



**Regional Greenhouse Gas
Emission Reduction Opportunity
Study**

Final Report

May 18, 2022





Regional Greenhouse Gas Emission Reduction Opportunity Study

Final Report

Prepared For:

Municipality of the County of Kings
Town of Berwick
Town of Kentville
Town of Wolfville

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BACKGROUND AND CONTEXT

In recognition of the regional threat of climate change and the benefits of having a unified and collaborative mitigation strategy, the Municipality of the County of Kings, The Town of Berwick, The Town of Kentville, and The Town of Wolfville (hereafter referred to as the 'Region') are working cooperatively to identify opportunities to reduce greenhouse gas (GHG) emissions in the Region. The *Regional Greenhouse Gas Emission Reduction Opportunity Study* has identified and modeled the Region's community GHG emissions and has presented a range of GHG reduction opportunities to accomplish a long-term goal of becoming a net-zero community by 2050.

KEY TAKEAWAYS – COMMUNITY GHG EMISSIONS

Details of the community GHG emissions are presented in separate GHG inventory reports that have been prepared for each of the partner municipalities. Highlights of the Regional GHG emissions for the 2016 baseline year include:

- The Region's total gross base year community GHG emissions are 1,257,399 tonnes of equivalent carbon dioxide (CO₂e)
- The Region's top three sources of community GHG emissions are 1) energy consumption in institutional / commercial / industrial buildings, 2) on-road transportation fuel combustion, 3) energy consumption in residential buildings

KEY TAKEAWAYS – CARBON SEQUESTRATION

The estimated carbon sequestration in the Region's forest and wetland areas is equivalent to over 575,000 tonnes of CO₂e per year and is equal to 52% of the Region's gross base year community GHG emissions. While this is an inspiring fact that should be celebrated and recognized, the Region must be cognizant of how the calculated carbon sequestration is communicated in relation to the community GHG emissions. The Region is encouraged to manage and report its total (gross) community GHG emissions and removals of GHG through carbon sequestration as separate indicators each with their own set of improvement targets. This approach should avoid the following potential issues from occurring:

- GHG reduction targets being set against the net community GHG emissions (gross GHG emissions less GHG reductions from carbon sequestration)
- Misinterpretation by members of the community of the concept of gross vs net GHG emissions

GHG REDUCTION OPPORTUNITY ASSESSMENT

The GHG reduction opportunity analysis phase was accomplished through three key stages:

- **Engagement and Identification** – potential GHG reduction opportunities were identified through community stakeholder engagement and other sources
- **Evaluation and Ranking** – several ranking criteria were defined against which each potential GHG reduction opportunity was evaluated

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- **Prioritization** – the results of the evaluation and ranking analysis were used to assign each potential GHG reduction opportunity to an implementation prioritization category



The GHG reduction opportunity assessment resulted in the identification of 35 separate opportunities (presented in the table below). The recommended GHG reduction implementation timeframes are based on the points scored by opportunities in the ranking and evaluation phase, with the highest prioritization for implementation being assigned to the opportunities with the most points or immediate payback periods.

Implementation Category and Timeframe	IMMEDIATE	SHORT-TERM (within 2 years)	MEDIUM-TERM (2 to 5 years)	LONG-TERM (over 5 years)	NO MUNICIPAL CONTROL
GHG Reduction Opportunities	Industrial sector GHG emission reductions Implementation of low-cost energy improvements in residential sector Require new I-C-I buildings be net-zero by 2030 Reduce landfilled waste from I-C-I sector Increase diversion of organics from landfill to compost Reduce landfilled waste from residential sector Manure management strategies	Additives for hydronic heating systems Conversion to natural gas heating for I-C-I buildings Berwick Community Solar Garden project Increase transit usage Alternative cattle feeding strategies Increased adoption of cover crops Increase of tree cover in Region Reduce tree harvest area through carbon offset projects	Increased residential solar hot water heating Increased residential heat pumps Deep retrofits of existing homes Increased heat pumps in I-C-I buildings Meadowview solar facility Southwest Quadrant wind energy project Increased use of ENERGYSTAR appliances Installation of solar PV systems (residential)	Conversion of residential water heaters to electricity Deep retrofits of existing I-C-I buildings Increased solar hot water heating in I-C-I buildings	Provincial electricity grid decarbonization Federal fuel-efficiency standards (light-duty vehicles) Improved fuel efficiency and electrification of commercial vehicles

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	Improved nitrogen management	Conversion of marginal farmland to vegetated	Installation of solar PV systems (I-C-I buildings) Increased adoption of electric vehicles Increased use of active transportation Increased adoption of no-till agriculture		
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MODELING OF FUTURE GHG EMISSIONS

The third phase of the *Regional GHG Emission Reduction Opportunity Study* project was the **GHG modeling analysis**. Community GHG models are tools that allow local governments to assess the impact of predicted population changes and GHG reduction opportunities on the future profiles of community energy use and GHG emissions. Modeling analyses are performed using a range of scenarios that are designed to encompass the likely GHG reduction path that will be followed by the Region moving forward.

Four modeling scenarios were defined for this analysis:

1. **Business As Usual (BAU)**: All input variables remain at baseline (2016) levels with the exception of population growth
2. **Beyond Business As Usual (Beyond BAU)**: Only input variables that are not controlled or influenced by the municipal partners fluctuate (e.g. population growth, electricity grid renewable content, vehicle fuel efficiency standards).
3. **Conservative Reduction**: All input variables are dynamic and fluctuate between the modeling milestone time periods (2030, 2050). A conservative set of GHG reduction opportunity adoption rates are assigned
4. **Aggressive Reduction**: All input variables are dynamic and fluctuate between the modeling milestone time periods (2030, 2050). An aggressive set of GHG reduction opportunity adoption rates are assigned

The modeling analysis performed in this project have utilized the milestone dates and reduction targets that have been defined by the Intergovernmental Panel on Climate Change as needed to limit anthropogenic warming to 1.5 degrees Celsius:

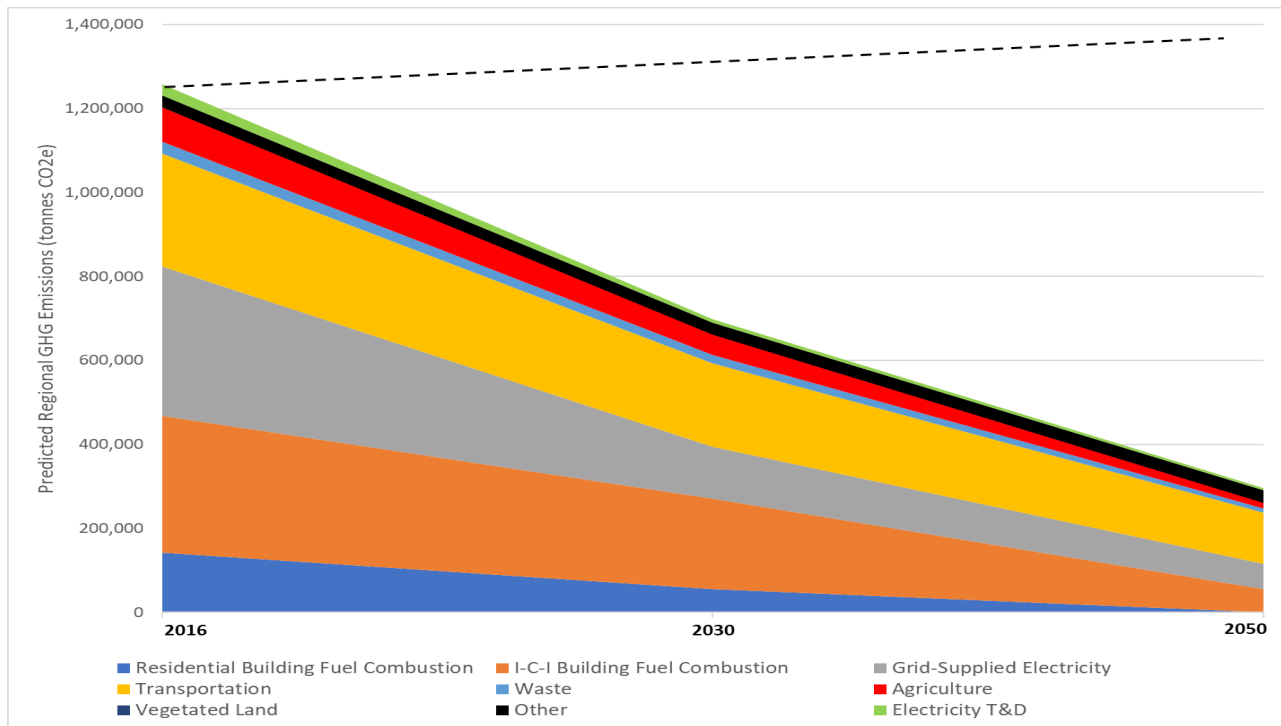
- 45% reduction in GHG emissions by 2030
- Net zero GHG emissions by 2050

These milestone dates and reduction targets have been adopted by a growing number of governments around the world, including the government of Canada, the province of Nova Scotia, and the Town of Wolfville.

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None of the modeling scenarios defined in this analysis allow the Region to accomplish the target levels of 45% reduction by 2030 and net-zero GHG emissions by 2050. The Aggressive scenario achieves 98% of the 2030 GHG reduction target level and 78% of the 2050 net-zero GHG target level. The figure below shows that over 60% of the remaining GHG emissions in 2050 are from sources (grid-supplied electricity, on-road transportation) that are strongly influenced by variables such as the provincial electricity grid composition and federal vehicle fuel efficiency standards that are governed by external stakeholders. It is possible that the external stakeholders that control these variables (Nova Scotia Power, Government of Canada) may introduce more stringent and aggressive timelines for greening the Nova Scotia electricity grid or on-road vehicles, respectively. If more stringent and aggressive timelines do occur for these externally-controlled variables it will contribute to a much more feasible 'path to zero' for the Region. In the meantime, the Region is encouraged to begin developing a detailed implementation plan that follows the Aggressive scenario GHG reduction opportunity recommendations to achieve the impressive GHG emission reductions that are predicted to occur.



RECOMMENDATIONS

1. Use the unified voice of the Region to advocate with external organizations (provincial govt., federal govt., utilities) that control or influence portions of the Region's GHG emissions
2. Development of a Regional Climate Action Plan
3. Adoption of Community GHG Reduction targets by Town of Berwick, Town of Kentville, and Municipality of the County of Kings
4. Establishment of Regional Climate Action Coordinator position and Regional Climate Action Committee

DISCLAIMER & ACKNOWLEDGEMENTS

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This Regional Greenhouse Gas Emissions Reductions Strategy was supported by the Province of Nova Scotia's Department of Natural Resources and Renewables Low Carbon Communities grant funding program.

The Municipality of the County of Kings, The Town of Berwick, The Town of Kentville, and The Town of Wolfville are very grateful for the support of the following community stakeholder organizations who contributed to the engagement phase of the project or provided input data sets for which the baseline GHG emission calculations were reliant:

- Acadia University
- Benjamin Bridge Wine House
- Berwick Electric Commission
- Efficiency Nova Scotia
- Kings Transit Authority
- Nova Scotia Power
- QUEST
- Valley Regional Enterprise Network
- Valley Waste

Disclaimer

Reasonable skill, care and diligence have been exercised to assess information acquired during the preparation of this analysis, but no guarantees or warranties are made regarding the accuracy or completeness of this information. This document, the information it contains, the information and basis on which it relies, and factors associated with implementation are subject to changes that are beyond the control of the authors. The information provided by others is believed to be accurate but has not been verified.

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This analysis applies to the geographic area of Kings County and its constituent towns and cannot be applied to other jurisdictions without analysis. Any use by The Municipality of the County of Kings, The Town of Berwick, The Town of Kentville, and The Town of Wolfville, their project partners, sub-consultants or any third party, or any reliance on or decisions based on this document are the responsibility of the user or third party.

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1.1 REGIONAL DESCRIPTION AND CONTEXT

The County of Kings is located in central Nova Scotia on the shore of the Bay of Fundy, with its northeastern part forming the western shore of the Minas Basin (Figure 1). Boasting some of the best farmland in Nova Scotia, along with the world's highest tides, the County is particularly vulnerable to the threats posed by global climate change, which poses a disproportionately higher risk to coastal communities and those dependent on agricultural livelihoods.



Figure 1: Map of the County of Kings and its constituent municipalities (map courtesy of Kings Regional Municipal Climate Change Action Plan).

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With a combined population of 60,600 the County and its constituent towns (Town of Berwick, Town of Kentville, Town of Wolfville) is the third most populous county in Nova Scotia. In recognition of the threat of climate change, and the realization that they are stronger when they work together, the *Kings Regional Municipal Climate Change Action Plan*¹ was developed as a collaborative effort between the County and its constituent towns to address the issue of climate change adaptation. Moving forward, the County and its constituent towns (hereafter referred to as the 'Region') are seeking to take a similar approach to climate change mitigation, working cooperatively to identify opportunities to reduce greenhouse gas (GHG) emissions in the Region. The *Regional Greenhouse Gas Emission Reduction Opportunity Study* presented here has identified and modeled the Region's community GHG emissions and has presented a range of GHG reduction opportunities to accomplish a long-term goal of becoming a net-zero community by 2050.

It is important to recognize that the past and present efforts to address climate change at the Regional level have been complemented by numerous initiatives led by each of the individual municipalities (Figure 2). The municipal-level initiatives have included alternative energy projects, active transportation strategies, climate change mitigation planning, and numerous policies influential to GHG reductions. These past and present efforts at both the municipal level and the Region as a whole have been a key source of GHG reduction opportunities that are included in this study.

The development of the *Regional Greenhouse Gas Emission Reduction Opportunity Study* followed a three-phase process as depicted in Figure 3:

- Community Greenhouse Gas Inventory Development
- Identification and Analysis of Greenhouse Gas Reduction Opportunities
- Modeling of Greenhouse Gas Emissions using the CURB Model

Each of the three phases are allocated a section of this study report, where details pertaining to the planning and completion of the phase are provided. The **community GHG inventory** represents the 2016 base year GHG emissions for the Region against which the performance of the GHG reduction efforts included in this *Regional Greenhouse Gas Emission Reduction Opportunity Study* will be assessed. The **GHG reduction opportunity analysis** involves the identification, ranking, and prioritization of the numerous potential opportunities that were assessed in this project. The highest-ranked GHG reduction opportunities (based on several ranking criteria) have been included as recommended actions in the *Regional Greenhouse Gas Emission Reduction Opportunity Study* for consideration by the Regional partners. The **modeling of GHG emissions** provides strategic guidance regarding the impact of recommended GHG reduction actions from both an emissions reduction and financial costing point of view. Modeling has been performed for multiple scenarios (business-as-usual, low-carbon) to the years 2030 and 2050 so as to be aligned with the Province of Nova Scotia's *Sustainable Development Goals Act*.

This *Regional Greenhouse Gas Emission Reduction Opportunity Study* has synthesized all phases of this important project into a strategic document that sets the stage for the crucial implementation of the GHG reduction opportunities that have been identified.

¹ *Kings 2050: Municipal Climate Change Action Plan* (Kings County NS). November 2013.

REGIONAL GREENHOUSE GAS REDUCTION SPOTLIGHT

The Municipality of the County of Kings has installed a solar photovoltaic array on the roof of the County municipal administrative building in Coldbrook. The solar array will generate 130,000 kWh of clean renewable electricity each year, approximately 50% of the building's electricity needs.



Image courtesy of saltwire.com

The Municipality of the County of Kings is also developing a 7 MW solar facility (Meadowview project) that will generate approx. 9.2 million kWh of electricity annually and is investigating the development of a 4.2 MW wind farm complex in the southwest portion of the County.



Image courtesy of Union of Nova Scotia Municipalities

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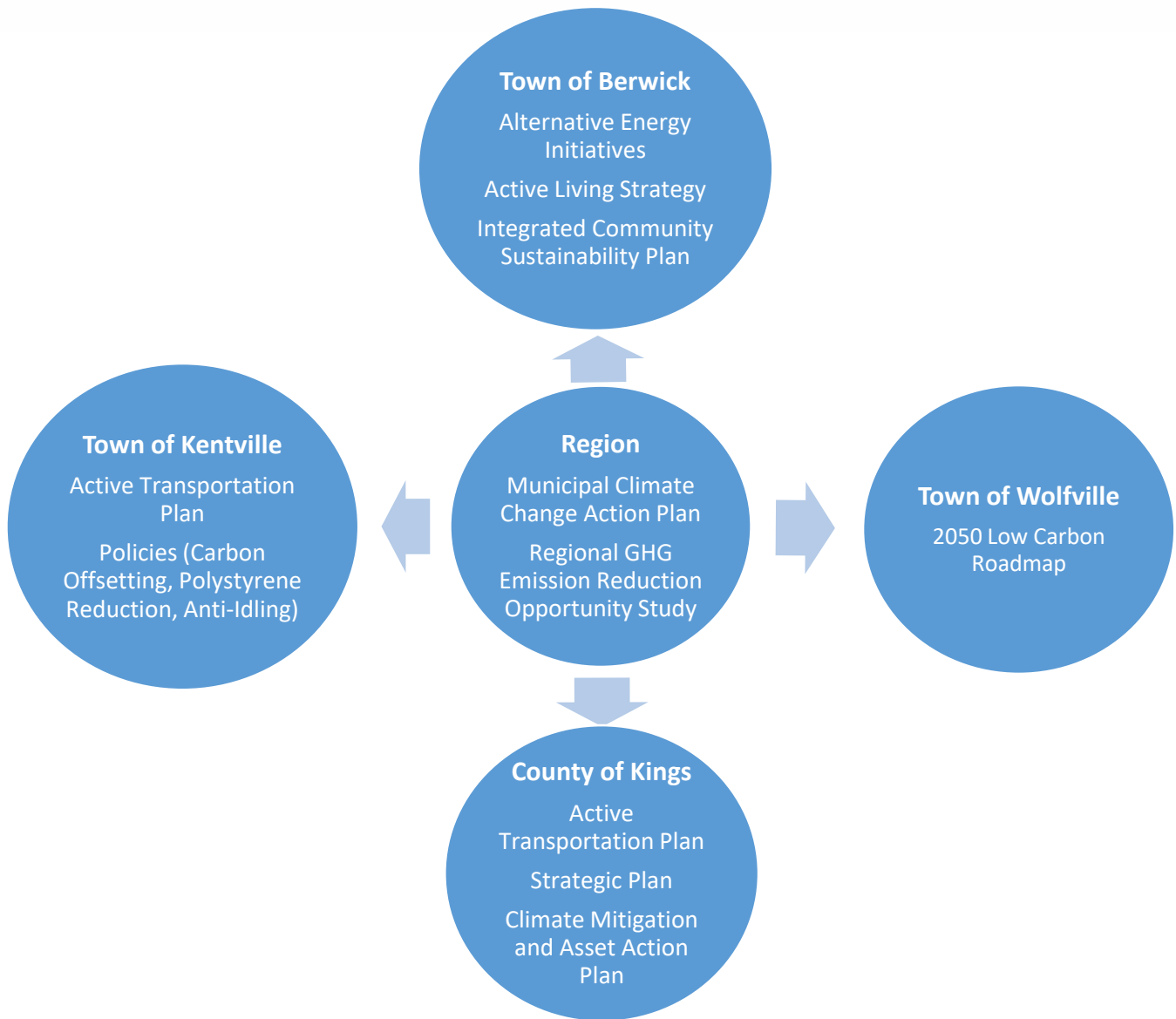


Figure 2: Depiction of climate change efforts led at the Regional level (centre circle) or by the individual municipalities.

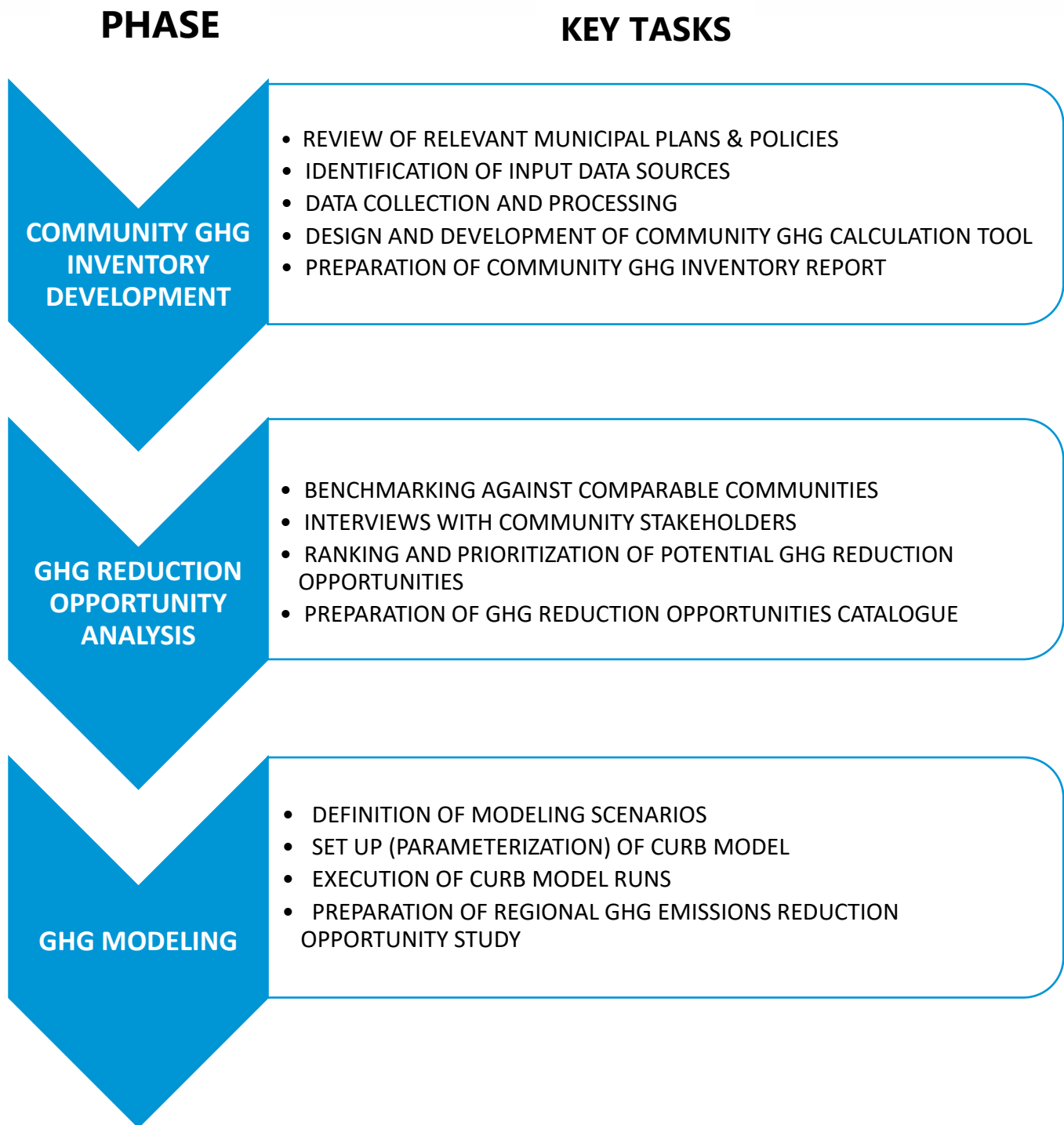


Figure 3: The three-phase process (with key tasks) followed in the development of the *Regional GHG Emissions Reduction Opportunity Study*.

The Region's community GHG inventory presented in this section quantifies the 2016 base year emissions from the sources of GHG that are emitted by the Region's residents and business operations. This section provides a summary of the methodological approach followed and results of the Region's base year community GHG inventory assessment².

GUIDING FRAMEWORK

The Greenhouse Gas Protocol is a suite of guidance documents and support tools that has emerged as the leading global framework for the quantification of organizational GHG emissions. In recognition of the unique GHG emission sources and management characteristics of municipal organizations and their communities, *The GHG Protocol* (in partnership with ICLEI and the C40 Cities Climate Leadership Group) developed a stand-alone version of their framework specific to quantification of community GHG emissions³ (referred to hereafter as '*The GPC Protocol*'). *The GPC Protocol* was used to guide the development of the Region's base year GHG inventory.

BASE YEAR REPORTING PERIOD

The GPC Protocol requires that a 12-month period be defined as the base year for a community GHG inventory. Establishing a base year enables the tracking of emissions and progress towards emission reduction goals over time. **The Region has chosen to assign the period of January 1, 2016 – December 31, 2016 as the base year for its community GHG inventory.** This base year was selected for the following reasons:

- Alignment and consistency with existing GHG quantification and reporting efforts that have already occurred within the municipalities that comprise the *Regional Greenhouse Gas Emission Reduction Opportunity Study*.
- The selected base year is aligned with the most recently published Government of Canada Census. Given the reliance of Census data as key inputs in the calculation of certain GHG emission sources, it was recognized that aligning the Region's base year with a Census reporting year was desirable.

COMMUNITY GHG BOUNDARY

The GPC Protocol requires that a community report its GHG emissions using two distinct but complementary approaches to defining the inventory boundary:

1. Scopes Framework: Under this approach, a community reports on all GHG emissions that are attributable to activities taking place within the geographic boundary of the community by assigning the emissions into one of the following categories (Figure 4):

² Additional detail of the Region's Community GHG Inventory are available in two products that have been developed to complement this report: a) a spreadsheet-based "Regional Community GHG Calculation Tool", and b) a Community GHG Inventory Report (separate reports prepared for each partner municipality).

³ The Greenhouse Gas Protocol. 2013. *Global Protocol for Community-Scale Greenhouse Gas Emission Inventories*.

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- **Scope 1** – GHG emitted within the boundary of the community
- **Scope 2** – GHG emitted from the consumption of grid-supplied electricity
- **Scope 3** – GHG emitted outside of the boundary of the community

2. City-Induced Framework: Under this approach, a community reports on GHG emissions that are attributable to activities taking place within the geographic boundary of the community using two levels of reporting:

- **BASIC**: covers GHG sources that occur in most communities and which often have available data
- **BASIC+**: a more comprehensive assessment of GHG sources which often entails more challenging data collection and calculation procedures

The Region’s community GHG inventory boundary as defined using both *GPC Protocol* boundary definition and reporting frameworks (Scopes, City-Induced) is presented in Table 1. Note that the Region’s community GHG inventory has been prepared at the BASIC+ level of detail.

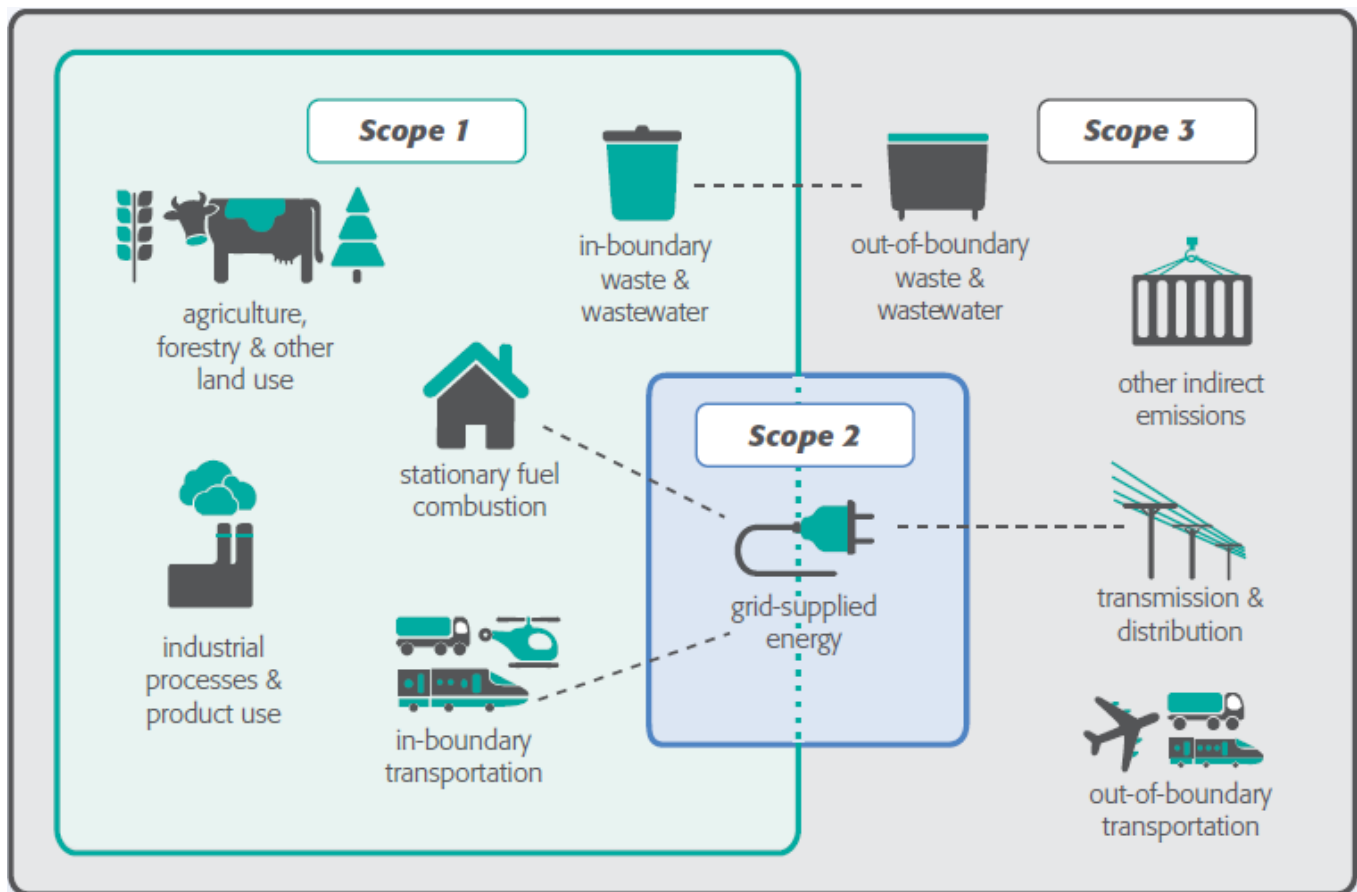


Figure 4: Allocation of greenhouse gas sources using the scopes-based framework as is required for *GPC Protocol* reporting of community emissions (image courtesy of The Greenhouse Gas Protocol).

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Table 1 The boundary of the Region’s community GHG emission inventory using both the Scopes Framework and City-Induced Framework approaches as required by *The GPC Protocol*.

BASIC			
Scope 1	Scope 2	Scope 3	Non-Scope
Stationary Fuel Combustion – Residential	Electricity Consumption – Residential	Solid waste generated in the Region and landfilled outside of Region	Biomass Energy (wood combustion in residential buildings or industrial facilities)
Stationary Combustion – Institutional / Commercial / Industrial	Electricity Consumption - Institutional / Commercial / Industrial	Composting of waste generated in the Region but composted outside of Region	
On-Road Transportation Fuel Combustion (In-Region)			
Wastewater generated and treated in the Region			
BASIC+			
Scope 1	Scope 2	Scope 3	
Industrial Processes and Product Use (refrigerant release)		Electricity transmission and distribution losses	
Livestock		On-Road Transportation Fuel Combustion (Out of Region)	
Agricultural Land Use			
Forest/Wetland Land Cover			

Several GHG emission sectors and individual GHG emission sources were excluded from the Region’s community GHG inventory. *The GPC Protocol* requires that a justification be provided for each GHG sector or individual emission source that is excluded from the community GHG inventory (Table 2).

CALCULATION AND REPORTING APPROACH

The quantification methodology for most of the Region’s sources of community GHG emissions uses an emission factor calculation. This methodology requires three types of data:

- the appropriate input “activity data” (e.g., sector-specific energy consumption, waste disposal records)
- the fuel-specific or activity-specific “emission factor”
- the “global warming potential” for each type of GHG

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These three types of data are combined into the following equation to calculate the GHG emissions:

$$GHG\ emissions = [activity\ data] * [emission\ factor] * [global\ warming\ potential]$$

In addition to the emission factor approach for calculating GHG emissions, a small number of Region community GHG sources use either a modeling approach or a per-capita estimate approach. The type of calculation approach used for each of the Region’s sources of community GHG emissions is described in Table 3. A detailed description of the input activity data, emission factors, and calculation methodology used for each individual GHG emission source is provided in the accompanying Regional Community GHG Calculation Tool and Regional Community GHG Inventory Reports (separate reports prepared for each partner municipality).

Table 2: List of GHG sectors and sources excluded from the Region community GHG inventory and rationale for their exclusion.

