town of BRIDGEWATER

Community Energy Investment Plan: The Way Forward

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Learn more about Energize Bridgewater at:

energizebridgewater.ca

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FCM FEDERATION OF CANADIAN MUNICIPALITIES FÉDÉRATION CANADIENNE DES MUNICIPALITÉS

Contents

ABBREVIATIONS

BAU	Business as usual scenario
CO2	Carbon dioxide
CO2e	Carbon dioxide equivalents
CDD	Cooling degree days
CEIP	Community Energy Investment Plan
CH4	Methane
DE	District energy
GHG	Greenhouse gas emissions
GPC	Global Protocol for Community Scale Greenhouse Gas Emissions Inventories
GWP	Global warming potential
HDD	Heating degree days
LCS	Low carbon scenario
MAC	Marginal abatement curve
MAG	Modelling Advisory Group
MCA	Multi-criteria analysis
NPV	Net present value
SCC	Social cost of carbon
VKT	Vehicle kilometres travelled

KEY ENERGY AND EMISSIONS UNITS

GHG emissions

1 ktCO2e = 1,000 tCO2e

Energy

1 MJ= 0.001 GJ
1 TJ= 1,000 GJ
1 PJ= 1,000,000 GJ
1 GJ= 278 kWh
1 MWh= 1,000 kWh
1 GWh=1,000,000 kWh

In the numbers, for the Town of Bridgewater

Population, 2016: 8,532

Population, 2050: 9,460 (+8% over 2016)

New dwellings, 2018-2050: 417

New non-residential floor space, 2018-2050: 53,779 m2 (578,882 ft2)

Per capital GHG emissions, 2011: 44.6 tCO2e/person+

Per capita GHG emissions, 2016: 34 tCO2e/person+

Per capita GHG emissions in 2050 if the Energy Shift is implemented: 7.8 tCO2e/person (-69% over 2016)+

Total energy consumption 2016: 2,605,454 GJ

Total energy consumption if Bridgewater doesn't take action, 2050: 2,466,802 GJ

Total energy consumption if Bridgewater implements the Energy Shift, 2050: 1,564,681 GJ (-37% over the BAU in 2050)

Total expenditures on energy, 2016: $89 million*

Total expenditures on energy if Bridgewater doesn't take action, 2050: $205 million*

Total expenditures on energy if Bridgewater implements the Energy Shift, 2050: $56 million* (-73% over the BAU in 2050)

Average residential energy expenditures per househld per year in 2011: $4,073[X]

Average residential energy expenditures per household per year in 2050 in the BAU: $6,957[X]

Average residential energy expenditures per household per year in 2050 in the Energy Shift: $1,534[X] (-78% over the BAU in 2050)

Total expenditures on energy in commercial buildings in 2016: $39/m2*

Total expenditures on energy in commercial buildings, if Bridgewater doesn't take action, 2050: $138/m2*

Total expenditures on energy in commercial buildings if Bridgewater implements the Energy Shift, 2050: $29/m2* (-79% over the BAU in 2050)

Total investment required for the Energy Shift, 2018-2050: $374 million**

Person years of employment generated as a result of the Energy Shift, 2018-2050: 3,707

Total GHG emissions, 2016: 307,000 tCO2e

Total GHG emissions if Bridgewater doesn't take action: 2050: 240,000 tCO2e

Total GHG emissions if Bridgewater implements the Energy Shift, 2050: 74,000 tCO2e (-76% over 2016)

+This is the total GHG emissions divided by the total population.

xThese numbers do not include household energy expenditures on transportation.

*With 2% inflation

**This total assumes all the investments are made individually; if they are integrated, the total decreases.

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Executive Summary

EXECUTIVE SUMMARY

The Community Energy Investment Plan (CEIP) is a component of a larger project, Energize Bridgewater, which seeks to accelerate the transition to a clean energy economy for Bridgewater. The CEIP involved a combination of extensive community engagement and technical analysis over the period of a year and half.

The CEIP identifies a pathway towards renewable energy and energy savings. This pathway saves money, increases the resilience of the community, stimulates local economic development, generates job, improves air quality, amongst other benefits. The sub title of the report "the way forward" captures the imperative of the pathway, as a result of both the global necessity of addressing climate change and the opportunity to incur social, ecological and economic benefits locally. The aim of the technical analysis was to provide an investment roadmap using a detailed energy and emissions model. The analysis began by considering the drivers that determine the community's energy consumption and greenhouse gas (GHG) emissions, answering the question "where are we now?" Analysis of future trajectories included a business as usual (BAU) scenario, which evaluated what might happen if no additional policies or actions are put in place. The Energy Shift scenario explored the implications of achieving GHG reductions consistent with what is required to prevent dangerous climate change–an 80% reduction in GHG emissions by 2050 over 2011 levels.

The pathway is feasible. The modelling results indicate that the Energy Shift, with deep emissions reductions in the order of 80% or more by 2050, is technically feasible, economically beneficial and logistically challenging. GHG emissions can decline from 385,000 tCO2e in 2011 to 74,000 tCO2e in 2050, a decrease of 80% and equivalent to taking nearly 36,000 cars off the road. The analysis relies on technologies available today and additional future technological developments will further enable GHG reductions and efficiency gains.

The Energy Shift pays for itself. In 2016, cost of energy to the community was $89 million, but by 2050 energy costs are projected to rise to $206 million per year in the BAU, as the population increases, energy prices increase, carbon pricing comes into force and as a result of inflation at 2% per year. Energy costs in 2050 can fall to $56 million per year by investing in the Energy Shift, a decrease of 81%. As a result, the community can save over $2 billion in energy costs in the 32 year period between 2018 and 2050, and GHG emissions will be 80% lower than they were in 2011. Nearly all of the 20 plus actions contained in the Energy Shift generate financial returns and represent investment opportunities for the municipality, businesses and utilities.

The Energy Shift saves energy. By 2050, total energy consumption is reduced by 37%, or almost 1 million GJ per year- for comparison, this is equal to approximately 38,000 cords of dried hardwood. Cumulative savings between 2018 and 2050 are 16 million GJ.

The Energy Shift is an economic development strategy. Previous discussions on environmental issues have tended to pit economic development versus the environment. The Energy Shift achieves both environmental and economic outcomes, stimulating investment, generating employment opportunities, reducing energy costs

and reducing GHG emissions at the same time. An average of 115 person-years of employment would be added to the economy per year, with a cumulative total of over 3,700 person-years of employment created by 2050.

The Town can enable the Energy Shift. The Energy Shift requires a major and sustained effort by the community, businesses, organizations, and the Town. The Town will play a leadership role, and has already established programs or activities that support the pathway. These initiatives, such as clean energy financing and net zero homes, need to be scaled up, and new initiatives on renewable energy and district energy added. Ongoing support from higher levels of government in the form of policies, programs, and regulations will be required to enable the Energy Shift pathway.

Municipalities have a long history of addressing challenges to improve the quality of life of citizens, as the Town of Bridgewater has demonstrated by its early investments in an electrical grid. The transition to a low carbon economy represents an incredible opportunity to stimulate economic development, improve quality of life, improve public health outcomes, reduce poverty, reduce air pollution and GHG emissions, and generate new employment opportunities.

Arch on Bridge and King Street, Bridgewater, Nova Scotia.—2.

Part 1: Bridgewater's Energy Future

Introduction: Municipalities are leading

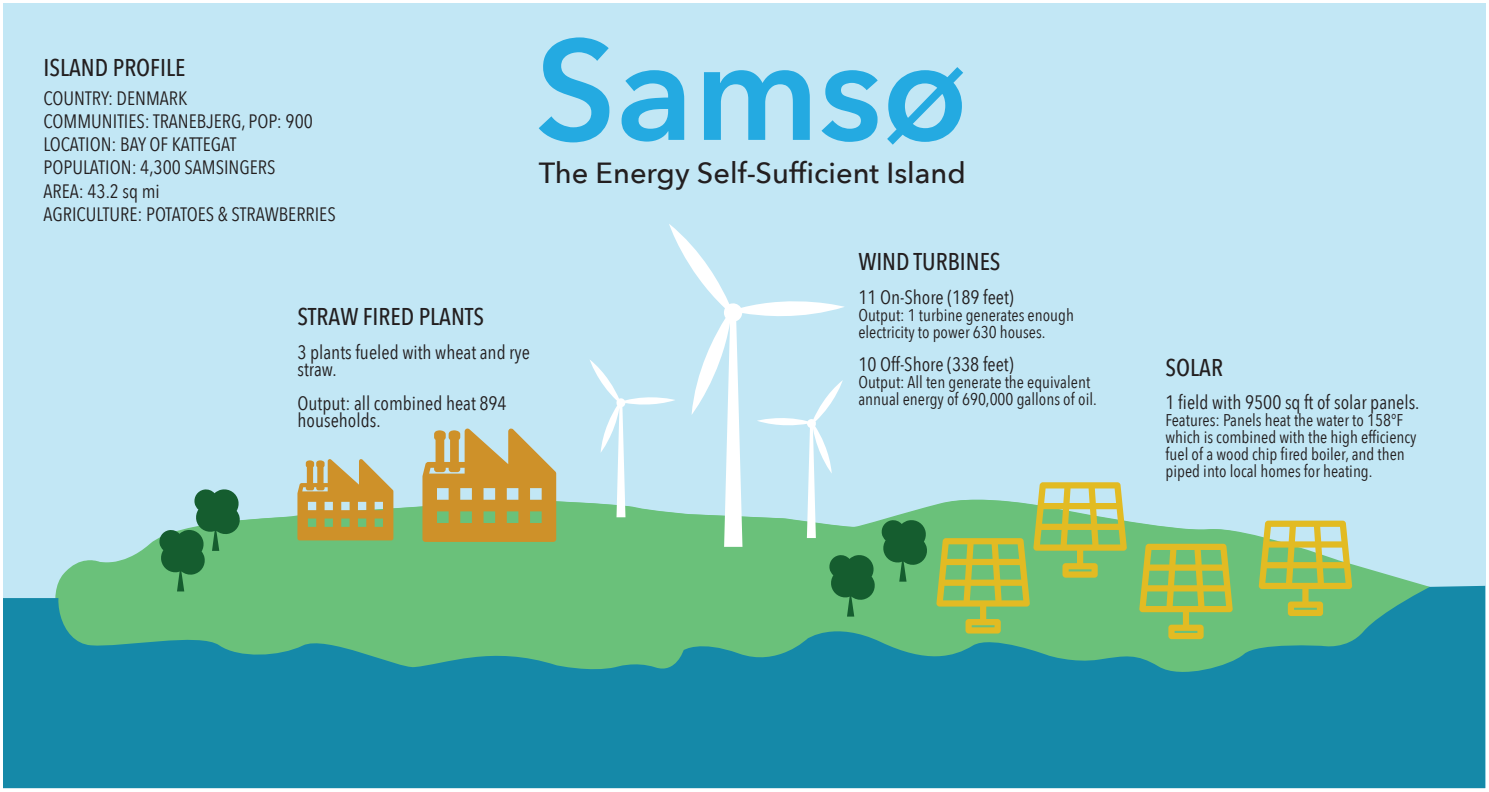
The Town of Bridgewater is joining the ranks of thousands of municipalities in Canada and around the world which are taking significant actions to dramatically reduce GHG emissions, while stimulating a new economy.

