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Commercial and Institutional Building Energy Use Survey Review

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Executive Summary

- The Commercial and Institutional Building Energy Use Survey (CIBEUS) is intended to provide government, utility providers, building managers and academic researchers with pertinent information on energy use characteristics to aid them in decision-making and consideration of policy issues.
- The survey is similar in scope and focus to that of its US Commercial Buildings Energy Consumption Survey (CBECS) counterpart. The main differences between the two surveys are:
 - (1) CIBEUS coverage is limited to buildings in larger metropolitan areas (and therefore has very limited coverage of buildings in some parts of the country);
 - (2) CBECS supplements the survey data with location-specific information on cooling and heating degree days (as opposed to a uniform assumption across all buildings in all locations);
 - (3) CBECS surveys the same buildings over time, providing a longitudinal sample that is very useful for ‘micro’ analysis of energy use by commercial and institutional buildings.
- In both the CBECS and CIBEUS data, there are many instances in which data have to be imputed. While this imputation is necessary, and in fact useful, for any use of the data set involving aggregation to national totals, the imputed values need to be flagged for those using the data for micro-level analysis.
- Statistical analysis of the data indicates that there are differences across locations in energy use. This implies that better national totals might be achieved should buildings in under-represented geographical and climatic regions be included in further surveys.
- The current CIBEUS data set provides an important starting point for an understanding of energy use patterns for buildings in the commercial and institutional sectors of the Canadian economy. It provides high-quality detailed information on an important subset of these buildings. As further data are gathered over time, and as more is learned about buildings in other regions of the country, the usefulness of the data for government agencies, utilities, building owners/managers and academic researchers will increase.

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Section 1: Background Information

Initial Goals of the Survey

The Commercial and Institutional Building Energy Use Survey (CIBEUS) was implemented with an aim to serve the purposes of a wide variety of stakeholders. Among the stakeholders considered in the design and implementation of the survey were various levels of government, utility providers, building managers, and academic researchers.

It was originally envisioned that the survey data might, among other things, provide information that would enable survey users to:

- (1) Understand energy consumption and energy efficiency characteristics of commercial and institutional buildings in Canada;
- (2) Identify ways of decreasing energy consumption and costs in commercial and institutional buildings;
- (3) Assess the fulfillment of greenhouse gas emission commitments by providing baseline information regarding fuel use in commercial and institutional buildings.

For purposes (1) and (3), the survey data are generally used to aggregate up from individual buildings to nationwide totals. For the second envisaged purpose of the survey, however, the goal is to use the data pertaining to the characteristics and energy-use patterns of sampled buildings for making inferences about particular (out-of-sample)

buildings. A data set that is designed primarily for uses (1) and (3) may or may not be useful when looking at the types of questions likely to be asked in (2).

Survey coverage

In order to qualify for inclusion in the first CIBEUS survey, a commercial or institutional building must have been located in a Census Metropolitan Area or Census Area (CMA/CA) with a population of greater than 175,000, with the exception of the Atlantic region where buildings in CMA/CAs with populations greater than 50,000 were surveyed. No buildings in northern Canada were surveyed.

Sampling was conducted in such a way as to ensure the inclusion of buildings of a variety of sizes, age classes, and types. Each of the 24 CMA/CAs included in the coverage was broken down by enumeration area (EAs). All EAs were classified into one of three categories, based on the total number of buildings and the number of buildings constructed within the past 2 years in that EA. Wherever possible, at least two EAs from each category were selected from each CMA/CA, with buildings sampled from 370 (out of a total of 20,322) EAs.

A total of 4750 buildings were selected for the survey, with an aim of providing reliable national estimates by type, age and size of building. Only those buildings with at least 1000 sq feet of floor space, of which at least one-half was devoted to commercial or institutional activities, and with 6 or more employees were included in the survey.

In order to ensure adequate coverage of certain classes of important specialized atypical buildings, the inclusion of hospitals, colleges, universities and shopping centres was not left to chance via random sampling within the EAs. Instead, lists provided by appropriate authorities were used as a basis for selecting buildings belonging to these institutional categories.

Data Collected

In order to satisfy as many end-uses of the data as possible, while taking into consideration survey costs, the following information was requested of all survey participants.

A *basic info* (type of structure, ownership)

B *general physical characteristics* (age, size, parking, walls)

C *occupancy characteristics* (activities, # of occupants, hours, seasonal use)

D *energy efficiency characteristics* (renovations, reasons for renovations, payback required on renovations, windows, lighting, heating/cooling, window:wall ratio, R-value and type of walls, R-value and type of roof)

E energy consumption (fuel sources: electricity needs; heating, % of building heated, heating equipment; hot water; cooling, % of building cooled, equipment; shared facilities/services with other buildings)

F energy quantities and costs (electricity, natural gas, fuel/heating oil, district steam, district hot water) *

* Although mentioned in the questionnaire, energy cost data are not included in the CIBEUS data set.

2. Comparison to the US Commercial Buildings Energy Consumption Survey (CBECS)

Survey Design

The CIBEUS survey was modeled after its US CBECS counterpart. The US Department of Energy has been gathering information on energy use in commercial buildings since 1979, with their most recent surveys being conducted in 1995 and 1999. Sample sizes for the CBECS and CIBEUS data sets are comparable, with the Canadian data set sampling a larger proportion of total buildings, but restricting its sample to larger urban areas.

Sampling Strategy

For the most part, sampling strategies are similar, with the CBECS sampling strategy being a little more complex than that of CIBEUS and not being restricted to larger

metropolitan areas. The CBECS survey, unlike CIBEUS, does have a time dimension to it. The CBECS survey is currently a longitudinal (panel) survey, with the same buildings being examined at approximately 5-year intervals. The existing panel is supplemented each time with a survey of new buildings. A recent innovation in the CBECS survey is a move towards telephone interviews, preceded by mail-outs providing information about the questions that will be asked over the course of the telephone interview.