Rationale for Exclusion	GHG Sector or Source Excluded
Insufficient data available for calculation	<ul style="list-style-type: none"> ▪ Water-borne navigation ▪ Off-road transportation ▪ Aviation ▪ Emissions from industrial processes occurring within the community
Not applicable to the Region	<ul style="list-style-type: none"> ▪ Fugitive emissions from mining, processing, storage and transportation of coal ▪ Emissions from waste generated outside the community and disposed within the community
Identified as not relevant or of limited importance to the Region with regard to GHG emissions	<ul style="list-style-type: none"> ▪ Railways ▪ Incineration and open burning
Emissions data captured in Industrial / Commercial / Institutional stationary energy consumption	<ul style="list-style-type: none"> ▪ Agriculture, forestry and fishing activities – Stationary Energy ▪ Non-specified sources – Stationary Energy

The Region’s community GHG inventory includes the emissions associated with several types of GHG, including:

- Carbon Dioxide – CO₂
- Methane – CH₄
- Nitrous Oxide – N₂O

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For reporting purposes, GHG emissions are expressed in metric tonnes of equivalent carbon dioxide (CO₂e). Global warming potentials (GWPs) must be applied to convert different types of GHG into the common reporting unit of CO₂e. GWPs are a relative measure that allow for different pollutants to be compared in terms of their climate change impacts – CO₂ is the reference value and is equal to 1. For pollutants other than CO₂, the 100-year GWP values from the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report are used to convert emissions to CO₂e.

Table 3: Calculation approach used for each source of GHG in the Region’s community GHG inventory.

Calculation Approach	GHG Sources Calculated
Modeling	<ul style="list-style-type: none"> ▪ Solid waste disposed in landfill
Primary Activity Data with Emission Factors	<ul style="list-style-type: none"> ▪ Residential Sector Electricity Consumption ▪ Institutional / Commercial / Industrial Electricity Consumption ▪ On-Road Transportation Fuel Consumption (commuter vehicle use) ▪ Wastewater Treatment ▪ Biological treatment (composting) of solid waste ▪ Livestock ▪ Forest and wetland land cover
Secondary Activity Data with Emission Factors	<ul style="list-style-type: none"> ▪ Residential Sector Stationary Fuel Combustion (including biogenic) ▪ Institutional / Commercial / Industrial Stationary Fuel Combustion (including biogenic) ▪ On-Road Transportation Fuel Consumption (personal vehicle use and commercial vehicles) ▪ Electricity transmission and distribution losses
Per-Capita Estimate	<ul style="list-style-type: none"> ▪ Industrial processes and product use (refrigerant losses) ▪ Agricultural land management

REGIONAL COMMUNITY GHG INVENTORY SUMMARY: EMISSIONS

The *GPC Protocol* requires that a community GHG inventory be presented at both the summary level (GHG sectors) and a detailed level (individual GHG emission sources).

The detailed community GHG inventory results are presented in Appendix A for each individual partner municipality and as a consolidated Regional total. The detailed results include total emissions by individual GHG source, scope, and GHG type (CO₂, CH₄, N₂O). The detailed results also include the required (by *GPC Protocol*) quality assessment of activity data and emission factors used in the GHG calculations. Most of the Region’s GHG emission source categories were assigned data quality values of either ‘High’ or ‘Medium’. In general, ‘High’ data

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quality was assigned when primary data was used in the calculations. 'Medium' data quality was assigned when secondary data sources (e.g. Census of Canada) were used in the calculations.

The Regional community GHG emissions are presented at the summary level in Table 4 (a – e) and includes total emissions by sector, scope, and GPC reporting level (BASIC and BASIC+). Summary-level emissions are presented for each individual partner municipality and as a consolidated Regional total.

Table 4: Community GHG inventory summary report, including total GHG emissions by sector, scope (1, 2, 3, biogenic), and GPC reporting level (BASIC - as indicated by light green, BASIC+ as indicated by blue). Pink represents changes in land-based carbon through forests and wetlands.

(a) Region

Sector	Total by Scope (tonnes CO ₂ e)				Total by city-induced reporting level (tonnes CO ₂ e)	
	Scope 1	Scope 2	Scope 3	Biogenic	BASIC	BASIC+
Stationary Energy	313,410	354,644	26,545	162,627	830,681	857,226
Transportation	115,479	0	153,406	0	115,479	268,885
Waste	1,753		27,376		29,129	29,129
IPPU	20,340				0	20,340
Agriculture	81,910				0	81,910
GHG Emissions	532,892	354,644	207,327	162,627	975,289	1,257,490
Forest / Wetland	-577,778				0	-577,778

(b) Municipality of the County of Kings

Sector	Total by Scope (tonnes CO ₂ e)				Total by city-induced reporting level (tonnes CO ₂ e)	
	Scope 1	Scope 2	Scope 3	Biogenic	BASIC	BASIC+
Stationary Energy	244,215	285,886	21,536	126,598	656,699	678,235
Transportation	104,398	0	124,771	0	104,398	229,169
Waste	1,152		21,182		22,334	22,334
IPPU	15,985				0	15,985
Agriculture	81,910				0	81,910
GHG Emissions	447,660	285,886	167,489	126,598	783,431	1,027,633
Forest / Wetland	-574,380				0	-574,380

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(c) Town of Berwick

Sector	Total by Scope (tonnes CO ₂ e)				Total by city-induced reporting level (tonnes CO ₂ e)	
	Scope 1	Scope 2	Scope 3	Biogenic	BASIC	BASIC+
Stationary Energy	10,991	4,490	167	5,917	21,398	21,565
Transportation	2,111	0	5,466	0	2,111	7,577
Waste	99		985		1,084	1,084
IPPU	842				0	842
Agriculture	0				0	0
GHG Emissions	14,043	4,490	6,618	5,917	24,593	31,068
Forest / Wetland	-111				0	-111

(d) Town of Kentville

Sector	Total by Scope (tonnes CO ₂ e)				Total by city-induced reporting level (tonnes CO ₂ e)	
	Scope 1	Scope 2	Scope 3	Biogenic	BASIC	BASIC+
Stationary Energy	32,134	33,196	2,501	18,112	83,442	85,943
Transportation	5,324	0	13,496	0	5,324	18,820
Waste	265		2,833		3,098	3,098
IPPU	2,105				0	2,105
Agriculture	0				0	0
GHG Emissions	39,828	33,196	18,830	18,112	91,864	109,966
Forest / Wetland	-2,366				0	-2,366

(e) Town of Wolfville

Sector	Total by Scope (tonnes CO ₂ e)				Total by city-induced reporting level (tonnes CO ₂ e)	
	Scope 1	Scope 2	Scope 3	Biogenic	BASIC	BASIC+
Stationary Energy	26,070	31,072	2,341	12,000	69,142	71,483
Transportation	3,646	0	9,673	0	3,646	13,319
Waste	237		2,376		2,613	2,613
IPPU	1,408				0	1,408
Agriculture	0				0	0
GHG Emissions	31,361	31,072	14,390	12,000	75,401	88,823
Forest / Wetland	-921				0	-921

REGIONAL GREENHOUSE GAS REDUCTION SPOTLIGHT

The Town of Berwick has several completed or planned projects to reduce fossil fuel combustion and increase renewable electricity capacity in the Town:

- The Town is a partner in the 10-turbine Ellershuse wind farm (with the Towns of Antigonish and Mahone Bay)
- The Town is developing a Community Solar Garden project
- Thirteen level-2 electric vehicle charging stations have been installed in the Town
- A heat pump installation program is available to the Town's residents in partnership with Credit Union Atlantic and the Towns of Antigonish and Mahone Bay

Image courtesy of Town of Berwick

Image courtesy of saltwire.com

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The distribution of total Regional gross base year community GHG emissions by consolidated sectors is provided in Figure 5. Building energy consumption (fossil fuels + electricity + biomass) is the largest source of GHG emissions in the Region, representing over 67% of the gross community total. On-road transportation (In-Region + Out-of-Region) represents 22% of the Region's gross community GHG emissions, while agriculture (livestock + soil management) represents approx. 7% of the total GHG emissions. All told, the consolidated sectors of building energy, on-road transportation, and agriculture represent over 95% of the Region's gross community GHG emissions and are therefore a focus of GHG reduction efforts recommended in this study.

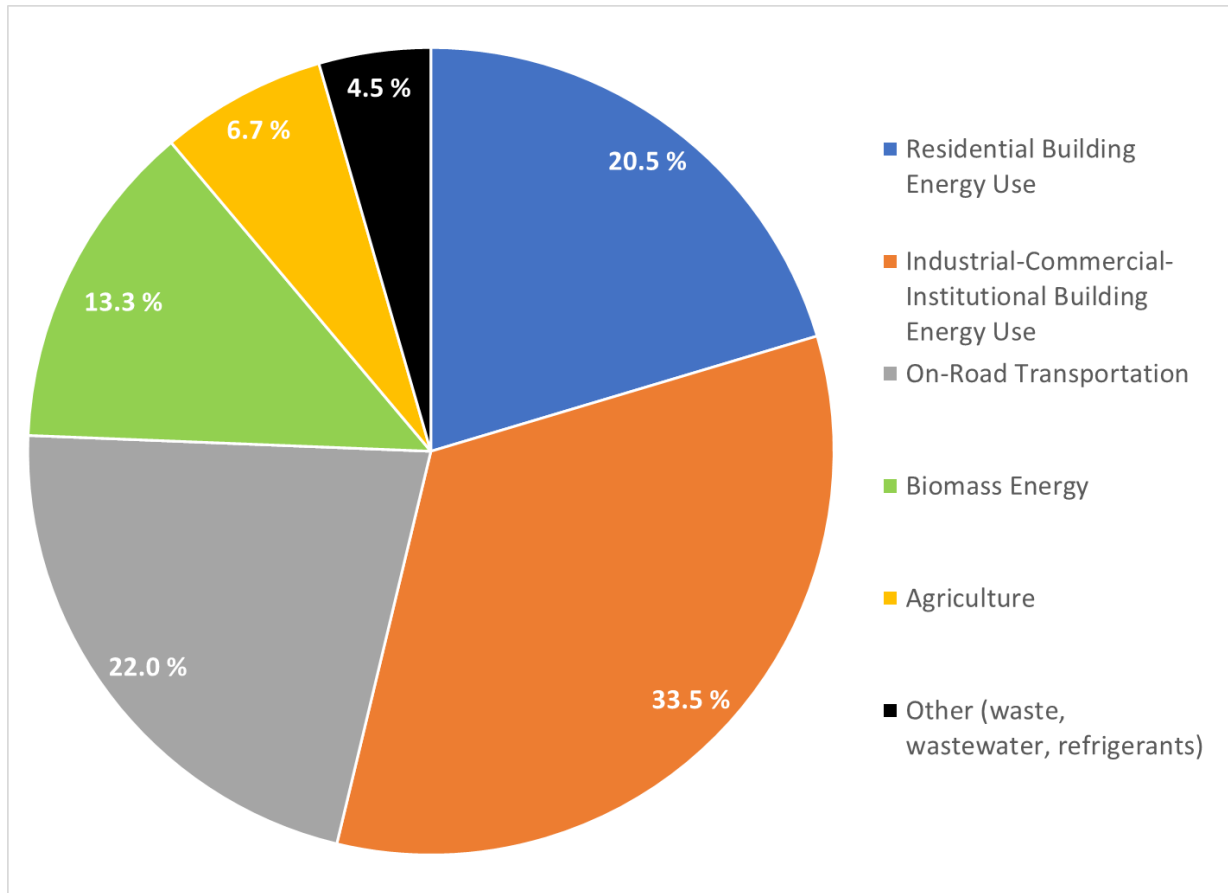


Figure 5: Graphic representation of Regional base year community GHG emissions by consolidated sector. Percentage values represent the contribution of each consolidated GHG sector to the Region's gross community GHG emissions total.

REGIONAL COMMUNITY GHG INVENTORY SUMMARY: SEQUESTRATION

Vegetated ecosystems (e.g., forest, wetland) store a significant amount of carbon in the living biomass of the vegetation (aboveground and belowground, debris, litter, and soil). The main pools of carbon in vegetated ecosystems and the primary carbon flux pathways are shown in Figure 6.

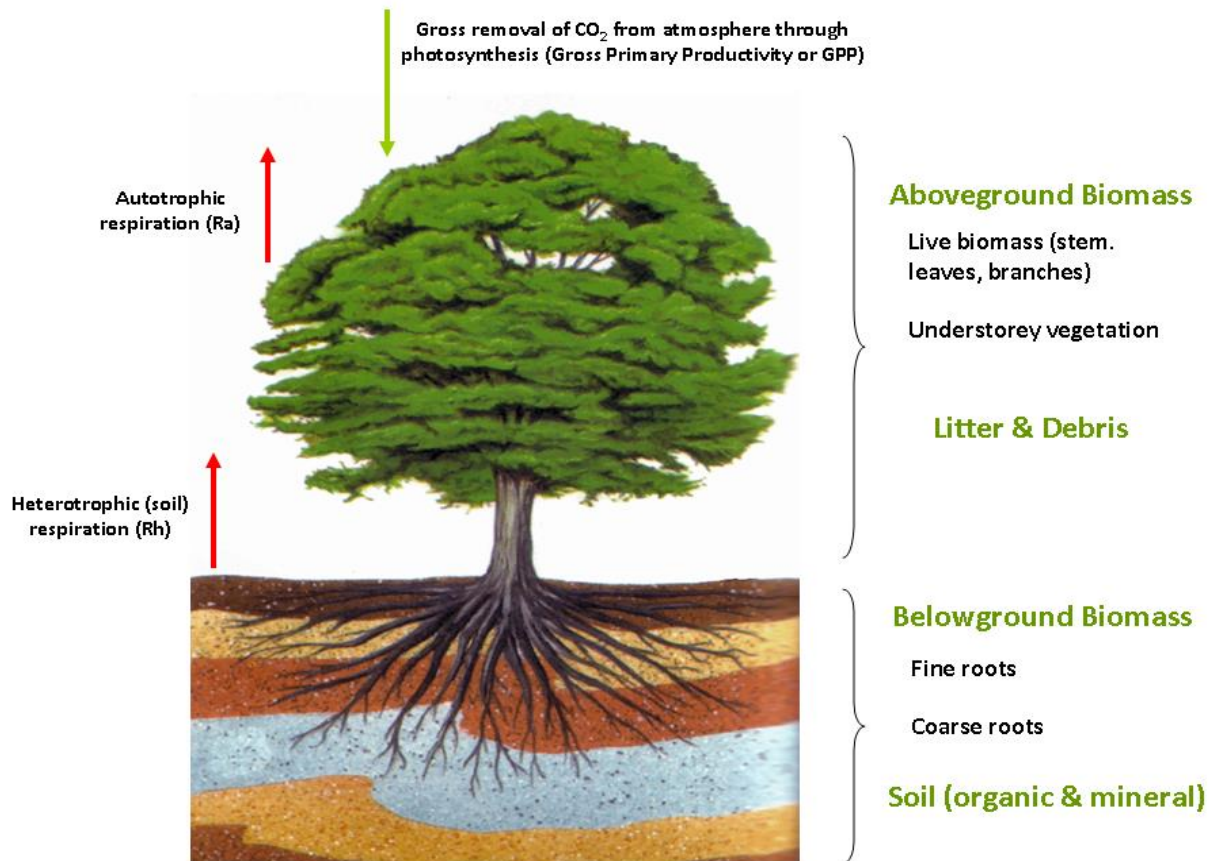


Figure 6: The carbon cycle (carbon pools and pathways). Primary carbon flux pathways are indicated with arrows. Net carbon gains through photosynthesis are shown as a green arrow; net carbon losses from respiration are shown as red arrows

The *GPC Protocol* describes how changes in stored carbon should be quantified in a community GHG inventory. The protocol recognizes that some of the most significant GHG aspects of a community with large tracts of vegetated land (both public and private ownership) will occur through the management of stored carbon. Communities should quantify and report carbon storage changes that are based on the following land cover conditions:

- Change in land cover (e.g. forest converted to non-forest, wetland converted to non-wetland)
- Consistent land cover (e.g. forest remaining forest, wetland remaining wetland)

The approximately 165,000 hectares of forest and wetland areas in the Region (public and private ownership) have a significant impact on annual carbon sequestration. When the Region's forests and wetlands remain in their current state, they will act as a carbon sink, meaning they will remove carbon dioxide from the atmosphere.

When the Region’s forests and wetlands are removed or converted to another land use (e.g. pine beetle-induced deforestation, harvest, development) they will act as a source of carbon dioxide emissions to the atmosphere.

The estimated carbon sequestration impact of the Region’s forest and wetland areas are presented in Table 4 (a – e) for each individual partner municipality and as a consolidated Regional total. Note that the values for forest or wetland converted to another land cover are assumed to be zero since this is the base year community GHG inventory. Future years of the Region’s community GHG inventory will have a value for forest or wetland that have been converted to another land cover in the time since the base year GHG inventory.

The estimated carbon sequestration in the Region’s forest and wetland areas is equivalent to over 575,000 tonnes of CO₂e per year and is equal to 52% of the Region’s base year gross community GHG emissions. The contribution of forests and wetlands to the estimated annual carbon sequestration is shown in Figure 7.

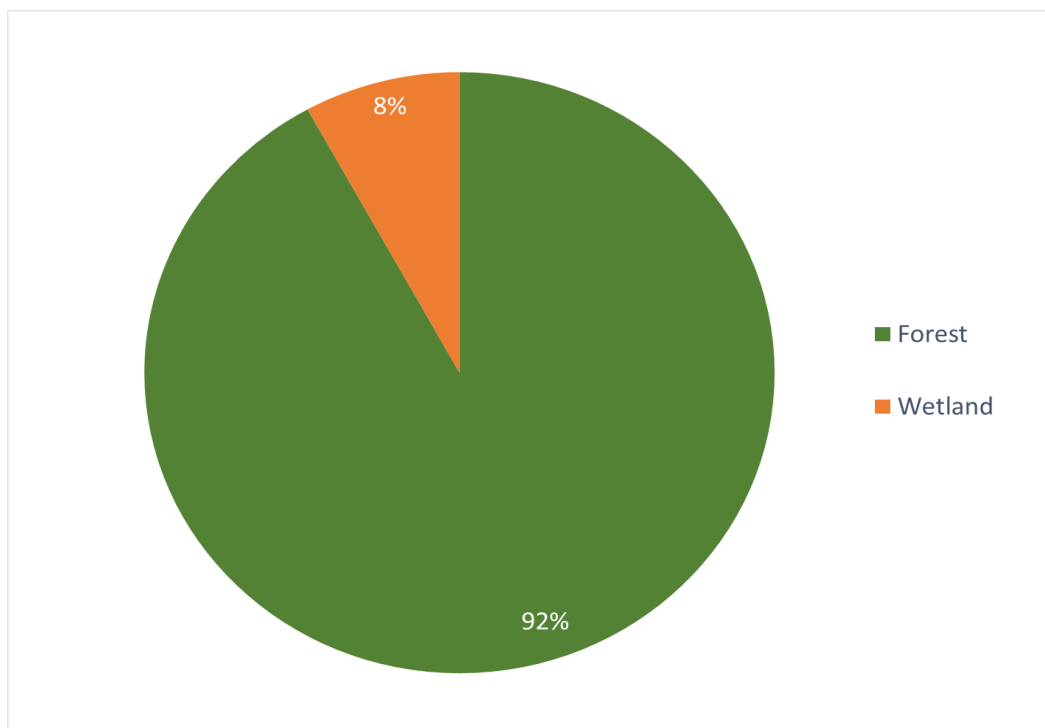


Figure 7: Graphic representation of contribution of forest and wetland land cover to Regional base year community GHG sequestration. Percentage values represent the contribution of forest and wetland to the Region’s total community GHG sequestration total.

Management and Reporting of GHG Emissions and Reductions

The estimated carbon sequestration in the Region’s forest and wetland areas is an inspiring figure that should be celebrated and recognized. However, the Region must be cognizant of how the calculated carbon sequestration is communicated in relation to the community GHG emissions. The Region and its individual partner municipalities are encouraged to manage and report the total (gross) community GHG emissions and removals of GHG emissions through carbon sequestration as separate indicators each with their own set of improvement targets. This approach should avoid the following potential issues from occurring:

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- GHG reduction targets being set against the net community GHG emissions (gross GHG emissions less GHG reductions from carbon sequestration)
- Misinterpretation by members of the community of the concept of gross vs net GHG emissions

GHG Emissions Intensity

Organizations are encouraged to define normalized variables that can be used to monitor their GHG performance on an intensity basis in addition to the absolute totals. The intensity metric that is utilized for the Region’s community GHG emissions is ‘**GHG emissions per capita**’.

The Region’s per-capita community GHG emissions were compared to other Nova Scotia communities for which information was available as well as provincial and national averages (Table 5). The Region’s per-capita GHG emissions are:

- Significantly below the national average and are slightly greater than the Nova Scotia provincial average.
- significantly higher than the neighbouring District of West Hants, likely due to a greater contribution of GHG emissions from livestock agriculture in the Kings County Region
- 30% greater than the Regional Municipality of Halifax, likely due to the increased use of alternative transportation and mass transit in the urban Halifax area.

Table 5: Comparison of a sample of per-capita GHG emissions from the national, provincial, and municipal levels.

Jurisdiction	Per-Capita GHG (tonnes CO ₂ e / person)	Source
Canada National Average	20.4	Canada Energy Regulator (National / Provincial / Territorial Energy Profiles)
Nova Scotia Provincial Average	16.4	Canada Energy Regulator (National / Provincial / Territorial Energy Profiles)
County of Kings Region	17.1*	This study
District of West Hants, NS	15.0	District of West Hants Corporate and Community GHG Inventory (February 2020)
Regional Mun. of Halifax	13.1	Halifax Regional Municipality Energy Use and GHG Emissions Baseline Inventory

*only stationary energy (fossil fuel + electricity), transportation, solid waste disposal, and livestock agriculture are included in the Region’s per capita value to maintain equivalency with the GHG emission boundaries utilized in the West Hants and Halifax community GHG inventories. If all GHG emission sources from in this study are included the Region’s actual per-capita value is 20.7 tonnes CO₂e / person.

GREENHOUSE GAS REDUCTION
OPPORTUNITY ASSESSMENT

The second phase of the *Regional GHG Emission Reduction Opportunity Study* project was the **GHG reduction opportunity analysis**. This phase involved the identification, ranking, and prioritization of numerous potential GHG reduction opportunities. The highest-ranked GHG reduction opportunities (based on several ranking criteria) have been included as recommended actions in the *Regional Greenhouse Gas Emission Reduction Opportunity Study* for consideration by the Regional partners.

The GHG reduction opportunity analysis phase was accomplished through three key stages:

- **Engagement and Identification** – potential GHG reduction opportunities were identified through community stakeholder engagement and other sources
- **Evaluation and Ranking** – several ranking criteria were defined against which each potential GHG reduction opportunity was evaluated
- **Prioritization** – the results of the evaluation and ranking analysis were used to assign each potential GHG reduction opportunity to an implementation prioritization category

A description of each stage and the resultant findings are presented in this section of the report.



STAGE 1: ENGAGEMENT AND IDENTIFICATION

The first stage of the process was to compile a comprehensive list of potential GHG reduction opportunities for consideration to be included as recommended actions in the *Regional GHG Emission Reduction Opportunity Study*. The comprehensive list was populated using a variety of approaches including community stakeholder engagement, review of municipal plans and policies, and benchmarking against comparable communities.

Community Stakeholder Engagement

The Region is fortunate to be home to a large number of engaged and passionate community stakeholders that represent a diverse set of interests and expertise. It was recognized that community stakeholder engagement is a critical aspect of maximizing the potential positive impacts of the *Regional GHG Emission Reduction Opportunity Study* project for multiple reasons:

- 1 The municipal partner organizations of the Region only have direct control over a fraction of the GHG emissions in the community. The successful reduction of the Region's community GHG emissions will require the support and participation of a range of community stakeholders as implementation partners

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2 Many community stakeholders have already begun to implement or are planning their path to reduced GHG emissions. Their experiences and expertise are invaluable resources that could help guide the community

A list of community stakeholders to approach for engagement in the *Regional GHG Emission Reduction Opportunity Study* project was compiled by the municipal partner organizations. The compilation of the list included a consideration of many factors including:

- Representation of all Region partner municipalities
- Representation of a diverse range of key industry sectors
- Representation from public-sector services influential to GHG emission reductions (e.g. waste disposal, public transit)
- Key energy providers (e.g. Nova Scotia Power, Berwick Electric Commission)
- Significant industrial or institutional organizations

Feedback and input from community stakeholders was solicited using multiple methods of engagement, including an invite-only web-based survey and a series of webinar interviews. In Appendix B a full list of community stakeholders invited to participate in the engagement efforts and a template version of the web-based survey is provided with a summary of the stakeholder feedback. A list of all community stakeholders that participated in the engagement efforts for the project is provided in Table 6. Details of the community stakeholder feedback received in this project (“What We Heard”) is presented as Appendix C to this report.

Table 6: List of community stakeholder organizations engaged in the project.

Community Stakeholder Organization	Sector Represented	Method of Engagement
Nova Scotia Power	Electricity utility	Survey, interview
Berwick Electric Commission	Electricity utility	Survey, interview
Acadia University	Institutional	Survey, interview
Kings Transit Authority	Public transit	Survey, interview
Valley Waste	Solid waste management	Survey, interview
Benjamin Bridge Wine House	Agriculture, Tourism	Survey, interview
QUEST	Municipal energy management	Survey, interview
Valley Regional Enterprise Network	Economic development	Survey
Efficiency Nova Scotia	Municipal energy efficiency	Interview

REGIONAL GREENHOUSE GAS REDUCTION SPOTLIGHT

The Town of Kentville has approved a number of plans and policies intended to reduce fossil fuel combustion and environmental impacts in the Town:

- "Kentville Moves" Active Transportation Plan
- Anti-Idling Standard Operating Procedure for Town-owned vehicles
- Carbon offsetting policy for travel conducted by Town staff and Council
- Expanded polystyrene (Styrofoam) reduction policy in Town operations
- Kentville Integrated Community Sustainability Plan



Images courtesy of Town of Kentville



Review of Municipal Plans and Policies

The past and present efforts to address climate change within the Region have included alternative energy projects, active transportation strategies, climate change mitigation planning, and numerous policies influential to GHG reductions. A review was conducted of plans and policies from all of the partner municipalities to ensure existing or planned initiatives are recognized in this project and to ensure the *Regional GHG Emission Reduction Opportunity Study* is aligned with existing initiatives in the Region. A list of the municipal documents reviewed in this stage are provided in Table 7.

Table 7: Documents from the Regional partner municipalities reviewed in the identification of potential GHG reduction opportunities.

Municipality	Documents Reviewed
County of Kings	Kings County 2050: Municipal Climate Change Action Plan Climate Mitigation and Asset Action Plan Strategic Plan 2021 – 2024 Active Transportation Plan
Town of Berwick	Active Living Strategy Municipal Planning Strategy Integrated Community Sustainability Plan
Town of Kentville	Active Transportation Plan Municipal Planning Strategy Transportation Master Plan Policies (Carbon Offsetting, Anti-Idling, Polystyrene Restriction)
Town of Wolfville	Municipal Planning Strategy 2050 Low Carbon Roadmap Community Energy and Emissions Mitigation Plan

Benchmarking Against Other Communities

Benchmarking is an opportunity to glean ideas for challenges or opportunities pertaining to identification of GHG reduction opportunities that could also be applicable in the Region. Three Canadian communities that are recognized as leaders in community climate action planning were selected for the benchmarking assessment. For each of the selected benchmarking communities the publicly-available documentation pertaining to their climate change action planning initiatives were obtained and reviewed (Table 8).

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Table 8: Documents from the benchmarked communities reviewed in the identification of potential GHG reduction opportunities.

Benchmark Community	Documents Reviewed
Halifax Regional Municipality	Halifact 2050: A Climate Action Plan for Halifax Low-Carbon Technical Report
Town of Bridgewater (Nova Scotia)	Energy Management Plan 2021 – 2025 Energize Bridgewater Community Energy Planning Toolkit 2013 Municipal Climate Change Action Plan Community Energy Investment Plan
Oxford County (Ontario)	Community Sustainability Plan Managed Forest Plan Zero Waste Plan 100% Renewable Energy Plan

Potential GHG Reduction Opportunities Identified

The stakeholder engagement and document review efforts in this stage resulted in a list of 35 potential GHG reduction opportunities that encompass all of the GHG sectors that contribute to the Region’s community GHG inventory (Table 9). Additional information about each potential GHG reduction opportunity is provided in Appendix D (“GHG Reduction Opportunities Catalogue”).

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Table 9: List of potential GHG reduction opportunities identified in the engagement and identification phase.

GHG Inventory Sector	Potential GHG Reduction Opportunities Identified
RESIDENTIAL BUILDING (Fossil Fuel Combustion)	<ol style="list-style-type: none"> 1. Increased installation of solar hot water heating 2. Conversion of water heaters from heating oil to electricity 3. Increased installation of heat pumps in homes 4. Deep retrofits of existing homes
INSTITUTIONAL – COMMERCIAL BUILDING (Fossil Fuel Combustion)	<ol style="list-style-type: none"> 5. Increased use of additives for hydronic heating systems 6. Conversion from fuel oil to natural gas for space heating 7. Deep retrofits of existing institutional – commercial buildings 8. Increased installation of heat pumps 9. Increased installation of solar hot water heating 10. Industrial sector GHG emission reductions
GRID-SUPPLIED ELECTRICITY	<ol style="list-style-type: none"> 11. Implementation of Meadowview Solar project 12. Implementation of Southwest Quadrant wind energy project 13. Increased use of ENERGYSTAR appliances in residential sector 14. Increased adoption of low-cost energy improvements in residential sector 15. Increased installation of solar PV systems in residential sector 16. Increased installation of solar PV systems in institutional-commercial sector 17. Berwick Community Solar Garden project 18. Require new institutional-commercial buildings be net-zero energy by 2030 19. Decarbonization of provincial electricity grid
TRANSPORTATION	<ol style="list-style-type: none"> 20. Increased adoption of electric vehicles 21. Improved passenger vehicle fuel efficiency standards 22. Increased transit usage 23. Increased use of active transportation 24. Improved commercial vehicle fuel efficiency and electrification
WASTE DISPOSAL	<ol style="list-style-type: none"> 25. Reduce landfill waste from institutional-commercial-industrial sector 26. Increase organic waste diversion from landfill to composting 27. Reduce landfill waste from residential sector
AGRICULTURE	<ol style="list-style-type: none"> 28. Alternative cattle feeding strategies 29. Implementation of manure management strategies 30. Increased adoption of no-till agriculture 31. Improved nitrogen management 32. Increased adoption of cover crops
FORESTRY AND WETLANDS	<ol style="list-style-type: none"> 33. Increase of tree cover in the Region 34. Reduced forest harvesting through carbon offset projects 35. Conversion of marginal farmland to vegetated land cover

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STAGE 2: EVALUATION AND RANKING

Evaluation of the GHG reduction opportunities identified in this project included a consideration of several ranking criteria (Table 10). Each of the GHG reduction opportunities were assigned a ranking point value for each of the criteria (5 = best, 0 = worst) which were summed to obtain the total points for the opportunity. Total points were used to assign the opportunities to a recommended prioritization timeframe in stage 3.

Table 10: Description of ranking criteria used in evaluation of GHG reduction opportunities.

Point Value	RANKING CRITERIA						
	GHG Reduction in 2050 (tonnes CO2e / year)	Timeframe (years)	Total Cost to Community (\$)	Cost per Individual Implementation* (\$ / location)	Cost per tonne of GHG reduced (\$ / tonne)	Payback Period (years)	Co-Benefits
5	Over 100,000	Immediate	No cost	No cost	No cost	Immediate	5 or more co-benefits
4	50,000 – 100,000	Up to 1 year	Up to 10,000	Up to 1,000	Up to 100	Up to 1 year	4
3	10,000 – 50,000	1 – 2	10,000 – 100,000	1,000 – 10,000	100 – 500	1 – 2	3
2	5,000 – 10,000	2 – 5	100,000 – 1 million	10,000 – 100,000	500 – 1,000	2 – 5	2
1	1,000 – 5,000	5 – 10	1 million - 10 million	100,000 – 1 million	1,000 – 10,000	5 – 10	1
0	Under 1,000	Over 10	Over 10 million	Over 1 million	Over 10,000	Over 10	0

**This is an indicator for situations where many buildings (residential or I-C-I), vehicles, or farm operations are collectively grouped in one GHG reduction opportunity. The 'cost per individual implementation' is intended to provide an estimate of the implementation cost that would be encountered by a typical owner of a building, vehicle, or farm operation*

The results of the evaluation of each potential GHG reduction opportunity against the ranking criteria is presented in Appendix E for both the 'conservative' and 'aggressive' modeling scenarios (to be defined in the GHG Modeling Analysis section of the report). Details pertaining to the assumptions used in the evaluation of each GHG reduction opportunity are provided in the "GHG Reduction Opportunities Catalogue" (Appendix D).

