

Vancouver General Hospital: Using Wasted Heat to Replace Natural Gas



A newly installed heat recovery chiller is capturing previously wasted heat, generated by the hospital's chilled water plant, and converting it into thermal energy for use in building heating – both domestic hot water and hot water heating. This measure will result in an estimated 10% reduction in natural gas consumption by the hospital's central steam plant.

Project Summary

Vancouver General Hospital (VGH) offers specialized health care services to more than a million people in Vancouver and across the province. It is also a teaching hospital affiliated with the University of British Columbia, and home to one of the largest research institutes in Canada.

In early 2015, the cooling plant serving three buildings on the VGH campus was identified as an energy and emission reduction opportunity. The steam-operated absorption chillers needed repair, and at the same time, the shift away from manual control was desired. Another driver of the project was increasing capacity so that peak cooling demand could be accommodated in the future. Considering climate projections for Metro Vancouver predicting hotter summers going forward, this capacity will be required more frequently.

A typical water cooling system removes heat from the inside air and transfers it into water. The water is then passed through the cooling towers and this heat is rejected into the outside air. In a cooling system with heat recovery capacity, rather than reject this heat into the outside air it is captured and used for heating loads: domestic hot water and hot water heating. This recovered heat reduces the amount of energy required (in this case natural gas), which reduces greenhouse gas emissions. An additional benefit is that the cooling towers are used less; therefore less water is used for cooling. Cooling tower maintenance needs are also lowered, yielding additional savings.

A partnership between the facility maintenance & operation group and energy management team was formed, and a consultant was engaged to proceed with an investment grade energy study in mid-2015. A new cooling plant heat recovery system was designed in 2016, and constructed in mid-2017.



GHG Reductions & Savings

- The low-risk heat recovery chiller project is expected to reduce GHG emissions at Vancouver General Hospital by 1,968 tonnes per year.
- The project will save an estimated 39,600 GJ in energy – a net energy saving of 35,000 GJ per year, after the increase in electricity to run the new equipment.
- The business case projected payback within six years; net present value of \$1.2 million.
- The total cost of the project was \$1.4 million.
- Operational cost savings amounted to \$265,000 in energy, water, and offsets savings.



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Making the Case

The energy study considered both operational requirements and environmental impact. The results made a strong business case for the project, predicting payback within six years. Notably, the study identified that the existing chiller, a low-efficiency steam-absorption model, consumed 43% of the total chiller plant energy, even though it was only being operated 25% of the time of the two other main chillers. VGH has a year-round, 300-ton base cooling load, and the heat captured from this process was being ejected through cooling towers. The integration of two new heat recovery chillers into the central cooling plant, along with several other energy-optimizing measures, would support the peak cooling load and recover waste heat from the cooling process, improving the plant's operation and minimizing the hospital's environmental impact.

The facility maintenance and operation director and senior site manager were supportive of the project and aware of the benefits. Other stakeholders were engaged, including the finance and capital project teams, as early as possible. A strong team of over 15 people was assembled and saw the project through to completion.

\$1.1 million was funded by the Carbon Neutral Capital Program from the Ministry of Health, and the remaining from Vancouver Coastal Health capital finance.

Once the project started, as with any major retrofit, there were other smaller projects required to enable progress – for instance, the team discovered that the amount of refrigerants in the chillers meant the mechanical room required additional ventilation. Regular project meetings with the facility maintenance operation team, energy team, consultant, building automation team, and representatives from the chiller manufacturer kept everyone abreast of issues as they arose and allowed immediate action when required. The meetings began on a weekly basis, then went to twice a month, and are still occurring to fine-tune and assess performance.

During the construction phase, there were many system shutdown requests; however there were minimal clinical impacts. With most of the work occurring in mechanical rooms and the use of service elevators, the public and most hospital staff wouldn't have known the project was happening.

Project Technology

“Several different heat recovery chiller configurations were assessed, and the installation of one 250-ton dedicated heat recovery chiller was prioritized to take advantage of heat recovery to offset the steam generation; this ensures the greatest operational savings and GHG mitigation.

The other integral project measures were an upgrade to a variable speed drive on the lead chiller condenser pump and the addition of a dedicated cooling plant control system to automatically stage chillers, pumps and cooling towers at their most efficient operating points. The design included the tie-in connections for the second chiller... to minimize the install costs and potential shutdown requirements.

Considering the complexity of the central cooling plant, a commissioning and optimization plan was developed to ensure the plant operates as designed over the shoulder seasons.”

(Vancouver Coastal Health Authority
2016 Carbon Neutral Action Report)



Results

In addition to reduced GHG emissions and energy savings, the heat recovery chiller project has resulted in a more efficient system for VGH:

- There is less manual control, reducing maintenance costs, and freeing up resources to be used elsewhere.
- The automated system also reduces the risk of human error.
- There is less waste heat being lost through cooling towers; the towers are running less, and less water is being used.

The project also revealed additional areas for potential improvements. VGH is now looking at a second heat recovery chiller, and implementing a chiller strategy versus project-by-

project decisions, as part of a robust energy efficient system. Kori Jones, VGH Energy Manager, says site teams are more aware of possible partnerships and support for energy and emission reduction opportunities. "Health care employees are invested in their hospitals and communities – inside and outside of the hospital walls. Providing more opportunities to actively pursue an effective response to climate change in their work place is a culture we need to foster."

He adds the process for collaboration among energy, site, and capital teams, is always improving and they're able to communicate more effectively. This will serve VGH and other Vancouver Coastal Health sites as they move forward with strategic energy management planning.



Lessons Learned

1. Engage site facility team as early as possible and include them in the design process.
2. Run through as many 'what if' scenarios as you can. For example, how would the system perform under a loss of power or pump failure.
3. Communicate the benefits of the project to as wide an audience as possible. You never know who will be your advocate when you need support.
4. Look at any code compliance issues early in the timeline to avoid unexpected delays.
5. Plan and budget for a year of controls optimization, and monitoring and verifying results. At VGH, the control system is still being regularly reviewed for optimal results.

Related Resources & Links

- Carbon Trust, "Heat recovery – a guide to key systems and applications"
https://www.carbontrust.com/media/31715/ctg057_heat_recovery.pdf
- Carbon Trust, "Heat recovery checklist"
<https://www.carbontrust.com/media/175667/ctl142-heat-recovery-checklist.pdf>
- Carbon Trust, "How to implement heat recovery in heating, air conditioning and ventilation systems"
https://www.carbontrust.com/media/147119/j7948_ctl030_how_to_implement_hvac_heat_recovery_aw.pdf
- Engineers Newsletter, "Water side heat recovery" - Trane Co.
https://www.trane.com/content/dam/Trane/Commercial/global/products-systems/education-training/engineers-newsletters/waterside-design/admapn023en_0207.pdf
- Natural Resources Canada, Energy benchmarking for hospitals
<http://www.nrcan.gc.ca/energy/efficiency/buildings/energy-benchmarking/15909>
- Canadian Coalition of Green Healthcare
<http://greenhealthcare.ca/>

Government Funding Programs

- B.C. Government, PSO Funding Information
<https://www2.gov.bc.ca/gov/content/environment/climate-change/public-sector/resources>

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