May 2014

Paying More for Power

Electricity Costs in the US and Canada

by Gerry Angevine
& Kenneth P. Green

May 2014

Paying More for Power

Electricity Costs in the US and Canada

by Gerry Angevine and Kenneth P. Green

Contents

Executive summary

A review of electricity costs across North America, as reflected by monthly electricity bills (excluding taxes), reveals that Canadians are paying more for their power, on average, than our neighbors to the south. Average total electricity costs per kilowatt-hour in Canadian cities are greater than in US cities, especially when outlier Honolulu is excluded from the group of US cities. In that case, costs for small commercial electricity consumers are found to be more than 8 percent greater in Canada than in the US, while costs for small industrial consumers are almost 30 percent greater. When the comparisons are based only on monthly electricity bills in cities located in provinces and states that are not well endowed with developed hydroelectric generation capacity, the Canada-US differences are even greater. Clearly, Canadian commercial and industrial electricity consumers appear to have a competitive disadvantage versus their US counterparts.

Cities located in jurisdictions where coal combustion is the dominant mode of electric generation have distinctly lower electricity costs, on average, across all three customer demand classifications that were reviewed (residential, small commercial, and small industrial) than other cities.

Many states where gas-fired generation capacity is dominant, such as Massachusetts, New York, and New Jersey, are net importers of long-haul gas, with the result that the delivered cost to the generators is much greater than in gas-dominant states such as Texas, Louisiana, and Oklahoma, which are net exporters of gas. This may, at least in part, explain why consumers in gas-importing states which rely heavily on gas-fired generation do not appear to benefit from low electricity costs relative to consumers in other states. On the other hand, cities in gas-rich states where gas-fired electricity is the dominant source of power tend to have lower costs. Tulsa, OK, for example, has the lowest commercial and industrial costs and the second lowest residential costs overall.

The presence of hydroelectric capacity as the dominant mode of electric generation in the jurisdiction where a given city is located also appears to contribute to low electricity costs. This helps to explain why cities in Quebec, Manitoba, British Columbia, Idaho, Washington State, and Oregon tend to enjoy lower electricity costs than many other cities.

The assessment also found that having nuclear power as the leading in-state source of electricity appears to contribute to higher costs in some cases.

Based on their analysis, the authors call on Canadian federal and provincial policy makers to focus on measures that could help to secure lower electricity costs for future generations and reduce the disparity between Canadian and US electricity costs. In this regard, they put forward a number of recommendations including: 1) the development of remaining hydro resources where feasible and competitive with available alternatives; 2) the facilitation of investment in advanced technology combined-cycle gas-fired generators and coal-fired capacity to meet base load requirements (whichever is most competitive); and 3) a review of subsidies and incentives for investment in renewable energy technologies and of charges on emissions from fossil-fueled electric generation to ensure that, recognizing environmental goals and objectives, efforts to level the playing field between polluters and non-polluters do not place unnecessarily high burdens on taxpayers and electricity consumers.

Introduction

This study compares the cost that consumers pay for electricity in selected Canadian and American cities. Possible reasons for the apparent differences in the cost per kilowatt-hour (kWh) of electricity consumed, such as the major source of electricity produced in the province, state or district where each city is located, are examined. In addition, unit costs in the group of Canadian cities are compared with unit costs in the group of US cities. Finally, policy recommendations are put forward that are intended to promote the interests of Canadian electricity consumers by lessening their disadvantage relative to their American counterparts.

The study compares the total cost of electricity per kWh that appears on consumers' typical monthly bills. This includes not only the cost of producing the electrical energy, but also the transmission and distribution service costs which are necessary to transport the electricity to the end users.

The basis for the cost comparisons

The study relies on two major annual surveys of electricity costs. The first, undertaken by Hydro-Quebec, provides the total cost on customers' bills as at April 1, 2013 in terms of cents per kilowatt-hour (kWh), based on information received from or pertaining to electric distribution utilities in 12 Canadian and 10 US cities (Hydro-Quebec, 2013). The Canadian centers included are St. John's, Halifax, Charlottetown, Moncton, Montreal, Ottawa, Toronto, Winnipeg, Regina, Edmonton, Calgary, and Vancouver. The US cities included in the Hydro-Quebec survey are Boston, New York, Miami, Detroit, Nashville, Chicago, Houston, Seattle, Portland OR, and San Francisco.

The second information source for electricity costs is the *National Electric Rate Survey*, undertaken by the Lincoln Electric System of Lincoln, Nebraska, which reports costs effective as of January 1, 2013 for 106 US cities in terms of US dollars. The Edison Electric Institute's *Typical Winter Bills* report provided the information reported in the Lincoln Electric System Survey for the majority of the investor-owned utilities. Bills for the other investor-owned utilities and for municipality-owned utilities were surveyed by the Lincoln Electric System. For each city, the Lincoln Electric System calculated typical bills for each month of the year and then averaged them to account for seasonal variations.

Both surveys were focused on the delivered cost of electricity on customer bills pertaining to specified levels of consumption, including applicable rate riders. The Hydro-Quebec survey provides rate information both with and without the sales and other taxes that are levied on electricity bills in the various cities. However, the Lincoln Electric System Survey only provides cost information exclusive of taxes. For cities where consumers have the right to choose between purchasing their electricity requirements from a marketer at a contractually agreed price or from the distributor at a regulated price option, as in Alberta, Ontario, Massachusetts, or Texas, Hydro-Quebec used the regulated (default) price whereas the Lincoln Electric System survey calculated "average" electricity prices for each city.[1]

1. Where consumers have the option of choosing between a regulated rate or purchasing electricity from a marketer, wholesale markets have been deregulated and the regulated rates are therefore a function of market conditions. Nevertheless, if there are significant

Hydro-Quebec's cost information was used for all 10 US cities included in their survey, nine of which (all but Houston) are also included in the Lincoln Electric System survey. In total, information was available for 119 distinct locations: the 22 Canadian and US cities in the Hydro-Quebec survey, and the 97 US cities in the Lincoln Electric System survey that are not included in Hydro-Quebec's survey.

Rates offered by some utilities with respect to electrical energy vary depending on the season and/or time of day when the energy is consumed. In the United States, for example, a number of utilities set a higher price in summer, when demand for air-conditioning is stronger. In Quebec, on the other hand, demand increases in winter because of heating requirements. Since, for some utilities, April 1 (the date used for the cost comparison in the Hydro-Quebec survey) may fall within a period in the year when the rate is relatively high, whereas for others it may fall in a period when the rate is relatively low, Hydro-Quebec calculated an annual average rate in the case of utilities whose rates vary according to season or time of day.[2]

differences, on average, between marketers' contractual rates and regulated rates the different approaches taken in the two surveys could bias the cost comparisons provided in this study. Because customers that have a choice over their electricity provider generally pay negotiated contract prices for electrical energy that are lower than the regulated rates, their actual all-in costs may be lower than indicated by Hydro-Quebec. For example, that survey uses the monthly default rate for small industrial and other consumers whereas a large majority of small industrial customers in Alberta have contract rates that are lower than the default rate. Prices paid by consumers who purchase electricity from marketers are generally confidential and no attempt was made by the authors to estimate the lowest rate, or range of rates, paid by such customers. As a consequence, for the Alberta cities at least, the costs per kWh indicated here, being taken straight from the Hydro-Quebec report, are most likely overstated to some extent—especially in the case of industrial consumers, most of which have negotiated rates.

In a recent report sponsored by the Manning Foundation and the Independent Power Producer Society of Alberta, London Economics International generated estimates of what an "all-in" delivered cost of power comparison would look like across Canada if one accounted for an array of market distortions, such as: differences in initial endowments; the levels of leverage and impact on overall provincial debt burden; suppressed equity returns; differences in tax regimes; and the impact of heritage contracts and export revenues. As a courtesy to the reader, we present two of their figures from the report in Appendix 1, one for residential customers, and another for industrial customers.

2. In the case of utilities whose supply costs are determined by the market (as in Alberta, Texas, and other jurisdictions where wholesale electricity markets have been developed to allow prices to be determined through the interaction of electricity supply offers and bids to purchase), Hydro-Quebec used average prices for the month of March 2013 (a high cost month) to estimate the cost of the energy component on the typical consumer's bill as of April 1st.

The issue of changing rates according to season and/or time of day is handled somewhat differently in the Lincoln Electric System survey. In that survey, the costs indicated to be effective as of January 1, 2013 are monthly average costs estimated for 2013 as a whole. This incorporates the effects of both summer and winter rates and also time-of-use rate changes.

Although Hydro-Quebec estimated annual average electricity rates for utilities whose rates vary according to season, the annual average of monthly electricity bill costs approach utilized in the Lincoln Electric System survey may nevertheless provide a more accurate basis for intercity comparison than the point-in-time comparison used in the Hydro-Quebec survey (bills as of April 1, 2013). However, sufficient information was not available to allow the authors to present electricity costs per kWh for the 12 Canadian and 10 American cities included in that survey on an annual average basis.

In order to compare the costs in the two surveys, data in terms of US cents per kilowatt-hour in the Lincoln Electric System survey was converted to Canadian cents per kilowatt-hour using the noon Bank of Canada US-to-Canadian dollar exchange rate on January 2, 2013. At that point in time the Canadian dollar was worth about US$ 1.01.[3]

In order to link price information for cities in the Lincoln Electric System report to that provided in the Hydro-Quebec survey, cost data in terms of Canadian cents per kilowatt-hour were compared for each of the nine US cities that were included in both surveys, and the average percentage differences calculated. In general, this indicated that the costs for those nine cities published in the Lincoln Electric System's *National Rate Survey* were a

3. From January 2, 2013 until mid-January 2014, the value of the Canadian dollar depreciated by about 10 percent against the US dollar. When the results of the two 2014 surveys become available for comparison, other things equal the stronger value of the US dollar in January 2014 than a year earlier will result in the costs tabulated by the Lincoln Electric System survey for US cities being considerably higher than in 2013 when expressed in Canadian dollar terms. This will imply that the discrepancy between US and Canadian electricity costs in favor of the US identified in the current study has narrowed or perhaps even shifted to such an extent that, on average, Canadian costs will appear more favorable than US costs. To ensure consistency in annual comparisons of Canadian and US electricity costs going forward, in spite of inevitable exchange rate fluctuations, it would be necessary to hold the value of the Canadian dollar constant in terms of its US counterpart. There are several ways of doing this. One would be to continue to use the exchange rate as observed on January 2, 2013. A more logical option, perhaps, would be to revise the 2013 comparison and undertake similar comparisons in future years using the average exchange rate during a selected historical period such as, for example, from 1983 to 2013. One could also select an exchange rate based on a study (or studies) of the purchasing power parity of the Canadian dollar. But because the perception of the exchange rate that would give Canadians the same purchasing power as Americans will change with time, the exchange rate that is adopted for this purpose would need to be reviewed and adjusted from time to time.

bit greater than those indicated by Hydro-Quebec.[4] For this reason, the cost data for the other 97 US centers included in the Lincoln Electric System survey was adjusted accordingly.

Both surveys provided cost comparisons for an array of different electricity demand levels and consumption volumes. Many of these were not the same and, therefore, not comparable. Fortunately, it was possible to link and compare costs from the two surveys for the following three categories:

- Residential service at the 1,000 kWh per month consumption level;
- Small commercial power demand at the 40 kW level with monthly electricity consumption of 10,000 kWh (35 percent load factor);
- Small industrial sector demand at the 1,000 kW level with monthly consumption of 400,000 kWh (56 percent load factor).

4. This is most likely because the Lincoln Electric System survey results reflect the effects of summer rates which, in most US centers, are higher than in the winter or spring because load peaks during the hot summer months as a consequence of cooling requirements. For the nine US cities included in both surveys, in the case of residential service at the rate of 1,000 kWh per month, the prices in the Lincoln Electric System survey averaged one percent higher than in the Hydro-Quebec survey. For the small commercial load category the difference was only 0.2 percent. However, for small industrial consumption at the 400,000 kWh per month level, the difference averaged almost 4.4 percent, with the largest differences apparent in Chicago and New York.

How the costs compare

Table 1 shows how electricity costs for the three types of customers in the 119 jurisdictions compare. The 12 Canadian cities are highlighted. The arithmetic means for each rate class and the standard deviation are indicated at the bottom of the table. Because the Hydro-Quebec survey provides costs both with and without taxes, while the Lincoln Electric System survey only provides cost information without taxes included, the comparison of costs in the 119 cites that is presented here, and throughout most of the following analysis and discussion, is without regard to taxes.[5]

1. Residential electricity costs

The arithmetic average residential electricity cost over all 119 jurisdictions is 12.12 cents per kWh. As indicated by table 1, several cities have much lower costs than this, while others have much higher costs. Only four Canadian cities (Montreal, Winnipeg, Vancouver, and Moncton) have lower costs than the average. The difference between the lowest cost (6.87 cents per kWh in Montreal) and costs in the two cities with the highest costs (Honolulu at 32.36 cents and San Francisco at 22.94 cents) is vast. For example, electricity costs residential customers nearly five times as much per kWh as in Montreal.[6]

19 cities' costs per kWh vary by more than one standard deviation (3.65 cents per kWh) from the mean and the overall distribution is skewed. At the lower end, seven cities' costs are more than one standard deviation less than the average cost, and top-ranked Montreal's cost for the indicated residential class is almost one and a half standard deviations less. At the upper end of the range, 12 cities have costs greater than a single standard deviation from the mean. Outlier Honolulu's cost is 5.5 standard deviations above the average cost, while costs per kWh in New York, San Diego, and San Francisco are almost three standard deviations greater.

5. A comparison of costs with and without taxes included, based on the information provided with respect to the 22 cities covered in the Hydro-Quebec survey, is provided in a separate section.

6. This reflects the fact that Honolulu depends, for the most part, on oil combustion to meet its electricity commitments.