These efforts are the result of a growing recognition that municipalities have a direct influence over the demand for GHG emissions as well as the pathway to a low or zero carbon future. Communities are not sectors but are integrated systems, in which an action in one sector influences GHG emissions in another sector, and municipalities have unique abilities to influence this system.

Municipal decisions on infrastructure investments, including buildings, transportation, waste treatment and energy provision lock in patterns of energy consumption and GHG emissions for fifty years or more; once these investments are made they are very expensive to modify. With careful consideration of their investments, municipalities can stimulate the economy, substantially reduce GHG emissions and save energy. Finally, the energy system is tangible and real for citizens at the community scale, in a way that it is not a the provincial or national scale.

Inspiration: Energy transformation on the island of Samsø

Samsø is a farming island with a population of 4,000 in Denmark. In 1998, a competition sponsored by the Danish ministry of the environment and energy awarded the island the salary of one person to implement a vision of a renewables master plan. Ten years later, the island was carbon neutral with eleven one megawatt wind turbines providing the villages on the island with clean electricity and ten offshore wind turbines offsetting emissions from the island's vehicle and ferry fleet. District energy systems supply three quarters of the island's houses with heat and hot water from boilers fueled by locally grown straw; biomass boilers are also used for dwellings outside of the district energy network. Much of the renewable energy investments have been made by locals, either as individuals or through co-operatives, ensuring that the economic benefits remain local. The objective of the Samsø has now evolved from carbon neutral to 100% fossil fuel free by 2030 with plans to convert the ferry and vehicles to local biofuels and electric motors; electric cars are already in wide use.[1]



The Town of Bridgewater: A story of leadership and innovation

THE YEAR IS 2050…

In the face of global, regional and local challenges, Bridgewater has emerged as a diverse, thriving and healthy community. Settled on the historic LaHave River, this regional town is a place that brings people together. We prosper thanks to a green, self-supportive economy, in which all people are able to meet their basic needs. Our community, and especially our youth, embrace our achievements, including a complete shift to sustainable and affordable energy, transportation, housing, food, and the responsible use of our natural resources. Inspired by traditional and new values, we work together to create a community that serves the needs of current and future generations.

~The Town of Bridgewater's vision statement from the Integrated Community Sustainability Plan

The Town of Bridgewater has developed a reputation for innovation on sustainability policies and action plans, gaining national exposure, for example through the Federation of Canadian Municipalities. This work originated with the Integrated Community Sustainability Plan (ICSP) and Bridgewater has successfully embedded a sustainability lens in major projects such as the Downtown and Waterfront Master Plan.

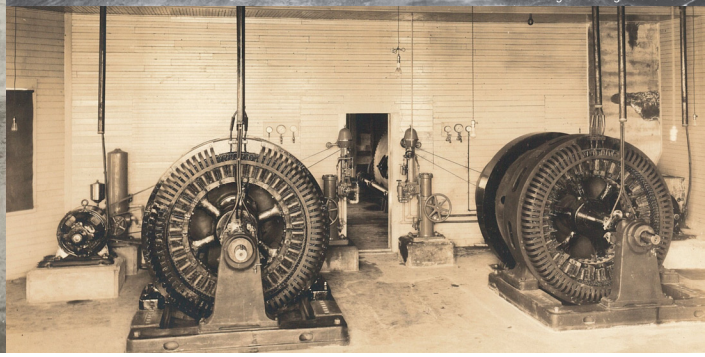
Bridgewater's latest Municipal Planning Strategy (MPS) was adopted in 2014 and contains sustainability outcomes derived from the ICSP. In 2015, the Town completed the Municipal Climate Change Action Plan (MCCAP) and produced an updated Energy Management Plan for the period of 2015-2019.

Energize Bridgewater (energizebridgewater.ca) is the Town's community-wide effort to develop a resilient energy future. The effort includes an Energy Partnership that engages organisations and businesses and a Living Energy Laboratory, which supported pilot projects. A website, Energize Bridgewater, acts as the communications portal for the project.

The Town also has a number of related initiatives, most notably, the Property Assessed Clean Energy (PACE) program, which was successfully piloted with neighbouring municipalities. The program provided a combined total of $525,000 in financing to residents in the four partner municipalities for retrofits. Bridgewater's financing comes from the Municipal Finance Corporation.

The provision of public infrastructure–water provision, wastewater and stormwater management, roads and solid waste collection–is a significant sustainability challenge for the Town of Bridgewater, described in detail within the ICSP. The costs of building, managing and maintaining the infrastructure continue to rise as costs of materials increase, regulations become more rigorous and environmental damages from weather increase. At the same time, municipal financial resources are constant or declining, a significant threat to the Town's future viability.[2] Future infrastructure investments need to consider both climate mitigation and adaptation and life cycle costs.


King St. looking north c.1915



2 The infrastructure challenge is described in detail in Section IV of the Town's ICSP.

Bridgewater's history of local energy generation[3]

"If we have modern conveniences, there will be no need to turn away prospective citizens as was done this summer."
– Bridgewater Bulletin,
September 18, 1900.

The Bridgewater Electric Light, Water and Power Company was incorporated in 1891; generation consisted of a 25 horsepower steam engine on King Street. In 1897, the Bridgewater Power Company was incorporated and a 10 kW hydro-electric system was constructed in Hebb's Mills. In 1898, the Bridgewater Power Company purchased the plant and rights of the Bridgewater Electric Light, Water and Power Company. In 1902, the Town of Bridgewater purchased the hydro plant for $22 200, creating a public utility. Profits in 1903 were $1,700, paying for streetlights, water for fire and a wastewater system. In 1940, the Town borrowed $125,000 to build a second hydro-electric generator at Conquerall Mills.

Bridgewater's Public Service Commission was formed in 1948 in order to purchase the electric and water utilities from the Town. Electricity was supplied to 2,500 people, distributed on 88 km of rural line. One third of power was supplied from the hydro plants, with the rest being bought from the Nova Scotia Power Commission.

Keith Wentzell, the coordinator for the Public Service Commission from 1964-1969, was responsible for introducing the off-peak load theory, a practice that was adopted provincially resulting in improved electrical rates.

By 1969 the Bridgewater Public Service Commission was supplying less than 10 percent of the required power for the town and surrounding area, with the remainder being purchased from the Nova Scotia Power Corporation (NSPC). In 1970, Bridgewater Electrical Utility was sold to the Nova Scotia Power Corporation for approximately $1 million. Both hydro-electric plants were decommissioned shortly thereafter. The Conquerall Mills plant was given to the Nova Scotia Government and 8,000 red pine trees were planted in 1976 on land that was flooded when the plant was running.

"Electricity was charged by the number of outlets one had regardless of the kilowatt hours used. Therefore everyone would always leave the lights on in all the rooms. Mrs. Christie said it was a truly beautiful sight to look across the river and see all of the houses lit up."
- Mrs. Rita Christie

3 This section is based on material compiled and prepared by: Linda Bedford and Peter Oickle; DesBrisay Museum

The energy system: Transformation and opportunity

The energy system globally is undergoing rapid change, and this creates opportunities and challenges for the Town. Examples of key trends are as follows:

- Governments are increasingly supporting low or zero carbon options: Federal and provincial policies are increasingly oriented to supporting low or zero carbon options for the energy system. This means decreased funding or incentives for fossil fuel industries and increased programs and support for renewable energy and conservation activities.

- Renewable energy is increasingly accessible: It is relatively easy and becoming easier for households and businesses to generate their own energy. Dwellings in Nova Scotia are already adding solar photovoltaic systems onto their homes with a net-metering arrangement with Nova Scotia Power. As the cost of solar systems decline, solar PV systems will become increasingly accessible. New financing mechanisms are also reducing barriers.

- Costing carbon creates new opportunities: There is a growing market for carbon reductions and because of its relatively high carbon intensity, there are opportunities for low cost carbon reductions. Households in Bridgewater use more fuel and dirtier fuels than other jurisdictions in Canada, because the dominant heating fuel is fuel oil and the building stock is older and therefore less efficient.

- Energy storage technologies are changing the grid: Energy storage technologies such as batteries are already available for houses and businesses and as the costs continue to decline, number of installations will increase rapidly.

- New models of electric vehicles are available every day: Consumers are already purchasing electric vehicles in Nova Scotia and as the purchase price decreases and the range increases, there are compelling reasons as to why the number of electric vehicles on the road will increase exponentially.

- Heating systems remain a challenge, but new options are coming online: Heat pumps continue to improve in efficiency and have been widely adopted in Bridgewater already. District energy systems are gaining traction as a

more efficient system for providing heating and cooling to communities with the flexibility to add or subtract technologies as required.

- Microgrids are breaking down the barriers between heating and electricity: Microgrids include electricity generation from solar or combined heat and power, converting excess power to hot water which is then used for heating, with electric batteries and other technologies.

- New financing strategies are increasing participation: Municipalities and financial institutions are offering mechanisms that reduce financial barriers to energy retrofits and renewable technologies. Bridgewater's PACE program is a good example.

Municipalities around the world are creating innovative policies and strategies to support or engage with these trends while advancing local priorities such as reducing air pollution, stimulating economic development and new employment opportunities, increasing the livability of the community, and improving affordability.

Empowering Bridgewater: A cultural perspective

The process of change and transformation can have major impacts on the culture of a community as people seize opportunities and adjust expectations and behaviours. As part of the Energize Bridgewater project, an analysis of current best practices related to culture and behavior change programming were analysed. The research used a literature review, a series of community workshops and a survey in order to identify the current perception of energy in Bridgewater, barriers and motivators to action, and strategies to empower citizens. Key findings of the report are as follows:

1. Households, businesses, and organizations feel strongly that energy use in the Town today is convenient, important to the economy, in need of change, and making them feel helpless and that they have no control.

2. There is a high degree of uncertainty regarding the characteristics of the energy system in the Town today; educational programs therefore need to be enhanced.

3. Having a common goal or vision is a strong motivator for residents, businesses and organizations. The common desirable characteristics of an energy system identified through this work are: clean, efficient, secure, and affordable.

4. Residents, businesses and organizations of Bridgewater care more about ensuring that the energy system is clean and efficient than others in the community think they do. Community members should be made aware of the strong desire for a clean and efficient energy system so that community members are aware that these objectives are more broadly shared than they think.

5. Any actions, programs or initiatives in Energize Bridgewater should:

   a. Build on the current belief that energy is good for the economy;

   b. Indicate that the initiative or program represents a shift in the way things are currently done;

   c. Increase the influence of participants, and the Town in general over their energy consumption;

   d. Result in the energy system becoming cleaner and more efficient, secure, and affordable; and

   e. Continue to make energy use as convenient as possible.

Source: Adapted from IndEco Strategic Consulting (2017). Culture and Behaviour Change Assessment report.

