

Conditional Demand Analysis of Residential Energy Consumption

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Introduction

Information on end-use energy consumption is used for power and natural gas system planning, load forecasting, marketing and demand side management. End-use consumption refers to the consumption of space heating, space cooling, water heating, lighting and other specific uses as opposed to total consumption. This paper summarizes the methodology and results of residential end-use studies for electricity and natural gas for British Columbia. The two studies use Conditional Demand Analysis (CDA) to estimate Unit Energy Consumption (UEC) values for residential end-uses. CDA is a multivariate regression technique which combines utility billing data with weather information and customer survey data. The CDA models integrate thermodynamic principles with household behavioral information. Saturation refers to the share of households with that end-use with all households with that fuel used as the base.

Results

The studies generated UEC estimates (annual energy consumption per unit) for 14 electricity end-uses (kWh per year) and 10 natural gas end-uses (GJ per year), with results weighted to the customer population. The models perform well with adjusted R-squared of 0.83 for the electricity model and 0.85 for the natural gas model. Major electricity end-uses include primary electric space heating at 5,037 kWh per year, electric water heating at 3,186 kWh per year, secondary electric space heating at 2,310 kWh per year and lighting at 1,937 kWh per year. Major natural gas end-uses include primary space heating at 67.80 GJ per year, water heating at 20.76 GJ per year, fireplace logs at 15.77 GJ per year, and fireplace inserts at 15.77 JG per year.

Table 1. End-Use Saturations and Unit Energy Consumption

End Use	Electricity		Natural Gas	
	Saturation (per household)	UEC (kWh per year)	Saturation (per household)	UEC (GJ per year)
Primary space heating	0.28	5,037	0.95	67.80
Secondary space heating	0.29	2,310	0.04	18.05
Fireplace insert	-	-	0.30	15.77
Fireplace logs	-	-	0.28	16.84
Central air conditioner	0.07	346	-	-
Room or portable air conditioner	0.14	207	-	-
Water heating	0.42	3,186	0.84	20.76
Refrigerator or freezer	2.11	1,112	-	-
Range, cook top or oven	1.07	721	0.18	8.48
Barbeque	-	-	0.10	3.12
Dishwasher	0.77	38	-	-
Clothes washer or clothes dryer	1.80	648	0.06	3.96
Lighting	1.00	1,937	-	-
Television	1.93	878	-	-
Personal computer	1.11	656	-	-
Pool	0.05	3,912	0.03	53.49
Hot tub	0.17	2,618	0.01	17.86
Total	-	12,744	-	105.0