AUTUMN 2006 VOL. 6.1

CBEEDAC

enerInfo BUILDING

IN THIS ISSUE…

Commercial Sector Energy Studies
Energy Use in Canadian Malls & Shopping Centres
STUDENT RESEARCH
SEMINAR SERIES

CBEEDAC, sponsored in part by Natural Resources Canada via the National Energy Use Database Initiative, is housed at the University of Alberta.

enerInfo Building is published three times per year by the Canadian Building Energy End-Use Data and Analysis Centre (CBEEDAC) at the University of Alberta.

Department of Economics
University of Alberta
8-14 Tory Building
Edmonton, Alberta
Canada T6G 2H4

www.ualberta.ca/~cbeedac

P. (780) 492-4134
F. (780)492-3300

E. cbeedac@ualberta.ca

CANADIAN Building Energy End-Use DATA AND ANALYSIS CENTRE
commercial • residential • institutional

COMMERCIAL SECTOR ENERGY STUDIES

Among the projects that CBEEDAC researchers have investigated over the past year are several that relate to the commercial sector. In Canada, the primary source of data for empirical analysis pertaining to this sector is the Commercial and Institutional Building Energy Use Survey (CIBEUS), conducted in 2001, with data pertaining to calendar year 2000. Although this data set has been used to investigate energy efficiency for the commercial sector as a whole,* until recently very few empirical studies have examined particular subsets of this sector in Canada.

In this newsletter we provide an overview of a recently completed CBEEDAC report in which authors Denise Young and Jon Buck focus on energy use in Canadian shopping centres and malls. These types of commercial buildings are typically treated separately in the literature on commercial energy utilization in view of their (often) unique design characteristics as well as their usage patterns which generally differ substantially from other commercial buildings. Among other features, malls and other shopping centres utilize large amounts of floor space on relatively few levels, tend to be spread out over large expanses of land, and have several separate tenants (which may include, for example, supermarkets, other retail outlets, restaurants, medical/dental clinics, as well as hotels and amusement parks in larger structures) with varying energy requirements.

Another recently completed CBEEDAC project pertaining to the commercial sector investigated whether energy usage patterns differ when a particular activity is the sole activity, the main activity or a minor activity in commercial buildings. A summary of the results of this study, as well as other studies pertaining to the residential sector, will be included in the next edition of *enerInfo Building.*

*See, for example, "Efficiency Frontiers", *enerInfo Building,* 4-2, Winter 2005.

Energy Use in Canadian Malls and Shopping Centres

D. Young and J.Buck

Shopping centres and malls house a variety of commercial activity types – such as medical clinics, retail stores, supermarkets, food services, hotels, swimming pools, hair salons, offices, etc. – and consequently have design characteristics that differ from most other types of commercial buildings, such as stand-alone retail stores or office buildings. These design characteristics, along with tenancy characteristics, location, and the extent of energy conservation measures that have been adopted, are expected to play an important role in the patterns of energy utilization of different shopping centres and malls.

In Canada, data on energy use and other characteristics for a sample of malls and shopping centres in large urban areas in 2000 are included in the CIBEUS data set. Energy use and building characteristics for a sub-sample of 153 strip malls and enclosed shopping centres that have complete energy information, as summarized in the accompanying tables, illustrate the similarities and differences across these different buildings in terms of both design characteristics and energy usage. On average, enclosed malls are larger than strip malls, have larger numbers of staff, and are open longer hours, although hours of operation vary much more widely for strip malls. Enclosed malls are more likely to have a supermarket as a major tenant but less likely to have a restaurant. On average, they provide air-conditioning to a larger proportion of their building area than do strip malls. While strip malls use on average 6.1% as much electricity as enclosed shopping malls, and 6.7% as much energy in total, to a large extent this difference in energy usage reflects differences in building size and operating characteristics. In terms of energy intensity – measured as energy use per square foot of area – on average enclosed shopping malls are more energy efficient than strip malls, although variation in energy intensity across individual shopping centres is greater for strip malls.

In terms of construction characteristics, window types are very similar in the two forms of shopping centres, with approximately 80% of windows involving some form of double glazing. Over 70% of enclosed malls have concrete block walls, but this proportion drops to less than 55% for strip malls, where approximately one-quarter have metal or wood stud-framed walls. Strip malls are more likely to heat with furnaces and less likely to heat with boilers than enclosed malls, although for both types of structures, packaged heat units are the most common form of heating equipment. Although the most common form of roof type is

Table 1: Shopping Centre Summary Statistics

Variable	28 Enclosed Malls Avg. (Min-Max)	125 Strip Malls Avg. (Min-Max)
Year of Construction	1969.5 (1910-1990)	1981.6 (1920-1999)
Area (excl. park, mechanical)	343496 (10332-1539200)	18202 (1768-120000)
Staff - main shift (2000)	406 (20-1500)	35.5 (2-300)
Weekly hours of operation	80.9 (58.-119)	77.4 (12.00-168)
% with supermarket tenant	0.32	0.02
% with restaurant tenant	0.21	0.39
% gross area cooled	96.6 (50-100)	66.4 (0-100)
% gross area heated to >10°C	99.96 (99-100)	96.9 (25-100)
Annual electricity use (GJ)	20947.2 (273.0-83991.4)	1286.1 (55.0-16862.9)
Annual energy use (GJ)	30880.9 (273.0-155174.9)	2074.6 (101.4-23359.1)
Total energy intensity (2000)	0.10 (0.03-0.62)	0.15 (0.01-0.88)

an insulated deck type roof, these are much more prevalent in enclosed malls (57%) than strip malls (38%). Conversely, many more strip malls (34%) than enclosed malls (11%) have some form of insulated truss roof.