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STAGE 3: PRIORITIZATION

The recommended GHG reduction implementation strategy is based on the points scored by opportunities in the ranking and evaluation phase, with the highest prioritization for implementation being assigned to the opportunities with the most points or immediate payback periods (Table 11). GHG reduction opportunities are assigned to one of five implementation timeframes:

- IMMEDIATE (20 or more points or immediate payback)
- SHORT-TERM: within 2 years (15 – 19 points)
- MEDIUM-TERM: 2 – 5 years (10 – 14 points)
- LONG-TERM: over 5 years (less than 10 points)

It is recognized that there are additional issues beyond the evaluation criteria that were used in this assessment which the partner municipalities must consider in developing the Region’s GHG reduction implementation strategy. Examples include climate change adaptation strategies, social equity considerations, and many more. It is desirable that all GHG reduction opportunities that are considered for implementation must not have a detrimental impact on the other issues that the partner municipalities must manage. Therefore it is assumed that the partner municipalities will develop the Region’s GHG reduction implementation strategy based on the information provided in this report and other influencing factors that exist.

Table 11: Results of prioritization assessment of potential GHG reduction opportunities (using evaluation scoring of “Aggressive” modeling scenario). “No Municipal Control” indicates that the control or influence over the implementation of the opportunity lies with an external third-party(s) and not the partner municipalities.

Implementation Category and Timeframe	IMMEDIATE	SHORT-TERM (within 2 years)	MEDIUM-TERM (2 to 5 years)	LONG-TERM (over 5 years)	NO MUNICIPAL CONTROL
GHG Reduction Opportunities	Industrial sector GHG emission reductions Implementation of low-cost energy improvements in residential sector Require new I-C-I buildings be net-zero by 2030 Reduce landfilled waste from I-C-I sector Increase diversion of organics from landfill to	Additives for hydronic heating systems Conversion to natural gas heating for I-C-I buildings Berwick Community Solar Garden project Increase transit usage Alternative cattle feeding strategies Increased adoption of cover	Increased residential solar hot water heating Increased residential heat pumps Deep retrofits of existing homes Increased heat pumps in I-C-I buildings Meadowview solar facility Southwest Quadrant wind energy project	Conversion of residential water heaters to electricity Deep retrofits of existing I-C-I buildings Increased solar hot water heating in I-C-I buildings	Provincial electricity grid decarbonization Federal fuel-efficiency standards (light-duty vehicles) Improved fuel efficiency and electrification of commercial vehicles

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	<p>compost</p> <p>Reduce landfilled waste from residential sector</p> <p>Manure management strategies</p> <p>Improved nitrogen management</p>	<p>crops</p> <p>Increase of tree cover in Region</p> <p>Reduce tree harvest area through carbon offset projects</p> <p>Conversion of marginal farmland to vegetated</p>	<p>Increased use of ENERGYSTAR appliances</p> <p>Installation of solar PV systems (residential)</p> <p>Installation of solar PV systems (I-C-I buildings)</p> <p>Increased adoption of electric vehicles</p> <p>Increased use of active transportation</p> <p>Increased adoption of no-till agriculture</p>		
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GREENHOUSE GAS MODELING ANALYSIS

The third phase of the *Regional GHG E mission Reduction Opportunity Study* project was the **GHG modeling analysis**. Community GHG models are tools that allow local governments to assess the impact of predicted population changes and GHG reduction opportunities on the future profiles of community energy use and GHG emissions. Modeling analyses are performed using a range of scenarios that are designed to encompass the likely GHG reduction path that will be followed by the Region moving forward.

CURB GREENHOUSE GAS MODEL

The Climate Action for Urban Sustainability (CURB) model was used for the GHG reduction modeling analyses in this project. CURB was developed by the World Bank, C40 Cities Climate Leadership Group, and Bloomberg Philanthropies to help cities map out climate change action plans and to evaluate their cost, feasibility, and impact. CURB provides strategic-level analysis to help municipalities identify and prioritize low-carbon infrastructure and GHG reduction actions. CURB measures the GHG impacts of more than 1000 actions across six inventory sectors:

- Private Building Energy
- Municipal Buildings and Public Lighting
- Electricity Generation
- Solid Waste
- Water and Wastewater
- Transportation



Several data sources specific to the Region were entered into the CURB model (Table 12). In developing the modeled output on GHG reduction actions, CURB considers the influence or authority of the partner municipalities over each individual GHG source (ownership, policy influence, budget control).

Table 12: CURB model input data requirements and sources

CURB Model Data Requirement	Source of Data
Climate Category	Environment Canada climate normals data for Kentville CDA weather station
Population	2016 Census of Canada
Population Growth Prediction	Nova Scotia Department of Finance and Treasury Board
Electricity Grid Composition to 2050	Nova Scotia Power
Electricity consumption by sector	Nova Scotia Power, Berwick Electric Commission
Energy cost	Canada Energy Regulator (electric), Efficiency NS (fossil fuels)

MODELING SCENARIOS

An effective GHG reduction modeling analysis requires the definition of multiple scenarios to predict a range of forecasted GHG emission reductions. Modeling scenarios are defined based on the following input variables that will impact the future reductions in GHG emissions that can be realized in the Region:

- Population growth
- Renewable energy content in Nova Scotia electricity grid
- Fuel efficiency standards of on-road vehicles (light-duty passenger vehicles, commercial vehicles)
- Assumed adoption rates for the GHG reduction opportunities identified in this project

Four modeling scenarios were defined for this analysis (Business As Usual, Beyond Business As Usual, Conservative Reduction, Aggressive Reduction):

5. **Business As Usual (BAU)**: All input variables remain at baseline (2016) levels with the exception of population growth
6. **Beyond Business As Usual (Beyond BAU)**: Only input variables that are not controlled or influenced by the municipal partners fluctuate (e.g. population growth, electricity grid renewable content, vehicle fuel efficiency standards).
7. **Conservative Reduction**: All input variables are dynamic and fluctuate between the modeling milestone time periods (2030, 2050). A conservative set of GHG reduction opportunity adoption rates are assigned
8. **Aggressive Reduction**: All input variables are dynamic and fluctuate between the modeling milestone time periods (2030, 2050). An aggressive set of GHG reduction opportunity adoption rates are assigned

A description of the input variables that are manipulated in each modeling scenarios is presented in Table 13.

MILESTONE DATES AND ASSIGNED REDUCTION TARGETS

The modeling analysis performed in this project have utilized the milestone dates and reduction targets that have been defined by the Intergovernmental Panel on Climate Change as needed to limit anthropogenic warming to 1.5 degrees Celsius:

- 45% reduction in GHG emissions by 2030
- Net zero GHG emissions by 2050

These milestone dates and reduction targets have been adopted by a growing number of governments around the world, including the government of Canada, the province of Nova Scotia, and the Town of Wolfville.

REGIONAL GREENHOUSE GAS REDUCTION SPOTLIGHT

The Town of Wolfville has exhibited leadership in addressing climate change within its community. The Town has officially adopted an aggressive greenhouse gas reduction target to be a 'net-zero' carbon community by 2050. The Town has approved a *Climate Action Plan* to guide the path to achieve its net-zero carbon target.



Several greenhouse gas reduction initiatives have been implemented or planned in the Town:

- Installation of electric vehicle charging stations
- Conversion of district energy heating system at Acadia University from fuel oil to natural gas



Images courtesy of Town of Wolfville

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Table 13: Input variables assigned for each model scenario at milestone dates.

Model Input Variable	MODEL SCENARIOS							
	BAU		Beyond BAU		Conservative		Aggressive	
	2030	2050	2030	2050	2030	2050	2030	2050
Population Growth (% / year)	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
Electricity grid renewable content (%)	18.6	18.6	67.8	82.6	67.8	82.6	67.8	82.6
Fuel Efficiency Improvement (%)	0	0	19.1	40.2	19.1	40.2	19.1	40.2
GHG REDUCTION OPPORTUNITY ADOPTION RATES (%)								
1. Increased residential solar hot water heating	0	0	0	0	10	25	25	50
2. Conversion of residential water heaters to electricity	0	0	0	0	25	50	50	75
3. Increased installation of heat pumps in homes	0	0	0	0	10	25	25	50
4. Deep retrofits of existing homes	0	0	0	0	10	25	25	50
5. Use of additives for hydronic heating systems	0	0	0	0	25	50	50	100
6. Conversion from fuel oil to natural gas for space heating (I-C-I sector)	0	0	0	0	25	50	50	100
7. Deep retrofits of existing I-C-I buildings	0	0	0	0	10	25	25	50
8. Increased installation of heat pumps (I-C-I sector)	0	0	0	0	25	50	50	100
9. Increased installation of solar hot water heating (I-C-I sector)	0	0	0	0	25	50	50	100
10. Industrial sector GHG emission reductions	0	0	0	0	30.5	69.3	30.5	69.3
11. Meadowview Solar project	0	0	0	0	100	100	100	100

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12. Southwest Quadrant wind energy project	0	0	0	0	100	100	100	100
13. Increased use of ENERGYSTAR appliances	0	0	0	0	10	25	25	50
14. Increased adoption of low-cost energy improvements in residential sector	0	0	0	0	10	25	25	50
15. Increased installation of solar PV systems in residential sector	0	0	0	0	10	25	25	50
16. Increased installation of solar PV systems (I-C-I sector)	0	0	0	0	10	25	25	50
17. Berwick Community Solar Garden	0	0	0	0	100	100	100	100
18. Require new I-C-I buildings be net-zero energy by 2030	0	0	0	0	100	100	100	100
19. Electricity grid renewable content (%)	18.6	18.6	67.8	82.6	67.8	82.6	67.8	82.6
20. Increased adoption of electric vehicles	0	0	0	0	10	25	25	75
21. Improved Fuel Efficiency Improvement (%) for passenger vehicles	0	0	19.1	40.2	19.1	40.2	19.1	40.2
22. Increased transit usage	0	0	0	0	10	25	25	50
23. Increased use of active transportation	0	0	0	0	3	3	3	6
24. Improved commercial vehicle fuel efficiency (%)	0	0	19.1	40.2	19.1	40.2	19.1	40.2
25. Reduce landfill waste from I-C-I sector	0	0	0	0	10	25	25	50
26. Increase organic waste diversion from landfill to composting	0	0	0	0	10	25	25	50
27. Reduce landfill waste from residential sector	0	0	0	0	10	25	25	50

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28. Alternative cattle feeding strategies	0	0	0	0	10	25	25	50
29. Manure management strategies	0	0	0	0	10	25	25	50
30. Increased adoption of no-till agriculture	0	0	0	0	10	25	25	50
31. Improved nitrogen management	0	0	0	0	10	25	25	50
32. Increased adoption of cover crops	0	0	0	0	10	25	25	50
33. Increase of tree cover in the Region	0	0	0	0	1	1	1	1
34. Reduced forest harvesting through carbon offset projects	0	0	0	0	5	10	5	10
35. Conversion of marginal farmland to vegetated land cover	0	0	0	0	10	25	25	50

MODELING ANALYSIS RESULTS

The modeling analysis was performed for the four modeling scenarios and the results are presented in Table 14 and Figure 8 (a – d). None of the modeling scenarios defined in this analysis allow the Region to accomplish the target levels of 45% reduction by 2030 and net-zero GHG emissions by 2050 (Table 14). Not surprisingly, the Aggressive scenario achieves the highest level of GHG emission reductions. The Aggressive scenario achieves over 98% of the 2030 GHG reduction target level and over 78% of the 2050 net-zero GHG target level.

The Beyond BAU scenario is an indication of the predicted GHG emission reductions that would occur from externally controlled variables (e.g. fuel efficiency standards, electricity grid composition) without the partner municipalities implementing additional GHG reduction opportunities. The Beyond BAU scenario achieves 47% of the 2030 GHG reduction target level and 32% of the 2050 net-zero GHG target level. This modeling scenario indicates that significant effort is going to be required by the partner municipalities to accomplish the GHG reduction shortfall that is not met in the Beyond BAU scenario.

The stacked timeline graphs in Figure 8 display both the amount of predicted GHG emissions at each milestone modeling date as well as the contributing sectors to the GHG emissions. Figure 8a portrays the contribution of community GHG sectors to the Aggressive scenario modeled GHG emissions in the year 2050. The modeled scenario defined in this analysis was able to achieve 78% of the net-zero GHG target in 2050. Using the stacked

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bar graph in Figure 8a it is evident that over 80% of the remaining GHG emissions in 2050 are from three community GHG sectors:

- Institutional-Commercial-Industrial Fuel Combustion
- Grid-Supplied Electricity
- Transportation

Much of the emissions that are predicted to remain in 2050 are strongly influenced by externally controlled variables such as the provincial electricity grid composition and federal vehicle fuel efficiency standards. It is possible that the external stakeholders that control these variables (Nova Scotia Power, Government of Canada) may introduce more stringent and aggressive timelines for greening the Nova Scotia electricity grid or on-road vehicles, respectively. If more stringent and aggressive timelines do occur for these externally controlled variables it will contribute to a much more feasible 'path to zero' for the Region. In the meantime, the Region is encouraged to begin developing a detailed implementation plan that follows the Aggressive scenario GHG reduction opportunity recommendations to achieve the impressive GHG emission reductions that are predicted to occur.

Table 14: Results of GHG reduction modeling analyses for the four modeled scenarios.

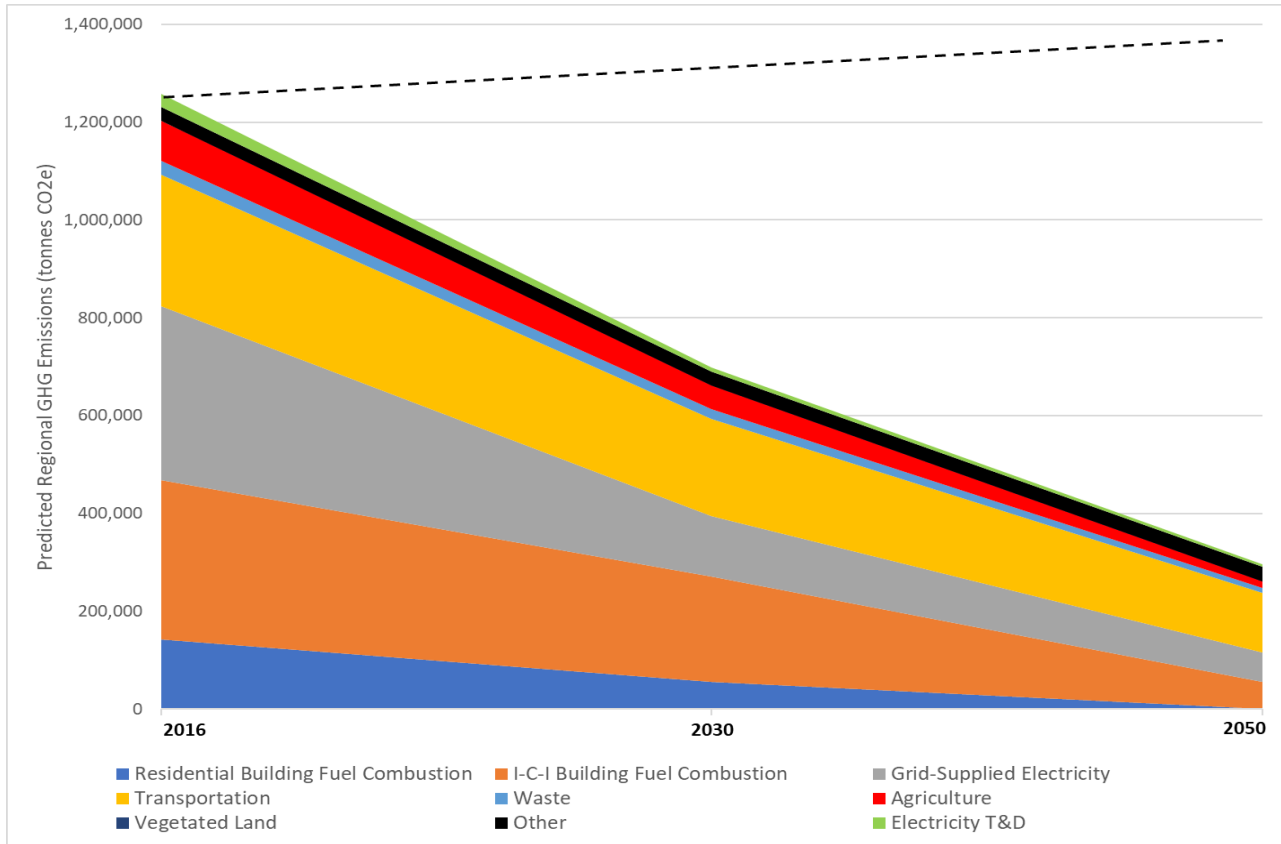
Base Year GHG = 1,257,399 tonnes CO2e	Modeled GHG Emissions (tonnes CO2e)							
	BAU		Beyond BAU		Conservative		Aggressive	
	2030	2050	2030	2050	2030	2050	2030	2050
Target Emissions	691,569	0	691,569	0	691,569	0	691,569	0
Reduction Needed	616,126	1,383,139	616,126	1,383,139	616,126	1,383,139	616,126	1,383,139
Predicted Emissions	1,307,695	1,383,139	1,016,478	933,064	824,352	461,142	699,055	295,654
Reduction Predicted	0	0	291,216	450,075	483,343	921,997	608,640	1,087,485
Reduction Shortfall	(616,126)	(1,383,139)	(324,910)	(933,064)	(132,783)	(461,142)	(7,486)	(295,654)

Figure 8 (next page): Graphic representation of modeled GHG emissions for each milestone year with the contribution of each community GHG emission sector. The dashed line represents the BAU emissions amount. Stacked graphs are provided for each model scenario: (a) Aggressive, (b) Conservative, (c) Beyond BAU, (d) BAU.

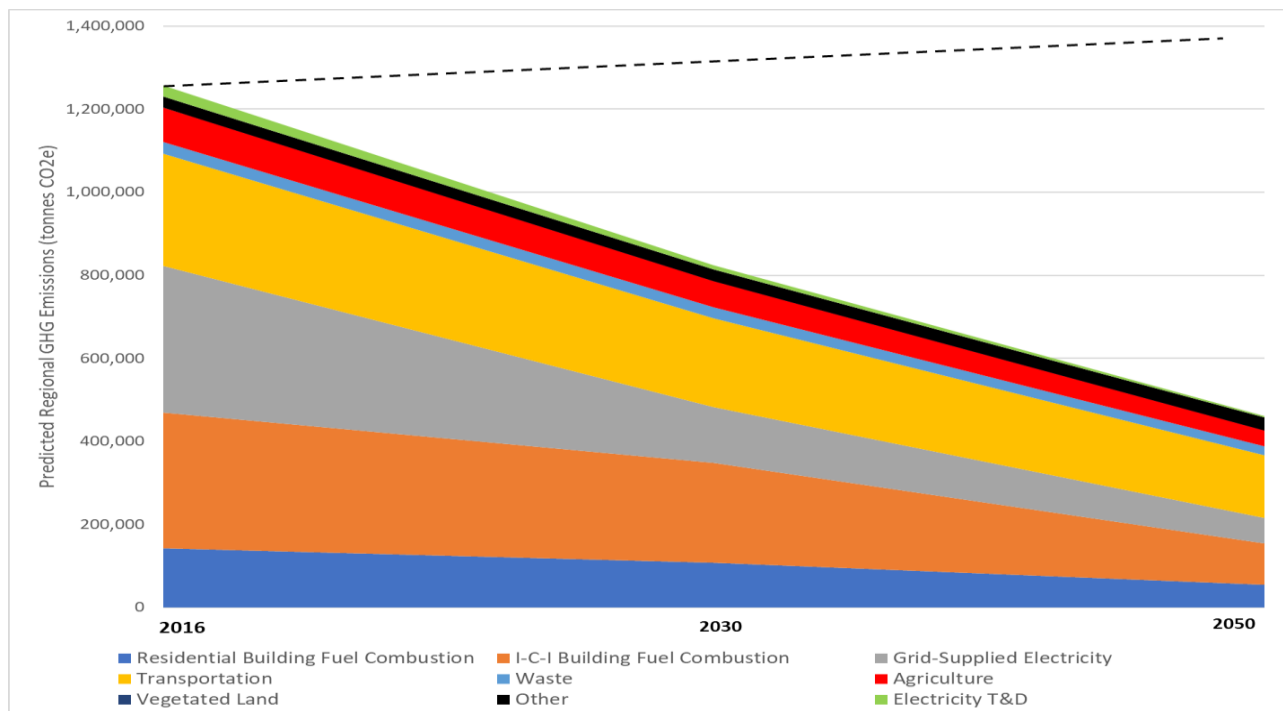
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a) Aggressive Reduction Scenario



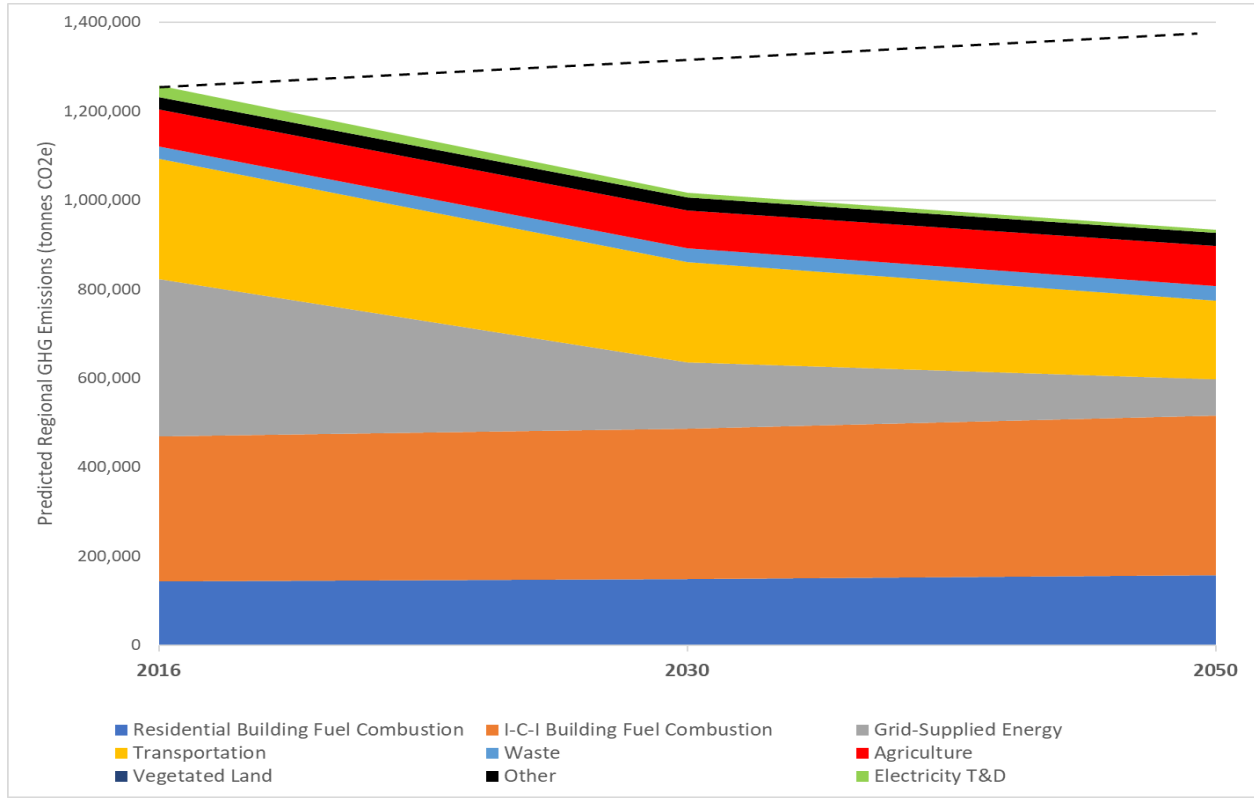
b) Conservative Reduction Scenario



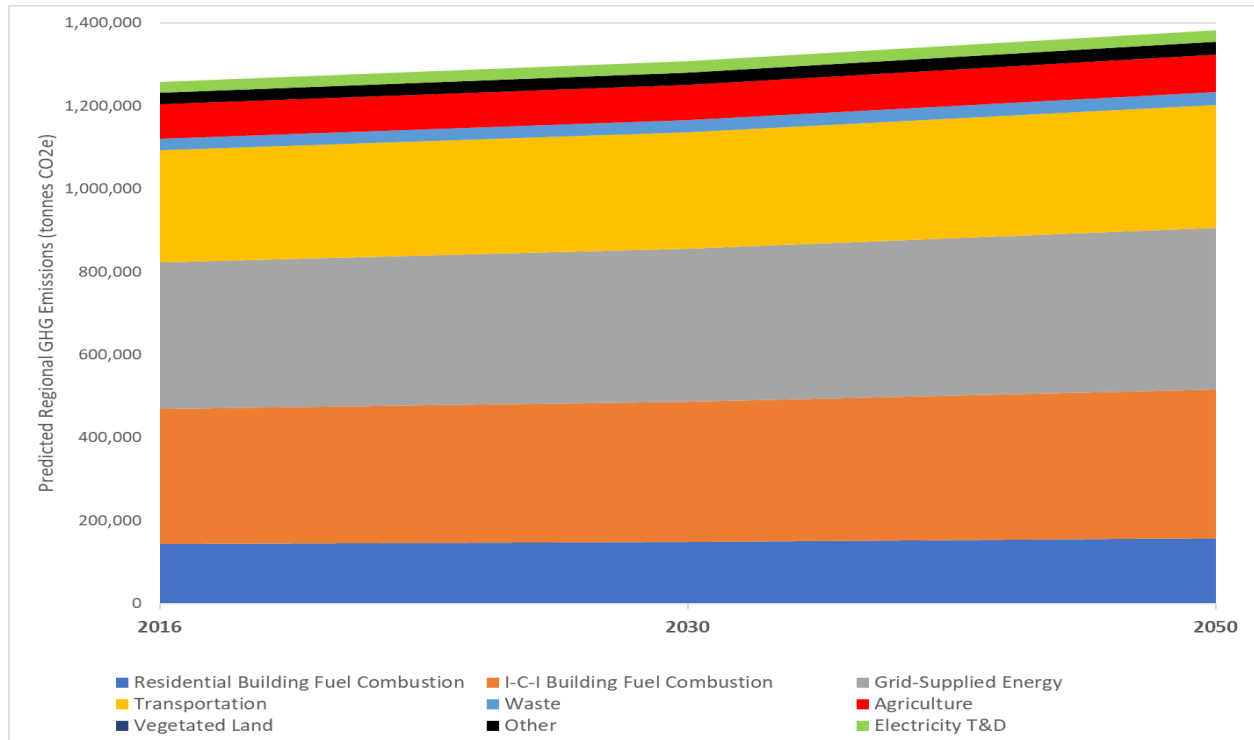
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c) Beyond BAU Scenario



d) BAU Scenario



RECOMMENDED NEXT STEPS

In the development of the *Regional GHG Emission Reduction Opportunity Study*, several opportunities have been identified for the partner municipalities to consider.

1. Development of a Regional Climate Action Plan

The *Regional GHG Emission Reduction Opportunity Study* is a critical step in the Region's journey to increased climate change mitigation and increased local energy security. This document has identified a range of GHG reduction opportunities available locally that will move the Region towards the ambitious targets for the years 2030 and 2050. However, the *Regional GHG Emission Reduction Opportunity Study* is not the final step. The Region's partner municipalities are encouraged to collaborate in the next phase of the Region's climate mitigation efforts which is the development of a Regional Climate Action Plan.

A Regional Climate Action Plan would take the higher-level findings presented in this report and develop a detailed implementation strategy for the GHG reduction opportunities. Specific 'implementation blueprints' would need to be developed for each GHG reduction opportunity that is adopted by the Region's partners. At a minimum the implementation blueprints should include the following specific details for each GHG reduction opportunity:

- Timeframe for initiation and completion
- Performance indicators that will be used to track progress
- Responsible organization or individual who will oversee management of the opportunity
- Sources of funding for the opportunity
- Detailed assessment of predicted GHG emission reductions

2. Adoption of Council-Approved GHG Reduction Targets

The modeling analysis performed in this project have utilized the milestone dates and reduction targets that have been defined by the Intergovernmental Panel on Climate Change as needed to limit anthropogenic warming to 1.5 degrees Celsius:

- 45% reduction in GHG emissions by 2030
- Net zero GHG emissions by 2050

These milestone dates and reduction targets have been adopted by a growing number of governments around the world, including the government of Canada, the province of Nova Scotia, and the Town of Wolfville. The partner municipalities of The Town of Berwick, Town of Kentville and County of Kings are encouraged to join the Town of Wolfville in officially adopting these GHG reductions targets to ensure a consistent Regional set of targets is in place.

3. Creation of a Regional Climate Action Coordinator Position and Climate Planning Committee

The potential for meaningful and lasting results to occur from the *Regional GHG Emission Reduction Opportunity Study* and a potential future Regional Climate Action Plan will be greatly enhanced from the creation of a Regional Climate Action Coordinator position. Currently the climate-related initiatives at each of the partner municipalities are led by driven and passionate individuals at different levels of management within their organization (administrative, management, executive). The current individuals also serve as climate representatives for their organization in addition to other roles that are their primary focus in their organization. A single individual who represents the interests of the Region and is primarily assigned to the Region's climate action planning is strongly encouraged.

In addition to the establishment of a Regional Climate Action Coordinator position, the Region is encouraged to establish a Regional Climate Planning Committee that is composed of staff or council representatives from each partner municipality. The current group of individuals at the partner municipalities who have helped to lead this project would be strong candidates to populate the Climate Planning Committee given their passion and expertise that have been showcased in the *Regional GHG Emission Reduction Opportunity Study* project.

4. Advocate for Climate Change Action Planning as a Unified Regional Voice

The results of this study have shown that the Region can accomplish impressive GHG reductions through locally-led initiatives, yet there remain significant shortfalls in the required GHG reductions that are required to meet a target of 'net zero carbon' by 2050. Over 60% of the predicted GHG emissions that will remain in the Region in 2050 under the 'Aggressive' modeling scenario are controlled by external organizations such as the Government of Canada (fuel efficiency standards of passenger and commercial vehicles) and Nova Scotia Power (grid-supplied electricity carbon intensity). The partner municipalities are encouraged to advocate as a unified Regional voice with these external organizations for aggressive climate change action.