Bridgewater's vision: The Energy Shift

By 2050, Bridgewater's green, self-supportive economy will be securely powered by clean and efficient energy systems. The community's conscious investments into energy infrastructure, equipment, training, and education will make energy affordable and accessible for all members of the community, and contribute to our town's prosperity and resilience in the face of a changing climate and world.

~Bridgewater's Energy Shift vision

This plan provides a pathway for the community of Bridgewater to a low carbon future—the Energy Shift. The pathway begins with a detailed quantitative analysis of current conditions and what might happen if no additional policies are introduced–the business as usual scenario. Detailed technical analysis and consultation with energy experts has allowed for the development of an ambitious and fully-costed new 'energy pathway' for the community.

The development of the pathway was guided by community values, which are aligned with the sustainable community vision established by the ICSP, as follows:

Clean – our energy systems should not pollute the environment or harm our health. This plan focuses on switching the community away from fossil fuels and onto renewable sources, such that by 2050 its GHG emissions are reduced by 80% compared to 2011 emissions levels.

Efficient – our use of energy should minimize needless consumption and waste. This plan's primary strategy is to reduce wasted energy especially from heating systems and commercial / industrial processes, which together account for well over half of the community's energy consumption. Energy conservation also relates to our personal and organizational behavior, and requires education and training to change awareness and habits.

Secure – our energy systems must be resilient to economic shocks and climatic disruptions. This plan prioritizes solutions that lower our dependency on externally-sourced energy by driving down energy needs, increasing local energy generation and ownership, and increasing the skill and capacity of the community to innovate its own energy solutions.

Affordable – energy should be affordable for all people, businesses, and organizations in our community. By participating in the actions in this plan, overall energy costs will decline substantially in all sectors and for all residents. The actions in this plan have been developed to maximize economic viability, and offer significant local investment and economic development opportunities.

The energy shift pathway consists of three overarching technical strategies:

1. Energy efficient buildings: accounting for 57% of the needed energy shift, and representing the most technically and financially secure approach, this strategy involves making deep energy retrofits to all buildings in the community, and ensuring that new buildings are built to superior energy standards

2. New community-scale energy systems: accounting for 40% of the needed energy shift, this strategy involves exploring opportunities to deploy to large-scale solar, wind, and hydro generation, as well as district heating and local energy storage systems

3. Clean & active transportation systems: accounting for 3% of the needed energy shift, this strategy involves electrifying the community's vehicle fleets, introducing autonomous vehicles, expanding public transit and active transportation systems, and increasing land use efficiency.

The Energy Shift: Partnering with the Mi'Kmaq

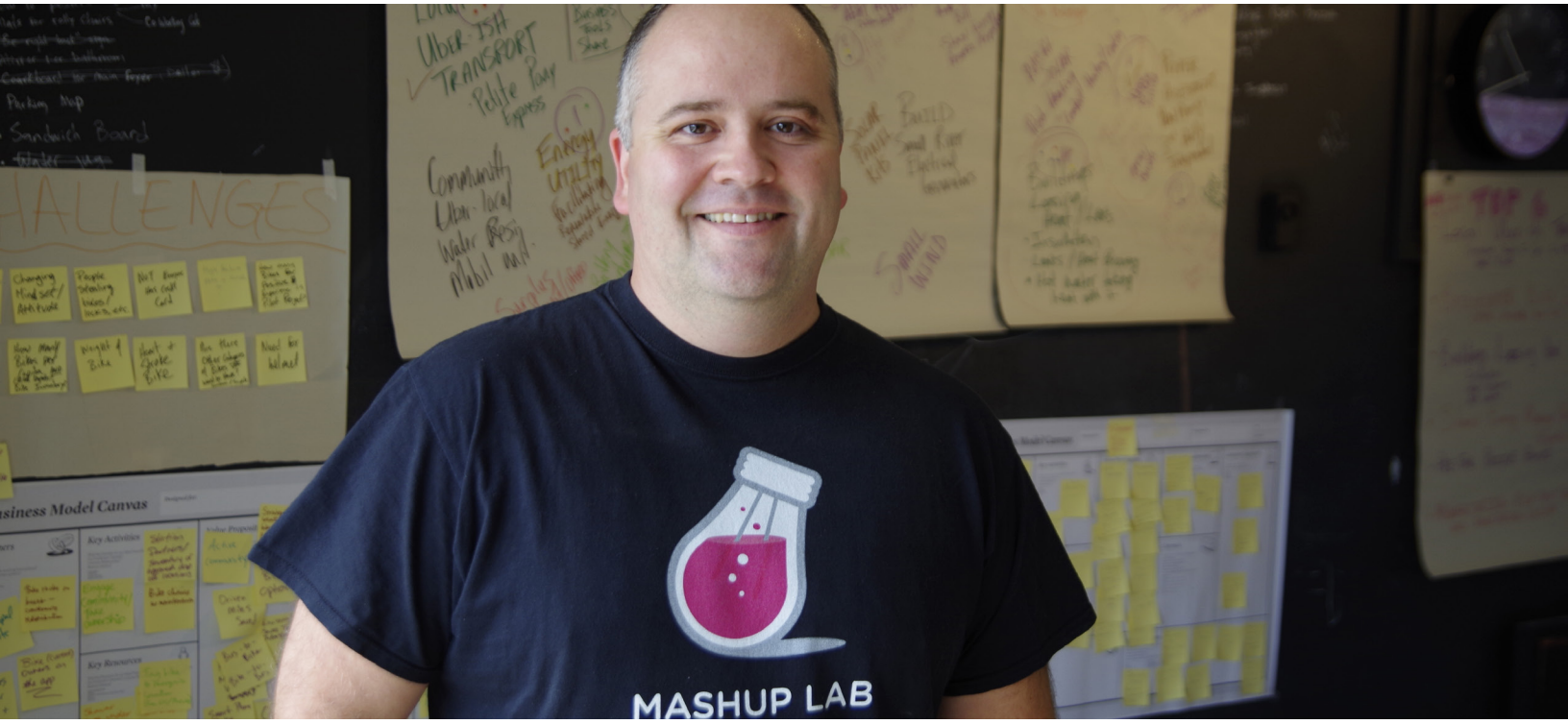
The Town of Bridgewater is located in Sipekne'katik (the Wild Potato Area) on the unceded territory of the Mi'Kmaq. This land contains abundant natural resources, including windy coastlines, powerful tides, and ample forests. In managing these resources, Nova Scotia's Indigenous people have long practiced the concept of Netukulimk, the responsible use of the natural bounty provided by the Creator without jeopardizing the integrity and productivity of these resources. Renewable energy projects, like wind farms or solar fields around Bridgewater, offer the opportunity to practice Netukulimk while promoting economic development and greenhouse gas reductions.

The Town of Bridgewater recognizes the value of Mi'Kmaq teachings and has reached out to local Indigenous groups with requests to incorporate their teachings into the Community Energy Investment Plan (CEIP), as well as to establish a long term relationship centered around dialogue, understanding, and partnership building. The goal is to forge an ongoing and mutually beneficial relationship that works together for a cleaner energy future. Work conducted so far includes consulting with local and regional experts on how to facilitate Indigenous project participation in a way that aligns with First Nations mandates, and bringing First Nations representation into Energize Bridgewater events. The next step is to engage with the Mi'kmaw Conservation Group (MCG) and the Acadia First Nation to identify the challenges for participation and how to overcome these through meaningful and supportive partnership.

The Energy Shift: Community investments

The energy shift pathway requires an unprecedented investment for the community in clean local infrastructure and equipment: nearly $400 million in energy efficient buildings, new community-scale energy systems, and clean & active transportation systems over 32 years (2018-2050). This investment more than pays for itself both when all the actions are combined and at the level of specific actions. The following tables illustrate the financial returns of specific actions within the energy shift pathway. The investment required would be undertaken by a mix of public and private sector entities and not solely the municipality.

Return on investment is calculated by dividing the benefit of an investment by the cost of an investment, where the benefit of an investment is defined as the gain from the investment minus the cost of the investment. For example an investment of $100 generates a return of $1,000. The return on investment equals 1,000-100/1000, or 900%. For an investment of $100 that generates a return of $100, the return on investment is 100-100/100, or 0%. Note that these calculations are the aggregate of annual investments over the period of 2018-2050, which incorporate variation in costs of energy and the actions over time as well as a discounting rate of 3%. As a result, the return of specific annual investments will vary from year to year. Note that financial numbers in the tables below are reporting in today's dollars, with future dollars being discounted at a rate of 3%



Strategy 1: Energy efficient buildings

- Total investment (2018-2050): $153 million

Undertake deep energy retrofits to all buildings in Bridgewater, and ensure that new buildings are built to superior energy standards. This strategy achieves 57% of the GHG emissions reductions of the energy shift, and represents the most technically and financially secure approach.

Investment opportunity	**Economic benefit (2018-2050)**			**Energy benefit (GHG emissions reduced, 2018-2050, kilotonnes)**
	Investment ($ millions)	Savings ($ millions)	Return on investment (%)	
Net zero and passive house performance standards: by 2030, all newly constructed buildings meet the highest energy performance standard.	1.7	15	805%	45
Retrofit existing buildings: by 2050, the envelope efficiency of all homes and apartments, and all commercial facilities is improved by 50%, and industrial facilities operate 50% more efficiently.	84	382	353%	1,290
Heat pumps: by 2050, 60% of all residential buildings and 85% of all commercial buildings have heat pumps installed.	19	105	451%	354
Solar PV and hot water: by 2050, 80% of all buildings have solar PV systems, and 50% of buildings have solar hot water systems installed.	48	80	65%	308

Strategy 2: New community-scale energy systems

- Total investment (2018-2050): $157 million

Deploy large-scale solar, wind and hydro generation in or near Bridgewater, as well as district energy and energy storage systems. This strategy achieves 40% of the needed energy shift.

Investment opportunity	Economic benefit (2018-2050)			Energy benefit (GHG emissions reduced by 2050, kilotonnes)
	Investment ($ millions)	Savings ($ millions)	Return on investment (%)	
Community scale solar PV and storage: By 2050, install 12 MW of ground-mounted solar PV systems and install 5kW battery banks in 50% of homes.	24	100	312%	329
District energy system: by 2050, supply the downtown commercial buildings with district heating and cooling, generated through sustainably-harvested local wood heat, geothermal heat exchange or a heat exchanger in the river.	53	64	20%	156
Community-scale wind and hydro power: by 2050, install a 20 MW run-of-river hydro power system and 12 MW of large-scale wind turbines	80	172	115%	911

Strategy 3: Clean & active transportation systems

- Total investment (2018-2050): $64 million

Electrify all vehicles in the community (introducing autonomous vehicles), expand public transit and active transportation systems, and increase land-use efficiency. This strategy achieves only 3% of the needed energy shift, but is necessary to enable more local renewable energy as vehicles will form part of the community's energy storage system.

