

Sustainability & Energy Management at York Guest Lecture

The Next Hundred Million Reasons

Brad Cochrane, Director, Energy Management
2015

<http://energymanagement.info.yorku.ca/>



redefine THE POSSIBLE.



Keele Campus Overview



KEELE CAMPUS

- Founded in March 1959, and is now Canada's third-largest university
- Canada's leading interdisciplinary research and teaching university
- Over 50,000 students and over 7,000 employees
- Over 8,000,000 sq. ft. and have the single largest campus in Canada
- Expansion of undergraduate engineering program (civil, mechanical, electrical)
- Spring 2015 announcement of new satellite campus in Markham
- Major Faculty of Environmental Studies
- 21MW historical peak elect peak load (with new Life Sciences, Track & Field Stadium and Lassonde School of Engineering Bergeron buildings)
- Over 13,900 tons of centralized chillers for air conditioning (2015 peak: 9,256)
- Prime opportunity for peak shaving (even with new successful YST chiller)
- Provincially designated host site for nuclear incident
- Similar to scope of City of North Bay

Motto – **redefine** THE POSSIBLE,
Tentanda Via: The Way must be tried
<http://energymanagement.info.yorku.ca/>



Energy Management Department Overview within Campus Services & Business Operations Division



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/tri-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 TSSA certified Operating Engineers 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 \$41,500,000 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 E, P, C contractor. In February 2006, the pilot project for the YorkW!\$E Energy Management Program was brought forward for Board approval.

Johnson Controls was the major sub-contractor for all of our building automation system upgrades along with being the equipment supplier in our featured flag ship measure being a 3,000 ton steam turbine chiller.

Since that time, numerous energy conservation measures were approved and implemented in campus buildings and in the central plant and utility distribution systems with >\$3,330,000 in utility company incentives to date being reinvested (with another \$1,030,000 for new steam chiller, and other lighting and compressor upgrades pending).

What next on the journey to reducing utility spending/increasing costs?



- Completed review of possible next steps in early 2012 as natural gas prices had fallen making some original HVAC heating measures financially unattractive, and the electricity Global Adjustment regulations well defined and understood, are there now better unforeseen options – ANSWER: **YES**



New Tri-generation JC York 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 York Steam Turbine (YST) 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 Life Extension– electrical sub-station equipment

Old 1964 Chiller on the way out!



Incentive cheque presentation



Board of Governors approved of \$5,000,000 budget to engineer, procure and install a 3,000 ton tri-generation York Steam Turbine (YST) driven chiller in the Keele Campus Central Utilities Building – Are we delivering the projected results? YES



- Infrastructure Life Extension– electrical sub-station equipment: **yes reduced peak/duration**
- Modernization and reliability – replaces very inefficient & obsolete 1964 unit: **yes**
- Reduced annual electrical consumption by 5,231,000 kWh and peak consumption by 2MW, Maximizing York Electrical Power Generation – unloads back end cogen boiler steam constraint (2.8MW gain in August 2014 commissioning and testing) **yes, see below**
- Minimization of Imported Power and reducing cost of purchased electricity Investment Business Case and Incentive Timeliness (<8 year payback, with an electricity saving/avoidance of \$523,101/year), **yes**

Year	June CDD	July CDD	Sub-Total CDD
2014	68.1	71.0	139.1
2015	32.3	114.3	146.6 little warmer

Year	June kWh Imported	July kWh Imported	Sub-Total Imported
2014	6,162,458 (18.0MVA)	4,730,717 (16.7MVA)	10,893,175
2015	3,797,842 (14.9MVA)	2,858,412 (15.7MVA)	6,656,254
			4,236,921 less kWh imported

Year	June kWh Generated	July kWh Generated	Sub-Total Generated (Totals)
2014	1,603,795	3,227,816	4,831,611 (15,724,786)
2015	3,233,078	4,898,466	8,131,544 (14,787,798)
			3,299,933 more generation

New Pan Am and Engineering building **250,000 kwh increase year over year**, good results even with cogen downtime for new 407 area Enbridge Gas Pipeline reinforcement, and cool nights under utilized and better than expected results on other CW improvements, surprise surprise the Global Adjustment rate went up, Hydro Bill cost avoidance >\$500,000 in two months despite phased in start up in June