APPENDIX A:
COMMUNITY GHG INVENTORY DATA

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(a) Region

GPC Ref No	Scope	GHG Emissions Source	Inclusion	in tonnes of CO ₂ e			Total CO ₂ e	DATA QUALITY	
				CO ₂	CH ₄	N ₂ O		Activity Data	Emission Factors
I		STATIONARY ENERGY SOURCES							
I.1		Residential buildings							
I.1.1	1	Emissions from fuel combustion within the community	Yes	68,300	12,657	1,669	82,626	M	H
I.1.2	2	Emissions from grid-supplied energy consumed within the community	Yes	167,093	187	746	168,026	H	M
I.1.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	Yes				12,581	M	M
I.2		Commercial and institutional buildings/facilities							
I.2.1	1	Emissions from fuel combustion within the community	Yes	65,411	24	423	65,858	M	H
I.2.2	2	Emissions from grid-supplied energy consumed within the community	Yes	82,495	92	368	82,955	H	M
I.2.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	Yes				6,209	M	M
I.3		Manufacturing industry and construction							
I.3.1	1	Emissions from fuel combustion within the community	Yes	156,126	935	459	157,520	M	H
I.3.2	2	Emissions from grid-supplied energy consumed within the community	Yes	103,089	116	458	103,663	H	M
I.3.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	Yes				7,755	M	M
I.4		Energy industries							
I.4.1	1	Emissions from energy used in power plant auxiliary operations within the community	Yes	6,561	3	36	6,600	H	H
I.8.1	1	Emissions from fugitive emissions within the community	Yes				806	L	H
II		TRANSPORTATION							
II.1		On-road transportation							
II.1.1	1	Emissions from fuel combustion for on-road transportation occurring within the community	Yes	114,927	200	352	115,479	M	M
II.1.2	2	Emissions from grid-supplied energy consumed within the community for on-road transportation	Yes						
II.1.3	3	Emissions from portion of transboundary journeys occurring outside the community boundary, and transmission and distribution losses from grid-supplied energy consumption	Yes				153,406	M	M
III		WASTE							
III.1		Solid waste disposal							
III.1.2	3	Emissions from solid waste generated within the community but disposed in landfills or open dumps outside the community	Yes				26,685	H	H
III.2		Biological treatment of waste							
III.2.2	3	Emissions from solid waste generated within the community but treated biologically outside of the community	Yes				691	H	H
III.4		Wastewater treatment and discharge							
III.4.1	1	Emissions from wastewater generated and treated within the community	Yes			1,753	1,753	H	H
IV		INDUSTRIAL PROCESSES AND PRODUCT USE (IPPU)							
IV.2	1	Emissions from product use occurring within the community	Yes				20,340	M	M
V		AGRICULTURE, FORESTRY AND LAND USE (AFOLU)							
V.1	1	Emissions from livestock within the community	Yes	0	36,543	17,995	54,538	H	M
V.2	1	Emissions from land within the community	Yes				-577,778	H	M
V.3	1	Emissions from aggregate sources and non-CO ₂ emission sources on land within the community	Yes	3,017	0	24,355	27,372	M	M
VI		BIOGENIC							
		Biogenic	Yes	162,627	0	0	0	M	H

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(b) County of Kings

GPC Ref No	Scope	GHG Emissions Source	Inclusion	in tonnes of CO ₂ e				DATA QUALITY	
				CO ₂	CH ₄	N ₂ O	Total CO ₂ e	Activity Data	Emission Factors
I		STATIONARY ENERGY SOURCES							
I.1		Residential buildings							
I.1.1	1	Emissions from fuel combustion within the community	Yes	54,526	10,105	1,333	65,964	M	H
I.1.2	2	Emissions from grid-supplied energy consumed within the community	Yes	133,296	151	602	134,049	H	M
I.1.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	Yes				10,098	M	M
I.2		Commercial and institutional buildings/facilities							
I.2.1	1	Emissions from fuel combustion within the community	Yes	57,092	21	369	57,482	M	H
I.2.2	2	Emissions from grid-supplied energy consumed within the community	Yes	50,997	58	230	51,285	H	M
I.2.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	Yes				3,863	M	M
I.3		Manufacturing industry and construction							
I.3.1	1	Emissions from fuel combustion within the community	Yes	119,701	716	352	120,769	M	H
I.3.2	2	Emissions from grid-supplied energy consumed within the community	Yes	99,987	114	451	100,552	H	M
I.3.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	Yes				7,575	M	M
II		TRANSPORTATION							
II.1		On-road transportation							
II.1.1	1	Emissions from fuel combustion for on-road transportation occurring within the community	Yes	103,894	183	321	104,398	M	M
II.1.2	2	Emissions from grid-supplied energy consumed within the community for on-road transportation	Yes						
II.1.3	3	Emissions from portion of transboundary journeys occurring outside the community boundary, and transmission and distribution losses from grid-supplied energy consumption	Yes				124,771	M	M
III		WASTE							
III.1		Solid waste disposal							
III.1.2	3	Emissions from solid waste generated within the community but disposed in landfills or open dumps outside the community	Yes				20,655	H	H
III.2		Biological treatment of waste							
III.2.2	3	Emissions from solid waste generated within the community but treated biologically outside of the community	Yes				527	H	H
III.4		Wastewater treatment and discharge							
III.4.1	1	Emissions from wastewater generated and treated within the community	Yes			1,152	1,152	H	H
IV		INDUSTRIAL PROCESSES AND PRODUCT USE (IPPU)							
IV.2	1	Emissions from product use occurring within the community	Yes				15,985	M	M
V		AGRICULTURE, FORESTRY AND LAND USE (AFOLU)							
V.1	1	Emissions from livestock within the community	Yes		36,543	17,995	54,538	H	M
V.2	1	Emissions from land within the community	Yes				-574,380	H	M
V.3	1	Emissions from aggregate sources and non-CO ₂ emission sources on land within the community	Yes	3,017		24,355	27,372	M	M
VI		BIOGENIC							
		Biogenic	Yes	126,598	0	0	0	M	H

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GPC Ref No	Scope	GHG Emissions Source	Inclusion	in tonnes of CO ₂ e			Total CO ₂ e	DATA QUALITY	
				CO ₂	CH ₄	N ₂ O		Activity Data	Emission Factors
I STATIONARY ENERGY SOURCES									
I.1 Residential buildings									
I.1.1	1	Emissions from fuel combustion within the community	Yes	2,308	427	56	2,791	M	H
I.1.2	2	Emissions from grid-supplied energy consumed within the community	Yes	1,997	0	0	1,997	H	M
I.1.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	Yes				74	M	M
I.2 Commercial and institutional buildings/facilities									
I.2.1	1	Emissions from fuel combustion within the community	Yes	2,205	1	14	2,220	M	H
I.2.2	2	Emissions from grid-supplied energy consumed within the community	Yes	1,040	0	0	1,040	H	M
I.2.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	Yes				39	M	M
I.3 Manufacturing industry and construction									
I.3.1	1	Emissions from fuel combustion within the community	Yes	5,927	36	17	5,980	M	H
I.3.2	2	Emissions from grid-supplied energy consumed within the community	Yes	1,453	0	0	1,453	H	M
I.3.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	Yes				54	M	M
II TRANSPORTATION									
II.1 On-road transportation									
II.1.1	1	Emissions from fuel combustion for on-road transportation occurring within the community	Yes	2,102	3	6	2,111	M	M
II.1.2	2	Emissions from grid-supplied energy consumed within the community for on-road transportation	Yes						
II.1.3	3	Emissions from portion of transboundary journeys occurring outside the community boundary, and transmission and distribution losses from grid-supplied energy consumption	Yes				5,466	M	M
III WASTE									
III.1 Solid waste disposal									
III.1.2	3	Emissions from solid waste generated within the community but disposed in landfills or open dumps outside the community	Yes				959	H	H
III.2 Biological treatment of waste									
III.2.2	3	Emissions from solid waste generated within the community but treated biologically outside of the community	Yes				26	H	H
III.4 Wastewater treatment and discharge									
III.4.1	1	Emissions from wastewater generated and treated within the community	Yes			99	99	H	H
IV INDUSTRIAL PROCESSES AND PRODUCT USE (IPPU)									
IV.2	1	Emissions from product use occurring within the community	Yes				842	M	M
V AGRICULTURE, FORESTRY AND LAND USE (AFOLU)									
V.1	1	Emissions from livestock within the community	Yes					H	M
V.2	1	Emissions from land within the community	Yes				-111	H	M
V.3	1	Emissions from aggregate sources and non-CO ₂ emission sources on land within the community	Yes					M	M
VI BIOGENIC									
		Biogenic	Yes	5,917	0	0	0	M	H

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(d) Town of Kentville

GPC Ref No	Scope	GHG Emissions Source	Inclusion	in tonnes of CO ₂ e			Total CO ₂ e	DATA QUALITY	
				CO ₂	CH ₄	N ₂ O		Activity Data	Emission Factors
I STATIONARY ENERGY SOURCES									
I.1 Residential buildings									
I.1.1	1	Emissions from fuel combustion within the community	Yes	6,930	1,284	169	8,383	M	H
I.1.2	2	Emissions from grid-supplied energy consumed within the community	Yes	18,759	21	85	18,865	H	M
I.1.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	Yes				1,421	M	M
I.2 Commercial and institutional buildings/facilities									
I.2.1	1	Emissions from fuel combustion within the community	Yes	5,252	2	34	5,288	M	H
I.2.2	2	Emissions from grid-supplied energy consumed within the community	Yes	13,495	15	61	13,571	H	M
I.2.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	Yes				1,022	M	M
I.3 Manufacturing industry and construction									
I.3.1	1	Emissions from fuel combustion within the community	Yes	18,299	110	54	18,463	M	H
I.3.2	2	Emissions from grid-supplied energy consumed within the community	Yes	756	1	3	760	H	M
I.3.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	Yes				58	M	M
II TRANSPORTATION									
II.1 On-road transportation									
II.1.1	1	Emissions from fuel combustion for on-road transportation occurring within the community	Yes	5,301	8	15	5,324	M	M
II.1.2	2	Emissions from grid-supplied energy consumed within the community for on-road transportation	Yes						
II.1.3	3	Emissions from portion of transboundary journeys occurring outside the community boundary, and transmission and distribution losses from grid-supplied energy consumption	Yes				13,496	M	M
III WASTE									
III.1 Solid waste disposal									
III.1.2	3	Emissions from solid waste generated within the community but disposed in landfills or open dumps outside the community	Yes				2,758	H	H
III.2 Biological treatment of waste									
III.2.2	3	Emissions from solid waste generated within the community but treated biologically outside of the community	Yes				75	H	H
III.4 Wastewater treatment and discharge									
III.4.1	1	Emissions from wastewater generated and treated within the community	Yes			265	265	H	H
IV INDUSTRIAL PROCESSES AND PRODUCT USE (IPPU)									
IV.2	1	Emissions from product use occurring within the community	Yes				2,105	M	M
V AGRICULTURE, FORESTRY AND LAND USE (AFOLU)									
V.1	1	Emissions from livestock within the community	Yes					H	M
V.2	1	Emissions from land within the community	Yes				-2,366	H	M
V.3	1	Emissions from aggregate sources and non-CO ₂ emission sources on land within the community	Yes					M	M
VI BIOGENIC									
		Biogenic	Yes	18,112	0	0	0	M	H

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GPC Ref No	Scope	GHG Emissions Source	Inclusion	in tonnes of CO ₂ e				DATA QUALITY	
				CO ₂	CH ₄	N ₂ O	Total CO ₂ e	Activity Data	Emission Factors
I STATIONARY ENERGY SOURCES									
I.1 Residential buildings									
I.1.1	1	Emissions from fuel combustion within the community	Yes	4,536	841	111	5,488	M	H
I.1.2	2	Emissions from grid-supplied energy consumed within the community	Yes	13,041	15	59	13,115	H	M
I.1.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	Yes				988	M	M
I.2 Commercial and institutional buildings/facilities									
I.2.1	1	Emissions from fuel combustion within the community	Yes	862	0	6	868	M	H
I.2.2	2	Emissions from grid-supplied energy consumed within the community	Yes	16,963	19	77	17,059	H	M
I.2.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	Yes				1,285	M	M
I.3 Manufacturing industry and construction									
I.3.1	1	Emissions from fuel combustion within the community	Yes	12,199	73	36	12,308	M	H
I.3.2	2	Emissions from grid-supplied energy consumed within the community	Yes	893	1	4	898	H	M
I.3.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	Yes				68	M	M
I.4 Energy industries									
I.4.1	1	Emissions from energy used in power plant auxiliary operations within the community	Yes	6,561	3	36	6,600	H	H
I.8.1	1	Emissions from fugitive emissions within the community	Yes				806	L	H
II TRANSPORTATION									
II.1 On-road transportation									
II.1.1	1	Emissions from fuel combustion for on-road transportation occurring within the community	Yes	3,630	6	10	3,646	M	M
II.1.2	2	Emissions from grid-supplied energy consumed within the community for on-road transportation	Yes						
II.1.3	3	Emissions from portion of transboundary journeys occurring outside the community boundary, and transmission and distribution losses from grid-supplied energy consumption	Yes				9,673	M	M
III WASTE									
III.1 Solid waste disposal									
III.1.2	3	Emissions from solid waste generated within the community but disposed in landfills or open dumps outside the community	Yes				2,313	H	H
III.2 Biological treatment of waste									
III.2.2	3	Emissions from solid waste generated within the community but treated biologically outside of the community	Yes				63	H	H
III.4 Wastewater treatment and discharge									
III.4.1	1	Emissions from wastewater generated and treated within the community	Yes			237	237	H	H
IV INDUSTRIAL PROCESSES AND PRODUCT USE (IPPU)									
IV.2	1	Emissions from product use occurring within the community	Yes				1,408	M	M
V AGRICULTURE, FORESTRY AND LAND USE (AFOLU)									
V.1	1	Emissions from livestock within the community	Yes					H	M
V.2	1	Emissions from land within the community	Yes				-921	H	M
V.3	1	Emissions from aggregate sources and non-CO ₂ emission sources on land within the community	Yes					M	M
VI BIOGENIC									
		Biogenic	Yes	12,000	0	0	0	M	H

APPENDIX B:
STAKEHOLDER SURVEY RESULTS

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LIST OF ORGANIZATIONS INVITED TO PARTICIPATE IN COMMUNITY STAKEHOLDER ENGAGEMENT:

Invited Organization	Participated in Stakeholder Engagement
Acadia University	Yes
Annapolis Valley Chamber of Commerce	No
Annapolis Valley First Nation	No
Benjamin Bridge Wine House	Yes
Berwick Electric Commission	Yes
Eden Valley Poultry	No
Efficiency Nova Scotia	Yes
FarmWorks Investment Co-op	No
Glooscap First Nation	No
Kentville Business Community	No
Kings Point to Point	No
Kings Transit Authority	Yes
Michelin Tire	No
Member of Parliament, Members of Legislative Assembly	No
Nova Scotia Power	Yes
QUEST	Yes
Valley Regional Enterprise Network	Yes
Valley Waste	Yes
Wolfville Business Development Corporation	No

APPENDIX C:
'WHAT WE HEARD' STAKEHOLDER FEEDBACK

Berwick Electric Commission

1) Could you please provide me some information about your professional background?

I started out as a lineman with Nova Scotia Power and have been working with the Berwick Electric Commission since 1979. I took over as the Superintendent and Manager of Utilities in 1983. I have progressively gotten more involved in regulatory affairs and the greening of energy supply.

2) In your opinion, what is the most pressing climate change concern impacting your community (i.e. sea level rise, forest fire, drought, warmer winters, etc)?

I would say that direct impacts on Berwick are generally going to be weather related, such as increased storms and rainfall. Since we are not directly located on the coastline, sea-level rise is less of a concern.

3) What are some challenges that you foresee that are preventing your community from implementing climate change action (i.e. lack of policy or funding opportunities, etc)?

I think the biggest struggle currently is transportation. We are seeing citizens move to heat pumps for heating sources and are encouraging that through a financing program. We are going to be installing several EV charging stations around the Town in an attempt to accelerate the uptake of personal transport. Through this, we are going to be increasing demand on our residential circuits and they currently not built for this capacity, so we will need to install extra transformers. Our concern is that increased electrical use can only be acceptable if we can make it sufficiently non-emitting (i.e. changing the source of electricity that drives the electric car).

Operating costs of electric vehicles is lower, and the total emissions from the vehicle will be lower as well. If you go up the manufacturing chain of the vehicles, there are some differences (i.e. it would take a certain number years for the higher carbon intensity of the manufacturing process to be paid back). Nova Scotia is currently 32% non-emitting, whereas Berwick is 80% because we import energy from outside of the province. Finally, the Berwick community generally recognizes that a climate emergency exists. We are getting more requests for rooftop solar installations because people would like to be a part of the solution.

4) What are the actions that your organization has taken so far to combat against climate change? Is there a sustainability plan in place?

While there is no formal plan in place, we have many climate-based initiatives on the go. We are planning on developing a sizable solar farm and are looking for imports that are non-emitting. We are also looking at a program to subsidize EV car chargers in citizens' residents. An electric vehicle is an additional 6000 kWh/yr for that customer, which is significant revenue for the Commission. Our hope is that we want to encourage the wise usage of electricity, replace carbon-emitting sources with electricity, and source virtually all of our power supply from non-emitting sources.

5) Could you please elaborate on the Berwick Solar Garden project? Is this initiative operational? What is its projected future contribution to Berwick electricity consumption?

Right now, we are waiting for the signing of a contribution agreement between the wind farm company (AREA – Alternative Resource Energy Authority). The contract is to build solar gardens in each municipality - Antigonish, Berwick and Mahone Bay. We expect to sign the contribution agreement in September, which would be between the provincial government and AREA. There has been already an announcement by politicians. We expect to start groundwork fencing in Fall 2021, and commence mechanical construction in Spring 2022. It is 4.8 MW in Berwick, which is close to 12,000 solar panels. We expect it to be fully operational by the end of 2022. It would contribute about 5000 Mwh per year to overall consumption, which is about 14% of sales. Solar farms also do not experience as much NIMBY-ism (Not In My Backyard) compared to wind farms, however land uses do tend to arise.

6) Could you please provide details on the Ellershouse / AREA Wind Farm? Any future plans to expand this wind farm or invest in other wind farms to increase wind contribution to Berwick grid?

There is a regulatory matter, which is making it risky to implement more wind related contribution to the grid. Wind energy is reliant upon back-up energy supply and there is a rate that Nova Scotia Power was encouraged by the government to set up called back-up top-up and spill services, where presently the wind farm looks to customers to regulate energy (i.e. same amount of kWh/yr) and we trade energy back and forth with Nova Scotia Power to retain that balance. The concept is that the inputs and outputs would be roughly equivalent over time. The rate is currently looking to be changed in a way that it is noneconomic for us to use. It is currently an open matter with the utility review board. If it is resolved in our favour, then building more wind farms would make more economic sense. Otherwise we will look at alternative means to backup wind power, which may involve diesel-powered generation and buying the most acceptable fuels that we can to run them with. There are some new options currently entering the market called hydron-treated vegetable oil which we are also taking a look at (whereby hydrogen is diffused and oxygen is extracted), or biodiesel, etc. We could also buy capacity outside of the province, but there is only a single transmission line that conjoins Nova Scotia with New Brunswick, which has limitations in terms of its electric carrying capacity.

7) What has been the performance of the Alba Nova pilot? Are there plans to expand the project beyond the pilot phase?

The project is still in the pilot and commissioning phase. We are currently awaiting a field evaluation by an approval rating agency to assess the safety of the battery units. This project is funded by and a collaboration between the Canadian Department of Energy and the British Department for Business, Energy and Industrial Strategy. They cooperated to sponsor projects that showcase innovative energy applications.

8) What has been the reasons for the underperformance of the Factorydale hydroelectric project? What are the predicted future levels of hydroelectric contribution to Berwick's grid?

The project is currently at a standstill due to some insurance issues that we are currently dealing with. Prior to this, it was underperforming due to lower streamflow and unexplained mechanical failures which led to a lot of lost production. Some of the rectifiers were failing at an unacceptable rate, which is currently being addressed. Overall, hydroelectric projects are unlikely to be expanded due to the limited cost effectiveness.

9) Could you please expand on Berwick overall grid renewable content?

Most of the imported electricity is derived from New Brunswick Power. The decision-making is based on both cost and the environmental impacts (i.e. GHG intensity factor). Currently there is no formal documentation from BEC to report on the annual renewable content values.

10) What has been the level of intake for the Home Heat Pump Program? What is the predicted level of future uptake? What is the projected contribution of this program to Berwick's annual electricity reduction?

We may have reached the point of market transformation already regarding the Heat Pump Program. They have replaced some fossil-fuel based heating systems in some citizens' home, which is a big win for us. But there are trade-offs as those people who are not able to take advantage of such programs will ultimately end up paying more for electricity.

11) What are some other energy conservation initiatives that the Town of Berwick has taken on in the past? Any conservation initiatives being planned for the future (confirmed or in-consideration)? What factors are reviewed in the decision-making for future conservation initiatives or renewable energy projects?

There is the PACE Program (Property Assessed Clean Energy) which looks at building envelope initiatives and is a priority in Nova Scotia.

Benjamin Bridge Winery

1) Could you please provide me some information about your professional background?

I am a Senior Manager at Benjamin Bridge, and a part of my organization's sustainability committee, which comprises of the Head Winemaker, myself and one of the owners of the winery. The three of us are at the executive/senior management level, and then the Head Horticulturist, Production Manager, Culinary Manager and E-Commerce Sales Manager. It's a little less representative of the company as a whole because it's an opt in thing. It's almost like an extracurricular thing. But I would say it is a pretty broad spectrum. So myself, I'm a senior manager, the head wine maker who's also a senior manager and one of the owners, Ashley McConnell Gordon, who's like the founding family. And actually, I'm part of the family as well. I'm

the first cousin of the twin sisters that own it. So there's three of us that are, I would say, probably like, executive level or senior management level on the committee. We have our production manager who's making a lot of the procurement decisions around packaging and sourcing for our supplies as it relates to the actual product, like the bottles, the screw caps, the parcels that they come in and what companies they're coming from. He's on the committee and then our culinary manager, who is in the hospitality team. It's largely like a senior management and mid-level management group. There's not a whole lot of people who are maybe, like, entry level, but a pretty broad range. It kind of touches the farm production, hospitality and marketing.

2) What are some specific risks and/or opportunities that you foresee impacting Nova Scotia's winery industry due to climate change in the coming years (operationally, risks and opportunities; expand on things mentioned in the survey such as carbon sequestration potential of winery, tilling practices, etc – opportunities; increased energy costs, carbon tax - risks)?

From an operational perspective, one thing that we have really struggled with is the local and foreign labour dynamic. It has been difficult to maintain a consistent and local labour workforce. Furthermore, energy costs have definitely been risks, but we have retrofitted one of our buildings to be more energy efficient and built off-grid huts for our agricultural team. We are also developing a solar array for those huts. On the agricultural side, the increased frequency and severity of storms, droughts, floods, overall higher temperatures, later frosts in the spring, etc.

3) You had mentioned in your survey response that one of the challenges preventing small businesses such as yours from implementing climate change action is the lack of a general roadmap – do you foresee the regional GHG study as a means to overcome that hurdle?

- a. **Does the regional GHG study have potential to facilitate increased regional or community partnerships related to climate change action?**
- b. **Could you please elaborate on some of the other gaps you had identified in the survey that are hindering climate change action (i.e. lack of funding and overall support, lack of educational resources for small businesses)?**

a. Yeah. I mean, from the operational perspective, like, one thing that we have really struggled with is local labor and the foreign labor kind of dynamic. And that's something with a lot of this mass migration and just, like, a lot of jobs in the agricultural sector. That's something we're really trying to inoculate ourselves against. It's been really hard to maintain a consistent local labor force. And if we're talking about reducing our footprint, and we have five or six people who are on our team coming for seven months out of the year from Mexico like that, that's like sort of an operational thing that we are really focused on. That's a short-term thing. Energy cost is definitely a risk. But we've renovated a building to be more efficient, and we've built off grid cons. It cuts for our agricultural team. We're just about to start on a solar array for those. So, we're trying to go off grid as much as possible. So that's kind of how we're addressing that that risk, then just on the agricultural side, like, I know you said operational, but like on the agricultural side, like, I think just the boiler plate stuff is like the increased frequency of storms, the increased severity of storms, the increase of extremes of both drought floods, higher heat units in the summer, later and later frost in the spring. I hate to phrase it this way, but in a good position with grapes because they're genetically from an arid climate. And so, they do well in droughts and high heat, unlike a lot of our mixed used farms

around here. So, we're kind of good in that way. But again, it's just a matter of time before we get wiped out and then just something that's very specific to the wine world that might not be on the radar is acidity is very important in wine and something that Nova Scotia has hung it's had on and is very, very important to our style of wine is high acid. And the only way you get to high acid is by having long, moderated summers without drastic increase of heat units. And so, we are able to mature our this is kind of going off on a tangent, but we're able to mature our grapes on the vine for a longer period of time. They pick in late October, early November for some of our sparkling at a very high acid level, which means we're getting a very mature flavor with a very fresh float profile. And this is equivalent to what champagne would have experienced if I'm correct in the 1960s, 1970s. But because of global warming, they've lost those acidity units over time. And now champagne itself, as the region is becoming, they're having to pick earlier and earlier, and they're picking green fruit. So, this is actually it's very particular to wine, but it's now starting to impact the qualitative, what they can ask for those bottles of wine. And so, we kind of talk about how we're adjacent to the champagne terroir, and we have a very similar climate. But we talk about this internally that the writing is on the wall internally for us to be making the champagne styles of wine that we're making in building an international reputation on, like we're just in that sweet zone and headed towards the same place that champagne is headed.

In terms of offsets - So we haven't looked into agricultural offsets, but that's definitely something we'd be super keen on. And I feel like for Benjamin Bridge, we were started as a labor of love and for many, many years, we didn't have to be super profitable in order to keep going, because it was an investment by the two people who started the business. Any other winery is like a rational business that in order to invest in something more sustainable, like the are going to need an incentive. So for us, we're able to do this as sort of like a value add or because it's our own personal values or it's future proofing us even just in terms of our marketing, that people want to buy from ethical businesses who are concerned with these things. Other businesses are very much going to need an incentive. And I think that would also incentivize us to really track it a bit more closely. Agricultural offsets would be amazing. And that was the whole carbon offset thing as we looked into that. And we're like, okay, we're going to pay, like, \$75,000 a year to have, like, trees planted somewhere in Northern Ontario. Like, that just doesn't make sense for us. When we started, we also work with consultants who are into organic and biodynamics. And we were just talking about what a metric ton of living soil can sequester with the microorganisms that are living in the soil, with the fungus and just the different life cycles that are happening there. And just also, as you touched on how we cut the cane, what we do at that cane, whether some wineries burn it or wood ship it? Well, we have a compost pile, and that goes into an anaerobic composting system. So, yeah, just lots of little micro decisions along the way. But I would say for us there's almost we could cobble together some traceability, but it would be pretty raw. I think those are the two things offset, like some sort of incentive for other businesses to do this, and then a good model to track it.

- b. Yeah. I mean, we started out by approaching the County of Kings, I think she's the sustainability coordinator or climate change coordinator, and she gave us all of the resources that she had available to us, but it was still sort of it was, like was sort of up to you. And I think if you don't have somebody on your team who's super passionate about it or even, like, pretty well versed in it. It's just it's very intimidating and just mountainous that you don't know where to begin. And I think what I was kind of referring to as a general roadmap is here's ten

things that you as a business could do, like reducing your plastics, like figuring out how much packaging you use and trying to reduce it by 10%, even just things that are industry standards. Because when we started this, we just didn't really know. Is it achievable to get to no plastic? Are there even alternatives for the tapes that we use? And there's just certain things that were like, how do we even go about finding the alternative? So I think having that, like, really basic, basic, basic roadmap for a business on where to start. And then I think once you're on the path, then like, for us, our journey was finding out pretty early on that carbon offsets just did not fit our philosophy. So they'll figure it out as they go. But having somewhere to start, I think, is the biggest hurdle for small businesses who don't and small businesses in particular don't have a lot of wiggle room with time and resources.

4) Could you please tell us a bit more about your organization's sustainability plan?

It's pretty loose, but we have we have our sustainability plan actually is not just about the environmental side. It's also about the people side of things. The operational profit side of things is kind of like the background piece, but we're really trying to move towards what we call like a regenerative model. So we were organic for 20 years and our vineyard. And now we're moving towards more a regenerative agricultural model, which means that every five years or something like that, we may have to spray a synthetic molecule and not be considered organic. But more important to us is that we are composting all of the waste that is coming from the property that we're actually using that to encourage microbial health on the mind, all of these sort of closed loop kind of systems. So within that Regenerative model, one of the things with people is like fair wages. We have health benefits for all people on our team and including our seasonal vineyard workers. We pay like two or \$3 above minimum wage as the entry level wage coming into our hospitality. Nobody on our team is paid minimum wage, even if it's their first day at the lowest paid job in the company, it's above minimum wage. And there's also a really important thing in the regenerative model, which is that you have transparency from top to bottom in the business. Yeah, we have really open meetings, all this sort of stuff. So we have the social things that are kind of coming along. We've been doing anti racist workshops as a management group, all of these sort of social justice, super progressive, just everything we can to look after people, because that's what we sort of identified early on. That unless we're looking after the people who are working in the business, reducing greenhouse gases and reducing our plastic consumption. And all of these things don't really matter, and they have to happen one at the same time. So it's an integrated approach. And on the environmental or planet side of things, we have, like, real broad goals at this point in time. So one thing is that we use a lot of water in a winery because we're cleaning tanks all the time. We're cleaning floors. And so we installed flow meters on on our water systems and on all of our tanks so that we can assess I get a one year snapshot of during the harvest season is because we're cleaning presses from cycle to cycle, so that's when we really use the most amount of water. So we're trying to this year capture our water use so that we can figure out how to either reduce that or get a recycling system in place to we have just a standing mandate that at every turn of a decision, we're always trying to make sure that there's no plastic involved and shortening any transportation to get goods to us. So a lot of our glass might come out of Germany or France. Corks are coming from Italy. A lot of materials are coming out of France. So we're trying to look for either local suppliers or in a lot of cases, we're taking prototypes that we have from France to a local manufacturer and saying, Can you replicate something like this in aluminum for us here and other things, too, like we used to buy all of our packaging came from Uline cardboard packaging with plastic inserts that were molded to fit a wine bottle. We found a pulp company out of Ontario that does recycle pulp fiber inserts. So we now have those fiber inserts. And the

cardboard boxes are now produced with Maritime Paper, which is a company here that has, like, a forestry certification that they work with in New Brunswick. So the Mills are in New Brunswick, the manufacturers in Dartmouth, Nova Scotia, just those kind of decisions. So any opportunity, every person on the sustainability committee is aware. But every person on the team is aware that at any opportunity, if you can make a more local or a better product decision, will pay X amount more for that. We are installing a full solar array with, like, a battery system and stuff. So those are going to be completely off grid. Our current building, our winery building is on the grid. It does have, like, a lot of green sort of technology. One of the sisters who owns the winery is an architect. And so she has built in lot of efficiency into the building. But her dream is for when our next building, which isn't going to be in the next two to three years built, we're going to probably go for LEED certification on the building itself. People work in production. We're just trying to really empower people to just like, let go early days of like, let's try to trace it. And then we can report back to our customers about, like, we reduce our carbon footprint by X amount, and we kind of have let that go because it's just like we'd rather make the better choices than try to trace it, which again relates back to that point, running a small business, you have to let go of those things sometimes.

5) Could you please elaborate on some of the climate change actions that you identified in your survey responses?:

- **Need to audit GHG emissions**
- **Recycling of grape waste into new beverages**
- **Increase biodiversity and soil health for greater carbon sequestration/acre**

Need to audit - I think that was probably what I think because we haven't audited. We haven't done a formal audit, and we did contact a company who could come in and do that for us, and we just hit pause. We were planning to get started on that when COVID hit, so we decided to hit pause on getting our greenhouse gas audit done. And we also at the time, felt like we didn't needed to do more research in terms of whether that was beneficial to us and how we were going to use that audit.

Recycling of grape waste into new beverages - That's a really exciting thing that we've just started doing. And we actually had reached out to the town of Wolfville. We were trying to find a way to kind of tie it to climate crisis, and we thought that we could do something with the town of Rolesville, where, like, a certain percentage of the sales from the cans could go back into, like, an initiative in our local community. We weren't able to get that piece of it off the ground before we launched it. But essentially, the way it works is to make wine is you have full, full, plump grapes. They all go into a pneumatic press with, and the lung presses them, and the juice falls out of the bottom. The juice gets moved into a tank. It ferments and becomes wine. These presses, they can tumble and they sort of like, shake up and loosen up. This is what we call Pumas, and the grape hummus can be pressed over and over and over again until it becomes almost like a dry cake form. And at that point, it's kind of like it's done. A lot of people just put that into a garbage bin. Or for us, we would normally just compost that. But we were through the lens of sustainability. We were trying to figure out how can we extend the life of that? How can we sort of reuse that in some way rather than just recycling it in our compost? And so there's this concept in old French wine making, where they would press the grapes to make the good wine. And then they pour water back on the grape skins and then let that ferment again, and the initial wine might make it to 12% alcohol through the fermentation. This would only make it to five to 6% alcohol. And it was sort of a slang word, meaning like the crap wine and that crap wine. The peace would be the wine that

was given to the vineyard, the agricultural workers at lunch because they didn't want to give them the good wine, but also a lower alcohol wine you could have at lunch. It. So we wanted to kind of take that and turn it on its head because not only is it sustainable, but the idea of the vineyard workers are now the owners in this day and age. And we all grew up on the vineyard. But we're now the people who are making the line. We put water back onto the grape skins, be allowed to men for a second time. And we've made two versions of this. And so they're a 6% alcohol wine that we actually do in aluminum cans. A big debate or a big topic in the wine industry is bottles. There's no reason that people should be packaging and heavy glass bottles that are imported from all over the world because they just have a huge carbon footprint. So we've been really pushing this aluminum can trend in Nova Scotia. So everybody's following suit. But it's not only a great economic model for a winery to be able to get a second pressing out of your grapes. But it's just like an addition of water. You're also getting that low, moderate alcohol that people are looking for. And it's kind of when those grape skins go to compost, they are done done done at that point. Yeah. It's just about pushing the raw material a little bit further. And we are embarking on something this year, which is going to be extracting further flavor components from low skin after the pressing. So we're hoping to get a third life out of them. But yeah, that was a big project, and we're super happy with how that one.