Table 1: Electricity cost comparisons, 2013

Residential customers Monthly consumption of 1000 kWh			Small commercial customers 40 kW power demand Monthly consumption of 10,000 kWh			Small industrial customers 1,000 kW power demand Monthly consumption of 400,000 kWh		
		CAN cents per kWh			*CAN cents per kWh*			*CAN cents per kWh*
2	Montreal	6.87	1	Tulsa	6.23	1	Tulsa	4.01
3	Tulsa	7.11	2	Boise	6.27	2	Des Moines	4.91
4	Tacoma	7.48	3	Tacoma	7.27	3	Boise	4.94
5	Winnipeg	7.63	4	Seattle	7.28	4	Tacoma	4.99
6	Spokane	7.74	5	Winnipeg	7.48	5	Las Vegas	5.36
7	Baton Rouge	7.92	6	Lincoln	7.49	6	Oklahoma City	5.38
8	Springfield MO	8.33	7	Baton Rouge	7.53	7	Davenport	5.57
9	Lexington	8.50	8	Las Vegas	7.69	8	Lexington	5.67
10	Boise	8.64	9	Reno	7.89	9	Winnipeg	5.76
10	Lincoln	8.74	10	Des Moines	8.04	10	Baton Rouge	5.84
11	Fargo	8.87	11	Colorado Springs	8.09	11	St. Louis	6.05
12	Vancouver	8.91	12	Eugene	8.14	12	Louisville	6.09
13	Oklahoma City	8.93	13	Oklahoma City	8.23	13	Seattle	6.21
14	Huntsville	8.94	14	St. Louis	8.26	14	Eugene	6.21
15	Seattle	8.97	15	Omaha	8.28	15	Chicago	6.27
16	St. Louis	9.03	16	Davenport	8.47	16	Charlotte	6.29
17	Davenport	9.08	17	Shreveport	8.51	17	Greensboro	6.29
18	Shreveport	9.17	18	Wichita	8.56	18	Cleveland	6.47
19	Tucson	9.18	19	Little Rock	8.59	19	Springfield MO	6.49
20	Louisville	9.20	20	Raleigh	8.66	20	Omaha	6.53
21	Des Moines	9.22	21	Charlotte	8.67	21	Jackson	6.55
22	Eugene	9.22	22	Greensboro	8.67	22	Lincoln	6.56
23	Jackson	9.33	23	Springfield MO	8.86	23	Norfolk	6.63
24	Memphis	9.33	24	Pittsburgh	8.87	24	Richmond VA	6.63
25	Wheeling W.VA	9.45	25	Lexington	8.88	25	Birmingham	6.82
26	Miami	9.46	26	Fargo	9.03	26	Mobile	6.82
27	Indianapolis	9.58	27	Montreal	9.05	27	Colorado Springs	6.87
28	New Orleans	9.64	28	Dallas	9.10	28	Little Rock	6.88
29	Duluth	9.66	29	Houston	9.18	29	Fargo	6.93
30	Austin	9.75	30	Louisville	9.30	30	Wichita	6.99
31	Kansas City MO	9.89	31	Wheeling W.VA	9.36	31	Shreveport	6.99
32	Knoxville	10.00	32	Huntsville	9.41	32	Wheeling W.VA	7.04
33	Little Rock	10.01	33	Kansas City MO	9.43	33	Cedar Rapids	7.06
34	Tampa	10.01	34	New Orleans	9.46	34	Dallas	7.09
35	Charlotte	10.05	35	Erie	9.48	35	Duluth	7.17
36	Greensboro	10.05	36	Norfolk	9.57	36	Vancouver	7.23
37	Houston	10.10	37	Richmond VA	9.57	37	Indianapolis	7.30
38	Denver	10.14	38	Vancouver	9.60	38	Kansas City MO	7.33
39	Raleigh	10.16	39	Duluth	9.60	39	Roanoke	7.38
40	Salt Lake City	10.27	40	Miami	9.74	40	Montreal	7.38
41	Colorado Springs	10.39	41	Memphis	9.80	41	New Orleans	7.40
42	Norfolk	10.46	42	Portland OR	9.83	42	Erie	7.40

Table 1, continued

Residential customers Monthly consumption of 1000 kWh			Small commercial customers 40 kW power demand Monthly consumption of 10,000 kWh			Small industrial customers 1,000 kW power demand Monthly consumption of 400,000 kWh		
		CAN cents per kWh			*CAN cents per kWh*			*CAN cents per kWh*
43	Richmond VA	10.46	43	Sioux Falls	9.90	43	Salt Lake City	7.41
44	Reno	10.47	44	Jackson	9.93	44	Denver	7.42
45	Wichita	10.58	45	Roanoke	10.05	45	Portland, OR	7.46
46	Kansas City KS	10.62	46	Indianapolis	10.14	46	Billings	7.49
47	Nashville	10.62	47	Chicago	10.20	47	Raleigh	7.57
48	Portland, OR	10.63	48	Rockford	10.38	48	Sioux Falls	7.57
49	Springfield IL	10.70	49	Knoxville	10.38	49	Tucson	7.59
50	El Paso	10.71	50	Minneapolis	10.43	50	Evansville	7.68
51	Cincinnati	10.75	51	Saint Paul	10.43	51	Mesa	7.75
52	Billings	10.80	52	Tampa	10.61	52	Miami	7.76
53	Omaha	10.82	53	Salt Lake City	10.65	53	Huntsville	7.79
54	Atlanta	10.92	54	Cedar Rapids	10.73	54	Cincinnati	7.79
55	Columbus GA	10.92	55	Cleveland	10.75	55	Spokane	7.79
56	Savannah	10.92	56	Tucson	10.81	56	Buffalo	7.83
57	Mesa	10.93	57	Regina	10.82	57	Pittsburgh	7.92
58	Roanoke	11.00	58	Kansas City KS	10.87	58	Minneapolis	7.93
59	Sioux Falls	11.12	59	Nashville	10.88	59	Saint Paul	7.93
60	Cleveland	11.32	60	Billings	10.94	60	Phoenix	7.99
61	Overland Park	11.33	61	Cincinnati	10.99	61	Philadelphia	8.05
62	Phoenix	11.39	62	Jacksonville	11.04	62	Alberquerque	8.08
63	Chicago	11.43	63	Austin	11.18	63	Tampa	8.16
64	Rockford	11.58	64	Buffalo	11.21	64	Memphis	8.21
65	Lansing	11.61	65	Milwaukee	11.23	65	Overland Park	8.32
66	Minneapolis	11.69	66	Overland Park	11.33	66	Rockford	8.38
67	Saint Paul	11.69	67	Portland ME	11.34	67	Houston	8.42
68	Cheyenne	11.69	68	Spokane	11.35	68	El Paso	8.59
69	Birmingham	11.70	69	Mesa	11.38	69	Columbia	8.68
70	Mobile	11.70	70	El Paso	11.41	70	Austin	8.68
71	Dallas	11.82	71	Denver	11.43	71	Kansas City KS	8.73
72	Moncton	11.82	72	Evansville	11.69	72	Milwaukee	8.82
73	Las Vegas	11.87	73	Lansing	11.77	73	Knoxville	8.85
74	Jacksonville	11.96	74	Baltimore	11.93	74	Reno	8.93
75	Alberquerque	12.18	75	Philadelphia	11.95	75	Cheyenne	8.98
76	Washington DC	12.20	76	Alberquerque	12.17	76	Grand Rapids	9.19
77	Erie	12.26	77	Ottawa	12.26	77	Gary	9.22
78	Ottawa	12.39	78	Columbia	12.28	78	Lansing	9.28
79	Toronto	12.48	79	Toronto	12.40	79	Nashville	9.38
80	Anchorage	12.54	80	Moncton	12.46	80	Atlanta	9.39
81	St. John's	12.55	81	St. John's	12.58	81	Columbus GA	9.39
82	Baltimore	12.59	82	Birmingham	12.67	82	Savannah	9.39
83	Gary	12.90	83	Mobile	12.67	83	Regina	9.53
84	Milwaukee	12.94	84	Grand Rapids	12.82	84	Newark	9.56

Table 1, continued

Residential customers Monthly consumption of 1000 kWh		CAN cents per kWh	Small commercial customers 40 kW power demand Monthly consumption of 10,000 kWh		CAN cents per kWh	Small industrial customers 1,000 kW power demand Monthly consumption of 400,000 kWh		CAN cents per kWh
85	Regina	13.15	85	Detroit	12.91	85	Patterson	9.56
86	Cedar Rapids	13.20	86	Gary	13.00	86	Columbus OH	9.65
87	Grand Rapids	13.28	87	Anchorage	13.13	87	St. John's	9.82
88	Columbus OH	13.35	88	Springfield IL	13.17	88	Jacksonville	9.83
89	Columbia	13.44	89	Edmonton	13.25	89	Portland, ME	9.84
90	Edmonton	13.90	90	Cheyenne	13.33	90	Detroit	10.00
91	Wilmington	13.95	91	Atlanta	13.34	91	Madison	10.00
92	Portland, ME	13.96	92	Columbus GA	13.34	92	Anchorage	10.27
93	Buffalo	14.00	93	Savannah	13.34	93	Washington DC	10.29
94	Los Angeles	14.27	94	Madison	13.41	94	Baltimore	10.43
95	Pawtucket	14.43	95	Washington DC	13.50	95	Ottawa	10.59
96	Cambridge	14.74	96	Columbus OH	13.61	96	Springfield IL	10.60
97	Calgary	14.81	97	Los Angeles	13.77	97	Pueblo	10.85
98	Charlottetown	14.87	98	Phoenix	13.80	98	Los Angeles	10.94
99	Evansville	14.92	99	Pueblo	13.92	99	Moncton	10.98
100	Madison	15.08	100	Cambridge	14.27	100	Cambridge	11.15
101	Waterbury	15.15	101	Wilmington	14.38	101	Wilmington	11.29
102	Philadelphia	15.21	102	Halifax	14.85	102	Toronto	11.85
103	Pittsburgh	15.26	103	Pawtucket	15.54	103	Pawtucket	12.35
104	Halifax	15.45	104	Charlottetown	15.54	104	Waterbury	12.38
105	Pueblo	15.45	105	Springfield MA	15.78	105	Halifax	12.44
106	Detroit	15.54	106	Waterbury	15.79	106	Manchester	12.71
107	Burlington	15.59	107	Newark	15.86	107	Charlottetown	12.87
108	Springfield MA	16.31	108	Patterson	15.86	108	Burlington	13.26
109	Manchester	16.44	109	Manchester	16.22	109	San Diego	13.36
110	Boston	16.50	110	Bridgeport	16.27	110	Springfield MA	14.04
111	Newark	16.56	111	New Haven	16.27	111	San Francisco	14.09
112	Patterson	16.56	112	Calgary	16.93	112	Bridgeport	14.11
113	Bridgeport	19.27	113	Burlington	17.29	113	New Haven	14.11
114	New Haven	19.27	114	Boston	17.57	114	Boston	14.15
115	Hampstead	20.61	115	San Francisco	17.79	115	Calgary	15.27
116	New York	21.75	116	Hampstead	18.46	116	New York	15.58
117	San Diego	22.40	117	San Diego	18.47	117	Hampstead	15.95
118	San Francisco	22.94	118	New York	19.70	118	Edmonton	17.92
119	Honolulu	32.36	119	Honolulu	31.05	119	Honolulu	28.25
	Arithmetic mean	12.12		Arithmetic mean	11.58		Arithmetic mean	8.92
	Standard deviation	3.65		Standard deviation	3.39		Standard deviation	3.19

Note: Cities above the red lines have prices that are at least one standard deviation less than the average price; cities below the black lines have prices that are at least one standard deviation greater than the average price.

Sources: Hydro-Quebec (2013); Lincoln Nebraska Electric System (2013); calculations by authors.

Table 2 illustrates how residential electricity costs per kWh in the 12 Canadian cities alone compare, according to the Hydro-Quebec Survey. The average cost in these cities, at 12.07 cents per kWh, is just slightly less than the average for all 119 cities in the two surveys. The four Canadian cities with the lowest electricity costs per kWh are top-ranked Montreal, 4th ranked Winnipeg, 12th ranked Vancouver and 72nd place Moncton. Those with the highest costs per kWh of electricity consumed are 104th ranked Halifax, 98th ranked Charlottetown, 97th ranked Calgary and 90th place Edmonton.[7] Costs in both Montreal and Winnipeg are more than one standard deviation below the average below for all cities. No Canadian city has residential electricity costs per kWh that are one standard deviation greater than the average for all cities.

Table 2: Comparison of residential electricity costs per kWh in Canadian cities, 2013

	Costs to residential customers (Monthly consumption of 1000 kWh)	
		CAN cents per kWh
1	Montreal	6.87
2	Winnipeg	7.63
3	Vancouver	8.91
4	Moncton	11.82
5	Ottawa	12.39
6	Toronto	12.48
7	St. John's	12.55
8	Regina	13.15
9	Edmonton	13.90
10	Calgary	14.81
11	Charlottetown	14.87
12	Halifax	15.45
	Arithmetic mean	12.07

Sources: Hydro-Quebec (2013); calculations by authors.

7. These findings with respect to Canada are corroborated by the survey of Canadian cities' electricity costs undertaken by Manitoba Hydro with regard to costs applicable to this class of customers as of May 1, 2013 (Manitoba Hydro, 2013). While some minor differences were indicated in the case of Toronto, Winnipeg, Edmonton, and Calgary, the overall findings are closely similar. Again, it is worth noting that the Hydro-Quebec study may not accurately reflect the actual differential in the all-in delivered cost of electricity with regard to Alberta jurisdictions. See footnote 1 and Appendix 1 for additional information.

2. Small commercial consumer costs

The average cost of electricity consumed by small commercial customers in the 119 cities surveyed is 11.58 cents per kWh, only slightly less than that for the residential customer rate class. As with residential costs, several cities have costs that are much lower than this, while others have much higher costs. Again the spread between the cost in the city with the lowest cost (Tulsa at 6.23 cents per kWh) and the two cities with the highest costs, Honolulu at 31.05 cents per kWh and New York at 19.70 cents, is vast. 29 of the 119 cities have costs that are either one standard deviation less or greater than the mean.

At the lower end of the scale, where 12 cities' costs per kWh are more than a single standard deviation (3.39 cents per kWh) less than the average cost for all 119 cities, top-ranked Tulsa and second place Boise both have costs about 1.5 times the standard deviation less than the mean. The costs of the 10 other cities in this group vary much less from the average.

At the upper end, 17 cities' costs per kWh are more than one standard deviation greater than the mean. As with the residential costs, those cities with costs with the greatest differentials from the mean are outlier Honolulu (5.7 standard deviations) and several New York State and California cities. New York City's cost for this commercial customer class, for example, is about 2.4 standard deviations greater than the average cost for all 119 cities and the costs in San Diego and Hampstead, NY are about two standard deviations greater.

