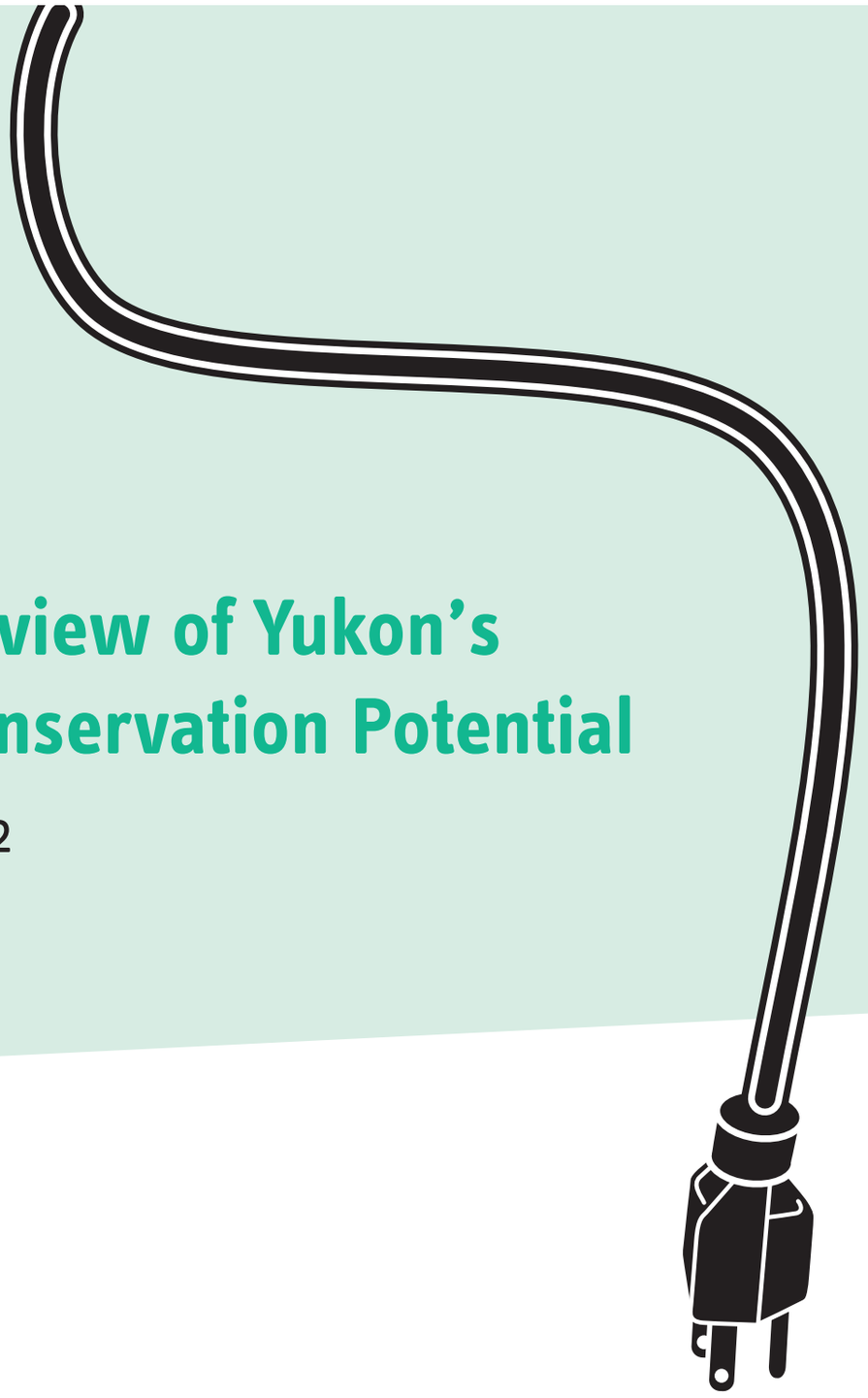


Review of Yukon's Conservation Potential

2012

Lighting up the North

Yukon Electrical
An ATCO Company

YUKON ENERGY

energy solutions centre

Introduction

This study is part of a broader effort to find innovative ways of meeting individual and corporate electrical needs while minimizing pollution and greenhouse gases. This study will provide a resource for Yukon Energy Corporation, Yukon Electrical Company Limited (YECL), and the Government of Yukon to develop a comprehensive vision of the territory's future electricity needs.

