Richmond Building
Energy Challenge
Benchmarking
Agenda

• Why Energy Management?
• Why Benchmark Energy Use?
• Value of Portfolio Manager
• Features of Portfolio Manager Tool
• Using Portfolio Manager
• How the Richmond Building Energy Challenge Can Help
WHY ENERGY MANAGEMENT?
Context for Energy Management

• **Financial benefits** from a decrease in operating costs
  – Hedge against energy cost volatility;
• General improvement in **operating efficiency**
• Improvement in **stakeholder relations**
• Mitigation of **environmental impact**
• Enhancement of the organization’s **public image**
• Improvement of the financial case for **facility renewal**
• And many others . . .
Assessing Your Need for an Energy Management Strategy

- The business opportunity?
- Importance of energy to the organization?
- Current use of energy and its cost relative to total operational cost?
- Energy-related opportunities and their risks?
- Alignment of energy management with organizational goals and image?
- Legislation and compliance?
- Other current organizational needs?
Low Risk!

“Aside from the easy “low-hanging fruit” many EE projects produce payback periods that are slightly longer than most financial officers prefer.

This simple investment criterion takes capital investment proposals off the executive agenda before they even appear. However, the risks of EE investments, which are lower or non-existent compared to alternative investments, are neither well-quantified nor well-communicated to business leaders.”
Q & A
WHY BENCHMARK YOUR ENERGY USE?
Benchmarking is...

- The process of comparing one’s performance metrics to better, best, median and historical performance.
A Simple Energy Plan Can Start with Benchmarking

Benchmark to prepare the Organization

Monitor & Target

Spot Savings Opportunities

Take Action

Operational Actions

Equipment Repair & Improvement

New Process & Technology
Using Benchmarking as a guide to improvements

Measure
Data

Result

Take Action

Information

Analyze
Benchmarking leads to ...

- increased knowledge about how one’s building is performing
- a desire to improve one’s performance through better practices
- a dialogue/investigation of differences between buildings
- the development of baselines and improvement targets
- monitoring of all energy performance
Benchmarking An Energy Management Best Practice

• Energy Performance
  – Consumption related to drivers

• Energy Practice
  – Technical
  – Operational
  – Organization

• Better practices -> better performance

• Best practice -> best performance
Benchmarking
Promoting Change & Delivering Results!

- California study revealed that 60% of participants were prompted by benchmarking to invest in energy efficiency:
  - Improved energy management processes
  - Building upgrades
  - Behavioural efficiency projects

- The U.S. EPA found that users who benchmarked their buildings saved an average of 7% over three years.


Clear Trends
Linking Energy Efficiency to Profitability

“The results suggest that an otherwise identical commercial building with an Energy Star or LEED certification will rent for about three percent more per square foot; the difference in effective rent is estimated to be about six percent. The increment to the selling price may be as much as 13 percent.”

On The Economics of Green Buildings
By Nils Kok, Visiting Scholar, UC Berkeley Assistant Professor, Maastricht University

http://corporate-sustainability.org/on_the_economics_of_green_buildings/
Internal Benchmarking Example – High Schools
External Benchmarking Example—High Schools

BC Secondary Schools BEPI CY2013 (ekWh/m²)

Average: 152 ekWh/m²

41 Schools
VALUE OF PORTFOLIO MANAGER
What is ENERGY STAR Portfolio Manager?

• Free, secure online tool where you can:
  – Benchmark the energy use intensity (EUI) of all of your buildings; eligible buildings will receive ratings on a 1-100 scale
  – Track changes in energy use over time in single buildings, groups of buildings, or entire portfolios
  – Track cost savings and CO₂ emissions
  – Track water usage

• Based on U.S. ENERGY STAR methodology
• Run by NRCan (Natural Resources Canada)
Portfolio Manager...

• Is based upon the proven strategic approach of benchmarking as the first step to improving energy efficiency
• Is a cost management tool for business that treats energy as any other resource to be managed.
• Helps building owners and managers to strategically manage energy in individual buildings and across their entire building portfolios by offering guidance and tools to:
  – assess energy performance,
  – set reduction goals,
  – track savings over time, and
  – report performance improvement.
NRCan’s Role

• Natural Resources Canada is the gatekeeper for ENERGY STAR Portfolio Manager in Canada.