Only four of the 12 Canadian cities included have costs per kWh for this class of customer that are less than the average for all 119 cities: Winnipeg, Montreal, Vancouver, and Regina. **Table 3** shows how the costs per kWh compare among just the 12 Canadian cities surveyed by Hydro-Quebec.

At 12.27 cents per kWh, the average cost is 0.69 cents per kWh higher than the average for all 119 cities. Winnipeg, Montreal, Vancouver, Regina, and Ottawa have lower costs than the Canadian average but, except for Winnipeg, the costs in all five locations are considerably above the average cost of 6.91 cents per kWh in the five cities (of 119) with the lowest costs. Seven cities have higher costs than the Canadian average with Calgary, Charlottetown, Halifax, and Edmonton standing out. All four locations are among the group of 21 (of 119) having the highest costs.[8]

Only one Canadian city, Winnipeg, has a commercial customer class cost which is more than one standard deviation less than the average for all 119 cities. At the upper end of the scale, the costs for two cities—Charlottetown and Calgary—are more than a single standard deviation greater than the mean cost.

8. Again, it is worth noting that the Hydro-Quebec study may not accurately reflect the actual differential in the all-in delivered cost of electricity with regard to Alberta jurisdictions. See footnote 1 and Appendix 1 for additional information.

Table 3: Comparison of commercial electricity costs per kWh in Canadian cities, 2013

	Costs to commercial customers Monthly consumption of 10,000 kWh	
		CAN cents per kWh
1	Winnipeg	7.48
2	Montreal	9.05
3	Vancouver	9.60
4	Regina	10.82
5	Ottawa	12.26
6	Toronto	12.40
7	Moncton	12.46
8	St. John's	12.58
9	Edmonton	13.25
10	Halifax	14.85
11	Charlottetown	15.54
12	Calgary	16.93
	Arithmetic mean	12.27

Sources: Hydro-Quebec (2013); calculations by authors.

3. Small industrial consumer costs

As indicated in table 1, the average cost for the small industrial electricity customer class (demand of 1,000 kW with monthly consumption of 400,000 kWh) in the 119 cities surveyed is 8.92 cents per kWh. This is considerably less than the vicinity of 12 cents per kWh observed in the case of the two other rate classes compared. This most likely reflects strategic decisions on the part of governments and regulators to assign lower electric power rates to large volume customers because of economic development considerations and strategies. Only three of the 12 Canadian jurisdictions have costs per kWh applicable to this customer class that are less than the overall average: Winnipeg, Vancouver, and Montreal. Reasons why those cities fare better when it comes to electricity costs than their Canadian peers are examined in the following sections.

While the average cost for this customer class is significantly less than those for the two other classes examined, the differential between the lowest cost (a remarkable 4.01 cents per kWh in Tulsa) and the highest rate (Honolulu at 28.25 cents per kWh) is about as large as in the other cases. Consequently, the standard deviation (3.19 cents per kWh) is only 20 cents per kWh less than that for the small commercial customer class.

Eight cities have costs that are greater than a single standard deviation less than the average cost for all 119 cities. Top-ranked Tulsa's cost per kWh is about 1.5 standard deviations less than the mean, while second place Des Moines' cost is about 1.3 standard deviations lower.

At the upper end of the range, where 17 cities' costs are more than a single standard deviation greater than the mean, there are some large differentials compared with the average. Honolulu is an even greater outlier than in the two other customer classes examined, with a cost per kWh more than six standard deviations above the mean. Edmonton's cost is about 2.8 standard deviations greater than the average and New York's is about two standard deviations greater. The costs for Hampstead, NY and Calgary are also about two standard deviations above the mean. The differences between the small industrial class costs for each of the 12 other cities in this group of 17 and the average cost fall between 1 and 1.6 standard deviations.

Table 4 illustrates the costs for the 12 Canadian cities alone. Their average cost of 10.97 cents per kWh is 2.05 cents per kWh greater than for all 119 cities ranked. Six Canadian cities have costs lower than the Canadian average. The highest Canadian costs are in 118th ranked (of 119) Edmonton, 115th ranked Calgary, 107th ranked Charlottetown and 105th place Halifax.[9]

Of interest is the fact that not a single Canadian city is represented in the group of eight cities whose costs for this customer class are more than one standard deviation less than the average for all 119 cities compared. On the other hand, four of the 12 Canadian cities have costs that are more than a single standard deviation above the mean.

Table 4: Comparison of industrial electricity costs per kWh in Canadian cities, 2013

Costs to industrial customers
Monthly consumption of 400,000 kWh

		CAN cents per kWh
1	Winnipeg	5.76
2	Vancouver	7.23
3	Montreal	7.38
4	Regina	9.53
5	St. John's	9.82
6	Ottawa	10.59
7	Moncton	10.98
8	Toronto	11.85
9	Halifax	12.44
10	Charlottetown	12.87
11	Calgary	15.27
12	Edmonton	17.92
	Arithmetic mean	10.97

Sources: Hydro-Quebec (2013); calculations by authors.

9. Again, it is worth noting that the Hydro-Quebec study may not reflect the actual differential in the all-in delivered cost of electricity accurately with regard to Alberta jurisdictions. See footnote 1 and Appendix 1 for additional information.

Reasons for the differences in costs

In this section we discuss a number of possible reasons why electricity costs are higher or lower in some cities than others. Ideally, multivariate statistical analysis—which would simultaneously determine the contribution of each factor to electricity costs while taking other factors into account—would have been helpful. However, where appropriate, reference is made to the results of statistical tests undertaken to determine whether the differences in the arithmetic means of costs between two groups such as cities in coal-intensive states/provinces, on the one hand, and in non-coal intensive jurisdictions, on the other, are "significant." That is, the tests indicate whether the difference in the means is the result of random occurrences or survey sampling errors, thereby implying that there is no fundamental difference between the two data sets, or a consequence of fundamental factors such as the availability of relatively low-cost coal-fired electric generation in one group of cities but not in the other.[10]

1. Differences between customer classes

The ranking of cities according to their electricity costs is essentially the same for each of the three customer classes. However, the rankings do not precisely conform. The fact that there are differences in the rankings according to customer type reflects the fact that regulators (and politicians) in the various states and provinces have somewhat different perspectives as to the portions of the overall cost of electricity generated in their respective regions that the various kinds of customers (e.g., residential, commercial, and industrial) should bear.

10. In order to test whether differences in mean values were statistically significant, P-values and t-values were calculated for the data sets being compared. At the 95 percent confidence level, if P-values were found to be less than 0.05, the null hypothesis that the difference was due solely to random factors—i.e., that there was no fundamental difference in the two data sets involved and that they could have come from essentially the same population—was rejected, and it was concluded that the difference was statistically significant.

Residential electricity costs are frequently the focus of much debate leading up to and during provincial and state elections and, as in the October 7, 2013 Nova Scotia election, can be a key issue (Alberstat, 2013). But competition among jurisdictions to attract commercial and industrial investors also gives rise to political pressures, as businesses lobby to maintain or obtain competitive advantages vis-à-vis businesses in neighboring states or provinces. And governments themselves sometimes have policies which require that industrial customers in their jurisdiction have cost advantages over competitors which result in residential and/or commercial customers having to bear a larger share of the burden than otherwise. In Canada, for example, comparison of residential and industrial costs per kWh in Vancouver, Winnipeg, Regina, and cities in the Atlantic Provinces indicates that residential consumers in those locations appear to be subsidizing large industrial consumers. But commercial consumers are faced with even higher costs than residential electricity consumers in Montreal, Vancouver, Moncton, and Charlottetown, thereby subsidizing industrial class consumers to an even greater extent.

2. Availability of developed hydroelectric resources

Because of their low fuel costs, one might expect jurisdictions in which the hydroelectric share of electric generation capacity is particularly large to be in a position to provide lower-cost electricity than other jurisdictions. And this would be most likely if most of the hydro facilities were built when capital costs were considerably less than they are today, the average size of those facilities were relatively large so as to provide economies of scale, and most of the site locations were not so remote as to result in transmission costs that offset the relatively low electric generation cost compared to other sources.

Table 5 provides a comparison of electric generation capacity by type in the various Canadian provinces. This demonstrates that hydroelectric capacity is dominant in Newfoundland and Labrador, Quebec, Manitoba, and British Columbia. It is therefore not surprising that, for all three customer classes compared, electricity costs are lowest in those Canadian cities included in table 1 which are located in Quebec (Montreal), Manitoba (Winnipeg), and British Columbia (Vancouver).

St. John's, Newfoundland does not fare so well. This is mainly because about 80 percent of Newfoundland and Labrador's hydro capacity is embodied in the 5,428 MW Churchill Falls facility in Labrador, from which electricity is sold to Hydro-Quebec under the terms of a long-term agreement, and is not available to electricity consumers on the island of Newfoundland (including St. John's) where most of the population of the province resides. Investor-owned Newfoundland Power, from which the cost information with regard to the St. John's electricity customer classes was obtained for the

Table 5: Canadian electric generation capacity by type and province (megawatts and % share of provincial total), 2013

	Fossil fuel combustion		Nuclear		Hydro		Wind		Other		Total
	MW	*%*	*MW*	*%*	*MW*	*%*	*MW*	*%*	*MW*	*%*	*MW*
Newfoundland & Labrador*	585	7.9	0	0.0	6,781	91.4	54	0.7	0	0.0	7,420
Prince Edward Island	117	41.6	0	0.0	0	0.0	164	58.4	0	0.0	281
Nova Scotia	2,006	74.8	0	0.0	376	14.0	281	10.5	20	0.7	2,683
New Brunswick**	2,849	72.1	0	0.0	951	24.1	150	3.8	0	0.0	3,950
Quebec***	1,822	4.4	675	1.6	38,196	92.0	817	2.0	0	0.0	41,510
Ontario	13,877	38.4	11,990	33.2	8,408	23.3	1,742	4.8	143	0.4	36,160
Manitoba	501	8.9	0	0.0	5,054	89.3	104	1.8	0	0.0	5,659
Saskatchewan	3,177	75.6	0	0.0	856	20.4	171	4.1	0	0.0	4,204
Alberta	10,845	85.9	0	0.0	887	7.0	890	7.1	0	0.0	12,622
British Columbia	1,288	8.5	0	0.0	13,745	90.8	103	0.7	0	0.0	15,136

Notes: * 5,428 MW of the 6781hydro capacity is from the Churchill Falls Facility in Labrador, which is not available to the island of Newfoundland.

** Excludes the 680 MW (gross) Point Lepreau nuclear plant that was returned to service in late 2012.

*** Includes the 675 MW Gentilly II nuclear plant that is being dismantled.

Source: Statistics Canada CANSIM Table 127-0009.

Hydro-Quebec study, purchases 90 percent of its electricity requirements from Crown-owned Newfoundland and Labrador Hydro and generates most of the balance from an array of smaller hydroelectric stations (Newfoundland Power, 2013). Newfoundland and Labrador Hydro itself has nine hydroelectric plants and several fossil fuel combustion generation facilities (Newfoundland and Labrador, 2013). The relatively small hydro facilities on the island of Newfoundland do not benefit from the economies of scale inherent in the large hydro plants in Quebec, Manitoba, Winnipeg, British Columbia, and Labrador's Churchill Falls.

Although Ontario's hydroelectric capacity is less than its fossil fuel combustion and nuclear capacity, the fact that it is nevertheless quite significant (23 percent of total capacity) may help to explain why cities in that province (Ottawa and Toronto) have costs per kWh that are less than those of cities in provinces other than hydro-rich Quebec, Manitoba, and British Columbia.

Table 6 shows electric generation capacity by type by US state and the District of Columbia. From the table, it is apparent that hydroelectric capacity is the dominant form of capacity in Washington (69 percent), Idaho (64 percent), Oregon (58 percent) and South Dakota (42 percent).[11] Hydro is also dominant in Montana, although its 45 percent share of total generation capacity in that state is just a bit greater than coal-fired capacity's 41 percent.[12] Other things equal, this suggests that if the hypothesis that an abundance of hydroelectric supply contributes to low electricity prices holds weight, cities in Washington, Idaho, Oregon, and South Dakota, and perhaps in Montana, should perform well relative to many of the other cities whose costs per kWh are provided in table 1.[13]

In fact, this appears to be the case. In the residential customer cost comparison, all eight of the US cities located in the states with large endowments of developed hydroelectric capacity have lower costs than 51 of the 107 US cities included in the 119-city comparison. In fact, four of the eight (Tacoma, WA, Spokane, WA, Boise, ID, and Seattle) are positioned among the group of 15 cities with the lowest residential electricity costs. Eugene, OR ranks 22nd, Portland, OR, 48th, Billings, MT, 52nd and Sioux Falls, SD, 59th.

In the small commercial customer cost comparison, three of the five cities with lowest costs are from the hydro rich states of Idaho and Washington: Boise, Tacoma, and Seattle. Eugene has the 12th lowest rate (of 119), Portland, OR, the 42nd lowest, and Sioux Falls, SD the 43rd lowest. Billings, MT, where hydro is also an important source of electricity, yet neck and neck with coal, sits in the 60^{sth} position (of 119). Spokane fell in 68th place.

In the small industrial customer cost comparison the results are also supportive of the hypothesis that an abundance of hydro capacity is conducive to low electricity costs, though not quite as overwhelming. In this case, as in the residential cost comparison, four of the eight cities in states with

11. In this study, "dominant" is generally used to indicate not only the greatest type of electric generation capacity that is available but also that the kind of capacity identified is significantly greater than the other kinds of capacity that are available in the same jurisdiction.

12. Where two or more sources of electricity in the same state represent approximately the same shares of total capacity, the state is highlighted in purple in the table.

13. This, however, is without regard to the age of the hydro facilities. Facilities that are older than, say, 20 years most likely cost considerably less per unit of capacity than hydro facilities built within the last 10 years. The older the average age of the hydro fleet, the lower the depreciation charge per unit of output is likely to be and hence also the cost. But this also means that the state (or provincial) hydroelectric system may be facing considerable maintenance costs, as in British Columbia. A detailed examination of the vintage of hydro facilities in the various hydro-rich jurisdictions would help to explain why some have a cost advantage relative to others and, therefore, are better positioned to support lower costs to consumers.