Investment opportunity	Economic benefit (2018-2050)			Energy benefit (GHG emissions reduced by 2050, kilotonnes)
	Investment ($ millions)	Savings ($ millions)	Return on investment (%)	
Electric vehicles: by 2050, all vehicles in Bridgewater are electric, allowing vehicle batteries to add to the community's total energy storage.	24	80	226%	98
Autonomous (self-driving) vehicles: by 2050, the majority of vehicles in Bridgewater operate autonomously, allowing households to own 50% fewer vehicles, However, increased access results in higher overall transportation energy consumption.	36	114	222%	-52

Investment opportunity	Economic benefit (2018-2050)			Energy benefit (GHG emissions reduced by 2050, kilotonnes)
	Investment ($ millions)	Savings ($ millions)	Return on investment (%)	
Public transit and active transportation: by 2050, Bridgewater public transportation system expanded and fully electric. Investments in walking and cycling infrastructure allow 50% of short distance trips to be done by foot or by bike.	4	10	139%	41

The financial returns have been calculated as a combination of operational savings and direct energy savings (including savings on the cost of carbon that will soon begin affecting energy prices), and take into consideration the lifetime of the implemented infrastructures or equipment. Additional detail on investment potential for specific technologies and opportunities is provided in Part 2: Technical Backgrounder of this document.

The attractiveness of the investment will vary according to the investment return expectations of the organisation or business making the investment. A key future step will be matching investment opportunities with prospective investors, whether they be households, businesses, the municipality or other entities.

There are barriers that currently limit the potential investments and these will need to be addressed through policies or other mechanisms. Examples of the barriers include the following:

- A lack of awareness of the business case.
- The lack of a whole-system analysis; some of the opportunities are only apparent when considered in the context of the energy system as a whole.
- The lack of financing strategies; for example, in many cases renters pay the utility cost and have no influence over the building's energy efficiency, whereas owners influence the building envelope but have no incentive because they don't pay utility costs, a challenge known as the split incentive.
- A governance gap: municipal, provincial and federal policies and programs are in their infancy and have not been formulated to support some opportunities.
- Lock-in: There are psychological barriers to change that inhibit the uptake of new approaches, particularly if they involve inconvenience of one form or another.

Stimulating the low carbon economy: The example of locally-sourced wood

"(Locally-sourced high efficiency wood heat) for those space heating requirements is where we need to go. There is great precedence built in Europe, it's not new technology."
– Dale Prest, Community Forests International

The Town of Bridgewater is surrounded by a rich resource base of privately owned woodland. Following Annapolis County, Lunenburg County has the highest level of standing merchantable timber volume in Western Nova Scotia. There is great opportunity to improve the overall ecological health of forests through restoration forestry using partial harvesting methods such as pre-commercial thinning, single tree and group selection cuts, crown release, and shelterwood treatments to remove low-grade wood.

The market for low-grade pulpwood in the province is poor and it is not economically feasible to send pulpwood to the closest market in Pictou County. In the absence of a market for these low-grade wood products, it is difficult for landowners to justify the costs of forest improvement treatments, and consequently much of this work is either not being done, or woodlots are cleared.

"Because there's no market for those kinds of products, there's likely less partial harvesting than would be happening otherwise if there were markets" - Mary Jane Rodger, Medway Community Forest Co-op

Municipalities are in a unique position to drive sustainably-sourced forest bioenergy use at the local level. A properly designed community-scale high efficiency wood heat system can be one of the most powerful tools to drive improved forest management practices. Improved revenue streams could help support greater use of partial harvesting methods in the region, and if every forest stand was harvested using partial harvest methods, over time there could be gradual improvement in the region's forests, leading to higher value wood products and benefiting local economies. Improving revenue streams from harvesting also adds to the economic value of land managed for forest products, which better enables forest management to compete with other land uses (e.g. development).

Locally-sourced high efficiency wood heat as described here is very different from the 60 megawatt (MW) biomass power plant in Port Hawkesbury, and should not be confused with the characteristics of that facility. Characteristics that define sustainable forest bioenergy:

- The fuel source whenever possible should come from mill residues which are otherwise being sent to a landfill and by-products from thinnings and restoration work.
- Fuel must not be from whole tree harvesting because tops, branches, roots, and other fine materials are necessary for soil development.
- Fuel should be only that for which there is no practical higher value as determined by local market conditions.
- The end use should be for a distributed heat and energy production network not large scale power generation.
- When the restorative forestry as well as the harvesting and trucking are considered, three times more jobs are created in the United States by using sustainable biomass fuels than solar or wind per dollar invested.

Source:

The full findings of this analysis are captured the report Sustainable Bioenergy Supply from Low-Intensity Forest Practices for the Town of Bridgewater and the Municipality of the District of Lunenburg (2017). The report was produced by the Mersey Tobeatic Research Institute (MTRI), in partnership with the Town of Bridgewater and the Municipality of the District of Lunenburg.

The Energy Shift: Economic impact

The modelling results indicate that deep emissions reductions, in the order of 80% or more by 2050, are technically feasible, economically beneficial and logistically challenging, a finding that is both encouraging and inspiring. The Energy Shift requires a major and sustained effort by the Town, the community, businesses and higher levels of government. In some cases the Town has already established programs or activities that support the pathway, but these need to be scaled up, whereas in other cases the activities are entirely new.

The analysis begins by considering the drivers that contribute to current greenhouse gas emissions, answering the question "where are we now?" Different scenarios were evaluated, including a business as usual (BAU) scenario which asks the question what will happen if no additional policies or actions are put in place. The Energy Shift scenario explores the implications of achieving GHG reductions consistent with what is required to prevent dangerous climate change–an 80% reduction in GHG emissions by 2050 over 2011 levels.

The Energy Shift pathway in this analysis relies on technologies available today. Additional future technological developments will further enable GHG reductions. However, many investments that the Town or community makes or enables today will have long-term implications, which lock-in patterns of GHG emissions; this analysis provides insight on the implications of a wide range of decisions.

The way in which strategies are implemented will influence the social benefits that the pathway delivers. Some of the actions deliver significant economic returns, while others are more marginal. The Town is, in many cases, uniquely able to unlock these opportunities. An important consideration then is which activities should the private sector undertake versus the Town itself; to whom should the returns be directed?

The detailed results of the technical modelling of community's energy system are included in Part 2 of this document; this section provides a high level overview of key findings.

THE ENERGY SHIFT USES ENERGY MORE EFFICIENTLY

When energy is used, energy is converted into forms that cannot be used, for example, in the case of a car, energy is lost as heat. The Energy Shift scenario requires significantly less energy than the BAU scenario to provide the same energy services-transportation, heating and cooling dwellings, lighting and so on. These conversion losses decline from 55% in the BAU to 44% in the Energy Shift, largely as a result of the introduction of electric vehicles, which are more efficient than the internal combustion engine.

By 2050, total energy consumption is reduced by 37%, or almost 1 million GJ per year- for comparison, this is equal to approximately 38,000 cords of dried hardwood. Cumulative savings between 2018 and 2050 are 16 million GJ.

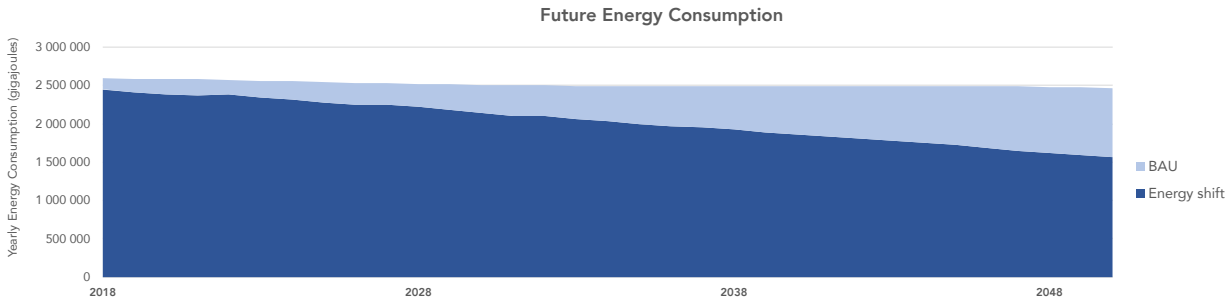


Figure 1. Energy consumption decreases in the Energy Shift relative to the BAU

THE ENERGY SHIFT WILL INJECT MONEY INTO THE LOCAL ECONOMY

The shift to a cleaner mix of energy sources, and more efficient use of energy, offers significant investment opportunities. Clean energy investments ramp up over time, adding an average of $11 million worth of capital investments per year to the economy (before inflation); note that this investment is not evenly distributed over time. Much of the investment, though not all, will be expended in and around the Bridgewater area, representing a new economic driver for the community.

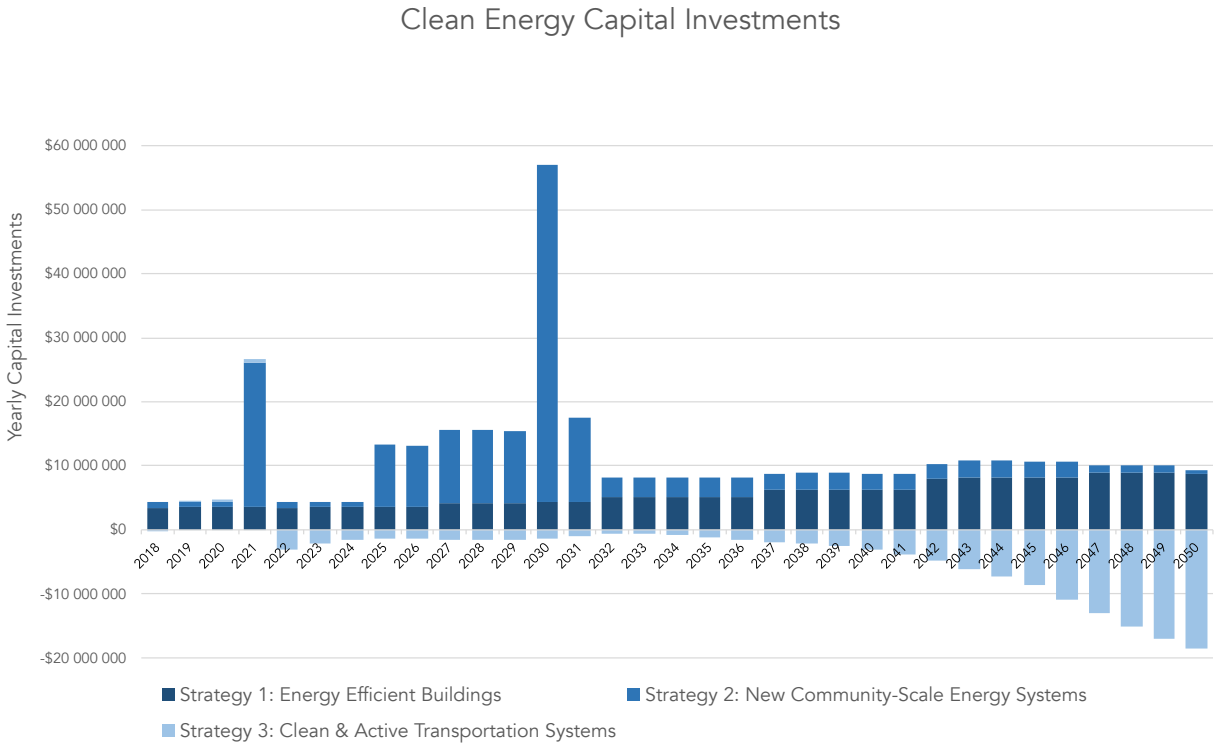


Figure 2. Additional investment by strategy as a result of the Energy Shift

The transportation sector is one area where investment could decline. Decreasing capital investment is projected beyond 2030 as a result of the introduction of autonomous vehicles. The most likely model for the deployment is of shared fleets of autonomous, electric vehicles. The primary impact of this change will be on industries in manufacturing, with potential implications for dealerships, depending on the ownership model of the shared fleets. Autonomous vehicles are also projected to be powered by electricity and electric vehicles require less maintenance, which will have an impact on businesses that provide maintenance services and vehicle parts. Note that while decreased number of vehicles on the road is a likely outcome of autonomous vehicles, the social and economic impacts are full of uncertainty, particularly for smaller, rural communities.