• For technical questions related to the tool, clients should consult with NRCan via info.services@nrcan.gc.ca
Canadian Adaptation

- Only national Canadian building energy use data survey
- Canadian factors for site and source energy and emissions calculations
- Bilingual interface – French and English
- Metric and imperial measurements
- 150+ Canadian weather stations
  - Auto mapped to the postal code of the building
- 1-100 ENERGY STAR performance scores for K-12 schools, commercial offices, hospitals & Food Retail
  - other building types will be added over time
Categories of Buildings

• Portfolio Manager offers benchmarking for ->

• Adjusted for location and weather variances between locations and years

- Bank branch
- Barracks
- Courthouse
- Data center
- Distribution center
- Financial office
- Hospital (general medical & surgical)
- Hotel
- K-12 school
- Medical office
- Multifamily housing
- Non-refrigerated warehouse
- Office
- Refrigerated warehouse
- Residence hall/dormitory
- Retail store
- Senior care community
- Supermarket/grocery store
- Wastewater treatment plant
- Wholesale club/supercenter
- Worship facility
Portfolio Manager
A Rating System for Buildings

• Using a standard **Energy Use Intensity** (EUI)
  – kWh/ft², GJ/m²

• An **ENERGY STAR Score**
  – Normalized for building operations.
  – Normalized for weather

• A comparison to median for building type

• Source & site energy
Why Use Portfolio Manager

• **Universal tool** – widely understood and accepted
  – Robust normalization for building conditions
  – Draws from an extensive energy use database
  – Based on source energy to account for the true impact of energy use, starting from generation and transmission

• **Ability to share data/scores**

• **Easy input and output of data**
  – Data is not captive
  – Easy interface to other software
  – Data can be uploaded automatically through web services

• **Complementary** to RETScreen® Plus and other tools E.g.:
  – Portfolio Manager for benchmarking and year-over-year comparisons
  – RETScreen Plus for detailed monitoring & verification
Additional Portfolio Manager Features

• Shareability
  – Permit/control others’ access for in/outputs
    • Including energy suppliers to upload your data
  – Account can be shared with the City of Richmond’s Energy coaches to assist with benchmarking

• Downloadable templates (with easy instructions)
  – Additional property details
  – Energy use and cost data
  – Report customization

• NRCan webinars and technical support
Q & A
FEATURES OF PORTFOLIO MANAGER
Detailed Metrics/Comparisons/Ratings

### Energy Performance (GJ/m²)
![Energy Performance Chart]

### Current Baselines & Targets
- **Selected Baselines:**
  - Energy: Dec 2011
  - Water: Not Available
- **Earliest Baselines:**
  - Energy: Dec 2008
  - Water: Not Available
- **Target:**
  - Target % Better than Baseline: 5
- **Design Target:**
  - Not Set

### Metrics Table

<table>
<thead>
<tr>
<th>Metric</th>
<th>Baseline (Mar 2006)</th>
<th>Current (Dec 2009)</th>
<th>Target*</th>
<th>Median Property*</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENERGY STAR score (1-100)</td>
<td>51</td>
<td>36</td>
<td>87</td>
<td>50</td>
</tr>
<tr>
<td>Source EUI (GJ/m²)</td>
<td>2.18</td>
<td>2.45</td>
<td>1.57</td>
<td>2.22</td>
</tr>
<tr>
<td>Site EUI (GJ/m²)</td>
<td>1.54</td>
<td>1.76</td>
<td>1.13</td>
<td>1.59</td>
</tr>
<tr>
<td>Source Energy Use (GJ)</td>
<td>2,690.6</td>
<td>3,030.3</td>
<td>1,938.7</td>
<td>2,740.2</td>
</tr>
<tr>
<td>Site Energy Use (GJ)</td>
<td>1,907.0</td>
<td>2,174.9</td>
<td>1,391.5</td>
<td>1,966.7</td>
</tr>
<tr>
<td>Energy Cost ($)</td>
<td>31,416.80</td>
<td>35,221.72</td>
<td>22,548.27</td>
<td>31,849.57</td>
</tr>
<tr>
<td>Total GHG Emissions (Metric Tons CO₂e)</td>
<td>82.3</td>
<td>94.5</td>
<td>60.5</td>
<td>85.4</td>
</tr>
</tbody>
</table>

**ENERGY STAR Score (1-100)**
- **Current Score:** 66
- **Baseline Score:** 35
Numerous Reporting Possibilities…
Custom Reports & Excel or XML Export
Sustainable Building Checklist
“Sustainable Practice Benchmarking”

Correlate performance to practice across a building portfolio!
Portfolio Manager - Monitoring Tool
ENERGY STAR Performance Score for Canadian Buildings

• 1-100 score for K-12 schools, hospitals and commercial office buildings
  – Scores will be available on a progressive basis, other building types will be added over time

• Energy performance scores are based on the 2009, Survey of Commercial and Institutional Energy Use (SCIEU)

