Sustainability & Energy Management at York Guest Lecture

The Next Hundred Million Reasons

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YORK UNIVERSITÉ UNIVERSITY

redefine THE POSSIBLE.

AGENDA

- **Introductions and Opening Remarks**
- **Keele Campus Overview**
- **York University Energy Management Overview**
- **YorkW!$E Energy Management Project Overview**
- **Scheduling Opportunity – A great first year**
- **New Steam Chiller Project**

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 55,000 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 and future engineering building)
- Over 10,000 tons of centralized chillers for air conditioning
- Prime opportunity for peak shaving
- 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

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 for heating and 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

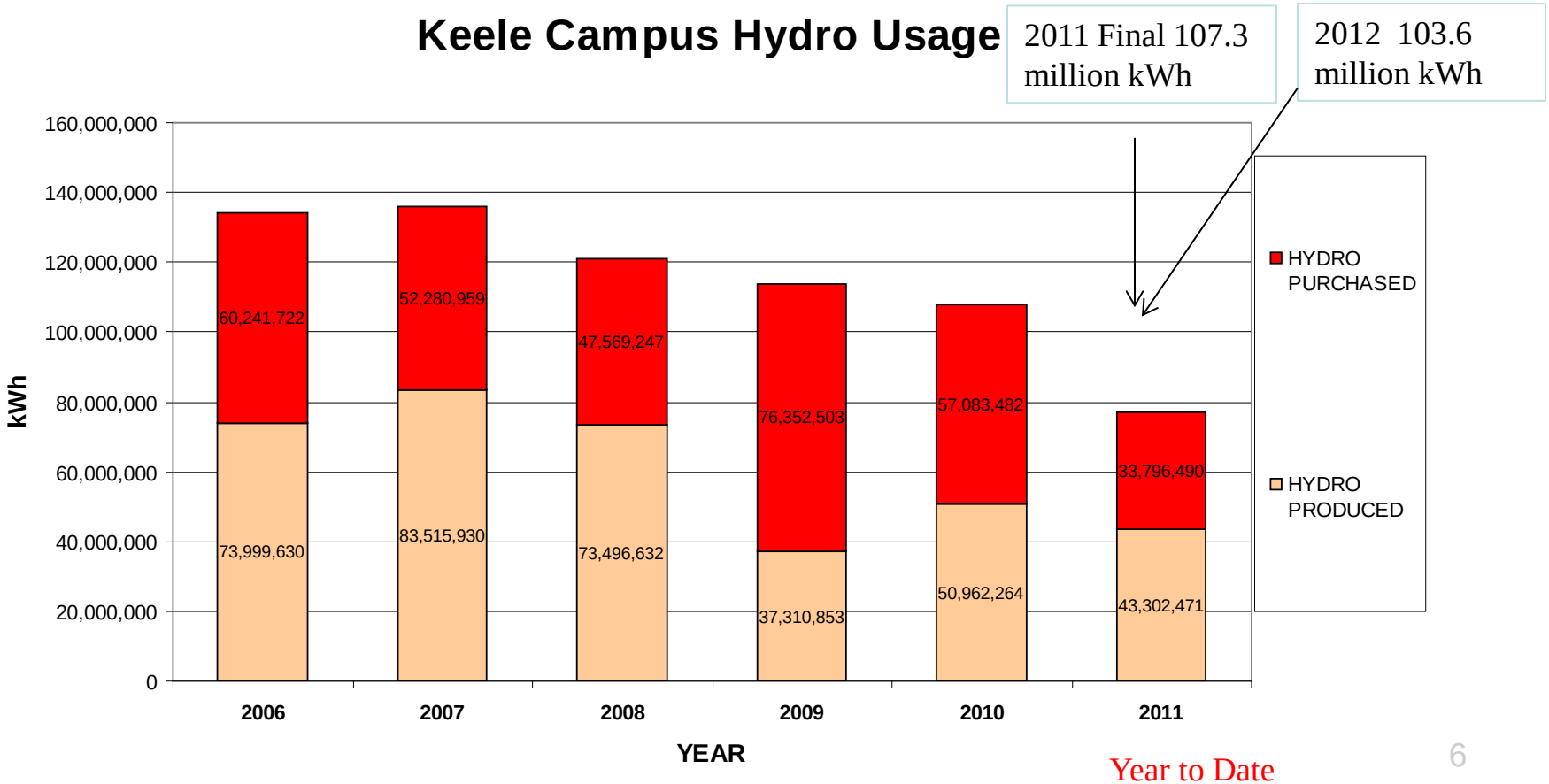
Historical Operating Budget - $25 million (almost $70,000/day, $0.80/sec)

- 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 in1997, additional 5 MW in 2003

Energy Management Overview



Year to Date

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 >$2,330,000 in incentives to date being reinvested.