The results of similar studies from other parts of Canada cannot simply be applied to Yukon in a "cookie cutter" approach. The Yukon situation differs from other jurisdictions in several important ways. Due to the relatively cold climate, space heating electricity consumption, including electric space heating, is a much larger share of the total. The cost of new generation is also relatively high.

Although much of the electricity supplied to customers on the hydro grid comes from legacy hydroelectric generation, at peak times any additional power needed is supplied by diesel generators. Severe climate and generation cost combine to make measures that save space heating electricity more financially attractive than they are in most other parts of Canada. Another key difference in the Yukon situation is that the growth in electricity requirements is expected to be quite large. Utility planners anticipate relatively high rates of new construction in both residential and commercial buildings, and also expect that the majority of the new buildings will be electrically-heated. Growth rates are also heavily dependent on the development of new mines in the territory.

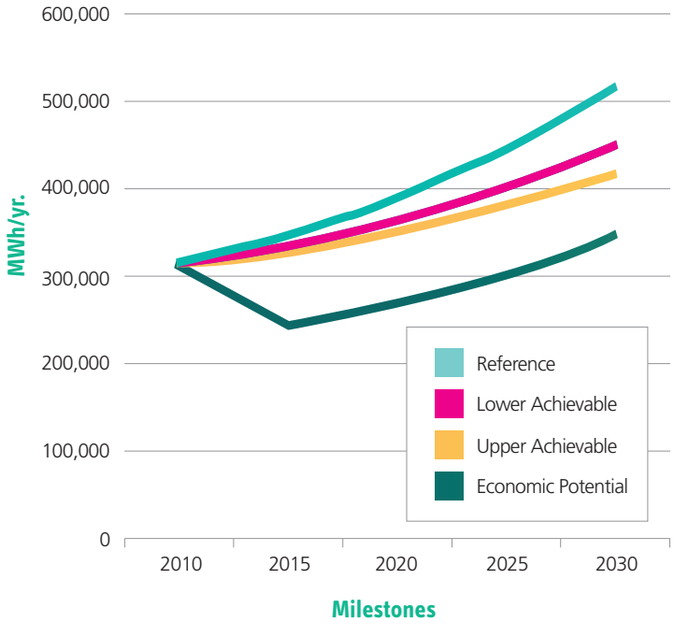
Key Findings – Combined Electrical Savings Potential Residential and Commercial Sectors

If no new electricity conservation/efficiency programs were undertaken (a scenario called the reference case), total electricity consumption would rise from approximately 312,000 MWh/yr. in 2010 to about 515,000 MWh/yr. by 2030, an increase of about 65 percent.

The economic potential for electricity savings, including all measures that are economically feasible to implement, is approximately 168,000 MWh/yr. by 2030. If the upper end of the savings potential were achieved, the electricity savings of 97,000 MWh/yr. in 2030 would limit the total electricity consumption to about 418,000 MWh/yr., a decrease of about 18 percent relative to the reference case consumption. This would mean that 48 percent of projected growth in consumption would be met by electricity conservation/efficiency programs.

If the lower end of the savings potential were achieved, the electricity savings of 66,000 MWh/yr. in 2030 would limit the total electricity consumption to about 450,000 MWh/yr., a decrease of about 13 percent relative to the reference case consumption. This would mean that 32 percent of projected growth in consumption would be met by electricity conservation/efficiency programs.

Annual Electricity Consumption–Electricity-efficiency Achievable Potential Relative to Reference Case and Economic Potential Forecast, (MWh/yr. Peak Demand Reduction Potential)



The study's scope was defined in the following ways:

- The study addressed residential households (residential sector), and commercial and institutional buildings (commercial sector). The large industrial customers (mines) were not included in the study, but are being addressed separately and individually.
- The study addressed all regions of Yukon that are served by either Yukon Energy or YECL. Customers served by both the hydroelectric grid and the stand-alone diesel grids are included.
- The study covered a 20-year period, from a base year of 2010 to the final milestone year in 2030.

Peak Demand Reduction Potential

The electricity saving measures identified also tend to reduce the demand for electricity at peak times. The study examined three different peak periods for electricity demand in Yukon, but this summary focuses on the results for the system annual peak hour.