Increase biodiversity and soil health for greater carbon sequestration/acre - We have an apiary of about nine or ten beehives where we're producing our own tiny. And so we've added pollinator gardens to feed those bees. And we have a culinary garden where we're growing a lot of heritage things there. We're producing our own popping corn that then we use in our winery. When people come and have a glass of wine, you're giving complimentary popcorn with your glass of wine that's grown on the property to do all of these, like, really integrated things. But the idea with that is that everything is kind of like being used on the property. So the corn stocks and husks, like when we harvest those for the year that gets added to our great compost, and then we're doing things like we're making compost tea out of that, and then that gets applied to the culinary gardens. But that will also get applied to our vineyard. So that's just kind of like a good, healthy dose of microorganisms with those compost teas. That is like just adding that rate to the soil itself. We've moved away from tilling practices both in the vineyard and in the culinary gardens, trying to get to that more kind of like a permaculture approach where we're not mowing or killing unless we really, really have some other sort of benefit that outweighs. That both the tractor usage, the fossil fuel usage, the compaction on the land, but then also the oxidization of the soil and the loss of an ecosystem within the soil. So we have a lot of these little projects that are going on. We have a fresh water spring on the property. We've got a lot of wildlife. We're just trying to really encourage that. We don't no longer like mow ditches or the headlands around the vineyard, because that's where all of our weeds and sort of Indigenous species are growing. And we're just trying to really monitor that and just really take stock of what's growing on the land and what we can encourage. And we have milkweed growing, and so we're trying to make sure that that gets a little fence put around it into the milkweed, so that it is going to propagate year after year because we're surrounded by corn farmers down here, and they're all knocking back the milkweed as much as they can. So just trying to make our 90 acres of vineyard in the Gasparo Valley, trying to make that like a refuge and just letting we have to chop down a tree that's going to be allowed to rot. That's not going to be wood chipped or burnt, like it's going to rot into the soil, just little things like this. And then also within our vineyard practices, there's a whole bunch of things that we're doing. We're trying to use plant based practices more so than synthetic anything. So if we have a mild problem, we're using stinging nettle as a tea. We use chamomile tea. We're using horse tail as a tea. A lot of teas are getting spread on our vineyard, and those have different

microbial properties that actually help the plants. But it also increases the soil life. And we work with a biodynamic consultant who kind of helps us with that stuff. And he'll make recommendations about what we should be doing and when to kind of just have things that will never, ever impact the bottom line of a bottle of wine. But they're going to very much impact the soil life on the 90 acres that we're kind of like occupying. Yeah, I'd say that's a very loose answer, because a lot of it's not quantifiable right now, but it's just again, it's like this general sense of everybody's pushing in the right direction and making little changes here and there.

6) Are there any new initiatives being considered?

We have one new initiative. I don't think I'm allowed to disclose what it is just yet because we're trying to strike a deal on it, but it does relate to the solar industry, solar power. And I'm just trying to think of one that I could maybe disclose. We have a few different format things that we're trying to come out with. We're just looking at tons of different formats to try to move. We really feel like in the next ten years, the wine industry is going to be moving away from wine glass from glass bottles, heavy glass bottles. We can't do that with all of our products, but we're looking into, like, any and all formats right now, including, like, Tetra packs boxes, big aluminum cans, small aluminum cans, just like everything that you can imagine. We're trying to be as open minded as it relates to that as possible. And I think COVID really showed that a lot of things could be done. You saw a lot of cocktail companies and a lot of different wine companies doing tasting packs in compostable couches and stuff. So we're really excited about all that kind of stuff. And we just had a meeting this morning kind of talking about let's put all the options on the table. Let's find out how much they cost, where they come from, how they're produce and trying really hard not to stay stuck in this model of, like, wine comes in a honking big bottle and get shipped around the world that way. But, yeah, that's one thing that we're working on, and then there will be. I mentioned this LEED certified building like that we were supposed to start work on that this year, but like, a few different elements came to play. But eventually in the next couple of years, that's something we do need is like a purpose built building where we're broken up right now between two communities. We're actually broken up between just outside of Wolfville and in the industrial park and Berwick. So that's not great because we're doing a lot of commuting, so we need to figure out our warehouse model, but also we don't have enough hospitality space. So we will be building something eventually and that we want to be very thoughtful with how that happens.

7) Some research shows that climate change could have a positive impact to Nova Scotia wineries. What is your opinion on this matter? Could speak more to the unpredictability of growing seasons that you had mentioned in your survey response (ability to grow new varieties of grapes, longer growing season, milder winters)-

<https://www.cbc.ca/news/canada/nova-scotia/climate-change-nova-scotia-wine-industry-grapes-1.4508844>

How do you get excited about something like that? Right? Like that. Is that's, like, climate crisis right there? Like, the fact that over 30 years, like, you can't grow certain plants and suddenly you can grow plants. So, I mean, yeah, it's great. We can grow wines that we couldn't grow before. But to me, it's always like, at what cost? And this is what I was kind of talking about with that champagne model is like, well, we had a really hard time. Solano is one of the most difficult grapes to grow because it wants to be in Southern France. That's where it's from. And, you know, like, in this model, it looks like we're going to be able to grow some solvable. But it also like, will our friends who grow wheat and raise pigs and all of this stuff like, will they be benefiting from it? It

might be more suitable, but grapes, like genetically come from the Fertile Crescent, which is yeah, like, pretty different than Nova Scotia. Yeah. This has been the wine makers, like, everybody's talking about this. How it's like it's getting better and better, like, 2020 was like, best vintage on record. And what happened to all of our farming friends? Like, they suffered severe droughts and everybody invested in irrigation for the first time in history in Nova Scotia. So, I mean, it looks accurate. I would agree it's gonna get better and better for grape growing in Nova Scotia. It's just such a hard thing to feel any positivity about, I guess, objectively. It is positive that it will become more suitable for grapes. But, like, emotionally, I find it very difficult to be at all excited about that even as a wine grower. But yeah. I mean, if you see, like, our region already in the 2018, like, we're that little green strip, that's very, very suitable. And it's one of the only strips in 2018 other than over. So sure. And over there on the So shore, where there's that sort of green just below your cursor that is not super suitable because they get a lot of fog, so they might be warmer, but they're not great. e have a grape growers over there and the quality is not quite there. It's good filler, but that little line in the Valley, that's the apple growing region. It's a traditional farm Valley and that dark green line right there is a right in there. That's where we're growing now. It is suitable now. And there's very few spots in Nova Scotia that you can grow. So it's great. Everybody will be growing grapes in 2050. But those coastal ones, like, down along the Southern Coast there in 2050, all those new green pockets, even though they're going to get the heat units to ripe in their grapes, they deal with so much fog. Like, if you travel down to that region, all of the pine trees, like you'll have a 50 year old pine tree that's 10ft tall because of the wind. Like it's barren kind of landscape. Yeah. It's going to be a better climate for it. But will the top soil be any more fertile? Probably not.

Nova Scotia Power

1) Could you please provide me some information about your professional background?

Educational wise, I am a chemical engineer who graduated from Dalhousie University. And as I said, working with such power and the environment team various roles there, including inhibitions reporting calculations and pre-recording, etcetera. And then two years ago moved into the asset management team, doing a lot of risk management work and also working on the climate adaptation file within that role. Yeah, that's my background.

2) Could you please tell us a bit more about your organization's sustainability plan?

So each year at the Emera level, so Emera being the parent company that they compile sustainability stories and sustainability metrics that goes into an annual report that's available publicly stakeholders and just general public. So that's sustainability report and the program that sustains that is fed into by each of the Emera affiliates, including those quotient power. So we have engagement every year again that provides updates on appropriate metrics within sustainability, whether it's resource consumption, emissions reduction plans, way and resource type stuff, as well as typical sustainability metrics. We feed into that program, keep those programs going, communicate back through that annual report. And within that, you'll find sustainability reports as well as their climate commitment, which lines within our net zero by 2050.

3) Could you please elaborate on the renewable energy target you had mentioned in your survey answer (80% by 2030)? How do you foresee attaining this target?

So another good resource that I want to point you to is the 2020 IRP (Integrated Resource Plan) report. Our Integrated resource plan, which is our long term strategic planning document. So it's a 25 year outlook on our future infrastructure. It has some nice graphs on GC reductions as well as load growth scenarios or load profiles, scenarios that are a range of scenarios that would be possible that the plan to cover. That kind of outlines the difference paths or different potential paths to those different targets, including 2030. Since then, we've kind of locked in on the specific scenario of our coal generation fleet retiring by 2030. Initially within the IRP plan, that we would have talked about. A couple scenarios with the coal generation fleet retired by 2040 versus 2030 in both scenarios are talked about in the IRP, where this had since then, NS Power has made the commitment that we will be retiring all of our coal led by 2030. Within that retirement plan, we set to offset those lost megawatts. So that'll be done through a combination of means again outlined within the IRP document. But they are pretty, I guess, common to other utilities in Canada. So we'd be looking at greater regional integration. So some transmission investment to link into other jurisdictions to bring in renewable hydro generation that would be increasing in generation on our grid. And the province would have released that latest RFP for 350 MW of new wind development, to offset some of that coal fleet going offline. And then we're also looking at some coal conversions. So converting essentially some of those coal units to burn natural gas. And then an increase, essentially a fast acting generation. So our combustion turbine fleet or jet engines, so to speak, that's the main plant for 2030. Essentially there's four main generating units across the province that burn primarily coal. And that would be the coal fleet.

4) What is the estimated contribution of the utility's wind energy generation (i.e. wind farms at Nuttby Mountain and Digby Neck, etc) to Kentville, Wolfville and the County of Kings? Are there any future plans to expand wind generation or invest in other wind farms?

That's a good question. I don't know off the top of my head what, you know, relative contribution they would provide town. But I could find that out. The second question, the second part of the question on what new wind infrastructure would we be planning, and that's a bit of a question mark at this point. Again, it's a discussion with the Province on how much of a role Nova Scotia Power will play in new wind development versus other private developers or entities potentially playing a role there at this time unclear how much when development we will take on ourselves at this point.

5) Once fully operational, what will be the total contribution of the Maritime Link to the grid?

Yeah, I don't want to get that number wrong, so I don't have it off the top of my head either. I know it's quite publicly available if you search for associate base block that strikes needed minimum 150 MW with the ability to above and beyond that for additional energy that will be available on the market for anything above and beyond that base lock that comes out of Newfoundland. So yeah. Okay. I don't know. Off the top of my head, I know that is quite publicly available.

6) What has been the performance so far of the Annapolis Tidal Station project? Why haven't more tidal projects been implemented?

So Nova Scotia Power has a long history with tidal. Actually, we installed our first tidal system, Annapolis Tidal system in late seventies, early eighties, and that was a dam storage type design, and that was functioning operating until about three, four years ago. We've since made the decision to decommission it. Beyond that, the power. We did do an initial trial of the underwater tidal turbines, the Minas Basin Station. Our initial trial, it was in for several months. So we did successfully pilot the deployment of those turbines and recovery. But since then, the pilot did transition to Emera and became an Emera tidal initiative. And they did their own pilot. But I don't know, I haven't been following the last two, three years, if that still, it's still an active research project. I know there are still some other developers in the space that are still looking at different research initiatives into tidal energy, but as it stands today, no switch power not actively working on any new tidal development. But yeah, it's just the investment needed to extend the life of that particular asset just exceeds how much generation it actually provides. It just doesn't make a sense. Which is why we moving towards decommissioning at this time. But from the new research, the new types of tidal that the companies are looking at it's single turbines that live bottom of the space and there to be commercially viable. They have to lay out a group of them that are all connected to a distribution network that comes on shore. So that's kind of the different projects that have been proposed, but again, not being actively worked on by Nova Scotia Power. And the main reason is there's still viable alternatives and the cost for wind development is still significantly cheaper compared to tidal, tidal still is quite a bit more expensive to develop and the challenges of deploy and bring the turbines up for maintenance.

7) What is the source of biomass fuel used at the power plant in Port Hawkesbury? Are any plans to expand the use of biomass as an alternative energy source in Nova Scotia beyond this initiative in the future?

So the biomass site burns a combination of bark and chips, and they also have the ability to for natural gas when needed as well. So they kind of dual source ability. The source of the biomass is managed there's regulations or strict, I believe it comes from various sources. The sawmills which provides the wood chips of the bark. For the most part, is byproducts or residues that are being used as the feedstock for that biomass plant. And it's not new trees being cut down specifically does be used as a wood chip source. For instance, we did do some trials, maybe a decade ago on biomass. But by and large, we haven't increased that adoption. I don't know all the reasons why, but, you know, we're not really. I think it's probably again within the regulations, there are limits on how much biomass we can actually burn. I think within the proper biomass plant that's probably going to be our main source of biomass.

8) Is the Community Solar Garden Pilot Project currently operational? Are there any future plans to expand/set-up similar initiatives in Wolfville, Kentville or and/or the County of Kings?

We have a small team, our smart Grid Nova Scotia team that are that are doing several different pilots or research and development projects and initiatives. So the solar garden was one of those such initiatives. Another example was the battery pilot program done a couple of years ago. But it was just a matter of our team looking at wanting to do that, a solar garden or solar have a commercial scale solar project. I know quite a bit of work went into pro finding a suitable site over such a development. And then I know there was an application made with Natural Resources

Canada to support that program and help fund that particular development. And that was a successful application. It was a matter of take advantage of federal program to support that development. Yeah. I know what last I heard a month or so ago, construction was ongoing, but still in the pilot phase. And within our IRP, we looked at, you know, is that it makes sense for us to continue to look at developing solar more broadly. That doesn't come out as a clear recommendation from the IRP planning process. Again, wind is still our economic choice, and there's still more suitable locations. Solar again, pending changes, like if there's further government incentives or other reasons that would make it more commercially viable.

- 9) You had mentioned in your survey answers that the electrification of sectors such as vehicles and home heating are also a means to decrease energy use/increase efficiency. Could you please elaborate on some of the initiatives the utility has implemented in this regard? What is Nova Scotia doing to promote these opportunities (i.e. electrification of vehicles and homes)? Are there future initiatives on the horizon?**

Yeah. And certainly there are some levers that no switch power utilizes when it comes to demand side management and response strategies, etc. We do have, you know, some rate design that allows us to add what we call interruptible customers. So customers that have a lower, lower electricity rate, but that we can turn off when the peaks are going high and we don't happen if we didn't have to apply to support that peak demand, we can ask those particular interruptible customers to come off. So we've got leaders like that that we actively use to help to get response. But from a broader customer perspective, that mandate is passed to Efficiency One, which is a standalone corporation. We provide funding to them on an annual basis, but they are the ones that manage energy efficiency programs, you know, get exposure, whether it's things like heat rate or heat pump rebates or home energy efficient rebate programs around home retro fit, all things like that fall within efficiency ones and date. But again, I would point to the IRP report, which talks about some different scenarios around location where demand could go and as well as kind of the demand response strategy and how much control or how much reduction emerging efficiency programs could we see future energy.

- 10) What has been the level uptake for the EV Fast Charging Network program? What is the predicted future expansion of the project (i.e. number of charging stations, etc)?**

It's the regulator that approves capital investments. We brought forward a recommendation to install fast charging network across Nova Scotia, and the decision from the to the review board was that they did not want no social power leading that making that investment in that installation infrastructure. We are certainly involved in the process, but they actually had other developers and other parties lead the installation of the initial fast charging network that's there today.

So the utility report is essentially decided in my understanding that nova scotia power will not be the I guess, the lead developer in net to enhance that existing fast charging network electric charging network for vehicles across the province that will be driven by others. Still not clear to me who is going to be taking that on. Is it going to be a case by case, you know, town or a company here? Town here has to make those decisions. I don't know where that is going to come from that drive, but certainly it's important to determine and electrification.

Certainly that was a big focus on the IRP planning process that we did. We considered three main scenarios, a low of verification future, which we defined as a current pace of growth in building

and transportation electrification, which may be inconsistent with some of the targets that are out there. But again, just based on the last couple of years of electrification uptake. The second was our middle extrication scenario where we were assuming half of the building and infrastructure building a Tres station were achieved compared to the high notification scenario, which was near a complete electric vision of space and water heating demand by 2050 and percent of sales of electric vehicles for light duty vehicles by 2040.

So those are kind of just to show we have a range of electrification scenarios that we've considered in long term planning, including a high uptake electrification. And we've got a program outcomes. Conclusions based on those potential litigation programs. Definitely. That's a huge for any electric utility. That's a huge opportunity when you talk about decarbonizing other industries by having them clean up. Once we clean up our grid and no other electricity grid, then we can help clean up other industries by having the turn to classification on their eating, transportation, etc.

Yeah. Like a short answer. Yes. Certainly. We have our own customer solutions team, which is very focused on these types of initiatives. So we have got a residential customer solutions team better deploying some projects or some pilots like actually, I was supposed to be getting one installed in my house today. Get to relate to formal but a battery power system, a Tesla power wall. So we've got, like I said, pilot, I think 100, 150 customers across the province are getting these battery systems installed that the utility power will manage them in as far as when they're engaged, when they're drawing from the grid to charge up, and when they're not and obviously the benefits of customer itself power goes out.

11) Are you highly confident or somewhat confident or not very confident that the target can be matched by the 2030 time frame?

Yeah, we have our co chief operating officer is taking a lead on what we're calling the ECEI initiative, which is essentially that plan to get that reduction by 2030 at the highest levels of our company or making a priority. So it's definitely something we believe is achievable. As far as getting the whole retired, you know, getting new in generation on the grid. Another supporting infrastructure supporting generation.

QUEST/Town of Wolfville

1) Could you please provide some more information about your professional background? Specifically, could you please elaborate on your previous role with the Town of Wolfville?

I was the director of the bicycle co-op at the University of British Columbia when I was a student there, I worked for about four years in cycling advocacy and charitable programs and active transportation programs. Went from there to doing more transportation planning, especially around local community level plans and community advocacy around active transportation. Moved to Nova Scotia in 2016 and worked for two years as the climate change mitigation coordinator for the town of Wolfville. It was a staff capacity grant from the Federation of Canadian Municipalities that created the role for two years for the town. I was hired and developed climate change mitigation, mostly emission reduction programs, policies, projects and so on for the Town. And one of those, towards the end, was proposing and getting funding for the regional study that

you guys are commissioning now so that the Wolfville experiences could kind of be pushed out beyond its boundaries and get more folks in the region involved.

So in BC because our electricity is so relatively carbon low, transportation is the largest source of emissions for any community. So I was working on transportation, mostly just because it was the biggest piece of the pie to address. In Wolfville, I developed a proposal and got funding, more or less promise from the province, to do a comprehensive active transportation network within the town. We did a lot of community engagement. We think we got about 420 people providing input and feedback into our survey. We worked with Cycling Scotia to develop a network study for the town and then with local engineering and planning firm to do kind of more detailed design. And I thought because it's a small town and most of the trips are already by walking in the fair amount of cycling, it would be something that the Town would be interested in, but Council decided not to pursue it. So I don't know if my active transportation background helped, but it was definitely something I tried to work towards during my time would come. Yeah, it turned out from an emissions perspective, active transportation, at least within Wolfville, isn't really something that's going to move the needle for emissions because so many of our trips are regional and associated with Halifax. It's a pretty minor part of the whole. So trying to move active transportation more at a regional level would probably have a lot more impact than just the network within the community.

2) What are some of the areas that you would say the Town of Wolfville excels in reducing its greenhouse gas emissions?

The University of Acadia has done a lot to reduce emissions in the last, I would say like ten or eleven years. They've done a lot of energy efficiency with their buildings and they switched their fuel source for their campus heating system. And so they've managed to cut their emissions. The town, I would say prior to my work there hadn't done much. They joined the Partners for Climate Protection program, and I think they developed three different greenhouse gas inventories and some recommendations and reports and studies, but they didn't do or implement anything, I can't think of anything that they actually implemented while I was there. We started we looked at active transportation and I got funding for a number of different initiatives that some of which we were able to do. We had to put on hold that I think are rolling out in the next little while started a PACE program, and I don't know if that's something you'd be familiar with in Ontario, but it's quite a common type of program in. So PACE - is a financing program for homeowners and business owners to be able to borrow very low interest loans from the municipality and then invest that in energy efficiency in their buildings. We worked with a local group to apply for funding from the Federation of Canadian Municipalities for zero interest loans. I think they finally signed the agreement in July, and I was just talking to the folks there. They said that it's 50 people at the first workshop, more than any of the other communities that are participating. So it seems like that program is going well. But the town likes to talk about sustainability and climate change and these kind of things, but I don't think it has done much or has any real appetite for the investment or the actions that it would take to really move the needle at a corporate level, or necessarily unless with some of these programs before adding financing and funding to do things at the community level either. Honestly, the political appetite now is not very high. We had pretty significant change in Council, and I don't think the new Mayor and counselor has much interest in any side of a progressive agenda, whether that's social or environmental. A lot of the senior management are quite old and conservative and in traditional bloomer fashion, they just don't see any money in it or think that it doesn't make any sense because it's not what they're used to doing. So there just

doesn't seem to be much internal leadership or vision at the town to do these kind of things, talk about them, take credit for them. Great. But the action went with a lot of push back and skepticism, and I just don't think that it's a community that has much real interest in this kind of work. As I said, Acadia has done a lot, and I think they've done a lot with a little like they're not the most financially well placed University right now, but they've really been strategic about what they can do. I think there's a lot of people within the community who are interested and as I mentioned, our active transportation rate is really high. There is a lot of interest in energy efficiency, solar energy, things like that. So I think the community has some really strong building blocks to work on these things and some factors that don't move against them. It's an older community. Consider things, like parking and noise and heritage are pretty high on the list for a lot of members. But I would say the biggest stumbling block for the community is, yeah, just the lack of will within the municipality to either move initiative forward or really provide leadership and direction. One of the things I realized working with the Town is just how little control it has over a lot of the significant sources of emissions that are regulatory. That's really a matter of how they're set up and what they can work on. Nova Scotia Power has probably the dirtiest in terms of carbon electricity in Canada, and they're making strides towards greening. But even traditional electrification strategies don't work all that well here because you get a heat pump and not much more. As I mentioned, the Town could do community transit and really try to improve transportation. But with so many people driving into regional trips for work and things like that, it's a pretty small part. So a big part of what's holding will fall back. It's just that it's a small community that doesn't have a lot of power to adjust its emissions, even when it does work on where it can.

3) What are some specific areas of improvement for the Town in terms of GHG reduction initiatives?

I don't know if it would make a huge impact, but we got funding for a study to look at community transit and being such a small and relatively compact community, I think that would have a lot of that could have a lot of impact in terms of how people travel, which is still a pretty significant part of the emissions profile. So that's an area that they could move on. I think I mentioned the PACE program, which seems like it has a lot of potential. And from what I've heard is being really well received. But because Wolfville is a university town, about half of the residents live in rental facilities and not only can PACE not work for a lot of rental buildings, but there's no real incentive for landlords to try to make a building more efficient. There are ways that it can be done, though, and I think that it would be a really big part of what the municipality could do. There's some pretty great programs from Efficiency Nova Scotia that rely on landlords reaching out and self selecting and can cover energy efficiency costs, even for pretty substantial projects. So, if the Town could work with landlords and there are a lot of them and they own a lot of the town, it could be an area that they could really incentivize or just try to make attractive or even just raise awareness and try to encourage people to apply. So I think there's a carrot in a way of just like making better relationships and trying to help encourage the property owners and landlords towards those things. There's also initiatives like there are a number of them in Vermont and Florida, I think where basically communities will impose, like, a minimum, a minimum energy efficiency standard for renters. So if you have a property that you want to rent, you need to get a license. And as part of that, and there's a bunch of different ways to do it so that it's not super onerous which you require a minimum amount of energy efficiency in the building, and then Efficiency Nova Scotia and the PACE program can provide a lot of incentives and rebates and help to finance those kinds of projects. The Town doesn't have a rental licensing system, but with 1800 rental units, they

really should. There's a lot of concerns around noise, personal safety, fire and things like that. And efficiency is just one of them. So it's an area where the town probably could with one initiative, have a pretty large impact on not just energy use and emissions, but a lot of concerns.

4) You mentioned political will and effective policy as a challenge in implementing climate change action. Could you please elaborate more on this?

I mean, having worked for the Town, there are a lot of policies that could be revised. I think the biggest one is something that I asked to do while I was there and was told that they wouldn't. But there are more municipalities that are doing this. You wouldn't have to make it from scratch. There could be other examples to look to is what's called a climate lens on municipal decision making. And there are systems now that are relatively simple and don't require really specialized skill or heavy calculations, a policy that basically required staff when they're asking for Council direction or proposing investment to assess the climate change mitigation and adaptation impact of that decision, so that, at the very least, Council can look at something and say, okay, there are reasons to do this. So that would be a way of any decision that comes from a Council, like a meaningful investment or a change or something they're going to do. At the very least, it gives them the opportunity to do the right thing. It also provides transparency. So if other residents or stakeholders want to question why something is done, they can point to a discrepancy or ask questions about it. So it's an information and transparency reminder. And then the last thing I would say is it can help to integrate it into the standard practice, like instead of it being something that you have to think about yourself or, you know, remember to ask or someone has to bring up. And when it becomes habit or just becomes a default, then it is more consistently applied and considered rather than being something that might be introduced by someone at some point. But it relies on an individual action, rather than going back to your first point, being baked into a standard policy and practice.

5) QUEST has a number of projects occurring in Nova Scotia, either completed or in the development phase, including Energize Bridgewater and the Annapolis Royal "Back to the Future" project. Are there any similar projects being considered for the Towns of Wolfville, Kentville, Berwick or Kings County? What are the criteria for project consideration?

I've only been at Quest for about six months, and there's potentially with any organization, there's going to be institutional memory and things that are not remembered. I can ask around internally if anybody remembers, about the Back to the Future project. But I don't remember that one. Energized Bridgewater - I don't know that we've been directly involved in it, but we have been helping them kind of move some of their ideas forward. Bridgewater, if you want to do a little digging into them, they are like light years, way ahead of most communities in terms of how rigorously and effectively they thought about the challenges to their climate ambitions. I can't speak to the effectiveness of their plan because they're really still building it. But they've investigated a lot of difficult issues, that some of which I mentioned before making impossible or challenging for municipalities in Nova Scotia to address their climate impact. So, for example, we have about three municipalities in the province that have their own energy utilities. And most other people are grounded within Nova Scotia Power, which set very significant limitations on anything to do with electricity. And so to address Bridgewater, part of what they've been doing is trying to understand whether there is potential beyond what is generally understood for them to invest in a bunch of different energy and electricity related ventures, like large scale renewables and things like that. I mentioned PACE. It's a good program to address a very significant part of

the emissions profile in the community, which is single family homes owned, lived in by their owners. And so they've been looking at ways of overcoming, like ways of working with landlords, ways of making it more effective or efficient to address energy efficiency. And one of the big projects, maybe the core project is trying to develop a comprehensive financing platform for energy efficiency upgrades. Whether that's integrating, like government funding, private funding, cooperative community funding, trying to integrate all of that into a fund that can implement retrofits at scale and for low income earners rather than doing it on a one by one house basis based on their financial ability. So trying to aggregate community energy projects to make them more attractive, I guess, to more competitive sources of financing, working with banks and private financing Corporation Esco and so on to try to say, what do you need from a project to be interested and then working on the mechanism that will take, you know, 300 homes in their community and turn it into one package that they can they can provide to an investor. So I think that's the biggest part of Energized Bridgewater, but you have to I mean, there's so much that they're doing in the new directions that I can't really explain it all in the call.

QUEST in Nova Scotia is really fortunate to have core funding from the provincial government. They kind of recognize that there is a low level of capacity within for a lot of communities working on these issues. And so they fund us to basically figure out, you know, broadly across the province, but also strategically in different places, how we can contribute to what the communities are doing and where their identified needs are. So we run something called the Municipal Energy Learning Group, which is probably about 100 members from across Nova Scotia. 20 to 40 show up for each meeting, and it happens every couple of months. We do kind of like a round table of people talking about what they're working on and sharing struggles or things that they've done well and trying to brainstorm solutions for one another. So trying to create a community of practice around climate action and energy issues and then do presentations either on, you know, things that people want to understand more about will try to find a speaker who can. I think the last one we did was about energy poverty, which is something that a lot of communities are dealing with. So trying to illustrate what that issue was and then talk about the programs that address it. We did a really interesting one about embodied carbon in new buildings, trying to explain, like, it's not just operational energy. That's part of the carbon responsibility of a building anyway, trying to do educate and build capacity at a mass level and then more target in a strategic program. So we're working on a methodology for trying to calculate the economic impact of community energy and climate plans. So hoping to work with will fill once there is finished to sort of illustrate what the benefits are to a community of working on these areas, working with the region that you're working with on a building energy sort of road map study. So we want to be able to look at energy use in all 50 community and municipal buildings in the region and then pick out the ones that will have the best Return on Investment for energy efficiency upgrades. So you can kind of get an entire portfolio the way that, for example, Acadia did, and then be strategic about saying if we replace the windows in this building will spend X and we'll save X times two over the next five years.

Kentville has sent staff to the Energy Learning group, although they don't have an energy or climate person on staff. The Municipality of the County of Kings had a climate adaptation person who you may have met, but I don't think she's there anymore. So now they've got like an Economic Development Specialist who's doing energy stuff. We worked a little bit with Kings County on they want to be able to have, like these plans to do a lot of renewable energy generation. But recently they don't really have the mechanism. They can build the thing. But then how do they sell it to the market or to customers? So trying to work with them a little bit to help them understand the

programs that are coming online and the opportunities that are there. If you had some discussions with them, tried to connect them with people who can give them a more solid answer or answers to more technical questions about what they're working on. And then I know we were involved with the Town of Berwick. They're one of the few municipalities that has their own electrical utility. And so there were conversations with them and some other folks in our network on things that they could do to push some of these ideas forward. So they're building a community solar garden. We had them present on what they're doing. And I think in the past we're sort of feeding them some ideas and examples, case studies from different places about how that can happen. They're also doing some really interesting work on integrated efficiency and renewable generation and energy storage to try to minimize the peaks for their electrical utility. And I know QUEST helped a little bit with some of the research behind the project that they're doing now, but that was all before my time. So it's not something I can speak to much.

6) What are some of the challenges that Nova Scotia faces in particular that hinder it from achieving a lower carbon economy?

My sense is that Nova Scotia cares more about its past than it does about the future. It's a very conservative and just demographically, a very old and traditional kind of place. And so I think that we had this is going a little bit off, like there was a relatively young leader of the Liberal Party who was the interim leader, had a lot of really progressive ideas around social and environmental issues. And it was the smallest surprise in the world when the Liberals got kicked out and the Conservatives got brought in because they were focusing on healthcare. Rates of obesity, alcoholism, all these chronic problems are through the roof. So hospitals need a ton of money and staff to be able to keep up with things. And the Conservative government said, we're going to resource these hospitals to as much as we can. And the Province very quickly pivoted to that message, away from climate change, addressing poverty, dealing with the housing prices, trying to improve universities and schools. That's really not of interest as far as I can tell, and political will seems very traditional and conservative. So I say big picture that's it's also not a very well off province. So a lot of the work that's going to need to be done is going to cost money. And there isn't the will or the steady stream of revenue that is going to help manage the transition. It's very rural and spread out. And so recently the provincial government has poured billions of dollars into twinning highways that are empty so that it's even easier and safer for people to drive around. Not that there's a ton of people. I've never heard of highways being twinned when there's no congestion. But that was a big focus. I don't know why it happened, but that was the decision, rather than investing in public transit to help people get around into regionally or even building up communities so that you don't have to drive 40 km to get groceries, they decided that they were just going to twin all the highways so that you can even more easily drive from one small town to the next. So that focus on roads and that investment is kind of insane and moving against what they need to do. And then the last thing I would say is that in the Province sold its utility to a private corporation that runs the electrical system based on a profit motivation rather than a consideration. So the Province can make all the plans and statements and investments that it wants. But at the end of the day, Nova Scotia Power has no reason to do anything that's going to cost reduce its profit margin. And in fact, because of the terms of the sale, they're guaranteed a minimum rate of return on their investment amortized for the next 30 years. And so Canada has a mandate at a national level to phase out all coal power and burning by 2030. This province has an exception and Nova Scotia Power has a right to not only run the coal plants in the Province for the next 25 years, but to profit from the coal plants. So if you shut the coal plants down and replace it with solar wind, anything else, they have a certain amount of money that they expect

to make until 2043 that the Province would have to pay them not to run the plants. So I can't really think of a more difficult situation for a Province to put itself in. Even if you pay for all of the infrastructure for energy, the utility has a right to profit off of the things that they purchase and an expectation of profit. And so a lot of those emissions are, if you can't, like, securitize it at zero or negative interest or find some way to make it more profitable for the utility to not run them, then to demand compensation for them. You're stuck with that infrastructure.

