Yukon Electricity Conservation and Demand Management Potential Review (CPR 2011)

Customer-Side Renewable and Alternative Energy

9 January 2012

Submitted to:
Yukon Energy, Yukon Electrical Company,
Government of Yukon

Submitted by:
ICF Marbek
300-222 Somerset Street West
Ottawa, Ontario K2P 2G3

Tel: +1 613 523-0784
Fax: +1 613 523-0717
info@marbek.ca
www.marbek.ca

Executive Summary

Background and Objectives

Yukon residents rely on electricity not only to live meaningful, healthy lives but also to support and strengthen the economy. Given concerns about climate change, there is growing interest not only in how electricity is generated, transmitted and distributed, but also in how efficiently it is used on the customer's end. In Yukon, as well as in a growing number of North American jurisdictions, how electricity is generated and used is being closely analyzed to find innovative ways of meeting individual and corporate energy service needs while minimizing pollution and the creation of greenhouse gases.

Experience throughout many North American jurisdictions has demonstrated that energy efficiency, conservation and customer-supplied alternative energy technologies all have a significant potential to reduce energy consumption, energy costs and emissions. The 2009 *Energy Strategy for the Yukon* also recognizes this potential and notes the following efficiency and conservation priorities:

- Avoid the cost and environmental impact of building new generation
- Increase energy efficiency in Yukon by 20% by 2020
- Reduce energy consumption in Yukon buildings
- Reduce energy consumption for transportation in Yukon
- Promote the use of energy-efficient products by providing incentives for products that meet energy performance standards
- Improve energy efficiency for Yukon government operations.

Efficient use of electricity through conservation, peak demand control and alternative energy sources can assist greatly in the path forward for the electrical supply industry. This study will provide an opportunity for Yukon Energy Corporation (YEC), Yukon Electrical Company Limited (YECL), and the Government of Yukon to develop a comprehensive vision of the territory's future energy service needs.

More specifically, the objective for this study is to provide:

"…a necessary reference point to determine the potential for (electricity) demand side management (DSM) in the Yukon."[1]

Scope

The scope of this study is summarized below:

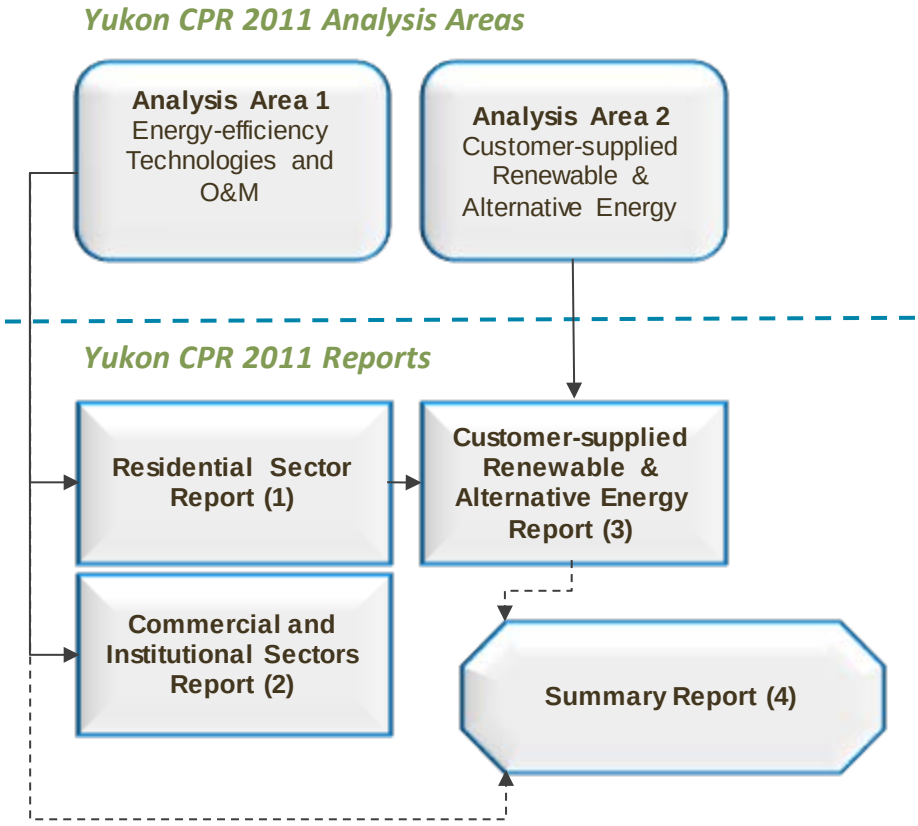
- **Sector Coverage:** This study addresses two sectors: residential households (Residential sector), and commercial and institutional buildings (Commercial sector).[2]

[1] Yukon Energy Corporation Request For Proposals #2010-045, "Consulting Services for Electricity Conservation and Demand Management Potential Study," 2011.

- **Geographical Coverage:** The study addresses all regions of Yukon that are served by either YEC or YECL. Customers served by both the hydroelectric grid and the stand-alone diesel grids are included. Note that the hydroelectric grid is remote and dependent on trucked fuel to meet demand above the existing hydro / wind capacity, while the stand-alone diesel grids rely on fuel that is trucked or flown in at all times.
- **Study Period:** This study covers a 20-year period. The Base Year is the calendar year 2010, with milestone periods at five-year increments: 2015, 2020, 2025 and 2030. The Base Year of 2010 was selected to enable this study's results to be aligned with the most recent load forecasting data provided by YEC.
- **Technologies:** This study addresses a comprehensive range of demand-side management (DSM) measures. This includes all electrical efficiency technologies or measures that are expected to be commercially viable by the year 2015, as well as peak load reduction technologies and customer-side renewable energies.

CPR 2011 has been organized into four analysis areas and the results are presented in four reports, as show in Exhibit ES 1, below.

Exhibit ES 1 Overview of CPR 2010 Organization – Analysis Areas and Reports



[2] Yukon's Industrial sector consists primarily of a small number of operating mines. Efficiency opportunities within these sites will be addressed outside of this study.

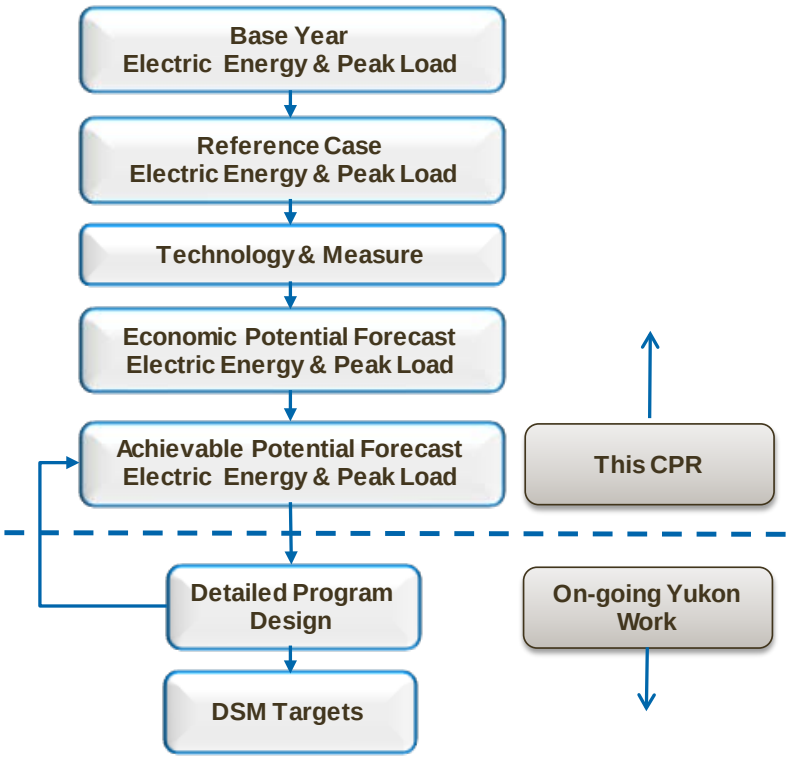
This report presents the results of Analysis Area 2: Customer-side Renewable and Alternative Energy (Report 3 in Exhibit ES 1 above), addressing the electricity use that could be offset by a selected number of small-scale customer-side renewable or alternative energy technologies in the Residential and Commercial sectors. These technologies include: solar photovoltaic (PV), solar domestic hot water heating, wood-pellet furnaces (residential) and wood-pellet boilers (commercial).

Approach

The customer-side renewable and alternative energy (CSRAE) measures were modeled at the level of individual application using the RETScreen model. RETScreen is a modelling tool developed and maintained by Natural Resources Canada (NRCan) specifically for analyzing renewable energy systems such as those addressed by this study.

The potential contribution of CSRAE measures to electricity savings in the Residential and Commercial sectors used the same definitions of building types and end uses as used in the other study Analysis Areas and aggregated in the RSEEM (Residential Sector Energy End-use Model) and CSEEM (Commercial Sector Electricity End-use Model) models.

Exhibit ES 2 CPR 2010: Main Analytic Steps



The major steps in the general approach to the study are outlined in Exhibit ES 2 above. Specific procedures for the CSRAE options were as follows:

- Step 1: Select candidate CSRAE technologies

- Step 2: Define "typical" small-scale applications
- Step 3: Estimate Yukon resource potential for each CSRAE technology
- Step 4: Model the potential energy production for each CSRAE technology
- Step 5: Establish the current cost and performance data for each CSRAE technology
- Step 6: Calculate the levelized cost of energy conservation or generation for each CSRAE technology
- Steps 7, 8 and 9: Estimate the "unbundled" Technical, Economic and Achievable Potentials for each CSRAE technology.

Overall Study Findings

As in any study of this type, the results presented in this report are based on a number of important assumptions. Assumptions such as those related to the current penetration of efficient technologies and the rate of future growth in the building stock are particularly influential. Wherever possible, the assumptions used in this study are consistent with those used by the Yukon utilities and government. However, the reader is referred to a number of caveats throughout the main text of the report.

Given these assumptions, the CPR 2011 findings confirm the existence of potential opportunities for off-setting electric load with customer-side renewable and alternative technologies in Yukon's Residential and Commercial sectors.

A summary of the potential levels of savings in purchased electric energy provided by the CSRAE technologies is presented below in Exhibit ES 3. By 2030, the potential reduction in purchased electricity from the use of CSRAE technologies were estimated to be approximately 18,030 MWh/yr. for the Upper Achievable Potential scenario and about 5,860 MWh/yr. for the Lower Achievable Potential scenario.

In the Residential sector, small-scale CSRAE technologies would provide between 6,500 MWh/yr. and 2,830 MWh/yr. of electricity by 2030 in, respectively, the Upper and Lower Achievable Potential scenarios. In the Commercial sector, small-scale CSRAE technologies would provide between 11,540 MWh/yr. and 3,030 MWh/yr. of electricity by 2030 in, respectively, the Upper and Lower Achievable Potential scenarios.

Selected highlights are presented below:

- The range of potential results varies very widely between the Upper and Lower Achievable scenarios. This reflects the large number of unknown factors.
- Under the Upper scenario, the Commercial sector has a significantly higher potential than the Residential sector. However, under the Lower scenario, the potentials in the Commercial and Residential sectors are comparable.
- The largest potential may be with pellet-burning appliances, assuming an aggressive approach.
- Even under the Upper scenario, the absolute amount of savings possible from solar hot water is the smallest for the technologies examined.

- Solar PV could provide considerable generation under the Upper scenario, even though the penetration of this technology is expected to start later than for the others.

Exhibit ES 3 Summary of Annual Electric Energy Generation from Customer-supplied Renewable and Alternative Energy Technologies (MWh/yr.)

	Technology	Scenario	Achievable Potential (MWh/yr.)			
			2015	2020	2025	2030
Residential	Solar PV	Upper	0	0	423	1873
		Lower	0	0	282	1249
	Solar Thermal	Upper	62	283	724	1462
		Lower	33	152	390	787
	Pellet-Burning Appliance	Upper	78	312	700	3162
		Lower	20	78	175	791
	Sub Total	Upper	140	595	1,846	6,497
		Lower	53	230	846	2,827
Commercial	Solar PV	Upper	0	0	702	3304
		Lower	0	0	447	2102
	Solar Thermal	Upper	12	68	199	449
		Lower	6	34	100	224
	Pellet-Burning Appliance	Upper	142	972	3214	7783
		Lower	13	88	292	708
	Sub Total	Upper	155	1,040	4,116	11,535
		Lower	19	122	839	3,034
	Total	**Upper**	**295**	**1,634**	**5,962**	**18,033**
		Lower	**72**	**352**	**1,685**	**5,861**

Table of Contents

List of Exhibits

1 Introduction

1.1 Background and Objectives

Yukon residents rely on electricity not only to live meaningful, healthy lives but also to support and strengthen the economy. Given the concerns over the environmental implications, including climate change, and the limited generating capacity in the Yukon, there is growing interest not only in how electricity is generated, transmitted and distributed, but also in how efficiently it is used on the customer's end. In Yukon, as well as in a growing number of North American jurisdictions, how electricity is generated and used is being closely analyzed to find innovative ways of meeting individual and corporate energy service needs while minimizing pollution and the creation of greenhouse gases.

Experience throughout many North American jurisdictions has demonstrated that energy efficiency, conservation and customer-supplied alternative energy technologies all have a significant potential to reduce energy consumption, energy costs and emissions. The 2009 *Energy Strategy for the Yukon* also recognizes this potential and notes the following efficiency and conservation priorities:

- Avoid the cost and environmental impact of building new generation
- Increase energy efficiency in Yukon by 20% by 2020
- Reduce energy consumption in Yukon buildings
- Reduce energy consumption for transportation in Yukon
- Promote the use of energy-efficient products by providing incentives for products that meet energy performance standards
- Improve energy efficiency for Government of Yukon operations.

Efficient use of electricity through conservation, peak demand control and alternative energy sources can assist greatly in the path forward for the electrical supply industry. This study will provide a resource for Yukon Energy Corporation (YEC), Yukon Electrical Company Limited (YECL), and the Government of Yukon to develop a comprehensive vision of the territory's future electricity needs.

More specifically, the objective for this CPR 2010 study is to provide:

"…a necessary reference point to determine the potential for (electricity) demand-side management (DSM) in the Yukon."[3]

[3] Yukon Energy Corporation Request For Proposals #2010-045, "Consulting Services for Electricity Conservation and Demand Management Potential Study," 2011.

1.2 Scope of Study

The scope of this study is summarized below:

- **Sector Coverage:** This study addresses two sectors: residential households (Residential sector), and commercial and institutional buildings (Commercial sector). Yukon's on-grid Industrial sector consists primarily of a small number of operating mines, which are not appropriate to be included in this type of study. Efficiency opportunities within these sites are being addressed outside this study.
- **Geographical Coverage:** The study addresses all regions of Yukon that are served by either YEC or YECL. Customers served by both the hydroelectric grid and the stand-alone diesel grids are included. Note that the hydroelectric grid is remote, not connected to other grids, and dependent on trucked fuel to meet demand above the existing hydro / wind capacity, while the stand-alone diesel grids rely on fuel that is trucked or flown in at all times.
- **Study Period:** This study covers a 20-year period. The Base Year is the calendar year 2010, with milestone periods at five-year increments: 2015, 2020, 2025 and 2030. The Base Year of 2010 was selected to enable this study's results to be aligned with the most recent load forecasting data provided by YEC.[4]
- **Technologies:** This study addresses a comprehensive range of demand-side management (DSM) measures. This includes all electrical efficiency technologies or measures that are expected to be commercially viable by the year 2015, as well as peak load reduction technologies and customer-side renewable energies.

1.2.1 Data Caveat

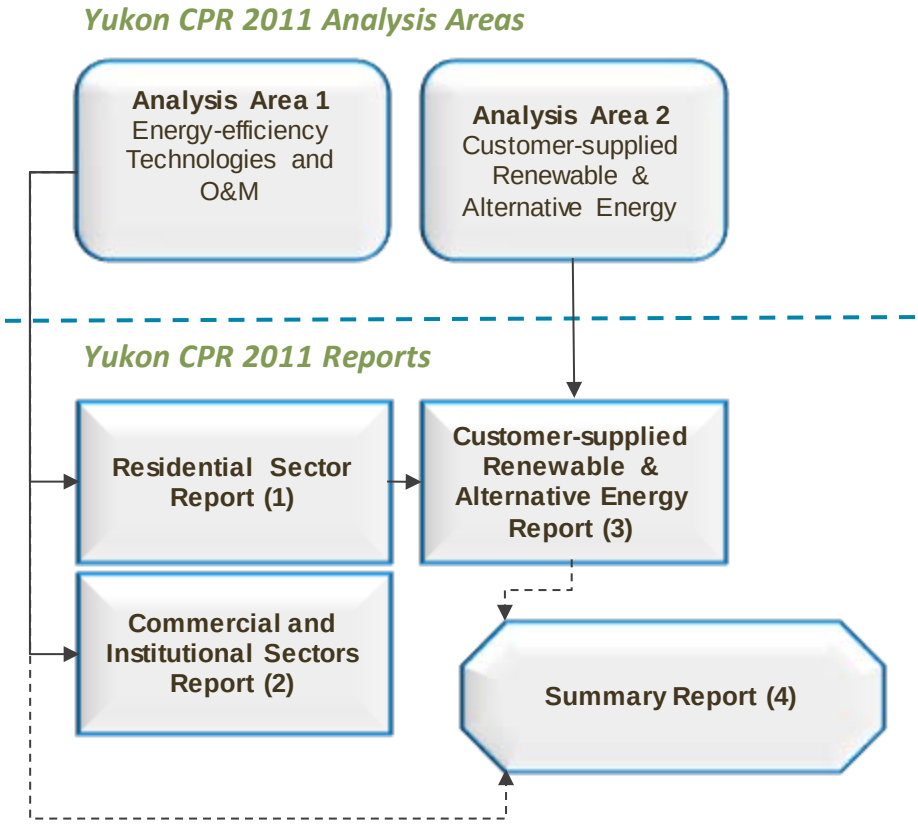
As in any study of this type, the results presented in this report are based on a large number of important assumptions. Assumptions such as those related to the current penetration of energy-efficient technologies, the rate of future growth in the stock of residential buildings and customer willingness to implement new energy-efficiency measures are particularly influential. Wherever possible, the assumptions used in this study are consistent with those used by YEC, YECL and the Government of Yukon and are based on best available information, which in many cases includes the professional judgment of the consultant team, client personnel and local experts. The reader should, therefore, use the results presented in this report as best available estimates; major assumptions, information sources and caveats are noted throughout the report.

1.3 Study Organization

Exhibit 1 presents an overview of the study's organization; as illustrated, the study has been organized into two analysis areas and four individual reports. A brief description of each analysis area and the report contents is provided below in Exhibit 1.

[4] Yukon Energy Corporation, *20-Year Resource Plan – 2011, First Draft*, April 2011.

Exhibit 1 Overview of CPR 2011 Organization – Analysis Areas and Reports



1.3.1 Analysis Area 1 – Energy-efficiency and Peak Load Technologies and O&M

This area of the CPR 2011 assesses electric energy and peak load reduction opportunities that could be provided by electrical efficiency and peak load reduction technologies that are expected to be commercially viable by the year 2015; operation and maintenance (O&M) practices are also addressed. The results of Analysis Area 1 are presented in two individual sector reports and summarized in the Summary Report.

1.3.2 Analysis Area 2 – Customer-Supplied Renewable and Alternative Energies

This area of the CPR 2011 assesses electric energy reduction opportunities that could be provided by customer-supplied renewable energies. The results of Analysis Area 2 are presented in a single report and are also summarized in the Summary Report.

1.4 Report Organization

This report presents the Customer-side Renewable and Alternative Energy (CSRAE) results. It is organized and presented as follows:

- Section 2 presents an overview of the study methodology, including a definition of key terms and an outline of the major analytic steps involved.
- Section 3 presents the forecast level of Residential sector electricity use in Yukon over the period 2010 to 2030. The information presented in this section is an abridged version of the

more detailed analysis contained in the companion report entitled *Yukon Electricity Conservation and Demand Management Potential Review: Residential Sector.*

- Section 4 presents the forecast level of Commercial sector electricity use in Yukon over the period 2010 to 2030. The information presented in this section is an abridged version of the more detailed analysis contained in the companion report entitled *Yukon Electricity Conservation and Demand Management Potential Review: Commercial Sector.*
- Section 5 identifies and assesses the selected CSRAE technologies for the Residential and Commercial sectors.
- Section 6 presents the Economic Potential Electricity Forecast for the CSRAE technologies over the study period 2010 to 2030 for the Residential and Commercial sectors.
- Section 7 presents the estimated Upper and Lower Achievable Potential for CSRAE technologies over the study period 2010 to 2030 for the Residential and Commercial sectors.

Appendix A presents the tables used to calculate technical potential.

Appendix B presents the slides used at the 17 November 2011 Achievable Workshop.

Appendix C presents data collected at the same workshop.

2 Study Methodology

This section provides an overview of the methodology employed for this study. More specifically, it addresses:

- Definition of terms
- Major analytic steps
- Analytic models.

2.1 Definition of Terms

This study uses numerous terms that are unique to analyses such as this one and consequently it is important to ensure that readers have a clear understanding of what each term means when applied to this study.

A brief description of some of the most important terms and their application within this study is included below.

Base Year Electricity Use

The Base Year is the starting point for the analysis. It provides a detailed description of where and how electrical energy is currently used in the existing building stock. Building electricity use simulations were undertaken for the major sub sector building types and calibrated to actual utility customer billing data for the Base Year. As noted previously, the Base Year for this study is the calendar year 2010.

Base Year Electric Peak Load Profile

Electric peak load profiles refer to specific time periods throughout the year when Yukon's generation, transmission and distribution system experiences particularly high levels of electricity demand. These periods are of particular interest to system planners; improved management of electricity demand during these peak periods may enable deferral of costly system expansion. This study addresses three specific peak periods, as outlined in the main text.

Reference Case Electricity Use (includes "natural" conservation)

The Reference Case electricity use estimates the expected level of electrical energy consumption that would occur over the study period in the absence of new (post-2010) utility-based DSM initiatives. It provides the point of comparison for the subsequent calculation of Economic and Achievable electricity savings potentials. Creation of the Reference Case required the development of profiles for new buildings in each of the sub sectors, estimation of the expected growth in building stock, and finally an estimation of "natural" changes affecting electricity consumption over the study period. The Reference Case is calibrated to YEC's most recent load forecast, minus the impacts of new, future DSM initiatives.

Reference Case Electric Peak Load Profile

The Reference Case peak load profile estimates the expected electric peak loads in each of the three defined peak periods over the study period in the absence of new utility DSM program initiatives. It provides the point of comparison for the subsequent calculation of Economic and Achievable Potentials for peak load reduction.

Demand-Side Management (DSM) Measures

DSM measures can include energy efficiency (use more efficiently), energy conservation (use less), demand management (use less during peak periods), fuel switching (use a different fuel to provide the energy service) and customer-side generation (displace load off of grid). Fuel switching is not included in this study.

The Cost of Conserved Energy (CCE)

The CCE is calculated for each energy-efficiency technology measure. The CCE is the annualized incremental capital and O&M cost of the upgrade measure divided by the annual energy savings achieved, excluding any administrative or program costs. The CCE represents the cost of conserving one kWh of electricity; it can be compared directly to the cost of supplying one new kWh of electricity.

Levelized Cost of Generation/Conservation (LCG/LCC)

The LCG or LCC is calculated for each customer-side renewable or alternative energy technology measure. The LCG/LCC is the annualized incremental capital and O&M cost of the measure divided by the annual energy generated or conserved, excluding any administrative or program costs. The LCG/LCC represents the cost of generating or conserving one kWh of energy; it can be compared directly to the cost of supplying one new kWh of electricity. (The choice of LCG/LCC depends on the technology: solar PV systems generate electricity and would therefore have an LCG; wood-pellet burning furnaces conserve electricity in an electrically heated home and would therefore have an LCC.)

Economic Potential Electricity Forecast

The Economic Potential Electricity Forecast is the level of electricity consumption that would occur if all equipment and building envelopes were upgraded to the level that is cost effective against the economic threshold value,[5] which has been set at different prices per kWh for the different supply system types. (One kWh from the hydroelectric grid is much less expensive than one kWh from the diesel grid in Old Crow.) All the energy-efficiency, renewable or alternative energy upgrades included in the technology assessment that had a CCE or LCG/LCC equal to, or less than, the economic threshold value for a given supply system were incorporated into the Economic Potential Forecast.

[5] The economic threshold value is related to the cost of new avoided electrical supply. The values for each supply system were selected to provide the CPR with a reasonably useful time horizon (life) to allow planners to examine options that may become more cost effective over time. Further discussion is provided in Section 6 of this report.

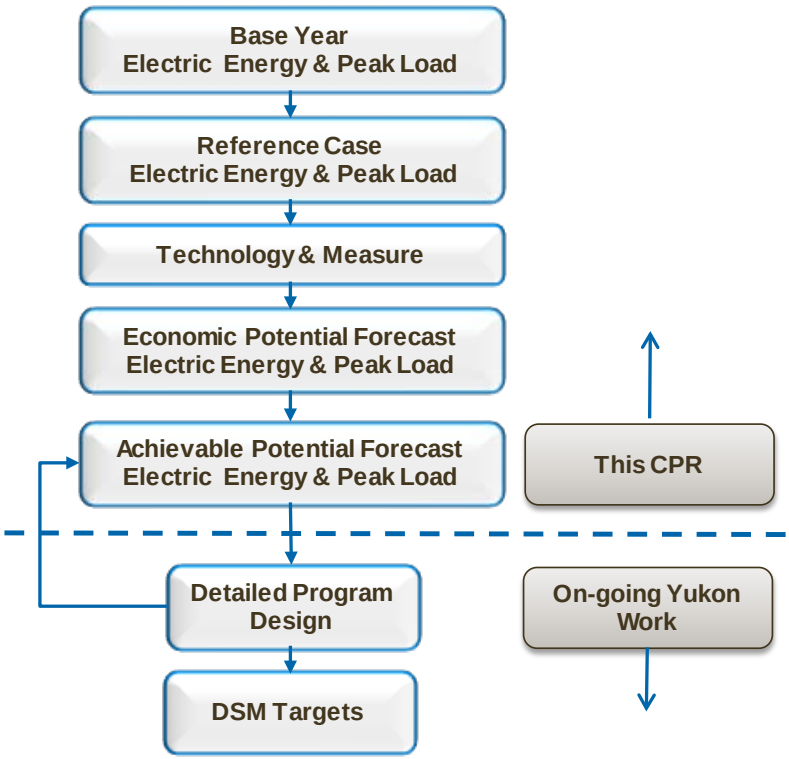
Achievable Potential

The Achievable Potential is the proportion of the savings identified in the Economic Potential Forecasts that could realistically be achieved within the study period. The Achievable Potential recognizes that it is difficult to induce customers to purchase and install all the electrical efficiency technologies that meet the criteria defined by the Economic Potential Forecast. The results are presented as a range, defined as Lower and Upper.

2.2 Major Analytic Steps

The study was conducted within an iterative process that involved a number of well-defined steps, as illustrated in Exhibit 2.

Exhibit 2 Major Analytic Steps



A summary of the steps is presented below.

Step 1: Develop Base Year Electric Energy and Peak Load Calibration Using Actual Utility Billing Data

Build a model of electric energy and demand for the sector, disaggregated to all the building types and end uses, calibrated to sales of electricity in Yukon. This includes the following sub-steps:

- Compile and analyze available data on Yukon's existing building stock.
- Develop detailed technical descriptions of the existing building stock.
- Undertake computer simulations of electricity use in each building type and compare these with actual building billing and audit data.
- Compile actual utility billing data.
- Create sector model inputs and generate results.
- Calibrate sector model results using actual utility billing data.
- Use end-use load shape data to convert electric energy use to electric demand in each selected peak period.

Step 2: Develop Reference Case Electric Energy Use and Peak Load Profile

Extend the base year model to the end of the study period, based on forecast building stock growth and expected natural changes in construction practices, equipment efficiency levels and/or practices. This includes the following sub-steps:

- Compile and analyze building design, equipment and operations data and develop detailed technical descriptions of the new building stock.
- Develop computer simulations of electricity use in each new building type.
- Compile data on forecast levels of building stock growth and "natural" changes in equipment efficiency levels and/or practices.
- Define sector model inputs and create forecasts of electricity use for each of the milestone years.
- Compare sector model results with the YEC 2010 load forecast for the study period.
- Use end-use load shape data to convert electric energy use to electric demand in each selected peak period over the study period.

Step 3: Identify and Assess Customer-side Renewable and Alternative Energy Technologies

Compile information on customer-side renewable and alternative energy measures that can save electric energy, and assess them for technical applicability and economic feasibility. This includes the following sub-steps:

- Develop list of CSRAE technologies.
- Compile Yukon renewable energy resource data.
- Compile cost and performance data for each technology.
- Identify, though modelling, the potential annual electric energy savings or generation contribution of each CSRAE technology.
- Determine the levelized unit cost of conserved or generated energy.

Step 4: Estimate Economic Electric Energy Savings Potential

Develop an estimate of the electric energy savings potential that would result from implementing all of the economically feasible measures in all the buildings where they are applicable. This includes the following sub-steps:

- Compile utility economic data on the forecast cost of new electricity generation and set an economic threshold value; different economic threshold values were selected for each supply system (hydroelectric and diesel grids).
- Screen the identified CSRAE options from Step 3 against the economic threshold values.
- Identify the potential applications of CSRAE measures within the residential and commercial buildings.

Step 5: Estimate Achievable Potential Electricity Savings

Develop an estimated range for the portion of economic potential savings that would likely be achievable within realistic DSM programs. This includes the following sub-steps:

- For each of the identified opportunities, create an Opportunity Profile that provides a high-level implementation framework, including measure description, cost and savings profile, target sub sectors, potential delivery allies, barriers and possible synergies.
- Review historical Achievable program results and prepare preliminary Assessment Worksheets.
- Conduct a half-day workshop involving the consultant team, technical experts and Yukon program personnel to reach general agreement on the Upper and Lower range of Achievable Potential.

2.3 Analytical Models

The CSRAE measures were modeled using RETScreen, a modelling tool developed and maintained by Natural Resources Canada (NRCan) specifically for analyzing renewable and alternative energy systems such as those addressed by this study. Renewable and alternative energy analysis modules supported by the software are summarized in Exhibit 3.

Exhibit 3 RETScreen Renewable/Alternative Energy Modules

Power	Heating	Cooling
▪ Fuel cell ▪ Gas turbine - combined cycle ▪ Geothermal power ▪ Hydro turbine ▪ Ocean current power ▪ Photovoltaic ▪ Reciprocating engine CHP ▪ Solar thermal power ▪ Steam turbine ▪ Tidal/wave power ▪ Wind turbine	▪ Biomass system ▪ Heat pump ▪ Passive solar heating ▪ Solar air heater ▪ Solar water heater	▪ Absorption ▪ Desiccant ▪ Free cooling ▪ Heat pump ▪ Other

RETScreen also contains energy-efficiency modules.

The total potential contribution of CSRAE measures was estimated with custom-designed spreadsheets. Tables produced by these spreadsheets can be found in Appendix A.

3 Residential Sector Electricity Use (2010 to 2030)

As noted in Section 1, this report assesses electricity load reduction opportunities that could be provided by small-scale customer-side renewable and alternative energy technologies. As the intent of the CPR is to present the results of this analysis area within a stand-alone report, this section provides highlights of Residential sector electricity use in Yukon over the 20-year planning period covered by this CPR (2010-2030).

The information presented in this section is an abridged version of the more detailed analysis contained in the main Residential sector report entitled, *Yukon Electricity Conservation and Demand Management Potential Review (CPR 2011): Residential Sector.* This abridged description of electricity use in Yukon's Residential sector presents highlights of the main report as follows:

- Yukon residential housing stock (2010 and 2030)
- Residential electricity use patterns
- Total Residential sector electricity consumption (2010 and 2030).

3.1 Yukon Residential Housing Stock (2010 and 2030)

The Yukon utility companies currently (2010) serve approximately 15,787 residential accounts; by the end of the study period (2030), the number of customers is expected to grow to approximately 21,849. To facilitate the analysis of energy-efficiency and peak load reduction opportunities, utility customer billing data, and, to a lesser extent, Yukon Housing Corporation data and the results of Yukon's Residential Electrical End-Use Survey (REEUS) were used to organize the existing residential housing stock into 17 distinct dwelling types:

- Pre-1980 electrically heated single detached homes
- 1980 & newer electrically heated single detached homes
- Pre-1980 non-electrically heated single detached homes
- 1980 & newer non-electrically heated single detached homes
- Pre-1980 electrically heated attached/row housing
- 1980 & newer electrically heated attached/row housing
- Pre-1980 non-electrically heated attached/row housing
- 1980 & newer non-electrically heated attached/row housing
- Existing electrically heated apartment/condo units
- Existing electrically heated apartment/condo common areas
- Existing non-electrically heated apartment/condo units
- Existing non-electrically heated apartment/condo common areas
- Existing electrically heated mobile/other
- Existing non-electrically heated mobile/other

- Seasonal housing
- Residential garages
- Sentinel Lighting.

Seasonal housing accounts were separated from the remaining population of housing by identifying accounts that had consumption of less than 3,000 kWh/yr. These accounts were separated in order to develop a more realistic average consumption for the dwellings that are fully occupied throughout the year.

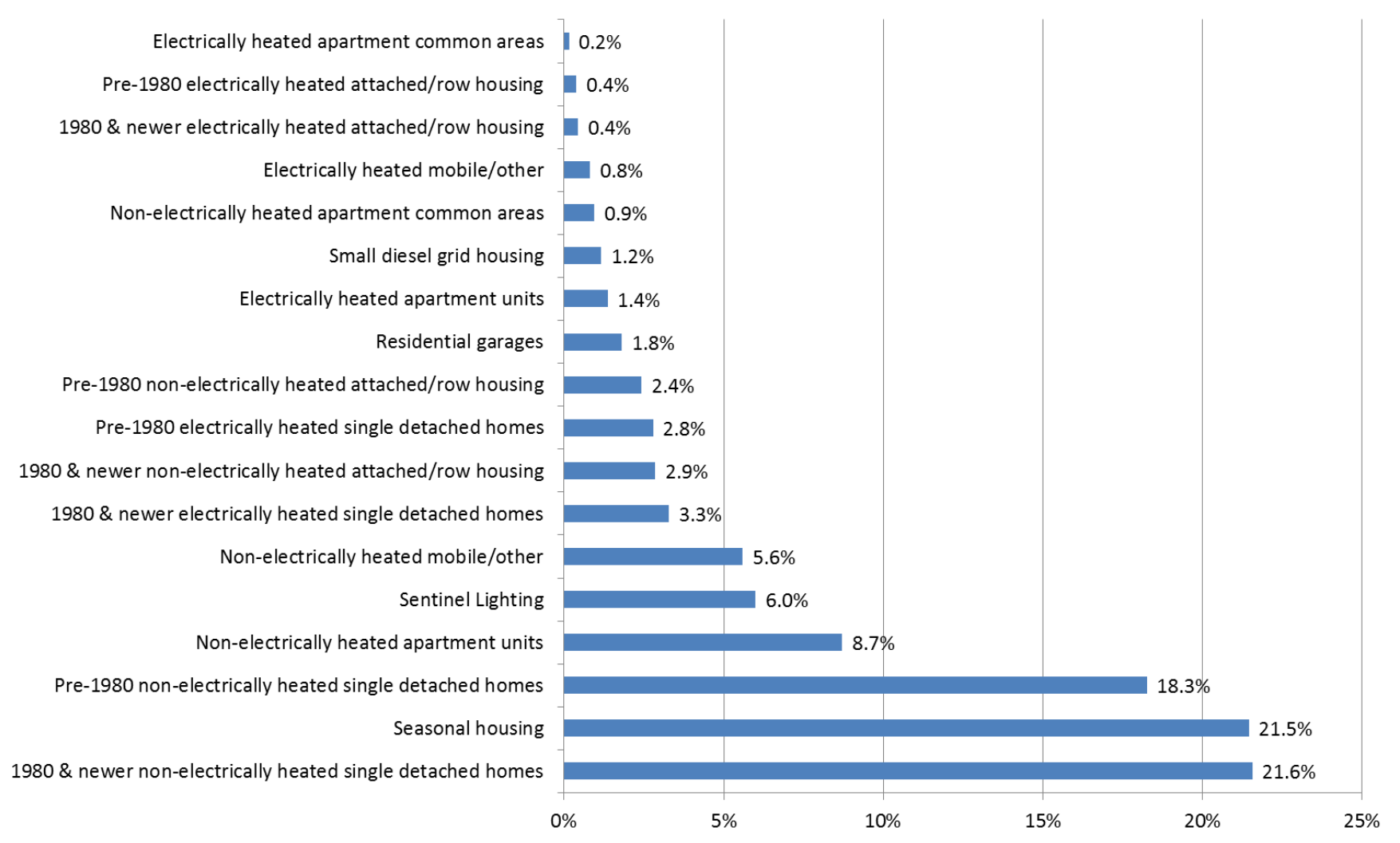
In two of the supply system categories (Small Diesel and Old Crow), the number of dwellings was too small to permit the detailed division outlined above. For these two categories, except for the garages identified in the billing data and the seasonal houses separated as above, the remaining dwellings were grouped in a category called Small Grid Housing.

A summary of the distribution of Yukon's residential dwellings is provided in Exhibit 4 and Exhibit 5. Exhibit 4 provides details of the estimated breakdown by dwelling type, supply system type and Yukon Government versus non-government accounts. Exhibit 5 shows the breakdown by dwelling type graphically.

Exhibit 4 Existing Yukon Residential Units by Dwelling Type, Supply System, and Government versus Non-government Categories

Dwelling Types	Dwelling Units								
	Hydro Grid		Large Diesel		Small Diesel		Old Crow		Total
	Non-government	Government	Non-government	Government	Non-government	Government	Non-government	Government	
1980 & newer non-electrically heated single detached homes	3,177	38	179	11	-	-	-	-	3,405
Pre-1980 non-electrically heated single detached homes	2,691	33	151	9	-	-	-	-	2,884
1980 & newer electrically heated single detached homes	513	6	-	-	-	-	-	-	519
Pre-1980 electrically heated single detached homes	434	5	-	-	-	-	-	-	439
1980 & newer non-electrically heated attached/row housing	421	5	24	1	-	-	-	-	451
Pre-1980 non-electrically heated attached/row housing	356	4	20	1	-	-	-	-	381
1980 & newer electrically heated attached/row housing	68	1	-	-	-	-	-	-	69
Pre-1980 electrically heated attached/row housing	58	1	-	-	-	-	-	-	59
Non-electrically heated apartment units	1,271	61	42	2	-	-	-	-	1,376
Non-electrically heated apartment common areas	132	15	2	1	-	-	-	-	150
Electrically heated apartment units	205	10	-	-	-	-	-	-	215
Electrically heated apartment common areas	21	3	-	-	-	-	-	-	24
Non-electrically heated mobile/other	802	3	79	0	-	-	-	-	884
Electrically heated mobile/other	129	-	-	-	-	-	-	-	129
Small diesel grid housing	-	-	-	-	88	19	64	12	184
Seasonal housing	3,041	44	171	11	56	-	65	-	3,388
Residential garages	263	1	16	-	4	-	-	-	284
Sentinel Lighting	798	-	85	-	62	-	2	-	947
Grand Total	14,378	231	769	37	211	19	131	12	15,787

Exhibit 5 Existing Yukon Residential Units by Dwelling Type



As illustrated in the above exhibits,

- Approximately 92.5% of residential accounts are connected to the hydro grid and just over 5% are connected to large diesel systems. Approximately 1.5% are connected to small diesel systems and almost 1% of those dwellings are located in Old Crow, a fly-in community also served by a small diesel system.
- Nearly 2% of residential accounts are Government of Yukon accounts. The other 98% are not.
- 46% of the residential accounts are single detached homes, just over 10% are apartment units (and approximately 1% are accounts for the common areas of apartment buildings), approximately 6% are attached dwellings such as duplexes, row houses or townhouses, and 6.5% are mobile homes. Approximately 6% are separate accounts for Sentinel Lighting, nearly 2% are detached garages with separate accounts, and just over 1% are in the Small Grid Housing category. The percentages for single detached homes and Small Grid Housing are reduced by the removal of the accounts under 3,000 kWh/yr., which account for 21.5% of the accounts and are considered seasonally-occupied housing (cottages or cabins).
- The single-family detached and attached homes are divided into older and newer dwellings using 1980 as a dividing line. Approximately 46% of the dwellings were built before 1980.
- Electricity is a relatively uncommon heating fuel in Yukon. In fact, in diesel grid communities, using electricity as the main heating fuel in a dwelling is not permitted. Consequently, only approximately 13% of dwellings in Yukon use electricity as their main heating fuel. The remaining 87% mainly use oil, propane or wood. The use of electricity for heating in the areas served by the hydro grid is rapidly increasing.

Exhibit 6 indicates how the residential dwellings are expected to increase over the study period.

Exhibit 6 Residential Accounts by Dwelling Type and Milestone Year

Dwelling Types	Number of Dwellings			
	2015	2020	2025	2030
1980 & newer non-electrically heated single detached homes	3,724	4,021	4,291	4,535
Pre-1980 non-electrically heated single detached homes	2,884	2,884	2,884	2,884
1980 & newer electrically heated single detached homes	769	1,044	1,336	1,635
Pre-1980 electrically heated single detached homes	439	439	439	439
1980 & newer non-electrically heated attached/row housing	495	535	573	606
Pre-1980 non-electrically heated attached/row housing	381	381	381	381
1980 & newer electrically heated attached/row housing	128	202	291	392
Pre-1980 electrically heated attached/row housing	59	59	59	59
Non-electrically heated apartment units	1,501	1,622	1,736	1,841
Non-electrically heated apartment common areas	163	176	188	200
Electrically heated apartment units	400	697	1,133	1,731
Electrically heated apartment common areas	44	76	123	187
Non-electrically heated mobile/other	927	968	1,005	1,038
Electrically heated mobile/other	163	200	239	280
Small diesel grid housing	189	195	202	209
Seasonal housing	3,558	3,717	3,863	3,995
Residential garages	298	312	324	334
Sentinel Lighting	990	1,031	1,068	1,101
Grand Total	17,114	18,561	20,134	21,849

3.2 Residential Sector Electricity Use Patterns

Electricity use within each of the dwelling types listed above is divided into specific end uses. In this study, an end use is defined as “the final application or final use to which energy is applied.” End uses are the services of economic value to the users of energy. Exhibit 7 and Exhibit 8 provide additional detail:

- Exhibit 7 provides a summary of the major Residential sector end uses used in this study, together with a brief description of each.
- Exhibit 8 shows the relative distribution of Residential sector electricity in 2010 through 2030 by dwelling type and end use.

Exhibit 7 Residential Electric End Uses

End Use	Description
Space heating	All space heating, including both central heating and supplementary heating
Ventilation and circulation	Primarily the furnace fan, but also includes the fan in heat recovery ventilators as well as kitchen and bathroom fans. Also includes pumps in hydronic heating systems
Domestic hot water (DHW)	Heating of water for DHW use. Does not include hydronic space heating
Indoor lighting	Interior lighting, excluding indoor holiday lighting
Outdoor lighting	Exterior lighting, excluding outdoor holiday lighting
Holiday lighting	Holiday lighting, including both indoor and outdoor
Cooking	Includes ranges, separate ovens and cook tops and microwave ovens
Refrigerator	
Freezer	
Dishwasher	
Clothes washer	
Clothes dryer	
Spa heaters and pumps	Includes both indoor and outdoor spas, both the heating systems and the pumps
Computer and peripherals	Computers, both desktop and laptop, printers, scanners, modems, faxes, PDA and cell phone chargers, security systems, etc.
Television	
Set-top boxes	Includes digital cable converters, satellite converters, and PVRs
Home entertainment electronics	Stereos, DVD players, VCRs, boom boxes, radios, video gaming systems
Block heaters & car warmers	Electric plug-in devices for pre-heating the engine block of a car for ease of starting, and for warming up the passenger compartment of the car. Also includes car battery warmers
Heat tape, propane heaters, circulation pumps	Electric plug-in devices for preventing water lines from freezing, including both heat tape and circulation pumps, and devices for warming outdoor propane tanks so the propane will flow easily
Small appliance & other	There are hundreds of additional items within this category, each accounting for a fraction of a percent of household energy use, e.g., hair dryers, doorbells, garage door openers, home medical equipment, electric lawnmowers, etc.