Table 6: US summer electric generation capacity by type and jurisdiction (megawatts and % share of state total), 2011

	Natural gas		Coal		Nuclear		Hydro		Petroleum		Wind		Other	Total
	MW	*%*	*MW*	*%*	*MW*	*%*	*MW*	*%*	*MW*	*%*	*MW*	*%*	*MW*	*MW*
AK	838	40.5	111	5.4	0	0.0	415	20.1	669	32.4	7	0.3	27	2,067
AL	12,073	37.1	11,457	35.2	5,043	15.5	3,272	10.0	43	0.1	0	0.0	689	32,577
AR	7,882	49.4	4,535	28.4	1,823	11.4	1,341	8.4	22	0.1	0	0.0	354	15,957
AZ	13,548	50.1	6,225	23.0	3,937	14.6	2,720	10.1	93	0.3	138	0.5	382	27,043
CA	41,274	60.4	411	0.6	4,390	6.4	10,136	14.8	517	0.8	**3,770**	**5.5**	7,797	68,295
CO	5,283	37.3	5,596	39.5	0	0.0	662	4.7	178	1.3	**1,793**	**12.6**	670	14,182
CT	2,925	32.0	564	6.2	2,103	23.0	122	1.3	3,185	34.9	0	0.0	233	9,132
DC	10	1.3	0	0.0	0	0.0	0	0.0	790	98.8	0	0.0	0	800
DE	2,295	68.3	794	23.6	0	0.0	0	0.0	113	3.4	2	0.1	155	3,359
FL	33,332	55.9	10,204	17.1	3,924	6.6	55	0.1	10,672	17.9	0	0.0	1,440	59,627
GA	14,263	38.4	12,988	35.0	4,061	10.9	2,049	5.5	1,251	3.4	0	0.0	2,502	37,114
HI	0	0.0	180	7.0	0	0.0	24	0.9	2,000	78.1	92	3.6	266	2,562
IA	2,343	15.3	6,935	45.4	601	3.9	144	0.9	1,047	6.8	**4,203**	**27.5**	15	15,288
ID	812	19.1	17	0.4	0	0.0	2,704	63.5	5	0.1	**611**	**14.4**	106	4,255
IL	13,578	31.0	14,857	33.9	11,486	26.2	34	0.1	887	2.0	**2,737**	**6.2**	251	43,830
IN	5,646	20.6	18,949	69.1	0	0.0	60	0.2	450	1.6	1,340	4.9	959	27,404
KS	4,568	35.8	5,188	40.7	1,175	9.2	3	0.0	545	4.3	**1,272**	**10.0**	7	12,758
KY	4,864	23.0	15,290	72.4	0	0.0	822	3.9	70	0.3	0	0.0	68	21,114
LA	18,889	72.1	3,424	13.1	2,133	8.1	192	0.7	994	3.8	0	0.0	566	26,198
MA	5,971	43.9	1,560	11.5	685	5.0	263	1.9	3,107	22.8	30	0.2	1,985	13,601
MD	2,043	16.2	4,896	38.9	1,705	13.6	590	4.7	2,933	23.3	120	1.0	296	12,583
ME	1,645	36.6	85	1.9	0	0.0	742	16.5	1,007	22.4	**323**	**7.2**	691	4,493
MI	11,028	36.9	11,347	37.9	3,957	13.2	238	0.8	639	2.1	375	1.3	2,318	29,902
MN	4,880	32.2	4,710	31.1	1,594	10.5	197	1.3	813	5.4	**2,576**	**17.0**	392	15,162
MO	5,525	25.0	12,425	56.3	1,190	5.4	570	2.6	1,218	5.5	459	2.1	674	22,061
MS	11,552	74.3	2,526	16.3	1,190	7.7	0	0.0	35	0.2	0	0.0	240	15,543
MT	376	6.2	2,442	40.6	0	0.0	2,725	45.3	54	0.9	**378**	**6.3**	45	6,020
NC	8,026	28.2	12,251	43.0	4,970	17.5	1,964	6.9	544	1.9	0	0.0	704	28,459
ND	10	0.2	4,147	67.1	0	0.0	508	8.2	72	1.2	**1,423**	**23.0**	24	6,184
NE	1,784	21.8	4,160	50.9	1,245	15.2	278	3.4	363	4.4	333	4.1	11	8,174
NH	1,207	28.9	546	13.1	1,246	29.9	493	11.8	499	12.0	24	0.6	159	4,174
NJ	10,093	54.9	2,001	10.9	4,113	22.4	5	0.0	1,381	7.5	8	0.0	773	18,374
NM	3,291	39.9	3,990	48.3	0	0.0	83	1.0	4	0.0	**750**	**9.1**	136	8,254
NV	7,255	62.3	2,873	24.7	0	0.0	1,051	9.0	11	0.1	0	0.0	456	11,646
NY	18,809	47.5	2,813	7.1	5,219	13.2	4,319	10.9	5,161	13.0	1,399	3.5	1,909	39,629
OH	8,244	24.8	21,251	63.9	2,134	6.4	102	0.3	1,030	3.1	160	0.5	359	33,280
OK	13,445	61.6	5,307	24.3	0	0.0	858	3.9	69	0.3	**1,811**	**8.3**	334	21,824
OR	3,042	20.9	585	4.0	0	0.0	8,420	57.9	0	0.0	**2,208**	**15.2**	280	14,535
PA	10,055	21.9	18,068	39.4	9,642	21.0	760	1.7	4,325	9.4	789	1.7	2,178	45,817
RI	1,735	97.5	0	0.0	0	0.0	3	0.2	16	0.9	2	0.1	23	1,779
SC	5,329	22.1	7,258	30.1	6,486	26.9	1,337	5.6	668	2.8	0	0.0	3,003	24,081
SD	661	17.6	497	13.2	0	0.0	1,594	42.4	228	6.1	**780**	**20.7**	0	3,760
TN	4,654	22.0	8,581	40.6	3,401	16.1	2,616	12.4	40	0.2	29	0.1	1,807	21,128
TX	68,860	63.1	23,180	21.2	4,960	4.5	689	0.6	208	0.2	**10,361**	**9.5**	921	109,179
UT	2,015	26.5	4,903	64.4	0	0.0	255	3.3	28	0.4	324	4.3	88	7,613
VA	8,163	33.1	5,848	23.7	3,539	14.3	866	3.5	2,370	9.6	0	0.0	3,899	24,685
VT	0	0.0	0	0.0	620	52.9	324	27.7	101	8.6	45	3.8	81	1,171
WA	3,828	12.5	1,340	4.4	1,097	3.6	21,067	69.1	15	0.0	**2,454**	**8.0**	706	30,507
WI	6,084	33.2	8,405	45.9	1,750	9.6	388	2.1	722	3.9	612	3.3	340	18,301
WV	1,044	6.0	15,441	89.0	0	0.0	285	1.6	11	0.1	528	3.0	33	17,342
WY	120	1.4	6,482	76.9	0	0.0	307	3.6	6	0.1	**1,412**	**16.7**	104	8,431

Note: States are highlighted according to the dominant type of electric generation as follows:

Gas Coal Nuclear Hydro Petroleum No single technology dominant

Where wind capacity exceeds five percent it is boldfaced.

Source: EIA (2013a).

large developed hydro resources have costs that are among those of the 14 cities (of 119) with the lowest costs. These include Boise, Tacoma, Seattle, and Eugene, of which Boise and Tacoma rank third and 4th, respectively. Portland, OR, Billings, Sioux Falls and Spokane rank 45th, 46th, 48th and 55th, respectively.

Looking at all (i.e., both Canadian and US) cities listed in table 1, in the residential cost comparison seven of the 12 cities from provinces and states with dominant hydroelectric capacity shares (including Newfoundland and Labrador) are among the group of 15 cities that have the lowest costs.[14] In both the small commercial and small industrial customer class comparisons, five of the 12 cities from hydro-rich provinces and states show up among the 15 with the best (lowest) costs.

The coefficient of correlation between the cities' residential costs and the hydro share of electricity produced in the corresponding jurisdictions, although small (0.19), is negative. This suggests, at least, that in jurisdictions where the hydro share of the electricity that is produced is relatively high, cities are somewhat likely to have relatively low electricity costs.

The difference between the mean residential cost of 8.91 cents per kWh for the 11 cities in hydro dominant jurisdictions (based on the hydro share of conventional capacity in the Canadian provinces, US states, and Washington, DC) and the mean residential cost of 12.26 cents per kWh in the other 107 cities (Honolulu excluded) was found to be very significant according to the statistical tests.[15] This supports the view that residential electricity costs in cities located in jurisdictions where hydro is the dominant source of supply might be expected to be lower, in general, than costs in other cities. The results for the difference of means test undertaken with respect to both the small commercial and small industrial cost classes were similar.[16]

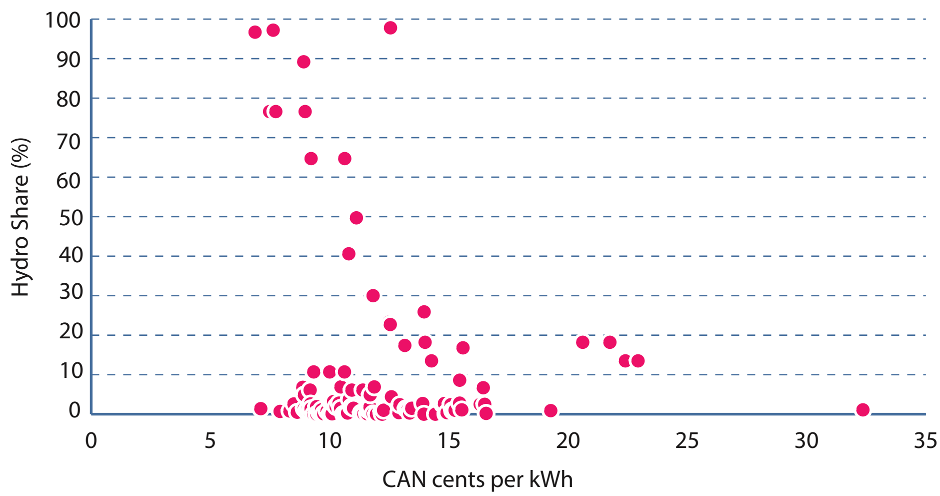
As explained above, these difference of means tests were based on groups differentiated according to whether or not developed hydro capacity was dominant in the various jurisdictions. In 2012, hydroelectric generation was the major source of electricity produced in all of the hydro capacity dominant states and provinces except Montana, where coal-fired facilities were the source of 50.3 percent of electricity production and hydroelectric facilities only 40.6 percent (EIA, 2013b). When Billings, MT was excluded from the group of cities identified as being in hydro dominant states and the difference

14. The eight US cities already noted plus St. John's, Montreal, Winnipeg, and Vancouver.
15. St. John's, NL was excluded from the group of hydro cities because its electricity comes from a collection of mainly small hydro facilities and fossil fuel plants.
16. For the small commercial rate class the mean cost was 8.83 cents per kWh for the 11 "hydro" cities compared with 11.69 cents per kWh for the other 107 cities (Honolulu excluded). For the small industrial rate class the corresponding mean costs were 6.64 cents per kWh and 8.97 cents per kWh.

of means tests were repeated, the differences in the means continued to be statistically significant for each of the customer class cases.

Figure 1 illustrates the relationship between residential electricity costs in the cities surveyed and hydro's share of electricity production in the respective jurisdictions.

Figure 1: Hydro shares of electricity production and residential electricity costs in cities surveyed



Sources: Hydro-Quebec (2013); Lincoln Nebraska Electric System (2013); EIA (2013b); calculations by authors.

3. Substantial reliance on coal-fired electric generation

In the preceding section it was noted that cities in jurisdictions where hydro-electric generation capacity is the major source of electricity tend to benefit from low electricity costs. Here, we investigate whether this might also be true where coal-fired electricity is the dominant supply source.

Table 5 indicates that, in Canada, fossil fuel combustion is the major type of electric generation capacity in Nova Scotia, New Brunswick, Saskatchewan, and Alberta and an important source of supply, along with nuclear power, in Ontario. However coal-fired thermal plants only dominate the electric generation capacity mix in Saskatchewan where they constitute 48 percent of SaskPower's generation capacity, compared with 24 percent for hydro, 23 percent for natural gas, and 5 percent for wind (SaskPower, 2013).

The combined capacity of Nova Scotia Power's generating stations at Trenton, Point Tupper, Lingan, and Point Aconi, which rely on mixtures of coal, petroleum coke, and/or heavy fuel oil for their fuel source, is 1,247 MW. This constitutes almost 52 percent of the generation capacity that Nova Scotia Power either owns or for which it has contractual supply relationships with independent power producers (Nova Scotia Power, 2013a, 2013b). But since coal is just one of the three fuels that are used in the four plants, coal does not appear to be the dominant source of electricity in the province.

In Alberta, where coal and natural gas fired plants represent, respectively, 38.1 percent and 38.8 percent of total generation capacity, significantly more electricity is still being produced from coal plants each year than from natural gas combustion (Alberta Energy, 2014; National Energy Board, 2013)). In Ontario, where coal is being phased out as an electricity supply source, coal-fired generation capacity's nine percent share is dwarfed by nuclear capacity (36 percent), natural gas (28 percent), and hydro (22 percent) (Ontario Independent Electric System Operator, 2013). While NB Power's Belledune coal station is relatively large (458 MW), the province's fossil fuel combustion capacity is dominated by fuel oil, diesel, and natural gas-fired plants owned by NB Power, Emera Inc., and TransCanada Corp. (NB Power, 2013; Wikipedia, 2013).

As indicated in table 6, in the United States coal is the dominant type of electric generation capacity in 14 states: Iowa, Indiana, Kentucky, Maryland, Missouri, North Carolina, North Dakota, Nebraska, Ohio, Pennsylvania, Tennessee, Utah, West Virginia, and Wyoming. As anticipated, coal combustion was the leading in-state source of electricity in each of these states in 2012. But coal facilities also represented the largest share of electricity produced in nine other states: Arkansas, Arizona, Colorado, Kansas, Michigan, Minnesota, Montana, New Mexico, and Wisconsin. In each of these states, coal-fired generation led by a considerable margin—except in Montana, where hydro was a close second (EIA, 2013b).