YorkW!$E Energy Management Project

Current Status

At this juncture, the $41,000,000 program is about 80% complete, with all projects funding committed.

Results have been very positive as weather-normalized savings have been calculated at 22%. The project is well along the path to reaching the 25% goal, even with the 5% Campus growth in buildings, and a higher student population.

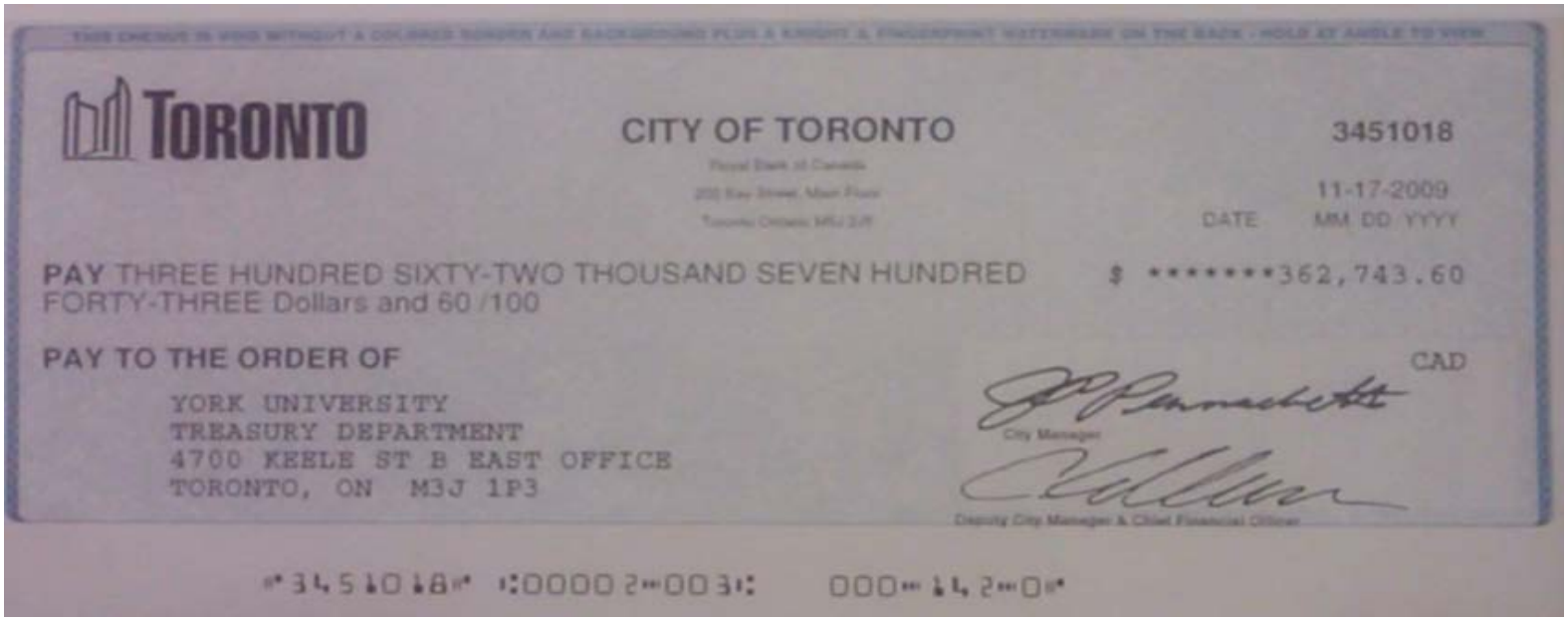
Metering installed as a foundation measure in this program has created the tools to underpin engagement success stories like the 'Res Race to Zero'. This provides us new insight to shape future upgrades and initiatives, and to target ongoing energy reduction/conservation activities.

We continue to pursue available incentives with our contractor MCW Custom Energy Solutions Ltd. to support the project and are proud of the incentive revenues.