A regression model is used to examine the extent to which design and occupancy characteristics impact significantly on energy intensity in shopping centres. While building size is found to be important, with larger malls using energy less intensively, some other design and construction characteristics – particularly wall type and roof type – also have important effects on energy intensity, although the types of heating equipment, cooling equipment, and main energy source that is used do not. Holding the effects of

Table 2: Shopping Centre Building Characteristics: Walls, Windows, Roofs, Heating

	Enclosed Malls	Strip Malls
Window Type	**% of buildings**	**% of buildings**
single glaze	10.7	10.4
double glaze	57.1	59.2
double glaze sealed	21.4	23.2
other	10.7	7.2
Wall Type	**% of buildings**	**% of buildings**
curtain walls	3.6	5.6
metal stud framing with surface insulation	10.7	12.8
wood frame walls with surface insulation	3.6	12.8
concrete block with interior finishing	60.7	47.2
concrete block without interior finishing	10.7	6.4
other/missing info.	10.7	15.2
Roof Type	**% of buildings**	**% of buildings**
attic roof fully insulated	14.3	8.8
insulated wood truss roof	0.0	12.8
insulated metal truss roof	10.7	20.8
insulated deck type roof	57.1	37.6
other/missing info	17.9	20.0
Maint Heating Equipment	**% of buildings**	**% of buildings**
furnace	7.1	34.4
individual space heaters	17.9	12.8
boiler	21.4	3.2
packaged heat units	46.4	44.0
other	7.2	5.6

Shopping Centres (cont'd.)

all other variables constant, enclosed malls – which generally have 'common areas' where thermal comfort and lighting are provided – tend to use energy more intensively than strip malls. Within the regression analysis, an examination of tenancy characteristics, to the extent that the data set allows, indicates that the type of tenant is also important, with malls housing restaurants using more energy per square foot than other malls, but neither the number of employees nor the hours of operation is found to have a significant effect on energy intensity.

One issue that the study was unable to address in detail concerns the potential impact of programs aimed at improved energy efficiency behaviour on the part of shopping centre managers and tenants. In the regression analysis, the use of (at least one) lighting conservation feature was found to have no significant effect on energy intensity, while the use of (at least one) HVAC conservation feature was found to increase energy use per square foot. Investigation of the reasons behind these results, which would appear to require more detailed information on the composition and possibly layout of shopping centres than is available in the CIBEUS data set, remains as a subject for future research.

STUDENT RESEARCH

As summer drew to a close some of the graduate and undergraduate student researchers working for CBEEDAC scattered to various parts of the globe. ***Nigel Fish*** decided to extend his visit to China, while ***Jevan Cherniwchan*** left to pursue graduate studies in Vancouver and ***Allan Wesley*** began working for the federal government in Ottawa. Both ***Samuel Gamtessa*** and ***Junaid Jahangir*** are continuing to work on their PhD dissertations on topics related to the Centre's activities – modelling residential retrofit behaviour, and aspects of electricity market restructuring, respectively – supervised by CBEEDAC researchers.

SEMINAR SERIES

Beginning in September 2006, CBEEDAC along with CABREE (Centre for Applied Business Research in Energy and the Environment) is sponsoring a bi-weekly applied energy workshop in the Department of Economics at the University of Alberta. The objective of the workshop is to bring together researchers and students in economics, business, law, political science, and related areas that share broadly defined interests in applied energy-related research (including energy-environment-economy interactions). Information about forthcoming workshops can be accessed at http://www.uofaweb.ualberta.ca/economics/events.cfm

BUILDING SERVICES

CBEEDAC has the expertise to provide services to the building sector in the area of data storage and analysis. For more information regarding these services, on becoming a sponsor of CBEEDAC, or about the services provided by other Data and Analysis Centres contact CBEEDAC or see our Web site (www.ualberta.ca/~cbeedac).

CBEEDAC reports are available online in PDF format.

If you house and/or collect data that could become a valuable addition to Canada's Building Energy End Use information system please consider contacting the Centre with your data information.

If you find the *enerInfo Building* newsletter informative, please tell your colleagues and direct them to our Web site or office where they can download or request a copy. If you want to stop receiving this newsletter or have received it in error, please contact us. We respect the privacy of those on our mailing list.