To understand whether the 53 cities in the surveys located in the 23 US states and two Canadian provinces (Alberta and Saskatchewan) where coal-fired generation facilities were the leading producer of electricity in 2012 may be benefiting, on average, from relatively low electricity costs, we compared costs for those cities with those for all other cities (excluding outlier Honolulu) for each of the three types of customers.

With regard to the residential customer rate classification, 25 of the 53 cities in jurisdictions where coal is the major source of electricity production have electricity costs among the group of 50 cities (of 119) with the lowest costs. Further, only 17 are in the group of 50 cities with the highest costs. The average cost for the group of 53 cities is 11.33 cents per kWh. This is nearly 9 percent less than the 12.44 cent per kWh average cost for the other 65 cities listed in table 1 (excluding Honolulu).

In the small commercial customer rate class example, 23 of the 53 cities located in jurisdictions where coal is the leading in-state or -province source of electricity are among the group of 50 cities with the lowest costs, while only 16 are among the group of 50 with the highest costs. The average cost for the 53 cities in jurisdictions where coal combustion is the major source of electricity is 10.66 cents per kWh. That is 1.37 cents per kWh (11.4 percent), less than the average cost of 12.03 cents per kWh in the other 65 cities (Honolulu excluded).

In the small industrial rate class case, 27 of the 53 "coal" cities are among the 50 cities in the overall group with the lowest electricity costs while, again, only 16 are among the 50 cities with the highest costs. The average cost for the 53 cities in jurisdictions where coal is the major source of electricity of electric generation is 8.10 cents per kWh. This is 12.9 percent less than the average cost of 9.29 cents per kWh in the remaining 65 cities (excluding Honolulu).

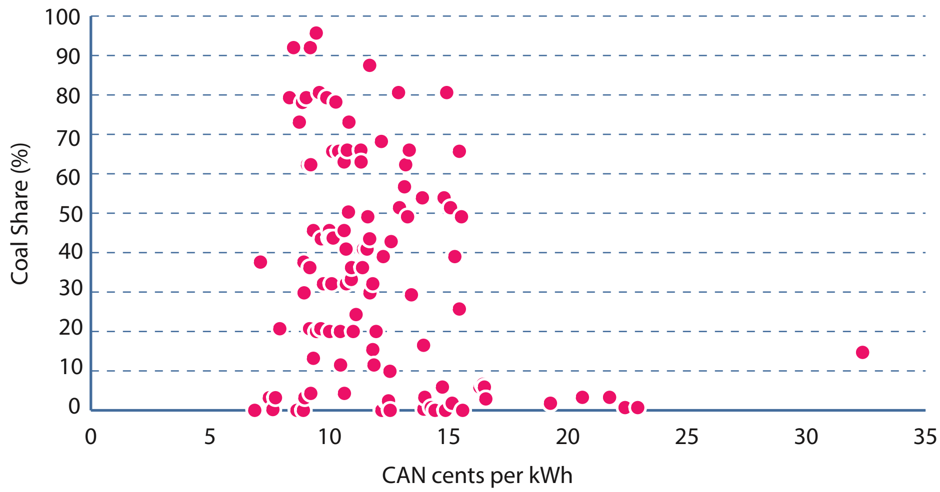
A priori, one might expect states in which coal-fired generation is dominant, and which also produce the greatest quantities of thermal coal, to benefit even more than coal-capacity-dominant states where coal production is much less. That is, one might expect that the four cities in the survey in Wyoming, West Virginia, and Kentucky—all very large coal producers—would stand out as having lower electricity costs than the 49 other "coal" cities. However, even though Lexington and Louisville are generally among the top performers, a number of the other "coal "cities have lower costs. Further, though competitive (among 32 cities with the lowest costs in all three rate class examples), Wheeling, WV is consistently outperformed by a number of other cities in jurisdictions where coal-fired electric generation is dominant. Cheyenne, WY varies in rank from 68^{th} (of 119) to 90^{th} (of 119), even though that state is by far America's largest coal producer.

By way of summary, the foregoing analysis appears to indicate that cities which are located in jurisdictions where coal-fired generation is the major source of electricity may be in a position to offer lower electricity costs than many of the other cities whose rates are compared in the Hydro-Quebec and Lincoln Electric System surveys. To some degree, this argument is supported by the estimated value of the coefficient of correlation with regard to residential electricity rates in the 119 cities and the coal-fired power generation share of the electricity produced in the states and provinces where the cities are located. While it is rather low (0.31), the fact that the correlation coefficient is negative does suggest that one might expect costs to be relatively low in cities located in states or provinces where the share of electricity produced from steam sourced from coal combustion is relatively high.

For all three customer classes, the difference in the mean electricity cost between the group of cities located in jurisdictions where coal combustion is not the leading source of electricity production and cities in those states and provinces where coal-fired generation is the major source of the electricity produced was found to be statistically significant. That is, there is reason to believe that the differences in the average electricity costs between the two groups is not a random occurrence or the result of statistical error. In other words, reliance on electricity produced mainly from coal-fired generation facilities appears to explain why cities in some jurisdictions enjoy lower electricity costs than others.

The relationship between city electricity costs per kWh and the coal facility share of the electricity produced in the respective jurisdictions is illustrated in **figure 2**.[17]

Figure 2: Coal-fired generation shares of electricity production and residential electricity costs in cities surveyed



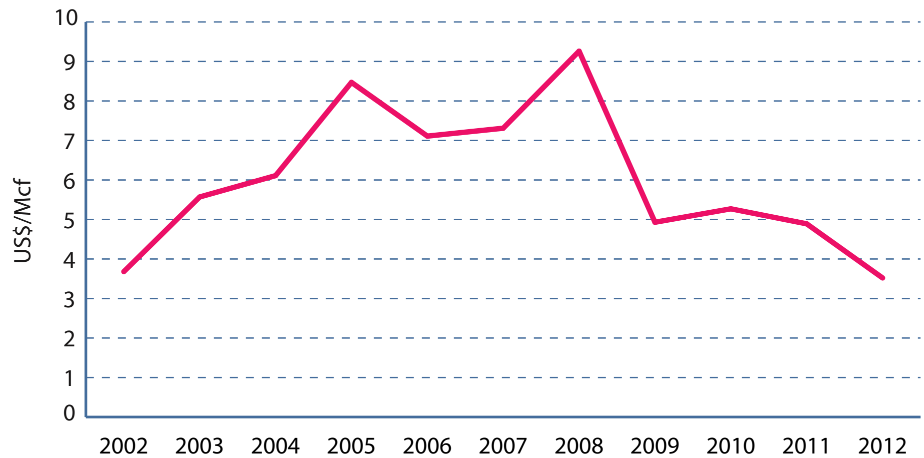
Sources: Hydro-Quebec (2013); Lincoln Nebraska Electric System (2013); EIA (2013b); calculations by authors.

4. Natural gas

Figure 3 illustrates that the implied price of natural gas paid by US power generators was lower during 2012, on average, than at any other time during the previous decade.[18] The 2012 gas price of $3.52 per thousand cubic feet (Mcf) was clearly much lower than in 2008 when the price averaged $9.26 per Mcf. This suggests, at least, that cities located in jurisdictions where natural gas combustion is a major source of electricity may have been in a pos-

17. For Canada, the 2012 electricity production shares by province for coal-fired combustion and other electric generation technologies were derived from data published by the National Energy Board (NEB, 2013). Corresponding data for US states and the District of Columbia was calculated from Energy Information Administration data (EIA, 2013b).
18. This data is calculated by the US Energy Information Administration from information collected via EIA Form 923 regarding the volume and cost of fuel purchased by power plant operators. Review of the plant-by-plant information contained in the *Fuel Receipts and Cost Time Series File* produced by the EIA from Form 923 data for January 2012 indicates that most of the natural gas that is used for power generation is purchased on a contractual basis from gas producers and marketers.

Figure 3: Natural gas price paid by US electric power companies, 2002–2012



Source: EIA (2014).

ition to enjoy relatively low electricity costs when the 2013 Lincoln Electric System survey was undertaken, compared with cities in jurisdictions with little gas-fired capacity.

In order to test whether cities in jurisdictions with substantial gas-fired electric generation capacity might have a relative advantage in terms of electricity costs, we first identified the states and districts in which natural gas is either the dominant or a major form of electric generation capacity (table 6). Guided by that information, we then identified those states and districts where the natural gas share of electricity produced in 2012 was greater than any other single in-state source of supply (EIA, 2013b). Next, we assessed how electricity costs in the cities located in states where gas-fired generation was the largest kind of electricity production compared, on average, with those in the rest of the group of 119 cities.

In 2012, natural gas combustion was the major form of electricity generation in 13 US states: Alaska, California, Delaware, Florida, Louisiana, Maine, Massachusetts, Mississippi, Nevada, New York, Oklahoma, Rhode Island, and Texas. Gas also constituted the greatest share of electricity production in the District of Columbia. From the list of US cities surveyed we determined that 29 US cities are located in those jurisdictions.

From table 5 and investigation of the gas-share of electricity production in the Canadian provinces, we discovered that while natural gas is an important source of electricity in some cases, especially Alberta, it was not the major source of supply in that or any other province during 2012.

In the residential rate class example, two of the 29 cities in states where gas combustion is the major supply source are among the 10 cities (of 119) with lowest electricity costs and 12 of the 29 are among the 50 (of 119) with lowest costs. However, 17 of the 29 "gas" cities are among the 50 cities (of

119) with the highest costs. Moreover, the average cost for all 29 cities located in states where gas-fired generation is dominant, 13.06 cents per kWh, is 1.25 cents per kWh or 10.6 percent *greater* than the average cost for the 90 other cities in the survey. Tests indicated that the difference between the mean cost for the 29 cities in gas-dominant jurisdictions and the mean cost for all other cities (excluding Honolulu) is statistically significant. However, if Honolulu is included in the "other" group the difference between the mean values is not significant. For this reason it is not clear that the difference in average residential electricity costs in the two groups of cities is a reflection of gas-fired electricity being the major source of supply for cities in the one group, but not in the other.

In the small commercial customer rate class example, four of the 29 "gas" cities (Tulsa, Baton Rouge, Las Vegas, and Reno) are among the group of 10 cities (of 119) with the lowest costs. Also, 11 (of 29) are among the 50 (of 119) with the lowest costs. Yet 13 of the 29 cities in states where gas combustion is the major in-state source of electricity are among the 50 (of 119) cities with the highest costs. Moreover, the average cost for the 29 "gas" cities, at 12.15 cents per kWh, is 6.6 percent greater than the average cost for the 90 other cities. In this case, the difference between the mean costs in cities in the "gas" and "other" states (with or without outlier Honolulu included) was not statistically significant. That is, it could have occurred randomly. In other words, there appears to be no justification to distinguish between small commercial customer electricity costs in the two groups of cities on the basis of gas-fired generation being either the major or a lesser component of the electricity produced.

For the small industrial rate class the findings were similar. Four of the 29 cities located in states where gas-fired generation is the major form of production are among the 10 (of 119) cities with the lowest costs, and eight of the 29 are among the 50 (of 119) with the lowest costs. However, in this case, 16 of the 29 "gas" cities are among the 50 (of 119) cites with the highest costs. And the average cost for the group of 29 cities is 11.3 percent greater than that for the 90 other cities. With this rate class the difference of means test results were mixed as for residential costs: statistically significant (though mildly so) with Honolulu excluded from the "other" group, but not significant when Honolulu was included.

These mixed results indicate that being located in a state or district where natural gas combustion is the major form of electricity production does not guarantee that a city will have higher or lower than average electricity costs. While cities in some such states (e.g., Florida, Louisiana, Mississippi, Oklahoma, and Texas) are mostly among the group of 50 cities (of 119) with lowest costs for all 3 customer classes reviewed, cities in some states where gas-fired electric generation is very important generally have costs that are greater than average—and in some cases, as in California, Massachusetts, and New York, very much greater.

Several factors contribute to whether a state where gas-fired electric generation is dominant has relatively low electricity costs. One is the extent of the contribution made by competing sources of supply in the state, such as coal and hydro. Another is location. Oklahoma, Louisiana, and Texas, for example, are major producers and net exporters of natural gas. In gas-rich states such as these, the local price of gas is likely to be lower than in states that are net importers of gas such as New York and Massachusetts, where the delivered cost of gas includes significant transmission charges.

Another important factor is the extent to which gas-fired facilities are being relied upon to meet baseload and not merely peak demand requirements, as has traditionally been the case with gas combustion generation facilities. State-by-state electricity generation data for 2012 indicates that Delaware, Mississippi, and Nevada, for example, were relying on gas-fired generation to meet at least 70 percent of their total electricity production requirements (much more than New York), implying considerable utilization during non-peak periods (EIA, 2013b).

Another factor is a state's electricity supply mix since, in spite of having substantial quantities of relatively low-cost electricity from gas, electricity costs may be pulled up by high cost sources of electricity such as wind power, oil combustion, and pumped storage.[19] California and New York, for example, have significant dependence on wind power and pumped storage. Massachusetts is also burdened by significant pumped storage costs.

Another factor is the relative efficiency of the gas-fired power plants that are available. For example, single or simple cycle burners that only generate electricity via gas turbines are less efficient (require more gas per unit of electricity generated) than combined-cycle plants in which exhaust gases from a gas generator are cycled to a steam generator where they are used to generate additional electricity. States where state-of-the-art combined-cycle gas-fired plants are being built will be in a better position to take advantage of low gas prices.

19. Pumped storage is hydroelectric generation made possible by pumping water into reservoirs. Because the pumps themselves consume considerable volumes of costly fuels such as natural gas or diesel fuel, this non-conventional source of hydroelectric electricity is generally very costly. However, the availability of pumped storage to help meet electricity requirements during peak electricity demand periods can allow 'baseload' supply sources such as coal-fired generators and nuclear plants to maintain operating levels without interruption other than for maintenance, therefore achieving high levels of efficiency. Baseload simply refers to generating units slated for operation on a continuous 24-7 basis because of their low all-in unit costs.

