site

- Continuing & long-term care services
- 316,000 square feet
- 205 beds
Organizational Commitment

- Senior management is very supportive of conservation projects
- Focus on total life cycle costs
- Operating budget pays for initiatives and savings repay it
- The process improves over the time as results appear
- Energy considerations when relocation is discussed
- Use HIRF funding to replace aging hydronic boilers and steam boilers to be added this year
- GHC helped convey the impact of HVAC system on energy conservation. Previously the focus had been on building envelope
Smart Conservation

➢ Hiring our in-house BAS Technician
   ➢ BAS energy services contract initially included weekly site visit, but hospital felt it wasn’t enough
   ➢ extended the contract to include 2 site visits per week with a total cost of $160 k per year
   ➢ increasing the hours did not result in better service or timely resolution of issues
   ➢ hospital pitched the business case to management for a full-time staff member
   ➢ overcame union issues by including supervisor/project roles in the position
   ➢ helped understand the complete picture around HVAC systems
   ➢ acted as a mediator in resolving the fundamental issues
   ➢ previously the BAS contractor would only resolve operational issues, not optimization projects
   ➢ made it much easier for staff to regularly present issues
   ➢ does a daily scan of the systems to confirm the operation
   ➢ most BAS programs are locked, but changes are explained to staff and some room for adjustments
Smart Conservation

- Created our own conservation fund
  - Hospital allotted $1.5 million for a new chiller to meet their peak capacity as certain areas were short on CHW
  - However, ventilation and chilled water system optimization eliminated the need for the new chiller
  - Since the money was already allotted, used it towards further HVAC optimization
  - **Projects since 2013 were funded by the $1.5 million not spent on the chiller project as well as HIRF funds**
  - The hospital takes full advantage of the incentives that are offered in the area, mostly with KW Hydro’s SaveOnEnergy. They have closed 63 projects and have received $125,000 in incentives. There are another 21 open projects with $50,000 incentive money pending
➢ The positive culture and support of management have enabled staff to take on initiatives
➢ Whole team became energy conscious and started looking for opportunities to improve systems and eliminate waste
➢ Sent staff to building operator training with 50% of the cost offset by utilities support
➢ Staff have been empowered to run with an idea and come up with solutions through collaboration
➢ Staff never give up, some ideas are 15 years old before finding a solution
➢ With less complaints, staff have more time to work on new conservation projects
➢ Awards, recognition, and incentives make great motivators
➢ We celebrate successes with the team
➢ Lessons learned - involve operations staff early in design stage of the project
Total Savings in 2017 vs 2012

2017 Total Savings:
16.5% reduction in total energy: 36,859 GJ
1,210 tonnes GHG emissions
Approx. $856,712
Results (2012 Baseline)

Total Savings Achieved:
9.6% reduction: 10,059,000 kWh worth $1,509,000

Total Savings Achieved:
13% reduction: 1,889,000 m³ worth $567,000
Scheduling
- Installed approximately 60 VFDs and implemented new scheduling for all units where applicable
- Used VAV boxes – building is 95% DDC controls – to close off the dampers and isolate zones
- Air supply scheduled off for departments not occupied 24/7

Supply Air Temperature Reset
- SAT resets on most AHUs based on OAT for some units and by polling reheat valves on others
- Resulted in reduced cold and hot calls
- Energy impacts on reheat and cooling loads
Boiler and Heating Pump Projects

- Previously 3 Volcano boilers ran during summer. Installed 3 Spirax Sarco Easy heats which avoided running the HW boilers and put more load on (short cycling) steam boilers.
- Replaced the 3 Volcanos with 4 Fulton Condensing HW boilers
- Presently installing 3 new Miura steam boilers
- Run steam boiler in summer to support sterilizer, kitchen, domestic hot water and reheat load
- Reset steam pressure from 95PSI to 85PSI
- Replaced hundreds of reheat valves which were passing

- Eliminated 8 secondary pumps - primary pumps had enough head and flow to overcome pressure drop in the entire loop
- Added new drives on primary and secondary pumps
Chiller Projects

- Initially, chilled water pumps speed was capped 75%, causing flow issues on equipment at end of loop
- Primary variable system was run at constant speed most of the time

- Removed the 75% cap to increase flow
- Revised sequence of operations and fixed valves
- Converted primary constant-only to variable flow system
- Reset supply water temperatures
- Resulted in increased system capacity and eliminated the requirement for a third chiller
➢ The CEM and electrician came up with the idea
➢ Installed a HE to provide free cooling during winter
➢ Extended central plant CHW loop for summer operation, as it is more efficient than using the 35 ton air cooled chiller
➢ Free cooling eliminated the use of air cooled chiller in winter
➢ Total budget $62,000, 0.8 year payback, $20,000 incentive

Nov 17th to 23rd:
Other Projects

- LED installations from 2014 to 2018
  - 500 Fixture replacements

- Water Cost Reductions
  - Will be using RO water from power house to supplement water softener brine tanks

- Equipment
  - Bio-Medical Waste Containers – Replace old inefficient refrigeration equipment with new high efficient equipment
  - Air compressors - Fixed leaks, eliminated two 10 HP compressors

- Understanding Load Increases
  - New CT scanner installed May/18 – consumes twice as much electricity as old unit
  - Two radiation bunkers added. Five out of six are running, increasing operating hours
Further Cost Reductions

- Switched to Class A and contracted to ECNG
- Installed a GA switch in the facility areas (accessible to all staff) that provides demand limiting during peak days
- BAS is programmed to demand limit all non-clinical AHUs through VFD speed and temperatures
- Can reduce demand by 400 kW in limiting mode
- Hit 2 peaks and missed 3 in 2017, reducing electricity costs by $175,000
- Hit all 5 peaks in 2018
Freeport Site
Freeport Results (2012 Baseline)