Our carbon footprint has been reduced and the reductions have facilitated capital cost avoidances by creating infrastructure capacity for the addition of a new Life Sciences Building. (=Sustainability, no new resources)

YorkW!$E Energy Management Project

Package 1 Lighting Upgrade Incentive Cheque



YorkW!$E Energy Management Project

Quick Stats – Campus Buildings

- 51 Buildings across both Campus have had new energy efficient lighting installed that has reduced lighting demand by over **2.3 MW** (2,300 kW)
- 31 Buildings have had major controls upgrades adding over 2,000 new control and monitoring points,
- 141 Variable Speed drives have been added to 19 Campus buildings representing 3,185 hp of fan power converted to Variable Air Volume Control (VAV)
- 2,350,000 CFM of ventilation on Campus has been converted to VAV
- 160 new utility meters installed on Campus (Keele Campus)

YorkW!$E Energy Management Project

Quick Stats – Central Utilities Building (CUB)

- new Variable Speed Drives (VSD) have been installed as part of the cooling system upgrades in the CUB. (Chilled Water pumps and Cooling Tower #3)

- 350 hp of new VSD's have been installed as part of the heating system upgrades in the CUB (Boiler Feed water pumps).

Scheduling Opportunity

What are the major opportunities and critical technical and incentive challenges going forward to reduce consumption and peak demand of chilled water load for air conditioning:

- First tackle **reduction** of load – manually optimize classroom utilization scheduling with building automation scheduling (turn off what is not in use, work toward proactive scheduling techniques)
- Study completed on summer 2010 classroom utilization, large conservation opportunity
- We believe we can harvest up to **0.5 MW** in load reduction (direct and indirect), in the summer months.

Background

- 1 BTU is approximately equivalent to the heat emitted when a match ignites.
- According to ASHREA (American Society for Heating, Refrigeration, and Air Conditioning Engineers), on average, a seated human being gives off 350 BTU's per hour.
- If there are 100 students in this lecture hall that is 35,000 matches per hour or 105,000 in a 3 hour lecture.

Period of Low Occupancy

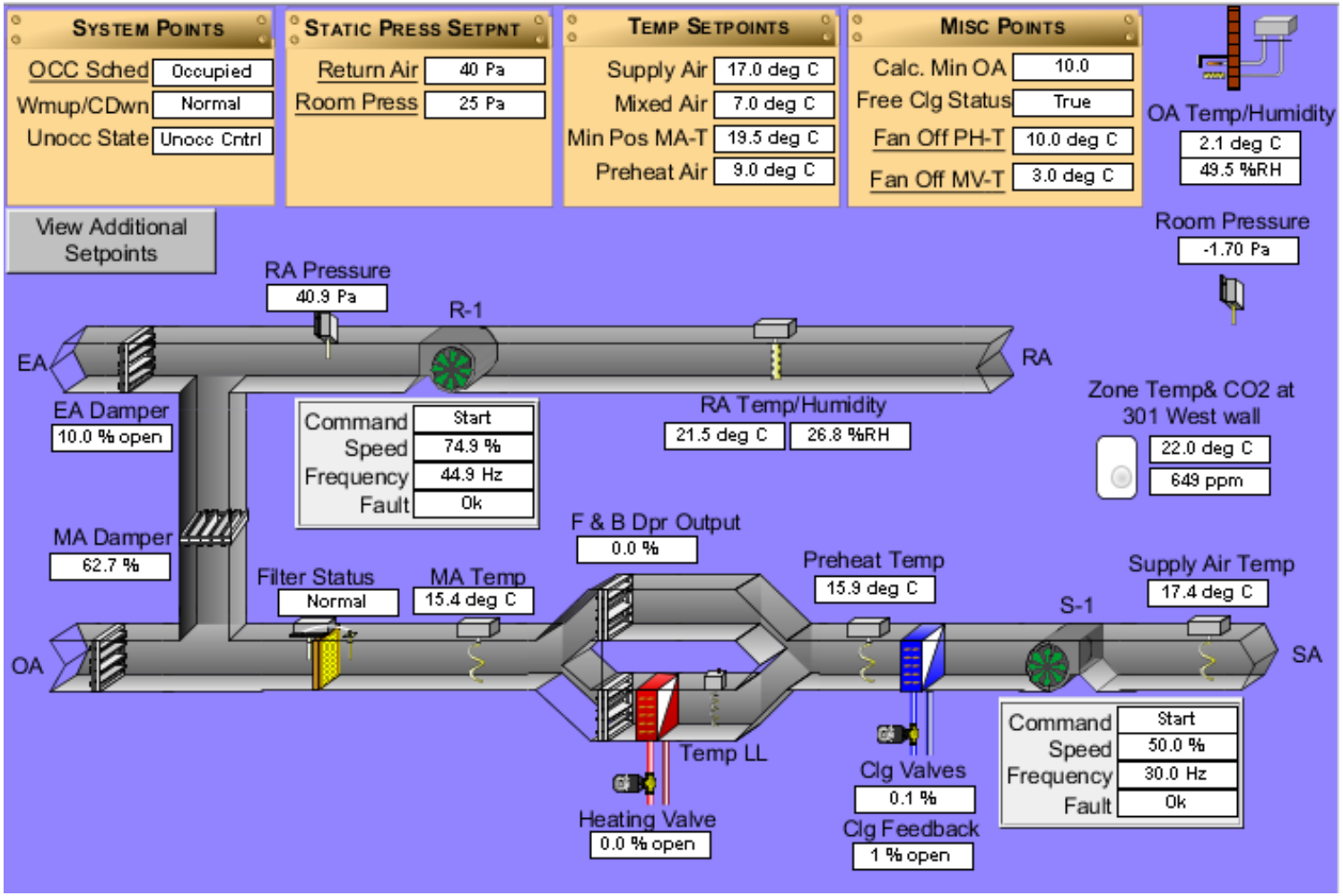
In 2010, a study identified opportunities to reduce consumption during periods of low occupancy:

- Weekends
- Statutory Holidays
- Lead in/lead out
- Exams/Reading Week
- Summer Schedule

Family Day Test Weekend

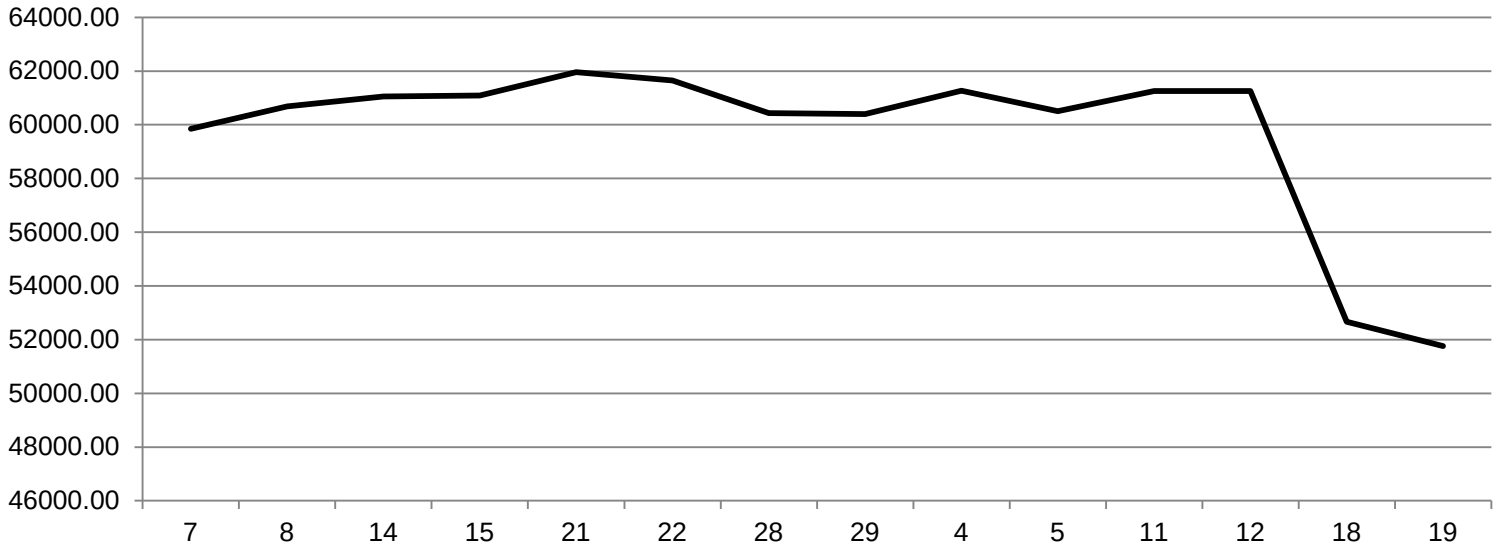
- Pilot project began in January of 2012
- First test occurred on the family day weekend targeting **127 building ventilation fans** in **19 buildings**

Curtis Lecture Hall



Results: Electricity

8,736.47 kWh electricity saved each day, on average, which saved **$611.55 - 873.65 per day**, assuming a rate of 7 to 10 cents per kWh, associated heating savings on same order approximately **$720 per day**