In the absence of new electricity conservation/efficiency initiatives, the study estimates that the total peak load in the annual peak hour will grow to about 107 MW by 2030, an increase of about 67 percent.

Electric energy savings would provide peak load savings between approximately 15 MW (14 percent) and 22 MW (21 percent) during the annual peak hour by 2030.

Combined Peak Load Reductions for the Annual Peak Hour, from Electric Energy Savings Measures, Reference Case, Economic and Achievable Scenarios (MW)

Milestone Year	Average Peak Load (MW)	Peak Load Savings (MW, %).			
	Reference Case	Upper Achievable		Lower Achievable	
2010	64.4				
2015	71.9	3.2	4%	2.2	3%
2020	81.1	7.7	9%	5.4	7%
2025	92.7	13.8	15%	9.2	10%
2030	107.4	22.4	21%	14.9	14%

Residential Results

Electricity savings potential are illustrated in the residential sector for three scenarios, by five-year milestones. The economic potential savings estimate includes all measures that are economically feasible to implement in the study period. The estimates of the achievable potential savings present the range of savings that can be realistically achieved based on barriers and hurdles determined by Yukon stakeholders during consultation.

Electricity Savings by Milestone Year for Three Scenarios (MWh/yr.)

Year	Economic Potential Scenario		Upper Achievable Potential Scenario		Lower Achievable Potential Scenario	
	Potential Savings (MWh/yr.)	% Savings Relative to Ref Case	Potential Savings (MWh/yr.)	% Savings Relative to Ref Case	Potential Savings (MWh/yr.)	% Savings Relative to Ref Case
2015	37,234	24%	5,114	3%	2,711	2%
2020	42,572	25%	13,554	8%	7,792	5%
2025	49,415	25%	23,598	12%	13,539	7%
2030	57,246	25%	37,097	16%	22,239	10%

*Results are measured at the customer's point-of-use and do not include line losses.

The estimated achievable potential for residential electric savings through technology adoption was estimated to be between 22,000 MWh/yr. and 37,000 MWh/yr. by 2030. The most significant opportunities were in the actions that addressed space heating. Significant savings can also be found in domestic hot water, clothes dryers, standby load in household electronics and 13 other end uses.

Highlights of the Residential Electricity Saving Measures

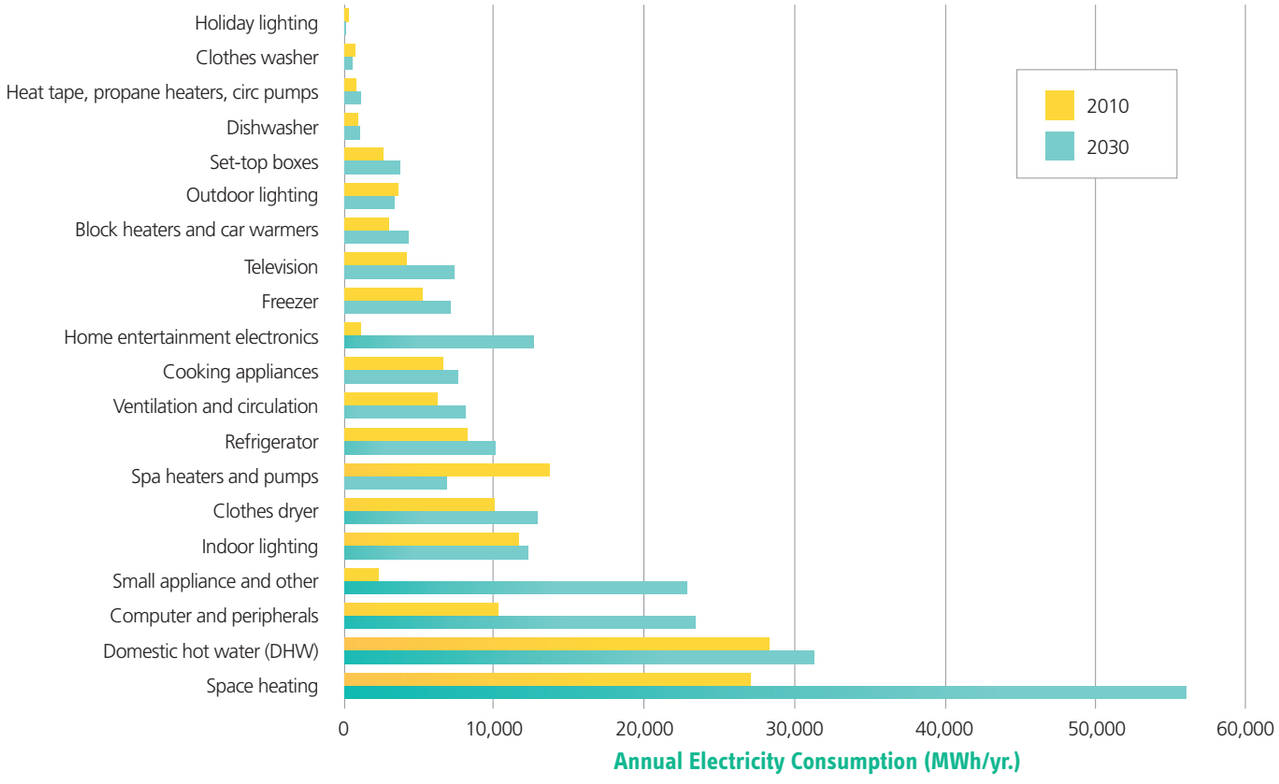
Space heating savings account for approximately 55 percent of the achievable potential savings in 2030. The most significant measures that save space heating include high-performance new homes, heat pumps (both central units and ductless mini-splits), zone heating systems and LEED certified apartment buildings.