• Median energy use intensity values (EUI) available for almost all buildings
  – EUI can be used for monitoring and tracking instead of or in addition to a 1-100 ENERGY STAR performance score.
Simple Statement of Energy Performance

[Image of ENERGY STAR® Statement of Energy Performance]

**Building 3**

Primary Property Function: Office  
Gross Floor Area (m²): 1,423  
Built: 1955

For Year Ending: December 31, 2013  
Date Generated: April 21, 2014

### Energy Consumption and Energy Use Intensity (EUI)

<table>
<thead>
<tr>
<th>Site EUI</th>
<th>0.99 GJ/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source EUI</td>
<td>1.37 GJ/m²</td>
</tr>
</tbody>
</table>

**Annual Energy by Fuel**

- Natural Gas (GJ): 1 (65%)
- Electric - Grid (GJ): 0 (35%)

**National Median Comparison**

- National Median Site EUI (GJ/m²): 1.04
- National Median Source EUI (GJ/m²): 1.43
- % Diff from National Median Source EUI: 8306%

**Annual Emissions**

- Greenhouse Gas Emissions (MtCO₂e/year): 62
Understanding The ENERGY STAR Energy Performance Score

Range of Values

<table>
<thead>
<tr>
<th>Building Characteristic</th>
<th>5th percentile</th>
<th>Median</th>
<th>95th percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square Feet</td>
<td>7,215</td>
<td>69,635</td>
<td>549,681</td>
</tr>
<tr>
<td>Operating Hours</td>
<td>40</td>
<td>60</td>
<td>120</td>
</tr>
<tr>
<td>Workers per 1000 ft²</td>
<td>0.7</td>
<td>2.4</td>
<td>5.6</td>
</tr>
<tr>
<td>Computers per 1000 ft²</td>
<td>0.6</td>
<td>2.5</td>
<td>6.5</td>
</tr>
<tr>
<td>Heating Degree Days</td>
<td>965</td>
<td>4,221</td>
<td>6,799</td>
</tr>
<tr>
<td>Cooling Degree Days</td>
<td>154</td>
<td>1,114</td>
<td>3,671</td>
</tr>
</tbody>
</table>

Portfolio Manager Canadian Median = 1.9 GJ/m²

95th percentile = 3.6 GJ/m²
5th percentile = 0.8 GJ/m²
The ENERGY STAR Score Accounts for Drivers

- **Hours**
- **Workers**
- **Cooling Degree Days**
Q & A
USING PORTFOLIO MANAGER
How to Get Started

http://www.nrcan.gc.ca/energy/efficiency/buildings/energy-benchmarking/3693
Getting Data into Portfolio Manager – 3 Options!

- Manual data entry
- Spreadsheet upload
- Web services

Export Also!
Data You Will Need

• Floor area (sq.ft or meters):
  – Office space, Parking and Data center
• Occupant #’s
• Number of PCs
• Operating hours by week
• % that can be heated/ cooled
• Data center:
  – Configuration (UPS, Cooling redundancy)
## Case Study: Richmond Office

<table>
<thead>
<tr>
<th>Name</th>
<th>Primary Function</th>
<th>Gross Floor Area (time-weighted)</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outdoor Parking</td>
<td>Parking</td>
<td>9,478 m²</td>
<td>I want to...</td>
</tr>
<tr>
<td>Office</td>
<td>Office</td>
<td>8,708 m²</td>
<td>I want to...</td>
</tr>
<tr>
<td>Data Centre</td>
<td>Data Center</td>
<td>279 m²</td>
<td>I want to...</td>
</tr>
</tbody>
</table>

Property GFA (Buildings): **8,986** *(used to calculate EUI)*

Property GFA (Parking): 9,478

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### Energy Star Score

- **Current Score:** 76
- **Baseline Score:** 72

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### Property Characteristics

<table>
<thead>
<tr>
<th>Value</th>
<th>Current As Of</th>
<th>Temporary Value?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross Floor Area</td>
<td>93727 ft²</td>
<td>01/01/2000</td>
</tr>
<tr>
<td>Weekly Operating Hours</td>
<td>68</td>
<td>01/01/2000</td>
</tr>
<tr>
<td>Number of Workers on Main Shift</td>
<td>301</td>
<td>01/01/2000</td>
</tr>
<tr>
<td>Number of Computers</td>
<td>397</td>
<td>11/01/2011</td>
</tr>
<tr>
<td>Percent That Can Be Heated</td>
<td>50 % or more</td>
<td>01/01/2000</td>
</tr>
<tr>
<td>Percent That Can Be Cooled</td>
<td>50 % or more</td>
<td>01/01/2000</td>
</tr>
</tbody>
</table>
Richmond Office (continued)