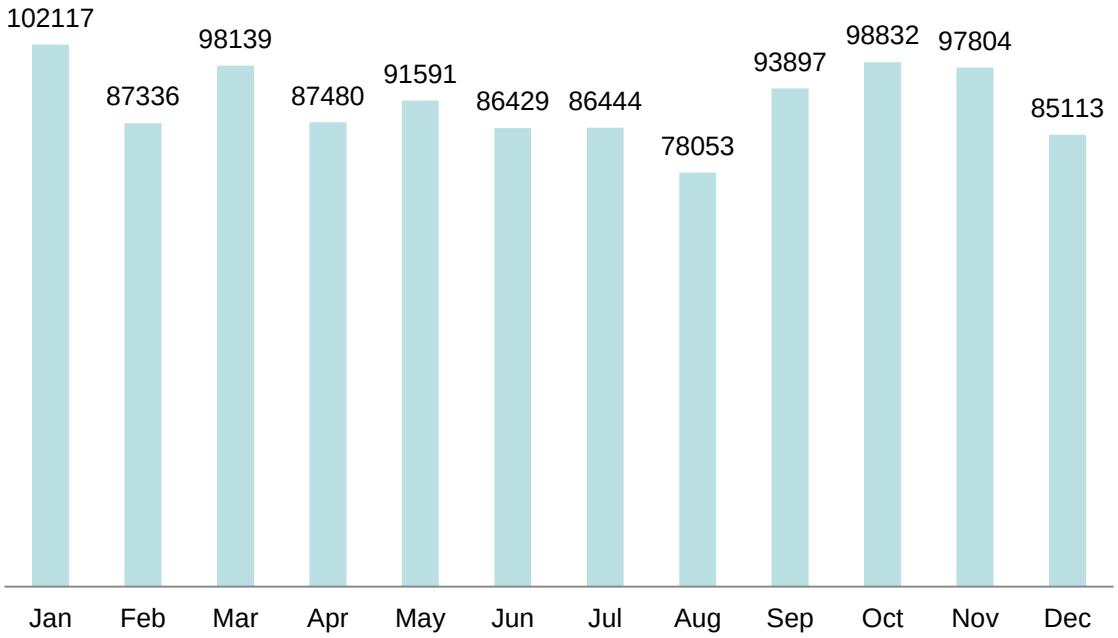
Extrapolated over a Year?

- Weekends (104 days)
- Statutory Holidays (32 days)

- **Annual Electricity Savings 83,171.21$ to 118,816.01$**

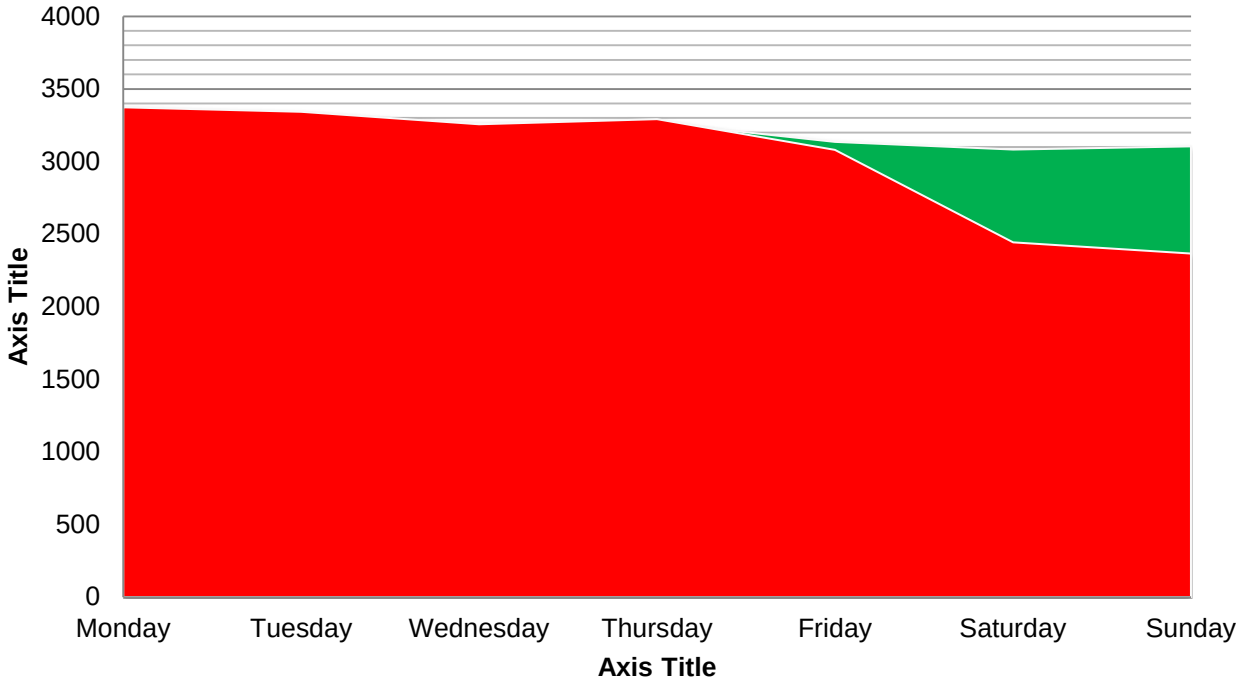
Case Study: Curtis Lecture Halls

Total Electricity Consumed in Curtis Lecture Halls by Month in 2011 (kWh)



Total Annual Electricity Consumed in 2011: 1,093,235 kWh

Curtis Lecture Halls



Curtis Lecture Hall consumed 18.3% less energy during the test weekend resulting in a decrease in consumption by 535 kWh/day.