Exhibit 8 Distribution of Electricity Consumption, by Dwelling Type and End Use in the Base Year (2010)

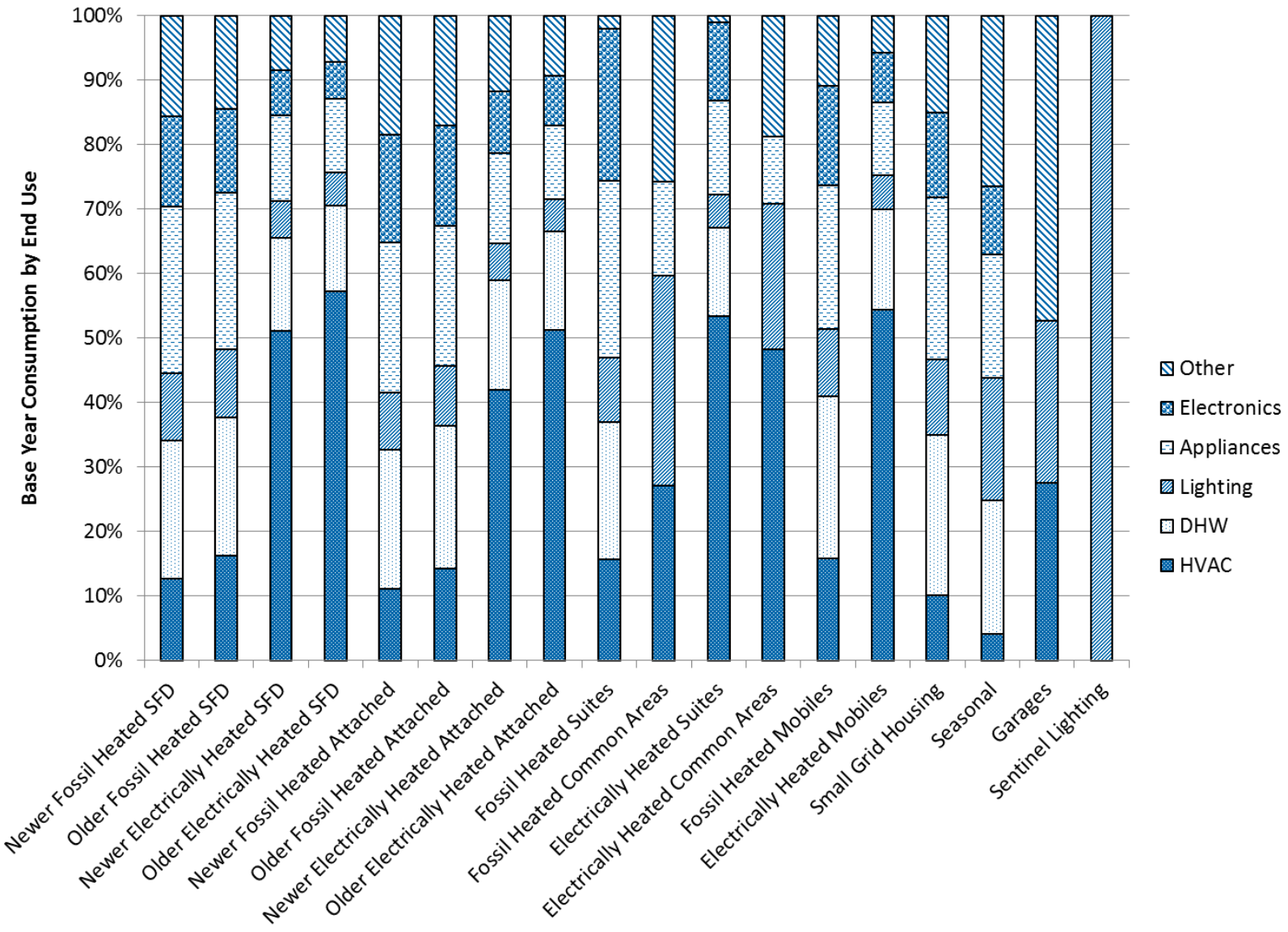


Exhibit 8 highlights the differences among dwelling types. In general, for example, attached dwellings show a lower percentage of consumption for HVAC than single detached houses. The exhibit also highlights how much more of the electricity is used for HVAC in an electrically heated dwelling.

3.3 Total Residential Electricity Consumption (2010 and 2030)

The following five exhibits present the Reference Case over the course of the study period (2010 to 2030). As with all results presented in this report, values are those that would be measured at the customer's point-of-use and do not include line losses.

- Exhibit 9 presents the model results in tabular form, by dwelling type, end use and milestone year
- Exhibit 10 graphically presents the model results for 2030 by dwelling type
- Exhibit 11 graphically presents the model results for 2030 by supply type and government versus non-government
- Exhibit 11 graphically presents the model results for 2030 by end use.

Exhibit 9 Reference Case Electricity Consumption, Modelled by End Use, Dwelling Type and Milestone Year (MWh/yr.)

Dwelling Types	Milestone Years	HVAC	Appliances	Electronics	DHW	Other	Lighting	TOTAL
Single Detached House	2010	24,479	23,194	12,428	20,552	14,007	9,744	104,403
	2015	27,942	23,657	15,590	20,520	13,193	9,772	110,674
	2020	31,696	24,843	19,436	20,511	12,845	9,697	119,029
	2025	35,609	26,330	23,788	20,975	16,096	9,503	132,301
	2030	39,582	28,003	29,950	21,404	22,968	9,185	151,092
Apartment/Condo Suites and Common Areas	2010	3,634	2,951	2,087	1,943	1,106	2,066	13,786
	2015	5,185	2,647	2,879	2,142	1,345	2,246	16,444
	2020	7,542	3,074	4,033	2,465	1,786	2,464	21,363
	2025	10,906	3,707	5,627	2,988	2,777	2,705	28,711
	2030	15,445	4,559	8,129	3,691	4,764	2,943	39,531
Attached Dwelling	2010	2,040	2,130	1,521	2,149	1,697	865	10,403
	2015	2,469	2,238	1,942	2,203	1,600	879	11,331
	2020	3,000	2,394	2,470	2,284	1,533	887	12,568
	2025	3,624	2,634	3,078	2,441	1,897	885	14,560
	2030	4,330	2,901	3,931	2,620	2,693	870	17,345
Mobile	2010	2,435	1,962	1,352	2,276	966	918	9,908
	2015	2,777	1,933	1,684	2,267	973	919	10,553
	2020	3,126	2,011	2,083	2,262	1,041	911	11,435
	2025	3,477	2,116	2,524	2,309	1,374	893	12,693
	2030	3,825	2,238	3,137	2,352	2,021	863	14,436
Garages and Seasonal Housing	2010	408	760	421	820	1,462	975	4,846
	2015	428	757	529	797	1,387	956	4,853
	2020	446	772	679	772	1,356	927	4,952
	2025	462	794	878	763	1,624	889	5,410
	2030	478	820	1,189	752	2,155	843	6,237
Small Grid Housing	2010	206	510	267	504	304	237	2,029
	2015	213	507	322	483	274	228	2,027
	2020	221	512	389	463	256	218	2,058
	2025	229	525	465	455	306	207	2,187
	2030	238	543	579	449	416	195	2,421
Sentinel Lighting	2010	-	-	-	-	-	609	609
	2015	-	-	-	-	-	623	623
	2020	-	-	-	-	-	634	634
	2025	-	-	-	-	-	657	657
	2030	-	-	-	-	-	678	678
TOTAL	2010	33,201	31,506	18,076	28,244	19,542	15,414	145,984
	2015	39,013	31,739	22,946	28,412	18,771	15,623	156,505
	2020	46,031	33,606	29,092	28,756	18,817	15,738	172,039
	2025	54,308	36,107	36,360	29,931	24,074	15,739	196,519
	2030	63,898	39,064	46,915	31,268	35,017	15,577	231,739

Notes:
1) Results are measured at the customer's point-of-use and do not include line losses.
2) Any differences in totals are due to rounding.
3) Rounding reduces many non-zero values in this table to apparent zeroes.

Exhibit 10 Distribution of Electricity Consumption in 2030 by Dwelling Type

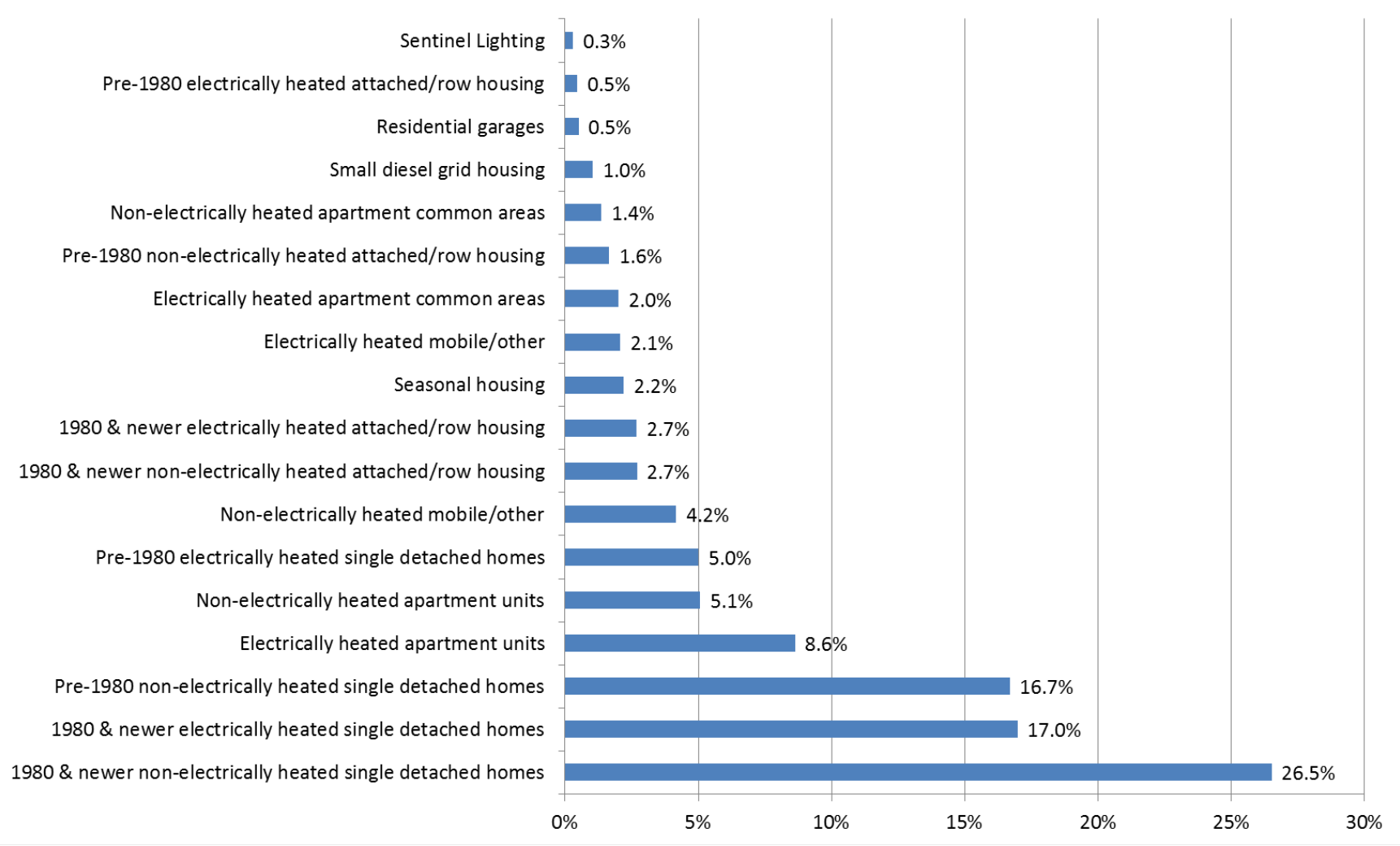


Exhibit 11 Distribution of Electricity Consumption, by Supply Type and Government versus Non-government in the Base Year (2030)

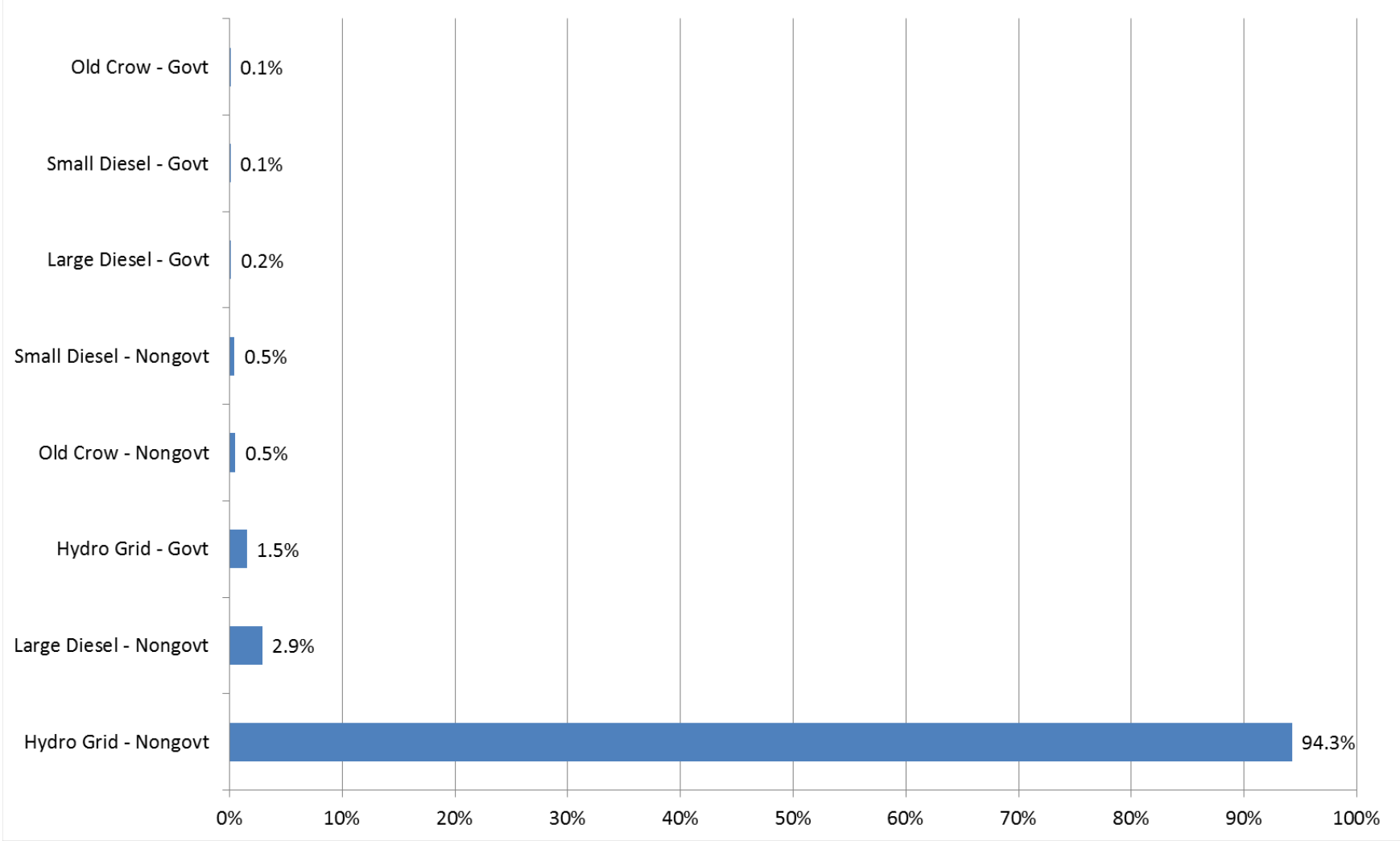


Exhibit 12 Distribution of Electricity Consumption in 2030 by End Use

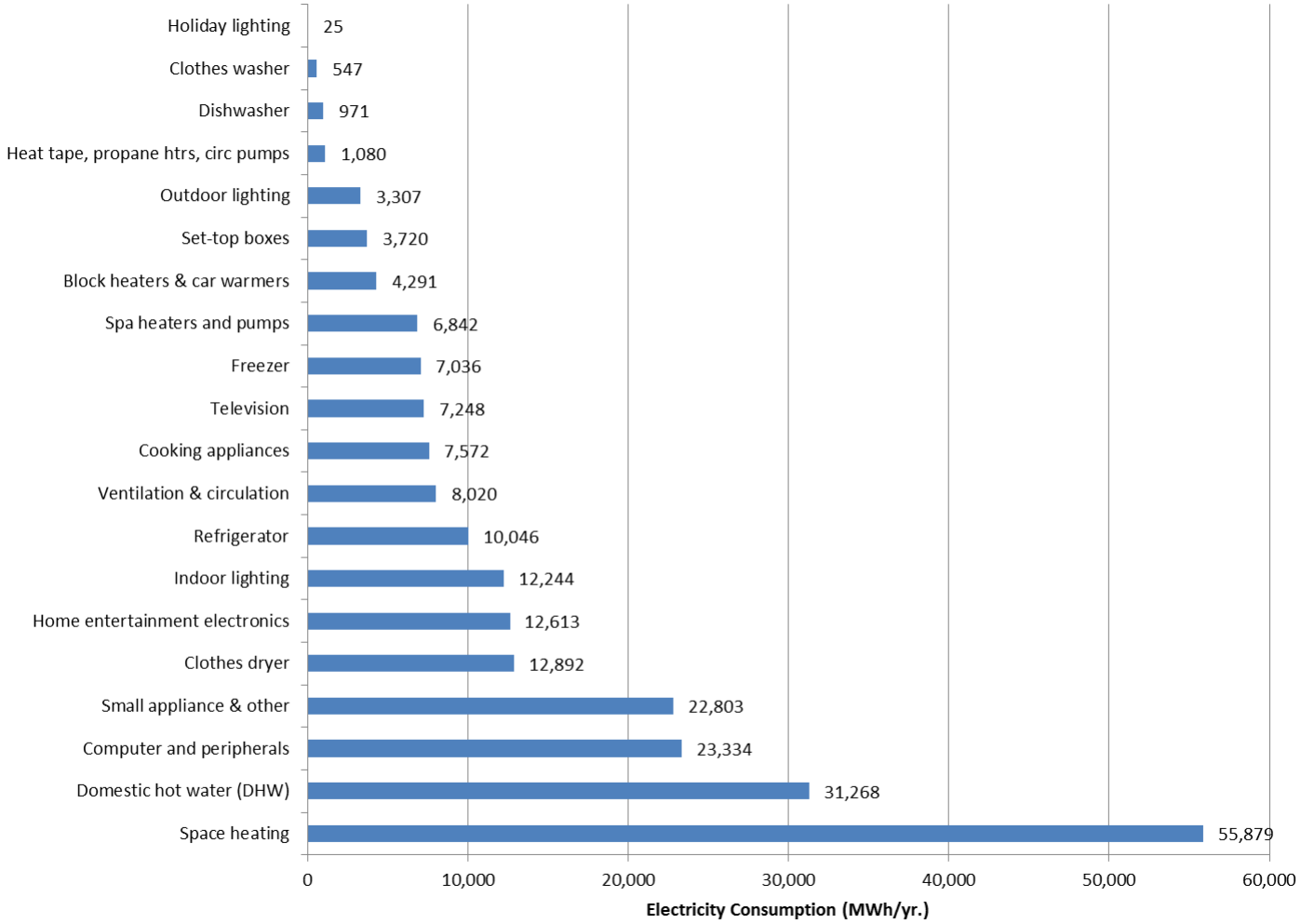
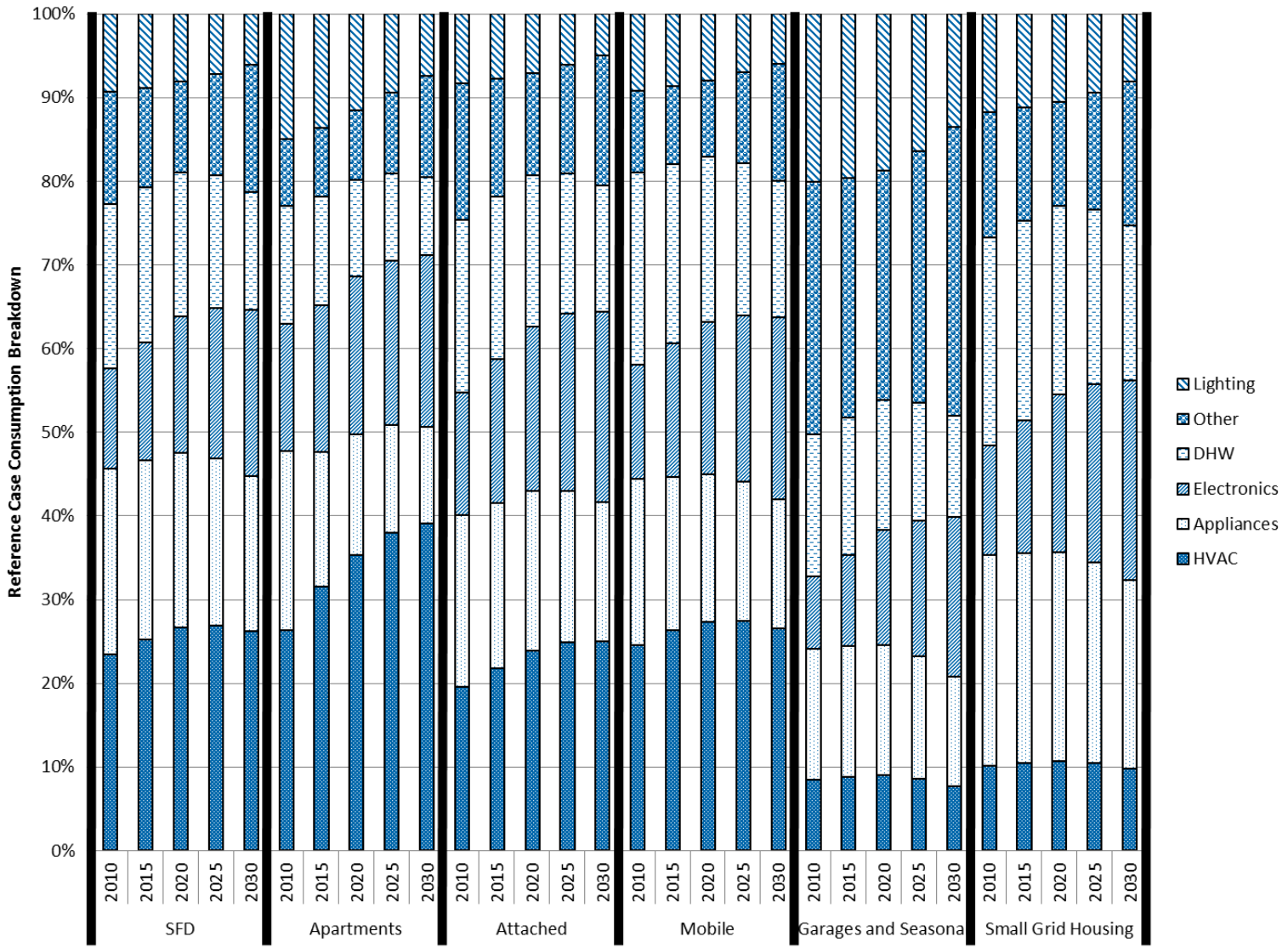


Exhibit 13 Distribution of Electricity Consumption, by Dwelling Type and End Use in the Base Year (2010 to 2030)



Selected highlights of electricity use in 2030 are provided below.

By Dwelling Type

Single detached dwellings will continue to account for the majority of residential electricity use in Yukon, but will decline to approximately 65% of residential electricity consumed in 2030. Attached houses (duplexes, row houses and townhouses), will account for the next largest share, rising to 17% of residential electricity. Apartment buildings, including both the suites and common areas, are expected to account for 7% of residential electricity. Mobile homes will consume approximately 6% of residential electricity.

Seasonal houses are expected to use just over 2% of residential electricity. The dwellings in the Small Grid Housing category (accounts connected to small diesel grids and the Old Crow system) will continue to account for approximately 1% of residential electricity by 2030. Residential garages are expected to consume just over 0.5% of residential electricity. Sentinel Lighting is expected to use less than 0.5% of residential electricity.

By Supply Type and Government versus Non-government Accounts

The accounts connected to the hydro grid are expected to consume approximately 96% of residential electricity in 2030. Accounts connected to large diesel grids will consume approximately 3% of residential electricity. Accounts connected to small diesel grids are expected to consume less than 1% of residential electricity, as will accounts in the fly-in community of Old Crow.

Government of Yukon accounts are expected to consume approximately 2% of residential electricity in 2030, with non-government accounts consuming the other 98%.

By End Use

HVAC is expected to account for 28% of consumption in 2030, a modest decline from the current level; 24% of that will be electric space heating and the remainder will be fans and pumps, including furnace fans, boiler circulation pumps, HRV fans, and bathroom and kitchen exhaust.

Domestic water heating is expected to account for approximately 13% of residential electricity consumption by 2030, a substantial decline from current values. This decrease is expected to occur primarily because of improved efficiency of devices in the home that use hot water, such as dishwashers, clothes washers, showerheads and faucet aerators.

4 Commercial Sector Electricity Use (2010 to 2030)

To provide background for the discussion of CSRAE technologies in the Commercial sector, this section provides highlights of Commercial[6] sector electricity use in Yukon over the 20-year planning period covered by this CPR (2010-2030). The information presented in this section is an abridged version of the more detailed analysis contained in the main Commercial sector report entitled, *Yukon Electricity Conservation and Demand Management Potential Review (CPR 2011): Commercial Sector.* This abridged description of electricity use in Yukon's Commercial sector presents highlights of the main report as follows:

- Yukon commercial building stock (2010 and 2030)
- Commercial electricity use patterns
- Total Commercial sector electricity consumption (2010 to 2030).

4.1 Yukon Commercial Building Stock (2010 and 2030)

To facilitate the analysis of energy-efficiency and peak load reduction opportunities, Yukon utility customer billing data and building modelling results were used to organize the existing commercial building stock into 16 distinct sub sectors, as listed in Exhibit 14.

Exhibit 14 Commercial Sub Sectors

▪ Office	▪ Warehouse/Wholesale
▪ Food Retail	▪ Other General Service Buildings
▪ Non-Food Retail	▪ Street Lighting
▪ Hotel/Motel	▪ Non-Buildings
▪ Health	▪ Parking Lot Plug[7]
▪ Education	▪ General Service Buildings – Diesel Rate Zones
▪ Restaurant & Tavern	▪ Non-Buildings – Diesel Rate Zones
▪ Recreation Centres	▪ Street Lighting – Diesel Rate Zones

The following sub sectors require further explanation:

- **Recreation Centres.** This sub sector generally includes skating or curling rinks with both natural and artificial ice.
- **Other General Service Buildings**. This sub sector represents buildings that do not fit into the specific sub sectors shown in Exhibit 14 including churches, theatres, service stations and transportation buildings, as well as buildings with a significant "process" load such as placer mines, manufacturing and light industrial facilities. This sub sector is not subjected to the same detailed analysis as the other building sub sectors.
- **Non-buildings.** This sub sector includes facilities such as microwave repeater stations and telephone exchanges. Although these accounts are sometimes associated with a "building,"

[6] Throughout this report, the term "commercial" is used to include both commercial and institutional buildings unless otherwise noted.
[7] The Parking Lot Plug sub sector includes only those accounts serving separately metered parking lot receptacles.

the majority of their electricity use is consumed by the unique equipment that they house. This sub sector will be tracked throughout the study but will not be subjected to detailed analysis.

The addition of floor area is used to drive changes in Yukon's commercial building stock over the study period, including changes to equipment and electricity use. For the purposes of this study, the base case floor area was derived by dividing the actual utility sales data for each building sub sector by the applicable fuel share and saturation-weighted whole-building electricity use intensity (EUI).

Exhibit 15 shows the resulting estimates of floor area within each building sub sector for the hydro grid, while Exhibit 16 provides estimates of the total commercial floor area in each of the three diesel grids.

Exhibit 15 Commercial Sector Floor Space, by Sub Sector and Milestone Year – Hydro Region

Sub Sector	Floor Area (ft^2)				
	2010	2015	2020	2025	2030
Office	1,364,000	1,541,000	1,742,000	1,968,000	2,224,000
Food Retail	195,000	221,000	250,000	282,000	319,000
Non-food Retail	912,000	1,034,000	1,171,000	1,327,000	1,503,000
Hotel / Motel	618,000	697,000	786,000	886,000	1,000,000
Healthcare	209,000	235,000	264,000	296,000	333,000
Education	1,742,000	1,987,000	2,267,000	2,586,000	2,949,000
Restaurant	195,000	224,000	257,000	295,000	339,000
Recreation Centres	499,000	556,000	619,000	690,000	768,000
Warehouse / Wholesale	1,439,000	1,629,000	1,844,000	2,087,000	2,362,000
Other General Service	1,782,000	1,993,000	2,228,000	2,492,000	2,786,000
Grand Total	8,955,000	10,116,000	11,427,000	12,909,000	14,584,000

Exhibit 16 Commercial Sector Floor Space, by Sub Sector and Milestone Year – Diesel Regions

Region	Floor Area (ft^2)				
	2010	2015	2020	2025	2030
Large Diesel	464,000	477,000	490,000	504,000	519,000
Small Diesel	118,000	119,000	120,000	121,000	121,000
Old Crow	57,000	63,000	69,000	76,000	83,000
Grand Total	639,000	658,000	679,000	701,000	723,000

The total estimated 2010 floor area is 9.6 million square feet, with approximately 93% of this found in the hydro grid region. By 2030, the total estimate floor area is 15.3 million square feet, with approximately 95% of the area in the hydro grid area.

4.2 Commercial Sector Electricity Use Patterns

Electricity use within each of the sub sectors listed above is divided into specific end uses. In this study, an end use is defined as "the final application or final use to which energy is applied." End uses are the services of economic value to the users of energy. Exhibit 17 through Exhibit 21 provide additional detail.

- Exhibit 17 provides a summary of the major Commercial sector end uses used in this study, together with a brief description of each.
- Exhibit 18 shows the Base Year (2010) annual electricity consumption by sub sector and end use. As with all of the exhibits in this study, electricity consumption is measured at the customer's point-of-use and does not include line losses.
- Exhibit 19 and Exhibit 20 graphically show the Base Year (2010) annual electricity consumption by sub sector and end use.
- Exhibit 21 shows the Base Year (2010) distribution by supply type and government versus non-government buildings.

Exhibit 17 Commercial Sector End Uses

End-Use	Description/Comments
General lighting	Lighting in main function areas of building - typically linear fluorescent
Architectural lighting	Lighting in lobbies, corridors, stairwells, etc. – typically incandescent or compact fluorescent
High-bay lighting	High-bay lighting in warehouses, gymnasiums, etc.
Outdoor lighting	Security lighting, outdoor signage, parking lot lights
Space heating	Electric boilers, unit heaters, baseboard heaters, portable space heaters, heat pumps, etc.
Space cooling	Compressors associated with chillers and DX equipment
HVAC fans & pumps	Auxiliaries including fans, pumps, cooling tower fans
DHW	DHW boilers, tank heaters
Computers & office equipment	Computers, monitors, servers, printers, copiers, etc.
Other plug loads	Receptacle loads except computers & office equipment
Cooking equipment	Food preparation equipment including ranges, broilers, ovens
Refrigeration	Fridges, coolers, display cases, walk-in coolers and freezers, open coolers, open freezers, ice plants (in ice rinks)
Elevator	Passenger and freight elevators, escalators
Miscellaneous	Miscellaneous equipment
Street lighting	Roadway lighting
Block Heater	Separately metered parking lot receptacles serving automotive block heaters.

Exhibit 18 Base Year Annual Electricity Consumption by Sub Sector and End Use (MWh/yr.)

Sub Sector	General Lighting	Architectural Lighting	High-bay Lighting	Outdoor Lighting	Space Heating	Space Cooling	HVAC Fans and Pumps	Water Heating	Computer Equipment	Other Plug Loads	Cooking Equipment	Refrigeration	Miscellaneous	Non Buildings	Street Lighting	Block Heater	Grand Total
Office	6,006	1,989	-	597	5,637	569	2,680	440	3,783	975	134	141	841	-	-	-	23,792
Food Retail	588	579	993	257	547	38	473	101	171	164	121	6,056	50	-	-	-	10,137
Non-food Retail	4,647	2,477	929	799	1,938	152	1,274	134	490	587	236	353	236	-	-	-	14,252
Hotel / Motel	805	1,443	-	271	2,025	136	912	622	338	305	199	479	221	-	-	-	7,756
Healthcare	1,165	430	-	183	640	43	1,220	70	232	363	108	81	96	-	-	-	4,630
Education	3,576	1,413	545	382	2,961	48	1,536	988	1,070	871	450	450	225	-	-	-	14,514
Recreation Centres	480	256	1,793	547	156	3	327	128	25	207	290	2,397	129	-	-	-	6,739
Restaurant	431	1,556	-	554	1,147	62	623	331	95	125	816	1,758	50	-	-	-	7,549
Warehouse / Wholesale	829	681	5,993	630	1,043	6	859	111	658	597	149	2,601	372	-	-	-	14,529
Other Gen Service	8,462	3,719	907	1,171	5,434	507	2,995	405	2,950	1,210	314	437	779	-	-	-	29,290
General Service - Diesel Grids	1,798	1,100	718	382	60	125	958	316	636	387	228	967	208	-	-	-	7,885
Non-Buildings	-	-	-	-	-	-	-	-	-	-	-	-	-	20,795	-	-	20,795
Street lighting	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,917	-	3,917
Parking Lot Plug	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	348	348
Grand Total	**28,786**	**15,643**	**11,878**	**5,773**	**21,587**	**1,689**	**13,859**	**3,647**	**10,450**	**5,792**	**3,044**	**15,719**	**3,207**	**20,795**	**3,917**	**348**	**166,133**

Exhibit 19 Distribution of Electricity Consumption by Sub Sector, Base Year (2010)

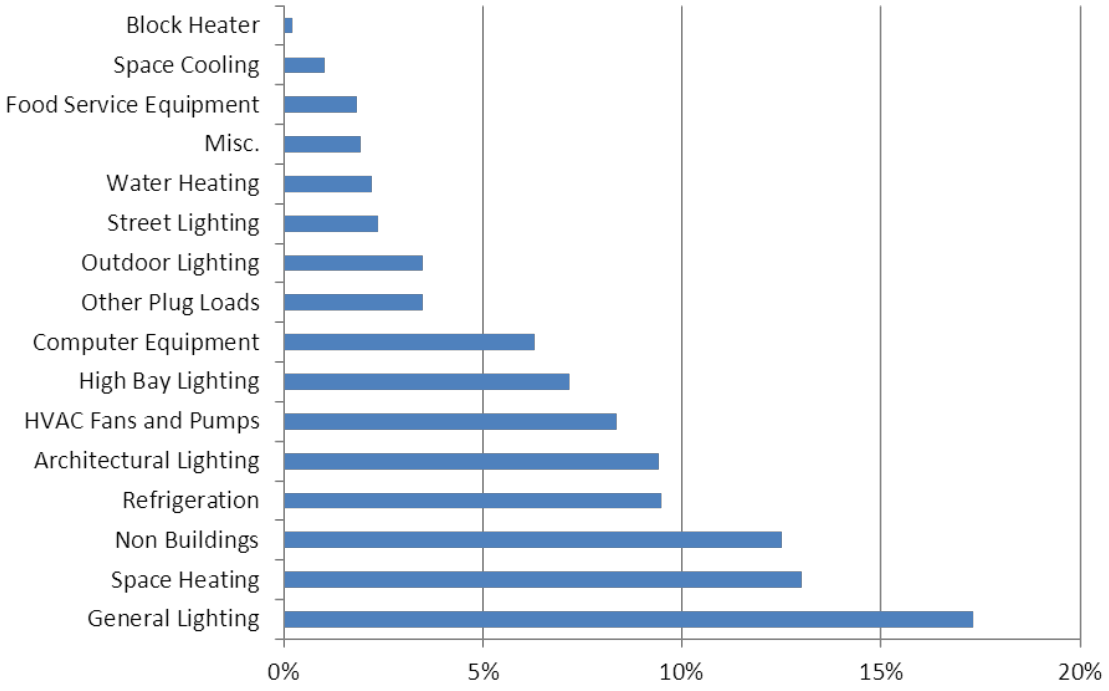


Exhibit 20 Distribution of Electricity Consumption by End Use, Base Year (2010)

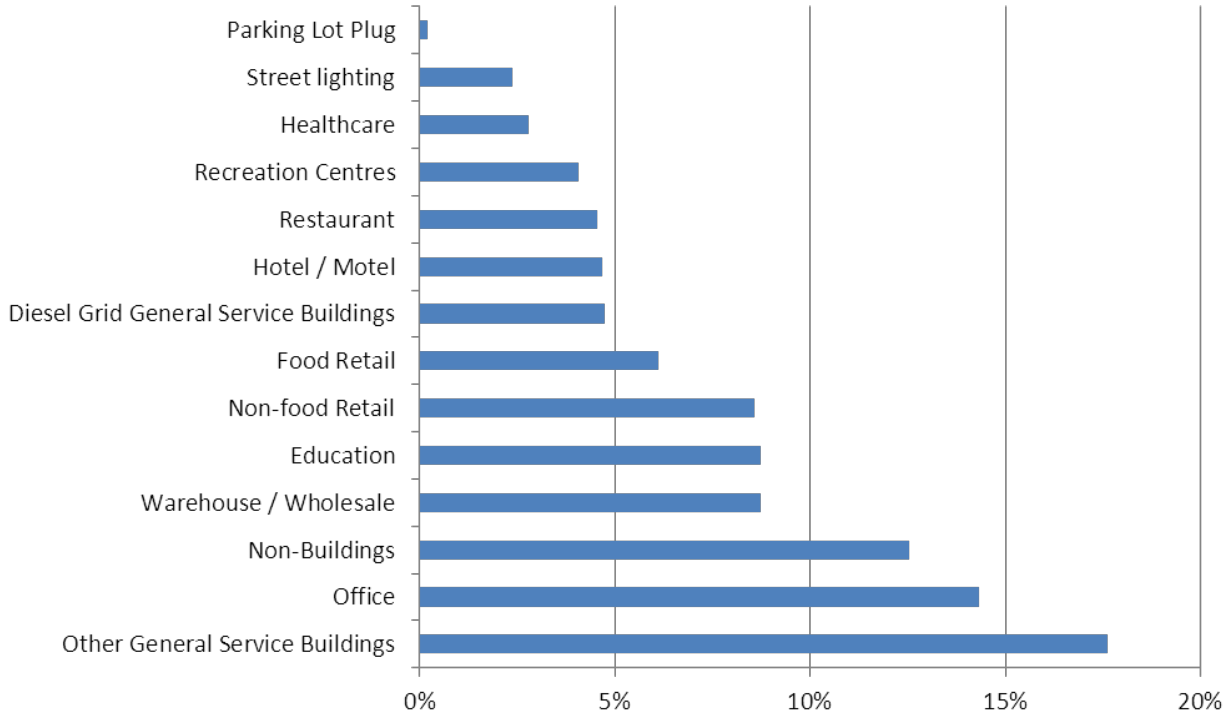
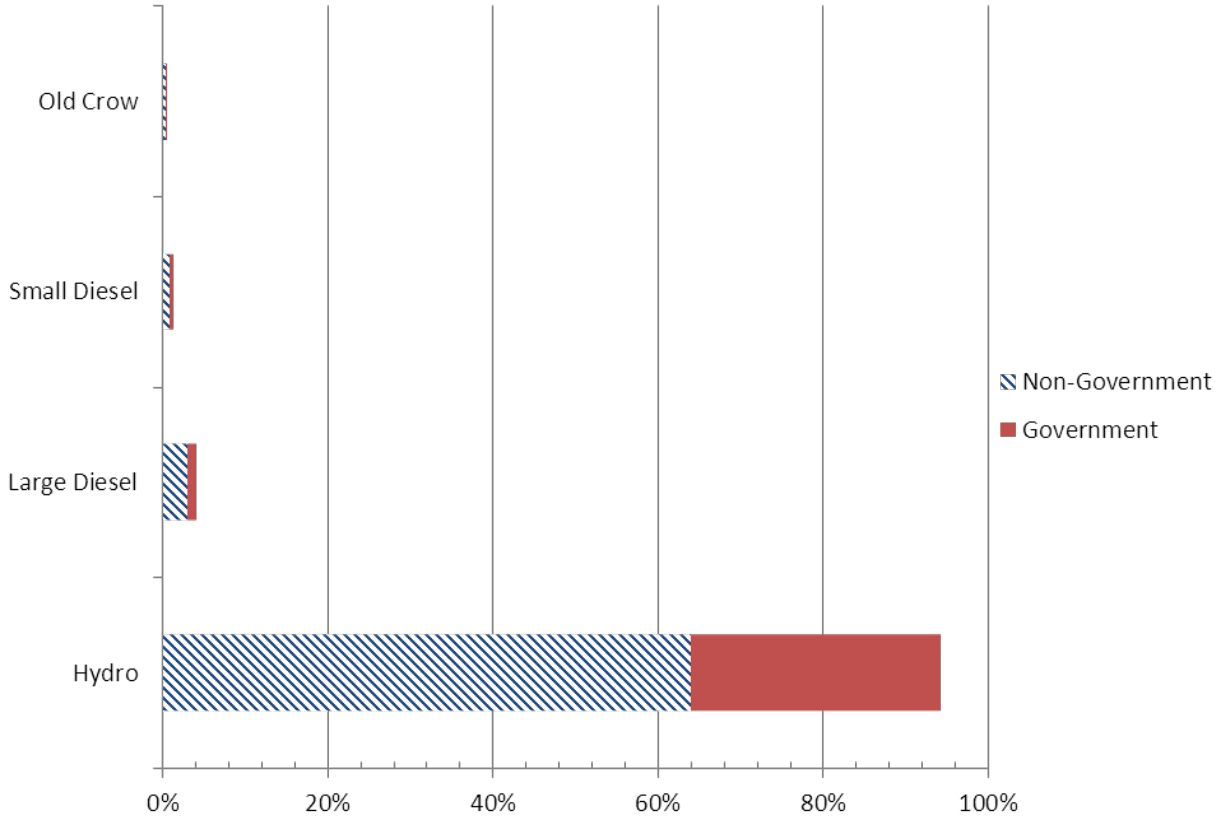


Exhibit 21 Distribution of Electricity Consumption by Supply Type and Government versus Non-government, Base Year (2010)



Highlights from the above exhibits include:

- Other General Service buildings account for the largest share of electricity use within the building sub sectors (18%), followed by Office (14%) and Education, Warehouse/Wholesale & Non-food Retail at 9% each.
- Non-buildings account for 13% of Base Year Commercial sector electricity use
- Space heating is the second largest end use, accounting for 13% of commercial sector electricity use followed by refrigeration (9%), HVAC Fans & Pumps (8%), and computer equipment (6%).
- The accounts connected to the hydro grid consume approximately 94% of commercial electricity. Accounts connected to large diesel grids consume approximately 4% of commercial electricity. Accounts connected to small diesel grids consume approximately 1% of commercial electricity, while accounts in the fly-in community of Old Crow account for less than 1%.
- Government accounts make up approximately one third of commercial electricity use

4.3 Total Commercial Electricity Consumption (2010 and 2030)

Exhibit 22 and Exhibit 23 present the Reference Case over the course of the study period (2010 to 2030). As with all results presented in this report, values are those that would be measured at the customer's point-of-use and do not include line losses.

Highlights from these exhibits include:

Hydro Grid

Overall electricity use grows a total of 71% over the study period. This growth is driven in large part by increases in Space Heating electricity consumption, which grows 179% between 2010 and 2030, due to a large number of new electrically-heated buildings being introduced in to the building stock. A knock-on effect of the move toward electric space heating in new buildings is that electricity consumption for water heating also increases dramatically (211%), as electrically heated buildings rarely invest in fossil fuel infrastructure for water heating only.