7) What are the criteria of selection for the Smart Energy Benchmark Pilot Communities project?

A lot of the tools that we develop, we will reach out to communities that are interested. Or sometimes we put out a request for expression of interest. I don't think the benchmark communities have to pay anything, but sometimes there's a nominal fee. If we're looking for a lot of funding, which comes from foundations or from federal programs, we want the Municipal communities to value it. So sometimes there's a fee for the benchmark. It was a tool that the original idea, I think, was something we could create where either the municipality or a community group could do a rigorous but not really technically difficult self-assessment. What we realized through the program is to make a meaningful analysis of community readiness to implement these programs. It just isn't accessible. The tool to most communities, especially the smaller ones. The larger cities have the technical expertise where they can hire a consultant to do it from smaller communities, where the land is a lot more valuable. I think to them about where they need to work on their issues. So all that to say, I think the idea was to try to is often to create these tools and then integrate them into a process where we can do the work for them. So an example would be the Smart Energy Community Accelerator program that's going on in New Brunswick, where it's both like a climate change planning program, but then also move straight into implementation. So you work with communities. And one of the first steps would be at the benchmark to say, okay, we're coming in. We don't know this place and the energy people don't know the waste people and the waste people don't know the transportation people. Let's do a baseline assessment of where you're at not only in terms of what you're doing, but the underlying circumstances that determine how people move or where waste is going, policy and governance structures. And then once we understand that once we benchmarked you against other communities, but also giving you a sense of where your strengths and your weaknesses are. We can develop a plan to show up those weaknesses and sort of help you figure out what you want. If you want to work on this, what do you need to be able to do to get there? So as an example, we were talking about Kings County earlier. They had all this area that they wanted to use for renewable energy generation, but their land use planning and their community engagement around that issue was terrible, frankly. It took ten years. But they got there. They had to do a lot of work to get to the point of understanding, like what renewable energy is on the scale. They wanted to do, what the implications were like, what that really meant for the rest of their community, rather than there's a crew out back and they're putting up a windmill sorry, ma'am, sort of thing and create land use plans and do the rigorous community consultation to identify the circumstances and get buy in to that point. And so they did no real community engagement until that issue came up. They had a pretty awful land use plan until that issue came up. So helping them get to the point to say, okay, you want to get here, you need to do these things to get to that. That's what the benchmarking tool is and integrating it into something, which you do the benchmark, you create a plan, you identify the things you want to do. And now you know the weaknesses of the roadmap to get there. And then the next step would be help with implementation. So, like with Kings County mapping renewable energy potential or doing, like, transportation studies. The way that we did in Wolfville a couple of years ago, trying to what are

the next steps to actually get you to implement these things. Because, again, most of the communities that Quest works with in Atlantic Canada, they're too small and don't have the resources to hire someone with all of that expertise. And you want to bring on a consultant. They'll charge you \$100,000 to hand you a blank spreadsheet. No offense, but I have to really know, like when we got at proposal, it was awesome. It was so much different from some of the other ones we saw, partially because we had people reaching out and telling us what they were going to do and told them to go to help because you can get very little if you don't know what you really want or what you're asking. So Quest and organizations like yourselves, like finding people to provide the right the right tools and accessibly so that community can do that. The benchmark, it seems like a great program, but it really needs to be understood and utilized in context with a more, you know, kind of comprehensive approach to community energy planning.

Acadia University

1) Could you please provide some more information about your professional background and your current role at Acadia University?

I'm the Sustainability Coordinator at Acadia, and I've been in this role for twelve years now, and I have a very broad portfolio on campus. So my focus is in five main areas, including energy and climate change, but also water, food, transportation and to some extent, biodiversity, but more as a partner with the Harry Irving Botanical Gardens and Irving Center. And they really focus, of course, in that area. So six in a way. I've worked in municipal government, in the nonprofit sector, in environmental education, community development, ecotourism. So in a number of different capacities with a lot of different types of organizations, but a little bit with the private sector, but for the most part in the public sector.

2) You mentioned in your survey responses that your organization has a sustainability plan in place. Could you please elaborate more on this? Is the Acadia University Sustainability Assessment related to the sustainability plan or its own stand-alone initiative? Are there any plans to update this document?

So the assessment is based on our commitment to the Talloires Declaration. And that was a very early assessment in our first broad campus wide broad sustainability assessment, looking at all areas of operations, but also including education and outreach and promotion. So it was fairly high level, but it did have some metrics included. So that was some early work that we did to sort of get a baseline for where the University was at in terms of actioning, sustainability and advancing some initiatives. And again, that was based on the Declaration that our President signed in 2006. It included an assessment of our performance related to the goals that were included in a strategic plan at the time. So that's an important background about that particular sustainability assessment. It was meant to be an analysis of our baseline performance but not necessarily represent our plan moving forward. So in terms of sustainability plans for the institution, we actually have multiple plans. So there are sustainability principles, goals and objectives in our food services plan, for example, that have to do with, again, a broad spectrum of goals and performance indicators related to animal welfare, but also sustainable production, dining hall, commercial kitchen infrastructure, whether commercial equipment is Energy Star certified, these kinds of things. So there are a number of goals related to energy and climate in

that plan. Our new strategic plan, which was unveiled just last year, has some significant commitments and goals related to sustainability, but also energy and climate action, including a proposed target date and emissions reductions. That date was a proposed date that we refer to that as sort of our working target. And right now we're working on doing some research on putting in place a more informed strategy for when we might be able to achieve carbon neutrality. So there are a number of goals related to energy, climate for the whole campus in our strategic plan, and that's really our high level framework for sustainability and climate action on campus. There are other operational working annual work plans that have shorter term targets for the work that we're doing. So we have multiple plans in place, and we're working on a lot of different fronts in this area.

I would read the 2025 Strategic Plan and the specific goals under the umbrella of caring for our planet. That would be really our high level sustainability and climate action commitment, and then all the other to fall out of that.

- 3) The original estimation of Acadia University's GHG emissions did not include Scope 3, which was also a recommendation made at the end of the report "A complete inventory of Acadia's emissions should be conducted in the future and include emissions from Scopes 1, 2, and also 3 where practical. An inventory of GHG emissions should also account for offsets such as forest preservation, certified retail offsets, and green power certificates, which will have a net positive impact on total emissions." Has this inventory been completed? If not, are there any plans to complete it in the future?**

So we continue to do some of that work, and we've done some third party verification looking at ten year comparisons, and GHG emissions. And of course, we have historical tracking reports of our utility data dating back to 2005. Again, right now, 2005 is our working baseline base. Of course, those targets in government have evolved over the years since we started doing this work, but that's continued to be our working baseline for greenhouse gas emissions. I do annual estimates, and then from time to time, we'll do a third party certification validation of that work. So the most recent one, we did was interested in the ten year trend.

- 4) Could you please expand on some of the on-campus initiatives that target the reduction of energy and climate change (i.e. the idle-free campus initiative, rooftop solar array installation, wind-solar demonstration project, implementation of charging stations, bike loan program, energy management program, etc)? Which ones have been the most successful and why?**

So as you can see, we have a really broad scope of activities related to energy and climate change. As with everything else. And some initiatives impact our missions directly in terms of reducing your energy use on campus. And some are more indirect and getting into the Scope Three area, for example. So in terms of reducing our direct emissions, the renewable energy project, of course, is significant. That is our first significant array on campus. And since 2007, we've been very focused on energy efficiency. That's probably on our top priority. And there have been a ton of energy efficiency initiatives that have been implemented and are also ongoing, and that includes things you've already mentioned and that I included in my response things like window upgrades, insulation, building optimization, hybrid hot water heaters. Together, these have significantly reduced our emissions over time. And of course, when we implement these initiatives, many of which have had funding, for example, from Efficiency Nova Scotia or other organizations. We track the performance of those initiatives. So energy efficiency is really important and will continue to

be very important for us and expanding renewables on campus. Certainly, I also run a number of outreach and engagement programs on campus behavior training programs that have been very successful. Our Vampire Power Education program and the Holiday Energy Management Program, which has been long running, has been very successful at optimizing our savings over the holiday break. Those building Occupancy programs and behavior programs continue to be really important.

The conversion of natural gas is a major infrastructure investment that significantly reduced our emissions. Of course, since we originally were burning oil, which has a high carbon intensity, of course. And so that's been very significant and, and other education initiatives are more indirect emissions reductions because some would fall into Scope Three. So really, the renewables, the fuel switching and energy efficiency are the top three.

5) In 2015, Acadia converted the entirety of its heating system from oil to natural gas. Could you please explain what this transition process was like and the extent of impact it had on reducing Acadia's GHG emissions?

The fuel switch from oil to natural gas resulted in around 21% reduction in greenhouse gas emissions. So that's the size of the portion of our productions on campus. And we know that was anticipated. Of course, whenever organizations have the opportunity to do a major fuel switch, it's a big ticket item, but also has, in fact, we've reduced significantly on our electricity through efficiencies, but also improvements in the emissions factor in Nova Scotia. And that's an important part of everyone's emissions production. I might not be the best person to talk to you about the technical feasibility involved in the conversion. I don't recall that there were significant issues at the time the conversion from oil to natural gas. I think it's not the same as the switch from a natural gas to full renewables. That's a very different content transition, right? I mean, if you have specific questions about that project, probably the best person to talk to is the director of facilities. But again, don't recall that, of course, there were significant infrastructure investments and federal funding that was part of that. And I believe there was a provincial piece as well that enabled that project. But I think an infrastructure that had to be retrofitted and new infrastructure built to handle our compressed natural gas facility, so that there was a lot involved in that project. But again, I'm not aware of any particular barriers or issues that arose around that transition on.

6) Reporting requirements and public procurement processes were listed as major hindrances in your response that prevent your organization from implementing climate change action. Could you please expand on this and ways that you think these obstacles can be overcome?

So smaller organizations like Acadia have limited capacity to do some of this work, and we have competing priorities in other areas of campus. So all of these major initiatives require funding. Typically in the public sphere, as on the private sector where funding is involved, it's a fairly lengthy involved process with no appearance approval that takes a significant amount of staff, time and resources and sometimes finances to support. And then if we're successful, then in addition to implementing the project, of course, there are numerous reporting requirements, as there should be when public monies are involved. It's a significant time and cost factor to manage a funding process from beginning to end and then ongoing reporting that sometimes required, for example, pull our electric vehicle charging station for our single EV station. Annual reporting is required for that project for the next ten years for one electric vehicle charging station. So there's a lot involved in terms of resources to pursue and implement these projects. The public

procurement process is important that all public institutions are accountable for public money and, of course, were supportive of doing at work. But it does add significantly to project timelines, sometimes making projects not viable because of the time involved in procuring equipment and supplies for projects. It's not sometimes an insignificant barrier to moving forward some of this work. I'm not sure what the resolution is for that we do have procurement staff on campus, but sometimes with technical work, that team needs to lean pretty heavily on the project managers the project instigators for those initiatives. So building capacity within our organizations to support that procurement process is important, but it's really difficult for small organizations to build in support positions like that. Long term mitigation - you know, I think there is the extent that universities and colleges are already working together in a number of areas. So we're increasingly looking to collective efforts to mitigate some of that work and try to kind of leverage our purchasing capacity and our collective expertise to move forward as a sector. And so we've talked with government about that. And, you know, we talk and work with each other. There's an Atlantic Universities and Colleges Sustainability network. I'm the past chair, and there's a lot of work that we've done within that organization to try to advance some of this work together. Particularly, it's helpful for the smaller institutions that have smaller teams. Not all Nova Scotia universities and colleges have dedicated sustainability staff. There's only a few of us that that puts the burden on expanding sustainability portfolios on typically two facilities or custodial teams. And it's sometimes hard to move forward and progress quickly when that's the case. So working together, I think government has a role to play in supporting public institutions in building our capacity to do more of this work as well as address high priorities in other areas, including accessibility and data management and other important things for education institutions.

- 7) You had listed the reduction of GHG emissions from operations such as fuel conversion, peak demand management, electric vehicle charging infrastructure, energy efficiency measures, renewable energy generation and carbon offsets as specific areas of climate change action identified in the Acadia University Sustainability Plan. Have any specific reduction goals or targets been set for any of these areas? Acadia University has set a target of achieving carbon neutrality by 2030. What are the steps required to attain this objective?**

So for that, again, that's our working target for carbon neutrality. It's an early target compared to government, most of whom and a lot of the other institutions across Canada are looking to 2050 for net zero. So again, that's a working target for us. And we're in the process of doing a lot more work to fine tune a realistic target for neutrality all the while continuing with our existing initiatives and energy efficiency. So we'll continue to pursue a variety of infrastructure initiatives around energy efficiency. You know, where participating in the consultations at the provincial level, as new programs emerge, the Shared Solar program as well as the Green Choice program. So those are very much of interest to us and exploring more opportunities for onsite renewables and other initiatives. So all that work is continuing while we try to determine an appropriate target for becoming carbon neutral.

- 8) Could you please speak to the 2019 Draft Acadia Strategic Plan, specifically how it relates to sustainability, climate change, SDGs and Acadia's membership with the Sustainable Development Solutions Network (SDSN)?**

So there are a few initiatives related to the SDGs that's also included in our new strategic plan. And so we're just beginning some of this work. Of course, COVID interrupted a lot of our momentum on a number of fronts. So we're working on identifying how Acadia can align our work

related to the UN SDGs. And, of course, our activities in research education service as well as operations will relate to the SDGs. So we're in the process of kind of mapping that out what that is our current state of affairs in relation to our performance with respect to the SDGs. And then there are also a number of initiatives that are in place related to that. So, yes, we are a member of the network. Our representative is actually Dr. Glen in physics in the Department of Community Development. He's been very involved in that network, working with them on a number of things. We do a lot in a classroom related to the SDGs. We're an education institution. So right now we're really focused on how research and teaching can align with the SDGs. And so we have a number of student projects, I have one right now with the students looking at goal number two and zero hunger and how our work related to sustainable food and food security and production relates to that work. So, as you know, a very broad framework with 17 goals and some of those goals we've been focused on for some time predating the unveiling of the SDGs a number of years ago. And like other institutions, we're working to align our work with that global work.

9) Can you please explain the Talloires Declaration that Acadia University became signatory to in 2006 and how it relates to climate change adaptation/mitigation?

So the Declaration is a ten point action plan. It was really the first statements from the University, from the global University sector, support of advancing sustainability at our institutions and taking responsibility for our being part of that solution. It's a high level framework, as many of these things are with actions related to institutional ecology, waste management, etc. So that became our high level blueprint for sustainability on campus and the guiding document for the work in my office, which was created in 2008. Initially, the University created my position, the position of sustainability coordinator to advance work. And then over time, the position evolved into becoming a sustainability office that had a broader mandate. So that's how our declaration really was the blueprint for the work of my initial work and the work of the sustainability office. Now, of course, we have a strategic plan in addition to the Declaration, and there have been other sort of guiding documents that have guided our work over the last number of years.

Valley Waste Resource Management

1) Could you please provide some more information about your professional background and your current role with Valley Waste-Resource Management?

I'm the Communications Manager for Valley Waste, and I've been here for 22 years. Actually never planned to get into the garbage business. I took community development at Acadia University, and started out in Halifax, and then came to the Valley, did the same here, and I've just been here ever since. Our organization, Valley Waste, we are an intermunicipal organization. We're owned by six municipalities, including all the ones that are working with you on your study. So we're basically an environmental friendly organization. We try to be as best we can, so maximize waste diversion while maintaining... Trying to be fiscally responsible at the same time for our parties, the people that own us. We basically overlook all aspects of solid waste for the Annapolis Valley. So Kings County, all the towns, including the towns in Annapolis County. And that includes collection, transfer station, landfill disposal, recycling processing, organics processing, hazards, all those above items. However, most of those items we contract out to private companies. The only thing we do ourselves is run the two transfer stations, and we do the administrative overhead, as well as education enforcement programs for the region. Okay, I think that covers the basics, at

least. So, yeah, I went to Acadia University, '94 to '98, and then got right into solid waste a couple of months after that. I did start out here, though, as an educator. So I did education to the public sector and the business sector, most of the business sector for myself, and then moved on to communications, overseeing all of the enforcement education in the region about 10 years ago.

2) What is the business model of Valley Waste and how does it integrate with municipal operations?

- A. Could you please elaborate on the sites that you are responsible for?**
- B. Could you please elaborate more on the waste wood stream?**
- C. So you would oversee the contracts for the collection, disposal and recycling of the crib-side residential sources of waste. Sounds like ICI waste also moves through your facilities So with that, is it safe to say it's typically private haulers or contractors that service the ICI sector, and then they would choose to use your facility? Or if not, they would go wherever to other privately run facilities to manage that material. Do you do contract, or are there any sectors of the ICI realm that you are more involved with?**
- D. When it comes to your tipping fees that you would charge an ICI customer coming through the landfill, how does that compare to what they would pay for tipping fees for, let's say they had a separate organic stream, or for recycling that they would take elsewhere. I'm just wondering what the delta is between tipping fees for dispose or landfilled versus diverted materials?**
- E. When we put forth recommendations, waste is a sector that represents five or six percent of the areas' greenhouse gas emissions, mostly from almost 95 or so percent from landfill gases. But what role? I'm trying to figure out the roles of Valley Waste versus the municipalities here.**

We do contract out most of our services. In doing that, it makes us cost efficient, so economies of scale is very important in the solid waste business, it's very expensive. So when you have the waste from six municipalities, you drive down the cost overall for everyone, because you're overhead and the operational facilities are spread out over a greater amount of waste. We try to salvage whatever they can, make money off what we can, whether it's scrap metal. We have a reuse center, though it's closed right now, where we sell off stuff that shows up at our landfill, and basically have a yard sale every weekend, and that generates about 60,000 a year in revenue, although we do have costs associated with that. And we try to be both socially acceptable, and environmentally sound, but at the same time, we have to manage our budget very carefully. We do have contract increases every year on all of our major contracts. So every year we always have a few percent increase in costs. And then every time we go out for tender, sometimes it lowers it a little bit for a brief amount of time. But trying to keep that increase outside of that is very difficult. We don't have a lot of costs outside of our private contracts. We do have our own staff for education and enforcement, and our site that we have to run. But outside of that, it's all based on tender contracts.

- A. So we do have three facilities ourselves. One is our administrative office, which is located on the same site as our transfer station in Kentville. It's in the Kentville Business Park. So that, in an office, we have about 10, 11 people in here, and then we have our transfer station in Kentville, which has another 15 or so people. And then we got a transportation in Lawrencetown in Annapolis County, and it's smaller, it only has about five people working**

there, but most, about 70 percent of them purely managers on this end of the region in Kentville, and everything from Aylesford. You know where Aylesford is, I'm assuming. But on the West side, Kings County, everything East of that goes to Kentville site, and everything West of Aylesford goes to the Lawrencetown site, so it's a roughly 70/30 split. We have a lot more industrial waste at this end of the region as well. Our landfill is owned by another municipality, Kaiser Meadow in Chester, so the Municipality District of Chester owns that landfill. However, our arrangement with them is one that we share in the cost benefit of that landfill, so we're not owners, but we get the same benefits as an owner does, so the more tonnage that goes into that landfill, the more people that use that landfill, that lowers our cost, because your fixed costs are spread out. And when there are extra costs for the landfill, whether we're building new infrastructure, or there's a reevaluation of the post closure cost and our cost would go up as well. So it's directly related to how well that landfill's managed. Our recycling, our blue bag materials. We pay Scotia Recycling, which is a private company to process that. We pay a set fee that goes up a certain percent every year. They are located here in Kentville as well on our site, we lease them land. Now there's a great cost benefit to have them here because we don't have to truck our recycling outside of the region, and all the curbside trucks use their facilities, don't have to even come to our facility. That saves us a lot of moving material around. And because they're on our site, we get the revenue that they have, and what they have to send the landfill, what they can't recycle. And then our organic processing is in Brookfield. So we do have a contract with them and they truck their organics to Brookfield, so that's a bit of a haul as well. So Chester and organics are outside of the region, recycling is right here. We do have other contracts, like hazardous waste, but there wouldn't be huge volumes on that, but that would be transported to Sussex, New Brunswick.

- B. Sure, all the wood we grind up, it gets processed at Brooklyn Energy in Liverpool. It's a steam plant, a biomass steam plant, so that's where our wood goes to make electricity. And the year that you guys stacked your data, 100 percent of all of our wood went there. They've since become a little bit more picky. They only want very clean wood now, which is only about a third of what we process. So what happens to the shingles is, they are made up of your paper, your tar paper, and then there's the grip on the shingle. The tar paper part does get ground up as well. That goes to Lafarge in Brookfield for the cement plant, cement kiln. So a company that's a private contractor that does that, Halifax C&D, they send that there. And then the grit is used in pavement again. Also all of our brush, like our trees, our Christmas trees, all the branches we get, that would go to Brooklyn as well. Also our lumber. Let's say you tore down a house, and the clean number that's within the walls, that would go there, just not the painted or pressure-treated.
- C. The answer is yes and no. So in the Annapolis Valley, so all those municipalities that you guys are doing your study on, we also collect, or we allow them, the same amount of limits as a household. So a lot of your small businesses, like your mom and pop shops, they would use the curb side program. So even in that curbside data I provided to you guys, there is a portion of... There's ICI, so maybe it's a family-run pizza restaurant, right? They would have a green card, four bags for garbage, four bags recycling. And outside of that, it would all be private. So it would be up to the business, the private sector to bring it to us or not. We do have flow control, so we have a law that says they have to bring the garbage to us, only the garbage, that we have full control over. And that's because our costs, our landfill are directly related to the quantity. So that helps drive down the overall cost of the program. So they're not allowed to take that out to another part of the province. But what does leave, what may not come to

us is organics, so they can haul directly to a local composting facility. Recycling. They may have a private contract directly with those recycling, or they may have contracts with the private recyclers, so we wouldn't necessarily see all of that. Same as scrap metal, probably doesn't come to us because we charge, whereas they may be able to make money off of that. On construction and demolition waste, we don't have flow control on at the time of your study. We do now, but a large... Some of the big demolitions would go to private construction demolition debris sites, and not to us. We still receive, though, about 6,000 tons of construction demolition debris, mostly from the private sector at our facilities.

- D. So our charge for landfill or residual waste is \$125 a ton. To recycle or compost, it's \$97, so there's a bit of a savings there, but not a huge savings. And then construction and demolition debris. If you bring in mixed debris, so wood shingles, drywall, mixed together, it's \$125. If you bring it in, separate, it's \$75. So if you bring in just wood, there's a discount of \$50 a ton to separate that. One thing that you'll see on your data is, it's not perfect, because a lot of people come in with multiple amounts of material. So let's say you're cleaning out your house, you come to our site. Unless you go around our scale two or three times to get the lower rate for each of those streams... 99 percent of people won't do that. They'll just pay the garbage rate, \$125. So it's always the outgoing numbers, which are a little bit different than the incoming, because we do have different... The recycling would have gone to the recycling plant. And if you bring in mixed C&D, we pull it all that metal and wood, because it's cheaper for us, or we make money off of it, right? If I could just add, I think when we set our tipping fee rates, it's a debate between the environment versus cost recovery. So I would love to see recycling, organics at a lower fee to create more incentive for the business sector to sort their waste. But at the same time, there's pressures to charge the business sector as much as possible. If anything, they want them to pay the full cost of our programs, so that's a debate that happens at our board level, and through our budget process every year.
- E. Actually, if you go on the Nova Scotia Legislator Library, online library, and just search AECOM, efficiency, solid waste, you'll find it. It's a 300 page document. So one of the outcomes they had was, there's a real challenge with governance in Nova Scotia in general on solid waste. So ultimately, individual councils decide what happens, through their budget process. But the intermunicipal organizations like ourselves, or the solid waste departments, they generally have a better feel for how to maximize diversion and so on, at a reduced cost. But there is a bit of a disconnect there. Some of the recommendations was, we're actually one of the better ones. We're an intermunicipal organization where we have our own board that makes decisions. However, where it breaks up is then each individual council has to decide. So our board can only recommend things to the individual councils. Ultimately, they decide. But what happens is, the communication between the board and the individual councils may not be great, right? They're one representative from the council, so they may not carry all the necessary information back. And so there is the thought now within our region that our board may even change and have all the mayors at our table, so there'd be at least a little bit more authority on what happens, because I really think that there's a lack of education understanding between the councils that saw our budget, and the people that manage that budget. It's always been an issue, but it's really highlighted in that report, if you look it up.

3) Energy efficient office buildings were identified as a climate action win for your organization in your survey response. Could you please elaborate on this? What energy efficient measures have been implemented in particular?

So our organization in 2014 developed an office building here in Kentville that is both LEED Gold certified, as well as Passive House certified. It was one of the first office buildings actually in Canada to have both, and so we're quite proud of it. It is very energy efficient. It's not as energy efficient as I said it was going to be, but it's still pretty good. We have trouble with the heating system, mostly the heating and cooling, but the building is super insulated, so the walls are R50 and the attic is R100, all very airtight windows and doors, we have an oil heat pump system through the entire building. So energy efficient wise, that's what we have here. Plus, the building is made from a lot of recycled, and we use materials as much as we could. And I think that's about it, but it is quite green, I would say, compared to most places. We do have a wind turbine on site as well, that generates electricity. It only generates about... I'm going to say 90,000 kilowatt hours a year, maybe. But it does offset some of our energy here.

4) Does the landfill have a landfill gas collection system in there? Either flared or to produce energy of any type?

No, unfortunately they don't. They're just not big enough, I don't think yet. And it hasn't been around long enough. Although it's been there 20 years, but they just have venting, that's all. They do have a company called Sustained Technologies, I'm not sure if you've heard of them. The plan was for them to actually take all the garbage that we send the landfill using advanced technology such as pyrolysis to make fuel out of the plastics, and to make fuel pellets, like wood pellets, out of the card material in the garbage. But my understanding is, they're still not running. They've been trying to run for five or six years now, so they're having some troubles, but that was one of our goals as an organization, to have even more diversion from landfill, because if it's operating properly, it should divert another 85 percent of what we send the landfill. But that is a private contractor not... We don't own them or... We still contract our garbage to Chester Landfill, and it would be them that would give our garbage to this facility.

5) In your experience, what are some of the major obstacles that hinder increased diversion rates for these areas in particular and what are some ways to overcome them?

We feel we have a really good diversion program here, especially our curbside program, we got very good performance from, where we could be better is on our construction demolition debris, which makes up at least a third of our waste. Right now because the markets for C&D waste have actually stumbled a little bit the last couple of years, so I mentioned earlier that they will take our clean wood, but they won't take our painted wood anymore. So we're landfilling that now, and we don't want to, but it's the most economical way for us to manage it. What we could do is grind it and use it as cover, either at a C&D site, or landfill. That's an extra, you know, \$50 a ton to do that, so cost is a hindrance. Dry wall, there is market for clean dry wall, but not very good for stuff with paint on it, or wall paper, all that stuff. So right now we actually had to landfill a bunch of our drywall that we had saved up for a couple years. It just turned into mush, and the market didn't want it. It was too wet, and it had other contaminants in it. So cost availability. Markets are really big. In terms of recycling, Scotia Recycling does try to recycle everything they can, but it's only to a point. In our blue bags, we say, "Put all your plastic containers in, we'll recycle them." But the reality is, you know, a portion of them just can't be recycled. There's no market, or they're too

dirty, or we have an issue with contamination from curbside. So people put in their diaper in the blue bag. Well, that's gonna... They come across a diaper on the sorting line, they're not going to touch it for a few feet. So a bunch of recycling is going to go in the garbage.

So I just think education is really important. Trying to find markets that are sustainable and cost effective would be the key deterrent. But the willingness is here. I can tell you. I'd love for you guys come for a tour of our site, actually. We'll show you everything we can do, and how we do try to divert as much as possible. But we wish we could do more, just market conditions and cost would be the biggest issue.

- 6) What is the breaking point, or the break even point, where it becomes financially viable in terms of landfill size to consider gas collection, especially for one that would need to be retrofitted. This is not a new construction where it can be factored in, this is one that's been around for 25, 30 years.**

So I don't have the answer. I know there's regulations in place in certain parts of the country that require landfills of a certain size. They must have these collection systems in place for either generating energy out of the gas, or just flaring it off even. What is that point where it becomes... Where Kaiser Meadows would look at that seriously? Yeah, there is, like when you say there is a tonnage or... And length or age of landfill that is ideal, and I don't know the exact. I understand it's at least 25 years and 100,000 tons, something like that. But I really don't know the business plan on gas recovery. I do know that there is some, they did recover gas for a period of time. But again, that was before... There's still gas in a landfill even after you've removed organics, because you're always going to have some in there. But organics is your big contributor to that. But in Halifax, they have this front end process, I'm sure you guys are aware of all this, but they have a process where they sort waste further, like in your garbage, before it goes to landfill. But the one challenge they found was that, instead of waiting 25 years for gas, or getting it quickly, like only a few years because it's already in advanced decomposition, so they're flaring off the landfill as they're doing it, basically, they're getting gas almost right away. But I don't think they have enough to actually make energy from it. But I really don't know for sure.

- 7) Over what period of time had an organics program been in place or not over the life of the landfill? And even that when an organic program has been implemented, how is that organics material being processed? Is it typically windrow composting, or is it going to an digester system?**

And so on, because in some cases, the landfill gas recovery might not be the best bang for your buck. It might be digesting that organic matter and getting your energy recovery there. I've seen arguments made that in some cases it may not be worth having a separate organics diversion program at all. Just a landfill it all, and have a good landfill gas recovery system in place at the landfill. So there's no easy answer there. It's very complex. There's the cost of obviously the equipment to install, then there's the cost of what... The cost of carbon is probably a big thing as well. As there's more and more regulations that get put into place in terms of trying to price carbon and drive us towards a low carbon economy, there's still only a certain level of facilities that are going to be impacted by those regulations. And big landfills are usually included in those kinds of programs, whether they're carbon taxes, or cap and trade, or whatever. But if they're smaller, they may not be subject to those carbon regulations. And then that is another disincentive to put in an expensive landfill gas collection program.

8) Are there any future plans to implement waste-to-energy technology in your business operations?

No

9) What is the extent of influence that Valley Waste has in determining the construction of large-scale waste infrastructure projects?

Well, yeah, we would have a lot of influence. We would oversee that entire project. However, we would have to get approval from our council. On an operational level, we would do all the work. We hire the consultants, like you guys do that. But ultimately, our board would approve it, and then through our budget process, the councils would approve it. But we would be the experts on it in the region.

10) What has Valley Waste's role been in conducting educational outreach and influencing behavioral changes around waste reduction amongst the general public?

That's something where we do a lot of, and we're very proud of. We have a very good education team here. We have educators that work with both the business sector and the house residential sector. So we go out... Well, first off, we inspect everything that comes in. So every business load that comes in, we inspect it, and we follow up with education. Households, we do curbside inspections. We do our door-to-door education. We are in schools. We have our own education program at our site where we call Planet Protectors, which is this three-hour interactive... We wear costumes and bring schools in for tours, and that's in partnership with Acadia University. We're very, very high level education here.

So we're a hundred percent the education on behalf of the municipalities on solid waste. So even if our hotline would receive all calls, we put out our own brochure separate from theirs. They would just refer to us, if someone called them. We would do all education for them. The only thing we don't do for them is our services that we provide. That's a package deal for all of our municipalities. But if they want to do something above and beyond what we do, they can do that on their own bill. So Christmas tree collection would be one of them. They would collect trees themselves. We still provide brush collection, but they take as much as you can put out, but outside of that, it's completely us. Same with enforcement. So any illegal dumping, non-compliance with sorting, improper storage in their municipalities, like an apartment building has rodents, whatever. We manage all that on their behalf.

11) On the topic of enforcement or inspections, when it comes to loads coming through your facilities, to what extent are things that enforced with regards to recyclables or organics being observed in the large... Is there thresholds that you have where there's too much OCC or organics or something in a load that's going to be rejected, or a surcharge applied to that load?

Yeah, it would be a judgment call on how much contamination is too much, and it depends on how often we work with that business, so we always try to educate first. The first time someone comes in with unsorted waste, or too much cardboard, we follow up either with a visit, or a letter, or presentations to the staff, whatever it be. If it continues to be a problem, we usually are standard for someone coming in as a double tipping fee, or penalty fee. So you'd be looking at

\$250 a ton instead. And if they still continue, then they're either denied access to our site, or they can be fined through either administrative fines or SOTs. And curbside, your main reduction is, it's not going to get picked up, if it's not sold properly, and if it continues to be a problem again, we can cut off service to your house, or apartment, or whatever it is, and it can also be fines. And I'll just add that the revenue from those fines would come to us, and not to individual municipality. So even though we're reinforcing their by-law, so each has their own by-law, we enforce it on their behalf and collect the fees from that.