Space heating accounts for a very large percentage of the potential, but the space heating savings potential is also a very large percentage of the reference case space heating consumption. Between 22 percent and 37 percent of space heating could potentially be saved. The potential in electrically heated dwellings, as a percentage of their reference case consumption, is three to four times as large as it is in dwellings without electric heat. Domestic hot water savings account for approximately 13 percent of 2030 achievable potential savings. The measure that saves the most domestic hot water is the efficient clothes washer.

Clothes dryers account for eight to ten percent of 2030 achievable potential savings. The reduction in clothes dryer electricity comes from the faster spin speeds in the high-efficiency clothes washers, which reduce drying time.

Computers account for approximately five percent of the achievable potential savings in 2030. The savings in computers and their peripherals are expected to come primarily from the use of smart power bars that reduce standby losses.

Electricity Use by End Use, Residential Sector, 2010 and 2030 (MWh/yr.)



Commercial Results

The study shows the electricity savings potential in the commercial sector for three scenarios, by five-year milestones. The economic potential savings estimate includes all measures that are economically feasible to implement in the study period. The estimates for achievable potential savings present the range of savings that can be realistically achieved.

The estimated achievable potential for commercial electric energy savings through technology adoption was estimated to be between 44,000 MWh/yr. and 60,000 MWh/yr. by 2030. The most significant savings opportunities were in the actions that addressed indoor lighting and space heating.

Commercial Annual Electricity Consumption–Electricity-efficiency Achievable Potential Relative to Reference Case and Economic Potential Forecast for the Commercial Sector (MWh/yr.)

Milestone Year	Annual Consumption, Commercial				Potential Annual Savings, Commercial					
			Achievable Potential				Achievable Potential			
	Reference Case	Economic Potential	Upper	Lower	Economic Potential		Upper		Lower	
	MWh/yr.	MWh/yr.	MWh/yr.	MWh/yr.	MWh/yr.	%	MWh/yr.	%	MWh/yr.	%
	(A)	(B)	(C)	(D)	(A-B)		(A-C)		(A-D)	
2010	166,133									
2015	189,035	124,423	177,913	180,766	64,612	34%	11,122	6%	8,269	4%
2020	215,775	137,356	192,398	198,567	78,419	36%	23,377	11%	17,208	8%
2025	247,045	153,503	209,028	218,839	93,542	38%	38,017	15%	28,206	11%
2030	283,673	173,267	223,854	240,056	110,406	39%	59,819	21%	43,617	15%

Residential Reference Case

In the base year of 2010, Yukon's residential sector consumed about 146,000 MWh. The results shows that domestic hot water and space heating each account for about 19 percent of total residential electricity use. These are followed by spa heaters and pumps with about nine percent, indoor lighting with eight percent, and computers (with their peripherals) and clothes dryers with about seven percent each. Refrigerators account for six percent, followed by cooking, ventilation/circulation, and freezers with four percent each. Other end uses account for three percent or less of the total.