THE ENERGY SHIFT WILL RESULT IN JOB OPPORTUNITIES

Dollars invested in renewable energy and building retrofits will mostly go to tradespeople, equipment suppliers, contractors, and associated services such as engineering, legal, and financial. The analysis indicates that these investments will generate new employment locally. For example, every million dollars invested:

- …is expected to generate 9 person-years of employment when spent on building retrofits.
- …is expected to generate 8 person-years of employment when spent on community-scale energy systems.
- …is expected to generate 3 person-years of employment when spent on new vehicles.

On the negative side of the jobs equation, automotive trades may see a net decline in jobs due to the arrival of autonomous vehicles, which require less maintenance than the internal combustion engine.

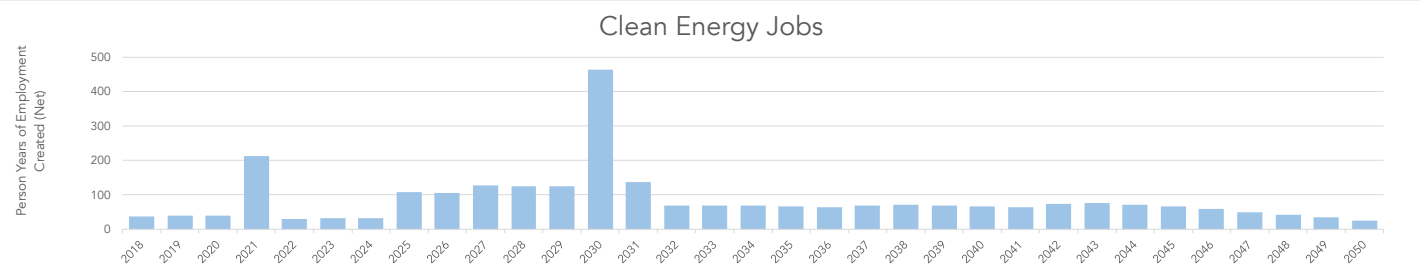


Figure 3. Additional person-years of employment resulting from the Energy Shift

Overall the Energy Shift is projected to add an average of 115 person-years of employment to the economy per year, with a cumulative total of over 3,700 person-years of employment created by 2050.

THE ENERGY SHIFT WILL DECARBONISE THE ECONOMY

An economy that can develop without the need for fossil fuels is a goal of governments around the world. Decreasing the GHG emissions per unit of gross domestic product is known as decarbonisation. GHG emissions per person fall 84% by 2050 over 2011 in the Energy Shift, a total decline from 385,000 tCO2e in 2011 to 74,000 tCO2e in 2050, equivalent to taking nearly 36,000 cars off the road.

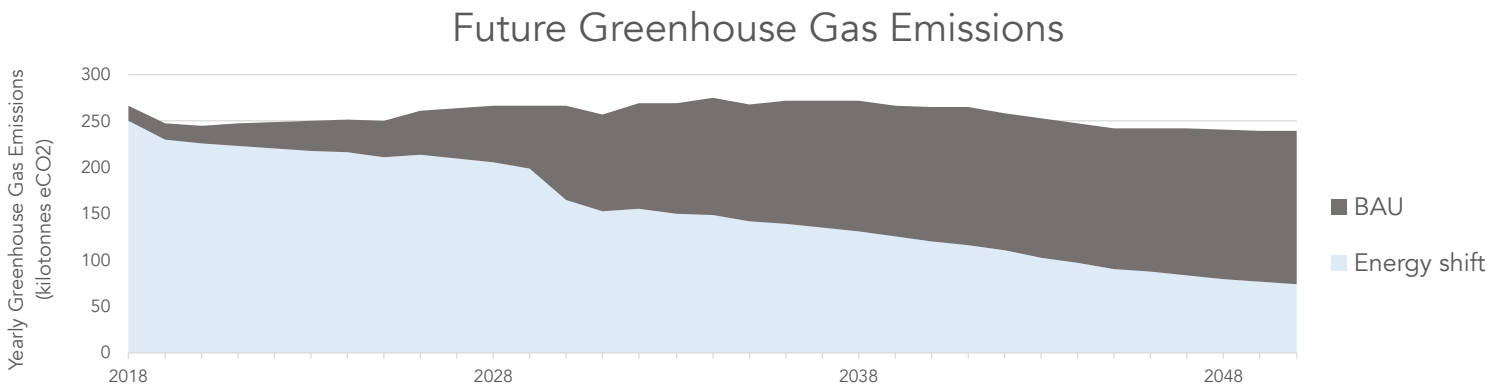


Figure 4. GHG emissions in the BAU vs the Energy Shift

THE ENERGY SHIFT REDUCES ENERGY COSTS

The business as usual scenario projects relatively steady energy consumption, in which population growth is offset by fuel efficiency standards in vehicles, and decreased heating requirements due to climate change. In 2016, energy cost the community $89 million, but by 2050 energy costs are projected to rise to $206 million per year, as the population increases, energy prices increase, carbon pricing comes into force and as a result of inflation at 2% per year.

By making the investments in the Energy Shift, the community will have access to cleaner, more efficient, more secure, and more affordable energy–energy costs in 2050 will be one quarter of the BAU at $56 million per year, including 2% inflation. In the Energy Shift scenario, the community can save over $2 billion in energy costs over 33 years, and GHG emissions will be 80% lower than they were in 2011.

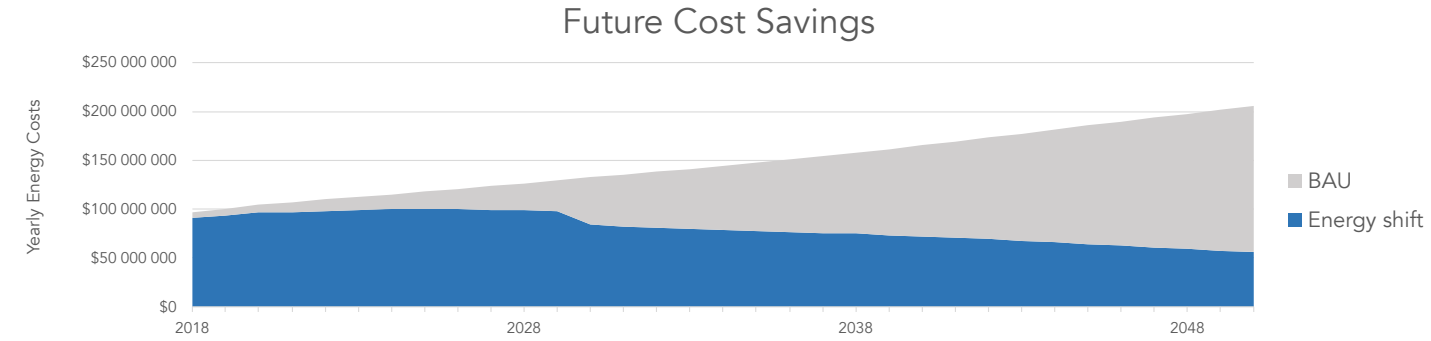


Figure 5. Reduced energy expenditures as a result of the Energy Shift

In 2012, the commercial, institutional, and industrial sectors spent $49 million per year on energy for their facilities, approximately $54 per m2 of commercial floor space. As a result of the energy shift, this is projected to decline to $29 per m2 by 2050, including 2% inflation.

As a result of the economic opportunity, the energy shift constitutes a new economic development strategy for Bridgewater, focused on energy efficiency, renewable energy, and capacity building. It is a powerful way forward for the entire community, at a time when there is pressing need to both address climate concerns, as well as improve community wellbeing and economic prosperity.

Improving well-being: Retrofits for rental housing

In addition to economic benefits, the Energy Shift will result in social and health benefits. In 2016, more than 43% of Bridgewater's 4,080 households were rentals. The Town consulted with energy service providers, community service providers, and landlords throughout the summer of 2017 and held a focus group with 14 participants in mid-August. In the fall of 2017, Craig Dedels from the Dalhousie School of Planning supplemented these efforts through eighteen one-to-one interviews.

Rental housing in Bridgewater is perceived to be hard to find and expensive. Many interviewees mentioned that vacancy rates are low, and some rental housing tenants expressed feeling lucky to find a place to live at all. Almost half of renters spend more than 30% of their income on shelter costs, and that number increases in the case of lone-parent and one-person households. In general, Bridgewater's homes are characterized as old and leaky.

More households in Atlantic Canada experience energy poverty than anywhere else in the country, and Bridgewater is no exception. A household is considered to be in a state of energy poverty if they are spending more than 10% of their monthly income on energy services. A household does not need to be low-income to experience energy poverty. Utility bills that spike in the winter can catch people unaware and make it difficult to budget. When a household is experiencing energy poverty, they may be forced to choose between paying utility bills, buying groceries, or purchasing medication.

There is a strong association between poor housing conditions and the well-being of inhabitants. Living in cold and damp conditions can lead to health problems such as influenza, heart disease, and hypothermia. Improper air circulation promotes the growth of mould and puts residents at risk of respiratory illnesses. Living in thermal discomfort is especially problematic for young children, seniors, and people with underlying health conditions.

Rental housing tenants face an additional challenge because they have little control over the efficiency of their units. Some assistance exists in the form of emergency energy funds from organizations in Bridgewater, like the United Way and the Society of St. Vincent de Paul. While they are delivered with good intentions, the funds run out quickly and do not permanently reduce the prevalence of energy poverty.

Rental property owners make decisions about features that affect energy efficiency (e.g. building envelope, appliances), while rental housing tenants make choices about their energy consumption (e.g. turning lights on or off, washing clothes in cold water). This dynamic causes the problem of split incentives. One type of split incentive arises when the owner pays for energy costs through the rent, giving the tenant little reason to practice energy conservation. The other form occurs when tenants are billed directly for energy costs, making the owner less likely to invest in efficiency upgrades. Both forms counteract energy conservation efforts.