12) What is the fleet composition of the vehicles used to collect waste? How are they powered?

So that's a private contract for curbside. They are just regular gas or diesel trucks. They are a single pass truck, though, so there's four streams on each garbage truck. Garbage, organics, container recycling, and paper recycling, so it's a single pass every two weeks. So there are some benefits to that, we don't have to run the roads twice. A lot of municipalities have two trucks, and one week, they'll pick up two streams, and every week they pick up there too. So we have a single pass, however, it doesn't have compaction, so it does have to come in more frequently into our facilities. But we do have our own fleet of vehicles as well. They're all either diesel or gas. So we do have three roll-off trucks that transfers materials from our Lawrencetown site to the Kentville site, and we have half-tons, and so on. And then we have diesel loaders as well.

13) When it comes to your procurement policies and so on, do you have any leverage in those? Or is there any environmental aspect generally included in your tender documents to give preferential treatment, but recognition of, or place any value on perhaps services or otherwise that might have a more less environmental impact, or things like that?

We do. There is a grade, part of the scoring is environmental aspect of it, but probably not enough. Let's just say I would agree with that. We don't mark people considerably higher if they were using renewable energy to run the vehicles. So we would have that ability, but I don't think we focus well enough on that, because again, it comes down to cost, it's a lot of the times. We don't know, we've awarded to the lowest bidder. It's value for money, but it does play a big role in it.

14) There has been some discussion of expanding the current extended producer responsibility (EPR) program in the province. Could you please speak to this and what it would mean for Valley Waste's operations and the municipalities?

Well, you asked the right person, because this is something I'm extremely passionate about. I'm actually the spokesperson on behalf of municipalities in Nova Scotia on that topic, so it's something we desperately need, especially for packaging and printing paper in Nova Scotia. Most of the nation has that already, or 80 percent of the population in Canada has it. So we're paying into the program, but we're not getting the benefits. Although it's been good this year, the markets, it took through a private contract, but we've had real struggles marketing a lot of the materials in Nova Scotia in the last five years. So we desperately need it, both from a financial perspective, but also environmental management perspective. So we're huge supporters of that. All of our municipalities have been pushing for it. So for municipalities in Nova Scotia, it's the number one priority to the Nova Scotia Federation municipalities. So yeah, it doesn't stop there. We need it for other items. Much of our hazard waste should be under an EPR program, which we don't have. We spent \$250,000 a year on hazardous waste, and most provinces have a lot of that covered. Financially, minimum that would be a million dollar savings for our municipalities a

year. This is based on the BC model, but it could actually be more than that. But so both financially and from an operational, it would really streamline our recycling programs across the province, less confusion.

15) The Ontario model is going to be basically removing the whole blue box system out of municipalities hands, and putting it onto the producers of the material. And I'm struggling to think here of how if that kind of model takes shape, how we what would the role of Valley Waste be in that kind of world?

So typically under a full EPR program. So Ontario is moving towards a full... So again, just like you said, they would manage both the operational and the financial marketing part of the program. But typically what happens, and it would ultimately be up to municipalities to negotiate this. But typically the collection is still managed through by municipalities to their contracts, as well as education and some oversight. But once it arrives at a facility, then the processing, the transportation, the storage would all be covered by the producers of the brand owners, but we would have the right to refuse that. So on BC, they have a full model. So in most places in BC, the collection is still done via municipalities and the education. However, I think in Vancouver they passed over the collection as well, so they refused to do that themselves. So it could be either way. But the most realistic is no significant change for the consumer. It's more on the back end. So essentially the municipality could act as a contractor, so to speak, to the producers to collect, potentially process the materials. And really, if and when that transition happens, the producers could come with an offer on the table of, given that an organization like yours has all the infrastructure and stuff in place, it might be in their best interest to take leverage or take advantage of what you have there, rather than trying to do it all themselves. But ultimately, it would be up to you or municipalities to decide whether they would like to continue to be in that world, and act as that service provider or not. And if they decide not to, then it's up to the producers to go to market, or to figure out... They'd be mandated to recover certain materials at certain rates. And it would be up to them really to figure out how they're going to do that. Whereas right now it's the municipal rate payers that are ultimately responsible for collection and processing. It would be shifting that responsibility to the producers to figure out the best and the most efficient way to do that, which may or may not include some or all municipalities, depending on the local circumstances. Yeah. And it would come down to what the province requires in a plan from the industry. I will say, and I don't know if this is public or not, but Scotia Recycling on our facility here, they're probably the biggest player in the province. They want.... If that ever happens, they'll certainly bidding on it, and this facility in Kentville, they're doubling, they're expanding it. They're doubling its size and putting in optical sorting. So I don't know if that's their stance to try to get EPR here, but they want to prove it, that they can do it, because typically under that, you're recycling your container line. That's the most expensive to manage, so it would most likely be just one or two of those facilities in the province that would do it with greater volume through an optical sorter.

King's Transit Authority

- 1) Could you please provide some more information about your professional background and your current role with the King's Transit Authority?**

I am a municipal consultant, management consultant doing local government work. I've been doing that for about ten years. That has involved a lot of municipal restructuring activity. But before I was in this job, I was the CEO of Kings County for seven years. And before that, I worked with the LFX Regional and my work there and involved buses, garbage and transit. So I ran a Metro Transit, which is now Halifax Transit at one point years ago.

- 2) What is your business model and how does it integrate with the municipalities?**

The King's Transit Authority is an inter municipal organization that consists of representatives from the Council of Kings County, Wolfville, Berwick and can fill it also has transit service contracts with the municipalities of Annapolis County and Digbee County.

- 3) You mentioned in your survey response that one of the obstacles hindering your organization from implementing climate change action was transit links to municipal climate change plans. Could you please elaborate a bit more on this?**

Yes. I think that King's Transit is focused on its daily service, its daily operations. Until now, individual municipalities may have climate change initiatives and plans. Kings Transit is not an integral part of those as far as I know, but we don't know for sure what that is. We're a small organization and very focused on our day to day operations. COVID - I actually had the service for several months in the middle of COVID and between the ceasing of service last year and general concerns in the community about COVID, our ridership is down quite significantly from what it was before COVID. So we're in rebuilding the stage right.

- 4) "Providing a sustainable transportation network" is listed as part of the Kings Transit Authority mission and to "preserve and sustain the environment" is listed as an organizational objective. Could you please provide some details on the transit authority's process of attaining those goals? Have any specific targets been put in place?**

I guess I would say that kind of goal response to the fact that we're providing an option to individual automobiles. Having said that, a lot of our riders are what I call transit captive riders. They do not have an automobile. I think we are improving accessibility for people Annapolis Valley who do not have other means of travel and who might have to rely on more energy intensive modes of travel if Kings Transit, we're not there.

- 5) In your opinion, how important are transportation-based initiatives in reducing overall regional GHG emissions?**

I think they are important. Having said that, I don't think the community or the communities in the Valley are well organized to rely heavily on public transit, but it does play a role. There's no doubt. I think that a lot of the destinations and services Annapolis Valley have been designed around automobile transport goes to public transport.

- 6) You mentioned that upgrading the municipal fleet to include electrification of municipal buses is something that is being considered. Are there any specific plans that have been put in place to propel this forward? If yes, what are they? If no, what are the obstacles preventing this?**

Yeah. Fortunately, the work that you're doing now, I believe, is going to feed into some initiatives. Kings Transit and the Municipal Kings County are jointly working on an application for GHG reduction funding that would involve a review of the transit service and the possibility of electrifying the entire fleet.

- 7) Could you please provide an overview of the Transit Master Plan and Electrification Study?**

At this point in time. We developed terms of reference to take to the senior levels of government for potential funding. Contact those two studies. That it's one study. But those two components.

- 8) Does the transit authority conduct any programs/campaigns for public engagement to influence behavioral changes such as encourage increased use of public transportation?**

I think the only thing I would say is generally in marketing the system, we try to promote the ease of access. One of the best examples is we have automatic vehicle location systems on the bus and use an app called Double Map. So we encourage people to use Double Map to know when their bosses are coming. The service frequency. Here the headway, if you will, instead of being 15 minutes or 30 minutes like you might be used to in Kitchener. Here, they're two hour frequencies.

So I just would say in our general promotions, and we don't do a lot of advertising. Kids is probably a good example. I suspect advertise more than we do, but we are able to promote not only the service, right. But the ease of access. This covered facing application we use.

- 9) In your opinion, what are some ways to increase ridership/the use of public transportation amongst the general public? What are the obstacles that need to be overcome?**


I would say the biggest obstacle is increased funding. As an example, we would like to get back to hourly service. We had to go to two hour service because of COVID, and we're waiting financially now to be in a position to have enough ridership right to go back to hourly. But if we were waiting for ridership revenue to come back, we could have increased municipal funding. And that would allow us to get back to all the service or better than that.

APPENDIX D:
GHG REDUCTION OPPORTUNITY CATALOGUE

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CATALOGUE #	1
GHG SECTOR / SOURCE	RESIDENTIAL BUILDINGS / Emissions from Fuel Combustion
CO-BENEFITS	Improved air quality, Reduced energy costs for consumers
OPPORTUNITY TITLE	<p>Increased Installation of Solar Hot Water Heating in Homes</p>  <p><i>Image courtesy of Efficiency Nova Scotia</i></p>
KEY ASSUMPTIONS	<p>Ranking and prioritization of this opportunity was based on the following assumptions:</p> <ul style="list-style-type: none"> ▪ Water heating accounts for 14.5% of residential energy use in Nova Scotia (Source: Comprehensive Energy Use Database, Nova Scotia Residential Sector, Table 2) ▪ Installation cost of \$9,000, not including potential rebates or incentives from government or utilities Estimated savings of \$800/year in energy costs (Source: City of Halifax, https://www.halifax.ca/home-property/solar-projects/about-solar-city) ▪ Number of households obtained from 2016 Census of Canada

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CATALOGUE #	2
GHG SECTOR / SOURCE	RESIDENTIAL BUILDINGS / Emissions from Fuel Combustion
CO-BENEFITS	Improved air quality, Reduced energy costs for consumers
OPPORTUNITY TITLE	<p>Conversion of Water Heaters from Heating Oil to Electricity</p> <div data-bbox="868 556 1063 1081" data-label="Image"> </div> <p><i>Image courtesy of Efficiency Nova Scotia</i></p>
KEY ASSUMPTIONS	<p>Ranking and prioritization of this opportunity was based on the following assumptions:</p> <ul style="list-style-type: none"> ▪ Water heating accounts for 14.5% of residential energy use in Nova Scotia Heating oil is used for 50% of water heating energy use in Nova Scotia (<u>Source</u>: Comprehensive Energy Use Database, Nova Scotia Res. Sector, Tables 2, 10) ▪ Installation cost of \$3,000, not including potential rebates or incentives from government or utilities ▪ Annual fuel costs of electricity are 33% lower than heating oil (<u>Source</u>: https://smarterhouse.org/water-heating/replacing-your-water-heater) ▪ Number of households obtained from 2016 Census of Canada

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CATALOGUE #	3
GHG SECTOR / SOURCE	RESIDENTIAL BUILDINGS / Emissions from Fuel Combustion
CO-BENEFITS	Improved air quality, Reduced energy costs for consumers
OPPORTUNITY TITLE	<p>Increased Installation of Heat Pumps in Homes</p> <div data-bbox="743 556 1193 1102" data-label="Image"> </div> <p><i>Image courtesy of Efficiency Nova Scotia</i></p>
KEY ASSUMPTIONS	<p>Ranking and prioritization of this opportunity was based on the following assumptions:</p> <ul style="list-style-type: none"> ▪ Space heating accounts for 67% of residential energy use in Nova Scotia (Source: Comprehensive Energy Use Database, Nova Scotia Res. Sector, Table 2) ▪ Installation cost of \$8,500, not including potential rebates or incentives from government or utilities Heat pump installation reduces heating energy use by 75% Average annual savings from reduced energy use is \$1,900 (Source: Nova Scotia Power https://www.nspower.ca/your-home/energy-products/heat-pumps/heat-pump-installation-costs-and-rebates) ▪ Number of households obtained from 2016 Census of Canada

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CATALOGUE #	4
GHG SECTOR / SOURCE	RESIDENTIAL BUILDINGS / Emissions from Fuel Combustion
CO-BENEFITS	Improved air quality, Reduced energy costs for consumers, Increased in-home comfort
OPPORTUNITY TITLE	Deep Retrofits of Existing Homes  <p><i>Image courtesy of Energy Mix Productions Inc.</i></p>
KEY ASSUMPTIONS	Ranking and prioritization of this opportunity was based on the following assumptions: <ul style="list-style-type: none">▪ Deep retrofit will accomplish a 50% reduction in energy use per year▪ Deep retrofit will cost \$50,000, not including potential rebates or incentives from government or utilities▪ Average annual residential energy cost (electricity + other heating fuels) in Nova Scotia pre-retrofit of \$5,000▪ Average annual GHG emissions from residential energy use in Nova Scotia is 8.83 tonnes of CO_{2e} / home

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CATALOGUE #	5
GHG SECTOR / SOURCE	INSTITUTIONAL & COMMERCIAL BUILDINGS / Emissions from Fuel Combustion
CO-BENEFITS	Improved air quality, Reduced energy costs
OPPORTUNITY TITLE	<p>Increased Use of Additives for Hydronic Heating Systems</p> <div data-bbox="662 552 1393 1129" data-label="Diagram"> </div> <p style="text-align: center;"><i>Image courtesy of Endo Enterprises (UK) Ltd.</i></p>
KEY ASSUMPTIONS	<p>Ranking and prioritization of this opportunity was based on the following assumptions:</p> <ul style="list-style-type: none"> ▪ 9% of commercial buildings use hydronic heating systems (Source: StatsCan. Table 38-10-0286-01. Primary heating systems and type of energy) ▪ Additive reduces energy consumption by 10%; this is a conservative estimate compared to 15% claimed by manufacturer (Endo Enterprises UK Ltd.) ▪ Average cost per building of \$6,000 Average annual savings from reduced energy use is \$1,800 (Source: Town of Bridgewater Energy Management Plan 2021-2025) ▪ Number of commercial buildings is assumed to be 5% of the total number of residential buildings
IMPLEMENTATION RESPONSIBILITY	County of Kings, Town of Berwick, Town of Kentville, Town of Wolfville

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CATALOGUE #	6
GHG SECTOR / SOURCE	INSTITUTIONAL & COMMERCIAL BUILDINGS / Emissions from Fuel Combustion
CO-BENEFITS	Improved air quality, Reduced energy costs
OPPORTUNITY TITLE	<p>Conversion from Fuel Oil to Natural Gas for Heating</p>  <p><i>Image courtesy of CBC News</i></p>
KEY ASSUMPTIONS	<p>Ranking and prioritization of this opportunity was based on the following assumptions:</p> <ul style="list-style-type: none"> ▪ Fuel oil accounts for 29% of space heating energy use in Nova Scotia’s commercial / institutional buildings (<u>Source</u>: Comprehensive Energy Use Database, Nova Scotia Commercial / Institutional Sector, Table 24) ▪ Average cost to convert from fuel oil to natural gas heating is \$5,500 ▪ Cost of natural gas is 25% less per GJ than heating oil (<u>Source</u>: Efficiency NS) ▪ Number of commercial buildings is assumed to be 5% of the total number of residential buildings

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CATALOGUE #	7
GHG SECTOR / SOURCE	INSTITUTIONAL & COMMERCIAL BUILDINGS / Emissions from Fuel Combustion
CO-BENEFITS	Improved air quality, Reduced energy costs, Improved in-building comfort
OPPORTUNITY TITLE	<p>Deep Retrofits of Existing Commercial / Institutional Buildings</p>  <p><i>Image courtesy of Efficiency Nova Scotia</i></p>
KEY ASSUMPTIONS	<p>Ranking and prioritization of this opportunity was based on the following assumptions:</p> <ul style="list-style-type: none"> ▪ Deep retrofit will accomplish a 50% reduction in energy use per year ▪ Deep retrofit will cost \$55 / square foot, not including potential rebates or incentives from government or utilities (<u>Source</u>: Canada Green Building Council, "Building Solutions to Climate Change") ▪ Average commercial building size of 18,000 square feet (<u>Source</u>: Statistics Canada) ▪ Average annual GHG emissions from residential energy use in Nova Scotia is 173 tonnes of CO₂e / building ▪ Number of commercial buildings is assumed to be 5% of the total number of residential buildings

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CATALOGUE #	8
GHG SECTOR / SOURCE	INSTITUTIONAL & COMMERCIAL BUILDINGS / Emissions from Fuel Combustion
CO-BENEFITS	Improved air quality, Reduced energy costs
OPPORTUNITY TITLE	<p>Increased Installation of Heat Pumps in Commercial / Institutional Buildings</p>  <p><i>Image courtesy of Nova Scotia Power</i></p>
KEY ASSUMPTIONS	<p>Ranking and prioritization was based on the following assumptions:</p> <ul style="list-style-type: none"> ▪ Space heating accounts for 47% of commercial / institutional energy use in NS (<u>Source</u>: Comprehensive Energy Use Database, Nova Scotia Commercial / Institutional Sector, Table 2) ▪ Installation cost of \$51,000 (calculated as 6 times the residential unit cost), not including potential rebates or incentives from government or utilities Heat pump installation reduces heating energy use by 65% Average annual savings from reduced energy use is \$11,400 (calculated as 6 times the residential savings) (<u>Source</u>: Efficiency Nova Scotia) ▪ Number of commercial buildings is assumed to be 5% of the total number of residential buildings

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CATALOGUE #	9
GHG SECTOR / SOURCE	INSTITUTIONAL & COMMERCIAL BUILDINGS / Emissions from Fuel Combustion
CO-BENEFITS	Improved air quality, Reduced energy costs
OPPORTUNITY TITLE	<p>Increased Installation of Solar Hot Water Heating in Commercial / Institutional Buildings</p>  <p><i>Image courtesy of Efficiency Nova Scotia</i></p>
KEY ASSUMPTIONS	<p>Ranking and prioritization was based on the following assumptions:</p> <ul style="list-style-type: none"> ▪ Water heating accounts for 5% of commercial / institutional building energy use in Nova Scotia (<u>Source</u>: Comprehensive Energy Use Database, Nova Scotia Commercial / Institutional Sector, Table 2) ▪ Solar heaters reduce water heating energy use by 50% (<u>Source</u>: Efficiency Nova Scotia) ▪ Installation cost of \$54,000 (calculated as 6 times the residential cost), not including potential rebates or incentives from government or utilities Estimated savings of \$4,800/year in energy costs (6 times the residential savings) ▪ Number of commercial buildings is assumed to be 5% of the total number of residential buildings

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CATALOGUE #	10
GHG SECTOR / SOURCE	INDUSTRIAL FACILITIES
CO-BENEFITS	Improved air quality, Reduced energy costs, Decreased carbon pricing impacts
OPPORTUNITY TITLE	<p>Industrial Sector GHG Emission Reductions</p>  <p><i>Image courtesy of CBC</i></p>
KEY ASSUMPTIONS	<p>Ranking and prioritization of this opportunity was based on the following assumptions:</p> <ul style="list-style-type: none"> ▪ Assume industrial sector in Region experience GHG reductions aligned with the mandated GHG reductions imposed on large emitters in the NS cap and trade program (approx. 4% reduction per year) ▪ Assume that the annual reduction in GHG (4% per year) applied in the first compliance period of the cap and trade program will continue through 2030 and 2050

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CATALOGUE #	11
GHG SECTOR / SOURCE	RESIDENTIAL & I-C-I BUILDINGS / Emissions from Grid-Supplied Energy
CO-BENEFITS	Improved air quality, Reduced exposure to carbon taxes, Increased local energy security
OPPORTUNITY TITLE	<p>Meadowview Solar Facility</p>  <p><i>Image courtesy of CTV News Atlantic</i></p>
KEY ASSUMPTIONS	<p>Ranking and prioritization was based on the following assumptions:</p> <ul style="list-style-type: none"> ▪ 7 MW facility will operate at 15% capacity = 9,198,000 kWh per year ▪ Solar-generated electricity has a GHG emission factor of zero ▪ GHG reductions are calculated using 2016 Nova Scotia provincial grid electricity GHG intensity ▪ Estimated cost of \$8.19 million for project based on rate of \$1,170 per KW (Source: https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/market-snapshots/2018/market-snapshot-cost-install-wind-solar-power-in-canada-is-projected-significantly-fall-over-long-term.html) ▪ Payback is calculated using COMFIT rates for large-scale wind (13.1 cents/kWh)

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CATALOGUE #	12
GHG SECTOR / SOURCE	RESIDENTIAL & I-C-I BUILDINGS / Emissions from Grid-Supplied Energy
CO-BENEFITS	Improved air quality, Reduced exposure to carbon taxes, Increased local energy security
OPPORTUNITY TITLE	<p>Southwest Quadrant Wind Energy Project</p>  <p><i>Image courtesy of Union of Nova Scotia Municipalities</i></p>
KEY ASSUMPTIONS	<p>Ranking and prioritization of this opportunity was based on the following assumptions:</p> <ul style="list-style-type: none"> ▪ 4.2 MW facility will operate at 25% capacity = 9,198,000 kWh per year ▪ Wind-generated electricity has a GHG emission factor of zero ▪ GHG reductions are calculated using 2016 Nova Scotia provincial grid electricity GHG intensity ▪ Estimated cost of \$8.4 million for project based on rate of \$2 million per MW ▪ Payback is calculated using COMFIT rates for large-scale wind (13.1 cents/kWh)

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CATALOGUE #	13
GHG SECTOR / SOURCE	RESIDENTIAL BUILDINGS / Emissions from Grid-Supplied Energy
CO-BENEFITS	Improved air quality, Reduced energy costs for consumers
OPPORTUNITY TITLE	<p>Provide Rebates on ENERGY STAR Appliance Purchases</p>  <p><i>Image courtesy of ENERGY STAR</i></p>
KEY ASSUMPTIONS	<p>Ranking and prioritization of this opportunity was based on the following assumptions:</p> <ul style="list-style-type: none"> ▪ Appliance use accounts for 14.4% of residential energy use in Nova Scotia (<u>Source</u>: Comprehensive Energy Use Database, Nova Scotia Res. Sector, Table 2) ▪ Assume 25% energy savings of ENERGY STAR appliance compared to conventional ▪ Assume households have 5 major appliances each that are subject to a rebate ▪ Rebate amount of \$100 per major appliance replaced ▪ Payback period of 2 years is provided by US Environmental Protection Agency ▪ Number of households obtained from 2016 Census of Canada

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CATALOGUE #	14
GHG SECTOR / SOURCE	RESIDENTIAL BUILDINGS / Emissions from Grid-Supplied Energy
CO-BENEFITS	Improved air quality, Reduced energy costs for consumers
OPPORTUNITY TITLE	<p>Low-Cost Residential Energy Efficiency Improvements</p>  <p><i>Image courtesy of Efficiency Nova Scotia</i></p>
KEY ASSUMPTIONS	<p>Ranking and prioritization of this opportunity was based on the following assumptions:</p> <ul style="list-style-type: none"> ▪ 10% energy savings is feasible through aggressive targeting of low-cost energy efficiency improvements (\$500/year savings with assumed annual energy cost of \$5,000) ▪ Assume cost of \$20,000 for promotion of incentive program plus \$500/household for technology upgrades (e.g. programmable thermostats, light timers, LED bulbs, etc.) ▪ Average annual GHG emissions from residential energy use in Nova Scotia is 8.83 tonnes of CO₂e / home ▪ Number of households obtained from 2016 Census of Canada

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CATALOGUE #	15
GHG SECTOR / SOURCE	RESIDENTIAL BUILDINGS / Emissions from Grid-Supplied Energy
CO-BENEFITS	Improved air quality, Reduced energy costs for consumers
OPPORTUNITY TITLE	<p>Increased Installation of Solar PV Systems on Homes (PACE Program)</p>  <p><i>Image courtesy of Halifax Solar City program</i></p>
KEY ASSUMPTIONS	<p>Ranking and prioritization of this opportunity was based on the following assumptions:</p> <ul style="list-style-type: none"> ▪ Installation cost of \$21,750, not including potential rebates or incentives from government or utilities ▪ Assume 10,000 kWh / year of grid-supplied electricity is avoided ▪ Annual energy savings from solar PV system is \$1,300 / household ▪ GHG reductions are calculated using 2016 Nova Scotia provincial grid electricity GHG intensity ▪ Number of households obtained from 2016 Census of Canada

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CATALOGUE #	16
GHG SECTOR / SOURCE	INSTITUTIONAL-COMMERCIAL BUILDINGS / Emissions from Grid-Supplied Energy
CO-BENEFITS	Improved air quality, Reduced energy costs
OPPORTUNITY TITLE	<p>Increased Installation of Solar PV Systems on Institutional / Commercial Buildings</p>  <p><i>Image courtesy of saltwire.com</i></p>
KEY ASSUMPTIONS	<p>Ranking and prioritization was based on the following assumptions:</p> <ul style="list-style-type: none"> ▪ Installation cost of \$100,000, not including potential rebates or incentives from government or utilities ▪ Assume 50,000 kWh / year of grid-supplied electricity is avoided ▪ Annual energy savings from solar PV system is \$10,500 / building ▪ GHG reductions are calculated using 2016 Nova Scotia provincial grid electricity GHG intensity ▪ Number of commercial buildings is assumed to be 5% of the total number of residential buildings
IMPLEMENTATION RESPONSIBILITY	County of Kings, Town of Berwick, Town of Kentville, Town of Wolfville

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CATALOGUE #	17
GHG SECTOR / SOURCE	RESIDENTIAL & I-C-I BUILDINGS / Emissions from Grid-Supplied Energy
CO-BENEFITS	Improved air quality, Reduced exposure to carbon taxes, Increased local energy security
OPPORTUNITY TITLE	<p>Berwick Community Solar Garden</p>  <p><i>Image courtesy of saltwire.com</i></p>
KEY ASSUMPTIONS	<p>Ranking and prioritization of this opportunity was based on the following assumptions:</p> <ul style="list-style-type: none"> ▪ 10 MW facility will operate at 15% capacity = 13,140,000 kWh per year ▪ Solar-generated electricity has a GHG emission factor of zero ▪ GHG reductions are calculated using local electricity GHG intensity calculated for Town of Berwick (135 g CO_{2e} / kWh) ▪ Estimated cost of \$10 million (<u>Source</u>: Town of Berwick) ▪ Payback is calculated using COMFIT rates for large-scale wind (13.1 cents/kWh)

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CATALOGUE #	18
GHG SECTOR / SOURCE	INSTITUTIONAL-COMMERCIAL BUILDINGS / Emissions from Grid-Supplied Energy
CO-BENEFITS	Improved air quality, Reduced energy costs, Improved comfort within the building
OPPORTUNITY TITLE	<p>Require New Institutional / Commercial Buildings be Net-Zero Energy by 2030</p>  <p><i>Image courtesy of CBC News</i></p>
KEY ASSUMPTIONS	<p>Ranking and prioritization of this opportunity was based on the following assumptions:</p> <ul style="list-style-type: none"> ▪ Assume same number of institutional / commercial building stock in the future – new buildings only replace existing buildings at the end of their life ▪ Assume net-zero building code is implemented in 2030 ▪ Assume 1% turnover / replacement of residential buildings each year ▪ Assume net-zero construction does not incur a cost premium over conventional construction

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CATALOGUE #	19
GHG SECTOR / SOURCE	ALL BUILDINGS / Emissions from Grid-Supplied Energy
CO-BENEFITS	Improved air quality, Reduced exposure to carbon taxes
OPPORTUNITY TITLE	<p>Provincial Electricity Grid Decarbonization</p>  <p><i>Image courtesy of Nalcor Energy</i></p>
KEY ASSUMPTIONS	<p>Ranking and prioritization of this opportunity was based on the following assumptions:</p> <ul style="list-style-type: none"> ▪ 81.4% of Nova Scotia electricity in 2016 generated from fossil fuel combustion (<u>Source:</u> National Inventory Report) ▪ Estimate 32.2% of Nova Scotia electricity in 2030 will be generated from fossil fuel combustion (<u>Source:</u> Nova Scotia Power 2020 Integrated Resource Plan) ▪ Estimate 17.4% of Nova Scotia electricity in 2050 will be generated from fossil fuel combustion (<u>Source:</u> Nova Scotia Power 2020 Integrated Resource Plan)

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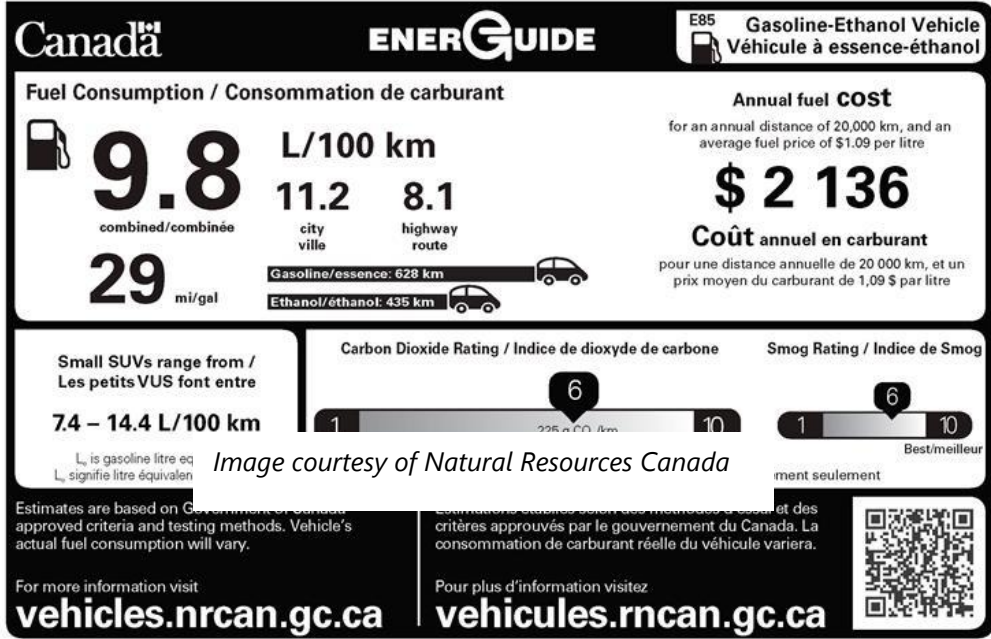
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CATALOGUE #	20
GHG SECTOR / SOURCE	TRANSPORTATION / On-Road Fuel Combustion (In-Region and Out-of-Region)
CO-BENEFITS	Improved air quality, Reduced fuel costs
OPPORTUNITY TITLE	<p>Increased Adoption of Electric Vehicles (Investment in Charging Station Availability)</p>  <p><i>Image courtesy of Town of Wolfville</i></p>
KEY ASSUMPTIONS	<p>Ranking and prioritization of this opportunity was based on the following assumptions:</p> <ul style="list-style-type: none"> ▪ Assume cost of \$11,750 per EV charger installation (Source: https://www.canada.ca/en/natural-resources-canada/news/2021/07/canada-invests-in-new-ev-chargers-in-nova-scotia.html) ▪ Assume 100 charging stations to be installed ▪ Assume average energy efficiency of 18 kWh / 100 km emits 41% less GHG than fossil fuel vehicles at a distance of 20,000 km / year ▪ GHG reductions are calculated using 2016 Nova Scotia provincial grid electricity GHG intensity

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CATALOGUE #	21
GHG SECTOR / SOURCE	On-Road Transportation Fuel Combustion (In-Region and Out-of-Region)
CO-BENEFITS	Improved air quality, Reduced exposure to carbon taxes
OPPORTUNITY TITLE	<p>Federal Fuel Efficiency Standards</p>  <p>Federal Fuel Efficiency Standards</p> <p>Fuel Consumption / Consommation de carburant</p> <p>9.8 L/100 km combined/combiniée</p> <p>29 mi/gal</p> <p>11.2 L/100 km city ville 8.1 L/100 km highway route</p> <p>Annual fuel cost for an annual distance of 20,000 km, and an average fuel price of \$1.09 per litre \$ 2 136 Coût annuel en carburant pour une distance annuelle de 20 000 km, et un prix moyen du carburant de 1,09 \$ par litre</p> <p>Small SUVs range from / Les petits VUS font entre 7.4 – 14.4 L/100 km</p> <p>Carbon Dioxide Rating / Indice de dioxyde de carbone 6</p> <p>Smog Rating / Indice de Smog 6 Best/meilleur</p> <p><i>Image courtesy of Natural Resources Canada</i></p> <p>Estimates are based on Government of Canada approved criteria and testing methods. Vehicle's actual fuel consumption will vary. Estimations établies selon des méthodes approuvées par le gouvernement du Canada. La consommation de carburant réelle du véhicule variera.</p> <p>For more information visit vehicles.nrcan.gc.ca Pour plus d'information visitez vehicules.nrcan.gc.ca</p>
KEY ASSUMPTIONS	<p>Ranking and prioritization of this opportunity was based on the following assumptions:</p> <ul style="list-style-type: none"> Assume low-range federal fuel efficiency target of 1.5% improvement per year is maintained through 2050 (results in 19.1 and 40.2% improvement in average vehicle fuel efficiency by 2030 and 2050, respectively)