National Aggregations

Methods used to obtain national estimates based on the surveyed buildings are methodologically very similar across the two surveys. The buildings surveyed are taken to be representative of buildings in their age/size/type stratum, and values from surveyed buildings are weighted up to generate local, provincial/regional or national totals. The uncertainty inherent in these totals is gauged through the estimation of standard errors for the estimates.

The fact that the coverage in the Canadian data set is limited to buildings in larger metropolitan areas may have implications for the relative quality of the Canadian national estimates. It is implicitly assumed that the energy-use characteristics in non-sampled areas are similar to those in the sampled areas of the country.

There are also differences in the quality of the data used for calculating seasonal energy expenditures. While the CIBEUS data set assumes a fixed number of days in each of the summer and winter seasons, the CBECS survey questionnaire data are supplemented with

information on location-specific heating and cooling degree-days. Average daily temperature information allows for the construction of degree-day totals that correspond more closely to the buildings in the sample than the use of a uniform assumption across all buildings in all locations.

Variables Included in the Data Sets

The sets of variables in the CBECS and CIBEUS data sets are quite similar. The CBECS data set includes information on some factors not included in the CIBEUS data set. The CBECS surveys include some limited information on space usage (commercial food preparation, computer rooms (1995 survey only)), as well as a limited equipment inventory (heating and cooling, refrigeration, water heating, lighted floor space, lighting equipment, office equipment.) Also included in the CBECS data set are information on the source of purchase for energy, and information on whether or not the building had been participating in any sort of demand-side management projects sponsored by their energy supplier(s). As mentioned previously, the CBECS data set is also supplemented with location-specific weather data.

Missing Values and Imputed Data

In both surveys, aside from complete non-response for some buildings originally targeted in the survey, there are a significant number of observations with incomplete information. This can range from missing data on one or two building characteristics, to missing data on energy consumption. In both the CBECS and CIBEUS data sets, missing data are imputed based on the characteristics of other similar buildings in the data set.

While imputing these data can be useful in terms of eventual aggregation to regional or national totals, the fact that these data are imputed is very important information for any user who wishes to use these data sets for generating microeconomic inferences regarding energy use patterns in commercial and institutional buildings. The presence of measurement error due to imputation in some or all of the variables in any particular observation is important information for researchers when making decisions regarding which observations and which estimation methods to use. It is therefore important that imputed data be flagged, as is the case for the publicly available CBECS data sets.

3. CIBEUS National Estimates Extrapolation to Buildings in Smaller Centres

The current CIBEUS survey targets only commercial and institutional buildings located within larger urban centres. As a result, there is no coverage of buildings in the northern regions of the country and limited coverage of certain regions such as the prairies. The climactic conditions in the areas omitted from the survey will, in many cases, be more severe than those in the areas included in the survey.

Given that the mix of buildings, operating hours, and energy requirements and availability options are likely to be different from those in the 24 urban centres that were covered in the survey, it is quite possible that the extrapolation of energy intensity and other energy use data to buildings in other parts of the country might not be very reliable.

One way to check the reliability of the (implicit) extrapolations used in the national aggregations would be to actually survey a selection of buildings in non-covered regions and then compare the actual energy use data to that predicted from similar buildings already included in the survey. This is, however, a fairly expensive option and is complicated by the fact that the dates of observation for the buildings will differ. Given that energy prices have changed in the interim, adjustments would need to be made to account for these differences.

It is possible to say something about whether or not extrapolation might be a reasonable option by examining within-sample buildings in the current CIBEUS data set. The CMA/CAs covered in the survey do present a fairly broad range of geographic locations and climactic conditions. In order to examine similarities of energy use and energy intensity characteristics across various regions in the country, we consider a simple model wherein energy use (or intensity) is regressed on a variety of factors, including the geographical location of the building. These models are estimated for overall energy usage and intensity, electricity usage and intensity, and natural gas usage and intensity.

The set of controls selected from the CIBEUS data set are the building's age (measured via B1 in the CIBEUS data set, the year of construction), the size of the building (measured via B2 in the CIBEUS data set, area in square feet), dummy variables indicating single or multiple retrofits since 1995 (retany and retmany), dummy variables indicating the presence of lighting or heating conservation features (conslight and consheat), the type of district in which the building is located (measured by EA type

dummies), and the hours of operation of the building (C3H). Although not comprehensive, these control for a variety of factors that would be expected to affect energy use.

In addition to these factors, dummy variables for location (Atlantic, Quebec, Prairie, and BC) are included in the models. These locations present differing general climactic conditions, with buildings in BC facing generally temperate conditions, and those in the prairies facing harsher conditions than elsewhere.

Preliminary testing showed that the regression coefficients were not constant across building size, so separate regressions are reported for four size groupings of building: 1000 – 5000 sq ft; 5000-10000 sq ft; 10000-50000 sq ft; and those buildings 50000 sq ft or larger. The results for overall energy use and intensity are presented in Tables 1 through 8, for 24. The main coefficients of interest in these regressions are those corresponding to the location dummies.

Significant regional effects are highlighted (in yellow). When it comes to overall energy usage and intensity there are significant differences across regions for 3 out of 4 of the size categories. The same is true for natural gas. There are fewer differences across regions as far as electricity usage and intensity are concerned, but differences do exist.

These differences may be due to different building characteristics not controlled for in the regressions, different climates, different relative prices of energy sources across location

and differences in availability of some energy sources. This suggests that inferences regarding energy use characteristics for out-of-sample centres where climactic conditions, relative prices and fuel availability might not be as accurate as might be hoped if based on information from other regions of the country.