In the absence of new electricity conservation/efficiency initiatives, electricity consumption in the residential sector is expected to grow to about 232,000 MWh/yr. by 2030, an increase of about 59 percent. It is shown that space heating is expected to rise to 24 percent of residential electricity consumption, while domestic hot water is expected to fall to 13 percent. These will be followed by computers (with their peripherals) at ten percent, small appliances and other (including as yet unknown end uses), also at ten percent, clothes dryers at six percent, home entertainment electronics and indoor lighting at five percent each, and refrigerators at four percent. Other end uses each account for three percent or less of the total.

Commercial Reference Case

In the base year of 2010, Yukon's commercial sector consumed about 166,000 MWh. **The study shows that lighting is the largest commercial sector end use, accounting for approximately 37 percent of total commercial sector electricity use.** Indoor lighting, which consists of general, architectural and high-bay lighting, accounts for approximately 34 percent, while outdoor lighting accounts for the remaining three percent of lighting use. HVAC end uses (space heating, space cooling and HVAC fans and pumps) account for 22 percent of base year electricity use. Cooking equipment, domestic water heating and a number of smaller end uses account for the remaining commercial sector electricity use. Non-building loads are treated as both an end use and sub sector in this analysis. These loads account for 13 percent of commercial sector end-use electricity consumption.

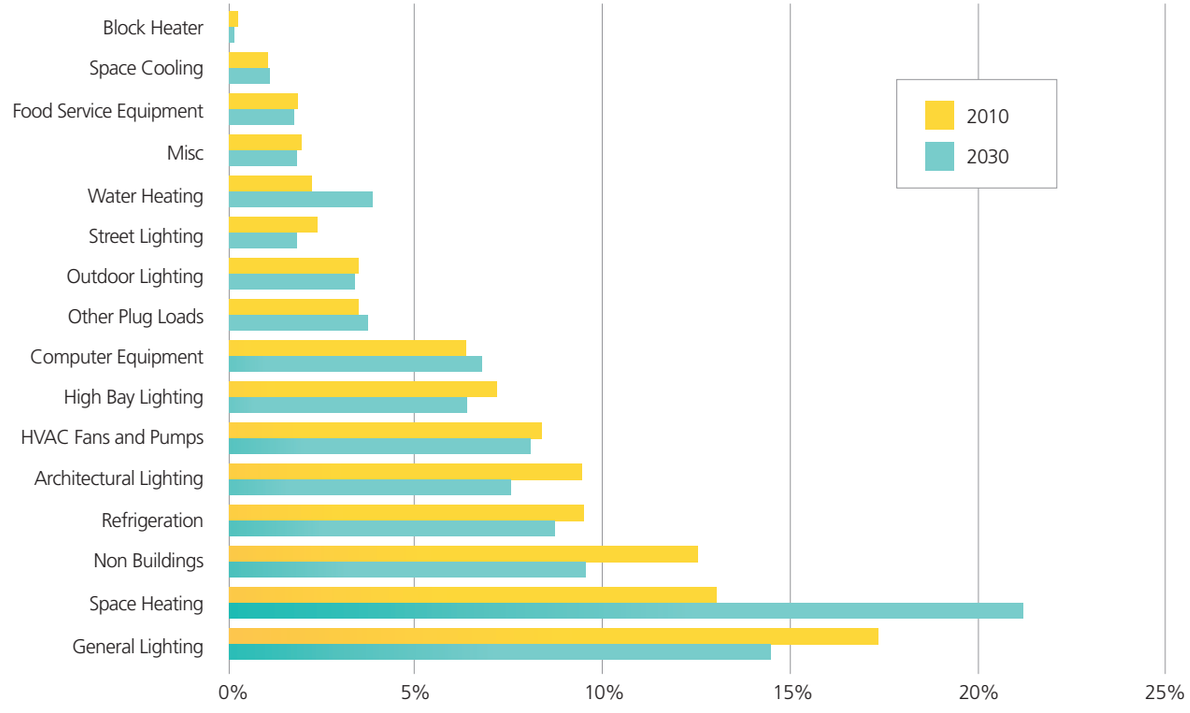
The study also presents the reference case consumption by end use in 2030, at the end of the study period, for comparison. In the absence of new electricity conservation/efficiency initiatives, electricity consumption in the commercial sector is expected to grow to about 284,000 MWh/yr. by 2030, an increase of over 70 percent. This growth is driven in large part by increases in space heating electricity consumption, which grows 179 percent between 2010 and 2030, due to a large number of new electrically heated buildings being introduced in to the building stock. The move toward electric space heating in new buildings means that electricity consumption for water heating also increases dramatically (211 percent), as electrically heated buildings rarely invest in fossil fuel infrastructure for water heating only.