In terms of absolute contribution, Space Heating accounts for the largest portion of overall load growth (nearly 39,000 MWh, or approximately one-third of total load growth). This is followed by General Lighting (10%), HVAC Fans & Pumps (8%), Refrigeration (8%) and Computer Equipment (7%).

Reference Case electricity consumption increases at a reasonably similar rate across all sub sectors. In general, electricity use for sub sectors in which space heating constitutes a relatively high portion of electricity use (i.e. Hotel/Motel and Education) show larger increases than average, while sub sectors in which space heating constitutes a relatively small portion of overall energy use (i.e. Recreation Centres and Food Retail) show smaller increases.

Diesel Grids

Reference Case electricity consumption is dictated almost exclusively by growth rates applied for the three diesel regions.

Exhibit 22 Reference Case Annual Electricity Consumption by Milestone, Sub Sector and End Use (MWh/yr.) – Hydro Grid

Sub Sector / Milestone Year	General Lighting	Architectural Lighting	High-Bay Lighting	Outdoor Lighting	Space Heating	Space Cooling	HVAC Fans and Pumps	Water Heating	Computer Equipment	Other Plug Loads	Cooking Equipment	Refrigeration	Miscellaneous	Non-Buildings	Street Lighting	Block Heater	Grand Total
Office													-				-
2010	6,006	1,989	-	597	5,637	569	2,680	440	3,783	975	134	141	841	-	-	-	23,792
2015	6,628	2,173	-	675	7,028	731	3,058	540	4,417	1,139	151	159	950	-	-	-	27,650
2020	7,325	2,381	-	763	8,601	912	3,484	653	5,167	1,332	171	180	1,073	-	-	-	32,044
2025	8,107	2,616	-	862	10,378	1,114	3,967	780	6,052	1,561	193	203	1,213	-	-	-	37,046
2030	8,981	2,882	-	974	12,387	1,339	4,511	924	7,094	1,829	218	230	1,371	-	-	-	42,740
Food Retail													-				-
2010	588	579	993	257	547	38	473	101	171	164	121	6,056	50	-	-	-	10,137
2015	648	642	1,101	285	752	48	550	127	200	192	137	6,795	57	-	-	-	11,534
2020	717	714	1,224	316	985	59	636	157	234	224	155	7,630	64	-	-	-	13,115
2025	793	795	1,362	352	1,248	71	734	190	274	263	175	8,574	73	-	-	-	14,904
2030	878	886	1,519	392	1,545	85	845	228	322	308	198	9,641	82	-	-	-	16,929
Non-food Retail													-				-
2010	4,647	2,477	929	799	1,938	152	1,274	134	490	587	236	353	236	-	-	-	14,252
2015	5,070	2,660	1,038	958	2,764	202	1,515	185	574	687	267	400	267	-	-	-	16,587
2020	5,547	2,868	1,162	1,139	3,700	258	1,788	242	673	806	302	453	302	-	-	-	19,240
2025	6,084	3,104	1,302	1,344	4,761	320	2,097	307	790	946	342	514	342	-	-	-	22,253
2030	6,688	3,371	1,461	1,575	5,963	389	2,447	380	929	1,112	388	582	388	-	-	-	25,673
Hotel / Motel													-				-
2010	805	1,443	-	271	2,025	136	912	622	338	305	199	479	221	-	-	-	7,756
2015	882	1,574	-	305	2,680	168	1,029	1,126	391	355	225	540	270	-	-	-	9,545
2020	969	1,722	-	344	3,418	203	1,160	1,694	453	415	254	609	325	-	-	-	11,566
2025	1,066	1,889	-	388	4,251	242	1,308	2,334	527	485	286	686	387	-	-	-	13,850
2030	1,175	2,077	-	438	5,189	286	1,475	3,057	613	567	323	774	457	-	-	-	16,431
Healthcare													-				-
2010	1,165	430	-	183	640	43	1,220	70	232	363	108	81	96	-	-	-	4,630
2015	1,276	456	-	204	995	53	1,405	122	270	421	121	91	107	-	-	-	5,521
2020	1,399	486	-	229	1,394	63	1,612	181	314	490	136	102	121	-	-	-	6,527

Sub Sector / Milestone Year	General Lighting	Architectural Lighting	High-Bay Lighting	Outdoor Lighting	Space Heating	Space Cooling	HVAC Fans and Pumps	Water Heating	Computer Equipment	Other Plug Loads	Cooking Equipment	Refrigeration	Miscellaneous	Non-Buildings	Street Lighting	Block Heater	Grand Total
2025	1,537	519	-	256	1,843	75	1,846	246	366	571	153	115	136	-	-	-	7,662
2030	1,690	557	-	286	2,347	89	2,108	320	426	665	172	129	153	-	-	-	8,941
Education													-				-
2010	3,576	1,413	545	382	2,961	48	1,536	988	1,070	871	450	450	225	-	-	-	14,514
2015	3,953	1,501	618	435	4,549	58	1,752	1,197	1,261	1,026	513	481	257	-	-	-	17,602
2020	4,381	1,602	702	496	6,361	70	1,999	1,435	1,489	1,212	585	517	293	-	-	-	21,141
2025	4,864	1,717	798	566	8,427	83	2,280	1,706	1,761	1,433	667	559	334	-	-	-	25,195
2030	5,411	1,848	907	646	10,785	98	2,601	2,016	2,084	1,696	761	606	381	-	-	-	29,839
Recreation Centres													-				-
2010	480	256	1,793	547	156	3	327	128	25	207	290	2,397	129	-	-	-	6,739
2015	513	269	1,959	609	328	3	355	198	29	239	323	2,635	144	-	-	-	7,605
2020	550	283	2,144	678	520	3	387	277	34	275	360	2,901	160	-	-	-	8,571
2025	591	299	2,350	755	733	4	422	365	39	317	401	3,196	178	-	-	-	9,648
2030	636	317	2,579	841	970	4	460	463	45	366	446	3,525	198	-	-	-	10,849
Restaurant													-				-
2010	431	1,556	-	554	1,147	62	623	331	95	125	816	1,758	50	-	-	-	7,549
2015	483	1,686	-	618	1,383	79	714	595	113	149	938	2,020	58	-	-	-	8,835
2020	542	1,835	-	691	1,654	98	818	898	134	177	1,078	2,322	66	-	-	-	10,315
2025	610	2,007	-	775	1,966	119	939	1,246	160	211	1,239	2,669	76	-	-	-	12,017
2030	687	2,204	-	871	2,325	143	1,077	1,647	191	251	1,424	3,067	88	-	-	-	13,975
Warehouse / Wholesale													-				-
2010	829	681	5,993	630	1,043	6	859	111	658	597	149	2,601	372	-	-	-	14,529
2015	907	745	6,693	713	2,006	7	939	180	770	698	168	2,944	421	-	-	-	17,191
2020	996	817	7,485	808	3,095	8	1,029	258	902	818	190	3,332	476	-	-	-	20,214
2025	1,095	899	8,382	914	4,329	10	1,131	346	1,058	960	216	3,771	539	-	-	-	23,649
2030	1,206	992	9,397	1,035	5,724	12	1,246	445	1,242	1,127	244	4,269	610	-	-	-	27,549
Other General Service													-				-
2010	8,462	3,719	907	1,171	5,434	507	2,995	405	2,950	1,210	314	437	779	-	-	-	29,290
2015	9,181	3,987	1,002	1,355	6,978	499	3,429	508	3,409	1,399	351	489	871	-	-	-	33,459
2020	9,981	4,286	1,108	1,562	8,706	492	3,913	623	3,947	1,620	393	546	974	-	-	-	38,150
2025	10,869	4,621	1,227	1,792	10,637	484	4,455	751	4,574	1,877	439	611	1,089	-	-	-	43,427
2030	11,853	4,995	1,360	2,050	12,797	477	5,061	895	5,304	2,177	491	683	1,218	-	-	-	49,361

Sub Sector / Milestone Year	General Lighting	Architectural Lighting	High-Bay Lighting	Outdoor Lighting	Space Heating	Space Cooling	HVAC Fans and Pumps	Water Heating	Computer Equipment	Other Plug Loads	Cooking Equipment	Refrigeration	Miscellaneous	Non-Buildings	Street Lighting	Block Heater	Grand Total
Non-Buildings													-				-
2010	-	-	-	-	-	-	-	-	-	-	-	-	-	19,402	-	-	19,402
2015	-	-	-	-	-	-	-	-	-	-	-	-	-	19,673	-	-	19,673
2020	-	-	-	-	-	-	-	-	-	-	-	-	-	20,619	-	-	20,619
2025	-	-	-	-	-	-	-	-	-	-	-	-	-	22,479	-	-	22,479
2030	-	-	-	-	-	-	-	-	-	-	-	-	-	25,564	-	-	25,564
Street lighting													-				-
2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,592	-	3,592
2015	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,642	-	3,642
2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,817	-	3,817
2025	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4,162	-	4,162
2030	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4,733	-	4,733
Parking Lot Plug													-				-
2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	340	340
2015	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	345	345
2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	361	361
2025	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	394	394
2030	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	448	448
Grand Total													-				-
2010	26,988	14,543	11,160	5,390	21,527	1,564	12,901	3,331	9,814	5,405	2,816	14,752	2,998	19,402	3,592	340	156,523
2015	29,543	15,694	12,412	6,158	29,465	1,848	14,745	4,777	11,434	6,304	3,194	16,554	3,401	19,673	3,642	345	179,189
2020	32,407	16,995	13,825	7,025	38,435	2,166	16,827	6,416	13,347	7,368	3,624	18,593	3,855	20,619	3,817	361	205,680
2025	35,615	18,466	15,421	8,004	48,573	2,523	19,177	8,272	15,601	8,623	4,111	20,898	4,367	22,479	4,162	394	236,686
2030	39,205	20,129	17,222	9,109	60,032	2,922	21,831	10,375	18,250	10,099	4,665	23,506	4,945	25,564	4,733	448	273,033

Exhibit 23 Reference Case Annual Electricity Consumption by Milestone, Sub Sector and End Use (MWh/yr.) – Diesel Grids

Region / Milestone Year	General Lighting	Architectural Lighting	High Bay Lighting	Outdoor Lighting	Space Heating	Space Cooling	HVAC Fans and Pumps	Water Heating	Computer Equipment	Other Plug Loads	Cooking Equipment	Refrigeration	Miscellaneous	Non Buildings	Street Lighting	Block Heater	Grand Total
Large Diesel																	
2010	1,281	768	580	276	41	108	680	219	415	281	154	783	143	826	215	3	6,771
2015	1,287	779	595	284	42	111	701	237	442	299	162	804	147	826	215	3	6,935
2020	1,294	791	609	293	42	114	723	255	470	318	170	826	152	828	215	3	7,105
2025	1,300	804	624	302	43	118	745	274	500	339	178	848	157	831	216	3	7,283
2030	1,307	817	640	312	44	121	768	293	532	361	186	870	161	835	217	3	7,468
Small Diesel																	
2010	325	251	91	79	12	15	194	74	151	70	62	158	47	464	86	4	2,083
2015	320	251	92	79	12	16	195	76	158	73	63	159	47	464	86	4	2,097
2020	316	252	92	80	12	16	197	77	165	77	64	160	48	464	86	4	2,111
2025	312	253	93	81	12	16	198	79	172	80	66	161	48	465	86	4	2,125
2030	307	253	94	81	12	17	200	81	179	83	67	162	48	465	86	4	2,140
Old Crow																	
2010	192	82	46	28	7	2	85	23	70	36	12	26	19	103	24	-	756
2015	205	86	50	31	7	3	94	27	80	41	14	29	21	103	25	-	814
2020	219	91	54	34	7	3	104	31	90	47	15	31	22	104	25	-	879
2025	234	97	59	38	8	3	116	36	102	53	16	34	25	105	25	-	951
2030	250	103	65	42	9	4	128	41	116	60	18	37	27	107	26	-	1,032

5 Customer-side Renewable and Alternative Energy Technologies

5.1 Introduction

This section identifies and assesses the potential of the selected customer-side renewable and alternative energy (CSRAE) technologies for small-scale applications in the Residential and Commercial sectors. The discussion is organized and presented as follows:

- Background
- Methodology
- CSRAE technologies included in study scope
- Description of technologies, including information on applications, costs and performance
- Total “unbundled” Technical Potential.

5.2 Background

Interconnection standards, net metering policies and feed-in tariffs facilitate the use of customer-side renewable electricity generation technologies because they often eliminate the need for electricity storage when the system output exceeds the building electrical needs. This decreases both the cost and the complexity of the required systems.

The Government of Yukon and the Yukon utilities have drafted a net metering policy, conducted public consultation, and are now finalizing the policy. Under the draft policy, system size would be limited to 5 kW for customers on a shared transformer and 25 kW for customers on individual transformers.

When considering solar PV systems, this study assumes a net metering policy is in place.

5.3 Methodology

The following provides a brief description of the steps that were employed to assess CSRAE technologies.

Step 1 Select Candidate CSRAE Technologies

The candidate CSRAE technologies were selected in collaboration with YEC, YECL and Government of Yukon personnel based on a combination of a literature review and previous study team experience.

Step 2 Define “Typical” Small-scale Applications

For each CSRAE technology, a typical system size and configuration was defined for Residential and Commercial sector applications.

Step 3 Estimate Yukon Resource Potential for each CSRAE

Secondary data sources were drawn upon, including NRCan's *Photovoltaic Potential and Solar Resource Maps of Canada* and data collected by the Yukon Energy Solutions Centre, to estimate the renewable resource potentials.

Step 4 Model the Potential Energy Production for each CSRAE

The RETScreen software was used to estimate the amount of heat or electricity that would be generated by "typical" installations of each of the CSRAE technologies in Yukon. For the purpose of this modelling, Whitehorse weather data was used.

Step 5 Establish Current Cost and Performance Data for Each CSRAE Technology

Information on the cost of implementing each CSRAE was compiled from a variety of secondary sources, including websites and research papers, as well as interviews with industry experts.

Step 6 Calculate the LCG or LCC for each CSRAE Technology

The levelized cost of energy generation or conservation was calculated for each technology. This quantity is sensitive to the chosen discount rate. Based on the recommendation of YEC, YECL and the Government of Yukon, a 5.25% real discount rate was used.

Step 7 Estimate Approximate "Unbundled" Technical Potential for each CSRAE Technology

The potential "unbundled" energy production that could theoretically be provided by each CSRAE technology was estimated. In this application, the term "unbundled" means that the energy production for each CSRAE technology is calculated without consideration of other possible options or practical considerations that could affect the results in a real life application.

The strength of the unbundled approach is that it provides insight into the relative size of the potential energy impacts associated with individual technologies; this perspective is often of particular value to program design personnel who may need to consider combinations of technologies and measures that differ from those selected for the CPR analysis.

5.4 CSRAE Technologies Included in Study Scope

This report addresses a select number of small-scale customer-side renewable and alternative energies identified in consultation with YEC, YECL and Government of Yukon personnel. They include solar photovoltaic, solar domestic hot water (DHW) heating and wood-pellet heating appliances. Wind systems for residential and commercial applications are discussed in this report but, because of poor wind regimes in most inhabited areas of Yukon, are not fully analyzed.

Exhibit 24 lists the CSRAE technologies that are included in this study.

Exhibit 24 CSRAE Technologies and Applications Included in Study

Technology	Sector	Vintage	Energy Type
Photovoltaic electric	Residential, Commercial	New/Existing	Electricity
Solar DHW	Residential, Commercial	New/Existing	Heat
Wood-pellet appliances	Residential	New/Existing	Heat

The following technologies listed in Exhibit 25 were not included:

Exhibit 25 CSRAE Technologies and Applications Not Included in Study

Technology	Reason for Exclusion
Micro-combined heat and power systems	These are most commonly natural gas-fired systems, a fuel that is not readily available in Yukon.
Wind electric	As discussed in Section 5.8, wind regimes in occupied areas of the province are not favourable.

The chosen technologies are reviewed in the sub sections below. Each discussion covers the following:

- Technology description
- Yukon resource potential
- Application experience in Yukon and other jurisdictions (high level only)
- Installed costs and performance
- Estimated unbundled Technical Potential.

5.5 Solar Photovoltaic

5.5.1 Technology Description

Photovoltaic (PV) cells convert light energy directly into electricity. The conversion efficiency of PV panels has been increasing as the technologies and manufacturing processes improve. Leading-edge technology efficiency is currently in the range of 20% and the efficiency of future technologies is expected to exceed 40%.[8] There are currently three primary commercially available types of PV cells: monocrystalline (sliced wafers), polycrystalline (sandwiches), and thin film (thin layers of silicon deposited on substrate).

Monocrystalline technology is based on growing and slicing single crystals of silicon into wafers. With the addition of semiconductors, the wafers are installed into modules where they convert sunlight to electricity. Efficiencies range from 14% up to 20%.[9]

[8] Syanne Olson, "NREL confirms world-record 43.5% efficiency on Solar Junction's CPV cell." *PVTech*. http://www.pv-tech.org/news/nrel_confirms_world_record_43.5_efficiency_on_solar_junctions_cpv_cell. Accessed 15 October 2011.
[9] *Technology Roadmap: Solar photovoltaic energy 2010*, International Energy Agency, http://www.iea.org/papers/2010/pv_roadmap.pdf. Accessed 19 October 2011.

Strengths:

- More efficient

Weaknesses:

- More expensive to produce

Polycrystalline cells are sandwiches of silicon wafers or ribbons containing many crystals fused together. They are less efficient but are also less expensive to produce. Typical conversion efficiencies are in the 13% to 15% range for commercially available products.[10]

Strengths:

- Less expensive to produce

Weaknesses:

- Less efficient

Thin film is manufactured by depositing extremely thin semiconductor coatings on a substrate material such as aluminum, plastic or glass. There are several thin-film technologies; efficiencies range between 6% and 12%.[11] Because of the lower cost of materials and the ease of production, thin film can be easily integrated into building components like window glass, siding and roofing materials.

Strengths:

- Less expensive to produce
- Can be combined with structural components, which further decreases installed costs

Weaknesses:

- Less efficient
- Less stable (shorter life)
- Some use toxic components such as cadmium

Module warranties are typically in the 20-25 year range. Over this time period, the modules degrade to and then stabilize at 85% of their nameplate capacity. Many systems 30 years and older are still producing power reliably.

A number of trends are expected to reduce the future cost of PV technologies:

- The integration of PV systems with other building components (often called building-integrated PV) may reduce costs. By combining elements that were previously separate into integrated packages, advanced structural, thermal and generating capabilities can be combined into a single product. Examples include PV thermal, which integrates PV into the building envelope while harnessing the heat generated by the panels for the purposes of ventilation pre-heating,[12] windows that have PV direct-feeding LED lights, and transparent PV film on windows.

[10] *Technology Roadmap: Solar photovoltaic energy 2010*, International Energy Agency, http://www.iea.org/papers/2010/pv_roadmap.pdf. Accessed 19 October 2011.
[11] *Technology Roadmap: Solar photovoltaic energy 2010*, International Energy Agency, http://www.iea.org/papers/2010/pv_roadmap.pdf. Accessed 19 October 2011.
[12] As an example, see the PV thermal installation at Concordia University in Montreal, Quebec. http://mediarelations.concordia.ca/pdf/Solar_PanelsENG.pdf.

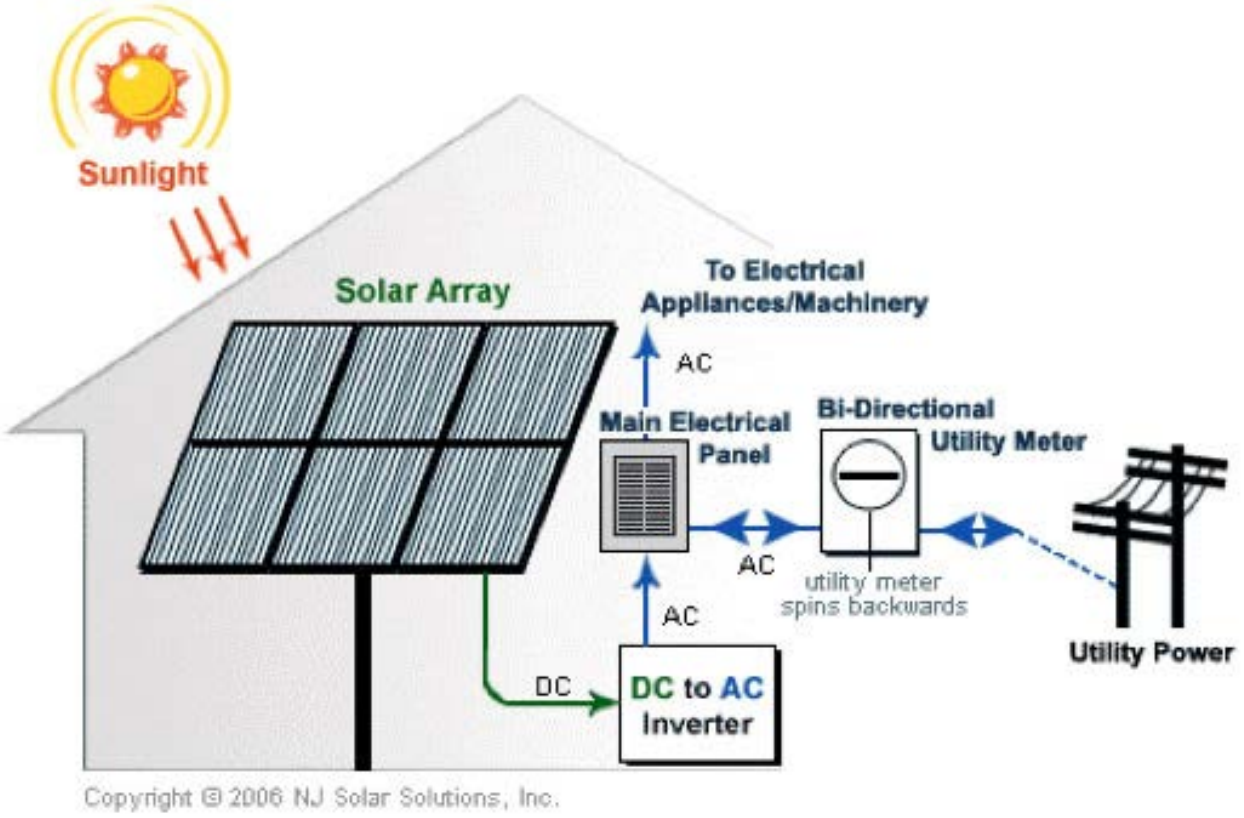
- The major competition for the use of the silicon crystals is computer chips, which means that there is a steady and growing competition for the resource. The development of non-silicon PV options may decrease PV system costs.
- Research into organic conductive materials could result in a significant cost reduction for PV systems. This technology would allow "printing" of organic PV modules, using less expensive processes than required for current technologies. However, this research is in the early stages, the efficiencies are currently low, and this technology is not expected to reach commercial viability before the end of the study period.[13]
- PV conversion efficiency was once thought to have a theoretical limit of 30%; however, this limit has recently been increased to 85%.[14] (This increase is due to the possibility of capturing some of the energy that is usually lost as heat and converting it to electricity) Additional research in this area may lead to further cost reductions.
- Finally, in locations where solar PV is not yet well-established, design, installation and capital costs are likely to decrease as the local solar PV market matures.

5.5.2 Typical Residential Installation

Exhibit 26 illustrates a typical residential PV installation. As shown, the electricity is taken from the PV array, which is typically located on the roof, and passes through an inverter before being fed into the electrical control panel of the house.

[13] "Analyst: organic PV to remain stuck in a niche," *Optics.org*, 18 April 2011, http://optics.org/news/2/4/24. Accessed 15 October 2011.
[14] Kevin Bullis, "Better Thermal Photovoltaics," *Technology Review*, MIT, 21 January 2009, http://www.technologyreview.com/energy/21981/. Accessed 19 October 2011.

Exhibit 26 General Schematic of a Residential Grid-Connected PV System[15]



One function of the inverter, beyond transforming the power from DC to AC, is to disconnect the system from the grid in the event of grid failure. Protection against backfeed when the grid is down is of paramount importance in these systems.

The addition of battery storage enables users to operate independently of the grid in the event of grid failure or, alternately, to deliver energy to the grid on peak and to store energy from the day for use at night. However, batteries add cost and complexity to the system; therefore, system performance and costs in this report assume grid-connected systems without batteries.

For the purposes of this study, a 3-kW system is assumed to be "typical" for single-family detached or attached residences, and a 20-kW system is assumed to be "typical" for apartment buildings.

5.5.3 Typical Commercial Installation

The components of a commercial system are the same as the residential configuration. Medium to large size commercial systems typically range from about 10 to 100 kW (or more), depending on a number of factors, including available roof area, economics, and the building's electricity load. In some jurisdictions, trends are towards larger systems to take advantage of attractive feed-in tariffs and economies of scale, with interconnections of 100 kW up to 350 kW not

[15] Image available at http://www.dwelltek.com/solar_photovoltaic.html. Please note: Public reprinting of this document requires permission from the identified source.

uncommon. For this study, a 20-kW system was chosen as typical for the generally smaller size buildings in Yukon.

5.5.4 Solar Resource Potential in Yukon

According to NRCan's *Photovoltaic Potential and Solar Resource Maps of Canada*,[16] much of Yukon is characterized by a moderate annual average solar resource potential, receiving between 3.3 to 4.2 kWh/m^2/day for panels mounted at an angle equal to the latitude. This is comparable to much of the other territories, the interior of British Columbia, Nova Scotia, and Newfoundland and Labrador, but less than that in much of the prairies and parts of Ontario and Quebec. The solar potential in Yukon is on par with that of much of Alaska. Of course, the northern latitudes receive much less sun during the winter months when compared to the summer months. The Yukon Energy Solutions Centre reports that residential solar PV users are able to reliably generate solar energy eight months of the year.[17]

In general, fixed solar PV panels are placed on an angle equal to the latitude of the location. In northern areas, some experts recommending installing panels at an angle equal to that of the latitude plus 20^o.[18] This results in a lower annual yield, but would increase production during the winter months when the sun's angle is very low. Other experts suggest mounting panels vertically in northern applications when sun can be reflected off snow.[19] Systems that track the sun will produce more electricity but are also more complicated, making them both more expensive and more likely to need repairs.

5.5.5 Application Experience in Yukon

Yukon Energy has used a portable solar-hybrid unit since 1999 to demonstrate the advantages of solar power.[20] The Yukon Energy Solutions Centre estimates that approximately 50 residential systems have been installed, primarily in southern Yukon.[21] All of these are independent of the electrical grid because Yukon has not had a net metering or feed-in tariff.[22] Six demonstration sites have been installed on administrative or institutional buildings, including:

- 4-kW system on the Yukon Government Administration Building (Whitehorse)
- 2-kW system at Yukon College
- 3.3-kW system on the Information and Operations Centre of the Vuntut National Park
- 4.0-kW system on the Watson Lake Northern Lights Centre

---

[16] Available at https://glfc.cfsnet.nfis.org/mapserver/pv/pvmapper.phtml?LAYERS=2700,2701,2057,4240&SETS=1707,1708,1709,1710,1122&ViewRegion=-2508487%2C5404897%2C3080843%2C10464288&title_e=PV+potential+and+insolation&title_f=Potentiel+photovoltaique+et+ensoleillement&NEK=e. Accessed 19 October 2011.
[17] "Solar Energy," Energy Solutions Centre, Yukon Energy, Mines, and Resources, http://www.energy.gov.yk.ca/solar.html#Solar_Energy_in_the_Yukon. Accessed 19 October 2011.
[18] "Solar Energy," Energy Solutions Centre, Yukon Energy, Mines, and Resources, http://www.energy.gov.yk.ca/solar.html#Solar_Energy_in_the_Yukon. Accessed 19 October 2011.
[19] *Renewable Energy in the Northwest Territories*, 16 August 2010, http://www.energy.ca/users/getdownload.asp?DownloadID=575. Accessed 19 October 2011.
[20] Yukon Development Corporation, Yukon Energy Corporation, *Annual report 2011*, http://www.yukonenergy.ca/downloads/db/13_annual_report_2001.pdf. Accessed 19 October 2011.
[21] "Solar Energy," Energy Solutions Centre, Yukon Energy, Mines, and Resources, http://www.energy.gov.yk.ca/solar.html#Solar_Energy_in_the_Yukon. Accessed 19 October 2011.
[22] Personal communication with Shane Andre, director of the Energy Branch of the Yukon Department of Energy, Mines and Resources.

- 12-kW system at the Arctic Research facility in Old Crow
- 2-kW system at the Yukon Research Centre lab facility in Whitehorse.

Due to the low numbers of installations, the retail and installation market is not mature.

5.5.6 Installed Cost and Performance

As explained in Section 5.5.5, Yukon has not had grid-connected solar PV systems due to the historical absence of an interconnection standard, feed-in-tariff or net metering policy. Consequently, determining appropriate installed costs is difficult. For the purposes of this study, we have used costs developed for the lower western area of Canada ($7/W in residential installations, and $6/W in commercial installations[23]) multiplied by factors that account for the typical difference in prices between this region and Yukon.[24] The multipliers and per watt installed costs are presented in Exhibit 27 below.

Exhibit 27 Solar PV Installed Costs Calculations

Grid	Multiplier	Approximate Installed Cost	
		Residential	Commercial
Hydro	1.15	$8.05/W	$6.90/W
Large Diesel	1.22[25]	$8.54/W	$7.32/W
Small Diesel	1.22[26]	$8.54/W	$7.32/W
Old Crow	2.30	$16.10/W	$13.80/W

The RETScreen renewable energy modelling software tool was used to estimate the amount of electricity that would be generated by each of the "typical" PV systems in Yukon. The following assumptions were made:

- Whitehorse weather file
- Conventional monocrystalline technology
- Mounting angle equal to the latitude or equal to latitude plus 20^{o}
- Fixed collectors within 30^{o} of due south.

As illustrated in Exhibit 28 each kilowatt of installed PV capacity generates approximately one kWh of electricity per year when installed at an angle equal to that of the latitude.

[23] Discussions with Solar Outpost on June 24, 2010.
[24] Values developed in consultation with Phil Borgel of YEC, starting with data available from the Yukon Bureau of Statistics.
[25] Assumes 20% of lower western cost is labour.
[26] Assumes 20% of lower western cost is labour.

Exhibit 28 Annual Delivered Energy by System Size (kWh/yr.)

Angle	Residential (3 kW)	Small Commercial (20 kW)
Equal to latitude	3,200	22,000
Equal to latitude + 20 deg.	2,900	20,000

For purposes of this study, the higher "equal to latitude" values will be used as they will produce slightly better economic indicators.

Exhibit 29 presents estimated total installed costs and performance for each of the sample PV systems, together with the estimated cost of electricity generation. The estimates assume a discount rate of 5.25% and a 25-year lifetime. As shown, the current levelized cost of generation for PV systems ranges from $0.46/kWh to $1.10/kWh.

Exhibit 29 Solar PV Levelized Cost of Generation

System Size (kW)	Grid	Annual Generation (kWh)	Total Installed Cost	O & M ($/kWh/yr.)[27]	Levelized Cost of Generation ($/kWh)
3	Hydro	3,200	$24,150	$0.005	$0.55
	Large Diesel	3,200	$25,620	$0.005	$0.59
	Small Diesel	3,200	$25,620	$0.005	$0.59
	Old Crow	3,200	$48,300	$0.005	$1.10
20	Hydro	22,000	$138,000	$0.005	$0.46
	Large Diesel	22,000	$146,400	$0.005	$0.49
	Small Diesel	22,000	146,400	$0.005	$0.49
	Old Crow	22,000	$276,000	$0.005	$0.92

5.5.7 Estimated Unbundled Technical Potential

Roof space, building tenure, orientation of the building relative to the sun, and solar access all have an impact on how much energy can be produced from a PV system. In general, it is more economical to install a PV system on a building at the time of construction; however, retrofitting is technically feasible. To estimate the Technical Potential, the following were assumed:

- Based on previous work undertaken by BC Hydro, it was estimated that approximately one-third of existing residential single-family detached and row housing have reasonable solar exposure. Given the advantages provided by new construction, the technical applicability was increased by a further (approximately) one-third for new residential buildings to 45%. For all housing segments except for apartments/condos, a 3-kW system was assumed to be appropriate. A 20-kW system was assumed for apartments/condo buildings, given the greater roof area.
- For commercial buildings, the same BC Hydro study estimated that approximately 30% of existing sites provide a suitable application for PV installations. As in the Residential sector, PV technical applicability was estimated to increase to 45% for new buildings. A 20-kW system was assumed to be appropriate for commercial buildings.

[27] Cost of less than $0.01/kWh/year provided in: Public Renewables Partnership, *Solar PV cost factors*. http://www.repartners.org/solar/pvcost.htm. Anecdotal information from Patrick Bateman of CANSIA (9 January 2011) suggests costs less than $0.0003/kWh/yr.

Exhibit 30 provides a summary of the Technical Potential results for the total service area. Additional details are presented in Appendix A.

Exhibit 30 PV Technical Potential (MWh/yr.) by Sector, 2030

Technology	Sector	Potential
Solar PV	Residential – Existing	13,427
	Residential – New	7,383
	Commercial – Existing	2,995
	Commercial – New	3,012
	Total	26,816

5.6 Solar DHW

5.6.1 Technology Description

There are two main types of solar water collectors suitable for Yukon's climate:

Glazed flat plate collectors are fixed in a frame between a glass cover and an insulated back. They have a selective coating, are efficient at collecting solar energy with low losses back to the environment and can be operated year-round when freeze protection is included in the system. Glazed flat plate collectors are best suited for applications requiring moderate water temperatures (50^{o}C) in medium to cold climates. In Yukon, where snow may accumulate on the collectors, the slight heat loss through the front of glazed collectors is useful for melting the snow. Glazed flat plate collectors have historically been less expensive than evacuated tube collectors; however, this is changing as Chinese manufacturers are producing less expensive evacuated tube collectors.

Strengths:

- Historically less expensive
- Suited to low-draw residential applications
- Losses melt accumulated snow

Weaknesses:

- Loses more heat to surroundings
- Typically generates lower temperature water

Evacuated tube collectors are more complex. They have a selective coating and are enclosed in a sealed, evacuated glass tubular envelope. Many systems use a sealed heat pipe on each tube to extract heat from an absorber. A liquid is vaporized while in contact with the heated absorber and the heat is recovered at the top when the vapour condenses. The condensed liquid then returns to the absorber through gravity. Evacuated tube collectors are good at capturing solar energy with very low losses back to the environment, which means they are efficient but less likely to melt accumulated snow. They are best suited for applications requiring moderate to high water temperatures (60^{o}C-80^{o}C) in cold climates without significant snow accumulation. The higher water temperatures generated by these collectors may create a scalding hazard in a low-demand residential DHW system.

Strengths:

- Fewer losses to environment
- Typically generates higher water temperatures (which may or may not be a strength, depending on application)

Weaknesses:

- Historically more expensive and less robust
- Less likely to melt accumulated snow
- May not be as suited to low-draw residential systems

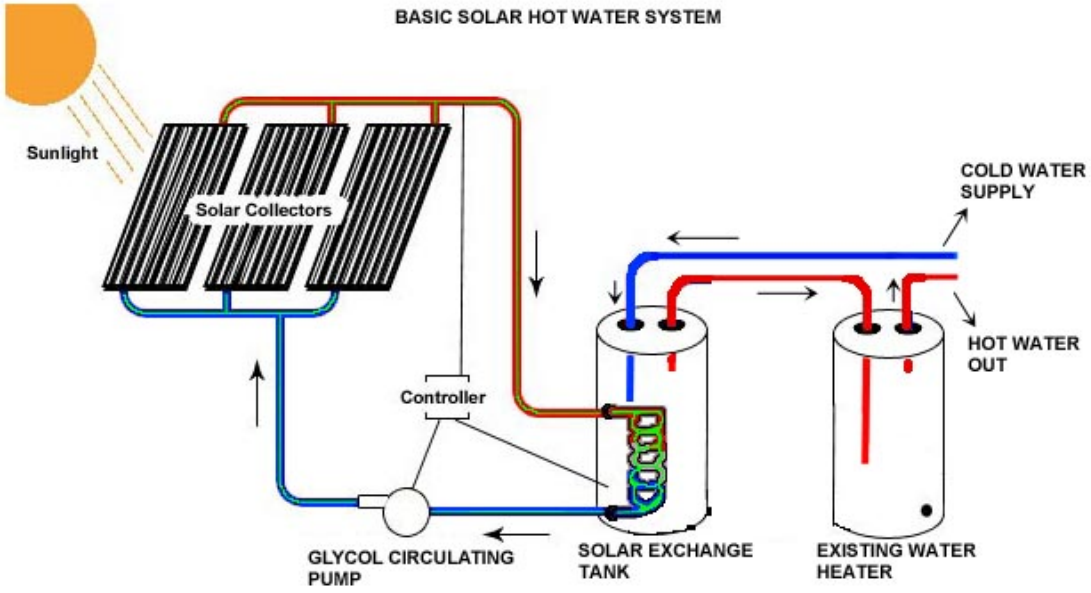
5.6.2 Typical Residential Installation

A cold climate solar water heating system typically includes the following components:

- Solar collector array and support structure to collect radiation
- Thermal storage tank to store energy during times when the collector is not operating, such as at night or during overcast periods. Typically, a conventional water heating system (with a volume of about 300L) is used for storage and back up to the solar water heating system
- Liquid handling unit, which includes the pump required to move the fluid from the solar collector to the storage tank. It also includes valves, strainers and a thermal expansion tank
- Controller, which activates the circulator pump only when useable heat is available from the solar collectors (not required if a PV-powered circulator pump is used)
- Freeze protection, typically through the use of an antifreeze heat transfer fluid with a low toxicity in the solar collector loop. The solar collector fluid is separated from the hot water in the storage tank by a heat exchanger.

A typical flat plate solar thermal installation is shown below in Exhibit 31. Solar collectors are mounted on the roof. Working fluid is circulated by a small pump and heated as it passes through the collector. A heat exchanger extracts heat from the working fluid and the hot water is stored in a storage tank. In cooler climates, such as Yukon, a conventional hot water heater is required to meet the full DHW load.

Exhibit 31 General Schematic of a Typical Solar DHW Installation[28]



5.6.3 Typical Commercial Installation

The components of a commercial system are the same as a residential configuration. However, the scale of the system is larger, typically in the order of a 50 m^2 collector area with a 2,500 L storage tank.

5.6.4 Solar DHW Resource Potential

The general solar resource potential for solar thermal is the same as solar PV, as described in Section 5.5.4.

5.6.5 Application Experience in Yukon and Other Jurisdictions

The review of Yukon application experience noted the following:

- Through the Good Energy Program of the Government of Yukon, a 15% rebate (of pre-tax purchase cost, up to a maximum of $1,200) is available for the installation of a qualified solar hot water heating system. The Yukon Energy Solutions Centre reported that two of these rebates were paid in the past two years.
- An October 2008 survey of the Canadian active solar thermal collector industry and markets[29] noted that per capita sales in Yukon, NWT and Nunavut are more than double the average per capita rate in Canada, although the actual numbers are small.
- In 2008, the Yukon Housing Corporation commissioned a study[30] to determine the appropriate solar DHW system size for duplexes in Whitehorse and Dawson. The study

[28] Jaba Solar, *How it Works.* http://www.jabasolar.com/technology.shtml. Accessed 6 October 2010. Please note: Public reprinting of this document requires permission from the identified source.
[29] SAIC, *Final Report: Survey of Active Solar Thermal Collectors, Industry and Markets in Canada (2008).* CanmetENERGY, October 2009. http://www.cansia.ca/sites/default/files/nrcan__canadian_st_market_2008.pdf. Accessed 19 December 2011.

used RETScreen with Yukon Housing water load information, Environment Canada weather data, and Canadian Weather Energy and Engineering Data Set solar resource data. This study found, for duplexes in Whitehorse, that three flat plate collectors or two evacuated tube collectors provided a 50% solar fraction, a 454 L (120 US gal) tank was both sufficient and readily available, and that the usual rule of matching collector slope to latitude held.

- Discussions with personnel from the Yukon Energy Solutions Centre indicated that some of the installations of evacuated tube collectors in Yukon have experienced high failure rates, whereas similar collectors in British Columbia have not. One theory is that the extreme temperatures experienced in Yukon are causing this failure rate.

5.6.6 Installed Costs and Performance

The installed cost of solar collectors can vary widely according to technology, manufacturer, and the complexity of the installation. Previous studies in the lower western regions of the country used an installed cost of $7,000 for a two panel flat plate residential system. Installed costs of commercial systems may be lower per square meter, due to economies of scale. For these earlier studies, we used a cost of $1,000/m^2, based on the cost of a large Saskatchewan commercial installation.[31] As was done for solar PV installed costs, these base costs were then multiplied by factors that approximate the cost difference between the lower western regions and Yukon locations.[32] The results of these calculations can be seen in Exhibit 32.

Exhibit 32 Solar DHW Installed Costs Calculations

		Approximate Installed Cost	
Grid	Multiplier	Residential	Commercial
Hydro	1.15	$8,050	$1,150/m^2
Large Diesel	1.22[33]	$8,540	$1,220/m^2
Small Diesel	1.22[34]	$8,540	$1,220/m^2
Old Crow	2.30	$16,100	$2,300/m^2

An analysis was completed using RETScreen to estimate the energy availability for a solar thermal hot water installation. For the purpose of this analysis, glazed, fixed collectors at an angle equal to the latitude and within 30^o of due south were assumed. Results are summarized in Exhibit 33 below.

[30] Didier Thevenard, *Solar Domestic Hot Water System Sizing for Whitehorse, YT, and Dawson, YT,* 18 August 2008, http://www.housing.yk.ca/pdf/YHCESCSolarDHW-080829.pdf. Accessed 19 October 2011.
[31] "Saskatchewan's Largest Solar Hot Water System Installed by Suncatcher Solar Homes." 14 March 2008. Government of Canada. http://www.environment.gov.sk.ca/adx/aspx/adxGetMedia.aspx?DocID=1708,1607,94,88,Documents&MediaID=919&Filename=Suncatcher+Solar+Media+Release.pdf. Accessed 19 December 2011. (Assumed that "forty solar hot water collectors" means forty standard size panels.)
[32] Values developed in consultation with Phil Borgel of YEC, starting with data available from the Yukon Bureau of Statistics.
[33] Assumes 20% of lower western cost is labour.
[34] Assumes 20% of lower western cost is labour.

Exhibit 33 Solar DHW Levelized Cost of Conservation

System Size	Grid	Annual Generation (kWh)	Total Installed Cost	O & M ($/kWh/yr.)[35]	Levelized Cost of Conservation ($/kWh)
2 panels	Hydro	2,200	$11,270	-	$0.30
	Large Diesel	2,200	$11,956	-	$0.32
	Small Diesel	2,200	$11,956	-	$0.32
	Old Crow	2,200	$22,540	-	$0.60
50 m^2	Hydro	23,900	$57,500	-	$0.20
	Large Diesel	23,900	$61,000	-	$0.21
	Small Diesel	23,900	$61,000	-	$0.21
	Old Crow	23,900	$115,000	-	$0.39

Costs for the systems described above are also given in Exhibit 33. As can be seen, the levelized cost of generating heat is estimated to range from $0.20/kWh to $0.60/kWh.

5.6.7 Estimated Unbundled Technical Potential

For the purpose of this analysis, it has been assumed that solar DHW can be installed in 30% of the existing electrically heated stock and 45% of new electrically heated stock.[36] Two-panel systems have been assumed for all residences except for apartments/condos, which are assumed to have 50 m^2 size systems. All commercial systems are assumed to be 50 m^2 except for Offices, Non-food Retail and Warehouses, which have hot water loads too low to justify a commercial-sized system. Based on these assumptions, the Technical Potential for solar DHW heating is estimated as 12.8 MWh/yr., as shown in Exhibit 34. Additional details are presented in Appendix A. This estimate is necessarily very rough, as systems would need to be sized for the DHW load of specific buildings.

Exhibit 34 Solar DHW Technical Potential (MWh/yr.) by Sector, 2030

Technology	Sector	Potential
Solar Hot Water	Residential – Existing	7,052.8
	Residential – New	4,586.3
	Commercial – Existing	335.2
	Commercial – New	786.8
	Total	12,761.1

[35] Maintenance costs for solar thermal systems are typically very low and were therefore not included in these calculations.
[36] This analysis focuses on displacing electricity used for heating hot water. Displacing other fuel sources would be fuel switching, which is beyond the scope of the current project.