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CATALOGUE #	22
GHG SECTOR / SOURCE	On-Road Transportation Fuel Combustion (In-Region and Out-of-Region)
CO-BENEFITS	Improved air quality, Reduced exposure to carbon taxes
OPPORTUNITY TITLE	<p>Increased Transit Usage (In-Region and Out-of-Region)</p>  <p><i>Image courtesy of Kings Transit Authority</i></p>
KEY ASSUMPTIONS	<p>Ranking and prioritization was based on the following assumptions:</p> <ul style="list-style-type: none"> ■ Adoption rates of 25% by 2030 and 50% by 2050 of all personal vehicle trips can be converted to transit with increased frequency and destinations ■ Transit usage currently represents 1.6% of all non-commercial travel in the Region (<u>Source:</u> 2016 Census of Canada) ■ GHG emissions per km travelled are 87% less for transit compared to personal vehicle ■ Assume cost of expanded transit is equal to the current annual operating expenses for Kings Transit (\$1.5 million) ■ Payback estimated using total cost savings from avoided fuel combustion using average fuel economy of 8.9 L/100 km and fuel cost of \$1.50/L

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CATALOGUE #	23
GHG SECTOR / SOURCE	TRANSPORTATION / On-Road Transportation Fuel Combustion (In-Region)
CO-BENEFITS	Improved physical and mental health of users, Tourism opportunity, Increased exposure of local businesses
OPPORTUNITY TITLE	<p>Increased Use of Active Transportation</p>  <p><i>Image courtesy of County of Kings</i></p>
KEY ASSUMPTIONS	<p>Ranking and prioritization was based on the following assumptions:</p> <ul style="list-style-type: none"> ▪ Assume investment in active transportation infrastructure will result in doubling of current active transportation level by 2030 and a 4x increase by 2050 ▪ Active transportation currently represents 3.2% of all in-Region travel for commuting (<u>Source</u>: 2016 Census of Canada) ▪ Assume same level of active transportation (3.2%) for In-Region non-commuting trips ▪ Predicted cost was estimated using sum of all short-term actions in the <i>County of Kings Active Transportation Plan (Draft Version, June 2021)</i> ▪ Payback estimated using total cost savings from avoided fuel combustion using average fuel economy of 8.9 L/100 km and fuel cost of \$1.50/L

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CATALOGUE #	24
GHG SECTOR / SOURCE	TRANSPORTATION / Commercial Vehicle Fuel Combustion (In- & Out-of-Region)
CO-BENEFITS	Improved air quality, Reduced exposure to carbon tax
OPPORTUNITY TITLE	Improved Fuel Efficiency and Electrification of Commercial Vehicles  <p><i>Image courtesy of greencarreports.com</i></p>
KEY ASSUMPTIONS	Ranking and prioritization of this opportunity was based on the following assumptions: <ul style="list-style-type: none">Assume same fuel efficiency improvements are accomplished in commercial vehicles as are achieved in the light-duty personal vehicle sector (results in 19.1 and 40.2% improvement in average vehicle fuel efficiency by 2030 and 2050, respectively)

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CATALOGUE #	25
GHG SECTOR / SOURCE	WASTE / Solid Waste Disposal
CO-BENEFITS	Landfill capacity retained, Increased awareness of waste reduction for the public, Opportunity for local businesses to promote environmental footprint reduction
OPPORTUNITY TITLE	<p>Reduce Landfilled Waste from I-C-I Sector</p>  <p><i>Image courtesy of AET Group Inc.</i></p>
KEY ASSUMPTIONS	<p>Ranking and prioritization was based on the following assumptions:</p> <ul style="list-style-type: none"> ▪ I-C-I sector accounts for 52% of all Regional landfilled waste (<u>Source:</u> Valley Waste) ▪ 2017 audit of I-C-I waste at Kaizer Meadow landfill revealed that 43% of landfilled waste should have been diverted through an existing Valley Waste option: 29% of audit was recyclable (plastic or paper); 14% of audit was organic ▪ Landfill reduction for I-C-I customers is based on an increase of the existing fee imposed for landfill disposal (recycling disposal not to be increased) ▪ Assumed cost of \$20,000 for promotion and communication to customers ▪ Estimated savings based on reduced disposal cost of recycling vs landfill

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CATALOGUE #	26
GHG SECTOR / SOURCE	WASTE / Solid Waste Disposal
CO-BENEFITS	Landfill capacity retained, Increased awareness of waste reduction for the public, Backyard composters provide residents with high-quality soils
OPPORTUNITY TITLE	<p>Increase the Amount of Residential Organic Waste that is Composted</p>  <p><i>Image courtesy of Fundy Compost</i></p>
KEY ASSUMPTIONS	<p>Ranking and prioritization was based on the following assumptions:</p> <ul style="list-style-type: none"> ▪ Residential accounts for 48% of all Regional landfilled waste (<u>Source:</u> Valley Waste) ▪ 2017 audit of residential waste at Kaizer Meadow landfill revealed that over 60% of landfilled waste should have been diverted through an existing Valley Waste option: <ul style="list-style-type: none"> 36% of audit was recyclable (plastic or paper); 25% of audit was organic ▪ Landfill reduction is based on a decrease of allowable garbage bag disposal (reduction of one bag every two weeks due to increased organic diversion) ▪ Assumed cost of \$20,000 for promotion and communication to customers ▪ Estimated savings based on reduced disposal cost for composting vs landfill

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CATALOGUE #	27
GHG SECTOR / SOURCE	WASTE / Solid Waste Disposal
CO-BENEFITS	Landfill capacity retained, Increased awareness of waste reduction for the public
OPPORTUNITY TITLE	<p>Reduce Landfilled Waste from Residential Sector</p>  <p><i>Image courtesy of Valley Waste Resource Management</i></p>
KEY ASSUMPTIONS	<p>Ranking and prioritization was based on the following assumptions:</p> <ul style="list-style-type: none"> ▪ Residential accounts for 48% of all Regional landfilled waste (<u>Source:</u> Valley Waste) ▪ 2017 audit of residential waste at Kaizer Meadow landfill revealed that over 60% of landfilled waste should have been diverted through an existing Valley Waste option: 36% of audit was recyclable (plastic or paper); 25% of audit was organic ▪ Landfill reduction is based on a decrease of allowable garbage bag disposal (reduction of one bag every two weeks due to increased recycling) ▪ Assumed cost of \$20,000 for promotion and communication to customers ▪ Estimated savings based on reduced disposal cost for recycling vs landfill

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CATALOGUE #	28
GHG SECTOR / SOURCE	AGRICULTURE / Livestock
CO-BENEFITS	Increased milk yield, Opportunity for local farms to promote sustainability of product
OPPORTUNITY TITLE	<p>Alternative Cattle Feeding Strategies with Increased Lipids / Decreased Fiber</p>  <p><i>Image courtesy of Town of Wolfville</i></p>
KEY ASSUMPTIONS	<p>Ranking and prioritization of this opportunity was based on the following assumptions:</p> <ul style="list-style-type: none"> ▪ Alternative feeding strategies can reduce enteric fermentation GHG emissions by 18% per kg milk produced (<u>Source:</u> Caro et al., 2016) ▪ Assume 11% cost increase of alternative feeding strategies compared to conventional feeding strategies (<u>Source:</u> Caro et al., 2016) ▪ Predicted increase in milk yield from alternative feeding strategies of 11%. Potential increased cost of alternative feeding strategies presumed to be net-zero when considering the increased milk yield ▪ Number of cattle farms in County (88) obtained from 2016 Census of Agriculture

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CATALOGUE #	29
GHG SECTOR / SOURCE	AGRICULTURE / Livestock
CO-BENEFITS	Reduced odour and ammonia emissions, Opportunity for local farms to promote sustainability of product
OPPORTUNITY TITLE	<p>Manure Management Strategies Implemented</p>  <p><i>Image courtesy of Dairy Farmers of Canada</i></p>
KEY ASSUMPTIONS	<p>Ranking and prioritization was based on the following assumptions:</p> <ul style="list-style-type: none"> ▪ Multiple low-cost manure management strategies can be implemented that can reduce GHG emissions from manure storage significantly (<u>Source</u>: Dairy Farmers of Canada): <ul style="list-style-type: none"> - straw cover on stored liquid manure (15% reduction) - complete emptying and cleaning of manure storage tank in the spring (40% reduction) - separation of solid and liquid manure and composting of solids (30% reduction) ▪ Assume all recommended manure management strategies can be implemented at no cost to the farm enterprise ▪ Number of cattle farms in County (88) obtained from 2016 Census of Agriculture

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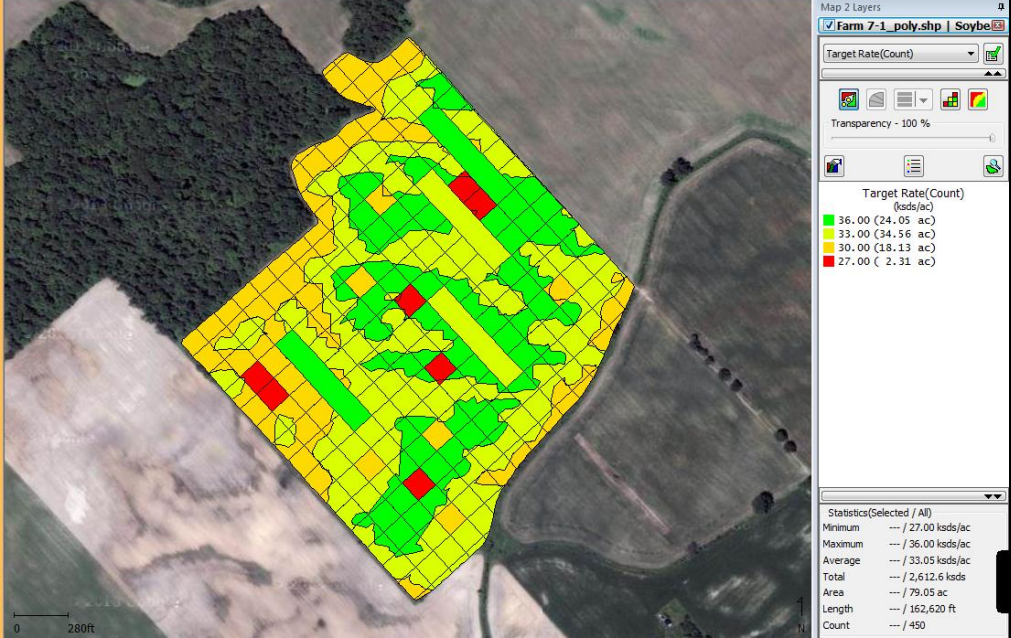
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CATALOGUE #	30
GHG SECTOR / SOURCE	AGRICULTURE / Land Management
CO-BENEFITS	Improved soil health / reduction of erosion, Opportunity for local farms to promote sustainability of product
OPPORTUNITY TITLE	<p>Increased Adoption of No-Till Agriculture</p>  <p><i>Image courtesy of Nova Scotia Department of Agriculture</i></p>
KEY ASSUMPTIONS	<p>Ranking and prioritization of this opportunity was based on the following assumptions:</p> <ul style="list-style-type: none"> ▪ Current use of conventional tillage in the County is 66% (<u>Source:</u> 2016 Census of Agriculture) ▪ No-till agriculture reduces GHG emissions through carbon sequestration by 0.22 tonnes / ha / year (<u>Source:</u> Chahal et al., 2020) ▪ Assume only farms greater than 70 ha convert to no-till (344 farms in County greater than 70 ha in 2011 Census of Agriculture) ▪ Assume cost for converting to no-till (new drill equipment) is \$50,000 per farm ▪ Assume cost increases for equipment would be recovered within 5 years by reductions in cost for fuel, equipment wear-and-tear, and labour

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CATALOGUE #	31
GHG SECTOR / SOURCE	AGRICULTURE / Land Management
CO-BENEFITS	Reduced operating expenses (fertilizer expenses), Reduced nitrogen losses to surface and ground water, Opportunity for local farms to promote sustainability of product
OPPORTUNITY TITLE	<p>Improved Nitrogen Management (4 "Rs")</p>  <p><i>Image courtesy of fieldcropnews.com</i></p>
KEY ASSUMPTIONS	<p>Ranking and prioritization of this opportunity was based on the following assumptions:</p> <ul style="list-style-type: none"> ▪ 4R = 'Right' place, 'Right' time, 'Right' rate, 'Right' source ▪ Current use of 4R nitrogen management in County assumed to be 25% ▪ 4R nitrogen management reduces GHG emissions by 20% (Source: Fert. Research Ins.) ▪ Cost for implementing 4R N management is \$17.11/ ha (De LaPorte et al. 2021) ▪ Net gains for implementing 4R N management is \$11.14/ha/year (De Laport et al.) ▪ Assume average farm size of 41 ha (2016 Census of Agriculture)

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CATALOGUE #	32
GHG SECTOR / SOURCE	AGRICULTURE / Land Management
CO-BENEFITS	Improved soil health / reduction of erosion, Opportunity for local farms to promote sustainability of product
OPPORTUNITY TITLE	<p>Increased Adoption of Cover Crops</p>  <p><i>Image courtesy of country-guide.ca</i></p>
KEY ASSUMPTIONS	<p>Ranking and prioritization of this opportunity was based on the following assumptions:</p> <ul style="list-style-type: none"> ▪ Current use of cover crops in County assumed to be 15% ▪ Cover cropping reduces GHG emissions through carbon sequestration by 3.32 tonnes / ha / year (<u>Source</u>: Chahal et al 2020) ▪ Cost for implementing cover crops is \$22.42 / ha (De LaPorte et al. 2021) ▪ Assume average farm size of 41 ha (2016 Census of Agriculture)

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CATALOGUE #	33
GHG SECTOR / SOURCE	FORESTRY AND WETLANDS / Land Cover and Land Use Change
CO-BENEFITS	Recreational opportunities, Biodiversity and wildlife enhancement, Positive impacts on air quality, water quality and soil erosion
OPPORTUNITY TITLE	<p>Increase Area of Forest Land Through Tree Planting</p>  <p style="text-align: right; font-size: small;">©MHaverstock</p> <p style="text-align: center;"><i>Image courtesy of Town of Kentville</i></p>
KEY ASSUMPTIONS	<p>Ranking and prioritization of this opportunity was based on the following assumptions:</p> <ul style="list-style-type: none"> ▪ Assume that 1% of non-forested land (both public and private ownership) can be converted to tree cover through municipal policies or incentives ▪ Urban forest carbon sequestration rate (3.4 tonnes CO₂e / ha / year) for Nova Scotia is used (<u>Source</u>: National Inventory Report) ▪ Tree planting density of 200 trees / hectare ▪ Cost per tree planted is \$2.50 (<u>Source</u>: Nottawasaga Valley Conservation Authority)

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CATALOGUE #	34
GHG SECTOR / SOURCE	FORESTRY AND WETLANDS / Land Cover and Land Use Change
CO-BENEFITS	Recreational opportunities, Biodiversity and wildlife enhancement, Positive impacts on air quality, water quality and soil erosion
OPPORTUNITY TITLE	<p>Enhanced Protection of Existing Forest Lands Through Carbon Offsets</p>  <p><i>Image courtesy of Nova Scotia Department of Natural Resources</i></p>
KEY ASSUMPTIONS	<p>Ranking and prioritization of this opportunity was based on the following assumptions:</p> <ul style="list-style-type: none"> ▪ Approximately 27% of forested land in Region is subject to harvesting in large tracts privately owned by pulp companies ▪ 5% of total harvested land base can be protected by carbon offset project (2093 ha) in 2030; amount is doubled in 2050 ▪ Annual carbon offset generation from 'Avoided Harvest' projects is approximately 2 tonnes / ha / year = 4185 tonnes of carbon offsets per year ▪ Conservative carbon offset sale price of \$5 / tonne

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CATALOGUE #	35
GHG SECTOR / SOURCE	FORESTRY AND WETLANDS / Land Cover and Land Use Change
CO-BENEFITS	Recreational opportunities, Biodiversity and wildlife enhancement, Positive impacts on air quality, water quality and soil erosion
OPPORTUNITY TITLE	<p>Conversion of Marginal Farmland to Natural Areas</p>  <p><i>Image courtesy of Rideau Valley Conservation Authority</i></p>
KEY ASSUMPTIONS	<p>Ranking and prioritization was based on the following assumptions:</p> <ul style="list-style-type: none"> ▪ Approximately 30% of the 40,000 ha of cropland in the County is categorized as CLI-4 which have 'severe limitations that restrict use for crops' ▪ Assume 25% and 50% of CLI-4 cropland is converted to forest by 2030 and 2050, respectively ▪ Urban forest carbon sequestration rate (3.4 tonnes CO₂e / ha / year) for Nova Scotia is used (<u>Source</u>: National Inventory Report) ▪ Tree planting density of 200 trees / hectare ▪ Cost per tree planted is \$2.50 (<u>Source</u>: Nottawasaga Valley Cons. Authority)

APPENDIX E:
GHG REDUCTION OPPORTUNITY RANKINGS

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CONSERVATIVE SCENARIO

Catalogue No. & Opportunity Description	Assumed Adoption Rate		GHG Reduction in 2030 (tonnes CO2e)					GHG Reduction in 2050 (tonnes CO2e)					Time-frame	Total cost	Cost per facility	Cost / tonne reduced	Pay-back period	Co-ben.	Total Pts.
	2030	2050	REG	KGS	BER	KEN	WOL	REG	KGS	BER	KEN	WOL	Years	'000 000 \$	'000 \$	'000 \$	Years	No.	
	1. Increased solar hot water heating (residential)	10%	25%	3,460	2,768	104	346	242	8,649	6,919	259	865	605	2 – 5	42.5	9	4.9	11.3	
2. Conversion of water heaters from heating oil to electricity (residential)	25%	50%	8,089	6,471	243	809	566	16,178	12,942	485	1,618	1,132	5 – 10	14.2	3	3.3	12.0	2	8
3. Increased use of heat pumps (residential)	10%	25%	15,626	12,501	469	1,563	1,094	39,066	31,253	1,172	3,907	2,735	5 - 10	40.2	8.5	1.3	4.4	2	12
4. Deep retrofits of existing buildings (residential)	10%	25%	11,444	9,155	343	1,144	801	28,610	22,888	858	2,861	2,003	5 - 10	324.4	50	11.3	20.0	3	9
5. Additives for hydronic heating systems (I-C-I)	25%	50%	923	738	37	102	55	1,845	1,476	74	203	111	2 – 5	0.3	6	0.2	1.3	2	15
6. Conversion from fuel oil to natural gas for heating (I-C-I)	25%	50%	1,595	1,276	64	175	96	3,189	2,551	128	351	191	2 – 5	1.3	5.5	0.4	0.5	2	15

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	2030	2050	REG	KGS	BER	KEN	WOL	REG	KGS	BER	KEN	WOL	Years	'000 000 \$	'000 \$	'000 \$	Years	No.	
	7. Deep retrofits of existing buildings (I-C-I)	10%	25%	4,952	3,962	198	545	297	12,380	9,904	495	1,362	743	5 - 10	235.1	990	11.4	44.0	
8. Increased use of heat pumps (I-C-I)	25%	50%	11,366	9,093	455	1,250	682	22,731	18,185	909	2,500	1,364	5 - 10	24	51	2.3	4.5	2	11
9. Increased solar hot water heating (I-C-I)	25%	50%	930	744	37	102	56	1,860	1,488	74	205	112	5 - 10	25.6	54	30.6	11.3	2	4
17. Berwick Community Solar Garden	50%	100%	1,774	0	1,774	0	0	1,774	0	1,774	0	0	5 - 10	Nil	Nil	0	N.A.	2	21
11. Meadowview Solar Facility			2,442	2,442	0	0	0	1,282	1,282	0	0	0	< 5	8.2	8,190	1.3	7.0	3	10
12. Southwest Quadrant Wind Energy			2,442	2,442	0	0	0	1,282	1,282	0	0	0	< 5	8.4	8,400	1.4	7.0	3	10
13. Rebates on ENERGY STAR appliances	10%	25%	361	289	4	40	29	605	484	6	67	48	> 10	3.2	0.5	1.5	2.0	2	12
14. Residential low-cost energy efficiency initiatives	10%	25%	1,003	802	10	110	80	1,680	1,344	17	185	134	1 - 2	2.4	0.5	0.4	1.0	2	19

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	2030	2050	REG	KGS	BER	KEN	WOL	REG	KGS	BER	KEN	WOL	Years	'000 000 \$	'000 \$	'000 \$	Years	No.	
	15. Increased solar PV systems (residential)	10%	25%	5,396	4,317	54	594	432	13,489	10,791	135	1,484	1,079	5 - 10	102.8	21.8	3.0	16.4	
16. Increased solar PV systems (I-C-I)	10%	25%	1,356	1,098	14	108	136	1,780	1,442	18	142	178	5 - 10	47.5	100	2.8	9.5	2	10
10. Industrial sector GHG emission reductions			79,146	63,317	3,166	8,706	4,749	179,966	143,973	7,199	19,796	10,798	> 10	Nil	Nil	0	N.A.	3	21
18. Net-zero for new buildings by 2030 (I-C-I)			0	0	0	0	0	30,997	24,798	1,240	3,410	1,860	> 10	Nil	Nil	0	N.A.	3	21
19. Provincial electricity grid decarbonization			210,094	170,176	2,101	18,908	18,908	276,623	224,065	2,766	24,896	24,896	> 10	N.A.	N.A.	N.A.	N.A.	2	
20. Increased adoption of EVs; investment in charging infrastructure	10%	25%	1,539	1,324	46	108	62	2,020	1,737	61	141	81	5 - 10	1.2	11.8	0.1	6.0	2	12
21. Federal fuel efficiency standards (light-duty vehicles)			17,927	15,417	538	1,255	717	37,638	32,369	1,129	2,635	1,506	> 10	N.A.	N.A.	N.A.	N.A.	2	

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	2030	2050	REG	KGS	BER	KEN	WOL	REG	KGS	BER	KEN	WOL	Years	'000 000 \$	'000 \$	'000 \$	Years	No.	
	22. Increase transit usage	10%	25%	8,166	7,023	245	572	327	20,415	17,557	612	1,429	817	< 5	1.5	1,500	0.2	0.5	
23. Invest in active transportation infrastructure	3%	3%	1,266	1,089	38	89	51	1,266	1,089	38	89	51	< 5	4.5	238.5	4.2	7.9	3	10
24. Improved efficiency and electrification of commercial vehicles			33,430	28,750	1,003	2,340	1,337	70,360	60,510	2,111	4,925	2,814	> 10	N.A.	N.A.	N.A.	N.A.	2	
25. Reduce the amount of waste landfilled (I-C-I)	10%	25%	1,388	1,069	56	139	125	3,469	2,671	139	347	312	< 1	0.02	Nil	0.001	0.5	3	25
26. Increase the amount of organic waste that is composted (residential)	10%	25%	1,281	986	51	128	115	3,203	2,466	128	320	288	1-2	0.02	0.2	0.001	0.5	3	23
27. Reduce the amount of waste landfilled (residential)	10%	25%	1,281	986	51	128	115	3,203	2,466	128	320	288	< 1	0.02	Nil	0.001	0.5	2	24
28. Alternative cattle feeding strategies	10%	25%	483	483	0	0	0	1,208	1,208	0	0	0	1-2	1.3	14.2	1	< 1	2	15

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	2030	2050	REG	KGS	BER	KEN	WOL	REG	KGS	BER	KEN	WOL	Years	'000 000 \$	'000 \$	'000 \$	Years	No.	
	29. Improved manure management strategies	10%	25%	1,769	1,769	0	0	0	4,422	4,422	0	0	0	1-2	Nil	Nil	0	< 1	
30. Increased adoption of no-till agriculture	10%	25%	339	339	0	0	0	847	847	0	0	0	1-2	3.9	50	4.5	< 5	2	11
31. Improved nitrogen management ("4 R's")	10%	25%	365	365	0	0	0	913	913	0	0	0	1-2	0.08	0.3	0.08	1.5	3	20
32. Increased adoption of cover crops	10%	25%	6,583	6,583	0	0	0	16,457	16,457	0	0	0	2-5	0.1	0.9	0.007	0	2	18
33. Increased forest area through tree planting	1%	1%	1,938	1,938	0	0	0	1,938	1,938	0	0	0	< 5	0.3	0.5	0.1	0	3	15
34. Enhanced protection of existing forest lands through carbon offsets	5%	10%	4,185	4,185	0	0	0	8,370	8,370	0	0	0	1-2	0.1	100	0.01	5.0	3	18
35. Conversion of marginal farmland to natural areas	10%	25%	10,200	10,200	0	0	0	20,400	20,400	0	0	0	< 5	1.5	0.5	0.1	0	3	16

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AGGRESSIVE SCENARIO

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	2030	2050	REG	KGS	BER	KEN	WOL	REG	KGS	BER	KEN	WOL	Years	'000 000 \$	'000 \$	'000 \$	Years	No.	
	1. Increased solar hot water heating (residential)	25%	50%	8,649	6,919	259	865	605	15,735	12,588	472	1,574	1,101	2 - 5	85.1	9	4.9	11.3	
2. Conversion of water heaters from heating oil to electricity (residential)	50%	75%	16,178	12,942	485	1,618	1,132	17,655	14,124	530	1,766	1,236	5 - 10	28.3	3	3,3	12.0	2	9
3. Increased use of heat pumps (residential)	25%	50%	39,066	31,253	1,172	3,907	2,735	78,132	62,506	2,344	7,813	5,469	5 - 10	80.3	8.5	1.3	4.4	2	13
4. Deep retrofits of existing buildings (residential)	25%	50%	26,269	21,015	788	2,627	1,839	44,557	35,646	1,337	4,456	3,119	5 - 10	648.8	50	11.3	20.0	3	10
5. Additives for hydronic heating systems (I-C-I)	50%	100%	1,845	1,476	74	203	111	3,690	2,952	148	406	221	2 - 5	0.5	6	0.2	1.3	2	16
6. Conversion from fuel oil to natural gas for heating (I-C-I)	50%	100%	3,189	2,551	128	351	191	6,378	5,102	255	702	383	2 - 5	2.6	5.5	0.4	0.5	2	16

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	2030	2050	REG	KGS	BER	KEN	WOL	REG	KGS	BER	KEN	WOL	Years	'000 000 \$	'000 \$	'000 \$	Years	No.	
	7. Deep retrofits of existing buildings (I-C-I)	25%	50%	12,380	9,904	495	1,362	743	20,819	16,655	833	2,290	1,249	5 - 10	470.3	990	11.4	44.0	
8. Increased use of heat pumps (I-C-I)	50%	100%	22,731	18,185	909	2,500	1,364	45,462	36,370	1,818	5,001	2,728	5 - 10	48	51	2.3	4.5	2	12
9. Increased solar hot water heating (I-C-I)	50%	100%	1,860	1,488	74	205	112	3,720	2,976	149	409	223	5 - 10	51.3	54	30.6	11.3	2	5
17. Berwick Community Solar Garden			1,774	0	1,774	0	0	1,774	0	1,774	0	0	5 - 10	Nil	Nil	0	N.A.	2	21
11. Meadowview Solar Facility			2,442	2,442	0	0	0	1,282	1,282	0	0	0	< 5	8.2	8,190	1.3	7.0	3	10
12. Southwest Quadrant Wind Energy			2,442	2,442	0	0	0	1,282	1,282	0	0	0	< 5	8.4	8,400	1.4	7.0	3	10
13. Rebates on ENERGY STAR appliances	25%	50%	605	484	6	67	48	635	508	6	70	51	> 10	6.5	0.5	1.5	2.0	2	12
14. Residential low-cost energy improvement initiatives	25%	50%	1,680	1,344	17	185	134	1,764	1,411	18	194	141	1 - 2	4.8	0.5	0.4	1.0	2	20

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	2030	2050	REG	KGS	BER	KEN	WOL	REG	KGS	BER	KEN	WOL	Years	'000 000 \$	'000 \$	'000 \$	Years	No.	
	15. Increased solar PV systems (residential)	25%	50%	13,489	10,791	135	1,484	1,079	14,163	11,330	142	1,558	1,133	5 - 10	205.5	21.8	3.0	16.4	
16. Increased solar PV systems (I-C-I)	25%	50%	3,390	2,746	34	271	339	3,560	2,884	36	285	356	5 - 10	95	100	2.8	9.5	2	10
10. Industrial sector GHG emission reductions			79,146	63,317	3,166	8,706	4,749	179,966	143,973	7,199	19,796	10,798	> 10	Nil	Nil	0	N.A.	3	21
18. Net-zero for new buildings by 2030 (I-C-I)			0	0	0	0	0	30,997	24,798	1,240	3,410	1,860	> 10	Nil	Nil	0	N.A.	3	21
19. Provincial electricity grid decarbonization			210,094	170,176	2,101	18,908	18,908	276,623	224,065	2,766	24,896	24,896	> 10	N.A.	N.A.	N.A.	N.A.	2	
20. Increased adoption of EVs; investment in charging infrastructure	25%	75%	3,848	3,309	115	269	154	6,041	5,195	181	423	242	5 - 10	1.2	11.8	0.1	6.0	2	14
21. Federal fuel efficiency standards (light-duty vehicles)			17,927	15,417	538	1,255	717	37,638	32,369	1,129	2,635	1,506	> 10	N.A.	N.A.	N.A.	N.A.	2	

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	2030	2050	REG	KGS	BER	KEN	WOL	REG	KGS	BER	KEN	WOL	Years	'000 000 \$	'000 \$	'000 \$	Years	No.	
	22. Increase transit usage	25%	50%	20,415	17,557	612	1,429	817	40,830	35,114	1,225	2,858	1,633	< 5	3	3,750	0.2	0.5	
23. Invest in active transportation infrastructure	3%	6%	1,266	1,089	38	89	51	2,533	2,178	76	177	101	< 5	9.1	238.5	4.2	7.9	3	10
24. Improved efficiency and electrification of commercial vehicles			33,430	28,750	1,003	2,340	1,337	70,360	60,510	2,111	4,925	2,814	> 10	N.A.	N.A.	N.A.	N.A.	2	
25. Reduce the amount of waste landfilled (I-C-I)	25%	50%	3,469	2,671	139	347	312	6,938	5,342	278	694	624	< 1	0.02	Nil	0.001	0.5	3	26
26. Increase the amount of organic waste that is composted (residential)	25%	50%	3,203	2,466	128	320	288	6,406	4,933	256	641	577	1-2	0.02	0.2	0.001	0.5	3	23
27. Reduce the amount of waste landfilled (residential)	25%	50%	3,203	2,466	128	320	288	6,406	4,933	256	641	577	< 1	0.02	Nil	0.001	0.5	2	24
28. Alternative cattle feeding strategies	25%	50%	1,208	1,208	0	0	0	2,416	2,416	0	0	0	1-2	2.5	14.2	1	< 1	2	15

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	2030	2050	REG	KGS	BER	KEN	WOL	REG	KGS	BER	KEN	WOL	Years	'000 000 \$	'000 \$	'000 \$	Years	No.	
	29. Improved manure management strategies	25%	50%	4,422	4,422	0	0	0	8,844	8,844	0	0	0	1-2	Nil	Nil	0	< 1	
30. Increased adoption of no-till agriculture	25%	50%	847	847	0	0	0	1,694	1,694	0	0	0	1-2	7.8	50	4.5	< 5	2	12
31. Improved nitrogen management ("4 R's")	25%	50%	913	913	0	0	0	1,826	1,826	0	0	0	1-2	0.1	0.3	0.08	1.5	3	20
32. Increased adoption of cover crops	25%	50%	16,457	16,457	0	0	0	32,914	32,914	0	0	0	2-5	0.2	0.9	0.007	0	2	18
33. Increased forest area through tree planting	1%	1%	1,938	1,938	0	0	0	1,938	1,938	0	0	0	< 5	0.3	0.5	0.1	0	3	15
34. Enhanced protection of existing forest lands through carbon offsets	5%	10%	4,185	4,185	0	0	0	8,370	8,370	0	0	0	1-2	0.1	100	0.01	5.0	3	18
35. Conversion of marginal farmland to natural areas	25%	50%	10,200	10,200	0	0	0	20,400	20,400	0	0	0	< 5	3	0.5	0.1	0	3	16