

Heat reclaim system reduces natural gas consumption 70%, greenhouse gas emissions 35%

In 2014, Morguard's property management team was looking to save energy costs and improve operations given the facility's big cooling load. Because of lighting and occupant load in the shops, there is a need for year-round cooling while at the same time requiring heat for ventilation systems. During a routine visit, the centre's operations manager asked Trane representatives about efficiency improvement methods. Trane, a manufacturer of heating, ventilation and air conditioning (HVAC) systems, knew the centre's mechanical systems and configurations well. They suggested heat recovery as an option to reclaim and reuse waste heat for space heating.

Address

2929 Barnet Highway,
Coquitlam

Ownership/Management

Pensionfund Realty Ltd /
Morguard Properties

Type of building

Mall: shops, food court,
offices

Year of construction

1979, expanded in 2000

Floor area

1.2 million sq ft

CASE STUDY - COQUITLAM

COQUITLAM CENTRE MALL



THE BUILDING Coquitlam Centre is a shopping mall housing 200 stores, a food court and administrative offices. Constructed in 1979, the north section of the mall was expanded 17 years ago and new chillers, gas boilers, and controls were installed. The two-level shopping centre stretches over 1 million sq ft and an average number of 34,000 people visit the mall each day.

Pre-Retrofit Energy Type	Annual Energy Use GJ	BEPI kWh/m ²	Annual Expenditure \$	GHG tCO ₂ e
Gas	10,000	20	100,000	500
Electricity	90,000	180	2,000,000	550
Total	100,000	200	2,100,000	1,050

In the mall, heating is only supplied to the common areas, such as the corridors and hallways. The shops are heated by the lights and the incoming warmth from the common areas. Exterior shops that don't benefit from the residual

heat have their own rooftop gas heaters that tenants control and pay for themselves. For hot water, a hot water loop runs through seven rooftop air handling units (AHUs) that also supply cooling to the common areas.

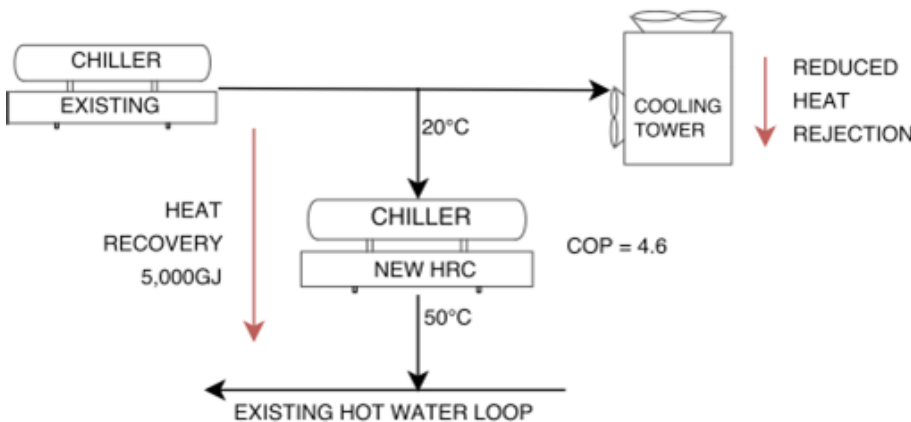
THE SOLUTION Trane engaged SES Consulting, a mechanical consultant, for the design of the heat reclaim system. Together, they proposed a heat recovery chiller (HRC) that would reject waste energy into existing heating water systems instead of the facility cooling towers. This solution was appealing to Morguard since it meant increasing the efficiency of the existing chillers as well as reducing natural gas and water consumption.

SYSTEM DESIGN The mall's existing plant had a constant volume hot water tank fed by two 6 million BTU gas boilers. This hot water is supplied at 40°C (104°F) and at 60°C (140°F) to two heating systems that operate in the old and new sections of the mall, respectively. Since the old mall runs at 40°C, it previously ran on a heat exchanger to keep the temperatures lower. The new HRC project re-piped the heating

supply system to run in series. This way, the water at 60°C goes to the loads of the new mall first and the cooler return water is then mixed as needed and supplied to the 40°C old mall.

This piping redesign allowed the existing heat exchanger to be removed. All distribution pumps were switched from constant flow to variable flow in order to pump only the water that's

needed. The HRC intercepts the return water from the mall and reheats it before it enters the boiler. On average, the entire mall can be heated solely by the heat recovery chiller down to 2°C outside temperature, after which the boilers turn on to top-up the heat in the system. The scope of the project also included replacing leaking AHU coil valves as well as the addition of speed drives on major heat pumps.



Simple schematic of the system design

TECHNICAL DETAILS

Technology	Heat Recovery Chiller (HRC)
Make & Model	Trane, model RTWD Water-cooled Series R Helical Rotary Chiller
Service provided	Med temp. hydronic space heating
Installation Date	February 2016
Load Temperature	60°C (140°F)

PROJECT PROCESS The project took just over 1 year for consultation, design and implementation. In January 2015, Trane and SES Consulting started working together to verify design details and the feasibility of the heat recovery system. The team developed a sequence of operations to maximize recovered heat and calculated potential energy savings. The project team then subsequently approached FortisBC to inquire about funding opportunities. After conducting their own technical and financial assessment, FortisBC approved the project for a rebate of \$237,000. Once it was clear that the investment was technically feasible and financially sound, Morguard Properties added it to their capital plan.