5.7 Pellet Stoves, Furnaces and Boilers

5.7.1 Technology Description

Yukon has a long history of heating with wood using fireplaces and stoves. This analysis focuses on pellet stoves, furnaces and boilers because they are newer technologies and require less day-to-day effort on the part of the user.

Pellet stoves are typically self-feeding and self-igniting, and are both cleaner and more efficient than wood stoves. Many can be direct-vented to the outside, facilitating installation in homes without chimneys. Because they are inherently cleaner burning than wood-burning appliances, pellet stoves are exempt from EPA regulations, although some manufacturers voluntarily certify their pellet stoves.[37] Pellet burning stoves also have disadvantages. They require about 100 kWh of electricity per month,[38] limiting their use to homes with a reliable electricity supply. Pellet-burning stoves are also more complicated than wood-burning stoves, potentially increasing maintenance costs. Finally, pellets are typically more expensive than cord wood, and pellet supplies in some areas may be unreliable.

Pellet-burning boilers and furnaces are also available, with similar benefits and disadvantages to pellet-burning stoves. These units may come with small on-board pellet storage containers or, where space permits, can be connected to larger storage units.

5.7.2 Typical Residential Installation

Pellet-burning stoves typically heat the space in which they are located; however, in open plan homes they may provide heat to most of the house. Furnaces heat air in a central location and distribute it through ductwork, making them most suitable for new homes or homes with existing ductwork. Boilers heat water in a central location, distributing the heat through radiators or in-floor heating systems. Consequently, pellet boilers are most suitable for new homes or homes with existing hot water distribution systems. These technologies are available in a range of sizes suitable for homes and are most efficient when they are properly sized

The Residential Electrical End-Use Survey suggests that approximately 70% of electrically heated homes in Yukon are heated with electric furnaces. Consequently, a pellet burning furnace was chosen as a “typical” installation. Because these homes may not already have a suitable chimney, a direct-vented model was chosen. A pellet furnace is shown in Exhibit 35.[39]

[37] “Consumers – Types of Appliances,” *Burn Wise*, United States Environmental Protection Agency, http://www.epa.gov/burnwise/appliances.html#pelletstoves. Accessed 19 October 2011.
[38] “Wood and Pellet Heating,” *Energy Savers*, United States Environmental Protection Agency, http://www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12570. Accessed 19 October 2011.
[39] Image available at http://www.pelletking.com/ProductInfo.aspx?productid=SCF-050. Please note: Public reprinting of this document requires permission from the identified source.

Exhibit 35 Picture of a Pellet Furnace

5.7.3 Typical Commercial Installation

Commercial buildings with large heating loads often have boilers and hydronic distribution systems. For this reason, a pellet-burning boiler was chosen as "typical" for commercial and institutional buildings. Pellet boilers are typically paired with either an electric or a fossil fuel boiler that can provide additional heat when needed. Because this study is focused on offsetting electricity consumption, a backup electric boiler was assumed.

5.7.4 Pellet-Burning Appliance Potential

Although the amount of fire and beetle-killed wood vastly exceeds the demand for wood fuel in Yukon, there are currently no pellet producers in the territory. However, approximately 65% of Canadian wood pellet production takes place in nearby British Columbia,[40] typically from sawmill waste. A few Whitehorse businesses are currently importing, from BC and elsewhere, skids of 18 kg bags of pellets.

The potential for wood pellet production in Yukon has been studied.[41] Because the wood waste supply is low, pellets would need to be manufactured from round wood. The higher cost of raw materials and high cost of transportation would prohibit Yukon-produced pellets from competing with BC-produced pellets outside the territory. This means that Yukon pellet production will not become cost effective until the territorial demand for pellets increases significantly.

[40] Wood Pellet Association of Canada, "Production", http://www.pellet.org/wpac_002.htm. Accessed 19 October 2011.
[41] PBrand Bioenergy Consulting, *An Economic Evaluation of a Bioenergy Opportunity in Yukon*, October 2009, http://www.energy.gov.yk.ca/pdf/yukon_bioenergy_final_report_2009.pdf. Accessed 19 October 2011.

5.7.5 Application Experience in the Yukon and Other Jurisdictions

According to the Residential Electrical End-Use Survey, approximately 26% of Yukon residents use wood as their primary heat source, with many others using wood as a supplemental heat source. Because of air quality issues, the City of Whitehorse regulates the types and models of new wood-burning appliance installations; however, pellet-burning stoves and central heating systems are exempt from this regulation.

The Yukon Energy Solutions Centre currently offers up to a $600 rebate for EPA-qualified woodstoves/furnaces, EPA white tag-rated wood boilers, or ULC-rated wood pellet stove/furnace/boilers. The Yukon Energy Solutions Centre reported that five rebates have been paid for pellet-burning appliances over the course of the past three years.

Wood-burning commercial heating equipment has been installed in the Yukon, although many of these installations have either not worked or have been experimental. For example:

- A wood chip/pellet external boiler was installed in the Elijah Smith Elementary School but has since been converted to propane. A retrofit study was performed and recommended replacing the boiler with a new automatic-feed pellet boiler.[42]
- A fluidized bed gasifier was installed in the Yukon College (Whitehorse) in 1987. This system never operated properly and was decommissioned in 1991. Several studies have been conducted on redesigning this system, but the system has not been returned to operation.[43]
- The Kluane First Nation operates a central wood-burning boiler providing heat and hot water to four community buildings. This system was installed in 1998.[44]
- A new pellet boiler system is currently being commissioned at the Whitehorse Correctional Facility.

Considerable commercial-scale wood pellet burning activity has been taking place recently in the Northwest Territories. Installations include:

- North Slave Correctional Facility (two 750-kW boilers)
- Yellowknife Arena, Curling Club & Ruth Inch Memorial Pool (one 750-kW boiler)
- Chief Jimmy Bruneau Regional High School (one 750-kW boiler)
- Kalerni Dene School (three 23-kW boilers)

In most cases, these pellet boilers are supplemented by fossil fuel boilers during peak periods.

[42] VENTEK Energy Systems, Inc, *Feasibility of and Options for a Public Bioenergy Heating Systems Retrofit for Energy Solutions Centre Government of Yukon*, 31 March 2009, http://www.energy.gov.yk.ca/pdf/yg_bioenergy_retrofit_feasibility_march31_2009.pdf. Accessed 19 October 2011.
[43] CANMET Energy Technology Centre – Ottawa, *Re-Capitalization of Yukon College Gasifier*, May 2009, http://www.energy.gov.yk.ca/pdf/college_gasifier_recap_study_may_09.pdf. Accessed 19 October 2011.
[44] Windfall Ecology Centre, *Ontario First Nations and Renewable Energy, Context, Opportunities, and Case Studies*, Ontario Sustainable Energy Association, http://www.turtleisland.org/resources/renewenergy.pdf. Accessed 19 October 2011.

5.7.6 Installed Costs and Performance

The U.S. Department of Energy indicates that pellet stove efficiency can range from 78% to 85%.[45] A U.S. federal tax credit is available for pellet-burning appliances that have an efficiency of at least 75%, which means that manufactures will aim to meet that target. Manufacturer efficiency claims vary; for this study, we have assumed a conservative residential furnace seasonal efficiency of 75%.

Some pellet furnaces can be fitted with an optional domestic hot water coil. For simplicity, we have not included this feature in the calculations for this study. Actual savings may, therefore, be conservative.

Pellet-burning appliances use electricity to drive the pellet feeding system. For the residential scenario, a value of 100 kWh per month during the heating season has been assumed. This may be an underestimate, given the colder Yukon climate; however, this represents only a small fraction of the overall electricity savings.

Pellet furnaces are currently not readily available from the two Whitehorse suppliers of pellet appliances. U.S. prices for pellet furnaces appear to be in the range of $5,000. We assumed that a pellet furnace requires an extra $1,000 in installation costs. Exhibit 36 shows the approximate cost of installing a pellet furnace, using the same cost multiplier used in Sections 5.5 and 5.6 to account for the higher costs of both equipment and labour in Yukon.

Exhibit 36 Pellet Furnace Installed Costs Calculation

Grid	Multiplier	Residential
Hydro	1.15	$6.900
Large Diesel	N/A	N/A
Small Diesel	N/A	N/A
Old Crow	N/A	N/A

As of September 2011, the cost of an 18 kg bag of pellets in Whitehorse was $7.70, including tax. [46] This is likely to be a conservative price point; in a more mature market, the relative price of pellets would be expected to drop. One preferred pellet source is Pinnacle Pellets in British Columbia, due to the perceived higher quality of pellets from this source. Pinnacle cites 4.7 MWh/t as the heating value of these pellets.

Robust information on life expectancy of residential pellet-burning appliances appears not to be available. For this study, a value of 20 years was used.

Robust information on annual residential maintenance costs also appears not to be available; based on anecdotal information, we have assumed no significant additional maintenance costs.

Exhibit 37 shows the levelized cost of conserved energy for a pellet furnace under the assumptions given above.

[45] "Wood and Pellet Heating," *Energy Savers*, U.S. Department of Energy, http://www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12570. Accessed 19 October 2011.
[46] Personal communication with clerk at Goodey's Gas Bar, Whitehorse, October 2011.

Exhibit 37 Pellet Furnace Levelized Cost of Conserved Energy

Grid	Annual Savings (kWh)	Total Installed Cost	LCC ($/kWh)
Hydro	13,900	$6,900	$0.19

For the commercial scenario, we assumed the installation of a 250-kW moving grate burner in a school, providing both heating and hot water. One manufacturer, Binder GmbH, claims a 92% efficiency;[47] we assumed a seasonal efficiency of 85%. The estimated installed cost of this boiler is $400,000.[48] We assumed a labour cost of $12,775 (half hour per day at $70/hour.) This is likely a conservative number, as newer pellet boilers have automatic ash cleaning. We also assumed a life expectancy of 20 years.

Exhibit 38 shows the levelized cost of conserved energy for a commercial pellet boiler under the assumptions given above.

Exhibit 38 Pellet Boiler Levelized Cost of Conserved Energy

Grid	Annual Savings (kWh)	Total Installed Cost	Annual Maintenance Cost	LCC ($/kWh)
Hydro	488,000	$400,000	$12,775	$0.20

5.7.7 Estimated Unbundled Technical Potential

Electric heating is not allowed in either the large or small diesel grid areas or in Old Crow. Because this study is focused on reducing electricity consumption, the installation of pellet appliances is only relevant in the hydro grid area.

In the Residential sector, 50% of the electrically heated existing and renovated single-family and attached homes in the hydro grid area were assumed to be able to install wood pellet furnaces. This allows for heating done with existing electric baseboards (approx. 30%), homes without space for a pellet furnace, and homes where chimneys cannot be installed. For new homes, a technical applicability of 70% was used.

For the Commercial sector, we assumed pellet boilers were appropriate for all building types except Offices, Non-food Retail and Restaurants, which have the lowest average heating loads per building. We assumed pellet boiler use was technically possible in 20% of existing and renovated buildings and 60% of new buildings in these sub sectors, and we assumed that 90% of the electricity required for space and water heating in these buildings could be displaced by the pellet boiler.

Exhibit 39 shows the potential electricity savings possible due to the use of pellet furnaces or boilers in the hydro grid area.

[47] Binder, *Heating with Biomass*, http://www.woodenergy.com/media/325920/2007-binder_folder_en.pdf. Accessed 28 October 2011.
[48] Personal communication with Bruce Elliot of Arctic Green Energy, 26 October 2011.

Exhibit 39 Pellet-Burning Appliances Technical Potential (MWh/yr.) by Sector, 2030

Technology	Sector	Potential
Pellet-Burning Appliances	Residential – Existing	6,209
	Residential – New	9,601
	Commercial – Existing	1,545
	Commercial – New	12,605
	Total	29,961

5.8 Small-Scale Wind

5.8.1 Technology Description

Wind electric systems are available in a range of technologies and sizes, from 400 W turbines designed for use at a seasonal home to large utility-size turbines of up to 2 MW or 3 MW capacities; even larger wind turbines are emerging for the off-shore market.

5.8.2 Wind Resource Potential

Starting in the 1980s, a variety of individuals and organizations have monitored wind speeds in numerous Yukon locations. Wind speeds are generally highest at higher elevations, such as mountain tops. In valley areas, where most of the population lives, wind speeds are considerably lower.[49] Wind speeds measured through the Yukon Energy Solutions Centre wind prospecting service are almost always under six km/h, too low for successful small-scale wind generation. In these areas, speeds tend to be highest during the winter, which may be of some interest to off-grid residents who generate electricity with solar PV systems during the rest of the year. However, there has yet to be a successful installation under this program.

5.8.3 Application Experience in the Yukon

As mentioned above, the low wind speeds in the inhabited areas of Yukon have effectively prohibited the development of small-scale wind except under very specific conditions. Utility-scale wind installations at high elevations, where wind speeds are considerably higher, have been successful. For example, YEC is operating 150-kW and 660-kW wind turbines on Haeckel Hill in the Whitehorse area.

5.8.4 Estimated Unbundled Technical Potential

Because average annual wind speeds in the inhabited areas of Yukon are low, the Technical Potential for customer-side wind generation is effectively zero in Yukon.

5.9 Total CSRAE Technical Potential

A summary of the unbundled Technical Potential for all CSRAE technologies described above is presented in Exhibit 40.

[49] Yukon wind speed data is collected at the Yukon Renewable Energy Resource Map found at http://www.energy.gov.yk.ca/renewable_energy_map_viewer_jump.html.

Exhibit 40 Total CSRAE Technical Potential (MWh/yr.)

Technology	Sector	Potential
Solar PV	Residential – Existing	13,427
	Residential – New	7,383
	Commercial – Existing	2,995
	Commercial – New	3,012
	Sub-Total	26,816
Solar Hot Water	Residential – Existing	7,053
	Residential – New	4,586
	Commercial – Existing	335
	Commercial – New	787
	Sub-Total	12,761
Pellet-Burning Appliances	Residential – Existing	6,209
	Residential – New	9,601
	Commercial – Existing	1,545
	Commercial – New	12,605
	Sub-Total	29,961
Total		69,538

6 CSRAE Economic Potential

6.1 Introduction

This section presents the CSRAE Economic Potential electric energy for the study period 2010 to 2030. In this report, the Economic Potential estimates the level of electricity generation that would occur if all cost-effective small-scale customer-side renewable and alternative energy technologies were implemented.

The discussion in this section is organized as follows:

- Avoided cost used for screening
- Summary of results
- Future cost trends.

6.2 Avoided Cost Used For Screening

In this study, the definition of "cost effective" varies by grid, as shown in Exhibit 41 below:

Exhibit 41 Avoided Costs by Grid

Grid	Avoided Cost
Hydro	$0.35 / kWh
Large Diesel	$0.30 / kWh
Small Diesel	$0.30 / kWh
Old Crow	$0.64 / kWh

For example, for a technology to be cost effective in the Old Crow grid region, the levelized cost of energy generated (or conserved) would need to be less than or equal to the avoided cost of $0.64/kWh.

6.3 Total CSRAE Economic Potential

Examination of the levelized costs of energy generation and costs of conserved energy calculated in Sections 5.5.6, 5.6.6 and 5.7.6 indicate that:

- Solar hot water meets the economic screening threshold in all regions and for both sectors **except** for residential non-apartment installations in both small and large diesel grids. Note that apartment building size installations pass the screening threshold in all grids.
- Residential pellet furnaces and commercial pellet boilers meet the screening threshold in the hydro grid, and would meet it even if installed costs were considerably higher
- Solar PV does not meet the screening criteria in any region or sector.

Larger solar DHW systems and wood-pellet burning appliances meet the economic screening criteria for all supply systems. Smaller solar DHW meet the criteria in the hydro and Old Crow supply system regions.

Exhibit 42 below shows the total Economic Potential resulting from:

- Commercial solar hot water systems
- Residential solar hot water systems in the hydro and Old Crow grid regions, but only apartment solar hot water systems in the large and small diesel grids
- Residential pellet furnaces and commercial pellet boilers in the hydro grid region.

Exhibit 42 Total CSRAE Economic Potential (MWh/yr.)

Technology	Sector	Technical Potential	Economic Potential	%
Solar PV	Residential – Existing	13,427	0	0%
	Residential – New	7,383	0	0%
	Commercial – Existing	2,995	0	0%
	Commercial – New	3,012	0	0%
	Sub Total	26,816	0	0%
Solar Hot Water	Residential – Existing	7,053	6,680	95%
	Residential – New	4,586	4,570	100%
	Commercial – Existing	335	335	100%
	Commercial – New	787	787	100%
	Sub Total	12,761	12,372	97%
Pellet-Burning Appliances	Residential – Existing	6,209	6,209	100%
	Residential – New	9,601	9,601	100%
	Commercial – Existing	1,545	1,545	100%
	Commercial – New	12,605	12,605	100%
	Sub Total	29,961	29,961	100%
Total		69,538	42,333	61%

6.4 Future Cost Trends

Although small-scale solar PV systems do not currently meet the study's economic threshold, there is a general expectation that they are likely to become competitive with other electricity generation options sometime within the 20-year period covered by this study. For example, the U.S. Department of Energy's SunShot Initiative is aiming to achieve grid parity by 2020.[50] Recently, a report by Ernst & Young suggested that retail grid parity might generally be achieved between 2012 and 2015.[51] It is difficult to estimate at what point this might occur in Yukon. On the one hand, the installed cost per system will be more expensive than in other areas in Canada and the amount of electricity generated will be lower due to the lower insolation; on the other hand, the cost of electricity generated conventionally is also more expensive.

[50] SunShot Initiative, U.S. Department of Energy, http://www1.eere.energy.gov/solar/sunshot/. Accessed 19 October 2011.
[51] Becky Stuart, "Renewable energy investment high, but industry issues remain," *PV Magazine*, 3 March 2011, http://www.pv-magazine.com/news/details/beitrag/renewable-energy-investment-high--but-industry-issues-remain_100002386/. Accessed 19 October 2011.

Due to the possibility of PV grid parity during the study period, it was decided to include this technology within the Achievable Potential discussions presented in Section 7.

PV is expected to be economically cost effective before the end of the study period.

Solar thermal systems and pellet-burning appliances are more mature technologies; significant technological developments are not expected. However, mature Yukon markets for these technologies would be expected to reduce the installed costs and, for wood-pellet burning appliances, the ongoing cost of wood pellets.

7 CSRAE Achievable Potential

7.1 Introduction

This section presents the Achievable Potential for customer-side renewable and alternative energy technologies for the study period (2010 to 2030). The Achievable Potential is defined as the proportion of the renewable and alternative energy opportunities identified in the CSRAE Economic Potential Forecast that could realistically be achieved within the study period.

The remainder of this discussion is organized into the following subsections:

- Description of Achievable Potential
- Approach to the estimation of Achievable Potential
- Results.

7.2 Description of Achievable Potential

Achievable Potential recognizes that, in many instances, it is difficult to induce all customers to purchase and install all the renewable and alternative energy technologies that meet the criteria defined by the Economic Potential Forecast. For example, customer decisions to implement these measures can be constrained by important factors such as:

- Higher first cost of renewable or alternative energy technology(s)
- Need to recover investment costs in a short period (payback)
- Lack of product performance information
- Aesthetic or space concerns
- Lack of product and service availability.

The rate at which customers accept and purchase CSRAE technologies will be influenced by numerous factors, including the level of financial incentives, information and other measures put in place by Yukon utilities and governments and the private sector to remove barriers such as those noted above. It will also be strongly influenced by future CSRAE technology performance improvements and cost reductions as well as future costs for large-scale supply side electricity generation technologies.

The Achievable Potential results in this section are presented as a band of possibilities, rather than a single line. This is because any estimate of Achievable Potential over a 20-year period is necessarily subject to uncertainty. Consequently, the discussion of Achievable Potential that is summarized in the following sub sections were conducted for two scenarios: Lower and Upper.

The Lower Achievable Potential assumes Yukon market conditions similar to those contained in the Reference Case. That is, the customers' awareness of CSRAE options and their motivation levels remain similar to those in the recent past and technology improvements continue at historical levels. It also assumes that the Yukon utilities' and governments' ability to influence

customers' decisions towards increased investments in CSRAE options remain roughly in line with previous experience.

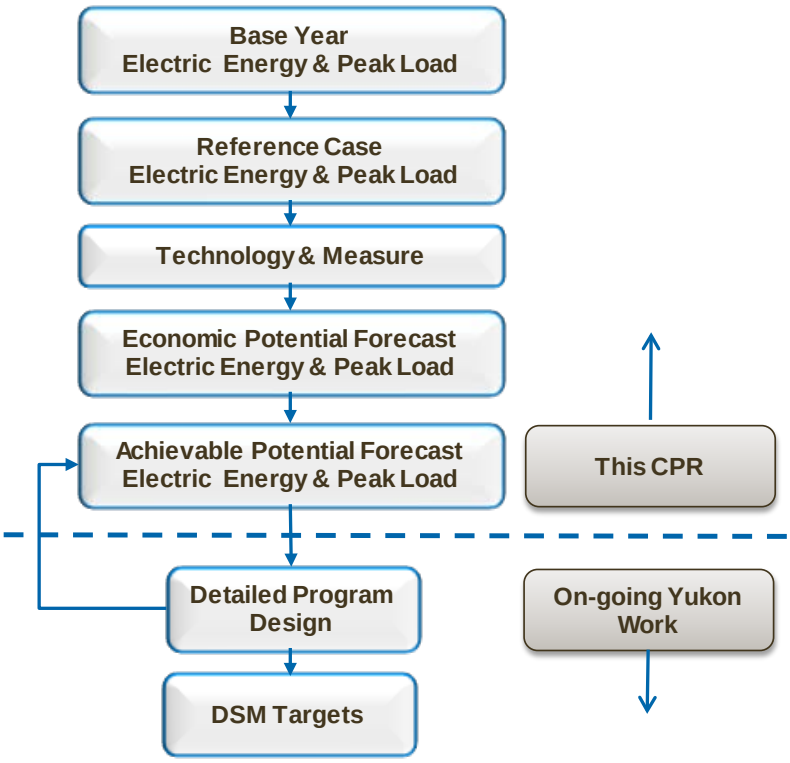
The Upper Achievable Potential assumes Yukon market conditions that aggressively support investment in CSRAE technologies. For example, this scenario assumes that real energy prices increase over the study period and that federal and territorial government actions to mitigate climate change result in increased levels of complementary CSRAE technology initiatives. Upper Achievable Potential typically does not reach Economic Potential levels; this recognizes that some portion of the market is typically constrained by barriers that cannot realistically be affected by programs within the study period.

7.2.1 Achievable Potential Versus Detailed Program Design

It should also be emphasized that the estimation of Achievable Potential is not synonymous with either the setting of specific program targets or with program design. While both are closely linked to the discussion of Achievable Potential, they involve more detailed analysis that is beyond the scope of this study.

Exhibit 43 (also presented as Exhibit 2) shows the relationship between Achievable Potential and the more detailed program design.

Exhibit 43 Achievable Potential versus Detailed Program Design



7.3 Approach to the Estimation of Achievable Potential

Achievable Potential was estimated in a five-step approach.

- Priority opportunities were selected
- Opportunity profiles were created
- Opportunity worksheets were prepared
- A half-day workshop was held
- Workshop results were aggregated and extended to other opportunities, where appropriate.

Further discussion is provided below.

Step 1: Select Priority Opportunities

The first step in developing the Achievable Potential estimates required selection of the renewable and alternative energy opportunities identified in the Technical and Economic Potential Forecasts to be discussed during the Achievable workshop. For the renewable and alternative energy technologies, the primary considerations were either:

- The technology already meets the economic screening criteria, or
- The technology is expected to be economically viable by the end of the study period.

The chosen opportunities are shown in Exhibit 44. As noted in Section 6.4, Opportunity 2 was included in the Achievable discussions because it is expected to become economical before the end of the study period.

Exhibit 44 CSRAE Sector Opportunities

Opportunity	Measure
1	Solar thermal DHW in commercial buildings with larger DHW loads
2	Solar PV on commercial buildings
3	Wood pellet furnaces in single-family and attached homes in the hydro grid region
4	Wood pellet boilers commercial buildings with larger heating loads

Step 2: Create Opportunity Profiles

The next step involved the development of brief profiles for each of the opportunities noted above in the form of PowerPoint slides. The slides are presented in Appendix B.

The purpose of the opportunity profiles was to provide a high-level logic framework that would serve as a guide for participant discussions in the Achievable workshop (see Step 4 below). The intent was to define a broad rationale and direction without getting into the much greater detail required of program design, which, as noted previously, is beyond the scope of this project. As illustrated in Appendix B, each opportunity profile addresses the following areas:

- Technology Description – provides a summary of the technology, assumptions, annual electricity generation and Economic Potential.

- Economic Indicators – provides estimates of levelized cost per unit of generated or conserved electricity.
- Target Dwelling/Building Type and Typical Application – highlights the dwelling/building types and applications offering the most significant opportunities.
- Eligible Participants – provides an estimate of the number of dwellings/buildings that could be affected, and the total generation possible, during the study period if the entire Economic Potential were to be captured.

Step 3: Prepare Opportunity Assessment Worksheets

A draft assessment worksheet was prepared for each opportunity profile. The assessment worksheets complemented the information contained in the PowerPoint slides by providing quantitative data on the size of the eligible population of potential participants. The population data were taken from the detailed modelling results contained in the Economic Potential Forecast.

The worksheets, including the results recorded during the workshop discussions, are provided in Appendix C. As illustrated in Appendix C, each opportunity assessment worksheet addresses the following areas:

- Approximate Levelized Unit Cost of Generated (or Conserved) Electricity – shows the approximate levelized cost of generating each kWh of electricity by the measure. For the purposes of the workshop, this information provided participants with an indication of the scope for using financial incentives to influence customer participation rates.
- Economic Potential in Terms of Applicable Participants (e.g., number of dwellings/buildings) – shows the total number of potential participants in terms of dwellings or buildings (as appropriate) that could theoretically take part in the opportunity. Numbers shown are from the eligible populations used in the Economic Potential Forecasts.
- Participation Rates (%) – these fields were filled in during the workshops (described below), based on input from the participants. They show the percentage of eligible applications that workshop participants concluded could be achievable in the last milestone period (2030).
- Achievable Potential in Terms of Applicable Participants (e.g., number of dwellings or buildings) – these fields were calculated by the spreadsheet based on the participation rates provided by the participants.

Step 4: Achievable Workshop

The most critical step in developing the estimates of Achievable Potential was a half-day Achievable Potential workshop held on 17 November 2011. Workshop participants consisted of core members of the consultant team, DSM program and technical personnel from YEC, YECL and the Government of Yukon, industry and community representatives. Together, the participating personnel brought many years of experience to the workshop related to the technologies and markets as well as the design and delivery of energy-efficiency, renewable and alternative energy programs in Yukon.

The purpose of this workshop was to:

- Promote discussion regarding the technical and market constraints confronting the identified CSRAE opportunities
- Identify potential strategies for addressing the identified constraints, including potential partners and delivery channels
- Compile participant views related to how much of the identified economic savings could realistically be achieved over the study period.

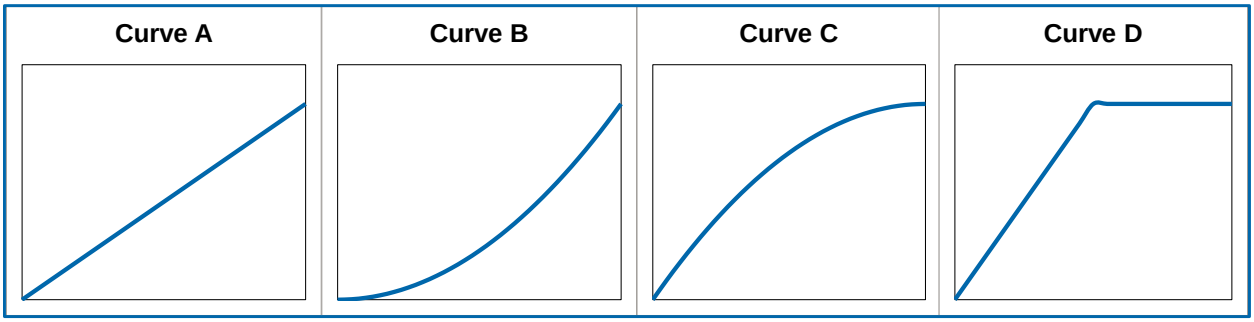
Following a brief consultant presentation that summarized the study methodology to date, the workshop provided a structured assessment of each of the selected opportunities. The opportunity assessment consisted of a facilitated discussion of the key elements affecting successful promotion and implementation of the CSRAE opportunity. More specifically:

- What are the major constraints/challenges constraining customer adoption of the identified renewable and alternative fuel opportunities?
- How big is the “won’t” portion of the market for this opportunity?
- What are the preferred strategies and potential partners for addressing the identified constraints (high level only)?
- What are the key criteria that determine customers’ willingness to proceed?
- Who are the key potential channel partners?
- What are the optimum intervention strategies e.g., push, pull, combination?
- How sensitive is this opportunity to incentive levels?

Following discussion of market constraints and potential intervention strategies, participants’ views on potential participation rates were recorded. The steps involved were as follows:

- The participation rate for the Upper Achievable scenario in 2030 was estimated
- The shape of the adoption curve was selected for the Upper Achievable scenario. Rather than seek consensus on the specific values to be employed in each of the intervening years, workshop participants selected one of four curve shapes that best matched their view of the appropriate “ramp-up” rate for each opportunity, as described in Exhibit 45
- The process was then repeated for the Lower scenario.

Exhibit 45 Participation Rate Curves



Curve A represents a steady increase in the expected participation rate over the study period.

Curve B represents a relatively slow participation rate during the first half of the study period followed by a rapid growth in participation during the second half of the 20-year study period.

Curve C represents a rapid initial participation rate followed by a relatively slow growth in participation during the remainder of the study period.

Curve D represents a very rapid initial participation rate that results in virtual full saturation of the applicable market during the first half of the study period.

Step 5: Aggregate and Extend Opportunity Results

The final step involved aggregating the results of the individual opportunities to provide a view of the potential Achievable in both the Residential and Commercial sectors.

7.4 Achievable Workshop Results

The following sub sections present a summary of the workshop discussions for each of the CSRAE opportunities listed in Exhibit 44 above, with a summary of key values presented in Section 7.4.6. Included for each opportunity are:

- Participation estimates (for 2030) made by workshop participants, with comments, where needed, about values assumed in the calculations, presented in Section 7.5
- Where needed, additional participation estimates made after the workshop for the purposes of the calculations, presented in Section 7.5
- Selected highlights that attempt to capture key discussion themes related to the opportunity. Two comments applicable to all technologies are presented in Section 7.4.5.

Appendix C provides copies of the assessment worksheets used during the workshop.

7.4.1 Solar Hot Water

Achievable workshop participants provided 2030 participation rate estimates for the Commercial sector of 40% for the Upper Achievable scenario and 20% under the Lower Achievable scenario. Participants thought the most likely participation rate curve would be B.

For the Residential sector, participation rates of approximately one-third that estimated for the Commercial sector (Upper 13%, Lower 7%), with the same rate curve used for the Commercial sector, were later used for the Achievable Potential calculations. This estimate includes systems placed on large apartment systems, which share characteristics with the Commercial sector,[52] and some participation by other residences in the hydro and Old Crow grids.

The use of evacuated tube solar collectors in the Yukon climate may be problematic. Further research needs to be done.

[52] Apartment building account for approximately 25% of the solar DHW economic potential in the residential sector.

Participants commented that evacuated tube installations in Yukon have been plagued by a high level of failures. This may be due to large temperature swings. Flat plate installations appear to be more reliable. The use of evacuated tube solar collectors in Yukon's climate needs to be carefully investigated before being recommended or supported by a program.

Participants also commented that very little metered performance data has been collected in Yukon, and both residential and commercial pilot or demonstration projects would be helpful. Consideration should be given to establishing pilot metered installations to verify performance before encouraging wider use of solar hot water systems.

7.4.2 Solar PV

Achievable workshop participants provided a wide range of estimates for participation in the Commercial sector due to the uncertainty about future prices. Calculations have been made with the mid-point estimates (Upper 55%, Lower 35%). Participants suggested Curve B was the most appropriate, but also recognized that significant penetration is likely to be delayed until the second half of the study period.

For the Residential sector, participation rates of approximately one-sixth of that estimated for the Commercial sector (Upper 9%, Lower 6%) were later assumed for the Achievable Potential calculations. This includes systems placed on large apartment systems, which share characteristics with the Commercial sector,[53] and some participation by other residences. Again, significant penetration is assumed to be delayed until 2025, and Curve B was used.

Almost half of the potential for solar-generated electricity occurs between February and May, when hydro reserves are the lowest.

One participant discussed how the availability of solar-generated electricity matched the system demand. In some respects, the availability of solar-generated electricity and the system demand for electricity are not well matched. (When it's hot and sunny, the demand for electricity is at its lowest.) However, almost half of the solar-generated electricity can be made between February and May, while hydro reserves are lowest in April to mid-May. Overall solar PV helps the hydro system.

7.4.3 Wood Pellet Furnaces (Residential)

Achievable workshop participants suggested that a 20% penetration rate by 2030 was appropriate for wood pellet furnaces in single-family detached and attached homes. A rate curve was not provided but was assumed to be B. A Lower Achievable penetration was also not provided and was assumed to be 5%.

Participants commented that:

- Pellet stoves are currently more popular than pellet furnaces and may have a larger potential
- Although emissions from pellet appliances are lower than with wood appliances, some consideration should be given to the air quality impact of a high density of pellet appliances
- Pellet boilers have the advantage of also being able to provide hot water.

[53] Apartment building account for approximately 10% of the solar PV technical potential in the residential sector.

7.4.4 Wood Pellet Boilers (Commercial)

Achievable workshop participants suggested a narrow range of values (50%-60%) for the Upper Achievable scenario. For calculations, the mid-point value (55%) was used. A Lower Achievable participation rate of 5%, and, under both scenarios, a Curve B rate were suggested at the workshop.

Emissions from wood-pellet appliances are much lower than those from wood-burning appliances; however, possible location-specific problems should be investigated before widespread use is encouraged.

Participants commented that wood pellet boiler installations in the Northwest Territories are rumoured to have air quality issues. This should be thoroughly investigated before additional installations are encouraged in Yukon.

Participants also commented that some earlier biomass installations were not successful, so successful pilot projects will be important.

7.4.5 General Comments

Two of the comments made by participants apply to all CSRAE technologies:

- Small commercial building owners often have difficulty financing energy-efficiency or renewable energy projects. Providing low-cost financing may increase uptake with this group
- Potential permitting/insurance issues should be examined before launching programs to minimize barriers. This could include inspector training.

7.4.6 Summary of Participation Rates and Rate Curves

Exhibit 46 summarizes the participant rate and rate curve assumptions discussed above:

Exhibit 46 Summary of Achievable Potential Participation Rates and Curves

	Technology	Participation Factor 2030	Curve
Residential	Solar PV	9%	B (mod)
		6%	B (mod)
	Solar Thermal	13%	B
		7%	B
	Pellet-Burning Appliance	20%	B
		5%	B
Commercial	Solar PV	55%	B (mod)
		35%	B (mod)
	Solar Thermal	40%	B
		20%	B
	Pellet-Burning Appliance	55%	B
		5%	B

7.5 Summary of Achievable Potential

A summary of the Upper and Lower Achievable Potential results is presented in Exhibit 47.

Exhibit 47 CSRAE Achievable Potential by Milestone Year

	Technology	Economic Potential (MWh/year)*				Scenario	Achievable Potential (MWh/yr.)			
		2015	2020	2025	2030		2015	2020	2025	2030
Residential	Solar PV	15,092	16,878	18,781	20,810	Upper	0	0	423	1873
		15,092	16,878	18,781	20,810	Lower	0	0	282	1249
	Solar Thermal	7,624	8,693	9,898	11,250	Upper	62	283	724	1462
		7,624	8,693	9,898	11,250	Lower	33	152	390	787
	Pellet-Burning Appliance	6,263	6,240	6,223	15,811	Upper	78	312	700	3162
		6,263	6,240	6,223	15,811	Lower	20	78	175	791
	Sub Total	28,979	31,812	34,902	47,870	Upper	140	595	1,846	6,497
		28,979	31,812	34,902	47,870	Lower	53	230	846	2,827
Commercial	Solar PV	3,614	4,315	5,109	6,007	Upper	0	0	702	3304
		3,614	4,315	5,109	6,007	Lower	0	0	447	2102
	Solar Thermal	496	679	886	1,122	Upper	12	68	199	449
		496	679	886	1,122	Lower	6	34	100	224
	Pellet-Burning Appliance	4,134	7,067	10,388	14,150	Upper	142	972	3214	7783
		4,134	7,067	10,388	14,150	Lower	13	88	292	708
	Sub Total	8,245	12,061	16,383	21,279	Upper	155	1,040	4,116	11,535
		8,245	12,061	16,383	21,279	Lower	19	122	839	3,034
	Total	**37,224**	**43,873**	**51,285**	**69,149**	**Upper**	**295**	**1,634**	**5,962**	**18,033**
		37,224	**43,873**	**51,285**	**69,149**	**Lower**	**72**	**352**	**1,685**	**5,861**

*For PV, this is the technical potential; the current economic potential is 0.

Exhibit 48 presents the Achievable Potential by sector and technology.

Exhibit 48 2030 CSRAE Achievable Potential by Sector

Technology	Sector	Technical Potential	Economic Potential		Achievable Potential		% of Econ.*
Solar PV	Residential – Existing	13,427	0	9%	Upper	1,208	9%
				6%	Lower	806	6%
	Residential – New	7,383	0	9%	Upper	664	9%
				6%	Lower	443	6%
	Commercial – Existing	2,995	0	55%	Upper	1,647	55%
				35%	Lower	1,048	35%
	Commercial – New	3,012	0	55%	Upper	1,657	55%
				35%	Lower	1,054	35%
	Sub Total	26,816	0		Upper	5,177	19%
					Lower	3,351	12%
Solar Hot Water	Residential – Existing	7,053	6,680	13%	Upper	868	13%
				7%	Lower	468	7%
	Residential – New	4,586	4,570	13%	Upper	594	13%
				7%	Lower	320	7%
	Commercial – Existing	335	335	40%	Upper	134	40%
				20%	Lower	67	20%
	Commercial – New	787	787	40%	Upper	315	40%
				20%	Lower	157	20%
	Sub Total	12,761	12,372		Upper	1,911	15%
					Lower	1,012	8%
Pellet-Burning Appliances	Residential – Existing	6,209	6,209	20%	Upper	1,242	20%
				5%	Lower	310	5%
	Residential – New	9,601	9,601	20%	Upper	1,920	20%
				5%	Lower	480	5%
	Commercial – Existing	1,545	1,545	55%	Upper	850	55%
				5%	Lower	77	5%
	Commercial – New	12,605	12,605	55%	Upper	6,933	55%
				5%	Lower	630	5%
	Sub Total	29,961	29,961		Upper	10,945	37%
					Lower	1,498	5%
Total		**69,538**	**42,333**		**Upper**	**18,033**	**26%**
					Lower	**5,861**	**8%**

*For solar PV, this is percent of technical

7.5.1 Interpretation of Results

Highlights of the results shown in the preceding exhibits are provided below:

- The range of potential results varies very widely between the Upper and Lower Achievable scenarios. This reflects the large number of unknown factors
- Under the Upper scenario, the Commercial sector has a significantly higher potential than the Residential sector. However, under the Lower scenario, the potentials in the Commercial and Residential sectors are comparable
- The largest potential may be with pellet-burning appliances, assuming an aggressive approach

- Even under the Upper scenario, the absolute amount of savings possible from solar hot water is the smallest
- Solar PV could provide considerable generation under the Upper scenario, even though the penetration of this technology is expected to start later than for the others.

Assuming an aggressive approach, the largest potential may be with pellet-burning appliances.

Solar PV may provide significant potential even if penetration of the technology does not begin immediately.

8 Glossary

Achievable Potential:
The portion of the economic conservation potential that is achievable through government and utility interventions and programs given institutional, economic and market barriers.

Avoided Cost:
By reducing energy consumption and capacity requirements through the implementation of demand-side management programs, the Yukon utilities avoid the cost of having to buy energy on the open market, contract for long term supply, and/or build and run new generation facilities. This avoided cost is used to develop a benchmark against which the cost of energy efficiency measures can be compared.

Base Year:
The Base Year for the 2011 CPR is the 2010 sales for the two utilities. This number is derived from 2010 sales and forecast 2010 energy and capacity requirements as is explained in each report.

Benchmark for Economic Analysis:
The study established benchmarks for the economic cut-off for new avoided electrical supply on each of the four different supply systems in Yukon. These values were selected to provide the CPR study with a reasonably useful time horizon (life) to allow planners to examine options that may become more cost-effective over time. The following values were used:

- Residential accounts on the Hydro Grid: $0.35/kWh
- Residential accounts on Large Diesel and Small Diesel systems: $0.30/kWh
- Residential accounts on the Old Crow system: $0.64/kWh

Cost of Conserved Energy (CCE):
The CCE is calculated for each energy-efficiency measure. The CCE is the annualized incremental capital and operating and maintenance (O&M) cost of the upgrade measure divided by the annual energy savings achieved, excluding any administrative or program costs. The CCE represents the cost of conserving one kWh of electricity; it can be compared directly to the cost of supplying one new kWh of electricity.

Demand-side Management (DSM):
DSM is the influencing of customers' electricity use to obtain desirable and quantifiable changes in that use.

Economic Potential:
The Economic Potential is the savings in electricity consumption due to energy efficient measures whose Cost of Conserved Energy (CCE) is less than or equal to the Benchmark for Economic Analysis

Electricity Audit:
An on-site inspection and cataloguing of electricity-using equipment/buildings, electricity consumption, and the related end uses. The purpose is to provide information to the customer and the utility. Audits are useful for load research, DSM program design, and identifying specific energy-saving projects.

Electric Capacity:
The maximum electric power that a device or network is capable of producing or transferring.

Electricity Conservation:
Activities by utilities or electricity users that result in a reduction of electric energy use without adversely affecting the level or quality of energy service provided. Electricity conservation measures include substitution of high-efficiency motors for standard efficiency ones, occupancy sensors in office buildings, insulation in residences, etc.

Electricity Efficiency:
The ratio of the useful energy delivered by a dynamic system to the amount of electric energy supplied to it.

Electric Energy:
Energy in the form of electricity. Energy is the ability to perform work. Electric energy is different from electric power. Electric energy is measured in kilowatt-hours, megawatt-hours or gigawatt-hours.

Electricity Intensity:
Electric energy use measured per application or end use. Examples would include kilowatt-hours per square meter of lit office space per day, kilowatt-hours per tonne of potash produced, and kilowatt-hours per year per residential refrigerator. Electricity intensity increases as electricity efficiency decreases.

Electric Power:
The rate at which electric energy is produced or transferred, usually measured in watts, kilowatts and megawatts.

End use:
The services of economic value to the users of energy. For example, office lighting is an end use, whereas electricity sold to the office tenant is of no value without the equipment (light fixtures, wiring, etc.) necessary to convert the electricity into visible light. End use is often used interchangeably with energy service.

Energy Service:
An amenity or service supplied jointly by energy and other components such as buildings, motors and lights. Examples of energy services include residential space heating, commercial refrigeration, natural gas production, and lighting. The same energy service can frequently be supplied with different mixes of equipment and energy.

Financial Incentive:
Certain financial features in the utility's demand-side management programs designed to motivate customer participation. These may include features designed to reduce a customer's net cash outlay, payback period or cost of finance to participate in a specific demand-side management measure or technology.

Kilowatt (kW):
One thousand watts, the basic unit of measurement of electric energy. One kilowatt-hour represents the power of one thousand watts (one kilowatt) for a period of one hour. A typical non-electrically heated detached home in Yukon uses about 12,800 kWh per year. A four foot fluorescent lamp in an office might use about 100-200 kWh per year and a large coal-fired plant might produce about three billion kWh per year.

