Energy Management and Information System
McGill University – Utilities & Energy Management

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• Who we are
• Our challenges
• Our approach
• The EMIS project
• Lessons learned
who we are

• One of the oldest universities in Canada
  Established 1821

• Top 1 university in Canada, among top 20 universities in the world

• 21 faculties
  Medicine, Law, Music, Chemistry, Engineering, Physics, Biochemistry, etc.

• Old stock of buildings
  Average age: 50+ years

• Research intensive
  12 Nobel Prize winners,
  $1.1 billion endowment in 2012
who we are

• 36,000 students
  11,000 faculty and staff
• Total gross area: 800,000 m²
  (8.5 million sq. ft.)
• Annual energy use: 1.4 million GJ
  (1.3 million MMBTU | 385 GWh-e)
• Annual energy cost: CAD $18M
  (€ 14 million)
• 2 steam distribution networks
  500+ million lb steam / year
• 2 power distribution networks
  30MW peak demand
• 3 main chilled water distribution networks
  12,000-ton capacity
• ±1,000 HVAC systems
our challenges

• Highly energy intensive university

• Utilities not metered at building level

• Numerous HVAC systems

• Systems controlled by other unit
our approach

$30 million five-year investment program to improve energy performance

**Improve infrastructure**
- energy audits, HVAC upgrades, heat recovery, etc.

**Improve operations**
- processes and day-to-day operations, retro-commissioning

ENERGY MANAGEMENT INFORMATION SYSTEM
Hardware

- $3.0 million investment
- 400+ meters installed electricity, steam, condensate, natural gas, hot water, chilled water
- 70+ buildings monitored 50% of campus gross area
- 80% of energy use monitored
- 18 months to install, set up, and integrate meters to existing metering platform
- Procedures and tools developed to verify and validate installations, set-ups, and equipment

- Credibility
  Consistent process, standard set-ups, constant validation
Software

- Collect and organize data
- Plot energy demand in real time against external factors $T_{\text{out}}$, $RH_{\text{out}}$, wind speed and direction, net solar radiation

- Generate reports to follow trends in long-term energy use
- Train “typical curves” to benchmark buildings against themselves and detect anomalies
- Engage building occupants
“Humanware”

- Multidisciplinary team comprising energy managers, HVAC managers, control technicians, and ad-hoc guests
- Analyse anomalies and implement measures
  - Corrective (short term solutions)
  - Preventive (long term solutions)
- Coordinate operations energy generation and distribution vs energy demand on campus
- Review processes, inform decision makers

- Examples of anomalies: abnormal trend in energy use, random spike in demand, unnecessary energy use during unoccupied hours, etc.
Examples of Measures

- Review HVAC schedules to realign occupants’ needs and optimal operations
- Optimize ventilation and temperature set points
- Enthalpy control of fresh air
- Peak shaving steam generation and peak power
the project
the project
Optimization of the Ventilation Schedule
Electricity Savings – McGill Bookstore

12-month savings: $9k | 22% cost baseline
HVAC Schedule Optimization + Enthalpy Control + Steam Shutdown

Steam Savings – McGill Bookstore

12-month savings: $41k | 61% of cost baseline
HVAC Schedule Optimization + Occupancy Detection
Total Energy Savings - Bronfman Management Building

12-month savings: $131k | 31% of cost baseline
Quantifiable Results

- Review of HVAC schedules
  $180k | 18,000 GJ for 18 buildings reviewed (of 40)

Other Benefits

- Enhanced cooperation and better understanding of each party’s priorities
- Pro-active solution seeking and sharing of information
- Positive impact on other energy projects (e.g., ReCx)
- Increased awareness of Building Operations team

Fodder for Projects

- Student projects co-supervised / supported by Energy Management team
  - Behaviour change project in dorms and labs
  - Steam demand forecast model
  - Steam generation optimization algorithm
Limitations

- **Level of granularity of metering**
  More granularity would allow us to pinpoint problems more easily but digesting ±400 meters has proved very tedious

- **Extensive monitoring means a lot of extra activities that aren’t core business**
  e.g., meter maintenance, annual verification of equipment, etc.

- **Recurring cost**
  to maintain new assets, pay for software fees, coordinating activities, etc.

- **Hardware and software doesn’t forgo the need for brain power**
On the Roadmap

• Finish implementing revised HVAC schedules

• Address occupancy detection, ventilation and temperature set points through retro-commissioning

• Better predict steam and power demand

• Peak shaving and load shedding

• Continuous building optimization?
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Take a peek at our energy dashboard!
mcgill.pulseenergy.ca

thank you