Coguitlam Centre Mall

INSTALLATION CONSIDERATIONS

Despite the Trane RTWD chiller's relatively small size, the biggest obstacle was finding a space for the new equipment as well as for the necessary re-piping. This was overcome by relocating the existing air compressor system to a different part of the room, removing the air separator that was not needed, as well as reusing existing piping from the old heat exchanger system to make room for the new chiller. Success came from carefully considering the design of the new system and ensuring the right parties were involved from the beginning. The

HRC's single-and dual-point power electrical connection options allowed using existing electrical wiring. In February 2016 the new system was installed. The HRC was lifted over the food court and into the door of the mechanical room. There were no disruptions to the centre's operation. SES Consulting commissioned the system for one year after installation.

The selected unit is a Series R RTWD helical rotary chiller. Ranging in size from 80 to 250 tons, the equipment operates over a wide range of conditions, and under widely varying loads. It is ideal for both industrial and commercial use. Used in heat recovery mode, the HRC generates leaving condenser water temperatures as high as 60°C (140°F).



HRC in the mall's mechanical room

ANNUAL SAVINGS

65% GAS

5% ELECTRICITY

35% GREENHOUSE GASES

ECONOMIC ANALYSIS The total installation costs amounted to \$470,000. FortisBC's \$237,000 incentive reduced the total installation costs to \$232,700. 80% of the incentive was paid at the completion of the project and the remaining 20% one year after the installation was completed and energy savings were verified.

Coquitlam Centre's heat recovery project resulted in a 70% reduction in annual gas consumption, 4% reduction in electricity use, and a 35% decrease in annual GHG emissions. Morguard now pays \$110,000 less in annual energy costs – leading to a simple payback of 2.1 years, including the incentive. The mall is also using less water and chemicals due to decreased cooling tower use.

COSTS

Installation Costs	\$470,000
- Fortis BC Incentive	(\$237,300)
Total Installation Costs	\$232,700

ANNUAL SAVINGS

Gas GJ	6,500
Electricity kWh	1,100,000
GHG tCO ₂ e	350
\$	\$110,000
Simple Payback years	
without incentive	4.3
with incentive	2.1
Measure Life years	20

“IF THE BOARD SAYS NO TO ONE PROJECT, GO FOR ANOTHER ONE. FIND SOMETHING THAT WILL WORK FOR THE PROPERTY.”

Ken Petherick, Operations Manager, Coquitlam Centre

USER EXPERIENCE & RECOMMENDATIONS

“Good preparation to get all the information together to present to the Board was essential. The initial payback of 4.5 years was sufficient to get their buy-in. The Fortis incentive then put it over the top for us. The retrofit is even more successful than we thought: additional electricity savings could be achieved through monitoring and fine tuning the

system as well as adding speed drives to the pumps.”

“The centre's four engineers had a two hour training session initially to explain how the equipment runs. It is hooked into our control system and the team logs it every day. It was important to have SES monitor the system for one year. Trane is also here every other week servicing the chillers so they check on the HRC as well.”

“The next project we are going to start is LED lighting upgrades. Being proactive in doing studies and proposing upgrades to the owners is important. Property managers need to keep asking the question: ‘What can I do to make things better?’ If the Board says no to one project, go for another one. Find something that will work for the property.”

Ken Petherick, Operations Manager, Coquitlam Centre

APPLICABILITY Given the nearly year-round need to provide space cooling to retail stores and heat ventilation air for common areas, indoor shopping malls are ideal for heat recovery chillers, as the heating and cooling loads are almost exactly overlapping.

Most heat recovery chillers have similar dimensions and electrical service capacity as the chillers that they replace, meaning that space can usually be identified in existing mechanical rooms.

Very large efficiency gains and reduction in greenhouse gas emissions can be achieved using heat recovery chillers.

LIMITATIONS Piping and control changes are likely to be required. The extent of these changes will have an impact on the economic viability of the project.

In buildings where the heating plant is in a different location than the chiller, additional system configuration will be required, which will further increase costs.

In buildings with multiple rooftop cooling units, retrofitting units with economizers could be a cost-effective alternative to a central heat-recovery-chiller for free cooling. Free cooling ends up dumping a huge amount of 'free heat' so this must be considered when retrofitting a shopping mall.

DESIGN CONSIDERATIONS

Multiple heating system loops, as is a common solution when a major building addition takes place, can be an opportunity rather than a constraint for implementing a heating recovery system. In the case of Coquitlam Centre, the piping was reconfigured to utilize the temperature difference between the old and new buildings.

In some shopping malls, there could be an opportunity to incorporate additional waste heat sources, such as supermarket refrigeration equipment or restaurant exhaust.

**COQUITLAM CENTRE'S
HEAT RECOVERY PROJECT
RESULTED IN A 70%
REDUCTION IN ANNUAL GAS
CONSUMPTION AND A 4%
REDUCTION IN ELECTRICITY
USE: AN ANNUAL ENERGY
COST SAVINGS OF \$110,000.**

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