Levelized Cost of Generation/Conservation (LCG/LCC):
The LCG or LCC is calculated for each customer-side renewable or alternative energy technology measure. The LCG/LCC is the annualized incremental capital and O&M cost of the

measure divided by the annual energy generated or conserved, excluding any administrative or program costs. The LCG/LCC represents the cost of generating or conserving one kWh of energy; it can be compared directly to the cost of supplying one new kWh of electricity. (The choice of LCG/LCC depends on the technology: solar PV systems generate electricity, and would therefore have an LCG; wood-pellet burning furnaces conserve electricity in an electrically heated home and would therefore have an LCC.)

Load Forecast:
The forecast of electricity demand over a specified time period. Long-term load forecasts usually pertain to a 10- to 20-year period. In the case of Yukon, the load forecast assumes a specific set of rates or prices for electricity and competing energy forms, as well as many other economic variables.

Load Shape:
The time pattern and magnitude of a utility's electrical demand.

Megawatt (MW):
One thousand kilowatts.

"Natural Change" in Electricity Intensity:
The future change in electricity intensity in a given end use that is expected to occur in the absence of utility demand-side management programs. In developing an estimate of natural change in electricity intensity it is necessary to make an explicit assumption about the future prices of electricity and competing fuels.

Reference Case:
Provides a forecast of electricity sales that includes natural conservation (that which would occur in the absence of DSM programs) but no impacts of utility DSM programs. The Reference Case for the study is based on the 2010 YECL load forecast.

Sector:
A group of customers having a common type of economic activity.

Sub sectors:
A classification of customers within a sector by common features. Residential sub sectors are by type of home (single-family dwelling or apartment). Commercial sub sectors are generally by type of commercial service (retail and wholesale trade).

Supply System:
Electricity is supplied by YEC and YECL to customers using four different supply systems, which vary in terms of retail rates and generation costs. The four different systems are as follows:

- **Hydro grid:** All customers of YEC and most customers of YECL are connected to a grid that is served primarily by hydroelectricity
- **Large diesel:** YECL customers in Watson Lake are served by a large diesel grid
- **Small diesel:** YECL customers in Destruction Bay/Burwash, Beaver Creek and Swift River are served by three small diesel grids
- **Old Crow:** YECL customers in Old Crow are served by a diesel grid for which the fuel must be flown into the community.

Technical Efficiency:
Efficiency of a system, process, or device in achieving a certain purpose, measured in terms of the physical inputs required to produce a given output. In the context of electricity conservation the relevant input is electric energy.

Technology-Based Potential:
Energy and or capacity/demand savings realized through the implementation of energy-efficiency technologies.

Watt:
The basic unit of measurement of electric power.

Yukon Service Area:
Yukon Service Area is the territory of the Yukon. This includes all customers served by YEC or YECL, including those connected to the hydro grid as well as customers on the large and small diesel supply systems, and the system serving the fly-in community of Old Crow.

Appendix A Technical Potential Calculations

Technical Potential was calculated with custom spreadsheets that applied each technology to the appropriate portion of households (residential) or approximate number of buildings (commercial). Assumptions about building size and penetration of electric end use are consistent with the assumptions made for the residential and commercial Base and Reference cases. Technical applicability, appropriate system size, and annual per unit electricity generation assumptions are shown in the following exhibits.

Exhibit A-1 Residential Technical Potential Calculation Tables

Hydro Grid Non-Government

Residential: Existing and Renovated Stock

PV – Electricity	System Design Size (kW)	Annual Generation Per Bldg (kWh/yr.)	Est. Technical Applicability	2015		2020		2025		2030	
				# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)
Pre-1980 electrically heated single detached homes	3	3,200	30%	434	417	434	417	434	417	434	417
1980 & newer electrically heated single detached homes	3	3,200	30%	513	492	513	492	513	492	513	492
Pre-1980 non-electrically heated single detached homes	3	3,200	30%	2,691	2,583	2,691	2,583	2,691	2,583	2,691	2,583
1980 & newer non-electrically heated single detached homes	3	3,200	30%	3,177	3,050	3,177	3,050	3,177	3,050	3,177	3,050
Pre-1980 electrically heated attached/row housing	3	3,200	30%	58	56	58	56	58	56	58	56
1980 & newer electrically heated attached/row housing	3	3,200	30%	68	65	68	65	68	65	68	65
Pre-1980 non-electrically heated attached/row housing	3	3,200	30%	356	342	356	342	356	342	356	342
1980 & newer non-electrically heated attached/row housing	3	3,200	30%	421	404	421	404	421	404	421	404
Electrically heated apartment units			0%	205	0	205	0	205	0	205	0
Electrically heated apartment common areas	20	22,000	30%	21	139	21	139	21	139	21	139
Non-electrically heated apartment units			0%	1,271	0	1,271	0	1,271	0	1,271	0
Non-electrically heated apartment common areas	20	22,000	30%	132	868	132	868	132	868	132	868
Electrically heated mobile/other	3	3,200	30%	129	124	129	124	129	124	129	124
Non-electrically heated mobile/other	3	3,200	30%	802	769	802	769	802	769	802	769
Seasonal housing	3	3,200	30%	3,041	2,919	3,041	2,919	3,041	2,919	3,041	2,919
Residential garages			0%	263	0	263	0	263	0	263	0
Sentinel Lighting			0%	798	0	798	0	798	0	798	0
Total				14,378	12,229	14,378	12,229	14,378	12,229	14,378	12,229

Residential: New Stock

PV – Electricity	System Design Size (kW)	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	2015		2020		2025		2030	
				# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)
Pre-1980 electrically heated single detached homes	3	3,200	45%	0	0	0	0	0	0	0	0
1980 & newer electrically heated single detached homes	3	3,200	45%	248	357	521	750	810	1,167	1,108	1,595
Pre-1980 non-electrically heated single detached homes	3	3,200	45%	0	0	0	0	0	0	0	0
1980 & newer non-electrically heated single detached homes	3	3,200	45%	313	451	604	870	869	1,251	1,107	1,595
Pre-1980 electrically heated attached/row housing	3	3,200	45%	0	0	0	0	0	0	0	0
1980 & newer electrically heated attached/row housing	3	3,200	45%	58	84	132	190	220	317	321	462
Pre-1980 non-electrically heated attached/row housing	3	3,200	45%	0	0	0	0	0	0	0	0
1980 & newer non-electrically heated attached/row housing	3	3,200	45%	43	62	83	119	119	171	151	218
Electrically heated apartment units			0%	179	0	467	0	891	0	1,476	0
Electrically heated apartment common areas	20	22,000	45%	18	181	48	473	91	904	151	1,497
Non-electrically heated apartment units			0%	121	0	237	0	346	0	447	0
Non-electrically heated apartment common areas	20	22,000	45%	12	124	25	243	36	355	46	458
Electrically heated mobile/other	3	3,200	45%	34	49	71	102	110	159	151	217
Non-electrically heated mobile/other	3	3,200	45%	43	62	83	119	119	171	151	218
Seasonal housing	3	3,200	45%	162	234	313	451	450	648	574	826
Residential garages			0%	14	0	27	0	39	0	50	0
Sentinel Lighting			0%	43	0	82	0	118	0	151	0
Total				1,287	1,601	2,691	3,317	4,219	5,143	5,884	7,087

Hydro Grid Non-Government

Residential: Existing and Renovated Stock

Solar DHW – Heat	System Size (m^2)	Annual Savings Per Bldg (kWh/yr.)	Est. Technical Applicability %	2015			2020			2025			2030		
				# of Buildings	% with Electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with Electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with Electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with Electric DHW	Total Annual Production (MWh/yr.)
Pre-1980 electrically heated single detached homes	6	2,200	30%	434	100%	286	434	100%	286	434	100%	286	434	100%	286
1980 & newer electrically heated single detached homes	6	2,200	30%	513	100%	339	513	100%	339	513	100%	339	513	100%	339
Pre-1980 non-electrically heated single detached homes	6	2,200	30%	2,691	79%	1,410	2,691	79%	1,410	2,691	79%	1,410	2,691	79%	1,410
1980 & newer non-electrically heated single detached homes	6	2,200	30%	3,177	79%	1,665	3,177	79%	1,665	3,177	79%	1,665	3,177	79%	1,665
Pre-1980 electrically heated attached/row housing	6	2,200	30%	58	100%	38	58	100%	38	58	100%	38	58	100%	38
1980 & newer electrically heated attached/row housing	6	2,200	30%	68	100%	45	68	100%	45	68	100%	45	68	100%	45
Pre-1980 non-electrically heated attached/row housing	6	2,200	30%	356	79%	187	356	79%	187	356	79%	187	356	79%	187
1980 & newer non-electrically heated attached/row housing	6	2,200	30%	421	79%	221	421	79%	221	421	79%	221	421	79%	221
Electrically heated apartment units			0%	205	100%	0	205	100%	0	205	100%	0	205	100%	0
Electrically heated apartment common areas	50	23,900	30%	21	100%	151	21	100%	151	21	100%	151	21	100%	151
Non-electrically heated apartment units			0%	1,271	80%	0	1,271	80%	0	1,271	80%	0	1,271	80%	0
Non-electrically heated apartment common areas	50	23,900	30%	132	80%	754	132	80%	754	132	80%	754	132	80%	754
Electrically heated mobile/other	6	2,200	30%	129	100%	85	129	100%	85	129	100%	85	129	100%	85
Non-electrically heated mobile/other	6	2,200	30%	802	79%	420	802	79%	420	802	79%	420	802	79%	420
Seasonal housing	6	2,200	30%	3,041	41%	830	3,041	41%	830	3,041	41%	830	3,041	41%	830
Residential garages	6		0%	263	50%	0	263	50%	0	263	50%	0	263	50%	0
Sentinel Lighting	6		0%	798	0%	0	798	0%	0	798	0%	0	798	0%	0
Total				14,378		6,431	14,378		6,431	14,378		6,431	14378.179		6,431

Residential : New Stock

Solar DHW – Heat	System Size (m^2)	Annual Savings Per Bldg (kWh/yr.)	Est. Technical Applicability %	2015			2020			2025			2030		
				# of Buildings	% with Electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with Electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with Electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with Electric DHW	Total Annual Production (MWh/yr.)
Pre-1980 electrically heated single detached homes	6	2,200	40%	0	100%	0	0	100%	0	0	100%	0	0	100%	0
1980 & newer electrically heated single detached homes	6	2,200	40%	248	100%	218	521	100%	459	810	100%	713	1,108	100%	975
Pre-1980 non-electrically heated single detached homes	6	2,200	40%	0	79%	0	0	79%	0	0	79%	0	0	79%	0
1980 & newer non-electrically heated single detached homes	6	2,200	40%	313	79%	219	604	79%	422	869	79%	607	1,107	79%	774
Pre-1980 electrically heated attached/row housing	6	2,200	40%	0	100%	0	0	100%	0	0	100%	0	0	100%	0
1980 & newer electrically heated attached/row housing	6	2,200	40%	58	100%	51	132	100%	116	220	100%	193	321	100%	282
Pre-1980 non-electrically heated attached/row housing	6	2,200	40%	0	79%	0	0	79%	0	0	79%	0	0	79%	0
1980 & newer non-electrically heated attached/row housing	6	2,200	40%	43	79%	30	83	79%	58	119	79%	83	151	79%	106
Electrically heated apartment units			0%	179	100%	0	467	100%	0	891	100%	0	1,476	100%	0
Electrically heated apartment common areas	50	23,900	40%	18	100%	175	48	100%	457	91	100%	873	151	100%	1,446
Non-electrically heated apartment units			0%	121	80%	0	237	80%	0	346	80%	0	447	80%	0
Non-electrically heated apartment common areas	50	23,900	40%	12	80%	95	25	80%	187	36	80%	274	46	80%	354
Electrically heated mobile/other	6	2,200	40%	34	100%	30	71	100%	62	110	100%	97	151	100%	133
Non-electrically heated mobile/other	6	2,200	40%	43	79%	30	83	79%	58	119	79%	83	151	79%	106
Seasonal housing	6	2,200	40%	162	41%	59	313	41%	114	450	41%	164	574	41%	209
Residential garages	6		0%	14	50%	0	27	50%	0	39	50%	0	50	50%	0
Sentinel Lighting	6		0%	43	0%	0	82	0%	0	118	0%	0	151	0%	0
Total				1,287		907	2,691		1,933	4,219		3,087	5884.4566		4,384

Hydro Grid Non-Government

Residential: Existing Stock

Pellet Furnace	Est. Technical Applicability %	2015 # of Buildings	2015 kWh Electricity Used for Heating per Building	2015 kWh Elect. Used For Pellet Furnace per Building	2015 Total Annual Savings (MWh/yr.)	2020 # of Buildings	2020 kWh Electricity Used for Heating per Building	2020 kWh Elect. Used For Pellet Furnace per Building	2020 Total Annual Savings (MWh/yr.)
Pre-1980 electrically heated single detached homes	50%	363	14,856	1,100	2,494	307	14,856	1,100	2,112
1980 & newer electrically heated single detached homes	50%	429	12,075	1,100	2,352	363	12,075	1,100	1,992
Pre-1980 non-electrically heated single detached homes	0%	2,248	1,438	0	0	1,904	1,438	0	0
1980 & newer non-electrically heated single detached homes	0%	2,654	1,027	0	0	2,248	1,027	0	0
Pre-1980 electrically heated attached/row housing	50%	45	9,045	1,100	179	35	9,045	1,100	139
1980 & newer electrically heated attached/row housing	50%	53	6,602	1,100	145	41	6,602	1,100	112
Pre-1980 non-electrically heated attached/row housing	0%	277	899	0	0	214	899	0	0
1980 & newer non-electrically heated attached/row housing	0%	327	656	0	0	253	656	0	0
Electrically heated apartment units	0%	122	5,719	0	0	66	5,719	0	0
Electrically heated apartment common areas	0%	12	13,935	0	0	7	13,935	0	0
Non-electrically heated apartment units	0%	755	519	0	0	411	519	0	0
Non-electrically heated apartment common areas	0%	78	1,265	0	0	43	1,265	0	0
Electrically heated mobile/other	0%	108	9,345	0	0	91	9,345	0	0
Non-electrically heated mobile/other	0%	670	851	0	0	567	851	0	0
Seasonal housing	0%	2,716	35	0	0	2,460	35	0	0
Residential garages	0%	235	500	0	0	213	500	0	0
Small diesel grid housing	0%	0	880	0	0	0	880	0	0
Sentinel Lighting	0%	713	0	0	0	646	0	0	0
Total		11,804	79,647	4,400	5,170	9,869	79,647	4,400	4,355

Residential: Renovated Stock

Pellet Furnace	Est. Technical Applicability %	2015 # of Buildings	2015 kWh Electricity Used for Heating per Building	2015 kWh Elect. Used For Pellet Furnace per Building	2015 Total Annual Savings (MWh/yr.)	2020 # of Buildings	2020 kWh Electricity Used for Heating per Building	2020 kWh Elect. Used For Pellet Furnace per Building	2020 Total Annual Savings (MWh/yr.)
Pre-1980 electrically heated single detached homes	50%	71	14,411	1,100	475	127	14,411	1,100	845
1980 & newer electrically heated single detached homes	50%	84	11,834	1,100	453	150	11,834	1,100	805
Pre-1980 non-electrically heated single detached homes	0%	443	1,395	0	0	787	1,395	0	0
1980 & newer non-electrically heated single detached homes	0%	523	996	0	0	929	996	0	0
Pre-1980 electrically heated attached/row housing	50%	13	8,774	1,100	50	23	8,774	1,100	89
1980 & newer electrically heated attached/row housing	50%	15	6,470	1,100	41	27	6,470	1,100	73
Pre-1980 non-electrically heated attached/row housing	0%	79	872	0	0	142	872	0	0
1980 & newer non-electrically heated attached/row housing	0%	94	636	0	0	168	636	0	0
Electrically heated apartment units	0%	83	5,719	0	0	139	5,719	0	0
Electrically heated apartment common areas	0%	9	13,935	0	0	14	13,935	0	0
Non-electrically heated apartment units	0%	516	519	0	0	859	519	0	0
Non-electrically heated apartment common areas	0%	53	1,265	0	0	89	1,265	0	0
Electrically heated mobile/other	0%	21	9,064	0	0	38	8,793	0	0
Non-electrically heated mobile/other	0%	132	825	0	0	234	800	0	0
Seasonal housing	0%	324	34	0	0	580	34	0	0
Residential garages	0%	28	490	0	0	50	490	0	0
Small diesel grid housing	0%	0	854	0	0	0	854	0	0
Sentinel Lighting	0%	85	0	0	0	152	0	0	0
Total		2,574	78,093	4,400	1,019	4,509	77,796	4,400	1,811

Hydro Grid Non-Government

Residential: New Stock

Pellet Furnace	Est. Technical Applicability %	2015 # of Buildings	2015 kWh Electricity Used for Heating per Building	2015 kWh Elect. Used For Pellet Furnace per Building	2015 Total Annual Savings (MWh/yr.)	2020 # of Buildings	2020 kWh Electricity Used for Heating per Building	2020 kWh Elect. Used For Pellet Furnace per Building	2020 Total Annual Savings (MWh/yr.)
Pre-1980 electrically heated single detached homes	70%	0	14,411	1,100	0	0	14,411	1,100	0
1980 & newer electrically heated single detached homes	70%	248	11,834	1,100	1,860	521	11,834	1,100	3,915
Pre-1980 non-electrically heated single detached homes	0%	0	1,395	0	0	0	1,395	0	0
1980 & newer non-electrically heated single detached homes	0%	313	996	0	0	604	996	0	0
Pre-1980 electrically heated attached/row housing	70%	0	8,774	1,100	0	0	8,774	1,100	0
1980 & newer electrically heated attached/row housing	70%	58	6,470	1,100	218	132	6,470	1,100	495
Pre-1980 non-electrically heated attached/row housing	0%	0	872	0	0	0	872	0	0
1980 & newer non-electrically heated attached/row housing	0%	43	636	0	0	83	636	0	0
Electrically heated apartment units	0%	179	5,719	0	0	467	5,719	0	0
Electrically heated apartment common areas	0%	18	13,935	0	0	48	13,935	0	0
Non-electrically heated apartment units	0%	121	519	0	0	237	519	0	0
Non-electrically heated apartment common areas	0%	12	1,265	0	0	25	1,265	0	0
Electrically heated mobile/other	0%	34	8,273	0	0	71	8,273	0	0
Non-electrically heated mobile/other	0%	43	753	0	0	83	753	0	0
Seasonal housing	0%	162	34	0	0	313	34	0	0
Residential garages	0%	14	490	0	0	27	490	0	0
Sentinel Lighting	0%	43	0	0	0	82	0	0	0
Total		1,287	77,229	4,400	2,078	2,691	77,229	4,400	4,410

Hydro Grid Non-Government

Residential: Existing Stock

Pellet Furnace	Est. Technical Applicability %	2025 # of Buildings	2025 kWh Electricity Used for Heating per Building	2025 kWh Elect. Used For Pellet Furnace per Building	2025 Total Annual Savings (MWh/yr.)	2030 # of Buildings	2030 kWh Electricity Used for Heating per Building	2030 kWh Elect. Used For Pellet Furnace per Building	2030 Total Annual Savings (MWh/yr.)
Pre-1980 electrically heated single detached homes	50%	264	14,856	1,100	1,817	231	14,856	1,100	1,588
1980 & newer electrically heated single detached homes	50%	312	12,075	1,100	1,714	273	12,075	1,100	1,498
Pre-1980 non-electrically heated single detached homes	0%	1,638	1,438	0	0	1,432	1,438	0	0
1980 & newer non-electrically heated single detached homes	0%	1,934	1,027	0	0	1,690	1,027	0	0
Pre-1980 electrically heated attached/row housing	50%	27	9,045	1,100	108	21	9,045	1,100	85
1980 & newer electrically heated attached/row housing	50%	32	6,602	1,100	87	25	6,602	1,100	69
Pre-1980 non-electrically heated attached/row housing	0%	166	899	0	0	131	899	0	0
1980 & newer non-electrically heated attached/row housing	0%	197	656	0	0	154	656	0	0
Electrically heated apartment units	0%	34	5,719	0	0	17	5,719	0	0
Electrically heated apartment common areas	0%	3	13,935	0	0	2	13,935	0	0
Non-electrically heated apartment units	0%	210	519	0	0	104	519	0	0
Non-electrically heated apartment common areas	0%	22	1,265	0	0	11	1,265	0	0
Electrically heated mobile/other	0%	79	9,345	0	0	69	9,345	0	0
Non-electrically heated mobile/other	0%	488	851	0	0	427	851	0	0
Seasonal housing	0%	2,259	35	0	0	2,099	35	0	0
Residential garages	0%	195	500	0	0	181	500	0	0
Small diesel grid housing	0%	0	880	0	0	0	880	0	0
Sentinel Lighting	0%	593	0	0	0	551	0	0	0
Total		8,454	79,647	4,400	3,726	7,416	79,647	4,400	3,239

Residential: Renovated Stock

Pellet Furnace	Est. Technical Applicability %	2025 # of Buildings	2025 kWh Electricity Used for Heating per Building	2025 kWh Elect. Used For Pellet Furnace per Building	2025 Total Annual Savings (MWh/yr.)	2030 # of Buildings	2030 kWh Electricity Used for Heating per Building	2030 kWh Elect. Used For Pellet Furnace per Building	2030 Total Annual Savings (MWh/yr.)
Pre-1980 electrically heated single detached homes	50%	170	14,411	1,100	1,130	203	14,411	1,100	1,352
1980 & newer electrically heated single detached homes	50%	201	11,834	1,100	1,077	240	11,834	1,100	1,289
Pre-1980 non-electrically heated single detached homes	0%	1,053	1,395	0	0	1,259	1,395	0	0
1980 & newer non-electrically heated single detached homes	0%	1,243	996	0	0	1,487	996	0	0
Pre-1980 electrically heated attached/row housing	50%	31	8,774	1,100	119	37	8,774	1,100	141
1980 & newer electrically heated attached/row housing	50%	36	6,470	1,100	97	43	6,470	1,100	116
Pre-1980 non-electrically heated attached/row housing	0%	190	872	0	0	225	872	0	0
1980 & newer non-electrically heated attached/row housing	0%	224	636	0	0	267	636	0	0
Electrically heated apartment units	0%	171	5,719	0	0	188	5,719	0	0
Electrically heated apartment common areas	0%	18	13,935	0	0	19	13,935	0	0
Non-electrically heated apartment units	0%	1,061	519	0	0	1,167	519	0	0
Non-electrically heated apartment common areas	0%	110	1,265	0	0	121	1,265	0	0
Electrically heated mobile/other	0%	50	8,529	0	0	60	8,273	0	0
Non-electrically heated mobile/other	0%	313	776	0	0	375	753	0	0
Seasonal housing	0%	782	34	0	0	942	34	0	0
Residential garages	0%	68	490	0	0	81	490	0	0
Small diesel grid housing	0%	0	854	0	0	0	854	0	0
Sentinel Lighting	0%	205	0	0	0	247	0	0	0
Total		5,924	77,508	4,400	2,423	6,962	77,229	4,400	2,897

Hydro Grid Non-Government

Residential: New Stock

Pellet Furnace	Est. Technical Applicability %	2025 # of Buildings	2025 kWh Electricity Used for Heating per Building	2025 kWh Elect. Used For Pellet Furnace per Building	2025 Total Annual Savings (MWh/yr.)	2030 # of Buildings	2030 kWh Electricity Used for Heating per Building	2030 kWh Elect. Used For Pellet Furnace per Building	2030 Total Annual Savings (MWh/yr.)
Pre-1980 electrically heated single detached homes	70%	0	14,411	1,100	0	0	14,411	1,100	0
1980 & newer electrically heated single detached homes	70%	810	11,834	1,100	6,089	1,108	11,834	1,100	8,323
Pre-1980 non-electrically heated single detached homes	0%	0	1,395	0	0	0	1,395	0	0
1980 & newer non-electrically heated single detached homes	0%	869	996	0	0	1,107	996	0	0
Pre-1980 electrically heated attached/row housing	70%	0	8,774	1,100	0	0	8,774	1,100	0
1980 & newer electrically heated attached/row housing	70%	220	6,470	1,100	826	321	6,470	1,100	1,206
Pre-1980 non-electrically heated attached/row housing	0%	0	872	0	0	0	872	0	0
1980 & newer non-electrically heated attached/row housing	0%	119	636	0	0	151	636	0	0
Electrically heated apartment units	0%	891	5,719	0	0	1,476	5,719	0	0
Electrically heated apartment common areas	0%	91	13,935	0	0	151	13,935	0	0
Non-electrically heated apartment units	0%	346	519	0	0	447	519	0	0
Non-electrically heated apartment common areas	0%	36	1,265	0	0	46	1,265	0	0
Electrically heated mobile/other	0%	110	8,273	0	0	151	8,273	0	0
Non-electrically heated mobile/other	0%	119	753	0	0	151	753	0	0
Seasonal housing	0%	450	34	0	0	574	34	0	0
Residential garages	0%	39	490	0	0	50	490	0	0
Sentinel Lighting	0%	118	0	0	0	151	0	0	0
Total		4,219	77,229	4,400	6,915	5,884	77,229	4,400	9,528

Hydro Grid Government

Residential: Existing and Renovated Stock

PV – Electricity	System Design Size (kW)	Annual Generation Per Bldg (kWh/yr.)	Est. Technical Applicability	2015		2020		2025		2030	
				# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)
Pre-1980 electrically heated single detached homes	3	3,200	30%	5	5	5	5	5	5	5	5
1980 & newer electrically heated single detached homes	3	3,200	30%	6	6	6	6	6	6	6	6
Pre 1980 non-electrically heated single detached homes	3	3,200	30%	33	31	33	31	33	31	33	31
1980 & newer non-electrically heated single detached homes	3	3,200	30%	38	37	38	37	38	37	38	37
Pre-1980 electrically heated attached/row housing	3	3,200	30%	1	1	1	1	1	1	1	1
1980 & newer electrically heated attached/row housing	3	3,200	30%	1	1	1	1	1	1	1	1
Pre 1980 non-electrically heated attached/row housing	3	3,200	30%	4	4	4	4	4	4	4	4
1980 & newer non-electrically heated attached/row housing	3	3,200	30%	5	5	5	5	5	5	5	5
Electrically heated apartment units			0%	10	0	10	0	10	0	10	0
Electrically heated apartment common areas	20	22,000	30%	3	20	3	20	3	20	3	20
Non-electrically heated apartment units			0%	61	0	61	0	61	0	61	0
Non-electrically heated apartment common areas	20	22,000	30%	15	101	15	101	15	101	15	101
Electrically heated mobile/other	3	3,200	30%	0	0	0	0	0	0	0	0
Non-electrically heated mobile/other	3	3,200	30%	3	3	3	3	3	3	3	3
Seasonal housing	3	3,200	30%	44	43	44	43	44	43	44	43
Residential garages			0%	1	0	1	0	1	0	1	0
Small diesel grid housing	3	3,200	30%	0	0	0	0	0	0	0	0
Sentinel Lighting			0%	0	0	0	0	0	0	0	0
Total				231	255	231	255	231	255	231	255

Residential: New Stock

PV – Electricity	System Design Size (kW)	Annual Generation Per Bldg (kWh/yr.)	Est. Technical Applicability %	2015		2020		2025		2030	
				# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)
Pre-1980 electrically heated single detached homes	3	3,200	45%	0	0	0	0	0	0	0	0
1980 & newer electrically heated single detached homes	3	3,200	45%	2	3	4	6	6	9	8	12
Pre 1980 non-electrically heated single detached homes	3	3,200	45%	0	0	0	0	0	0	0	0
1980 & newer non-electrically heated single detached homes	3	3,200	45%	3	4	5	7	7	10	8	12
Pre-1980 electrically heated attached/row housing	3	3,200	45%	0	0	0	0	0	0	0	0
1980 & newer electrically heated attached/row housing	3	3,200	45%	1	1	1	2	2	3	3	4
Pre 1980 non-electrically heated attached/row housing	3	3,200	45%	0	0	0	0	0	0	0	0
1980 & newer non-electrically heated attached/row housing	3	3,200	45%	0	0	1	1	1	1	1	1
Electrically heated apartment units			0%	7	0	15	0	26	0	40	0
Electrically heated apartment common areas	20	22,000	45%	2	19	5	45	8	78	12	118
Non-electrically heated apartment units			0%	4	0	7	0	10	0	13	0
Non-electrically heated apartment common areas	20	22,000	45%	1	10	2	18	3	26	3	33
Electrically heated mobile/other	3	3,200	45%	0	0	0	0	0	0	0	0
Non-electrically heated mobile/other	3	3,200	45%	0	0	0	0	0	0	0	0
Seasonal housing	3	3,200	45%	2	2	3	4	4	6	5	8
Residential garages			0%	0	0	0	0	0	0	0	0
Small diesel grid housing	3	3,200	45%	0	0	0	0	0	0	0	0
Sentinel Lighting			0%	0	0	0	0	0	0	0	0
Total				21	39	43	84	68	133	94	188

Hydro Grid Government

Residential : Existing Stock

Pellet Furnace	Est. Technical Applicability %	2015				2020			
		# of Buildings	kWh Electricity Used for Heating per Building	kWh Elect. Used For Pellet Furnace per Building	Total Annual Savings (MWh/yr.)	# of Buildings	kWh Electricity Used for Heating per Building	kWh Elect. Used For Pellet Furnace per Building	Total Annual Savings (MWh/yr.)
Pre-1980 electrically heated single detached homes	50%	4	14,856	1,100	30	4	14,856	1,100	27
1980 & newer electrically heated single detached homes	50%	5	12,075	1,100	29	5	12,075	1,100	26
Pre 1980 non-electrically heated single detached homes	0%	29	1,438	0	0	26	1,438	0	0
1980 & newer non-electrically heated single detached homes	0%	34	1,027	0	0	31	1,027	0	0
Pre-1980 electrically heated attached/row housing	50%	1	9,045	1,100	3	1	9,045	1,100	3
1980 & newer electrically heated attached/row housing	50%	1	6,602	1,100	2	1	6,602	1,100	2
Pre 1980 non-electrically heated attached/row housing	0%	3	899	0	0	3	899	0	0
1980 & newer non-electrically heated attached/row housing	0%	4	656	0	0	3	656	0	0
Electrically heated apartment units	0%	7	5,719	0	0	5	5,719	0	0
Electrically heated apartment common areas	0%	2	13,935	0	0	1	13,935	0	0
Non-electrically heated apartment units	0%	43	519	0	0	30	519	0	0
Non-electrically heated apartment common areas	0%	11	1,265	0	0	8	1,265	0	0
Electrically heated mobile/other	0%	0	9,345	0	0	0	9,345	0	0
Non-electrically heated mobile/other	0%	3	851	0	0	2	851	0	0
Seasonal housing	0%	41	35	0	0	39	35	0	0
Residential garages	0%	1	500	0	0	1	500	0	0
Small diesel grid housing	0%	0	880	0	0	0	880	0	0
Sentinel Lighting	0%	0	0	0	0	0	0	0	0
Total		190	79,647	4,400	65	160	79,647	4,400	58

Residential : Renovated Stock

Pellet Furnace	Est. Technical Applicability %	2015				2020			
		# of Buildings	kWh Electricity Used for Heating per Building	kWh Elect. Used For Pellet Furnace per Building	Total Annual Savings (MWh/yr.)	# of Buildings	kWh Electricity Used for Heating per Building	kWh Elect. Used For Pellet Furnace per Building	Total Annual Savings (MWh/yr.)
Pre-1980 electrically heated single detached homes	50%	1	14,411	1,100	4	1	14,411	1,100	7
1980 & newer electrically heated single detached homes	50%	1	11,834	1,100	4	1	11,834	1,100	7
Pre 1980 non-electrically heated single detached homes	0%	4	1,395	0	0	7	1,395	0	0
1980 & newer non-electrically heated single detached homes	0%	4	996	0	0	8	996	0	0
Pre-1980 electrically heated attached/row housing	50%	0	8,774	1,100	1	0	8,774	1,100	1
1980 & newer electrically heated attached/row housing	50%	0	6,470	1,100	0	0	6,470	1,100	1
Pre 1980 non-electrically heated attached/row housing	0%	1	872	0	0	1	872	0	0
1980 & newer non-electrically heated attached/row housing	0%	1	636	0	0	1	636	0	0
Electrically heated apartment units	0%	3	5,719	0	0	5	5,719	0	0
Electrically heated apartment common areas	0%	1	13,935	0	0	2	13,935	0	0
Non-electrically heated apartment units	0%	18	519	0	0	31	519	0	0
Non-electrically heated apartment common areas	0%	4	1,265	0	0	8	1,265	0	0
Electrically heated mobile/other	0%	0	9,064	0	0	0	8,793	0	0
Non-electrically heated mobile/other	0%	0	825	0	0	0	800	0	0
Seasonal housing	0%	3	34	0	0	6	34	0	0
Residential garages	0%	0	490	0	0	0	490	0	0
Small diesel grid housing	0%	0	854	0	0	0	854	0	0
Sentinel Lighting	0%	0	0	0	0	0	0	0	0
Total		41	78,093	4,400	9	71	77,796	4,400	15

Hydro Grid Government

Residential : New Stock

Pellet Furnace	Est. Technical Applicability %	2015				2020			
		# of Buildings	kWh Electricity Used for Heating per Building	kWh Elect. Used For Pellet Furnace per Building	Total Annual Savings (MWh/yr.)	# of Buildings	kWh Electricity Used for Heating per Building	kWh Elect. Used For Pellet Furnace per Building	Total Annual Savings (MWh/yr.)
Pre-1980 electrically heated single detached homes	70%	0	14,411	1,100	0	0	14,411	1,100	0
1980 & newer electrically heated single detached homes	70%	2	11,834	1,100	16	4	11,834	1,100	32
Pre 1980 non-electrically heated single detached homes	0%	0	1,395	0	0	0	1,395	0	0
1980 & newer non-electrically heated single detached homes	0%	3	996	0	0	5	996	0	0
Pre-1980 electrically heated attached/row housing	70%	0	8,774	1,100	0	0	8,774	1,100	0
1980 & newer electrically heated attached/row housing	70%	1	6,470	1,100	2	1	6,470	1,100	5
Pre 1980 non-electrically heated attached/row housing	0%	0	872	0	0	0	872	0	0
1980 & newer non-electrically heated attached/row housing	0%	0	636	0	0	1	636	0	0
Electrically heated apartment units	0%	7	5,719	0	0	15	5,719	0	0
Electrically heated apartment common areas	0%	2	13,935	0	0	5	13,935	0	0
Non-electrically heated apartment units	0%	4	519	0	0	7	519	0	0
Non-electrically heated apartment common areas	0%	1	1,265	0	0	2	1,265	0	0
Electrically heated mobile/other	0%	0	8,273	0	0	0	8,273	0	0
Non-electrically heated mobile/other	0%	0	753	0	0	0	753	0	0
Seasonal housing	0%	2	34	0	0	3	34	0	0
Residential garages	0%	0	490	0	0	0	490	0	0
Small diesel grid housing	0%	0	854	0	0	0	854	0	0
Sentinel Lighting	0%	0	0	0	0	0	0	0	0
Total		21	77,229	4,400	18	43	77,229	4,400	37

Hydro Grid Government

Residential: Existing Stock

Pellet Furnace	Est. Technical Applicability %	2025 # of Buildings	2025 kWh Electricity Used for Heating per Building	2025 kWh Elect. Used For Pellet Furnace per Building	2025 Total Annual Savings (MWh/yr.)	2030 # of Buildings	2030 kWh Electricity Used for Heating per Building	2030 kWh Elect. Used For Pellet Furnace per Building	2030 Total Annual Savings (MWh/yr.)
Pre-1980 electrically heated single detached homes	50%	4	14,856	1,100	25	3	14,856	1,100	23
1980 & newer electrically heated single detached homes	50%	4	12,075	1,100	24	4	12,075	1,100	22
Pre 1980 non-electrically heated single detached homes	0%	24	1,438	0	0	22	1,438	0	0
1980 & newer non-electrically heated single detached homes	0%	28	1,027	0	0	26	1,027	0	0
Pre-1980 electrically heated attached/row housing	50%	1	9,045	1,100	2	1	9,045	1,100	2
1980 & newer electrically heated attached/row housing	50%	1	6,602	1,100	2	1	6,602	1,100	1
Pre 1980 non-electrically heated attached/row housing	0%	2	899	0	0	2	899	0	0
1980 & newer non-electrically heated attached/row housing	0%	3	656	0	0	3	656	0	0
Electrically heated apartment units	0%	3	5,719	0	0	2	5,719	0	0
Electrically heated apartment common areas	0%	1	13,935	0	0	1	13,935	0	0
Non-electrically heated apartment units	0%	21	519	0	0	15	519	0	0
Non-electrically heated apartment common areas	0%	5	1,265	0	0	4	1,265	0	0
Electrically heated mobile/other	0%	0	9,345	0	0	0	9,345	0	0
Non-electrically heated mobile/other	0%	2	851	0	0	2	851	0	0
Seasonal housing	0%	37	35	0	0	35	35	0	0
Residential garages	0%	1	500	0	0	1	500	0	0
Small diesel grid housing	0%	0	880	0	0	0	880	0	0
Sentinel Lighting	0%	0	0	0	0	0	0	0	0
Total		137	79,647	4,400	53	120	79,647	4,400	49

Residential: Renovated Stock

Pellet Furnace	Est. Technical Applicability %	2025 # of Buildings	2025 kWh Electricity Used for Heating per Building	2025 kWh Elect. Used For Pellet Furnace per Building	2025 Total Annual Savings (MWh/yr.)	2030 # of Buildings	2030 kWh Electricity Used for Heating per Building	2030 kWh Elect. Used For Pellet Furnace per Building	2030 Total Annual Savings (MWh/yr.)
Pre-1980 electrically heated single detached homes	50%	1	14,411	1,100	9	2	14,411	1,100	11
1980 & newer electrically heated single detached homes	50%	2	11,834	1,100	9	2	11,834	1,100	11
Pre 1980 non-electrically heated single detached homes	0%	9	1,395	0	0	11	1,395	0	0
1980 & newer non-electrically heated single detached homes	0%	11	996	0	0	13	996	0	0
Pre-1980 electrically heated attached/row housing	50%	0	8,774	1,100	1	0	8,774	1,100	2
1980 & newer electrically heated attached/row housing	50%	0	6,470	1,100	1	0	6,470	1,100	1
Pre 1980 non-electrically heated attached/row housing	0%	2	872	0	0	2	872	0	0
1980 & newer non-electrically heated attached/row housing	0%	2	636	0	0	2	636	0	0
Electrically heated apartment units	0%	7	5,719	0	0	8	5,719	0	0
Electrically heated apartment common areas	0%	2	13,935	0	0	2	13,935	0	0
Non-electrically heated apartment units	0%	40	519	0	0	46	519	0	0
Non-electrically heated apartment common areas	0%	10	1,265	0	0	12	1,265	0	0
Electrically heated mobile/other	0%	0	8,529	0	0	0	8,273	0	0
Non-electrically heated mobile/other	0%	0	776	0	0	1	753	0	0
Seasonal housing	0%	8	34	0	0	9	34	0	0
Residential garages	0%	0	490	0	0	0	490	0	0
Small diesel grid housing	0%	0	854	0	0	0	854	0	0
Sentinel Lighting	0%	0	0	0	0	0	0	0	0
Total		94	77,508	4,400	20	110	77,229	4,400	25

Hydro Grid Government

Residential: New Stock

		2025				2030			
Pellet Furnace	**Est. Technical Applicability %**	**# of Buildings**	**kWh Electricity Used for Heating per Building**	**kWh Elect. Used For Pellet Furnace per Building**	**Total Annual Savings (MWh/yr.)**	**# of Buildings**	**kWh Electricity Used for Heating per Building**	**kWh Elect. Used For Pellet Furnace per Building**	**Total Annual Savings (MWh/yr.)**
Pre-1980 electrically heated single detached homes	70%	0	14,411	1,100	0	0	14,411	1,100	0
1980 & newer electrically heated single detached homes	70%	6	11,834	1,100	48	8	11,834	1,100	63
Pre 1980 non-electrically heated single detached homes	0%	0	1,395	0	0	0	1,395	0	0
1980 & newer non-electrically heated single detached homes	0%	7	996	0	0	8	996	0	0
Pre-1980 electrically heated attached/row housing	70%	0	8,774	1,100	0	0	8,774	1,100	0
1980 & newer electrically heated attached/row housing	70%	2	6,470	1,100	7	3	6,470	1,100	10
Pre 1980 non-electrically heated attached/row housing	0%	0	872	0	0	0	872	0	0
1980 & newer non-electrically heated attached/row housing	0%	1	636	0	0	1	636	0	0
Electrically heated apartment units	0%	26	5,719	0	0	40	5,719	0	0
Electrically heated apartment common areas	0%	8	13,935	0	0	12	13,935	0	0
Non-electrically heated apartment units	0%	10	519	0	0	13	519	0	0
Non-electrically heated apartment common areas	0%	3	1,265	0	0	3	1,265	0	0
Electrically heated mobile/other	0%	0	8,273	0	0	0	8,273	0	0
Non-electrically heated mobile/other	0%	0	753	0	0	0	753	0	0
Seasonal housing	0%	4	34	0	0	5	34	0	0
Residential garages	0%	0	490	0	0	0	490	0	0
Small diesel grid housing	0%	0	854	0	0	0	854	0	0
Sentinel Lighting	0%	0	0	0	0	0	0	0	0
Total		68	77,229	4,400	55	94	77,229	4,400	73

Large Diesel Grid Non-Government

Residential: Existing and Renovated Stock

PV – Electricity	System Design Size (kW)	Annual Generation Per Bldg (kWh/yr.)	Est. Technical Applicability	2015		2020		2025		2030	
				# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)
Pre-1980 electrically heated single detached homes	3	3,200	30%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980 & newer electrically heated single detached homes	3	3,200	30%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pre-1980 non-electrically heated single detached homes	3	3,200	30%	151.2	145.2	151.2	145.2	151.2	145.2	151.2	145.2
1980 & newer non-electrically heated single detached homes	3	3,200	30%	178.6	171.4	178.6	171.4	178.6	171.4	178.6	171.4
Pre-1980 electrically heated attached/row housing	3	3,200	30%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980 & newer electrically heated attached/row housing	3	3,200	30%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pre-1980 non-electrically heated attached/row housing	3	3,200	30%	20.0	19.2	20.0	19.2	20.0	19.2	20.0	19.2
1980 & newer non-electrically heated attached/row housing	3	3,200	30%	23.7	22.7	23.7	22.7	23.7	22.7	23.7	22.7
Electrically heated apartment units			0%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Electrically heated apartment common areas	20	22,000	30%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-electrically heated apartment units			0%	41.7	0.0	41.7	0.0	41.7	0.0	41.7	0.0
Non-electrically heated apartment common areas	20	22,000	30%	2.0	13.2	2.0	13.2	2.0	13.2	2.0	13.2
Electrically heated mobile/other	3	3,200	30%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-electrically heated mobile/other	3	3,200	30%	79.2	76.0	79.2	76.0	79.2	76.0	79.2	76.0
Seasonal housing	3	3,200	30%	171.3	164.5	171.3	164.5	171.3	164.5	171.3	164.5
Residential garages			0%	16.3	0.0	16.3	0.0	16.3	0.0	16.3	0.0
Sentinel Lighting			0%	84.7	0.0	84.7	0.0	84.7	0.0	84.7	0.0
Total				768.6	612.2	768.6	612.2	768.6	612.2	768.6	612.2

Residential: New Stock

PV – Electricity	System Design Size (kW)	Annual Generation Per Bldg (kWh/yr.)	Est. Technical Applicability %	2015		2020		2025		2030	
				# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)
Pre-1980 electrically heated single detached homes	3	3,200	45%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980 & newer electrically heated single detached homes	3	3,200	45%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pre-1980 non-electrically heated single detached homes	3	3,200	45%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980 & newer non-electrically heated single detached homes	3	3,200	45%	3.1	4.5	6.3	9.1	9.5	13.7	12.8	18.4
Pre-1980 electrically heated attached/row housing	3	3,200	45%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980 & newer electrically heated attached/row housing	3	3,200	45%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pre-1980 non-electrically heated attached/row housing	3	3,200	45%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980 & newer non-electrically heated attached/row housing	3	3,200	45%	0.6	0.9	1.3	1.8	1.9	2.7	2.6	3.7
Electrically heated apartment units			0%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Electrically heated apartment common areas	20	22,000	45%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-electrically heated apartment units			0%	1.2	0.0	2.4	0.0	3.7	0.0	5.0	0.0
Non-electrically heated apartment common areas	20	22,000	45%	0.1	0.6	0.1	1.2	0.2	1.8	0.2	2.4
Electrically heated mobile/other	3	3,200	45%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-electrically heated mobile/other	3	3,200	45%	0.8	1.1	1.5	2.2	2.3	3.3	3.1	4.4
Seasonal housing	3	3,200	45%	1.6	2.4	3.3	4.7	4.9	7.1	6.6	9.5
Residential garages			0%	0.2	0.0	0.3	0.0	0.5	0.0	0.6	0.0
Sentinel Lighting			0%	0.8	0.0	1.6	0.0	2.4	0.0	3.3	0.0
Total				8.4	9.4	16.9	19.0	25.5	28.6	34.2	38.4