- LEED thresholds
  - 69 in the LEED EBOM 2009
  - 75 in the LEED EBOM v4

<table>
<thead>
<tr>
<th>Metric</th>
<th>Baseline (Mar 2013)</th>
<th>Current (Jan 2014)</th>
<th>Target*</th>
<th>Median Property*</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENERGY STAR score (1-100)</td>
<td>72</td>
<td>76</td>
<td>Not Set</td>
<td>50</td>
</tr>
<tr>
<td>Source EUI (GJ/m²)</td>
<td>1.65</td>
<td>1.58</td>
<td>Not Set</td>
<td>1.95</td>
</tr>
<tr>
<td>Site EUI (GJ/m²)</td>
<td>0.88</td>
<td>0.86</td>
<td>Not Set</td>
<td>1.06</td>
</tr>
<tr>
<td>Source Energy Use (GJ)</td>
<td>14,811.6</td>
<td>14,228.1</td>
<td>Not Set</td>
<td>17,516.8</td>
</tr>
<tr>
<td>Site Energy Use (GJ)</td>
<td>7,931.2</td>
<td>7,726.4</td>
<td>Not Set</td>
<td>9,512.3</td>
</tr>
<tr>
<td>Energy Cost ($)</td>
<td>Not Available</td>
<td>Not Available</td>
<td>Not Set</td>
<td>Not Available</td>
</tr>
<tr>
<td>Total GHG Emissions (Metric Tons CO2e)</td>
<td>132.1</td>
<td>136.7</td>
<td>Not Set</td>
<td>168.2</td>
</tr>
</tbody>
</table>
Source Energy

• Purpose of the conversion from site energy to source energy is to provide an equitable assessment of building-level energy efficiency.

• Why:
  – Most equitable unit of evaluation
  – Key unit of analysis is the building, not the utility
  – The use of national source-site ratios ensures that no specific building will be credited (or penalized) for the relative efficiency or availability of specific utility providers
  – No bias with regards to province, weather or heating energy source of your building

• We are evaluating the performance of the building, not the utility provider for the building
Source Energy

- By just looking at purchased energy, we are not evaluating the true performance of the building since transformation to heating energy occurs in different locations.
Help! – Is At Hand

• English & French language
• Extensive Frequently Asked Questions available
• Richmond Energy Coaches can help with creating your ESPM building profiles

info.services@nrcan.gc.ca
Q & A
MAKING IMPROVEMENTS - A CASE STUDY
Energy Performance Rating Guides the Energy Planning Process

Once you have established an energy performance baseline score, you are ready to set improvement goals and create an action plan. The guide below can help you interpret your score and determine appropriate steps.
# Case Study: Plotting the Energy Performance Improvement of NRCan Building #3

<table>
<thead>
<tr>
<th>Year</th>
<th>Score</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>30</td>
<td>Energy assessment</td>
</tr>
<tr>
<td>2010</td>
<td>24</td>
<td>HVAC retrofit of boiler, rooftop units and controls</td>
</tr>
<tr>
<td>2011</td>
<td>36</td>
<td>HVAC schedule adjustment</td>
</tr>
<tr>
<td>2012</td>
<td>40</td>
<td>Control system recommissioning</td>
</tr>
<tr>
<td>2013</td>
<td>56</td>
<td>Lighting retrofit, insulation added as part of roof replacement, awareness program</td>
</tr>
</tbody>
</table>
CONFIRMING ENERGY RETROFIT PERFORMANCE THROUGH TRACKING
International Performance Measurement and Verification Protocol (IPMVP)

Verification methods depend on the retrofit item

A. Partially measured retrofit isolation
   – With assumption/stipulations

B. Retrofit isolation
   – Fully measured

C. Whole facility
   – Or sub-metered part

D. Calibrated simulation
   – With software
Use Monitoring and Verification Principals

• Savings = Predicted Energy Use – Actual Energy Use After ECM project
  – Predicted energy use is based on your energy performance model, just like your baseline!
  – Will be adjusted for weather or other drivers
Mathematical Model Example

• HDDs or heating degree days are used to define how cold it is and to adjust to the current year

Line of Best Fit: “Model” of your consumption
Track Savings over Time using CUSUM Analysis
Meters, Sites, or whole Portfolio

Project: Prism AEO (2011063)
Site: Prism Engineering Ltd. - Burnaby Office
Meter: ELEC-Lighting
Q & A
Help Is Available!

• City Green will...
  – Help you identify what inputs are needed
  – Input your data into Portfolio Manager
  – Help you interpret your score
  – And more!
Thank you.

Robert Greenwald, P.Eng., MBA, President

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