5. Nuclear power

As indicated by table 6, nuclear power electric generation capacity is clearly very dominant only in the state of Vermont, where its share is about 72 percent. However, nuclear power is almost as important in terms of generation capacity as either natural gas or both gas and coal in Illinois, New Hampshire, Ontario, and South Carolina. Moreover, in 2012 nuclear power was the leading producer of electricity not only in those five jurisdictions but in Connecticut, New Jersey, and Virginia as well.[20]

That nuclear power's share of production is greater than its share of generation capacity in some cases (as in South Carolina, New Jersey, Illinois, and Connecticut) reflects the fact that nuclear power plants are generally relied upon to produce electricity on a continuous basis in order to help meet 'base-load' electricity demand requirements prevailing throughout the day. In contrast, because of their greater flexibility, gas-fired electric generation facilities are more often called on during peak demand periods, as in the early morning and in the late afternoon and early evening, when lighting, cooking, and heat energy requirements are greatest. For this reason the opposite is true. That is, the natural gas share of a jurisdiction's electricity production is generally less than the share of total generation capacity represented by gas-fired facilities.

In Ontario, where nuclear and gas-fired electric generation capacities constitute about the same shares of total capacity, it is therefore not surprising that the nuclear facilities have been producing more electricity than the gas combustion units. This also helps to explain why even though New Hampshire's nuclear generation capacity and gas-fired capacity are approximately the same, in 2012 the state's nuclear plants accounted for nearly 42.5 percent of the electricity produced and natural gas only a bit more than a third. In South Carolina, where nuclear power ranked second in terms of capacity (behind coal), nuclear plants were responsible for 53 percent of the state's electricity output compared with coal-fired facilities' 29 percent. Similarly, while nuclear power plants ranked third in terms of capacity in Illinois (behind both coal and natural gas), nuclear power was the source of almost 48 percent of the electrical energy produced compared with coal facilities' 41 percent and gas-fired units' 6 percent share (EIA, 2013b).

When we compared average electricity costs in the 16 cities included in the two surveys that are located in the eight jurisdictions cited in the first paragraph of this section with the average for the other cities in the surveys

20. Nuclear power's share of total electricity production in these eight jurisdictions was as follows: Vermont (75.9 percent of the total), Ontario (55.0 percent), South Carolina (52.9 percent), New Jersey (50.7 percent), Illinois (48.3 percent), Connecticut (47.3 percent), New Hampshire (42.5 percent), and Virginia (40.6 percent) (Statistics Canada, 2014; EIA, 2013b).

(with or without Honolulu) we found that they were clearly higher. For the residential rate class for example, the average cost in the 16 "nuclear" cities was more than two cents per kilowatt-hour (17.6 percent) greater than in all the other cities. Further, costs in the 16 cities in nuclear-intensive jurisdictions were 17.9 percent greater and more than two cents per kWh higher, on average, than in the other cities in the small commercial demand rate class example. In the small industrial demand case, costs averaged 16.5 percent greater in the "nuclear" cities.

While there are a few exceptions—for example, Chicago's per kWh cost for small industrial demand ranks 15th (of 119), and costs in Norfolk and Richmond, VA are consistently among the group of 50 cities (of 119) with the lowest costs—these comparisons suggest that cities in jurisdictions where nuclear power is the leading source of the electrical energy that is produced cannot be counted on as having competitive electricity costs. To the contrary, they tend to have higher costs.

For all three customer classes, tests of the differences between the mean electricity cost for cities in the eight jurisdictions where nuclear power is the major in-state source of electricity and the mean cost for cities (excluding Honolulu) in states where nuclear power is either not the leading supply source or absent indicated that they were statistically significant. In other words, costs in cities in the nuclear-strong jurisdictions are not only greater, on average, than costs in the other cities, but there is also reason to believe that this may be, at least in part, on account of the extent of penetration of nuclear power in the electricity production mix. At least, the statistical tests of the differences of means tell us that the differences in the average costs for the two groups are sufficiently large that they may not be the result of random occurrences.

The estimated coefficient of correlation between residential electric costs and the nuclear generation share of electricity produced in the states and provinces where each of the 119 cities in the survey are located is low but positive. This also suggests that costs may tend to be higher in cities in jurisdictions where the nuclear share of production is high.

6. Reliance on renewable energy sources

In recent years, policy makers in various states and provinces have succeeded in having special incentives for investments in renewable energy sources, especially wind power, put in place—even though, with but a few exceptions including older large hydroelectric installations, renewable energy sources are more costly sources of electricity.[21] This has been confirmed in a recent study

21. Other exceptions include biomass fueled combined heat and power (cogeneration) facilities and geothermal sources.

by the International Energy Agency (IEA) comparing the levelized cost of electricity (LCOE) for various types of electric generation technologies, which concluded that renewables generally cannot compete with non-renewable electricity sources (IEA, 2010; Angevine et al., 2012).[22]

Onshore wind generation has a lower LCOE than offshore wind generation or any of the solar technologies compared in the study. However, according to data provided for the IEA study by the Electric Power Research Institute, assuming a 10 percent discount rate onshore wind generation installations have higher LCOEs than nuclear plants, coal (pulverized coal combustion) plants, combined cycle natural gas turbine installations, and combined heat and power generation (i.e. cogeneration) facilities. A main reason for this is that capital costs are typically higher per unit of generation capacity in the case of wind than for technologies using non-renewable fuel sources. Another is that electricity produced by wind turbines, like power sourced from solar technologies, is not available on a 24/7 basis.

There are important added costs associated with wind generation that are not recognized in the Electric Power Research Institute data and other data used in the IEA study. First, because wind is not always available, wind plants generally have much lower capacity utilization rates than fossil fuel generation plants. Therefore, back-up sources of electricity supply such as gas-fired facilities must often be built. Second, because of the highly variable nature of wind velocity, extra costs must be incurred for balancing the electric system when wind generation facilities are added to the grid. Third, the cost of government incentives required to attract investment in wind facilities is not included. Finally, because wind facilities are frequently located in relatively remote or distant locations from load centers, the incremental transmission costs are greater, on average, than for non-renewable electric generation facilities (EIA, 2011). Although incremental transmission costs and system balancing costs are, by definition, not components of the LCOE calculations, they do impact the delivered cost of electricity.

The US Energy Information Association provides state-by-state electric generation information for wind, the largest source of renewable energy other than hydro. This indicates that wind is far from being a dominant or major source of the electricity produced even in the small number of states where wind represents more than 10 percent of total generation. For those states, and other states and provinces with significant shares of wind generation, it is not fruitful simply to compare electricity costs in the cities in such jurisdictions with costs in the other cities in the surveys in order to assess the impact of the availability of wind generation. The reason for this is that many

22. The LCOE measures the price at which an electricity producer must sell the output that is generated in order to recover the cost of the investment over the life of the power plant. It does not consider the costs of transmission and distribution.

factors, in addition to the supply that is available from a single relatively minor source such as wind, interact to determine city electricity costs. Other things equal, it is likely that costs associated with the dominant or major sources of supply have the most influence on the cost per kWh on electricity consumers' monthly bills.

Table 7 provides a list of the 14 states and two provinces where the wind share of total electricity production exceeded five percent in 2012, ranging from 24.8 percent in Iowa to 5.6 percent in Washington State.[23]

Table 7: Jurisdictions with wind generation >5% of total, 2012

State	Wind share (%)
Iowa	24.8
South Dakota	24.2
Minnesota	14.6
North Dakota	14.6
Idaho	12.2
Kansas	11.7
Colorado	11.3
Oklahoma	10.5
Oregon	10.4
Wyoming	8.8
Texas	7.5
Nova Scotia	7.2
New Brunswick	7.1
Maine	6.1
New Mexico	6.1
Washington	5.6

Sources: EIA (2013b); Statistics Canada (2014).

In Iowa, 62.3 percent of production came from coal-fired plants. The high proportion of output from presumably relatively low-cost coal-fired generation facilities would therefore appear to explain why the average of costs in the Iowa cities of Davenport, Des Moines, and Cedar Rapids was well below the average for all of the cities surveyed with respect to each of the three rate classes.

23. Although approximately 97 percent of the electricity produced in Prince Edward Island came from wind turbines, that province was excluded since most of the electricity consumed there is being imported.

In South Dakota, where wind constituted 24.2 percent of electricity production, natural gas combustion accounted for 24.3 percent and hydro for 49.7 percent. The fact that costs in Sioux Falls were lower than average over all three customer classes is therefore most likely a reflection of hydro's dominant role in the supply mix. The presence of significant supply from gas may reflect the fact that gas-fired plants as well as hydro facilities were relied upon during times when wind velocities were not sufficiently strong or steady to drive the wind turbines.

While wind was the source of 14.6 percent of the electricity produced in Minnesota, the relatively attractive (below average) performance of Duluth, Minneapolis, and Saint Paul with respect to costs for all three customer classes is likely attributable to the state's reliance during 2012 on coal-fired electricity production (43.5 percent) and nuclear power (22.4 percent).

Similarly, although wind also constituted 14.6 percent of supply in North Dakota, Fargo's attractive cost performance—as evidenced by well below average costs for each of the customer classes—was most likely the consequence of the availability of considerable coal-fired generation capacity which was responsible for 78.1 percent of the electricity produced in the state during 2012.

In Idaho, where wind had the fifth highest representation in terms of share of the electricity produced in 2012, at 12.2 percent, production was dominated by hydro which was responsible for a remarkable 70.6 percent of the state's power output. The share of production from gas-fired facilities was virtually the same as the wind share. Low-cost hydro, and the availability of both hydro and gas capacity to provide back up for the wind facilities, therefore probably goes a long way towards explaining Boise's very low electricity costs in all three customer classes, rather than the presence of wind capacity per se.[24]

Renewable energy "standards" or targets, as well as subsidies and incentives, are being used in many jurisdictions to attract investment in capacity to generate electricity from renewable energy sources such as wind in order to reduce air pollution and greenhouse gas emissions. Analysis of this topic is beyond the scope of this study. However, various reports including a recent study by Angevine et al. (2012) indicate that such subsidies can be very costly to taxpayers and can place a huge burden on electricity consumers, as with Ontario's Feed-in-Tariff program. For this reason, policy makers need to

24. In each of these cases, as elsewhere, multivariate regression analysis might have helped to explain the relative impacts of the various sources of supply and other factors on electricity costs. Because of wind's minor contribution relative to other sources of supply, as evidenced by the above discussion, grouping cities according to wind and no-wind categories and testing the differences of mean values for significance would not have been appropriate.

ensure that any emissions charges, subsidies, or incentives that are deemed essential to level the playing field between polluting and non-polluting electric generation facilities are carefully designed so that, all things considered, the field does not become tilted in favor of high-cost renewable energy technologies. In other words, the objective must be to achieve the lowest possible cost of electricity given whatever constraints (incremental costs) may be imposed by science-based environmental policy objectives.[25]

25. Population was also examined as a factor explaining differences among electricity costs in the 119 cities. For this purpose, Canadian population data was obtained from Statistics Canada (2013a, 2013b). Population data for the United States was obtained from the US Census (2013a, 2013b). To test the hypothesis that electricity costs are greater in larger cities than in small cities, the correlation between residential electricity costs in the 119 cities and city size in terms of population was calculated and a scatter diagram plotted. The analysis suggested that city size is not a significant cost-determining factor.

The impact of taxes levied on consumers' bills

When taxes applicable to electricity are included in the bill, the rankings can be much different from those derived with taxes excluded. More important, the actual cost to consumers can be appreciably greater. As noted earlier, comparison of costs in the group of 119 cities with and without taxes included was not possible because the required data were not available in the Lincoln Electric System survey. However, we were able to compare costs in this manner for the 22 cities included in the Hydro-Quebec Survey.[26] Costs with and without taxes are summarized in **table 8**.

For the 12 Canadian cities, on average, taxes add 10.1 percent to the residential service cost. However, taxes increase the cost to residential electricity consumers in the 10 U.S. cities by only 6.2 percent on average. In fact, in three of the 10 US cities (Boston, Nashville, and Seattle) there is zero tax on residential electricity consumption. Among the Canadian cities, the largest tax impacts in percentage terms occur in Regina (15 percent), Montreal (14.8 percent), and Toronto (14.6 percent), but increases in the residential per kWh cost are almost as large in Winnipeg, Charlottetown, Moncton, and Ottawa when taxes are included. In the US, the largest increases occur in Miami (14.8 percent), Chicago (13.2 percent), and Detroit (10.9 percent).

Because of a relatively low (4.9 percent) tax bite, St. John's jumps from 7th place (of 12) in the Canadian cities group to 4th place when taxes are included in the cost that residential customers pay for electricity. On the other hand, Miami drops from second place (of 10) among the 10 US cities to fifth

26. The taxes that were applied to typical consumer bills in the case of each of the three customer classes addressed in this study are listed in Appendix C of the Hydro-Quebec survey report. For the Canadian cities, these consisted of the federal goods and services tax and the applicable provincial sales tax (except in Alberta, which does not have a provincial sales tax). Where there is a 'harmonized' federal/provincial sales tax rate, as in the four Atlantic provinces and Ontario, that rate was used. The municipal sales taxes levied by Winnipeg and Regina were applied to bills in those cities. Similarly, for the American cities, all applicable state, municipal, and county sales taxes were applied.