4. Recommendations for Next CIBEUS Survey

- When collecting cross-sectional survey data over time, there are distinct advantages to the use of longitudinal or panel data rather than the collection of a series of unrelated random samples over time. With longitudinal data, the same buildings are surveyed in each subsequent survey year. This allows researchers to better track energy use across time, holding several of the building's characteristics constant over time. Since staying exclusively with the buildings in previous sample would lead to the exclusion of any newly constructed buildings, the sample would need to be supplemented with data through the use of an additional new construction sample. (In the CBECS survey, only buildings with a minimum floor space of 10,000 sq feet are included in the new construction sample.)
- For the CIBEUS data sets to be of use for many research purposes, data on the actual cost of energy purchases are required. Although these can be roughly estimated from the quantity data if the researcher has corresponding price data, the uncertainty of the estimates will result in less reliable statistical outcomes.

(Confidentiality requirements may prevent these data from being publicly available.)

- Data on the costs of retrofits would also be useful to researchers interested in exploring the economic factors associated with energy efficiency initiatives.
- Although detailed equipment inventories for all buildings would not be feasible, it would be useful to undertake (partial) equipment inventories for certain specialized buildings such as hospitals.
- Since the main building of a college (or hospital) may be atypical in terms of energy use, more extensive surveying of these specialized buildings would be beneficial.
- Given that climactic conditions can differ substantially across the urban areas covered in the survey, weather data specific to the location of the sampled buildings should be used in the determination of heating and cooling days.
- Coverage of buildings in smaller centres, especially those in currently unrepresented northern regions where energy consumption patterns are likely to be different, could improve the reliability of national estimates based on the CIBEUS survey data.

- Given the move to deregulation in many energy markets, more detailed information on the source of supply of energy could be included. Information on the purchase of ‘green’ energy and information regarding participation in demand-management programs could also be gathered.
- Provision of the data to the public in standard ASCII format (including imputed data flags for appropriate observations) would make the data more readily accessible to researchers.

5. Conclusions

The current CIBEUS data set provides an important starting point for an understanding of energy use patterns for buildings in the commercial and institutional sectors of the Canadian economy. It provides high-quality detailed information on an important subset of these buildings. As further data are gathered over time, and as more is learned about buildings in other regions of the country, the usefulness of the data for government agencies, utilities, building owners/managers and academic researchers will increase.

Table 1: Energy Usage: Size Group 1: 1000-5000 Sq ft.

Model: MODEL1					
Dependent Variable: ENERGY_TOTAL_USAGE					
Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	13	59352542	4565580	12.53	<.0001
Error	670	244128647	364371		
Corrected Total	683	303481189			
Root MSE	603.63160	R-Square	0.1956		
Dependent Mean	552.82451	Adj R-Sq	0.1800		
Coeff Var	109.19046				
Parameter Estimates					
Variable	Parameter Estimate	Standard Error	t Value	Pr > t	
Intercept	-1907.01815	1329.67245	-1.43	0.1520	
B1	0.89569	0.67707	1.32	0.1863	
B2	0.15828	0.02213	7.15	<.0001	
atlantic	-140.19620	81.87460	-1.71	0.0873	
quebec	-114.56731	60.72082	-1.89	0.0596	
prairie	119.63136	75.87945	1.58	0.1154	
bc	-28.30270	88.42801	-0.32	0.7490	
retany	128.90633	67.26352	1.92	0.0557	
retmany	-28.34748	87.88889	-0.32	0.7471	
conslight	66.66277	49.02124	1.36	0.1743	
consheat	11.31287	58.19761	0.19	0.8459	
type1	-197.67604	87.87114	-2.25	0.0248	
type2	-204.08487	95.03006	-2.15	0.0321	
C3H	6.11426	0.67027	9.12	<.0001	

Table 2: Energy Intensity: Size Group 1: 1000-5000 Sq ft.

Model: MODEL2
 Dependent Variable: INTENSITY_ENERGY

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	13	5.64600	0.43431	11.28	<.0001
Error	670	25.80195	0.03851		
Corrected Total	683	31.44794			

Root MSE	0.19624	R-Square	0.1795
Dependent Mean	0.19914	Adj R-Sq	0.1636
Coeff Var	98.54442		

Parameter Estimates

Variable	Parameter Estimate	Standard Error	t Value	Pr > t
Intercept	-0.32528	0.43228	-0.75	0.4520
B1	0.00025699	0.00022012	1.17	0.2434
B2	-0.00001543	0.00000719	-2.14	0.0324
atlantic	-0.03997	0.02662	-1.50	0.1337
quebec	-0.02855	0.01974	-1.45	0.1486
prairie	0.02927	0.02467	1.19	0.2359
bc	-0.01059	0.02875	-0.37	0.7128
retany	0.02542	0.02187	1.16	0.2455
retmany	-0.00859	0.02857	-0.30	0.7637
conslight	0.02009	0.01594	1.26	0.2079
consheat	0.01678	0.01892	0.89	0.3755
type1	-0.10393	0.02857	-3.64	0.0003
type2	-0.10452	0.03089	-3.38	0.0008
C3H	0.00218	0.00021790	10.02	<.0001

Table 3: Energy Usage: Size Group 2: 5000-10000 Sq ft.

Model: MODEL1
 Dependent Variable: ENERGY_TOTAL_USAGE

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	13	77808060	5985235	5.63	<.0001
Error	486	517015525	1063818		
Corrected Total	499	594823585			

Root MSE	1031.41551	R-Square	0.1308
Dependent Mean	1010.97561	Adj R-Sq	0.1076
Coeff Var	102.02180		

Parameter Estimates

Variable	Parameter Estimate	Standard Error	t Value	Pr > t
Intercept	-1047.72009	2293.68773	-0.46	0.6480
B1	0.36927	1.15709	0.32	0.7498
B2	0.11082	0.03342	3.32	0.0010
atlantic	-506.69347	173.47084	-2.92	0.0037
quebec	-280.76852	130.64706	-2.15	0.0321
prairie	53.48760	157.36890	0.34	0.7341
bc	68.52196	147.28401	0.47	0.6420
retany	2.66398	137.22016	0.02	0.9845
retmany	160.95556	170.91805	0.94	0.3468
conslight	127.68849	98.14847	1.30	0.1939
consheat	-70.95382	132.59702	-0.54	0.5928
type1	18.70055	159.29698	0.12	0.9066
type2	182.44736	178.07575	1.02	0.3061
C3H	8.94130	1.44603	6.18	<.0001

Table 4: Energy Intensity: Size Group 2: 5000-10000 Sq ft.