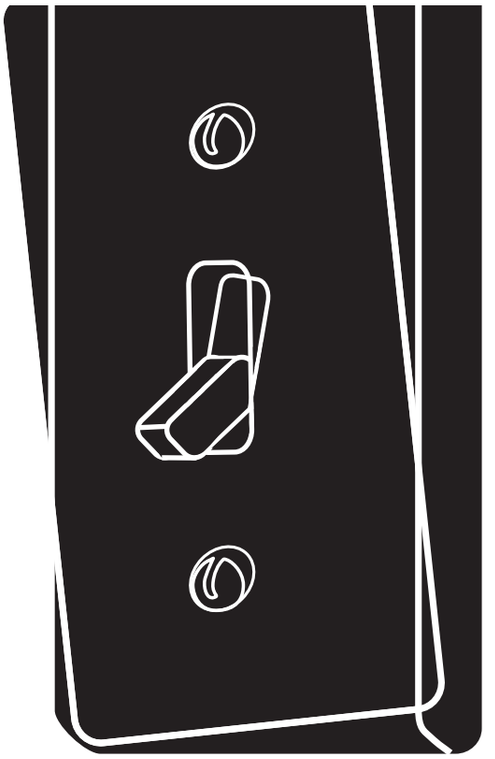
Three additional end uses grow by more than 85 percent from 2010 to 2030: space cooling (87 percent), plug loads (87 percent) and computer equipment (86 percent). These end uses are more significant contributors in later milestone years as a result of a trend toward higher space cooling saturations and computer equipment/plug load densities.

End uses which grow at a significantly slower rate than average include architectural lighting (38 percent) and general lighting (45 percent). Lighting end uses show a slight decline in importance as more efficient new buildings are introduced into the building stock through time, and as a result of naturally occurring lighting retrofits in existing buildings.

Electricity Use by End Use, Commercial Sector, 2010 and 2030 (MWh/yr.)

This is given as a percent of the total Commercial Sector load for 2010 and 2030.





Highlights of the Commercial Electricity Saving Measures

In 2030, HVAC savings account for 41 percent and 39 percent of upper and lower achievable potential savings, respectively. Indoor lighting accounts for 36 percent and 37 percent of 2030 savings under the upper and lower scenarios.

Over time, indoor lighting decreases as a share of overall savings, while HVAC increases. For example, in the lower achievable scenario, indoor lighting accounts for 48 percent of savings in 2015 (37 percent in 2030), while HVAC accounts for only 23 percent (39 percent in 2030). This is driven by two factors:

- Early milestone years present more lighting opportunities. These opportunities tend to be relatively low-cost, familiar technologies that workshop participants felt will be adopted relatively quickly. A significant portion of these opportunities are not available in later milestone years as a result of incoming legislation which is expected to transform the market for some lighting technologies.
- Overall electric space heating shares increase rapidly through time, as more new electrically heated buildings are added to the stock. This presents a growing opportunity for conservation.

Recommended Next Steps

This study is just one step in the process of developing an electricity strategy for the Yukon. Some recommended next steps include:

- Yukon should proceed to develop electricity conservation/efficiency programs addressing both the commercial and residential sectors.
- The technologies selected for program development should be subjected to more rigorous study than was possible with the large number of technologies examined in this review. This may include testing and demonstration in the Yukon climate in addition to an examination of the market barriers in the territory.
- Electricity conservation/efficiency program efforts should be leveraged as much as possible through collaboration with existing and planned programs by other entities.
- Future conservation potential studies should be coordinated with electrical end-use surveys. The scope of both should be determined in tandem, so that questions can be included in the survey to cover the building types, end uses, and technologies that will be studied in the conservation potential study. The timing of the survey should be such that the final results are in hand before the next conservation study begins. This would apply to both residential and commercial electrical end-use surveys.

Access the full Conservation Potential Review report at:

www.energy.gov.yk.ca/

www.yukonelectrical.com

www.yukonenergy.ca