Table 8: Electricity costs on April 1, 2013, with and without taxes

	Residential service Monthly consumption 1,000 kWh			Small commercial service 40 kW power demand 35% load factor Monthly consumption 10,000 kWh			Small industrial service 1000 kW power demand 56% load factor Monthly consumption 400,000 kWh		
	CAN cents per kWh			*CAN cents per kWh*			*CAN cents per kWh*		
	With tax	No tax	% difference	With tax	No tax	% difference	With tax	No tax	% difference
Canadian cities									
Calgary	15.55	14.81	5.0	17.77	16.93	5.0	16.03	15.27	5.0
Charlottetown	16.95	14.87	14.0	17.71	15.54	14.0	14.68	12.87	14.1
Edmonton	14.60	13.90	5.0	13.91	13.25	5.0	18.82	17.92	5.0
Halifax	16.22	15.45	5.0	17.08	14.85	15.0	14.30	12.44	15.0
Moncton	13.36	11.82	13.0	14.08	12.46	13.0	12.40	10.98	12.9
Montreal	7.89	6.87	14.8	10.41	9.05	15.0	8.49	7.38	15.0
Ottawa	14.00	12.39	13.0	13.86	12.26	13.1	11.97	10.59	13.0
Regina	15.12	13.15	15.0	13.03	10.82	20.4	11.48	9.53	20.5
St. John's	13.17	12.55	4.9	14.22	12.58	13.0	11.10	9.82	13.0
Toronto	14.30	12.48	14.6	14.21	12.40	14.6	13.39	11.85	13.0
Vancouver	9.55	8.91	7.2	10.76	9.60	12.1	8.09	7.23	11.9
Winnipeg	8.73	7.63	14.4	8.75	7.48	17.0	6.74	5.76	17.0
Average	**13.29**	**12.07**	**10.1**	**13.82**	**12.27**	**12.6**	**12.29**	**10.97**	**12.0**
American cities									
Boston	16.50	16.50	0.0	18.34	17.57	4.4	14.71	14.15	4.0
Chicago	12.94	11.43	13.2	11.38	10.20	11.6	7.27	6.27	15.9
Detroit	17.24	15.54	10.9	14.33	12.91	11.0	11.10	10.00	11.0
Houston	10.20	10.10	1.0	9.92	9.18	8.1	9.01	8.42	7.0
Miami	10.86	9.46	14.8	11.99	9.74	23.1	9.50	7.76	22.4
Nashville	10.62	10.62	0.0	11.64	10.88	7.0	10.04	9.38	7.0
New York	23.67	21.75	8.8	22.00	19.70	11.7	17.40	15.58	11.7
Portland, OR	10.80	10.63	1.6	9.98	9.83	1.5	7.57	7.46	1.5
San Francisco	24.69	22.94	7.6	19.15	17.79	7.6	15.18	14.09	7.7
Seattle	8.97	8.97	0.0	7.28	7.28	0.0	6.21	6.21	0.0
Average	**14.65**	**13.79**	**6.2**	**13.60**	**12.51**	**8.7**	**10.80**	**9.93**	**8.7**

Sources: Hydro-Quebec (2013); calculations by authors.

spot when taxes are included. All of the other changes in rank that occur in both groups of cities involve only one positional change.

With regard to the small commercial customer class, including taxes increases the costs paid by electricity consumers in the 12 Canadian cities by 12.6 percent on average, whereas for the 10 US cities the average increase is only 8.7 percent. In Canada, the biggest impacts occur in Regina (20.4 percent), Winnipeg (17.0 percent), and Montreal and Halifax (at 15.0 percent each). In the group of 10 US cities the largest impacts of taxes on electricity costs in this case occur in Miami (23.1 percent) and New York (11.7 percent). For this rate class the greatest change in rank among the Canadian cities when taxes are applied occurs in the case of Edmonton, which rises to 6th place (of 12) from 9th position. Among the US cities, Miami drops to 6th spot (of 10) from third; all other changes in rank only involve a single position.

The greater percentage impact of taxes on electricity costs in Canada than in the US that was seen with residential and small commercial rates is also evident with the costs per kWh for small industrial service—with costs in the 12 Canadian cities being impacted by 12.0 percent on average, compared with only 8.7 percent for the 10 US cities. Again, in Canada the largest impact is felt in Regina (20.5 percent) but Winnipeg consumers are hit hard by taxes as well (17.0 percent). Similar to the small commercial rate class, the US city where electricity costs are most affected by taxes is Miami (22.4 percent), but Chicago (15.9 percent) and New York (11.7 percent) are also impacted significantly. In the small industrial customer rate class the changes that occur in both the Canadian and US city rankings when taxes are included are limited to one-position changes.

Summary of selected electricity cost comparisons

Earlier, in the section **How the costs compare**, it was indicated that Canadian electricity costs per kWh tend to be higher, on average, than the average for all of the 119 cities included in the two surveys. As indicated in **table 9**, the average cost for the residential rate class is virtually the same for cities in both countries. But when outlier Honolulu is excluded from the US group of cities, the residential rate is 1.2 percent greater in Canada.

For the small commercial power demand classification, the average cost is 6.6 percent greater in Canada with Honolulu included in the US average, but 8.4 percent greater when Honolulu is excluded. With regard to the small industrial demand rate class, the average Canadian cost is 26.2 percent greater than the comparable US cost with Honolulu included but 28.9 percent greater when it is not. These comparisons indicate that, in general, both small and large Canadian businesses face a significant and troubling cost disadvantage relative to their American peers.

Looking only at those cities which are located in states and provinces where hydro capacity is not the dominant mode of available electric generation capacity—i.e., excluding cities in Quebec, Manitoba, British Columbia, Idaho, Montana, Oregon, South Dakota, and Washington—the differences between the two countries are worse. With Honolulu included, on average Canadian costs are 9.2 percent, 14.8 percent, and 39.5 percent greater than US costs in the residential, commercial, and industrial rate classes, respectively. With Honolulu excluded, the percentage differences are 14.1 percent, 16.8 percent, and 42.7 percent, respectively. Such significant differences should be a matter of great concern to Canadian policy makers. Not only are residential electricity consumers in many parts of Canada, including Ontario and Alberta, disadvantaged relative to most American consumers, but commercial and industrial electricity users are too—and to a much greater extent.

Table 9: Selected Canadian and US electricity cost comparisons

	Cents per kWh		
	Residential	**Small commercial**	**Small industrial**
All cities			
Canadian cities average	12.07	12.27	10.97
US cities average	12.12	11.51	8.69
Differences	-0.05	0.76	2.28
% by which Canadian rates exceed US rates on average	**-0.4**	**6.6**	**26.2**
All cities excluding Honolulu			
Canadian cities average	12.07	12.27	10.97
US cities with Honolulu excluded	11.93	11.32	8.51
Differences	0.14	0.95	2.46
% by which Canadian rates exceed US rates on average	**1.2**	**8.4**	**28.9**
All cities in jurisdictions where hydro not dominant			
Canadian cities not in hydro dominant QC., MB, or BC	13.49	13.45	12.36
US cities not in hydro dominant states	12.35	11.72	8.86
Differences	1.14	1.73	3.5
% by which Canadian rates exceed US rates on average	**9.2**	**14.8**	**39.5**
All cities in jurisdictions where hydro not dominant, excluding Honolulu			
Canadian cities not in hydro dominant QC, MB, or BC	13.49	13.45	12.36
US cities not in hydro dominant states or Honolulu	12.14	11.52	8.66
Differences	1.35	1.93	3.7
% by which Canadian rates exceed US rates on average	**11.1**	**16.8**	**42.7**

Sources: Hydro-Quebec (2013); Lincoln Nebraska Electric System (2013); calculations by authors.

Conclusions

Comparison of electricity costs in Canadian and US cities indicates that there are vast three- to four-fold and even greater differences between costs per kWh in cities like Montreal, Tulsa, and Tacoma on the one hand and Calgary, San Francisco, New York, and Honolulu on the other. Our search for explanations for the stark differences led us to conclude that Canadian consumers are paying more—on average—for electricity due in part to the shift away from less expensive coal-fired generation, as in Ontario, and insufficient reliance on natural gas for baseload generation, especially in gas-supply-rich provinces such as Alberta.

We found that having nuclear power as the major source of the electricity that is produced may contribute to higher electricity costs.

Somewhat surprisingly, in view of today's low natural gas prices, on average cities located in jurisdictions where natural gas combustion is the major source of electricity appear to have higher electricity costs than the others. This may be because, in a number of such jurisdictions, gas-fired capacity is mainly being used to meet peak rather than baseload (24/7) demand. Further, many states where gas-fired capacity is dominant, such as Massachusetts, New York, and New Jersey, are net importers of gas, with the result that the delivered cost to the generators is much greater than in gas dominant states such as Texas, Louisiana, and Oklahoma, which are net exporters of gas. Tulsa, OK, for example, has the lowest commercial and industrial costs and the second lowest residential costs overall.

A factor that seems to contribute to lower electric costs is the presence of hydroelectric capacity as the dominant mode of electric generation in the jurisdiction where a city is located. This appears to explain why cities in Quebec, Manitoba, British Columbia, Idaho, Washington State, and Oregon generally enjoy lower electricity costs than many other cities.

Cities located in jurisdictions where coal combustion is the major source of the electricity that is produced also have distinctly lower electricity costs, on average, across all three customer demand classifications than other cities.

As noted in the preceding section, many Canadian electricity consumers face significantly higher costs than US consumers. Consumers in cities in the non-hydro-dominant provinces such as Alberta, Saskatchewan, Ontario, New Brunswick, and Nova Scotia appear to be hit the hardest.

Policy recommendations

In view of the foregoing analysis and discussion, Canadian and provincial policy makers need to focus on measures that will help to secure lower electricity costs for future generations and reduce the disparity between Canadian and US electricity costs. In this regard, it is recommended that:

- Where they can compete with other sources of electricity, remaining undeveloped hydro resources (as in British Columbia, Manitoba, Quebec, Newfoundland and Labrador, and elsewhere) should be considered because of the stability that hydroelectric capacity can provide to electricity costs.[27]

- Given the favourable long-term outlook for natural gas supply and prices as a consequence of technological advances which allow gas production from shale gas formations, investment in state-of the-art advanced technology combined-cycle gas generators should be facilitated in order to help meet the anticipated growth in baseload electricity demand requirements (as opposed to the historical preference for mainly confining gas-fired generation to peak periods).

- Investment in coal-fired generation should be encouraged where competitive with other resources and technologies when the costs of meeting prudent environmental emissions regulations are taken into account.

- Subsidies and incentives to foster investment in wind power and other renewable energy technologies—policies intended to level the playing field between polluting and non-polluting electric generation facilities, such as Ontario's feed-in-tariff guarantees, and charges on emissions of airborne pollutants and greenhouse gas emissions from fossil fuel combustion generation facilities—should be re-examined to ensure that electricity consumers and taxpayers are not unduly penalized.

---

27. The current economic situation, with interest rates near historic lows, may provide a window of opportunity for financing projects with large capital costs.

- Opportunities should be sought for increased interprovincial electricity trade, opportunities which are likely to benefit electricity consumers in spite of the costs required to expand and/or upgrade existing transmission systems and interconnection capacities.

- Canadian and US provincial and state governments, and the electric utilities, should explore opportunities for increased electricity trade so that high cost jurisdictions may benefit from power imports. From Canada's perspective, this could help to ensure that as much as possible of the capacity of new hydro and other baseload generation facilities (that can compete in US states because of relatively low marginal costs) can be utilized at the time of commissioning. Similarly, opportunities for seasonal diversity interchange should be explored (e.g., exporting from winter peak areas during summer when power is needed in summer-peaking jurisdictions such as New York, and vice versa).

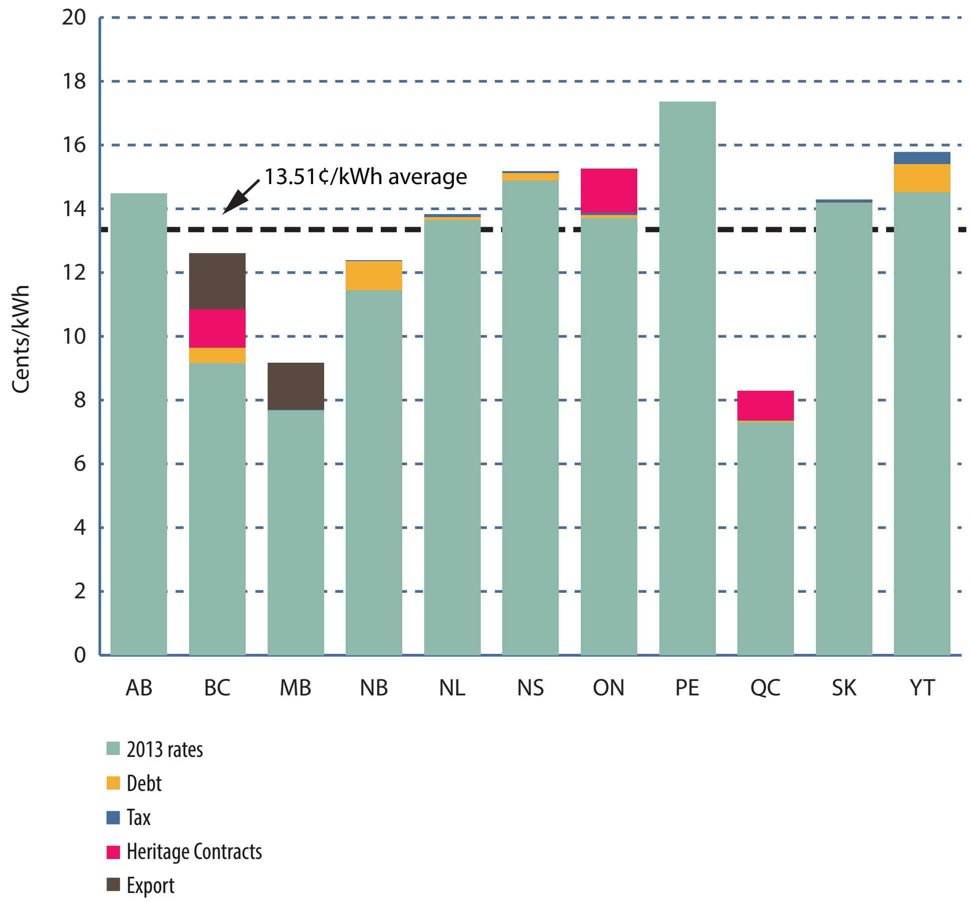
- In provinces where electric generation continues to be regulated, regulators should develop comprehensive long-term electricity supply plans designed to minimize consumers' future energy costs. Such plans should not only take into account the full range of technologies available for increasing generation capacity in regulators' respective jurisdictions, but also the potential for importing electricity supplies if that option is among the least-cost alternatives.

- In provinces where electricity generation facilities are wholly or mostly owned and operated by the Crown, invitations to bid to supply incremental baseload capacity should be issued from time to time, as required, to investors fully knowledgeable of the available resources and technologies, with the objective of ensuring that incremental supply costs can be minimized.