Model: MODEL2
 Dependent Variable: INTENSITY_ENERGY

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	13	1.65923	0.12763	5.50	<.0001
Error	486	11.27116	0.02319		
Corrected Total	499	12.93039			
Root MSE	0.15229	R-Square	0.1283		
Dependent Mean	0.14748	Adj R-Sq	0.1050		
Coeff Var	103.26054				

Parameter Estimates				
Variable	Parameter Estimate	Standard Error	t Value	Pr > t
Intercept	-0.11404	0.33866	-0.34	0.7365
B1	0.00010454	0.00017084	0.61	0.5409
B2	-0.00000477	0.00000494	-0.97	0.3344
atlantic	-0.08114	0.02561	-3.17	0.0016
quebec	-0.04491	0.01929	-2.33	0.0203
prairie	-0.00018260	0.02324	-0.01	0.9937
bc	0.01056	0.02175	0.49	0.6273
retany	0.00523	0.02026	0.26	0.7962
retmany	0.02136	0.02524	0.85	0.3978
conslight	0.01737	0.01449	1.20	0.2313
consheat	-0.00716	0.01958	-0.37	0.7148
type1	-0.00000989	0.02352	-0.00	0.9997
type2	0.02492	0.02629	0.95	0.3437
C3H	0.00143	0.00021351	6.72	<.0001

Table 5: Energy Usage: Size Group 3: 10000-50000 Sq ft.

Model: MODEL1
 Dependent Variable: ENERGY_TOTAL_USAGE

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	13	2735448131	210419087	18.00	<.0001
Error	858	10029758663	11689695		
Corrected Total	871	12765206794			

Root MSE	3419.01966	R-Square	0.2143
Dependent Mean	2728.35355	Adj R-Sq	0.2024
Coeff Var	125.31439		

Parameter Estimates

Variable	Parameter Estimate	Standard Error	t Value	Pr > t
Intercept	6462.52435	8532.80765	0.76	0.4490
B1	-4.06310	4.29893	-0.95	0.3449
B2	0.13491	0.01148	11.75	<.0001
atlantic	-1192.16844	433.29451	-2.75	0.0061
quebec	-1043.22914	339.68981	-3.07	0.0022
prairie	81.22031	353.25508	0.23	0.8182
bc	-593.65087	386.26598	-1.54	0.1247
retany	786.03363	339.67606	2.31	0.0209
retmany	-883.79177	412.34081	-2.14	0.0324
conslight	363.68474	237.29495	1.53	0.1257
consheat	572.88259	378.68087	1.51	0.1307
type1	-391.85207	427.19404	-0.92	0.3593
type2	-62.76361	453.31209	-0.14	0.8899
C3H	17.26227	3.55958	4.85	<.0001

Table 6: Energy Intensity: Size Group 3: 10000-50000 Sq ft.

Model: MODEL2
 Dependent Variable: INTENSITY_ENERGY

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	13	1.19960	0.09228	6.54	<.0001
Error	858	12.10558	0.01411		
Corrected Total	871	13.30518			

Root MSE	0.11878	R-Square	0.0902
Dependent Mean	0.12280	Adj R-Sq	0.0764
Coeff Var	96.72670		

Parameter Estimates

Variable	Parameter Estimate	Standard Error	t Value	Pr > t
Intercept	0.46306	0.29644	1.56	0.1186
B1	-0.00020719	0.00014935	-1.39	0.1657
B2	1.943679E-7	3.988162E-7	0.49	0.6261
atlantic	-0.05550	0.01505	-3.69	0.0002
quebec	-0.04028	0.01180	-3.41	0.0007
prairie	0.00422	0.01227	0.34	0.7313
bc	-0.02841	0.01342	-2.12	0.0346
retany	0.02891	0.01180	2.45	0.0145
retmany	-0.03247	0.01433	-2.27	0.0237
conslight	0.01384	0.00824	1.68	0.0934
consheat	0.02842	0.01316	2.16	0.0310
type1	-0.00667	0.01484	-0.45	0.6534
type2	0.00167	0.01575	0.11	0.9154
C3H	0.00069463	0.00012366	5.62	<.0001

Table 7: Energy Usage: Size Group 4: > 50000 Sq ft.

Model: MODEL1
 Dependent Variable: ENERGY_TOTAL_USAGE

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	13	4.021773E11	30936714137	65.22	<.0001
Error	306	1.451486E11	474341748		
Corrected Total	319	5.473259E11			

Root MSE	21779	R-Square	0.7348
Dependent Mean	24561	Adj R-Sq	0.7235
Coeff Var	88.67385		

Parameter Estimates

Variable	Parameter Estimate	Standard Error	t Value	Pr > t
Intercept	108304	96619	1.12	0.2632
B1	-59.37671	48.59207	-1.22	0.2227
B2	0.18743	0.00692	27.10	<.0001
atlantic	890.39108	5060.70922	0.18	0.8605
quebec	5295.12557	3419.60158	1.55	0.1225
prairie	5278.86781	3331.51411	1.58	0.1141
bc	1834.46775	4617.99581	0.40	0.6915
retany	-4208.72728	3417.03603	-1.23	0.2190
retmany	8697.87147	3759.16342	2.31	0.0213
conslight	1565.19534	2709.88205	0.58	0.5640
consheat	-3301.95538	6372.48983	-0.52	0.6047
type1	-2599.54756	5709.82379	-0.46	0.6492
type2	1426.16313	5526.14275	0.26	0.7965
C3H	37.29107	32.29762	1.15	0.2492

Table 8: Energy Intensity: Size Group 4: > 50000 Sq ft.