Large Diesel Grid Non-Government

Residential: Existing and Renovated Stock

Solar DHW – Heat	System Size (m^2)	Annual Generation Per Bldg (kWh/yr.)	Est. Technical Applicability %	2015			2020			2025			2030		
				# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)
Pre-1980 electrically heated single detached homes	6	2,200	30%	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0
1980 & newer electrically heated single detached homes	6	2,200	30%	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0
Pre-1980 non-electrically heated single detached homes	6	2,200	30%	151.2	79%	79.3	151.2	79%	79.3	151.2	79%	79.3	151.2	79%	79.3
1980 & newer non-electrically heated single detached homes	6	2,200	30%	178.6	79%	93.6	178.6	79%	93.6	178.6	79%	93.6	178.6	79%	93.6
Pre-1980 electrically heated attached/row housing	6	2,200	30%	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0
1980 & newer electrically heated attached/row housing	6	2,200	30%	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0
Pre-1980 non-electrically heated attached/row housing	6	2,200	30%	20.0	79%	10.5	20.0	79%	10.5	20.0	79%	10.5	20.0	79%	10.5
1980 & newer non-electrically heated attached/row housing	6	2,200	30%	23.7	79%	12.4	23.7	79%	12.4	23.7	79%	12.4	23.7	79%	12.4
Electrically heated apartment units			0%	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0
Electrically heated apartment common areas	50	23,900	30%	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0
Non-electrically heated apartment units			0%	41.7	80%	0.0	41.7	80%	0.0	41.7	80%	0.0	41.7	80%	0.0
Non-electrically heated apartment common areas	50	23,900	30%	2.0	80%	11.5	2.0	80%	11.5	2.0	80%	11.5	2.0	80%	11.5
Electrically heated mobile/other	6	2,200	30%	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0
Non-electrically heated mobile/other	6	2,200	30%	79.2	79%	41.5	79.2	79%	41.5	79.2	79%	41.5	79.2	79%	41.5
Seasonal housing	6	2,200	30%	171.3	41%	46.8	171.3	41%	46.8	171.3	41%	46.8	171.3	41%	46.8
Residential garages			0%	16.3	50%	0.0	16.3	50%	0.0	16.3	50%	0.0	16.3	50%	0.0
Sentinel Lighting			0%	84.7	0%	0.0	84.7	0%	0.0	84.7	0%	0.0	84.7	0%	0.0
Total				768.6		295.5	768.6		295.5	768.6		295.5	768.6		295.5

Residential: New Stock

Solar DHW – Heat	System Size (m^2)	Annual Generation Per Bldg (kWh/yr.)	Est. Technical Applicability %	2015			2020			2025			2030		
				# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)
Pre-1980 electrically heated single detached homes	6	2,200	40%	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0
1980 & newer electrically heated single detached homes	6	2,200	40%	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0
Pre-1980 non-electrically heated single detached homes	6	2,200	40%	0.0	79%	0.0	0.0	79%	0.0	0.0	79%	0.0	0.0	79%	0.0
1980 & newer non-electrically heated single detached homes	6	2,200	40%	3.1	79%	2.2	6.3	79%	4.4	9.5	79%	6.7	12.8	79%	8.9
Pre-1980 electrically heated attached/row housing	6	2,200	40%	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0
1980 & newer electrically heated attached/row housing	6	2,200	40%	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0
Pre-1980 non-electrically heated attached/row housing	6	2,200	40%	0.0	79%	0.0	0.0	79%	0.0	0.0	79%	0.0	0.0	79%	0.0
1980 & newer non-electrically heated attached/row housing	6	2,200	40%	0.6	79%	0.4	1.3	79%	0.9	1.9	79%	1.3	2.6	79%	1.8
Electrically heated apartment units			0%	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0
Electrically heated apartment common areas	50	23,900	40%	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0
Non-electrically heated apartment units			0%	1.2	80%	0.0	2.4	80%	0.0	3.7	80%	0.0	5.0	80%	0.0
Non-electrically heated apartment common areas	50	23,900	40%	0.1	80%	0.4	0.1	80%	0.9	0.2	80%	1.4	0.2	80%	1.8
Electrically heated mobile/other	6	2,200	40%	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0
Non-electrically heated mobile/other	6	2,200	40%	0.8	79%	0.5	1.5	79%	1.1	2.3	79%	1.6	3.1	79%	2.1
Seasonal housing	6	2,200	40%	1.6	41%	0.6	3.3	41%	1.2	4.9	41%	1.8	6.6	41%	2.4
Residential garages			0%	0.2	50%	0.0	0.3	50%	0.0	0.5	50%	0.0	0.6	50%	0.0
Sentinel Lighting			0%	0.8	0%	0.0	1.6	0%	0.0	2.4	0%	0.0	3.3	0%	0.0
Total				8.4		4.2	16.9		8.4	25.5		12.7	34.2		17.1

Large Diesel Grid Government

Residential: Existing and Renovated Stock

PV – Electricity	System Design Size (kW)	Annual Generation Per Bldg (kWh/yr.)	Est. Technical Applicability	2015		2020		2025		2030	
				# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)
Pre-1980 electrically heated single detached homes	3	3,200	30%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980 & newer electrically heated single detached homes	3	3,200	30%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pre-1980 non-electrically heated single detached homes	3	3,200	30%	9.4	9.0	9.4	9.0	9.4	9.0	9.4	9.0
1980 & newer non-electrically heated single detached homes	3	3,200	30%	11.1	10.7	11.1	10.7	11.1	10.7	11.1	10.7
Pre-1980 electrically heated attached/row housing	3	3,200	30%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980 & newer electrically heated attached/row housing	3	3,200	30%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pre-1980 non-electrically heated attached/row housing	3	3,200	30%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
1980 & newer non-electrically heated attached/row housing	3	3,200	30%	1.5	1.4	1.5	1.4	1.5	1.4	1.5	1.4
Electrically heated apartment units			0%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Electrically heated apartment common areas	20	22,000	30%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-electrically heated apartment units			0%	1.9	0.0	1.9	0.0	1.9	0.0	1.9	0.0
Non-electrically heated apartment common areas	20	22,000	30%	0.8	5.5	0.8	5.5	0.8	5.5	0.8	5.5
Electrically heated mobile/other	3	3,200	30%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-electrically heated mobile/other	3	3,200	30%	0.3	0.2	0.3	0.2	0.3	0.2	0.3	0.2
Seasonal housing	3	3,200	30%	10.7	10.2	10.7	10.2	10.7	10.2	10.7	10.2
Residential garages			0%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sentinel Lighting			0%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total				36.9	38.3	36.9	38.3	36.9	38.3	36.9	38.3

Residential: New Stock

PV – Electricity	System Design Size (kW)	Annual Generation Per Bldg (kWh/yr.)	Est. Technical Applicability %	2015		2020		2025		2030	
				# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)
Pre-1980 electrically heated single detached homes	3	3,200	45%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980 & newer electrically heated single detached homes	3	3,200	45%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pre-1980 non-electrically heated single detached homes	3	3,200	45%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980 & newer non-electrically heated single detached homes	3	3,200	45%	0.2	0.3	0.4	0.6	0.6	0.9	0.8	1.2
Pre-1980 electrically heated attached/row housing	3	3,200	45%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980 & newer electrically heated attached/row housing	3	3,200	45%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pre-1980 non-electrically heated attached/row housing	3	3,200	45%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980 & newer non-electrically heated attached/row housing	3	3,200	45%	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.2
Electrically heated apartment units	0		0%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Electrically heated apartment common areas	20	22,000	45%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-electrically heated apartment units	0		0%	0.1	0.0	0.1	0.0	0.2	0.0	0.2	0.0
Non-electrically heated apartment common areas	20	22,000	45%	0.0	0.3	0.1	0.5	0.1	0.8	0.1	1.0
Electrically heated mobile/other	3	3,200	45%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-electrically heated mobile/other	3	3,200	45%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seasonal housing	3	3,200	45%	0.1	0.2	0.2	0.3	0.3	0.5	0.4	0.6
Residential garages			0%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sentinel Lighting			0%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total				0.4	0.8	0.9	1.5	1.3	2.3	1.8	3.1

Large Diesel Grid Government

Residential: Existing and Renovated Stock

Solar DHW – Heat	System Size (m^2)	Annual Savings Per Bldg (kWh/yr.)	Est. Technical Applicability %	2015			2020			2025			2030		
				# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)
Pre-1980 electrically heated single detached homes	6	2,200	30%	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0
1980 & newer electrically heated single detached homes	6	2,200	30%	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0
Pre-1980 non-electrically heated single detached homes	6	2,200	30%	9.4	79%	4.9	9.4	79%	4.9	9.4	79%	4.9	9.4	79%	4.9
1980 & newer non-electrically heated single detached homes	6	2,200	30%	11.1	79%	5.8	11.1	79%	5.8	11.1	79%	5.8	11.1	79%	5.8
Pre-1980 electrically heated attached/row housing	6	2,200	30%	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0
1980 & newer electrically heated attached/row housing	6	2,200	30%	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0
Pre-1980 non-electrically heated attached/row housing	6	2,200	30%	1.2	79%	0.7	1.2	79%	0.7	1.2	79%	0.7	1.2	79%	0.7
1980 & newer non-electrically heated attached/row housing	6	2,200	30%	1.5	79%	0.8	1.5	79%	0.8	1.5	79%	0.8	1.5	79%	0.8
Electrically heated apartment units			0%	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0
Electrically heated apartment common areas	50	23,900	30%	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0
Non-electrically heated apartment units			0%	1.9	80%	0.0	1.9	80%	0.0	1.9	80%	0.0	1.9	80%	0.0
Non-electrically heated apartment common areas	50	23,900	30%	0.8	80%	4.8	0.8	80%	4.8	0.8	80%	4.8	0.8	80%	4.8
Electrically heated mobile/other	6	2,200	30%	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0
Non-electrically heated mobile/other	6	2,200	30%	0.3	79%	0.1	0.3	79%	0.1	0.3	79%	0.1	0.3	79%	0.1
Seasonal housing	6	2,200	30%	10.7	41%	2.9	10.7	41%	2.9	10.7	41%	2.9	10.7	41%	2.9
Residential garages			0%	0.0	50%	0.0	0.0	50%	0.0	0.0	50%	0.0	0.0	50%	0.0
Sentinel Lighting			0%	0.0	0%	0.0	0.0	0%	0.0	0.0	0%	0.0	0.0	0%	0.0
Total				36.9		20.0	36.9		20.0	36.9		20.0	36.9		20.0

Residential: New Stock

Solar DHW – Heat	System Size (m^2)	Annual Savings Per Bldg (kWh/yr.)	Est. Technical Applicability %	2015			2020			2025			2030		
				# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)
Pre-1980 electrically heated single detached homes	6	2,200	40%	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0
1980 & newer electrically heated single detached homes	6	2,200	40%	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0
Pre-1980 non-electrically heated single detached homes	6	2,200	40%	0.0	79%	0.0	0.0	79%	0.0	0.0	79%	0.0	0.0	79%	0.0
1980 & newer non-electrically heated single detached homes	6	2,200	40%	0.2	79%	0.1	0.4	79%	0.3	0.6	79%	0.4	0.8	79%	0.6
Pre-1980 electrically heated attached/row housing	6	2,200	40%	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0
1980 & newer electrically heated attached/row housing	6	2,200	40%	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0
Pre-1980 non-electrically heated attached/row housing	6	2,200	40%	0.0	79%	0.0	0.0	79%	0.0	0.0	79%	0.0	0.0	79%	0.0
1980 & newer non-electrically heated attached/row housing	6	2,200	40%	0.0	79%	0.0	0.1	79%	0.1	0.1	79%	0.1	0.2	79%	0.1
Electrically heated apartment units			0%	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0
Electrically heated apartment common areas	50	23,900	40%	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0
Non-electrically heated apartment units			0%	0.1	80%	0.0	0.1	80%	0.0	0.2	80%	0.0	0.2	80%	0.0
Non-electrically heated apartment common areas	50	23,900	40%	0.0	80%	0.2	0.1	80%	0.4	0.1	80%	0.6	0.1	80%	0.8
Electrically heated mobile/other	6	2,200	40%	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0
Non-electrically heated mobile/other	6	2,200	40%	0.0	79%	0.0	0.0	79%	0.0	0.0	79%	0.0	0.0	79%	0.0
Seasonal housing	6	2,200	40%	0.1	41%	0.0	0.2	41%	0.1	0.3	41%	0.1	0.4	41%	0.2
Residential garages			0%	0.0	50%	0.0	0.0	50%	0.0	0.0	50%	0.0	0.0	50%	0.0
Sentinel Lighting			0%	0.0	0%	0.0	0.0	0%	0.0	0.0	0%	0.0	0.0	0%	0.0
Total				0.4		0.4	0.9		0.8	1.3		1.2	1.8		1.7

Small Diesel Grid Non-Government

Residential: Existing and Renovated Stock

				2015		2020		2025		2030	
PV – Electricity	System Design Size (kW)	Annual Generation Per Bldg (kWh/yr.)	Est. Technical Applicability	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)
Seasonal housing	3	3,200	30%	56	54	56	54	56	54	56	54
Residential garages			0%	4	0	4	0	4	0	4	0
Small diesel grid housing	3	3,200	30%	88	85	88	85	88	85	88	85
Total				211	139	211	139	211	139	211	139

Residential: New Stock

				2015		2020		2025		2030	
PV – Electricity	System Design Size (kW)	Annual Generation Per Bldg (kWh/yr.)	Est. Technical Applicability %	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)
Seasonal housing	3	3,200	45%	0	0	0	0	0	0	0	0
Residential garages			0%	0	0	0	0	0	0	0	0
Small diesel grid housing	3	3,200	45%	0	0	0	0	0	0	0	0
Total				0	0	0	0	0	0	0	0

Small Diesel Grid Non-Government

Residential: Existing and Renovated Stock

Solar DHW – Heat	System Size (m^2)	Annual Savings Per Bldg (kWh/yr.)	Est. Technical Applicability %	2015			2020			2025			2030		
				# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)
Seasonal housing	6	2,200	30%	56	41%	15	56	41%	15	56	41%	15	56	41%	15
Residential garages			0%	4	50%	0	4	50%	0	4	50%	0	4	50%	0
Small diesel grid housing	6	2,200	30%	88	83%	48	88	83%	48	88	83%	48	88	83%	48
Total				211		63	211		63	211		63	210.5		63

Residential: New Stock

Solar DHW – Heat	System Size (m^2)	Annual Savings Per Bldg (kWh/yr.)	Est. Technical Applicability %	2015			2020			2025			2030		
				# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)
Seasonal housing	6	2,200	40%	0	41%	0	0	41%	0	0	41%	0	0	41%	0
Residential garages			0%	0	50%	0	0	50%	0	0	50%	0	0	50%	0
Small diesel grid housing	6	2,200	40%	0	83%	0	0	83%	0	0	83%	0	0	83%	0
Total				0		0	0		0	0		0	0		0

Small Diesel Grid Government

Residential: Existing and Renovated Stock

				2015		2020		2025		2030	
PV – Electricity	System Design Size (kW)	Annual Generation Per Bldg (kWh/yr.)	Est. Technical Applicability	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)
Seasonal housing	3	3,200	30%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Residential garages			0%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Small diesel grid housing	3	3,200	30%	18.9	18.2	18.9	18.2	18.9	18.2	18.9	18.2
Total				18.9	18.2	18.9	18.2	18.9	18.2	18.9	18.2

Residential: New Stock

				2015		2020		2025		2030	
PV – Electricity	System Design Size (kW)	Annual Generation Per Bldg (kWh/yr.)	Est. Technical Applicability %	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)
Seasonal housing	3	3,200	45%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Residential garages			0%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Small diesel grid housing	3	3,200	45%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Small Diesel Grid Government

Residential : Existing and Renovated Stock

				2015			2020			2025			2030		
Solar DHW – Heat	System Size (m^2)	Annual Savings Per Bldg (kWh/yr.)	Est. Technical Applicability %	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)
Seasonal housing	6	2,200	30%	0.0	41%	0.0	0.0	41%	0.0	0.0	41%	0.0	0.0	41%	0.0
Residential garages	6		0%	0.0	50%	0.0	0.0	50%	0.0	0.0	50%	0.0	0.0	50%	0.0
Small diesel grid housing	6	2,200	30%	18.9	83%	10.3	18.9	83%	10.3	18.9	83%	10.3	18.9	83%	10.3
Total				18.9		10.3	18.9		10.3	18.9		10.3	18.9		10.3

Residential : New Stock

				2015			2020			2025			2030		
Solar DHW – Heat	System Size (m^2)	Annual Savings Per Bldg (kWh/yr.)	Est. Technical Applicability %	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)
Seasonal housing	6	2,200	40%	0.0	41%	0.0	0.0	41%	0.0	0.0	41%	0.0	0.0	41%	0.0
Residential garages	6		0%	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0	0.0	100%	0.0
Small diesel grid housing	6	2,200	40%	0.0	83%	0.0	0.0	83%	0.0	0.0	83%	0.0	0.0	83%	0.0
Total				0.0		0.0	0.0		0.0	0.0		0.0	0.0		0.0

Old Crow Grid Non-Government

Residential: Existing and Renovated Stock

PV – Electricity	System Design Size (kW)	Annual Generation Per Bldg (kWh/yr.)	Est. Technical Applicability	2015		2020		2025		2030	
				# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)
Seasonal housing	3	3,200	30%	65	62	65	62	65	62	65	62
Small diesel grid housing	3	3,200	30%	64	62	64	62	64	62	64	62
Total				131	124	131	124	131	124	131	124

Residential: New Stock

PV – Electricity	System Design Size (kW)	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	2015		2020		2025		2030	
				# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)
Seasonal housing	3	3,200	45%	5	7	10	14	15	22	21	30
Small diesel grid housing	3	3,200	45%	5	7	10	14	15	22	21	30
Total				10	14	20	28	31	44	43	61

Old Crow Grid Non-Government

Residential: Existing and Renovated Stock

Solar DHW – Heat	System Size (m^2)	Annual Savings Per Bldg (kWh/yr.)	Est. Technical Applicability %	2015			2020			2025			2030		
				# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)
Seasonal housing	6	2,200	30%	65	41%	18	65	41%	18	65	41%	18	65	41%	18
Small diesel grid housing	6	2,200	30%	64	83%	35	64	83%	35	64	83%	35	64	83%	35
Total				131		53	131		53	131		53	131		53

Residential: New Stock

Solar DHW – Heat	System Size (m^2)	Annual Savings Per Bldg (kWh/yr.)	Est. Technical Applicability %	2015			2020			2025			2030		
				# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)
Seasonal housing	6	2,200	40%	5	41%	2	10	41%	4	15	41%	6	21	41%	8
Small diesel grid housing	6	2,200	40%	5	83%	3	10	83%	7	15	83%	11	21	83%	15
Total				10		5	20		11	31		17	43		23

Old Crow Grid Government

Residential: Existing and Renovated Stock

				2015		2020		2025		2030	
PV – Electricity	System Design Size (kW)	Annual Generation Per Bldg (kWh/yr.)	Est. Technical Applicability	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)
Seasonal housing	3	3,200	30%	0	0	0	0	0	0	0	0
Small diesel grid housing	3	3,200	30%	12	12	12	12	12	12	12	12
Total				12	12	12	12	12	12	12	12

Residential: New Stock

				2015		2020		2025		2030	
PV – Electricity	System Design Size (kW)	Annual Generation Per Bldg (kWh/yr.)	Est. Technical Applicability %	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)	# of Dwellings	Total Annual Production (MWh/yr.)
Seasonal housing	3	3,200	45%	0	0	0	0	0	0	0	0
Small diesel grid housing	3	3,200	45%	1	1	2	3	3	4	4	6
Total				1	1	2	3	3	4	4	6

Old Crow Grid Government

Residential: Existing and Renovated Stock

				2015			2020			2025			2030		
Solar DHW – Heat	System Size (m^2)	Annual Savings Per Bldg (kWh/yr.)	Est. Technical Applicability %	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)
Seasonal housing	6	2,200	30%	0	41%	0	0	41%	0	0	41%	0	0	41%	0
Small diesel grid housing	6	2,200	30%	12	83%	7	12	83%	7	12	83%	7	12	83%	7
Total				12		7	12		7	12		7	12		7

Residential: New Stock

				2015			2020			2025			2030		
Solar DHW – Heat	System Size (m^2)	Annual Savings Per Bldg (kWh/yr.)	Est. Technical Applicability %	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)	# of Buildings	% with electric DHW	Total Annual Production (MWh/yr.)
Seasonal housing	6	2,200	40%	0	41%	0	0	41%	0	0	41%	0	0	41%	0
Small diesel grid housing	6	2,200	40%	1	83%	1	2	83%	1	3	83%	2	4	83%	3
Total				1		1	2		1	3		2	4		3

Exhibit A-2 Commercial Technical Potential Calculation Tables

Hydro Grid Non-Government

Commercial: Existing Stock

PV – Electricity	System Design Size (kW)	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Approx. Floorspace (ft^2)/Building	2015			2020			2025			2030		
					Floorspace (ft^2)	Approx. # of Buildings	Total Annual Production (MWh/ yr.)	Floorspace (ft^2)	Approx. # of Buildings	Total Annual Production (MWh/ yr.)	Floorspace (ft^2)	Approx. # of Buildings	Total Annual Production (MWh/ yr.)	Floorspace (ft^2)	Approx. # of Buildings	Total Annual Production (MWh/ yr.)
Office	20	22,000	30%	15,000	788,462	53	347	788,462	53	347	788,462	53	347	788,462	53	347
Food Retail	20	22,000	30%	30,000	195,483	7	43	195,483	7	43	195,483	7	43	195,483	7	43
Non-food Retail	20	22,000	30%	10,000	864,237	86	570	864,237	86	570	864,237	86	570	864,237	86	570
Hotel / Motel	20	22,000	30%	20,000	617,841	31	204	617,841	31	204	617,841	31	204	617,841	31	204
Healthcare	20	22,000	30%	95,000	19,057	0	1	19,057	0	1	19,057	0	1	19,057	0	1
Education	20	22,000	30%	33,000	121,931	4	24	121,931	4	24	121,931	4	24	121,931	4	24
Restaurant	20	22,000	30%	4,000	191,253	48	316	191,253	48	316	191,253	48	316	191,253	48	316
Recreation Centres	20	32,000	30%	25,000	489,859	20	188	489,859	20	188	489,859	20	188	489,859	20	188
Warehouse / Wholesale	20	32,000	30%	30,000	1,154,073	38	369	1,154,073	38	369	1,154,073	38	369	1,154,073	38	369
Total				262,000	4,442,196	286	2,063	4,442,196	286	2,063	4,442,196	286	2,063	4,442,196	286	2,063

Commercial : New Stock

PV – Electricity	System Design Size (kW)	Annual Production Per Bldg (kWh/ yr.)	Est. Technical Applicability %	Approx. Floorspace (ft^2)/Building	2015			2020			2025			2030		
					Floorspace (ft^2)	Approx. # of Buildings	Total Annual Production (MWh/ yr.)	Floorspace (ft^2)	Approx. # of Buildings	Total Annual Production (MWh/ yr.)	Floorspace (ft^2)	Approx. # of Buildings	Total Annual Production (MWh/ yr.)	Floorspace (ft^2)	Approx. # of Buildings	Total Annual Production (MWh/ yr.)
Office	20	32,000	45%	15,000	102,522	7	98	218,374	15	210	349,291	23	335	497,230	33	477
Food Retail	20	32,000	45%	30,000	25,449	1	12	54,212	2	26	86,719	3	42	123,458	4	59
Non-food Retail	20	32,000	45%	20,000	114,877	6	83	245,024	12	176	392,471	20	283	559,516	28	403
Hotel / Motel	20	32,000	45%	20,000	78,974	4	57	168,043	8	121	268,497	13	193	381,792	19	275
Healthcare	20	32,000	45%	95,000	2,361	0	0	5,014	0	1	7,996	0	1	11,348	0	2
Education	20	32,000	45%	43,040	17,152	0	6	36,716	1	12	59,032	1	20	84,488	2	28
Restaurant	20	32,000	45%	5,380	28,554	5	76	61,371	11	164	99,087	18	265	142,434	26	381
Recreation Centres	20	32,000	45%	20,000	55,619	3	40	117,554	6	85	186,520	9	134	263,317	13	190
Warehouse / Wholesale	20	32,000	45%	35,000	152,224	4	63	324,526	9	134	519,555	15	214	740,309	21	305
Total				283,420	577,732	30	435	1,476,951	64	929	2,360,573	103	1,487	3,357,761	147	2,120

Hydro Grid Non-Government

Commercial: Existing Stock

Solar DHW-Heat	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Approx. Floorspace (ft^2)/Building	2015 Floorspace (ft^2)	2015 Approx. # of Buildings	2015 % Electric DHW	2015 Total Annual Production (MWh/ yr.)	2020 Floorspace (ft^2)	2020 Approx. # of Buildings	2020 % Electric DHW	2020 Total Annual Production (MWh/ yr.)
Office			15,000	788,462	53	50%	0.00	788,462	53	50%	0.00
Food Retail	23,900	30%	30,000	195,483	7	40%	18.69	195,483	7	40%	18.69
Non-food Retail			10,000	864,237	86	30%	0.00	864,237	86	30%	0.00
Hotel / Motel	23,900	30%	20,000	617,841	31	15%	33.22	617,841	31	15%	33.22
Healthcare	23,900	30%	95,000	19,057	0	10%	0.14	19,057	0	10%	0.14
Education	23,900	30%	33,000	121,931	4	50%	13.25	121,931	4	50%	13.25
Restaurant	23,900	30%	4,000	191,253	48	15%	51.42	191,253	48	15%	51.42
Recreation Centres	23,900	30%	25,000	489,859	20	10%	14.05	489,859	20	10%	14.05
Warehouse / Wholesale			30,000	1,154,073	38	15%	0.00	1,154,073	38	15%	0.00
Total			262,000	4,442,196	286		130.77	4,442,196	286		130.77

Commercial: New Stock

Solar DHW-Heat	Annual Production Per Bldg (kWh/ yr.)	Est. Technical Applicability %	Approx. Floorspace (ft^2)/Building	2015 Floorspace (ft^2)	2015 Approx. # of Buildings	2015 % Electric DHW	2015 Total Annual Production (MWh/ yr.)	2020 Floorspace (ft^2)	2020 Approx. # of Buildings	2020 % Electric DHW	2020 Total Annual Production (MWh/ yr.)
Office			15,000	102,522	7	90%	0.00	218,374	15	90%	0.00
Food Retail	23,900	45%	30,000	25,449	1	80%	7.30	54,212	2	80%	15.55
Non-food Retail			20,000	114,877	6	85%	0.00	245,024	12	85%	0.00
Hotel / Motel	23,900	45%	20,000	78,974	4	95%	40.34	168,043	8	95%	85.85
Healthcare	23,900	45%	95,000	2,361	0	60%	0.16	5,014	0	60%	0.34
Education	23,900	45%	43,040	17,152	0	75%	3.21	36,716	1	75%	6.88
Restaurant	23,900	45%	5,380	28,554	5	80%	45.66	61,371	11	80%	98.15
Recreation Centres	23,900	45%	20,000	55,619	3	55%	16.45	117,554	6	55%	34.77
Warehouse / Wholesale			35,000	152,224	4	70%	0.00	324,526	9	70%	0.00
Total			283,420	577,732	30		113.13	1,230,834	64		241.53

Hydro Grid Non-Government

Commercial: Existing Stock

Solar DHW-Heat	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Approx. Floorspace (ft^2)/Building	2025 Floorspace (ft^2)	2025 Approx. # of Buildings	2025 % Electric DHW	2025 Total Annual Production (MWh/ yr.)	2030 Floorspace (ft^2)	2030 Approx. # of Buildings	2030 % Electric DHW	2030 Total Annual Production (MWh/ yr.)
Office			15,000	788,462	53	50%	0.00	788,462	53	50%	0.00
Food Retail	23,900	30%	30,000	195,483	7	40%	18.69	195,483	7	40%	18.69
Non-food Retail			10,000	864,237	86	30%	0.00	864,237	86	30%	0.00
Hotel / Motel	23,900	30%	20,000	617,841	31	15%	33.22	617,841	31	15%	33.22
Healthcare	23,900	30%	95,000	19,057	0	10%	0.14	19,057	0	10%	0.14
Education	23,900	30%	33,000	121,931	4	50%	13.25	121,931	4	50%	13.25
Restaurant	23,900	30%	4,000	191,253	48	15%	51.42	191,253	48	15%	51.42
Recreation Centres	23,900	30%	25,000	489,859	20	10%	14.05	489,859	20	10%	14.05
Warehouse / Wholesale			30,000	1,154,073	38	15%	0.00	1,154,073	38	15%	0.00
Total			262,000	4,442,196	286		130.77	4,442,196	286		130.77

Commercial: New Stock

Solar DHW-Heat	Annual Production Per Bldg (kWh/ yr.)	Est. Technical Applicability %	Approx. Floorspace (ft^2)/Building	2025 Floorspace (ft^2)	2025 Approx. # of Buildings	2025 % Electric DHW	2025 Total Annual Production (MWh/ yr.)	2030 Floorspace (ft^2)	2030 Approx. # of Buildings	2030 % Electric DHW	2030 Total Annual Production (MWh/ yr.)
Office			15,000	349,291	23	90%	0.00	497,230	33	90%	0.00
Food Retail	23,900	45%	30,000	86,719	3	80%	24.87	123,458	4	80%	35.41
Non-food Retail			20,000	392,471	20	85%	0.00	559,516	28	85%	0.00
Hotel / Motel	23,900	45%	20,000	268,497	13	95%	137.17	381,792	19	95%	195.04
Healthcare	23,900	45%	95,000	7,996	0	60%	0.54	11,348	0	60%	0.77
Education	23,900	45%	43,040	59,032	1	75%	11.06	84,488	2	75%	15.83
Restaurant	23,900	45%	5,380	99,087	18	80%	158.47	142,434	26	80%	227.79
Recreation Centres	23,900	45%	20,000	186,520	9	55%	55.17	263,317	13	55%	77.88
Warehouse / Wholesale			35,000	519,555	15	70%	0.00	740,309	21	70%	0.00
Total			283,420	1,969,168	103		387.27	2,803,892	147		552.72

Hydro Grid Non-Government

Commercial: Existing Stock

				2015					2020				
Pellet Boilers	Est. Technical Applicability %	Est. % Electricity Displaced	Approx. Floorspace (ft^2)/Building	Floorspace (ft^2)	Approx. # of Buildings	% Electric Heating	Electric Heating EUI (kWH/ft^2)	Total Annual Savings (MWh/yr.)	Floorspace (ft^2)	Approx. # of Buildings	% Electric Heating	Electric Heating EUI (kWH/ft^2)	Total Annual Savings (MWh/ yr.)
Office_Govt			15,000	788,462	53	30%	14.4	0	788,462	53	30%	14.4	0
Food Retail_Govt	20%	90%	30,000	195,483	7	20%	15.3	107	195,483	7	20%	15.3	107
Non-food Retail_Govt			10,000	864,237	86	20%	11.1	0	864,237	86	20%	11.1	0
Hotel / Motel_Govt	20%	90%	20,000	617,841	31	20%	23.1	514	617,841	31	20%	23.1	514
Healthcare_Govt	20%	90%	95,000	19,057	0	10%	34.0	12	19,057	0	10%	34.0	12
Education_Govt	20%	90%	33,000	121,931	4	10%	18.1	40	121,931	4	10%	18.1	40
Restaurant_Govt			4,000	191,253	48	15%	50.7	0	191,253	48	15%	50.7	0
Recreation Centres_Govt	20%	90%	25,000	489,859	20	2%	17.5	32	489,859	20	2%	17.5	32
Warehouse / Wholesale_Govt	20%	90%	30,000	1,154,073	38	5%	15.0	156	1,154,073	38	5%	15.0	156
Total			262,000	4,442,196	286			861	4,442,196	286			861

Commercial: New Stock

				2015					2020				
Pellet Boilers	Est. Technical Applicability %	Est. % Electricity Displaced	Approx. Floorspace (ft^2)/Building	Floorspace (ft^2)	Approx. # of Buildings	% Electric Heating	Electric Heating EUI (kWH/ft^2)	Total Annual Savings (MWh/ yr.)	Floorspace (ft^2)	Approx. # of Buildings	% Electric Heating	Electric Heating EUI (kWH/ft^2)	Total Annual Savings (MWh/ yr.)
Office_Govt			15,000	102,522	7	80%	10.4	0	218,374	15	80%	10.4	0
Food Retail_Govt	60%	90%	30,000	25,449	1	80%	11.4	125	54,212	2	80%	11.4	267
Non-food Retail_Govt			20,000	114,877	6	80%	9.0	0	245,024	12	80%	9.0	0
Hotel / Motel_Govt	60%	90%	20,000	78,974	4	95%	15.4	625	168,043	8	95%	15.4	1,331
Healthcare_Govt	60%	90%	95,000	2,361	0	60%	26.2	20	5,014	0	60%	26.2	43
Education_Govt	60%	90%	43,040	17,152	0	65%	11.1	67	36,716	1	65%	11.1	143
Restaurant_Govt			5,380	28,554	5	80%	21.5	0	61,371	11	80%	21.5	0
Recreation Centres_Govt	60%	90%	20,000	55,619	3	35%	10.9	115	117,554	6	35%	10.9	243
Warehouse / Wholesale_Govt	60%	90%	35,000	152,224	4	50%	10.7	438	324,526	9	50%	10.7	934
Total			283,420	577,732	30			1,391	1,230,834	64			2,960

Hydro Grid Non-Government

Commercial: Existing Stock

				2025					2030				
Pellet Boilers	Est. Technical Applicability %	Est. % Electricity Displaced	Approx. Floorspace (ft^2)/Building	Floorspace (ft^2)	Approx. # of Buildings	% Electric Heating	Electric Heating EUI (kWH/ft^2)	Total Annual Production (MWh/ yr.)	Floorspace (ft^2)	Approx. # of Buildings	% Electric DHW	Electric Heating EUI (kWH/ft^2)	Total Annual Production (MWh/ yr.)
Office_Govt			15,000	788,462	53	30%	14.4	0	788,462	53	30%	14.4	0
Food Retail_Govt	20%	90%	30,000	195,483	7	20%	15.3	107	195,483	7	20%	15.3	107
Non-food Retail_Govt			10,000	864,237	86	20%	11.1	0	864,237	86	20%	11.1	0
Hotel / Motel_Govt	20%	90%	20,000	617,841	31	20%	23.1	514	617,841	31	20%	23.1	514
Healthcare_Govt	20%	90%	95,000	19,057	0	10%	34.0	12	19,057	0	10%	34.0	12
Education_Govt	20%	90%	33,000	121,931	4	10%	18.1	40	121,931	4	10%	18.1	40
Restaurant_Govt			4,000	191,253	48	15%	50.7	0	191,253	48	15%	50.7	0
Recreation Centres_Govt	20%	90%	25,000	489,859	20	2%	17.5	32	489,859	20	2%	17.5	32
Warehouse / Wholesale_Govt	20%	90%	30,000	1,154,073	38	5%	15.0	156	1,154,073	38	5%	15.0	156
Total			262,000	4,442,196	286			861.09	4,442,196	286			861.09

Commercial : New Stock

				2025					2030				
Pellet Boilers	Est. Technical Applicability %	Est. % Electricity Displaced	Approx. Floorspace (ft^2)/Building	Floorspace (ft^2)	Approx. # of Buildings	% Electric Heating	Electric Heating EUI (kWH/ft^2)	Total Annual Production (MWh/ yr.)	Floorspace (ft^2)	Approx. # of Buildings	% Electric DHW	Electric Heating EUI (kWH/ft^2)	Total Annual Production (MWh/ yr.)
Office_Govt			15,000	349,291	23	80%	10.4	0	497,230	33	80%	10.4	0
Food Retail_Govt	60%	90%	30,000	86,719	3	80%	11.4	427	123,458	4	80%	11.4	608
Non-food Retail_Govt			20,000	392,471	20	80%	9.0	0	559,516	28	80%	9.0	0
Hotel / Motel_Govt	60%	90%	20,000	268,497	13	95%	15.4	2,126	381,792	19	95%	15.4	3,023
Healthcare_Govt	60%	90%	95,000	7,996	0	60%	26.2	68	11,348	0	60%	26.2	96
Education_Govt	60%	90%	43,040	59,032	1	65%	11.1	230	84,488	2	65%	11.1	329
Restaurant_Govt			5,380	99,087	18	80%	21.5	0	142,434	26	80%	21.5	0
Recreation Centres_Govt	60%	90%	20,000	186,520	9	35%	10.9	385	263,317	13	35%	10.9	544
Warehouse / Wholesale_Govt	60%	90%	35,000	519,555	15	50%	10.7	1,495	740,309	21	50%	10.7	2,130
Total			283,420	1,969,168	103			4,731.83	2,803,892	147			6,731.57

Hydro Grid Government

Commercial: Existing Stock

PV – Electricity	System Design Size (kW)	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Approx. Floorspace (ft^2)/Building	2015			2020			2025			2030		
					Floorspace (ft^2)	Approx. # of Buildings	Total Annual Production (MWh/ yr.)	Floorspace (ft^2)	Approx. # of Buildings	Total Annual Production (MWh/ yr.)	Floorspace (ft^2)	Approx. # of Buildings	Total Annual Production (MWh/ yr.)	Floorspace (ft^2)	Approx. # of Buildings	Total Annual Production (MWh/ yr.)
Office_Govt	20	22,000	30%	15,000	575,527	38	253	575,527	38	253	575,527	38	253	575,527	38	253
Food Retail_Govt	20	22,000	30%	30,000	0	0	0	0	0	0	0	0	0	0	0	0
Non-food Retail_Govt	20	22,000	30%	10,000	48,022	5	32	48,022	5	32	48,022	5	32	48,022	5	32
Hotel / Motel_Govt	20	22,000	30%	20,000	0	0	0	0	0	0	0	0	0	0	0	0
Healthcare_Govt	20	22,000	30%	95,000	189,651	2	13	189,651	2	13	189,651	2	13	189,651	2	13
Education_Govt	20	22,000	30%	33,000	1,620,171	49	324	1,620,171	49	324	1,620,171	49	324	1,620,171	49	324
Restaurant_Govt	20	22,000	30%	4,000	3,314	1	5	3,314	1	5	3,314	1	5	3,314	1	5
Recreation Centres_Govt	20	32,000	30%	25,000	9,560	0	4	9,560	0	4	9,560	0	4	9,560	0	4
Warehouse / Wholesale_Govt	20	32,000	30%	30,000	284,998	9	91	284,998	9	91	284,998	9	91	284,998	9	91
Total				262,000	2,731,243	105	722	2,731,243	105	722	2,731,243	105	722	2,731,243	105	722

Commercial : New Stock

PV – Electricity	System Design Size (kW)	Annual Production Per Bldg (kWh/ yr.)	Est. Technical Applicability %	Approx. Floorspace (ft^2)/Building	2015			2020			2025			2030		
					Floorspace (ft^2)	Approx. # of Buildings	Total Annual Production (MWh/ yr.)	Floorspace (ft^2)	Approx. # of Buildings	Total Annual Production (MWh/ yr.)	Floorspace (ft^2)	Approx. # of Buildings	Total Annual Production (MWh/ yr.)	Floorspace (ft^2)	Approx. # of Buildings	Total Annual Production (MWh/ yr.)
Office_Govt	20	32,000	45%	15,000	74,834	5	72	159,400	11	153	254,960	17	245	362,947	24	348
Food Retail_Govt	20	32,000	45%	30,000	0	0	0	0	0	0	0	0	0	0	0	0
Non-food Retail_Govt	20	32,000	45%	20,000	6,383	0	5	13,615	1	10	21,808	1	16	31,090	2	22
Hotel / Motel_Govt	20	32,000	45%	20,000	0	0	0	0	0	0	0	0	0	0	0	0
Healthcare_Govt	20	32,000	45%	95,000	23,494	0	4	49,900	1	8	79,576	1	12	112,928	1	17
Education_Govt	20	32,000	45%	43,040	227,905	5	76	487,869	11	163	784,402	18	262	1,122,647	26	376
Restaurant_Govt	20	32,000	45%	5,380	495	0	1	1,063	0	3	1,717	0	5	2,468	0	7
Recreation Centres_Govt	20	32,000	45%	20,000	1,085	0	1	2,294	0	2	3,640	0	3	5,139	0	4
Warehouse / Wholesale_Govt	20	32,000	45%	35,000	37,592	1	15	80,141	2	33	128,304	4	53	182,819	5	75
Total				283,420	371,789	12	174	794,282	26	371	1,274,407	41	595	1,820,038	59	849

Hydro Grid Government

Commercial: Existing Stock

Solar DHW-Heat	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Approx. Floorspace (ft^2)/Building	2015 Floorspace (ft^2)	2015 Approx. # of Buildings	2015 % Electric DHW	2015 Total Annual Production (MWh/ yr.)	2020 Floorspace (ft^2)	2020 Approx. # of Buildings	2020 % Electric DHW	2020 Total Annual Production (MWh/ yr.)
Office_Govt			15,000	575,527	38	50%	0.00	575,527	38	50%	0.0
Food Retail_Govt	23,900	30%	30,000	0	0	40%	0.00	0	0	40%	0.0
Non-food Retail_Govt			10,000	48,022	5	30%	0.00	48,022	5	30%	0.0
Hotel / Motel_Govt	23,900	30%	20,000	0	0	15%	0.00	0	0	15%	0.0
Healthcare_Govt	23,900	30%	95,000	189,651	2	10%	1.43	189,651	2	10%	1.4
Education_Govt	23,900	30%	33,000	1,620,171	49	50%	176.01	1,620,171	49	50%	176.0
Restaurant_Govt	23,900	30%	4,000	3,314	1	15%	0.89	3,314	1	15%	0.9
Recreation Centres_Govt	23,900	30%	25,000	9,560	0	10%	0.27	9,560	0	10%	0.3
Warehouse / Wholesale_Govt			30,000	284,998	9	15%	0.00	284,998	9	15%	0.0
Total			262,000	2,731,243	105		178.61	2,731,243	105		178.6

Commercial : New Stock

Solar DHW-Heat	Annual Production Per Bldg (kWh/ yr.)	Est. Technical Applicability %	Approx. Floorspace (ft^2)/Building	2015 Floorspace (ft^2)	2015 Approx. # of Buildings	2015 % Electric DHW	2015 Total Annual Production (MWh/ yr.)	2020 Floorspace (ft^2)	2020 Approx. # of Buildings	2020 % Electric DHW	2020 Total Annual Production (MWh/ yr.)
Office_Govt			15,000	74,834	5	90%	0.00	159,400	11	90%	0.00
Food Retail_Govt	23,900	45%	30,000	0	0	80%	0.00	0	0	80%	0.00
Non-food Retail_Govt			20,000	6,383	0	85%	0.00	13,615	1	85%	0.00
Hotel / Motel_Govt	23,900	45%	20,000	0	0	95%	0.00	0	0	95%	0.00
Healthcare_Govt	23,900	45%	95,000	23,494	0	60%	1.60	49,900	1	60%	3.39
Education_Govt	23,900	45%	43,040	227,905	5	75%	42.71	487,869	11	75%	91.43
Restaurant_Govt	23,900	45%	5,380	495	0	80%	0.79	1,063	0	80%	1.70
Recreation Centres_Govt	23,900	45%	20,000	1,085	0	55%	0.32	2,294	0	55%	0.68
Warehouse / Wholesale_Govt			35,000	37,592	1	70%	0.00	80,141	2	70%	0.00
Total			283,420	371,789	12		45.42	794,282	26		97.20