Expanded over a year, this would **equate to 73,101 kWh** in Curtis Lecture Halls - nearly 0.7% of the building's total annual electricity consumption.

So what did 2012 scheduling achieve?

- Nothing less than amazing - absolute year over years savings of over 3%, (3,863,971 kWhr)
- Cooling Degree Days were up 14.8% (more air conditioning)
- Chilled Water for air conditioning DOWN 5.8%
- Chilled Water produced per Cooling Degree Day DOWN 17.9%
- Order of magnitude in $$$ saved - $350,000

What next on the journey to reducing consumption?

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

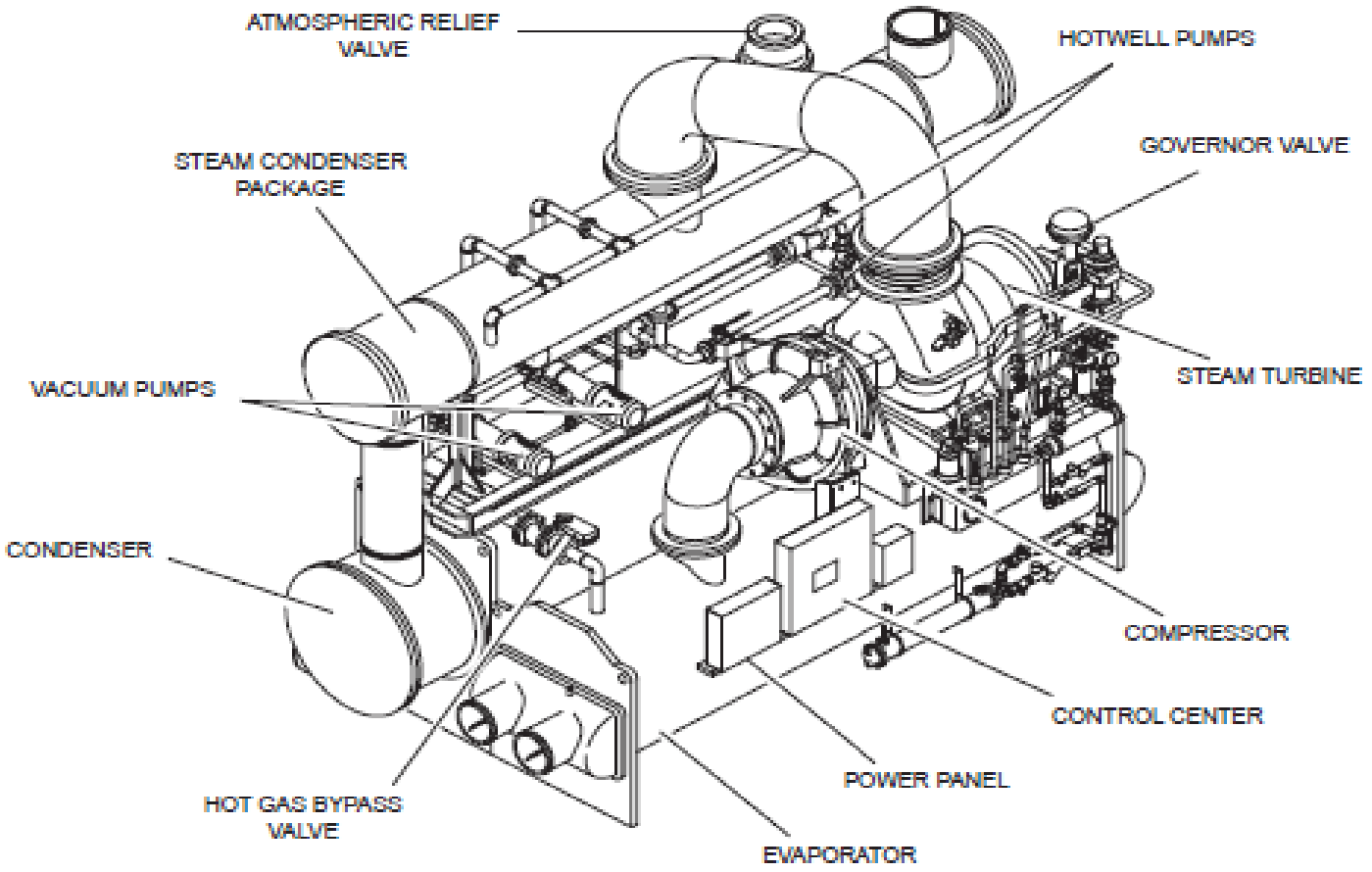
New Steam Turbine Chiller Project