Model: MODEL2
 Dependent Variable: INTENSITY_ENERGY

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	13	0.38887	0.02991	2.91	0.0005
Error	306	3.14890	0.01029		
Corrected Total	319	3.53778			
Root MSE	0.10144	R-Square	0.1099		
Dependent Mean	0.13711	Adj R-Sq	0.0721		
Coeff Var	73.98608				

Parameter Estimates					
Variable	Parameter Estimate	Standard Error	t Value	Pr > t	
Intercept	1.31264	0.45002	2.92	0.0038	
B1	-0.00062341	0.00022633	-2.75	0.0062	
B2	7.954025E-8	3.221758E-8	2.47	0.0141	
atlantic	-0.00353	0.02357	-0.15	0.8812	
quebec	0.01932	0.01593	1.21	0.2260	
prairie	0.02594	0.01552	1.67	0.0956	
bc	0.02209	0.02151	1.03	0.3053	
retany	-0.02700	0.01592	-1.70	0.0908	
retmany	0.03740	0.01751	2.14	0.0335	
conslight	0.00122	0.01262	0.10	0.9233	
consheat	0.00429	0.02968	0.14	0.8851	
type1	-0.02158	0.02659	-0.81	0.4179	
type2	0.01164	0.02574	0.45	0.6514	
C3H 1	0.00031706	0.00015043	2.11	0.0359	

Table 9: Electricity Usage: Size Group 1: 1000-5000 Sq ft.

Model: MODEL1
 Dependent Variable: ELECTRICITY_TOTAL_USAGE TOTAL USAGE

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	13	22026744	1694365	19.19	<.0001
Error	768	67795778	88276		
Corrected Total	781	89822522			

Root MSE	297.11236	R-Square	0.2452
Dependent Mean	252.55093	Adj R-Sq	0.2324
Coeff Var	117.64453		

Parameter Estimates

Variable	Parameter Estimate	Standard Error	t Value	Pr > t
Intercept	-1795.40813	652.41904	-2.75	0.0061
B1	0.81732	0.33229	2.46	0.0141
B2	0.07231	0.01021	7.08	<.0001
atlantic	41.91539	35.14002	1.19	0.2333
quebec	-35.84686	28.05628	-1.28	0.2017
prairie	4.87466	34.93555	0.14	0.8891
bc	31.61337	39.99179	0.79	0.4295
retany	31.17264	33.23208	0.94	0.3485
retmany	-8.11556	43.12821	-0.19	0.8508
conslight	58.97463	22.41549	2.63	0.0087
consheat	18.95864	26.32899	0.72	0.4717
type1	-52.42178	44.26659	-1.18	0.2367
type2	-67.68350	48.25754	-1.40	0.1612
C3H	3.71210	0.29926	12.40	<.0001

Table 10: Electricity Intensity: Size Group 1: 1000-5000 Sq ft.

Model: MODEL2
 Dependent Variable: INTENSITY_ELECTRICITY

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	13	2.65497	0.20423	19.03	<.0001
Error	768	8.24404	0.01073		
Corrected Total	781	10.89901			

Root MSE	0.10361	R-Square	0.2436
Dependent Mean	0.09207	Adj R-Sq	0.2308
Coeff Var	112.53542		

Parameter Estimates

Variable	Parameter Estimate	Standard Error	t Value	Pr > t
Intercept	-0.64843	0.22751	-2.85	0.0045
B1	0.00034571	0.00011587	2.98	0.0029
B2	-0.00000805	0.00000356	-2.26	0.0241
atlantic	0.01533	0.01225	1.25	0.2114
quebec	-0.00869	0.00978	-0.89	0.3745
prairie	-0.00327	0.01218	-0.27	0.7888
bc	0.01073	0.01395	0.77	0.4417
retany	0.00756	0.01159	0.65	0.5146
retmany	-0.00627	0.01504	-0.42	0.6768
conslight	0.01844	0.00782	2.36	0.0186
consheat	0.01391	0.00918	1.52	0.1300
type1	-0.02883	0.01544	-1.87	0.0622
type2	-0.02914	0.01683	-1.73	0.0837
C3H	0.00139	0.00010436	13.35	<.0001

Table 11: Electricity Usage: Size Group 2: 5000-10000 Sq ft.

Model: MODEL1
 Dependent Variable: ELECTRICITY_TOTAL_USAGE TOTAL USAGE

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	13	17076705	1313593	4.41	<.0001
Error	521	155039893	297581		
Corrected Total	534	172116599			

Root MSE	545.51019	R-Square	0.0992
Dependent Mean	425.92035	Adj R-Sq	0.0767
Coeff Var	128.07798		

Parameter Estimates

Variable	Parameter Estimate	Standard Error	t Value	Pr > t
Intercept	-2707.67348	1247.80360	-2.17	0.0305
B1	1.31814	0.63301	2.08	0.0378
B2	0.03825	0.01694	2.26	0.0244
atlantic	-126.24422	79.64823	-1.59	0.1136
quebec	-157.75787	68.27664	-2.31	0.0212
prairie	-182.43737	81.01367	-2.25	0.0247
bc	60.40981	76.22856	0.79	0.4284
retany	-55.12431	72.12156	-0.76	0.4450
retmany	38.62010	91.84168	0.42	0.6743
conslight	46.91994	49.41705	0.95	0.3428
consheat	-59.50588	68.67312	-0.87	0.3866
type1	90.72254	90.09302	1.01	0.3144
type2	237.53567	99.04546	2.40	0.0168
C3H	3.94818	0.72274	5.46	<.0001

Table 12: Electricity Intensity: Size Group 2: 5000-10000 Sq ft.

