Bishop’s University energy efficiency project:
The next step towards a
Carbon Neutral Campus
Context
Energy Efficiency Project

- Process started in 2008 by Bishop’s University
- 3 Energy Services Company submitted bids for a comprehensive turn-key energy efficiency project
- 2010: contract awarded to Ameresco after a detailed feasibility study was submitted and approved by BU
- Project in 2 phases:
  - 2010-2011: Decentralisation of heating systems
  - 2011-2012: Geothermal heating system
- Project monitoring and energy savings calculations for following 10 years
The threat of global warming
Evolution of GHG emissions

GHG emissions by source (Québec, 2000)

In bold: Where BU is taking action (everywhere we can!)

http://www.mddep.gouv.qc.ca/changements/ges/index.htm
On the threshold

The scientific community agrees that if the planet’s temperature increases by more than 3.6 °F, consequences will be disastrous and irreversible.

In 2007, the planet’s temperature had already increased by 1.3 °F since the industrial revolution.

Even if all countries enact the policies they have promised, the temperature rise will reach more than 6 °F in year 2100.

Bishop’s is taking action

- **Eliminating heating oil use** and **reducing natural gas use** with new decentralized **geothermal** heating system

- **Reducing electricity use** with high efficiency lighting and automated building controls for heating, air conditioning and ventilation systems

- **Reducing waste** with composting, recycling and by promoting better practices

- **Reducing GHG emissions for transportation** with new electric carts instead of fuel-driven carts
Energy conservation measures
Geothermal heating system
Geothermal heating system

Geothermal energy ???

- Below 50 feet, ground temperature is low but nearly constant in depth and in time (49 °F measured at the soccer field)
- This “low-grade” energy can be converted to “high-grade” or usable energy by using heat pumps
- Heat pumps convert free “low-grade” energy to usable energy with the use of electricity
- Electricity use is only 25-50% of energy produced (50-75% comes from the ground)
Geothermal heating system

Heat pumps

Electricity from Hydro-Québec

Free energy from the ground

Heat pump

Usable energy for heating

25%

75%
Geothermal heating system

Geothermal wells

- 500 feet deep in the ground
- Closed-circuit piping with circulating fluid to retrieve the ground’s thermal energy
Geothermal heating system

In practical terms...

- 57 geothermal wells in the soccer field
- + 2 big heat pumps in the old heating plant
- + 11 smaller heat pumps in the various buildings
- + 1 big underground loop connecting all buildings to the heating plant

= The first geothermal district heating system in Canada!
Geothermal heating system

Underground energy loop

➡️ Every building can take energy from the loop or reject energy in the loop.

➡️ If a building needs heat, it takes heat from the loop.

➡️ If a building needs air conditioning, it gives heat to the loop.

➡️ The geothermal system balances the loop if there is too much or not enough heat in the loop.

➡️ Modular system, future buildings can be connected to the loop.
Geothermal heating system

Underground energy loop

Energy loop

Geothermal system

Air conditioning

Heating
Geothermal heating system

Savings

⇒ 62% of greenhouse gases emissions
   • 2,364 tons of CO$_2$ per year
   • Equivalent to removing 1,478 cars from the road
   • Equivalent to planting 14,167 trees

⇒ 1,011,000 cubic meters of natural gas per year
   • Equivalent to heating 337 big single family houses (2,000 sq.ft. each)

⇒ 325,000$ in energy savings per year
High efficiency lighting
High efficiency lighting

Complete upgrade of lighting equipment

- Upgrade of fluorescent lighting fixtures to more efficient technology
  - T8 lamps (smaller tube with higher output)
  - Electronic ballasts
- Upgrade of exit signs to LED technology
- Upgrade of incandescent lighting to compact fluorescent technology
High efficiency lighting

Savings

⇒ 400,000 kWh per year
  • Equivalent to 22 average households using only electricity (family of 4 in a 2,000 sq.ft. house)
⇒ 26,000$ in energy savings per year
⇒ Long-term maintenance savings because of longer life expectancy of new lamps
Automated control system
Automated control system

Existing system

→ Automated control of ventilation, heating & air-conditioning
Automated control system

How to improve

» Controlling the precise volume of air delivered to the rooms to match the needs

Constant air volume system
Automated control system

How to improve

- Controlling the precise volume of air delivered to the rooms to match the needs

Variable air volume system
Automated control system

How to improve

- Example: squash courts in Price Sports Center
  
  - 6 courts with constant air volume, each room has a main air supply duct
  
  - Each court will be equipped with a motion detector that will control a motorised damper located in the main supply duct
  
  - Court unoccupied = minimum air supply
  
  - Court occupied = maximum air supply
Automated control system

Other ways to improve

- Stopping ventilation systems at night
- Controlling fresh air intake with CO₂ probes
- Controlling supplied air temperature based on outside air temperature
- Etc.
Automated control system

Savings

⇒ 675,000 kWh of electricity per year
  • Equivalent to 38 average households using only electricity
    (family of 4 in a 2,000 sq.ft. house)

⇒ 49,000 cubic meters of natural gas per year
  • Equivalent to heating 16 big single family houses (2,000 sq.ft.
    each)

⇒ 43,000 $ in energy savings per year
Continuing energy efficiency
Continuing energy efficiency

Making future projects energy efficient

- Ameresco can act as a consultant to Bishop’s University for all new major construction or renovation projects
- Integrating the environmental vision of the University in all future projects
- Making sure all parties move in the same direction, towards a carbon neutral campus
Continuing energy efficiency

Making existing systems match changing needs

- Review all major heating, ventilation, and air-conditioning systems to make sure they match the current needs
  - Modify systems based on findings
  - Correct mechanical and electrical problems
  - Optimize controls
  - Discover new energy conservation measures
  - Train operators and maintenance personnel
Integrating new ideas

- Special budget ready for implementing new energy conservation measures
- New ideas from Ameresco, University staff, students, etc.
- Ideas will be analysed by Ameresco to calculate potential savings and estimate implementation costs
- Ideas must present an interesting payback period (< 10 years approx.)
Savings summary
Next step towards a CARBON NEUTRAL CAMPUS
Questions