Most landlords acknowledge the benefits of energy efficiency improvements, but are unsure how to make them happen at their properties. Some programs do currently exist for rental housing in Bridgewater, however, landlords feel overloaded with information about different options. They associate participating in efficiency programs with websites that are difficult to navigate, excessive paperwork, and difficulties acquiring information from tenants. They also feel that they are not receiving reliable information from a trusted source. Numerous landlords suggested that they would be more likely to perform retrofits and upgrades if somebody walked them through the process.

The Town and its partners are well-situated to address barriers to rental housing energy efficiency improvements. Though there is no proven method to mend split incentives, communities around North America are seeing some success with the following mechanisms:

- Green leases
- Mandatory residential efficiency conservation measures
- Mandatory residential energy efficiency disclosures
- Home energy benchmarking and labelling
- Pay-as-you-save (PAYS) on-bill utility financing
- Energy efficiency retrofit tax credits
- Cohousing/home sharing arrangements.

The Town and its partners can tailor programs to local housing conditions and encourage a culture of energy efficiency among Bridgewater's relatively small group of landlords. For example, the Town's Clean Energy Financing (CEF) program, a form of Property Assessed Clean Energy (PACE) financing, features many positive aspects of the aforementioned mechanisms. The Town can review its bylaws and programs to create an environment that encourages creative financial solutions for rental sector energy efficiency improvements.

The following actions are recommended:

» Explore mechanisms to mend split incentives and work with partners to bring them to Bridgewater.

» Expand PACE and other existing financial tools to the rental sector and account for multi-unit buildings.

» Collect and publish energy investment stories to educate and inspire both renters and landlords.

» Establish an Energy Ambassador to act as a central resource for all things energy efficiency.

» Focus programming efforts on landlords while educating all stakeholders involved.

» Continue to recognize equity issues by protecting housing affordability in rental sector efficiency efforts.

Source: Dedels, C. W. (2017). Engaging Bridgewater's Rental Sector in Energy Efficiency Improvements: A Qualitative Analysis (Unpublished master's thesis). Dalhousie University, Halifax, Canada

Launching the Energy Shift: An implementation plan

The CEIP represents is a long-term strategy that will require sustained effort over decades; in the course of that time, the actions and programs will evolve. In order to launch the effort, specific actions have been identified that build on and scale up existing activities and lay a foundation for future programs and policies.

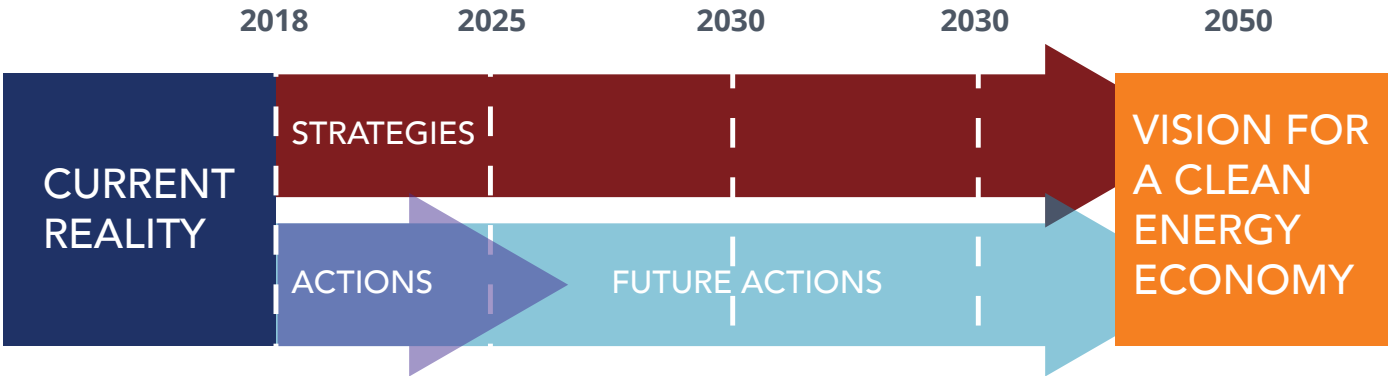


Figure 6. Long and short term investment opportunities

The overall strategies (Red-shaded bar above) have been discussed earlier in the report: 1. Energy efficient buildings, 2. New community-scale energy systems and 3. Clean & active transportation systems, which are designed to achieve the community's vision for a clean energy economy.

A series of shorter-term actions will kick-start and support these strategies, and future actions will build on the results of these efforts.

A collective endeavour

The Energy Shift offers energy investment opportunities to all sectors and members of the community, recognizing that each has a unique role to play, and unique skills and abilities to contribute. In order to achieve practical and lasting investments in the Energy Shift, the community will need to find new ways to collaborate, stimulate innovation, and invest financial resources in worthwhile projects, while drawing on new sources of expertise. The community will need to participate in regional energy and carbon markets, which are a potential source of revenue. These objectives make it necessary to set up new organizing and financing structures, or to modify existing structures for new purposes, including the following three examples:

Proposed Structure or Program	Purpose	Key Activities
The Bridgewater Energy Partnership	The community needs a public forum through which to educate itself on energy issues and to discuss and plan community energy opportunities. It also needs a means through which local businesses, organizations, and institutions can exercise leadership. We propose that the Town work with its current Energy Partners to formalize and expand the Energy Partnership, and ultimately share stewardship of the implementation and monitoring of this Plan with this group.	»Educate the community on energy issues »Collaborate on new energy initiatives »Monitor and communicate the community's progress in achieving the goals in this plan

Proposed Structure or Program	Purpose	Key Activities
The Living Energy Laboratory	The community needs a way to stimulate energy innovation, and community interest in leading energy efforts. It needs a way to support entrepreneurs, youth, and community businesses and organizations that have great ideas that can make our community's energy cleaner and more affordable. We propose that the Town work with its Energy Partners to formalize and expand the Living Energy Laboratory into a permanent energy innovation seed grant and support program.	»Issue periodic calls for energy-related proposals »Collect financial and other resources, and award them to worthy projects »Share learnings and outcomes with the community, and celebrate successes
Local Energy Development Utility	The community needs a way to develop, finance, and manage large scale energy projects, including a proposed 12MW solar farm, 12MW wind farm, a 20MW-run-of-river hydro system, and a district energy system. It also needs to find ways to help finance and fund a share of the over $200 million needed for residential and commercial building retrofits. The community will be well-served by having a locally owned and managed energy development utility with the technical and financial capability to carry out these tasks. Whether or not the structure should be a true public utility (e.g. an expansion of the current Public Service Commission of Bridgewater, which used to sell power), requires detailed assessment and consultations with the Utility and Review Board. An alternate structure involving a group of organizations (e.g. a non-profit working with one or more private partners) should also be examined.	»Develop the technical expertise to plan and manage community-scale energy projects »Aggregate local and external investments and funding »Plan, develop, and operate community energy infrastructures »Design and implement community energy financing and participation programs »Participate in regional energy and carbon markets

Partnering with households on retrofits: Clean Energy Financing

The Clean Energy Financing year 1 pilot program was launched on July 12, 2016, by the Town of Bridgewater and three partner municipalities.

The municipalities provide financing for homeowners to upgrade the energy efficiency of dwellings. The loans are paid pack on the property tax bill over ten years at a rate that is less than or exceeds the value of the energy savings. If a homeowner moves the payments stay with the house and are transferred to the next owner.

Administered by the Clean Foundation, the program has seen strong uptake from residents in all municipalities. In Bridgewater, 8 participants completed energy upgrades in the pilot year (2017-18), and 5 participants were enrolled as of October in 2017-18.

Across the 4 municipal units during the pilot year, the average homeowner received $9,200 in financing ($10,900 for Bridgewater homes). Several homeowners utilized close to the maximum allowable financing limit, and would have used more if they were permitted. On average, participating homes are estimated to save about 33% of their total energy consumption (30% for Bridgewater homes), indicating that the program is effective a stimulating a dramatic reduction in home energy consumption. On average, participating homes are estimated to save over 10 tons of GHG emissions per year (over 12 tons for Bridgewater homes).

Heat pumps and insulation were by the far the most frequently recommended and installed upgrades, accounting for nearly 90% of all upgrade costs. Other upgrades pursued include exterior windows, draft-proofing, and supplemental improvements required to successfully complete the energy upgrades.

The average estimated payback on the investment was 4.3 years. Because upgrade costs are paid in monthly installments over 10 years, participating homeowners are projected to have a significant improvement in annual cash flow, as their energy savings are more than twice their financing repayments. To illustrate the effect of the 4.3 year payback, consider the following example: if a homeowner has financed $10,000 worth of upgrades through the program, this means that their annual repayments will be about $1,200, while their annual energy savings are estimated to be around $2800, meaning that they would be about $1,600 cashflow positive per year, for 10 years. Savings would be even greater if the cost of energy were to rise.

On November 30, 2016, the Clean Energy Financing program was awarded the Union of Nova Scotia Municipalities' first annual Climate Change Leadership Award, which was jointly received by the 4 municipal units.

Source: de Vreede, L. (2016). Report to Bridgewater Town Council; Clean energy financing (PACE) program evaluation & renewal.

RECOMMENDED ACTIONS

Short-term actions have been identified for residents, businesses, organisations and institutions and the Town to provide a foundation for the Energy Shift.

Actions for Residents

Residents of Bridgewater will ultimately determine the success of the Energy Shift, by participating in initiatives, starting new businesses and engaging in programs. A key focus of future programs will be creating mechanisms that enable community members either individually or collectively in projects which provide financial returns, whether it is energy retrofits or renewable energy.

Table 1. Actions for residents

Action	Description
1. Support community leadership actions.	Residents can support the clean energy initiatives that are starting up in the community, and provide encouragement to people who are leading them. Residents can join an advisory committee or community group that is advancing the Energize Bridgewater vision.
2. Increase energy awareness.	Residents can continue learning about the benefits and practical applications of clean energy solutions for home, work, school, and community.
3. Invest in home energy retrofits and upgrades.	Residents can upgrade their homes with cost-effective clean energy technologies (improved insulation, heat pumps, solar technologies, water conservation measures, etc.) and practice low-cost energy conservation habits, such as reducing their use of dryers. Renters can encourage their landlords to make energy upgrades to their properties and take advantage of incentive programs.
4. Invest in a local clean energy projects.	Residents can take advantage of local investment programs that will be started by the Town of Bridgewater and the Energy Partners
5. Invest in and use clean transportation options.	Residents can take public transit, use active means of transportation (walking, cycling, wheeling), utilize transportation sharing services, and invest in electric vehicles.

