Action-Oriented Benchmarking for Commercial Buildings

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Three Types of Energy Benchmarking

Type of energy benchmarking	Benefits	Requirements
Whole building benchmarking	Screen facilities for overall energy-saving potential	Minimal data (utility bills, building features such as type and floor space)
Action-oriented benchmarking	Identify and prioritize specific energy-saving opportunities	Detailed building information, sub-metered or modeled end-use data
Investment-grade audit	Estimate savings and costs for specific energy-saving opportunities	Detailed building data, cost estimates, financial analysis

Study Approach - What We Did

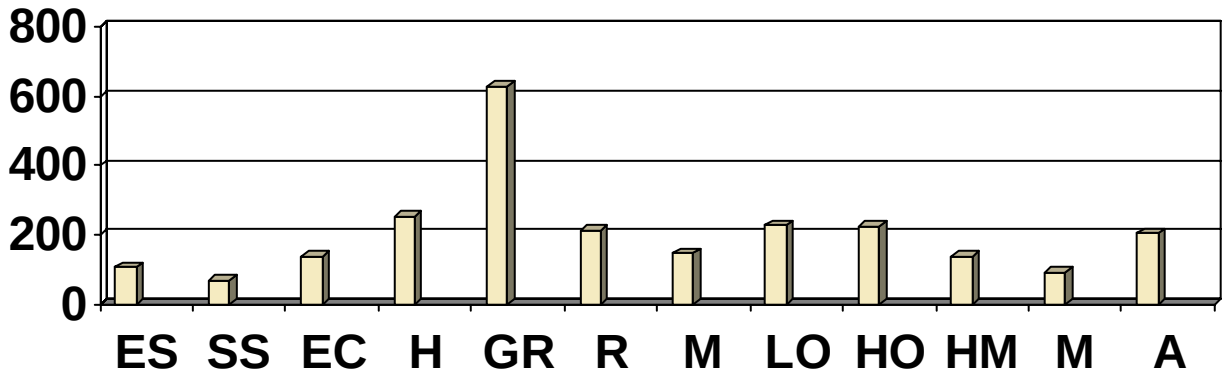
- 1. Identified candidate buildings
- 2. Obtained owner authorization to participate
- 3. Obtained utility data (electricity and natural gas)
- 4. Conducted 113 detailed on-site building reviews
- 5. Modeled energy use using EnerPro: (i) as built and (ii) as modified to just meet ASHRAE 90.1-2004 standard
- 6. Provided customers with building report: (i) annual and monthly energy end-use and costs compared to industry average, ASHRAE-compliant, and efficient buildings, (ii) their estimated GHG emissions, and (iii) specific energy savings opportunities in the building including estimated savings
- 7. Prepared a report on study findings and implications (ten end uses times eleven building types times two fuels)

Study Approach – What We Did

- Energy modeling used the Energy Profile Tool (EnerPro) which has a library of hundreds of model-based archetypes derived from DOE 2.1 models
- Default building characteristics for the benchmark modeling come from BC Hydro's load research and site visits programs
- Building site visits collected detailed information on occupancy, scheduling, building area, geometry, orientation, shell and systems (space heating, space cooling, interior lighting, exterior lighting, equipment, HVAC auxiliaries, refrigeration, vertical transport, domestic hot water and cooking)
- Previously we have used DOE 2.1 for energy modeling, but this is relatively expensive and time consuming for a benchmarking (as opposed to a research or evaluation) program

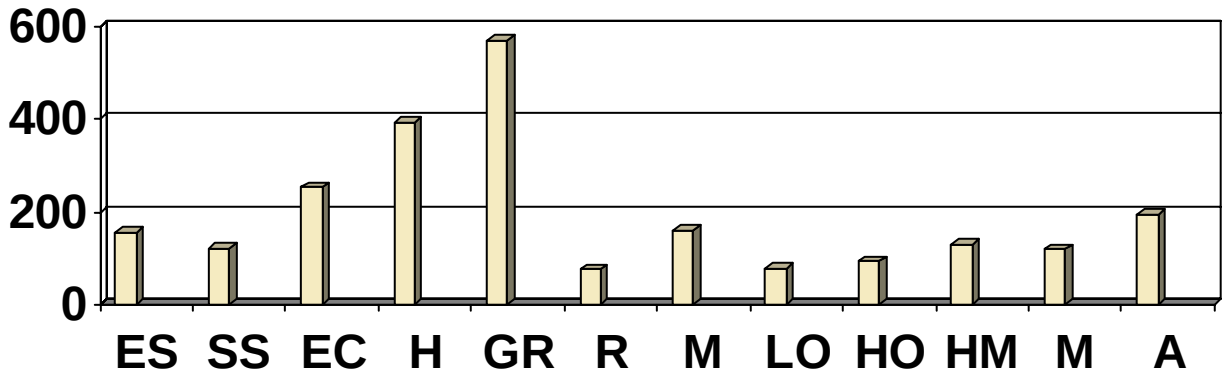
Whole Building Results: Electricity Unit Energy Consumption (kWh per sq m per year)

