

Sustainability & Energy Management at York Guest Lecture

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2016



redefine THE POSSIBLE.



AGENDA

- **Introductions and Opening Remarks**
- **Keele Campus Overview**
- **York University Energy Management Overview**
- **YorkW!\$E Energy Management Project Overview**
- **New Steam Chiller Cogeneration/Trigeneration Project**

Keele Campus Overview (we are big)



KEELE CAMPUS

- Founded in March 1959, and is now Canada's third-largest university
- Canada's leading interdisciplinary research and teaching university
- Over 53,000 students and growing fast
- Expansion of undergraduate engineering program
- Major Faculty of Environmental Studies
- Over 7,000 employees
- Single largest campus in Canada
- 8,000,000 sq. ft.
- 21MW electrical peak load (and growing with new Life Sciences Building, Stadium and Lassonde School of Engineering building)
- Over 12,000 tons of centralized chillers for air conditioning
- Prime opportunity for peak shaving
- Similar to scope of City of North Bay



Motto – **redefine** THE POSSIBLE,
Tentanda Via: The Way must be tried

Energy Management Overview



Energy Management Department's primary function is to provide;

- Heating,
- Cooling,
- Power, and
- Water to all academic, administrative, retail, and residences on campus
- Administer large energy retrofit project.

Central Utilities:

- Generates high pressure steam (250psi, 1,724kPa) for heating and 5°C chilled water for cooling,
- Delivers these by way of underground service tunnels to mechanical rooms of each building for distribution to the various heating, ventilating, and air conditioning (HVAC) units within the building
- Generate and distribute power through our 10 megawatt co-generation plant and associated 13,800 volt electrical distribution system.

The Energy Management unit is a 24-hour per day, 365 days per year operation that is staffed by highly skilled technicians and management whose sole responsibility is to provide the utilities requirements of our community in a safe and efficient manner and in accordance with all regulatory requirements.

Energy Management Overview



Historical Operating Budget - \$25 million (almost \$70,000/day, \$0.80/sec)

- Natural Gas 35%
- Electricity 40%
- Water 10%
- Oil – backup <1%
- Maintenance and Operations 15%

Previous energy management projects:

- \$17,000,000 natural gas fired co-generation facilities – 5MW in 1997, additional 5 MW in 2003

YorkW!\$E Energy Management Project



In September 2005, the concept of an Energy Performance Contracting Program was finalized, which aimed to invest \$41,000,000 in plant and building system renewal and retrofit projects so that annual energy costs and greenhouse gases could be reduced by 25%.

In November 2005, MCW Custom Energy Solutions Ltd. was selected as the successful contractor.