Actions for Businesses, organisations and institutions

Businesses and organizations will play a key role in advancing the Energy Shift, by undertaking the following actions:

Table 2. Actions for businesses, organisations and institutions

Action	Description
1. Invest in building retrofits and upgrades	Businesses & organizations can upgrade their facilities with cost-effective clean energy technologies (improved insulation, heat pumps, solar technologies, water conservation measures, etc.). They can also practice low-cost energy conservation habits, such as optimizing the scheduling of building systems and developing their own energy management programs. Commercial tenants can encourage their landlords to make energy upgrades to their properties and take advantage of incentive programs.
2. Invest in a local clean energy projects	Businesses and organizations can take advantage of local investment programs that will be started by the Town of Bridgewater and the Energy Partners. They can also participate as project development partners and contractors.
3. Transform local transportation	Businesses and organizations can support the public transportation system, use active means of transportation (walking, cycling, wheeling), and invest in electric vehicles and low-carbon shipping.
4. Invest in energy-related skills and training	Educate and increase training for staff in current energy technologies and best practices, assign staff to energy management activities, and participate in local clean energy opportunities.

Action	Description
5. Participate in community energy leadership actions	Make public commitments to prioritize clean energy, achieve specific energy and emissions reduction milestones, and participate in the Bridgewater Energy Partnership.

Table 3. Actions for the Town of Bridgewater

The Town's role in developing local regulations, services, and infrastructures, and its ability to ask for support and funding from other levels of government enables it to play a key role in stimulating the participation of the other community partners and sectors in this plan. Three specific roles have been identified for the municipality.

Table 4. The Town's actions

Action	Description
A. The Town as community capacity builder In order to support the broad and deep energy shift described here, the Town's first priority is to build its capacity to implement the Community Energy Investment Plan and to empower community partners to exercise leadership as well. This priority includes investing in staff, identifying funding, engaging the community, facilitating community processes and ensuring that its own practices reflect community's values and objectives.	
1. Invest in staff capacity to implement this Plan.	Apply for federal and provincial grants to support the work.
2. Build community leadership in the implementation of this Plan.	Set up a community advisory committee to champion and guide the implementation of the Plan.
3. Continue to partner with NSCC and other educational institutions to build capacity.	The Town will maximise the benefits from the Energy Shift if it has a skilled workforce able to provide the required services. Working with schools- children and youth- is equally important for the long term strategy.
4. Invest in staff capacity to implement clean energy solutions for municipal operations.	Develop part-time dedicated position(s) to accelerate the implementation of the Energy Management Plan and the vehicle fleet fuel conversion program.
5. Continue to engage and support action by other sectors within the community.	Through the Energy Partnership, the Energize Bridgewater website, the Energize Nova Scotia Discovery Fair, the Living Energy Laboratory and other mechanisms, engage community members and create opportunities for other sectors and organisations to contribute to the implementation of the CEIP, with the Town acting as a facilitator.
6. Align the economic development strategy with the CEIP.	As the analysis demonstrates, the CEIP is an economic development strategy in itself. The Town's economic development activities can be aligned with the CEIP to bring a new scope of expertise and focus to the actions contained within the CEIP.
7. Develop a revolving loan fund.	Set up a budgeting system whereby savings generated from energy management efforts are used to fund additional clean energy initiatives.
8. Partner with other municipalities in the region.	Continue to actively engage and partner with other municipalities in the broader region on the actions in the CEIP in order to increase impact and achieve economies of scale.
9. Track progress.	Monitor and track the community's progress in implementing this Plan. An annual reporting process should include appropriate indicators to evaluate progress and adapt to changing technologies, policies or other factors.
10. Share the Town's story.	With a track record in this field, the Town can share its story and expertise with other jurisdictions and sectors. This will continue to build the Town's profile and generate new opportunities and partnerships.

Action	Description
B. The Town as energy enabler The Town will undertake a series of enabling actions to make sure that clean energy initiatives are not slowed down by red tape, and to allow residents and community partners to pursue their own energy investments. This actions can include new policies or incentives to support low carbon construction and electric vehicles, financing programs for retrofits of commercial buildings, the development or policies or mechanisms that enable renewable energy projects and ensuring plans, policies and infrastructure investments maximise low carbon opportunities.	
11. Install community EV infrastructure.	Work with community partners to add public EV charging stations to strategic locations around the community, and encourage similar installations at commercial and residential properties.
12. Expand the retrofit program from single houses to neighbourhoods.	Develop a pilot program to retrofit an entire neighbourhood, as opposed to working at the household level. Consider a pilot program of community bonds or neighbourhood bonds as a mechanism to finance the retrofits and renewable energy projects. Where possible coordinate with other infrastructure upgrade requirements.
13. Expand Property Assessed Clean Energy Financing programs.	Maintain and expand annual financing limits for PACE programs, target deeper energy retrofits, and explore opportunities to expand program eligibility to include multi-unit residential, commercial, and institutional buildings.
14. Establish new local building codes or requirements and incentives to support low carbon buildings.	Work with and advocate to other levels of government to allow the Town to regulate or incentivize building efficiencies beyond provincial/federal codes, for example, using the approach of municipal stretch codes. Also establish incentives to build to higher energy standards e.g. green building PACE program. Ensure that these requirements and incentives are congruent with the objectives of the Municipal Climate Action Plan to avoid investments in areas with a high risk profile.
15. Support efficient land-use.	Enhance regulations and incentives to encourage residential and commercial development downtown and to increase walkability.
C. The Town as energy investor In order to generate additional revenues and cost savings, the Town will invest in clean energy opportunities on a community scale, as well as for its municipal operations. The Town can establish a local energy development utility for projects such as district energy, continue to invest in energy efficiency and renewable energy projects for its facilities and invest in the electrification of the municipal vehicle fleet.	
16. Renew and expand the Energy Management Plan for Facilities and initiate a Fleet Management program.	Establish new energy management targets beyond the 2019 deadline for all facilities. Electrify the Town's light-duty vehicle fleet over about a 10-year timeframe, with existing vehicles to be replaced with EVs at the end of their lifetime. New charging infrastructure, new operating procedures for staff, and new fleet management practices will be required to support the transition. These activities are important to build capacity within the Town, demonstrate to the community what is possible and to walk the talk, so that the Town can speak with experience.
17. Establish a local energy development utilities.	A local energy development utility can develop, finance, and manage large scale local energy projects, and provide residential and commercial clean energy services and financing. Opportunities to reconfigure the Public Service Commission of Bridgewater to bring energy services back into its portfolio need to be examined as a possible way to bring new clean energy infrastructures and services to the community and to explore collaboration with other municipalities and utilities.
18. Investigate opportunities for the deployment of renewable energy.	Potential generation opportunities include district energy systems, solar PV farms, wind farms, battery storage, and hydroelectricity generation. Consider incorporating advanced telecommunications as part of a new district energy system. Dedicate undeveloped municipal land for community-scale energy development.
19. Continue to invest in transportation infrastructure.	Expand the new transit system and electrify the buses, while continuing to invest in active transportation infrastructure and programming and support the deployment of electric vehicle charging stations in the community. Transportation is a major challenge for the community and innovation and creativity will be required to advance electric vehicles and increase walking and cycling mode share. Collaborating with other municipalities in the region including with the Joint Transportation Committee will be critical to addressing the longer vehicular trips.

Timeline of activities (2018-2020)

The Town has completed a prioritisation process and identified a specific timeline of activities over the next three years in order to launch the Town's actions over the next three years. This timeline is designed to achieve some quick wins in order to build momentum, to develop and articulate key mechanisms that will support implementation, as well as to "walk the talk" so that the Town can continue to build its expertise and to continue to build support in the community.

Table 5. Three year timeline

Implementation Priority	2018	2019	2020
1. Financing systems			
Local energy development utilities & structures.	Research & early development	Develop & deploy	Deploy & maintain
2. Signature energy projects			
Neighbourhood energy programs.	Research & early development	Develop & deploy	Develop & deploy
Solar farm.	Scoping study & land allocation	Develop	Develop
District energy system.	Research	Pre-Feasibility Study	Develop
3. Community engagement			
Energy Partnership.	Re-launch	Maintain	Maintain
Living Energy Laboratory.	Launch round 2	Launch round 3	Launch round 4
Events.	Small events, plan Discovery Fair 2	Host Discovery Fair 2 (spring)	Small events, plan Discovery Fair 3
4. Town Operations			
Facilities energy management plan.	Implementation & evaluation	Scoping Study & New Plan	Implementation
Fleet energy management.	Research & development	Deploy	Maintain
Active transportation & public transit.	Maintain	Maintain, AT plan revision	Maintain
Regional support & collaboration.	Maintain	Maintain	Maintain

Pilot project: Net Zero retrofits

In order to better understand the partnerships and financing required for retrofits, the Town has partnered in the Clean Net Zero Project, a multi-sectoral collaboration between municipalities, technical experts, and lending institutions. The project will map out a pathway that will reduce the barriers facing homeowners who want to make the leap to net zero energy.

A net zero building is one that produces at least as much energy as it consumes on an annual basis. By pairing deep energy retrofits to dramatically improve home's energy efficiency with the installation of small-scale renewable energy generation, homes are less polluting, more comfortable, and more cost-effective to maintain.

Supported by funding from Natural Resources Canada, the project will upgrade up to ten homes to net zero (or approaching net zero) standard in the Town of Bridgewater by March 2019. The project will also include:

» Public education and engagement to increase awareness and understanding of the benefits of retrofitting a home to net zero.

» Low interest upgrade financing available through property-assessed clean energy (PACE)-style loans provided to homeowners by participating municipalities.

» Contractor and tradesperson education and skills development for local businesses and technical students at the Nova Scotia Community College to help build local capacity to supply and install net zero upgrades.

Source: Clean Foundation

RECOMMENDATIONS FOR SENIOR LEVELS OF GOVERNMENT

The provincial and federal governments can enhance the ability of the Town of Bridgewater to enable the Energy Shift. The following recommendations will support that effort.

Table 6. Recommendations to support the Community Energy Investment Plan

Action	Description
Data availability	
1. Ensure energy and supporting data is accessible to municipalities.	Complete GHG inventories every two years for municipalities in Nova Scotia. Provide utility data on electricity and natural gas, and fuel sales of heating oil, gasoline and diesel consumption at a postal code level. Also provide motor vehicle registration data by vehicle type. A similar process is undertaken by the Province of BC called the Community Energy and Emissions Inventory. It reduces the burden both of the data providers and the municipalities, with financial economies of scale.
Municipal powers	
2. Introduce an energy step code for municipalities.	This approach would allow municipalities to set a local energy code that exceeds the energy requirements of the Nova Scotia Building Code on a voluntary basis. The Province of BC introduced an Energy Step Code in 2017.
3. Support regional energy planning efforts and inter-municipal project collaboration.	Many energy and emissions challenges cross municipal borders, in particular transportation. Additionally there are opportunities for economies of scale if projects and programs are delivered by a coalition of municipalities as opposed to individual municipalities.
Vehicle regulations	
4. Vehicle efficiency standards and provincial rebates for efficient and electric vehicles.	Continue to increase the fuel efficiency and GHG intensity targets for vehicles in Canada .
Energy system	
5. Strengthen cap and trade and carbon pricing regulations.	Nova Scotia's proposed cap and trade and carbon pricing regulations which need to be enhanced in order to support Bridgewater's energy transition, so that the real cost of fossil fuels are reflected in decision-making. At the same time, transition mechanisms need to be developed for individuals and communities which are economically reliant on fossil fuels, in particular marginalized or vulnerable populations, to protect them from energy cost increases.
6. Establish a target for a 100% renewable electricity grid by 2040.	Nova Scotia's electricity is relatively carbon intensive, which slows down the electrification strategy necessary for decarbonising energy services including heating and transportation. An ambitious renewables target will both support renewable energy projects in the town as well as electrification of vehicles and heating.
7. Introduce a feed-in-tariff for household-scale solar PV projects.	The economics of solar PV systems is limited by financial return. A five year feed-in-tariff program of $0.25/kWh would significantly increase the increase the uptake of solar PV systems in the Province while the price of PV continues to decline.
8. Guaranteed access to the grid for commercial and industrial renewable energy projects.	Guarantee access to the grid with competitive marginal pricing for commercial and industrial applications, with a premium for community-owned (municipal, cooperative, or nonprofit projects).
9. Clarify regulations related to combined heat & power (CHP) projects.	CHP projects both generate electricity and provide heat, which can result in a complex regulatory process. An expedited process for renewable-based CHP projects which advance sustainability outcomes would support district energy in Bridgewater.
Financing	
7. Provide loan guarantees for retrofit projects.	One of the major barriers to retrofit projects is the uncertainty of the financial return, if savings will actually materialise as calculated. Loan guarantees are an effective strategy to reduce this uncertainty and therefore reduce the costs of the financing.