Model: MODEL2
 Dependent Variable: INTENSITY_ELECTRICITY

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	13	0.38468	0.02959	4.64	<.0001
Error	521	3.32181	0.00638		
Corrected Total	534	3.70649			

Root MSE	0.07985	R-Square	0.1038
Dependent Mean	0.06263	Adj R-Sq	0.0814
Coeff Var	127.48788		

Parameter Estimates

Variable	Parameter Estimate	Standard Error	t Value	Pr > t
Intercept	-0.32770	0.18265	-1.79	0.0734
B1	0.00018693	0.00009266	2.02	0.0442
B2	-0.00000315	0.00000248	-1.27	0.2049
atlantic	-0.01706	0.01166	-1.46	0.1440
quebec	-0.02228	0.00999	-2.23	0.0262
prairie	-0.02633	0.01186	-2.22	0.0268
bc	0.01078	0.01116	0.97	0.3346
retany	-0.00737	0.01056	-0.70	0.4851
retmany	0.00739	0.01344	0.55	0.5826
conslight	0.00731	0.00723	1.01	0.3128
consheat	-0.00784	0.01005	-0.78	0.4358
type1	0.01192	0.01319	0.90	0.3664
type2	0.03254	0.01450	2.24	0.0252
C3H	0.00062823	0.00010579	5.94	<.0001

Table 13: Electricity Usage: Size Group 3: 10000-50000 Sq ft.

Model: MODEL1
 Dependent Variable: ELECTRICITY_TOTAL_USAGE TOTAL USAGE

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	13	726590953	55891612	11.16	<.0001
Error	853	4271729484	5007889		
Corrected Total	866	4998320437			

Root MSE	2237.83136	R-Square	0.1454
Dependent Mean	1295.76589	Adj R-Sq	0.1323
Coeff Var	172.70337		

Parameter Estimates

Variable	Parameter Estimate	Standard Error	t Value	Pr > t
Intercept	-4908.85890	5626.45817	-0.87	0.3832
B1	2.10975	2.82771	0.75	0.4558
B2	0.07071	0.00732	9.66	<.0001
atlantic	52.55222	256.19121	0.21	0.8375
quebec	-182.21304	230.64810	-0.79	0.4297
prairie	-227.80802	236.77428	-0.96	0.3363
bc	-70.95012	255.07691	-0.28	0.7810
retany	510.35542	227.60987	2.24	0.0252
retmany	-795.72131	275.43868	-2.89	0.0040
conslight	90.11883	157.71548	0.57	0.5679
consheat	199.69264	242.57757	0.82	0.4106
type1	-337.75208	326.28390	-1.04	0.3009
type2	-268.55138	337.97348	-0.79	0.4271
C3H	8.98973	2.26588	3.97	<.0001

Table 14: Electricity Intensity: Size Group 3: 10000-50000 Sq ft.

Model: MODEL2
 Dependent Variable: INTENSITY_ELECTRICITY

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	13	0.21315	0.01640	2.97	0.0003
Error	853	4.70997	0.00552		
Corrected Total	866	4.92312			

Root MSE	0.07431	R-Square	0.0433
Dependent Mean	0.05647	Adj R-Sq	0.0287
Coeff Var	131.58243		

Parameter Estimates

Variable	Parameter Estimate	Standard Error	t Value	Pr > t
Intercept	-0.03696	0.18683	-0.20	0.8432
B1	0.00003371	0.00009389	0.36	0.7197
B2	3.248188E-7	2.429737E-7	1.34	0.1816
atlantic	-0.00598	0.00851	-0.70	0.4824
quebec	-0.00554	0.00766	-0.72	0.4694
prairie	-0.00869	0.00786	-1.11	0.2694
bc	-0.00375	0.00847	-0.44	0.6578
retany	0.01940	0.00756	2.57	0.0104
retmany	-0.02775	0.00915	-3.03	0.0025
conslight	0.00366	0.00524	0.70	0.4854
consheat	0.00128	0.00805	0.16	0.8734
type1	-0.00519	0.01083	-0.48	0.6319
type2	-0.00389	0.01122	-0.35	0.7289
C3H	0.00034922	0.00007524	4.64	<.0001

Table 15: Electricity Usage: Size Group 4: > 50000 Sq ft.

Model: MODEL1
 Dependent Variable: ELECTRICITY_TOTAL_USAGE TOTAL USAGE

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	13	72886277471	5606636729	54.44	<.0001
Error	344	35425307300	102980544		
Corrected Total	357	1.083116E11			

Root MSE	10148	R-Square	0.6729
Dependent Mean	11005	Adj R-Sq	0.6606
Coeff Var	92.21230		

Parameter Estimates

Variable	Parameter Estimate	Standard Error	t Value	Pr > t
Intercept	-15379	48687	-0.32	0.7523
B1	6.55146	24.45669	0.27	0.7890
B2	0.08424	0.00350	24.07	<.0001
atlantic	-1306.97057	1761.10854	-0.74	0.4585
quebec	1137.96687	1542.88741	0.74	0.4613
prairie	-856.51768	1534.35021	-0.56	0.5771
bc	1723.89204	2043.21693	0.84	0.3994
retany	-1301.45616	1559.98519	-0.83	0.4047
retmany	4283.51952	1699.98132	2.52	0.0122
conslight	707.62860	1228.26387	0.58	0.5649
consheat	-2397.78307	3330.12067	-0.72	0.4720
type1	923.80856	2706.75060	0.34	0.7331
type2	1590.77079	2663.47035	0.60	0.5507
C3H	11.50235	13.82648	0.83	0.4060

Table 16: Electricity Intensity: Size Group 4: > 50000 Sq ft.