- Board of Governors approved of $5,000,000 budget to engineer, procure and install a 2,800 ton 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)
  - Requirement for Incremental Peak Chilling Capacity – new buildings
  - Maximizing York Electrical Power Generation – unloads cogen constraint
  - 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)
  - Modernization and reliability – replaces very inefficient 1964 unit
  - Infrastructure Cost Avoidance – electrical sub-stations, new chillers

New Steam Turbine Chiller Project

DESCRIPTION OF SYSTEM AND FUNDAMENTALS OF OPERATION



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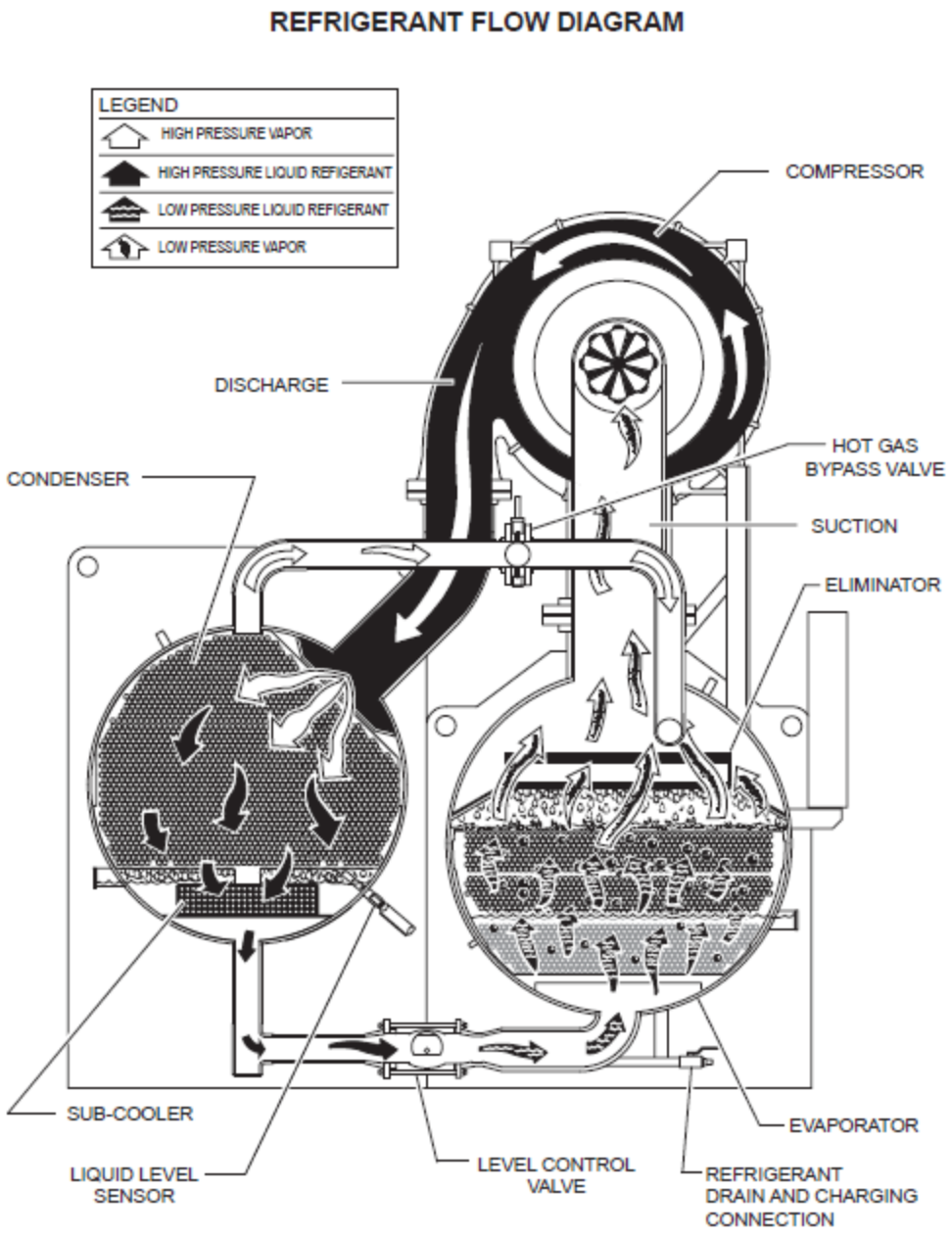
New Steam Turbine Chiller Project