Hydro Grid Government

Commercial: Existing Stock

Solar DHW-Heat	Annual Production Per Bldg (kWh/ yr.)	Est. Technical Applicability %	Approx. Floorspace (ft^2)/Building	2025 Floorspace (ft^2)	2025 Approx. # of Buildings	2025 % Electric DHW	2025 Total Annual Production (MWh/ yr.)	2030 Floorspace (ft^2)	2030 Approx. # of Buildings	2030 % Electric DHW	2030 Total Annual Production (MWh/ yr.)
Office_Govt			15,000	575,527	38	50%	0.00	575,527	38	50%	0.00
Food Retail_Govt	23,900	30%	30,000	0	0	40%	0.00	0	0	40%	0.00
Non-food Retail_Govt			10,000	48,022	5	30%	0.00	48,022	5	30%	0.00
Hotel / Motel_Govt	23,900	30%	20,000	0	0	15%	0.00	0	0	15%	0.00
Healthcare_Govt	23,900	30%	95,000	189,651	2	10%	1.43	189,651	2	10%	1.43
Education_Govt	23,900	30%	33,000	1,620,171	49	50%	176.01	1,620,171	49	50%	176.01
Restaurant_Govt	23,900	30%	4,000	3,314	1	15%	0.89	3,314	1	15%	0.89
Recreation Centres_Govt	23,900	30%	25,000	9,560	0	10%	0.27	9,560	0	10%	0.27
Warehouse / Wholesale_Govt			30,000	284,998	9	15%	0.00	284,998	9	15%	0.00
Total			262,000	2,731,243	105		178.61	2,731,243	105		178.61

Commercial : New Stock

Solar DHW-Heat	Annual Production Per Bldg (kWh/ yr.)	Est. Technical Applicability %	Approx. Floorspace (ft^2)/Building	2025 Floorspace (ft^2)	2025 Approx. # of Buildings	2025 % Electric DHW	2025 Total Annual Production (MWh/ yr.)	2030 Floorspace (ft^2)	2030 Approx. # of Buildings	2030 % Electric DHW	2030 Total Annual Production (MWh/ yr.)
Office_Govt			15,000	254,960	17	90%	0.00	362,947	24	90%	0.00
Food Retail_Govt	23,900	45%	30,000	0	0	80%	0.00	0	0	80%	0.00
Non-food Retail_Govt			20,000	21,808	1	85%	0.00	31,090	2	85%	0.00
Hotel / Motel_Govt	23,900	45%	20,000	0	0	95%	0.00	0	0	95%	0.00
Healthcare_Govt	23,900	45%	95,000	79,576	1	60%	5.41	112,928	1	60%	7.67
Education_Govt	23,900	45%	43,040	784,402	18	75%	147.01	1,122,647	26	75%	210.40
Restaurant_Govt	23,900	45%	5,380	1,717	0	80%	2.75	2,468	0	80%	3.95
Recreation Centres_Govt	23,900	45%	20,000	3,640	0	55%	1.08	5,139	0	55%	1.52
Warehouse / Wholesale_Govt			35,000	128,304	4	70%	0.00	182,819	5	70%	0.00
Total			283,420	1,274,407	41		156.23	1,820,038	59		223.54

Hydro Grid Government

Commercial : Existing Stock

				2015					2020				
Pellet Boilers	Est. Technical Applicability %	Est. % Electricity Displaced	Approx. Floorspace (ft^2)/Building	Floorspace (ft^2)	Approx. # of Buildings	% Electric Heating	Electric Heating EUI (kWH/ft^2)	Total Annual Savings (MWh/yr.)	Floorspace (ft^2)	Approx. # of Buildings	% Electric Heating	Electric Heating EUI (kWH/ft^2)	Total Annual Savings (MWh/ yr.)
Office_Govt			15,000	575,527	38	30%	14.4	0	575,527	38	30%	14.4	0
Food Retail_Govt	20%	90%	30,000	0	0	20%	15.3	0	0	0	20%	15.3	0
Non-food Retail_Govt			10,000	48,022	5	20%	11.1	0	48,022	5	20%	11.1	0
Hotel / Motel_Govt	20%	90%	20,000	0	0	20%	23.1	0	0	0	20%	23.1	0
Healthcare_Govt	20%	90%	95,000	189,651	2	10%	34.0	116	189,651	2	10%	34.0	116
Education_Govt	20%	90%	33,000	1,620,171	49	10%	18.1	529	1,620,171	49	10%	18.1	529
Restaurant_Govt			4,000	3,314	1	15%	50.7	0	3,314	1	15%	50.7	0
Recreation Centres_Govt	20%	90%	25,000	9,560	0	2%	17.5	1	9,560	0	2%	17.5	1
Warehouse / Wholesale_Govt	20%	90%	30,000	284,998	9	5%	15.0	39	284,998	9	5%	15.0	39
Total			262,000	2,731,243	105			684	2,731,243	105			684

Commerical : New Stock

				2015					2020				
Pellet Boilers	Est. Technical Applicability %	Est. % Electricity Displaced	Approx. Floorspace (ft^2)/Building	Floorspace (ft^2)	Approx. # of Buildings	% Electric Heating	Electric Heating EUI (kWH/ft^2)	Total Annual Savings (MWh/ yr.)	Floorspace (ft^2)	Approx. # of Buildings	% Electric Heating	Electric Heating EUI (kWH/ft^2)	Total Annual Savings (MWh/ yr.)
Office_Govt			15,000	74,834	5	80%	10.4	0	159,400	11	80%	10.4	0
Food Retail_Govt	60%	90%	30,000	0	0	80%	11.4	0	0	0	80%	11.4	0
Non-food Retail_Govt			20,000	6,383	0	80%	9.0	0	13,615	1	80%	9.0	0
Hotel / Motel_Govt	60%	90%	20,000	0	0	95%	15.4	0	0	0	95%	15.4	0
Healthcare_Govt	60%	90%	95,000	23,494	0	60%	26.2	200	49,900	1	60%	26.2	424
Education_Govt	60%	90%	43,040	227,905	5	65%	11.1	888	487,869	11	65%	11.1	1,902
Restaurant_Govt			5,380	495	0	80%	21.5	0	1,063	0	80%	21.5	0
Recreation Centres_Govt	60%	90%	20,000	1,085	0	35%	10.9	2	2,294	0	35%	10.9	5
Warehouse / Wholesale_Govt	60%	90%	35,000	37,592	1	50%	10.7	108	80,141	2	50%	10.7	231
Total			283,420	371,789	12			1,199	794,282	26			2,562

Hydro Grid Government

Commercial: Existing Stock

				2025					2030				
Solar DHW-Heat	Est. Technical Applicability %	Est. % Electricity Displaced	Approx. Floorspace (ft^2)/Building	Floorspace (ft^2)	Approx. # of Buildings	% Electric Heating	Electric Heating EUI (kWH/ft^2)	Total Annual Production (MWh/yr.)	Floorspace (ft^2)	Approx. # of Buildings	% Electric DHW	Electric Heating EUI (kWH/ft^2)	Total Annual Production (MWh/ yr.)
Office_Govt			15,000	575,527	38	30%	14.4	0	575,527	38	30%	14.4	0
Food Retail_Govt	20%	90%	30,000	0	0	20%	15.3	0	0	0	20%	15.3	0
Non-food Retail_Govt			10,000	48,022	5	20%	11.1	0	48,022	5	20%	11.1	0
Hotel / Motel_Govt	20%	90%	20,000	0	0	20%	23.1	0	0	0	20%	23.1	0
Healthcare_Govt	20%	90%	95,000	189,651	2	10%	34.0	116	189,651	2	10%	34.0	116
Education_Govt	20%	90%	33,000	1,620,171	49	10%	18.1	529	1,620,171	49	10%	18.1	529
Restaurant_Govt			4,000	3,314	1	15%	50.7	0	3,314	1	15%	50.7	0
Recreation Centres_Govt	20%	90%	25,000	9,560	0	2%	17.5	1	9,560	0	2%	17.5	1
Warehouse / Wholesale_Govt	20%	90%	30,000	284,998	9	5%	15.0	39	284,998	9	5%	15.0	39
Total			262,000	2,731,243	105			683.96	2,731,243	105			683.96

Commercial: New Stock

				2025					2030				
Solar DHW-Heat	Est. Technical Applicability %	Est. % Electricity Displaced	Approx. Floorspace (ft^2)/Building	Floorspace (ft^2)	Approx. # of Buildings	% Electric Heating	Electric Heating EUI (kWH/ft^2)	Total Annual Production (MWh/ yr.)	Floorspace (ft^2)	Approx. # of Buildings	% Electric DHW	Electric Heating EUI (kWH/ft^2)	Total Annual Production (MWh/ yr.)
Office_Govt			15,000	254,960	17	80%	10.4	0	362,947	24	80%	10.4	0
Food Retail_Govt	60%	90%	30,000	0	0	80%	11.4	0	0	0	80%	11.4	0
Non-food Retail_Govt			20,000	21,808	1	80%	9.0	0	31,090	2	80%	9.0	0
Hotel / Motel_Govt	60%	90%	20,000	0	0	95%	15.4	0	0	0	95%	15.4	0
Healthcare_Govt	60%	90%	95,000	79,576	1	60%	26.2	677	112,928	1	60%	26.2	960
Education_Govt	60%	90%	43,040	784,402	18	65%	11.1	3,058	1,122,647	26	65%	11.1	4,377
Restaurant_Govt			5,380	1,717	0	80%	21.5	0	2,468	0	80%	21.5	0
Recreation Centres_Govt	60%	90%	20,000	3,640	0	35%	10.9	8	5,139	0	35%	10.9	11
Warehouse / Wholesale_Govt	60%	90%	35,000	128,304	4	50%	10.7	369	182,819	5	50%	10.7	526
Total			283,420	1,274,407	41			4,111.35	1,820,038	59			5,873.56

Large Diesel Grid Non-Government

Commercial: Existing Stock

					2015			2020			2025			2030		
PV – Electricity	System Design Size (kW)	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)
Office	20	22,000	30%	15,000	26,343	1.8	11.6	26,343	1.8	11.6	26,343	1.8	11.6	26,343	1.8	11.6
Food Retail	20	22,000	30%	30,000	10,302	0.3	2.3	10,302	0.3	2.3	10,302	0.3	2.3	10,302	0.3	2.3
Non-food Retail	20	22,000	30%	10,000	49,401	4.9	32.6	49,401	4.9	32.6	49,401	4.9	32.6	49,401	4.9	32.6
Hotel / Motel	20	22,000	30%	20,000	63,552	3.2	21.0	63,552	3.2	21.0	63,552	3.2	21.0	63,552	3.2	21.0
Healthcare	20	22,000	30%	95,000	3,883	0.0	0.3	3,883	0.0	0.3	3,883	0.0	0.3	3,883	0.0	0.3
Education	20	22,000	30%	33,000	930	0.0	0.2	930	0.0	0.2	930	0.0	0.2	930	0.0	0.2
Restaurant	20	22,000	30%	4,000	9,409	2.4	15.5	9,409	2.4	15.5	9,409	2.4	15.5	9,409	2.4	15.5
Recreation Centres	20	32,000	30%	25,000	24,043	1.0	9.2	24,043	1.0	9.2	24,043	1.0	9.2	24,043	1.0	9.2
Warehouse / Wholesale	20	32,000	30%	30,000	53,727	1.8	17.2	53,727	1.8	17.2	53,727	1.8	17.2	53,727	1.8	17.2
Total				262,000	241,591	15.4	109.8	241,591	15.4	109.8	241,591	15.4	109.8	241,591	15.4	109.8

Commerical: New Stock

					2015			2020			2025			2030		
PV – Electricity	System Design Size (kW)	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)
Office	20	32,000	45%	15,000	746	0.0	0.7	1,514	0.1	1.5	2,303	0.2	2.2	3,115	0.2	3.0
Food Retail	20	32,000	45%	30,000	292	0.0	0.1	593	0.0	0.3	902	0.0	0.4	1,220	0.0	0.6
Non-food Retail	20	32,000	45%	20,000	1,431	0.1	1.0	2,903	0.1	2.1	4,418	0.2	3.2	5,977	0.3	4.3
Hotel / Motel	20	32,000	45%	20,000	1,770	0.1	1.3	3,590	0.2	2.6	5,460	0.3	3.9	7,382	0.4	5.3
Healthcare	20	32,000	45%	95,000	105	0.0	0.0	212	0.0	0.0	323	0.0	0.0	437	0.0	0.1
Education	20	32,000	45%	43,040	29	0.0	0.0	58	0.0	0.0	88	0.0	0.0	119	0.0	0.0
Restaurant	20	32,000	45%	5,380	306	0.1	0.8	622	0.1	1.7	949	0.2	2.5	1,285	0.2	3.4
Recreation Centres	20	32,000	45%	20,000	595	0.0	0.4	1,204	0.1	0.9	1,829	0.1	1.3	2,469	0.1	1.8
Warehouse / Wholesale	20	32,000	45%	35,000	1,544	0.0	0.6	3,133	0.1	1.3	4,767	0.1	2.0	6,448	0.2	2.7
Total				283,420	6,818	0.4	5.1	16,114	0.7	10.3	24,510	1.1	15.7	33,141	1.5	21.2

Large Diesel Grid Non-Government

Commercial: Existing Stock

Solar DHW-Heat	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	2015 Floorspace ($ft.^2$)	2015 Approx. # of Buildings	2015 % Electric DHW	2015 Total Annual Production (MWh/yr.)	2020 Floorspace ($ft.^2$)	2020 Approx. # of Buildings	2020 % Electric DHW	2020 Total Annual Production (MWh/yr.)
Office			15,000	26,343	1.8	50%	0.00	26,343	1.8	50%	0.00
Food Retail	23,900	30%	30,000	10,302	0.3	40%	0.98	10,302	0.3	40%	0.98
Non-food Retail			10,000	49,401	4.9	30%	0.00	49,401	4.9	30%	0.00
Hotel / Motel	23,900	30%	20,000	63,552	3.2	15%	3.42	63,552	3.2	15%	3.42
Healthcare	23,900	30%	95,000	3,883	0.0	10%	0.03	3,883	0.0	10%	0.03
Education	23,900	30%	33,000	930	0.0	50%	0.10	930	0.0	50%	0.10
Restaurant	23,900	30%	4,000	9,409	2.4	15%	2.53	9,409	2.4	15%	2.53
Recreation Centres	23,900	30%	25,000	24,043	1.0	10%	0.69	24,043	1.0	10%	0.69
Warehouse / Wholesale			30,000	53,727	1.8	15%	0.00	53,727	1.8	15%	0.00
Total			262,000	241,591	15.4		7.75	241,591	15.4		7.75

Commerical: New Stock

Solar DHW-Heat	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	2015 Floorspace ($ft.^2$)	2015 Approx. # of Buildings	2015 % Electric DHW	2015 Total Annual Production (MWh/yr.)	2020 Floorspace ($ft.^2$)	2020 Approx. # of Buildings	2020 % Electric DHW	2020 Total Annual Production (MWh/yr.)
Office			15,000	746	0.0	80%	0.00	1,514	0.1	80%	0.00
Food Retail	23,900	45%	30,000	292	0.0	85%	0.09	593	0.0	85%	0.18
Non-food Retail			20,000	1,431	0.1	95%	0.00	2,903	0.1	95%	0.00
Hotel / Motel	23,900	45%	20,000	1,770	0.1	60%	0.57	3,590	0.2	60%	1.16
Healthcare	23,900	45%	95,000	105	0.0	75%	0.01	212	0.0	75%	0.02
Education	23,900	45%	43,040	29	0.0	80%	0.01	58	0.0	80%	0.01
Restaurant	23,900	45%	5,380	306	0.1	55%	0.34	622	0.1	55%	0.68
Recreation Centres	23,900	45%	20,000	595	0.0	70%	0.22	1,204	0.1	70%	0.45
Warehouse / Wholesale			35,000	1,544	0.0	100%	0.00	3,133	0.1	100%	0.00
Total			283,420	6,818	0.4		1.24	13,829	0.7		2.51

Large Diesel Grid Non-Government

Commercial: Existing Stock

Solar DHW-Heat	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	2025				2030			
				Floorspace ($ft.^2$)	Approx. # of Buildings	% Electric DHW	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	% Electric DHW	Total Annual Production (MWh/yr.)
Office			15,000	26,343	1.8	50%	0.00	26,343	1.8	50%	0.00
Food Retail	23,900	30%	30,000	10,302	0.3	40%	0.98	10,302	0.3	40%	0.98
Non-food Retail			10,000	49,401	4.9	30%	0.00	49,401	4.9	30%	0.00
Hotel / Motel	23,900	30%	20,000	63,552	3.2	15%	3.42	63,552	3.2	15%	3.42
Healthcare	23,900	30%	95,000	3,883	0.0	10%	0.03	3,883	0.0	10%	0.03
Education	23,900	30%	33,000	930	0.0	50%	0.10	930	0.0	50%	0.10
Restaurant	23,900	30%	4,000	9,409	2.4	15%	2.53	9,409	2.4	15%	2.53
Recreation Centres	23,900	30%	25,000	24,043	1.0	10%	0.69	24,043	1.0	10%	0.69
Warehouse / Wholesale			30,000	53,727	1.8	15%	0.00	53,727	1.8	15%	0.00
Total			262,000	241,591	15.4		7.75	241,591	15.4		7.75

Commerical: New Stock

Solar DHW-Heat	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	2025				2030			
				Floorspace ($ft.^2$)	Approx. # of Buildings	% Electric DHW	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	% Electric DHW	Total Annual Production (MWh/yr.)
Office			15,000	2,303	0.2	80%	0.00	3,115	0.2	80%	0.00
Food Retail	23,900	45%	30,000	902	0.0	85%	0.27	1,220	0.0	85%	0.37
Non-food Retail			20,000	4,418	0.2	95%	0.00	5,977	0.3	95%	0.00
Hotel / Motel	23,900	45%	20,000	5,460	0.3	60%	1.76	7,382	0.4	60%	2.38
Healthcare	23,900	45%	95,000	323	0.0	75%	0.03	437	0.0	75%	0.04
Education	23,900	45%	43,040	88	0.0	80%	0.02	119	0.0	80%	0.02
Restaurant	23,900	45%	5,380	949	0.2	55%	1.04	1,285	0.2	55%	1.41
Recreation Centres	23,900	45%	20,000	1,829	0.1	70%	0.69	2,469	0.1	70%	0.93
Warehouse / Wholesale			35,000	4,767	0.1	100%	0.00	6,448	0.2	100%	0.00
Total			283,420	21,039	1.1		3.81	28,452	1.5		5.16

Large Diesel Grid
Government

Commercial: Existing Stock

					2015			2020			2025			2030		
PV – Electricity	System Design Size (kW)	Annual Production Per Bldg (kWh/yr).	Est. Technical Applicability %	Aprox. Floorspace (ft^2)/Building	Floorspace (ft^2)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace (ft^2)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace (ft^2)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace (ft^2)	Approx. # of Buildings	Total Annual Production (MWh/yr.)
Office_Govt	20	22,000	30%	15,000	12,299	1	5	12,299	1	5	12,299	1	5	12,299	1	5
Food Retail_Govt	20	22,000	30%	30,000	0	0	0	0	0	0	0	0	0	0	0	0
Non-food Retail_Govt	20	22,000	30%	10,000	4,915	0	3	4,915	0	3	4,915	0	3	4,915	0	3
Hotel / Motel_Govt	20	22,000	30%	20,000	0	0	0	0	0	0	0	0	0	0	0	0
Healthcare_Govt	20	22,000	30%	95,000	16,297	0	1	16,297	0	1	16,297	0	1	16,297	0	1
Education_Govt	20	22,000	30%	33,000	98,982	3	20	98,982	3	20	98,982	3	20	98,982	3	20
Restaurant_Govt	20	22,000	30%	4,000	0	0	0	0	0	0	0	0	0	0	0	0
Recreation Centres_Govt	20	32,000	30%	25,000	0	0	0	0	0	0	0	0	0	0	0	0
Warehouse / Wholesale_Govt	20	32,000	30%	30,000	23,490	1	8	23,490	1	8	23,490	1	8	23,490	1	8
Total				262,000	155,982	5	37	155,982	5	37	155,982	5	37	155,982	5	37

Commerical: New Stock

					2015			2020			2025			2030		
PV – Electricity	System Design Size (kW)	Annual Production Per Bldg (kWh/yr).	Est. Technical Applicability %	Aprox. Floorspace (ft^2)/Building	Floorspace (ft^2)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace (ft^2)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace (ft^2)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace (ft^2)	Approx. # of Buildings	Total Annual Production (MWh/yr.)
Office_Govt	20	32,000	45%	15,000	348	0	0	707	0	1	1,075	0	1	1,454	0	1
Food Retail_Govt	20	32,000	45%	30,000	0	0	0	0	0	0	0	0	0	0	0	0
Non-food Retail_Govt	20	32,000	45%	20,000	142	0	0	289	0	0	440	0	0	595	0	0
Hotel / Motel_Govt	20	32,000	45%	20,000	0	0	0	0	0	0	0	0	0	0	0	0
Healthcare_Govt	20	32,000	45%	95,000	440	0	0	892	0	0	1,356	0	0	1,832	0	0
Education_Govt	20	32,000	45%	43,040	3,034	0	1	6,161	0	2	9,384	0	3	12,705	0	4
Restaurant_Govt	20	32,000	45%	5,380	0	0	0	0	0	0	0	0	0	0	0	0
Recreation Centres_Govt	20	32,000	45%	20,000	0	0	0	0	0	0	0	0	0	0	0	0
Warehouse / Wholesale_Govt	20	32,000	45%	35,000	675	0	0	1,370	0	1	2,084	0	1	2,819	0	1
Total				283,420	4,640	0	2	9,418	0	4	14,339	0	6	19,406	1	8

Large Diesel Grid Government

Commercial : Existing Stock

Solar DHW-Heat	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	2015				2020			
				Floorspace ($ft.^2$)	Approx. # of Buildings	% Electric DHW	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	% Electric DHW	Total Annual Production (MWh/yr.)
Office_Govt			15,000	12,299	0.8	50%	0.00	12,299	0.8	50%	0.00
Food Retail_Govt	23,900	30%	30,000	0	0.0	40%	0.00	0	0.0	40%	0.00
Non-food Retail_Govt			10,000	4,915	0.5	30%	0.00	4,915	0.5	30%	0.00
Hotel / Motel_Govt	23,900	30%	20,000	0	0.0	15%	0.00	0	0.0	15%	0.00
Healthcare_Govt	23,900	30%	95,000	16,297	0.2	10%	0.12	16,297	0.2	10%	0.12
Education_Govt	23,900	30%	33,000	98,982	3.0	50%	10.75	98,982	3.0	50%	10.75
Restaurant_Govt	23,900	30%	4,000	0	0.0	15%	0.00	0	0.0	15%	0.00
Recreation Centres_Govt	23,900	30%	25,000	0	0.0	10%	0.00	0	0.0	10%	0.00
Warehouse / Wholesale_Govt			30,000	23,490	0.8	15%	0.00	23,490	0.8	15%	0.00
Total			262,000	155,982	5.3		10.88	155,982	5.3		10.88

Commerical : New Stock

Solar DHW-Heat	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	2015				2020			
				Floorspace ($ft.^2$)	Approx. # of Buildings	% Electric DHW	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	% Electric DHW	Total Annual Production (MWh/yr.)
Office_Govt			15,000	348	0.0	80%	0.00	707	0.0	80%	0.00
Food Retail_Govt	23,900	45%	30,000	0	0.0	85%	0.00	0	0.0	85%	0.00
Non-food Retail_Govt			20,000	142	0.0	95%	0.00	289	0.0	95%	0.00
Hotel / Motel_Govt	23,900	45%	20,000	0	0.0	60%	0.00	0	0.0	60%	0.00
Healthcare_Govt	23,900	45%	95,000	440	0.0	75%	0.04	892	0.0	75%	0.08
Education_Govt	23,900	45%	43,040	3,034	0.1	80%	0.61	6,161	0.1	80%	1.23
Restaurant_Govt	23,900	45%	5,380	0	0.0	55%	0.00	0	0.0	55%	0.00
Recreation Centres_Govt	23,900	45%	20,000	0	0.0	70%	0.00	0	0.0	70%	0.00
Warehouse / Wholesale_Govt			35,000	675	0.0	100%	0.00	1,370	0.0	100%	0.00
Total			283,420	4,640	0.1		0.64	9,418	0.3		1.31

Large Diesel Grid Government

Commercial : Existing Stock

Solar DHW-Heat	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	2025 Floorspace ($ft.^2$)	2025 Approx. # of Buildings	2025 % Electric DHW	2025 Total Annual Production (MWh/yr.)	2030 Floorspace ($ft.^2$)	2030 Approx. # of Buildings	2030 % Electric DHW	2030 Total Annual Production (MWh/yr.)
Office_Govt			15,000	12,299	0.8	50%	0.00	12,299	0.8	50%	0.00
Food Retail_Govt	23,900	30%	30,000	0	0.0	40%	0.00	0	0.0	40%	0.00
Non-food Retail_Govt			10,000	4,915	0.5	30%	0.00	4,915	0.5	30%	0.00
Hotel / Motel_Govt	23,900	30%	20,000	0	0.0	15%	0.00	0	0.0	15%	0.00
Healthcare_Govt	23,900	30%	95,000	16,297	0.2	10%	0.12	16,297	0.2	10%	0.12
Education_Govt	23,900	30%	33,000	98,982	3.0	50%	10.75	98,982	3.0	50%	10.75
Restaurant_Govt	23,900	30%	4,000	0	0.0	15%	0.00	0	0.0	15%	0.00
Recreation Centres_Govt	23,900	30%	25,000	0	0.0	10%	0.00	0	0.0	10%	0.00
Warehouse / Wholesale_Govt			30,000	23,490	0.8	15%	0.00	23,490	0.8	15%	0.00
Total			262,000	155,982	5.3		10.88	155,982	5.3		10.88

Commerical : New Stock

Solar DHW-Heat	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	2025 Floorspace ($ft.^2$)	2025 Approx. # of Buildings	2025 % Electric DHW	2025 Total Annual Production (MWh/yr.)	2030 Floorspace ($ft.^2$)	2030 Approx. # of Buildings	2030 % Electric DHW	2030 Total Annual Production (MWh/yr.)
Office_Govt			15,000	1,075	0.1	80%	0.00	1,454	0.1	80%	0.00
Food Retail_Govt	23,900	45%	30,000	0	0.0	85%	0.00	0	0.0	85%	0.00
Non-food Retail_Govt			20,000	440	0.0	95%	0.00	595	0.0	95%	0.00
Hotel / Motel_Govt	23,900	45%	20,000	0	0.0	60%	0.00	0	0.0	60%	0.00
Healthcare_Govt	23,900	45%	95,000	1,356	0.0	75%	0.12	1,832	0.0	75%	0.16
Education_Govt	23,900	45%	43,040	9,384	0.2	80%	1.88	12,705	0.3	80%	2.54
Restaurant_Govt	23,900	45%	5,380	0	0.0	55%	0.00	0	0.0	55%	0.00
Recreation Centres_Govt	23,900	45%	20,000	0	0.0	70%	0.00	0	0.0	70%	0.00
Warehouse / Wholesale_Govt			35,000	2,084	0.1	100%	0.00	2,819	0.1	100%	0.00
Total			283,420	14,339	0.4		1.99	19,406	0.5		2.70

Small Diesel Grid Non-Government

Commercial: Existing Stock

PV – Electricity	System Design Size (kW)	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	2015			2020			2025			2030		
					Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)
Office	20	22,000	30%	15,000	7,122	0.5	3.1	7,122	0.5	3.1	7,122	0.5	3.1	7,122	0.5	3.1
Food Retail	20	22,000	30%	30,000	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Non-food Retail	20	22,000	30%	10,000	485	0.0	0.3	485	0.0	0.3	485	0.0	0.3	485	0.0	0.3
Hotel / Motel	20	22,000	30%	20,000	29,707	1.5	9.8	29,707	1.5	9.8	29,707	1.5	9.8	29,707	1.5	9.8
Healthcare	20	22,000	30%	95,000	363	0.0	0.0	363	0.0	0.0	363	0.0	0.0	363	0.0	0.0
Education	20	22,000	30%	33,000	1,700	0.1	0.3	1,700	0.1	0.3	1,700	0.1	0.3	1,700	0.1	0.3
Restaurant	20	22,000	30%	4,000	9,509	2.4	15.7	9,509	2.4	15.7	9,509	2.4	15.7	9,509	2.4	15.7
Recreation Centres	20	32,000	30%	25,000	1,229	0.0	0.5	1,229	0.0	0.5	1,229	0.0	0.5	1,229	0.0	0.5
Warehouse / Wholesale	20	32,000	30%	30,000	4,637	0.2	1.5	4,637	0.2	1.5	4,637	0.2	1.5	4,637	0.2	1.5
Total				262,000	54,752	4.6	31.3	54,752	4.6	31.3	54,752	4.6	31.3	54,752	4.6	31.3

Commerical: New Stock

PV – Electricity	System Design Size (kW)	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	2015			2020			2025			2030		
					Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)
Office	20	32,000	45%	15,000	51	0.0	0.0	102	0.0	0.1	154	0.0	0.1	206	0.0	0.2
Food Retail	20	32,000	45%	30,000	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Non-food Retail	20	32,000	45%	20,000	4	0.0	0.0	7	0.0	0.0	11	0.0	0.0	14	0.0	0.0
Hotel / Motel	20	32,000	45%	20,000	209	0.0	0.2	420	0.0	0.3	632	0.0	0.5	846	0.0	0.6
Healthcare	20	32,000	45%	95,000	2	0.0	0.0	5	0.0	0.0	7	0.0	0.0	10	0.0	0.0
Education	20	32,000	45%	43,040	13	0.0	0.0	26	0.0	0.0	40	0.0	0.0	53	0.0	0.0
Restaurant	20	32,000	45%	5,380	78	0.0	0.2	157	0.0	0.4	237	0.0	0.6	317	0.1	0.8
Recreation Centres	20	32,000	45%	20,000	8	0.0	0.0	15	0.0	0.0	23	0.0	0.0	31	0.0	0.0
Warehouse / Wholesale	20	32,000	45%	35,000	34	0.0	0.0	68	0.0	0.0	102	0.0	0.0	136	0.0	0.1
Total				283,420	399	0.0	0.4	801	0.1	0.9	1,207	0.1	1.3	1,615	0.1	1.8

Small Diesel Grid Non-Government

Commercial : Existing Stock

Solar DHW-Heat	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	2015				2020			
				Floorspace ($ft.^2$)	Approx. # of Buildings	% Electric DHW	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	% Electric DHW	Total Annual Production (MWh/yr.)
Office			15,000	7,122	0	50%	0.00	7,122	0	50%	0.00
Food Retail	23,900	30%	30,000	0	0	40%	0.00	0	0	40%	0.00
Non-food Retail			10,000	485	0	30%	0.00	485	0	30%	0.00
Hotel / Motel	23,900	30%	20,000	29,707	1	15%	1.60	29,707	1	15%	1.60
Healthcare	23,900	30%	95,000	363	0	10%	0.00	363	0	10%	0.00
Education	23,900	30%	33,000	1,700	0	50%	0.18	1,700	0	50%	0.18
Restaurant	23,900	30%	4,000	9,509	2	15%	2.56	9,509	2	15%	2.56
Recreation Centres	23,900	30%	25,000	1,229	0	10%	0.04	1,229	0	10%	0.04
Warehouse / Wholesale			30,000	4,637	0	15%	0.00	4,637	0	15%	0.00
Total			262,000	54,752	5		4.38	54,752	5		4.38

Commerical : New Stock

Solar DHW-Heat	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	2015				2020			
				Floorspace ($ft.^2$)	Approx. # of Buildings	% Electric DHW	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	% Electric DHW	Total Annual Production (MWh/yr.)
Office			15,000	51	0	80%	0.00	102	0	80%	0.00
Food Retail	23,900	45%	30,000	0	0	85%	0.00	0	0	85%	0.00
Non-food Retail			20,000	4	0	95%	0.00	7	0	95%	0.00
Hotel / Motel	23,900	45%	20,000	209	0	60%	0.07	420	0	60%	0.14
Healthcare	23,900	45%	95,000	2	0	75%	0.00	5	0	75%	0.00
Education	23,900	45%	43,040	13	0	80%	0.00	26	0	80%	0.01
Restaurant	23,900	45%	5,380	78	0	55%	0.09	157	0	55%	0.17
Recreation Centres	23,900	45%	20,000	8	0	70%	0.00	15	0	70%	0.01
Warehouse / Wholesale			35,000	34	0	100%	0.00	68	0	100%	0.00
Total			283,420	399	0		0.16	801	0		0.32

Small Diesel Grid Non-Government

Commercial: Existing Stock

Solar DHW-Heat	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	2025 Floorspace ($ft.^2$)	2025 Approx. # of Buildings	2025 % Electric DHW	2025 Total Annual Production (MWh/yr.)	2030 Floorspace ($ft.^2$)	2030 Approx. # of Buildings	2030 % Electric DHW	2030 Total Annual Production (MWh/yr.)
Office			15,000	7,122	0	50%	0.00	7,122	0	50%	0.00
Food Retail	23,900	30%	30,000	0	0	40%	0.00	0	0	40%	0.00
Non-food Retail			10,000	485	0	30%	0.00	485	0	30%	0.00
Hotel / Motel	23,900	30%	20,000	29,707	1	15%	1.60	29,707	1	15%	1.60
Healthcare	23,900	30%	95,000	363	0	10%	0.00	363	0	10%	0.00
Education	23,900	30%	33,000	1,700	0	50%	0.18	1,700	0	50%	0.18
Restaurant	23,900	30%	4,000	9,509	2	15%	2.56	9,509	2	15%	2.56
Recreation Centres	23,900	30%	25,000	1,229	0	10%	0.04	1,229	0	10%	0.04
Warehouse / Wholesale			30,000	4,637	0	15%	0.00	4,637	0	15%	0.00
Total			262,000	54,752	5		4.38	54,752	5		4.38

Commerical: New Stock

Solar DHW-Heat	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	2025 Floorspace ($ft.^2$)	2025 Approx. # of Buildings	2025 % Electric DHW	2025 Total Annual Production (MWh/yr.)	2030 Floorspace ($ft.^2$)	2030 Approx. # of Buildings	2030 % Electric DHW	2030 Total Annual Production (MWh/yr.)
Office			15,000	154	0	80%	0.00	206	0	80%	0.00
Food Retail	23,900	45%	30,000	0	0	85%	0.00	0	0	85%	0.00
Non-food Retail			20,000	11	0	95%	0.00	14	0	95%	0.00
Hotel / Motel	23,900	45%	20,000	632	0	60%	0.20	846	0	60%	0.27
Healthcare	23,900	45%	95,000	7	0	75%	0.00	10	0	75%	0.00
Education	23,900	45%	43,040	40	0	80%	0.01	53	0	80%	0.01
Restaurant	23,900	45%	5,380	237	0	55%	0.26	317	0	55%	0.35
Recreation Centres	23,900	45%	20,000	23	0	70%	0.01	31	0	70%	0.01
Warehouse / Wholesale			35,000	102	0	100%	0.00	136	0	100%	0.00
Total			283,420	1,207	0		0.48	1,615	0		0.64

Small Diesel Grid Government

Commercial: Existing Stock

PV – Electricity	System Design Size (kW)	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	2015			2020			2025			2030		
					Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)
Office_Govt	20	22,000	30%	15,000	22,291	1.5	9.8	22,291	1.5	9.8	22,291	1.5	9.8	22,291	1.5	9.8
Food Retail_Govt	20	22,000	30%	30,000	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Non-food Retail_Govt	20	22,000	30%	10,000	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Hotel / Motel_Govt	20	22,000	30%	20,000	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Healthcare_Govt	20	22,000	30%	95,000	957	0.0	0.1	957	0.0	0.1	957	0.0	0.1	957	0.0	0.1
Education_Govt	20	22,000	30%	33,000	6,536	0.2	1.3	6,536	0.2	1.3	6,536	0.2	1.3	6,536	0.2	1.3
Restaurant_Govt	20	22,000	30%	4,000	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Recreation Centres_Govt	20	32,000	30%	25,000	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Warehouse / Wholesale_Govt	20	32,000	30%	30,000	12,949	0.4	4.1	12,949	0.4	4.1	12,949	0.4	4.1	12,949	0.4	4.1
Total				262,000	42,734	2.1	15.3	42,734	2.1	15.3	42,734	2.1	15.3	42,734	2.1	15.3

Commerical: New Stock

PV – Electricity	System Design Size (kW)	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	2015			2020			2025			2030		
					Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)
Office_Govt	20	32,000	45%	15,000	160	0.0	0.2	321	0.0	0.3	483	0.0	0.5	646	0.0	0.6
Food Retail_Govt	20	32,000	45%	30,000	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Non-food Retail_Govt	20	32,000	45%	20,000	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Hotel / Motel_Govt	20	32,000	45%	20,000	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Healthcare_Govt	20	32,000	45%	95,000	7	0.0	0.0	13	0.0	0.0	20	0.0	0.0	26	0.0	0.0
Education_Govt	20	32,000	45%	43,040	51	0.0	0.0	102	0.0	0.0	153	0.0	0.1	205	0.0	0.1
Restaurant_Govt	20	32,000	45%	5,380	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Recreation Centres_Govt	20	32,000	45%	20,000	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Warehouse / Wholesale_Govt	20	32,000	45%	35,000	94	0.0	0.0	189	0.0	0.1	285	0.0	0.1	381	0.0	0.2
Total				283,420	311	0.0	0.2	625	0.0	0.4	940	0.0	0.6	1,258	0.1	0.8

Small Diesel Grid Government

Commercial : Existing Stock

Solar DHW-Heat	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	2015 Floorspace ($ft.^2$)	2015 Approx. # of Buildings	2015 % Electric DHW	2015 Total Annual Production (MWh/year)	2020 Floorspace ($ft.^2$)	2020 Approx. # of Buildings	2020 % Electric DHW	2020 Total Annual Production (MWh/yr.)
Office_Govt			15,000	22,291	1.5	50%	0.00	22,291	1.5	50%	0.00
Food Retail_Govt	23,900	30%	30,000	0	0.0	40%	0.00	0	0.0	40%	0.00
Non-food Retail_Govt			10,000	0	0.0	30%	0.00	0	0.0	30%	0.00
Hotel / Motel_Govt	23,900	30%	20,000	0	0.0	15%	0.00	0	0.0	15%	0.00
Healthcare_Govt	23,900	30%	95,000	957	0.0	10%	0.01	957	0.0	10%	0.01
Education_Govt	23,900	30%	33,000	6,536	0.2	50%	0.71	6,536	0.2	50%	0.71
Restaurant_Govt	23,900	30%	4,000	0	0.0	15%	0.00	0	0.0	15%	0.00
Recreation Centres_Govt	23,900	30%	25,000	0	0.0	10%	0.00	0	0.0	10%	0.00
Warehouse / Wholesale_Govt			30,000	12,949	0.4	15%	0.00	12,949	0.4	15%	0.00
Total			262,000	42,734	2.1		0.72	42,734	2.1		0.72

Commerical : New Stock

Solar DHW-Heat	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	2015 Floorspace ($ft.^2$)	2015 Approx. # of Buildings	2015 % Electric DHW	2015 Total Annual Production (MWh/yr.)	2020 Floorspace ($ft.^2$)	2020 Approx. # of Buildings	2020 % Electric DHW	2020 Total Annual Production (MWh/yr.)
Office_Govt			15,000	160	0.0	80%	0.00	321	0.0	80%	0.00
Food Retail_Govt	23,900	45%	30,000	0	0.0	85%	0.00	0	0.0	85%	0.00
Non-food Retail_Govt			20,000	0	0.0	95%	0.00	0	0.0	95%	0.00
Hotel / Motel_Govt	23,900	45%	20,000	0	0.0	60%	0.00	0	0.0	60%	0.00
Healthcare_Govt	23,900	45%	95,000	7	0.0	75%	0.00	13	0.0	75%	0.00
Education_Govt	23,900	45%	43,040	51	0.0	80%	0.01	102	0.0	80%	0.02
Restaurant_Govt	23,900	45%	5,380	0	0.0	55%	0.00	0	0.0	55%	0.00
Recreation Centres_Govt	23,900	45%	20,000	0	0.0	70%	0.00	0	0.0	70%	0.00
Warehouse / Wholesale_Govt			35,000	94	0.0	100%	0.00	189	0.0	100%	0.00
Total			283,420	311	0.0		0.01	625	0.0		0.02

Small Diesel Grid Government

Commercial: Existing Stock

Solar DHW-Heat	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	2025 Floorspace ($ft.^2$)	2025 Approx. # of Buildings	2025 % Electric DHW	2025 Total Annual Production (MWh/year)	2030 Floorspace ($ft.^2$)	2030 Approx. # of Buildings	2030 % Electric DHW	2030 Total Annual Production (MWh/yr.)
Office_Govt			15,000	22,291	1.5	50%	0.00	22,291	1.5	50%	0.00
Food Retail_Govt	23,900	30%	30,000	0	0.0	40%	0.00	0	0.0	40%	0.00
Non-food Retail_Govt			10,000	0	0.0	30%	0.00	0	0.0	30%	0.00
Hotel / Motel_Govt	23,900	30%	20,000	0	0.0	15%	0.00	0	0.0	15%	0.00
Healthcare_Govt	23,900	30%	95,000	957	0.0	10%	0.01	957	0.0	10%	0.01
Education_Govt	23,900	30%	33,000	6,536	0.2	50%	0.71	6,536	0.2	50%	0.71
Restaurant_Govt	23,900	30%	4,000	0	0.0	15%	0.00	0	0.0	15%	0.00
Recreation Centres_Govt	23,900	30%	25,000	0	0.0	10%	0.00	0	0.0	10%	0.00
Warehouse / Wholesale_Govt			30,000	12,949	0.4	15%	0.00	12,949	0.4	15%	0.00
Total			262,000	42,734	2.1		0.72	42,734	2.1		0.72

Commerical: New Stock

Solar DHW-Heat	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	2025 Floorspace ($ft.^2$)	2025 Approx. # of Buildings	2025 % Electric DHW	2025 Total Annual Production (MWh/year)	2030 Floorspace ($ft.^2$)	2030 Approx. # of Buildings	2030 % Electric DHW	2030 Total Annual Production (MWh/yr.)
Office_Govt			15,000	483	0.0	80%	0.00	646	0.0	80%	0.00
Food Retail_Govt	23,900	45%	30,000	0	0.0	85%	0.00	0	0.0	85%	0.00
Non-food Retail_Govt			20,000	0	0.0	95%	0.00	0	0.0	95%	0.00
Hotel / Motel_Govt	23,900	45%	20,000	0	0.0	60%	0.00	0	0.0	60%	0.00
Healthcare_Govt	23,900	45%	95,000	20	0.0	75%	0.00	26	0.0	75%	0.00
Education_Govt	23,900	45%	43,040	153	0.0	80%	0.03	205	0.0	80%	0.04
Restaurant_Govt	23,900	45%	5,380	0	0.0	55%	0.00	0	0.0	55%	0.00
Recreation Centres_Govt	23,900	45%	20,000	0	0.0	70%	0.00	0	0.0	70%	0.00
Total			283,420	940	0.0		0.03	1,258	0.1		0.04

Old Crow Grid Non-Government

Commercial: Existing Stock

					2015			2020			2025			2030		
PV – Electricity	System Design Size (kW)	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)
Office	20	22,000	30%	15,000	6,988	0.5	3.1	6,988	0.5	3.1	6,988	0.5	3.1	6,988	0.5	3.1
Food Retail	20	22,000	30%	30,000	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Non-food Retail	20	22,000	30%	10,000	6,934	0.7	4.6	6,934	0.7	4.6	6,934	0.7	4.6	6,934	0.7	4.6
Hotel / Motel	20	22,000	30%	20,000	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Healthcare	20	22,000	30%	95,000	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Education	20	22,000	30%	33,000	26	0.0	0.0	26	0.0	0.0	26	0.0	0.0	26	0.0	0.0
Restaurant	20	22,000	30%	4,000	130	0.0	0.2	130	0.0	0.2	130	0.0	0.2	130	0.0	0.2
Recreation Centres	20	32,000	30%	25,000	249	0.0	0.1	249	0.0	0.1	249	0.0	0.1	249	0.0	0.1
Warehouse / Wholesale	20	32,000	30%	30,000	4,456	0.1	1.4	4,456	0.1	1.4	4,456	0.1	1.4	4,456	0.1	1.4
Total				262,000	18,782	1.4	9.4	18,782	1.4	9.4	18,782	1.4	9.4	18,782	1.4	9.4