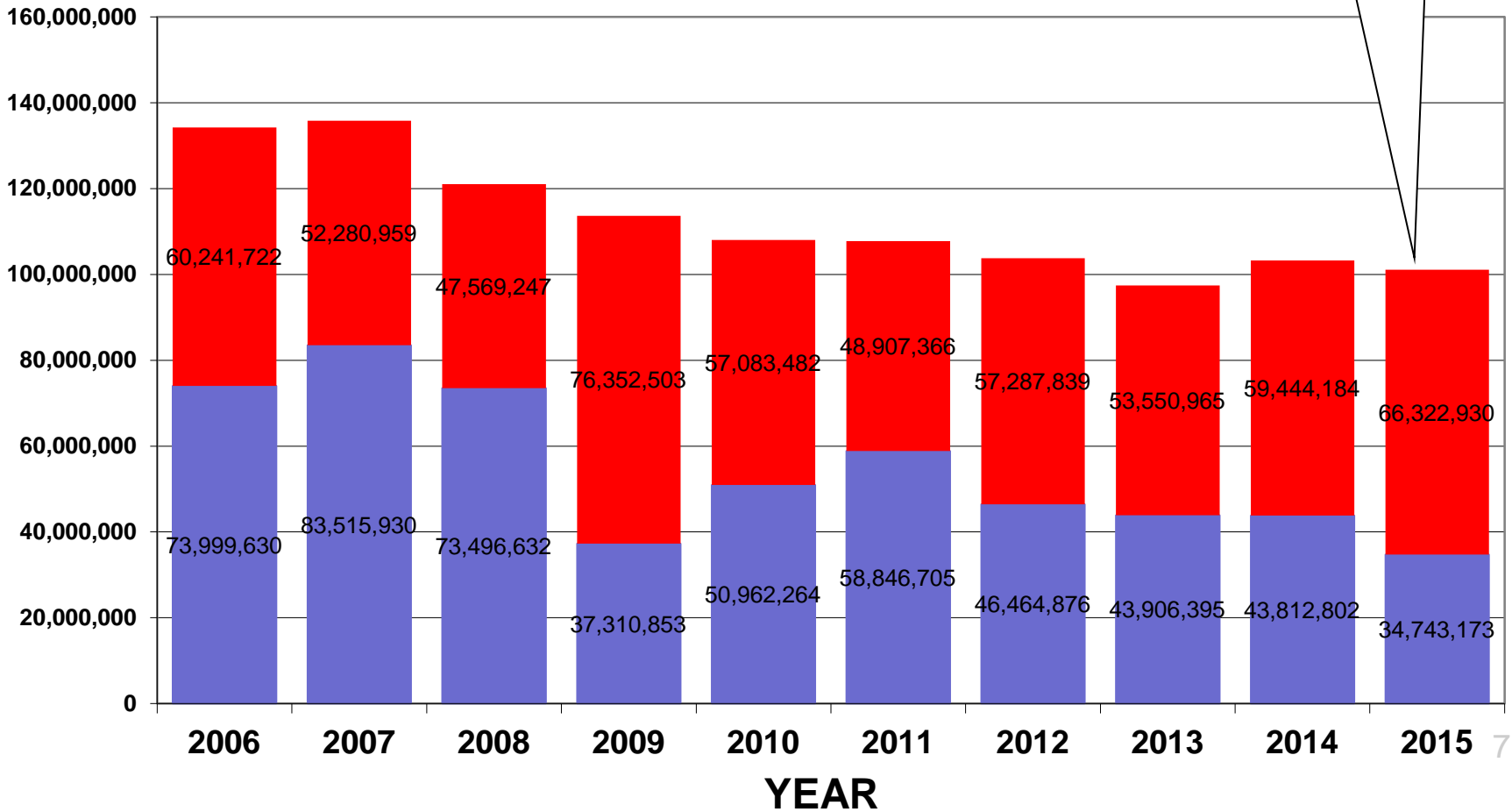
In February 2006, the pilot project for the YorkW!\$E Energy Management Program was brought forward for Board approval.

Since that time, numerous energy conservation measures have been approved and implemented in campus buildings and in the central plant and utility distribution systems with >\$4,400,000 in utility company incentives to date being reinvested

Energy Management Overview

25.6% reduction versus peak year of 2007

Keele Campus Hydro Usage



YorkW!\$E Energy Management Project



Current Status

At this juncture, the \$41,000,000 program is over 95% complete, with all projects funding committed.

Results have been very positive as weather-normalized savings have been calculated at 25+%.

Our carbon footprint has been reduced and the reductions have facilitated capital cost avoidances by creating infrastructure capacity for the addition of the new Life Sciences, Pan Am Stadium, Bergeron LSE Buildings and future 2nd Student Centre. (=Sustainability, no new resources)

What next on the journey to reducing consumption?



- Completed review of possible next steps in early 2012 as natural gas prices had fallen making some original HVAC heating measures financially unattractive, were there now better unforeseen options – ANSWER: **YES**



New Tri-generation Steam Turbine Chiller Project (nicknamed “King Kong” by plant operators)