- Electricity UECs are shown for elementary schools (ES), secondary schools (SS), extended care (EC), hospitals (H), grocery/restaurant (GR), stand alone retail (R), malls (M), low-rise office (LO), high-rise office (HO), motel/hotel (MH), multi-unit residential (M) and the average across building types (A)
- Average electricity consumption is 203.7 kWh per square meter per year



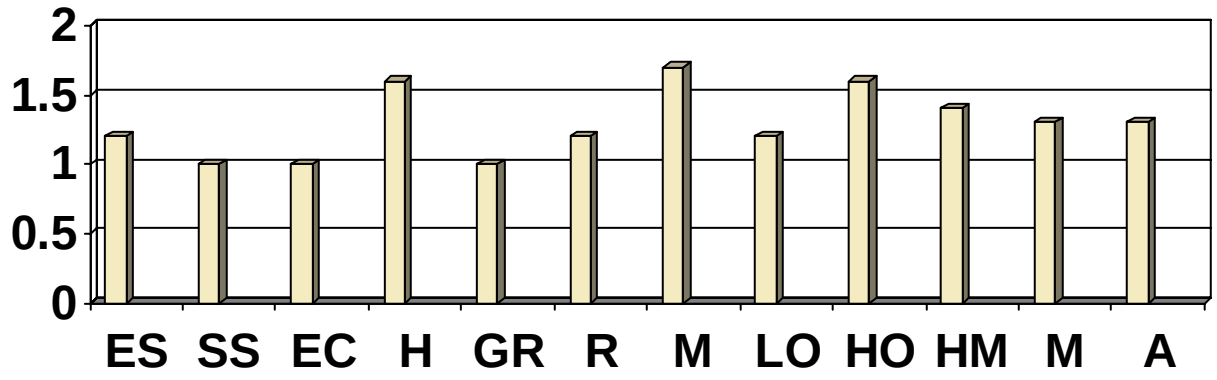
Whole Building Results: Natural Gas Unit Energy Consumption (kWh per sq m per year)

- Natural gas UECs are shown for elementary schools (ES), secondary schools (SS), extended care (EC), hospitals (H), grocery/restaurant (GR), stand alone retail (R), malls (M), low-rise office (LO), high-rise office (HO), motel/hotel (MH), multi-unit residential (M) and the average across building types (A)
- Average natural gas consumption is 195.3 kWh per square meter year



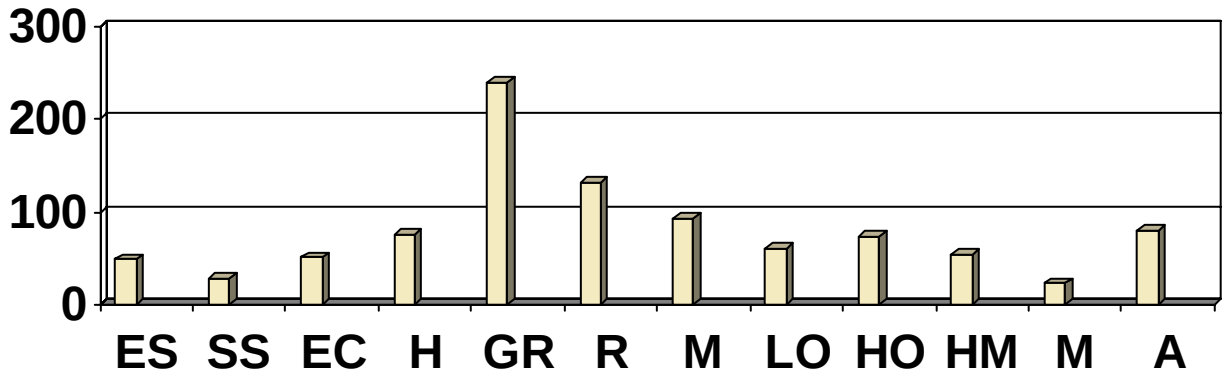
Whole Building Results: Benchmarking Actual Performance Divided by Modeled ASRAE 90.1-2004