Model: MODEL2
 Dependent Variable: INTENSITY_ELECTRICITY

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	13	0.06227	0.00479	2.06	0.0158
Error	344	0.79850	0.00232		
Corrected Total	357	0.86077			

Root MSE	0.04818	R-Square	0.0723
Dependent Mean	0.06715	Adj R-Sq	0.0373
Coeff Var	71.74422		

Parameter Estimates

Variable	Parameter Estimate	Standard Error	t Value	Pr > t
Intercept	-0.07219	0.23115	-0.31	0.7550
B1	0.00006264	0.00011611	0.54	0.5899
B2	1.766043E-8	1.661312E-8	1.06	0.2885
atlantic	-0.02338	0.00836	-2.80	0.0055
quebec	-0.00387	0.00733	-0.53	0.5977
prairie	-0.01581	0.00728	-2.17	0.0306
bc	0.00334	0.00970	0.34	0.7310
retany	0.00179	0.00741	0.24	0.8091
retmany	0.00934	0.00807	1.16	0.2480
conslight	0.00328	0.00583	0.56	0.5741
consheat	-0.01350	0.01581	-0.85	0.3938
type1	0.01323	0.01285	1.03	0.3041
type2	0.02783	0.01265	2.20	0.0284
C3H	0.00008890	0.00006564	1.35	0.1765

Table 17: Natural Gas Usage: Size Group 1: 1000-5000 Sq ft.

Model: MODEL1
Dependent Variable: NATURALGAS_TOTAL_USAGE TOTAL USAGE

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	12	18753288	1562774	8.49	<.0001
Error	424	78082261	184156		
Corrected Total	436	96835549			

Root MSE	429.13433	R-Square	0.1937
Dependent Mean	395.72535	Adj R-Sq	0.1708
Coeff Var	108.44247		

Parameter Estimates

Variable	Parameter Estimate	Standard Error	t Value	Pr > t
Intercept	-721.64513	1307.41241	-0.55	0.5813
B1	0.26819	0.66058	0.41	0.6849
B2	0.13285	0.01957	6.79	<.0001
quebec	24.41420	56.80852	0.43	0.6676
prairie	157.70445	56.27474	2.80	0.0053
bc	-20.89235	84.61776	-0.25	0.8051
retany	34.22765	64.34245	0.53	0.5950
retmany	-1.02983	81.47490	-0.01	0.9899
conslight	94.96573	43.16762	2.20	0.0284
consheat	-32.60807	56.39008	-0.58	0.5634
type1	-116.44457	130.05462	-0.90	0.3711
type2	-96.66598	134.62094	-0.72	0.4731
C3H	3.99695	0.61598	6.49	<.0001

Table 18: Natural Gas Intensity: Size Group 1: 1000-5000 Sq ft.

Model: MODEL2
 Dependent Variable: INTENSITY_NATURALGAS

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	12	1.23268	0.10272	5.30	<.0001
Error	424	8.21587	0.01938		
Corrected Total	436	9.44856			

Root MSE	0.13920	R-Square	0.1305
Dependent Mean	0.14058	Adj R-Sq	0.1059
Coeff Var	99.02066		

Parameter Estimates

Variable	Parameter Estimate	Standard Error	t Value	Pr > t
Intercept	0.16765	0.42410	0.40	0.6928
B1	-0.00004455	0.00021428	-0.21	0.8354
B2	-0.00000652	0.00000635	-1.03	0.3046
quebec	0.02273	0.01843	1.23	0.2181
prairie	0.04887	0.01825	2.68	0.0077
bc	-0.00363	0.02745	-0.13	0.8949
retany	0.00632	0.02087	0.30	0.7622
retmany	-0.00211	0.02643	-0.08	0.9364
conslight	0.02123	0.01400	1.52	0.1303
consheat	-0.00803	0.01829	-0.44	0.6608
type1	-0.03453	0.04219	-0.82	0.4135
type2	-0.03407	0.04367	-0.78	0.4357
C3H	0.00144	0.00019981	7.21	<.0001

Table 19: Natural Gas Usage: Size Group 2: 5000-10000 Sq ft.

Model: MODEL1
Dependent Variable: NATURALGAS_TOTAL_USAGE TOTAL USAGE

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	12	24392391	2032699	2.59	0.0027
Error	314	246446610	784862		
Corrected Total	326	270839001			

Root MSE	885.92427	R-Square	0.0901
Dependent Mean	748.37108	Adj R-Sq	0.0553
Coeff Var	118.38035		

Parameter Estimates

Variable	Parameter Estimate	Standard Error	t Value	Pr > t
Intercept	-852.35959	3012.59022	-0.28	0.7774
B1	-0.01895	1.52133	-0.01	0.9901
B2	0.08788	0.03580	2.45	0.0146
quebec	181.36694	137.90972	1.32	0.1894
prairie	60.54805	148.27660	0.41	0.6833
bc	221.21778	167.15471	1.32	0.1867
retany	-18.69935	139.55923	-0.13	0.8935
retmany	55.46991	176.06703	0.32	0.7529
conslight	55.83165	103.70590	0.54	0.5907
consheat	103.97851	157.39214	0.66	0.5093
type1	435.79787	249.68119	1.75	0.0819
type2	533.63200	269.26253	1.98	0.0484
C3H	5.68490	1.44056	3.95	<.0001

Table 20: Natural Gas Intensity: Size Group 2: 5000-10000 Sq ft.

Model: MODEL2
Dependent Variable: INTENSITY_NATURALGAS

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	12	0.45192	0.03766	2.39	0.0059
Error	314	4.95723	0.01579		
Corrected Total	326	5.40915			

Root MSE	0.12565	R-Square	0.0835
Dependent Mean	0.11006	Adj R-Sq	0.0485
Coeff Var	114.16002		

Parameter Estimates

Variable	Parameter Estimate	Standard Error	t Value	Pr > t
Intercept	-0.06462	0.42727	-0.15	0.8799
B1	0.00002914	0.00021576	0.14	0.8927
B2	-0.00000428	0.00000508	-0.84	0.4001
quebec	0.02316	0.01956	1.18	0.2372
prairie	0.00267	0.02103	0.13	0.8990
bc	0.02913	0.02371	1.23	0.2201
retany	-0.00053610	0.01979	-0.03	0.9784
retmany	0.00268	0.02497	0.11	0.9145
conslight	0.00864	0.01471	0.59	0.5573
consheat	0.00858	0.02232	0.38	0.7009
type1	0.06256	0.03541	1.77	0.0783
type2	0.08136	0.03819	2.13	0.0339
C3H	0.00088594	0.00020431	4.34	<.0001

Table 21: Natural Gas Usage: Size Group 3: 10000-50000 Sq ft.