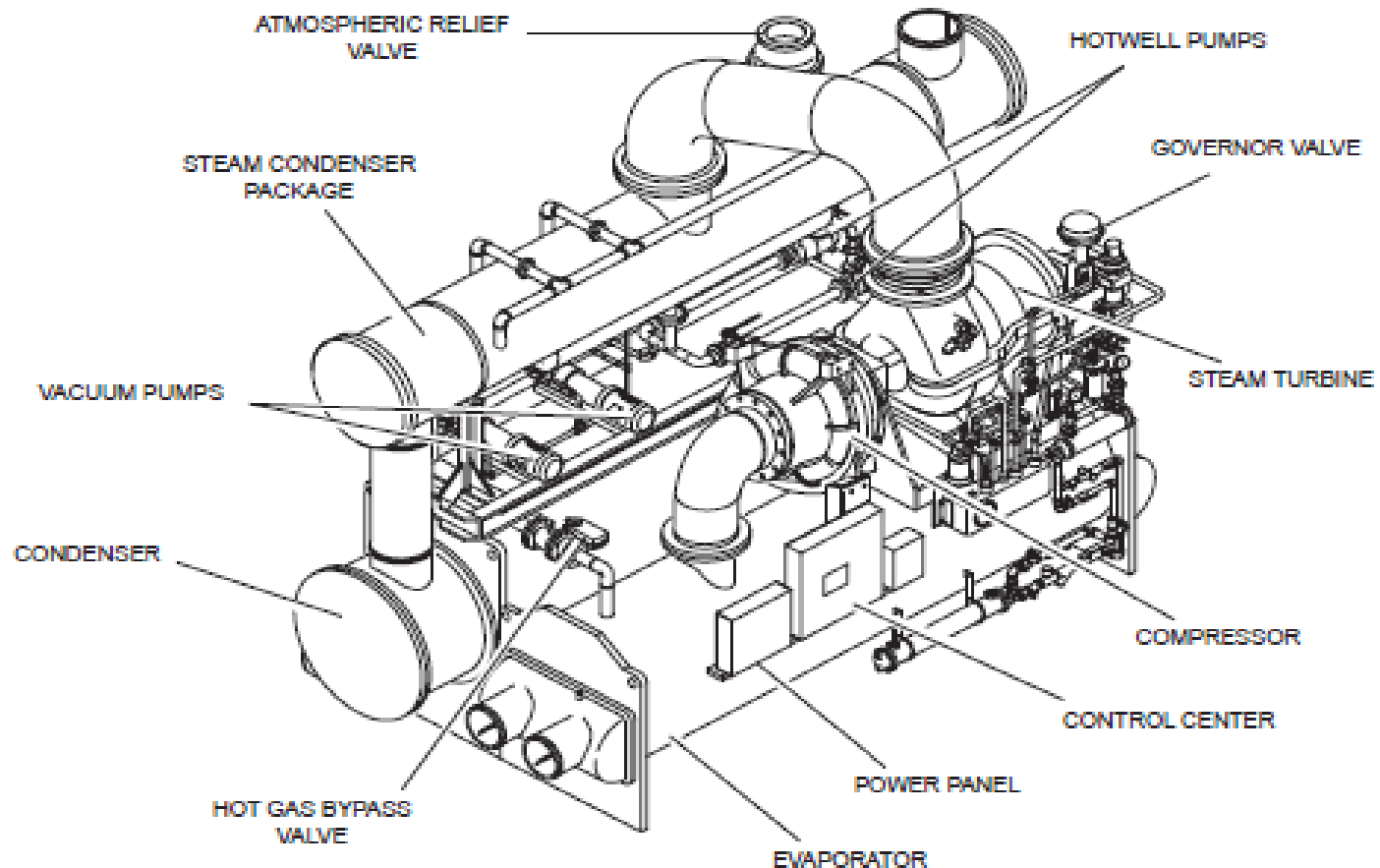


- Board of Governors approved of \$5,000,000 budget to engineer, procure and install a 3,000 ton tri-generation steam turbine driven chiller in the Keele Campus Central Utilities Building
- This project has several attributes which independently substantiate the concept;
 - Reduced energy consumption and associated environmental stewardship (reducing annual electrical consumption by 5,231,000 kWh and peak consumption by 2MW, over 4,000 tons of CO2 avoided assuming imported coal fired peaking generation, twice the capacity and efficiency, part load efficiency almost 4 x better during start up testing)
 - Requirement for Incremental Peak Cooling Capacity – various new buildings
 - Maximizing York Electrical Power Generation – unloads back end cogen boiler steam constraint (2.8MW gain in August 2014 commissioning and testing)
 - Minimization of Imported Power and reducing cost of purchased electricity Investment Business Case and Incentive Timeliness (<8 year payback, with an electricity saving of \$523,101/year, incentive over \$1,030,000 on electricity, \$44,000 on natural gas)
 - Modernization and reliability – replaces very inefficient obsolete 1964 unit
 - Infrastructure Cost Avoidance – electrical sub-stations, new chillers