- One natural benchmark is to compare actual energy consumption as a ratio of modeled energy consumption just meeting ASHRA 90.1-2004
- Three segments – secondary schools (SS), extended care (EC) and grocery store/restaurant (GR) – just meet the ASHRAE standard
- Three segments – hospitals (H), malls (M), high rise office (HO) – use at least 50% more energy than the ASHRAE standard



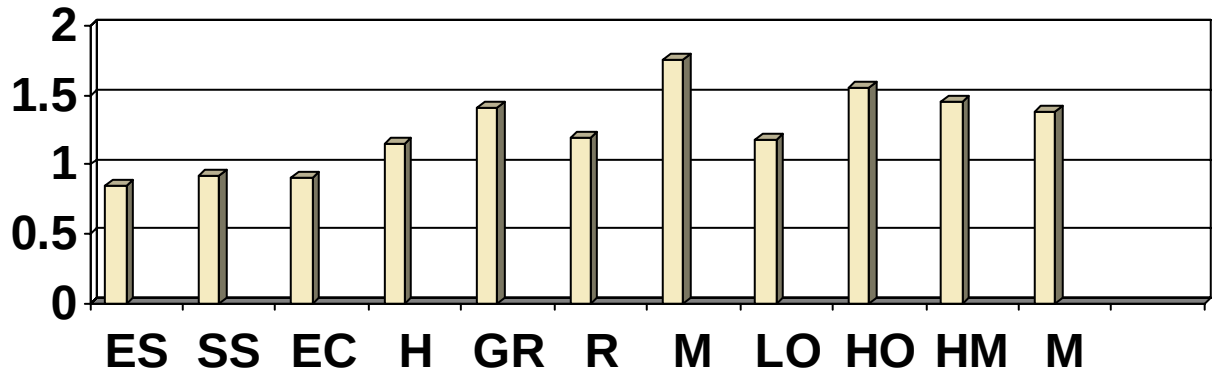
End Use Results: Interior Lighting (electricity, kWh per year)

- Average UEC for lighting is 79.9 kWh per square meter per year
- Extended care (EC), hospitals (H), grocery store/restaurant (GR), retail (R), malls (M), low rise office (LO), high rise office (HR), and motel/hotel (MH) have lighting loads over 50 kWh per square meter per year



End Use Results: Interior Lighting Use Ratio
(actual lighting power density divided by ASHRAE compliant power density)

- Elementary school (ES), secondary schools (SS), and extended care (EC) have lighting power densities less than ASHRAE requirements
- Other segments have higher lighting power densities higher than ASHRAE requirements with malls (1.75), high rise office (1.55), motel/hotel (1.45), and grocery store/restaurant (1.41) being particularly overlit



Sample Report: (1) Energy Costs

"How am I doing? Annual energy costs for your facility are $1.12 per ft^2. This is 44.6% lower than the industry average for stand-alone retail in the B.C. Coast region. Compared to a code-compliant reference, your facility's average annual use is 62.4% higher, resulting in an energy cost difference of 44.4% per year"

$/square foot	Electricity	Natural gas	Steam	Total
Your facility	$0.48	$0.63	$0.00	$1.12
Industry average	$1.74	$0.28	$0.00	$2.01
ASHRAE 90.1 reference	$0.58	$0.04	$0.00	$0.62

Sample Report: (2) End Use Energy

"How do you use energy? Here is the energy breakdown for your facility. Generally, you should focus your attention on the end uses with the largest costs; these often represent areas with the highest opportunity for savings"

End use	Annual Cost	mmBtu
Space cooling	$96	3.5
Space heating	$8835	671.0
Interior lighting	$3595	146.3
Miscellaneous equipment	$619	24.8
Fans and pumps	$2338	95.0
Exterior loads	$243	9.5
Domestic hot water	$222	5.5
Total	$15495	956.0

Sample Report: (3) Action Items

"Based on your energy profile, the following energy efficient measures show the greatest potential to save energy in your facility. Note that most measures are not additive and cannot be summed to obtain a cumulative total savings estimate"

Opportunity and estimated annual savings	Action item
Demand controlled ventilation ($4882)	Use carbon dioxide and/or occupancy sensors to control outside air while maintaining indoor air quality
Windows ($2179)	Replace low performance window units with thermally superior double pane windows with U-value of 0.42 or better
Infiltration ($671)	Caulk and weather strip around doors, windows and other building penetrations

Acknowledgements

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Questions