Total Savings Achieved:
19.3% reduction: 7,732,000 kWh
Approx. $1,160,000

Total Savings Achieved:
15.4% reduction: 788,000 m³
Approx. $236,000
Ventilation Systems
- Air testing was completed
- The AHU inlet guided vanes were adjusted to 100% open position and VFDs installed to optimize fan speeds and flow requirements
- Main floor departments are only occupied during the day, but zone dampers were not functional or seized for years
- Pneumatic dampers were fixed which enabled the scheduling of the main floor
- Supply Air Temperatures reset

Chiller Plant
- System pressure was too high to overcome CHW coil valve close off pressure
- Valves were leaking and overcooling the spaces causing comfort issues
- Installed VFDs, reduced the pump speed to maintain pressure
- Set up primary variable flow system to work properly

LED installations from 2014 to 2018
- 3 large Clever Brooks boilers are now on standby, 2 smaller PK Boilers carry the load
### Are We There Yet? Energy and Water Targets (2017)

#### Electricity (kWh/ft²)

<table>
<thead>
<tr>
<th>Hospitals</th>
<th>Base Actual</th>
<th>Target</th>
<th>Cooling Actual</th>
<th>Target</th>
<th>Base Actual</th>
<th>Target</th>
<th>Heating Actual</th>
<th>Target</th>
<th>Total Energy Actual</th>
<th>Target</th>
<th>Savings Potential %</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grand River Main Hospital</td>
<td>23.0</td>
<td>18.8</td>
<td>2.0</td>
<td>1.9</td>
<td>25.0</td>
<td>17.0</td>
<td>9.2</td>
<td>12.1</td>
<td>59.2</td>
<td>49.8</td>
<td>16.0</td>
<td>$527,138</td>
</tr>
<tr>
<td>Grand River Freeport Site</td>
<td>15.3</td>
<td>13.9</td>
<td>1.2</td>
<td>0.9</td>
<td>13.8</td>
<td>4.9</td>
<td>8.2</td>
<td>8.6</td>
<td>38.5</td>
<td>28.4</td>
<td>26.2</td>
<td>$155,801</td>
</tr>
</tbody>
</table>

#### Thermal (ekWh/ft²)

<table>
<thead>
<tr>
<th>Hospitals</th>
<th>Base Actual</th>
<th>Target</th>
<th>Cooling Actual</th>
<th>Target</th>
<th>Base Actual</th>
<th>Target</th>
<th>Heating Actual</th>
<th>Target</th>
<th>Total Energy Actual</th>
<th>Target</th>
<th>Savings Potential %</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grand River Main Hospital</td>
<td>23.0</td>
<td>18.8</td>
<td>2.0</td>
<td>1.9</td>
<td>25.0</td>
<td>17.0</td>
<td>9.2</td>
<td>12.1</td>
<td>59.2</td>
<td>49.8</td>
<td>16.0</td>
<td>$527,138</td>
</tr>
<tr>
<td>Grand River Freeport Site</td>
<td>15.3</td>
<td>13.9</td>
<td>1.2</td>
<td>0.9</td>
<td>13.8</td>
<td>4.9</td>
<td>8.2</td>
<td>8.6</td>
<td>38.5</td>
<td>28.4</td>
<td>26.2</td>
<td>$155,801</td>
</tr>
</tbody>
</table>

#### Water (litres/ft²)

<table>
<thead>
<tr>
<th>Hospitals</th>
<th>Base Actual</th>
<th>Target</th>
<th>Cooling Actual</th>
<th>Target</th>
<th>Total Water Actual</th>
<th>Target</th>
<th>Savings Potential %</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grand River Main Hospital</td>
<td>155.7</td>
<td>135.6</td>
<td>49.0</td>
<td>20.1</td>
<td>204.7</td>
<td>155.7</td>
<td>24.0</td>
<td>$117,947</td>
</tr>
<tr>
<td>Grand River - Freeport</td>
<td>76.3</td>
<td>76.3</td>
<td>12.9</td>
<td>12.9</td>
<td>89.2</td>
<td>89.2</td>
<td>0.0</td>
<td>$0</td>
</tr>
</tbody>
</table>

---

**Note:** The table above highlights the energy and water targets for two hospitals, Grand River Main Hospital and Grand River Freeport Site, along with the actual savings potential and cost associated with meeting these targets.
Data center
- Old data center is being relocated to new location
- Facility team is seen as a major stakeholder to spearhead energy conservation design ideas and involved from the design stage
- Trying to avoid a standalone A/C unit and instead use central chiller and free cooling, also incorporate BAS strategies

Ventilation
- Further installation of VFDs to reduce load

MRI & CT HVAC Project
- Trying to incorporate free cooling after the design and construction
- Facility team was involved late in the process

Boiler blower motors
- Experiencing motor failures, and installed VFDs on motors
- Would like to modulate the blower motor and damper together – Miura looking at this idea
Planning Ahead

- Large air compressor
  - Installed a VFD on compressor motor to reduce current from 57 to 20 amps
  - Also reduced from 60hz – to 52hz to stop motor vibrations
- O² tank
  - Tank farm evaporator covered in thick ice on 30ºC days
  - Possible 30 tons of free cooling that we could get if we wrap the condenser – still investigating
- On demand hot water heating
  - Use two quickheat heat exchangers to eliminate a 10,000 L hot water tank
- Kitchen
  - Replacing 30 food heating/cooling units from 40 to 30 amp loads
- Solar panels
  - Adding new 10 kW solar panels