Model: MODEL1
Dependent Variable: NATURALGAS_TOTAL_USAGE TOTAL USAGE

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	12	414899490	34574957	10.59	<.0001
Error	603	1969315134	3265863		
Corrected Total	615	2384214624			

Root MSE	1807.16977	R-Square	0.1740
Dependent Mean	1676.94959	Adj R-Sq	0.1576
Coeff Var	107.76530		

Parameter Estimates

Variable	Parameter Estimate	Standard Error	t Value	Pr > t
Intercept	4965.26449	5690.04353	0.87	0.3832
B1	-3.04372	2.84576	-1.07	0.2852
B2	0.06868	0.00742	9.25	<.0001
quebec	-159.16615	204.37679	-0.78	0.4364
prairie	571.56053	203.80915	2.80	0.0052
bc	-11.55724	262.98272	-0.04	0.9650
retany	2.04989	208.17717	0.01	0.9921
retmany	106.40377	254.99360	0.42	0.6766
conslight	87.31889	150.83437	0.58	0.5629
consheat	348.14834	239.20602	1.46	0.1461
type1	489.02981	391.83500	1.25	0.2125
type2	404.56689	407.18948	0.99	0.3208
C3H	4.83906	2.24742	2.15	0.0317

Table 22: Natural Gas Intensity: Size Group 3: 10000-50000 Sq ft.

Model: MODEL2
 Dependent Variable: INTENSITY_NATURALGAS

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	12	0.18891	0.01574	2.71	0.0014
Error	603	3.49973	0.00580		
Corrected Total	615	3.68863			

Root MSE	0.07618	R-Square	0.0512
Dependent Mean	0.08032	Adj R-Sq	0.0323
Coeff Var	94.85201		

Parameter Estimates

Variable	Parameter Estimate	Standard Error	t Value	Pr > t
Intercept	0.31341	0.23987	1.31	0.1918
B1	-0.00014865	0.00011997	-1.24	0.2158
B2	-3.76399E-7	3.129348E-7	-1.20	0.2295
quebec	-0.00379	0.00862	-0.44	0.6605
prairie	0.02144	0.00859	2.50	0.0128
bc	-0.00250	0.01109	-0.23	0.8217
retany	0.00480	0.00878	0.55	0.5844
retmany	-0.00265	0.01075	-0.25	0.8055
conslight	0.00679	0.00636	1.07	0.2860
consheat	0.01893	0.01008	1.88	0.0610
type1	0.02940	0.01652	1.78	0.0756
type2	0.02413	0.01717	1.41	0.1604
C3H	0.00023299	0.00009474	2.46	0.0142

Table 23: Natural Gas Usage: Size Group 4: > 50000 Sq ft.

Model: MODEL1
 Dependent Variable: NATURALGAS_TOTAL_USAGE TOTAL USAGE

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	12	29122268924	2426855744	13.11	<.0001
Error	206	38122197454	185059211		
Corrected Total	218	67244466378			

Root MSE	13604	R-Square	0.4331
Dependent Mean	10550	Adj R-Sq	0.4001
Coeff Var	128.94965		

Parameter Estimates

Variable	Parameter Estimate	Standard Error	t Value	Pr > t
Intercept	114265	71841	1.59	0.1133
B1	-57.20215	35.77639	-1.60	0.1114
B2	0.07176	0.00693	10.35	<.0001
quebec	217.98664	2677.30727	0.08	0.9352
prairie	8727.35940	2438.82415	3.58	0.0004
bc	-913.00441	3505.47239	-0.26	0.7948
retany	1264.37422	2515.76165	0.50	0.6158
retmany	-530.56678	2803.78399	-0.19	0.8501
conslight	1510.95775	2148.00849	0.70	0.4826
consheat	3486.57151	5460.82990	0.64	0.5239
type1	-12939	6079.89184	-2.13	0.0345
type2	-14560	5928.56295	-2.46	0.0149
C3H	59.54467	23.61370	2.52	0.0124

Table 24: Natural Gas Intensity: Size Group 4: > 50000 Sq ft.

Model: MODEL2
 Dependent Variable: INTENSITY_NATURALGAS

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	12	0.12030	0.01003	3.03	0.0006
Error	206	0.68208	0.00331		
Corrected Total	218	0.80238			

Root MSE	0.05754	R-Square	0.1499
Dependent Mean	0.06846	Adj R-Sq	0.1004
Coeff Var	84.04910		

Parameter Estimates

Variable	Parameter Estimate	Standard Error	t Value	Pr > t
Intercept	0.47302	0.30388	1.56	0.1211
B1	-0.00021337	0.00015133	-1.41	0.1601
B2	3.130408E-8	2.932858E-8	1.07	0.2871
quebec	0.00865	0.01132	0.76	0.4459
prairie	0.04237	0.01032	4.11	<.0001
bc	-0.00241	0.01483	-0.16	0.8712
retany	-0.00421	0.01064	-0.40	0.6927
retmany	0.01563	0.01186	1.32	0.1890
conslight	-0.00449	0.00909	-0.49	0.6215
consheat	0.02534	0.02310	1.10	0.2739
type1	-0.04366	0.02572	-1.70	0.0911
type2	-0.05635	0.02508	-2.25	0.0257
C3H	0.00028002	0.00009988	2.80	0.0055

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