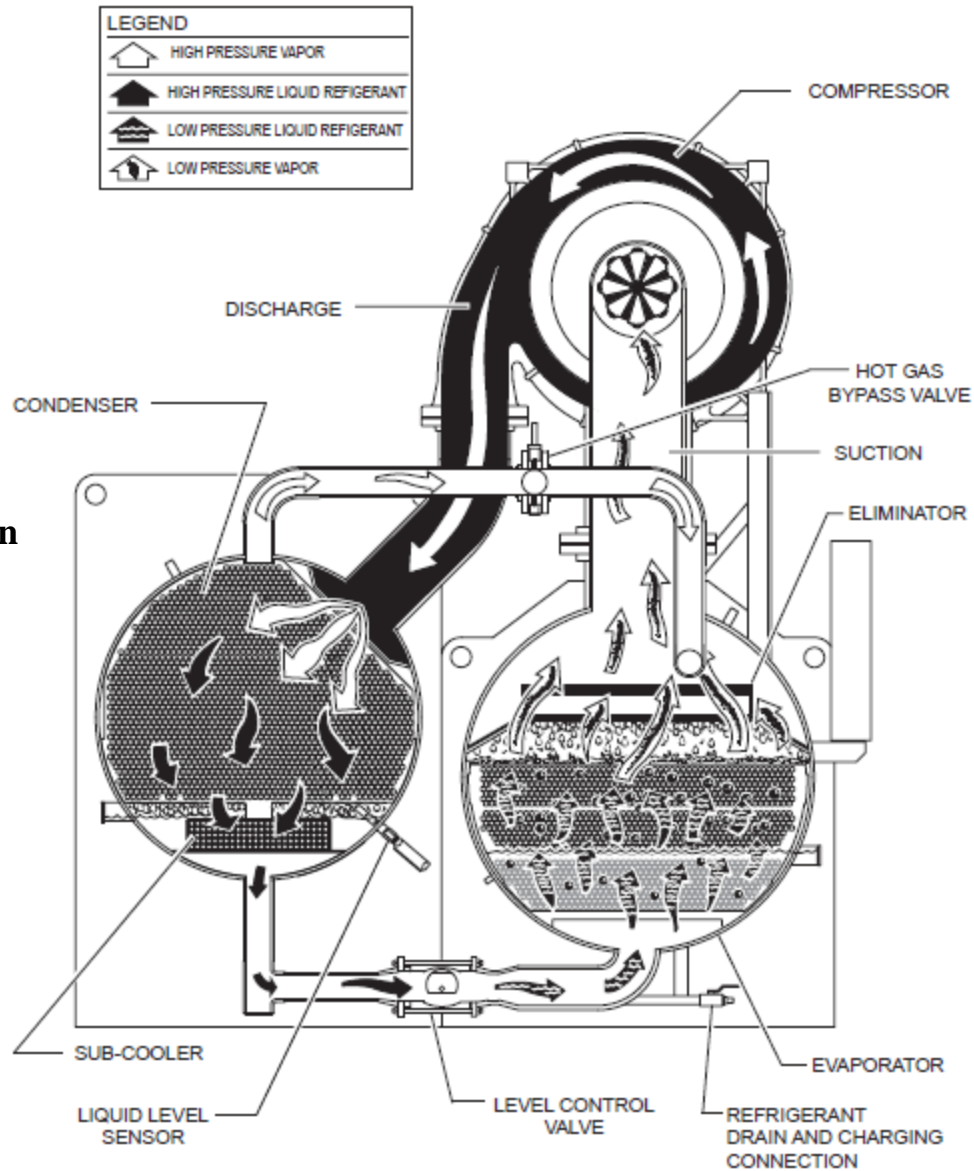
New Tri-generation Steam Turbine Chiller Project