Commerical: New Stock

					2015			2020			2025			2030		
PV – Electricity	System Design Size (kW)	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)
Office	20	32,000	45%	15,000	676	0.0	0.6	1,417	0.1	1.4	2,230	0.1	2.1	3,122	0.2	3.0
Food Retail	20	32,000	45%	30,000	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Non-food Retail	20	32,000	45%	20,000	686	0.0	0.5	1,439	0.1	1.0	2,267	0.1	1.6	3,177	0.2	2.3
Hotel / Motel	20	32,000	45%	20,000	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Healthcare	20	32,000	45%	95,000	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Education	20	32,000	45%	43,040	3	0.0	0.0	6	0.0	0.0	9	0.0	0.0	13	0.0	0.0
Restaurant	20	32,000	45%	5,380	14	0.0	0.0	31	0.0	0.1	48	0.0	0.1	68	0.0	0.2
Recreation Centres	20	32,000	45%	20,000	21	0.0	0.0	44	0.0	0.0	69	0.0	0.0	95	0.0	0.1
Warehouse / Wholesale	20	32,000	45%	35,000	437	0.0	0.2	917	0.0	0.4	1,444	0.0	0.6	2,023	0.1	0.8
Total				283,420	1,837	0.1	1.4	5,051	0.2	2.9	7,943	0.3	4.5	11,112	0.4	6.4

Old Crow Grid Non-Government

Commercial: Existing Stock

					2015			2020			2025			2030		
PV – Electricity	System Design Size (kW)	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)
Office	20	22,000	30%	15,000	6,988	0.5	3.1	6,988	0.5	3.1	6,988	0.5	3.1	6,988	0.5	3.1
Food Retail	20	22,000	30%	30,000	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Non-food Retail	20	22,000	30%	10,000	6,934	0.7	4.6	6,934	0.7	4.6	6,934	0.7	4.6	6,934	0.7	4.6
Hotel / Motel	20	22,000	30%	20,000	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Healthcare	20	22,000	30%	95,000	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Education	20	22,000	30%	33,000	26	0.0	0.0	26	0.0	0.0	26	0.0	0.0	26	0.0	0.0
Restaurant	20	22,000	30%	4,000	130	0.0	0.2	130	0.0	0.2	130	0.0	0.2	130	0.0	0.2
Recreation Centres	20	32,000	30%	25,000	249	0.0	0.1	249	0.0	0.1	249	0.0	0.1	249	0.0	0.1
Warehouse / Wholesale	20	32,000	30%	30,000	4,456	0.1	1.4	4,456	0.1	1.4	4,456	0.1	1.4	4,456	0.1	1.4
Total				262,000	18,782	1.4	9.4	18,782	1.4	9.4	18,782	1.4	9.4	18,782	1.4	9.4

Commerical: New Stock

					2015			2020			2025			2030		
PV – Electricity	System Design Size (kW)	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)
Office	20	32,000	45%	15,000	676	0.0	0.6	1,417	0.1	1.4	2,230	0.1	2.1	3,122	0.2	3.0
Food Retail	20	32,000	45%	30,000	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Non-food Retail	20	32,000	45%	20,000	686	0.0	0.5	1,439	0.1	1.0	2,267	0.1	1.6	3,177	0.2	2.3
Hotel / Motel	20	32,000	45%	20,000	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Healthcare	20	32,000	45%	95,000	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Education	20	32,000	45%	43,040	3	0.0	0.0	6	0.0	0.0	9	0.0	0.0	13	0.0	0.0
Restaurant	20	32,000	45%	5,380	14	0.0	0.0	31	0.0	0.1	48	0.0	0.1	68	0.0	0.2
Recreation Centres	20	32,000	45%	20,000	21	0.0	0.0	44	0.0	0.0	69	0.0	0.0	95	0.0	0.1
Warehouse / Wholesale	20	32,000	45%	35,000	437	0.0	0.2	917	0.0	0.4	1,444	0.0	0.6	2,023	0.1	0.8
Total				283,420	1,837	0.1	1.4	5,051	0.2	2.9	7,943	0.3	4.5	11,112	0.4	6.4

Old Crow Grid Non-Government

Commercial : Existing Stock

Solar DHW-Heat	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	2015 Floorspace ($ft.^2$)	2015 Approx. # of Buildings	2015 % Electric DHW	2015 Total Annual Production (MWh/yr.)	2020 Floorspace ($ft.^2$)	2020 Approx. # of Buildings	2020 % Electric DHW	2020 Total Annual Production (MWh/yr.)
Office			15,000	6,988	0.5	50%	0.00	6,988	0.5	50%	0.00
Food Retail	23,900	30%	30,000	0	0.0	40%	0.00	0	0.0	40%	0.00
Non-food Retail			10,000	6,934	0.7	30%	0.00	6,934	0.7	30%	0.00
Hotel / Motel	23,900	30%	20,000	0	0.0	15%	0.00	0	0.0	15%	0.00
Healthcare	23,900	30%	95,000	0	0.0	10%	0.00	0	0.0	10%	0.00
Education	23,900	30%	33,000	26	0.0	50%	0.00	26	0.0	50%	0.00
Restaurant	23,900	30%	4,000	130	0.0	15%	0.04	130	0.0	15%	0.04
Recreation Centres	23,900	30%	25,000	249	0.0	10%	0.01	249	0.0	10%	0.01
Warehouse / Wholesale			30,000	4,456	0.1	15%	0.00	4,456	0.1	15%	0.00
Total			262,000	18,782	1.4		0.04	18,782	1.4		0.04

Commerical : New Stock

Solar DHW-Heat	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	2015 Floorspace ($ft.^2$)	2015 Approx. # of Buildings	2015 % Electric DHW	2015 Total Annual Production (MWh/yr.)	2020 Floorspace ($ft.^2$)	2020 Approx. # of Buildings	2020 % Electric DHW	2020 Total Annual Production (MWh/yr.)
Office			15,000	676	0.0	90%	0.00	1,417	0.1	90%	0.00
Food Retail	23,900	45%	30,000	0	0.0	80%	0.00	0	0.0	80%	0.00
Non-food Retail			20,000	686	0.0	85%	0.00	1,439	0.1	85%	0.00
Hotel / Motel	23,900	45%	20,000	0	0.0	95%	0.00	0	0.0	95%	0.00
Healthcare	23,900	45%	95,000	0	0.0	60%	0.00	0	0.0	60%	0.00
Education	23,900	45%	43,040	3	0.0	75%	0.00	6	0.0	75%	0.00
Restaurant	23,900	45%	5,380	14	0.0	80%	0.02	31	0.0	80%	0.05
Recreation Centres	23,900	45%	20,000	21	0.0	55%	0.01	44	0.0	55%	0.01
Warehouse / Wholesale			35,000	437	0.0	70%	0.00	917	0.0	70%	0.00
Total			283,420	1,837	0.1		0.03	3,853	0.2		0.06

Old Crow Grid Non-Government

Commercial : Existing Stock

				2025				2030			
Solar DHW-Heat	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	Floorspace ($ft.^2$)	Approx. # of Buildings	% Electric DHW	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	% Electric DHW	Total Annual Production (MWh/yr.)
Office			15,000	6,988	0.5	50%	0.00	6,988	0.5	50%	0.00
Food Retail	23,900	30%	30,000	0	0.0	40%	0.00	0	0.0	40%	0.00
Non-food Retail			10,000	6,934	0.7	30%	0.00	6,934	0.7	30%	0.00
Hotel / Motel	23,900	30%	20,000	0	0.0	15%	0.00	0	0.0	15%	0.00
Healthcare	23,900	30%	95,000	0	0.0	10%	0.00	0	0.0	10%	0.00
Education	23,900	30%	33,000	26	0.0	50%	0.00	26	0.0	50%	0.00
Restaurant	23,900	30%	4,000	130	0.0	15%	0.04	130	0.0	15%	0.04
Recreation Centres	23,900	30%	25,000	249	0.0	10%	0.01	249	0.0	10%	0.01
Warehouse / Wholesale			30,000	4,456	0.1	15%	0.00	4,456	0.1	15%	0.00
Total			262,000	18,782	1.4		0.04	18,782	1.4		0.04

Commerical : New Stock

				2025				2030			
Solar DHW-Heat	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	Floorspace ($ft.^2$)	Approx. # of Buildings	% Electric DHW	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	% Electric DHW	Total Annual Production (MWh/yr.)
Office			15,000	2,230	0	90%	0.00	3,122	0	90%	0.00
Food Retail	23,900	45%	30,000	0	0	80%	0.00	0	0	80%	0.00
Non-food Retail			20,000	2,267	0	85%	0.00	3,177	0	85%	0.00
Hotel / Motel	23,900	45%	20,000	0	0	95%	0.00	0	0	95%	0.00
Healthcare	23,900	45%	95,000	0	0	60%	0.00	0	0	60%	0.00
Education	23,900	45%	43,040	9	0	75%	0.00	13	0	75%	0.00
Restaurant	23,900	45%	5,380	48	0	80%	0.08	68	0	80%	0.11
Recreation Centres	23,900	45%	20,000	69	0	55%	0.02	95	0	55%	0.03
Warehouse / Wholesale			35,000	1,444	0	70%	0.00	2,023	0	70%	0.00
Total			283,420	6,067	0		0.10	8,497	0		0.14

Old Crow Grid Government

Commercial: Existing Stock

PV – Electricity	System Design Size (kW)	Annual Production Per Bldg (kWh/yr')	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	2015			2020			2025			2030		
					Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)
Office_Govt	20	22,000	30%	15,000	4,469	0.3	2.0	4,469	0.3	2.0	4,469	0.3	2.0	4,469	0.3	2.0
Food Retail_Govt	20	22,000	30%	30,000	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Non-food Retail_Govt	20	22,000	30%	10,000	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Hotel / Motel_Govt	20	22,000	30%	20,000	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Healthcare_Govt	20	22,000	30%	95,000	2,396	0.0	0.2	2,396	0.0	0.2	2,396	0.0	0.2	2,396	0.0	0.2
Education_Govt	20	22,000	30%	33,000	19,143	0.6	3.8	19,143	0.6	3.8	19,143	0.6	3.8	19,143	0.6	3.8
Restaurant_Govt	20	22,000	30%	4,000	5	0.0	0.0	5	0.0	0.0	5	0.0	0.0	5	0.0	0.0
Recreation Centres_Govt	20	32,000	30%	25,000	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Warehouse / Wholesale_Govt	20	32,000	30%	30,000	1,974	0.1	0.6	1,974	0.1	0.6	1,974	0.1	0.6	1,974	0.1	0.6
Total				262,000	27,987	1.0	6.6	27,987	1.0	6.6	27,987	1.0	6.6	27,987	1.0	6.6

Commerical: New Stock

PV – Electricity	System Design Size (kW)	Annual Production Per Bldg (kWh/yr')	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	2015			2020			2025			2030		
					Floorspace (ft^2)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	Total Annual Production (MWh/yr.)
Office_Govt	20	32,000	45%	15,000	432	0.0	0.4	906	0.1	0.9	1,426	0.1	1.4	1,996	0.1	1.9
Food Retail_Govt	20	32,000	45%	30,000	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Non-food Retail_Govt	20	32,000	45%	20,000	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Hotel / Motel_Govt	20	32,000	45%	20,000	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Healthcare_Govt	20	32,000	45%	95,000	221	0.0	0.0	462	0.0	0.1	725	0.0	0.1	1,013	0.0	0.2
Education_Govt	20	32,000	45%	43,040	2,003	0.0	0.7	4,216	0.1	1.4	6,660	0.2	2.2	9,359	0.2	3.1
Restaurant_Govt	20	32,000	45%	5,380	1	0.0	0.0	1	0.0	0.0	2	0.0	0.0	3	0.0	0.0
Recreation Centres_Govt	20	32,000	45%	20,000	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Warehouse / Wholesale_Govt	20	32,000	45%	35,000	194	0.0	0.1	406	0.0	0.2	640	0.0	0.3	896	0.0	0.4
Total				283,420	2,850	0.1	1.2	5,991	0.2	2.5	9,453	0.3	4.0	13,268	0.4	5.6

Old Crow Grid Government

Commercial: Existing Stock

Solar DHW-Heat	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	2015				2020			
				Floorspace ($ft.^2$)	Approx. # of Buildings	% Electric DHW	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	% Electric DHW	Total Annual Production (MWh/yr.)
Office_Govt			15,000	4,469	0.3	50%	0.00	4,469	0	50%	0.00
Food Retail_Govt	23,900	30%	30,000	0	0.0	40%	0.00	0	0	40%	0.00
Non-food Retail_Govt			10,000	0	0.0	30%	0.00	0	0	30%	0.00
Hotel / Motel_Govt	23,900	30%	20,000	0	0.0	15%	0.00	0	0	15%	0.00
Healthcare_Govt	23,900	30%	95,000	2,396	0.0	10%	0.02	2,396	0	10%	0.02
Education_Govt	23,900	30%	33,000	19,143	0.6	50%	2.08	19,143	1	50%	2.08
Restaurant_Govt	23,900	30%	4,000	5	0.0	15%	0.00	5	0	15%	0.00
Recreation Centres_Govt	23,900	30%	25,000	0	0.0	10%	0.00	0	0	10%	0.00
Warehouse / Wholesale_Govt			30,000	1,974	0.1	15%	0.00	1,974	0	15%	0.00
Total			262,000	27,987	1.0		2.10	27,987	1		2.10

Commerical: New Stock

Solar DHW-Heat	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	2015				2020			
				Floorspace ($ft.^2$)	Approx. # of Buildings	% Electric DHW	Total Annual Production (MWh/yr.)	Floorspace ($ft.^2$)	Approx. # of Buildings	% Electric DHW	Total Annual Production (MWh/yr.)
Office_Govt			15,000	432	0	90%	0.00	906	0	90%	0.00
Food Retail_Govt	23,900	45%	30,000	0	0	80%	0.00	0	0	80%	0.00
Non-food Retail_Govt			20,000	0	0	85%	0.00	0	0	85%	0.00
Hotel / Motel_Govt	23,900	45%	20,000	0	0	95%	0.00	0	0	95%	0.00
Healthcare_Govt	23,900	45%	95,000	221	0	60%	0.01	462	0	60%	0.03
Education_Govt	23,900	45%	43,040	2,003	0	75%	0.38	4,216	0	75%	0.79
Restaurant_Govt	23,900	45%	5,380	1	0	80%	0.00	1	0	80%	0.00
Recreation Centres_Govt	23,900	45%	20,000	0	0	55%	0.00	0	0	55%	0.00
Warehouse / Wholesale_Govt			35,000	194	0	70%	0.00	406	0	70%	0.00
Total			283,420	2,850	0		0.39	5,991	0		0.82

Old Crow Grid Government

Commercial : Existing Stock

Solar DHW-Heat	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	2025 Floorspace ($ft.^2$)	2025 Approx. # of Buildings	2025 % Electric DHW	2025 Total Annual Production (MWh/yr.)	2030 Floorspace ($ft.^2$)	2030 Approx. # of Buildings	2030 % Electric DHW	2030 Total Annual Production (MWh/yr.)
Office_Govt			15,000	4,469	0	50%	0.00	4,469	0	50%	0.00
Food Retail_Govt	23,900	30%	30,000	0	0	40%	0.00	0	0	40%	0.00
Non-food Retail_Govt			10,000	0	0	30%	0.00	0	0	30%	0.00
Hotel / Motel_Govt	23,900	30%	20,000	0	0	15%	0.00	0	0	15%	0.00
Healthcare_Govt	23,900	30%	95,000	2,396	0	10%	0.02	2,396	0	10%	0.02
Education_Govt	23,900	30%	33,000	19,143	1	50%	2.08	19,143	1	50%	2.08
Restaurant_Govt	23,900	30%	4,000	5	0	15%	0.00	5	0	15%	0.00
Recreation Centres_Govt	23,900	30%	25,000	0	0	10%	0.00	0	0	10%	0.00
Warehouse / Wholesale_Govt			30,000	1,974	0	15%	0.00	1,974	0	15%	0.00
Total			262,000	27,987	1		2.10	27,987	1		2.10

Commerical : New Stock

Solar DHW-Heat	Annual Production Per Bldg (kWh/yr.)	Est. Technical Applicability %	Aprox. Floorspace ($ft.^2$)/Building	2025 Floorspace ($ft.^2$)	2025 Approx. # of Buildings	2025 % Electric DHW	2025 Total Annual Production (MWh/yr.)	2030 Floorspace ($ft.^2$)	2030 Approx. # of Buildings	2030 % Electric DHW	2030 Total Annual Production (MWh/yr.)
Office_Govt			15,000	1,426	0	90%	0.00	1,996	0	90%	0.00
Food Retail_Govt	23,900	45%	30,000	0	0	80%	0.00	0	0	80%	0.00
Non-food Retail_Govt			20,000	0	0	85%	0.00	0	0	85%	0.00
Hotel / Motel_Govt	23,900	45%	20,000	0	0	95%	0.00	0	0	95%	0.00
Healthcare_Govt	23,900	45%	95,000	725	0	60%	0.05	1,013	0	60%	0.07
Education_Govt	23,900	45%	43,040	6,660	0	75%	1.25	9,359	0	75%	1.75
Restaurant_Govt	23,900	45%	5,380	2	0	80%	0.00	3	0	80%	0.00
Recreation Centres_Govt	23,900	45%	20,000	0	0	55%	0.00	0	0	55%	0.00
Warehouse / Wholesale_Govt			35,000	640	0	70%	0.00	896	0	70%	0.00
Total			283,420	9,453	0		1.30	13,268	0		1.83

Appendix B Achievable Workshop Slides

The following slides informed discussion during the CSRAE Achievable Workshop held on 17 November 2011.

Yukon CPR 2011

Customer-side Renewable and Alternative Energy Technologies

Achievable Workshop
November 17, 2011

Yukon CPR

Agenda

- Introductions
  - Participants, objectives for the morning
- Overview of CPR Approach
  - Objectives & Scope
  - Major Steps & Outputs
  - Deliverables
- Overview of CSRAE Approach & Results
- Achievable Potential Discussion
  - Outline of Today's Proposed Discussion Format
  - Discussion of Specific Opportunities

Overview of CPR Approach

- ❑ Objectives
- ❑ Major Steps & Outputs
- ❑ Deliverables

Yukon CPR

CPR Objectives

- Characterize ***how*** and ***where*** electricity is currently used by YEC and YECL customers
- Identify the size of potential energy and capacity/demand savings over the next 20 years under selected scenarios
- Estimate the achievable potential for MWh savings and MW load reduction
- Develop estimate of the potential contribution of efficiency and customer-side renewable energies to the Yukon's future electricity service needs

Yukon CPR

Study Scope

- 2 Sectors
  - Residential
    - Hydro and large diesel grids divided into single detached, attached, apartments, mobile, seasonal and garages; some by pre- and post-1980; some by heating fuel
    - Small diesel and Old Crow areas divided into year-round, seasonal and garages
    - Government and non-government buildings considered separately
  - Commercial & Institutional
    - Divided into 13 categories
    - Government and non-government buildings considered separately

Note: Industry considered separately, outside of this study

Yukon CPR

Study Scope (cont'd)

- End uses
  - Vary by sector:
    - Residential: 20 end uses
    - Commercial: 16 end uses
- Technologies
  - Efficiency, customer-side renewable & alternate energy
  - Both electricity energy and capacity

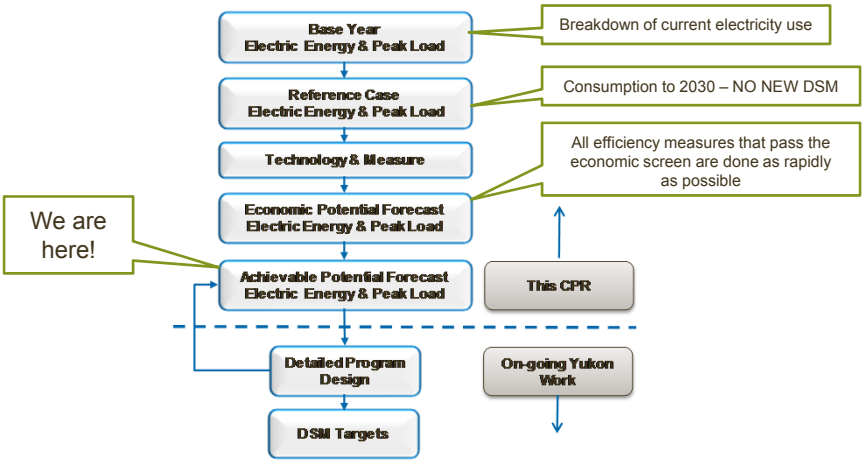
Yukon CPR

Study Scope (cont'd)

- 20 year timeframe
  - Base year is 2010
  - Milestones at 2015, 2020, 2025 and 2030
- Geographical
  - Hydro
  - Large Diesel
  - Small Diesel
  - Old Crow

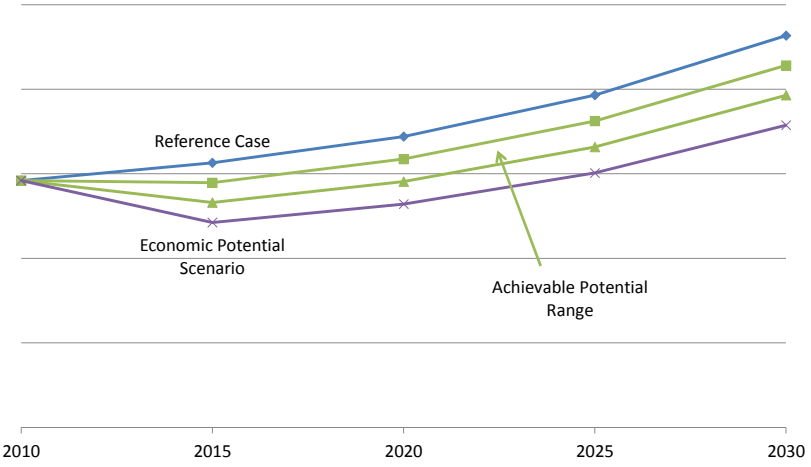
Yukon CPR

CPR Major Steps & Outputs



Yukon CPR

CPR Major Steps & Outputs (cont'd)



Yukon CPR

Study Deliverables

- Reports
  - Residential, Commercial, CSRAE, Summary
- Data Manager
  - Provides easy access to all data generated by Residential and Commercial studies
- Measure TRC Model
  - Provides all data for non-CSRAE measures
  - Easily updated by Yukon personnel

Yukon CPR

What this study is NOT

- It is not program design
- It is not setting DSM targets
- It is not an IRP

It is designed to provide input to all those processes.

CSRAE - Results

- ❑CSRAE Technologies
- ❑Methodology Overview
- ❑Overview of Results

Yukon CPR

CSRAE Technologies

- Chosen in consultation w/ YEC, YECL and Yukon Government
  - Solar PV
  - Solar Hot Water
  - Wood Pellet Furnaces and Boilers
  - Wind (not fully analyzed due to low wind regimes in settled areas)

(Solar spa heaters in residential report because technology is well-established, cost-effective & readily available)

CPR Yukon

Methodology—Technical Potential

- Identify and assess customer-side renewable and alternative energy technologies
- Investigate Yukon renewable resources
- Determine costs/performance data
- Model potential electric savings/generation per application
- Using residential and commercial reference case data, calculate technical potential

CPR Yukon

Methodology—Economic Potential

- Calculate levelized cost of energy conservation/generation
- Compare against the economic thresholds of:
  - Hydro grid: $0.35 / kWh
  - Large diesel grid: $0.30 / kWh
  - Small diesel grid: $0.30 / kWh
  - Old Crow grid: $0.64/ kWh
- Using residential and commercial reference case data, calculate economic potential of measures that qualify

CPR Yukon

Technologies Passing Econ. Screen

- Solar Hot Water (except for residential sectors in large and small diesel grids)
- Pellet-Burning Furnaces and Boilers

Solar PV does not currently pass the screen, but may become cost effective within the study period.

Yukon CPR 2011

CSRAE Achievable Potential

Yukon CPR

Achievable Potential - Definition

- The proportion of Economic Potential that can be realistically achieved
  - Includes consideration of customer perspective & market barriers
  - Recognizes that DSM programs can address some, but not all, market barriers
- Expressed as a range
  - Reflects the uncertainties of any forecast
  - Acknowledges that there are different levels of potential DSM program intervention
  - Recognizes that there are external factors that influence customer decisions

Yukon CPR

Achievable Potential – 2 Scenarios

- "Upper" = Very Best Possible Case
  - Theoretically = Economic potential minus "won't" portion of market
  - Aggressive DSM program approach implied
  - Highly supportive context, e.g. healthy economy, high level of public emphasis on climate change mitigation, etc.

"Lower" =

- DSM program support is similar to, or is only modestly increased, that of past 3 years
- Market interest/commitment to energy efficiency and environment remains approximately as current
- Federal gov't EE and GHG efforts as current

Yukon CPR

Today's Discussion

- Exchange of ideas and views
  - There are no wrong answers
  - Discussion is key!! Numbers will follow from it
- Today's Focus - selected opportunities
  - Sub set of the opportunities identified in the study
  - Selected to cover a variety of different technologies and markets
  - Will extrapolate results to remaining sub sectors and/or technologies

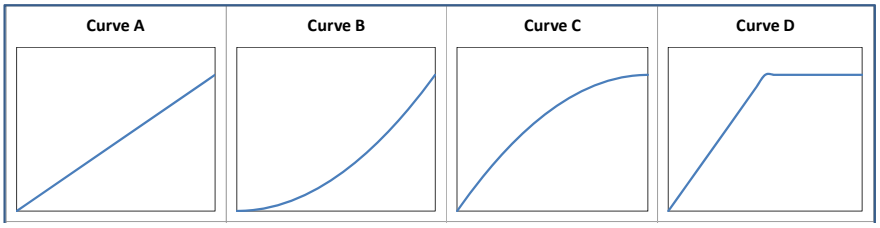
Yukon CPR

Discussion Approach

- Proposed approach to each opportunity discussion
  - Introduction by ICF-Marbek
  - Constraints, barriers & challenges
  - High level strategy
  - “Best Case” participation rates, 2030
  - “Lower Case” participation rates, 2030
  - Shape of adoption curve
  - Guidelines to consultants

Yukon CPR

Adoption Curves

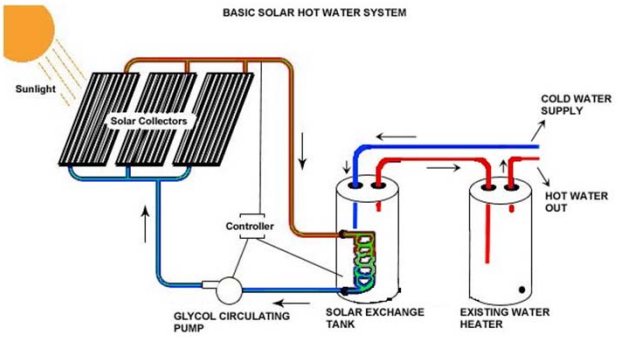


Yukon CPR 2011

CSRAE Opportunities

Yukon CPR

Solar Thermal



Yukon CPR

Solar Thermal Assumptions

- Southern exposure (within 30°)
- Installed costs:

Grid	Residential	Commercial
Hydro	$8,050	$57,500
Large diesel	$8,540	$61,000
Small diesel	$8,540	$61,000
Old Crow	$16,100	$115,000

- Useful life: 20 years
- DHW heating load can use all generated heat

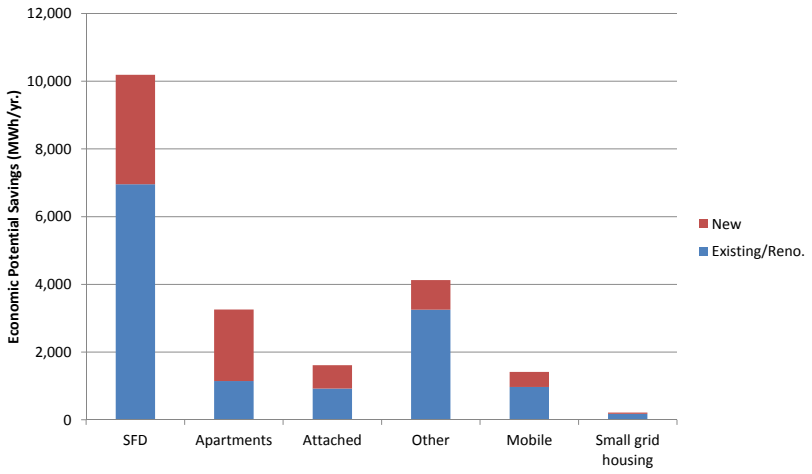
Yukon CPR

Solar Thermal Savings

- Residential: 2,200 kWh per installation
- Commercial: 23,900 kWh per installation

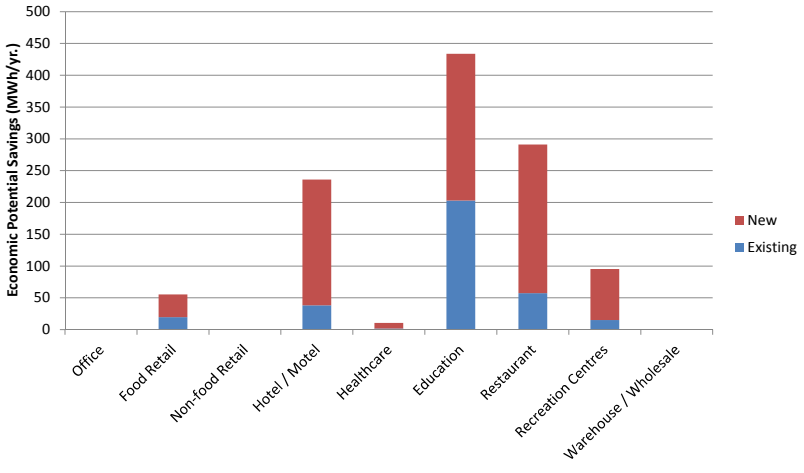
Yukon CPR

Solar Thermal Econ. Pot.—Res.



Yukon CPR

Solar Thermal Econ. Pot.—Com.



Yukon CPR

Solar Thermal Level. Cost Generation

- $0.20 to $0.39 / kWh (50 m^2 size)
- $0.30 to $0.60 / kWh (2 panels)

→ Most likely to become cost effective first on larger scale—such as on commercial buildings with adequately-sized roofs and larger DHW requirements.

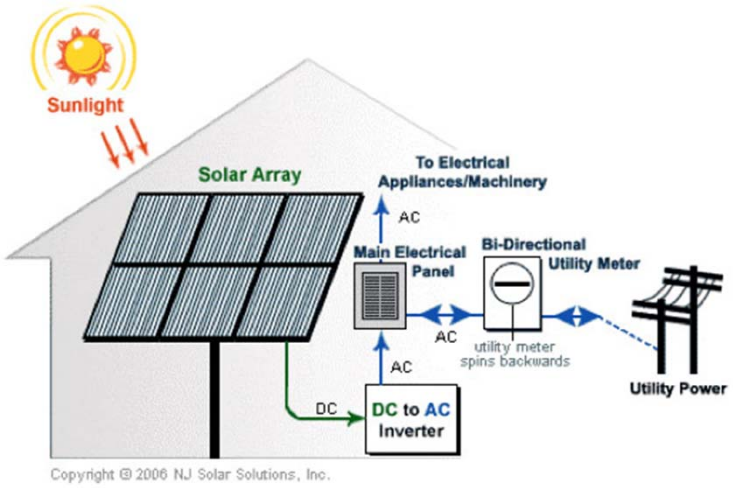
Yukon CPR

Opportunity 1: Solar Thermal on Com. Buildings with High DHW Loads

- Eligible participants:
  - Approximately 14 existing, 33 new commercial buildings w/ high DHW loads and electric water heating in 2030
  - Existing eligible immediately and new as built. Some cost savings in new buildings due to plumbing efficiencies.

Yukon CPR

Solar PV



Yukon CPR

Solar PV Assumptions

- Southern exposure (within 30°), angle equal to latitude
- Installed costs:

Grid	Residential	Commercial
Hydro	$8.05 / W	$6.90 / W
Large diesel	$8.54 / W	$7.32 / W
Small diesel	$8.54 / W	$7.32 / W
Old Crow	$1.610 / W	$13.80 / W

- Useful life: 20 years

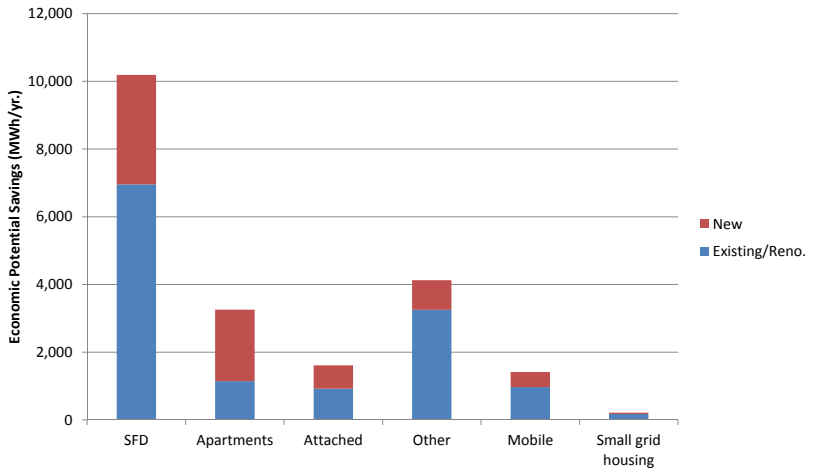
Yukon CPR

Solar PV Savings

- Residential: 3,200 kWh
- Commercial: 22,000 kWh

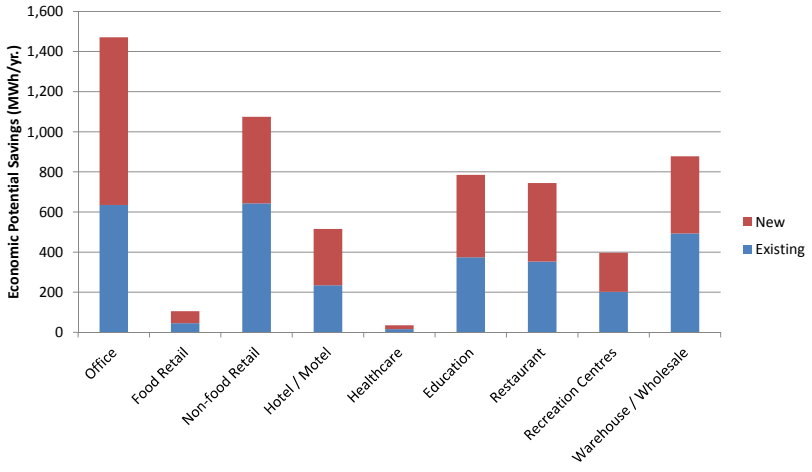
Yukon CPR

Solar PV Technical Potential—Res.



Yukon CPR

Solar PV Technical Potential—Com.



Yukon CPR

Solar PV Level. Cost Generation

- $0.55 to $1.10 / kWh (3 kW size, residential)
- $0.46 to $0.92 / kWh (20 kW size, commercial)

→ Most likely to become cost effective first on larger scale—such as on commercial buildings with adequately-sized roofs.

Yukon CPR

Opportunity 2: Solar PV on Com. Buildings

- Eligible participants:
  - Approximately 95 existing, 70 new commercial buildings in 2030
  - Existing eligible immediately and new as built. Some cost savings in new buildings.

Yukon CPR

Pellet Furnaces

Yukon CPR

Pellet Furnace Assumptions

- Option only valid in hydro grid area where it can substitute for an electric furnace
- Installed costs:
  - Incremental: $5,175 (instead of electrical furnace)
  - Full: $6,900 (in addition to electrical furnace)
- Useful life: 20 years
- No significant increment in maintenance costs
- Pellet price $7.70/ 18 kg bag
- Uses 100 kWh electricity per heating month (may be conservative)
- 75% seasonal efficiency (may be conservative)
- Technically feasible in 50% existing electrically heated single family and attached homes, 70% in new electrically heated single family and attached homes

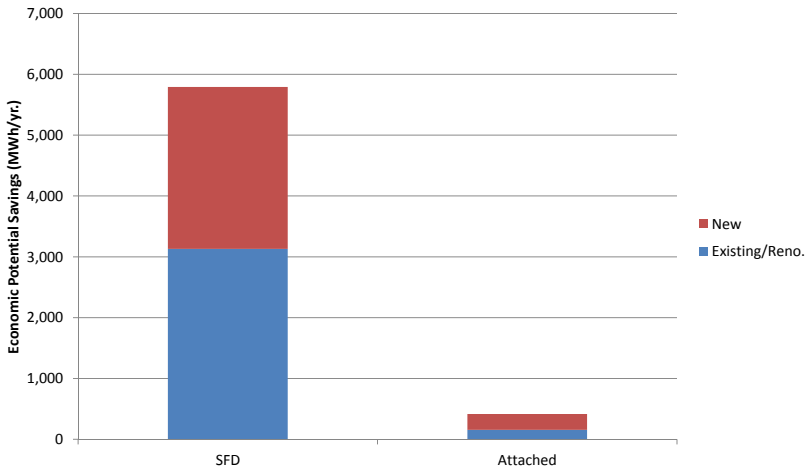
Yukon CPR

Pellet Furnace Savings

- Residential: all electricity used for heating in electric furnaces, but approximately 1,100 kWh per year required for fans and motors

Yukon CPR

Pellet Furnace Economic Potential



Yukon CPR

Pellet Stove Level. Cost Generation

- $0.18 / kWh (incremental)
- $0.19 / kWh (full)

→ Likely to be installed in both existing and new single-family and attached homes where space permits.

Yukon CPR

Opportunity 3: Pellet Furnaces in Single Family and Attached Homes in Hydro Grid

- Eligible participants:
  - Approximately 540 existing, 1010 new homes in 2030
  - Existing eligible immediately and new as built. Some cost savings in new buildings due to installation efficiencies.

Yukon CPR

Pellet Boilers

Yukon CPR

Pellet Boiler Assumptions

- Option only valid in hydro grid area where it can substitute for an electric boiler
- Installed costs $400,000
- Useful life: 20 years
- $12,755 annually in maintenance costs (may be conservative)
- Pellet price $7.70/ 18 kg bag
- 85% seasonal efficiency (may be conservative)
- Technically feasible in 20% of electrically heated commercial building types except offices, non-food retail and restaurants, 60% in new electrically heated buildings of the same types
- Displaces 90% of electricity used for space and DHW heating in building where installed

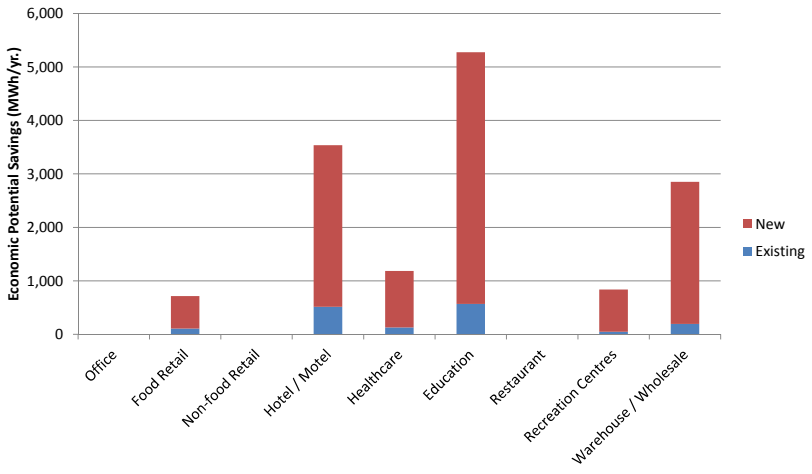
Yukon CPR

Pellet Boiler Savings

- Displaces 90% of electricity used for heating (space and DHW)

Yukon CPR

Pellet Boiler Technical Potential



Yukon CPR

Pellet Boiler Level. Cost Generation

- $0.20 / kWh

→Likely to be installed first in both existing and new commercial buildings with high heating loads and maintenance staff.

Yukon CPR

Opportunity 4: Pellet Boiler in Commercial Buildings

- Eligible participants:
  - Approximately 3 existing, 36 new commercial buildings in 2030
  - Existing eligible immediately and new as built. Less expensive in new buildings.

Yukon CPR

Small-Scale Wind

Yukon CPR

Wind in the Yukon

- Wind regimes in inhabited areas are low—almost always averaging under 6 km/h. This is too low for successful small-scale wind generation.
- High-elevation areas have much higher wind regimes and are suitable for utility-scale installations.
- Off-grid households may still be interested in small-scale wind, particularly in the fall/winter when PV generation is not possible and winds are a little higher.
- Experience off-grid may be helpful for on-grid regions in the future if new technologies improve generation in low-wind regimes.

Yukon CPR

Wrap Up

- Closing remarks
- Roundtable comments on the workshop
  - How well it matched your objectives
  - Things you liked
  - Things we should improve
- Thank you all around!

Appendix C Achievable Workshop Opportunity Assessment Worksheets

The following worksheets were used to collect information during the CSRAE Achievable Workshop held on 17 November 2011.

YUKON - ACHIEVABLE POTENTIAL WORKSHOP - CSRAE

CSRAE1: Solar Thermal DHW in Commercial Buildings with High DHW Loads

		COMMENTS
	2030	
MEASURE INFORMATION		
CEG(¢/kWh)	20 to 39	
ECONOMIC POTENTIAL		
Total Number of Buildings	120	Electric H20 with significant H20 load
Eligible Buildings	47	30% existing, 45% new buildings
PARTICIPATION RATES (%)		
BAU (Business as Usual) Marketing	20%	Curve B
Aggressive Marketing	40%	Curve B
ACHIEVABLE POTENTIAL		
BAU Marketing	9	
Aggressive Marketing	19	

YUKON - ACHIEVABLE POTENTIAL WORKSHOP - CSRAE

CSRAE2: Solar PV in Commercial Buildings

		COMMENTS
	2030	
MEASURE INFORMATION		
LUEC (¢/kWh)	46 to 92	
TECHNICAL POTENTIAL		
Total Number of Buildings	475	All commercial
Eligible Buildings	165	30% existing, 45% new
PARTICIPATION RATES (%)		
BAU (Business as Usual) Marketing	20-50%	Curve B
Aggressive Marketing	40-70%	Curve B
ACHIEVABLE POTENTIAL		
BAU Marketing	58	
Aggressive Marketing	91	

YUKON - ACHIEVABLE POTENTIAL WORKSHOP - CSRAE

CSRAE3: Pellet Furnaces in Single-Family and Attached Homes

		COMMENTS
	2030	
MEASURE INFORMATION		
LUEC (¢/kWh)	19	
ECONOMIC POTENTIAL		
Total Number of Buildings	2,525	Hydro grid, electrically heated, SFD & attached
Eligible Buildings	1,550	50% existing, 70% new
PARTICIPATION RATES (%)		
BAU (Business as Usual) Marketing		
Aggressive Marketing	20%	Pellet stove (for supplementary heat) may be much higher, notionally double.
ACHIEVABLE POTENTIAL		
BAU Marketing	0	
Aggressive Marketing	310	

YUKON- ACHIEVABLE POTENTIAL WORKSHOP - CSRAE

CSRAE4: Pellet Boilers in Commercial Buildings

		COMMENTS
	2030	
MEASURE INFORMATION		
LUEC (¢/kWh)	20	
ECONOMIC POTENTIAL		
Total Number of Buildings	75	Hydro grid, electrically heated, sign. heating load
Eligible Buildings	39	20% existing, 60% new
PARTICIPATION RATES (%)		
BAU (Business as Usual) Marketing	5%	Curve B
Aggressive Marketing	50%-60%	Higher than residential. Curve B
ACHIEVABLE POTENTIAL		
BAU Marketing	2	
Aggressive Marketing	21	