Appendix 1

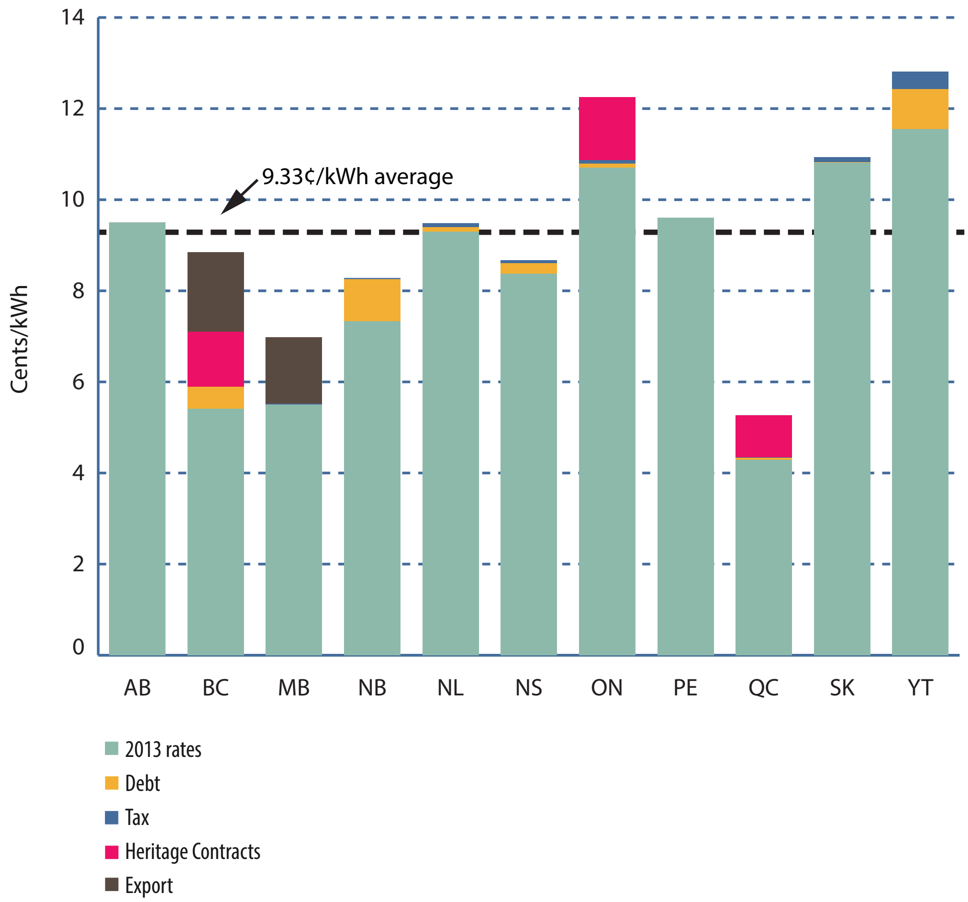
In a recent report sponsored by the Manning Foundation and the Independent Power Producer Society of Alberta (IPPSA), London Economics International generated estimates of what an "all-in" delivered cost of electricity comparison would look like across Canada if one accounted for an array of market distortions, such as: differences in initial endowments; the levels of leverage and impact on overall provincial debt burden; suppressed equity returns; differences in tax regimes; and the impact of heritage contracts and export revenues. As a courtesy to the reader, we present two of their figures from the report—one for residential customers, and another for industrial customers.

Figure A1: Rates for residential customers adjusting for various distortions, 2013



Source: London Economics International (2014).

Figure A2: Rates for industrial customers adjusting for various distortions, 2013



Source: London Economics International (2014).

References

Alberta Department of Energy (2014). *Electricity Statistics*. <http://www.energy.alberta.ca/Electricity/682.asp>

Alberstat, JoAnn (2013, September 15). Soaring Power Bills Key Election Issue. *Halifax Chronicle Herald*.

Angevine, Gerry, Carlos Murillo, and Nevena Pencheva (2012). *A Sensible Strategy for Renewable Electrical Energy in North America*. Fraser Institute. <http://www.fraserinstitute.org/uploadedFiles/fraser-ca/Content/research-news/research/publications/sensible-strategy-renewable-electrical-energy.pdf>

Hydro-Quebec (2013). *Comparison of Electricity Prices in Major North American Cities*. <http://www.hydroquebec.com/publications/en/comparison_prices/pdf/comp_2013_en.pdf>

International Energy Agency [IEA] (2010, March). *Projected Costs of Generating Electricity*.

Lincoln Electric System (2013). *National Electric Rate Survey*. <http://www.les.com/pdf/ratesurvey.pdf>

London Economics International (2014). *Power Prices in Context: Comparing Alberta Delivered Electricity Prices to Other Canadian Provinces on a Level Playing Field*. London Economics International.

Manitoba Hydro (2013). *Utility Rate Comparisons: Survey of Canadian Electricity Bills — Effective May 1, 2013*. <http://www.hydro.mb.ca/regulatory_affairs/energy_rates/electricity/utility_rate_comp.shtml>

All websites retrievable as of March 6, 2013.

National Energy Board (2013, November). *Reference Case – Generation by Primary Fuel Canada's Energy Future*. Appendices to *Canada's Energy Future*. <http://www.neb-one.gc.ca/clf-nsi/rnrgynfmtn/nrgyrprt/nrgyftr/2013/ppndcs/pxlctrctgnrtn-eng.html>

NB Power (2013). *Generation*. <http://www.nbpower.com/html/en/about/operating/generation.html>

Newfoundland Power (2013). *About Us*. <http://www.newfoundlandpower.com/AboutUs/Profile.aspx>

Newfoundland and Labrador Hydro (2013). *Operations*. <https://www.nlh.nl.ca/hydroweb/nlhydroweb.nsf/TopSubContent/Operations-Hydro%20Generation?OpenDocument>

Nova Scotia Power (2013a). *How We Make Electricity*. <https://www.nspower.ca/en/home/about-us/how-we-make-electricity/default.aspx>

Nova Scotia Power (2013b). *10 Year System Outlook Report*. Section 4, Generation Resources. <http://oasis.nspower.ca/site/media/oasis/20130702%20NSPI%20to%20UARB%2010%20Year%20System%20Outlook%20Report%20FILED.pdf>

Ontario Independent Electric System Operator (2013). *Supply Overview*. <http://www.ieso.ca/Pages/Power-Data/Supply.aspx>

SaskPower (2013). *Our Facilities and Electric System Map*. <http://www.saskpower.com/about-us/our-company-and-strategic-direction/our-facilities-and-system-map/?linkid=MM_facilities_systems_map>

Statistics Canada (2013a). *Population of Census Metropolitan Areas, 2012*. <http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/demo05a-eng.htm>

Statistics Canada (2013b). *Census Agglomeration of Charlottetown, 2011*. <http://www12.statcan.ca/census-recensement/2011/as-sa/fogs-spg/Facts-cma-eng.cfm?LANG=Eng&GK=CMA&GC=105>

Statistics Canada (2014). *Electric Power Generation by Class of Electricity Producer*. CANSIM Table 127-0007. <http://www5.statcan.gc.ca/cansim/a05?lang=eng&id=1270007&pattern=1270007&searchTypeByValue=1&p2=35>

US Census (2013a). *Large Metropolitan Statistical Areas – Population: 1990 to 2010*. <http://www.census.gov/compendia/statab/2012/tables/12s0020.pdf>

US Census (2013b). *2010 Population Finder.*
<http://www.census.gov/popfinder/>

US Energy Information Administration [EIA] (2011). *Annual Energy Outlook 2011: Levelized Cost of New Generation Resources in Annual Energy Outlook 2011.*
<http://www.eia.gov/forecasts/aeo/electricity_generation.cfm#3>

US Energy Information Administration [EIA] (2013a). *Annual Tabulation of Electric Generation Capacity by State.*
<http://www.eia.gov/electricity/data/state/> (Please see file "Existing Nameplate and Net Summer Capacity".)

US Energy Information Administration [EIA] (2013b). *Annual tabulation of Electric Generation by State.*
<http://www.eia.gov/electricity/data/state/> (Please see file "Net Generation by State by Type of Producer by Energy Source".)

US Energy Information Administration [EIA] (2014). *Fuel Receipts and Cost Time Series File (from Form 923).*
<http://www.eia.gov/electricity/data/eia923/>

Wikipedia (2013). *List of electrical generating stations in New Brunswick*.
<http://en.wikipedia.org/wiki/List_of_electrical_generating_stations_in_New_Brunswick>

About the authors

Gerry Angevine

Gerry Angevine is a Fraser Institute Senior Fellow. From July 2006 to the end of 2012 he was a Senior Economist with the Institute with responsibility for energy policy studies. He launched the global Petroleum Survey in 2007. Dr. Angevine has been President of Angevine Economic Consulting Ltd., an energy economics consulting firm, since 1999, and was a Managing Consultant with Navigant Consulting Ltd. from 2001 to 2004. He was President, CEO, and a Director of the Canadian Energy Research Institute from 1979 to 1999. Gerry has advised the Alberta Department of Energy and testified before the National Energy Board as an expert witness. He has also written analyses for the Fraser Institute of Ontario's 2007 Integrated Power System Plan and Alberta electric transmission policy as well as several studies addressing aspects of a continental energy strategy and policy changes required to expedite investment in Canadian crude oil and natural gas transportation infrastructure. He has A.M. and Ph.D. degrees in Economics from the University of Michigan, an M.A. Economics degree from Dalhousie University, and a B.Com. degree from Mount Allison University.

Kenneth P. Green

Kenneth P. Green is Senior Director of Natural Resource Studies at the Fraser Institute. He received his doctorate in Environmental Science and Engineering from the University of California, Los Angeles (UCLA), an M.S. in Molecular Genetics from San Diego State University, and a B.S. Biology from UCLA. Dr. Green has studied public policy involving risk, regulation, and the environment for more than 16 years at public policy research institutions across North America. He has an extensive publication list of policy studies, magazine articles, opinion columns, book and encyclopedia chapters, and two supplementary textbooks on climate change and energy policy intended for middle-school and collegiate audiences respectively. Ken's writing has appeared in major newspapers across the US and Canada, and he is a regular presence on both Canadian and American radio and television. Ken has testified before several state legislatures and regulatory agencies, as well as giving testimony to a variety of committees of the US House and Senate.

Acknowledgments

The authors are indebted to the anonymous reviewers for their comments, suggestions, and insights. Any remaining errors or oversights are the sole responsibility of the authors. As the researchers worked independently, the views and conclusions expressed in this paper do not necessarily reflect those of the Board of Trustees of the Fraser Institute, the staff, or supporters.

Publishing information

Distribution

These publications are available from <http://www.fraserinstitute.org> in Portable Document Format (PDF) and can be read with Adobe Acrobat® or Adobe Reader®, versions 7 or later. Adobe Reader® XI, the most recent version, is available free of charge from Adobe Systems Inc. at <http://get.adobe.com/reader/>. Readers having trouble viewing or printing our PDF files using applications from other manufacturers (e.g., Apple's Preview) should use Reader® or Acrobat®.

Ordering publications

To order printed publications from the Fraser Institute, please contact the publications coordinator:

- e-mail: sales@fraserinstitute.org
- telephone: 604.688.0221 ext. 580 or, toll free, 1.800.665.3558 ext. 580
- fax: 604.688.8539.

Media

For media enquiries, please contact our Communications Department:

- 604.714.4582
- e-mail: communications@fraserinstitute.org.

Copyright

Date of issue

K_w 2014 &pctgqcb8 ?sesqr 0./2'

ISBN

978-0-88975-290-0

Citation

Angevine, Gerry, and Kenneth P. Green (2014). *Paying More for Power: Electricity Costs in the US and Canada*. Fraser Institute. <http://www.fraserinstitute.org>

Cover illustration

Bill C. Ray

Supporting the Fraser Institute

To learn how to support the Fraser Institute, please contact

- Development Department, Fraser Institute
  Fourth Floor, 1770 Burrard Street
  Vancouver, British Columbia, V6J 3G7 Canada

- telephone, toll-free: 1.800.665.3558 ext. 586

- e-mail: development@fraserinstitute.org

Purpose, funding, & independence

The Fraser Institute provides a useful public service. We report objective information about the economic and social effects of current public policies, and we offer evidence-based research and education about policy options that can improve the quality of life.

The Institute is a non-profit organization. Our activities are funded by charitable donations, unrestricted grants, ticket sales, and sponsorships from events, the licensing of products for public distribution, and the sale of publications.

All research is subject to rigorous review by external experts, and is conducted and published separately from the Institute's Board of Trustees and its donors.

The opinions expressed by the authors are those of the individuals themselves, and do not necessarily reflect those of the Institute, its Board of Trustees, its donors and supporters, or its staff. This publication in no way implies that the Fraser Institute, its trustees, or staff are in favour of, or oppose the passage of, any bill; or that they support or oppose any particular political party or candidate.

As a healthy part of public discussion among fellow citizens who desire to improve the lives of people through better public policy, the Institute welcomes evidence-focused scrutiny of the research we publish, including verification of data sources, replication of analytical methods, and intelligent debate about the practical effects of policy recommendations.

About the Fraser Institute

Our vision is a free and prosperous world where individuals benefit from greater choice, competitive markets, and personal responsibility. Our mission is to measure, study, and communicate the impact of competitive markets and government interventions on the welfare of individuals.

Founded in 1974, we are an independent Canadian research and educational organization with locations throughout North America and international partners in over 85 countries. Our work is financed by tax-deductible contributions from thousands of individuals, organizations, and foundations. In order to protect its independence, the Institute does not accept grants from government or contracts for research.

Nous envisageons un monde libre et prospère, où chaque personne bénéficie d'un plus grand choix, de marchés concurrentiels et de responsabilités individuelles. Notre mission consiste à mesurer, à étudier et à communiquer l'effet des marchés concurrentiels et des interventions gouvernementales sur le bien-être des individus.

Peer review—validating the accuracy of our research

The Fraser Institute maintains a rigorous peer review process for its research. New research, major research projects, and substantively modified research conducted by the Fraser Institute are reviewed by experts with a recognized expertise in the topic area being addressed. Whenever possible, external review is a blind process. Updates to previously reviewed research or new editions of previously reviewed research are not reviewed unless the update includes substantive or material changes in the methodology.

The review process is overseen by the directors of the Institute's research departments who are responsible for ensuring all research published by the Institute passes through the appropriate peer review. If a dispute about the recommendations of the reviewers should arise during the Institute's peer review process, the Institute has an Editorial Advisory Board, a panel of scholars from Canada, the United States, and Europe to whom it can turn for help in resolving the dispute.