Action	Description
8. Continue to support PACE financing.	Property Assessed Clean Energy (PACE) financing is an important mechanism that enables municipalities to advance retrofits and renewable energy. Ensure that the Municipal Finance Corporation continues to support this mechanism, and ensure that PACE lending does not adversely affect municipalities' debt ratio when the Province assesses their financial performance indicators and ability to borrow.
9. Introduce new financing strategies such as community bonds.	Develop the appropriate legal context and programming elements to support municipalities in offering community bonds so that local residents can invest in renewable energy and retrofit projects in their own communities.
10. Apply a climate test to all infrastructure expenditures.	A climate test can be used to identify which investments will contribute to reduced GHG emissions and which investments will increase GHG emissions. A scaled incentive can be applied to infrastructure projects that reduce GHG emissions. If a project reduces GHG emissions, it is eligible for funding of 50% or more from other levels of government, whereas if it increases GHG emissions it eligible for funding of 25% or less.
11. Provide a funding program for municipal electric vehicles and public charging stations.	Electric vehicles can decrease a municipality's operating costs but are capital intensive. The lack of fast charging stations is a barrier to the uptake of electric vehicles. Municipally-owned charging stations can generate a new revenue stream for the Town, as well as charging its own vehicles.
Programming	
12. Provide enhanced programming for comprehensive building retrofits for low income and rental housing.	Energy poverty is a significant challenge in Bridgewater and there are significant social and health benefits to be gained by retrofitting low income and rental housing, while there are significant barriers to retrofits in these sectors, including capacity, financing, legal and split incentives. Enhanced programming would consider the house as a whole system, targeting net zero, so that all sectors of society can benefit from the Energy Shift.
13. Support skill and capacity development for skilled trades.	The energy transition will be reliant on developing and scaling a wide range of skills to ensure that local people benefit. The Province should develop a low carbon skills and capacity strategy that works with educational institutions to maximise the employment benefits.
14. Identify mode share targets and provide dedicated programming and funding for transit and active transportation.	Significant public health and other benefits are available as a result of the active transportation component of the Energy Shift. This requires new expertise and funding in infrastructure for walking and cycling (scaling up the level of ambition) and transit.
Studies and analysis	
15. Evaluate the impacts of autonomous, electric vehicles.	The development of autonomous electric vehicles is proceeding rapidly. The impact on small communities is not well understood. Complete an analysis of the economic and social impacts of autonomous vehicles and identify mechanisms for municipalities to start planning for their deployment.

MANAGING UNCERTAINTY AND ADAPTING TO CHANGE

Tracking the effectiveness of the actions in the CEIP helps to manage the risk and uncertainty associated with these efforts, as well as external forces such as evolving senior government policy, and new technologies which can disrupt the energy system. Key motivations for monitoring and evaluation include the following:

- Identify unanticipated outcomes.
- Adjust programs and policies based on their effectiveness.
- Manage and adapt to the uncertainty of climate change.
- Manage and adapt to emerging technologies.

Specific activities which have been identified to support the implementation of the CEIP include an annual work plan and review, an annual indicator report, an update of the GHG inventory every two years and and an update of the CEIP every five years.

Table 7. Monitoring and evaluation activities

Activity	Purpose	Description	Frequency
1. Annual work plan and review	Review work to-date and set annual priority actions	Annual report with prioritized actions	Annual
2. Annual indicator report	Track effectiveness of actions	Annual report on set of indicators with an analysis of the results	Annual
3. Inventory	Update energy and GHG emissions profile	Re-calculate the GHG emissions and energy inventory	Every 2 years
4. Update the CEIP	Update the CEIP to reflect changing conditions	Review each action and the progress being achieved. Identify new actions.	Every 5 years

Annual work plan and review

An annual work plan will identify all relevant activities to achieve the actions and policies in the plan, the responsible parties, the budget and the schedule. The results of the previous year's work plan should be reviewed to inform the development of subsequent work plans.

Annual indicator report

There are two aspects involved in the application of indicators: collecting data on indicators (monitoring), and interpreting the results of those indicators (evaluation). Over time, the Town can also evaluate its effectiveness in embedding the knowledge and wisdom gained through this process into the organization.

From the perspective of the CEIP, there are multiple purposes for which data is collected: to evaluate the effectiveness of the actions, to evaluate the impact of the actions on the community, and to evaluate the uptake of the lessons from the evaluation.

The Town of Bridgewater can launch its implementation report on Earth Day each year.

Figure 7. Types of indicators

Indicator Category	Question
1. Effectiveness indicators	Are the actions achieving their objectives?
2. Impact indicators	What is the impact of the actions on the community?

Effectiveness Indicators

These indicators will be designed to evaluate whether or not policies or actions are having an effect; they will vary from municipality to municipality according to the specifics of the community energy and emissions plan. The results of the indicators are then compared against the assumption in the modelling to monitor whether or not the community is on track with projections. Indicators should be developed for each policy or mechanism.

Impact Indicators

The Town should develop a set of indicators that track macro trends and drivers of GHG emissions in the municipality; these are designed to be reported on each year. An example set of indicators is included in Appendix 1.

Conclusion: The low carbon future beckons

In the Boston Evening Transcript newspaper, July 3, 1906, it was reported that

"Bridgewater was the scene of an experiment in electric lighting which is just now of peculiar social and economic interest for any community. The consumer pays $5 per electric light, and the householder $3 per light, per year, with a proportionate reduction for numbers of lights."

The innovation allowed lighting to be affordable for "every class of society" while the utility earned "a fine profit for the town". Municipalities have a long history of addressing challenges to improve the quality of life of citizens. The transition to a low carbon economy represents an opportunity to stimulate economic development, improve quality of life, improve public health outcomes, reduce air pollution, reduce GHG emissions and generate new employment opportunities.

The Town is uniquely positioned to unlock opportunities such as large scale building retrofits, building-scale renewable energy generation and low carbon land-use patterns. The Energy Shift pathway requires additional investment in capacity and partnerships, as the Town cannot achieve these objectives on its own, but the community has an established and growing reputation for innovation that will attract partners to help it succeed. In doing so, Bridgewater can establish itself as a regional and national leader in demonstrating the way forward toward greater community wealth and wellbeing, while at the same time finding real solutions to the urgent problem of climate change.

Community Energy Investment Plan: The Way Forward

Part 2: Technical Backgrounder

Glossary

Term	Definition
Business as usual (BAU)	A scenario that illustrates energy use and GHG emissions if no additional policies, actions or strategies are implemented.
Capital investment	Funds invested in fixed assets. Also known as CAPEX.
Carbon price	A representation of the cost of carbon as a result of a policy requirement by the Federal Government.
Constant dollars	Adjusted value of currency so that future expenditures are represented in 2017 dollars using a discounting rate of 3%.
Cumulative investment	The sum of annual investments added up over a defined period of years. For example, the cumulative investment from 2017 to 2020 is the sum of the investments in each of those years. Can be represented in either constant or current dollars.
Current dollars	Un-adjusted value of currency; future dollars are not adjusted. Also known as the nominal dollar value.
Discount rate	A rate that converts current dollars to constant dollars, indicating that future dollars are worth less than current dollars. For this analysis a discount rate of 3% was used.
Energy expenditures	Expenditures on fuel.
Low carbon ambitious (LC-amb)	A scenario that builds upon the moderate scenario with a set of more ambitious assumptions, which focus on increasing the deployment of solar heating/hot water and air and ground source heat pumps in the residential and commercial sectors to reduce consumption of natural gas for heating. Total remaining emissions in 2015 are 0.16 MT CO2e (90% reduction over 2011).
Net present value (NPV)	The value in the present of a sum of money, in contrast to some future value it will have when it has been invested at compound interest. A discounting rate of 3% was applied.
Operating expenditures	Operating expenses include maintenance expenditures, energy expenditures and carbon price expenditures. Also known as OPEX.
Person-years of employment	A person-year is defined as the amount of work done by an individual during a working year, on a specific job.
Total expenditures	Total expenditures include capital investments and operating expenses.

Appendix 1: Recommended community-scale indicators

Indicator	Trend	Data sources
Total new dwellings by type	An indication of the growth of the building stock.	Buildings permits
Average total floor area of new dwellings	An indication as to whether there is more or less additional floor space to heat or cool.	Building permits
Diversity of dwelling types	An indication of the types of dwellings and whether or not they have shared walls.	Building permits
Total new non-residential floorspace by type	An indication of the growth of the building stock.	Building permits
Total demolitions	An indication of the change in the building stock.	Demolition permits
Percentage of new dwelling units that are in downtown	An indication as to whether residential development is occurring in areas more appropriate for walking, cycling and transit or not.	Building permits and GIS analysis
Percentage of non-residential floorspace that is occurring in downtown	An indication as to whether commercial development is occurring in areas more appropriate for walking, cycling and transit or not.	Building permits and GIS analysis
Number of new dwellings that are within 400 m of a transit stop	Indication of transit accessibility.	GIS layers of transit and building footprint
Annual or monthly energy price by fuel (electricity, gasoline, diesel) ($/GJ)	Energy costs are an important indicator of opportunities for energy savings and renewable energy, household, municipal and business energy costs.	The Town already tracks energy costs.
Total energy consumption by sector for electricity (GJ)	An indication of trends in energy use in buildings.	Available on request from NS Power. Other fuels can be tracked if data becomes available.
Total solar PV installs (# of installation)	An indication of extent of decentralized renewable energy.	Building permits.
Total gasoline sales ($)	An indication of GHG emissions from vehicles.	Available for purchase from Kent Group Ltd.

Indicator	Trend	Data sources
Total transit trips	An indication of whether non-vehicular trips are increasing or not.	Available from the Town.
Length of physically separated cycling lanes	An indicator of opportunity for people of all ages to cycle.	Town