Load Profile from Toronto Hydro



Detail Profile



Tue Jun 16 2015 to Thu Jul 16 2015

Total Usage: 2,277,614.68 KWH
 Max Demand: 13,901.81 KW
 Occurred On: Jun 19 2015 11:15
 Load Factor: 22.021%

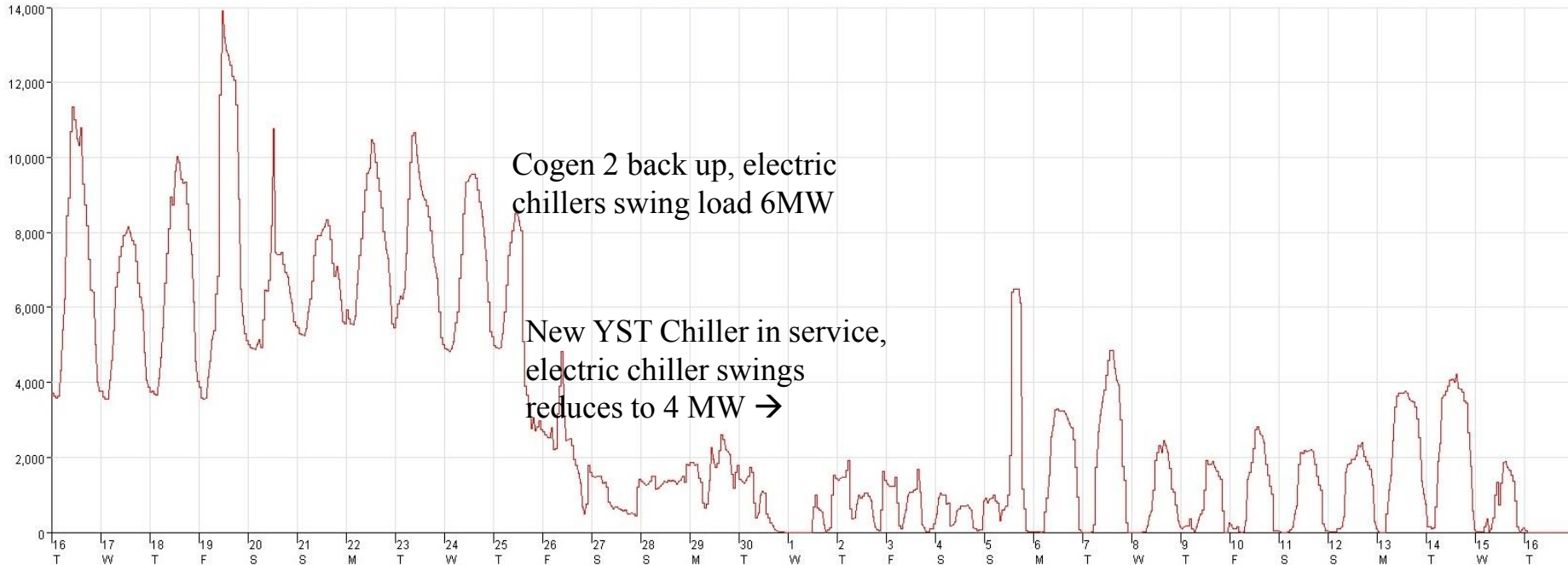
Tue Jun 16 2015 to Thu Jul 16 2015

Total Usage: 2,277,614.68 KWH
 Max Demand: 13,901.81 KW
 Occurred On: Jun 19 2015 11:15
 Load Factor: 22.021%

KW

Detail Profile

0817190195:Owned:TTAYORKUNIV



Cooler condenser temperatures!!!




PW

PROCESS WATER

Chiller 4 Details

NAMEPLATE	TONS	3000 ton
ACTUAL	TONS	CHW-CH-401-LD 3145 ton

A small green square icon with a vertical bar and a downward-pointing arrow, located at the bottom center of the screen.

New 2014 Chiller Installation in the
Central Utilities Building (Videos at
<http://energymanagement.info.yorku.ca/>)



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 went up another 8%), infrastructure replacement and universal climate change challenges are increasing (new HFC refrigerant & GHG /carbon tax regulations)
- See us on the continuing journey to tackle the remaining 100 million kWhs <http://energymanagement.info.yorku.ca/>

Questions (Easy)?

Brad Cochrane

email: bcochran@yorku.ca

<http://energymanagement.info.yorku.ca/>