DESCRIPTION OF SYSTEM AND FUNDAMENTALS OF OPERATION

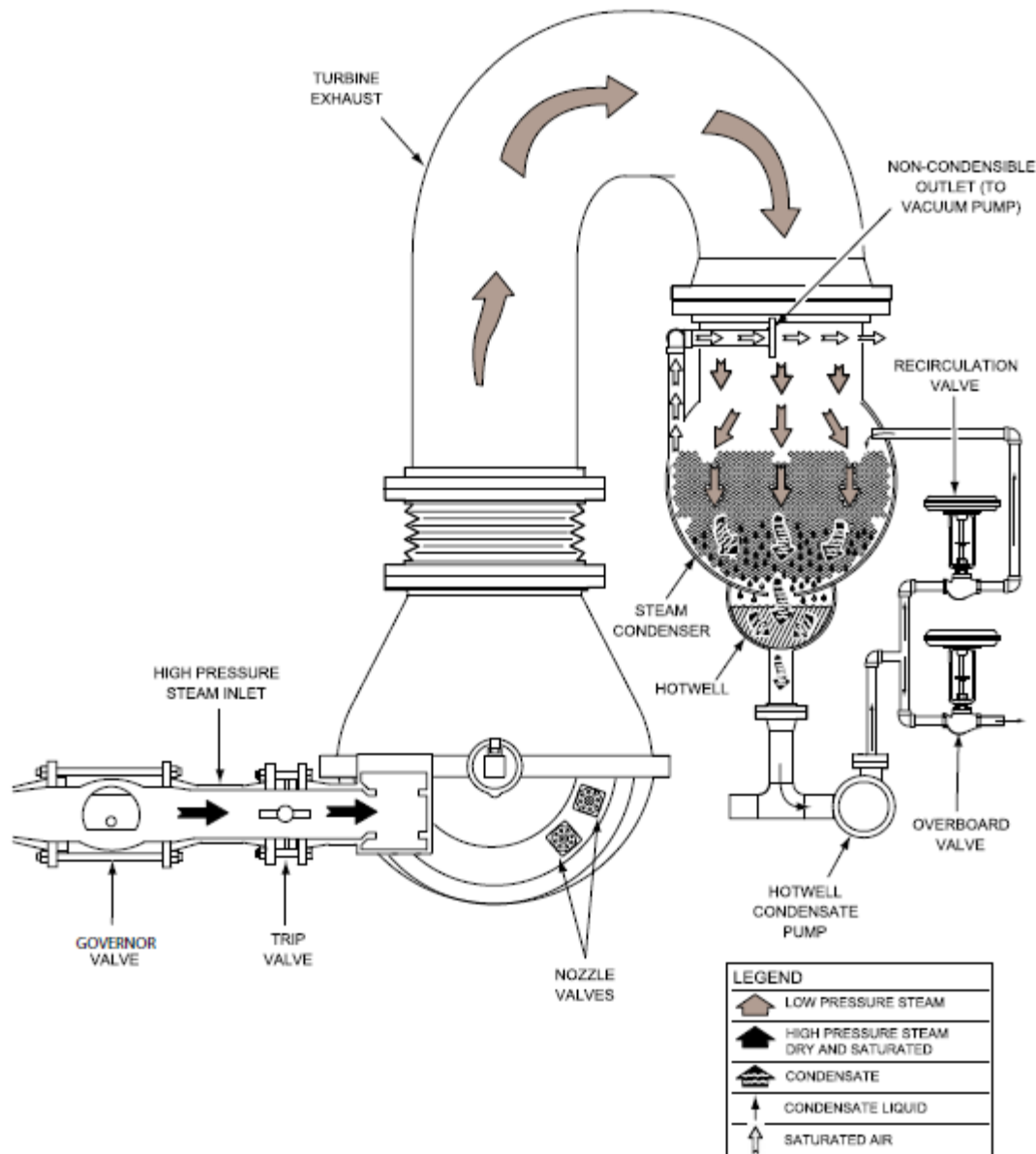


REFRIGERANT FLOW DIAGRAM



**New Tri-generation
Steam Turbine
Chiller Project**

STEAM AND CONDENSATE FLOW DIAGRAM



**New Tri-generation
Steam Turbine
Chiller Project,
steam recovered
from back of
natural gas turbines
(co-generation)**

Old 1964 Chiller on the way out!



New 2014 Chiller Installation in the Central Utilities Building



[Energy Management Website](#)

[Construction Video](#)

[Training Video](#)

The Next Hundred Million Reasons



- Amazing accomplishments we can all be proud in terms of sustainability progress
- First 30,000,000 kWh reduced but there are still hundreds of opportunities with daylight harvesting, and new technology opportunities like LEDs (active trials in parking garages, some high ceiling areas completed at cost of \$100k), and laboratory HVAC ACH modulation (Lumbers pilot)
- Need to deal with increasing costs (e.g. April 1, 2015 water goes up another 8%), infrastructure replacement and universal climate change challenges are increasing (new HFC refrigerant & GHG /carbon tax regulations)
- Join us on the continuing journey to tackle the remaining 100 million kWhs, do the little things that help x 53,000 students

Questions (Easy)?

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