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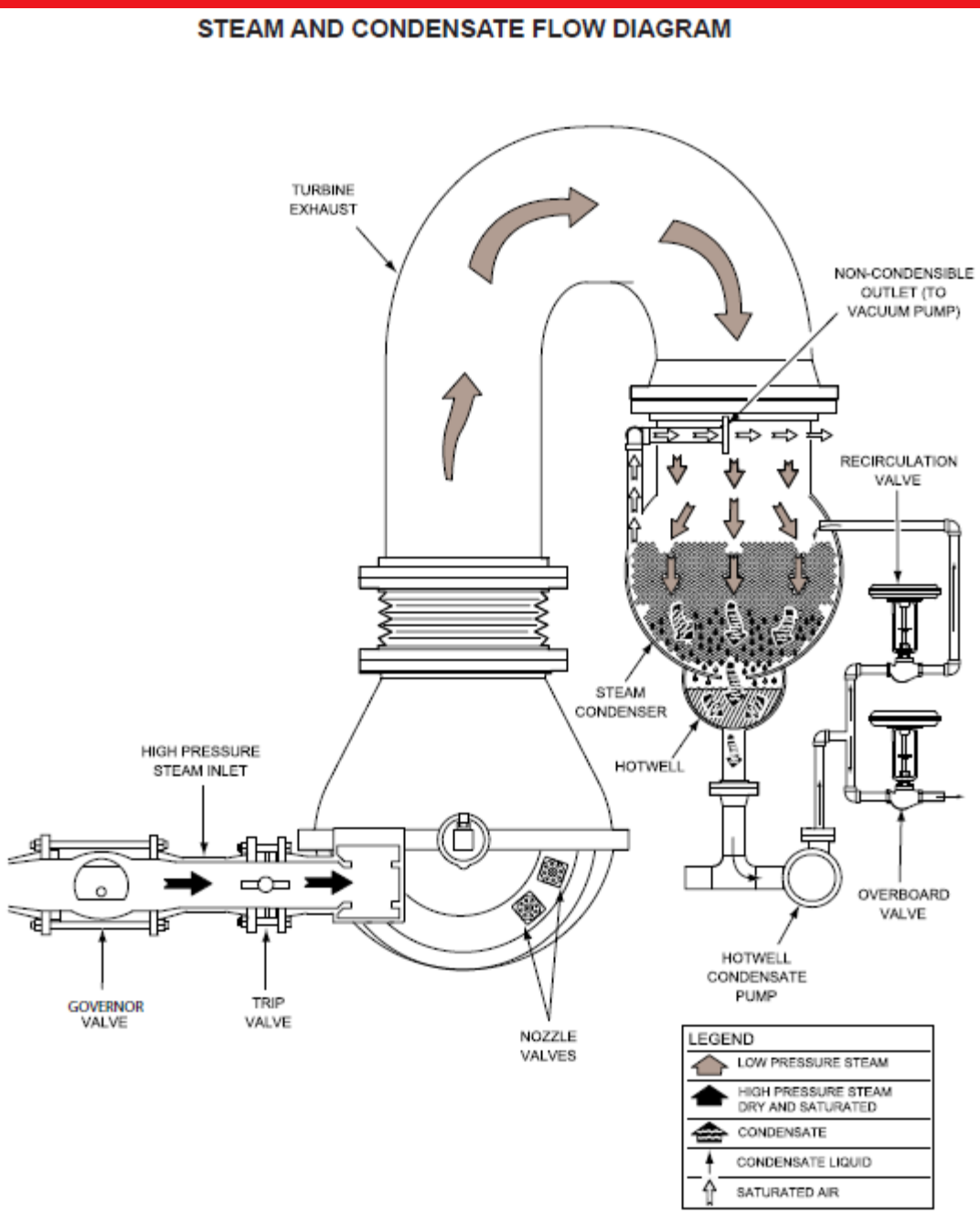
New Steam Turbine Chiller Project



The Next Hundred Million Reasons

Who did the math for Keele Campus Totals?

2012 kWh:	103.6 million kWh
New Steam Turbine Chiller	5.2 million kWh
2014 Target	98.4 million kWh

But……

Glendon consumes roughly 5.2 million kWh/yr = grand total still 103.6

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 new opportunities with daylight harvesting, and new technology opportunities like LEDs
- Need to deal with cost challenges and climate change are increasing – join us on the continuing journey to tackle the remaining 100 million kWhs

Questions (Easy)?

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